

Intelligent energy solutions

Researchers at the Competence Center Thermal Energy Systems and Process Engineering of the Lucerne University of Applied Sciences and Arts provide innovative thermal energy efficiency solutions

The Lucerne University of Applied Sciences and Arts is one of seven universities of applied sciences in Switzerland, fulfilling its mandate in the four areas of education, continuing and executive education, research and development, and services. The bachelor's and master's degree programmes follow the requirements of business, culture and civil society and prepare students for the needs of the job market. The university's school of engineering and architecture is one of six departments at the university and covers a diverse range of disciplines, including architecture, civil engineering, building technology, electrical engineering, mechanical engineering, medical engineering, business engineering and energy systems engineering. The university performs at the highest technical and academic levels in applied research, acting as an innovation partner for many companies in Switzerland and abroad. There are a total of 14 competence centres that work together with private industry, institutions and authorities to create new and practical innovations, products, solutions and concepts as part of their research projects. Two key research themes encompassed by the competence centres include 'building as a system' and 'intelligent energy solutions'.

Energy solution research

The energy solution research work and services at Lucerne's School of Engineering and Architecture support commercial enterprises in their efforts to play a role in the energy turnaround. Such support includes the development of systems, processes and products that are sustainable and energy efficient throughout their entire lifecycle. Together with business partners and other academic institutions, the university is strongly committed to national energy research within the context of the Swiss government's Energy Strategy 2050 and is an active contributor to the Swiss Competence Center Energy Research (SCCER) programme. In addition, partners in the private and public sectors benefit from the experience gained from the significant number of



past and ongoing research projects as well as from networks maintained by the university with numerous research institutions both in Switzerland and abroad.

CC Thermal energy systems and process engineering

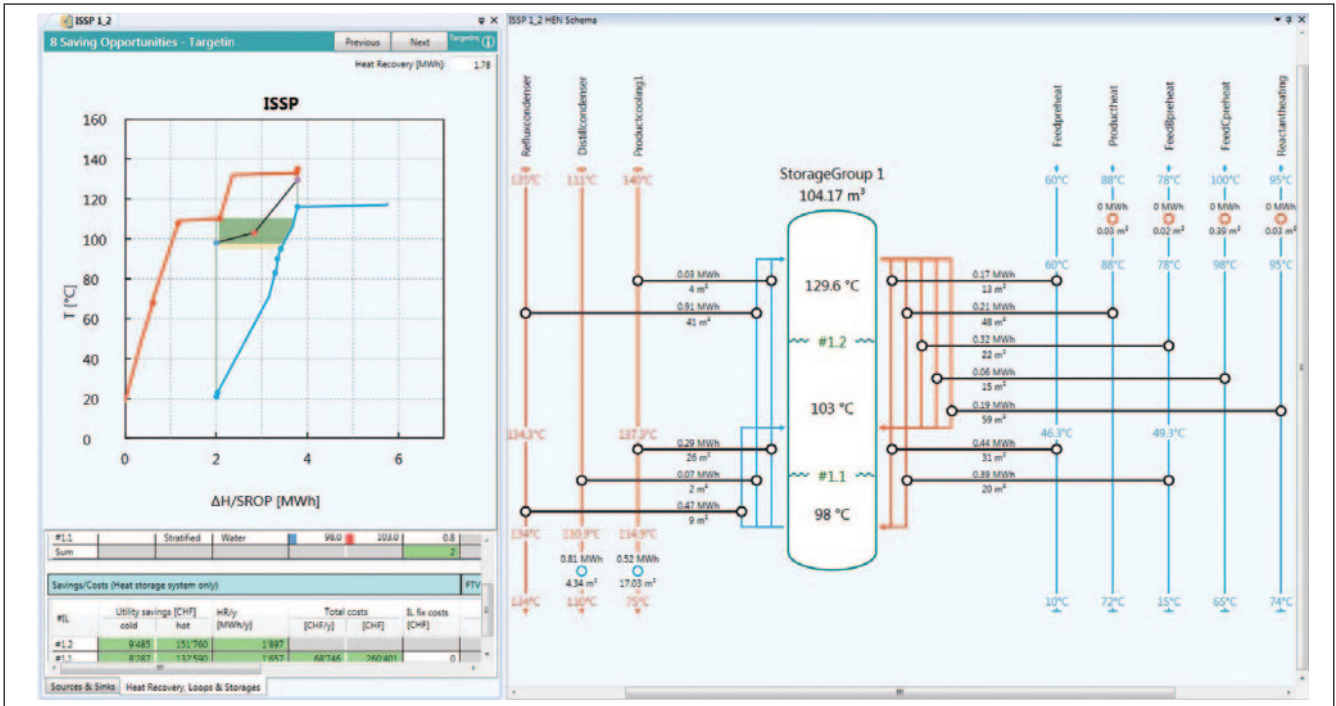
The Competence Center Thermal Energy Systems and Process Engineering is a leader in providing innovative and practical energy solutions in industry and buildings. Its experts develop and optimise concepts, technologies, software and equipment for efficient and resource-saving processes and products. Our areas of expertise include, in addition to thermal energy systems and process engineering, heat pump technologies, thermal energy storage systems, process integration and pinch analysis, as well as bioenergy processes for heat and power generation. In addition, teaching activities and state-of-the-art laboratory facilities support the work we do in these areas. The key focus is to provide high-end research and development as well as services in the fields of energy, processes and environmental engineering.

Reducing energy cost and CO₂ emissions

Rising energy costs and environmental incentive taxes mean that industrial companies must increase energy efficiency to remain competitive. Production processes should not only have maximum profitability but also conserve resources and produce low CO₂ and other emissions. In a related manner, industrial energy use constitutes a significant proportion of most European countries' total energy requirements. In many cases, the percentage is 20% or more, of which more than half is used solely to meet the need for process heating. Therefore, internal process heat recovery is central to increasing energy efficiency in order to achieve the desired benefit of reducing energy costs and CO₂ emissions.

For industrial process operation with significant heating and cooling requirements, a powerful approach to increasing the energy efficiency is to use process integration techniques. A particular popular and practical method is to use pinch analysis to meet this need of energy efficient and cost effective operations. The method provides a holistic approach that focuses on the entire production process and infrastructure, including the energy supply system. The analysis can even be extended to include multiple processes or companies to provide a total site analysis. Overall, the method provides answers to the following questions:

- What are the energy requirements of a fully optimised process?;
- How can the energy supply system be optimally integrated into the process?;
- What is the economic optimum for the investment and operating costs?; and
- How can this optimum state be achieved?



Pinch analysis avoids the imposed limitations when just focusing on optimising the individual unit operations. Experience has shown that the optimal combination of energy flows to recover heat in the overall process can achieve a greater efficiency increase than the often costly efficiency improvements of individual components. Proven results for the overall potential for reducing primary energy demand based on a pinch analysis is up to 40%.

Software PinCH 3.0 – a unique engineering tool for the praxis

The Competence Center Thermal Energy Systems and Process Engineering has worked closely with the Swiss Federal Office of Energy to develop the engineering tool PinCH for the practical application of pinch analysis. The user-friendly software enables the user to quickly and easily apply pinch analysis in a systematic and convenient manner and is being used in industry as well as in teaching and educational courses.

Presently, the PinCH software focus has been on the analysis and optimisation of direct heat recovery systems for continuous processes, traditionally the most significant energy consumers. However, additional capabilities are available for analysing time-dependent processes such as batch or semi-continuous operation for direct heat recovery opportunities. Although the present version of PinCH provides powerful functionality for the marketplace, it has only a limited amount of support for the analysis and optimisation of indirect heat recovery (IHR) systems involving thermal energy storage.

To meet the need for thermal energy storage design, the latest version (3.0) of the PinCH software has been developed. This version provides unique and leading technology for the conceptual design, costing and integration of thermal energy storages in batch and semi-continuous processes. It uses as a basis pinch analysis to enable powerful new functionality that supports a systematic workflow to evaluate indirect heat recovery

opportunities. This workflow can be easily applied sequentially or in parallel with the direct heat recovery assessment.

Key features include the design of the storage network based on the indirect source sink profile, thermocline development in the loading/unloading profile, storage capacity limitation effects charts, heat exchanger and storage network schema, etc. Altogether PinCH 3.0 provides a unique and first in its class capability to systematically design practical heat storage systems to be used in industrial processes based on the sound principles of pinch analysis.

In addition to the software, we have, together with the support of the Swiss Federal Office of Energy, established a Process Integration/PinCH Center. The centre provides comprehensive support to industrial companies and engineering firms in the fields of process integration and pinch analysis. Our comprehensive services include courses, individual and company-specific training, consulting, coaching and pinch analysis services. These activities are key to promoting pinch analysis in industry and eliminating barriers to greater industrial energy efficiency.



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