

TASK 5 – ENVIRONMENT AND ECONOMICS

2nd Stakeholder Meeting, Ecodesign Preparatory Study for Lifts

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ISR-University of Coimbra



Waide Strategic Efficiency



Fraunhofer
ISI



IMPORTANT NOTE ON STAKEHOLDER FEEDBACK

Please be aware that this is a draft consultation document that is only published for the purpose of receiving stakeholder comments. The underlying report may still undergo substantial revisions prior to being released as a final report of this preparatory study.

All stakeholders are invited to submit feedback using the default feedback form available in the download section of the project website at www.eco-lifts.eu.

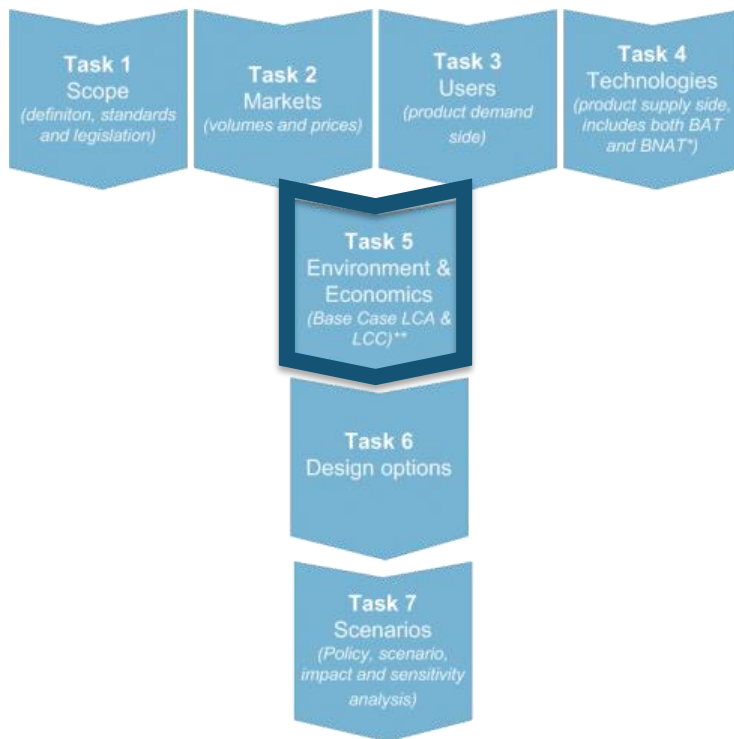
For references, please see the draft report.



TASK STRUCTURE

Project team members involved in Task 5 preparation

- **Autors:** K. Peeters, P. Van Tichelen (VITO)
- **Contributor:** J. Fong (ISR Coimbra); S. Hirzel, A. Durand (Fraunhofer ISI)
- **Review:** P. Waide (Waide Strategic Efficiency); S. Hirzel, A. Durand (Fraunhofer ISI)



Aim of Task 5 (environment and economics)

- Calculate the **life cycle environmental impact** of the base cases
- Calculate the **life cycle costs** of the base cases
- Calculate **EU totals**

TASK 5: ENVIRONMENT AND ECONOMICS

- **Subtasks**
 - Subtask 5.1: Product specific inputs
 - Subtask 5.2: Base Case Environmental Impact Assessment (using EcoReport 2014)
 - Subtask 5.3: Base Case Life Cycle Cost for consumers
 - Subtask 5.4: EU totals
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- **Output**
 - Starting point for calculation of improvement potential in task 6.

TASK 5: ENVIRONMENT AND ECONOMICS

- **Subtasks**
- Subtask 5.1: Product specific inputs
 - Selection of Base Cases
 - Collect all relevant quantitative Base Case information from previous tasks
- Subtask 5.2: Base Case Environmental Impact Assessment (using EcoReport 2014)
- Subtask 5.3: Base Case Life Cycle Cost for consumers
- Subtask 5.4: EU totals



SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Definition of Base Cases

Table 5-1: Overview of selected Base Case lifts

	Base Case 1A	Base Case 1B	Base Case 2A	Base Case 2B	Base Case 3	Base Case 4
Type	traction	hydraulic	traction	hydraulic	traction	traction
Rated load (Q) in [kg]	320	320	630	630	630	1 200
Rise [m]	12	12	12	12	21	30
Number of floors [-]	4	4	4	4	7	10
No. of daily trips (nd) [-]	50	50	125	125	300	750
Usage category	1	1	2	2	3	4
Average travel distance [-]	49%	49%	49%	49%	49%	44%
Average car load [-]	7.5%	7.5%	7.5%	7.5%	7.5%	6.0%
Number of operating days per year [days/year]	365	365	365	365	365	365
Designed service life [years]	25	25	25	25	25	25
FU [tkm]	64.4	64.4	316.9	316.9	1 331.0	6 504.3

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Sales, stock and product service life

Table 5-2: Overview of sales, stock and service life for the Base Cases

Base Case	Sales	Stock (2015)	Service life (LCA and LCC)
1A	3 182	134 530	25
1B	2 433	102 851	25
2A	34 920	1 476 430	25
2B	12 970	548 360	25
3	29 317	1 239 511	25
4	27 506	1 162 953	25
Total	110 327	4 664 635	

- From stock model developed in Task 2
- Reference year 2015

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Purchase price and repair and maintenance costs

Table 5-3: Estimated purchase price, installation cost and repair and maintenance cost for the lift Base Cases

Base Case	Price (hardware) [€]	Installation cost [€]	Repair, maintenance and inspection cost [€]
1A	17 000	15 000	37 000
1B	15 500	15 000	35 500
2A	21 500	17 000	41 500
2B	19 000	17 000	39 000
3	28 500	17 000	88 500
4	45 000	22 000	165 000

- Price and installation cost: based on expert estimate
- Repair, maintenance and inspection costs:
 - 1A, 1B, 2A, 2B: 2 inspection/regular maintenance per year; 400 euro per inspection
 - 3: 4 inspections/regular maintenance per year; 600 euro per inspection
 - 4: 6 inspections/regular maintenance per year; 800 euro per inspection
 - Parts and reparation over life time: cost identical to price of hardware

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Purchase price and repair and maintenance costs

- Difficult to obtain price information. If no additional information from stakeholders, we may opt to calculate a reduced LCC and exclude the costs for maintenance, inspections and replacements.
- Solution is: Focus only on extra costs which occur in the improvement potentials (Task 6)?



SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Use phase aspects

Table 5-4: Daily non-running energy consumption, daily running energy consumption and total annual energy consumption

Base Case	Daily running-mode energy consumption [Wh]	Daily non-running-mode [idle/standby] energy consumption [Wh]	Annual energy consumption [kWh]
1A	164	4 744	1 791
1B	324	4 744	1 850
2A	805	4 671	1 999
2B	1 640	4 671	2 304
3	3 383	4 909	3 026
4	21 384	4 807	9 560

- For LCC: electricity price €0.205 per kWh for all Base Cases

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Bill of materials

Table 5-5: Overview of component weight and technical life time per Base-Case

Base case:	1A		1B		2A		2B		3		4	
Component	Weight [kg]	Technical lifetime	Weight [kg]	Technical lifetime	Weight [kg]	Technical lifetime	Weight [kg]	Technical lifetime	Weight [kg]	Technical lifetime	Weight [kg]	Technical lifetime
Electric Motor	45	30	60	30	82	30	93	30	82	30	268	30
Gear box	22	30	-	-	28	30	-	-	28	30	0	0
Traction sheave	25	30	-	-	50	30	-	-	50	30	30	30
Brake	9	30	-	-	13	30	-	-	13	30	24	30
Speed governor	14	30	-	-	14	30	-	-	14	30	14	30
Bedplate	30	30	-	-	35	30	-	-	35	30	70	30
Controller	72	20	75	20	72	20	75	20	72	20	100	20
Guide rails	457	25	377	25	674	25	462	25	1.179	25	1.754	25
Car	316	30	316	30	451	30	451	30	451	30	719	30
Car Door	60	20	60	20	70	20	70	20	70	20	120	20
Landing Doors	240	20	240	20	280	20	280	20	490	20	1.200	20
Car Door Operators	4	20	4	20	4	20	4	20	4	20	7	20
Diverter pulleys	15	20	-	-	15	20	-	-	15	20	100	20
Ropes	17	20	-	-	23	20	-	-	35	20	115	20
Landing indicators and butto	1	15	1	15	1	15	1	15	2	15	3	15
Car indicators and buttons	9	15	9	15	9	15	9	15	10	15	13	15
Counterweight	587	30	-	-	675	30	-	-	670	30	1.314	30
Cylinder/Piston	-	-	108	25	-	-	144	25	-	-	-	-
Pump	-	-	6	30	-	-	8	30	-	-	-	-
Control Valve	-	-	18	25	-	-	18	25	-	-	-	-
Cabinet	-	-	10	30	-	-	10	30	-	-	-	-
Oil	-	-	59	10	-	-	90	10	-	-	-	-
Buffer	14	25	14	25	15	25	15	25	15	25	17	25
Hoistway Wiring	40	30	40	30	40	30	40	30	70	30	100	30
Intercom	1	20	1	20	1	20	1	20	1	20	1	20
Total Weight [kg]	1.977		1.397		2.552		1.770		3.306		5.968	

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Bill of materials

- Replacement of components with technical life time < 25 years:
 - Controller (1x)
 - Car door (1x)
 - Landing doors (1x)
 - Car door operators (1x)
 - Diverter pulleys (1x)
 - Ropes (1x)
 - Landing indicators and buttons (1x)
 - Car indicators and buttons (1x)
 - Oil (2x)
 - Intercom (1x)

SUBTASK 5.1: PRODUCT SPECIFIC INPUTS

Bill of materials: Proposed changes based on stakeholder feedback

- Bill of materials:
 - Rope system: 1:1 -> 2:1
 - Gearless technology
 - Add Batteries? Which type of batteries, weight per Base Case?

- Replacements:
- Ropes:
 - no replacement for base case 1?
 - 1 time replaced for base case 2?
 - 2 times replaced for base case 3?
 - 3 times replaced for base case 4?
- Oil:
 - no replacement for base case 1?
 - 1 time replaced for base case 2?
 - 2 times replaced for base case 3?
 - 3 times replaced for base case 4?

TASK 5: ENVIRONMENT AND ECONOMICS

- **Subtasks**
- Subtask 5.1: Product specific inputs
- Subtask 5.2: Base Case Environmental Impact Assessment (using EcoReport 2014)
 - LCA of Base Case 1A, 1B, 2A, 2B, 3 and 4
- Subtask 5.3: Base Case Life Cycle Cost for consumers
- Subtask 5.4: EU totals



SUBTASK 5.2: BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT

Environmental profile Base Case 1A and 1B

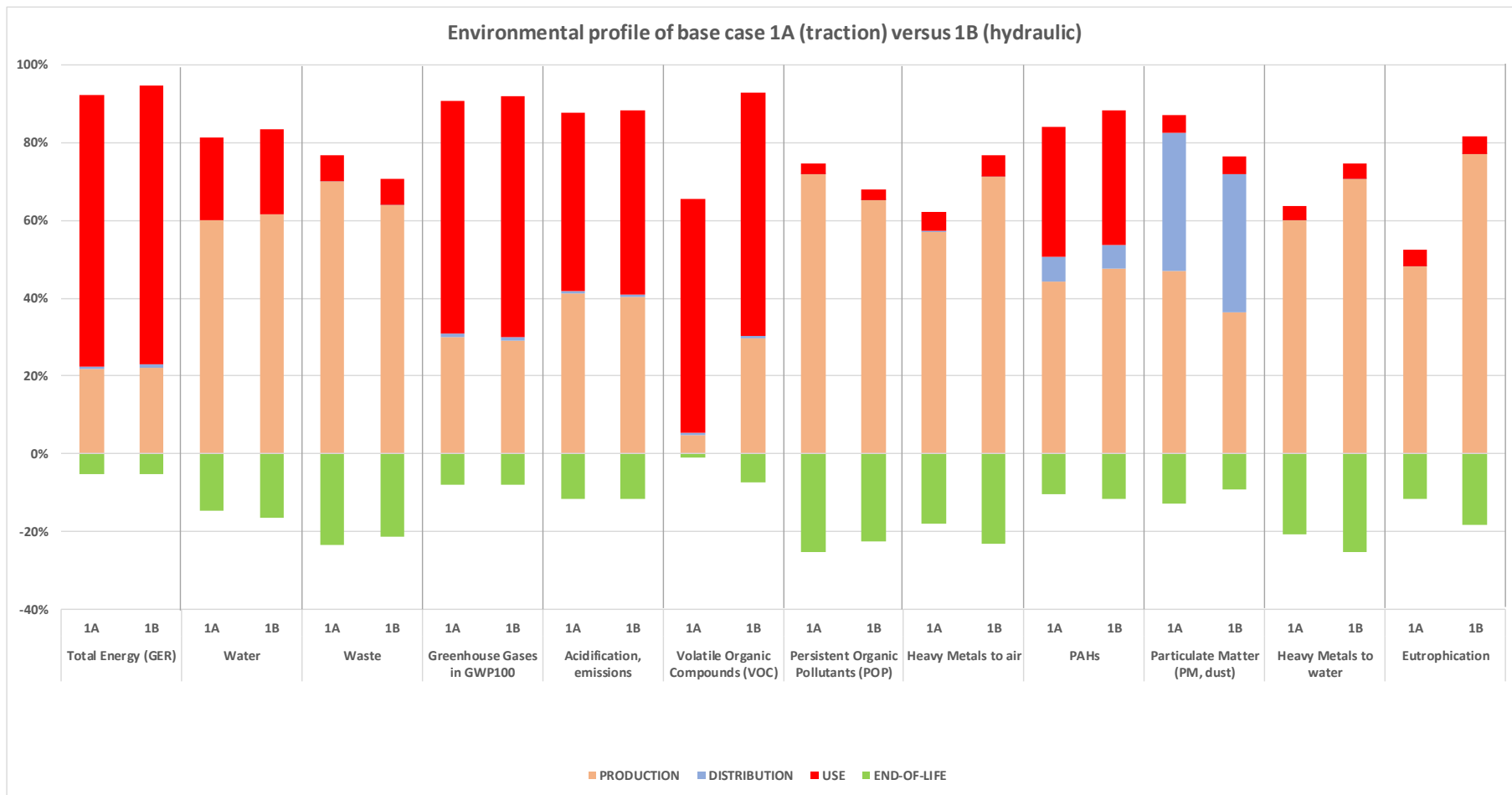


Figure 5-3: Environmental profile of Base Case 1A (traction) and Base Case 1B (hydraulic)

SUBTASK 5.2: BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT

Environmental profile Base Case 2A and 2B

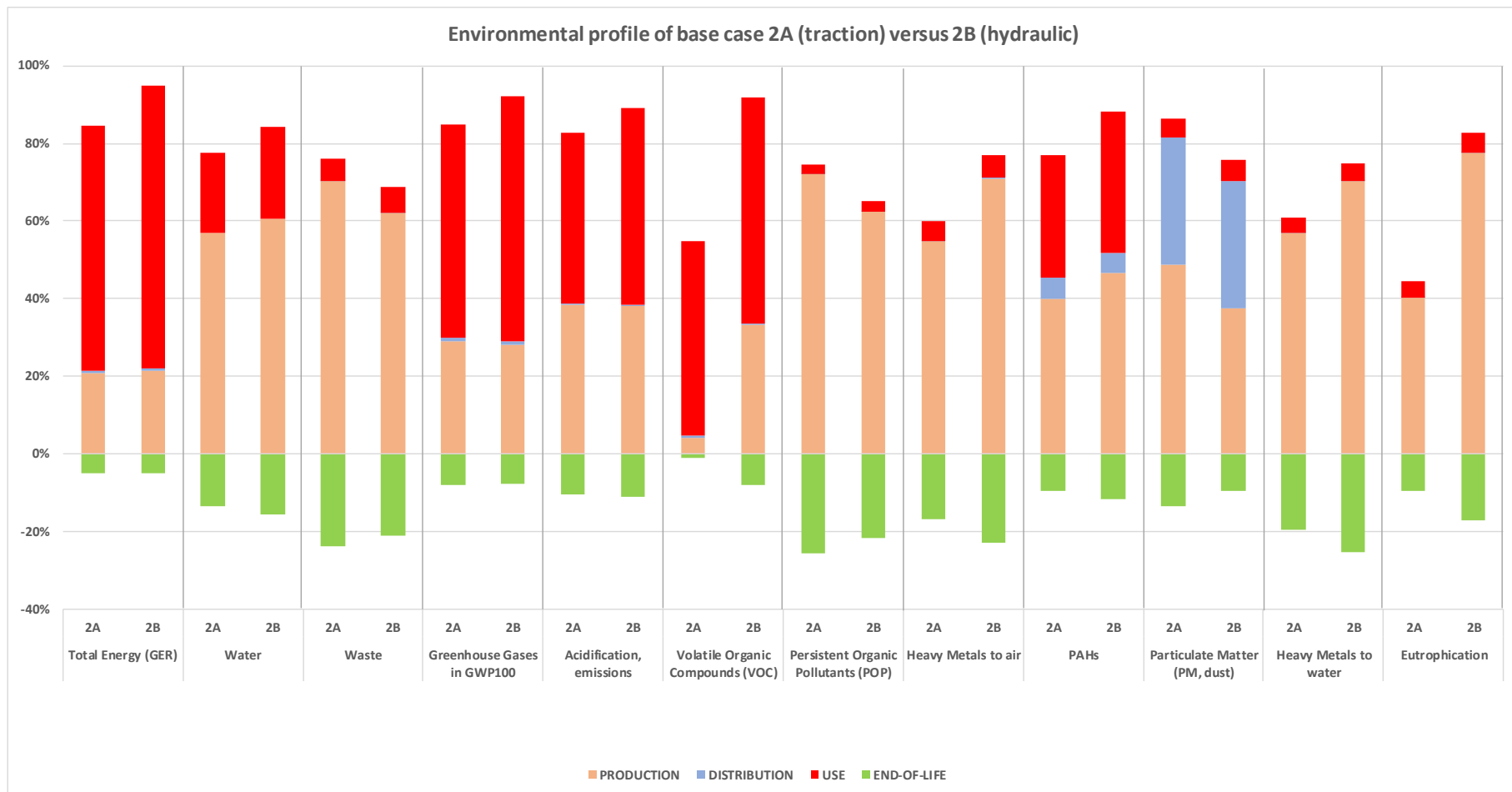


Figure 5-6: Environmental profile of Base Case 2A (traction) and Base Case 2B (hydraulic)

SUBTASK 5.2: BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT

Environmental profile Base Case 2A and 2B

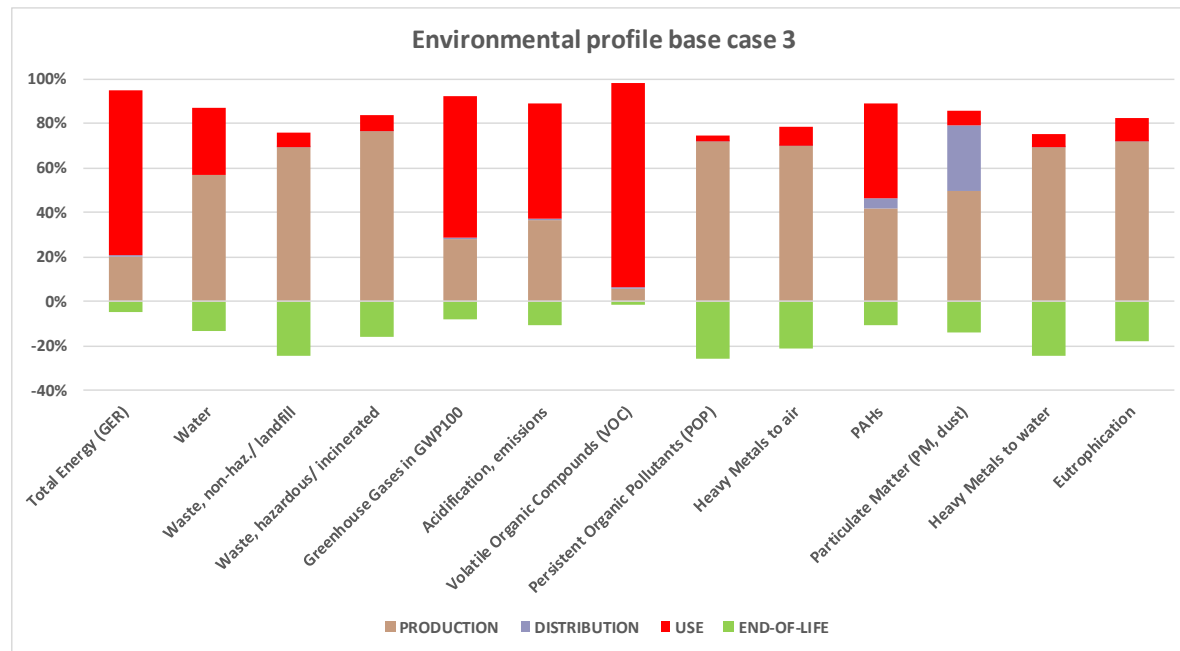


Figure 5-7: Environmental profile of Base Case 3

SUBTASK 5.2: BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT

Environmental profile Base Case 2A and 2B

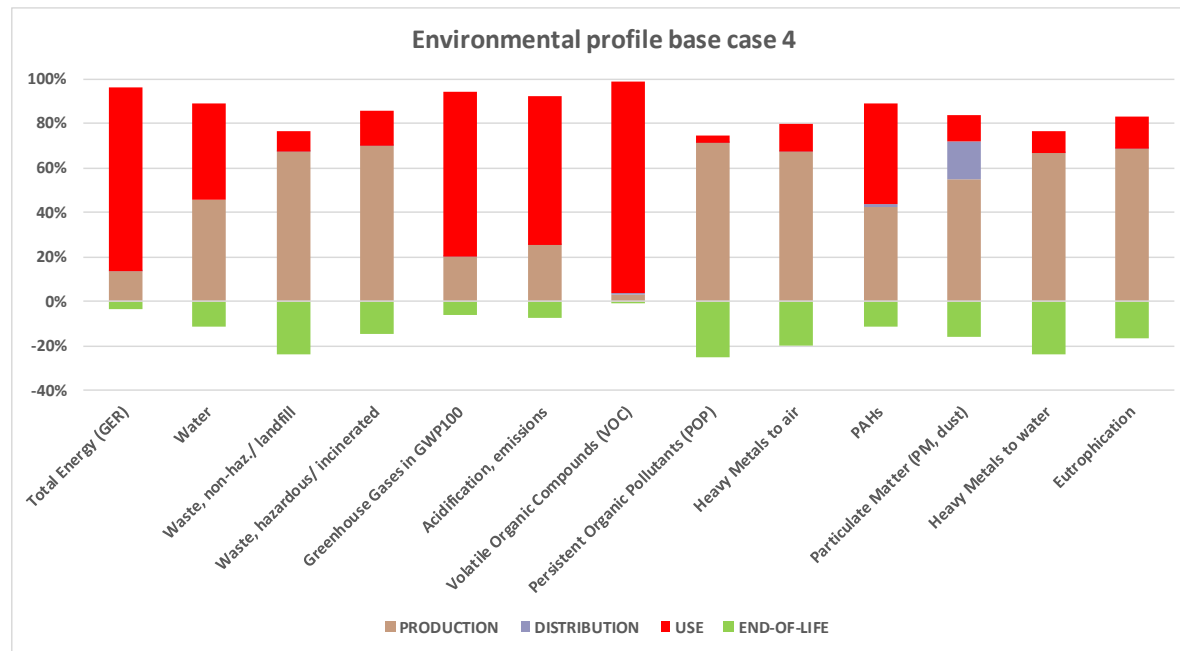


Figure 5-8: Environmental profile of Base Case 4

SUBTASK 5.2: BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT

Aspects related to the circular economy

- Lifetime
 - Defined by reparability and durability
 - **Question to stakeholders 5-5: Are you aware of design options which improve the reparability and durability of lifts?**
- Critical raw material index
 - Lift components which include critical raw materials are:
 - LED: Gallium and Indium
 - Permanent magnet motor (Base Case 4): Neodymium
 - Printed circuit boards and electronic components: several critical raw materials
 - Steel parts: Niobium in high strength steel; Tungsten in steel alloys
 - **Question to stakeholders 5-6: Are you aware of improvement options in this field which are relevant to lifts?**
 - Already mentioned by stakeholders, see previous slide, replacement of high strength steel (Nb)
- Already mentioned by stakeholders:
 - Options to replace high strength steel in car

TASK 5: ENVIRONMENT AND ECONOMICS

- **Subtasks**
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SUBTASK 5.3: BASE CASE LIFE CYCLE COSTS FOR CONSUMERS

Summary of Base Case life cycle costs

Table 5-15: Overview of life cycle costs for all Base Cases

Category	Subcategory	BC 1A	BC 1B	BC 2A	BC 2B	BC 3	BC 4
New product [in €]	Product	17 000	15 500	21 500	19 000	28 500	45 000
	Installation	15 000	15 000	17 000	17 000	17 000	22 000
	Electricity	9180	9480	10 244	11 806	15 510	48 994
	Repair & Maintenance	37 000	35 500	41 500	39 000	88 500	165 000
	Total	78 180	75 480	90 244	86 806	149 510	280 994
Total annual consumer expenditure [in million €]	Product	54	38	751	246	836	1 238
	Installation	48	36	594	220	498	605
	Electricity	49	39	605	259	769	2 279
	Repair & Maintenance	199	146	2 451	855	4 388	7 675
	Total	350	259	4400	1 581	6 491	11 797

Discount rate (interest minus inflation)	4%
Escalation rate (project annual growth of running costs)	4%

TASK 5: ENVIRONMENT AND ECONOMICS

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SUBTASK 5.4: EU TOTALS

EU total energy use per year

Table 5-13: EU totals

	Stock 2015 (units)	Energy use per year (kWh)	TWh/y for Europe
BC 1A	134530	1791	0.24
BC 1B	102851	1850	0.19
BC 2A	1476430	1999	2.95
BC 2B	548360	2304	1.26
BC 3	1239511	3026	3.75
BC 4	1162953	9560	11.12
Total	4664635		19.51
Total including stock not covered by any of the base cases	5403180		22.60

Almeida et al. 2012: 18.4 TWh/y

- Points for discussion
- Life time
 - Life time of 25 year is too low
 - Life time of base case 4 should be lower than life time of the other base cases: 10-15 years
- Bill of materials
 - Changes will be made (see earlier in the presentation)
- Base cases considered
 - Change base cases to lifts installed in 2018
 - Consider base cases which are more representative for the aged stock
- Energy consumption calculation
 - File on the website

THANK YOUR FOR YOUR ATTENTION

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