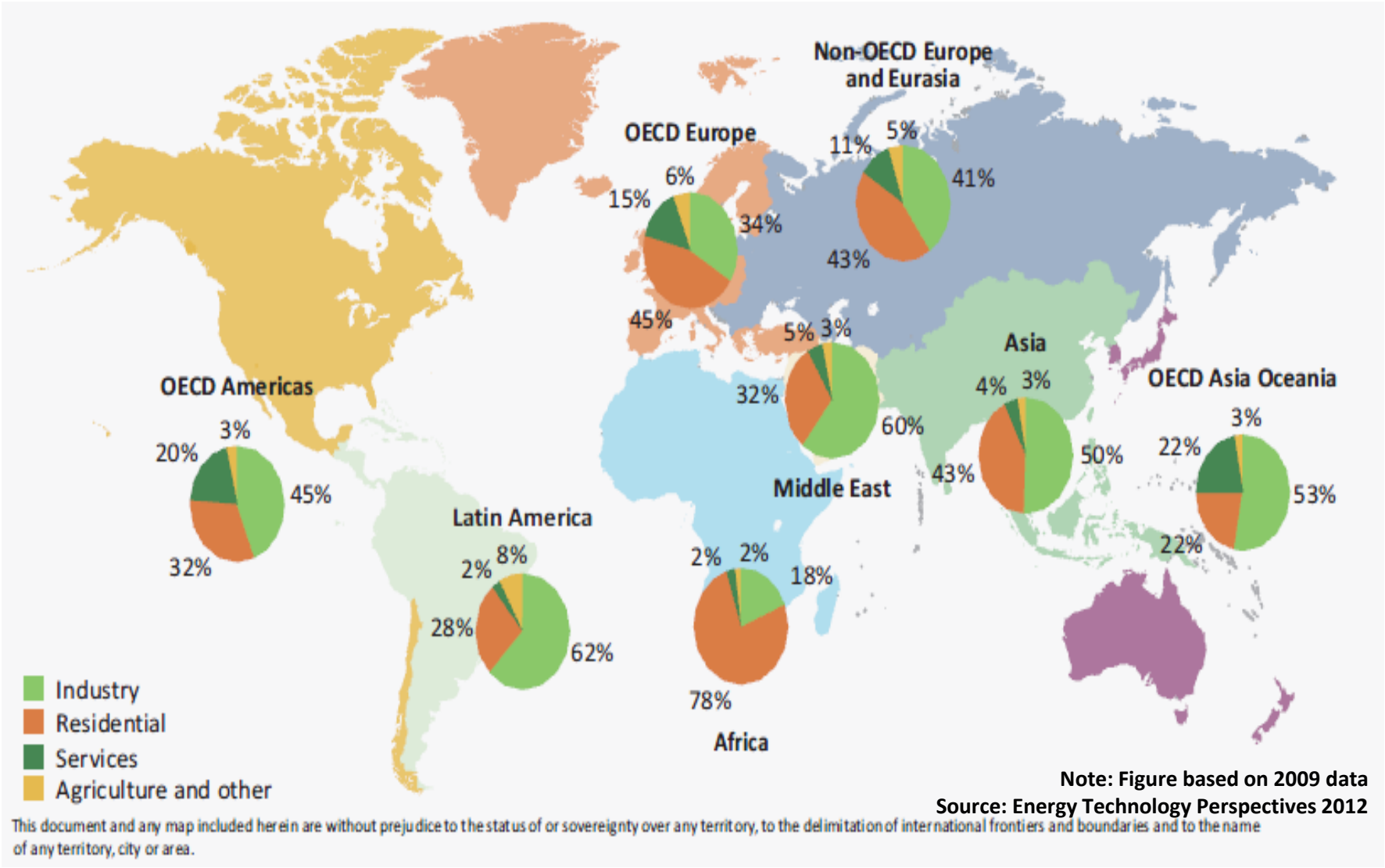
Solar Heat for Industrial Production Processes - Latest Research and Large Scale Installations

Christoph Brunner

AEE – Institute for Sustainable Technologies (AEE INTEC)
A-8200 Gleisdorf, Feldgasse 19
AUSTRIA

Industrial heat has an important role in the global economy

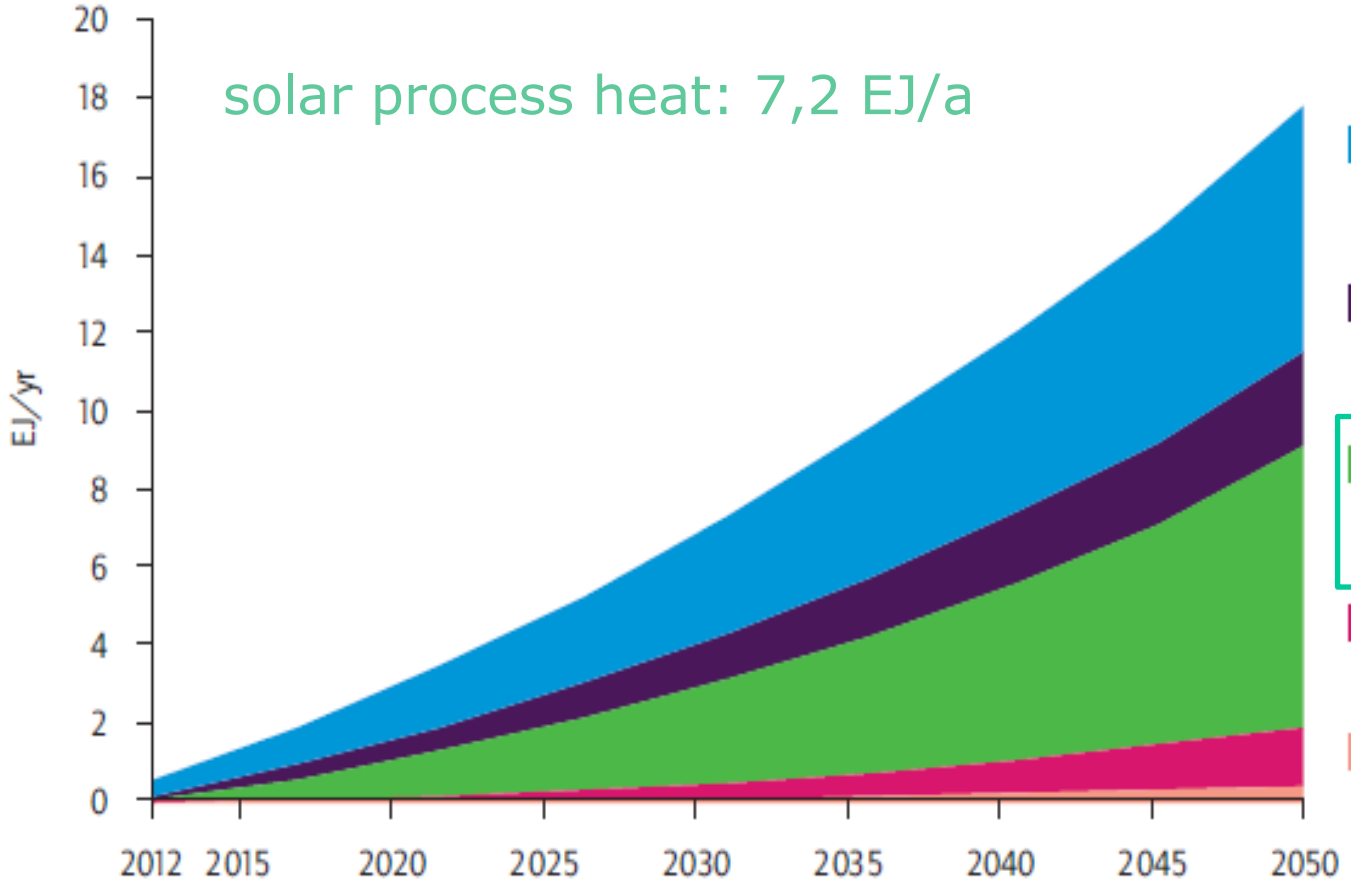


Note: Figure based on 2009 data

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

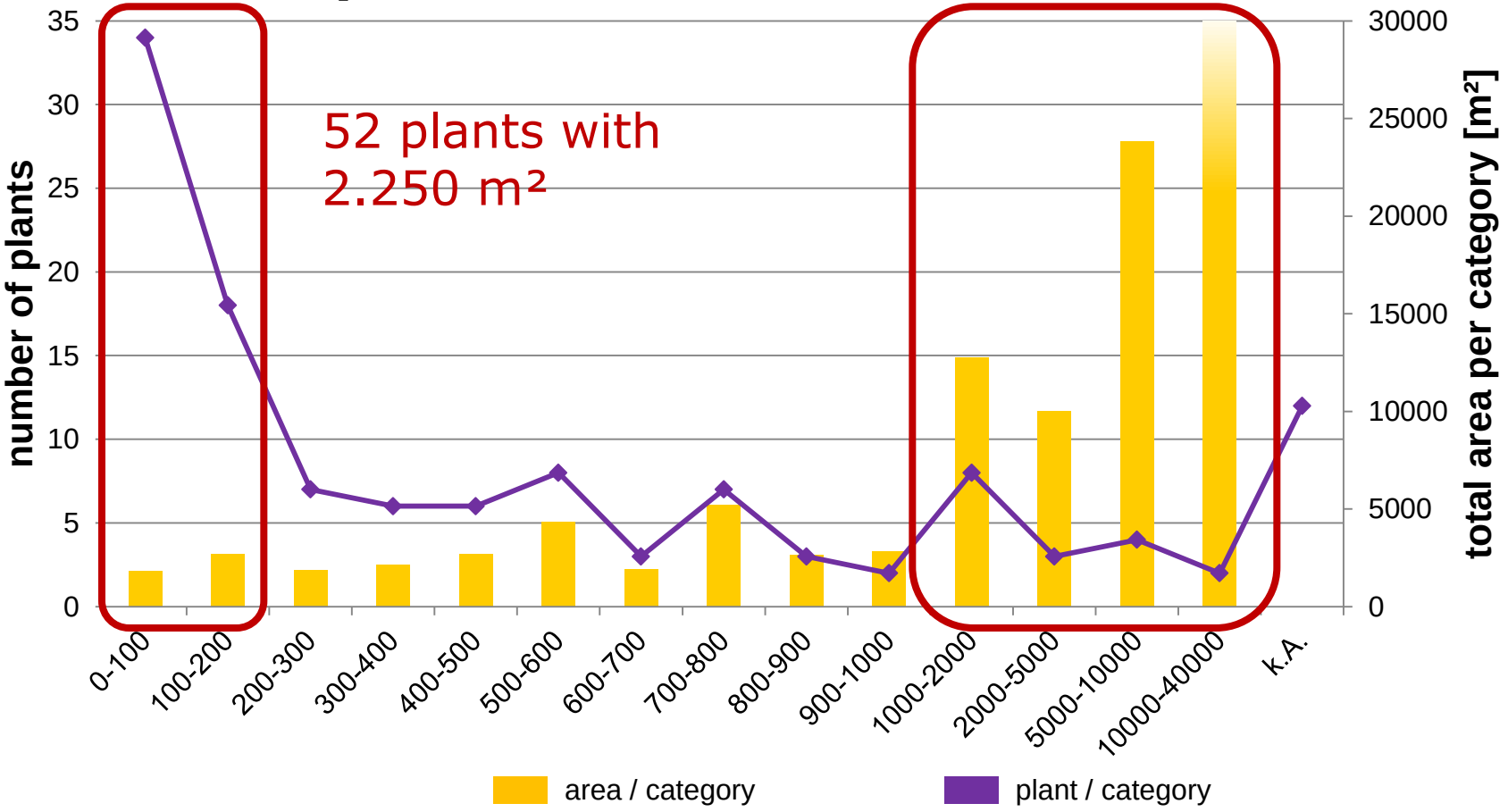
0.4 EJ/a

Source: IEA Technology Roadmap – Solar Heating & Cooling

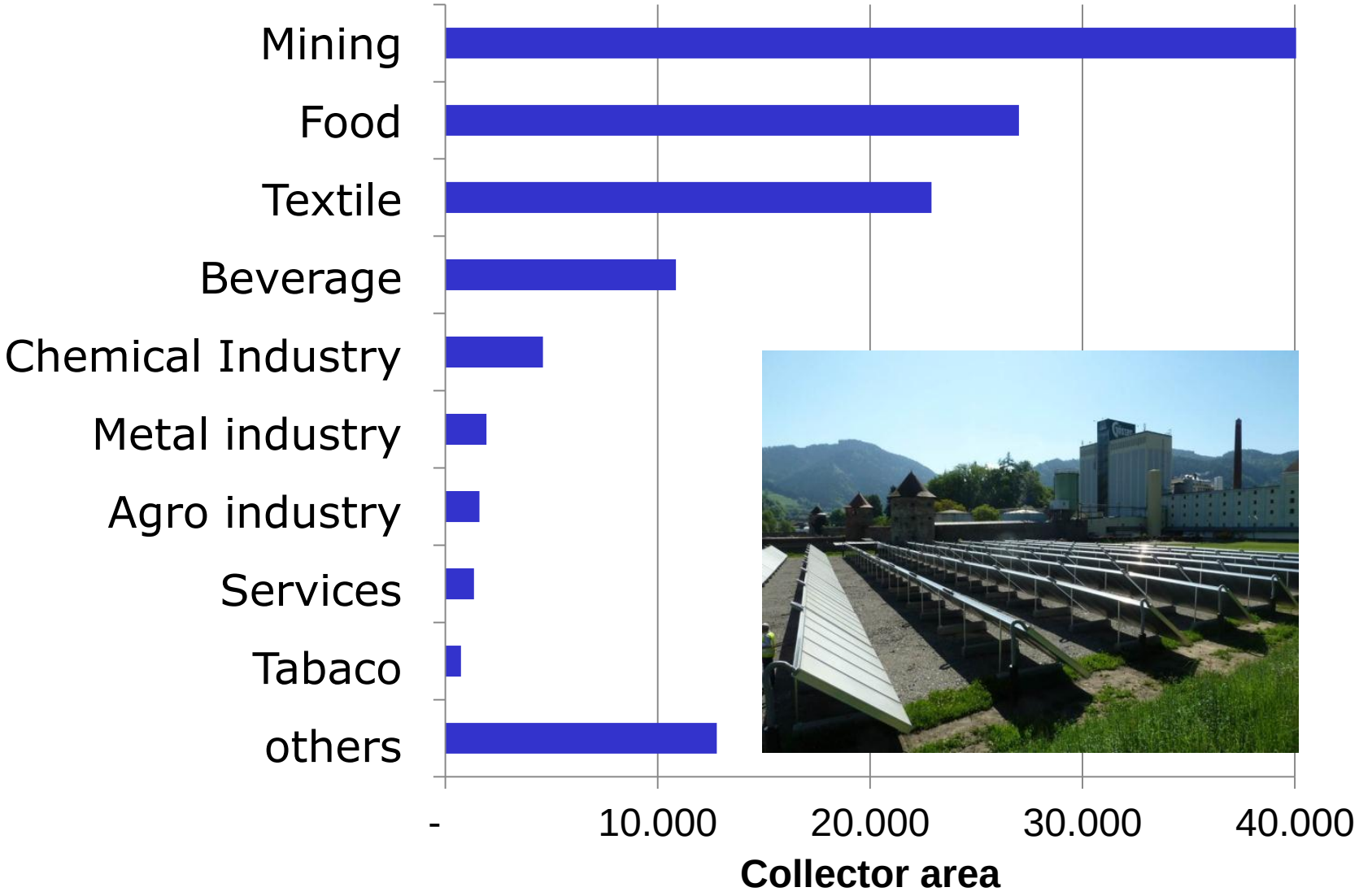
Existing process heat systems

17 plants with
98.700 m²

➢ **132 plants / 136.500 m² / 95,5 MW**

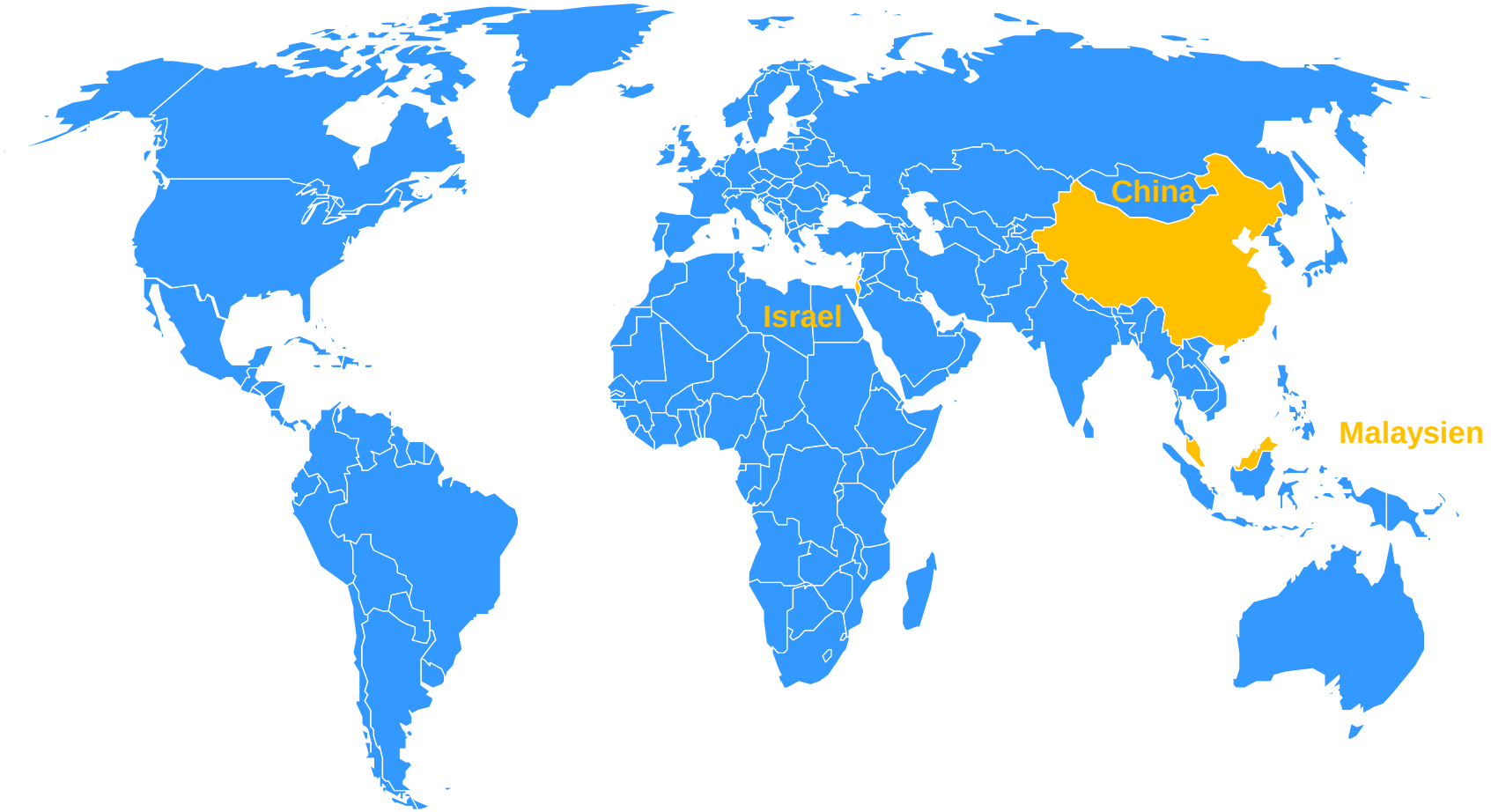


Industry Sub Sectors



ship-plants.info

SHIP in Asia



China's Solar Roadmap

- **Since 2013, the space of solar industrial and agricultural thermal application system increased rapidly.**
- **By 2020, 1.5% of industrial and agricultural thermal demand will be supplied by solar thermal**
- **During 2020-2030, there'll be an annual increase of 12% of solar thermal industrial and agricultural application space;**
- **During 2030-2050, the annual increase will reach 6%.**

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.**

Malaysia – start of the SHIP program in 2014 with GEF UNIDO and Research Institutions

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

- Realize 10 large-scale solar plants in combination with energy efficiency measures for industrial companies in Malaysia
- Start a training program with trainings for technicians and policy makers
- Development of a funding program for a sustainable support of future project developments
- Promising industrial sectors:
  - **Textiles**
  - **Food**
  - **Metals**
  - **Chemicals**
  - **Rubber**

Israel – collector development

- **New process-heat flat-plate collector developed by TIGI in Israel (honeycomb-structure under the glazing → minimized heat losses)**

SHIP in Africa

DUSTII – use of concentrating collectors

- **Pre-selection of companies based on ANME data and studies (20 candidates)**
- **Company visits and questionnaires (Top 6 Ranking)**
- **Energy-Audits and pre-feasibility study (Top 3 Ranking)**
- **Feasibility Study (1-2 partner-companies)**

Costs of Energy

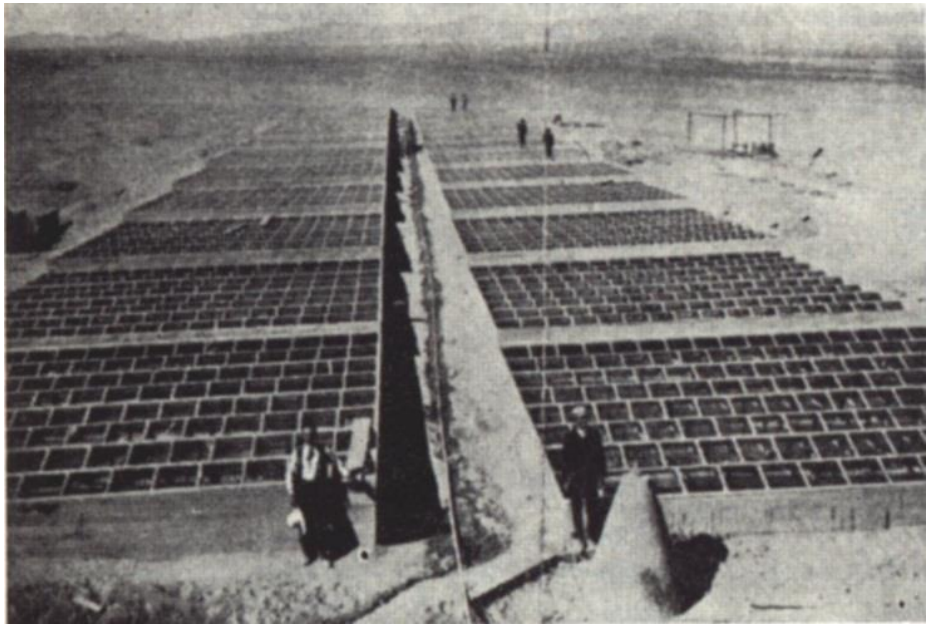
Energy	End user costs (net)
Natural gas	0,11 €/m3
Gasoil	0,53 €/litre
Heavy fuel	218 €/ton
GPL	503 €/ton

Source: STEG, Tunisian ministry of industry (January 2013)

SHIP in South-America

Chile – large plants in the past

- **Chile's advantage in Solar radiation was discovered by Charles Wilson in 1872. The Swedish Engineers built a 5,000 m² solar system to desalt brackish water. It delivered 20,000 liters / day and was in operation till 1912.**



Chile – large plants today

- **Three large solar-thermal applications in the minning-industry**
  - ⇨ Minera El Tesoro (2 MW parabolic trough by ABENGOA)
  - ⇨ Constanza Mine (350 kW flate plate collector, 80% solar fraction)
  - ⇨ Minera Gabriela Mistral (39.000 m² flate plate collector, 80% solar fraction).
  - ⇨ Other projects in the tendering or pre-study phase

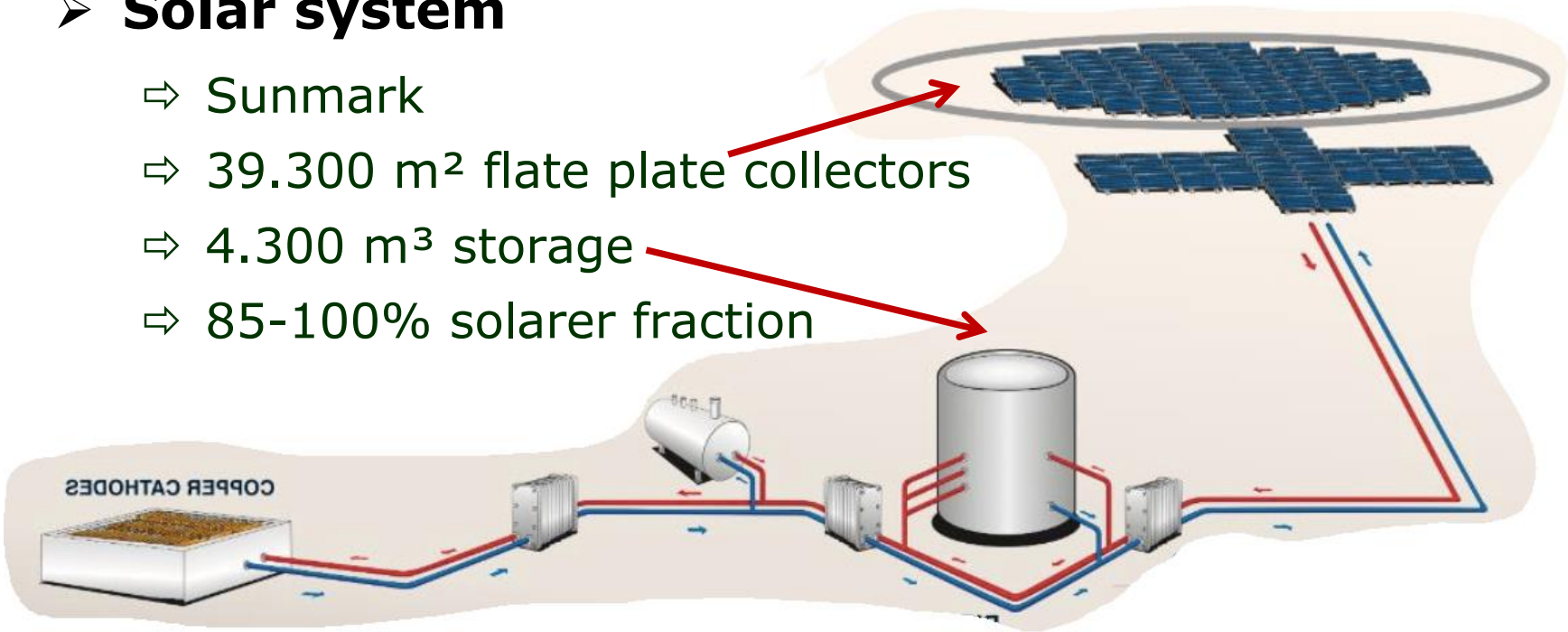

Minera Constanza (Antofagasta)


Minera Gabriela Mistral


Minera el Tesoro

World's largest solar field

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



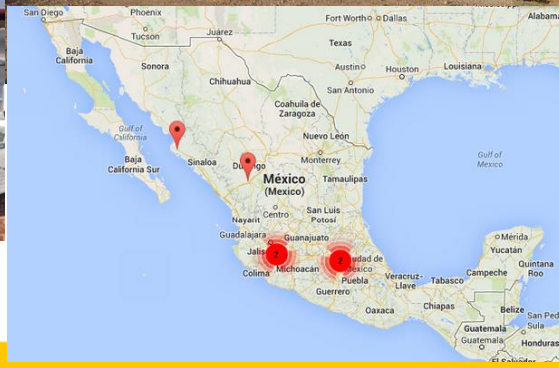
World's largest solar field

SHIP in North-America

Mexico – parabolic trough collectors

➢**6 installations from „Inventive Power“**

- **Buenavista Greenhouse**
- **La Doñita Dairy**
- **Lácteos Covbars Dairy**
- **Nutrición Marina (Food Pellets)**
- **Matatlan Dairy**
- **El Indio Dairy**



USA: Prestage Food

➢ Process

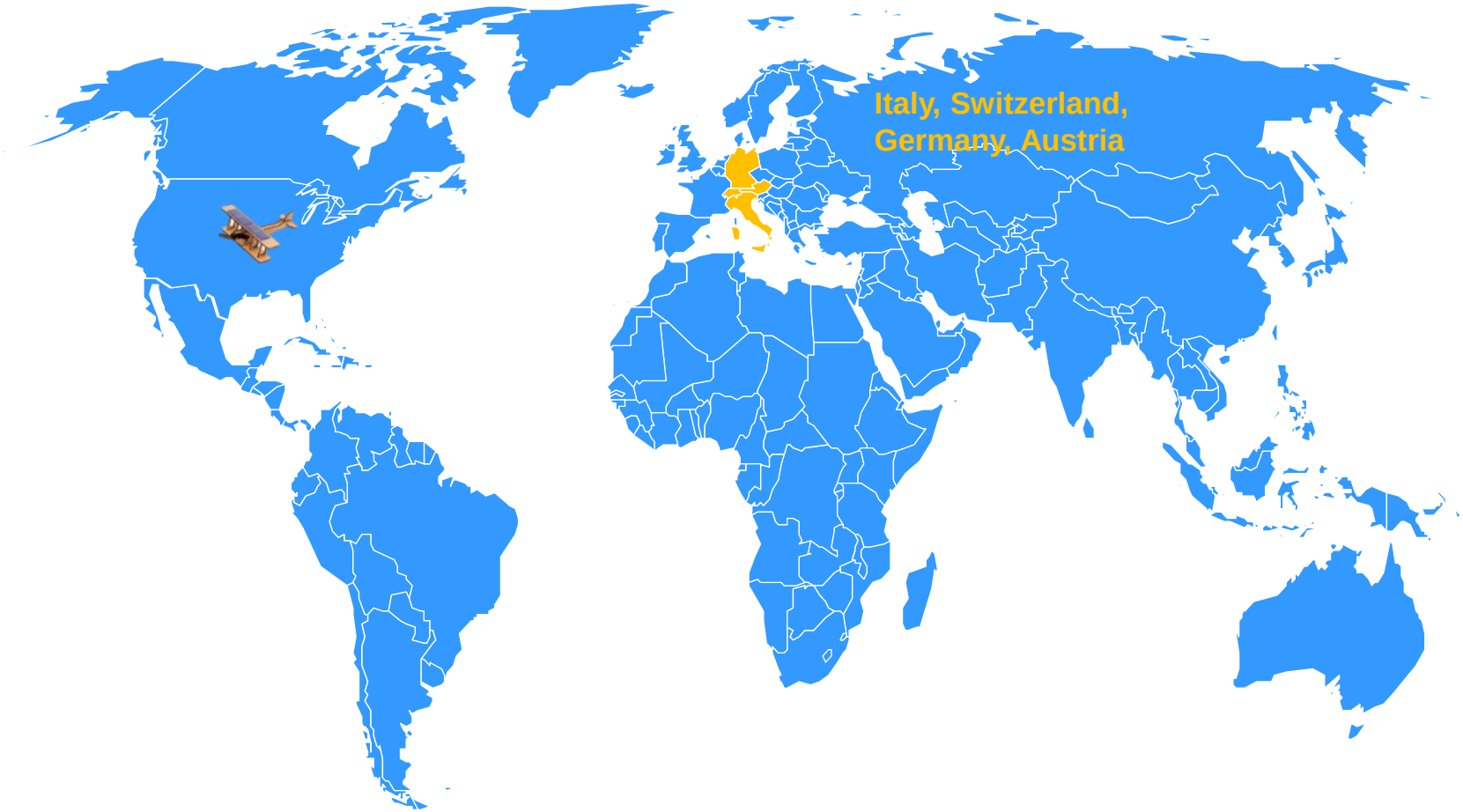
- ⇨ Poultry-processing plant in North Carolina, USA
- ⇨ ESCO: FLS Energy
- ⇨ 568 m³ hot water each day (60 °C)
- ⇨ Cleaning processes

➢ 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%

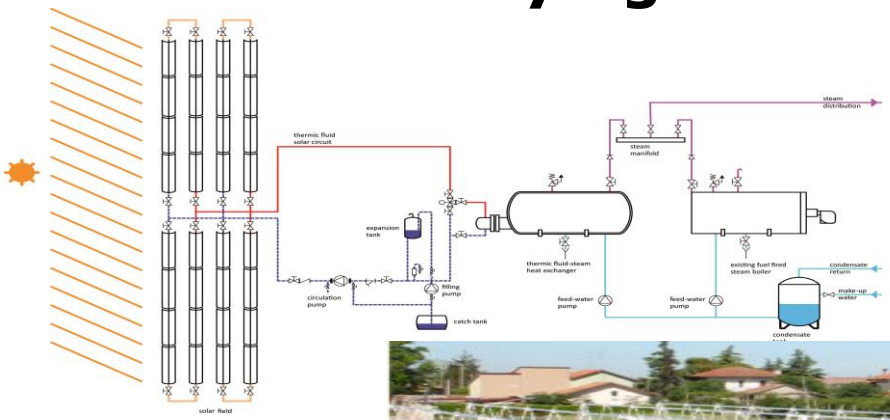
Bildquellen: FLS Energy

SHIP in Europe

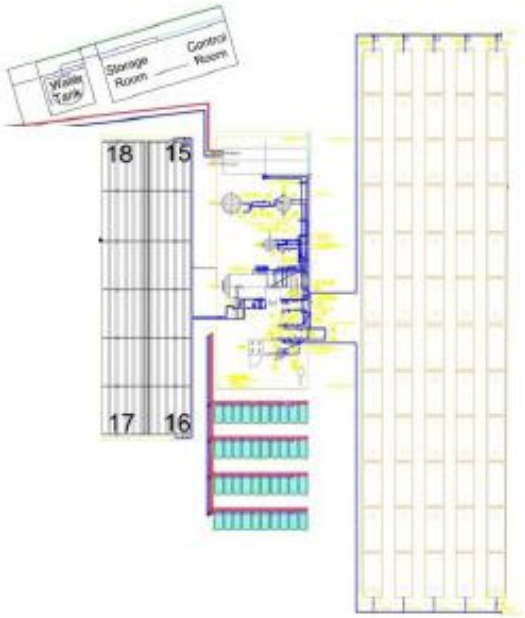


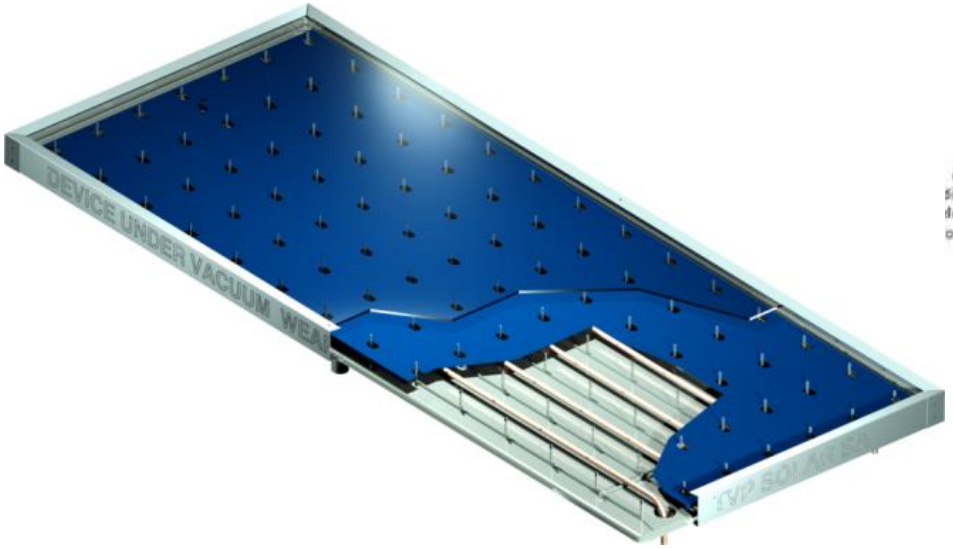
Italy – process steam project InSun

- **Location:** Italy
- **Size:** 1.2 MW (1’800 kg_{steam}/hr@10 bar)
- **Sector:** building materials
- **Process:** drying



Italy– TVP Solar – vacuum-flat plate collectors





Air
tioning/
dustrial
ooling

Masdar CITY

TVP SOLAR

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.

Germany- solar thermal process heat for the laundry industry - SoProW

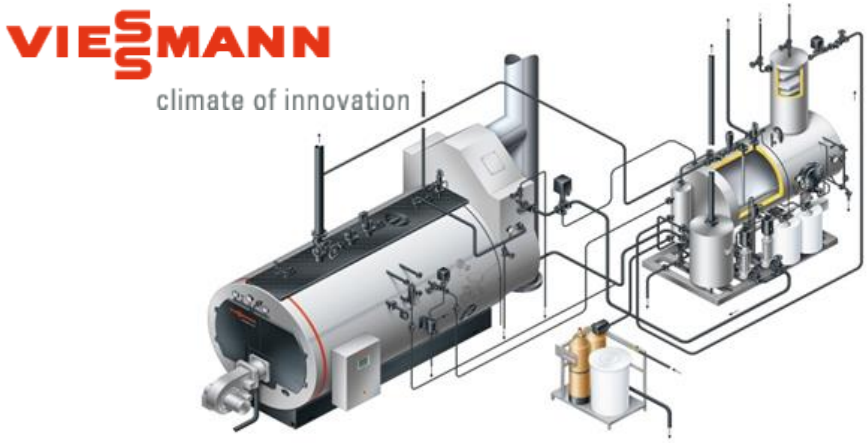
- **20 screenings, 10 case studies**
  - ⇨ Representative model laundry with/without efficiency measures for simulation studies
  - ⇨ Identification of potential integration points and development of systems
  - ⇨ General process heat system concepts optimization for T*SOL
  - ⇨ Testing area of solar steam generation with Fresnel-collectors equipped with measurement

Industrial washing machine with hot / cold waterand steam connection

Germany- SolSteam

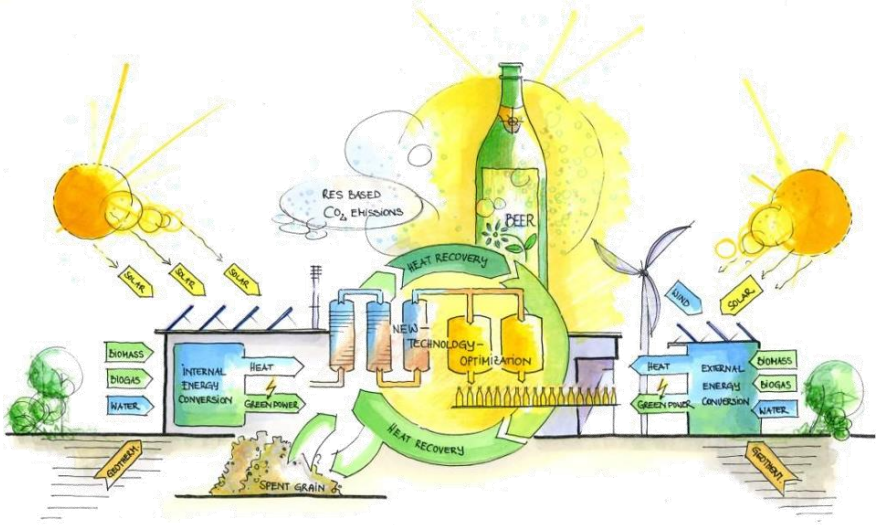
- **Integrated system concept based on proven components**
- **Secure steam supply to the processes in the usual quality**
- **Fuel saving by solar steam generation**
- **Sharing of peripheral components**

Industrial Solar Fresnel-Kollektor



Viessmann Dampfkessel mit Peripherie

Introduction to SolarBrew



Solar Brew: Solar Brewing the Future

EU FP7 (2012 – 2015)

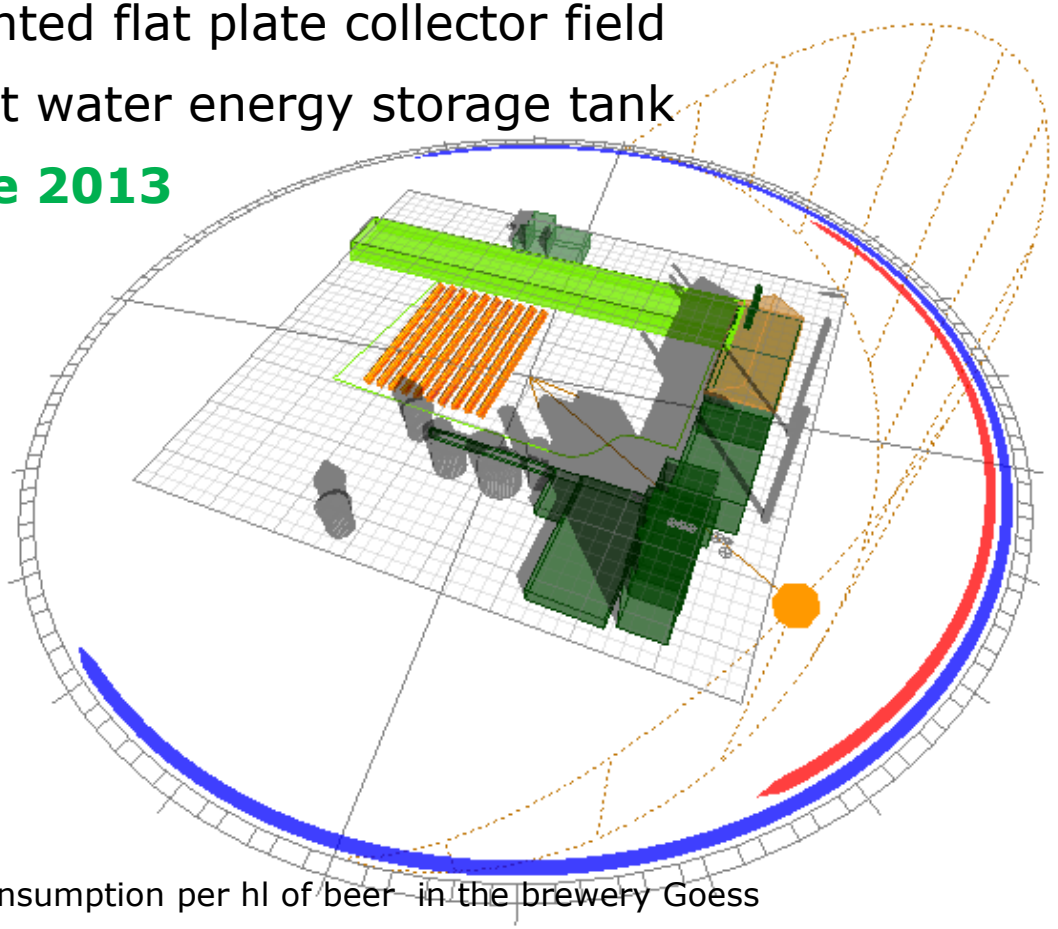
Projekt Nr. 295660

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

State of the project

BREWERY GOESS

- Solar assisted mashing process
- 1.500m² 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

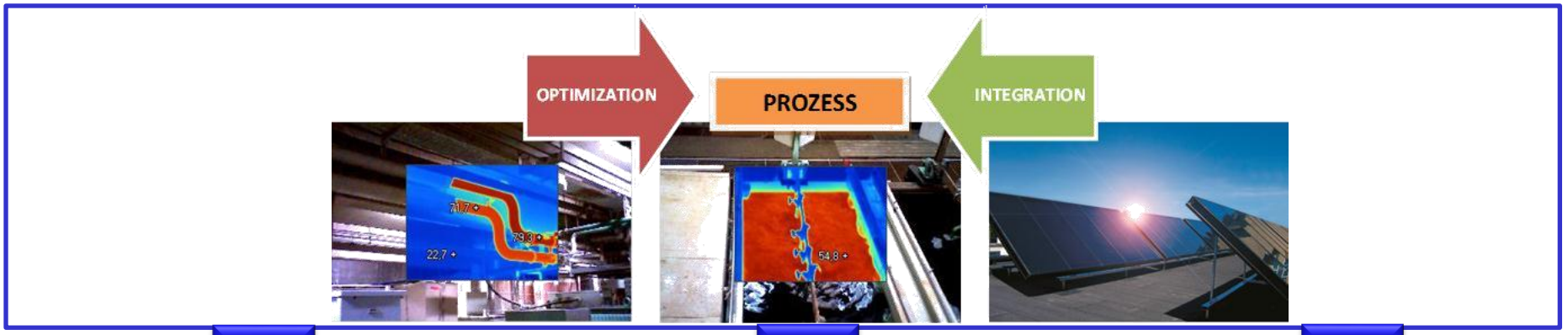
State of the project

BREWERY GOESS

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

Austria - IEA SHC Task 49 / IV

- **Task leader: AEE INTEC (Christoph Brunner)**
- **Duration: 4 years (start 2012)**
- **Joint Task with SolarPaces**



Subtask B
Process optimization
Process integration
Process intensification
(Bettina Muster – AEE INTEC)

Subtask C
Case studies
Integrations-equipment
Dissemination
(Werner Platzer – Fraunhofer ISE)

Subtask A
Process heat - collectors
(Pedro Horta – Uni Evora)

Research and Development Needs

- **Need of new technology and engineering concepts on the process side for**
  - ⇨ Increased energy efficiency
  - ⇨ Lower process temperatures
- **Standardized optimization and integration approach (branch concepts)**
- **Development, implementation and dissemination of case studies in various industry sectors, process integrations and locations (climate zones)**
- **Development of process heat collector technologies and their integration (hot water, direct steam, thermal oil,…)**
- **Training and awareness-raising**

Thank you for your attention

Christoph Brunner

AEE – Institute for Sustainable Technologies (AEE INTEC)
A-8200 Gleisdorf, Feldgasse 19
AUSTRIA