HÖGA KUSTEN INDUSTRIGRUPP

ABSOLICON SOLAR COLLECTOR AB

Absolicon – The obvious choice for your Master Thesis Project

Global warming is the biggest threat to society as we know it and the dominant cause for this is our consumption of fossil fuels. The hype around electric cars and solar cells suggests that most people are open to the idea of change towards more renewable options.

However, what is often overlooked is the fact that the energy usage for heating and cooling (thermal energy) equals that of electricity and transport combined[1]. You can help solve this part of the climate challenge!

Absolicon Solar Collectors is a stock market listed company in Härnösand with 25 employees working towards changing heat production in industry from fossil to solar. We sell the Absolicon T160 the most efficient solar concentrating collector in the world, producing heat up to 160°C. This makes it suitable for industrial process heat and district heating. Industrial process heat below 150°C constitutes roughly 7 % of the total energy demand, making it an immense market.

Absolicon's business plan is however not to sell solar collector fields across the globe. It is rather to sell production lines for licensed mass production of our solar collectors. The production line is robotized and capable of producing 50 MW (100 000 m^2) solar collectors per year. For a short introduction of the production line, see the link below.

https://vimeo.com/absolicon

Solar energy projects in an international environment

Considering that we have developed our products from scratch, it should come as no surprise that we put a lot of effort into research and development. Our work up until today has given us the best solar collector in the world, and we strongly believe that continued efforts in this area is the key to staying one step ahead of our competitors. As a result, we have many active or planned R&D projects in which a master thesis project could be conducted.

As we are expanding our sales and marketing department rapidly, we also offer projects towards marketing and market analysis. We have a long history of supervising master thesis projects and have found that the best way of defining a project is in discussion with the student.

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Solar industrial heating with a hybrid solar collector´s configuration and sand-based storage: Dynamic simulation and techno-economic analysis (30 cr)

Background

The industrial sector accounts for approximately 30 % of the total energy consumption in the OECD countries. The major share of the energy that is needed in industrial companies, services and agriculture is used for heating and cooling of buildings and for production processes at temperatures from ambient up to approx. 200 °C. The decarbonation of this heat demand is key to make our industries less carbon-intensive. In European framework ”Fit for 55”, several technologies are identified wich can play a major role for the transition to sustainable industrial energy system. Solar thermal is one technology, which make use of solar irradiance to produce heat with very low carbon foot print. A significant interest is seen all around the World for solar heating technologies in process heating application. Given its importance, IEA SHC has started task 64 to further create a knowledge base for industries and technology suppliers. Out of all available solar thermal technologies for medium temperature applications (upto 160 $_{o}$C), the parabolic trough is the most popular solar concentrating technology, used in the vast majority of new projects. Most of these projects provided heat for processes and steam networks in industry. Furthermore, Photovoltaic thermal (PVT) technology also is growing significantly and can meet heating demand in low temperature range, along with production of electricity, resulting in high area specific yields.

Research problem

To increase the share of solar heating in industries, storage is the center of the puzzle. The mischmatch in solar production and customers´s load demand brings thermal energy storage in the energy equation. However, the temporal variation in supply, and demand, bring the necessity to optimize the storage volume. Therefore, to obtain a higher solar fraction, usually, 2 possibilities exist:

- To have a very high storage capacity with a low storage utilization factor
- to Spill some energy to optimize the storage volume

Both the above options increase the Levelized cost of heating (LCOH) at high solar fraction. Therefore, the solution around this is to create a complete package of various solutions which may include a large, and cheap storage, and the use of multiple energy sources (solar thermal, PV, PVT), etc to meet a larger portion of heat demand. A storage solution is developed by Polar Night Energy, a company based in Finland. They have developed a solid, sensible heat-based storage with a temperature range from ambient up to 700 degrees Celsius. The storage medium is sand, or other low-cost solid material. The heat is transported via a patented piping system. This solution can be charged effectively using resistance heating, further powered by PV/PVT. A combined parallel solution of solar thermal, and PV/PVT driven sand based storage can be strong potential to cover a large part of industrial demand, and therefore the techno-economic evaluation is the scope of this thesis.

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Aims and Methodology

This project aims to evaluate the techno-economic feasibility of a hybrid solar thermal + PV (T) collector combination along with a sand-based storage system for process heating applications. The methodology will be finalized for specific aims mutually agreed by the student together with the supervisors at the beginning of the project. The tool to be used will be TRNSYS for model development, and Excel for economic calculations.

- A good starting point would be a literature review to establish an understanding of industrial process hearing, various system typologies, and storage types. A specific focus can be more on previous studies related to hybrid solar integration, and the control strategies used for such plants.
- Further development of TRNSYS model to evaluate the hybrid system configuration. This might involve parametric study on component, and system level. The analysis should answer if the combined Solar thermal + PV driven heating using a sand-based storage system can be effective for a range of boundaries conditions (various climates/load profiles/economic boundaries)
- Optimization and sensitivity analysis of hybrid configuration for range of boundary conditions, and finally the Economic feasibility of proposed hybrid configuration, and comparison with a reference case study.

Partners: This work will be in collaboration with Polar night energy (Finland), and Absolicon solar (Sweden).

Supervisors : Puneet Saini (puneet@absolicon.com) , Johan Heier (jhe@du.se), Markku Ylönen (polar night energy)

More info

Polar night energy https://polarnightenergy.fi/
IEA SHC task 64 https://task64.iea-shc.org/about
More on solar heating https://www.iea-shc.org/solar-heat-worldwide