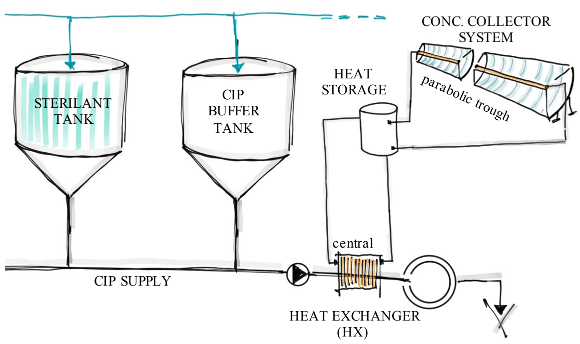
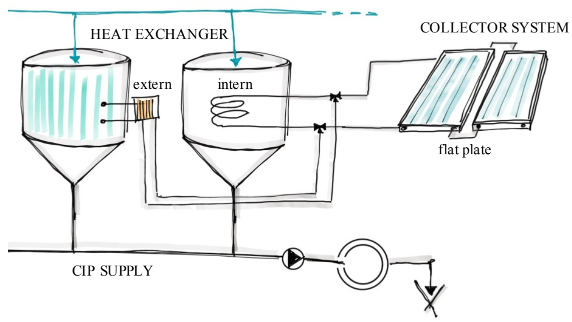
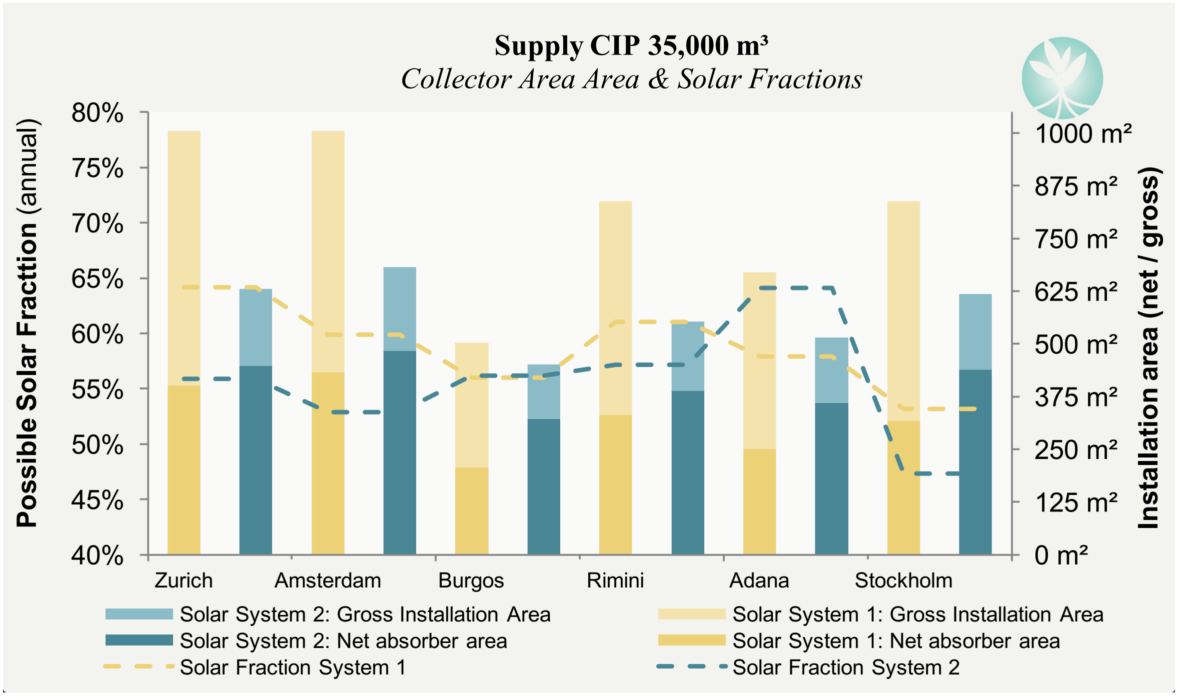
Executive Summary

Despite the general awareness on a positive trend of the renewable energy sector, the use of renewables in the global industry sector is devastatingly small. Nearly all the industrial applications are partially or fully dependent on burning fossil fuels to supply thermal energy. Therefore, it is a key issue to shift the EU towards a low-carbon economy, based on renewable energy sources and energy efficiency.

The undertaken study aims to examine the solarisation potential of aqueous cross-sectoral cleaning processes like the CIP procedure. These are numerously found in the whole FDM (food, drink & milk) industry. By analysing the solarisation potential of such processes a technical implementation approach needs to be done in the first place. Therefore, general *System Design Requirements* were determined and further used to design two different design approaches for the inclusion of solar thermal energy. The maximum monthly average of daily solar yields was set as main design parameter for both systems. This approach leads to a minimum of overproduction hours during summer time, which simplifies control procedures. Furthermore, it can be assumed that every kWh which is supplied by the solar thermal system is substituting a kWh of conventional supplied thermal energy. Still, each system layout requires a conventional back-up heating system. *Solar System 1* is a high temperature set up, including concentrating collectors and a high temperature heat storage. *Solar System 2* bases on a low temperature application, including flat plate collectors and no additional heat storage unit.

Solar System 1: High-Temperature Implementation	Solar System 2: Constant Water Heating
	
• high supply temperatures (> 100°C) • concentrating collector systems • central heat exchanger unit • instantaneous water heating • storage (steam / molten salt / thermal oil)	• flat plate collectors • decentralised heat exchangers (intern / extern) • low temperature system (< 100°C) • constant water heating • CIP tanks as buffer storage

The following Figure presents the investigation on the solar fraction and required net absorber areas as well as the total gross installation area for both solar systems at six European sites. In the first place, the higher efficiency of the concentrating collectors of *System 1* leads to smaller net absorber areas (dark yellow). But by applying its specific GIF (gross installation factor) this leads to an increased gross installation area (light yellow) compared to System 2. For *System 1* a GIF of 2.2 was applied for *System 2* only 1.4. The increased GIF for System 1 can be traced back on a more extensive installation set up which requires more space than horizontal installation of flat plates. Furthermore, also the collector unit sizes need to be considered in the system set up.



The solarisation of the CIP-process takes place as solar thermal support of the process – but at best as a 100% coverage. The degree of solarisation which can be achieved for such a process is measured as the *Solar Fraction*. The overall reduced complexity of *Solar System 2* and the fact that the installation effort and especially the total space demand for a flat plate system is significantly smaller compared to the requirements of *Solar System 1*, clarifies that *System 2* is the more reasonable solution. Considering that a few general assumptions and simplification were undertaken to achieve an overall potential analysis for the solarisation of CIP-processes all over Europe, the annual fraction may vary between 50% - 60%. Assuming that only 10 - 20% percent of European industrial production sites could implement a solarisation of the CIP-processes, this would already lead to total energy savings of 5 – 15 PJ in Europe per year. Moreover, by applying a standard CO2-Emission-Factor from the IPCC for the fuel combustion[1] of natural gas, which is 0.202 t/MWh[2], this could save 268,000 – 839,000 tons of CO2 emissions per year.

[1] A boiler efficiency for the supply of thermal energy is assumed with 90%

[2] ELCD, The European Reference Life Cycle Database: The Emission Factors. Technical annex