Parabolic Troughs in Process and District Heating

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Figure 1: View of the parabolic trough field in Limassol (photo: Protarget)

Figure 2: View of the parabolic trough field in Turnhout (photo: Avery Dennison)

About ProSolNetz

The ProSolNetz joint project aims to successfully integrate concentrated solar thermal energy into German heating networks and process heating from both an economic and technical perspective. The project is being implemented by a consortium consisting of technology providers, research institutes and planning offices. The main tasks of the project include the evaluation of pilot plants, whose measurement data will be used for validation and as proof of the functionality of concentrating collectors. Furthermore, technical solutions for improved system integration are being developed. Marketable design tools are being further developed for the calculation and prediction of yields from concentrating solar collectors.

Comparison of different collectors according to Solar Keymark

As part of IEA-SHC Task 68, which is thematically linked to the ProSolNetz project, the yields of concentrating and non-concentrating collectors for the Würzburg site were calculated and compared with each other [1]. For this purpose, the characteristic data of the collectors were determined in accordance with ISO 9806 under standardized conditions. The calculations were performed for different temperatures, using the annual yields from Solar Keymark certification for T = 25°C, T = 50°C, and T = 75°C, and calculations with ScenoCalc for T = 100°C.

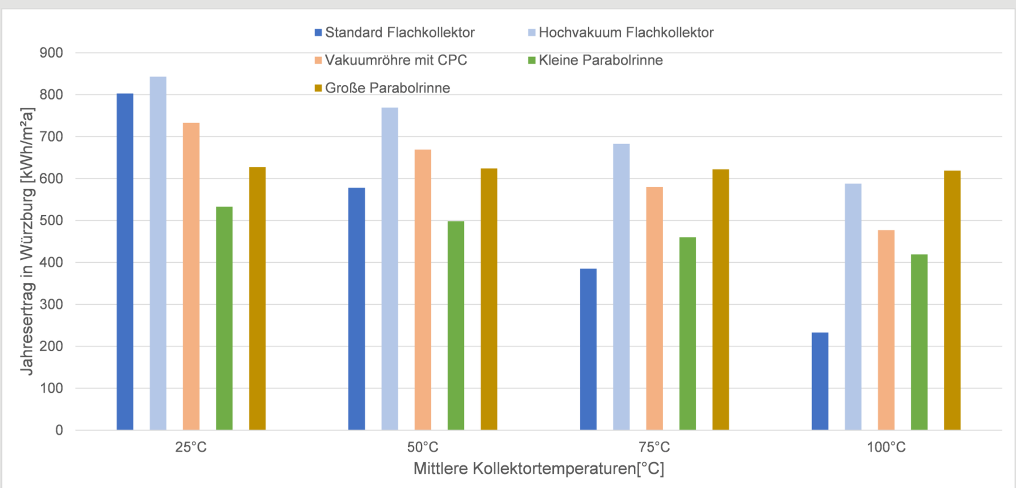

Figure 2: Comparison of the specific annual yield for Würzburg at different average operating temperatures according to Solar Keymark and ScenoCalc; FP: Flat plate collector; CPC: Vacuum tube with CPC (Compound Parabolic Concentrator); PTC: Parabolic trough Certification and for T = 100°C calculations with ScenoCalc were used. [1]

Calculation tools in the project

ScenoCalc District Heating: Calculation of the yield of solar thermal systems in heating networks. Extensions for parabolic trough collectors are planned.
Greenius: For the simulation of renewable electricity and heat energy systems. A connection to the Solar Keymark database was integrated.
ROKA: Software for heating networks with graphical network representation. Among other things, it is to be expanded to include the feed-in of heat from solar thermal energy.
ColSim: For the simulation of solar power plants and solar process heat with a model library.

Pilot Plants

Parabolic Trough Field in Limassol, Greece
The solar thermal plant from Protarget in Limassol (Cyprus, Greece) supplies the steam network of a beverage manufacturer. It has a thermal output of 140 kW. Silicone oil is used as the heat transfer medium, which is heated to temperatures of up to 430°C. The silicone oil heated in the solar field is used to generate saturated steam in the steam boiler, which can reach temperatures of up to 190°C. Surplus heat can be stored in a concrete storage tank, which can reach temperatures of up to 380 °C.

Parabolic trough field in Turnhout, Belgium
The plant has a thermal output of 2.5 MW, which is provided by 12 parabolic trough collectors of varying lengths with a total aperture area of 5539 m². The heat generated is fed into the customer's heat cycle at a temperature between 280 °C and 305 °C. For this purpose, the parabolic trough can supply heat at temperatures between 350 and 400 °C. Mineral oil is used as the heat transfer medium on the customer side of the BoP, while silicone oil is used on the solar field side. Since the heat demand on the consumer side fluctuates and is mostly below 1.8 MW, the excess heat is transferred to a concrete storage tank with a heat capacity of 4.5 MWh.

Cost-efficient irradiation measurements

Reliable and accurate measurements of direct normal irradiance (DNI) are required for the efficient control of concentrating solar process heat systems. DNI measurement systems used to date are associated with high costs and/or weaknesses in terms of robustness, maintenance requirements, and measurement accuracy. For an initial evaluation, the accuracy of the CaptPro, MS90, SPN1, RSP, and Pyrano-Cam measurement systems was compared.
CaptPro, MS-90, and SPN1 all exhibit more pronounced measurement errors. However, the accuracy of these instruments may still be sufficient for some applications. RSP and PyranoCam exhibit the highest accuracy. For MS-90 and SPN1, notable measurement errors were observed at increased turbidity. RSP and PyranoCam consistently showed low measurement errors for all atmospheric conditions examined.
PyranoCam's accuracy is very high and the system is operational. Still, unlike MS-90, SPN1, and RSP, it is not commercially available yet.

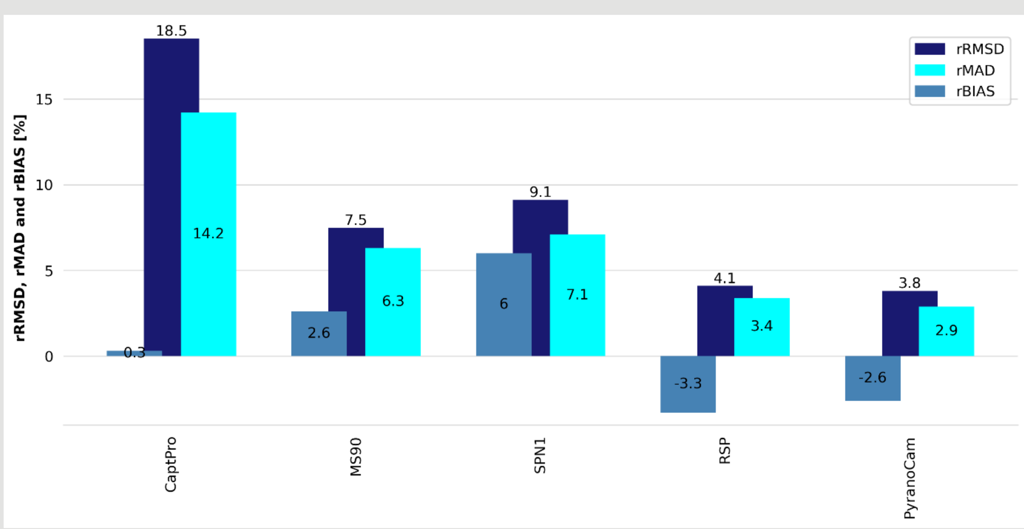

Figure 3: Comparison of the accuracy of direct normal irradiance (DNI) measuring devices evaluated for 10-minute averages of DNI; rRMSD: relative root mean square deviation; rMAD: relative mean absolute deviation; rBIAS: relative bias error

Trends and Projects

The development of the global SHIP market for 2024 was examined at the beginning of this year by the German agency Solrico. The market analysis [2] also examined the distribution of collector area on the SHIP world market by collector type. Compared to previous years, 2024 shows a different distribution of area among the various collector types. In 2024, concentrating technologies, especially parabolic troughs, dominated with an increase from 43% in the previous year to 69%. This year's large share of parabolic troughs is due to the construction of the large parabolic trough field in Handan, China.

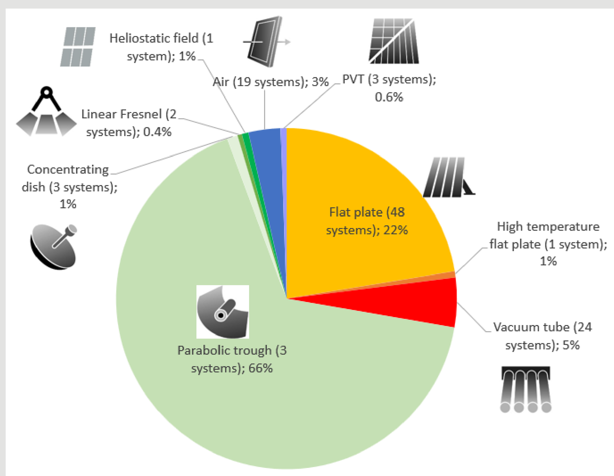

Figure 4: Distribution of collector area on the SHIP world market in 2024 (total: 171,874 m²). Only two small systems with unglazed collectors totaling 326 m² are not shown. [2]

According to a survey [3] conducted by Solrico for the Solar Industrial Heat Outlook 2025-2027, 28% of the 277 MW recorded (73 projects in total) are concentrating collectors. The remaining MW are accounted for by other non-concentrating collectors. The planned projects, which span around the globe, are all expected to be operational by the end of 2027.

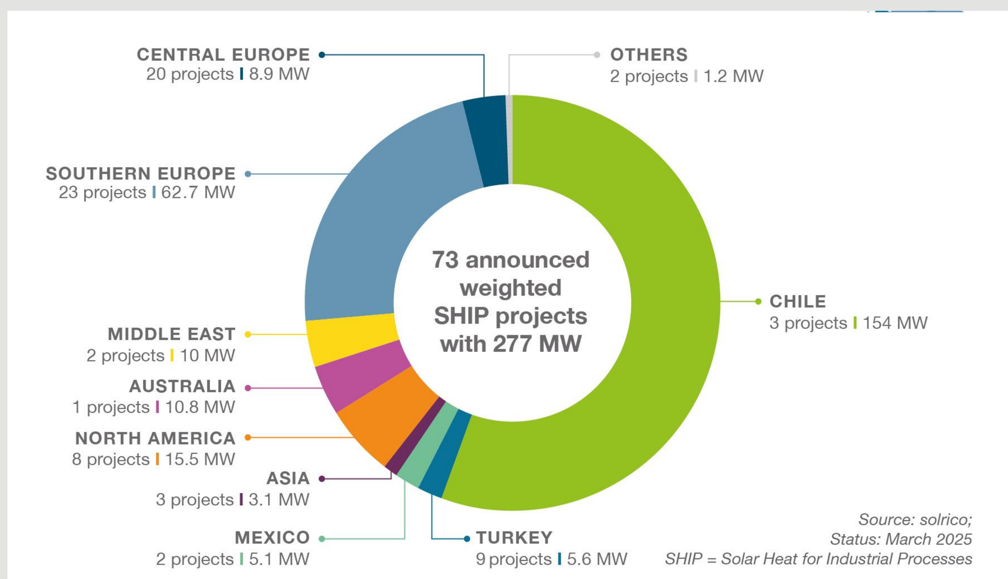

Figure 5: SHIP outlook in relation to the plant location [3].

References

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[3] Solrico, https://solarthermalworld.org/news/global-expansion-of-solar-industrial-heat-key-insights-from-the-latest-outlook/

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