



Solar Heat  
Europe  
ESTIF

# CEPI/ESF

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Pedro Dias, Secretary General

# Topics on Solar Heat for Industrial Processes: *focus on medium temperature applications*

SHIP temperature ranges

Requirements: area,  
location, orientation

Costs: estimation, evolution

Examples of medium  
temperature SHIP



# What is Solar Heat Europe



# Topics on Solar Heat for Industrial Processes: *focus on medium temperature applications*

SHIP temperature ranges

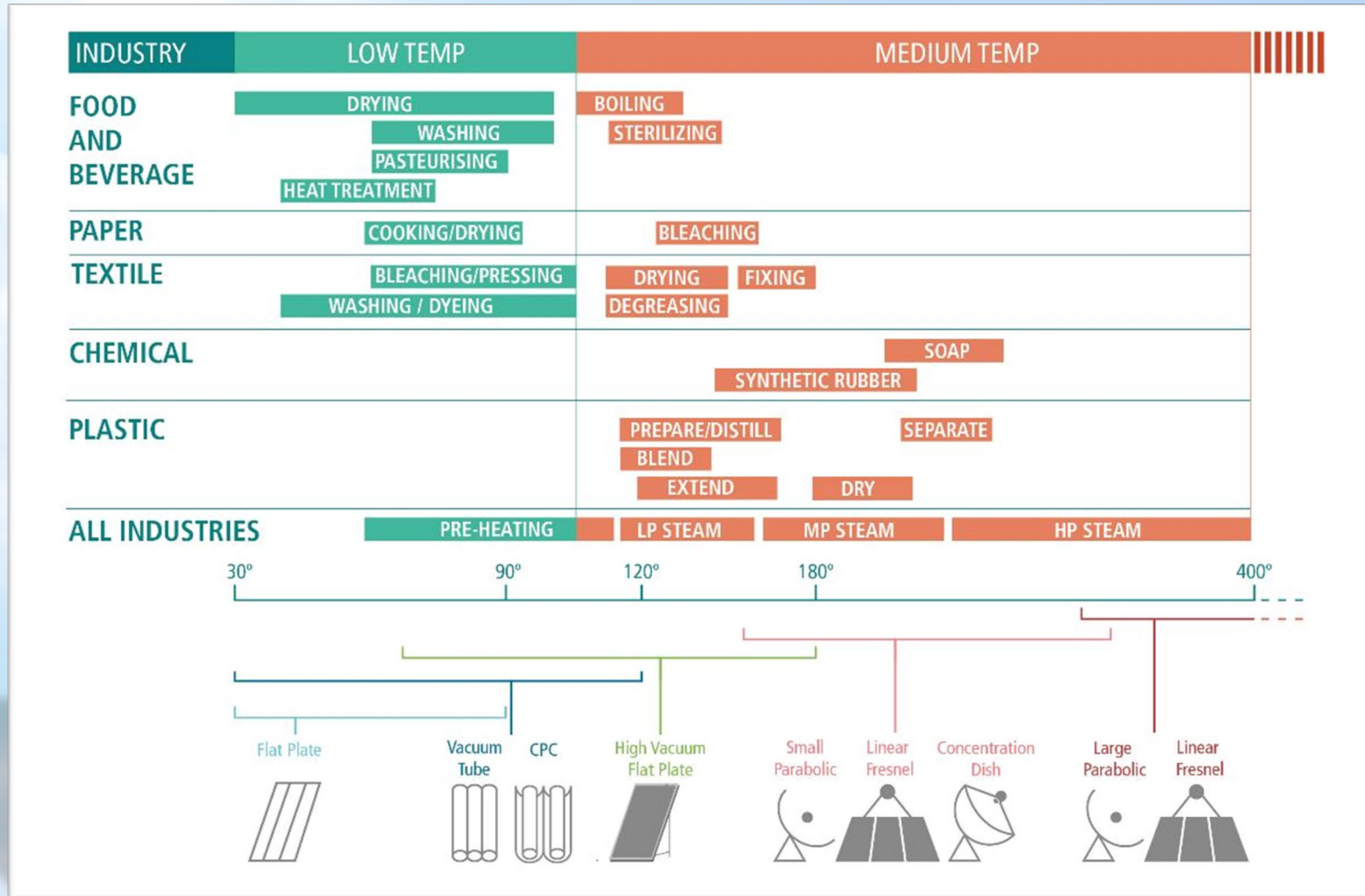
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# Temperature ranges







# Solar Panel/Collector types



**Flat Plate** (with single-axis tracker)



**Parabolic** (concentrated solar heat)



**Evacuated Tube**



**High-Vacuum Flat Plate**



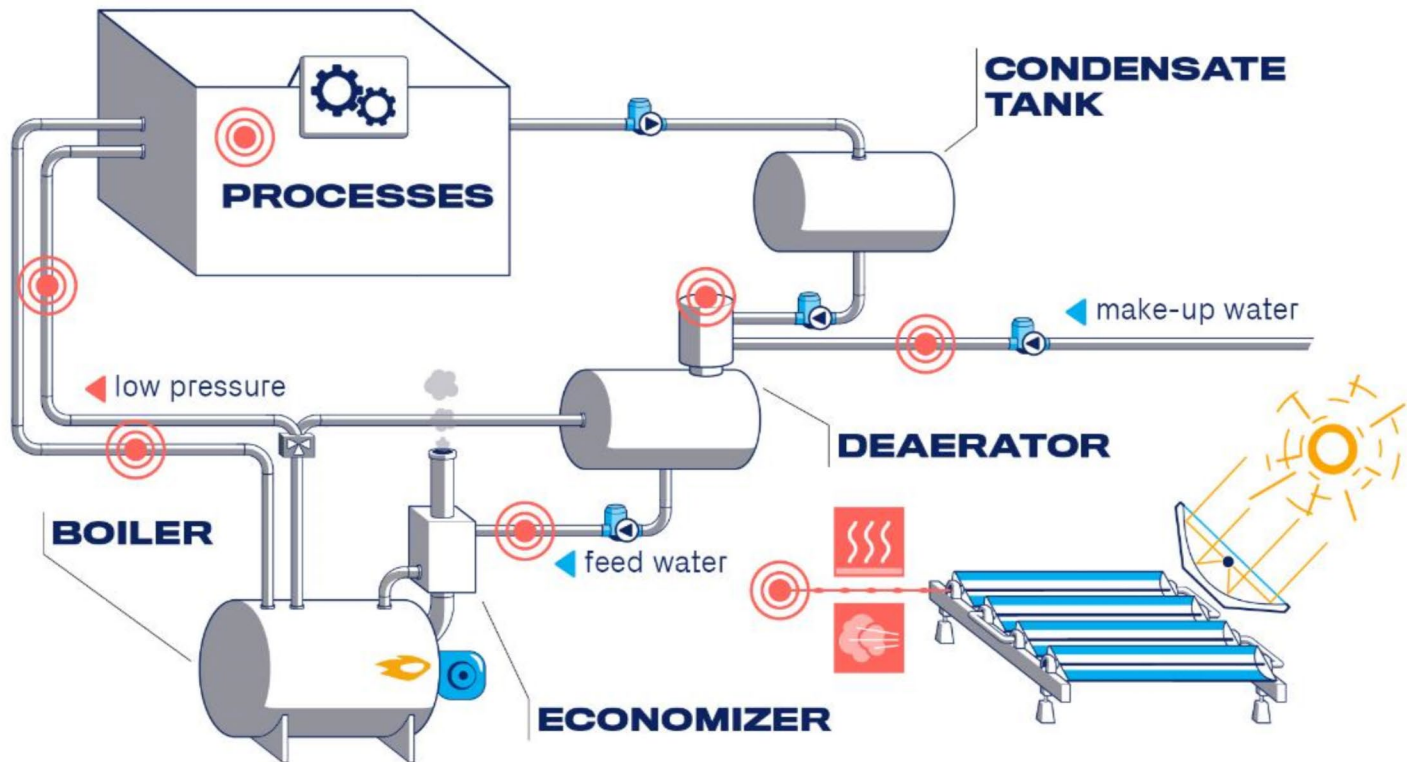
**Fresnel** (concentrated solar heat)



# Solar Heat for Industrial Process (SHIP)

## EASY SOLAR HEAT INTEGRATION

To existing heating systems



© Absolicon

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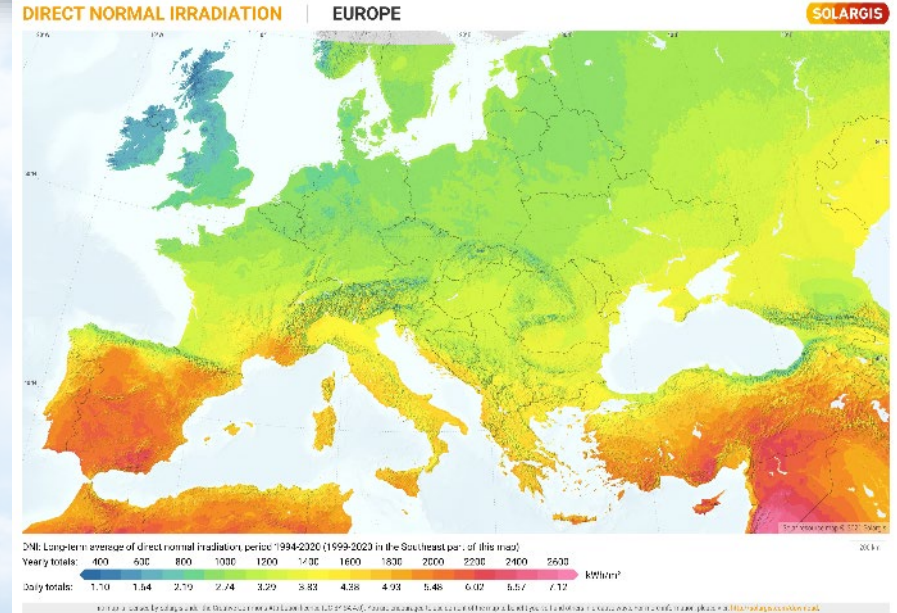
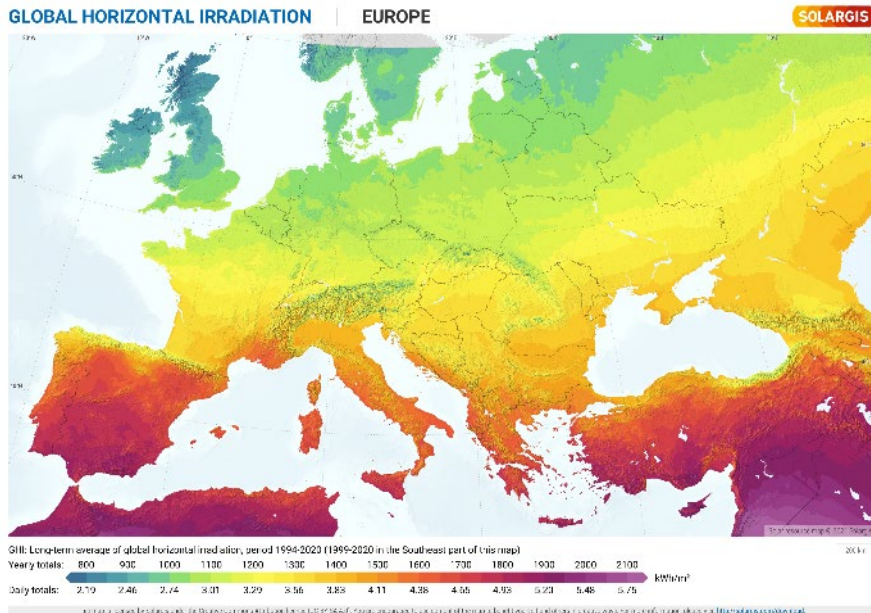
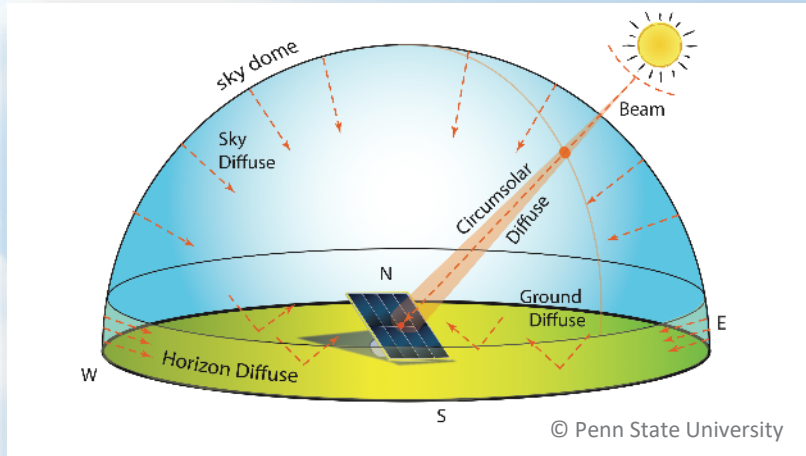
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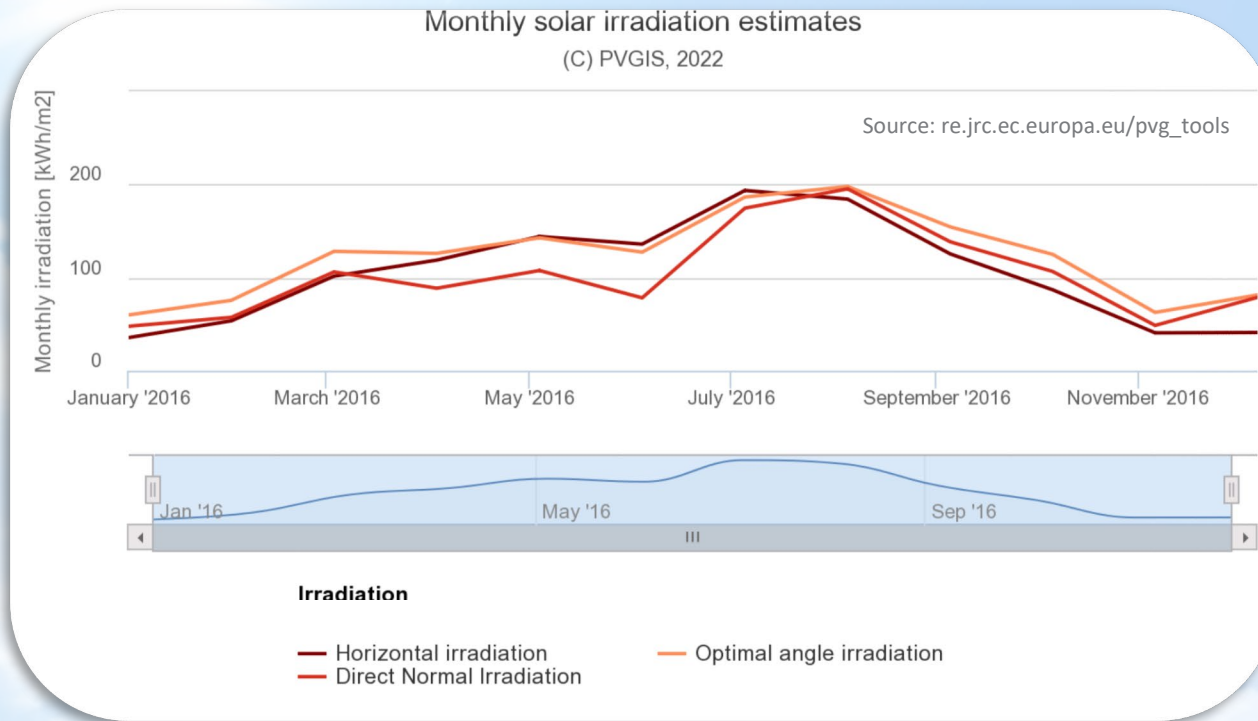


# Location, orientation





# Location, orientation







# Area requirements

- Rule of Thumb:
  - Parabolic Trough:
    - 2,5 times the collector apert. area
    - 1t steam  $\sim$  0,5 ha open area





# Area requirements



## Future cost of heat powered by solar

Your heat cost powered by solar will be **43.36** €/MWh for the next 15 years

Your heat cost powered by solar will be **28.35** €/MWh for the next 25 years

With Absolicon T160 Solar Collectors you can be competitive and lower CO2 emissions at the same time. There are several ways to integrate solar to your industry:

### EASY SOLAR HEAT INTEGRATION To existing heating systems



[Field Simulator \(Absolicon\)](#)



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# Cost estimation for SHIP

## Weighted-average LCOH for SHIP plants

### Low-temp heat

(below 150 °C)

Boiling, pasteurising,  
sterilising, cleaning, drying,  
washing, bleaching, steaming,  
pickling, cooking.

Asia and Mexico  
**3.8** USD-cent/kWh  
140 projects



**293 kW**



**731 kWh/m<sup>2</sup>**

Europe

**8.7** USD-cent/kWh  
82 projects



**400 kW**



**564 kWh/m<sup>2</sup>**

### Medium-temp heat

(150 to 400 °C)

Distilling, nitrate melting, dyeing,  
compression.

Global  
**9.7** US-cent/kWh  
11 projects



**334 kW**



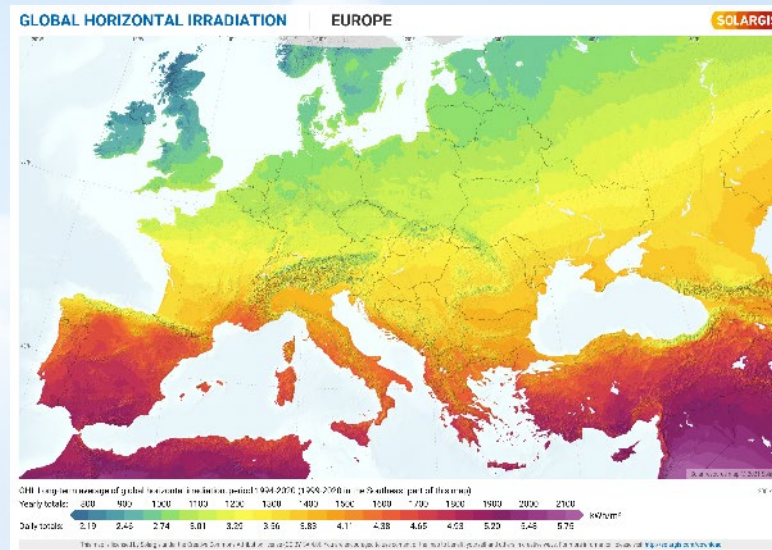
**654 kWh/m<sup>2</sup>**



# Cost estimation for SHIP

IRRADIANCE		1100	1300	1500	1700	1900	2100	2200	kWh/m <sup>2</sup> /year
Tm	@80°	3.9	3.1	2.7	2.3	2.1	1.8	1.8	c€/kWh
Tm	@100°	5.1	3.7	3.1	2.6	2.4	2.0	1.9	c€/kWh
Tm	@120°	6.4	4.3	3.4	2.9	2.6	2.1	2.1	c€/kWh
Tm	@150°	8.6	5.7	4.5	3.7	3.2	2.6	2.5	c€/kWh

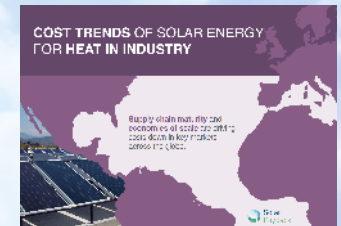
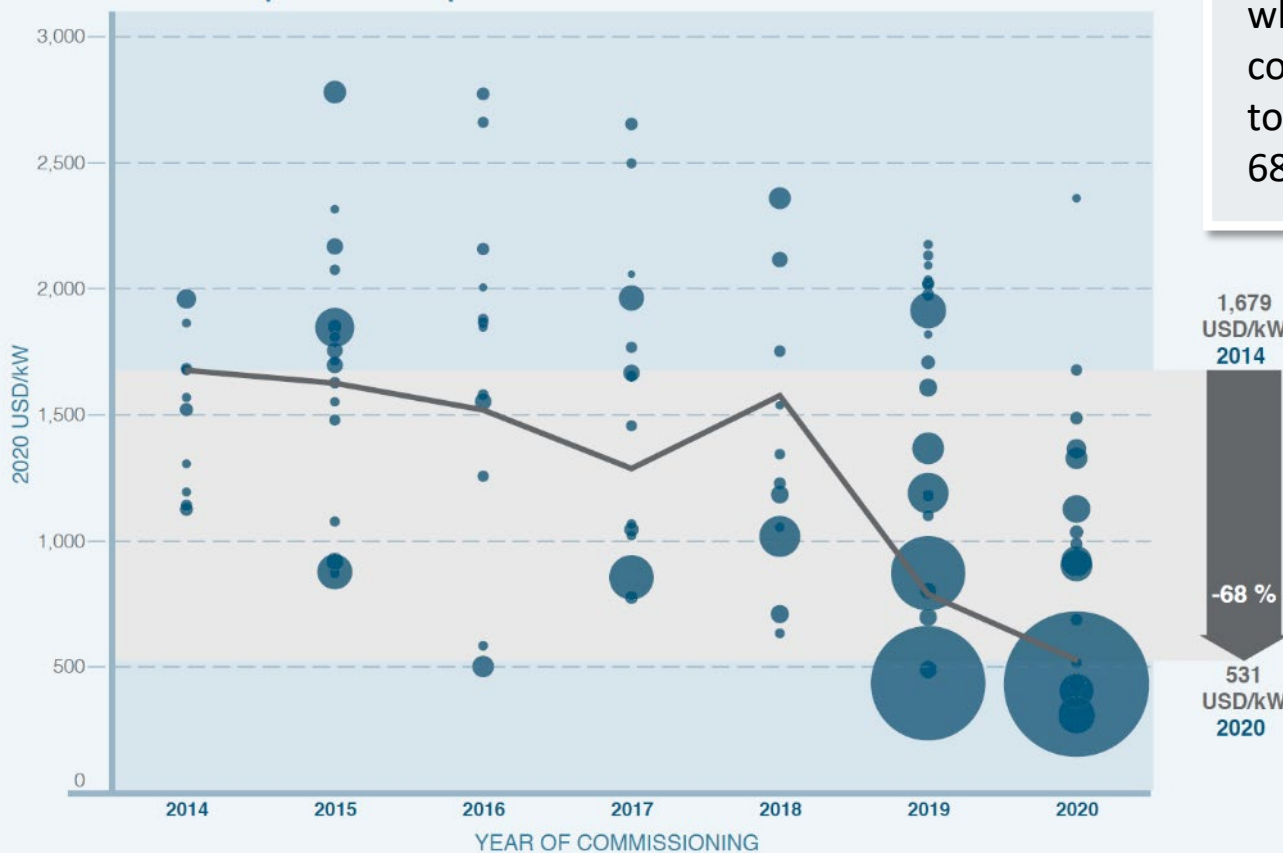
Source: TVP Solar





# Cost reduction in SHIP

In 2014, the weighted-average installed costs of 11 SHIP projects were 1 679 USD/kW, while the average of 15 plants commissioned in 2020 dropped to 531 USD/kW, a decrease of 68 %.



Source: *Cost Trends of Solar Energy for Heat in Industry, Solar Payback 2021*





# Cost estimation for SHIP

## Energy costs/year

Without solar heat  
**13,856,493 €**

With solar heat  
**13,045,827 €**

Savings  
**810,666 €**

Savings in total with a lifetime of 25 years  
**32,341,455 €**

## Energy consumption/year

Without solar heat  
**27,712,986 m<sup>3</sup>**

With solar heat  
**26,091,654 m<sup>3</sup>**

Savings  
**1,621,332 m<sup>3</sup>**

Percentage energy saving (gas)  
**5%**

Investment: **7,638,132 €** Return on investment 17.1%

Savings: **32,341,455 €** with a lifetime of 25+ years

Capital value: **4,868,691 €** Levelized cost of energy (LCOE): **3.2 Cent/kWh**

**CO<sub>2</sub> saving per year: 3,115 t**

**CO<sub>2</sub> saving after 25 years' operation: 77,875 t**

*Source: Solarlite CSP*



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# Limassol, Cyprus

Solar circuit temperature	250 °C
Pressure	6 bar (Silicat oil)
Power	1 MWth
Aperture area	1 500 m <sup>2</sup>
Collector type	Parabolic trough
Payback time	3,3 years
CO2 savings	700 t/a
Gas savings	€ 165 000
Conventional steam cost	50 €/t
Solar steam cost	10 €/t
Solar plant operator	KEAN Juice Co.



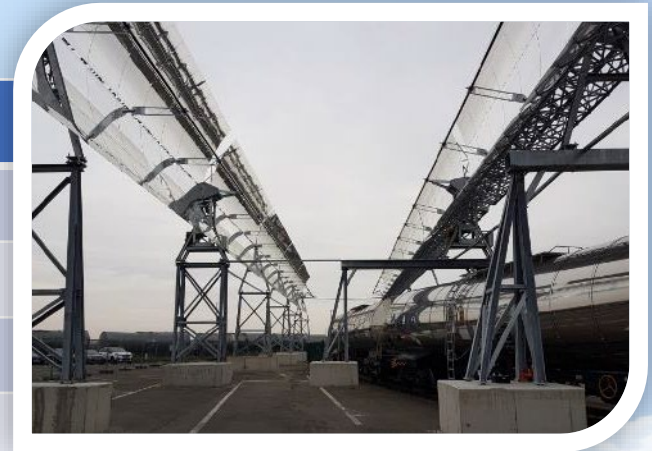
Source: ProTarget





# Belgium

	Antwerp	Oostende
Solar circuit temperature	330 °C	330 °C
Pressure	10 bar	10 bar
Medium	Silicat oil	Silicat oil
Power	0,5 MWth	0,5 MWth
Aperture area	1 100 m <sup>2</sup>	1 100 m <sup>2</sup>
Process temperature	180 °C	175 °C
Collector type	Parabolic trough	Parabolic trough
Solar plant operator	ADPO, Antwerp harbour	PROVIRON
	Antwerp	Oostende
Solar circuit temperature	330 °C	330 °C







# Maputo, Mozambique

Solar circuit temperature	160°C
Pressure	8 bar
Power	1 MWth
Aperture area	7 920 m <sup>2</sup>
Collector type	Parabolic trough
Estimated annual solar yield	6,3 GWh
Process temperature	120 °C
Heat Storage Size	1 660 m <sup>3</sup>
Heat Storage Pressure	1 bar
Solar plant operator	AB InBev



Source: Absolicon



# Baotou, Inner Mongolia, China

<b>Solar circuit temperature</b>	<b>220 °C</b>
<b>Aperture area (ground-mounted)</b>	<b>71 000 m<sup>2</sup></b>
<b>Aperture area (rooftop)</b>	<b>22 000 m<sup>2</sup></b>
<b>In operation since</b>	<b>October 2016 and June 2017</b>
<b>Heat transfer medium</b>	<b>Thermal oil</b>
<b>Total tank volume for both solar fields</b>	<b>66 000 m<sup>3</sup></b>
<b>Type of storage</b>	<b>14 steel tanks</b>
<b>Maximum tank water temperature</b>	<b>95 °C</b>



Source: Solarthermalworld.org; XuChen,2020



# Baotou, Inner Mongolia, China



<b>Estimated annual solar yield</b>	<b>83 GWh</b>
<b>Specific solar yield</b>	<b>887 kWh/m<sup>2</sup> (aperture area)</b>
<b>Backup system</b>	<b>Gas and electric boilers</b>
<b>Solar plant operator</b>	<b>XuChen Energy</b>
<b>Total amount invested</b> <i>(including storage, installation and heat network)</i>	<b>RMB 0.55 billion (USD 81.05 million)</b>
<b>Specific investment costs per m<sup>2</sup> of aperture area</b> <i>(including heat network)</i>	<b>872 USD/m<sup>2</sup></b>





# Ras Al Khaimah, United Arab Emirates

<b>Solar circuit temperature</b>	<b>180 °C</b>
<b>Pressure</b>	<b>6 bar</b>
<b>Medium</b>	<b>Silicat oil</b>
<b>Power</b>	<b>1 MW<sub>th</sub></b>
<b>Aperture area</b>	<b>1 500 m<sup>2</sup></b>
<b>Land area</b>	<b>500 m<sup>2</sup></b>
<b>Collector type</b>	<b>Parabolic trough</b>
<b>Specific solar yield</b>	<b>668 kWh/m<sup>2</sup> (aperture area)</b>
<b>Solar steam cost (average)</b>	<b>35 USD/MW<sub>th</sub></b>
<b>Solar steam cost (range winter/summer)</b>	<b>29- 40 USD/MW<sub>th</sub></b>
<b>Solar plant operator</b>	<b>Ocean Rubber Factory</b>



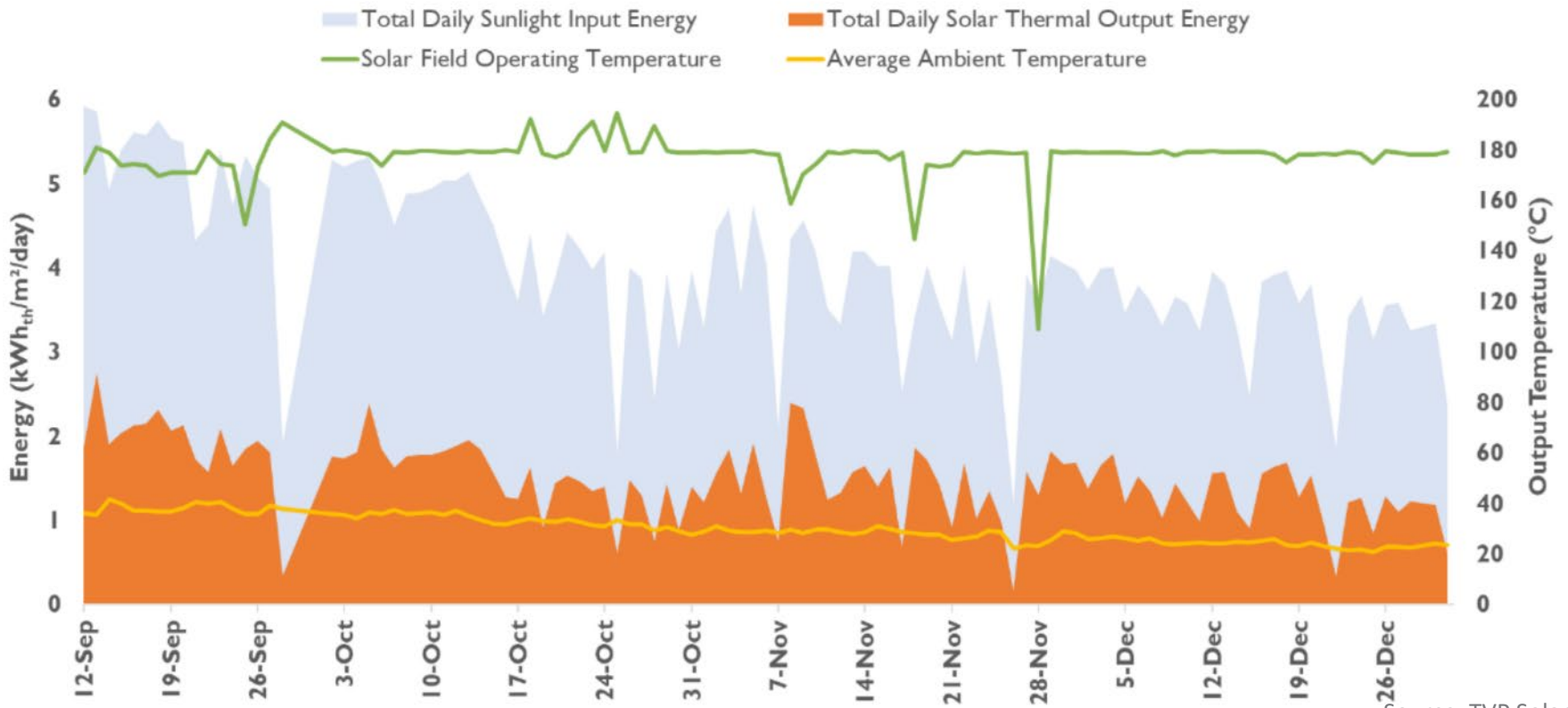
Source: TVP Solar





# Ras Al Khaimah, United Arab Emirates

## ORF Solar Thermal Plant Performance



Source: TVP Solar



# Greece

<b>In operation since</b>	<b>1999</b>
<b>Process Temperature</b>	<b>7-45 °C</b>
<b>Power</b>	<b>1,89 MWth</b>
<b>Collector area</b>	<b>2 700 m<sup>2</sup></b>
<b>Purpose</b>	<b>Warehouse cooling</b>
<b>Collector type</b>	<b>Flat Plate</b>
<b>Heat Storage Size</b>	<b>66 m<sup>3</sup></b>
<b>CO<sub>2</sub> savings</b>	<b>5 125 t/a</b>
<b>Solar plant operator</b>	<b>Sarantis S.A.</b>
<b>Specific investment costs per m<sup>2</sup> of collector area</b>	<b>484 €/m<sup>2</sup></b>
<b>Other emissions saved</b>	<b>SO<sub>2</sub>, CO, Nox, HC, Particles</b>



Source: S.O.L.E.



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