The Lactoserum powder plant at Fromeréville-les-Vallons near Verdun is owned by the French Lactalis Group. It is equipped with 15 000 m² of solar panels, equating to 13 MWth of capacity and will have a 3 000-m³ hot water storage tank.

NEWHEAT

- 23.9%

The decrease of the solar thermal market in the European Union between 2022 and 2023

SOLAR THERMAL AND CONCENTRATED SOLAR POWER BAROMETER

A study carried out by EurObserv'ER

The European Union solar thermal market's two-year growth spurt stalled abruptly in 2023, leading to a 23.9% market contraction. EurObserv'ER quantifies the annual installed solar thermal collector surface for 2023 at just over 1.8 million m2 compared to the previous year's installation figure of 2.4 million m2. The drop, which hit almost all EU countries, dealt the German market a particularly severe blow, pushing it down into second place in the rankings behind Greece. Looking on the bright side, the Greek solar thermal market expanded by 10%, and in doing so, consolidated its solar thermal supremo status. Other positive factors were the programmed build-up of solar heating networks in Germany and the commissioning of several major solar industrial heat projects.

Recent EU concentrated solar thermal projects have been geared to industrial heating needs. Currently, only one 4-MW Fresnel type power plant is under construction in Sicily.

59.9 MILLIONS M²

The cumulated surfaces of solar thermal in operation in the European Union in 2023

2 333.1 MWe

Total CSP capacity in operation in the European Union in 2023

Germany's largest solar thermal plant will supply the Leipzig-Lausen (Saxony) SDH. The 41-MW capacity installation with 65 000 m² of collectors, should be ready by the end of 2025 and its commissioning is scheduled for 2026. It will produce 26 GWh p.a., making savings of 7 000 tonnes of CO2 emissions.

LEIPZIGER STADTWERKE

SOLAR THERMAL

Although the European Union's solar thermal market appeared to be bouncing back over the past two years, it marked time in 2023. EurObserv'ER registered a sharp year-on-year (YoY) drop of ≈24% in the newly installed collector surface, that fell to just over 1.8 million m2 (tables 1 and 2). Apart from the Greek and French markets – the latter underpinned by its overseas territories (Guiana, Martinique, Reunion Island, Guadeloupe and Mayotte) – most of the key European solar thermal markets registered lower installed collector surface figures, including markets that had recovered in 2022 (Germany, Italy, Poland and the Netherlands). What is of more concern is that a number of formerly flourishing markets have been unable to stem their decline in sales (Spain, Portugal and Austria).

The European market downturn can be largely ascribed to plummeting sales in the residential sector. This primarily affects forced circulation solar thermal systems, both for domestic hot water production and combined solar heating systems. Thermosyphon systems, that are particularly well suited to Mediterranean and tropical climates (for instance in the French Overseas territories), have been left relatively unscathed. Major installations (>1 000 m2), regardless of whether they serve large multi-occupancy systems, the solar heating network segment or the industrial heat segment, still depend heavily on the incentive programmes implemented in the individual Member States. Commissioning these installations, that tend to have collector arrays ranging from several to tens of thousands of m2, may boost national statistics. To cite an example, the Groningen solar heating network in the Netherlands, which will shortly start up, has a collector surface of 48 000 m2, which equates to the combined surface of 12 000 individual 4-m2 hot water heaters (for 4 people). The EurObserv'ER findings on the major projects commissioned in the European Union in 2023 and early 2024 are presented in the second part of this barometer.

Methodology reminder: the market data presented in tables 1 and 2 covers systems that use flat-glazed and vacuum tube collectors, both of which are technologies geared to domestic hot water production or heating in the residential sector and heat and hot water production for heating networks and industrial processes. The data also includes unglazed collectors that tend to be used for heating pools, even if this technology is less diligently monitored by the statistical organizations. However, concentration mirrors (of the Fresnel or parabolic trough types) used for hot water or steam production are excluded from the glazed collector statistics presented in tables 1 and 2 as are data on hybrid PV-T collectors that use water or air as the heat carrier). Yet, EurObserv'ER describes recently commissioned systems that use CSP systems in the section on solar industrial heat. The PV-T collector monitoring results that combine photovoltaic technology and solar thermal technology are published in the June 2024 Solar Heat Worldwide publication, which is the industry reference study on solar heat and part of the International Energy Agency's SHC (Solar Heating and cooling) programme.

The climate of uncertainty does solar thermal no favours

Several factors stemming from the specific features of the changes to individual countries' regulations, subsidy levels and also the tougher European economic context conspired to upset the European Union's solar thermal market in 2023. Inflation's return, energy price hikes and rising interest rates have created a climate of uncertainty that is hardly conducive to investing in solar thermal. In many European countries the solar thermal market is a casualty of the crisis in the new build construction sector which is usually profitable for solar thermal. With the benefit of hindsight, the rise in the price of gas and foreboding about gas shortages arising from Russia's war on neighbouring Ukraine has provided little succour to solar thermal technology. Of all the renewable options, European households have been principally drawn to photovoltaic systems, resulting in the self-consumption and heat pump segments booming (although the HP market contracted in the second half of 2023 because of the sharp hike in the price of electricity). As for solar photovoltaic, it took full advantage of soaring electricity prices, and in an internecine war, continues to cast shade on solar thermal by commandeering Europe's roofs.

Several key European Union markets may have also been hit by the uncertainty surrounding their general elections and their associated, more conservative policy changes. Points in case are Italy in 2022 and the following year's early elections in the Netherlands. What is more, tensions within governmental coalitions have consequences for the implementation of energy efficiency policies and the promotion of renewable heating systems. The German market downturn (of 47% compared to 2022) can be directly attributed to the political uncertainty surrounding the statutory obligations to renew heating appliances, driven by the heating law and the promotion of renewable energy heating systems. The end of the "Superbonus" and credit transfer mechanisms (see below) also hit Italy's solar thermal market (which suffered a 28.7% drop on its 2022 level). The Polish market (37.7% down on its 2022 level) was toppled by the end of the solar thermal specific aid programme (municipal programmes co-financed by the European Union).

The Greek market, based essentially on thermosyphon systems was more positive, putting in a strong performance with a YoY increase of 10% in installed collector surface. Mainland France's combined solar systems were the main beneficiaries of the **MaPrimRénov'** and **Coup de pouce chauffage** incentive systems geared to low-income households, which explains their growth. The LACTOSOL solar thermal plant at Verdun, commissioned in March 2023 ,received **Fonds Chaleur** backing. It is Europe's biggest solar industrial heat installation that supplies a plant operated by the Lactalis dairy group and is equipped with flat-glazed collectors.

NEWS FROM AROUND THE MAJOR SOLAR THERMAL COUNTRIES

Greece... the solar thermal stronghold

Thermosyphon systems, that are particularly well suited to the Mediterranean climate, reign supreme in Greece. In 2023, the market expanded further, by ≈10% according to estimates provided by the EBHE (Hellenic Federation of Solar Industries) with 461 000 m2 of collector surface. Last year, Costas Travasaros, the former President of Solar Heat Europe, and Chair of the Board of Prime Laser Tech, attributed the Greek market's robustness to high energy prices. He added that the improved economic situation and the increase in the number of new and renovated dwellings also contributed to this gain. Similarly, the country's high equipment level could be put down to the fact that thermosyphon solar systems use proven, safe and economically affordable technology. In a recent opinion page for the Greek heating and air-conditioning sector magazine Thermoydravlikos, he explained that solar thermal's development potential had ample reserves. He claimed that "...only 35% of Greek households own a solar water heater, while the ownership level in countries such as Israel and Cyprus was 90%. If conditions are right, we could reach this target by 2030". He also recalled that "solar thermal systems offer substantial advantages for environmental protection and cutting polluting gas emissions, as during its lifetime, every solar water heater avoids the emission of 30 tonnes of CO2. That equates to 2 700 euros per solar water heater based on the December 2023 prices of the European Union emissions trading system (EU-ETS)".

The German solar thermal market is derailed

Germany had a bad year for solar thermal in 2023 and the situation worsened at the beginning of 2024. AGEE-Stat data shows that it only installed 376 000 m2 (equating to 55 000 new systems), which is a far cry from the 709 000 m2 installed in 2022 (i.e., a 47% drop). The BDH, Germany's heating industry federation, blames the situation on uncertainties and delays arising from the implementation of the

new heating law and the promotion of renewable energy heating systems from 2024 onwards. This drop is particularly troubling because the German heating appliance market had been performing well with 1.3 million heating boilers sold – a 34% increase. This thrust was driven by heat pump sales (356 000 units, with 51% growth) but particularly by sales of gas boilers (790 500 units, with 32% growth) and oil-fired boilers (112 500 units, with 99% growth). The HP market surge can be put down to Russia's war against Ukraine and consumers' concerns about potential gas shortages in 2022.
The BDH also points out that during the second half of 2023, the debate on the amendment to the Building Energy Act (GEG) and the future financing framework led to increased demand for modernising oil- and gas-fired heating systems, while heat pump sales declined. After months of controversy, the German Parliament adopted the coalition government's Heating Act in September 2023. Rowing back on the original plan, the act stipulates that the obligation to install heating systems running 65% on renewable energy, from 1 January 2024, would only apply to new dwellings. Initially, the law applied to all buildings, but the coalition government limited the law's remit under pressure from the Liberal party.
Solar thermal is likely to have a tough time in 2024, weak heating appliance market sales and the collapse of new building activity.
"The heating modernisation market is blighted by deep consumer misgivings", explains Markus Staudt, General Manager of BDH, to account for the market situation. The impact on the solar thermal energy market's development is particularly serious, with a 60% YoY drop in Q1 2024.

The end of the 110% Superbonus upsets the Italian market

Italy's solar thermal market, ranked third in the European Union, did not repeat its strong performance of 2022. Federico Musazzi, the Secretary-General of Assotermica a member of the ANIMA federation (the Italian mechanical engineering industry associations federation), reports that the solar thermal market contracted by about 28.7% between 2022 and 2023, from 339 750 to 242 242 m2 for a variety of reasons, including a downturn in apartment and new house sales compounded by the fact that the Superbonus in its original form, and the possibility of transferring tax credits, were curtailed. Households waited for a new incentive mechanism and postponed many investment decisions. We should point out that the Superbonus was set up to make energy transition easier to facilitate work on heat insulation, solar panels and window replacement. The mechanism consisted of a tax credit spread over 5 years. It equated to 110% of the investment sum and was transferrable, meaning that households could transfer the tax credit to construction firms that would sell on the credit to a banking establishment, that would in turn recover the money from the State. In 2023, the programme deemed too costly for Italy's public finances, prompted the Meloni government to reduce the Superbonus tax credit to 90% while introducing means testing to it. Yet it maintained the Superbonus at 110% for work already started providing certain income conditions were met. In 2024, the Superbonus was again reduced – to 70% – with the added restriction of being allocated exclusively to co-owners, and no longer for one-family housing projects. The tax credit rate will drop to 65% in 2025.

Structural faults thwart the Polish market

Despite increased sales of solar thermal collectors in 2021 and 2022, sales marked time in 2023 according to SPIUG, the Polish Association of Manufacturers and Importers of Heating Equipment. Sales slumped in Q4 of 2023 (by 66%), resulting in a YoY drop of 37.7% (130 800 m2 sold in 2023). The main reason for this contraction is that the local

Table No. 1

Annual installed surfaces in 2022 per type of solar thermal collectors (in m²) and capacity equivalent (in MWth)

Country	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent power (MWth)
	Flat plate collectors	Vacuum collectors			
Germany	524 000	185 000		709 000	496.3
Greece	419 000			419 000	293.3
Italy	339 750			339 750	237.8
Poland	208 500	1 500		210 000	147.0
France**	163 300			163 300	114.3
Spain	125 587	8 665	2 000	136 252	95.4
Cyprus	73 924			73 924	51.7
Portugal	66 100			66 100	46.3
Austria	56 830	660	1 480	58 970	41.3
Bulgaria	45 863			45 863	32.1
Netherlands	24 516	14 960	2 621	42 097	29.5
Czechia	23 167	2 336		25 503	17.9
Belgium	15 000	3 500		18 500	13.0
Romania*	16 932			16 932	11.9
Slovakia	16 000			16 000	11.2
Hungary*	14 000			14 000	9.8
Croatia*	13 558			13 558	9.5
Finland+	8 000			8 000	5.6
Luxembourg	3 574			3 574	2.5
Denmark	2 664			2 664	1.9
Sweden*	2 014			2 014	1.4
Lithuania*	1 751			1 751	1.2
Latvia*	1 700			1 700	1.2
Slovenia*	1 479			1 479	1.0
Estonia*	1 425			1 425	1.0
Malta+	1 051	263		1 314	0.9
Ireland	1 116			1 116	0.8
Total EU	2 170 801	216 884	6 101	2 393 786	1 675.7

*+ EurObserv'ER estimation based on the market trend of recent years (these are not sufficiently accurate to be used for percentual change reference in these markets). * Estimation from Solar heat Europe "Decarbonising heat with solar thermal market. Market outlook 2022-2023). ** including 96 500 m2 in the overseas departments. Note: PVT hybrid systems. CSP systems (Fresnel. Parabolic. Parabolic trough) and air collector systems are not included. Breakdown for glazed collectors between flat plate collectors and vacuum collectors is not always available.* ***Source: EurObserv'ER 2024***

Table No. 2

Annual installed surfaces in 2023 per type of solar thermal collectors (in m²) and capacity equivalent (in MWth)

Country	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent power (MWth)
	Flat plate collectors	Vacuum collectors			
Greece	461 000			461 000	322.7
Germany	268 000	108 000		376 000	263.2
Italy	242 242			242 242	169.6
France**	169 500			169 500	118.7
Poland	130 800			130 800	91.6
Spain	99 487	6 536	1 840	107 863	75.5
Cyprus	66 740			66 740	46.7
Portugal	51 410	1 590		53 000	37.1
Austria	43 891	1 319	1 038	46 248	32.4
Bulgaria+	36 700			36 700	25.7
Netherlands	19 870	12 360	2 621	34 851	24.4
Czechia	15 333	3 473		18 806	13.2
Romania+	13 500			13 500	9.5
Slovakia+	12 800			12 800	9.0
Belgium	9 300	2 500		11 800	8.3
Croatia+	10 800			10 800	7.6
Hungary+	9 600			9 600	6.7
Finland+	6 400			6 400	4.5
Luxembourg	2 755			2 755	1.9
Denmark	2 000			2 000	1.4
Sweden+	1 600			1 600	1.1
Lithuania+	1 400			1 400	1.0
Latvia+	1 400			1 400	1.0
Slovenia+	1 200			1 200	0.8
Estonia+	1 100			1 100	0.8
Malta+	1 000			1 000	0.7
Ireland+	700			700	0.5
Total EU	1 680 528	135 778	5 499	1 821 805	1 275.3

*+ EurObserv'ER estimation based on the market trend of recent years (these are not sufficiently accurate to be used for percentual change reference in these markets). * Estimation . ** including 83 500 m2 in the overseas departements. Note: PVT hybrid systems, CSP systems (Fresnel, Parabolic, Parabolic trough) and air collector systems are not included. Breakdown for glazed collectors between flat plate collectors and vacuum collectors is not always available.*
Source: EurObserv'ER 2024

authority projects that have depended on European Union-funded programmes for years, came to an end. Unfortunately, the situation did not improve in Q1 2024, when a further 75% drop, that SPUIG ascribes to the end of the local authority projects, was registered. Other contributory factors mentioned are greater consumer uncertainty arising from the economic context, the prospect of new local government-backed support programmes, less effective lobbying for solar thermal than for photovoltaic and heat pump solutions and wavering decision makers. On the bright side, the solar thermal market segment directly linked to wholesalers who supply installers (rather than tenders, which applied to the municipal programmes), is holding its ground despite being a minority segment of the Polish market (≈20% in 2023).

Spain... solar thermal's technology showcase

The Spanish solar thermal market is one of a kind in the European Union as it is shared by all solar thermal technologies: conventional flat glazed collectors along with prefabricated thermosyphon systems, vacuum tube collectors, unglazed collectors, as well as hybrid PV-T collectors and solar air collectors. Spain is even experimenting with the production of high-temperature industrial heat using CSP systems (see further on). According to the ASIT (Spanish solar thermal association) annual report, **2024 INFORME ANNUAL**, the 2023 solar thermal market taking all components together (excluding CSP) amounted to a surface of 137 500 m2 compared to 145 500 m2 in 2022 and 165 423 m2 in 2021. So, the market recorded an overall 5.5% contraction between 2022 and 2023, which is nonetheless an improvement on the 12% drop measured between 2022 and 2021.

As we explained in the methodology note, for its statistics, EurObserv'ER only includes glazed collectors that use a heat carrier fluid (namely flat glazed collectors, including thermosyphon systems, as well as vacuum tube collectors), in addition to unglazed collectors. If we re-examine the breakdown of ASIT's market data, the market for glazed collectors using a heat carrier fluid amounted to 106 023 m2 in 2023 compared to 134 242 m2 in 2022 and 150 197 m2 in 2021, i.e., a 21% drop between 2023 and 2022 and a 10.5% drop between 2022 and 2021. The market for "plastic" unglazed collectors remained stable at around 2 000 m2 (1 840 m2 in 2023, compared to 2 000 m2 in 2022). Incidentally, sales of PV-T collectors were gauged at 9 143 m2 in 2023 (8 000 m2 in 2022), and air collectors at 20 494 m2 (3 000 m2 in 2022). The strong growth of this technology in Spain can be ascribed to the commissioning of two major industrial installations, each of which uses 10 000 m2 of air collectors (see below).

Table No. 3

Cumulated capacity of solar thermal collectors installed in the European Union in 2022 and 2023** (in m² and in MWth)*

Country	2022 m²	2022 MWth	2023 m²	2023 MWth
Germany	22 414 890	15 690.4	22 395 490	15 676.8
Greece	5 442 000	3 809.4	5 742 000	4 019.4
Italy	4 953 763	3 467.6	5 116 005	3 581.2
Spain	4 449 343	3 114.5	4 586 843	3 210.8
Austria	4 616 474	3 231.5	4 459 936	3 122.0
France	4 090 975	2 863.7	4 111 000	2 877.7
Poland	3 405 690	2 384.0	3 511 490	2 458.0
Denmark	2 059 096	1 441.4	2 042 096	1 429.5
Portugal	1 545 055	1 081.5	1 598 054	1 118.6
Cyprus	1 139 643	797.8	1 176 383	823.5
Belgium	756 400	529.5	759 153	531.4
Netherlands	662 369	463.7	667 528	467.3
Czechia	611 242	427.9	630 048	441.0
Bulgaria	515 697	361.0	552 397	386.7
Hungary	418 000	292.6	425 600	297.9
Sweden	435 000	304.5	417 335	292.1
Ireland	345 907	242.1	345 215	241.7
Croatia	312 600	218.8	323 400	226.4
Slovakia	265 000	185.5	272 800	191.0
Romania	249 109	174.4	262 609	183.8
Slovenia	217 246	152.1	216 146	151.3
Luxembourg	88 000	61.6	92 900	65.0
Finland	73 095	0.0	75 850	53.1
Malta	46 485	32.5	45 405	31.8
Estonia	29 550	20.7	30 550	21.4
Latvia	23 320	16.3	24 270	17.0
Lithuania	21 672	15.2	22 672	15.9
Total EU 27	59 187 621	41 380.2	59 903 175	41 932.2

** All technologies included unglazed collectors. ** Estimation. Note: Some countries like France, Austria and Spain include PVT hybrid systems in their cumulated capacity of solar thermal collectors.* ***Source: EurObserv'ER 2024***

Thermosyphon systems, that are particularly well suited to the Mediterranean climate, reign supreme in Greece. In 2023, the market expanded further, by ≈10% according to estimates provided by the EBHE (Hellenic Federation of Solar Industries) with 461 000 m2 of collector surface.

SPOTLIGHT ON THE EUROPEAN MARKET FOR LARGE-SCALE SOLAR SYSTEMS

The EU already has 246 solar heating networks up and running

Denmark has long spearheaded heating network solarization. According to the data of the 2024 edition of Solar Heat Worldwide report, it had at least 124 heating networks at the end of 2023, spread over the country amounting to a collector surface of 1 608 591 m2 (equating to 1 126 MWth). That is better than China with its 72 solar heating networks (718 670 m2, equating to 503 MWth). In Denmark, activity is slacker because of its policy to encourage coupling networks with high-capacity heat pumps, to make use of excess renewable electricity on the power grid. Denmark connected only a single solar heating network in 2023, that of Blendstrup (2 000 m2). According to the Danish consultancy PlanEnergi's database, a further two projects are in their final stages, at Bjerringbro (8 000 m2) and Aeroskobing (1 910 m2).

Germany has overtaken Denmark to lead European SDH (Solar District Heating) efforts. According to Steinbeis Solites, the German research institute, the country already had 55 solar district heating plants in January 2024 with combined total capacity of 112 MW (equating to 160 317 m2). Six new small-scale solar thermal heating systems with a combined collector surface of 13 955 m2, were commissioned in 2023. Work is underway on nine additional systems totalling 79 MW of capacity (equating to 112 424 m2 of solar thermal collector surface), including the solar heating networks of Leipzig (65 000 m2), Bad Rappenau (29 000 m2), Sondershausen (6 086 m2), Jungnau (2 300 m2), Ammerbuch-Breitenholz (1 985 m2), Schönwald Bauabschnitt 1 (2 860 m2), Wolmirstedt (2 400 m2), Häusern (1 733 m2) and Markt Erlbach (1 060 m2). The same source reports that another 70 solar heating networks amounting to 395 968 m2 of collector surface (77 MWth), are at the preparatory phase. Taken together, these projects should triple Germany's solar heating network collector surface in the space of a few years.

Projects scheduled to go on stream in 2024 include that of Sondershausen which will have 6 086 m2 of TVP Solar flat vacuum collectors, which should start operating at the end of the first half of the year. Construction of Germany's largest heating network at Leipzig (65 000 m2, Ritter XL collectors) started in March 2024 and it should start operating early in 2026. According to the April 2023 press release published by Ritter XL, the plant will cover about 20% of the daily heating needs of Leipzig in the summer, while solar heating will cover 2% of the city's total annual district heating needs. The Local Heat Planning Law also sets national decarbonisation targets for heating networks. From 1st January 2024, at least 65% of renewable heating must be injected into any new heating network. By 2030, half of Germany's district heating will have to be produced in a climate neutral manner. Thomas Pauschinger, international R&D manager at the German Energy Efficiency Association for Heating, Cooling and CHP, AGFW, in an article entitled "District heating has never had such a high significance in Germany" published on the Solarthermalworld.org website on 28 April 2024, stated that the BEW (Federal Funding for Efficient Heating Networks) funding scheme launched in September 2022 was a game changer by making 4 billion euros of funding available until 2026. The plan's aim is to fund renovation measures for the long-term transition of heating plants, and also to change heat production capacities to use renewable energies and extend existing heating networks. The BEW programme grants subsidies of up to 40% of investment costs, plus an operating subsidy for solar district heating systems and the other renewable technologies, thus offering considerable potential. Germany currently has 4 100 district heating systems spanning 34 000 km of pipework delivering 140 TWh and covering 14% of its space heating demand. As it stands, 30% of this heating is already climate neutral if we include residual heating and waste incineration in addition to renewable energy sources.

Another major European SDH project that is nearing completion is the Groningen solar heating network in the Netherlands. It will have a collector surface of 48 000 m2 (33.6 MWth of capacity). Construction work on it started at the end of 2022. The plant will produce 25 GWh of solar heat. The solar share of the

city's total energy consumption will rise to 25%, while slashing emissions by 6 000 tCO2 p.a. The project benefitted from the Netherlands' SDE+ incentive programme.
The 2024 Solar Heat Worldwide study also reports on two extensions to existing SDH systems in the state of Styria, Austria, with 2 173 m2 (1.5 MWth) of newly installed collector surface. These extensions are on the Sankt Ruprecht/Raab heating network whose collector surface will rise to 1 954 m2 (1.4 MWth) and the Mürzzuschlag heating network whose collector surface will rise to 6 807 m2 (4.8 MWth).
The Solar Heat Worldwide report (2024 Edition) identified a total of 256 cities and localities supplied by a solar heating network at the end of 2023 with 1 372 MWth of combined capacity in Europe (the European Union plus Norway, the UK, Switzerland, Serbia and Montenegro). Within the narrower perimeter of the European Union, 246 cities and localities supplied by a solar heating network were identified with combined capacity of 1 353 MWth.

Solar industrial heat tries out all the technologies

Solar industrial heat is burgeoning, with ever bigger projects featuring collector arrays rising into the thousands, if not tens of thousands of m2. As it happens, this is not an exclusively European phenomenon, but is happening worldwide according to the Solar Heat Worldwide report, quoted above. China recently started up the biggest solar thermal heating installation (in 2024). It is a 114 000-m2 (77 MWth) parabolic trough CSP installation for a tourism and leisure complex that will heat buildings and produce snow.
What sets solar industrial heat projects apart is that they can use a much wider range of technologies in line with their temperature needs. Some use large-dimension flat-glazed collectors, similar to those used in SDH networks, others used glazed vacuum collectors (e.g.: the TVP Solar brand), others are CSP plants that use flat mirrors (Fresnel linear type), parabolic or parabolic trough collectors. The solar heating applications in industry (agrifood, paper making, chemicals, etc.) abound and they cover preheating air flows (e.g.: for drying), hot water circuits and the need for steady temperature maintenance.
The number of large-scale projects (>5 000 m2) commissioned in European Union countries in recent years has multiplied, resulting from the rollout of incentive systems, such as the **Fonds Chaleur** managed by Ademe in France, the **ISDE** programme (Sustainable Energy Investment Subsidy Scheme) managed by RVO in the Netherlands and the **European Regional Development Fund** (ERDF) in Spain. Thus, it follows that large projects can be found in France, Spain, and the Netherlands with a specific Dutch sideline in hothouse flower growing and market gardening greenhouse applications. The most recent projects commissioned include the biggest European solar thermal installation (excluding market gardening greenhouses), to start operating in March 2023, that uses flat-glazed collectors. This solar installation delivers heat to the Lactalis Group's Lactoserum powder plant at Verdun, one of the biggest powder dairy product production sites in France (80 000 tonnes of lactose and lactoserum p.a.). The Lactalis press release states that 15 000 m² of solar panels (equating to 13 MWth of capacity) were installed to preheat the drying tower. The panels are connected to a 3 000-m² storage tank, that can store several days' worth of heat production. Accordingly, it ensures that the heat supply is uninterrupted during the night and on cloudy summer days. The installation is designed to reduce the Verdun tower's gas consumption by

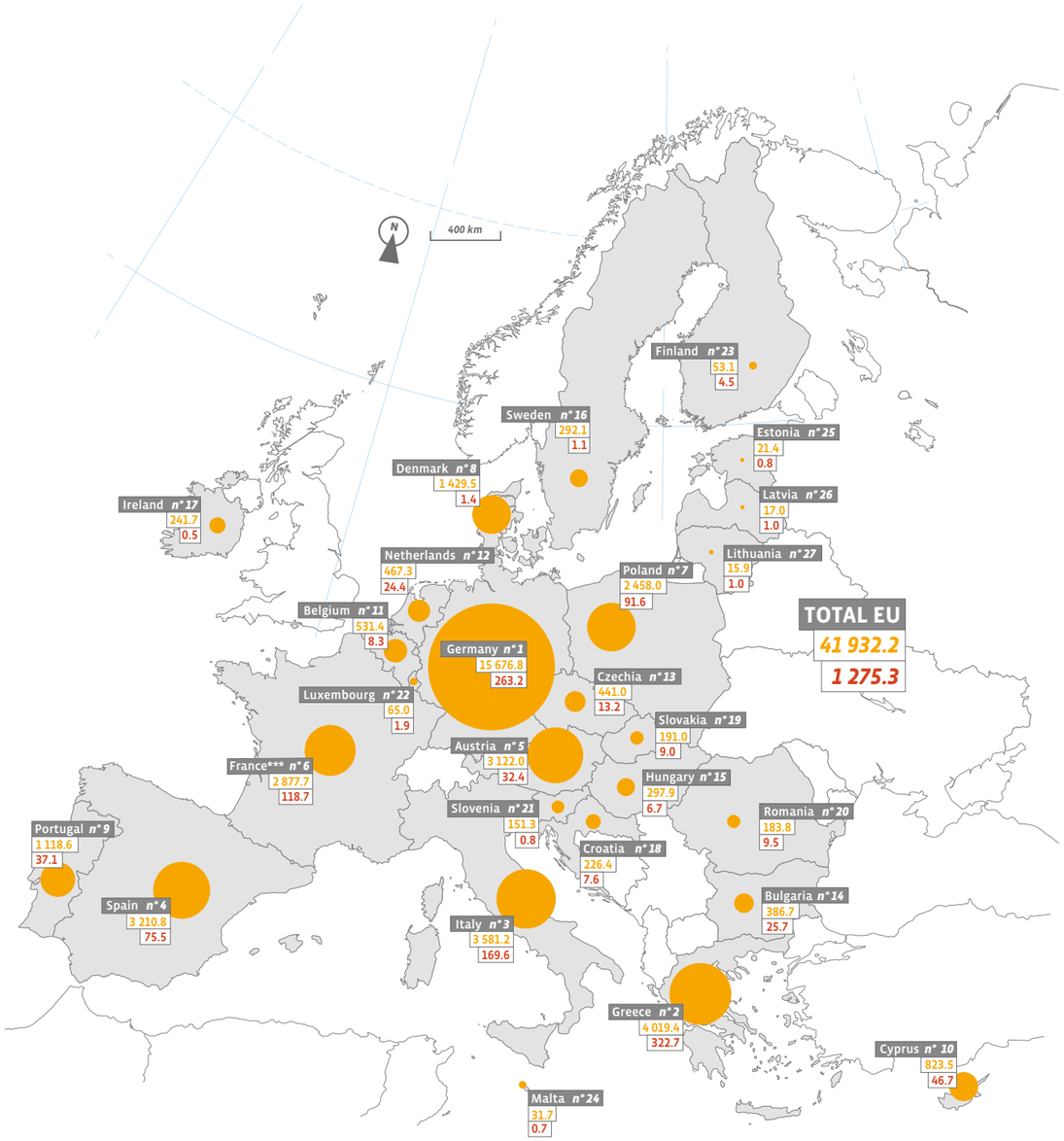
Table No. 4

Solar thermal capacities in operation per capita (m²/inhab. and kWh/inhab.) in 2023***

Country	m²/inhab.	kWth/inhab.
Cyprus	1.278	0.894
Greece	0.551	0.386
Austria	0.490	0.343
Denmark	0.344	0.241
Germany	0.265	0.186
Portugal	0.153	0.107
Luxembourg	0.141	0.098
Slovenia	0.102	0.071
Poland	0.096	0.067
Spain	0.095	0.067
Italy	0.087	0.061
Bulgaria	0.086	0.060
Croatia	0.084	0.059
Malta	0.084	0.059
Ireland	0.065	0.046
Belgium	0.065	0.045
France	0.060	0.042
Czechia	0.058	0.041
Slovakia	0.050	0.035
Hungary	0.044	0.031
Sweden	0.040	0.028
Netherlands	0.037	0.026
Estonia	0.022	0.016
Romania	0.014	0.010
Finland	0.014	0.010
Latvia	0.013	0.009
Lithuania	0.008	0.006
Total EU	**0.133**	**0.093**

** All technologies included unglazed collectors. ** Estimation. *** Overseas departments included.*
Source: EurObserv'ER 2024

Solar thermal capacity* installed in the European Union at the end of 2023 (MWth)**



Key

41932.2 — *Total solar thermal capacity installed at the end of 2023 (MWth).*

1275.3 — *Solar thermal capacity installed during the year 2023 (MWth).*

** All technologies included unglazed collectors. **Estimation. *** Overseas departments included for France*
Source: EurObserv'ER 2024

11%, so reducing on-site consumption by 7%. The solar panels will cover an average of 20-30% of the drying tower's heating needs and up to 60% of its summer needs (gas heating will top-up the remaining temperature requirement). Early in 2024, the Decarbomalt project, coordinated by Newheat, was started up on the Badass Barley Malt production site in Croatia. The solar thermal plant which is coupled to a storage tank and to two heat pumps, will preheat the air used to dry the malt. It has taken up about 4.5 million euros' worth of European Union financing awarded by the **Innovation Fund** for the demonstration of innovative low-carbon technologies. The solar part comprises a 23 400-m2 collector surface spread over 6 hectares, with a 4 000-m3 hot water storage volume and offers annual CO2 emissions reduction of 3 960 tonnes equivalent.

Concentrated solar thermal is also one of the technological options for industrial heat. In 2023, several large installations were commissioned. In September of that year, Avery Dennison, one of the world's leading packaging and materials manufacturers, commissioned Europe's largest solar thermal platform in its Turnhout production plant in Belgium. The renewable energy project comprises a parabolic trough system with 2 240 surface mirrors whose 5 540-m2 collector array will yield a maximum of 2.7 GWh of thermal power and it has six storage modules with a capacity of 5 MWh of thermal power. The project will contribute to delivering heat to run the drying ovens used during the coating process of adhesive products. Spain's excellent solar industrial heat market performance in 2023 can be ascribed to a widescale incentive programme funded to the tune of 108 million euros by the ERDF. The programme enabled major projects to start operations such as the parabolic trough CSP plant that delivers to the Heineken brewery in Seville. The 8-hectare plant has 43 414 m2 of collector surface, 30 MW of capacity and 68 MWh of storage capacity. As a result of the investment, fossil gas consumption will be slashed by over 60%. More recently, in March 2024, Heineken and CSIN (Solatom Indertec Company) opened the world's largest Fresnel type solar thermal power plant for industrial use (6 000 m2 of flat mirrors) at Quart de Poblet (4.2 MWth), near Valencia. This solar thermal plant, built in a record eight months, should slash CO2 emissions by about 1 300 tonnes p.a. By the end of 2024, the Heineken brewery at Valencia should be running 42% on renewable energy (both electricity and thermal). The Spanish programme has also contributed to the funding and 2023 commissioning of two large solar industrial heat installations that use air collector technology to supply heat to two plants (Solarwall Seville and Solarwall Madrid) of the L.Pernia group, an animal feed specialist. Each plant has 10 000 m2 of collectors amounting to 7 MWth of capacity.

VIESSMANN

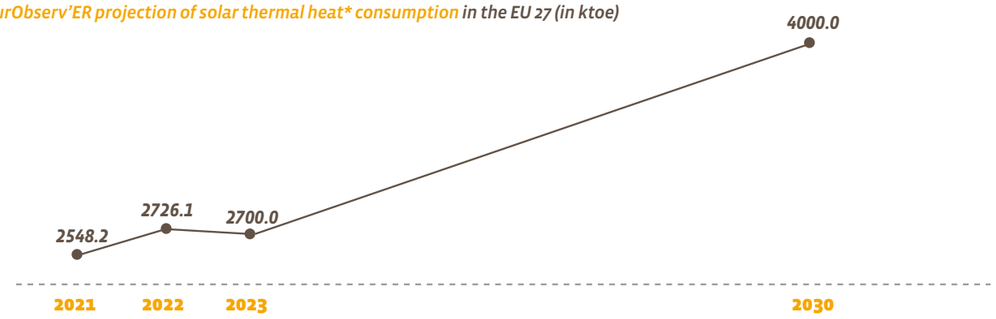
The Spanish solar thermal market is one of a kind in the European Union as it is shared by all solar thermal technologies: conventional flat glazed collectors along with prefabricated thermosyphon systems, vacuum tube collectors, unglazed collectors, as well as hybrid PV-T collectors and solar air collectors.

The solar thermal surface in service will contract in time

According to EurObserv'ER, by the end of 2023, the total surface of the European Union's solar thermal base should stand at less than 60 million m2, namely a 1.3% YoY increase (table 3).

Graph. No. 1

EurObserv'ER projection of solar thermal heat consumption in the EU 27 (in ktoe)*



Final energy consumption and gross heat production in the transformation sector.* ***Source: EurObserv'ER 2024*

The combined European surface should have increased by just under 716 000 m2. This estimate covers the three main solar thermal technologies (flat-glazed collectors, vacuum tube collectors and unglazed collectors) and incorporates the installation decommissioning hypotheses defined by each Member State. Austria for example, decommissions all its solar thermal installations after 25 years in service. In the event of data unavailability, EurObserv'ER adds the market data to those of the base in service at the end of 2022 published by Eurostat and decommissions glazed collectors whose service life is over 20 years. Even if solar thermal panels' service life can be longer, EurObserv'ER considers that the systems' service lives may be compromised by servicing flaws and changes of user.

We should note that total collector surfaces in service in several countries have increased a little and that some of them, such as Austria, have even initiated the reduction of their base. The reason for this trend may be the volumes decommissioned in the early 2000s that are approaching existing installed volumes (the 2003 EU market stood at about 1.7 million m2). Another example taken from AGEE-Stat data, is that Germany's 2023 market level was too small to guarantee the growth of the in-service base, which shrank for the first time by 0.1%. Decommissioning will increase in the coming years, given that installation levels were particularly high during the second half of the 2000s through to the start of the 2010s (culminating in 4.5 million m2 in 2008). Failing significant market recovery in a few years' time, this trend will raise the issue of whether solar heat's contribution level can be sustained to meet the European Union's targets.

Table No. 5

Representative European manufacturers of solar thermal systems and collectors

Company	Country	Business units
GreenOneTec	Austria	- Flat plate collectors OEM - Large area collectors up to 13.6m² - Thermosiphon solar system - Large scale solar thermal project
Dimas	Greece	- Flat plate collectors OEM - Thermosiphon tanks OEM - Absorbers OEM - Thermosiphon solar system
Bosch Thermotechnik	Germany	- Forced circulation solar system (Flat plate collector)
Papaemmanouel	Greece	- Thermosiphon solar system and forced circulation system
ThermoSolar	Germany	- Forced circulation solar system (flat plate collector)
Viessmann	Germany	- Forced circulation solar system (flat plate and vacuum tube collectors) - Large area vacuum tube collectors up to 10.3 m²
Delpaso Solar	Spain	- Forced circulation solar system (Flat plate collector)
BDR Thermea	Spain	- Forced circulation and thermosiphon solar system (Flat plate collector)
Rioglass	Spain	- Design and manufacturing of key optical components for CSP - Green enery solution (heat supply for industrial process, rooftop PV, supply of green amonia and hydrogen)
Ritter XL Solar	Germany	- Large area flat plate collectors - Turnkey solar thermal plant (SDH, Industry)

Source: EurObserv'ER 2024

Decarbonizing heating – the main challenge

Now, the solar thermal market's renewed downturn in 2023 is a disappointment for the combat against climate change. On Solar Heat Europe's own admission, in an April 2024 press release "The current growth rate of our sector falls short of the EU Solar Strategy's ambitions, which suggest our sector should at least triple by 2030—from 40.5 GWth to 140 GWth. Clearly, we need to scale up!"

Scaling up is what the European Union's decision-makers and institutions are trying to achieve through European regulations. That is the task of the revised Energy Performance of Buildings Directive (revamp) that was at last adopted in April 2024 by the European Parliament and published in the Official Journal of the European Union on 5 May 2024. The new Directive 2024/1275 sets the emission reduction targets for buildings, both for the European Union and its individual nations. Article 10 is exclusively devoted to solar energy (be it for electrical or heating purposes). It stipulates that the Member States shall ensure that all new buildings are designed to optimise their solar energy generation potential on the basis of the solar irradiance of the site, enabling the subsequent cost-effective installation of solar technologies. It also demands

Tabl. No. 6

Concentrated solar power plant in operation in the European Union at the end of 2023*

Project	Technology	Capacity (MWe)	Commisionning date
SPAIN			
Planta Solar 10	Central receiver	10	2007
Andasol-1	Parabolic trough	50	2008
Planta Solar 20	Central receiver	20	2009
Ibersol Ciudad Real (Puertollano)	Parabolic trough	50	2009
Puerto Errado 1 (prototype)	Linear Fresnel	1,4	2009
Alvarado I La Risca	Parabolic trough	50	2009
Andasol-2	Parabolic trough	50	2009
Extresol-1	Parabolic trough	50	2009
Extresol-2	Parabolic trough	50	2010
Solnova 1	Parabolic trough	50	2010
Solnova 3	Parabolic trough	50	2010
Solnova 4	Parabolic trough	50	2010
La Florida	Parabolic trough	50	2010
Majadas	Parabolic trough	50	2010
La Dehesa	Parabolic trough	50	2010
Palma del Río II	Parabolic trough	50	2010
Manchasol 1	Parabolic trough	50	2010
Manchasol 2	Parabolic trough	50	2011
Gemasolar	Central receiver	20	2011
Palma del Río I	Parabolic trough	50	2011
Lebrija 1	Parabolic trough	50	2011
Andasol-3	Parabolic trough	50	2011
Helioenergy 1	Parabolic trough	50	2011
Astexol II	Parabolic trough	50	2011
Arcosol-50	Parabolic trough	50	2011
Termesol-50	Parabolic trough	50	2011
Aste 1A	Parabolic trough	50	2012
Aste 1B	Parabolic trough	50	2012
Helioenergy 2	Parabolic trough	50	2012
Puerto Errado II	Linear Fresnel	30	2012
Solacor 1	Parabolic trough	50	2012
Solacor 2	Parabolic trough	50	2012
Helios 1	Parabolic trough	50	2012
Moron	Parabolic trough	50	2012
Solaben 3	Parabolic trough	50	2012
Guzman	Parabolic trough	50	2012
La Africana	Parabolic trough	50	2012
Olivenza 1	Parabolic trough	50	2012
Helios 2	Parabolic trough	50	2012
Orellana	Parabolic trough	50	2012
Extresol-3	Parabolic trough	50	2012
Solaben 2	Parabolic trough	50	2012
Termosolar Borges	Parabolic trough + HB	22,5	2012
Termosol 1	Parabolic trough	50	2013
Termosol 2	Parabolic trough	50	2013
Solaben 1	Parabolic trough	50	2013
Casablanca	Parabolic trough	50	2013
Enerstar	Parabolic trough	50	2013
Solaben 6	Parabolic trough	50	2013
Arenales	Parabolic trough	50	2013
Total Spain		2 303.9	
FRANCE			
La Seyne sur mer (prototype)	Linear Fresnel	0.5	2010
Augustin Fresnel 1 (prototype)	Linear Fresnel	0.25	2011
SUN CNIM (Ello project)	Linear Fresnel	9	2019
Total France		9.75	
ITALY			
Archimede (prototype)	Parabolic trough	5	2010
Archimede-Chiyoda Molten Salt Test Loop	Parabolic trough	0.35	2013
Freesun	Linear Fresnel	1	2013
Zasoli	Linear Fresnel + HB	0.2	2014
Rende	Linear Fresnel + HB	1	2014
Ottana	Linear Fresnel	0.6	2017
Solinpare CSP- Partanna	Linear Fresnel	4.26	2022
Total Italy		12.41	
DENMARK			
Aalborg-Brønderslev CSP project	Hybrid. Parabolic Trough	5.5	2016
Total Denmark		5.5	
GERMANY			
Jülich	Central receiver	1.5	2010
Total Germany		1.5	
Total European Union		2333.1	

*HB (Hybrid Biomass). *Pilots and prototypes included.* ***Source: EurObserv'ER 2024***

AVERY DENNISON PERFORMANCE TAPES EU

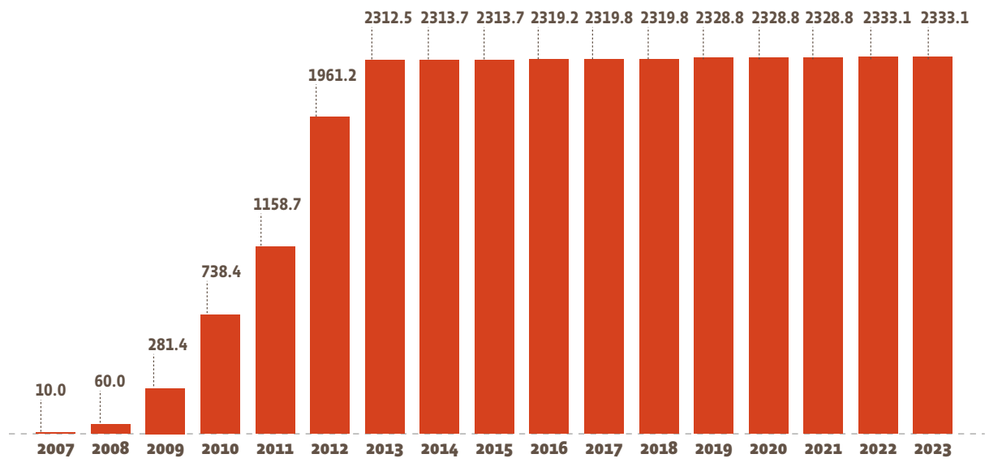
Avery Dennison, a packaging and materials manufacturer, commissioned Europe's largest solar thermal platform in its Turnhout production plant in Belgium in September 2023. The project comprises a parabolic trough system with 2 240 surface mirrors whose 5 540-m2 collector array

Only one single CSP power plant is under construction in the European Union. The project kicked off on 29 September 2021, when an EPC (Engineering Procurement and Construction) contract was signed for design, engineering and construction by the Fata Group of its third CSP power plant to be sited in the municipality of Mezzojuso, in Palermo province. The installation will use a blend of molten salts both as the heat carrier fluid and for thermal energy storage, equivalent to 16 hours of continuous operation at full load. The 4-MW capacity Fresnel type plant, will take up a total area of about 145 000 m2 with a mirrored surface of about 84 000 m2. Once commissioned, Italy's CSP electrical capacity will rise to 16.4 MW and that of the European Union to 2 337.1 MW.

the EU countries to gradually deploy solar energy installations in public and non-residential buildings, depending on their size, and in all residential buildings by 2030, where technically suitable and economically and functionally feasible. Specifically, Member States shall ensure that suitable solar energy installations are deployed no later than 31 December 2026, on all new public and non-residential buildings with useful floor area larger than 250 m2, on all existing public buildings with useful floor area larger than 2 000 m2 no later than 31 December 2027, 750 m2 no later than 31 December 2028, 250 m2 no later than 31 December 2030; no later than 31 December 2027, on existing non-residential buildings with useful floor area larger than 500 m2, where the building undergoes a major renovation or an action that requires an administrative permit for building renovations, works on the roof or the installation of a technical building system, no later than 31 December 2029, on all new roofed car parks physically adjacent to buildings.

Graph. No. 2

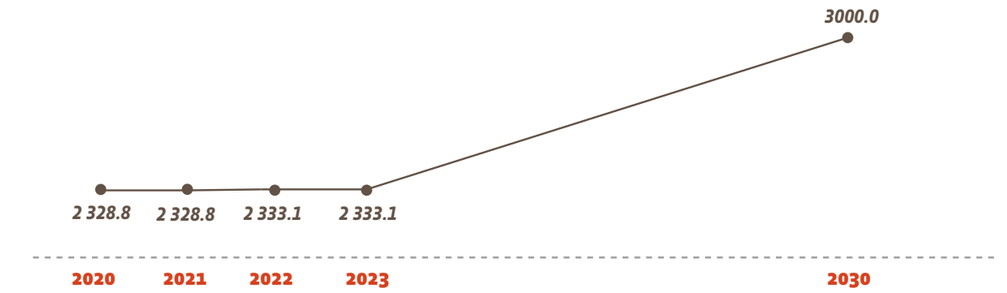
European Union concentrated solar power capacity trend (MW)



Source: EurObserv'ER 2024

Graph. No. 3

EurObserv'ER projection of the evolution of CSP capacity installed in the EU 27 (in GW)



Source: EurObserv'ER 2024

The Member States' national building renovation plans covered in article 3, shall include policies and measures on the deployment of appropriate solar energy installations on all buildings.
System hybridization will be a future key to the success of the renewable heating market – an element that was clearly stated by the European Commission in the RePowerEU plan, "Solar (thermal) panels associated with photovoltaic, combined with heat pumps can replace natural gas burners in houses and firms. Solar energy in the form of electricity, heat, or hydrogen can replace natural gas consumption in industrial processes." An essential point mentioned by Oleguer Fuertes, President of ASIT, in his introductory message in the annual report on the state of the Spanish solar thermal market, "2024 INFORME ANUAL ASOCIACIÓN" of the solar thermal industry was: "The key lies in hybridization, because it is only through the combination of the various technologies that we can move towards buildings with nearly-zero energy consumption. The current regulatory framework (in Spain) only paves the way for a minimal renewable contribution through heat pumps, whereas with hybrid systems, we could be three times more demanding. Today, there is no better hot water production technology than that of solar thermal, be it in terms of energy efficiency or CO_2 emissions." □

Sources: AGEE-Stat, BDEH, BSW (Germany), EBHE (Greece), Ministry for the Ecological Transition, ASIT (Spain), ENS (Denmark), Assotermica-Anima (Italy), DGEG (Portugal), Observ'ER (France), SPIUG (Poland), AEE Intec (Austria), Statistics Austria, ATTB(Belgium), Statistics Netherlands, EBHEK (Chypre), Ministry of Industry and Trade (Czechia), SEAI (Ireland), STATEC (Luxembourg), IEA SHC, Solar Heat Europe, EurObserv'ER, csp-guru, SolarPACES.

The next barometer will be about heat pumps.

Funded by the European Commission

This barometer was prepared by Observ'ER in the scope of the EurObserv'ER project, which groups together Observ'ER (FR), TNO (NL),Renewables Academy (RENAC) AG (DE), Fraunhofer ISI (DE), VITO (Flemish Institute for Technological Research) (BE) and Statistics Netherlands (NL). This document has been prepared for the European Commission however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.