The Ludwigsbourg (14 800-m²) solar thermal plant, north of Stuttgart. A water reservoir stores the heat obtained by the photothermal collectors and later releases it as hot water for use as domestic hot water or heating.

- 15.3%

The decrease of the solar thermal market in the European Union in 2020

SOLAR THERMAL AND CONCENTRATED SOLAR POWER BAROMETERS

A study carried out by EurObserv'ER

On balance, the European solar thermal sector put in a poor performance in 2020, as it compared badly with 2018 and 2019, when the sector seemed to be getting back on its feet. EurObserv'ER reports that the installed surface in the countries of the European Union to 27 is down by 15.3% compared to 2019, just under 2 million m². The Covid pandemic is not the only reason for the sector's troubles but should bear part of the blame for the slowdown observed in several national markets during the first half year. Other solar thermal markets, such as Germany's, finally returned to growth, driven by the country's restated political insistence on decarbonising its heating and domestic hot water production needs.

Concentrated Solar Power (CSP) plants cover all the technologies devised to transform solar radiation energy into very high temperature heat for onward conversion into electricity. CSP development is being pursued in countries that offer suitably propitious sunlight conditions, such as China, Chile, India, South Africa, the Middle East, and the Maghreb. The only a sizeable production sector in Europe is that of Spain, and after champing at the bit for many years, the Spanish sector expects an initial tender for at least 200 MW to be launched in 2021.

53.9 millions m²

The cumulated surfaces of solar thermal in operation in the European Union in 2020

2 328.8 MWe

Total CSP capacity in operation in the European Union in 2020

SOLAR THERMAL

The estimate for worldwide installed solar thermal capacity at the end of 2020 is 501 GWth, including 25.2 GWth of newly-installed capacity last year alone (table 1). Predictably, China accounts for most – 72% – of the global installed base (364 GWth) and new installations (18 MWth), and with its dominant industry and export performance, appears to have realized how solar thermal can assist the decarbonization of its industry and residential sector. India and Turkey, both of which had >1 GWth markets in 2020, come next, closely followed by Brazil. As reported by the Turkish Energy Transition Centre (SHURA), Turkey is primarily carried by its residential market. Although India has the second largest collector base after China, it is on a much smaller scale, while the installation trend in the United States is spiralling downwards. Only a few years ago, it boasted one of the world's biggest collector bases, but now installs even less than half the collector capacity of India or Turkey. Its industry could bounce back shortly if President Biden's declarations are followed by deeds. Incidentally, this is one of the sector's strong features, as policies are what drive solar thermal market development.

Across the European Union, the solar thermal market in 2020 can be viewed as a chiaroscuro painting… it is mainly dark, through the impact of the Covid pandemic, while the residential market segment is still dragging its feet in many countries. This side contrasts with the German market's strong upturn in 2020 spurred by tenacious political commitment. Likewise, the commissioning and announcements of very large-scale industrial solar heat projects and the setting up of new solar heating network markets shed a little light on the picture. If we return to the dark side, many national markets declared poor installation results, that are consistent with their previous years' performance. Cases in point are Austria, Italy, Spain and Belgium. Some of the bad results were predictable, such as the solar heating network market meltdown in Denmark and the sharp contraction of the Polish market once tendering took over from the defunct incentive system.

Some markets' decreases in business volumes can be directly ascribed to the Covid pandemic, which disrupted the industrial production and installation sectors for many weeks during the first six months. This holds particularly true for the Greek market, which fortunately should bounce back in 2021, and the same goes for the Spanish market which slipped slightly in 2020. The French market, whose collective residential segment struggled and whose major installations segment was sluggish in 2020, has broadly held up thanks to bullishness in the French Overseas Departments and Regions.

The commissioning of very large installations (sometimes exceeding 10 000 m²) in several medium-sized markets, may explain or accentuate annual variations. Projects of this type, which are few and far between, may blur the interpretation of market dynamics, in particular the dynamics of the domestic hot water production segment in the residential sector. This applies to France in 2020 and also the Netherlands where a very large project (the Nibbixwoud greenhouse with 15 000 m² of collectors) was administratively accounted for by Statistics Netherlands in 2019, thus accentuating the market downswing in 2020. Likewise, the commissioning of the Malteries Franco-Suisse project at Issoudun, France (13 243 m²) will slew the country's recorded installation level in 2021.

Tabl. n° 1

Main solar thermal markets outside the European Union (MWth)

Country	Total cumulative capacity in operation in 2020	Annually installed capacity	
		2019	2020
China	364 000	18 560	18 000
India	20 015	1 055	1 160
Turkey	18 400	1 325	1 350
Brazil	18 220	930	992
USA	18 000	600	505
Rest of the world	62 365	3 630	3 193
Total of the world	501 000	26 100	25 200

Sources: REN21, EurObserv'ER

© MAGALI GIRARDIN SIG

On 25 February 2021, the SIG SolarCAD II solar thermal plant at Le Lignon on the Geneva industrial services site (SIG), a public establishment of the canton of Geneva (Switzerland). The plant, with its 800 m² of collectors, will produce heat to be injected into the industrial heating network. The panels are equipped with vacuum collectors manufactured by the Geneva-based company TVP Solar.

THE EU MARKET FALLS BELOW THE 2 MILLION-M² THRESHOLD

According to EurObserv'ER, just under 2 million m² of solar thermal collectors were installed over the year 2020 in the new European Union of 27 (table 3). This figure equates to 1358.1 MWth of capacity and a 15.3% drop over the 12-month period.

The market data encompasses systems that use glazed flat plate and vacuum tube collectors, technologies geared to domestic hot water production and residential heating in addition to heat and hot water production for heating networks and industry, and unglazed collectors, which tend to be used for pool heating.

DIFFERENT TRENDS BY MARKET SEGMENT

The solar thermal market has many segments, primarily geared to the residential hot water production (domestic and collective) which generates the majority of sales and collector installations, be they forced circulation systems (that use a small electric pump to take the fluid to the hot-water tank which is separated from the collectors) or thermosiphon systems where the collector is placed below the hot-water tank.

Greece and Cyprus have decades-old, mature solar thermal thermosiphon system markets. This type of system, which is very cheap and suited to the Mediterranean climate in these sun-drenched countries, faces less competition from the other renewably-sourced domestic hot water production systems.

Ordinarily, thermosiphon systems markets are quite robust and include a major replacement market for decommissioned system, but there are exceptional years, and 2020 is one of them.

This contrasts with the forced circulation solar water heating system market that has been under pressure for over a decade, be it for individual, multi-family solar hot-water heaters or combined solar systems (that produce hot water

and heat). Despite their excellent energy efficiency performance and zero GHG emissions (apart from the small amount of electricity used by the pump), these systems are much more expensive to purchase than other 100% fossil fuel or 100% electrical solutions, primarily because of their lengthy installation times that involve climbing on the roof. Consequently, these appliances still rely on nationally implemented incentive policies. They also face fierce competition from other environmentally-friendly or low-emission heating systems, such as heat pumps, thermodynamic hot-water heaters and self-consumption photovoltaic systems, whose surplus energy is increasingly used for domestic hot water production. In recent years, sales of combined solar systems, which call for greater collector areas (4–6 times bigger) have become popular in the German-speaking countries… Germany and Austria… where this type of system is the most suitable and most widespread.

THE SDH MARKET SPREADS IN GERMANY

The SDH-solar district heating market is a distinct segment with specific players and collector technologies that use much bigger surface areas (up to about fifteen m² per collector).
This market segment accounted for about 10% of the European Union's installed solar thermal collector area in 2019. The solar district heating market share shrank (by 2–3%) in 2020 because of the downswing in activity in Denmark, the main player in this segment. The Danish consultancy planEnergi published its figures for the country showing that only 4 solar thermal collector fields were connected to a heating network in 2020, namely, Værum-Ørum (8 968 m² equating to 6.3 MWth), while three were extended: Farsø (2 722 m² equating to 1.9 MWth), Snedsted (1 865 m² equating to 1.3 MWth) and Flauenskjold (1 058 m² equating to 0.7 MWth), giving a total of 14 613 m² (equating to 10.1 MWth). This is much lower than the country's 2019 figure, when it connected about fifteen collector fields including 5 extensions for a total area of 191 319 m². It set a record in 2016 when almost 500 000 m² of collectors were installed over the twelve month period (equating to 317 MW).
The 2020 projects raise the total solar thermal collector area connected to Danish heating networks to about 1.6 million m² (1 596 194 m² to be precise, equating to 1 117 MWth, factoring in the decommissioned area). SDH segment activity should remain subdued in Denmark over the next two years, as only one project is planned for 2021, that of Præstø (8 013 m², equating to 5.6 MWth) and only one bigger project, (15 000 m² equating to 10.2 MWth) Faxe, is planned for 2022.

The planEnergi view is that heating network operators' interest in solar thermal is waning as they become more enthusiastic about high-capacity heat pumps. Heat pump sales actually outstripped solar thermal equipment sales in 2020, with as many as 60 major heat pump units commissioned throughout the country (adding up to 250 MW of combined capacity). This Danish market change is a reaction to low electricity prices for businesses and a heat pump technology-friendly support programme. It has come about because the electricity paid for by Danish heating network operators is the cheapest in Europe… about 6 euro cents per kWh. Since the country levies hardly any charges or tax on electricity, the levelized cost of heat produced by big heat pumps can fall to as little as 2 euro cents per kWh, making allowance for performance coefficients. This just cannot be matched by the cost of solar heat in Denmark which is about 3 euro cents per kWh. The policy to encourage the electrification of heating requirements was boosted by the March 2021 incentive mechanism that covers 15% of large heat pump installation costs, so taking solar thermal and biomass systems out of the running. One government aim is to take maximum advantage of the country's wind power output and reduce its electricity exports, thus delivering another hard blow to solar heat's prospects.

Tabl. n° 2

Annual installed surfaces in 2019 per type of collectors (in m²) and capacity equivalent (in MWth)

Country	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent capacity (MWth)
	Flat plate collectors	Vacuum collectors			
Germany	441 000	70 000		511 000	357.7
Greece	361 350			361 350	252.9
Poland	282 160	5 030		287 190	201.0
Spain	193 650	7 600	2 900	204 150	142.9
Denmark	194 310			194 310	136.0
Italy	133 282	13 943		147 225	103.1
France*	124 117			124 117	86.9
Austria	90 040	310	460	90 810	63.6
Cyprus	69 945			69 945	49.0
Portugal	59 850			59 850	41.9
Netherlands	38 964	9 906	2 621	51 491	36.0
Belgium	23 500	4 300		27 800	19.5
Croatia+	26 100			26 100	18.3
Bulgaria+	23 980			23 980	16.8
Czechia	16 000	7 000		23 000	16.1
Latvia+	21 672			21 672	15.2
Hungary+	21 000			21 000	14.7
Romania+	15 350			15 350	10.7
Ireland	7 143			7 143	5.0
Finland+	7 000			7 000	4.9
Slovakia+	5 000			5 000	3.5
Luxembourg	2 900			2 900	2.0
Lithuania+	2 000			2 000	1.4
Sweden	1 084	76	522	1 682	1.2
Slovenia+	1 473			1 473	1.0
Estonia+	1 425			1 425	1.0
Malta	521	130		651	0.5
Total EU	2 164 816	118 295	6 503	2 289 614	1 602.7

*+ EurObserv'ER estimation based on Eurostat database or ESTIF latest market survey. * including 80.202 m² in the overseas departments.* ***Source: EurObserv'ER 2021.***

Tabl. n° 3

Annual installed surfaces in 2020 per type of collectors (in m²) and capacity equivalent (in MWth)*

Country	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent capacity (MWth)
	Flat plate collectors	Vacuum collectors			
Germany	544 000	99 000		643 000	450.1
Greece	304 500			304 500	213.2
Spain	177 168	10 496	2 986	190 650	133.5
Poland	159 370	1 830		161 200	112.8
France	120 812			120 812	84.6
Italy	97 765	11 561		109 326	76.5
Cyprus	76 784			76 784	53.7
Austria	72 210	1 400	1 730	75 340	52.7
Portugal	49 874			49 874	34.9
Netherlands	20 640	9 487	2 621	32 748	22.9
Croatia+	26 100			26 100	18.3
Bulgaria+	24 000			24 000	16.8
Czechia	15 000	7 000		22 000	15.4
Hungary+	21 000			21 000	14.7
Belgium	15 300	2 900		18 200	12.7
Romania+	15 350			15 350	10.7
Denmark	14 613			14 613	10.2
Ireland	11 114			11 114	7.8
Finland+	7 000			7 000	4.9
Slovakia+	5 000			5 000	3.5
Luxembourg+	2 800			2 800	2.0
Lithuania+	2 000			2 000	1.4
Latvia+	1 600			1 600	1.1
Sweden+	1 000		500	1 500	1.1
Slovenia+	1 473			1 473	1.0
Estonia+	1 425			1 425	1.0
Malta	681			681	0.5
Total EU	1 788 579	143 674	7 837	1 940 090	1 358.1

*+ EurObserv'ER estimation based on Eurostat database or ESTIF latest market survey. * Estimation. ** including 91.352 m² in the overseas departments.*
Source: EurObserv'ER 2021.

Access to extremely low-priced electricity is not generally offered to heating network operators around the European Union, which means that there are still major development opportunities for solar heating networks elsewhere in Europe. This market segment is taking hold across Europe thanks to Danish solar heating network know-how and feedback. Germany is now driving the efforts in this segment. According to the *Solar Heat Worldwide 2021 edition* report, 11 new solar heating networks went on stream in 2020, in addition to the four already mentioned. Seven were constructed in Germany (for a total of 31 200 m²), two in Austria (6 571 m²) and one in Switzerland (784 m²). The biggest of these is in the German city of Ludwingsburg, which has a 14 800-m² collector field. Geneva's solar heating network, which went on stream in December 2020, uses bespoke collector technology developed by the manufacturer, TVP Solar. It is capable of heating the water all year round to a temperature of 75–90°C in a closed circuit. The solar thermal plant's panels are flat and insulated by a vacuum, thus enabling maximum solar energy to be collected throughout the year. More energy can be produced in winter using this technology than with conventional panels and at a higher temperature, even when the weather is bad. The manufacturer claims that a third of the heat will thus be produced during the six coldest months of the year.

There is still significant growth potential for solar heating networks, but they are a long way from reaching similar market levels to those enjoyed by Denmark. The German research institute Solites claims that the German solar heating network area, in the broad sense including collector fields used by industry, is expected to triple by 2025, from 100 000 m² at the beginning of 2021 (41 systems identified) to more than 300 000 m². The biggest network due to be constructed in the city of Greifswald, in Northeast Germany was made public in December 2020. It will have 13 MWth of installed capacity and is due to come on stream in 2022. In Austria, construction work began on the biggest solar heating network this summer. It will be connected to the Friesach urban heating network. The plant's installed capacity will be 4 MWth, comprising a 5 750-m² collector field (436 GREENoneTEC GK 3003 panels each 13.2 m²). The network is designed to supply 15% of the heating needs of the 500 apartments connected to it. The investment cost for the solar part is 2 million euros, resulting in a per m² cost of 348 euros. The solar yield will be 425 kWh per m².

Tabl. n° 4

Cumulated capacity of thermal solar collectors installed in the European Union in 2019 and 2020** (in m² and in MWth)*

Country	2019		2020	
	m²	MWth	m²	MWth
Germany	19 325 790	13 528.1	19 454 590	13 618.2
Greece	4 867 500	3 407.3	4 991 000	3 493.7
Austria	5 044 954	3 531.5	4 916 776	3 441.7
Spain	4 405 165	3 083.6	4 595 815	3 217.1
Italy	4 343 765	3 040.6	4 453 091	3 117.2
France***	3 304 000	2 312.8	3 386 800	2 370.8
Poland	2 696 000	1 887.2	2 857 200	2 000.0
Denmark	1 789 313	1 252.5	1 799 171	1 259.4
Portugal	1 347 955	943.6	1 397 829	978.5
Cyprus	1 084 111	758.9	1 107 209	775.0
Belgium	765 800	536.1	780 770	546.5
Netherlands	672 497	470.7	669 682	468.8
Czechia****	554 504	388.2	576 504	403.6
Bulgaria	425 478	297.8	449 478	314.6
Sweden	459 000	321.3	441 383	309.0
Hungary	350 000	245.0	371 000	259.7
Ireland	332 530	232.8	343 644	240.6
Croatia	272 200	190.5	298 300	208.8
Slovenia	224 318	157.0	225 791	158.1
Romania	204 350	143.0	219 700	153.8
Slovakia	211 000	147.7	216 000	151.2
Finland	73 000	51.1	79 000	55.3
Malta	73 485	51.4	74 166	51.9
Luxembourg	69 231	48.5	72 031	50.4
Latvia	47 792	33.5	49 392	34.6
Lithuania	24 150	16.9	26 150	18.3
Estonia	19 045	13.3	20 470	14.0
Total EU	52 986 933	37 090.9	53 872 942	37 711.1

** All technologies including unglazed collectors. ** Estimate. ***Overseas departments included. ****Czechia has consolidated its statistical series concerning the total surface area of solar thermal collectors in operation.* ***Source: EurObserv'ER 2021.***

The biggest project commissioned in April 2020 was the Nibbixwoud plant in the Netherlands. The facility comprises a 15 000-m2 collector field (10.5 MWth) that heats 4 hectares of floral hot houses.

THE CHALLENGES FACING INDUSTRIAL SOLAR HEAT

Another niche market segment has emerged from the sidelines, that of solar thermal systems for industrial processes. It harbours increasingly ambitious projects in areas as diverse as the food-processing industry, paper-making to heating greenhouses. The economic constraints on this market are arguably much tighter than others, while solar heat enjoys relatively long return times to become competitive. Decisions in the industrial sector are driven by highly competitive, short-term demands. Thus, as long as the price of gas remains so inexpensive, and the price of carbon does not act as a deterrent, substantial investment aids are vital.

The decarbonization of industry is a public policy priority and is crucial if carbon neutrality is to be achieved. Increasing numbers of countries have set up dedicated industrial solar heat support mechanisms. Examples are Germany (the BAFA aids), Austria (the Climate and Energy Fund (KLIEN)), France (the ADEME Heat Fund), Italy (the Ministry of Economic Development's Conto Termico), the Netherlands (the RVO's SDE++ programme) and more recently Spain. The latter has taken up European Union ERDF funds and awards investment aid to the Autonomous Regions in renewably-sourced thermal energy production installations through the IDAE (Institute for the Diversification and Saving of Energy).

The horticultural sector, with its huge greenhouses where flowers, fruit and vegetables grow, is one of the most promising sectors, as they require very big collector areas for heating and cooling. The Nibbixwoud plant in the Netherlands commissioned in April 2020 by brothers Jeroen and Marco Mol for their floral hot houses, is the biggest project to date. It comprises a 15 000-m² solar collector field (equating to 10.5 MWth) that heats 4 hectares in all. The project absorbed 4–5 million euros of investment and benefitted from the SDE ++ programme, which in the first year took the form of 78 euros/MWh tariff for a maximum eligible yield of 7 350 MWh per annum. The installation's maximum annual yield is estimated at 8 100 MWh, instead of burning 875 000 m³ of natural gas every year. We should point out that this project was administratively accounted for by Statistics Netherlands in 2019, hence the contraction of the Dutch solar thermal market in 2020 was accentuated. The Nibbixwoud plant was designed and installed by the Dutch company G2 Energy, which also installed and commissioned the Tesselaar freesia grower's hot house which is heated by a 9 300-m² collector field.

More recently, Kyotherm, an investment company specializing in third-party financing of renewable heat production projects, commissioned the Issoudun industrial solar plant, the biggest solar heating system in France. The plant is equipped with 893 Savosolar (Savo 15 SG-M) collectors, making for a 13 243-m² (10.6 MWth) collector field, that will supply heat to a malt house operated by Malteries Franco-suisses.

A 53.9 MILLION-M² SOLAR THERMAL BASE BY THE END OF 2020

According to EurObserv'ER, the total European Union solar

thermal base amounted to 53.9 million m² (37 711 MWth), an increase of 1.7% over 2019 (table 4). In 2020, the aggregate area increased by 0.9 million m², allowing for the decommissioning of 1.1 million m².

This estimate covers the three main solar thermal technologies (glazed flat collectors, vacuum tube collectors and unglazed collectors) and factors in the decommissioning hypotheses of the oldest installations used by the experts we contacted during the survey and Eurostat's N-1 data. Where official data was unavailable, EurObserv'ER based its calculations on market data that it has gathered applying a twenty-year decommissioning assumption for collectors. In some countries, the total collector areas increased slightly, while in others such as Austria, the collector base has started to contract because the volumes installed back in the early 2000s have been decommissioned, outstripping the newly-installed volumes. In the next few years there will be an increase in decommissioning because installation levels were particularly high from the second half of the 2000s to the early 2010s (peaking at about 5 million m² in 2008). Unless the market picks up significantly, this trend will gradually raise the issue of whether solar heat's contribution towards the European Union's targets can be maintained.

NEWS FROM THE MAIN EUROPEAN MARKETS

THE GREEK MARKET EXPECTS A STRONG REBOUND

The Greek solar thermal market, which is usually very robust, collapsed in 2020. According to the EBHE (the Greek solar thermal industry association), it stood at 304 500 m² in 2020, down from 361 250 m² in 2019. If we make allowance for system decommissioning, most of which were replaced, the total installed collector area in Greece increased by only 123 500 m² to just below the 5 million m² installed threshold.

Costas Travasaros, representing the EBHE, and who chairs Solar Heat Europe, believes this drop can be exclusively ascribed to the Covid pandemic. He points out that the year 2020 had started very well, slightly better than the start of 2019. The industrial sector lost about half of its sales in April and May, when shops were forced to close, and production slowed down as a result of the first lockdown. Sales in March and June were also affected. The rest of the year was relatively positive, especially in the tourism sector that uses a lot of solar energy. Costas Travasaros expects a much better year in 2021 with sales levels in the first six months on a par with those of the first half of 2019, which set an installation record.

Incidentally, the Cyprus market, that installs similar technologies to Greece, was relatively unscathed by the pandemic. The Cyprus Union of Solar Thermal Industrialists (EBHEK) claims that the market actually increased by 10% in 2020 over 2019, i.e., by 76 784 m². Replacements accounted for 53 686 m² of that figure, therefore 23 098 m² of the collectors were installed in new buildings (estimated on the basis of new construction permits).

THE PVT MARKET IS TAKING SHAPE

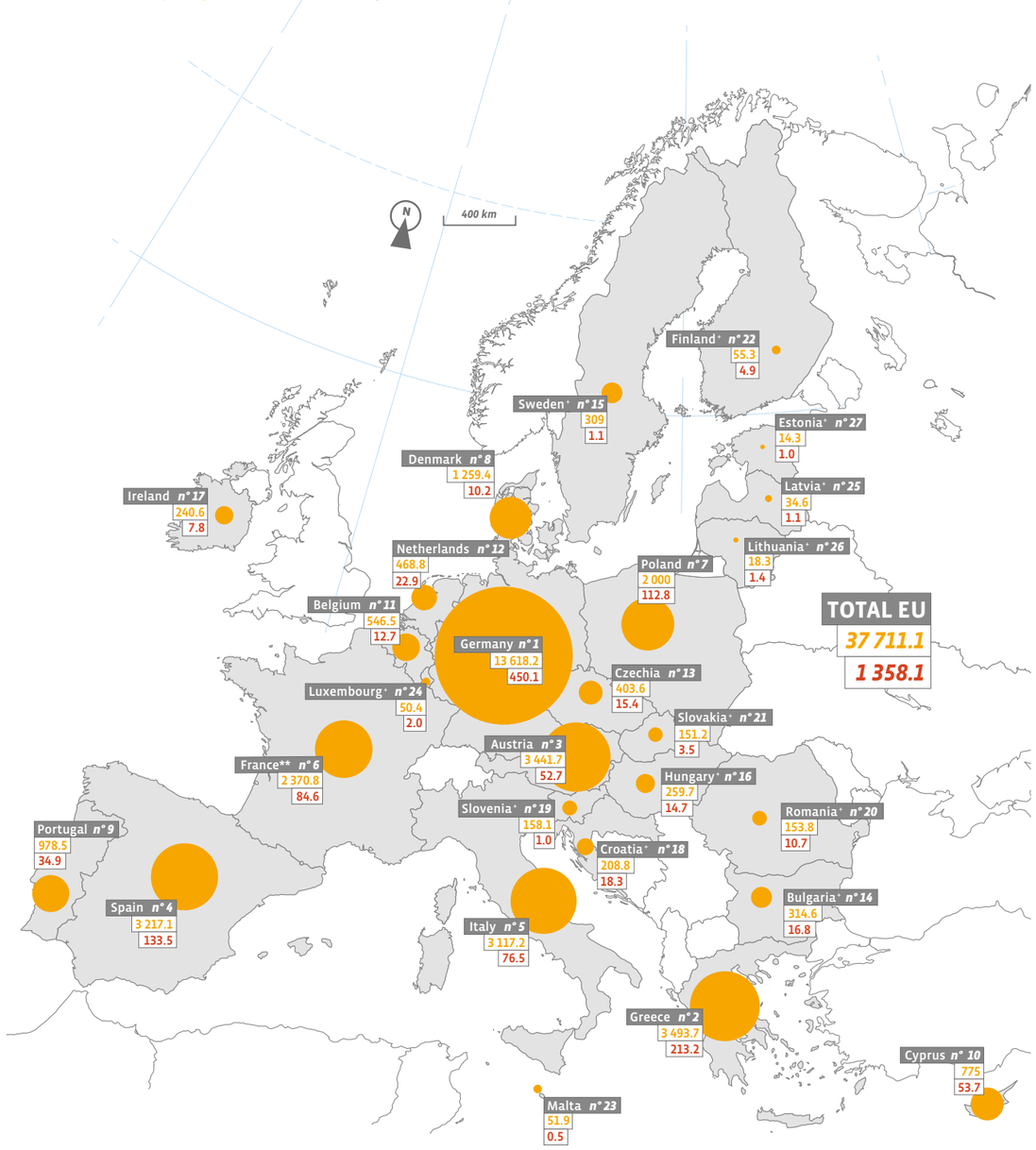
For the second time, this barometer reports on the development of hybrid water-based photovoltaic thermal collector technology (water-based PVT). These collectors can simultaneously produce electricity and heat (for domestic hot water and heating). Water-based PVT collectors use the heat released by the photovoltaic cells to heat a water-based heat transfer fluid. This not only improves PV cell yield but also recovers the solar heat that can be used for domestic hot water production or heating. These collectors can be either unglazed or glazed. The latter type has an additional glass plate superimposed over the photovoltaic module. Another PVT hybrid collector technology uses air as its heat transfer medium. This process, (also called the aerovoltaic system), is used to contribute to space heating.

Because estimates from the various sources are somewhat contradictory, we are at pains to offer an accurate picture of the European hybrid solar PVT market. Few official bodies, such as the statistics agencies and national statistical offices, contacted during the EurObserv'ER survey, keep records on this market segment, or publish no data because of statistical confidentiality rules (implemented when volumes are too low). The industry players positioned on this market segment are reluctant to publicly reveal their business data in order to ringfence their market share and stem the entry of new competitors into the market.

The Solar Heat Worldwide 2021 edition *annual report, published in May 2021, produced in partnership by the International Energy Agency's Solar Heating and Cooling programme and the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), gives indications on the global and European market. The report's collector base data takes up a study made by Task 60 of the IEA's SHC programme edited by the Austrian research institute, AEE Intec.*

If we focus on the water-based PVT market segment and combine the unglazed and glazed PVT collectors, the available EU data indicates that the collector base in service at the end of 2020 was 240 008 m² (table 6) compared to 187 057 m² in 2019, which is an increase of 54 951 m². The equivalent thermal capacity of the EU water-based PVT collector base was 136.8 MWth in 2020 coupled with an electrical capacity of 45.5 MWp (MW-peak). The most active countries are Germany with a total area in service of 118 944 m² (67.5 MWth, 22.5 MWp), followed by the Netherlands (55 647 m², i.e., 31.6 MWth and 10.6 MWp) and France (29 092 m², 16.5 MWth and 5.5 MWp). In June 2021, Observ'ER published a survey of manufacturers involved in the French market, whose results echoed those of AEE Intec, namely a collector base in service of 30 790 m², for 5.4 MWp of electrical capacity. The SHC report also presents data for the other types of PVT collector bases that use air as the heat transfer medium.

Solar thermal capacity installed in the European Union at the end of 2020* (MWth)



Key

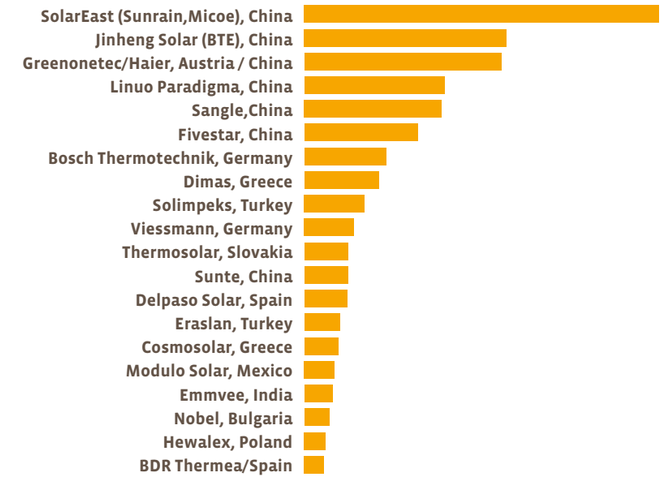
37 711.1 *Total solar thermal capacity installed at the end of 2020 (MWth).*

1 358.1 *Solar thermal capacity installed during the year 2020 (MWth).*

** Estimation.*
*** Overseas departments included for France.*
+ EurObserv'ER estimation based on Eurostat database or ESTIF latest market survey
Source: EurObserv'ER 2021.

Graph. n° 1

Ranking of the largest flat plate collector manufacturers worldwide (Collector area produced in 2020 in m²)



Source: Manufacturers' information market survey by solrico in February/March 2021, www.solrico.com

GERMANY TAKES BACK CONTROL OF ITS MARKET

The German solar thermal market, the biggest in the European Union, has been in steady decline since 2012 (9 years). In 2020 it made a vigorous comeback (increasing by 25.9% year-on-year).

According to AGEE stat, the Working Group on Renewable Energy Statistics of the Federal Ministry for Economic Affairs and Energy (BMWi), 643 000 m² of collectors were installed in 2020 (including 99 000 m² of vacuum tube collectors) compared to 511 000 m² in 2019. Thus, the German market returned to a higher level of activity than in 2017. The Covid pandemic, which was slow to affect the country, disrupted the sector less than that of Greece. However, the main reason for the German market's sharp upturn can be put down to the implementation of a new simplified and particularly motivating set of subsidies, the Federal Funding for Efficient Buildings Scheme (Bundesförderung für effiziente Gebäude – BEG). It applies to all heating appliances that run on renewable energies (biomass boilers, heat pumps, solar thermal and hybrid heating) and replaces all existing schemes, including the building renovation scheme, the Heating Systems Optimisation programme (HZO), the Energy Efficiency Incentive Programme (APEE) and the Market Rebate Programme for Renewable Energies (MAP) for the heating market. The programme's beneficiaries are myriad and extend to owners, property owners' associations, tenants, businesses, regional and local authorities, not-for-profit associations, including churches, legal entities and public-law and municipal companies.

This new subsidy scheme allows for the federal state to refund 30% of the eligible costs of adding a solar thermal system to an existing heating system, for example. When an old fuel-oil boiler is replaced by a powerful gas boiler combined with a solar thermal system, 40% of the eligible system installation cost is subsidized. A maximum subsidy of 45% is possible if an old fuel-oil boiler is combined with a heating system comprising a solar thermal system coupled to a biomass boiler or heat pump. The government has sent a strong signal to improve energy efficiency in all types of buildings through this new scheme. Furthermore, since 1 January 2021 it has levied a carbon tax on all CO_2 emissions in Germany generated by the use of fuels in sectors not covered by the European emission trading scheme. The tax is set at € 25 per tonne of CO_2 and will gradually rise to € 55 per tonne in 2025. In 2026, certificates will be auctioned ranging from € 55 to € 65 per tonne of CO_2. The carbon tax is not levied from ordinary consumers but paid by the natural gas suppliers, fuel-oil and fuel importers, fuel and domestic fuel-oil wholesalers and the refineries when the fuels are placed on the market. Coal will be included from 2023 onwards. Crucially, the German government has stated from the outset that the "carbon tax" revenues will be reinvested in climate protection measures or be returned to its citizens by way of compensation. The carbon tax remains a contentious issue with ordinary people, as borne out by the "Yellow Vests" movement in France. The French State has never been able to convince the people that the rise in carbon taxation was introduced for any other reason than for raising money to boost its coffers.

NEW GROWTH DRIVERS EXPECTED IN AUSTRIA

Austria, whose solar thermal equipment rate is the second highest of any European Union (0.552 m² per capita) market (table 5), illustrates the issues being faced by the solar thermal sector. In the second half of the 2000s, it spearheaded the European market (with annual installation records in excess of 360 000 m² in 2008 and 2009) through to the start of the 2010s. In 2020, it installed only 75 340 m² (72 210 m² of plate collectors, 1 400 m² of vacuum tube collectors and 1 730 m² of unglazed collectors) compared to its 2019 installation volume of 90 810 m² (90 040 m² of plate collectors, 310 m² of vacuum tube collectors and 460 m² of unglazed collectors) according to the AEE Intec research institute. This installation level is too low to maintain the total collector area in service, following a change in direction in 2016. AEE Intec claims that 128 178 m² of collectors were decommissioned during 2020 (83 769 m² of plate collectors, 3 279 m² of vacuum tube collectors and 41 130 m² of unglazed collectors), reducing the total area of solar thermal collectors in service from 5 044 944 to 4 918 726 m².

Tabl. n° 5

Solar thermal capacities in operation per capita (m2/inhab. and kWh/inhab.) in 2020***

Country	m²/inhab.	kWth/inhab.
Cyprus	1.247	0.873
Austria	0.552	0.387
Greece	0.466	0.326
Denmark	0.309	0.216
Germany	0.234	0.164
Malta	0.144	0.101
Portugal	0.136	0.095
Luxembourg	0.115	0.081
Slovenia	0.108	0.075
Spain	0.097	0.068
Poland	0.075	0.053
Italy	0.075	0.052
Croatia	0.074	0.051
Ireland	0.069	0.048
Belgium	0.068	0.047
Bulgaria	0.065	0.045
Czechia**	0.054	0.038
France***	0.050	0.035
Sweden	0.043	0.030
Slovakia	0.040	0.028
Netherlands	0.038	0.027
Hungary	0.038	0.027
Latvia	0.026	0.018
Estonia	0.015	0.011
Finland	0.014	0.010
Romania	0.011	0.008
Lithuania	0.009	0.007
Total EU	0.120	0.084

** All technologies included unglazed collectors. ** Estimate. *** Overseas departments included.*
Source: EurObserv'ER 2021.

Werner Weiss, AEE Intec's Director points out that the forced circulation solar thermal systems market in the individual and multi-occupancy residential segment (very widespread in German-speaking countries) came under strong pressure in Austria. It can be assumed that for lack of an incentive scheme as attractive as that of Germany, this market will continue to contract in years to come and that heat pumps and photovoltaic systems will replace it for water heating.

However, Werner Weiss, adds that two other segments of the market, namely local and urban heating networks and industrial heat have definite growth prospects. Because of their system size, these applications can take up economies of scale that will enable them to convert existing heating networks to run on renewable energies. The new Austrian Climate and Energy Fund programme should strengthen this initiative, especially for projects with >5 000-m² collector areas. The budget allocated by this fund for major solar thermal heating network and industrial heat projects has been considerably increased, with 45 million euros in 2021 and 2022, dedicated to conducting feasibility studies, plant construction and monitoring systems. We should compare this with the budget of only 2.5 million euros allotted to major installations in 2020. Furthermore, for the first time since the fund was set up in 2011, there is no limit on size. According to Roger Hackstock, Managing Director of Austria Solar, quoted in an article published by Bärbel Epp on the Solarthermalworld site, 18 projects for a total of 300 000 m² applied to take up these funds in 2020, which shows that there is keen interest in this type of project in Austria. Primarily, the fund will cover 100% of the feasibility study costs for <5 000-m² projects, up to 50% of investment costs for <2 000-m² plants and up to 30% for >2 000-m² plants (+5% for storage).

AN AILING INDUSTRY THAT NEEDS NEW OUTLETS

The annual Solrico agency survey is one of the main publications to focus on the solar thermal industry. This work, which is primarily reported by the solarthermalworld.com online platform, analyses the market's global trends and presents the sector's top 20 manufacturers. Predictably, Chinese companies monopolise the top ranks, buoyed by their internal market that alone accounts for 2.5 times more than all the other countries put together. SolarEast tops the ranking, ahead of Jinheng Solar (including its export branch BTE Solar) with the Chinese conglomerate Haier (which until December 2020 had a 51% share of GREENoneTEC) in third place. The production volumes of the top six Chinese companies increased by 12% in 2020. This trend flies in the face of all the other market players, because the other manufacturers taken together posted a 9% fall in output. Incidentally, the exact volumes have not been released because most of them are reluctant to reveal their generally declining figures.

IRENA circulated interesting information on the European market in March 2021 about a downward trend in production costs for solar heat for industrial process (SHIP) plants observed in two particularly mature markets, those of Germany and Austria. They have fallen by 51% (from 2014-2020) in Germany and by 42% (from 2012-2018) in six-year periods, to € 504 and € 715 per m² respectively. The observation is significant because the reductions have been made while the two countries' markets have been shrinking. The main reason for this cost reduction is that

the market is turning away from individual installations, whose production costs are comparatively higher per m², towards large operations (especially in industry) where economies of scale come into play. This is now one of the major European market trends. Manufacturers are generally looking for new outlets in addition to the residential sector to grow their businesses and therefore are either turning towards big panels for large projects or proposing high-temperature panels for very specific projects. The very large-scale operation (≥1 000 m²) panel niche has been chosen by several European companies looking for growth drivers. A case in point is Austria's GREENoneTEC which is a European benchmark setter. Following the buyout of 51% of the group's shares by its founder and CEO from its Chinese partner Haier, the company has reverted to being 100% European-owned. The solar thermal giant, whose annual solar thermal collector production capacity is 1.6 million m², has developed its production means by acquiring the Danish company Arcon-Sunmark, which specializes in big plants. The Arcon-Sunmark production lines have been relocated to the Sankt Veit site in Austria to supply the whole of Western Europe. Another major European player to take an active interest in major solar thermal operations is the Germany's Viessmann (ranked 10th worldwide). In 2020, the group started up a new solar thermal production line at Faulquemont, in Moselle (France). The Viessmann Faulquemont plant is the group's second biggest of 20 industrial sites and has its own R&D centre and employs 550 people. Like GREENoneTEC, Viessmann is increasingly interested in major solar thermal plants and has stated that this one will be mainly geared to urban heating networks and heat production for industrial processes. The last example of a company entering the major collector area niche is Finland's Savosolar, which specializes in large collectors. It has just delivered its panels to the 15 000-m² plant at Issoudun (France). It will be France's biggest solar thermal plant, whose purpose is to supply heat to the Boormalt malthouse production chain. The plant can generate temperatures of up to 70°C which will preheat the water upstream of the current processes and supplement a biomass boiler installed in 2013. The Finnish group has announced that it will be setting up a new branch in Paris as it considers that the French market has considerable potential.

The Swiss company TVP Solar is positioned on the high-temperature panel segment. This Geneva-based company develops and produces several ranges of vacuum solar thermal panels that can reach temperatures in excess of 80°C. By focussing on high temperatures, TVP Solar's solutions can replace or work on industrial processes that initially ran on gas or other fossil fuels. The SIG SolarCAD II project, initiated in February 2020 on the Lignon site, in the locality of Vernier (Switzerland), is turning out excellent results. It produced 157 MWh over the year and performed well in snowy conditions by supplying its industrial heating network at 80°C to cover 30% of its needs. The company has also supplied panels that can supply heat up to 200°C. Equipment of this type is mostly geared to the very energy-intensive seawater desalination process predominantly installed in Kuwait. Again, TVP Solar's vacuum modules may also be used in the Middle-East by oil companies such as Saudi Aramco (Arabian Oil Company) to replace own-account consumed fuels to heat their refineries' medium-temperature processes.

Tabl. n° 6

Total installed PV-T water collector area in European Union in 2019 and 2020 (m²) and corresponding thermal (in MWth) and electric capacity (in MWp)*

Pays	Total PV-T Water collector					
	2019			2020		
	m²	MWth	MWp	m²	MWth	MWp
Germany	112 074	56.2	20.7	118 944	67.5	22.6
Netherlands	30 353	15.2	5.6	55 647	31.6	10.6
France	12 687	6.4	2.3	29 092	16.5	5.5
Spain	12 902	6.7	2.0	16 646	9.0	2.8
Italy	15 501	7.8	2.8	15 628	8.8	2.9
Austria	1 179	0.8	0.3	1 950	1.0	0.3
Sweden	0	0.0	0.0	1 220	0.7	0.2
Belgium	728	0.4	0.1	912	0.5	0.2
Luxembourg	635	0.3	0.1	635	0.4	0.1
Hungary	578	0.3	0.1	578	0.3	0.1
Portugal	335	0.2	0.1	453	0.3	0.1
Pologne	0	0.0	0.0	150	0.1	0.0
Denmark	85	0.0	0.0	109	0.0	0.0
Slovenia	0	0.0	0.0	40	0.0	0.0
Greece	0	0.0	0.0	4	0.0	0.0
Total	187 057	94.236	34.135	242 008	136.757	45.455

**Covered, uncovered and evacuated tube collectors.*
Detailed information by technology available in the Solar Heat Worldwide Report, Edition 2021 - SHC Programme IEA and SHC Task 60/Report A1.
Source of data: IEA SHC Task 60 survey, AEE INTEC.

RENEWABLE HEAT IS IN LINE FOR A BREAK

On 14 July 2021, the European Commission revealed the outlines of the Green Deal for Europe, the major political mission it set itself at the beginning of its mandate. The stated ambition is nothing less than to build a new economic model by laying down the outlines of this radical change. All 27 EU member states have agreed to make the EU the first climate-neutral continent by 2050. To achieve this, they have undertaken to reduce their emissions by at least 55% by 2030, compared to 1990 levels. The aim is to lead the third industrial revolution, to create new markets based on clean technologies and new products. The European Commission reckons that by 2030, 35 million buildings could be renovated, and 160 000 additional green jobs created in the construction sector, primarily by electrifying the economy and increasing the use of renewable energies. The European Commission, in its draft amendment to the renewable energy directive 2018/2001, proposed to raise the binding renewable energy target to 40% (across the European Union) in the EU's energy package (from the current minimum of 32%).

One of the most important priorities of this policy will address the renovation of housing and buildings for more environmentally-friendly, energy-efficient lifestyles, that protect against extreme temperatures and combat energy precarity. The means made available match the challenges, the new European Social Climate Fund, that targets the EU citizens most exposed to energy precarity will contribute to reducing costs so that transition is fair and that nobody is left out. It will provide a 72.2 billion euro package over 7 years to finance building renovations and access to zero-emission and low-emission mobility. In addition to housing, public buildings must also be renovated, to use more renewable energies and be more energy-efficient. The Commission proposes to oblige the member states to renovate at least 3% of the total floor area of all public buildings every year, set a reference value (indicative goal) of 49% of renewable energies in buildings by 2030, and oblige the member states to increase the use of renewable energies in heating and cooling by 1.1 of a percentage point per annum by 2030.

The funding level is likely to lead to great opportunities for the solar thermal sector, in Europe's Eastern and South-Eastern countries, particularly where solar thermal heat is suitable and often the cheapest option for replacing a fossil energy-fired heating appliance or to "green" the predominantly coal-fired heating networks of Eastern Europe.

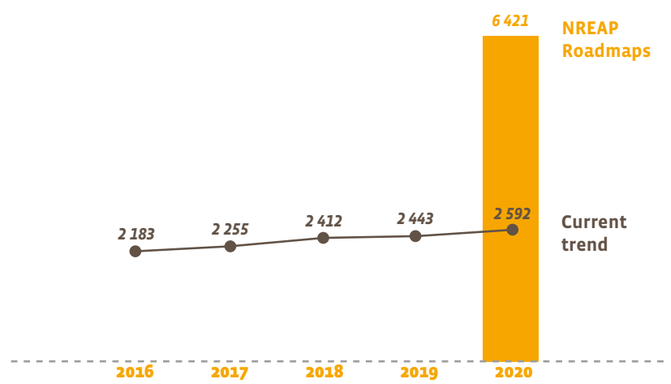
The implications of this major European political mission are extremely important for all the European actors who have been involved in the renewable heat arena for many years, especially as it is clearly directed towards the development of an industry, jobs and technologies "Made in Europe". The expectation level and needs of these actors prompted them to form an alliance, **The Renewable Heating and Cooling alliance** on 3 March 2021, that brings together Solar Heat Europe, EHPA, EGEC Euroheat and Power, Energycities and the European Climate Foundation. They aim to ensure the fastest possible development of zero-emission solutions for heating and cooling on the broadest scale. One of the keys to success will be access to the highest number of scale effects to reduce renewable heat costs. Coupled with the programmed increase in carbon tax, the market will naturally shift towards low-carbon solutions.

As it stands, the requirements are colossal and widen the scope of growth prospects. The European Commission assesses the current share of renewable energies in the EU's overall building stock at only 23.5%, mainly comprising stoves and biomass boilers. Heat pumps using ambient energy and geothermal energy still only account for 2.5%, and solar thermal about 1.2%. Buildings are responsible for most heating and cooling consumption. Currently, millions upon millions of fossil fuel-fired boilers (natural gas, coal and fuel-oil) are installed. About 88% of heating is generated by individual boilers and distributed in a very decentralized way. Roughly 12% of buildings are served by urban heating systems, most of which also use fossil fuel boilers. The renewable energy share of urban heating is only 29% (2018 figures, calculated on the basis of Eurostat and Euroheat & Power data as part of the ENER/C1/2018-496 study). Biomass accounts for 27% of this, while heat pumps supply 1.2%, geothermal energy 0.7% and solar thermal 0.1%. The natural gas share is 30%, while that of coal and peat is 27%.

It is time for action. During the week when Europe presented its GHG emission reduction strategy to move forwards on carbon neutrality, Germany and the Benelux countries were hit hard by the consequences of climate warming. Flooding of rarely witnessed duration and intensity and landslides took a heavy toll of victims and devastation. □

Graph. n° 2

Comparison of the current trend against the NREAP (National Renewable Energy Action Plans) roadmaps of the 27 member states (in ktoe)



Source: EurObserv'ER 2021.

SOLAR THERMAL AND CONCENTRATED SOLAR POWER BAROMETERS – **EUROBSERV'ER** – JULY 2021

CONCENTRATED SOLAR THERMAL POWER

The term Concentrated Solar Power (CSP) covers all the technologies that aim to transform solar radiation energy into very high temperature heat to convert it into either electricity or heat. There are tower plants, whose heliostat fields (devices fitted with reflectors to track the sun) concentrate the sunlight onto a receiver at the top of a tower, parabolic trough plants comprising parallel line-ups of long half-cylindrical reflectors that revolve around a horizontal axis to track the sun and concentrate its rays on a horizontal tube. There are also Fresnel plants comprising rows of flat reflectors that pivot, tracking the sun to redirect and concentrate the sun's rays permanently on an absorbing tube. A fourth, less widespread category, consists of parabolic plants with a parabolic reflector that reflects the sun's rays onto a convergence point, as the reflector's base is automatically orientated opposite the sun to track it.

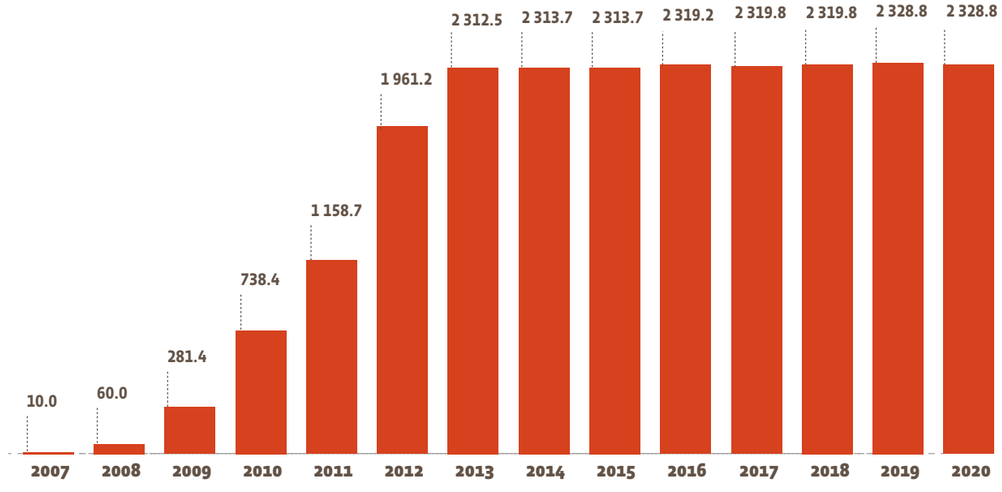
6 410.9 MW OF CSP CAPACITY INSTALLED WORLDWIDE AT THE END OF 2020

The countries and regions that offer suitably conducive sunlight conditions, such as China, India, Australia, South Africa, the Middle East, and the Maghreb are currently involved in CSP development. The Protermosolar (Spanish Solar Thermal industry Association) website put global CSP plant capacity at 6 410.9 MW at the end of 2020 (6 310.9 MW at the end of 2019, consolidated figure). Protermosolar's scoreboard has just one single entry for a newly-commissioned CSP plant in 2020. The CNNC Royal Tech Urat 100-MW capacity parabolic trough, which is China's biggest plant of this type, started feeding the grid on 8 January 2020. Construction of the plant absorbed a total investment of 2.9 billion RMB (379 million euros). It features a molten salts system that offers 10 hours of storage, and it is expected to produce 350 GWh of electricity per annum. It is the seventh of the first phase of 20 pilot projects to be commissioned (9 tower plants, 8 parabolic trough plants and 4 Fresnel plants) with 1 349 MW of combined capacity for a project announced on 14 September 2016 by the China National Energy Administration (CNEA). The Luneng Haixi project, a 50-MW tower plant, commissioned in September 2019 is the only one not on the CNEA's plant project list. China now has 8 CSP plants in service with 500 MW of combined capacity.

Protermosolar reports that construction was underway on 6 of the above plants on 1 January 2021 for 1 010 MW of combined capacity. They include 4 that are scheduled for commissioning in 2021, leaving two – the Shenzhen Jinfan Akesai (50-MW, parabolic trough plant) and the Shouhang Yumen (100-MW, tower plant) to go on stream in 2022. The latter will have a 10-hour storage system. Two plants are under construction in the United Arab Emirates on the Noor Energy 1 complex. The capacity of this super solar power site will be 700 MW of CSP in addition to a 250-MW photovoltaic plant. The complex will accommodate the DEWA IV 100-MW Tower, a 100-MW capacity tower plant equipped with a 15-hour storage system that is due to be commissioned in 2021, and the DEWA IV 3X200 MW Trough 1 parabolic trough plant scheduled to go into service in 2022. The

Graph. n° 3

European Union concentrated solar power capacity trend (MWe)



Source: EurObserv'ER 2021.

The Atacama 1/ Cerro Dominador plant in Chile is the latest project to go on stream, in April 2021. This 110-MW tower plant breaks new ground with its 17.5-hour storage system that enables it to operate 24 hours round the clock, with enough capacity to supply 380 000 city dwellers.

latter, with its 600 MW of capacity and 11-hour storage system, will take CSP technology into a new era.
The Atacama 1/ Cerro Dominador plant in Chile is the latest project to go on stream, in April 2021. This 110-MW tower plant breaks new ground with its 17.5-hour storage system that enables it to operate 24 hours round the clock, with enough capacity to supply 380 000 city dwellers. The plant has 10 600 x 140-m2 reflectors (called heliostats) that concentrate the sun's rays on the top of a 250-metre-high tower. The molten salts circulating in the receiver can be heated to over 560°C and are stored in large tanks for subsequent use to generate electricity through a steam turbine. This far-flung, project that is installed on the other side of the world, obtained funding from the European Union's LAIF programme and the German Development Bank KfW. It was constructed by a consortium formed by Acciona-Abengoa.
The Renewable Power Generation Costs 2020 annual report published by IRENA in June 2021 confirms that CSP plant costs have tumbled. It reports that the levelized cost of energy (LCOE) of CSP projects fell by 68% between 2010 and 2020, i.e., by 0.34 to 0.108 USD/kWh. IRENA added that average installation costs have plummeted, by about 31% between 2019 and 2020, to 4 581 USD/kW, and goes on to say that the magnitude of this drop in installation costs was amplified by the fact that several of the projects commissioned in 2019 were running late. Between 2010 and 2020, investment costs halved, while at the same time storage times were greatly extended. Load factors vary in line with solar radiation levels, technological configuration, storage time and also investors' commitment to optimizing output when market prices are at their highest. Between 2010 and 2020, average load factors ranged from 30–42% (with a maximum of 64% for a tower plant project with more than 10 hours of storage capacity).

Tabl. n° 7

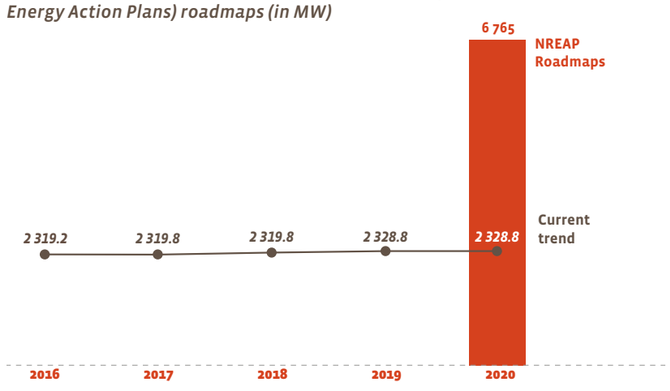
Concentrated solar power plant in operation at the end of 2020.

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		**2303.9**	
FRANCE			
La Seyne sur mer (prototype)	Fresnel	0.5	2010
Augustin Fresnel 1 (prototype)	Fresnel	0.25	2011
SUNCNIM	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
Total Italy		**8.15**	
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		**2328.8**	

HB (Hybrid Biomass). ***Source: EurObserv'ER 2021.***

Graph. n° 5

Comparison of the current trend against the NREAP (National Renewable Energy Action Plans) roadmaps (in MW)



Source: EurObserv'ER 2021.

2 328.8 MW IN THE EUROPEAN UNION

The capacity of the European Union's stock of CSP plants remained static in 2020. The last time a plant was connected to the grid – a 9-MW capacity Fresnel demonstration plant for the eLLO project – was in the summer of 2019 in the Pyrénées Orientales, France. If all the various pilot and demonstration plants are factored in, capacity remains stuck at 2 328.8 MW (table 7 and graph 3). We have added more CSP projects operating in the European Union to the list published in last year's barometer, namely Aalborg-Brønderslev in Denmark, commissioned in 2016 by Aalborg CSP. This parabolic trough project is unusual in that it is located in Northern Europe and is part of a CHP facility. It has 17.6 MWth of thermal capacity capable of delivering 5.5 MWe and is also distinguished by the fact that it is integrated with a Rankine cycle (ORC) biomass plant. It is the world's first large-scale system to demonstrate how CSP with an integrated energy system design can optimize ORC efficiency even in not particularly sunny regions. The plant comprises 40 rows of parabolic trough collectors each 125 metres long with an aperture area of 26 929 m². At times, the fluid temperatures reach about 330°C, which is sufficient to produce electricity. The system's flexibility enables the district heating network to be supplied at lower temperatures. Any waste heat is used and sent to the district heating network while electricity is generated at peak periods, in order to maximize the energy yield.

A CSP CALL FOR TENDER IS IMMINENT IN SPAIN

Spain boasts 2.3 GW of capacity and is the only European Union country to have developed its own commercially-viable CSP sector. According to RED Eléctrica de España, the country's 50 plants produced 4 538 GWh in 2020, which is down on the previous year's performance (5 166 GWh) and can be attributed to poorer sunlight conditions. The reference year for Spanish CSP is 2017 when the plants generated 5 347 GWh.

The Spanish sector is at last expanding after years of waiting since 2014, the year that the last Spanish plant was connected. Protermosolar's Secretary General Gonzalo Martín says that the finishing touches are being made to the legal framework that will enable new CSP tenders to be launched and that an initial tender for 200 MW of capacity is about to be announced. It has already been agreed that invitations for two new calls for tender for 200 MW each will be launched in 2023 and 2025. Thus, the government has already guaranteed that three tenders will be launched for a total of 600 MW of capacity. If we consider Spain's National Energy and Climate Plan's (NECP) roadmap, it looks like a drop in the ocean. The Target Scenario effectively provides for capacity to build up to 7 303 MW by the end of 2030 (5 000 MW more than today's figure) with an interim target of 4 803 MW by the end of 2025. Nonetheless, the tenders finally open up the possibility that the sector will bring out a whole new generation of CSP plants equipped with the latest technologies (primarily storage) on Spanish soil.

The sector is still waiting for the final choice of economic parameters to be made, such as the PPA periods, the maximum number of hours eligible for a guaranteed feed-in tariff or maximum prices, which will define the storage periods and proposed tariffs. The technological choices will depend on the parameters chosen in the tenders and in particular, maximum installation size. Confirmation has yet to be given on whether the tenders could also include hybrid photovoltaic or biomass CSP plants. While Gonzalo Martín is delighted with this revival of CSP in Spain, he points out that given the time it will take to prepare bids and set up the projects, a minimum of three to four years will elapse before new plants emerge from the ground. Hence in the best scenario, the first plants will be commissioned in 2024, if not 2025.

Portugal also has designs on CSP, but the results of the second tender published at the end of August 2020 (when 670 MW of its 700 MW target was retained) did not commit to solar thermal plants despite the fact that part of the procedure covered all types of solar plants with storage and was thus open to CSP and hybrid (PV-CSP) plants. In this second innovative category, the storage requirements were at least 20% of total capacity with a 1-hour period at rated capacity. In the end, bids for 483 MW of solar systems equipped with storage were successful, but all favoured photovoltaic systems + batteries. Perhaps the next round of tendering will facilitate the roll-out of a CSP sector in Portugal encouraged by the deployment of new projects in neighbouring Spain and the ability of these projects to reduce storage costs. Portugal is without a doubt one of the most promising countries for setting up a CSP sector, as its NECP has a 300-MW target for 2030. Elsewhere in Europe, no new CSP projects or tenders has been announced, leaving aside the demonstration projects we already know about, such as the EOS Green Energy project planned at the earliest for 2022 or 2023 in Cyprus. In the other countries whose sunlight conditions are conducive to CSP technologies, the Greek project (with a 70-MW target by 2030) is currently running late and is more conducive to demonstrator sites. The prospect of developing CSP in Italy has taken a back seat as the government has set its sights on developing other sectors. So, for the next few years Spain will continue to lead the European concentrated solar power plant sector. □

Sources : AGEE-Stat (Germany) EBHE (Greece), Ministry for the Ecological Transition (Spain), PlanEnergi (Denmark), ENS (Denmark), Assotermica-Anima (Italy), Observ'ER (France), SPIUG (Poland), AEE Intec (Austria), Statistics Austria, ATTB (Belgium), Statistics Netherlands, EBHEK (Chypre), Ministry of Industry and Trade (Czechia), SEAI (Ireland), NSO (Malta), IEA SHC, Solar Heat Europe, EurObserv'ER, Protermosolar.

The next barometer will be about renewable energies in transport.

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