Study on environmental impact of lifts

ELCA
European Lift & Lift Component Association

Interlift, October 14th, 2015.

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Is energy efficiency the only parameter to consider in order to improve environmental impact of lifts ?

Origin – Life Cycle Assesment

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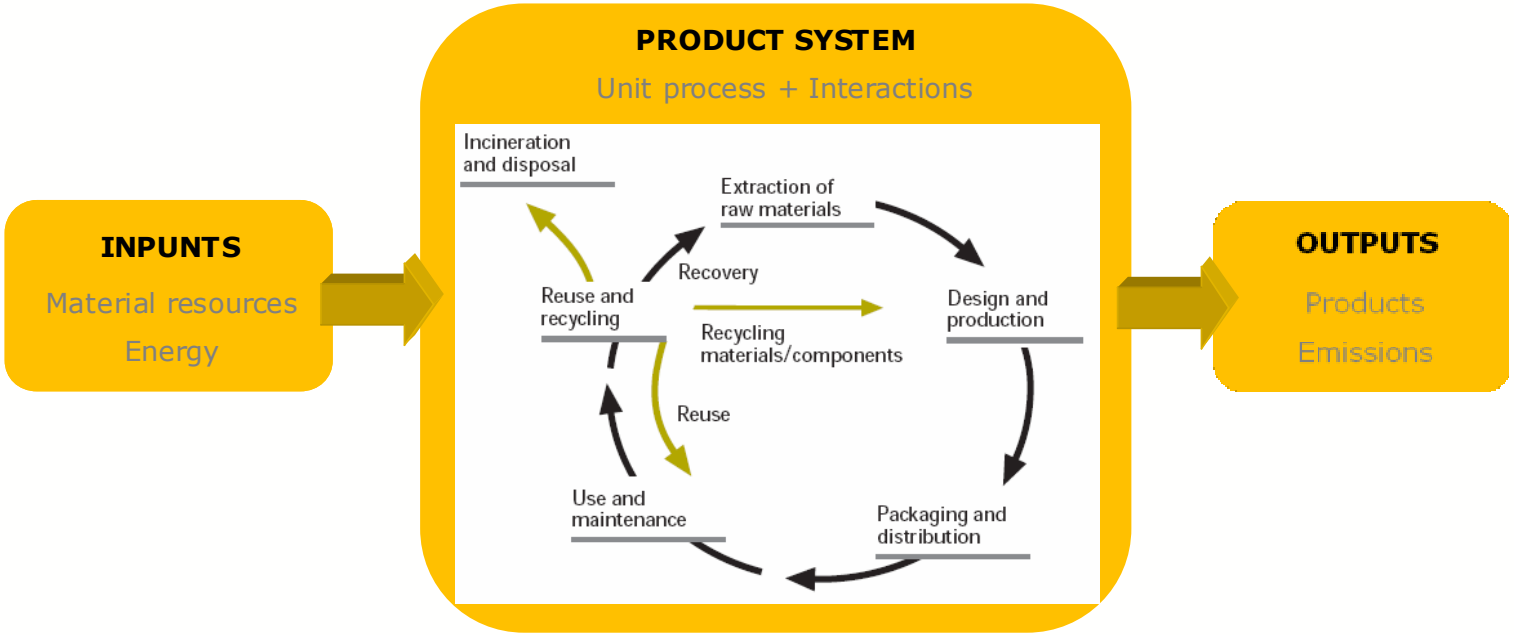
INSTITUTO TECNOLÓGICO DE ARAGÓN

"Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle" ISO 14040



"LCAs provide the best framework for assessing the potential environmental impacts of products currently available.".

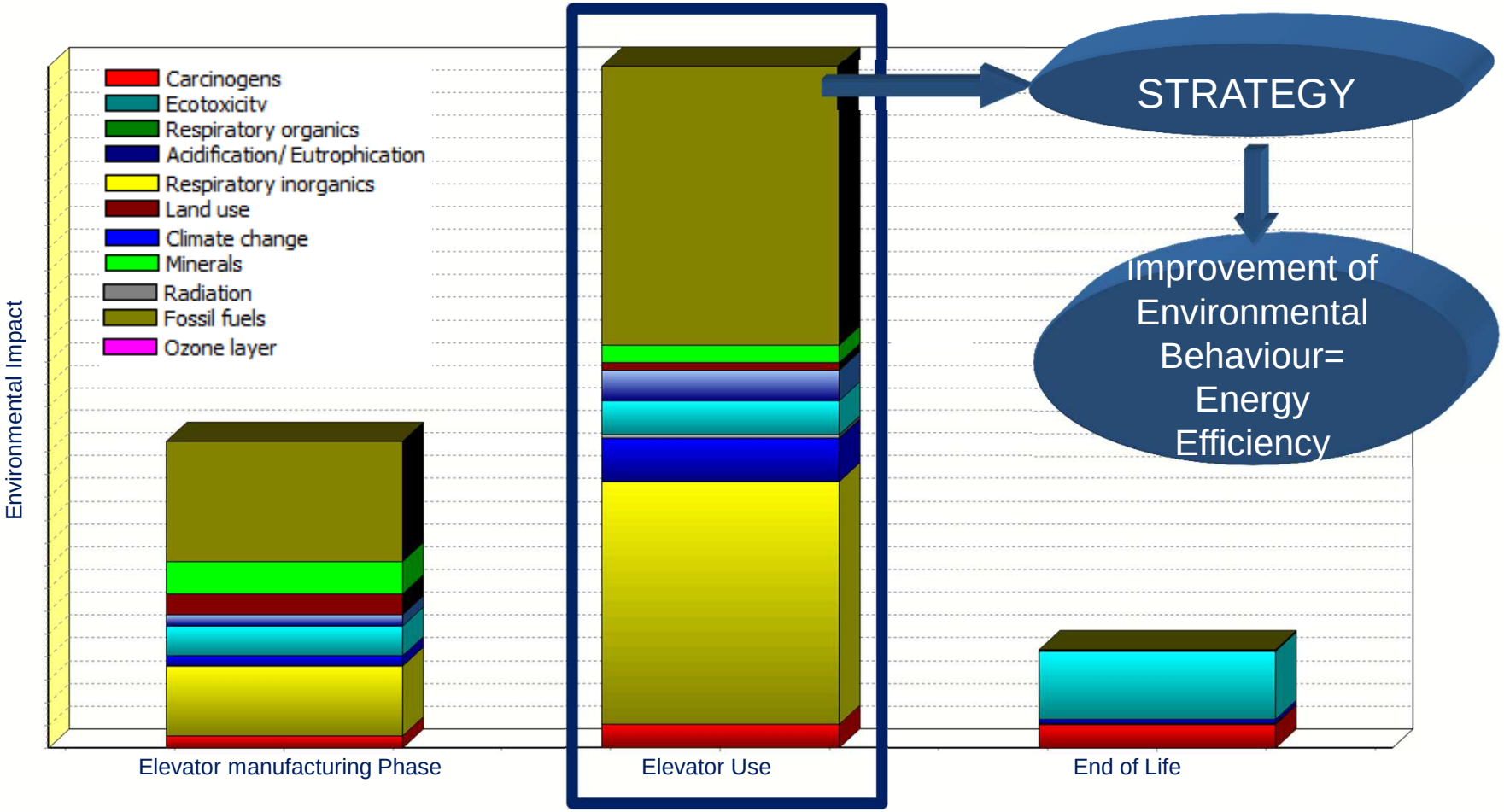
European Integrated Product Policy , IPP (COM (2003) 302)

Origin – Life Cycle Assesment

Materials	• Extraction of raw materials and logistics • Quantity of materials in the product
Production	• Use of resources, energy and materials • Emissions, waste materials
Distribution	• Logistics • Packaging
Instalation	• Energy use • Waste materials
Use	• Electrical consumption during all service life • Spare parts and auxiliary materials
End of life	• Dismantle and transportation • Final materials and components treatment

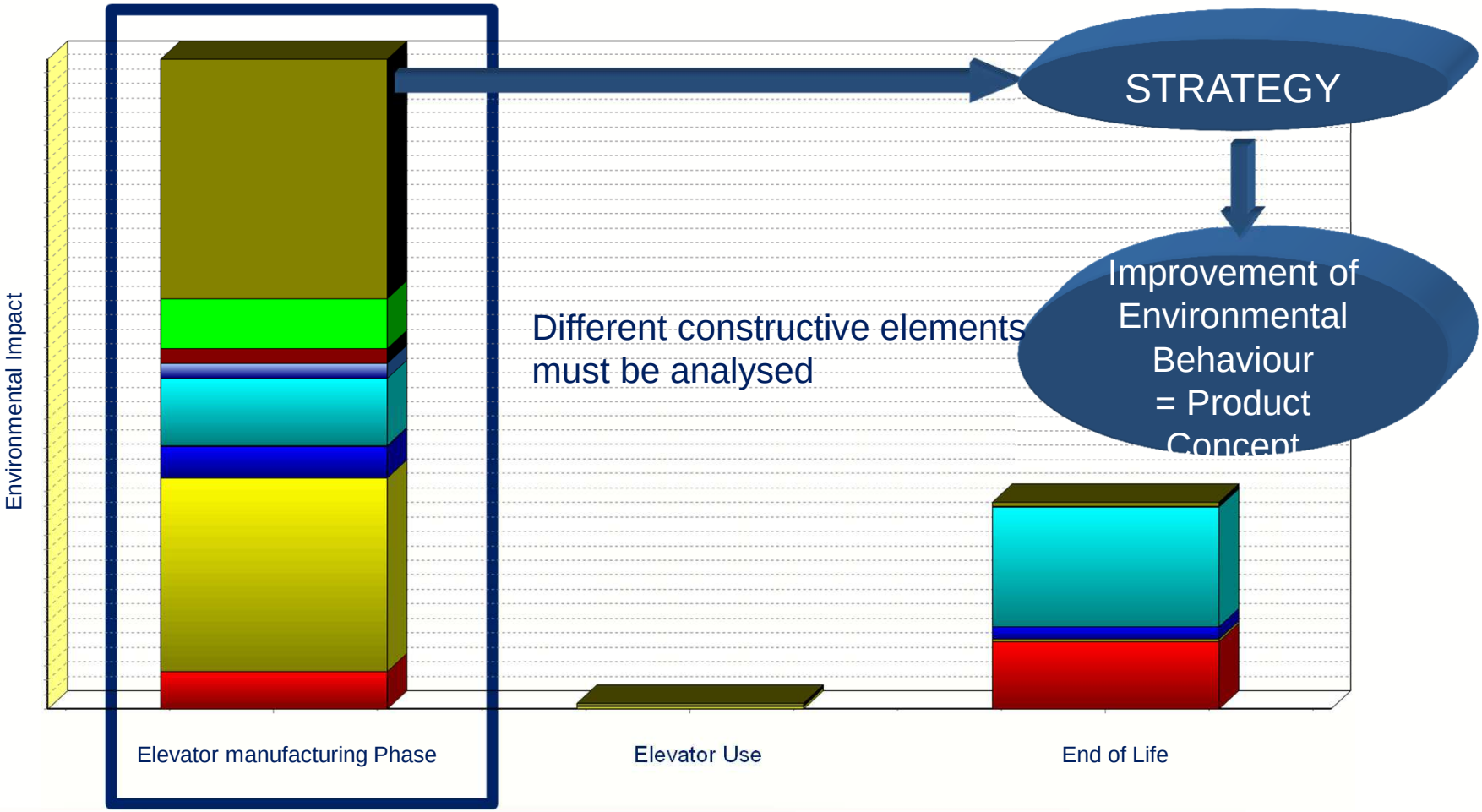
Strategies for improvement

Impact of the Different Lifecycle Phases – Residential Use (Simplification)

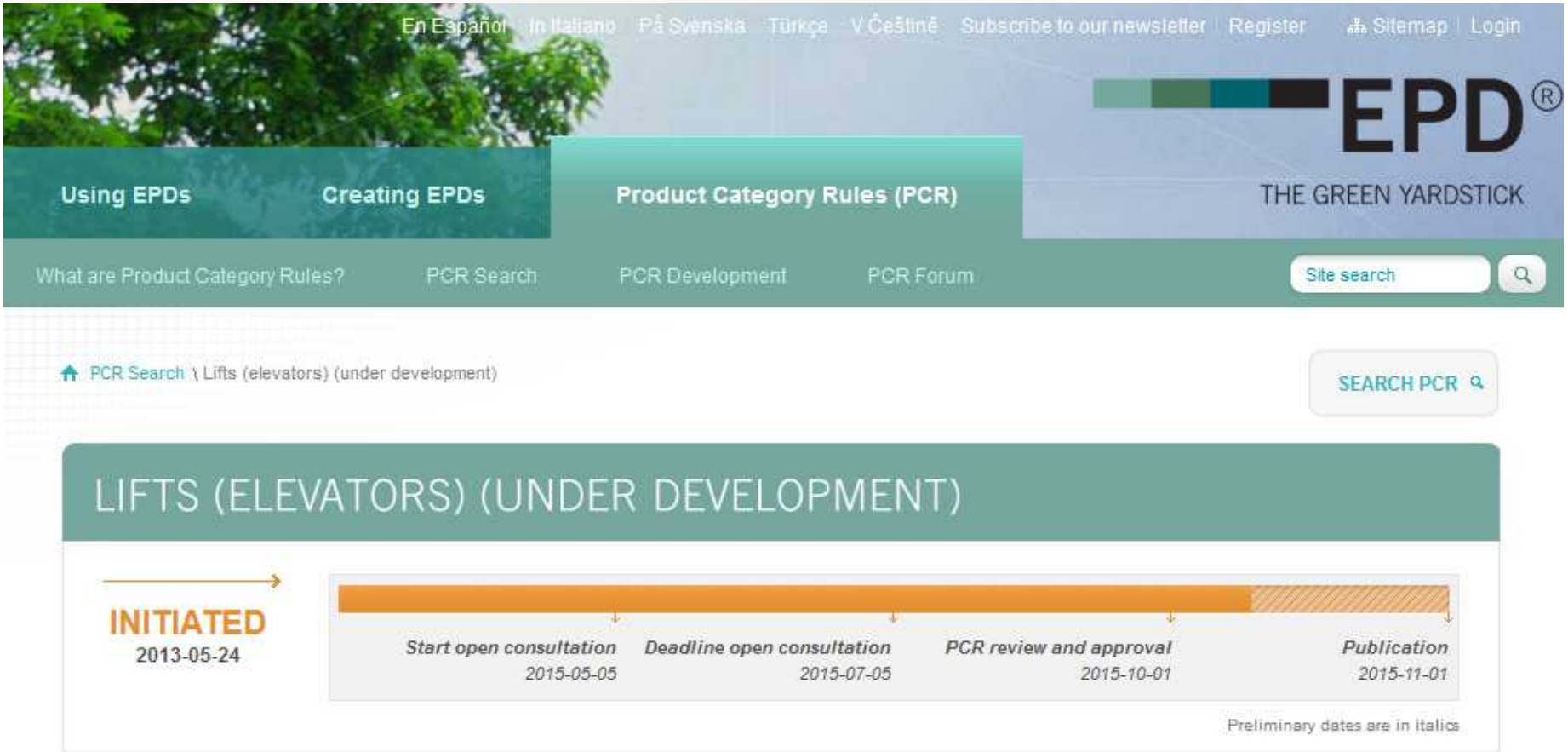


Strategies for improvement

Same Elevator Model (Lower use categorie)



PCR for lifts



PCR for lifts

EPD
Certified environmental product declaration

www.environdec.com

DETAILED INFORMATION

Name:	Lifts (elevators) (under development)
CPC Code(s):	4354 Lifts, skip hoists, escalators and moving walkways 43540 Lifts, skip hoists, escalators and moving walkways
GPI version:	General Programme Instructions 2.x (2013-)
Based on:	Basic Module: General purpose machinery
Contributor(s):	The ELA PCR for Lifts Working Group with the input from (alphabetically ordered): - Blain Hydraulics - EFESME - ELCA - GMV S.p.A. - Hydroware AB - KONE - Orona - OSMA Aufzüge - Otis Elevator Company - Schindler Elevators Ltd. - Schmidt+Sohn Aufzüge - ThyssenKrupp Elevator - VFA-Interlift - WITTUR Holding GmbH Carbotech AG, Dr. Ana Maria Lorente Lafuente, Instituto Tecnológico de Aragón, IQC GmbH, Technische Universität Berlin

Comparative analysis
Hydraulic - Traction

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Lift parameters and usage category

	hydraulic	traction	
B.1 Lift parameters			
Rated load	**450**	**450**	Kg
Rated speed	**0,5**	**1**	m/s
Travel	**16**	**16**	m
Number of floors	6	6	
Traction lift			
Counterbalancing	-	50	%
Acceleration	**0,7**	**0,7**	m/s2
Jerk	**1,25**	**1,25**	m/s3
Door operation time	**4**	**4**	s

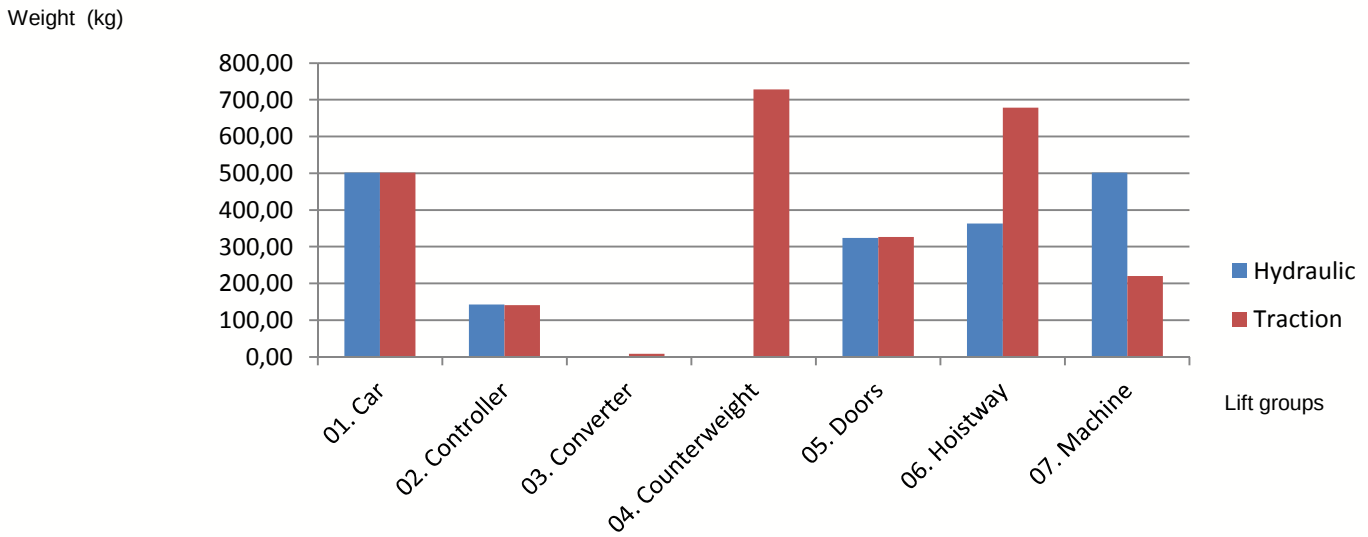
Lift parameters

Life span 20 years according to PCR document

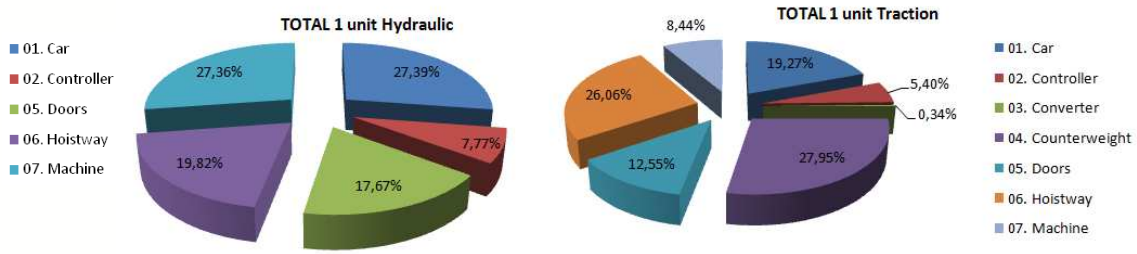
Usage category	1	2
Usage intensity/ frequency	Very low	Low
Number of trips per day (n_d) typical range	50 (<75)	125 (75 to <200)
Typical buildings and usage (operating days per year)	Residential building up to 6 dwellings (360 d) Residential care home (360 d) Small office or administrative building with few operations (260 d) Suburban railway stations (360 d)	Residential building up to 20 dwellings (360 d) Small office or administrative building with 2 to 5 floors (260 d) Small hotels (360 d) Office car parks (260 d) General car parks (360 d) Main line railway stations (360 d) Library (312 d) Entertainment centres (360 d) Stadia (intermit-tent)

Usage categories according to ISO 25745-2

Summary inventory: Groups materials



Group	Hydraulic	Traction
01. Car	501,86	501,86
02. Controller	142,33	140,55
03. Converter		8,76
04. Counterweight		728,00
05. Doors	323,88	326,78
06. Hoistway	363,14	678,66
07. Machine	501,35	219,80
Weight (kg)	1832,56	2604,40



Life Cycle Assessment: Purchasing

Transportation of components and materials from suppliers

Internal purchasing

Means of Transportation	Distance	Mass (kg)	tkm
Transport, by air	0,00 km	0,0 Kg	0,00 tkm
Transport, transoceanic freight ship	9666,00 km	2,4 Kg	22,73 tkm
Transport, by train	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (3,5 t - 7,5 t), EURO4	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (7,5 t - 16 t), EURO4	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (16 t - 32 t), EURO4	16317,00 km	1750,1 Kg	944,99 tkm
Transport, lorry > 32t, EURO4	0,00 km	0,0 Kg	0,00 tkm
TOTAL	25983,00 km	1752,4 Kg	**967,73 tkm**

Purchasing

Means of Transportation	Distance	Mass (kg)	tkm
Transport, by air	0,00 km	0,0 Kg	0,00 tkm
Transport, transoceanic freight ship	0,00 km	2,4 Kg	0,00 tkm
Transport, by train	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (3,5 t - 7,5 t), EURO4	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (7,5 t - 16 t), EURO4	0,00 km	0,0 Kg	0,00 tkm
Transport, lorry (16 t - 32 t), EURO4	15852,00 km	1750,1 Kg	1044,40 tkm
Transport, lorry > 32t, EURO4	0,00 km	0,0 Kg	0,00 tkm
TOTAL	15852,00 km	1752,4 Kg	**1044,40 tkm**

Data of general purchasing efforts for 1 unit of lift. When the distance is not known, it is considered 836 km as an average distance in Spain.

Same data considered for both lifts in this phase.

Life Cycle Assessment: Manufacturing efforts per unit

Consumption / Waste Manufacturing		
Electricity	689,992226	kWh
Gas	1269,9319	MJ
Gas welding	0,454641	kg
Gas oil	7,71341463	kg
Water	1233,122	kg
Waste sheet	187,12133	kg
Waste steel	19,8352	kg
Waste wood	45,23387	kg
Waste cardboard	6,97015	kg
Other waste	3,50658	kg

Data of general manufacturing efforts for 1 unit of lift.

Same data considered for both lifts in this phase.

Life Cycle Assessment: Distribution
(from manufacturing site to installation or customer site)

ACV lift - hydraulic			
Means of Transportation	**Distance**	**Mass (kg)**	**tkm**
Transport, lorry (7,5 t - 16 t), EURO4	500,00 km	1832,6 Kg	916,28 tkm
	500,00 km	1832,0 Kg	**916,28 tkm**

ACV lift - traction			
Means of Transportation	**Distance**	**Mass (kg)**	**tkm**
Transport, lorry (7,5 t - 16 t), EURO4	500,00 km	2604,4 Kg	1302,20 tkm
	500,00 km	1832,0 Kg	**1302,20 tkm**

It has been considered an average distance of lift distribution: 500km by medium size freight lorry.

Life Cycle Assessment: Use

	hydraulic	traction		
B.1 Lift parameters				
Rated load	**450**	**450**	Kg	
Rated speed	**0,5**	**1**	m/s	
Travel	**16**	**16**	m	
Number of floors	6	6		
Traction lift				
Counterbalancing	-	50	%	
Acceleration	**0,7**	**0,7**	m/s2	
Jerk	**1,25**	**1,25**	m/s3	
Door operation time	**4**	**4**	s	
B.2 Data determined by measurements, simulation or calculation				
Daily trips	**50**	**50**	(category 1)	
Idle power	**70**	**94**	W	
Standby_5 power	**70**	**94**	W	
Standby_30 power	**70**	**94**	W	
Reference cycle energy	**395,46**	**145,49**	kWs	(data from simulation)
	109,85	40,41	Wh	
Short cycle distance	**3,20**	**3,20**	m	
Short cycle energy	**95,88**	**34,77**	kWs	(data from simulation)
	26,63	9,66	Wh	
B.3 Data from tables				
Average travel distance	**49**	**49**	%	(category 1; > 3 stops)
Average car load	**7,5**	**7,5**	%	(category 1)
Load factor (KL)	**1,05**	**0,88**		
Rid	**13**	**13**		
Rst5	**55**	**55**	(category 1)	
Rst30	**32**	**32**		

Use Category: 1

lift	Consumption per year
hydraulic	1152 kWh/year
traction	983 kWh/year

Data of energy demand from energy simulations

Life Cycle Assessment: Use

	hydraulic	traction		
B.1 Lift parameters				
Rated load	**450**	**450**	Kg	
Rated speed	**0,5**	**1**	m/s	
Travel	**16**	**16**	m	
Number of floors	6	6		
Traction lift				
Counterbalancing	-	50	%	
Acceleration	**0,7**	**0,7**	m/s2	
Jerk	**1,25**	**1,25**	m/s3	
Door operation time	**4**	**4**	s	
B.2 Data determined by measurements, simulation or calculation				
Daily trips	**125**	**125**	(category 2)	
Idle power	**70**	**94**	W	
Standby_5 power	**70**	**94**	W	
Standby_30 power	**70**	**94**	W	
Reference cycle energy	**395,46**	**145,49**	kWs	(data from simulation)
	109,85	40,41	Wh	
Short cycle distance	**3,20**	**3,20**	m	
Short cycle energy	**95,88**	**34,77**	kWs	(data from simulation)
	26,63	9,66	Wh	
B.3 Data from tables				
Average travel distance	**49**	**49**	%	(category 2; > 3 stops)
Average car load	**7,5**	**7,5**	%	(category 2)
Load factor (KL)	**1,05**	**0,88**		
Rid	**23**	**23**		
Rst5	**45**	**45**	(category 2)	
Rst30	**32**	**32**		

Use Category: 2

lift	Consumption per year
hydraulic	1959 kWh/year
traction	1223 kWh/year

Data of energy demand from energy simulations

Life Cycle Assessment: Maintenance

Materials used in maintenance operations along the life span

Hydraulic

Group	Component	Hydraulic	Hydraulic Maintenance	%
01. Car	Car	279,3	5,4	1,9%
	Car frame	220,5	6,3	2,9%
	Car lighting	2,0	2,2	105,9%
02. Controller	Car button panel	11,3	0,0	0,0%
	Electrical appliances (Controller cabinet)	34,8	0,0	0,0%
	Electrical appliances (Hoistway)	58,7	0,0	0,0%
	Electrical cabinet	34,7	0,0	0,0%
	Floor button panel	2,9	1,7	58,8%
05. Doors	Car doors	24,5	0,0	0,0%
	Doors operator	27,6	0,0	0,0%
	Doors operator frequency controller	6,7	0,0	0,0%
	Floor automatic doors	265,0	0,0	0,0%
06. Hoistway	Car guides	268,7	0,0	0,0%
	Electrical appliances (Hoistway)	2,0	0,0	0,0%
	Hoistwary lighting	0,4	1,6	400,0%
	Mechanical assembly accessories	55,7	0,0	0,0%
	Puffer column	2,5	1,0	40,0%
	Traction guide	33,8	0,0	0,0%
07. Machine	Filter	1,4	0,0	0,0%
	Hand pump	1,6	0,0	0,0%
	Hydraulic assembly mechanical elements	88,6	0,0	0,0%
	Hydraulic oil (mineral, synthetic, bio)	119,3	47,7	40,0%
	Interconnecting pipes	9,3	0,0	0,0%
	Jack (cylinder and ram /piston)	174,0	0,5	0,3%
	Motor	19,8	0,0	0,0%
	Oil heating / cooling unit	15,0	0,0	0,0%
	Oil tank	51,0	0,0	0,0%
	Pressure switch	0,4	0,0	0,0%
	Pump	5,2	0,0	0,0%
	Valves	15,7	0,0	0,0%
Total general		1832,6	66,4	**3,6%**

Traction

Group	Component	Traction	Maintenance Traction	%
01. Car	Car	279,3	5,4	1,9%
	Car frame	220,5	6,3	2,9%
	Car lighting	2,0	2,2	105,9%
02. Controller	Car button panel	11,3	0,0	0,0%
	Electrical appliances (Controller cabinet)	48,1	0,0	0,0%
	Electrical appliances (Hoistway)	59,3	0,0	0,0%
	Electrical cabinet	19,0	0,0	0,0%
	Floor button panel	2,9	1,7	58,8%
03. Converter	Converter electrical appliances	8,8	0,0	0,0%
04. Counterweight	Counterweight frame	22,5	2,5	11,1%
	Counterweight shield	0,5	0,0	0,0%
	Fillings	705,0	0,0	0,0%
05. Doors	Cabinet adaptation sheet	2,9	0,0	0,0%
	Car doors	24,5	0,0	0,0%
	Doors operator	27,6	0,0	0,0%
	Doors operator frequency controller	6,7	0,0	0,0%
	Floor automatic doors	265,0	0,0	0,0%
06. Hoistway	Car guides	268,7	0,0	0,0%
	Counterweight guides	255,8	0,0	0,0%
	Electrical appliances (Hoistway)	2,0	0,0	0,0%
	Hoistwary lighting	0,4	1,6	400,0%
	Mechanical assembly accessories	63,8	0,0	0,0%
	Puffer column	3,5	2,0	57,1%
	Speed governor	49,5	0,0	0,0%
	Speed governor bed	1,3	0,0	0,0%
	Speed governor cable	6,4	0,0	0,0%
	Traction guide	26,2	26,2	100,0%
	Upper speed governor full shield	1,0	0,0	0,0%
07. Machine	Machine	200,3	0,0	0,0%
	Machine bed	4,5	0,0	0,0%
	Machine pulley	15,0	15,0	100,0%
Total general		2604,4	62,9	**2,4%**

Life Cycle Assessment: End of life

Group	%R	%V	%W
01. Ferrous metals	98%	0%	2%
02. Non Ferrous metal	98%	0%	2%
03. Thermoplastic	40%	30%	30%
04. Elastomer	80%	20%	0%
05. Fluids and gases	0%	100%	0%
06. Organic and natural materials	95%	5%	0%
07.Paint and surface coating	0%	0%	100%
08. Electronics	79%	19%	2%
09. Inorganic materials	43%	0%	57%
10, Adehesive	0%	0%	100%

Scenario used for the end of life of the product. (R: recyclation, V: valorization, W: waste).

General criteria environmental impact assessment:

▪**Impact Assessment Life Cycle**: Environmental impact analysis is performed on inventoried data (Summary of the Inventory V1.0) and the calculation method using as CML -IA baseline EU25 and ReCiPe, as one of the recommended by the **PCR** draft for lifts (Environdec)

▪**Software and Database**: LCA software used for conducting this study is **SimaPro 8.0.3** developed by Pré Consultants. The database implemented in this software is **Ecoinvent.v3.1** .

▪For this method, the environmental **impact categories** included in the study are:

- climate change: kg CO2e
- stratospheric Ozone: kg CFC- 11e
- potential acidification : kg SO2e
- potential eutrophication : kg PO4e
- photochemical oxidation: kg C2H4e
- ReCiPe: Pt (points).

Analysis to be done

20 years life span in different countries – standard LCA according to PCR

Lift	Use category (ISO)		Electricity MIX		
Hydraulic new installation	1	2	FR	UCTE	PL
Traction new installation					

Further analysis

Sensitivity analysis: stops, speed control, manufacturing, …

Maintenance (regular service) + replacement of certain components

Different modernization scenarios – building life span

Selection criteria based on daily trips – years of service (for a certain use cat.)

Results will be published in short

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