

Supplementary Material

Table S1. Mid-point indicators (CML-IA baseline V3.05) for the three scenarios (electricity from grid).

Indicator	Units	Scenario				
		BAS, grid	SH-TES, grid		PCM-TES, grid	
Abiotic depletion	kgSbe/kWh	4.92×10^{-7}	4.55×10^{-7}	−7.5%	5.31×10^{-7}	7.8%
Abiotic depletion (fossil fuels)	MJ/kWh	1.62	1.62	0.0%	1.60	−1.0%
Global warming	kgCO ₂ e/kWh	1.30×10^{-1}	1.32×10^{-1}	1.6%	1.08×10^{-1}	−16.6%
Ozone layer depletion (ODP)	kgCFC-11e/kWh	2.79×10^{-8}	2.81×10^{-8}	0.5%	2.52×10^{-8}	−9.7%
Human toxicity	kg1,4-DBe/kWh	7.18×10^{-2}	6.73×10^{-2}	−6.2%	7.86×10^{-2}	9.4%
Fresh water aquatic ecotox.	kg1,4-DBe/kWh	8.46×10^{-2}	8.99×10^{-2}	6.3%	7.76×10^{-2}	−8.2%
Marine aquatic ecotoxicity	kg1,4-DBe/kWh	1.47×10^2	1.50×10^2	1.9%	1.37×10^2	−7.4%
Terrestrial ecotoxicity	kg1,4-DBe/kWh	1.01×10^{-3}	1.05×10^{-3}	4.3%	9.15×10^{-4}	−9.5%
Photochemical oxidation	kgC ₂ H ₄ e/kWh	3.07×10^{-5}	3.05×10^{-5}	−0.8%	2.46×10^{-5}	−19.9%
Acidification	kgSO ₂ e/kWh	7.28×10^{-4}	7.43×10^{-4}	2.0%	6.20×10^{-4}	−14.8%
Eutrophication	kgPO ₄ ^{3−} e/kWh	2.37×10^{-4}	2.39×10^{-4}	1.2%	2.09×10^{-4}	−11.8%

Table S2. Mid-point indicators (CML-IA baseline V3.05) for the three scenarios (electricity from PV).

Indicator	Units	Scenario						
		BAS, PV	SH-TES, PV		PCM-TES, PV		Optimal, PV	
Abiotic depletion	kgSbe/kWh	1.13×10^{-6}	1.13×10^{-6}	−0.1%	1.05×10^{-6}	−6.9%	9.92×10^{-7}	−12.1%
Abiotic depletion (fossil fuels)	MJ/kWh	4.14×10^{-1}	3.45×10^{-1}	−16.8%	6.17×10^{-1}	49.1%	2.75×10^{-1}	−33.6%
Global warming	kgCO ₂ e/kWh	3.56×10^{-2}	3.23×10^{-2}	−9.3%	3.12×10^{-2}	−12.2%	2.80×10^{-2}	−21.3%
Ozone layer depletion (ODP)	kgCFC-11e/kWh	1.46×10^{-8}	1.40×10^{-8}	−4.3%	1.43×10^{-8}	−1.9%	1.41×10^{-8}	−3.5%
Human toxicity	kg1,4-DBe/kWh	6.25×10^{-2}	5.75×10^{-2}	−8.0%	7.10×10^{-2}	13.5%	6.09×10^{-2}	−2.6%
Fresh water aquatic ecotox.	kg1,4-DBe/kWh	5.23×10^{-2}	5.58×10^{-2}	6.6%	5.13×10^{-2}	−2.0%	4.70×10^{-2}	−10.2%
Marine aquatic ecotoxicity	kg1,4-DBe/kWh	8.96×10^1	8.91×10^1	−0.7%	8.93×10^1	−0.4%	7.95×10^1	−11.3%
Terrestrial ecotoxicity	kg1,4-DBe/kWh	1.30×10^{-4}	1.23×10^{-4}	−5.3%	1.95×10^{-4}	49.7%	1.50×10^{-4}	15.8%
Photochemical oxidation	kgC ₂ H ₄ e/kWh	1.22×10^{-5}	1.09×10^{-5}	−10.8%	9.48×10^{-6}	−22.5%	8.52×10^{-6}	−30.3%
Acidification	kgSO ₂ e/kWh	2.09×10^{-4}	1.94×10^{-4}	−7.2%	1.95×10^{-4}	−6.4%	1.60×10^{-4}	−23.2%
Eutrophication	kgPO ₄ ^{3−} e/kWh	1.10×10^{-4}	1.05×10^{-4}	−4.1%	1.05×10^{-4}	−4.4%	9.40×10^{-5}	−14.3%

Table S3. Incidence of most-impacting processes (BAS, grid).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, grid	87.85%	82.45%	88.32%	82.85%
Heat pump	4.12%	5.80%	4.88%	9.84%
Propylene glycol	1.86%	3.79%	1.39%	2.43%
Gravel	1.50%	2.06%	1.58%	1.37%
Polyethylene	1.38%	1.81%	0.83%	0.24%
Concrete	1.26%	0.69%	0.64%	0.56%
Sand	0.74%	0.97%	0.80%	0.63%
Steel, chromium	0.58%	0.79%	0.55%	0.57%
Reinforcing steel	0.38%	0.79%	0.25%	0.41%
Tube insulation	0.16%	0.28%	0.21%	0.15%
Sealing tape	0.07%	0.13%	0.07%	0.08%
Brass	0.06%	0.40%	0.42%	0.84%
Excavation	0.05%	0.04%	0.06%	0.05%
Tap water	0.00%	0.00%	0.00%	0.00%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, PV	0.00%	0.00%	0.00%	0.00%
Paraffin	0.00%	0.00%	0.00%	0.00%
PE	0.00%	0.00%	0.00%	0.00%
Polystyrene	0.00%	0.00%	0.00%	0.00%
Steel and iron (waste treatment)	0.00%	0.00%	0.00%	0.00%
Steel, low-alloyed	0.00%	0.00%	0.00%	0.00%
Waste reinforced concrete	0.00%	0.00%	0.00%	0.00%

Table S4. Incidence of most-impacting processes (SH-TES, grid).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, grid	91.41%	87.92%	91.52%	86.57%
Heat pump	4.05%	5.85%	4.78%	9.72%
Propylene glycol	0.63%	1.32%	0.47%	0.83%
Gravel	0.74%	1.04%	0.78%	0.68%
Polyethylene	0.47%	0.63%	0.28%	0.08%
Concrete	0.95%	0.53%	0.48%	0.42%
Sand	0.37%	0.49%	0.39%	0.31%
Steel, chromium	0.57%	0.80%	0.54%	0.56%
Reinforcing steel	0.38%	0.81%	0.25%	0.42%
Tube insulation	0.16%	0.28%	0.21%	0.14%
Sealing tape	0.07%	0.14%	0.07%	0.08%
Brass	0.00%	0.00%	0.00%	0.00%
Excavation	0.07%	0.07%	0.10%	0.07%
Tap water	0.02%	0.02%	0.01%	0.02%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, PV	0.00%	0.00%	0.00%	0.00%
Paraffin	0.00%	0.00%	0.00%	0.00%
PE	0.00%	0.00%	0.00%	0.00%
Polystyrene	0.00%	0.00%	0.00%	0.00%
Steel and iron (waste treatment)	0.00%	0.00%	0.00%	0.00%
Steel, low-alloyed	0.00%	0.00%	0.00%	0.00%
Waste reinforced concrete	0.11%	0.11%	0.13%	0.10%

Table S5. Incidence of most-impacting processes (PCM-TES, grid).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, grid	86.10%	84.18%	84.79%	76.83%
Heat pump	4.94%	7.24%	5.73%	11.16%
Propylene glycol	0.77%	1.63%	0.56%	0.95%
Gravel	0.45%	0.64%	0.46%	0.39%
Polyethylene	0.57%	0.78%	0.34%	0.09%
Concrete	0.50%	0.29%	0.25%	0.21%
Sand	0.22%	0.30%	0.24%	0.18%
Steel, chromium	0.70%	0.99%	0.65%	0.64%
Reinforcing steel	0.19%	0.40%	0.12%	0.19%
Tube insulation	0.19%	0.34%	0.25%	0.17%
Sealing tape	0.09%	0.17%	0.08%	0.09%
Brass	0.09%	0.66%	0.66%	1.27%
Excavation	0.01%	0.01%	0.02%	0.01%
Tap water	0.00%	0.00%	0.00%	0.00%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, PV	0.00%	0.00%	0.00%	0.00%
Paraffin	4.56%	5.33%	5.57%	3.16%
PE	−0.07%	−0.10%	−0.03%	0.01%
Polystyrene	0.43%	0.29%	0.13%	0.08%
Steel and iron (waste treatment)	−4.11%	−12.07%	−2.93%	−2.65%
Steel, low-alloyed	4.36%	8.91%	3.14%	7.22%
Waste reinforced concrete	0.00%	0.00%	0.00%	0.00%

Table S6. Incidence of most-impacting processes (BAS, PV).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, PV	55.65%	55.88%	59.24%	63.01%
Heat pump	15.03%	14.58%	17.02%	21.22%
Propylene glycol	6.78%	9.54%	4.85%	5.23%
Gravel	5.46%	5.18%	5.52%	2.95%
Polyethylene	5.05%	4.55%	2.90%	0.53%
Concrete	4.60%	1.73%	2.24%	1.20%
Sand	2.70%	2.44%	2.80%	1.37%
Steel, chromium	2.12%	1.99%	1.92%	1.22%
Reinforcing steel	1.38%	1.98%	0.86%	0.89%
Tube insulation	0.58%	0.69%	0.73%	0.32%
Sealing tape	0.27%	0.34%	0.24%	0.17%
Brass	0.21%	1.00%	1.46%	1.80%
Excavation	0.17%	0.10%	0.21%	0.10%
Tap water	0.00%	0.00%	0.00%	0.00%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, grid	0.00%	0.00%	0.00%	0.00%
Paraffin	0.00%	0.00%	0.00%	0.00%
PE	0.00%	0.00%	0.00%	0.00%
Polystyrene	0.00%	0.00%	0.00%	0.00%
Steel and iron (waste treatment)	0.00%	0.00%	0.00%	0.00%
Steel, low-alloyed	0.00%	0.00%	0.00%	0.00%
Waste reinforced concrete	0.00%	0.00%	0.00%	0.00%

Table S7. Incidence of most-impacting processes (SH-TES, PV).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, PV	64.89%	66.24%	67.47%	69.45%
Heat pump	16.57%	16.34%	18.34%	22.12%
Propylene glycol	2.58%	3.69%	1.80%	1.88%
Gravel	3.02%	2.91%	2.98%	1.54%
Polyethylene	1.91%	1.75%	1.07%	0.19%
Concrete	3.90%	1.49%	1.85%	0.96%
Sand	1.49%	1.37%	1.51%	0.71%
Steel, chromium	2.33%	2.23%	2.07%	1.28%
Reinforcing steel	1.56%	2.27%	0.95%	0.95%
Tube insulation	0.63%	0.78%	0.79%	0.33%
Sealing tape	0.30%	0.38%	0.26%	0.18%
Brass	0.00%	0.00%	0.00%	0.00%
Excavation	0.30%	0.18%	0.37%	0.16%
Tap water	0.06%	0.05%	0.05%	0.04%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, grid	0.00%	0.00%	0.00%	0.00%
Paraffin	0.00%	0.00%	0.00%	0.00%
PE	0.00%	0.00%	0.00%	0.00%
Polystyrene	0.00%	0.00%	0.00%	0.00%
Steel and iron (waste treatment)	0.00%	0.00%	0.00%	0.00%
Steel, low-alloyed	0.00%	0.00%	0.00%	0.00%
Waste reinforced concrete	0.45%	0.32%	0.49%	0.22%

Table S8. Incidence of most-impacting processes (PCM-TES, PV).

Process	Global Warming	Photochemical Oxidation	Acidification	Eutrophication
Electricity, PV	51.82%	58.93%	51.72%	53.91%
Heat pump	17.11%	18.81%	18.18%	22.20%
Propylene glycol	2.66%	4.24%	1.78%	1.89%
Gravel	1.55%	1.67%	1.47%	0.77%
Polyethylene	1.97%	2.01%	1.06%	0.19%
Concrete	1.75%	0.74%	0.80%	0.42%
Sand	0.77%	0.79%	0.75%	0.36%
Steel, chromium	2.41%	2.57%	2.05%	1.28%
Reinforcing steel	0.65%	1.05%	0.38%	0.38%
Tube insulation	0.66%	0.89%	0.78%	0.33%
Sealing tape	0.31%	0.44%	0.26%	0.18%
Brass	0.33%	1.72%	2.09%	2.52%
Excavation	0.05%	0.03%	0.06%	0.03%
Tap water	0.01%	0.01%	0.01%	0.01%
end-of-life concrete	0.00%	0.00%	0.00%	0.00%
end-of-life eps tank	0.00%	0.00%	0.00%	0.00%
end-of-life steel PCM	0.00%	0.00%	0.00%	0.00%
Electricity, grid	0.00%	0.00%	0.00%	0.00%
Paraffin	15.82%	13.83%	17.67%	6.29%
PE	-0.24%	-0.27%	-0.10%	0.01%
Polystyrene	1.49%	0.74%	0.40%	0.16%
Steel and iron (waste treatment)	-14.25%	-31.33%	-9.31%	-5.28%
Steel, low-alloyed	15.13%	23.13%	9.97%	14.36%
Waste reinforced concrete	0.00%	0.00%	0.00%	0.00%



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