Solar Heat for Industrial Production Processes - Latest Research and Large Scale Installations

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Presented by

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IEA Solar Heating and Cooling Programme

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

sustainable energy TRANSFORMATION

21 countries and 5 sponsors

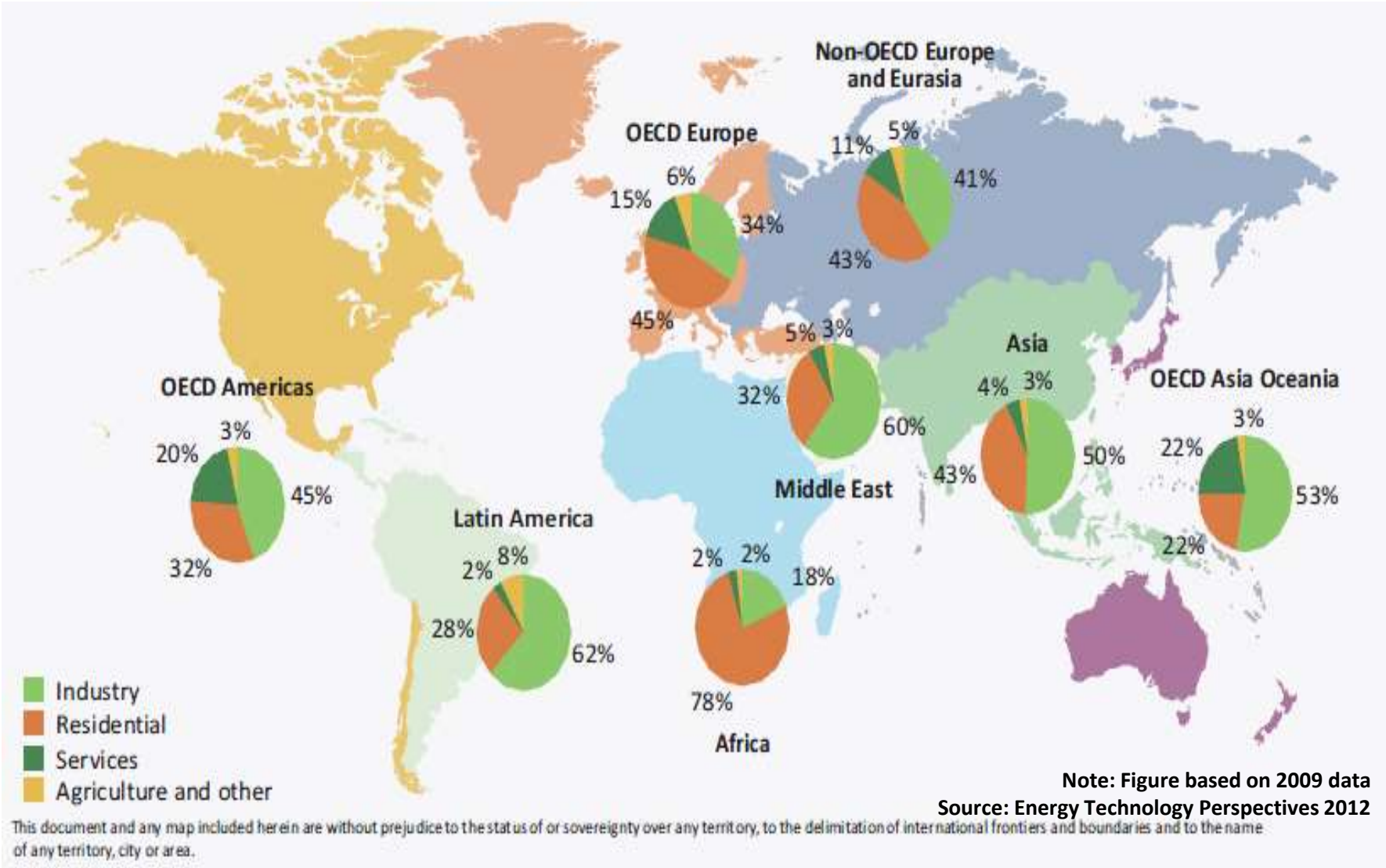
10 International Collaborative Research Tasks

- Covering Technology and Capacity Building
- Relevant to many solar technologies and applications

Comprehensive information Program

- Solar Heat worldwide
- Collaboration with Solarthermalworld.org
- www.iea-shc.org

Industrial heat has an important role in the global economy

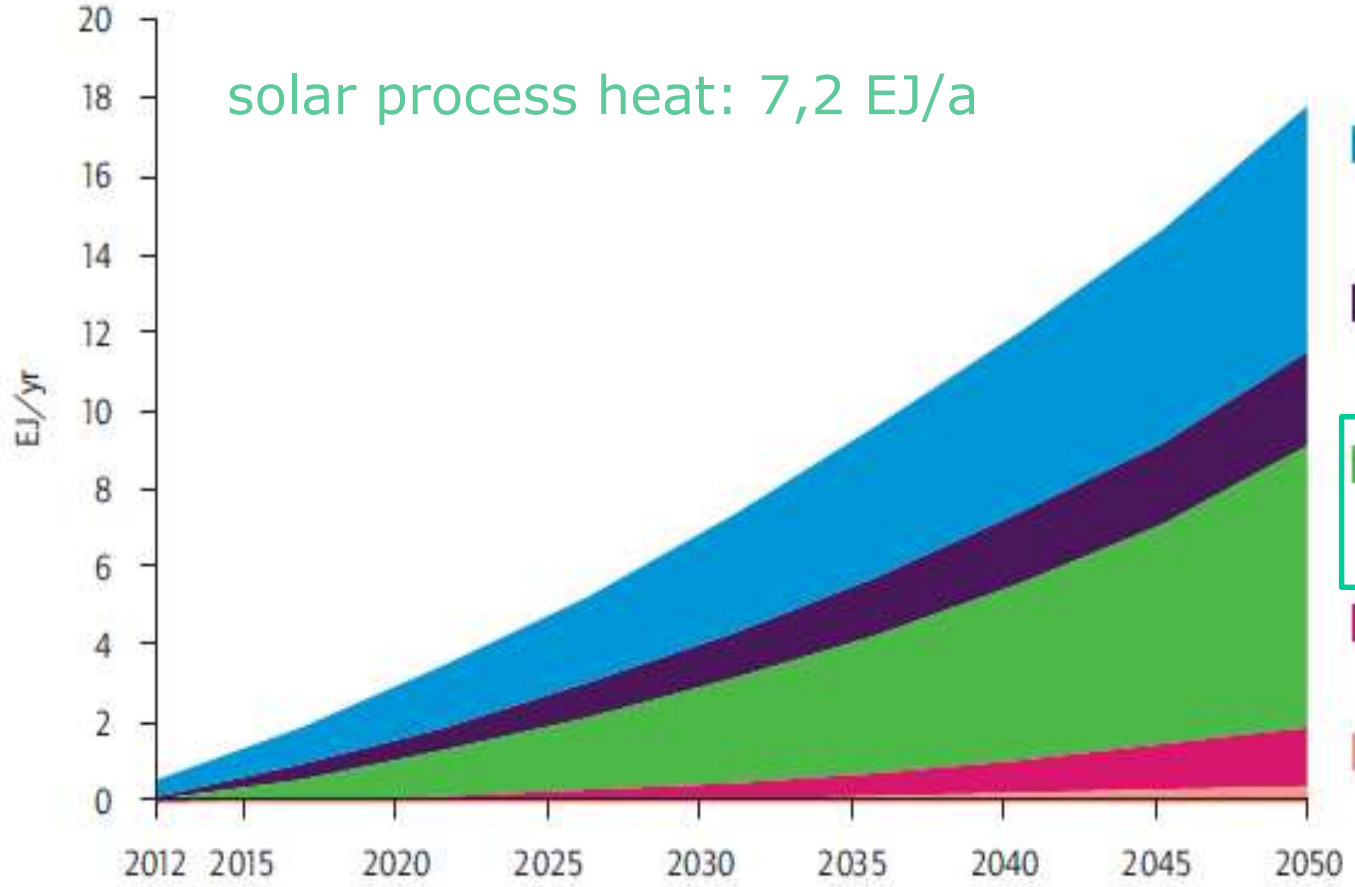


Note: Figure based on 2009 data

Source: Energy Technology Perspectives 2012

IEA Roadmap: Vision for solar heating and cooling (by sector in EJ/a)

solar process heat: 7,2 EJ/a



Solar water heating

Solar space heating

8.9 EJ/a

Solar industrial process heat (low temp)

7.2 EJ/a

Solar space cooling

1.5 EJ/a

Solar swimming pool heating

0.4 EJ/a

Source: IEA Technology Roadmap – Solar Heating & Cooling

Steps of energy efficiency analysis and implementation of renewable energy

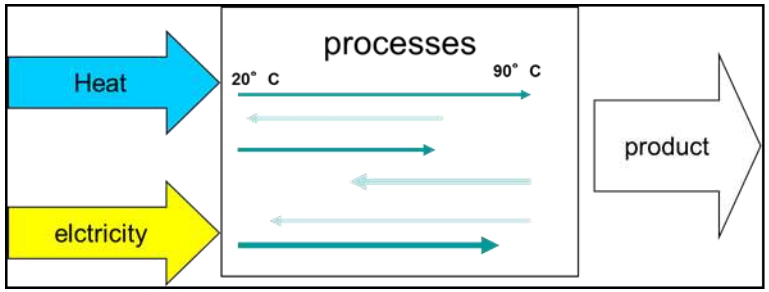
Collection and measurements of energy relevant data, mass and energy balance, visualization of the production process with flow sheet and Sankey diagram

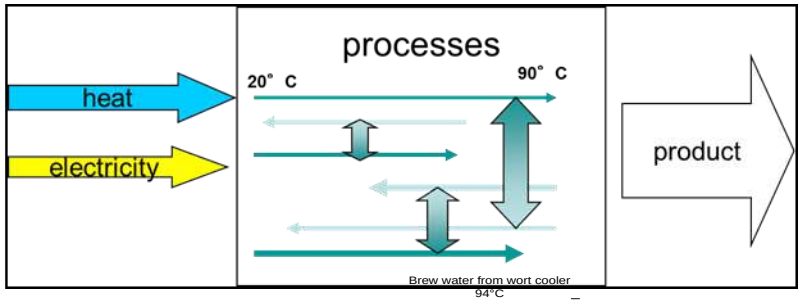
Technology optimization – use of energy efficient process technologies, optimized heat and mass transfer; lower the supply temperature

System optimization, energy efficent production, heat recovery, Pinch analysis, storage management

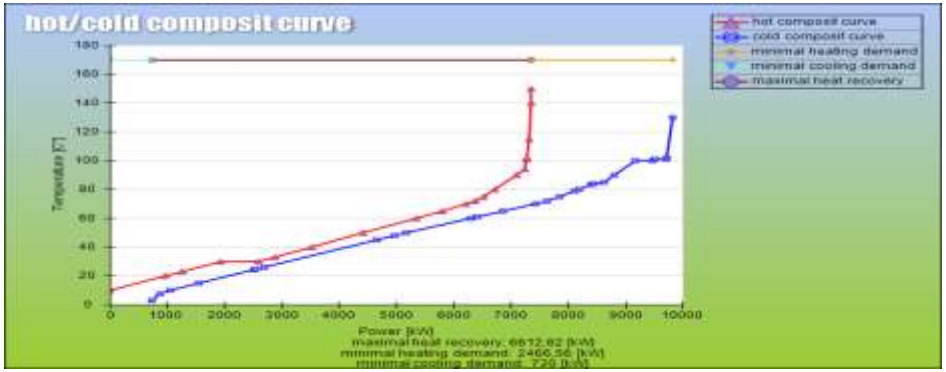
Implementation of renewable energy technologies; waste to energy, solar thermal energy, biomass

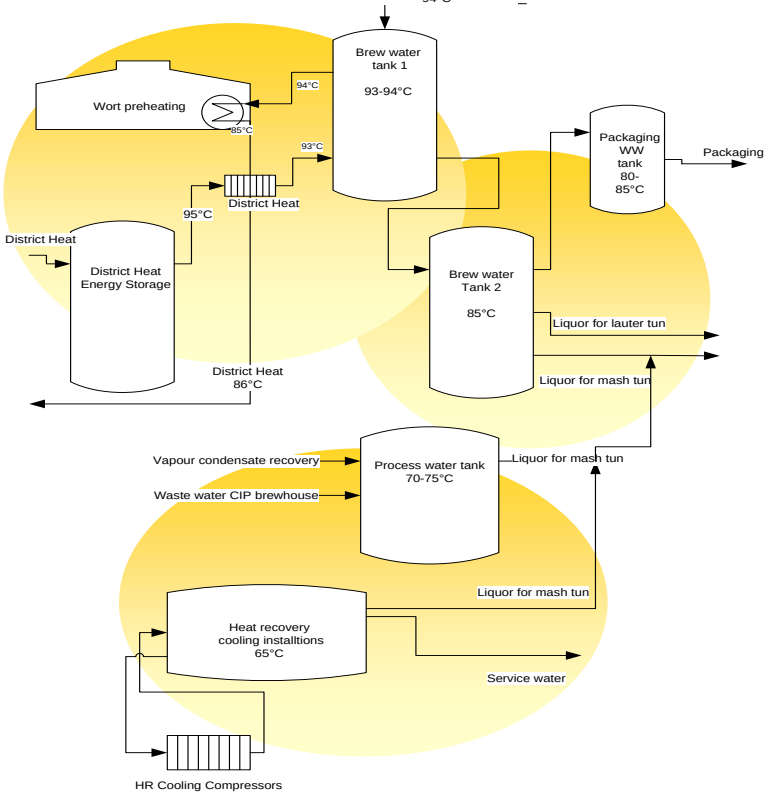
Heat exchanger network and heat storage management





- Minimum energy demand for heat and cold
- Heat exchanger network
- Design of heat storages
- Optimum integration point for RES



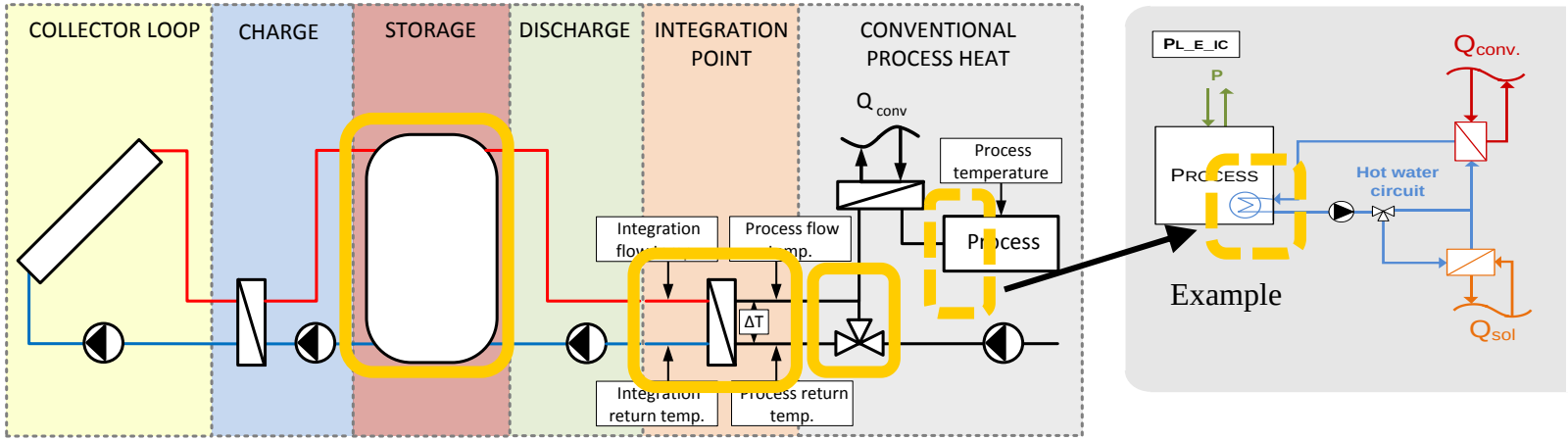


Principles of system integration

Supply level

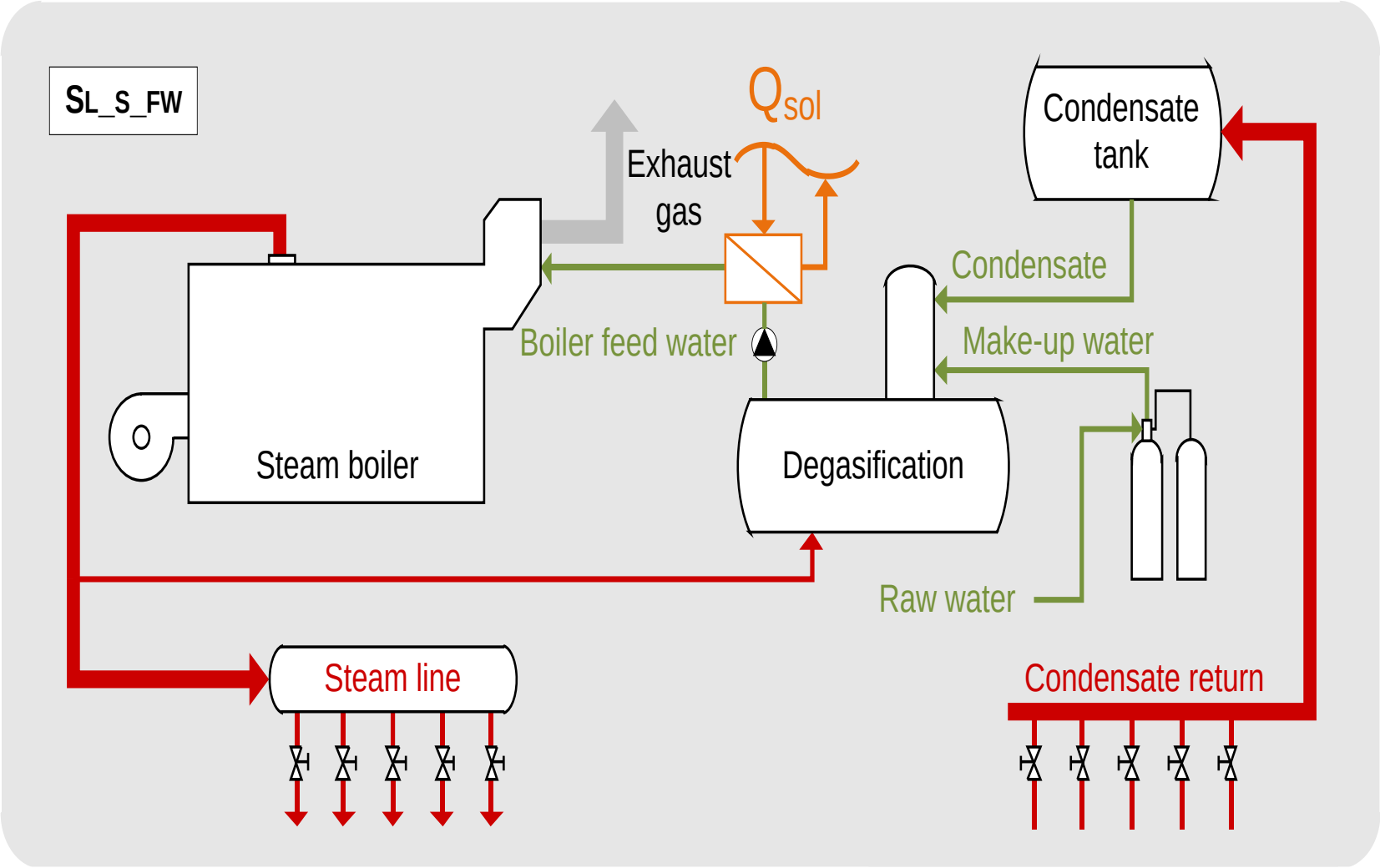
Process level

Integration Efficiency - Motivation



- Efficiency of storage
- Efficiency of heat exchanger after storage
- Efficiency of heat distribution
- Efficiency of heat exchanger within process

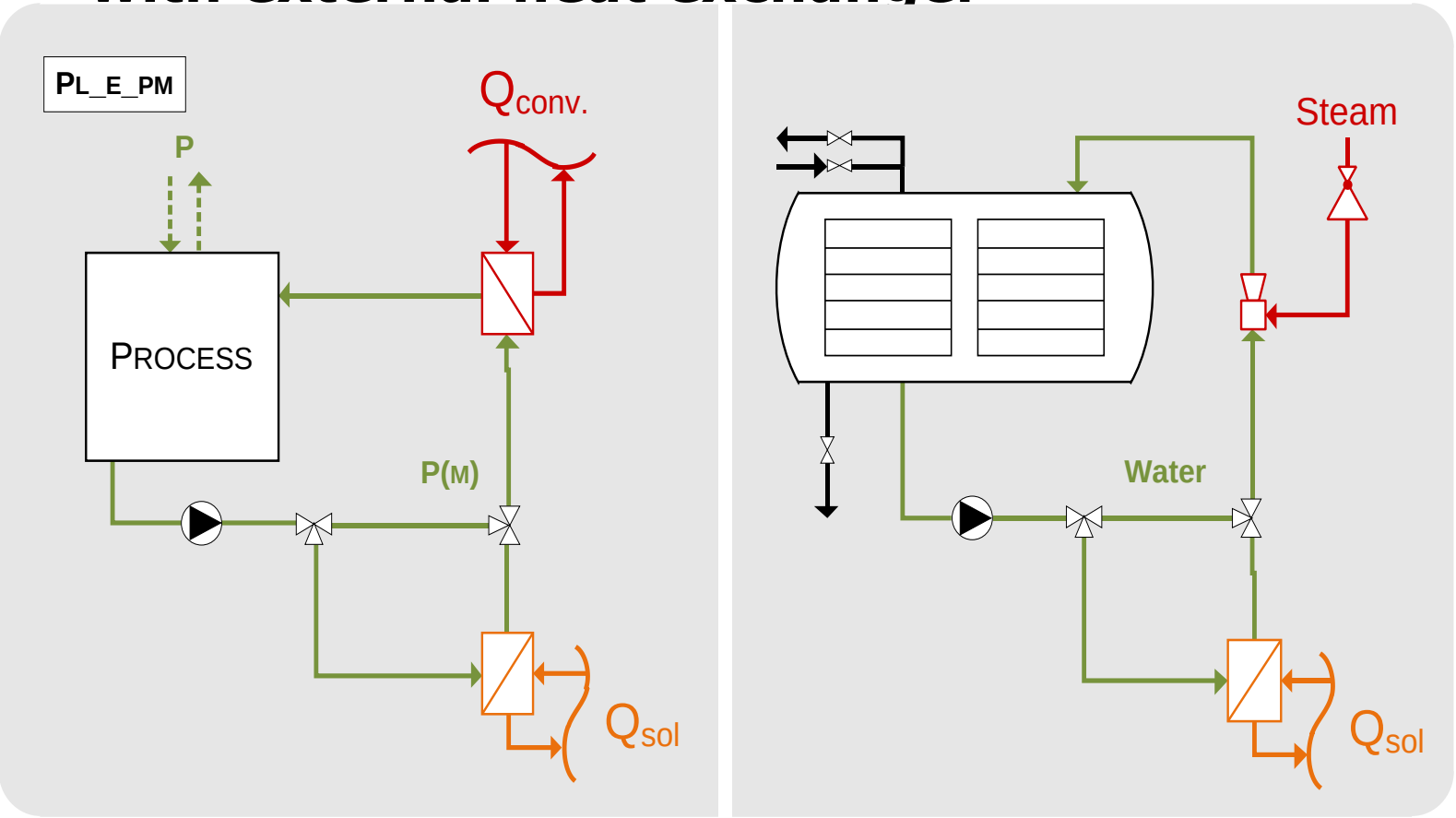
Pre-heating boiler feed water



Source: Bastian Schmitt Uni Kassel

Integration concepts

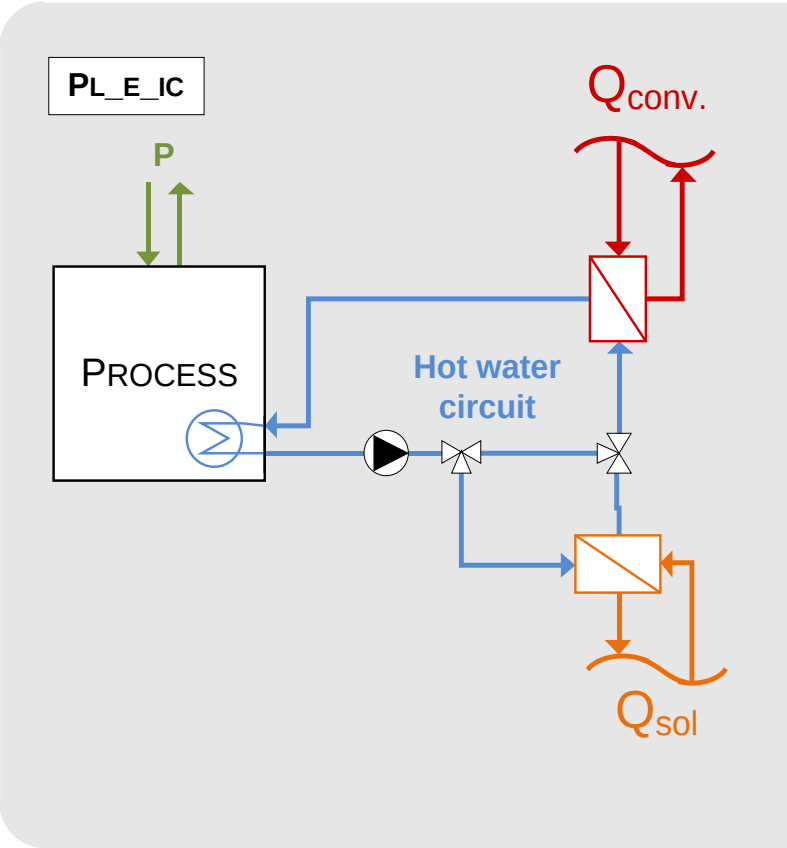
- **Solar heating of product or process media with external heat exchanger**

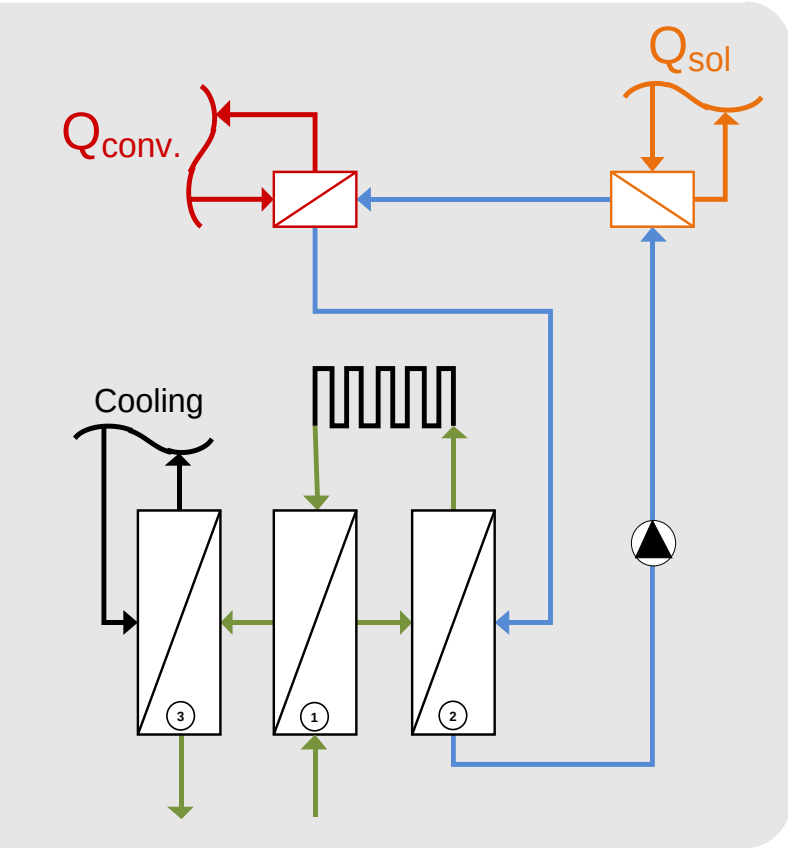


Source: Bastian Schmitt Uni Kassel

Integration concepts

- **Solar heating of intermediate hot water circuits with external heat exchanger**

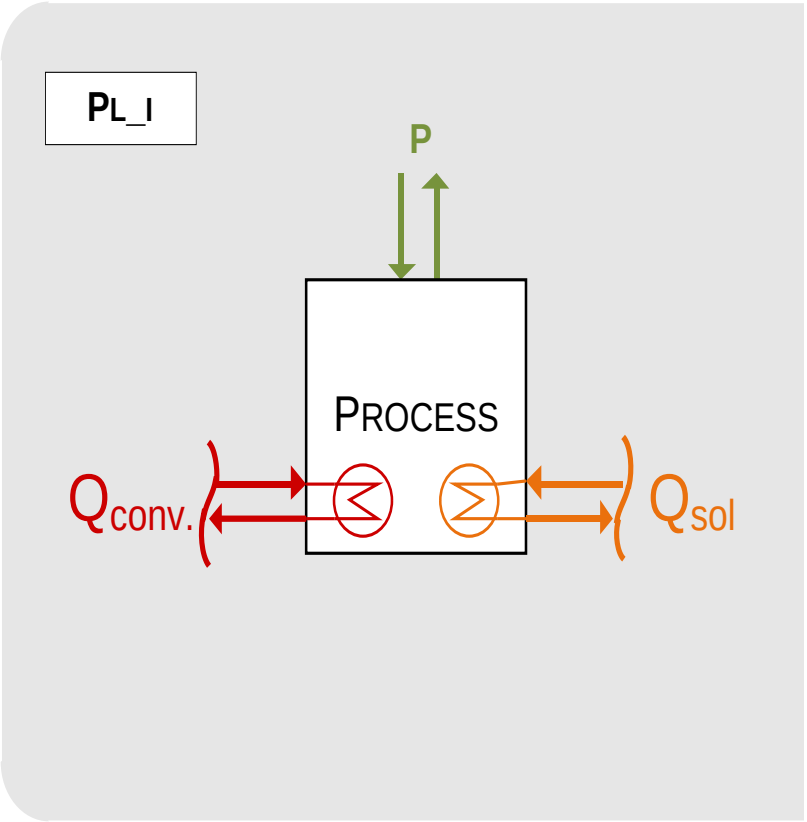


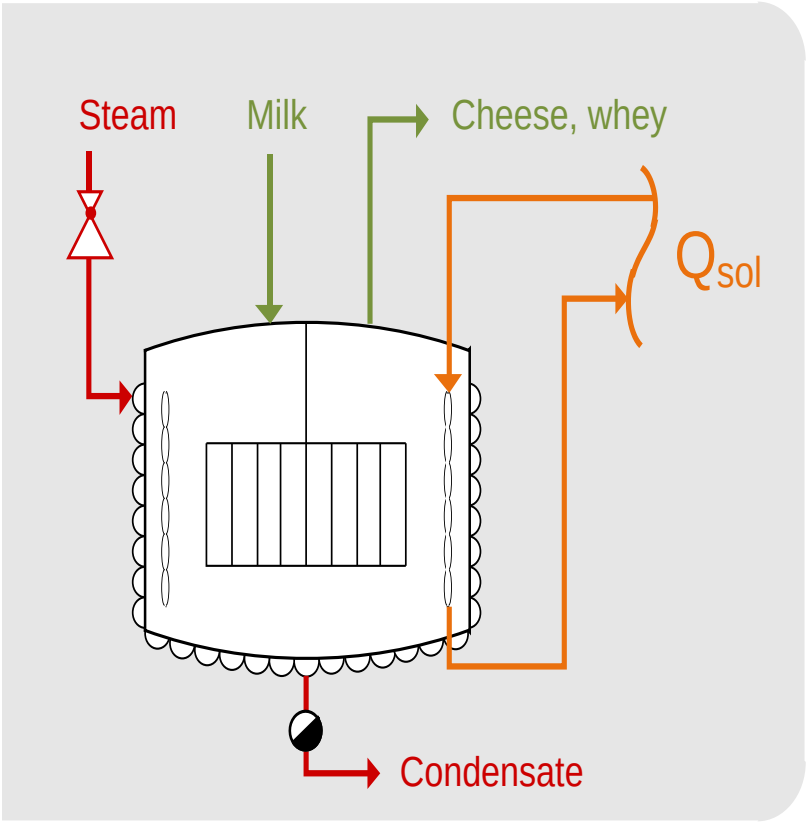


Source: Bastian Schmitt Uni Kassel

Integration concepts

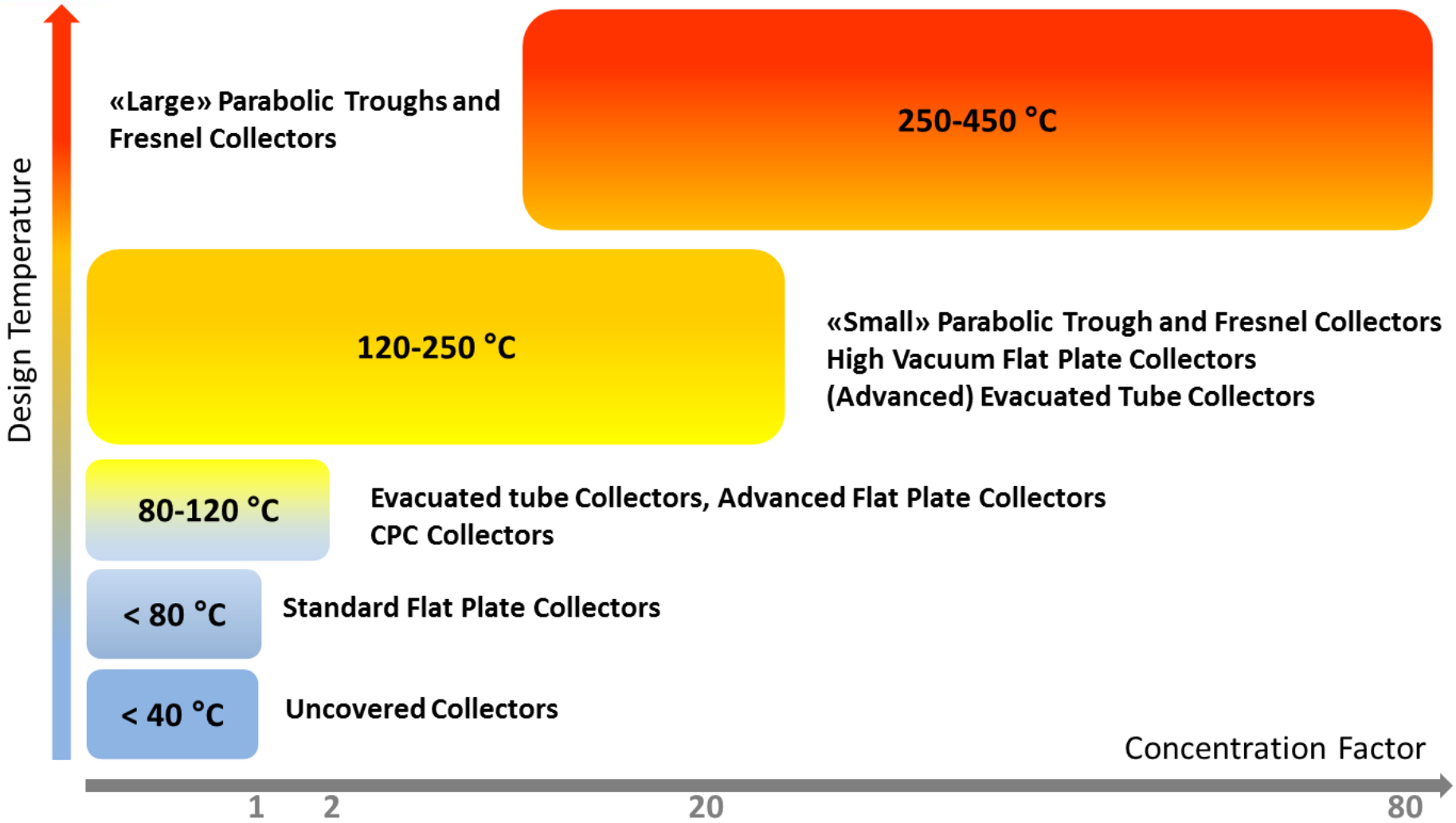
- **Solar heating of bath, machinery or tank with internal heat exchanger plates**





Source: Bastian Schmitt Uni Kassel

Overview collectors



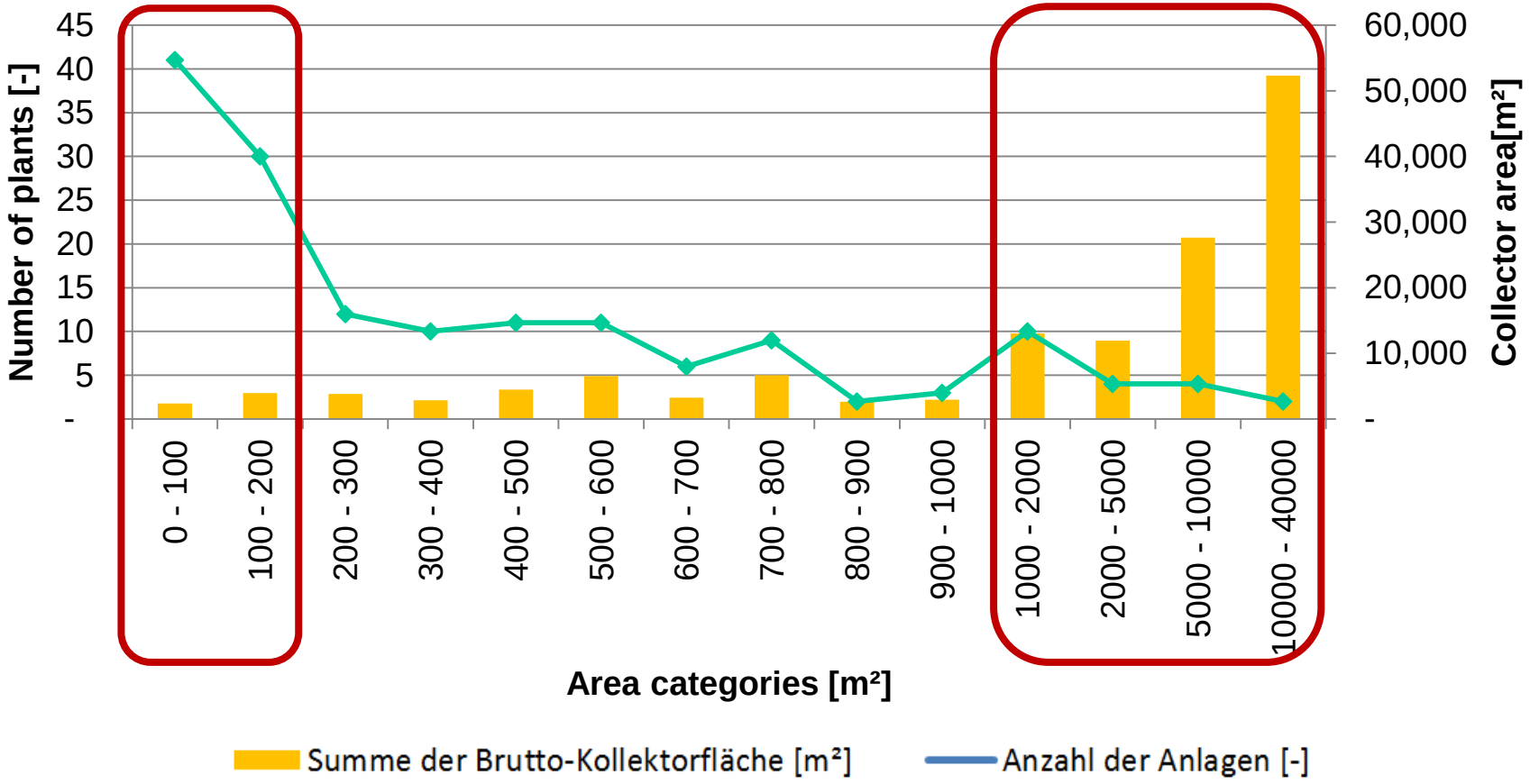
SHIP data base of realized plants

www. ship-plants.info

155 plants/ 144.406 m² collector area/ 101 MW

71 plants with 4,4 MW

20 plants with 73 MW



China – high number of very large systems

- **Foshan Jialida textiles Co. LTD.**
- **Collector area: 3000 m²**
- **Application: dyeing**
- **Completion: 2006**
- **Shenzhen Qinger Solar Energy Co.**

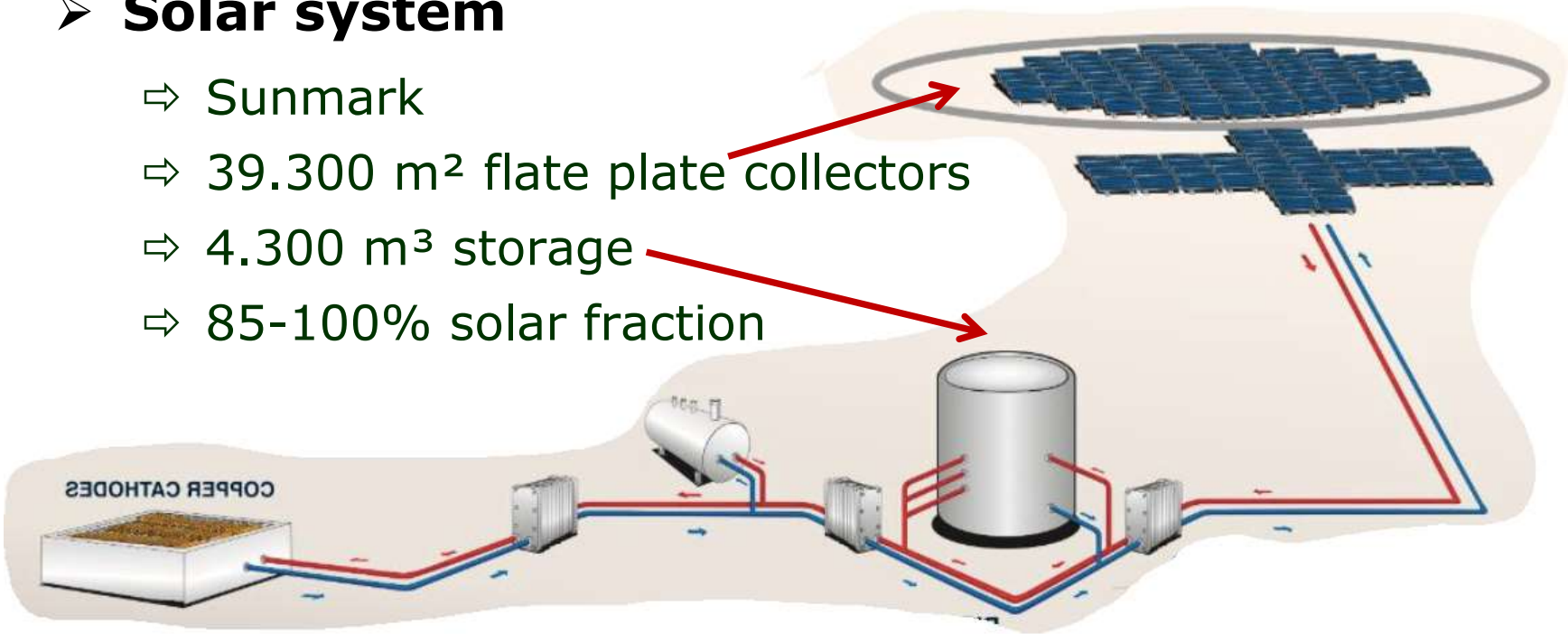
- **Dali Textiles Co. LTD. Xinchang**
- **Collector area: 13000 m²**
- **Application: dyeing**
- **Completion: 2008**
- **Shenzhen Qinger Solar Energy Co.**

China – high number of very large systems

- **Changshu printing and dyeing Co Ltd**
- **Collector area: 7460 m2**
- **Application: dyeing**
- **Completion: Sept. 2010**
- **Jiangsu Sunrain Solar Energy Co.**

World's largest solar field

- **Process**
  - ⇨ Copper recovery process
  - ⇨ Electrolyte constant at 50°C
  - ⇨ Aditionally cleaning processes
- **Solar system**
  - ⇨ Sunmark
  - ⇨ 39.300 m² flate plate collectors
  - ⇨ 4.300 m³ storage
  - ⇨ 85-100% solar fraction



World's largest solar field

USA: Prestage Food

➢ Process

- ⇨ Poultry-processing plant in North Carolina, USA
- ⇨ ESCO: FLS Energy
- ⇨ 568 m³ hot water each day (60 °C)
- ⇨ Cleaning processes

➢ Solar system

- ⇨ In operation since 2012
- ⇨ 7.804 m² flate plate collectors
- ⇨ 852 m³ storage (10 x 85 m³)
- ⇨ Solar fraction of hot water demand: 50%

Bildquellen: FLS Energy

Swiss– milk processing in the focus

- **LESA (Lateria Engiadinaisa SA) in Bever**
  - ⇨ 115m², heat contracting
  - ⇨ 1700 altitude, high snow load
- **Emmi Group (Fromagerie Tête de Moine) in Saignelégier**
  - ⇨ 627m², low temperatures to -20°C
- **Cremo SA in Fribourg**
  - ⇨ 585m²
  - ⇨ Assembled towards the south, unconventiolal tracking.

NEPSOLAR SPF INSTITUT FÜR SOLARTECHNIK HSR HOCHSCHULE FÜR TECHNIK RAPPERSWIL FHO Fachhochschule Ostschweiz

Largest SHIP application under construction in Mirrah, Oman

APPLICATION:

- **Generate steam for thermal enhanced oil recovery (EOR). In thermal EOR, steam is injected into an oil reservoir to heat the oil, making it easier to pump to the surface.**

ENERGY PRODUCTION

- **1,021 MW thermal (1 GW)**
- **TOTAL PROJECT AREA**
- **3 km²**

TECHNOLOGY

- **GlassPoint enclosed trough**
- **CONSTRUCTION START: 2015**
- **FIRST STEAM: 2017**

Mirrah, Oman

Parabolic troughs protected from soiling

GlassPoint

…in a greenhouse (Glasspoint technology)

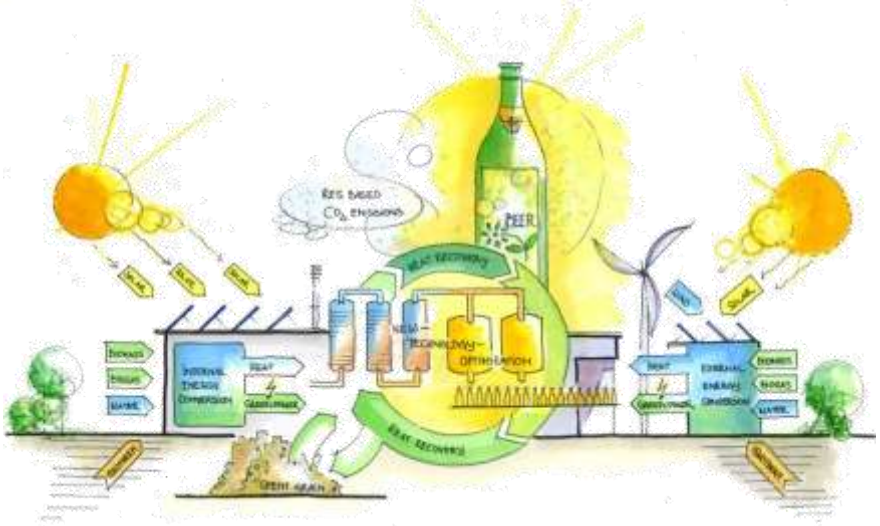
Mirrah, Oman

6000 t steam per day for enhanced oil recovery operations

…saving 1600 GWh_{th} gas, and 300 000 tCO2 a year

GlassPoint

Introduction to SolarBrew



Solar Brew: Solar Brewing the Future

EU FP7 (2012 – 2015)

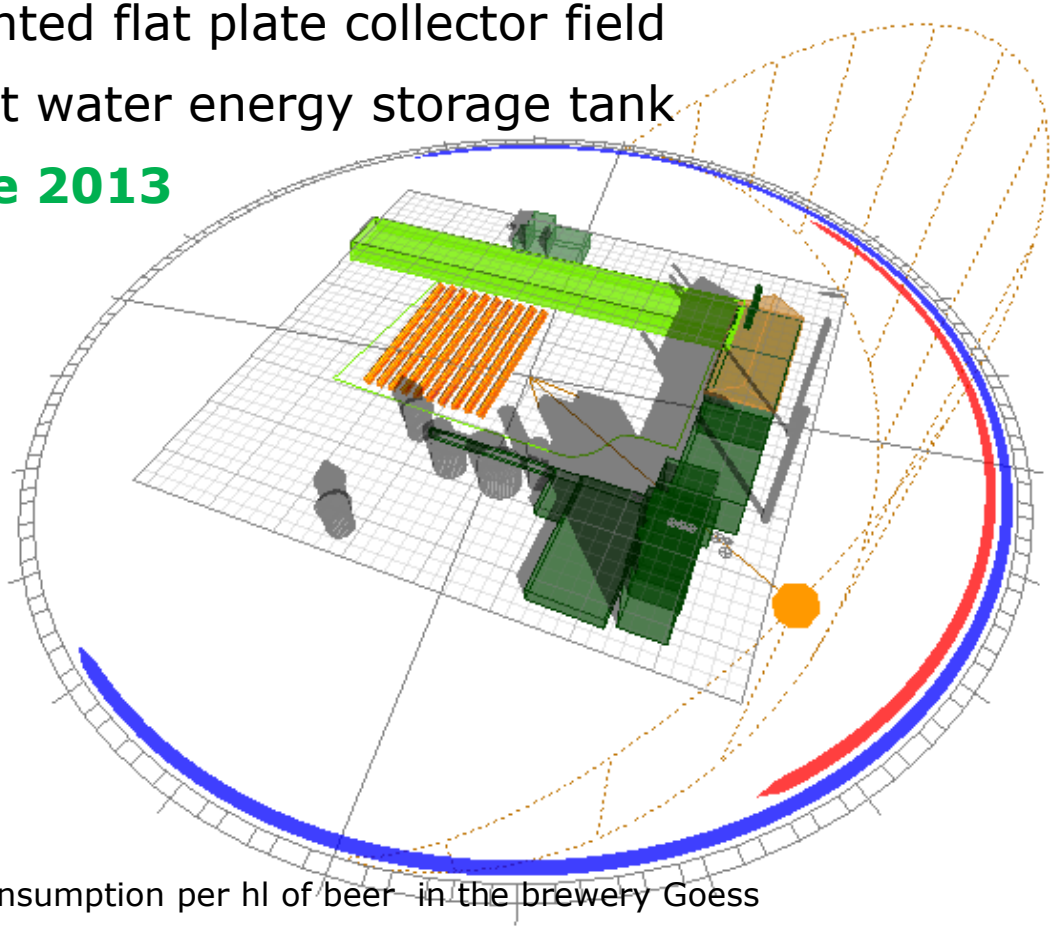
Projekt Nr. 295660

- **PROJECT CONSORTIUM**
- **AEE INTEC (coordinator)**
- **HEINEKEN Supply Chain B.V.**
- **GEA Brewery Systems GmbH**
  - process engineering
- **Sunmark A/S**
  - solar engineering

Green Brewery – Solar thermal collector field

BREWERY GOESS

- Solar assisted mashing process
- 1.470m² ground mounted flat plate collector field
- 200m³ pressurized hot water energy storage tank
- **Commissioned: June 2013**



4.6 million pints of beer
per year brewed with the power from the sun*

* assuming 60 MJ thermal energy consumption per hl of beer in the brewery Goess

State of the project

BREWERY GOESS

- Construction of the 1,500m² solar thermal collector field

Summary for decision

- Check if your energy need is at the appropriate temperature level for solar thermal
- Energy efficiency first
- Willingness for maybe changes in the process technology
- Important factors are the solar irradiation (shading), space availability and production times
- Pre-feasibility study with economical check
- Check of possibilities for Subsidies
- Cooperation between engineering company and solar company

- Green energy with a constant energy price

Thank you for your attention

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