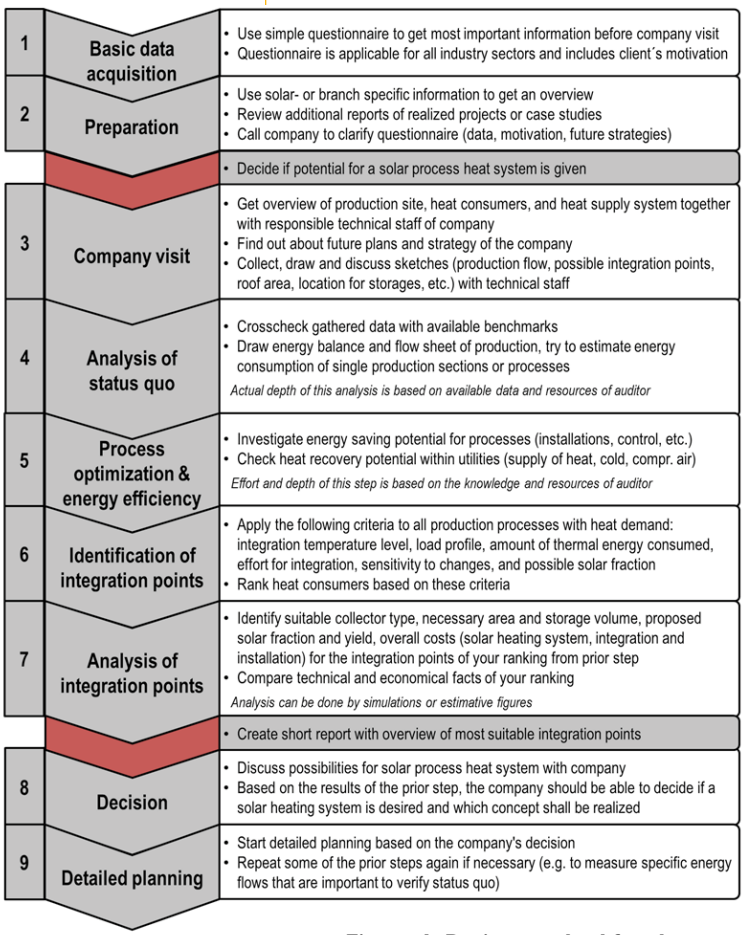
Guidelines Developed for Process Heat Integration

Solar planners, energy consultants and process engineers now have access to a general procedure to identify and rank suitable integration points and solar thermal system concepts when integrating solar heat into industrial processes. The guidelines were developed within SHC Task 49: Solar Heat Integration in Industrial Processes.

Integrating solar heat is possible at several points in the heat supply and distribution network of an industrial production site. Basically, integration points are on the supply level (including all processes for the production and distribution of heat) and the process level (including all operations performed on the process level, including the transfer of heat to basic operations). Due to the complexity of the industrial thermal energy system and the variety of integration possibilities, a methodology was defined for the best possible approach when integrating solar process heat systems in industrial processes. This methodology builds upon existing methods and experiences of various projects and *IEA SHC Task 33: Solar Heat for Industrial Processes.*

In Figure 1 the steps of the Assessment Methodology for Solar Heat Integration are shown. The purpose of the pre-feasibility assessment is to quickly find out if solar heat can be used in a company. Based on a few key data (temperature level of consumed process heat, the available roof or ground areas for solar heating systems, the production times, and the investment policy of the company) a decision can be made to use or not to use solar heat. The feasibility study (Steps 3-7) includes a company site visit to obtain an overview of the production site, heat consumers and heat supply as well as future plans and the strategy of the company. At this point, it is useful to collect, draw and discuss sketches (production flow, possible integration points, roof areas, location for storage, etc.) with the technical staff of the company. Based on the collected information and the relevant data provided by the company, the status quo can be analyzed by comparing the collected data with the available benchmarks and by calculating energy balances and flow charts of the production processes. In this step an attempt will be made to estimate the energy consumption of the individual production or processes. The actual depth of this analysis is based on the available data and resources of the internal auditor. (Schmitt, 2015a).



▲ **Figure 1: Rating method for the integration of solar process heat** (Schmitt, 2015a).

The three step process – optimization & energy efficiency, identification of integration points and analysis of integration points are described in detail in the *Integration Guidelines*. In order to achieve an efficient integration of the solar thermal plant in industrial processes, the analysis of the measure of process integration (process optimization, heat recovery) is decisive (Krummenacher und Muster, 2015). Process

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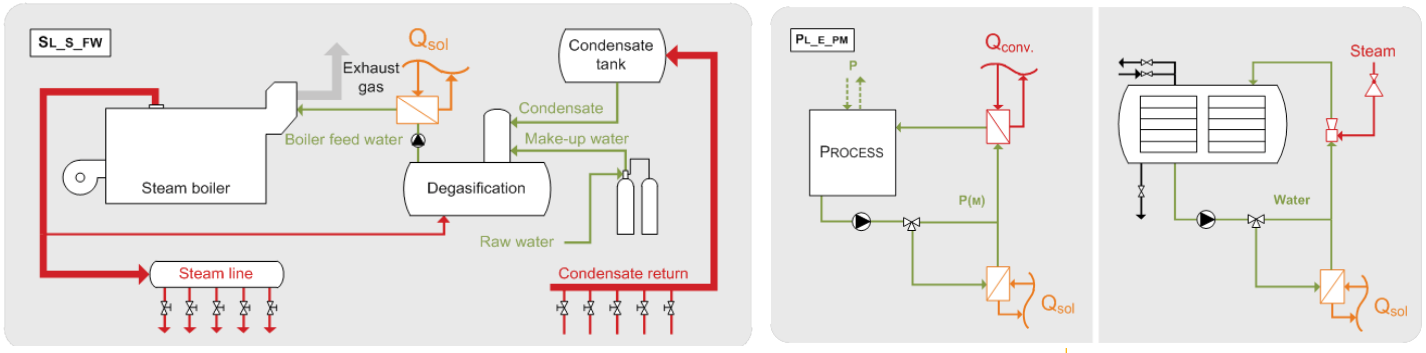
Heat Integration Guidelines *from page 7*



integration provides methodological approaches to the analysis of heat recovery and identification of integration points for a new heat supply. The pinch analysis is a powerful tool to identify promising integration points on the supply and process levels. A crucial point for good planning is the combined simulation of heat recovery and solar installation.

Process integration helps the planner to identify possible integration points for solar process heat. As a next step, a suitable *Solar Heat Integration Concept* must be selected for each of the possible integration points. This Solar Heat Integration Concept shows by which heat exchanger and hydraulic connection solar heat can be transferred to a process based on the existing heat supply technology.

To ensure the fast identification of a suitable integration concept, the *Integration Guideline* presents a classification of Solar Heat Integration Concepts, including the characteristics of individual concepts (Schmitt, 2015b; Schmitt, 2014; see examples in Figure 2).

The Solar Heat Integration Concept can be extended to *Solar Process Heat System Concepts - SHIP system concepts*. These SHIP system concepts describe the whole technical concept of the solar thermal process heating system. All components of the solar thermal installation (collector loop, charging, storage if required, discharging, etc.,) are now, in addition to the integration point, specified and classified. The *Integration Guideline* shows which solar thermal installations can be linked with which Solar Heat Integration Concepts (Helmke and Hess, 2015).

On large industrial sites, several integration points and corresponding Solar Heat Integration Concepts might seem promising. The ranking methodology in the *Integration Guideline*, gives recommendations on how to evaluate the most promising candidates of Solar Heat Integration Concepts before starting detailed techno-economic analyses (Hassine, 2015).

▲ **Figure 2: On the left, Solar Heat Integration Concepts for boiler feed water preheating (SL_S_FW). On the right, integration concept to provide solar heat for processes with an external heat exchanger (PL_E_PM) – general integration flow sheet (middle) and example sterilization process in an autoclave (right).**

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