Elevator Technology

Environmental Product Declaration

endura Machine Room-Less elevator

In accordance with ISO 14025

thyssenkrupp

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-01022
Publication date:	2017-03-21
Revision date:	2017-09-15
Validity date:	2020-03-21
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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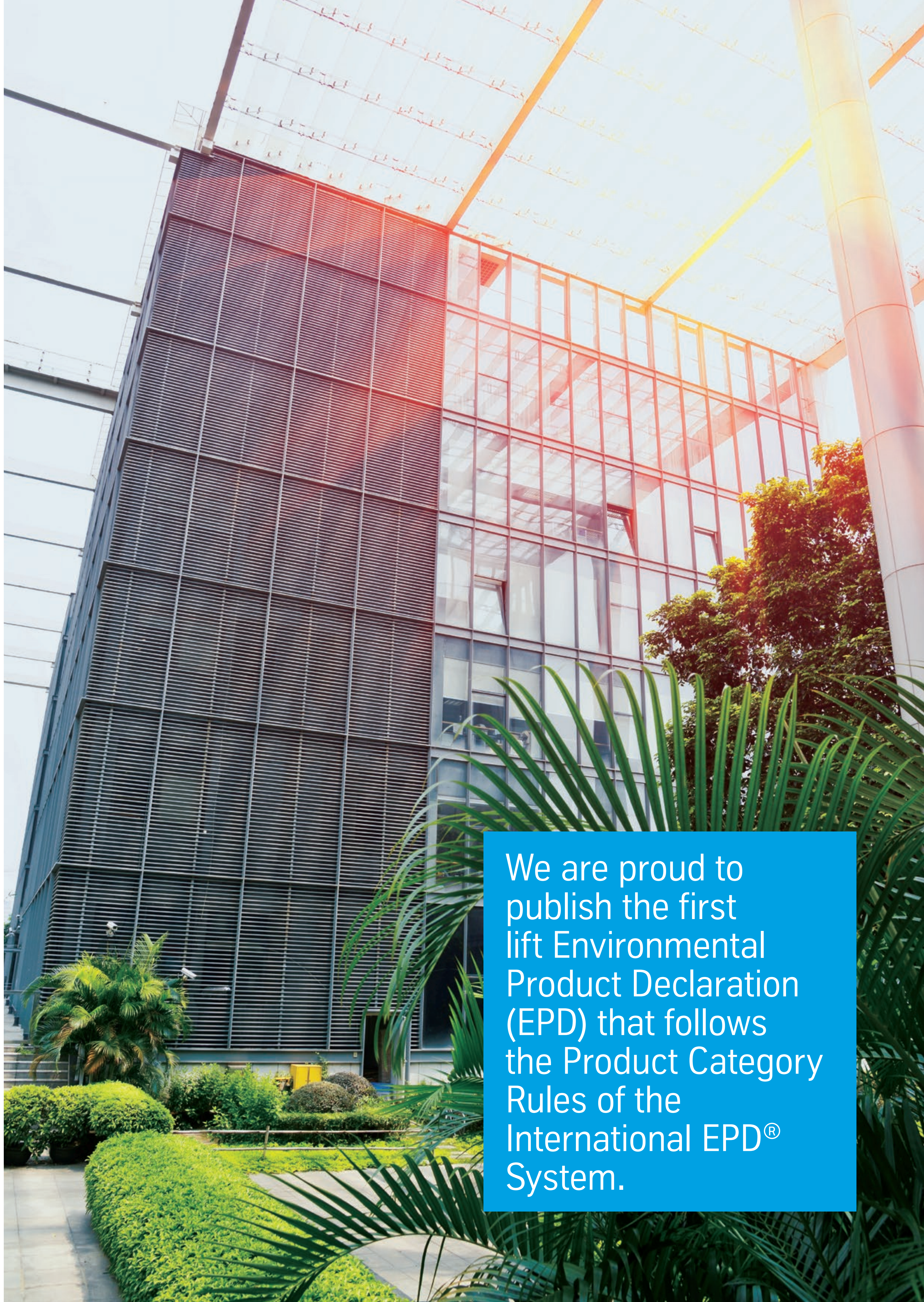


About us

thyssenkrupp is the result of a merger of two German steel companies: thyssen AG, founded in 1891, and Krupp, founded in 1811. The two companies combined their expertise and experience in the steel industry in order to offer a wider range of products and services, including premium carbon steel; high-performance alloys; automotive components and systems; material trading, logistical and industrial services; and elevators, escalators, moving walks and passenger boarding bridges.

Today, thyssenkrupp Elevator is the largest producer of elevators in the Americas, with more than 21,000 employees, more than 230 branch and service locations, and sales of more than $2.9 billion. thyssenkrupp Elevator Americas oversees all business for operations in the United States, Canada and Central and South America. It is a subsidiary of thyssenkrupp Elevator AG.

For more information about our company, visit https://www.thyssenkruppelevator.com

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 and HoloLens 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 aim to equip 180,000 elevators around the world with this revolutionary technology in 2017. HoloLens helps elevator service technicians to visualize and identify problems ahead of a job and have remote, hands-free access to technical and expert information when onsite, improving the way people and cities move. We don't plan to stop there.

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 the first 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 best-selling hydraulic product, endura MRL.

The endura MRL combines the components of the basic elevator design, the functionality of hydraulic power, and a truly machine room-less design – perfect for low-rise buildings. It maximizes building space and keeps construction coordination and costs low. The uncomplicated design provides dependable, capable equipment engineered for buildings with just a few floors. And the cost to maintain the endura MRL is lower than the cost of maintaining more complex low-rise MRL traction elevators.

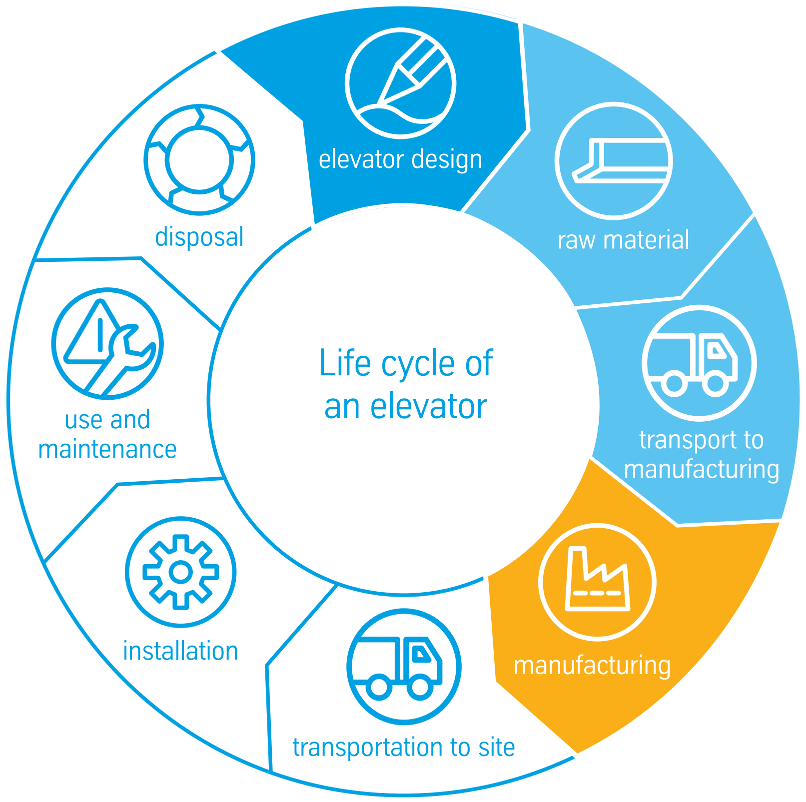
The general product system (shown below) is organized by three general life cycle stages: 1. Upstream, which includes the raw material supply, inbound transport and outsourced manufacturing; 2. Core, including own materials and in-house manufacturing; and 3. Downstream, which comprises transport and 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 25 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.

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



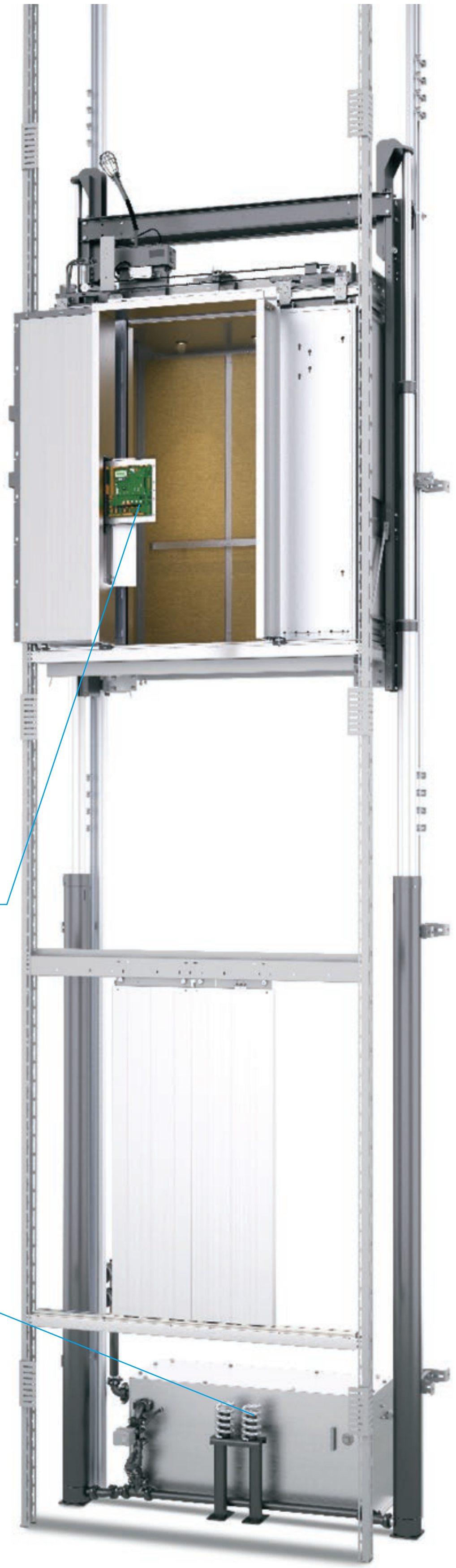
This declaration covers the endura MRL elevator produced in Middleton, TN, specified as follows:

endura MRL Elevator specifications	
Commercial name	endura MRL
Type of installation	New installation
Main purpose	Transport of passengers
Type of lift	Hydraulic MRL
Type of drive system	Hydraulic
Capacity rated load (fixed or range)	2500 lb (1,134 kg)
Rated speed (fixed or range)	150 fpm (45.72 m/min)
Number of stops (fixed or range)	3
Traveled height (fixed or range)	36’ (10.97 m)
Number of operating days per year (fixed or range)	260
Applied Usage Category (UC) according to ISO 25745-2	Category 2, Low usage intensity
Designed Reference Service Life (RSL)	25 years
Geographic region of intended installation region	North America
Recommended application (main market)	Low-rise
Building rise (typical)	2-4 floors
Building type	All
Optional equipment	Enviromax or mineral hydraulic oil, photovoltaic cells*
Additional requirements	Non-seismic

* photovoltaic cells are an engineered option.

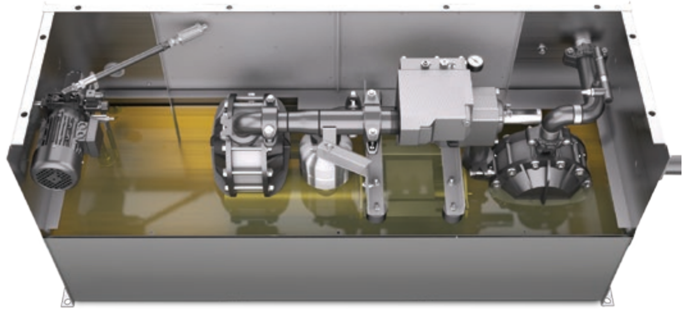
endura MRL

The endura MRL uses little electricity, has a small lifetime environmental impact, and virtually eliminates the use of petroleum by using enviromax™ — the industry’s first performance-improving, vegetable-based hydraulic fluid. LED lighting is standard, which drastically increases lighting lifespan, is mercury-free and offers a heat-free solution. Since the cab is from thyssenkrupp Elevator, you will 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.



Control panel in door jamb

Pump unit in pit



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 endura MRL 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:

$$\%Q = 1134/1000 \times 4.5\% = 0.051 \text{ [tonnes]}$$

The lifetime distance traveled for the endura MRL 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].

$$S_{RSL} = 7.35 \text{ [m]}/1000 \text{ [m/km]} \times 125 \text{ [trips/d]} \times 260 \text{ [d/yr]} \times 25 \text{ [yr]} = 5973 \text{ [km]}$$

Therefore, the functional unit provided by the endura MRL is calculated as:

$$FU = 0.051 \text{ tonnes} \times 5973 \text{ km} = 304.81 \text{ tonne-km}$$

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.

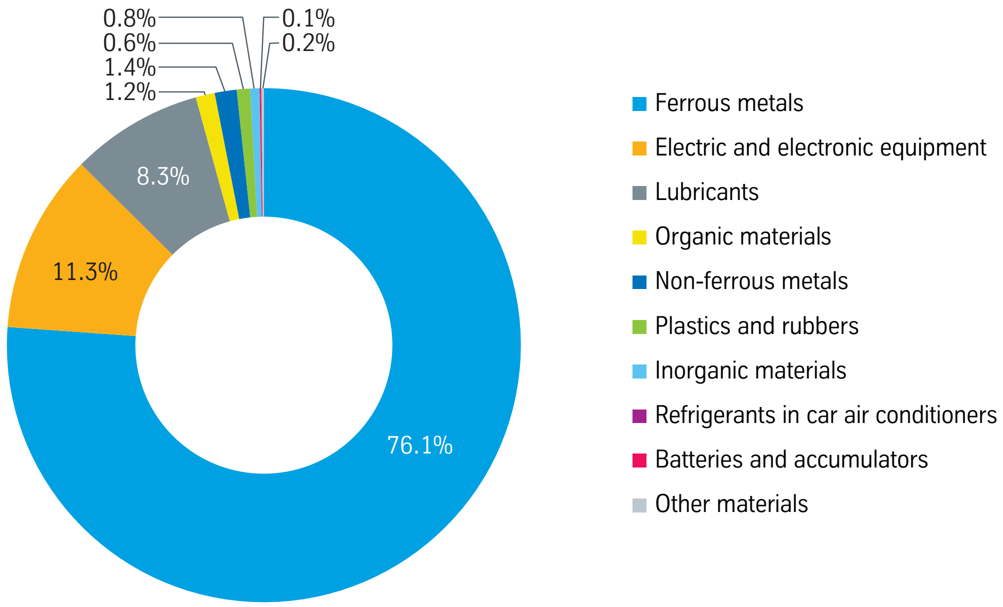
Content declaration

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	endura MRL
Ferrous metals	kg (%)	4085.23 (76.12%)
Electric and electronic equipment	kg (%)	606.10 (11.29%)
Lubricants	kg (%)	445.99 (8.31%)
Organic materials	kg (%)	64.58 (1.20%)
Non-ferrous metals	kg (%)	74.07 (1.38%)
Plastics and rubbers	kg (%)	45.20 (0.84%)
Inorganic materials	kg (%)	31.93 (0.59%)
Refrigerants in car air conditioners	kg (%)	0.00 (0.00%)
Batteries and accumulators	kg (%)	5.22 (0.10%)
Other materials	kg (%)	8.63 (0.16%)
Total mass	kg	5366.95

Table 1: Material composition by material classification for endura MRL

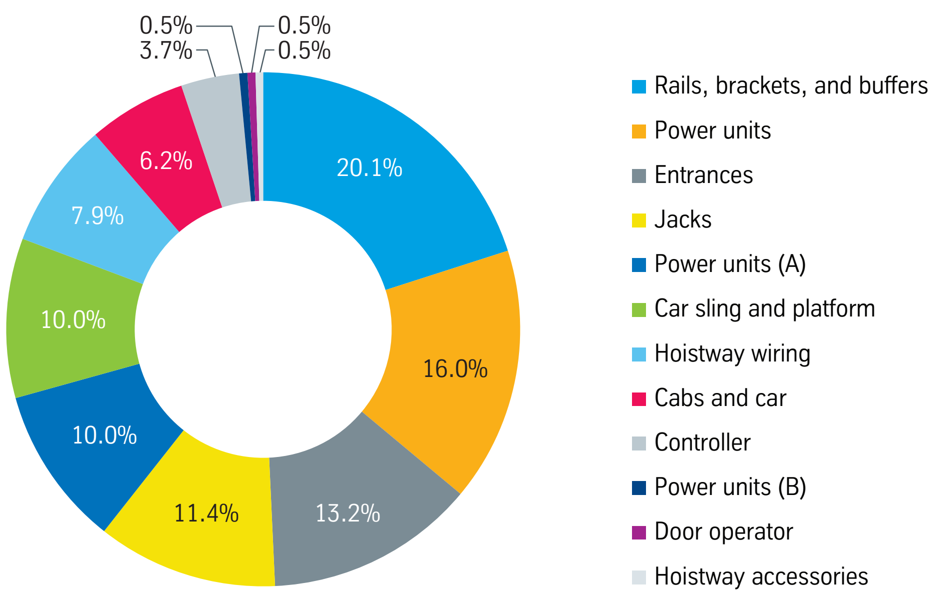
Elevator composition by material [kg]



Assembly name	Units	endura MRL
Rails, brackets, and buffers	kg (%)	1075.88 (20.05%)
Power units	kg (%)	859.49 (16.01%)
Entrances	kg (%)	708.61 (13.20%)
Jacks	kg (%)	609.92 (11.36%)
Power units (A)	kg (%)	539.72 (10.06%)
Car sling and platform	kg (%)	538.87 (10.04%)
Hoistway wiring	kg (%)	426.32 (7.94%)
Cabs and car	kg (%)	330.99 (6.17%)
Controller	kg (%)	196.67 (3.66%)
Power units (B)	kg (%)	28.06 (0.52%)
Door operator	kg (%)	26.87 (0.50%)
Hoistway accessories	kg (%)	25.54 (0.48%)
Total mass	kg	5366.95

Table 2: Material composition by assembly part for endura MRL

Elevator composition by assembly part [kg]



Environmental performance

Use of resources and energy

Primary energy and other resource use results are presented in this section for the endura MRL 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	9.03E+02	2.20E+02	4.57E+02	4.29E+04	1.12E-02	1.81E+00	0.00E+00
U2	7.00E+01	6.34E-01	2.69E-01	1.72E+02	0.00E+00	0.00E+00	0.00E+00
U3	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00
C2	1.24E+02	2.21E+01	9.72E+00	4.40E+03	0.00E+00	0.00E+00	0.00E+00
D1	4.93E+01	1.21E+02	2.70E+00	1.57E+03	0.00E+00	0.00E+00	0.00E+00
D2	1.80E+00	1.14E-01	6.14E-01	6.07E+01	0.00E+00	0.00E+00	0.00E+00
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	8.61E+02	9.18E+01	9.17E+01	4.25E+04	0.00E+00	0.00E+00	0.00E+00
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	7.89E-02	8.95E-03	5.26E-02	4.52E+00	0.00E+00	0.00E+00	0.00E+00
Total	2.01E+03	4.55E+02	5.62E+02	9.16E+04	1.12E-02	1.81E+00	0.00E+00

Table 3:Resource and energy categories for endura MRL (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	2.75E+05	6.70E+04	1.39E+05	1.31E+07	3.40E+00	5.53E+02	0.00E+00
U2	2.13E+04	1.93E+02	8.21E+01	5.25E+04	0.00E+00	0.00E+00	0.00E+00
U3	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00
C2	3.78E+04	6.75E+03	2.96E+03	1.34E+06	0.00E+00	0.00E+00	0.00E+00
D1	1.50E+04	3.68E+04	8.22E+02	4.77E+05	0.00E+00	0.00E+00	0.00E+00
D2	5.48E+02	3.47E+01	1.87E+02	1.85E+04	0.00E+00	0.00E+00	0.00E+00
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	2.62E+05	2.80E+04	2.79E+04	1.30E+07	0.00E+00	0.00E+00	0.00E+00
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	2.40E+01	2.73E+00	1.60E+01	1.38E+03	0.00E+00	0.00E+00	0.00E+00
Total	6.12E+05	1.39E+05	1.71E+05	2.79E+07	3.40E+00	5.53E+02	0.00E+00

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

Canola fields; a source of renewable oil.

	Resource type	Resource	Units	Upstream	Core	Downstream	Total
Non-renewable	Material	Inert rock	kg/tkm	4.23E+02	8.86E+00	9.05E+01	5.22E+02
		Iron ore	kg/tkm	2.48E+01	0.00E+00	0.00E+00	2.48E+01
		Other	kg/tkm	9.08E+00	8.58E-01	3.83E+00	1.38E+01
	Energy	Crude oil	kg/tkm	5.08E+00	1.65E-01	1.33E+00	6.57E+00
		Hard coal	kg/tkm	2.06E+01	1.33E+00	1.45E+01	3.64E+01
		Lignite	kg/tkm	2.04E+00	2.22E-01	2.19E+00	4.45E+00
		Natural gas	kg/tkm	3.89E+00	1.42E+00	5.97E+00	1.13E+01
		Other	kg/tkm	1.22E-02	1.54E-04	6.18E-03	1.86E-02
Renewable	Material	Water	kg/tkm	4.29E+04	4.35E+03	4.38E+04	9.10E+04
		Other	kg/tkm	1.88E+02	4.51E+01	3.34E+02	5.67E+02
	Energy	Hydropower	MJ/tkm	3.54E+01	3.17E+00	3.45E+01	7.31E+01
		Solar energy	MJ/tkm	1.74E+02	1.54E+01	1.40E+02	3.30E+02
		Wind power	MJ/tkm	8.78E+00	2.89E+00	3.09E+01	4.26E+01
		Other	MJ/tkm	1.41E+00	6.27E-01	6.89E+00	8.93E+00
Secondary resources	Materials	Steel scrap	kg/tkm	1.50E+00	0.00E+00	0.00E+00	1.50E+00
		Stainless steel scrap	kg/tkm	3.12E-01	0.00E+00	0.00E+00	3.12E-01
		Aluminium scrap	kg/tkm	4.83E-04	0.00E+00	0.00E+00	4.83E-04
		Iron scrap	kg/tkm	2.17E-04	0.00E+00	0.00E+00	2.17E-04
	Energy	Non-renewable	MJ/tkm	1.01E-02	0.00E+00	0.00E+00	1.01E-02
		Renewable	MJ/tkm	1.11E-03	0.00E+00	0.00E+00	1.11E-03
	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 endura MRL (per tkm)

	Resource type	Resource	Units	Upstream	Core	Downstream	Total
Non-renewable	Material	Inert rock	kg	1.29E+05	2.70E+03	2.76E+04	1.59E+05
		Iron ore	kg	7.55E+03	0.00E+00	0.00E+00	7.55E+03
		Other	kg	2.77E+03	2.61E+02	1.17E+03	4.20E+03
	Energy	Crude oil	kg	1.55E+03	5.02E+01	4.04E+02	2.00E+03
		Hard coal	kg	6.27E+03	4.05E+02	4.43E+03	1.11E+04
		Lignite	kg	6.21E+02	6.75E+01	6.68E+02	1.36E+03
		Natural gas	kg	1.19E+03	4.33E+02	1.82E+03	3.44E+03
		Other	kg	3.73E+00	4.71E-02	1.88E+00	5.66E+00
Renewable	Material	Water	kg	1.31E+07	1.33E+06	1.34E+07	2.77E+07
		Other	kg	5.74E+04	1.38E+04	1.02E+05	1.73E+05
	Energy	Hydropower	MJ	1.08E+04	9.66E+02	1.05E+04	2.23E+04
		Solar energy	MJ	5.30E+04	4.71E+03	4.28E+04	1.00E+05
		Wind power	MJ	2.67E+03	8.82E+02	9.43E+03	1.30E+04
		Other	MJ	4.30E+02	1.91E+02	2.10E+03	2.72E+03
Secondary resources	Materials	Steel scrap	kg	4.58E+02	0.00E+00	0.00E+00	4.58E+02
		Stainless steel scrap	kg	9.52E+01	0.00E+00	0.00E+00	9.52E+01
		Aluminium scrap	kg	1.47E-01	0.00E+00	0.00E+00	1.47E-01
		Iron scrap	kg	6.63E-02	0.00E+00	0.00E+00	6.63E-02
	Energy	Non-renewable	MJ	3.07E+00	0.00E+00	0.00E+00	3.07E+00
		Renewable	MJ	3.38E-01	0.00E+00	0.00E+00	3.38E-01
	Recovered energy flows		MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 6: Disaggregated resource and energy categories for endura MRL (absolute figures per RSL)

thyssenkrupp factory in Middleton, Tennessee

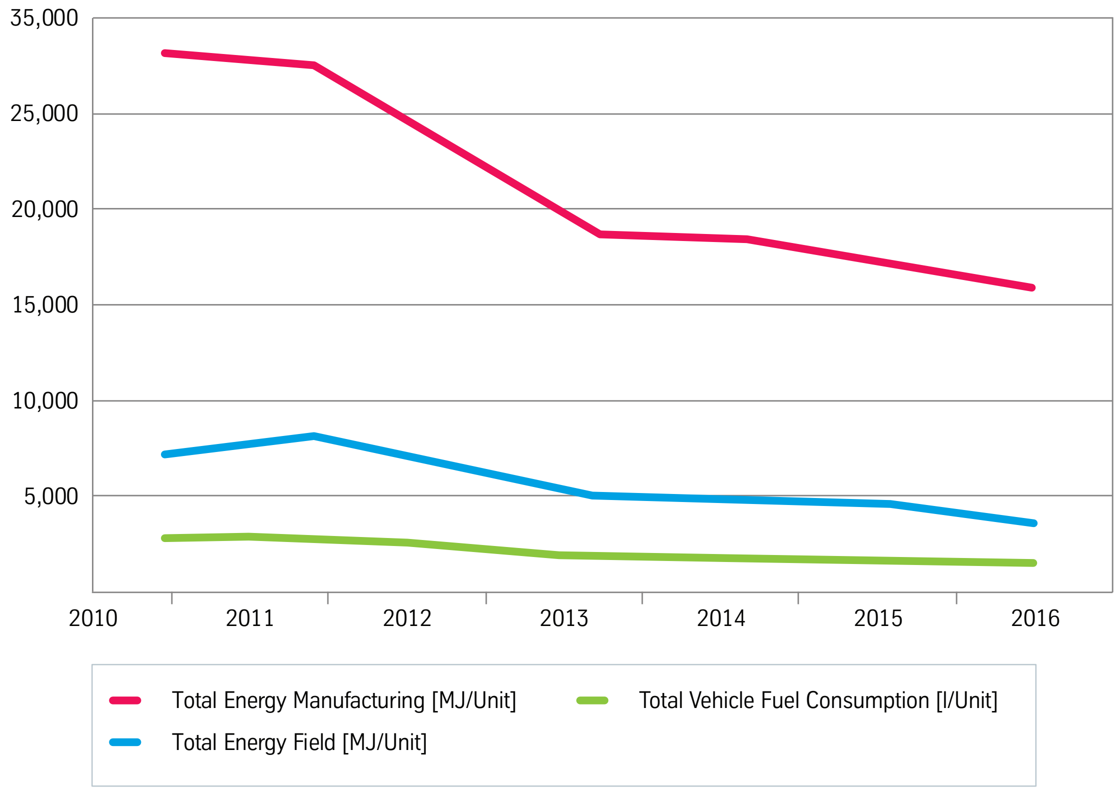
From a production standpoint, we continually strive to improve environmental performance within our core plants and factories. During the last six years, our energy demand at our Middleton, TN factory – which was built in 1969 – has stayed relatively constant, while production has increased 84 percent since 2010 (see graph on next page). We replaced 12 of the 50-ton AC units, resulting in $50,000 per year in energy savings and completed roof recoating for over half of the factory roof, lowering indoor office temperature and preventing repair costs. We abide by the ISO 14000 Environmental Management System and gather feedback from our global team in an effort to continually improve corporate processes and policies. In 2016, we hosted an Occupant Comfort Survey that resulted in 86 percent employee satisfaction in the factory. Also, we have volunteered for the Better Plants program twice, a program that requires a 20 percent reduction in energy. We're happy to have achieved LEED GOLD certification, earning 63 points out of the 60 required.

Energy efficiency improvements, however, aren't limited to operations. A large portion of the energy used in our entire life cycle comes from downstream. In 2016 alone, we serviced 220,655 elevators across the United States to ensure every passenger can depend on our elevators to move them up and down buildings safely. Therefore, we use a fleet of around 3,200 vehicles to regularly monitor and provide service to our elevators, and we have to use our fuel intelligently to meet our global GHG impact reduction goals. To do so, we diversify fuel to save energy and reduce GHG emissions — and we're now using the XL3 Hybrid Drive System, which results in a 25 percent increase in fuel economy per vehicle. We believe that having a mixed portfolio that includes propane, electric and hybrid vehicles makes a significant difference over traditionally powered engines, alternative fuels (flexi fuel), hybrid electric and other low emitting and efficient technologies.

Given that our vehicle replacement program is the main driver in our fuel reduction efforts, we upgrade the oldest fleet vehicles to use state-of-the-art technology and right-size the vehicle to fit the specific location and function. Our fleet also includes low GHG-emitting and fuel-efficient engines. By 2020, we will have increased the average fuel economy of our fleet from 15 to 17.8, thereby lowering our fuel consumption by 2,649,788 liters and preventing 5,738 tonnes of CO2 from being released into the atmosphere.

Looking forward, we expect fuel efficiency efforts to only increase across our product line — given our push to enhance route optimization, driver training, and MAX, our predictive maintenance and service solution. By implementing MAX alone, we estimate saving about 3,785,000 liters of gas and preventing 8,196 tonnes of CO2 from being released into the atmosphere. The interplay between MAX and Microsoft's HoloLens technology will enable service technicians to visualize and diagnose a problem well before any action needs to be taken.

Energy consumption vs. production



Potential environmental impacts

The life cycle impact assessment results for CML 2001 (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.

	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 ethene- eq/ tkm	kg CO_2-eq/ tkm
Upstream	8.69E+00	9.12E+02	4.31E-01	6.68E-02	3.97E-07	3.90E-02	8.11E+01
Core	3.64E-06	1.06E+02	2.27E-02	4.78E-03	1.98E-09	1.60E-03	8.45E+00
Downstream	1.23E-05	7.18E+02	2.03E-01	1.48E-02	2.19E-08	1.68E-02	6.38E+01
Total	8.69E+00	1.74E+03	6.57E-01	8.63E-02	4.21E-07	5.74E-02	1.53E+02

Table 7: CML 2001 (Version: January 2016) impact category results by life cycle stage (per tkm)

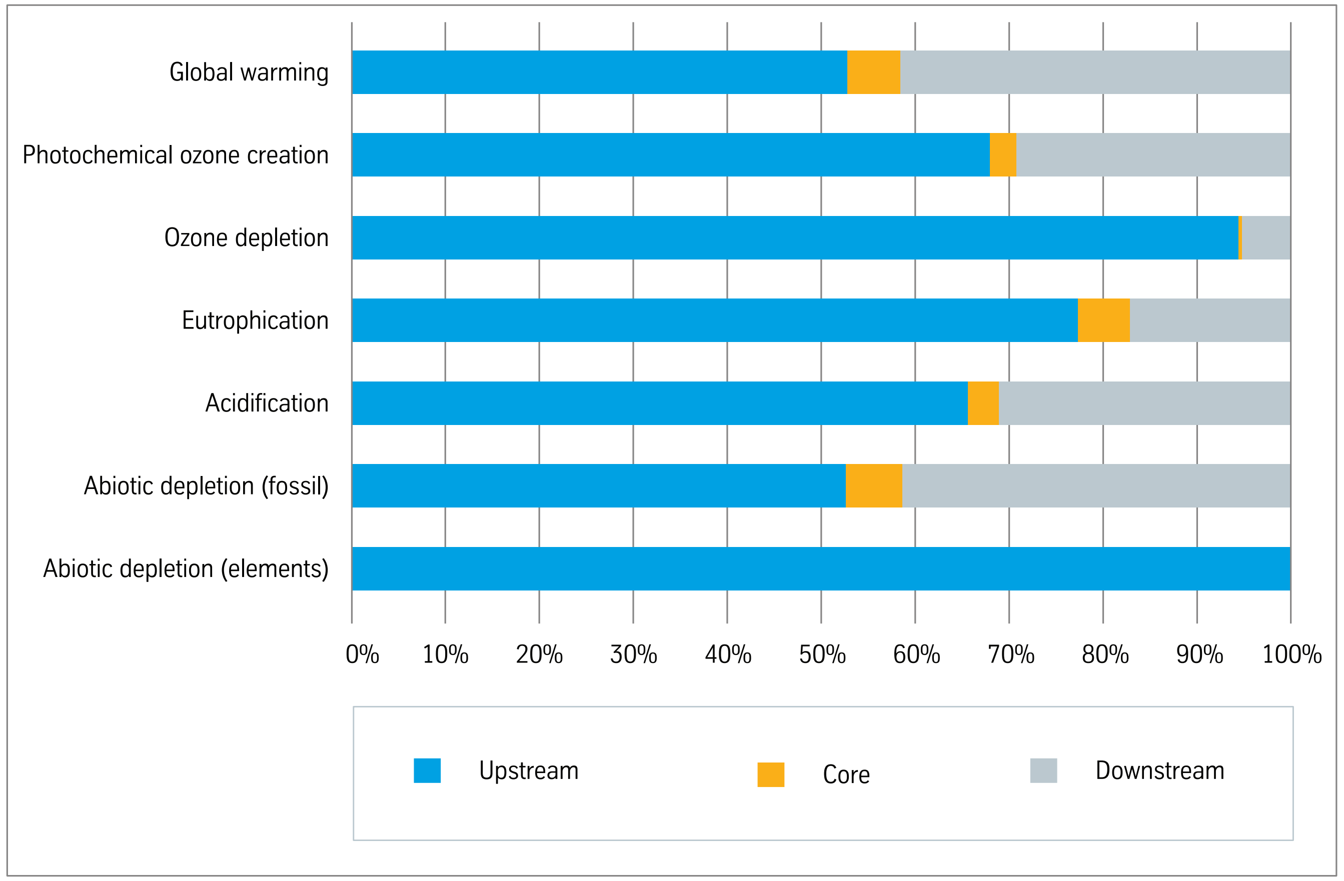


Figure: Elevator life cycle results by main modules (as percentages)

	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	2.64E+03	2.51E+05	1.17E+02	1.28E+01	1.21E-04	1.09E+01	2.24E+04
Core	1.11E-03	3.24E+04	6.93E+00	1.46E+00	6.04E-07	4.86E-01	2.58E+03
Downstream	8.82E+00	2.47E+05	7.66E+01	1.21E+01	7.17E-06	6.10E+00	2.18E+04
Total	2.65E+03	5.29E+05	2.00E+02	2.63E+01	1.28E-04	1.75E+01	4.68E+04

Table 8: CML 2001 (Version: January 2016) impact category results by life cycle stage (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	8.69E+00	8.43E+02	3.34E-01	5.55E-02	3.97E-07	3.28E-02	7.58E+01
U2	7.24E-07	6.97E+01	9.66E-02	1.12E-02	3.44E-11	6.26E-03	5.34E+00
U3	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00
C2	3.64E-06	1.06E+02	2.27E-02	4.78E-03	1.98E-09	1.60E-03	8.45E+00
D1	1.47E-06	4.58E+01	1.36E-02	2.98E-03	4.36E-10	4.17E-03	3.67E+00
D2	4.44E-08	1.75E+00	5.35E-03	1.49E-03	2.22E-12	1.50E-03	1.94E+00
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	1.08E-05	6.71E+02	1.84E-01	1.03E-02	2.14E-08	1.11E-02	5.82E+01
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	2.01E-09	7.61E-02	3.51E-05	4.77E-06	6.50E-14	3.37E-06	5.84E-03
Total	8.69E+00	1.74E+03	6.57E-01	8.63E-02	4.21E-07	5.74E-02	1.53E+02

Table 9: CML 2001 (Version: January 2016) impact category results 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	2.65E+03	2.57E+05	1.02E+02	1.69E+01	1.21E-04	9.99E+00	2.31E+04
U2	2.21E-04	2.12E+04	2.94E+01	3.42E+00	1.05E-08	1.91E+00	1.63E+03
U3	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00
C2	1.11E-03	3.24E+04	6.93E+00	1.46E+00	6.04E-07	4.86E-01	2.58E+03
D1	4.47E-04	1.39E+04	4.16E+00	9.09E-01	1.33E-07	1.27E+00	1.12E+03
D2	1.35E-05	5.34E+02	1.63E+00	4.54E-01	6.76E-10	4.56E-01	5.90E+02
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	3.29E-03	2.04E+05	5.62E+01	3.13E+00	6.53E-06	3.40E+00	1.77E+04
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	6.14E-07	2.32E+01	1.07E-02	1.46E-03	1.98E-11	1.03E-03	1.78E+00
Total	2.65E+03	5.29E+05	2.00E+02	2.63E+01	1.28E-04	1.75E+01	4.68E+04

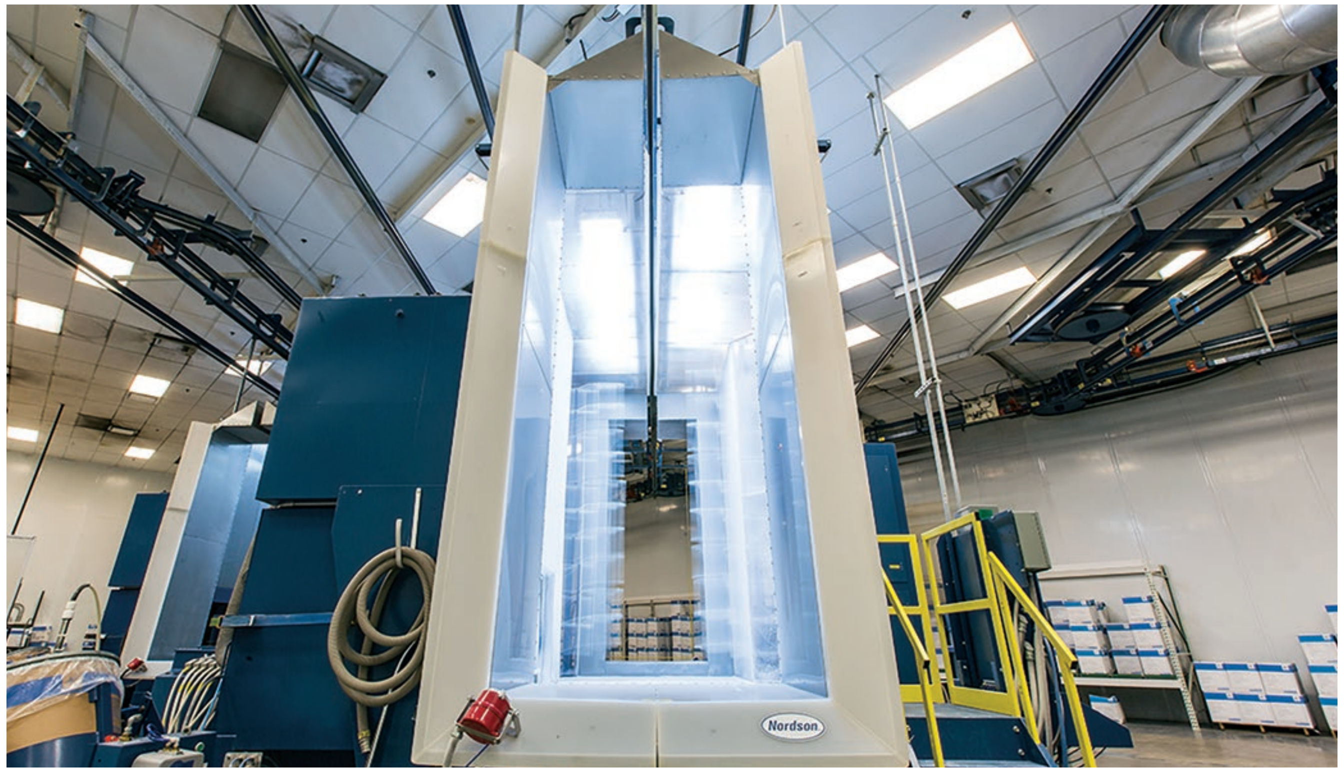
Table 10: CML 2001 (Version: January 2016) impact category results by life cycle information module (in absolute figures per RSL)

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	3.32E-01	8.47E-02	4.32E-07	3.16E+00	7.55E+01
U2	1.04E-01	4.07E-03	3.66E-11	2.05E+00	5.33E+00
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	2.29E-02	7.15E-03	2.11E-09	2.33E-01	8.42E+00
D1	1.63E-02	2.32E-03	4.58E-10	4.31E-01	3.66E+00
D2	7.39E-03	9.76E-04	2.36E-12	3.30E-02	1.72E+00
D3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4	1.73E-01	7.22E-03	2.28E-08	1.51E+00	5.79E+01
D5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D6	3.83E-05	3.21E-06	6.90E-14	7.42E-04	5.82E-03
Total	6.56E-01	1.06E-01	4.58E-07	7.41E+00	1.53E+02

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

Waste production

Recent highlights in waste production during manufacturing include updating our painting process to powder coating; we eliminated the painting line, 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	1.75E-04	3.29E+00
Core	7.03E-08	5.02E-01
Downstream	2.33E-05	2.56E+00
Total	1.98E-04	6.36E+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	5.34E-02	1.00E+03
Core	2.14E-05	1.53E+02
Downstream	7.10E-03	7.81E+02
Total	6.05E-02	1.94E+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	1.75E-04	3.29E+00
U2	8.58E-08	1.53E-03
U3	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00
C2	7.03E-08	5.02E-01
D1	2.28E-05	9.72E-02
D2	3.45E-09	1.81E+00
D3	0.00E+00	0.00E+00
D4	5.15E-07	2.83E-01
D5	0.00E+00	0.00E+00
D6	1.80E-09	3.65E-01
Total	1.98E-04	6.36E+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	5.33E-02	1.00E+03
U2	2.62E-05	4.67E-01
U3	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00
C2	2.14E-05	1.53E+02
D1	6.94E-03	2.96E+01
D2	1.05E-06	5.53E+02
D3	0.00E+00	0.00E+00
D4	1.57E-04	8.64E+01
D5	0.00E+00	0.00E+00
D6	5.49E-07	1.11E+02
Total	6.05E-02	1.94E+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 in this EPD was the U.S. average grid. If, instead, the elevator's operational use were provided by photovoltaic (PV) cells, 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 a Health Product Declaration (HPD) 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 CA01350 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. We're happy 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.

The endura MRL hydraulic elevator uses enviromax, the industry's first performance-improving, bio-based, readily biodegradable fluid with a Platinum Cradle to Cradle Material Health Certificate. enviromax is the only USDA-certified, bio-based product — and is fire-resistant and vegetable-based, using canola oil harvested from northern U.S. and Canada.

Furthermore, enviromax earned the Platinum Cradle to Cradle Material Health Certificate, and was also named LEED Material Ingredient Disclose Credit-eligible and LEED Material Ingredient Optimization Credit-Eligible. thyssenkrupp Elevator's Create-a-cab 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.

Elevator life cycle results

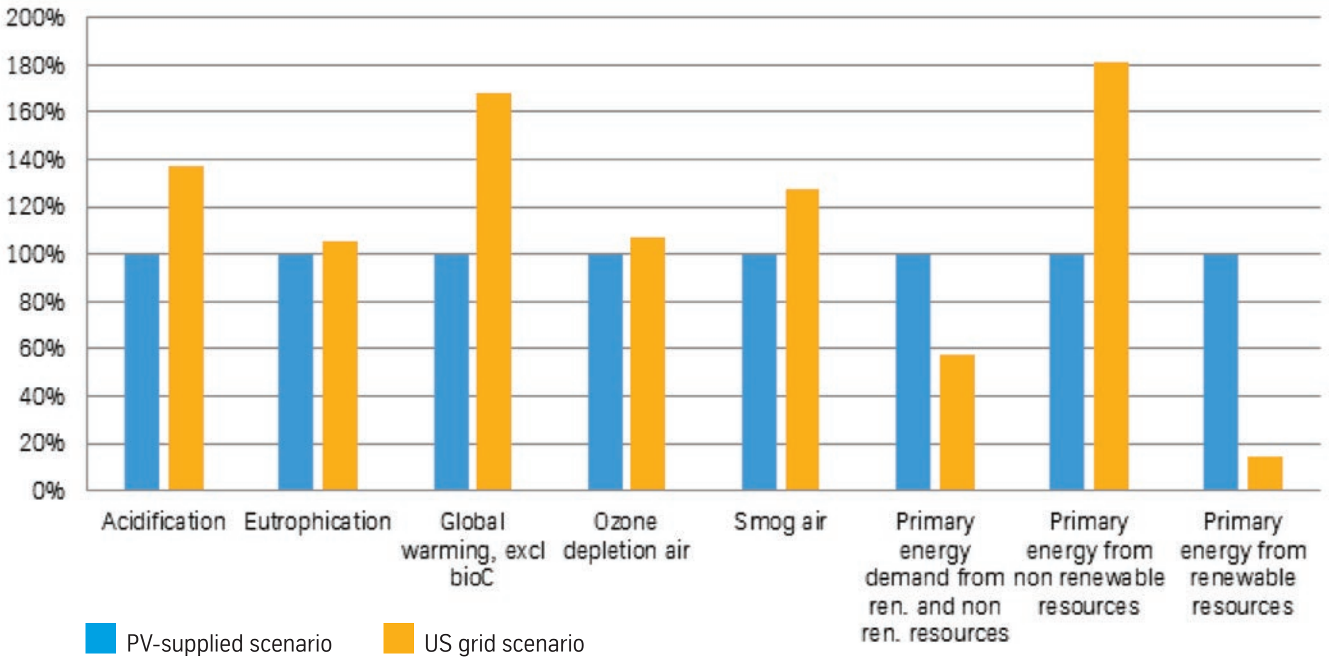
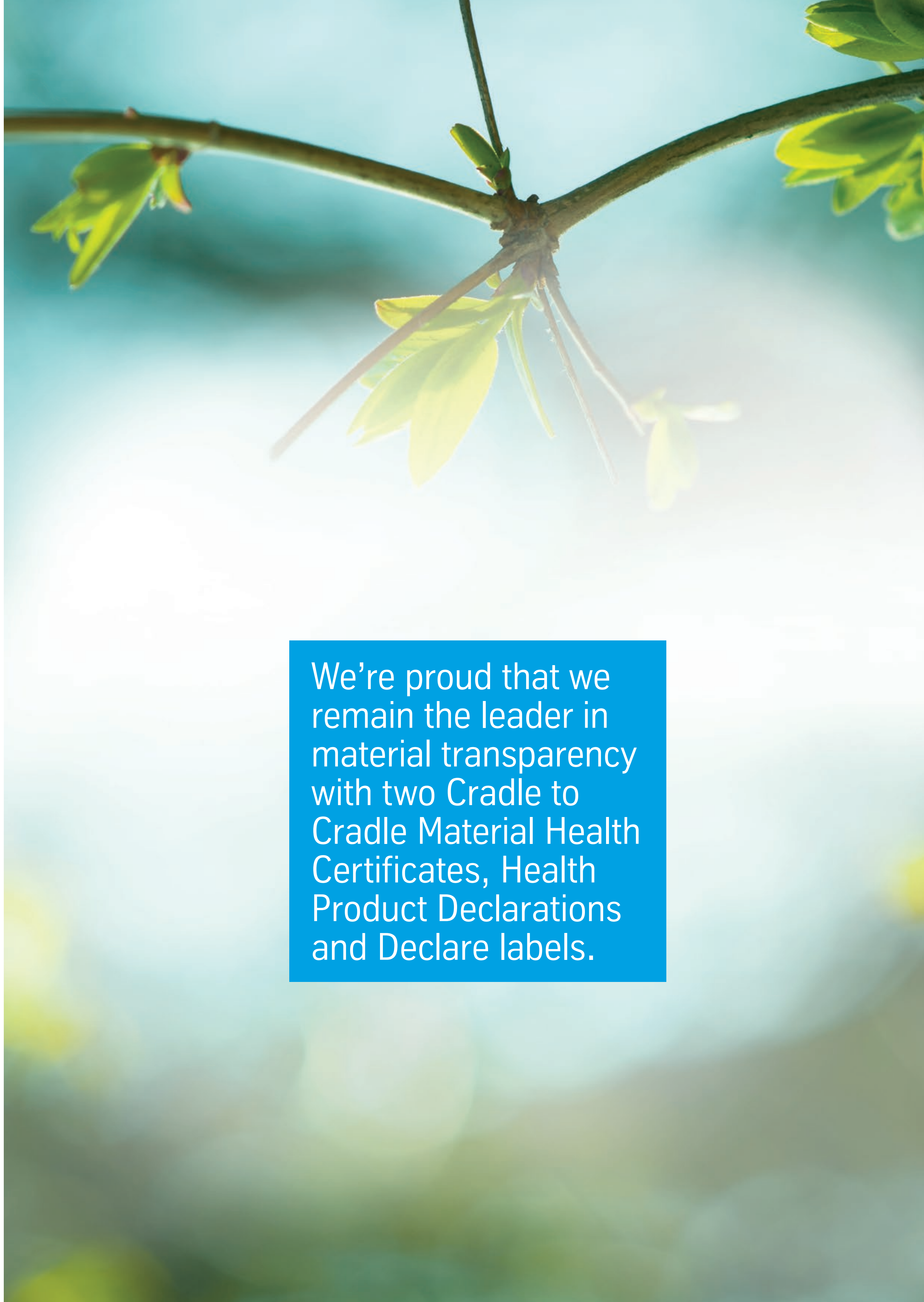


Figure: Elevator life cycle results (CML 2001 Jan 2016) with both PV and US grid-supplied electricity during use (PV scenario shown as 100%)



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

thyssenkrupp Elevator supports the U.S. Green Building Council and the LEED rating system through our corporate SILVER 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.

LEED v4
Credit Matrix

thyssenkrupp

Credit	Intent	How thyssenkrupp can help
Optimize Energy Performance	Use whole building energy simulation to achieve increasing levels of energy performance.	thyssenkrupp Elevator's energy calculator based on ISO 25745 can help you determine proposed energy savings over a baseline that can be added to your project's energy model.
Building Product Disclosure and Optimization: Environmental Product Declarations	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 published the first Lift Environmental Product Declaration (EPD) that follows the Product Category Rules of the International EPD® System for endura MRL.
Building Product Disclosure and Optimization: Sourcing of Raw Materials	Encourage the use of products and materials for which life-cycle information is available and reward teams for selecting products sourced in a responsible manner.	thyssenkrupp AG provides continuous and fully integrated reporting on its sustainability performance in our annual report, applying the international standards of the Global Reporting Initiative (GRI) and the UN Global Compact. Please visit: https://www.thyssenkrupp.com/en/company/sustainability/integrated-reporting/
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 Platinum and Bronze Cradle to Cradle Material Health Certificates. These certifications fulfill both the Disclosure and Optimization Material Ingredient points.

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Results evaluation

The results are evaluated using the CML 2001 (Version: 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.

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 this 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

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

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

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"

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

This EPD was revised on July 2017 to better reflect the product composition and life cycle of endura MRL.

Elevator Technology

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