



Solar Heat for Industrial Applications

Current state of play



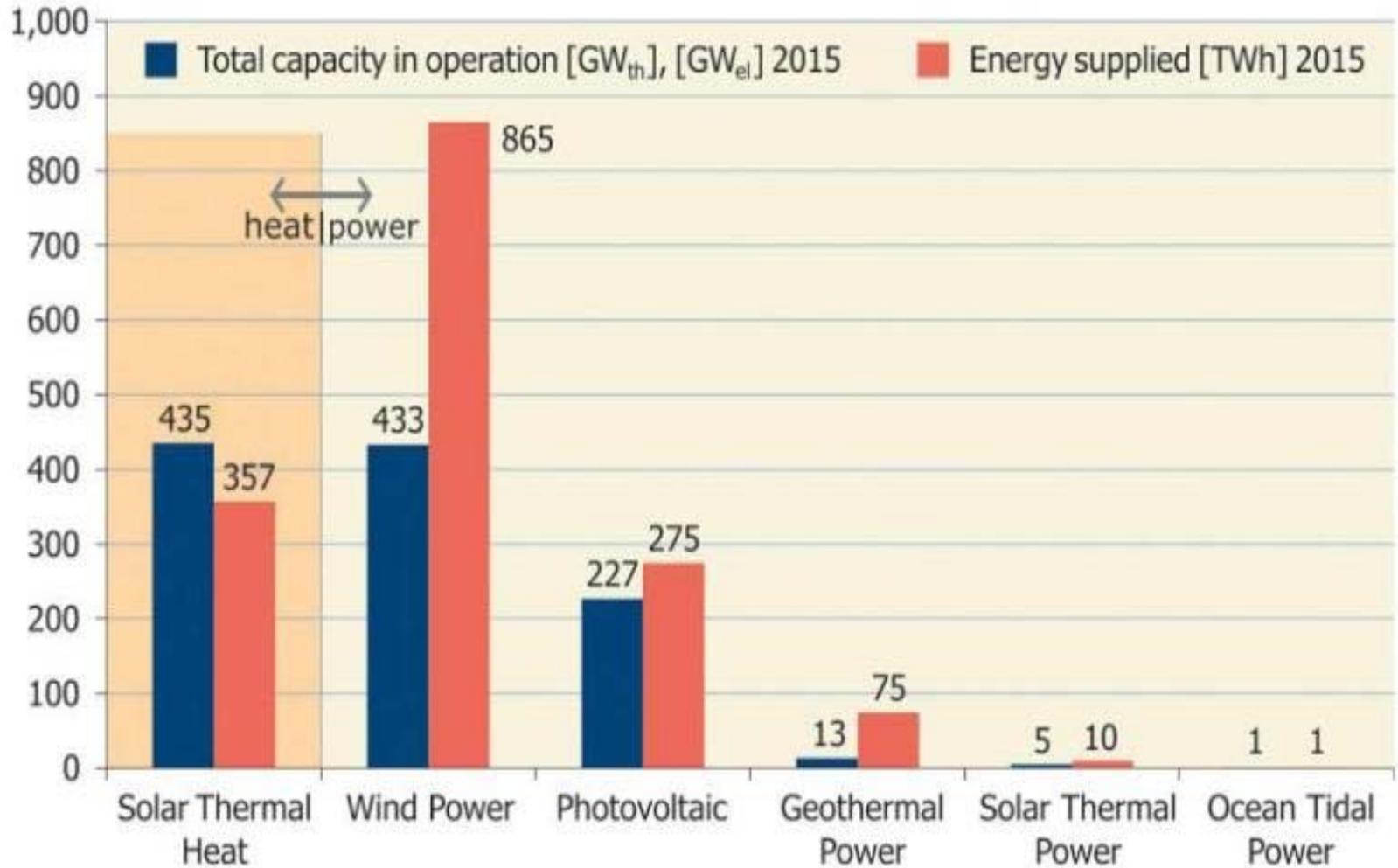
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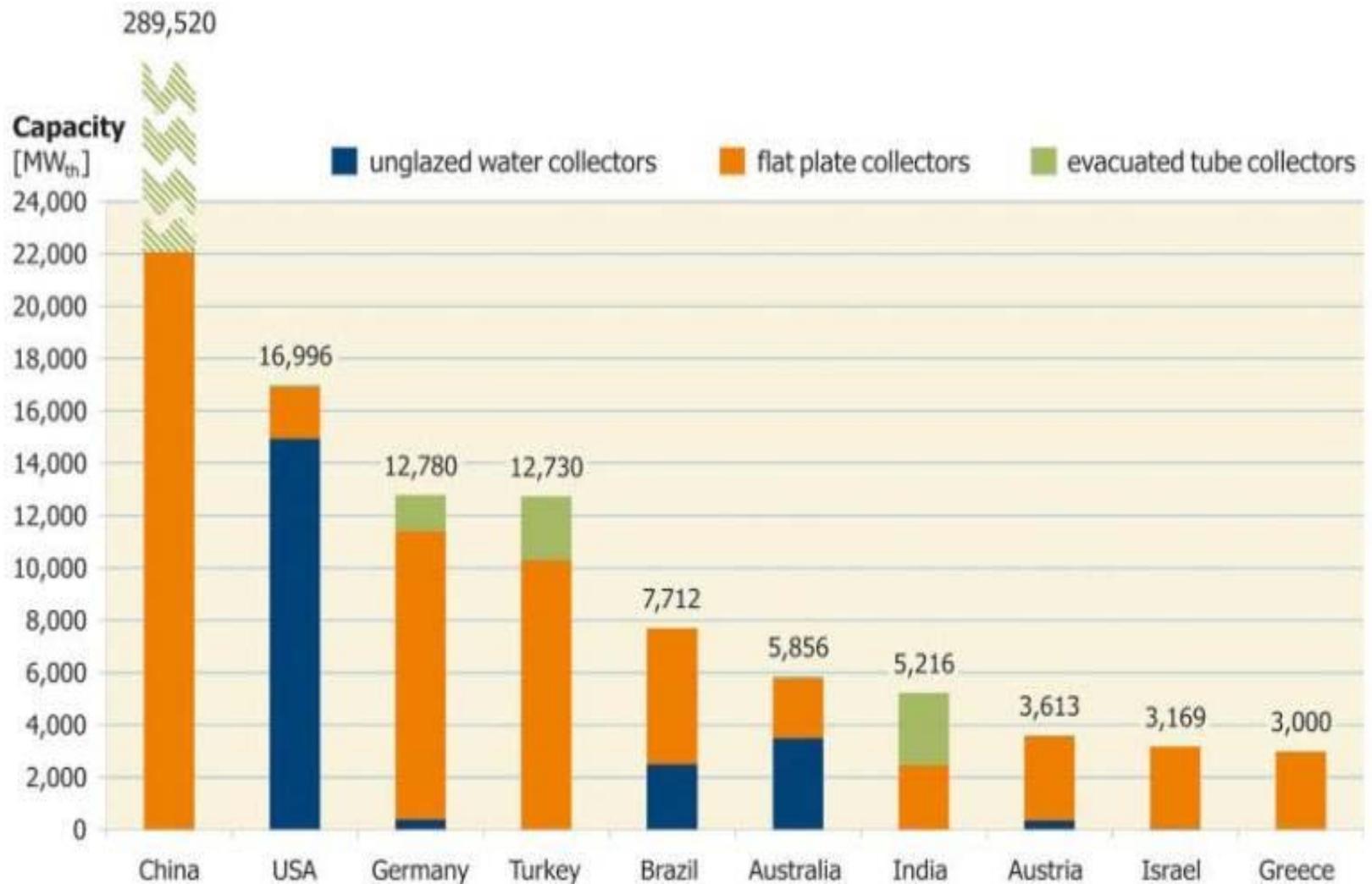
IEA – Solar Heating and Cooling Programme

Global Capacity in Operation 2015

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

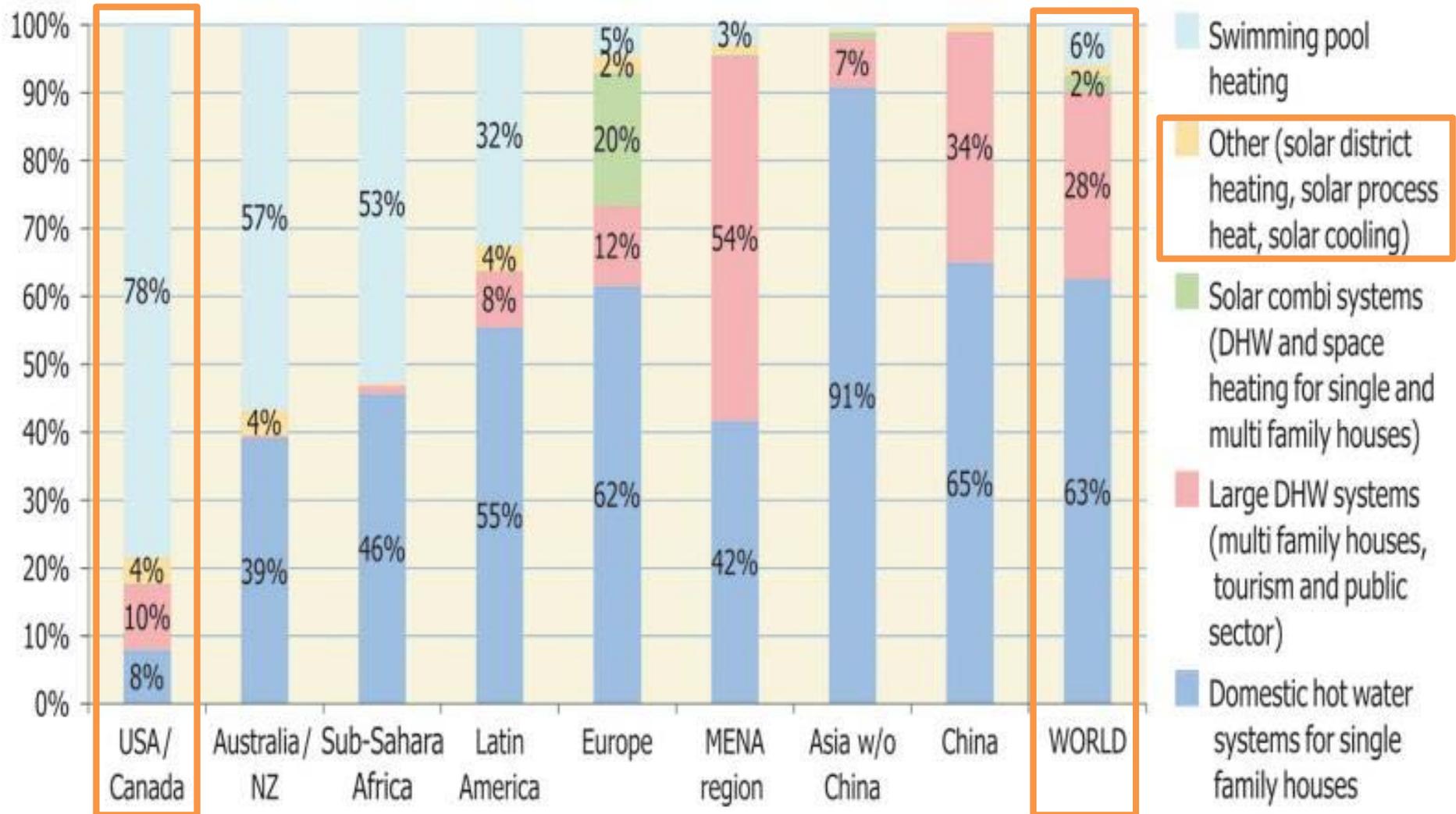


Total installed capacity of unglazed and glazed water collectors in operation in the 10 leading countries by the end of 2014



Distribution by application

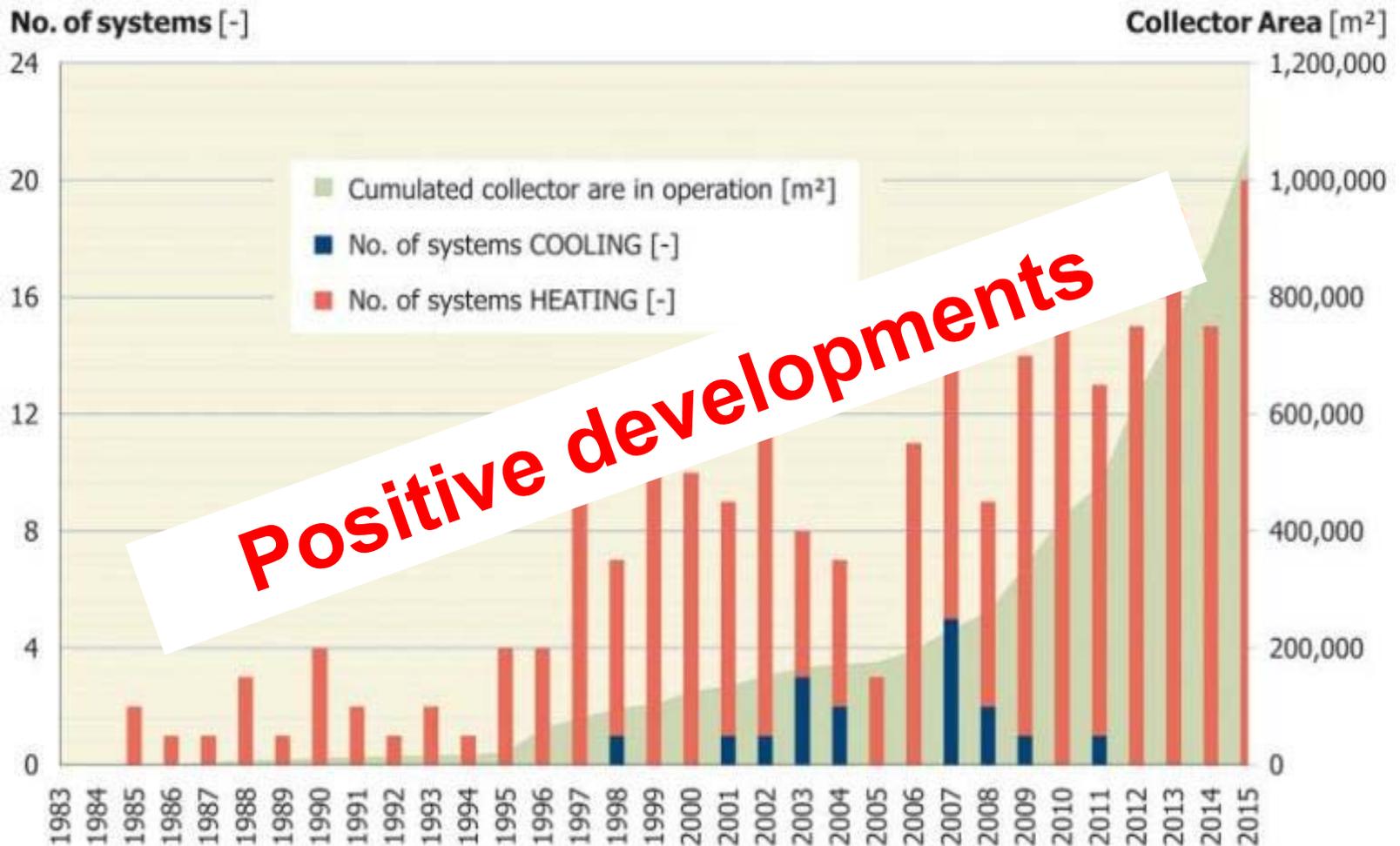
for the total installed water collector capacity
by economic region in operation by the end of 2014





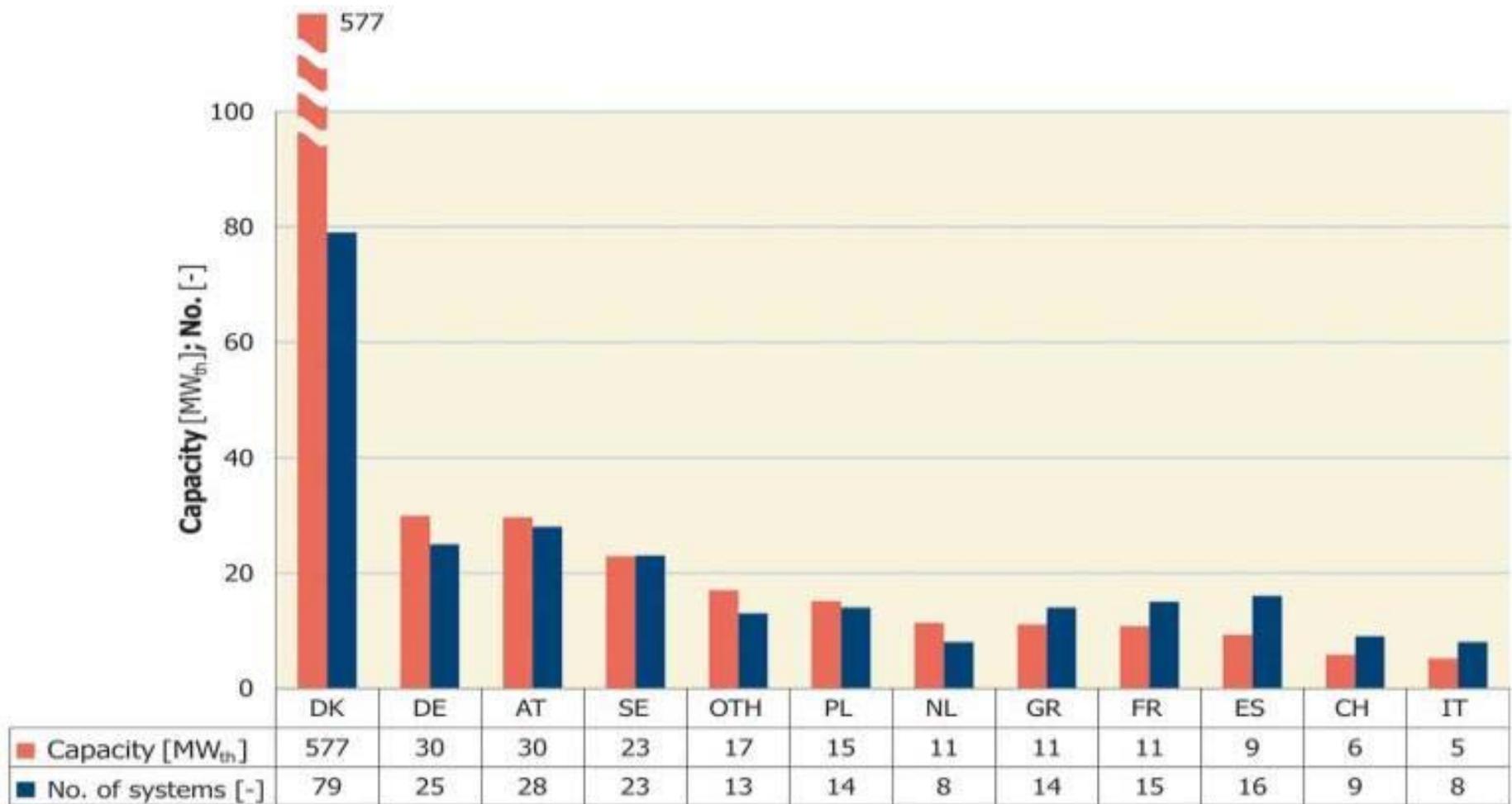
Turnover
The worldwide turnover of the solar thermal industry in 2014 is estimated at **€ 21 billion (US\$ 24 billion)**

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.



(Source: ARCON-SUNMARK)



District Heating System, Saudi Arabia

36.000 m² / 25 MW_{th}





District Heating System, Saudi Arabia

36.000 m² / 25 MW_{th}





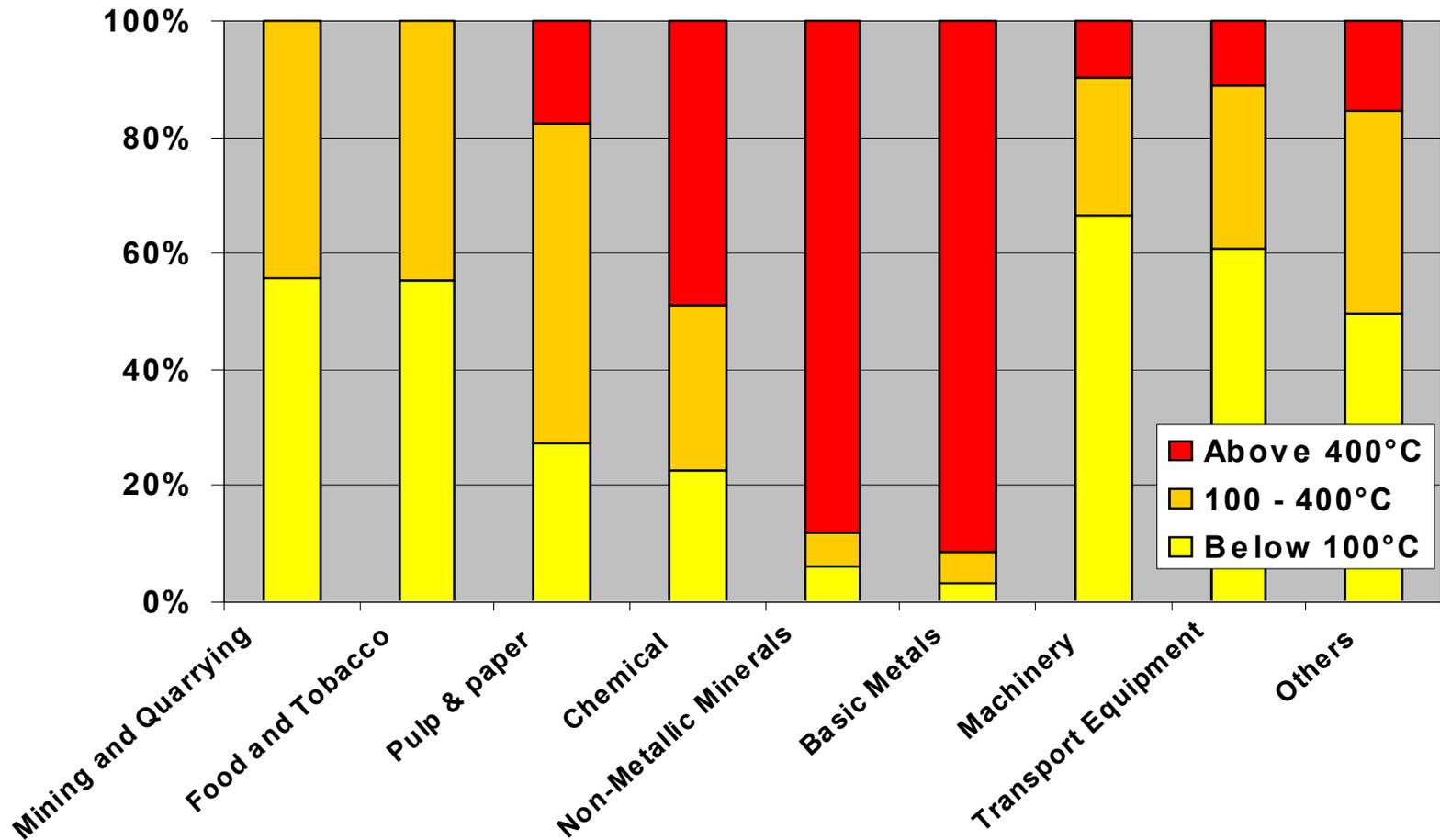
Pipes and Heat Exchangers



The image shows a massive concrete dam or bridge structure under construction. The structure is composed of numerous vertical panels, with a road and cables visible on top. The surrounding terrain is rugged and rocky, with some construction equipment and structures visible in the foreground. The text "SHIP Potential" is overlaid on the image in a large, white, sans-serif font, tilted slightly to the right.

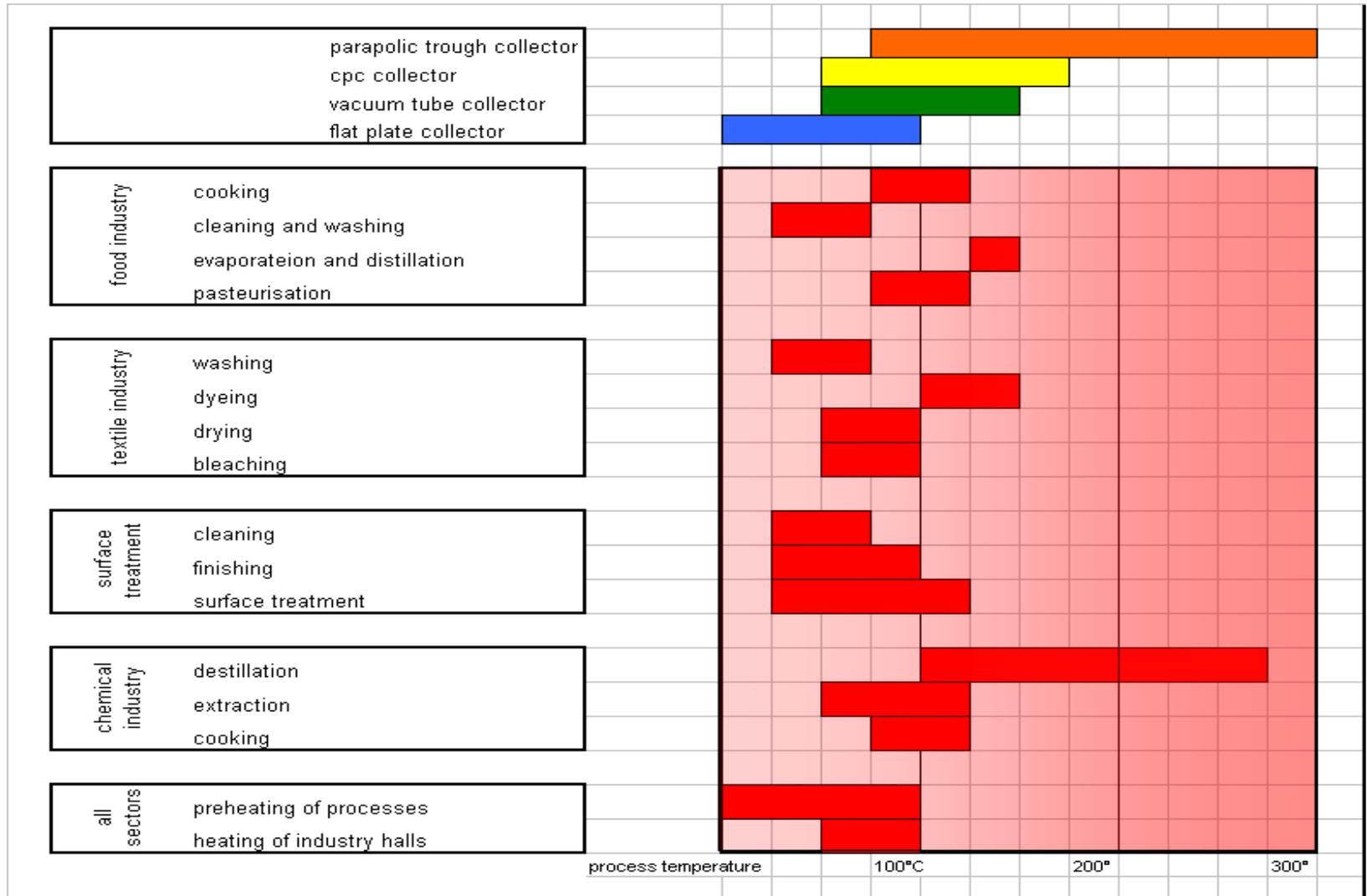
**SHIP
Potential**

Industrial heat demand by temperature level and industrial sector

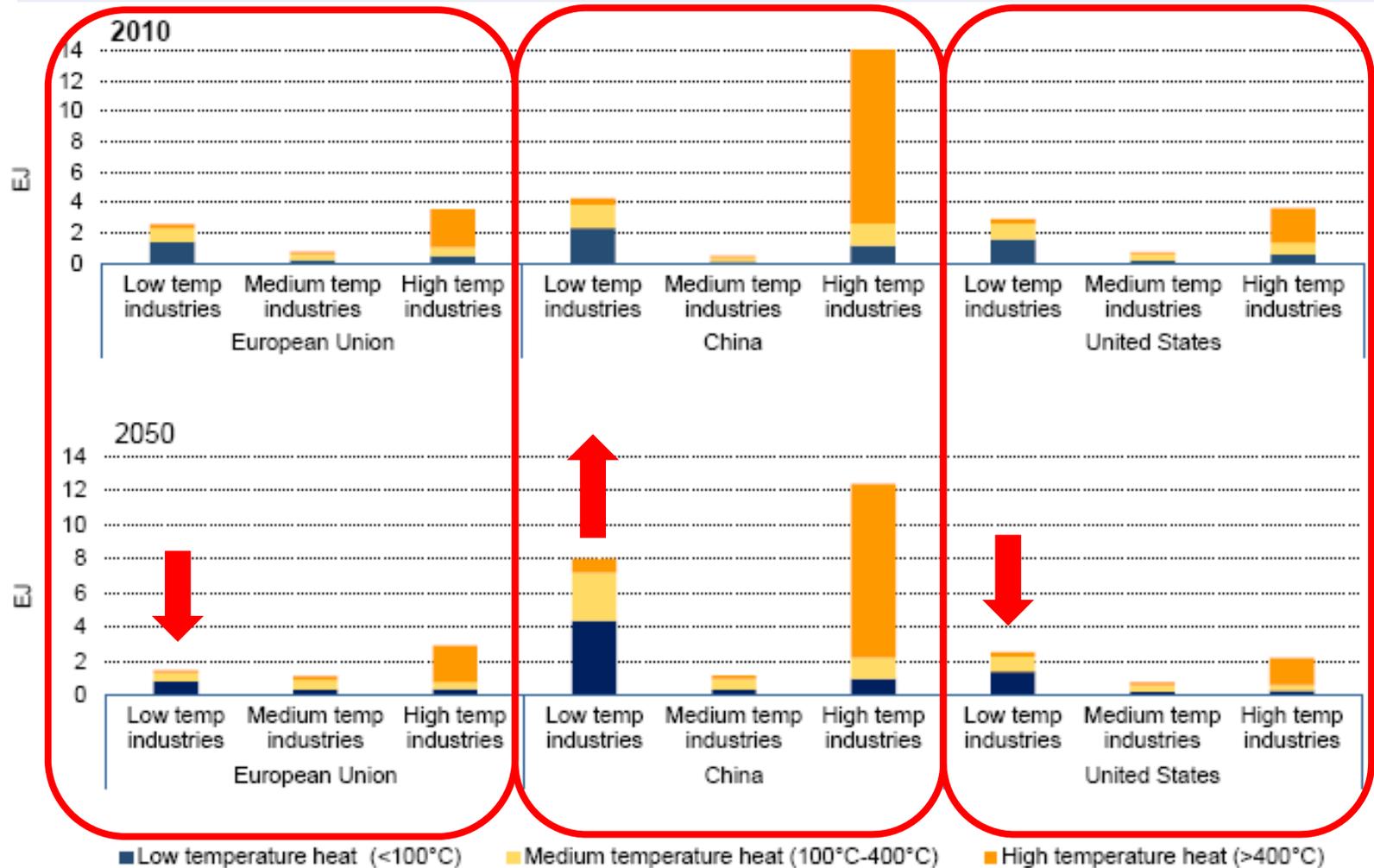


Source: ECOHEATCOOL

Temperature levels of processes

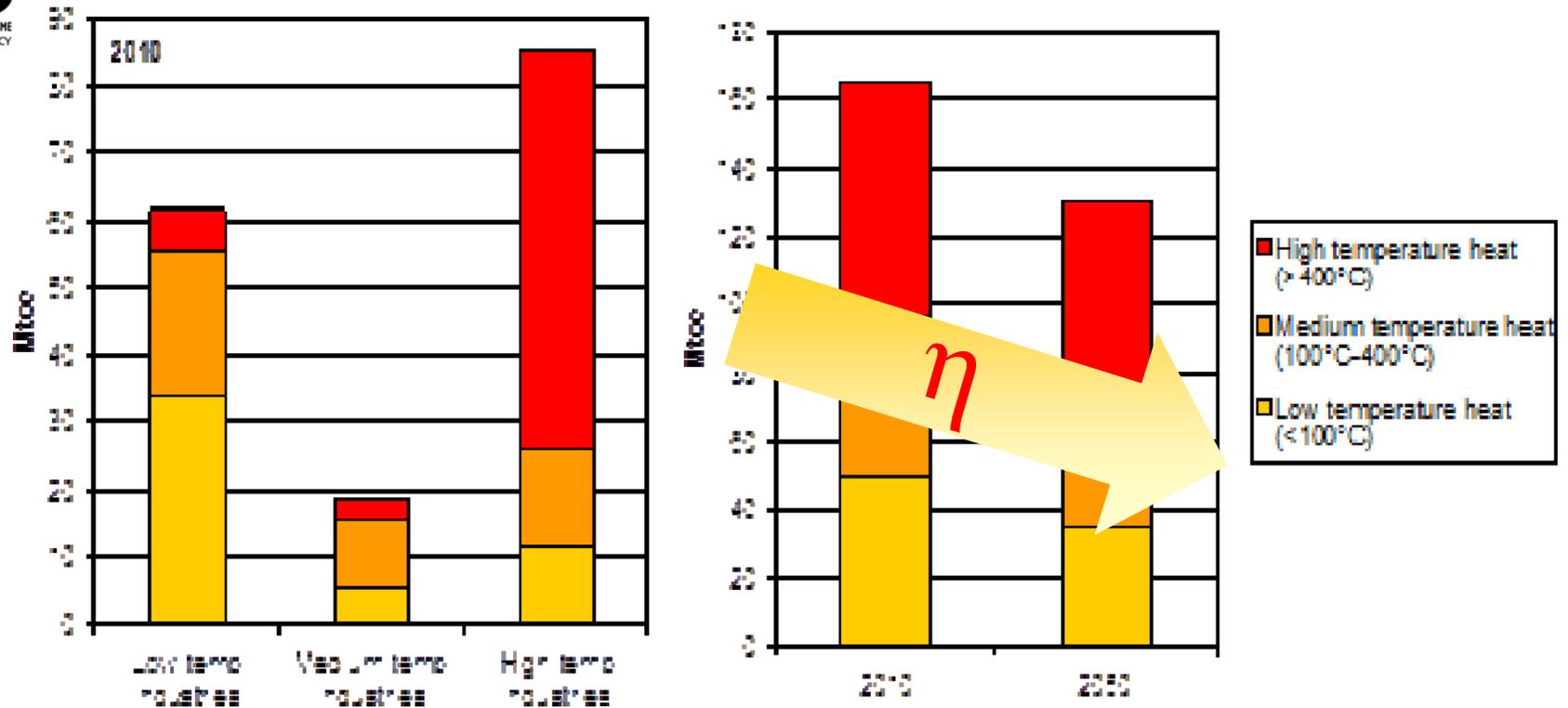


Industrial Heat Demand



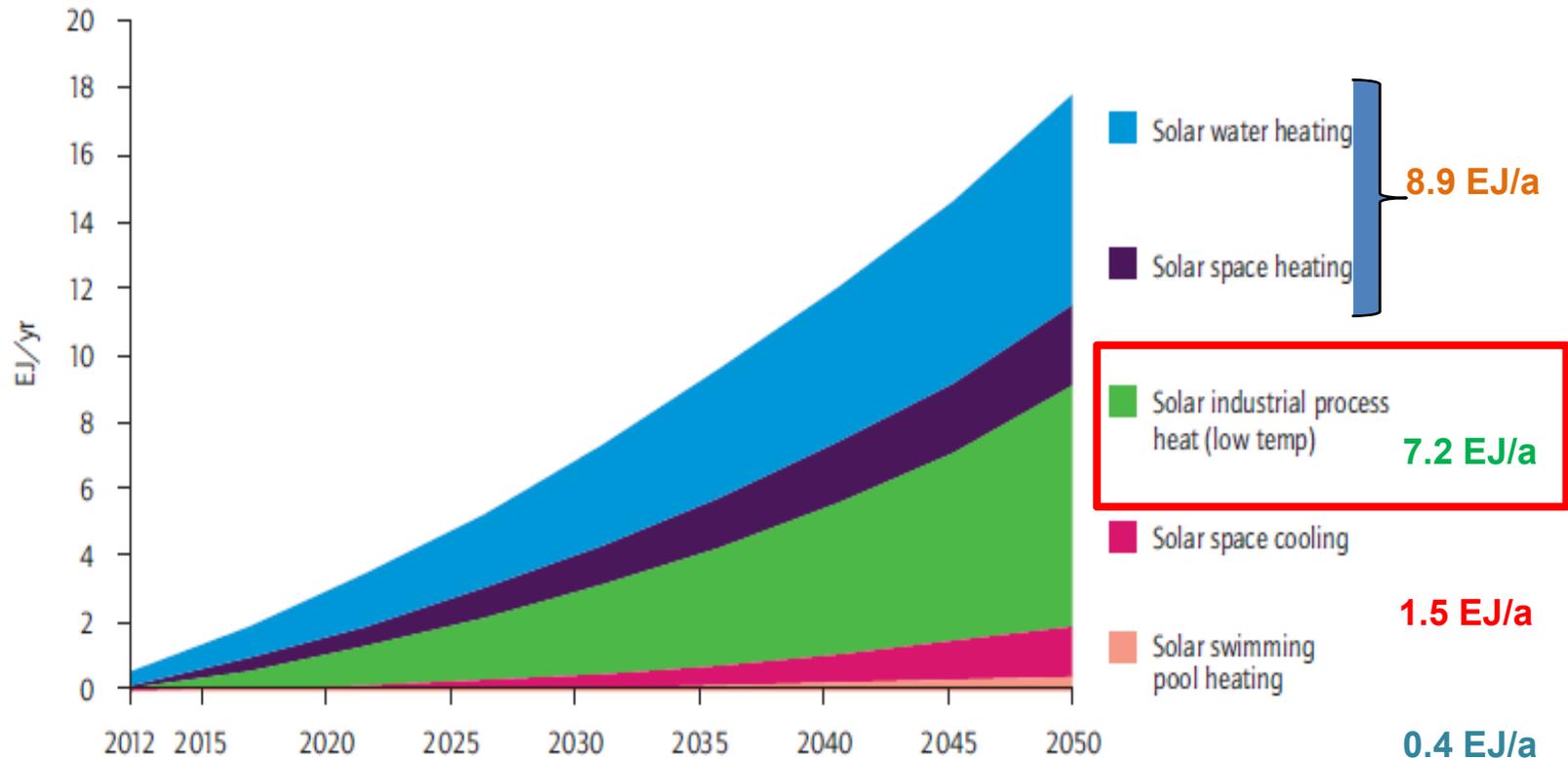
Source: IEA ETP 2012

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



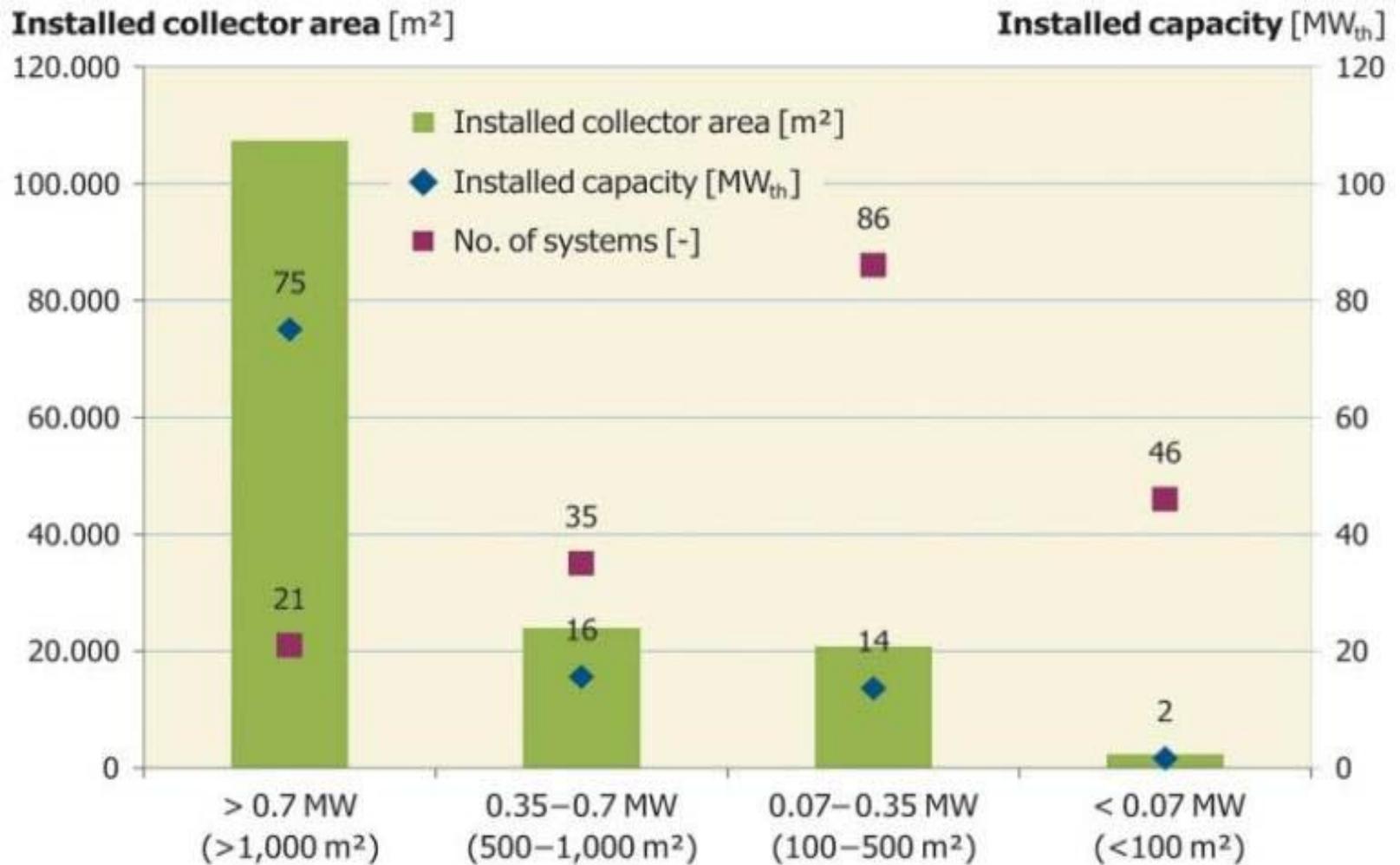
Source: IEA Technology Roadmap – Solar Heating & Cooling



SHIP Installed Systems and LCOH



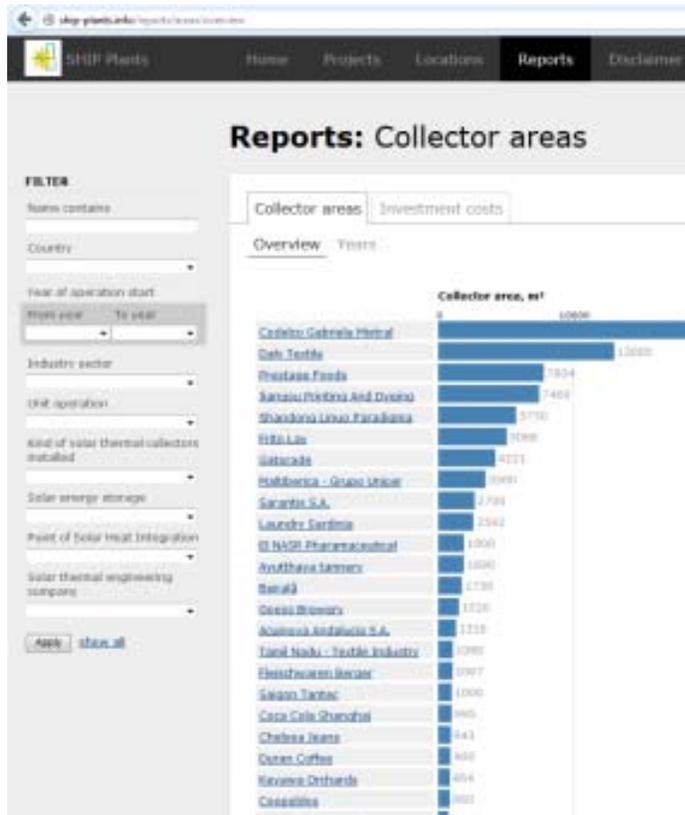
Global Solar Process Heat Applications



Source: Task 49/IV SHIP Database



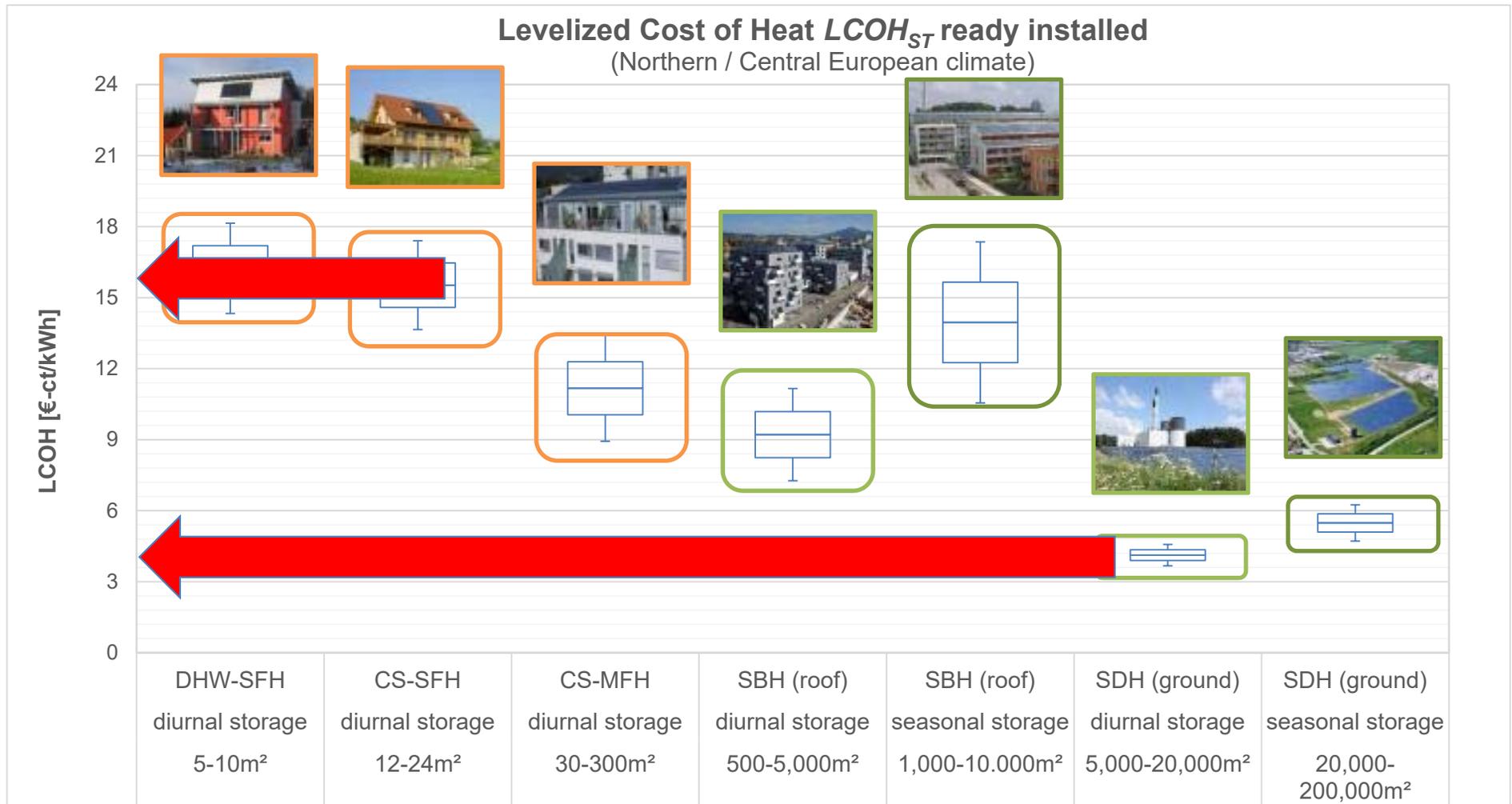
Database of solar process heat applications



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

Source: AEE INTEC and PSE

Levelized Cost of Heat



Source: Task 53, Franz Mauthner, AEE INTEC



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

120-250 °C



www.nep-solar.com



Source: Elimar Frank - SPF



Linear Concentrating Fresnel Collectors



< 120 - 250 °C



Built Examples





Space Heating of Factory Buildings

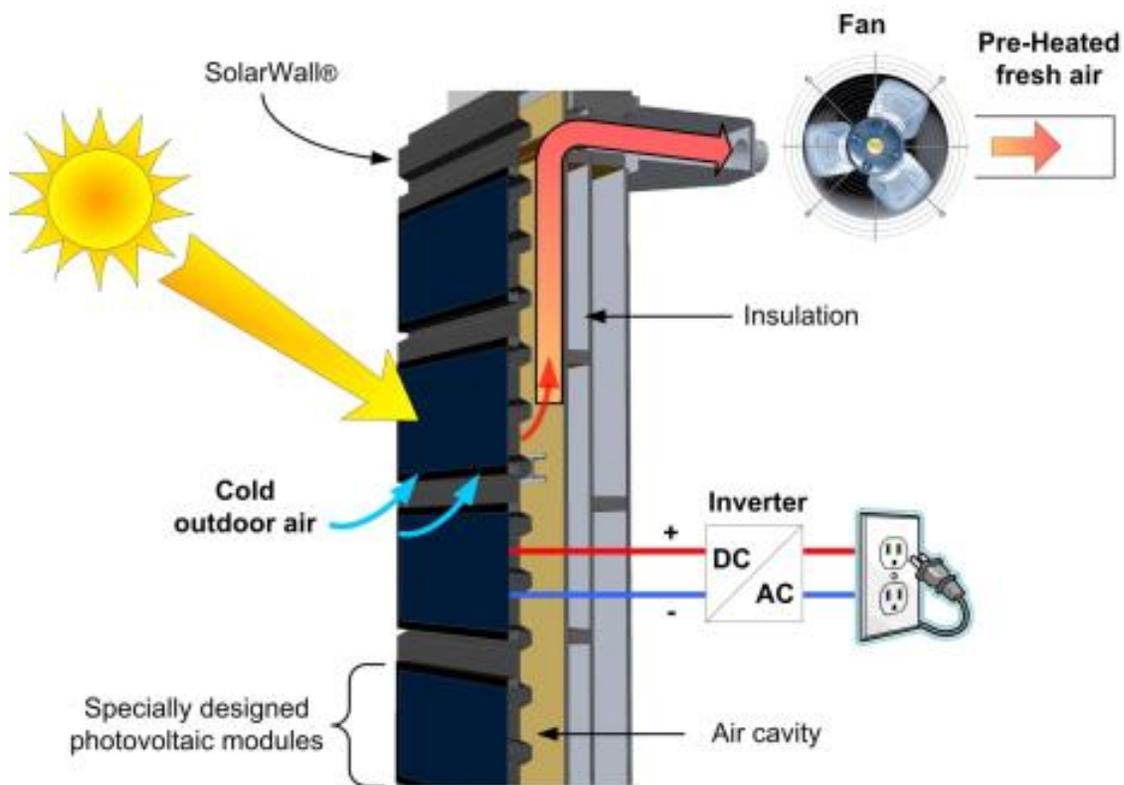


Space heating - air collectors



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



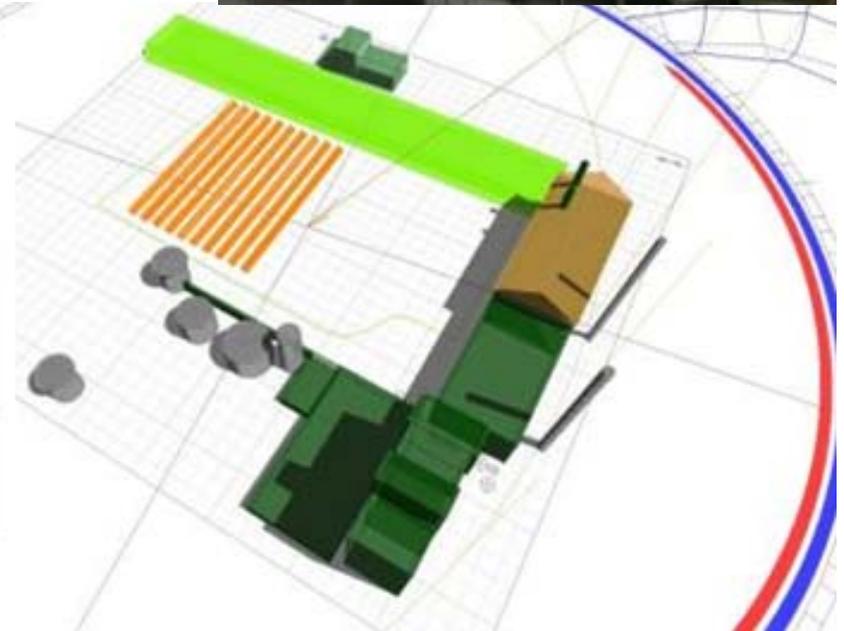
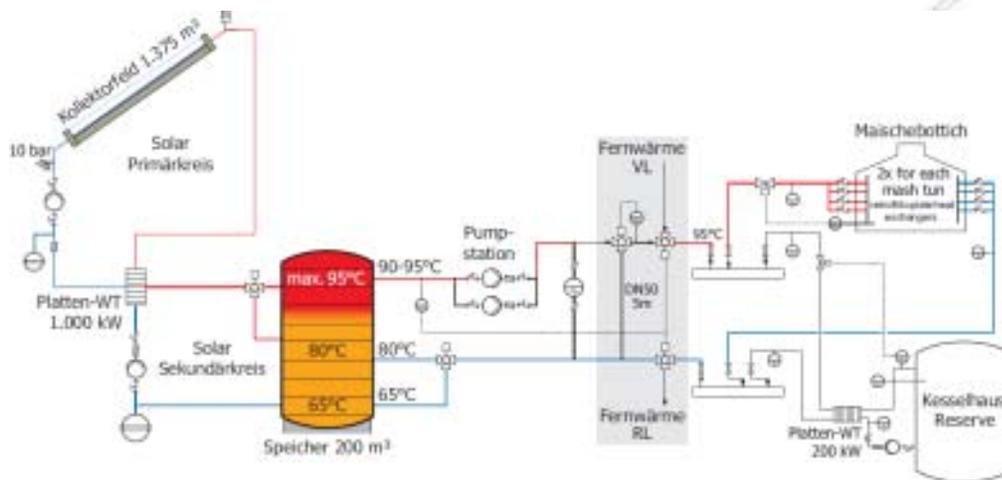
IEA SHC Task 49

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

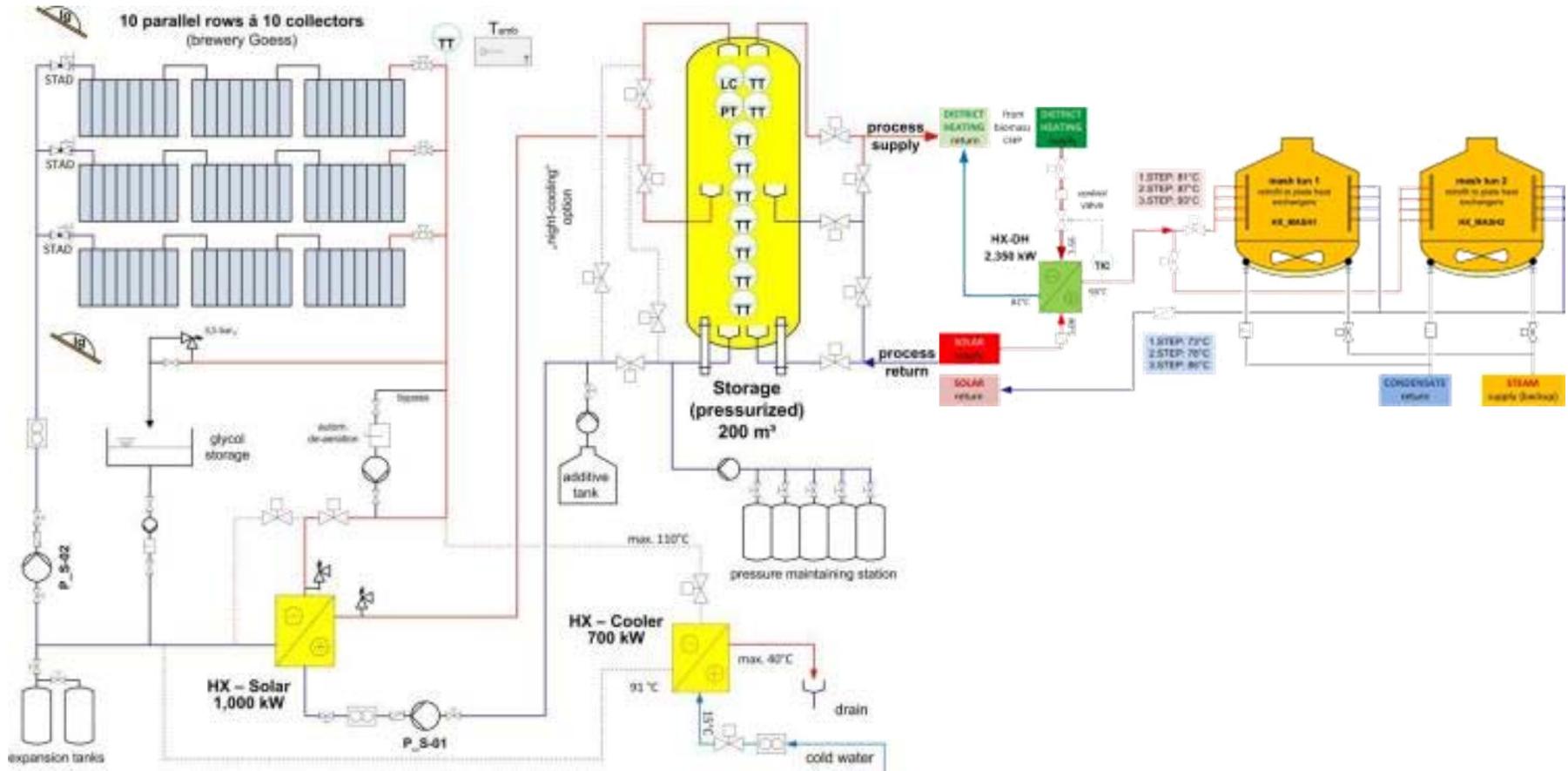


➤ Göss – construction of collector field



Source: AEE INTEC

Integration into the mashing process



Integration into the mashing process





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

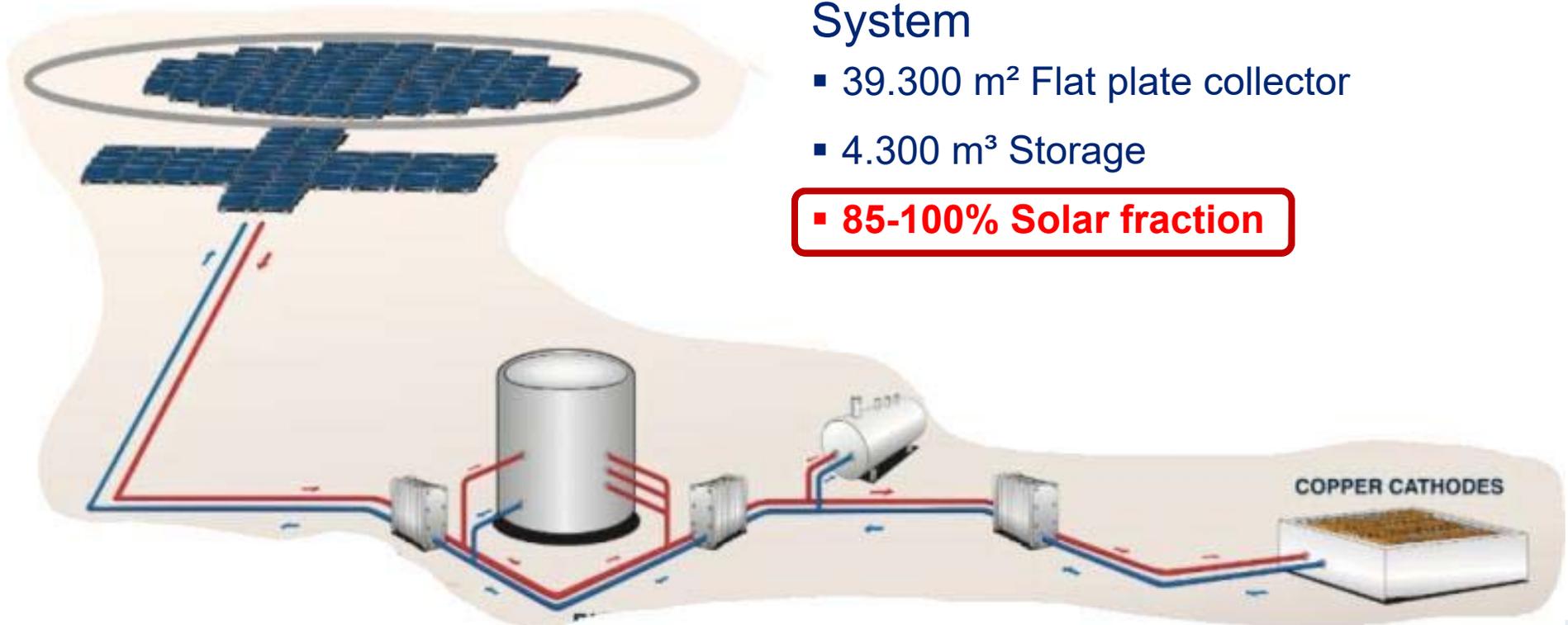
26MW_{th} (39,300 m²)

➤ Process

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

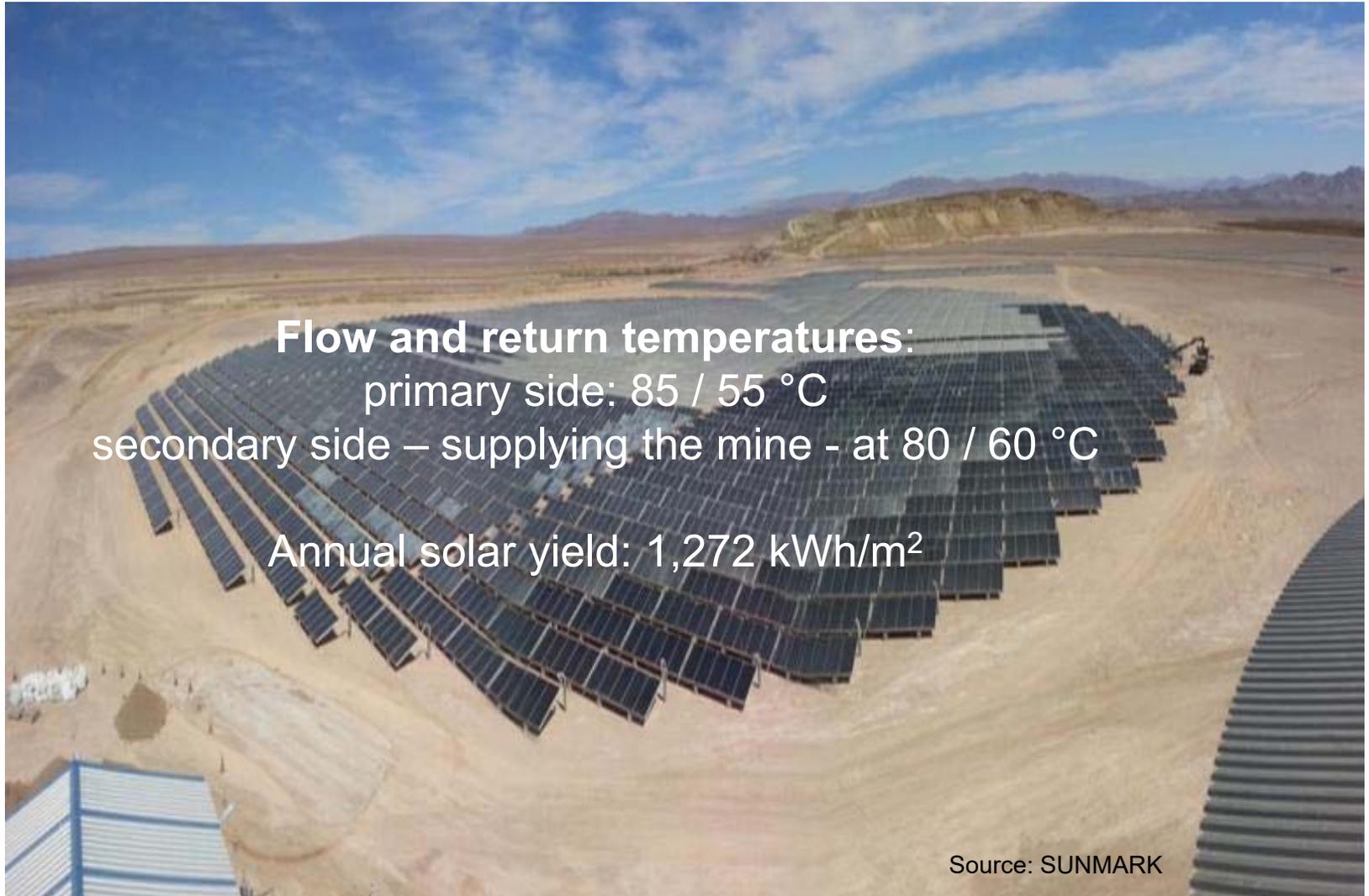
System

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





Copper Mine “Gabriela Mistral”, Chile 26MW_{th} (39,300 m²)



Flow and return temperatures:
primary side: 85 / 55 °C
secondary side – supplying the mine - at 80 / 60 °C

Annual solar yield: 1,272 kWh/m²

Source: SUNMARK



Copper Mine “Gabriela Mistral”, Chile

26MW_{th} (39,300 m²)



Source: SUNMARK



IDEA TO ACTION

Thank you for your Attention