



Solar Heat for Industrial Applications

Current state of play



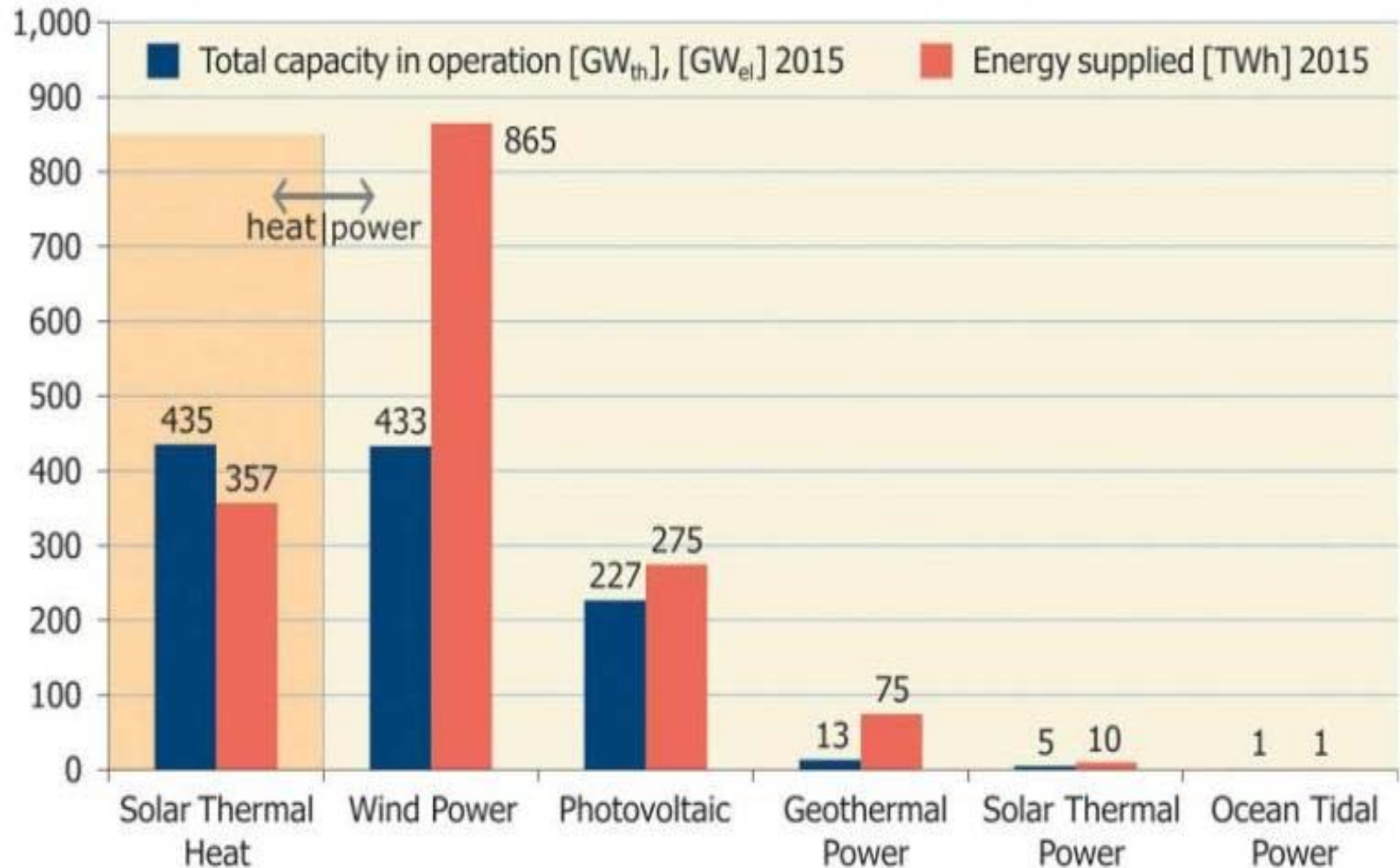
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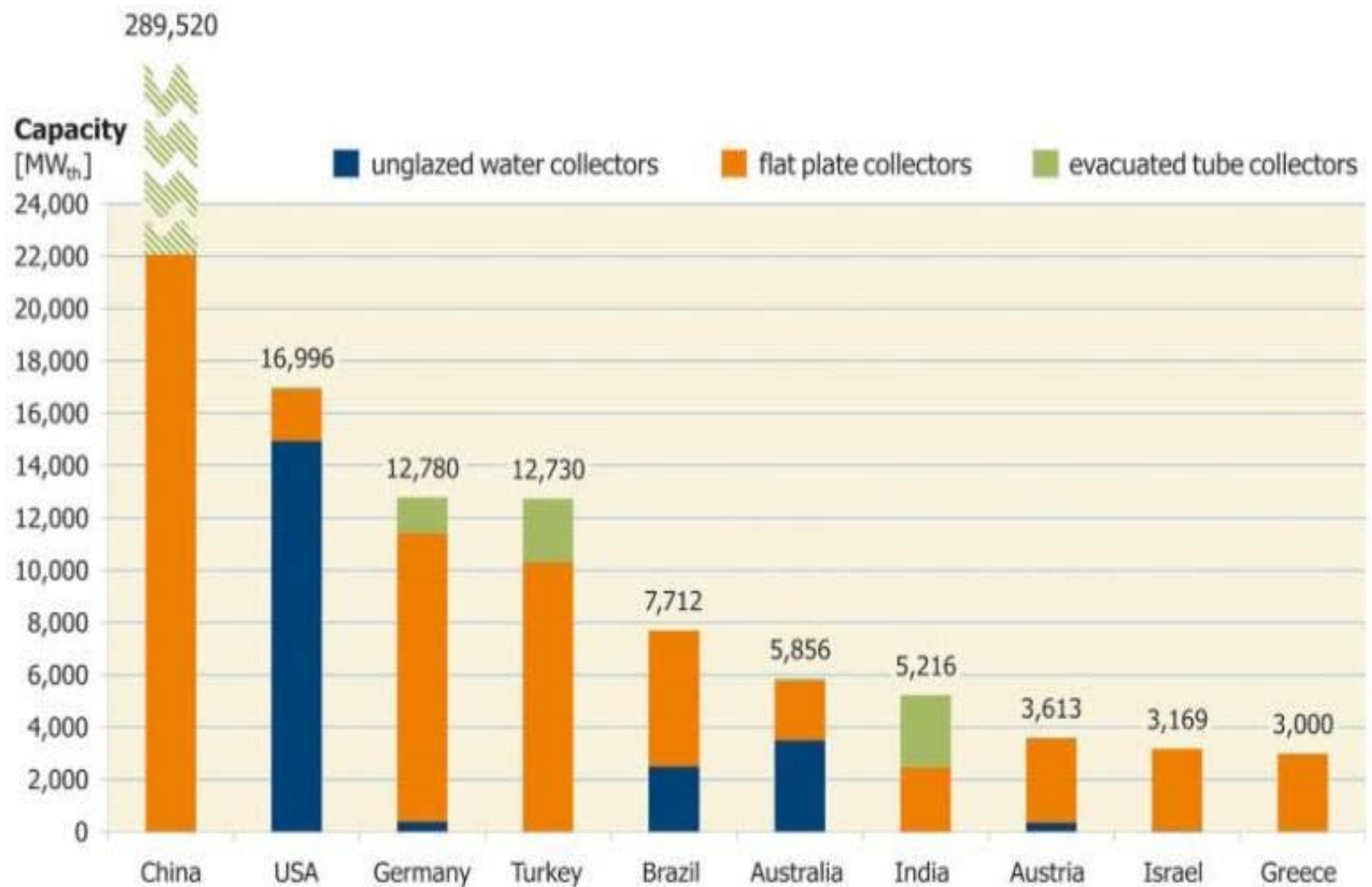
IEA – Solar Heating and Cooling Programme

Global Capacity in Operation 2015

Global capacity in operation [GW_{el}], [GW_{th}], and energy supplied [TWh_{el}], [TWh_{th}], 2015

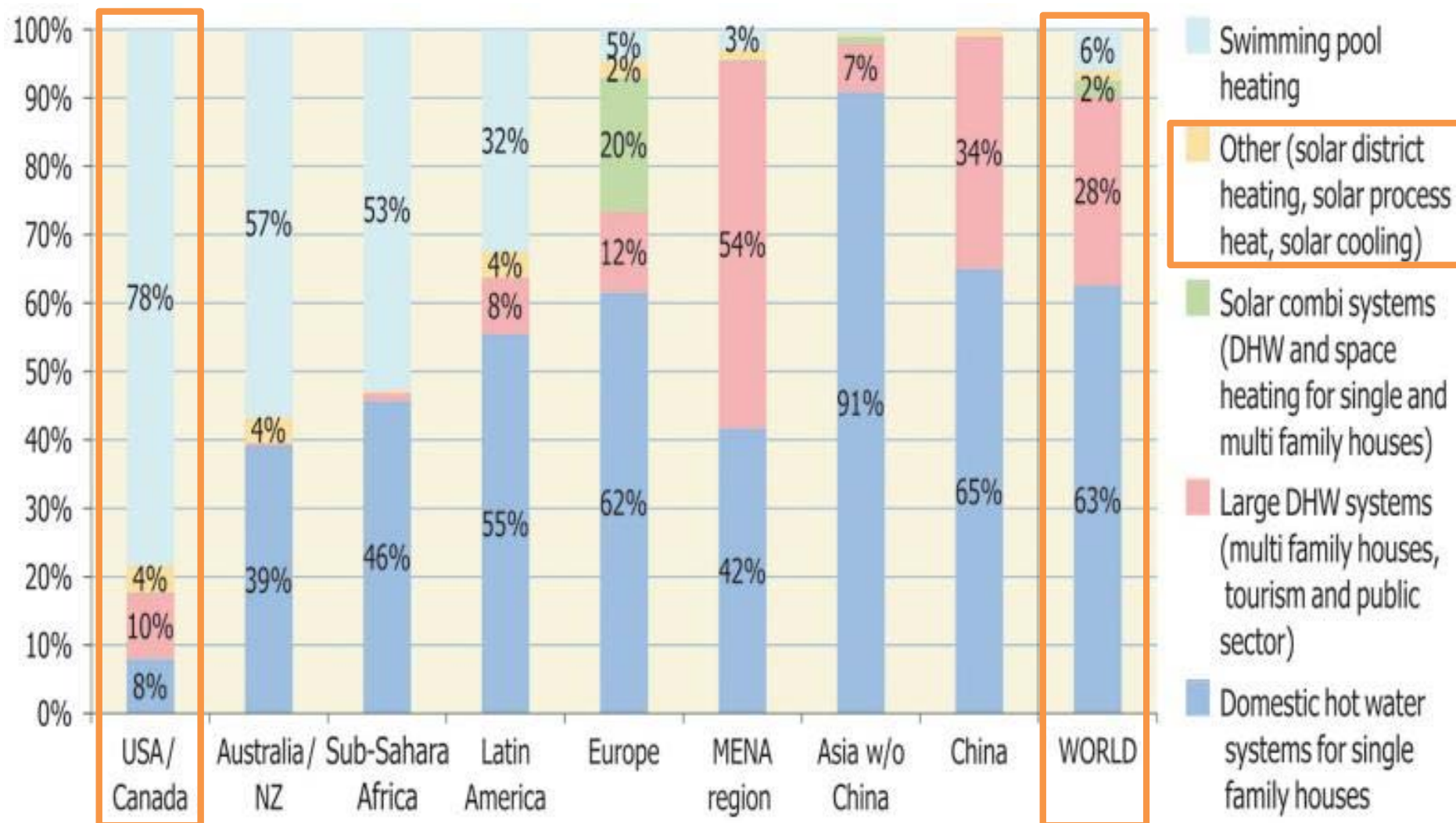


Total installed capacity of unglazed and glazed water collectors in operation in the 10 leading countries by the end of 2014



Distribution by application

for the total installed water collector capacity
by economic region in operation by the end of 2014

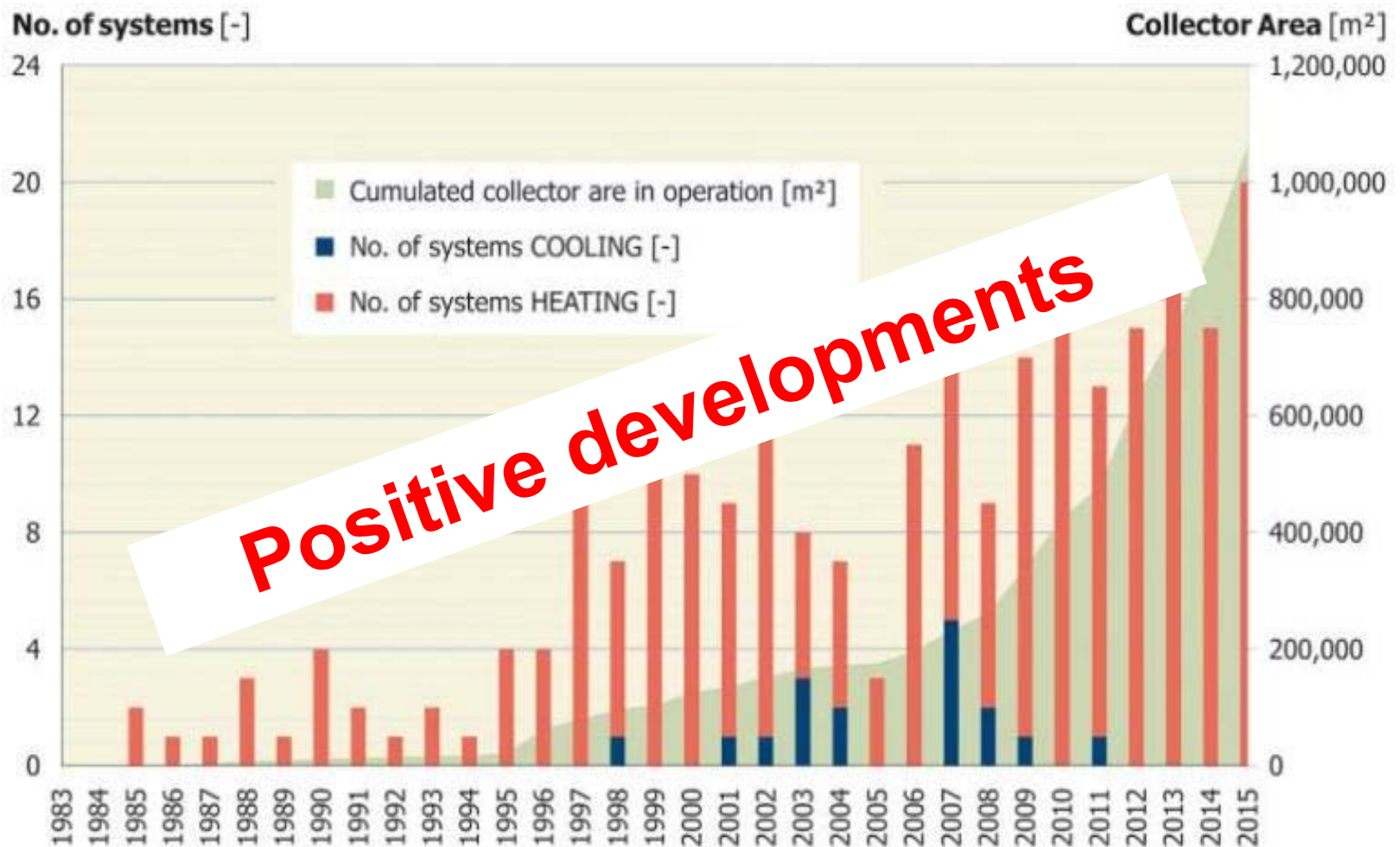




Turnover

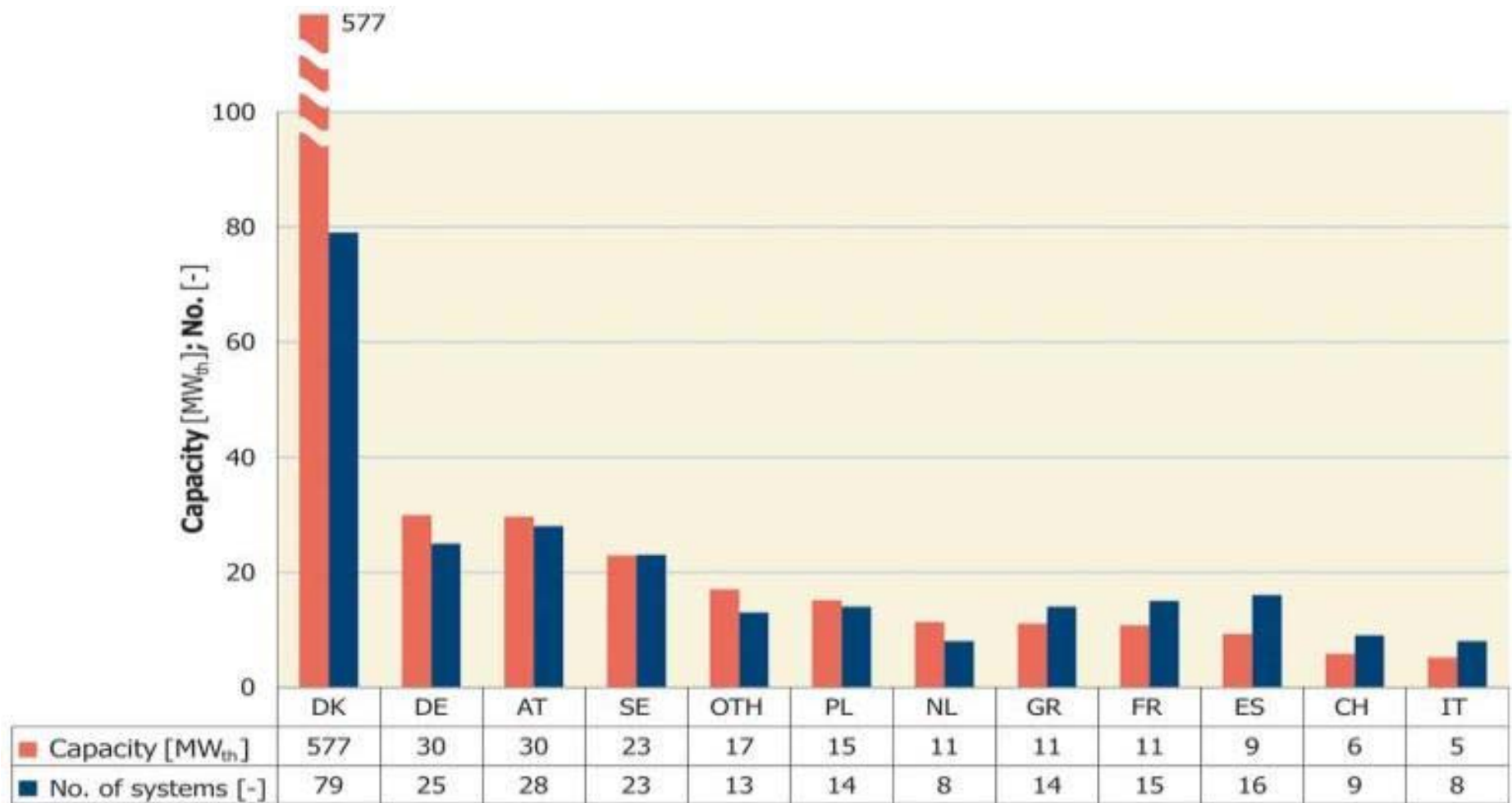
The worldwide turnover of the solar thermal industry in 2014 is estimated at **€ 21 billion (US\$ 24 billion)**

Large-Scale District Heating and Cooling Applications in Europe by 2015



Source: Jan-Olof Dalenbäck, Chalmers University of Technology, DK

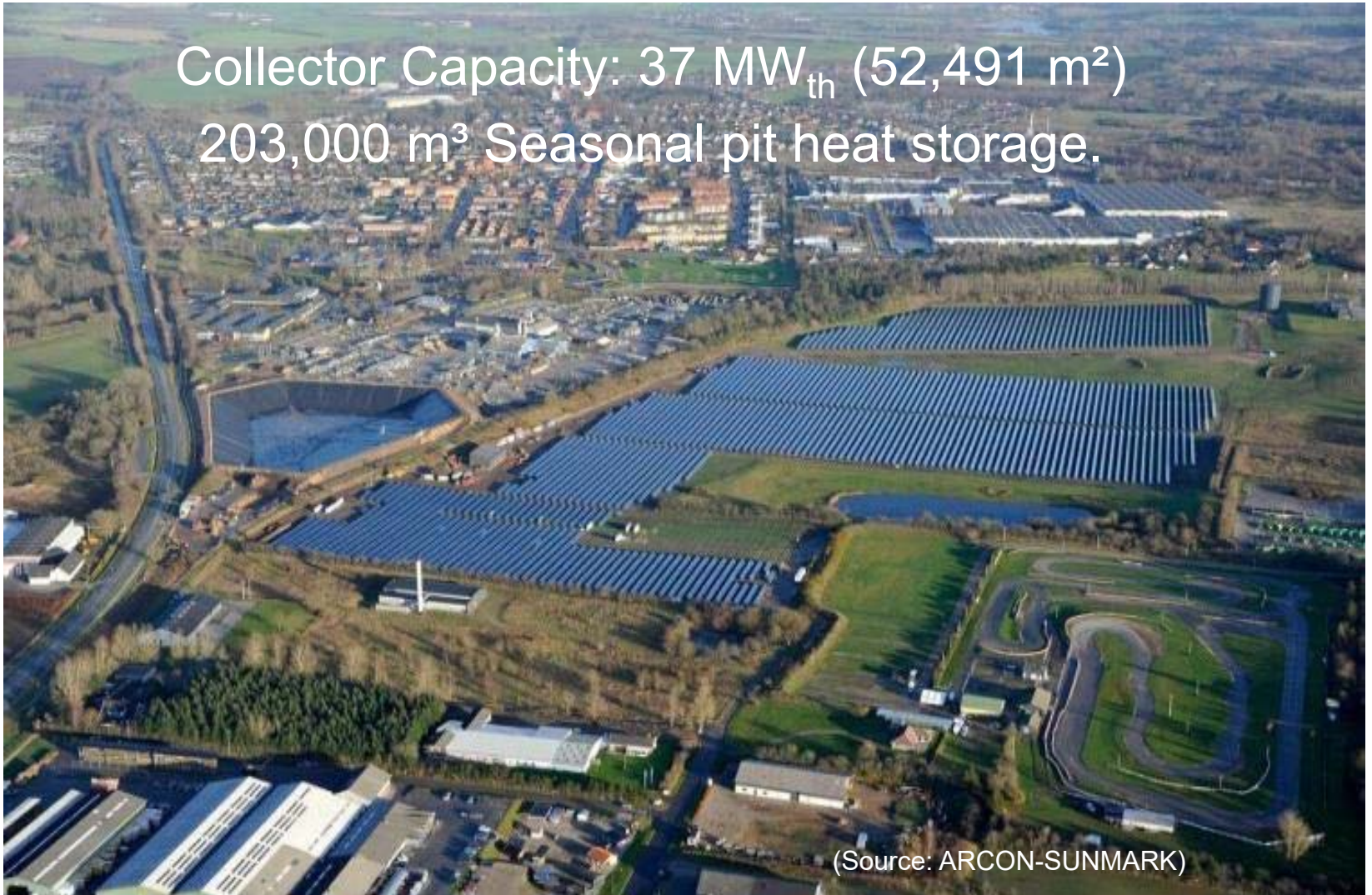
Large-Scale District Heating and Cooling Applications in Europe by the end of 2014



Source: Jan-Olof Dalenbäck, Chalmers University of Technology, DK

Vojens Solar District Heating Plant, DK

Collector Capacity: 37 MW_{th} (52,491 m²)
203,000 m³ Seasonal pit heat storage.





District Heating System, Saudi Arabia

36.000 m² / 25 MW_{th}



District Heating System, Saudi Arabia

36.000 m² / 25 MW_{th}



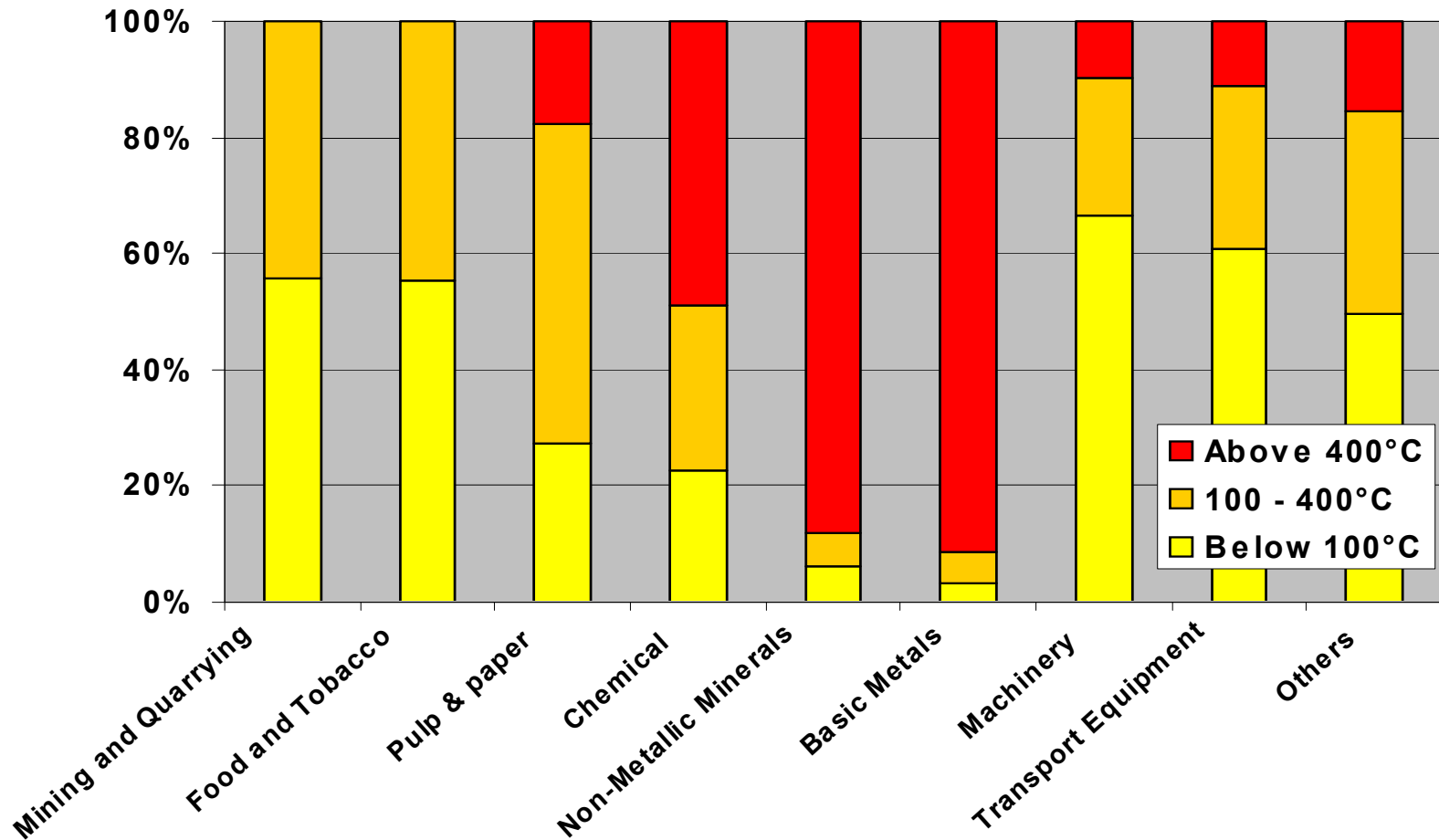
Pipes and Heat Exchangers



An aerial photograph of a massive open-pit mine. The mine's interior is characterized by numerous terraced levels, creating a stepped appearance. The rock faces show distinct horizontal and diagonal strata in various shades of brown, tan, and grey. A dark, winding road or conveyor system traverses the upper levels of the mine. In the lower central part of the image, a body of water, likely a tailings pond, is visible. Several small pieces of heavy machinery, including excavators and trucks, are positioned near the water's edge. The foreground shows the rugged, reddish-brown rim of the mine. The text "SHIP Potential" is overlaid in white, bold, sans-serif font, tilted diagonally across the center of the image.

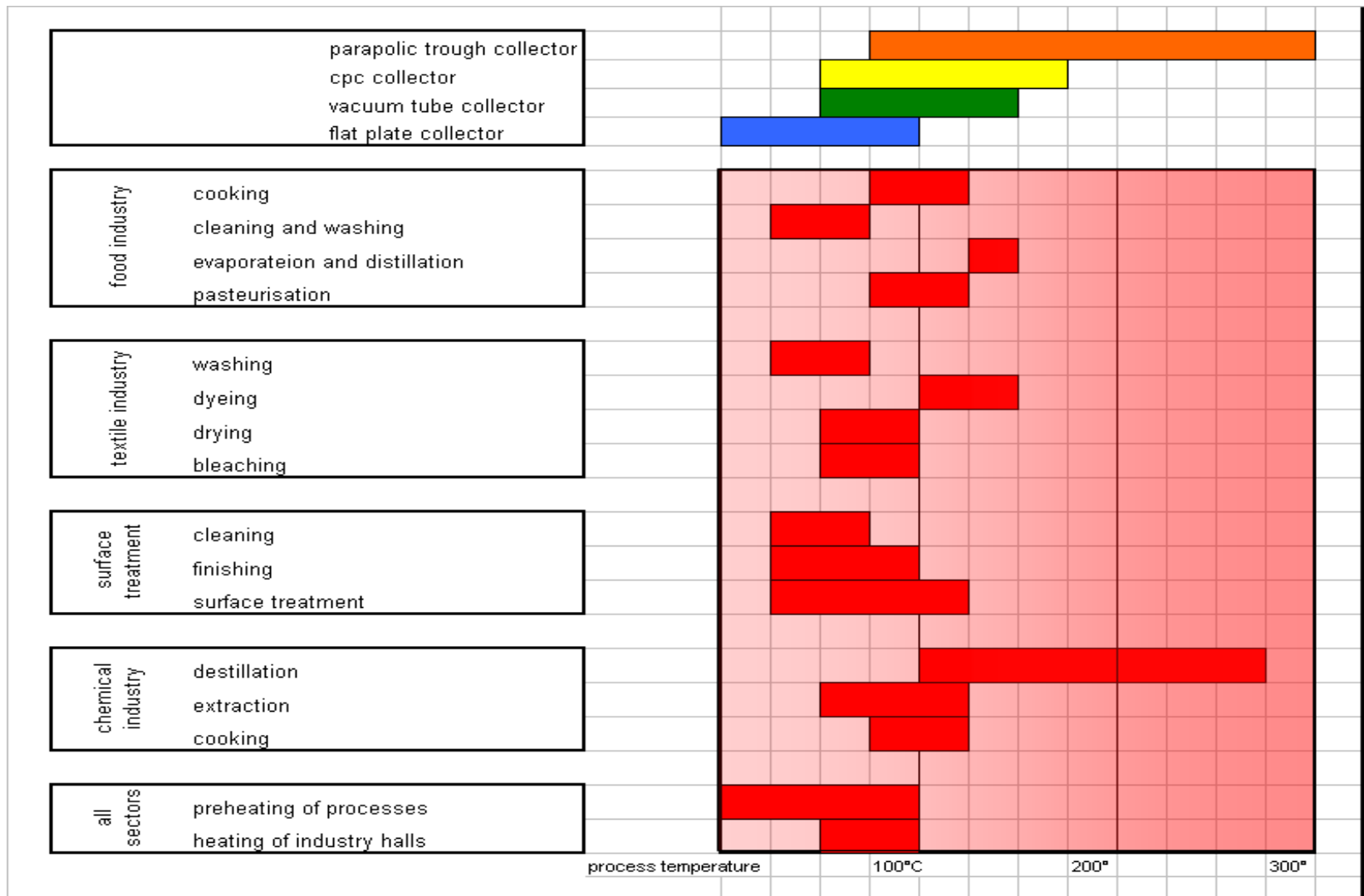
**SHIP
Potential**

Industrial heat demand by temperature level and industrial sector

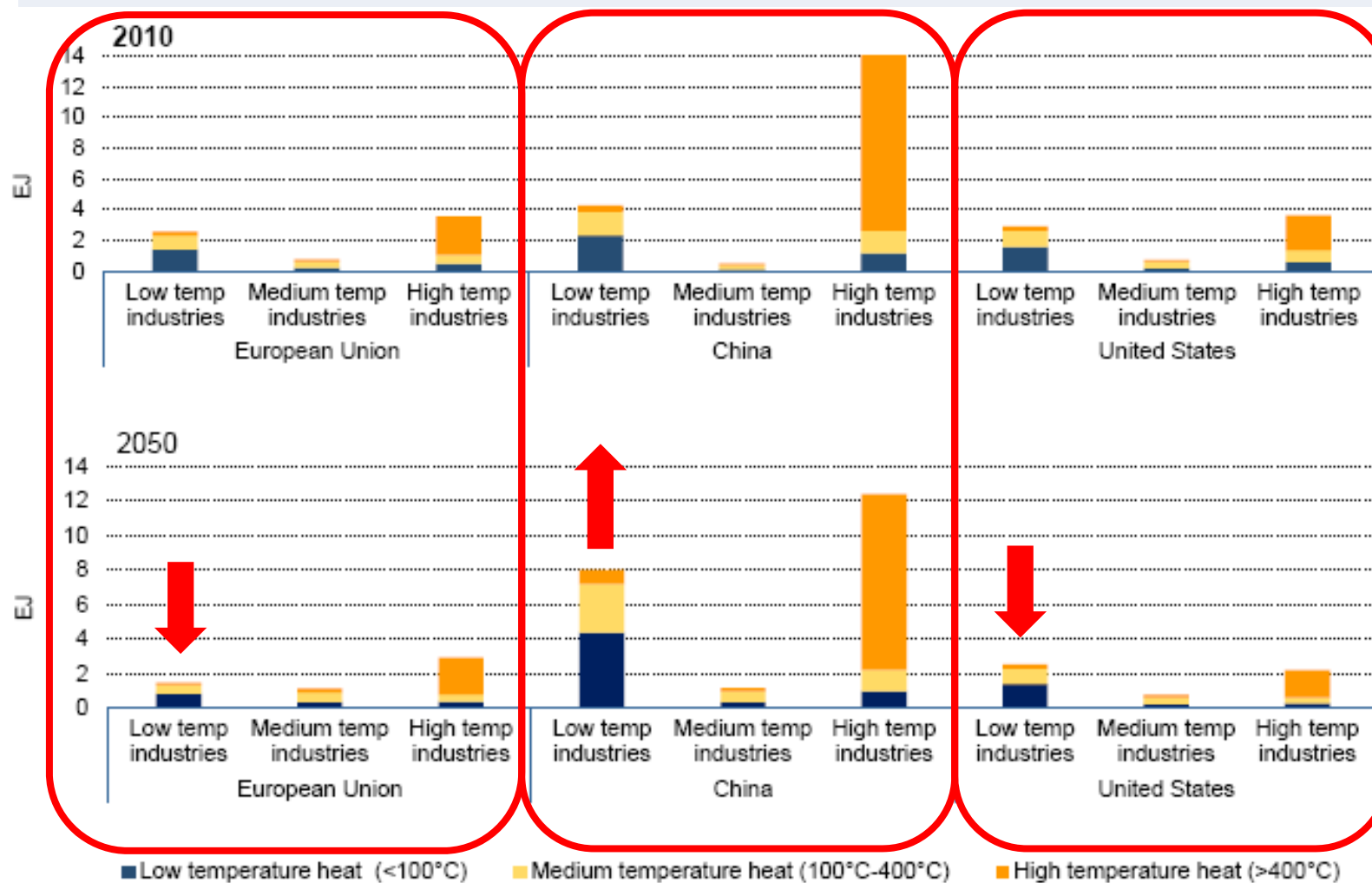


Source: ECOHEATCOOL

Temperature levels of processes

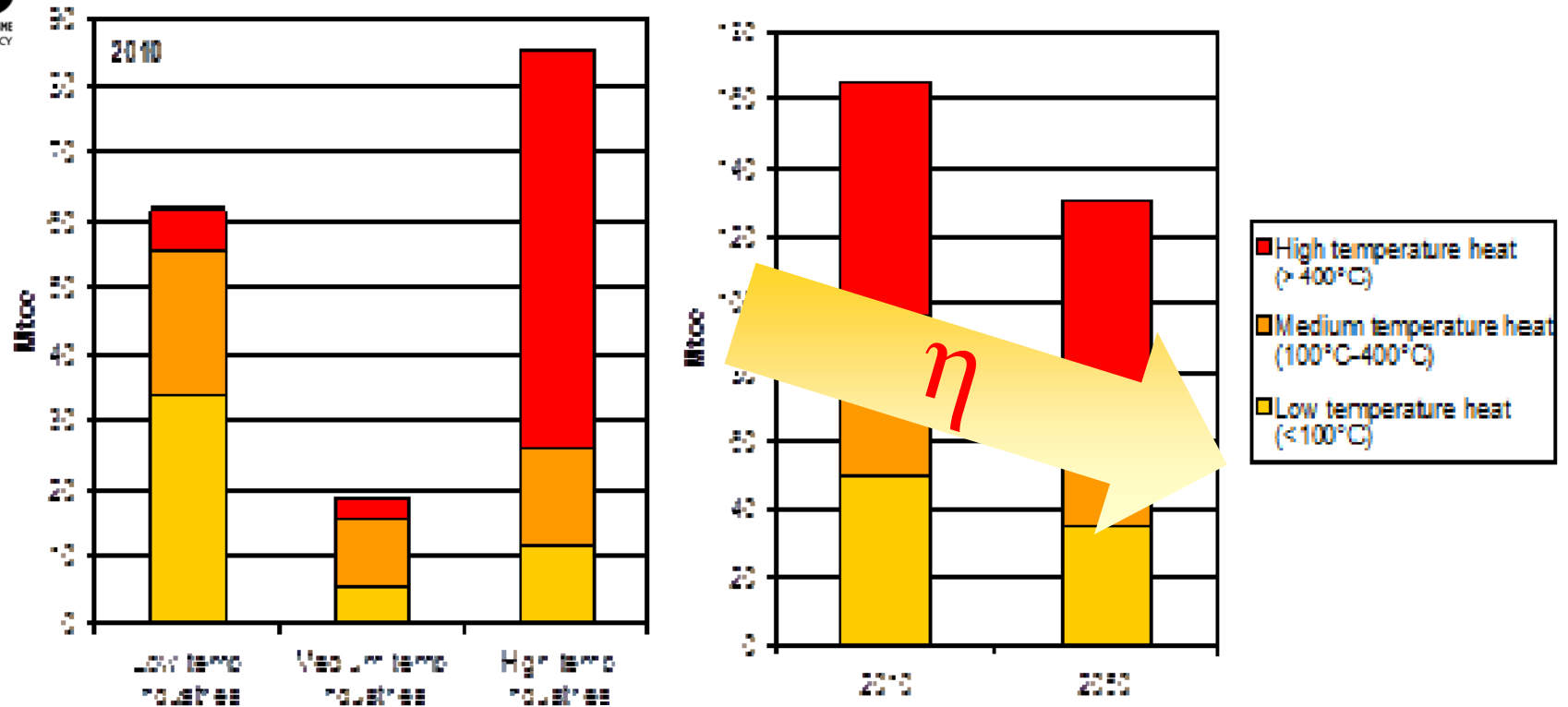


Industrial Heat Demand



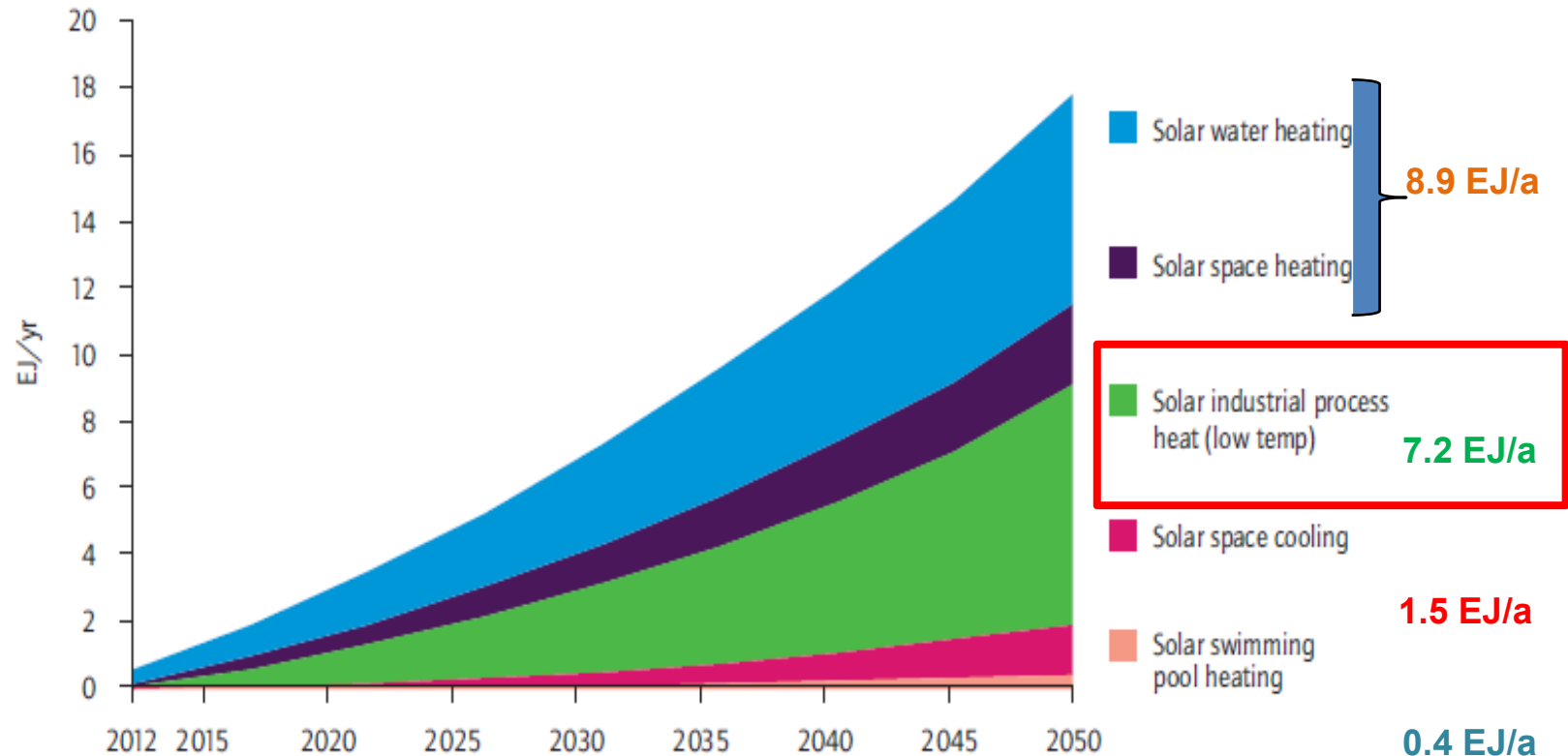
Source: IEA ETP 2012

Industrial heat demand by temperature level and industrial sector



Industrial heat demand by temperature level in the EU in 2010 (left) and industrial heat demand in the EU in 2010 and expected demand in 2050 (right). Source: OECD / IEA (2012).

Potential of solar heating and cooling by sector (EJ/yr)



Solar heating and cooling capacity could produce annually by 2050:

- **16.5 EJ solar heat (16% of TFE low temp. heat)**
- **1.5 EJ solar cooling (17% of TFE cooling)**

Source: IEA Technology Roadmap – Solar Heating & Cooling

Regional solar heating and cooling generation in buildings and industry

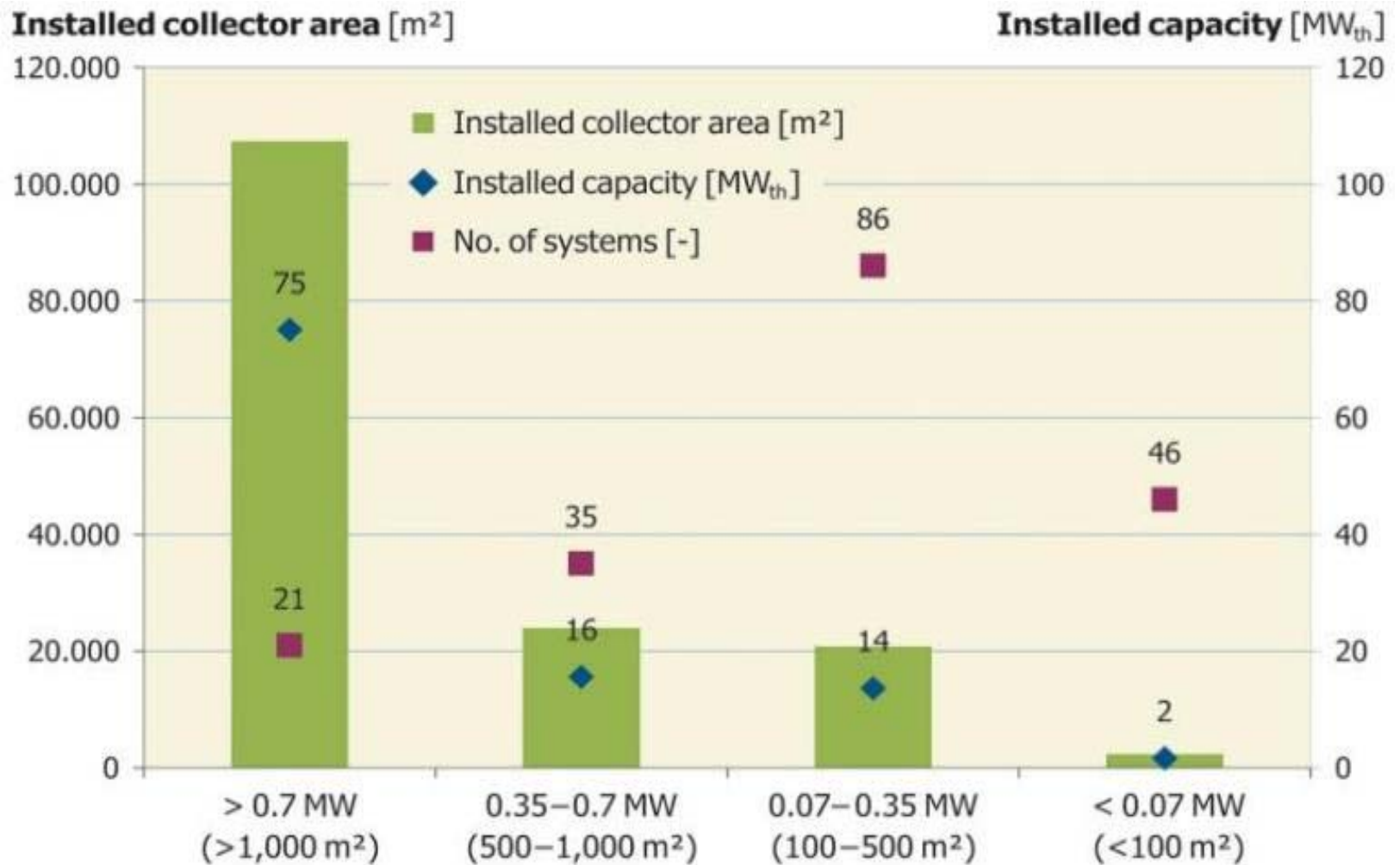


Source: IEA Technology Roadmap – Solar Heating & Cooling



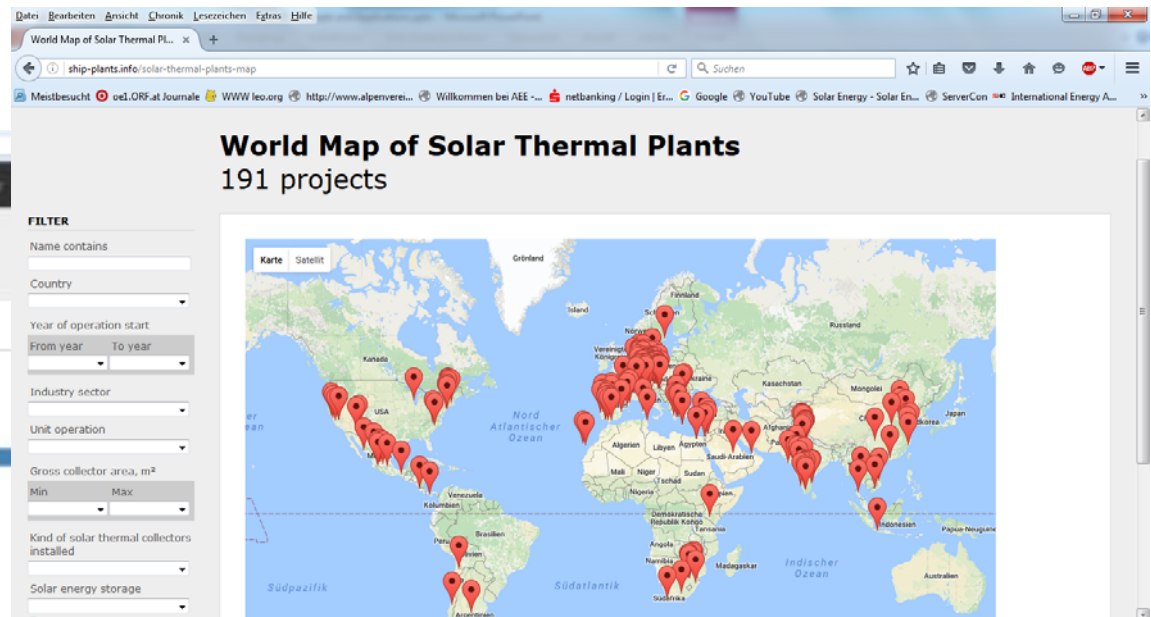
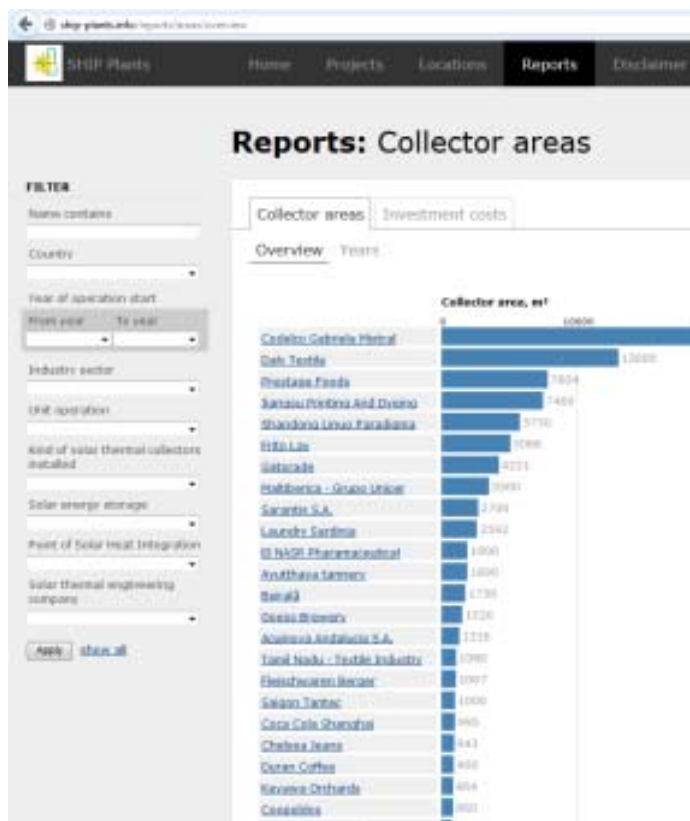
SHIP Installed Systems and LCOH

Global Solar Process Heat Applications



Source: Task 49/IV SHIP Database

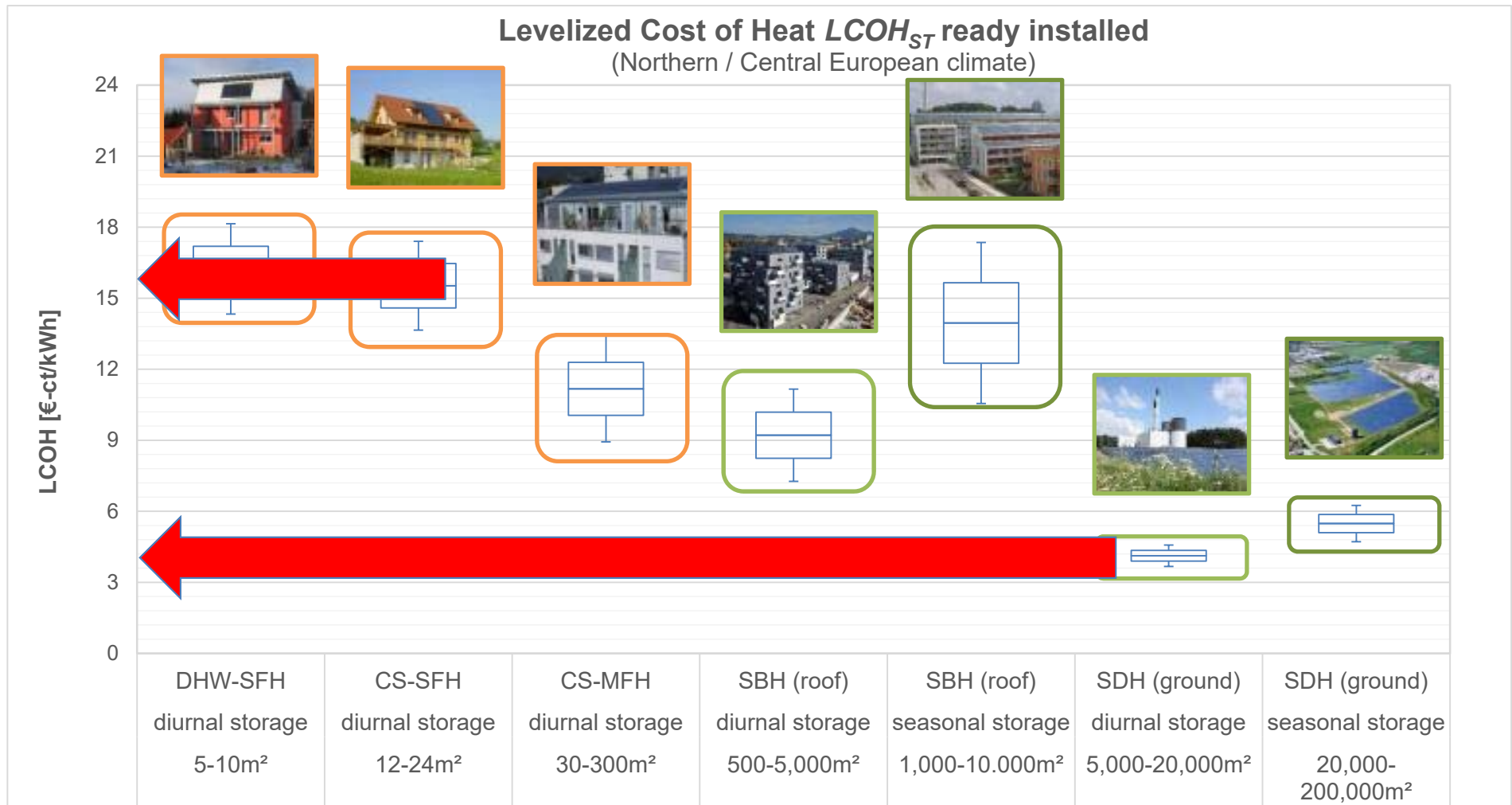
Database of solar process heat applications



<http://ship-plants.info/>

Source: AEE INTEC and PSE

Levelized Cost of Heat



Source: Task 53, Franz Mauthner, AEE INTEC

An aerial photograph of a massive open-pit mine. The mine's interior is characterized by numerous terraced levels, creating a stepped appearance. The rock faces show varying shades of brown, tan, and grey, indicating different geological strata. A dark, winding road or conveyor system traverses the upper levels of the mine. In the lower central part of the image, a body of water, likely a tailings pond, is visible, with several small structures or barges on its surface. The foreground shows the rugged, reddish-brown slopes of the mine's rim, with some sparse vegetation and utility poles.

Process Heat Collectors



Flat Plate Collectors



< 85 °C

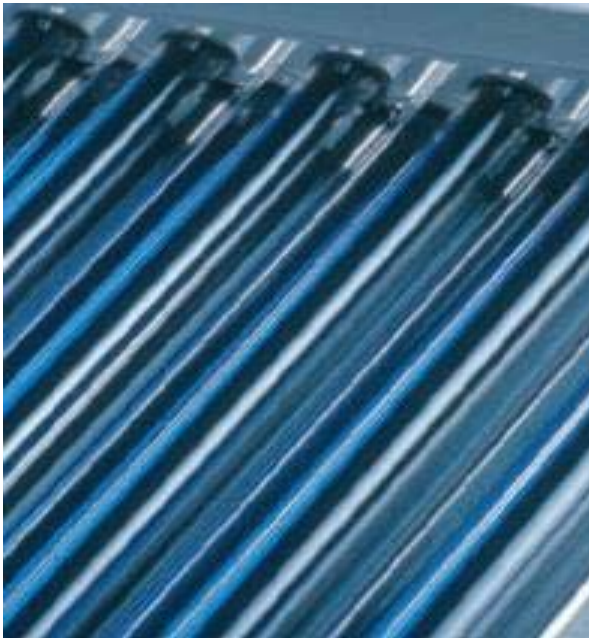




Advanced Evacuated Tube Collectors



< 80 -180 °C





High Vacuum Flat Plate Collectors



< 80 -180 °C



Parabolic Trough Collector

www.smirro.de

www.nep-solar.com

120-250 °C



Source: Elimar Frank - SPF

Linear Concentrating Fresnel Collectors

< 120 - 250 °C



Built Examples



Space Heating of Factory Buildings

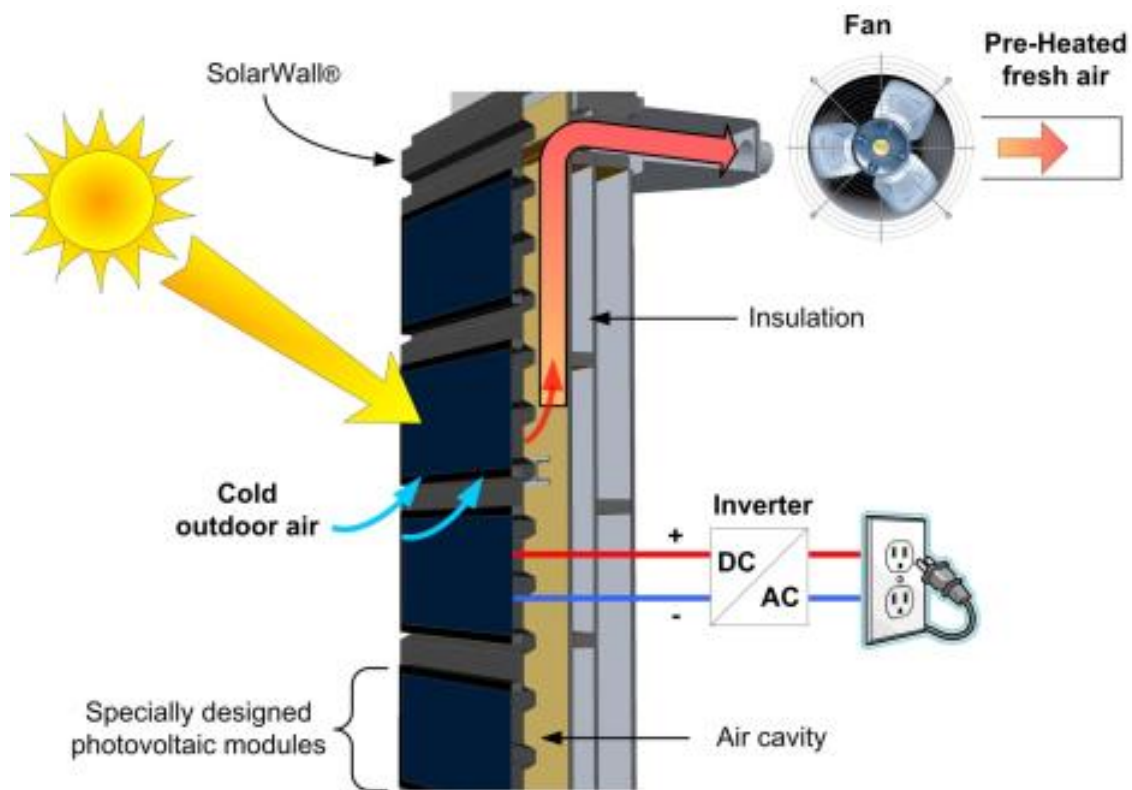


Space heating - air collectors



Source: SolaWall , Canada

Air collectors



Transpired solar collector cavity

Source: SolaWall , Canada

Air based Drying System



Prestage Food, North Carolina, USA

- Poultry processor in NC, USA
- Energy contractor: FLS Energy owner of system
- Demand of 568 [m³/d] of hot water (>60 °C) for cleaning of equipment
- System in operation since 2012
 - 7.804 m² flat plate collectors
 - 852 m³ storage tanks (10 x 85 [m³])
 - Covers 50% of hot water demand



Source: FLS Energy

Prestage Food, North Carolina, USA



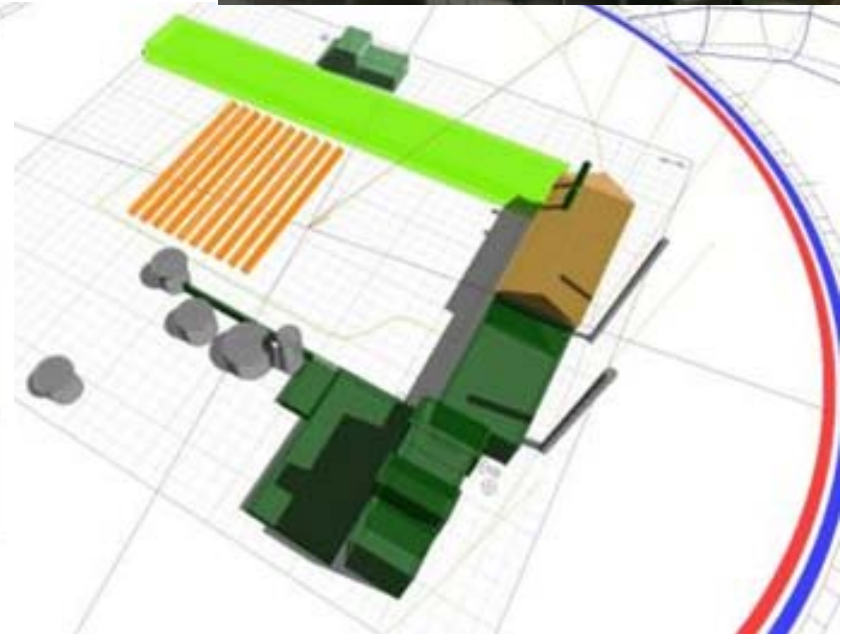
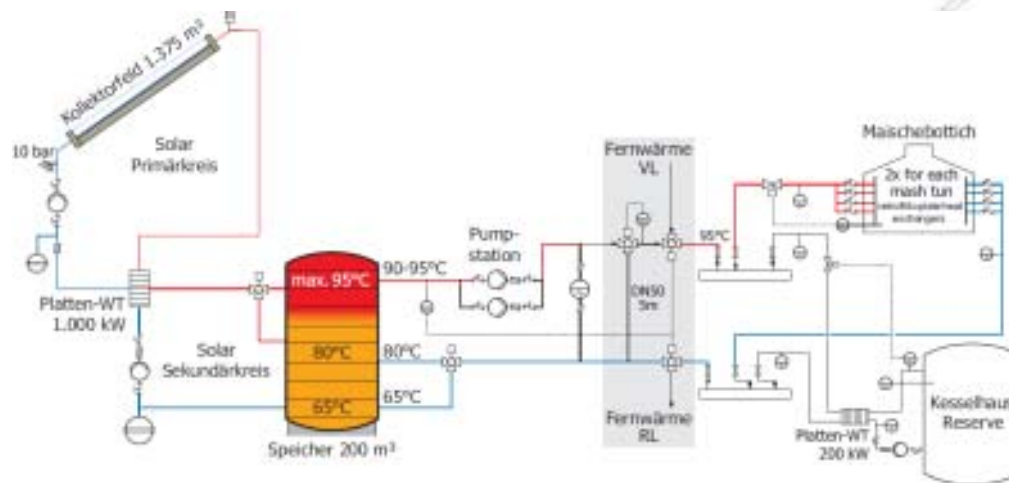
IEA SHC Task 49

Heineken Brewery- Göss Austria

Integration in mashing process (50–75°C)

System in operation since 2013

- 1.375 m² flat plate collectors



Heineken Brewery- Göss Austria



Source: AEE INTEC

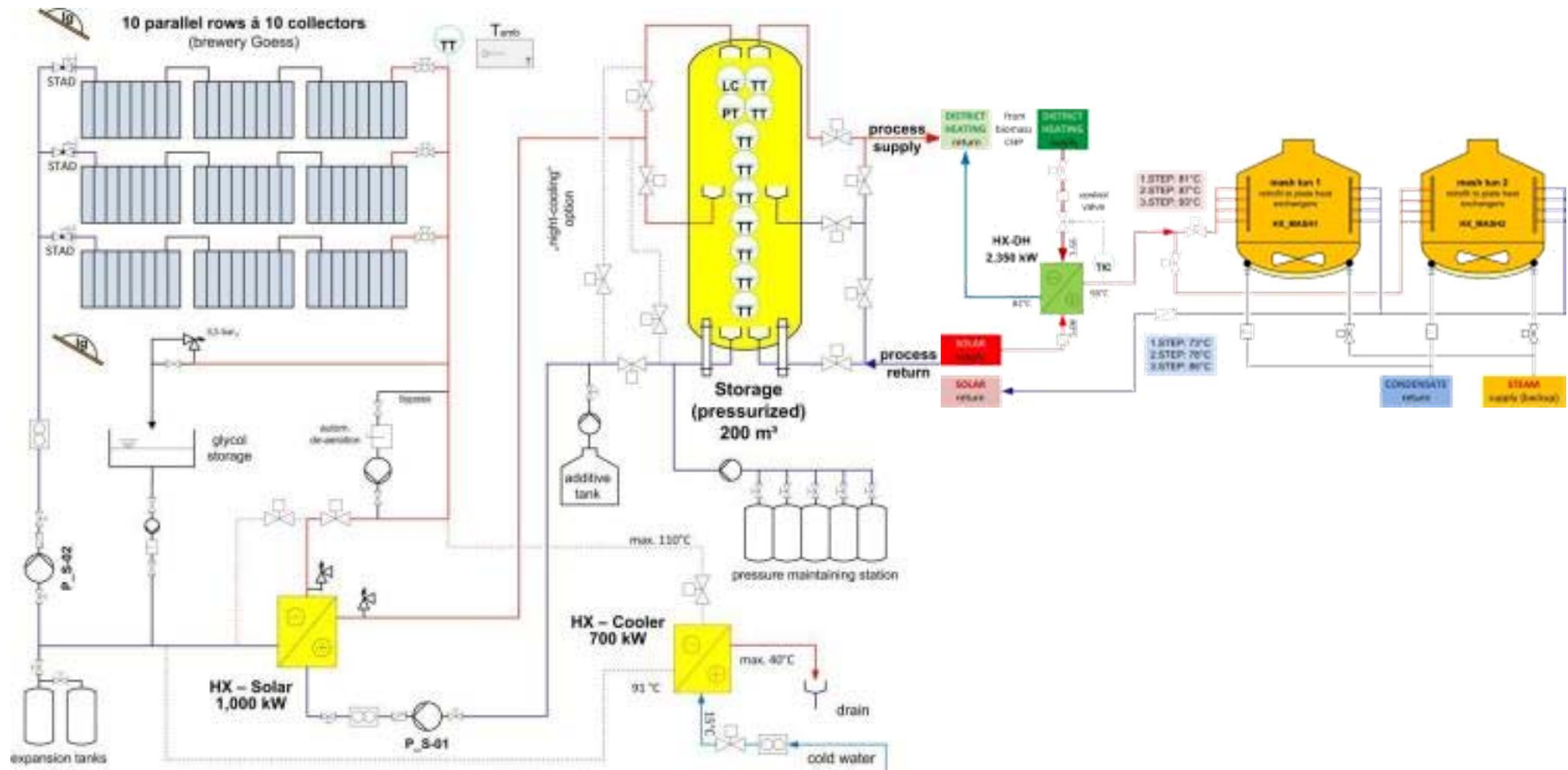
Heineken Brewery- Göss Austria

➤ Göss – construction of collector field

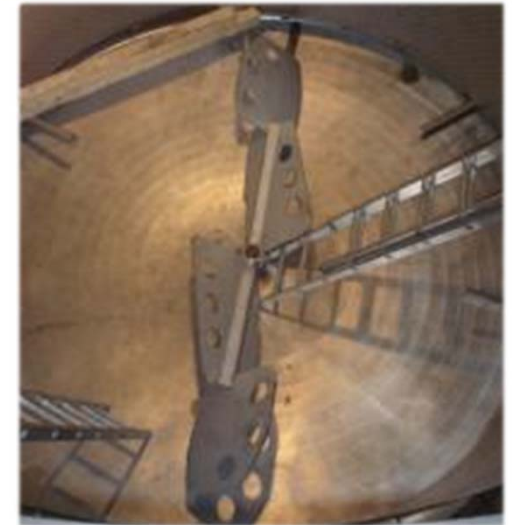


Source: AEE INTEC

Integration into the mashing process



Integration into the mashing process



Pre-Heating of Process Water



Gatorade (PepsiCo)

Phoenix, AZ, USA

892 m² solar collectors

38 m³ buffer tank

Pre-Heating fresh water for the soft-drink production at 35°C / 95°F

Annual Energy gains =
more than 1 Mio. kWh !!!
(= more than 1200 kWh/(m²*y) !)

Source: SOLID GmbH. Graz Austria

Pre-Heating of Process Water



Source: SOLID GmbH. Graz Austria

Copper Mine “Gabriela Mistral”, Chile

26MW_{th} (39,300 m²)



Source: ARCON-SUNMARK

Copper Mine “Gabriela Mistral”, Chile

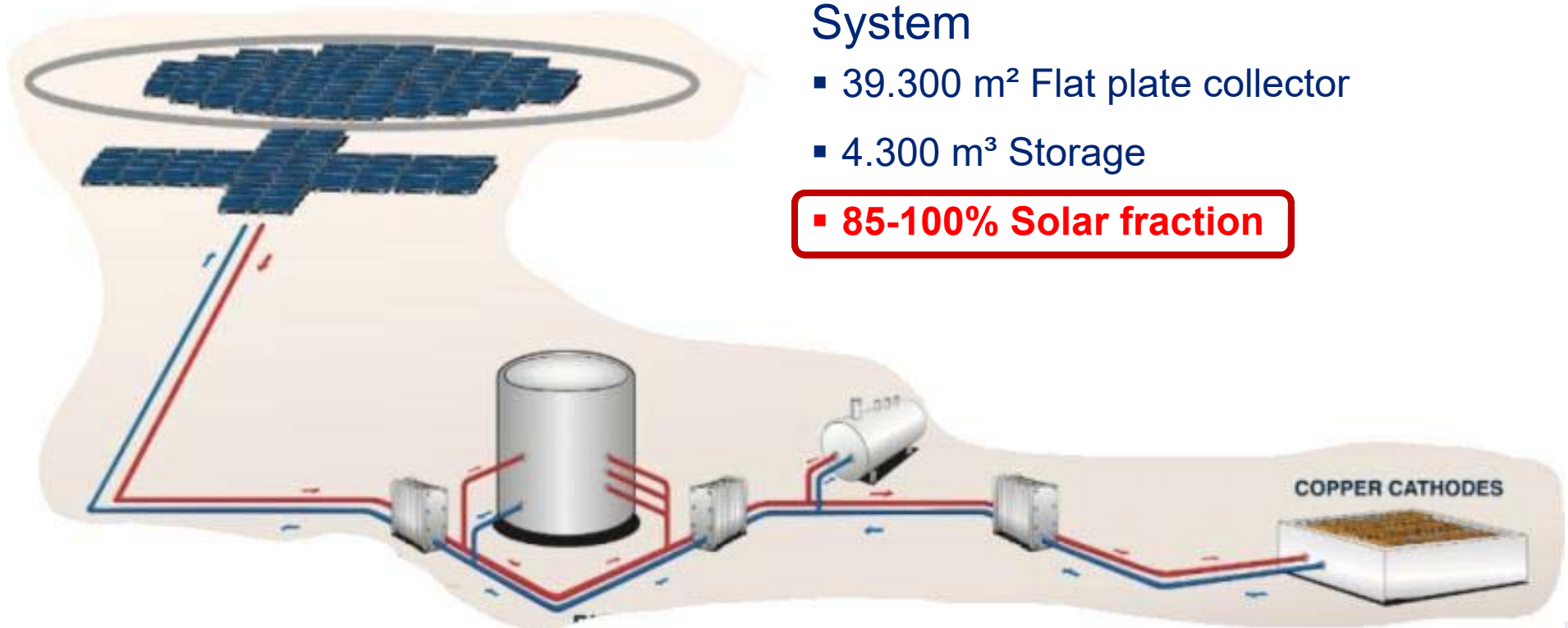
26MW_{th} (39,300 m²)

➤ Process

- ⇒ Electro winning of copper
- ⇒ Electrolyte is kept on a constant Temp. of 50 °C
- ⇒ Cleaning Processes

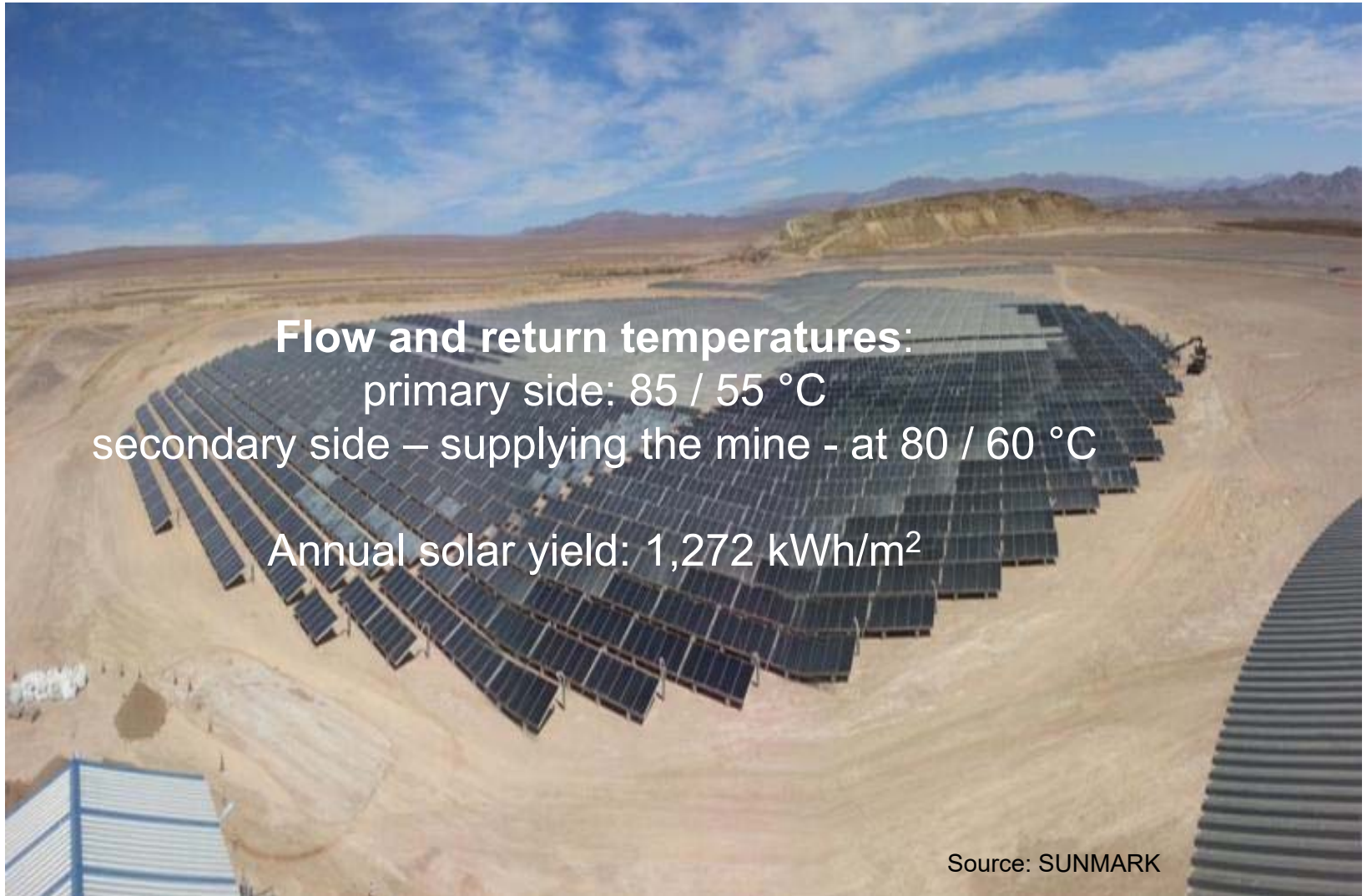
System

- 39.300 m² Flat plate collector
- 4.300 m³ Storage
- **85-100% Solar fraction**



Copper Mine “Gabriela Mistral”, Chile

26MW_{th} (39,300 m²)



Copper Mine “Gabriela Mistral”, Chile

26MW_{th} (39,300 m²)



Source: SUNMARK



AEE INTEC

IDEA TO ACTION

Thank you for your Attention