13 MW solar field on an area right next to the thermal power station in the northern German city of Greifswald supplies 8 GWh to the city's heat network annually

Source: Stadtwerke Greifswald

Bright Future for Solar District Heating in Europe

Multi-megawatt solar district heating plants are on the growth path across Europe. A new record-size system with 13 MW went online in Greifswald, Germany. Construction started of an even larger 37 MW solar heat plant in Groningen, Netherlands. High fossil fuel prices and financial support drive up demand also in Austria, Serbia and Kosovo. Six feasibility studies for systems between 20 and 50 MW have been or are being completed there.

Europe counts around 6,000 district heating systems estimates Professor Urban Persson from the Swedish University of Halmstadt. It is a Herculean task to decarbonise all these heat networks over the next 20 years. Solar thermal is one of the proven, available and cost-effective measures to help complete this enormous task. In total, 264 towns and cities in Europe use solar heat already (Figure 1). The frontrunning countries are Denmark (125 systems in operation), Germany (48 systems), Sweden (24 systems) and Austria (22 systems).

In recent years, round about ten solar district heating (SDH) systems have been added annually across Europe. In 2021, for example, three systems brought online in France and two in Austria. Denmark, Germany, the Netherlands and Sweden each completed one new installation. Altogether these systems added up to 23 MW. Reasons for the rather slow market development were "long planning periods, challenging permitting processes and installation delays due to the pandemic", according to the Renewables 2022 Global Status Report.

2022 has shown a trend reversal. Numerous large-scale SDH plants were announced and feasibility studies completed throughout the year. What is striking is that, these are plants in the 20 to 50 MW range. Most of them include seasonal storages that allow to save summer sunshine to cover space heating demand in autumn and winter (Figure 2).

So far only a few of SDH systems with this size and seasonal storage exist in Denmark and China. New countries such as the Netherlands, Austria, Kosovo and Serbia are fol-

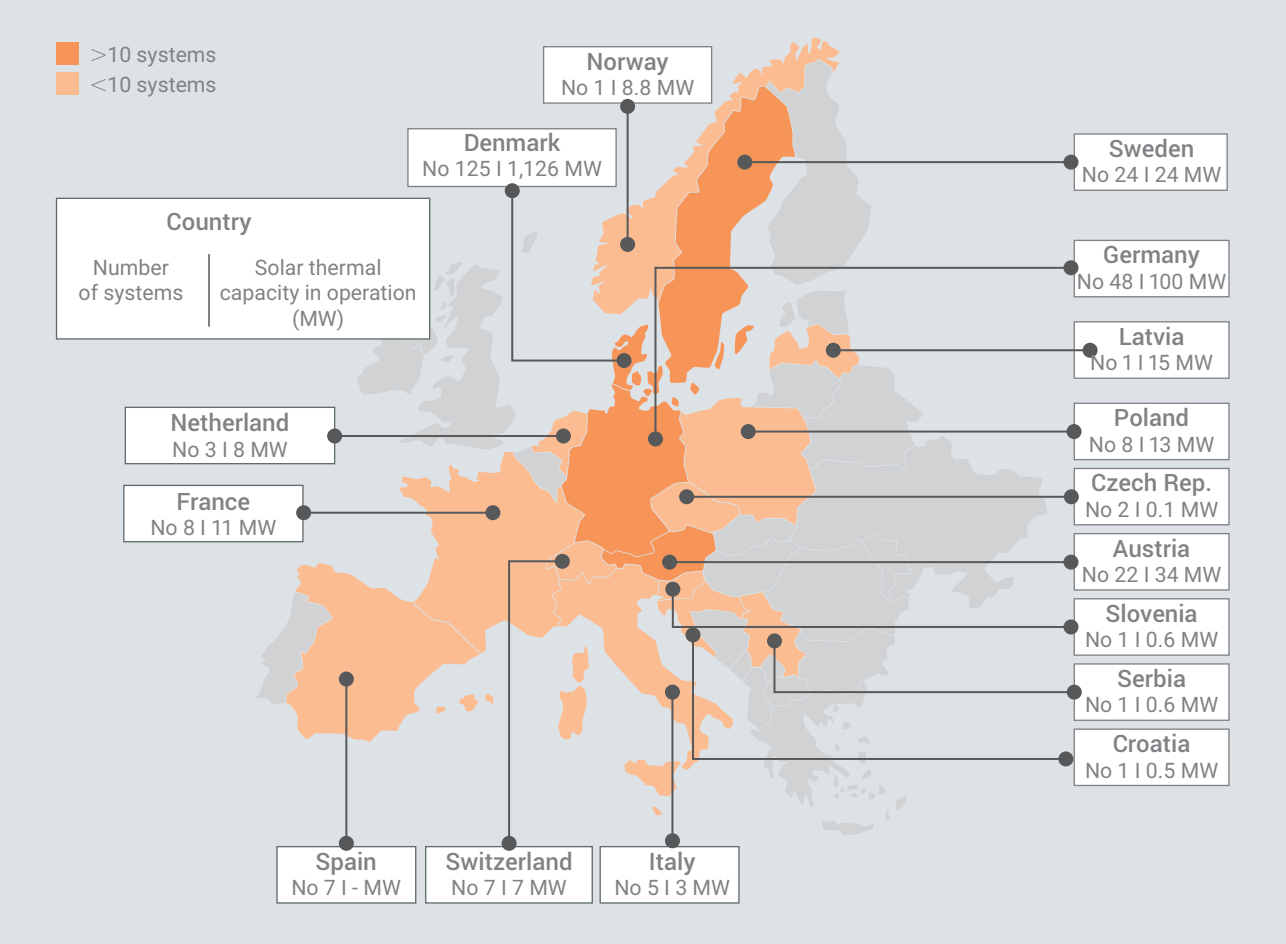

Figure 1. 264 towns and cities in Europe use solar heat

Source: Solar Heat Worldwide 2022, Germany: Solites, Spain: Association of District Heating and Cooling Companies (ADHAC)

lowing this track. The financial support for the creation of feasibility studies in Austria and the Western Balkans was crucial for this dynamic development.

Germany plays a special role. The SDH systems there are smaller on average, but a large number is in the planning phase, so that the SDH capacity could double in the coming years.

Netherlands: Fourth-largest SDH plant globally

At the beginning of November 2022 construction started of a 37 MW SDH plant in Groningen. Once finalised, the plant will be the fourth-largest SDH field in the world after those at the Danish town of Silkeborg with 110 MW, Baotou in China with 65 MW and the Danish town of Vojens which operates a 49 MW solar heat plant.

The 37 MW collector field will be connected to the district heating grid of Groningen, which is operated by the utility company Warmtestad. Three companies joined forces to develop this ambitious project: Solarfields, Netherlands, as the project developer, K3, Netherlands, as the investor, and TVP Solar, Switzerland, as the turnkey provider of the solar field. Together they founded a special purpose vehicle (SPV) – an entity which owns and operates the plant. This business model very well established in renewable electricity sector is more and more use for solar heat projects. The Groningen plant has a number of outstanding features: The collector field will consist of high-vacuum flat plate collectors that produce the required temperatures from 69 to 93 °C all year round. Furthermore, the project SPV has signed a long-term solar heat delivery contract over 30 years with the utility Warmtestad.

The solar thermal plant supports the ambition of Groningen to be energy neutral by 2035. It will cover 25% of the total heat demand for private and public buildings in the northwest of Groningen. Commissioning is planned for summer 2023.

Kosovo: Huge grants for air quality improvements

Financing for an even larger plant in Kosovo's capital Pristina with 40.6 MW collector field and a

408,000 m³ seasonal storage was secured at the end of 2022. The project is worth more than €80 million and includes two grants from Germany's KfW banking group and the European Union worth €31.6 and €21.5 million, respectively. The European Bank of Reconstruction and Development (EBRD) will cover €23.2 million with a loan.

"This new capacity will ensure access to the central heating system for about 38,000 citizens, which will replace individual heating systems and, at the same time, address the chronic problem of air pollution in Priština," is the Minister of Finance, Labour and Transfers Hekuran Murati quoted in EBRD's press release from 20 December 2022.

The feasibility study is currently being carried out by the Austrian company CES Clean Energy Solutions. The available area for the collector field and the underground pit storage are still under discussion. The government has studied locations in the municipality of Obiliq, south-east of Priština where a coal combined heat and power plant provides heat for the district heating network.

Serbia: Zero local emissions and low technical risk

In the Western Balkans, one of Europe's southernmost regions with high sunshine, large district heating networks are a common sight. Some of those are run at return temperatures as low as 45 °C, making them well-suited for solar energy, according to Bojan Bogdanovic, Principal Fund Manager of the Renewable District Energy in the Western Balkans (ReDEWeB) programme. The fund was set up under the auspices of EBRD in 2019 for technical assistance and grants for (pre)-feasibility studies.

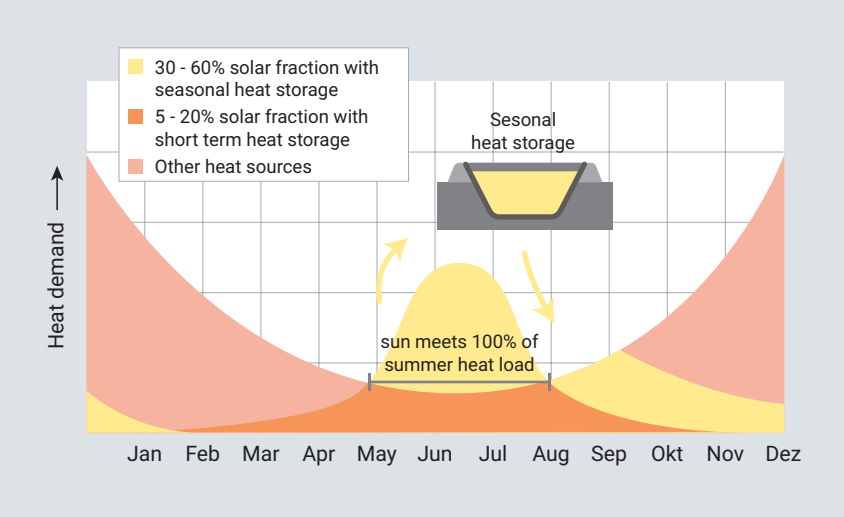

Figure 2. Seasonal storages can save the surplus energy from the summer sun for winter heating and also be used for power to heat applications

Source: IEA SHC Task 55

The proactive approach of Bogdanovic was successful. He has been talking to a lot of decision makers in municipalities across the Western Balkans during the last three years. This engagement resulted in funding for (pre)-feasibility studies in eight cities, of which two really large plants next to Priština are in the advanced planning stage: Pančevo and Novi Sad in Serbia.

The Northern Serbian city of Novi Sad is one of the cities with a rather modern district heating system and a committed municipal council which is pushing the planning for a multi-MW solar heat plant. The prefeasibility study compares different scenarios of collector fields between 45.5 and 136.5 MW together with seasonal storages. In September 2021 the municipality accepted the prefeasibility study's recommendations and decided to proceed. In December 2022 funding for the feasibility study from Western Balkans Investment Framework (WBIF) was secured.

What convinced the municipal decision makers the most are the zero local emissions of solar heat plants "... considering that most cities in the Western Balkans have an air quality problem and therefore solar heat is seen as an ideal solution for greening the district heating grid," said Bogdanovic in an interview with solarthermalworld.org and added: "The stable and predictable heat prices throughout the lifetime of the facility were seen as another important advantage, enabling the municipal utility to manage the system in an economically efficient way in the short, medium and long-term. What also convinced the municipality were the low technological risks, as SDH has been tested and operated successfully in a large number of plants across Europe."

Securing land is always a key issue that often delays the implementation. "In our experience it helps a lot to find city-owned land to speed up the planning process. It is also important to find an area where there is no competition with the construction or agricultural sectors", said Bogdanovic. For instance, in Novi Sad ReDEWeB found land in the sanitary water supply protected area, which is not suitable for building construction, industry or agriculture.

City, country	Planning progress	Variants of collector field size	Variants of seasonal storage size
Priština, Kosovo	Feasibility study under development	40.6 MW (58,000 m^2)	408,000 m^3
Pančevo, Serbia	Feasibility study completed	24.5 MW (35,000 m^2)	150,000 m^3
Novi Sad, Serbia	Pre-feasibility study completed and funding for feasibility study from WBIF secured	45.5 or 136.5 MW (65,000 or 195,000 m^2)	324,000 m^3 or 972,000 m^3
Eisenstadt, Austria	Feasibility study under development	10 MW (14,949 m^2) or 31 MW (44,847 m^2)	1,000 m^3 or 100,000 m^3
Wörgl, Austria	Feasibility study completed	24.5 MW (35,000 m^2)	150,000 m^3
Bruck an der Mur, Austria	Feasibility study completed	10 MW (14,949 m^2) or 35 MW (49,875 m^2)	5,000 m^3 or 150,000 m^3

Table 1. Multi-megawatt solar district heating plants in the planning phase in Kosovo, Serbia and Austria. WBIF stands for Western Balkans Investment Framework. The conversion factor 0.7 kW/m^2 was used to convert collector area in solar thermal capacity

Source: Bojan Bogdanovic/ReDEWeB, Climate & Energy Fund, Büro für Erneuerbare Energien

Austria: Uncapped funding for large solar heat plants

The role that ReDEWeB played successfully in the Western Balkans for the uptake of large SDH plants, is carried out in Austria by the Climate and Energy Fund. The fund increased its budget significantly in May 2021 to €45 million for conducting feasibility studies, putting up new large solar heat systems and monitoring them.

For the first time since the launch of the solar heat funding scheme in 2011, there is no upper limit on the size of collector fields or on the amount of funding that applicants can receive. This approach has led to a whole series of feasibility studies for multi-MW SDH plants partly together with seasonal storages. Ten feasibility studies were submitted in 2021 with an average size of 17.4 MW, according to Gernot Wörther, project administrator at the Climate and Energy Fund. This is a big jump in plant size, because the 327 solar heat projects supported since the start of the grant scheme had an average collector area of only 414 m^2. The largest Austrian SDH projects under planning are listed in Table 1.

Germany: Delivering constantly high temperatures

Germany currently leads the field of European SDH markets in terms of positive projections. Nine plants with around 21.8 MW are in the planning phase and around 50 plants with about 200 MW are currently in preparation, according to the German research institute Solites. If all the plants in preparation are actually built, the market volume could double in the coming years. Currently, 48 plants for SDH with about 100 MW solar thermal capacity are in operation in Germany (Figure 1).

2022 saw the commissioning of two new record-size SDH plants. In August the German project developer Ritter XL started operation of a 13 MW system in Greifswald.

In March 2022 the boiler manufacturer Viessmann finalized a 5 MW system also with vacuum tube collectors in the central German town Lemgo. This plant is on place three in the German SDH ranking. The solar field delivers a constant feed-in target temperature of 90 °C. This is achieved by running the solar circuit at different flow rates depending on the irradiation. In times of less sunshine the heat transfer medium flows more slowly through the collector field.

The owner of the system, Stadtwerke Lemgo, is satisfied with the performance of its new solar heat plant. Between March and September 2022, the utility already measured the predicted annual yield of 3.3 GWh. "We benefit from very low operational costs over its entire life cycle and we reduce the CO_2 and gas price risk," said Daniel Steube, Project and Energy Manager at Stadtwerke Lemgo.

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