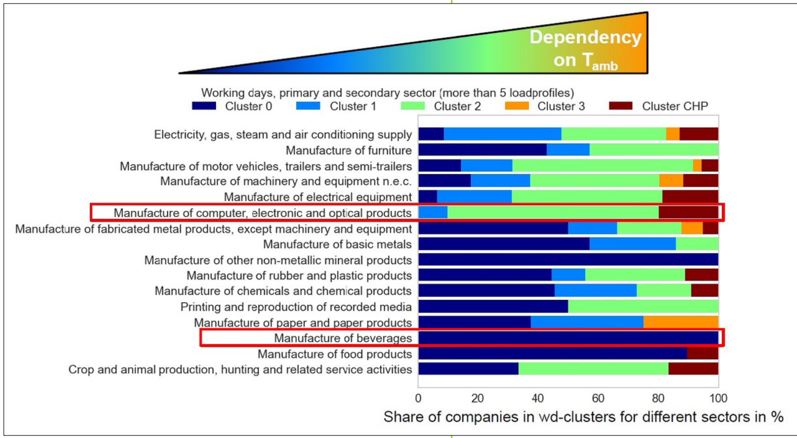
Tips and Tricks to Contract and Design a SHIP Project

It can be a big challenge to contract and design a SHIP (Solar Heat for Industrial Processes) project. SHC Task 64 on Solar Process Heat is working to support planners and investors as they consider such a project. During the recent SHC Solar Academy webinar, three SHC Task 64 experts shared tips and tricks on designing a SHIP project and the success factors to consider. The webinar recording, including the Q&A session, is available at https://www.iea-shc.org/solar-academy/webinar/solar-process-heat.

Felix Pag from the University of Kassel, Germany, started the webinar with a presentation on the role of solar in future industrial hybrid energy systems. Based on the analysis of measured heat profiles from several hundred industrial companies in Germany, he showed the sectors with a strong dependency of the heat load profile on the ambient temperature. In Figure 1, for example, a beverage manufacturer is placed into the cluster with no dependence on the ambient temperature, whereas manufacturers of computer, electronic and optical products have more processes that are related to the ambient temperature. "It is very important to consider the seasonal behavior of the heat load during the design phase," Felix Pag recommended. The good news for SHIP – almost all companies have summer heat demand that can be covered with solar collectors.



▲ **Figure 1. Proportions of companies with a certain load profile during working days within a particular industry segment. For example, 100% of beverage manufacturers are in cluster 0, whereas in other sectors, there is a bigger range.** Source: University of Kassel.

Cost Assessment of Hybrid Renewable Industrial Heat Systems

"At the beginning of SHC Task 64, we noticed that everybody was talking about the combination of solar and heat pumps, but there is no really established common system design methodology, and each planner has their own strategy based on individual experience", said Felix Pag. So, the researchers from the University of Kassel investigated three different system designs. They wanted to find out which parameters influence the levelized cost of heat of such hybrid systems. They first compared a parallel configuration where the heat pump and the solar field provide the required temperature together in parallel, then a variant where solar pre-heats the water, and finally, a configuration where the heat pump is the pre-heater.

Researchers found that the location, the hydraulic concept, and the load profile type have very little impact on the economics of the system (top part of Figure 2), whereas the other three parameters at the bottom of Figure 2 really make a difference to the levelized cost of heat (LCOH). Among them are the daily load profile and the temperature of the heat pump's heat source.

In Figure 2, you can also see that the heat pump capacity ratio, which is defined as the heat pump capacity divided by the maximum heat load of the factory, influences the economics significantly. "Our calculations have shown that a strong under-dimensioning of the heat pump results in lower LCOH, but the smaller the heat pump, the lower the renewable proportion you achieve over the year," said Felix Pag. He concluded that the heat pump capacity factor should be around 0.5 to find a good trade-off between lower LCOH and a reasonably high renewable energy fraction. In this variant, the capacity of *the heat pump is half of the total peak heat load of the factory.*

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More details about the results of the LCOH assessment will be published in a paper titled Hybrid Solar Thermal and Heat Pump Systems in Industry: Model-Based Development of Globally Applicable Design Guidelines, which is currently under review at Solar Energy Advances.

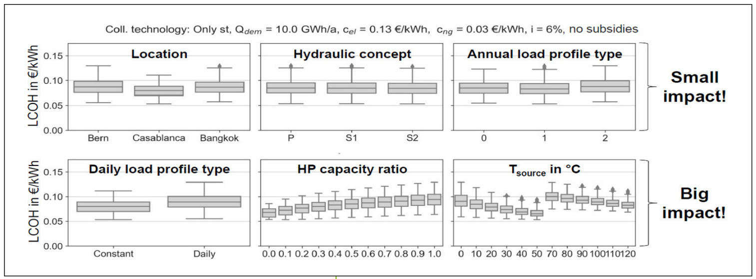


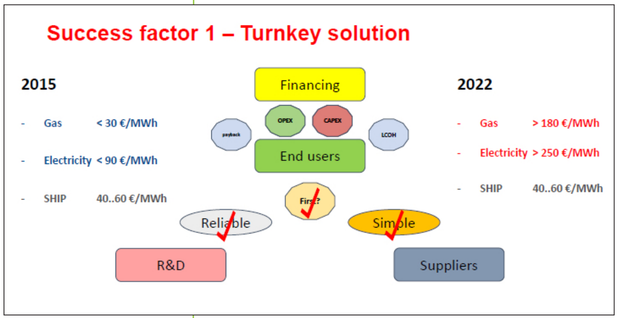
Figure 2. Parameters impacting the levelized cost of heat of hybrid SHIP systems calculated over 20 years (6% discount rate) based on fixed energy costs with a level from before the energy crises. Source: University of Kassel.

Three Success Factors for SHIP

Wolfgang Gruber-Glatzl from AEE INTEC, Austria, introduced some of the success factors for SHIP based on the project database http://www.ship-plants.info, which includes more than 400 plants worldwide. He looked at the perspective of the end user. Investors want to know if SHIP is a reliable solution, whether it is a simple solution, and if they will be the first ones to implement it or if it has been done before. "Once we have convinced the end user that SHIP is reliable and that there are experts with a lot of experience, the next important selling point is the constant and low heat prices," he said.

Success Factor 1: Turnkey solutions

Wolfgang Gruber-Glatzl noted that we try to avoid looking at payback times because they do not show the true value of solar industrial heat. While it is better to change the perspective towards the levelized cost of heat to illustrate the long-term energy security providing heat at reasonable costs. Hence the first success factor is a business model that establishes customer confidence by delivering solar heat instead of selling the collector field. An example of a successful ESCO (Energy Service Company) is the 10 MW solar thermal plant at the Boormalt malting factory in Issoudun in southern France that started operation in the first half of 2021.



Success Factor 2: Innovation

A high number of SHIP plants use flat-plate collectors, but there is a growing trend toward SHIP systems using evacuated flat-plate collectors or parabolic trough collectors to provide higher temperatures above 100 °C. The big advantage of these collector fields is that they can be integrated into the supply line on the utility side of the industrial plant. In these cases, you work with the facility manager instead of the production manager. It also means that a larger proportion of the heat demand can be covered, thus achieving economies of scale. The next area of innovation is expected to be hybrid solutions with heat pumps and seasonal storage and combined with sources of excess heat.

Solar process heat system for Martini & Rossi, with a capacity of 0.42 MWth, is equipped with high-vacuum flat plate collectors, Turin, Italy. Photo: TVP Solar, Switzerland.

Success Factor 3: Multiplication, Standardization

For the last success factor, Wolfgang Gruber-Glatzl looked to Mexico – the largest SHIP market in terms of the number of installed systems worldwide, where two dominating technology suppliers have optimized their selling points. Standardization has reduced planning costs. And high replicability makes their solutions competitive. It will be important that other SHIP providers reach this tipping point to accelerate their business and expand the SHIP market globally.

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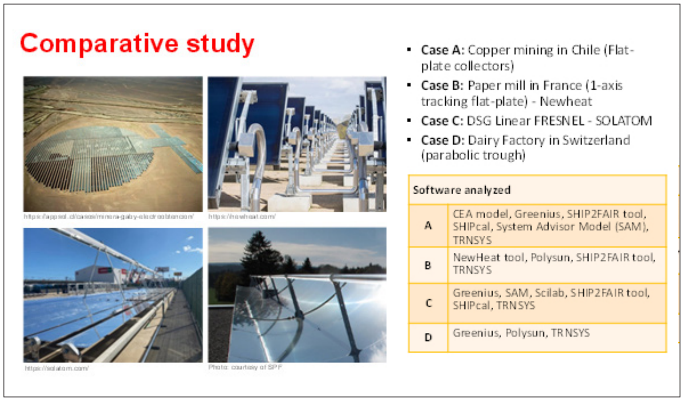
SHIP Plant Simulations

Alan Pino from the University of Seville spoke about the ongoing work on simulation and monitoring tools for assessing the potential benefits of SHIP plants. One area of work is a comparative study of different simulation tools to assess the plants' yield. In the first quarter of 2023, SHC Task 64 will publish the report, Guideline for Yield Assessment in SHIP Plants: Uncertainties derived from the simulation approaches. Solarthermalworld.org will post a news article once the report is published.

This article was contributed by Bärbel Epp, editor-in-chief of solarthermalworld.org.

Photo: Inventive Power SAPI de CV



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