



**Table 3: Benchmarks for ground-mounted solar thermal systems connected to (district) heating grids**

Solar thermal system category	SDH: Solar district heating Solar assisted district heating (ground mounted collector field)	
All systems of this category are <b>ground-mounted</b> and may be equipped with either <ul style="list-style-type: none"> <li>- short-term (diurnal) storages <b>(A)</b> or</li> <li>- long-term (seasonal) storages <b>(B)</b></li> </ul>		
Energy/technical data	A) with diurnal storage	B) with seasonal storage
Kind of solar thermal collector used <i>optional</i>	<b>FPC</b> -	<b>FPC</b> -
Kind of solar energy storage used <i>optional</i>	Non-pressurized TTES <i>pressurized TTES</i>	PTES <i>BTES, (ATES)</i>
<b>Typical size per unit</b> [m <sup>2</sup> <sub>gross</sub> ] <i>- range (from - to)</i>	<b>10,000</b> <i>5,000 – 20,000 (up to 150,000)</i>	<b>50,000</b> <i>20,000 – 70,000</i>
<b>Typical thermal peak capacity per unit</b> [kW] <i>- range (from - to)</i>	<b>7,000</b> <i>3,500 – 14,000</i>	<b>35,000</b> <i>14,000 – 140,000</i>
Typical storage volume per unit [m <sup>3</sup> <sub>H<sub>2</sub>Oe</sub> ]	<b>1,200</b>	<b>125,000</b>
Typical annual production per unit [MWh/a]	<b>4,100</b>	<b>17,500</b>
<b>Specific storage volume per unit</b> [ltr./m <sup>2</sup> <sub>gross</sub> ] <i>- range (from - to)</i>	<b>120</b> <i>90 – 150</i>	<b>2,500</b> <i>1,500 – 3,500</i>
<b>Typical solar energy yield SE</b> [kWh/m <sup>2</sup> <sub>gross</sub> /a] <i>- range (from - to)</i>	<b>410</b> <i>380 – 460</i>	<b>365</b> <i>340 – 390</i>
Typical solar fraction sf [-] <i>- range (from - to)</i>	<b>12%</b> <i>5 – 20%</i>	<b>50%</b> <i>40 – 60%</i>
Technical life time [years]	25	25
Financial data	A) with diurnal storage	B) with seasonal storage
<b>Specific cost ready installed</b> [1,000€/m <sup>2</sup> <sub>gross</sub> ] (excl. VAT, excl. subsidies)	<b>0.24 (+/- 12%)</b> <i>(0.21 – 0.27)</i>	<b>0.29 (+/- 15%)</b> <i>(0.25 – 0.33)</i>
<b>Specific cost (material only)</b> [1,000€/m <sup>2</sup> <sub>gross</sub> ] (excl. VAT, excl. subsidies)	<b>0.22 (+/- 12%)</b> <i>(0.19 – 0.25)</i>	<b>0.27 (+/- 15%)</b> <i>(0.23 – 0.31)</i>
<b>Specific cost (labor only)</b> [1,000€/m <sup>2</sup> <sub>gross</sub> ] (excl. VAT, excl. subsidies)	<b>0.02</b> <i>(0.02 – 0.02)</i>	<b>0.02</b> <i>(0.01 – 0.02)</i>
Investment per unit ready installed [1,000€/unit] (excl. VAT, excl. subsidies)	<b>2,400 (+/-12%)</b> <i>(2,100 – 2,700)</i>	<b>14,500 (+/-15%)</b> <i>(12,325 – 16,675)</i>
Fixed O&M per unit [€/m <sup>2</sup> <sub>gross</sub> /a]*	1.7	2.0
Variable O&M per unit [€/m <sup>2</sup> <sub>gross</sub> /a]*	1.5	1.3
<b>Levelized cost of heat LCOH</b> [€-ct/kWh] <i>- range (from - to)</i>	<b>4.1 (+/- 11%)</b> <i>3.7 – 4.6</i>	<b>5.5 (+/- 14%)</b> <i>4.7 – 6.3</i>

\* 0.75% of net investment cost (excl. labor)

\*\* Electricity for solar pump and control (around 1.5 kWh electrical / 100 kWh heat produced). Electricity: 24€-ct/MWh