

Annex 1: KPI determination

	existing solution = single glazing	Triple pane electrochromic glazing	Three pane thermal protective glazing	Electrochromic window film (Cleverfilm)	Window film (Thinsulate-40)	Window film (Bruxsafol)	Double WEMS™ unit attached to single glazing	single WEMS™ unit attached to single glazing
Single unit	Metrics for a single unit, 1 m ² size							
U value	5,56 W/(m ² K)	0,81 W/(m ² K)	0,83 W/(m ² K)	1,39 W/(m ² K)	3,57 W/(m ² K)	4,00 W / (m ² K)	0,80 W/(m ² K)	1,39 W / (m ² K)
R value = 1/U	0,18 (m ² K) / W	1,25 (m ² K) / W	1,21 (m ² K) / W	0,72 (m ² K) / W	0,28 (m ² K) / W	0,25 (m ² K) / W	1,25 (m ² K) / W	0,72 (m ² K) / W
mass per unit (1 m ² size)		38 kg	38 kg	0,1 kg	0,1 kg	0,1 kg	4,5 kg	4,1 kg
energy consumption per m ² window (*)	680 kWh/year	98 kWh/year	100 kWh/year	170 kWh/year	437 kWh/year	490 kWh / year	98 kWh/year	170 kWh / year
Price per m2 (including installation and wall connection work)		1.150 €	850 €	400 €	140 €	110 €	270 €	190 €
installation time (including wall connection work)		210 min	210 min	30 min	30 min	30 min	10 min	10 min
land fill through removal of the old window		0,1m ³	0,1m ³	0 m ³	0 m ³	0 m ³	0 m ³	0 m ³
Additional embodied CO ₂ emmission in case of renovation			87 kg / m2				58 kg / m2	40 kg / m2
Single house	Metrics for a residential house in Germany (Berlin region) with 20 m ² window area							
additional mass		760 kg	760 kg	2 kg	2 kg	2 kg	90 kg	82 kg
energy consumption	13600 kWh/year	1960 kWh/year	2000 kWh/year	3400 kWh/year	8740 kWh/year	9780 kWh / year	1960 kWh/year	3400 kWh / year
investment per house (unit + installation + maintainance)		23.000 €	17.000 €	8.000 €	2.800 €	2.200 €	5.400 €	3.800 €
installation time per house		4200 min	4200 min	600 min	600 min	600 min	200 min	200 min
land fill per house		2 m ³	2 m ³	0 m ³	0 m ³	0 m ³	0 m ³	0 m ³
Key performance indicator	Metrics for heating with gas / oil / electricity (assumes 85% efficient resistant heating) on 2021 price base							
energy costs in case of gas use (0,0706 € / kWh)	960 €	138 €	141 €	240 €	617 €	690 €	138 €	240 €
energy costs in case of oil use (0,0877 € / kWh)	1.190 €	169 €	173 €	295 €	764 €	855 €	169 €	295 €
energy costs in case of electricity use (0,177 € / kWh)	2.400 €	347 €	346 €	595 €	1.540 €	1.724 €	347 €	595 €
energy cost savings in case of gas use		822 €	819 €	720 €	343 €	270 €	822 €	720 €
energy cost savings in case of oil use		1.021 €	1.017 €	895 €	426 €	335 €	1.021 €	895 €
energy cost savings in case of electricity use		2.053 €	2.046 €	1.805 €	860 €	676 €	2.053 €	1.805 €
cost savings (heating and cooling energy / year)		85%	85%	75%	35%	28%	85%	75%
CO ₂ emission in case of gas use (0,22 kg / kWh)	2992 kg/year	432 kg/year	440 kg/year	748 kg/year	1923 kg/year	2152 kg / year	432 kg/year	748 kg / year
CO ₂ emission in case of oil use (0,316 kg / kWh)	4298 kg / year	620 kg / year	632 kg / year	1075 kg / year	2762 kg / year	3091 kg / year	620 kg / year	1075 kg / year
CO ₂ emission in case of electricity use (0,401 kg / kWh)	5454 kg / year	786 kg / year	802 kg / year	1364 kg / year	3505 kg / year	3922 kg / year	786 kg / year	1364 kg / year
CO ₂ savings in case of gas use		2560 kg/year	2552 kg/year	2244 kg/year	1069 kg/year	840 kg / year	2560 kg/year	2244 kg / year
CO ₂ savings in case of oil use		3678 kg / year	3666 kg / year	3223 kg / year	1536 kg / year	1207 kg / year	3678 kg / year	3223 kg / year
CO ₂ savings in case of electricity use		4668 kg / year	4652 kg / year	4090 kg / year	1949 kg / year	1532 kg / year	4668 kg / year	4090 kg / year
CO₂ emission savings		85%	85%	75%	35%	28%	85%	75%
pay back time in case of gas use		28,0 years	20,8 years	11,1 years	8,2 years	8,2 years	6,6 years	5,3 years
pay back time in case of oil use		22,5 years	16,8 years	8,9 years	6,6 years	6,6 years	5,3 years	4,3 years
pay back time in case of electricity use		11,2 years	8,3 years	4,4 years	3,3 years	3,3 years	2,7 years	2,1 years
							pay back in a third of the time of triple glazing	pay back in a quarter of the time of triple glazing
CO ₂ savings per invested Euro in case of gas use		0,11 kg/€	0,15 kg/€	0,28 kg/€	0,38 kg/€	0,38 kg / €	0,47 kg/€	0,59 kg / €
CO ₂ savings per invested Euro in case of oil use		0,16 kg / €	0,21 kg / €	0,40 kg / €	0,55 kg / €	0,55 kg / €	0,68 kg / €	0,85 kg / €
CO ₂ savings per invested Euro in case of electricity use		0,20 kg / €	0,27 kg / €	0,51 kg / €	0,77 kg / €	0,77 kg / €	0,86 kg / €	1,08 kg / €
							3 times more CO ₂ savings per Euro than with triple glazing	4 times more CO ₂ savings per Euro than with triple glazing

(*) based on heating and cooling degree days with 22°C reference indoor temperature calculated with BizEE (<https://www.degreedays.net/#generate>)