

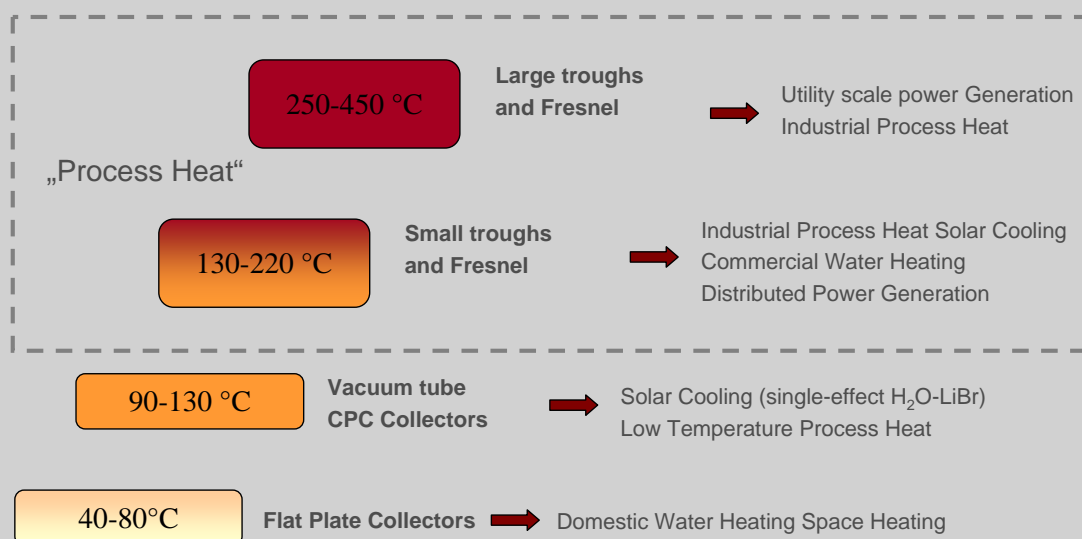


## Advantages of Linear Fresnel Collectors for Solar Cooling Applications

Christian Zahler  
Mirroxx GmbH, Freiburg, Germany

SolarPACES – Fraunhofer ISE Workshop  
„Chances and Potentials for Medium Scale Solarthermal Power Using Combined Heating, Cooling and Power“

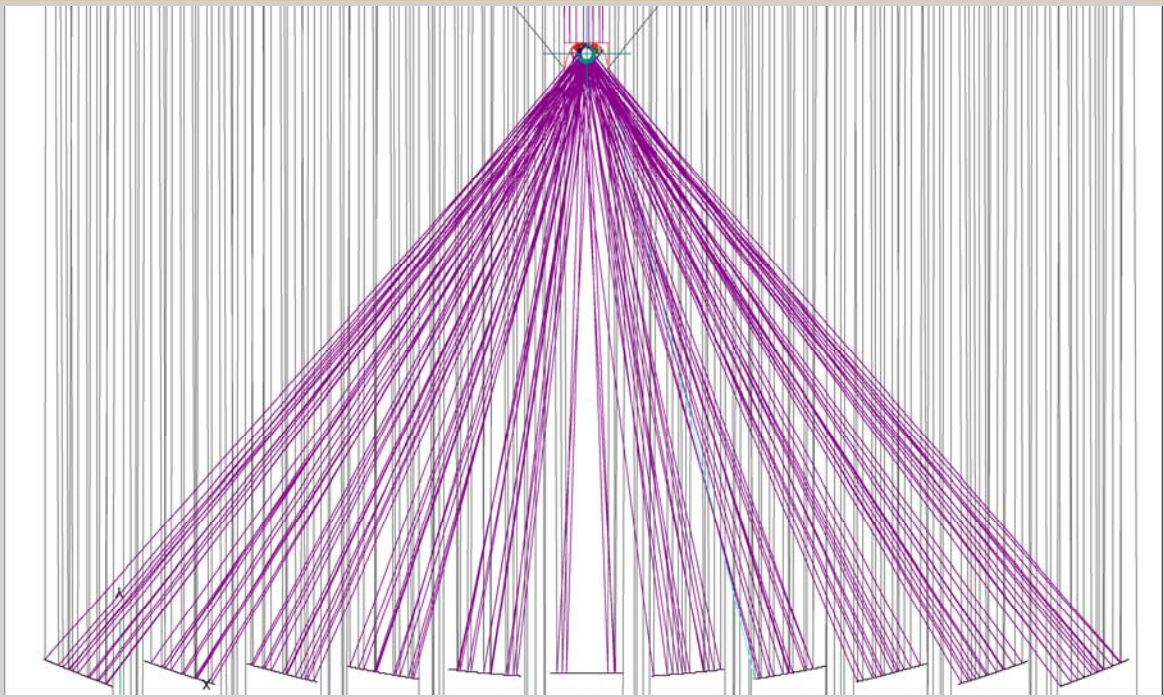
## Technology



# Basic Principle



solar heat for industry



[www.mirroxx.com](http://www.mirroxx.com)

# Concentrating Solar Collectors



solar heat for industry



source: man ferrostaal / solarpowergroup  
source: novatec-biosol

[www.mirroxx.com](http://www.mirroxx.com)

## Small Parabolic Troughs

M I R R O X X

solar heat for industry

- New Energy Partners
- Sopogy
- Solarlite
- ...



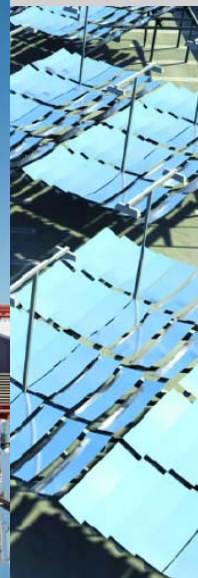
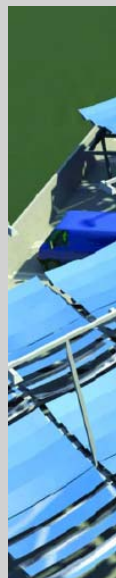
[www.mirroxx.com](http://www.mirroxx.com)

## Small Fresnel Collectors

M I R R O X X

solar heat for industry

- Heliodynamics
- Power-Spar
- Mirroxx



[www.mirroxx.com](http://www.mirroxx.com)

# History



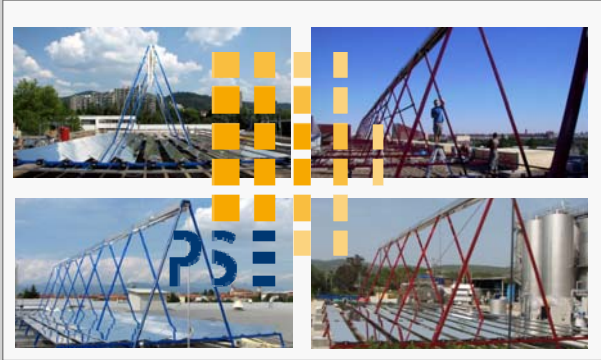
solar heat for industry

## From PSE to Mirroxx

✓ Development since 1999

✓ Pilot-Experience since 2005

✓ Commercialization since 2007



- Production line in Freiburg
- International co-operations
  - Sales
  - Installation
  - Sourcing

### Achievements:

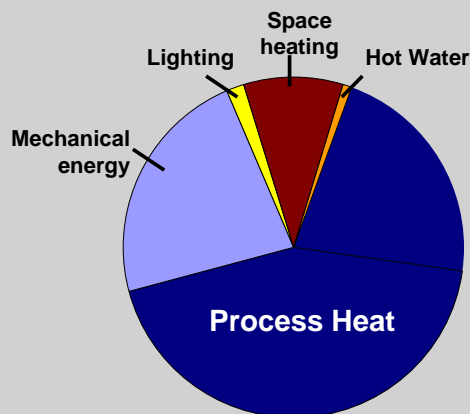
- 4 projects realized by PSE
- System reliability approved
- Sales and Collector-Production by Mirroxx GmbH founded in 11/08
- Increasing Commercial Quotes for different fields of use without marketing

# Motivation



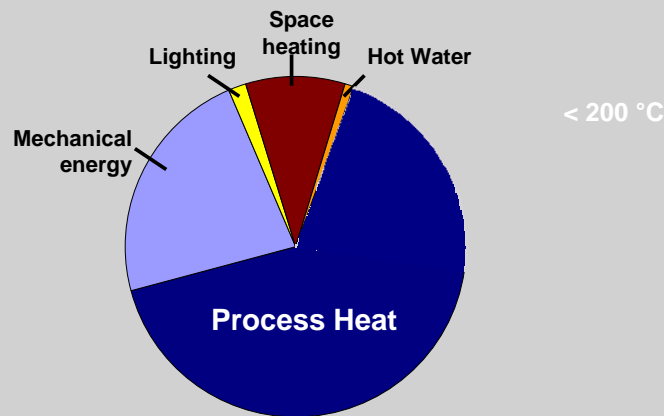
solar heat for industry

- 2/3 of industrial end energy consumption is thermal energy



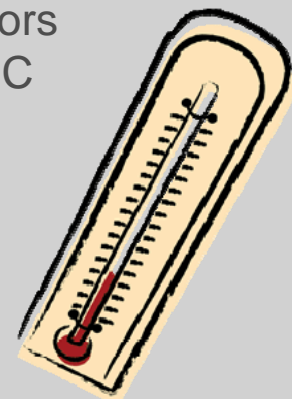
## Motivation

- 1/3 of the industrial process heat demand is below 200 °C

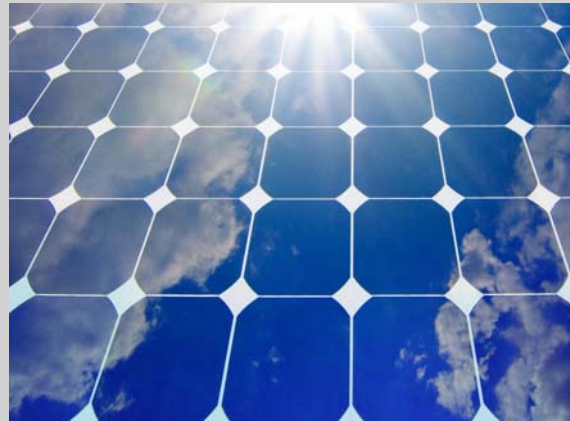


## Motivation

- Non-concentrating solar thermal collectors deliver temperatures of only up to 120 °C
- But many industrial processes require heat at higher temperatures



- The solar energy technologies mainly focused on are photovoltaic, solar thermal collectors for domestic hot water and solar thermal power plants



- Until now there was no renewable, reliable, cost-competitive energy source for industrial process heat above 150 °C available
- The volume of the European market for solar process heat is > 100 Billion €

## Modular approach



- Length: modular in steps of 4m
- Total Width: 7.5m
- Aperture Width: 5.5m
- Height: 4m
- Weight: 27 kg/m<sup>2</sup>
- Peak Power: 500 W/m<sup>2</sup>

## Mirroxx Fresnel collector perfectly suited for roof top installation



- | Temperature Range                      | Power Range                        |
|--|------------------------------------|
| ○ 150-200 °C pressurized water         | ○ Weight: 27 kg/m <sup>2</sup>     |
| ○ Up to 400 °C with thermal oil        | ○ Peak Power: 500 W/m <sup>2</sup> |
| ○ Direct steam up to 40 bar and 250 °C |                                    |

# Advantages

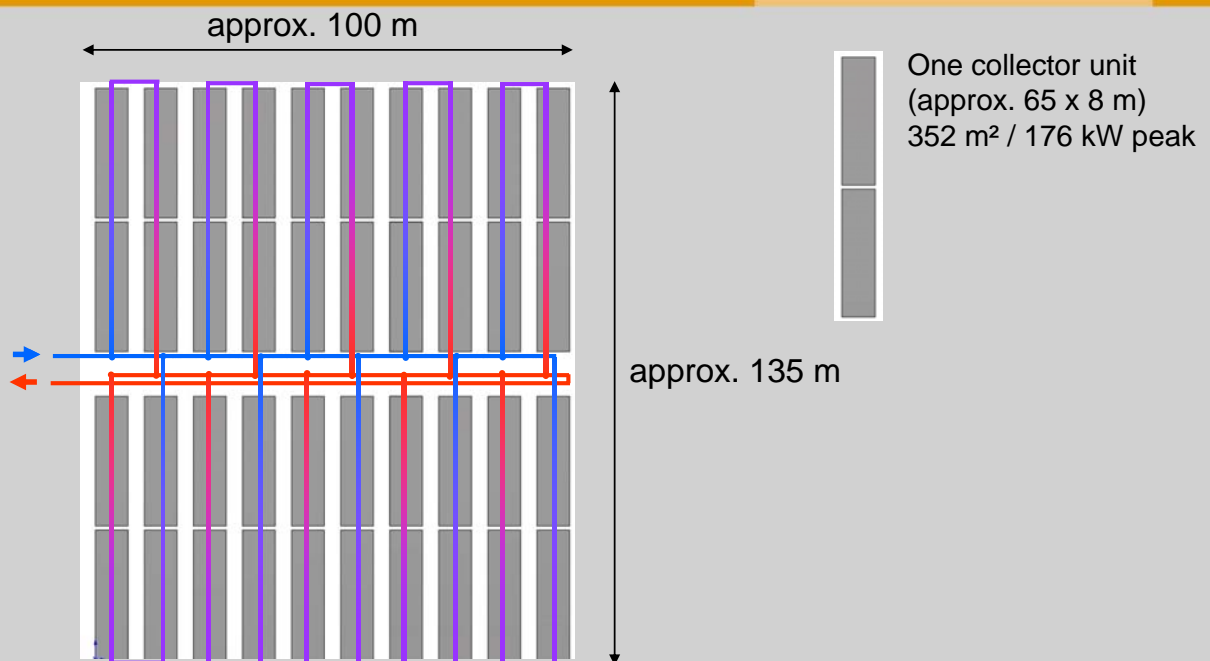
- Low wind load
- Good weight-spread
- High ground usage factor
- No north-south alignment necessary
  
- Primary mirrors made of flat glass
- Precise temperature and power control
- 70 mm absorber tube, 50 mm piping
- Remote control and monitoring via LAN and internet
  
- Stationary receiver
- Concentrated sunlight hits absorber tube from below

**Rooftop  
installation**

**Industry**

**Steam**

# Collector field layout with 7040 m<sup>2</sup> aperture area for a thermal peak power of 3.5 MW

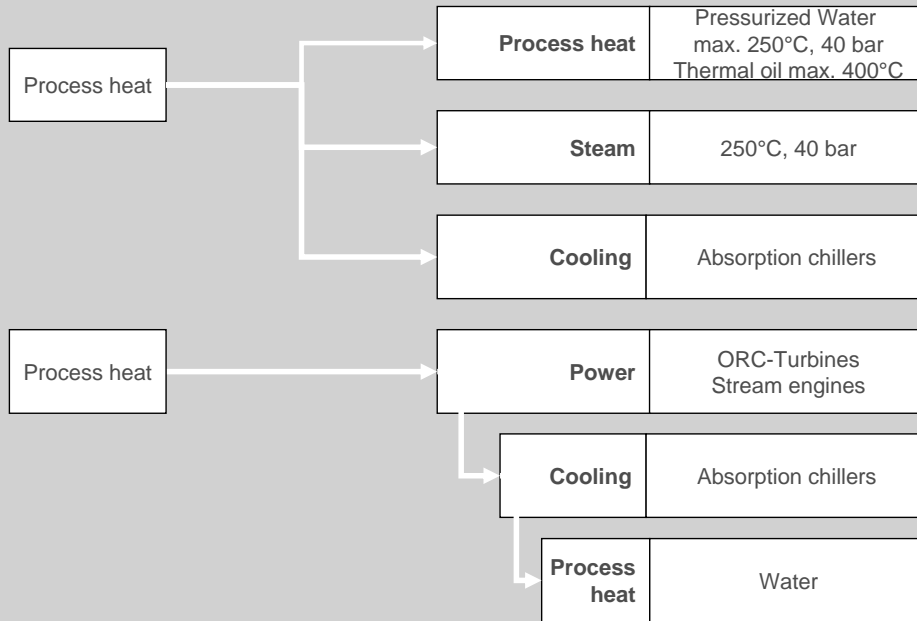


# Applications



solar heat for industry

## Process heat for various applications and even polygeneration



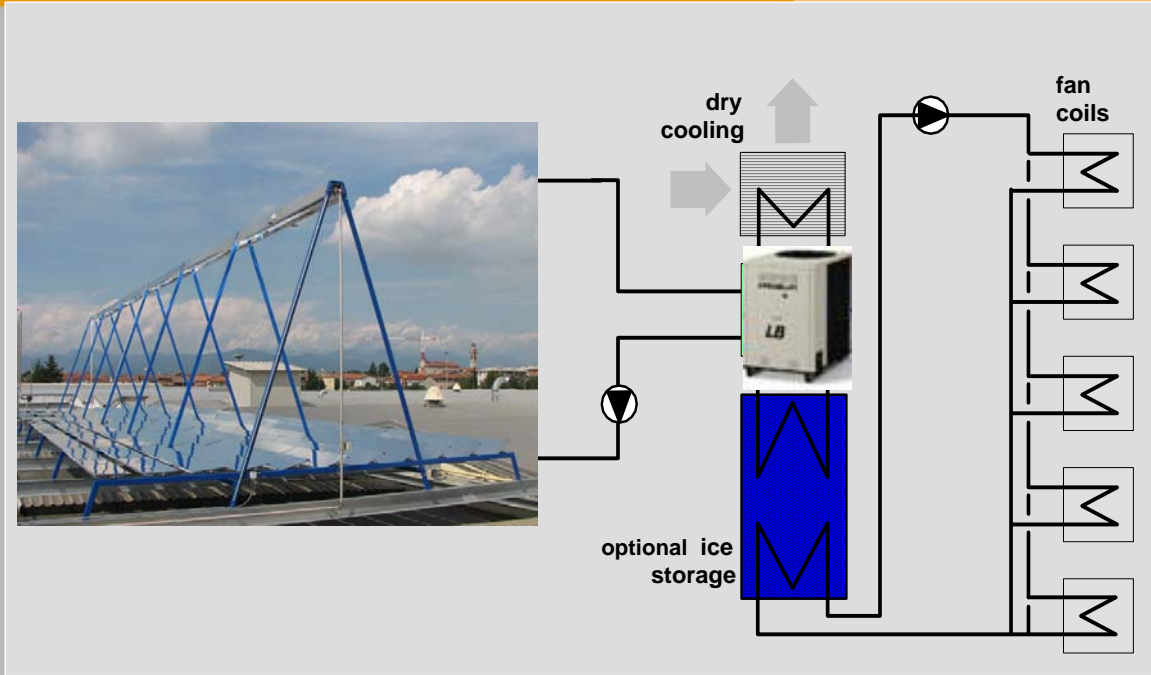
# Solar Cooling



solar heat for industry

	Single effect H <sub>2</sub> O/LiBr	Double effect H <sub>2</sub> O/LiBr	Triple effect H <sub>2</sub> O/LiBr	Single effect NH <sub>3</sub> /H <sub>2</sub> O
Temperature lift (max)	25 K	25 K	25 K	55 K
Temperature of Cold	5-20°C	5-20°C	5-20°C	-20°-20°C
Driving temperature	70-90°C	140-180°C	230-270°C	160-180°C
Max. COP	0,7-0,8	1,1-1,4	1,6-1,8	0,6-0,7

# Solar Cooling with NH<sub>3</sub>-H<sub>2</sub>O Chiller



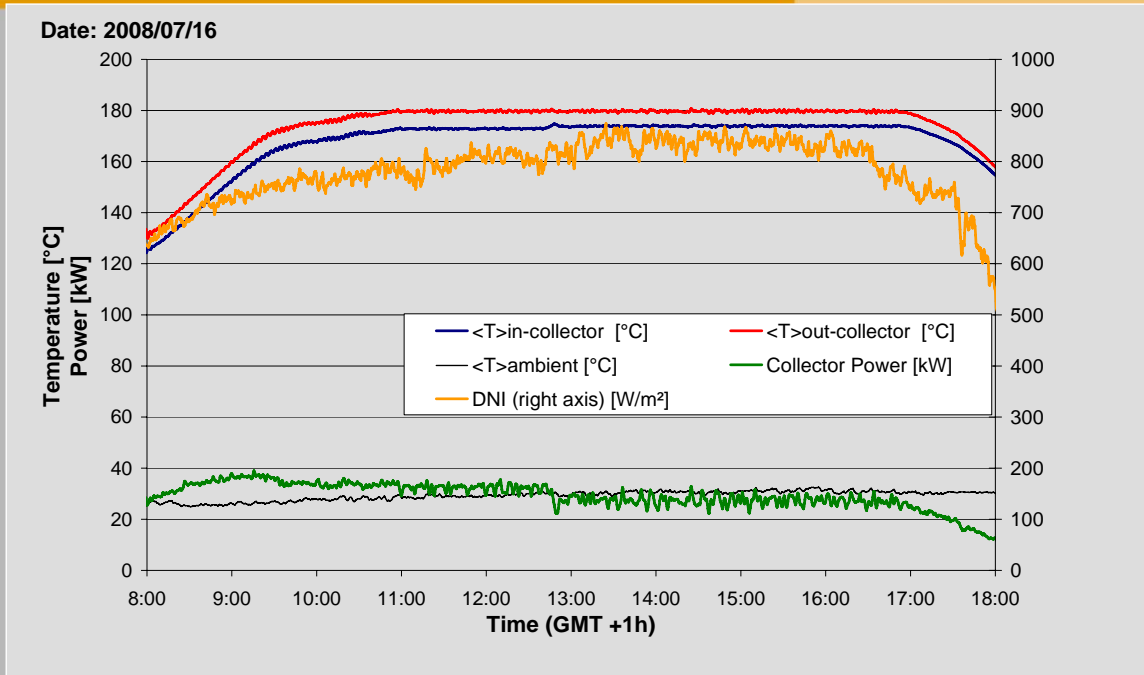
# Solar Cooling with NH<sub>3</sub>-H<sub>2</sub>O Chiller



# Collector Performance



solar heat for industry



# Solar Cooling with NH3-H2O Chiller



solar heat for industry



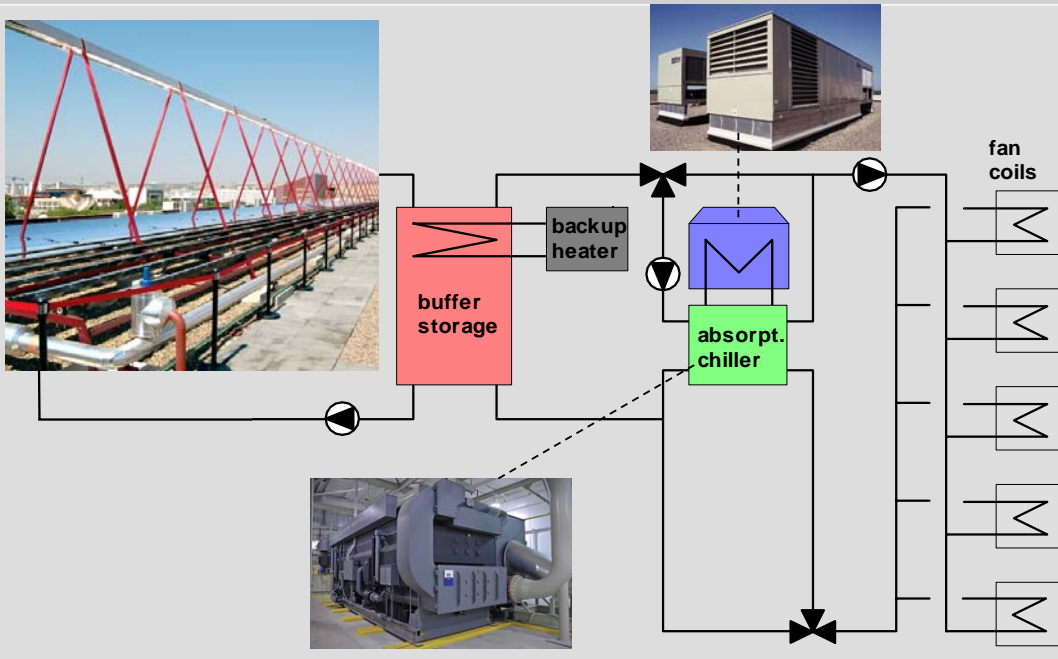
- Winery close to Tunis, Tunisia
- Collector: 44 kW<sub>p</sub>, 16 m Length, 88 m<sup>2</sup> Aperture
- Customer: Politecnico di Milano, Italy (EU Projekt MEDISCO)

# Solar Cooling with NH<sub>3</sub>-H<sub>2</sub>O Chiller



- Winery close to Tunis, Tunisia
- Collector: 44 kW<sub>p</sub>, 16 m Length, 88 m<sup>2</sup> Aperture
- Customer: Politecnico di Milano, Italy (EU Projekt MEDISCO)

# Solar Cooling with double effect H<sub>2</sub>O-LiBr Chiller

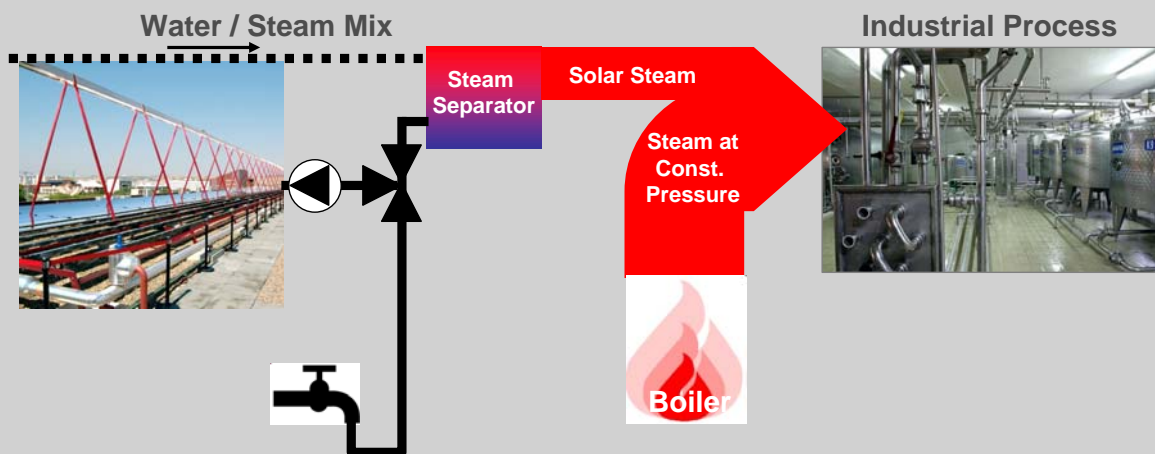


# Solar Cooling with double effect H<sub>2</sub>O-LiBr Chiller



# Direct Steam Generation

## Direct steam generation



- Peak solar capacity = nominal steam demand
- 100% security of supply
- No interference with industrial process

# Direct Steam Generation

## New direct steam generation demo system in Freiburg



- Technical specifications

- Length 24 m
- Aperture area 132 m<sup>2</sup>
- Working pressure 2-16 bar
- Peak power 70 kW
- Steam mass 500 kg / day
- Steam mass peak 120 kg / h
- Saturated Steam

- Topics

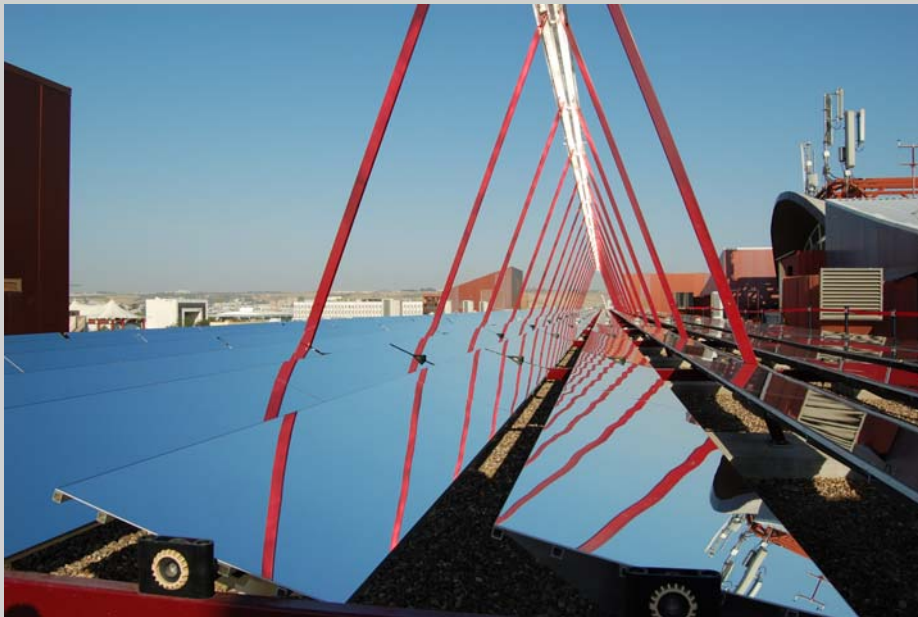
- Two-phase flow – heat transfer, pressure drop, flow rates
- Control concepts
- Dynamic effects – clouds, sudden pressure and temperature changes

Thank you for your attention!



The future of energy is solar!

**Thank you for your attention!**



**The future of solar process heat is fresnel!**