Eco-design preparatory study for lifts implementing the Eco-design Working Plan 2016-2019

Update of some assumptions based on the main comments provided during the 3rd stakeholder meeting

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One of the main message of the stakeholders on 11th of February 2019 was that the level of performance of Base Case (in the BAU scenario) is rather a B-class level according to ISO 25745-2:2012 than the C-class level (as presented in the draft report and the meeting). Based on this, the project team suggests to update some assumptions accordingly:

- the yearly energy consumption of the Base Cases (assumed for Task 4 and Task 5) have been lowered. The new assumptions are presented in Table 1, Table 2 shows the old assumptions (considered for the 3rd stakeholder meeting)
- the saving potentials of the design options have been updated: the energy consumption in the BAT configuration remains the same as presented during the 3rd stakeholder meeting, but since the reference performance level was improved (see previous point), the relative and absolute saving potentials needed to be corrected accordingly. The new assumptions are presented in Table 3, Table 5 shows the old one (considered for the 3rd stakeholder meeting). Table 4 presents the level of performances of the BC in the BAT configuration

In addition, some assumptions regarding the marginal costs of the design options have been updated. The new assumptions are presented in Table 6, Table 2 shows the old assumptions as presented in the 3rd stakeholder meeting.

Table 1: **NEW** assumptions of the Base Case (for Task 4 and Task 5).
Updated input parameters are marked in yellow

Energy demand calculation according to ISO 25745-2:2012							
Base Case ID		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
Q [kg]	rated load	450	450	630	630	1000	1250
one-way travel distance for target installation [m]		12	12	12	12	21	30
Number of stopping floors [-]		4	4	4	4	7	10
nd [-]	the number of trips per day	50	50	125	125	300	750
Usage Category		1	1	2	2	3	4
% of average travel distance [-]		49%	49%	49%	49%	49%	44%
%Q [-]	% of average car load	7.5%	7.5%	7.5%	7.5%	4.5%	6.0%
dop [-]	Number of operating days per year [days	360	360	360	360	360	360
Designed service life [years]		25	25	25	25	25	25
FU [tkm]		74.42	74.42	312.56	312.56	1131.17	6361.74
Type number {0=traction; 1=hybrid}		0	1	0	1	0	0
Nominal load category: {1= "<=800kg", 2= "801-<=1275kg"; 3= "1276-<=2000kg"; 4= ">2000kg"}		1	1	1	1	2	2
Usage Category + Nominal load category		1+1	1+1	2+1	2+1	3+2	4+2
Missing Parameters		Base Case 1A	Base Case 1B	Base Case 2A	Base Case 2B	Base Case 3	Base Case 4
Determination E_standby							
P_id [W]	power use in idle mode	100.0	100.0	130.0	130.0	150.0	165.0
P_st5 [W]	standby power used after 5 min	50.0	50.0	65.0	65.0	75.0	82.5
P_st30 [W]	standby power sued after 30 min	50.0	50.0	65.0	65.0	75.0	82.5
t_d [s]	time for the opening, opened and closing	10.0	9.0	10.0	10.0	10.0	8.0
a [m/s²]	average accelaration	0.5	0.5	0.5	0.5	0.5	1.0
J [m/s³]	average jerk	1.0	1.0	1.0	1.0	1.0	1.3
Determination E_travel							
Erc [Wh]	running energy of reference cycle accordi	19.0	37.0	26.0	52.0	51.0	87.0
Esc [Wh]	running energy of the short cycle	0.0					
ssc [m]	one-way travel distance of the short cycle	0.0					
Counterbalancing		0.5	0.0	0.5		0.5	0.5
k_L		0.9	1.1	0.9	1.1	0.9	0.9
Calculation							
E_y [kWh/a]	**annual energy consumption**	**555**	**654**	**922**	**1 274**	**1 994**	**5 536**
E_d [Wh]	**total daily energy consumption**	**1 542**	**1 816**	**2 561**	**3 540**	**5 538**	**15 378**
E_nr [Wh]	**daily non running [idle/standby] ener**	**1 339**	**1 340**	**1 868**	**1 868**	**2 277**	**2 459**
P_id [W]	power use in idle mode	100.00	100	130	130	150	165
R_id [%]	ratio of idle time consuming P_id	0.13	0.13	0.23	0.23	0.36	0.45
P_st5 [W]	standby power used after 5 min	50	50	65	65	75	82.5
R_st5 [%]	ratio of 5 min time consuming P_st5	0.55	0.55	0.45	0.45	0.31	0.19
P_st30 [W]	standby power sued after 30 min	50	50	65	65	75	82.5
R_st30 [%]	ratio of 30 min time consuming P_st30	0.32	0.32	0.32	0.32	0.33	0.36
t_nr [h]	*non-running [idle and standby] time per d*	23.71	23.72	23.36	23.36	22.32	20.55
t_rd [h]	*running time per day*	0.29	0.28	0.64	0.64	1.68	3.45
n_d	number of trips per day	50	50	125	125	300	750
t_av [s]	*time to travel the average travel distance,*	21.09	20.09	18.38	18.38	20.13	16.55
t_d	time for the opening, opened and closing	10.00	9	10	10	10	8
s_av [m]	*one-way average travel distance for targe*	5.88	5.88	5.88	5.88	10.29	13.2
v [m/s]	rated speed	0.63	0.63	1	1	1.6	2.5
a [m/s²]	average accelaration	0.5	0.5	0.5	0.5	0.5	1
J [m/s³]	average jerk	1.00	1.00	1.00	1.00	1.00	1.30
E_rd [Wh]	**daily running energy consumption**	**202**	**476**	**693**	**1 672**	**3 261**	**12 920**
n_d	number of trips per day	50	50	125	125	300	750
k_L	*load factor*	87.0%	105.0%	87.0%	105.0%	87.0%	90.0%
%Q	average car load	7.5%	7.5%	7.5%	7.5%	4.5%	6.0%
E_rav [Wh]	*running energy consumption of an averag*	9.31	18.13	12.74	25.48	24.99	38.28
s_av [m]	one-way average travel distance for target	5.88	5.88	5.88	5.88	10.29	13.2
i [%]		49%	49%	49%	49%	49%	44%
s_rc [m]	one-way travel distance of reference cycl	12	12	12	12	21	30
E_ssc [Wh]	*start/stop energy consumption for each t*	0	0	0	0	3.55271E-15	0
E_rm [Wh/m]	*average running energy consumption per*	0.791666667	1.541666667	1.083333333	2.166666667	1.214285714	1.45
E_rc [Wh]	running energy of reference cycle accordi	19.00	37	26	52	51	87
E_sc [Wh]	running energy of the short cycle	0.00	0	0	0	0	0
s_sc [m]	one-way travel distance of the short cycle	0.00	0.00	0.00	0.00	0.00	0.00
aditionally							
E_spc [mWh/[kg m]]		1.53	3.60	1.50	3.61	1.06	1.04
k_L		0.87	1.05	0.87	1.05	0.87	0.9
E_rav [Wh]		9.31	18.13	12.74	25.48	24.99	38.28
Q [kg]		450.00	450.00	630.00	630.00	1000.00	1250.00
s_av [m]		5.88	5.88	5.88	5.88	10.29	13.2
E_spr [mWh/[kg m]]							
E_rc [Wh]		19.00	37.00	26.00	52.00	51.00	87.00
Q [kg]		450.00	450.00	630.00	630.00	1000.00	1250.00
s_rc [m]		12.00	12.00	12.00	12.00	21.00	30.00

ISO 25745-2:2015	**Energy consumption per day (Wh)**					
A	1 281	1 281	1 501	1 501	3 339	9 938
B	2 514	2 515	2 836	2 836	5 566	15 420
C	4 956	4 959	5 423	5 423	9 465	24 158
D	9 804	9 810	10 470	10 470	16 430	38 292
E	19 449	19 460	20 380	20 380	29 125	61 611
F	38 655	38 677	39 912	39 912	52 602	100 575
G	38 655	38 677	39 912	39 912	52 602	100 575
Energy Performance Class of the Base C	B	B	B	C	B	B

Table 2: **OLD** assumptions of the Base Cases for Task 4 and Task 5 (as presented in the 3rd stakeholder meeting)

Energy demand calculation according to ISO 25745-2:2012							
Base Case ID		**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
Q [kg]	rated load	450	450	630	630	1000	1250
one-way travel distance for target installation [m]		12	12	12	12	21	30
Number of stopping floors [-]		4	4	4	4	7	10
nd [-]	the number of trips per day	50	50	125	125	300	750
Usage Category		1	1	2	2	3	4
% of average travel distance [-]		49%	49%	49%	49%	49%	44%
%Q [-]	% of average car load	7.5%	7.5%	7.5%	7.5%	4.5%	6.0%
dop [-]	Number of operating days per year [days	360	360	360	360	360	360
Designed service life [years]		25	25	25	25	25	25
FU [tkm]		74.42	74.42	312.56	312.56	1131.17	6361.74
Type number {0=traction; 1=hybrid}		**0**	**1**	**0**	**1**	**0**	**0**
Nominal load category: {1= "<=800kg", 2= "801-<=1275kg"; 3= "1276-<=2000kg"; 4= ">2000kg"}		**1**	**1**	**1**	**1**	**2**	**2**
Usage Category + Nominal load category		**1+1**	**1+1**	**2+1**	**2+1**	**3+2**	**4+2**
Missing Parameters		**Base Case 1A**	**Base Case 1B**	**Base Case 2A**	**Base Case 2B**	**Base Case 3**	**Base Case 4**
Determination E_standby							
P_id [W]	power use in idle mode	120.0	120.0	160.0	160.0	180.0	200.0
P_st5 [W]	standby power used after 5 min	120.0	120.0	160.0	160.0	180.0	200.0
P_st30 [W]	standby power sued after 30 min	120.0	120.0	160.0	160.0	180.0	200.0
t_d [s]	time for the opening, opened and closing	10.0	9.0	10.0	10.0	10.0	8.0
a [m/s²]	average accelaration	0.5	0.5	0.5	0.5	0.5	1.0
J [m/s³]	average jerk	1.0	1.0	1.0	1.0	1.0	1.3
Determination E_travel							
Erc [Wh]	running energy of reference cycle accordi	19.8	33.8	27.6	51.5	76.6	132.0
Esc [Wh]	running energy of the short cycle	0.0					
ssc [m]	one-way travel distance of the short cycle	0.0					
Counterbalancing		0.5	0.0	0.5		0.5	0.5
k_L		0.9	1.1	0.9	1.1	0.9	0.9
Calculation							
E_y [kWh/a]	**annual energy consumption**	**1 100**	**1 181**	**1 610**	**1 942**	**3 210**	**8 536**
E_d [Wh]	**total daily energy consumption**	**3 056**	**3 281**	**4 473**	**5 394**	**8 916**	**23 712**
E_nr [Wh]	**daily non running [idle/standby] ener**	**2 845**	**2 847**	**3 738**	**3 738**	**4 018**	**4 110**
P_id [W]	power use in idle mode	120.00	120	160	160	180	200
R_id [%]	ratio of idle time consuming P_id	0.13	0.13	0.23	0.23	0.36	0.45
P_st5 [W]	standby power used after 5 min	120	120	160	160	180	200
R_st5 [%]	ratio of 5 min time consuming P_st5	0.55	0.55	0.45	0.45	0.31	0.19
P_st30 [W]	standby power sued after 30 min	120	120	160	160	180	200
R_st30 [%]	ratio of 30 min time consuming P_st30	0.32	0.32	0.32	0.32	0.33	0.36
t_nr [h]	*non-running [idle and standby] time per d*	23.71	23.72	23.36	23.36	22.32	20.55
t_rd [h]	*running time per day*	0.29	0.28	0.64	0.64	1.68	3.45
n_d	number of trips per day	50	50	125	125	300	750
t_av [s]	*time to travel the average travel distance,*	21.09	20.09	18.38	18.38	20.13	16.55
t_d	time for the opening, opened and closing	10.00	9	10	10	10	8
s_av [m]	*one-way average travel distance for targe*	5.88	5.88	5.88	5.88	10.29	13.2
v [m/s]	rated speed	0.63	0.63	1	1	1.6	2.5
a [m/s²]	average accelaration	0.5	0.5	0.5	0.5	0.5	1
J [m/s³]	average jerk	1.00	1.00	1.00	1.00	1.00	1.30
E_rd [Wh]	**daily running energy consumption**	**211**	**435**	**735**	**1 656**	**4 898**	**19 602**
n_d	number of trips per day	50	50	125	125	300	750
k_L	*load factor*	87.0%	105.0%	87.0%	105.0%	87.0%	90.0%
%Q	average car load	7.5%	7.5%	7.5%	7.5%	4.5%	6.0%
E_rav [Wh]	*running energy consumption of an averag*	9.702	16.562	13.524	25.235	37.534	58.08
s_av [m]	one-way average travel distance for target	5.88	5.88	5.88	5.88	10.29	13.2
i [%]		49%	49%	49%	49%	49%	44%
s_rc [m]	one-way travel distance of reference cycl	12	12	12	12	21	30
E_ssc [Wh]	*start/stop energy consumption for each t*	0	0	0	0	0	0
E_rm [Wh/m]	*average running energy consumption per*	0.825	1.408333333	1.15	2.145833333	1.823809524	2.2
E_rc [Wh]	running energy of reference cycle accordi	19.80	33.8	27.6	51.5	76.6	132
E_sc [Wh]	running energy of the short cycle	0.00	0	0	0	0	0
s_sc [m]	one-way travel distance of the short cycle	0.00	0.00	0.00	0.00	0.00	0.00
aditionally							
E_spc [mWh/[kg m]]		1.60	3.29	1.59	3.58	1.59	1.58
k_L		0.87	1.05	0.87	1.05	0.87	0.9
E_rav [Wh]		9.702	16.562	13.524	25.235	37.534	58.08
Q [kg]		450.00	450.00	630.00	630.00	1000.00	1250.00
s_av [m]		5.88	5.88	5.88	5.88	10.29	13.2
E_spr [mWh/[kg m]]							
E_rc [Wh]		19.80	33.80	27.60	51.50	76.60	132.00
Q [kg]		450.00	450.00	630.00	630.00	1000.00	1250.00
s_rc [m]		12.00	12.00	12.00	12.00	21.00	30.00
	ISO 25745-2:2015	**Energy consumption per day (Wh)**					
	A	1 281	1 281	1 501	1 501	3 339	9 938
	B	2 514	2 515	2 836	2 836	5 566	15 420
	C	4 956	4 959	5 423	5 423	9 465	24 158
	D	9 804	9 810	10 470	10 470	16 430	38 292
	E	19 449	19 460	20 380	20 380	29 125	61 611
	F	38 655	38 677	39 912	39 912	52 602	100 575
	G	38 655	38 677	39 912	39 912	52 602	100 575
	Energy Performance Class of the Base Ca	C	C	C	C	C	C

Table 3: **NEW** assumptions for the design options (update of Table 6-2 in Task 6 report). *Updated input parameters are marked in yellow*

#	Measures	Base case 1a				Base case 1b				Base case 2a				Base case 2b				Base case 3				Base case 4			
		Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]
0	Base case demand	19	100	50	50	37	100	50	50	26	130	65	65	52	130	65	65	51	150	75	75	87	165	82.5	82.5
1	Use low energy equipment		-22%	-22%	-22%		-22%	-22%	-22%		-26%	-26%	-26%		-26%	-26%	-26%		-28%	-28%	-28%		-28%	-28%	-28%
2	Switch off components				-50%				-50%				-50%				-50%				-50%				-50%
3	Use deep standby				-50%				-50%				-50%				-50%				-50%				-50%
4	Optimize machine / power unit	-22%				-40%				-22%				-40%				-6%				-6%			
5 (a)	Minimize friction	-10%				-2%				-9%				-2%				-6%				-6%			
6	Use regenerative drive	-20%				-20%				-20%				-20%				-35%				-35%			
7	Improve door operators	-1%				-1%				-1%				-1%				-1%				-1%			
#8: Combination			-22%	-22%	-81%		-22%	-22%	-81%		-26%	-26%	-82%		-26%	-26%	-82%		-28%	-28%	-82%		-28%	-28%	-82%
	Improved demand	10.5	78	39	10	17.0	78	39	10	14.5	96.2	48.1	12	23.9	96.2	48.1	12	28.8	108	54	14	49.1	118.8	59.4	15
	Changed compared to base case	45%	22%	22%	81%	54%	22%	22%	81%	44%	26%	26%	82%	54%	26%	26%	82%	44%	28%	28%	82%	44%	28%	28%	82%

Table 4: Updated energy consumptions of the Base Cases with all design options (update of Table 6-3 in Task 6 report).

	BC1A	BC1B	BC2A	BC2B	BC3	BC4
Overall: E_rd [Wh]	112	219	386	770	1840	7291
Overall: E_nr [Wh]	823	823	1112	1112	1341	1441
Overall: E_d [Wh]	935	1042	1499	1882	3181	8732
Stand-by: Class	Class 1	Class 1	Class 1	Class 1	Class 2	Class 2
Running: Class	Class 2	Class 4	Class 2	Class 4	Class 1	Class 1
Overall: Class	Class 1	Class 1	Class 1	Class 2	Class 1	Class 1

Table 5: **OLD** assumptions for the design options (see Table 6-2 in Task 6 report).

#	Measures	Base case 1a				Base case 1b				Base case 2a				Base case 2b				Base case 3				Base case 4			
		Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]	Running [Wh]	Idle [W]	5 min [W]	30 min [W]
0	**Base case demand**	19.8	120	120	120	33.8	120	120	120	27.6	160	160	160	51.5	160	160	160	76.6	180	180	180	132.0	200	200	200
1	**Use low energy equipment**		-35%	-35%	-35%		-35%	-35%	-35%		-40%	-40%	-40%		-40%	-40%	-40%		-40%	-40%	-40%		-40%	-40%	-40%
2	**Switch off components**			-50%	-50%			-50%	-50%			-50%	-50%			-50%	-50%			-50%	-50%			-50%	-50%
3	**Use deep standby**				-75%				-75%				-75%				-75%				-75%				-75%
4	**Optimize machine / power unit**	-25%				-40%				-25%				-40%				-35%				-35%			
5 (a)	**Minimize friction**	-10%								-10%								-10%				-10%			
6	**Use regenerative drive**	-20%				-20%				-20%				-20%				-35%				-35%			
7	**Improve door operators**	-1%				-1%				-1%				-1%				-1%				-1%			
#8: Combination	**Improve door operators**		-35%	-68%	-92%		-35%	-68%	-92%		-40%	-70%	-93%		-40%	-70%	-93%		-40%	-70%	-93%		-40%	-70%	-93%
	Improved demand	10.5	78	39	10	15.9	78	39	10	14.6	96	48	12	24.2	96	48	12	28.4	108	54	14	48.9	120	60	15
	Changed compared to base case	47%	35%	68%	92%	53%	35%	68%	92%	47%	40%	70%	93%	53%	40%	70%	93%	63%	40%	70%	93%	63%	40%	70%	93%

Table 6: **NEW** assumptions for the marginal costs of design options by base case. *Updated input parameters are marked in yellow*

#	Design option	Base case 1A	Base case 1B	Base case 2A	Base case 2B	Base case 3	Base case 4
Costs of for BAU level		32000	30500	38500	36000	45500	67000
1	Use low energy equipment	300	300	300	300	500	700
2	Switch off components	100	100	100	100	100	100
3	Use deep standby	300	200	400	200	500	800
4	Optimize machine / power unit	400	2900	500	3800	800	1300
5	Minimize friction	800	-	900	-	1300	1900
6	Use regenerative drive	1500	1500	2000	2000	2500	2500
7	Improve door operators	40	40	40	40	70	100

Rationale for the changes:

- switch off components: it requires additional adaption of the software and some minor improvements of the hardware. The corresponding costs are low (100 € / lift) but the improvement is not free.
- use regenerative drive: the old assumptions were based on generic drive technologies but not for the specific systems used for lift applications. A frequency converter is required for regenerative power supply, which is by default not installed in lift motor systems.

Table 7: **OLD** assumptions for the marginal costs of design options by base case (see Table 6-5 in Task 6 report)

#	Design option	Base case 1A	Base case 1B	Base case 2A	Base case 2B	Base case 3	Base case 4
Costs of for BAU level		32000	30500	38500	36000	45500	67000
1	Use low energy equipment	300	300	300	300	500	700
2	Switch off components	0	0	0	0	0	0
3	Use deep standby	300	200	400	200	500	800
4	Optimize machine / power unit	400	2900	500	3800	800	1300
5	Minimize friction	800	-	900	-	1300	1900
6	Use regenerative drive	100	1500	100	2000	200	200
7	Improve door operators	40	40	40	40	70	100