

# THE COMEBACK OF THE HYDRAULIC LIFT

## Life Cycle Assessments - LCA of Hydraulic & Traction Lifts

### Comparison & Conclusions

## ELEVCON 2018

presentation by  
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# INITIATIVE

## Life Cycle Analysis

by ELCA working group *LIFTS*

**Start | End** 2014 | 2017

**Scope** independent from a specific supplier  
LCA for typical European modern hydraulic and traction lifts

**General conditions** PCR Lifts 2015

**Participants and Co-financing**

- Germany | ALGI, Blain Hydraulics, Oildinamic
- Greece | Kleemann
- Italy | GMV, Hidronic Lift, IGV, Moris, Omar Lift, Startelevator
- Spain | Mac Puarsa
- Sweden | Hydroware



# INITIATIVE



Expert laboratory  
in charge of the study

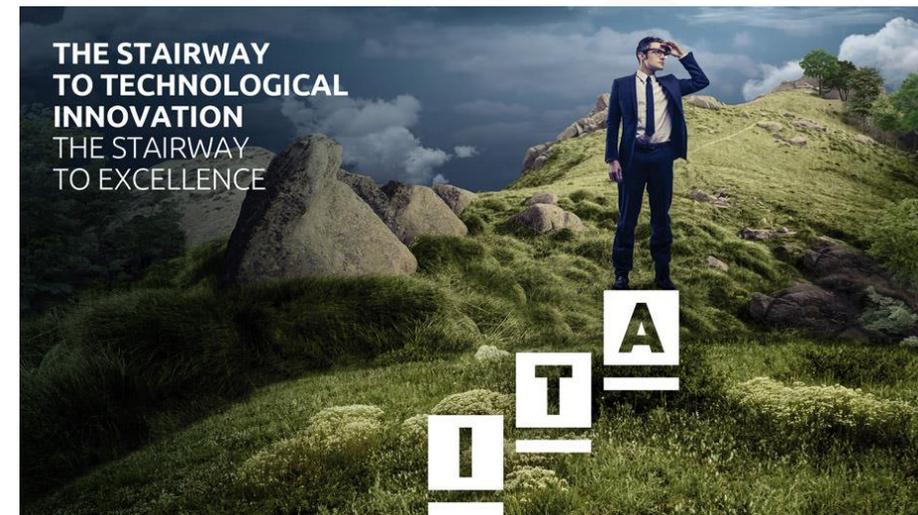
**ITAINNOVA**  
Instituto Tecnológico de Aragón  
Saragossa, Spain

Project manager

Carlos Peribáñez



**ITA**, the technology centre at the university of Saragossa has a wide experience in LCA's and efficiency-related topics. **ITA** laboratories monitor new technologies such as robotics, automation and automotive.



# INITIATIVE

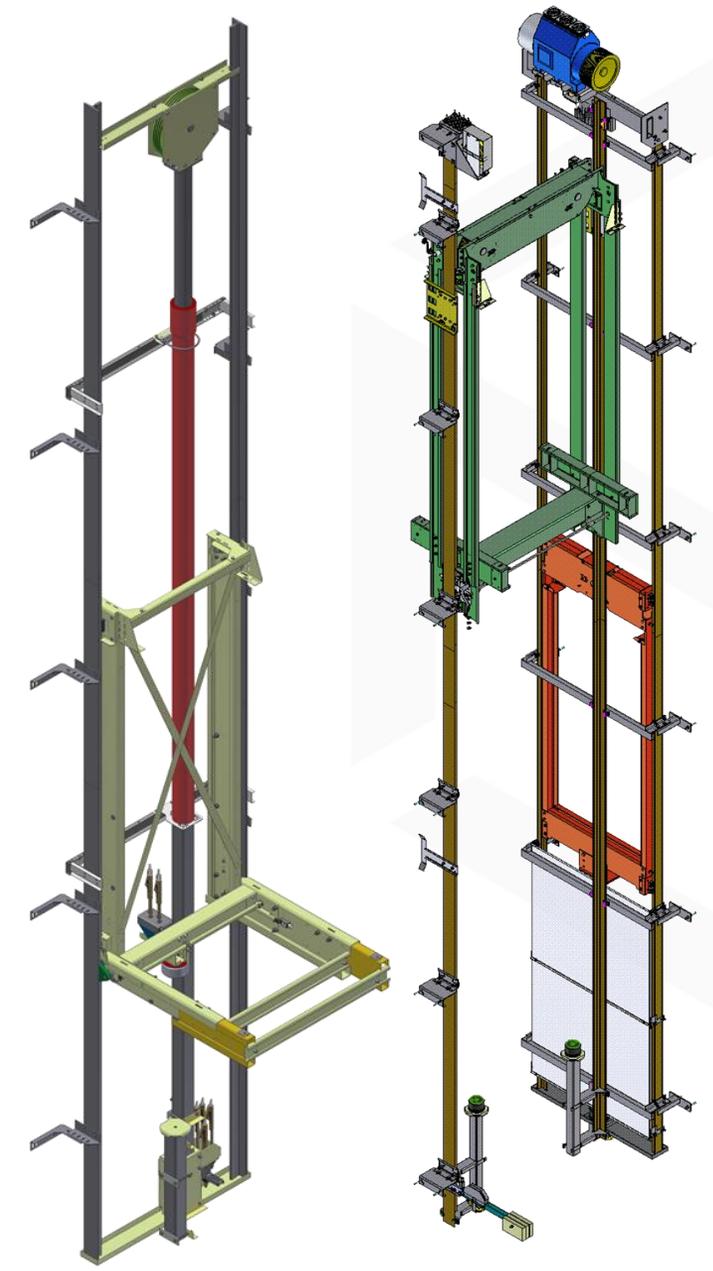


## Lift definition

Lift parameters	Hydraulic drive	Traction drive
Rated load	450 kg	450 kg
Rated speed	0,5 m/s	1,0 m/s
Travel	10 m	10 m
Stops	4	4
Counterweight	-	50%
Drive specification	1:2; oil emerged motor with electronical valve	gearless MRL 2:1, inverter without energy recovery

## Life span

**20 years**  
(minimum period after which more intensive interventions or modernizations are needed)



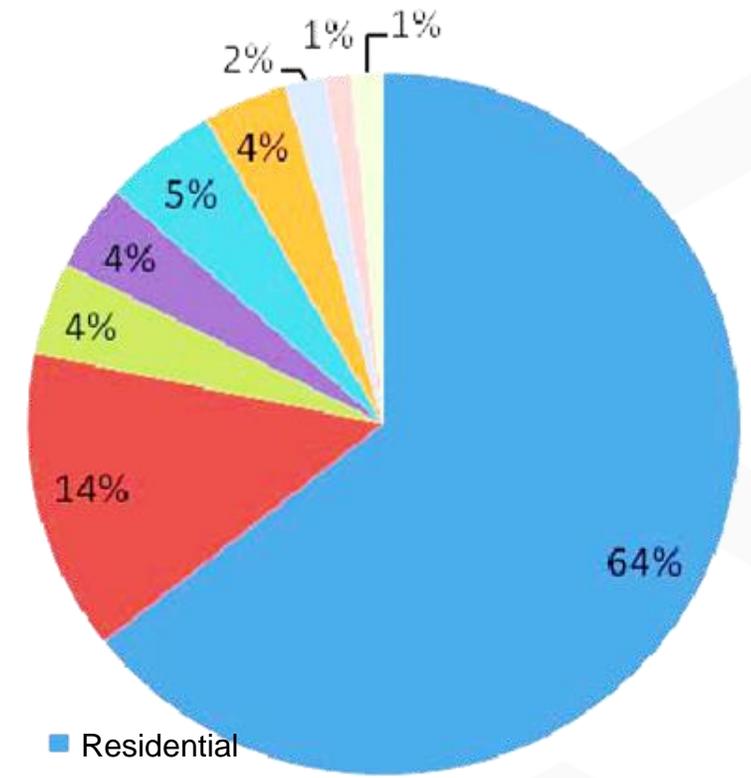
# INITIATIVE



## Usage - ISO 25745-II

Usage category	1	2	3
<b>Trips per day</b>	Ø 50 < 75	Ø 125 < 200	Ø 300 < 500
<b>Typical installations</b>	small <b>condominium</b> , <b>office building</b> ; <b>underground station</b>	<b>condominium</b> up to 20 flats, small office or <b>administration building</b> up to 5 floors, small <b>hotel</b> , <b>stadium</b> , recreational facilities	<b>condominium</b> up to 50 flats, medium size office building, hotel, <b>airport</b> , small <b>hospital</b> , <b>shopping centre</b>

Table A.1  
Energy consumption of lifts



- Residential
- Office
- Hospital
- Industrial
- Commercial
- Hotel
- Senior Residences
- Traffic
- Others

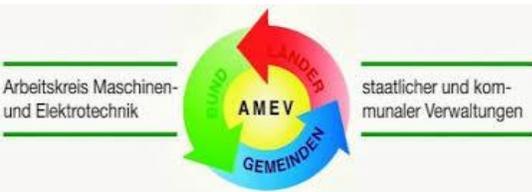
Lift distribution according to building types in Europe (E4 study)

# INITIATIVE



## Background to the initiative

- Reduction of **energy consumption, efficiency** and **sustainability** are strong focus of European policies.
- A lift **has a long life-time**. It is installed for a minimum of 20 years and the total life span often reaches 50 years and more. **Production, repair, maintenance and modernization** therefore have a large impact.
- A lift is a **mean of transportation**. It implies comfort, full accessibility and reliability in the transportation of people and goods. The lift **optimizes the usage of a building and its value**. **At this context energy consumption must be looked at of the full life cycle of the lift**. It's not enough to only evaluate the electricity consumption during use phase, that in a modern lift in a 5-stops residential building is very low, 170 € per year.
- **Misleading campaigns** have been led. Often they were based on **wrong conclusions, taking only energy consumption during use into consideration**. An example thereof is the German AMEV Lifts 2010, a guideline for planners having to order lifts in public tenders. AMEV requested to justify the use of any hydraulic lift in public buildings. This meant a practical exclusion of hydraulic lifts, also modern, efficient ones.

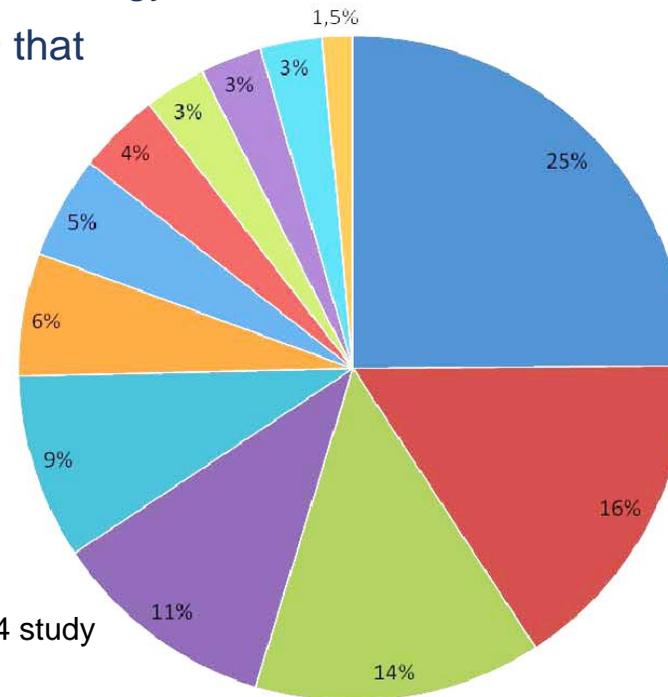


# INITIATIVE



## Scope of ITA Study

1. **Collecting data** and producing LCA's for medium-travel lifts, which **represent some 80%** of the European **new lifts** market, using present-day technology
2. **Compare hydraulic drive lifts and gearless MRL**
3. Analysing **new installations** but also **modernizations** comparing a full replacement and a partial modernization
4. Getting the **advantages** of each drive technology with numbers
5. Developing an **LCA** as basis for an EPD that could become a joint project
6. Understanding the **PCR** impact



Graph: E4 study



# Life Cycle Inventory



## Start: LCI

Lifts
Hydraulic new installation
Traction new installation
Hydraulic modernization

- Materials
- Transports
- Manufacturing
- Distribution
- Use
- End of life

phases for Life Cycle Inventory

The LCI takes all raw **materials** into account.

An important parameter in the **manufacturing** phase is the dedicated **energy**.

Transport and distribution, delivery distances, influence the final result. The usage phase, and hereby mainly the **energy consumption** and the **maintenance**, is one of the crucial phases for the LCA result.

Dismantling and recycling have less impact thanks to a **high rate of recyclability**.

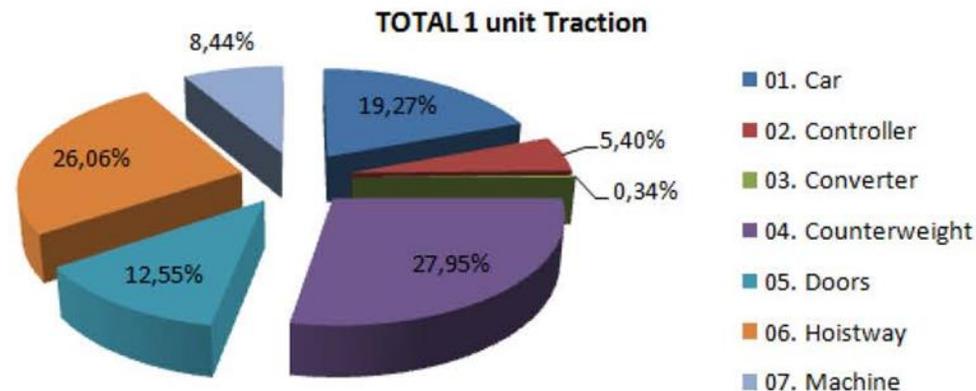
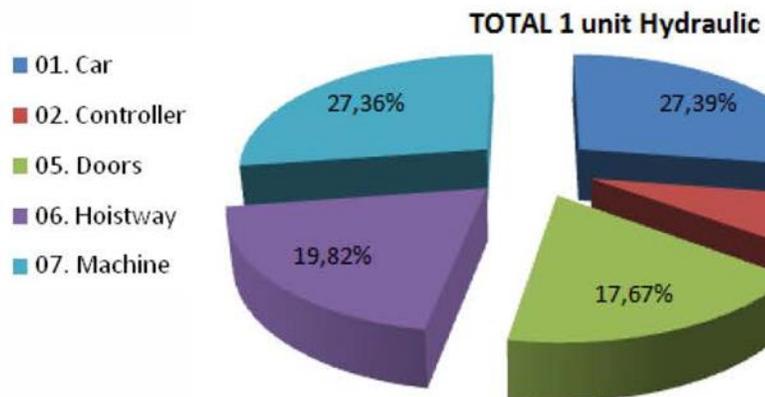
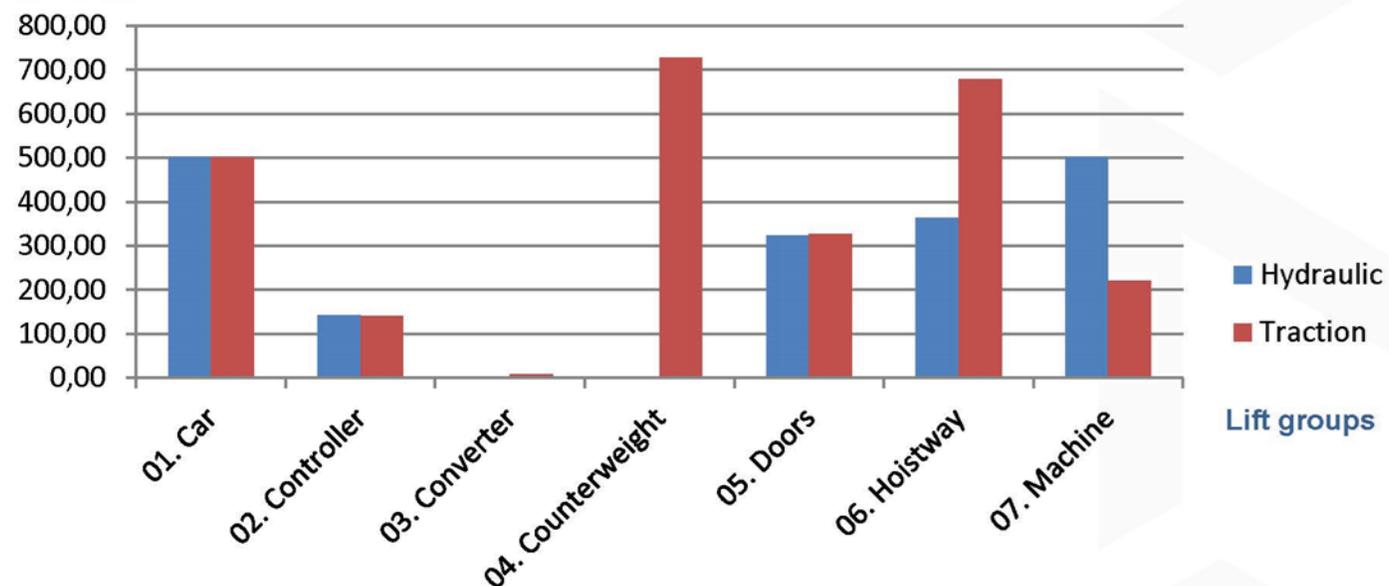
<b>1</b>	<b>LCA and Life Cycle Inventory (LCI)</b>							
1.1	Definition of scope and Inventory requirements							
1.2	LCI data recompileation							
1.3	LCI analysis and validation							
1.4	Evaluation and impact assessment (LCIA)							
1.5	Complete report an report summary for publication							
<b>2</b>	<b>Sensitivity and comparison analysis</b>							
2.1	Definition of parameters for analysis							
2.2	Sensitivity analysis							
2.3	Qualitative comparison with traction lift							
2.4	Complete report and sumaries for publication							

# Material phase



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
<b>Weight (kg)</b>	<b>1832,56</b>	<b>2604,40</b>

Weight (kg)



# Purchasing phase



	Hydraulic	Traction
External purchasing (ton*km)	840	1063
Internal purchasing (ton*km)	1585	1395
<b>Total (ton*km)</b>	<b>2425</b>	<b>2458</b>

**External** = raw material transport to manufacturing facilities

**Internal** = processed material transport between manufacturing facilities



# Manufacturing phase

**Energy source consumption** is the main factor in the manufacturing phase.

For both types of lifts the same data are considered.

Consumption / Waste Manufacturing		
	Amount	Unit
Electricity	690	kWh / lift
Natural gas - offices	1269,9	MJ / lift
Natural gas - production	65,47	kWh / lift
Gas oil	7,71	kg / lift
Water	1233	kg / lift
Oils	3,6	liter/ lift
Lubricants, greases ...	0,087	kg / lift
Cutting Fluids / Coolants	0,01144063	liter/ lift
Adhesives	0,03124444	kg / lift
Detergent	0,477	kg / lift
Solder Wire - Steel	0,13168617	kg / lift
Solder Wire - Aluminium	13	kg / lift
Welding gases - Argon	1	kg / lift
Nitrogen	0,12	kg / lift
Solid particulates	7,42	kg / lift
CO	21	kg / lift
VOCs (volatile organic compounds)	59,6	kg / lift
Steel	206,95	kg / lift
Aluminium	4,37	kg / lift
Iron	45,88	kg / lift
Cardboard	6,9	kg / lift
Copper Cables	3,5	kg / lift
Wood	45,2	kg / lift

# Distribution phase



	Hydraulic	Traction
Means of Transportation	Transport, lorry (7,5 t - 16 t), EURO4	
Distance	500,00 km	
Mass (kg)	1832,6 Kg	2604,4 Kg
tkm	916,28 tkm	1302,21 tkm

For **both** types of lifts the **same average distance** of lift distribution is considered: 500 km by medium size freight lorry.

# Use phase



ISO 25745	Energy consumption per year [kWh/a]	
	Hydraulic drive	Traction drive
Usage category		
1	694	929
2	1011	1088
3	1753	1458

**Average quantity of spare part materials (kg) used for the 20 years life-span.**

**6.000 km of technicians' travel** has been taken into account for both kinds of lifts

	Total Kg of spare materials (20 YEARS)	
	HYDRAULIC	TRACTION
<b>01. Car</b>	<b>3,8</b>	<b>4,3</b>
Car - electrical appliances	0,6	1,1
Car frame	3,2	3,2
<b>02. Controller</b>	<b>28,0</b>	<b>94,9</b>
Electrical appliances (Controller cabinet)	24,7	91,6
Electrical appliances (Hostway)	3,3	3,3
<b>03. Converter</b>	<b>0,0</b>	<b>9,6</b>
Converter electrical appliances	0,0	9,6
<b>04. Counterweight</b>	<b>0,0</b>	<b>22,5</b>
Counterweight frame	0,0	22,5
<b>05. Doors</b>	<b>21,2</b>	<b>21,2</b>
Car doors	19,6	19,6
Floor automatic doors	1,7	1,7
<b>06. Hostway</b>	<b>34,6</b>	<b>26,6</b>
Hostway lighting	0,4	0,4
Puffer column	0,3	0,0
Ropes	33,8	26,2
<b>07. Machine</b>	<b>53,7</b>	<b>81,7</b>
Filter	2,7	0,0
Hydraulic oil (mineral, synthetic, bio)	39,4	0,0
Machine	0,0	66,7
Machine pulley / sheave	0,0	15,0
Motor	6,6	0,0
Oil heating / cooling unit	5,0	0,0
Pressure switch	0,1	0,0
<b>Total general</b>	<b>282,6</b>	<b>521,6</b>

# End of life phase



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. Adhesive	0%	0%	100%

Scenario used for the **end-of-life** of the lift.

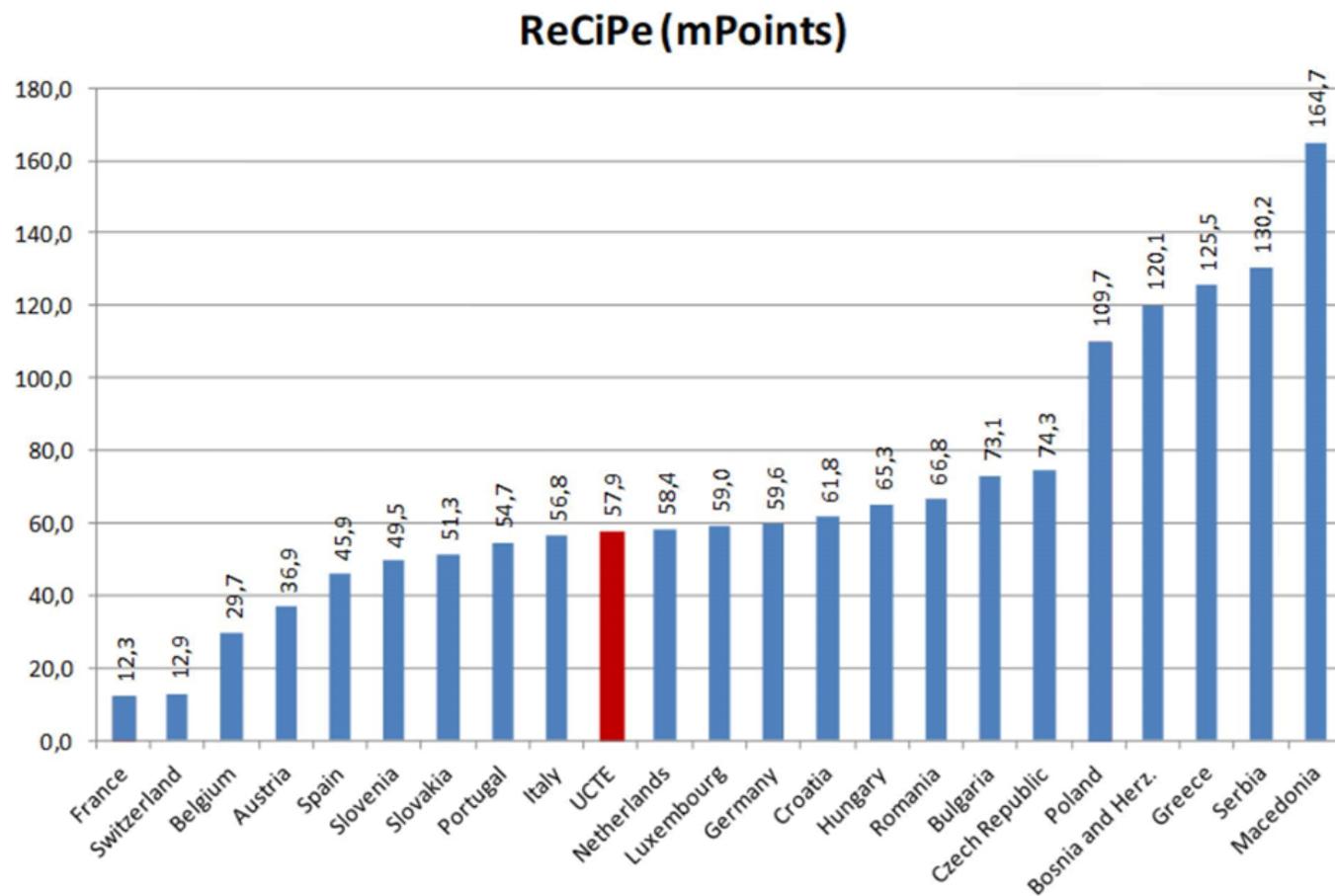
- R | Recycling
- V | Energy recovery
- W | Waste

# Environmental impact



## General criteria used for the environmental impact assessment

- **PCR Lifts** (Environdec) recommended calculation method, using CML-IA baseline EU25 and ReCiPe
- **Software** SimaPro 8.0.3  
Database: Ecoinvent.V3.1
- **Methods:**  
**Climate change** (kg CO<sub>2</sub>e)  
**ReCiPe** (Points) considers damages categories Human Health, Eco-system Quality, Climate Change, Resources
- **UCTE** electricity mix



# Environmental impact



## Absolute results

<i>Results for 20 years</i>	Climate change (kg CO2)		ReCiPe (Pto)	
	Hydraulic	Traction	Hydraulic	Traction
Materials	8.399	9.392	1.979	2.218
Purchasing	406	411	15	19
Manufacturing	919	919	62	62
Transport	200	284	20	29
Use (Usage category 1)	8.221	11.005	803	1.075
Use (Usage category 2)	11.977	12.889	1.170	1.259
Use (Usage category 3)	20.766	17.272	2.029	1.688
Maintenance	3.026	3.603	478	585
End of life	34	47	0,45	0,48
<b>TOTAL (Usage category 1)</b>	<b>21205</b> ✓	<b>25662</b>	<b>3357</b> ✓	<b>3988</b>
<b>TOTAL (Usage category 2)</b>	<b>24960</b> ✓	<b>27545</b>	<b>3724</b> ✓	<b>4172</b>
<b>TOTAL (Usage category 3)</b>	<b>33750</b>	<b>31928</b> ✓	<b>4583</b> ✓	<b>4600</b>

# Environmental impact



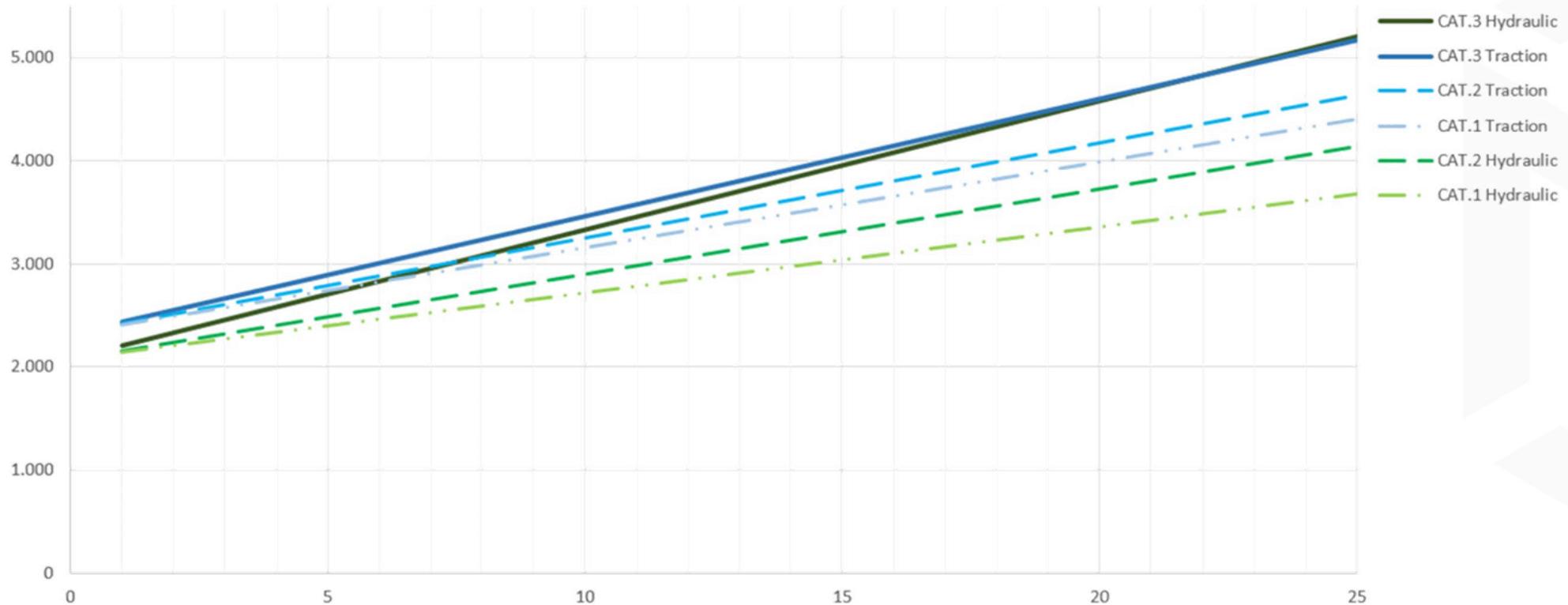
## Relative results

	Climate change (kg CO2)						ReCiPe (Pto)					
	Hydraulic			Traction			Hydraulic			Traction		
	Cat.1	Cat.2	Cat.3	Cat.1	Cat.2	Cat.3	Cat.1	Cat.2	Cat.3	Cat.1	Cat.2	Cat.3
<b>Materials</b>	39,6%	33,6%	24,9%	36,6%	34,1%	29,4%	58,9%	53,1%	43,2%	55,6%	53,2%	48,2%
<b>Purchasing</b>	1,9%	1,6%	1,2%	1,6%	1,5%	1,3%	0,4%	0,4%	0,3%	0,5%	0,5%	0,4%
<b>Manufacturing</b>	4,3%	3,7%	2,7%	3,6%	3,3%	2,9%	1,8%	1,7%	1,3%	1,5%	1,5%	1,3%
<b>Transport</b>	0,9%	0,8%	0,6%	1,1%	1,0%	0,9%	0,6%	0,5%	0,4%	0,7%	0,7%	0,6%
<b>Use (Usage category 1)</b>	38,8%			42,9%			23,9%			27,0%		
<b>Use (Usage category 2)</b>		48,0%			46,8%			31,4%			30,2%	
<b>Use (Usage category 3)</b>			61,5%			54,1%			44,3%			36,7%
<b>Maintenance</b>	14,3%	12,1%	9,0%	14,0%	13,1%	11,3%	14,2%	12,8%	10,4%	14,7%	14,0%	12,7%
<b>End of life</b>	0,2%	0,1%	0,1%	0,2%	0,2%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

# Environmental impact



**ReCiPe Hydraulic vs Traction**  
Breakpoint by years of use (per usage category)



Under the considerations of this study and for the Impact Ecoindicator ReCiPe, for Usage Category 1&2 results for hydraulic lifts are always lower in total Environmental Impact. The longer is the span life, the larger is the positive difference for hydraulic lifts.

In case of Usage Category 3, a breakpoint in years exists, around 21-22 years of use, up to which, total impact for hydraulics lifts is also lower in ReCiPe terms.

# Environmental impact

## SUMMARY



### Hydraulic Lift

- **better environmental profile** in the **initial phases “materials” and “transport”**
- **lower environmental impact** and the better global choice **for usage categories 1 and 2** (up to Ø125 trips/d), thanks also to the lower standby consumption
- could be a **good option in cat. 3** up to a life span of 20 years



### Traction Lift

- **advantageous for intense usage** (category 3 and higher, >300 trips/d), with a life span of at least 20 years
- **lower running energy** compensates for the initial higher impacts, resulting in a better environmental profile
- a **different electricity mix** from UCTE can obtain **different results** and conclusions

# Modernization



## MODERNIZATION OF AN INSTALLED HYDRAULIC LIFT

MATERIALS	Component	%
01. Car	Car	10,1%
	Car frame	0,0%
	Car lighting	100,0%
02. Controller	Car button panel	100,0%
	Electrical appliances (Controller cabinet)	100,0%
	Electrical appliances (Hostway)	100,0%
	Electrical cabinet	100,0%
	Floor button panel	100,0%
05. Doors	Car doors	0,0%
	Doors operator	100,0%
	Doors operator frequency controller	70,3%
	Floor automatic doors	0,0%
06. Hostway	Car guides	0,0%
	Electrical appliances (Hostway)	100,0%
	Hostway lighting	100,0%
	Mechanical assembly accessories	30,8%
	Puffer column	0,0%
	<b>Ropes</b>	100,0%
07. Machine	Filter	100,0%
	Hand pump	0,0%
	Hydraulic assembly mechanical elements	46,1%
	Hydraulic oil (mineral, synthetic, bio)	100,0%
	Interconnecting pipes	0,0%
	Jack (cylinder and ram /piston)	100,0%
	Motor	100,0%
	Oil heating / cooling unit	100,0%
	Oil tank	0,0%
	Pressure switch	100,0%
	Pump	100,0%
	Valves	100,0%
	<b>Total general in weight</b>	<b>35,5%</b>

Additionally, the following assumptions have been used obtain a simplified LCI in relation to a completely new hydraulic lift (*nH*):

- Transports:  
Proportional to total weight of *nH*
- Manufacturing:  
Proportional to total weight of *nH*
- Distribution:  
Proportional to total weight of *nH*
- Use (Energy):  
Same than *nH*
- Use (Maintenance):  
Same than *nH*
- End of Life:  
Proportional to 80% of *nH* impacts  
Usually high impact components in EoL phase are replaced.

*Simplified inventory*

# Environmental impact



## COMPARISON

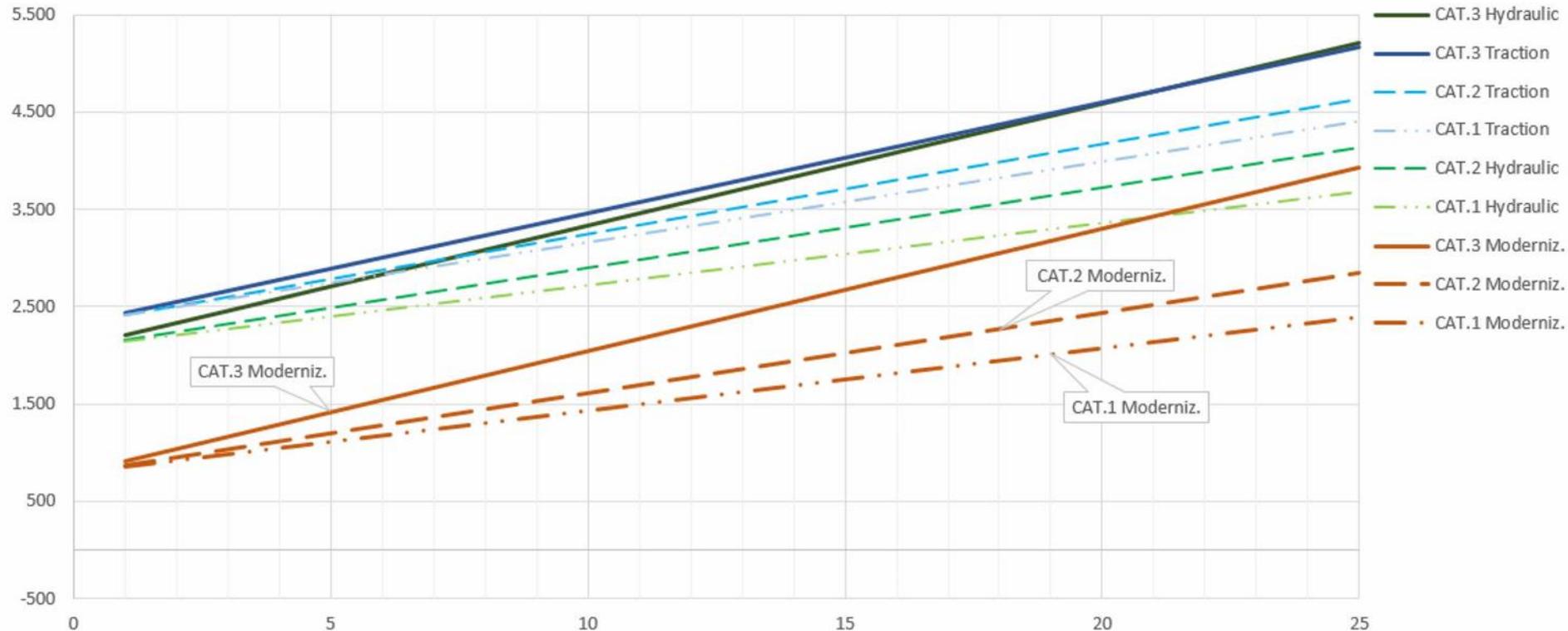
### MODERNIZED HYDRAULIC LIFT VERSUS THE SUBSTITUTION WITH A TOTAL NEW LIFT

<i>Results for 20years</i>	Climate change (kg CO2)			ReCiPe (Pts)		
	Hydraulic	Traction	H.Moderniz.	Hydraulic	Traction	H.Moderniz.
Materials	8.399	9.392	3.092	1.979	2.218	748
Purchasing	406	411	406	15	19	15
Manufacturing	919	919	334	62	62	22
Transport	200	284	72	20	29	7
Use (Usage category 1)	8.221	11.005	8.221	803	1.075	803
Use (Usage category 2)	11.977	12.889	11.977	1.170	1.259	1.170
Use (Usage category 3)	20.766	17.272	20.766	2.029	1.688	2.029
Maintenance	3.026	3.603	3.026	478	585	478
End of life	34	47	27	0,45	0,48	0,36
<b>TOTAL (Usage category 1)</b>	<b>21.205</b>	<b>25.662</b>	<b>15.178</b> ✓	<b>3.357</b>	<b>3.988</b>	<b>2.074</b> ✓
<b>TOTAL (Usage category 2)</b>	<b>24.960</b>	<b>27.545</b>	<b>18.933</b> ✓	<b>3.724</b>	<b>4.172</b>	<b>2.441</b> ✓
<b>TOTAL (Usage category 3)</b>	<b>33.750</b>	<b>31.928</b>	<b>27.723</b> ✓	<b>4.583</b>	<b>4.600</b>	<b>3.299</b> ✓

# Environmental impact



**ReCiPe Hydraulic vs Traction vs Modernization  
Breakpoint by years of use (per usage category)**



Under the considerations of this study and for the Impact Category of ReCiPe, for Usage Category 1, 2 & 3 results for modernization of hydraulic lifts are always lower (better) in total Environmental Impact than any other new lift with similar characteristics. For Cat.1&2, the longer is the span life, the larger is the positive difference for the modernization.

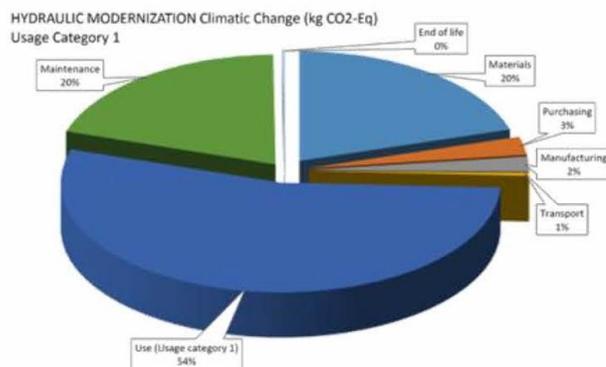
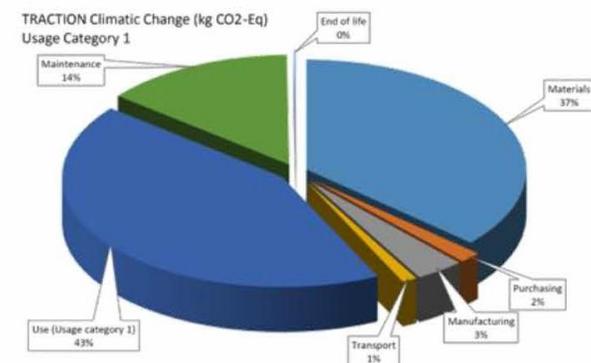
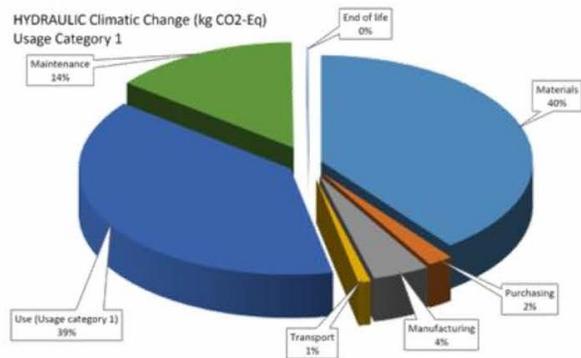
In case of Usage Category 3, a breakpoint in years could exist, but is expected to occur faraway the span life of the modernized lift.

**Hydraulic lift**

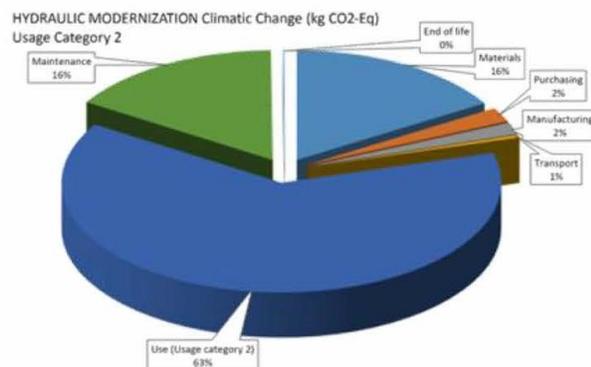
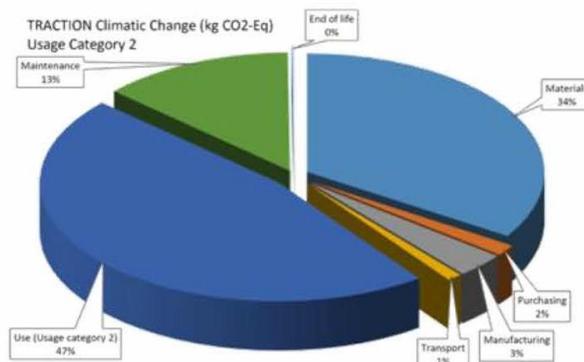
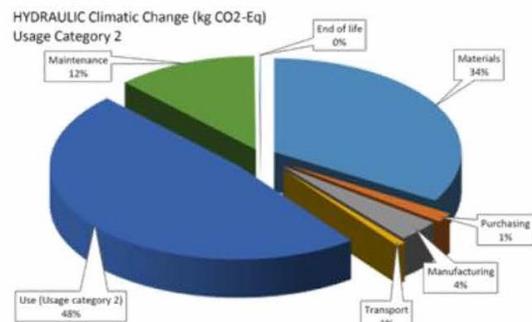
**Traction lift**

**Hyd. Modernization**

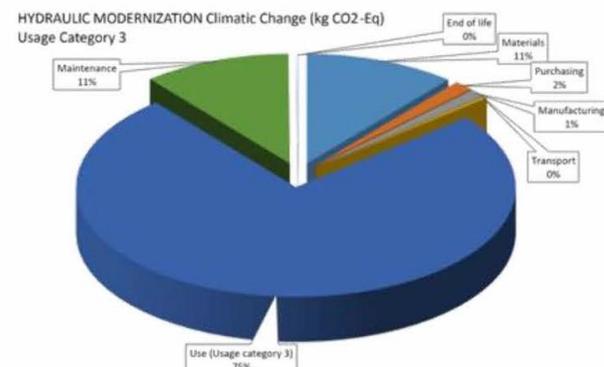
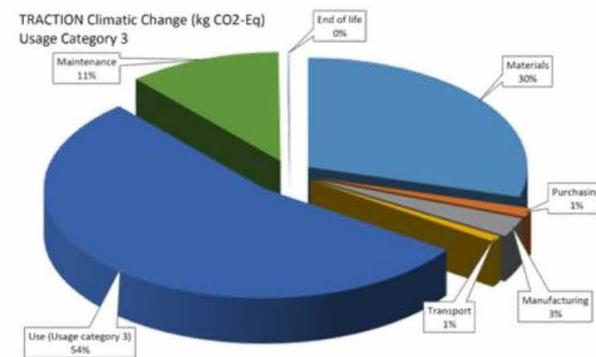
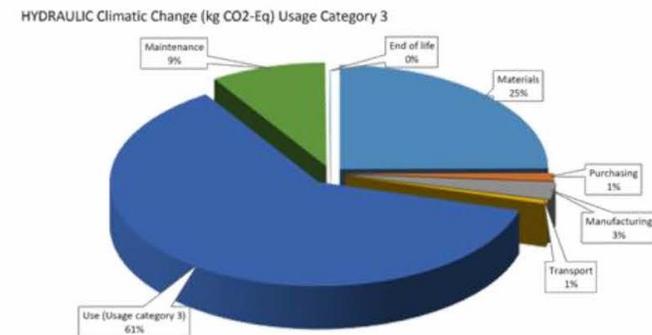
**Usage category 1**



**Usage category 2**



**Usage category 3**



# TOTAL SUMMARY



1. An **LCA** is the **only real analysis** of the environmental impact and **sustainability of lifts**. Energy consumption during use is only a part of it...
2. **Costs** and **efforts** for an LCA, and even an EPD, **are high**.
3. **LCAs** are **not in demand today** in Europe, in calls for tender.
4. **A modern hydraulic lift is perfect and more sustainable** for residential and low rise buildings with relatively low traffic.
5. For **high travel, higher traffic** combined with a **long life-span traction lifts** are the better solution with a **lower environmental impact**.
6. The **intelligent modernisation is more sustainable** than the complete replacement by a new lift.

This is: Circular economy at work!

Thank you for your attention.

# ELEVCON 2018

presentation by  
**Thomas Birnbaum** (Dipl.-Ing.)  
MQuattrolifts GmbH | Germany



**MQUATTRO**  
Lifts and support. Every day.