This project has received funding from the European Union's H2020 Coordination Support Action under Grant Agreement No. 894356.

Best Practice	SOLAR THERMAL PLANT	RENE-02
Application	Use of renewable energy production technologies	
SME sector	Industrial	
SME Sub-sector	All	
Technical description	A solar thermal installation transforms solar light directly into heat. The thermal energy obtained from this transformation is used to heat the water required for the uses of the building like DHW (Domestic Hot Water), for space heating or directly for use in the production cycle. As a renewable energy source, low-temperature solar thermal technology has enormous untapped potential. Solar thermal can be supported by other heat sources and combined with storage systems for a guaranteed supply. The integration of solar thermal systems in the industrial process heat can be done in the following ways: • Direct heating of a circulating fluid (e.g., feed water, return of closed circuits, air preheating). • In processes with low temperature requirements. • As an additional source for preheating the feed water of steam boilers. • Direct integration of solar heating in fossil fuel industrial steam boilers. There are three groups of solar thermal technologies: • Solar air collectors, suitable for the food-processing industry to replace gas and oil-based drying. • Solar water systems, installed on rooftops of any industrial building, can be of two types: evacuated tube solar collectors and flat plate collectors. • Solar concentrators (CSP), suitable for electricity generation or high temperature steam for industrial processes.	
Recommendation for optimisation	The average yield range production of Solar Thermal System can vary from 350 kWh to 400 kWh/year/m^2 installed, depending on the efficiency rate, weather conditions and orientation of solar thermal collectors. Factors to be evaluated to optimize the installation of a solar thermal system are: • The availability of spaces for the installation of panels, on the roof or on the appurtenant areas. • The correct size of the storage system.	

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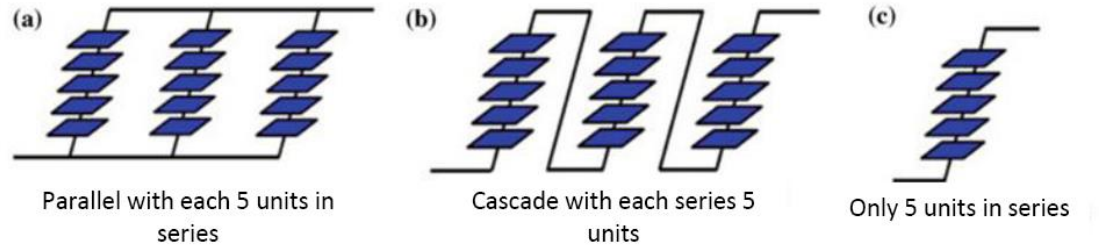
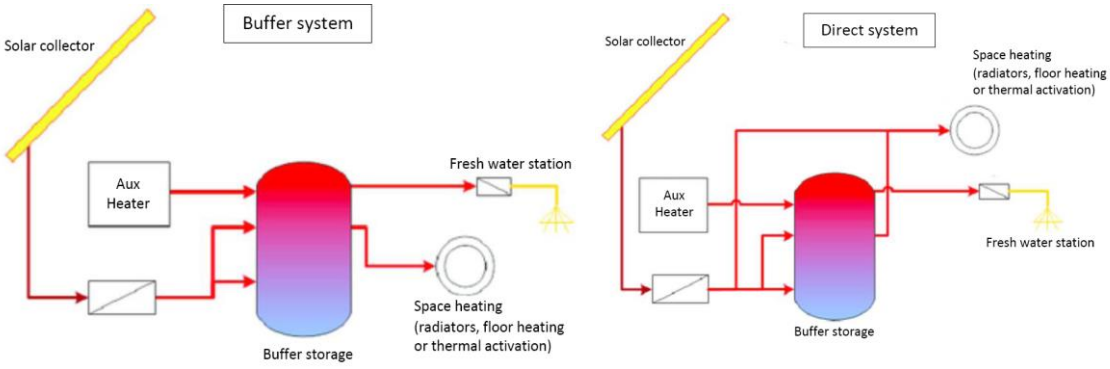
	• The value of heat demand during the day and seasons. The value of tilt angle depending on the use of solar thermal energy (DHW production, integration of heating system, industrial processes, etc.).
Relevant technical considerations	Industrial heating needs can be divided into three main temperature ranges. All these can be achieved with solar. • The lowest temperature range consists of everything below 80°C. Solar collectors can meet these temperatures and are commercially available today. • The intermediate temperature range is between 80°C and 250°C. While collectors serving this level of heat demand are relatively limited, they do exist and are on the verge of emerging in competitive commercial production. • The highest range includes anything above 250°C and requires concentrated solar energy (CSP) to reach those temperatures. With advanced solar heating technologies, temperatures of around 400°C can be produced. Systems such as flat plate collectors (FPC) and evacuated tube collectors (ETC) can produce heat up to 120°C. Extremely high FPCs and ETCs can produce temperatures up to 200°C.
Schemes and diagrams	 Solar collectors parallel and series arrangement. 

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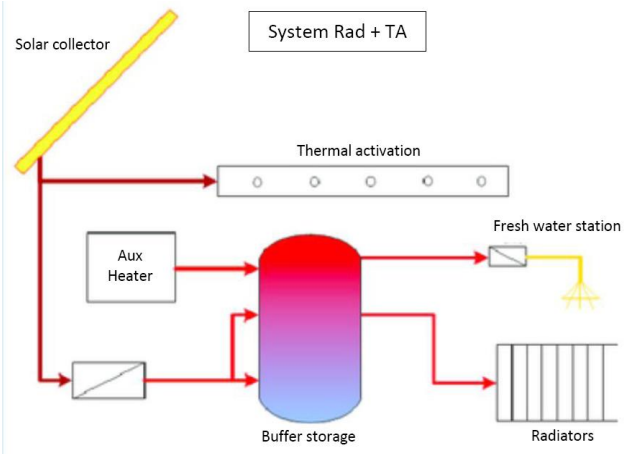
<table>
<tr><td></td><td colspan="2"> 

Different configurations of a solar thermal system.</td></tr>
<tr><td>Economics</td><td colspan="2">• For conventional EPCs and ETCs the costs range between 250-1,000 EUR/kW in Europe.
• Concentrated systems include Parabolic Dish Collectors with costs ranging from 350-1,600 EUR /kW, Parabolic Trough Collectors with costs ranging from 5,500-18,000 EUR /kW, and Linear Fresnel collectors in the range of EUR 1,100-1,700/ kW.</td></tr>
<tr><td>Energy savings</td><td colspan="2">Process solar-powered heating system scan meet up to 20-30 % of the heating needs of an average system.</td></tr>
<tr><td>Economic savings</td><td colspan="2">Economic savings of up to 20-30% on energy costs.</td></tr>
<tr><td>Average Payback Time</td><td colspan="2">3-6 years

The PBT is influenced by several factors that affect the performance of the system, including the efficiency of the solar collectors, proper maintenance and cleaning, and the possible presence of feed-in tariffs for the installation of solar thermal systems.</td></tr>
<tr><td>Emissions</td><td colspan="2">Depending on the location, a 1.4 MW_{th} system (2,000 m^2) could generate the equivalent of 1.1 MWh_{th}/year, a saving of about 175 Mt of CO_2.</td></tr>
<tr><td>Environmental benefits</td><td colspan="2">The environmental benefits come from less use of conventional methods of heat production, such as fossil fuel boilers.</td></tr>
<tr><td rowspan="2">Main NEBs

(Multiple benefits)</td><td>☒ Environmental benefits
☐ Increased productivity
☐ Work environment/ Health/Safety
☒ Increased competitiveness
☐ Maintenance</td><td>The measure can increase the competitiveness of the organization through a better corporate image, a reduction in energy costs and an increase in independence from non-renewable energy.</td></tr>
<tr><td colspan="2">MBenefits pilot case study:</td></tr>
</table>

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	Furniture maker improves reputation and reduces costs by upgrading to solar thermal https://www.mbenefits.eu/static/media/uploads/site-6/library/Cases and examples/mbenefits_pilot_case_study_a4l_501_dekormeble_.pdf
Replicability	Medium • In the industrial sector, solar thermal technology is mainly used for drying processes in the agri-food sector, in washing processes and in dairy plants. • In the tertiary sector it is possible to apply for hotels, laundries, shopping centres, swimming pools.
Related measures	• RENE-01: Photovoltaic • RENE-03: Others: biomass - geothermal energy
Case study	Implementation of the solar thermal system. Dairy industry in Sardinia (Italy, 2015) • Initial Situation: use of fuel oil systems to produce heat for industrial processes. • Description of the optimisation: the plant consists of 992 m^2 (gross area) of Fresnel collector and an installed thermal power of 470 kW_{th}. The solar collectors can produce steam at 200°C and 12 bar, fed directly into the steam system of dairy production without storage, replacing a part of the oil burned in traditional boilers. • Implementation costs: 140,000 EUR • Payback Time: approx. 5 years
References	Glembin et al. 2016 Web link: http://ship-plants.info/solar-thermal-plants/194-nuova-sarda-industria-casearia-italy?country=Italy ESTIF - European Solar Thermal Industry Federation http://solarheateurope.eu/welcome-to-solar-heat-europe/

This Best Practice was developed by the Impawatt Project (GA No. 785041) and adapted for the GEAR@SME Project (GA No. 894356)