Solar Steam Generation
The Hidden Challenge

Heat accounts for 74% of the industrial energy consumption. It is mostly provided using fossil fuels.
Industry Segments

Steam is widely used in different industrial segments all around the world. Steam provides heat in the production process for both low and medium temperature range.
ECOTHERM Solar Steam Boiler

ECOTHERM solar boilers offer an economic solution to reduce the fossil fuel consumption of existing steam systems.

**FOUR REASONS FOR SOLAR HEAT**

- Profit from the most powerful energy resource on earth
- Harvest three times more energy from the sun than with photovoltaics
- Replace imported fuels with local jobs
- Increase competitiveness of domestic manufacturing
Linear Fresnel reflectors use long, thin segments of mirrors to focus sunlight onto a fixed absorber located at a common focal point of the reflectors. These mirrors are capable of concentrating the sun’s energy to approximately 30 times its normal intensity. This concentrated energy is transferred through the absorber to heat up fluids or evaporate water for direct steam production.

History: Augustin-Jean Fresnel (1788 –1827), was a French engineer and who studied the behaviour of light both theoretically and experimentally. He is best known as the inventor of the fresnel lens.
ECOTHERM SOLAR – APPLICATIONS & INTEGRATION

INTEGRATION FOR STEAM GENERATION

• FULLY AUTOMATIC OPERATION
• IN COMBINATION WITH BOILERS
• EASY SYSTEM INTEGRATION
• NO CHANGES ON EXISTING SYSTEM
INTEGRATION FOR STEAM GENERATION

ECOTHERM Steam Drum → The link between solar field and steam consumers

average daily pressure curve

- Solar Irradiation
- Steam pressure
- Temperature
INTEGRATION FOR HOT WATER / THERMAL OIL APPLICATIONS

- FULLY AUTOMATIC OPERATION
- IN COMBINATION WITH BOILERS
- EASIER LOWER-COST SYSTEM
- HOT WATER UP TO 250 DEGREES

Sample application: district heating
INTEGRATION FOR SOLAR COOLING

- FULLY AUTOMATIC OPERATION
- TWO-STAGE ABSORPTION CHILLER
- COP > 1
- STEAM OR HOT-WATER DRIVEN (TEMPERATURE ≈ 150C)
ECOTHERM solar boilers can start and shut down automatically every day.
The operation data can be monitored and reviewed via remote control any time.
The pressure control unit ensures constant steam pressure in the steam line towards the production.
# Madrid Solar Output

## Project Example

**Location MADRID 2.000m²**

150°C direct steam generation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNI (solar radiation)</td>
<td>1.928 kWh/m²/year</td>
</tr>
<tr>
<td>DNI peak</td>
<td>1.000 W/m²</td>
</tr>
<tr>
<td>Optical peak efficiency</td>
<td>57.7%</td>
</tr>
<tr>
<td>Peak efficiency at noon incl. thermal losses</td>
<td>53.7%</td>
</tr>
<tr>
<td>Annual efficiency</td>
<td>33.2%</td>
</tr>
<tr>
<td>Annual thermal output</td>
<td>1.3 GWh</td>
</tr>
<tr>
<td>Peak steam production for 2.000m²</td>
<td>1.7 t/h</td>
</tr>
<tr>
<td>Peak thermal output for 2.000m²</td>
<td>1.1 MW</td>
</tr>
<tr>
<td>Annual steam generation</td>
<td>1.960 t/year</td>
</tr>
</tbody>
</table>
Installation

Premanufactured mirror modules are installed rapidly directly on the roof or any prepared substructure. Steam drum including control cabinet are delivered preassembled and prewired.
USP's

- Pre-assembled mirror module including drive and control
- Transport in compact units
- Easy to install
- Low area exposed to wind
- Low surface loading (25 kg/m² roof load)
- Perfect suitable for roof-top installation
- Mirrors easy to clean due to flat structure
- Same efficiency but lower system cost compared to competition
- Plants of individual size consist of several modules of 10m² mirror surface
- Guaranteed System Efficiency
- Collector efficiency certified by solar test centre (AIT according to ISO 9806:2013)
- TUV approved
Investment opportunity

**Golden End → free energy source after payback period**

Sample calculation based on:
- DNI: 2200 kWh/m²a
- Solar field size: 2.250 m²
- Steam pressure: 6 bar
- Operation: 7 days per week
- Life span: 25 years
- Actual steam price: 42 €/ton
- Fuel price increase: 2,5% p.a.
- Inflation: 2%

ROI: 6.1 years

Profit: 4 Mio EUR

Possible profit on invested capital of 900,000 EUR
HyCool: The Industrial Solar Cooling Solution

With the HyCool project EU, ECOTHERM demonstrates that solar heat can become a reliable energy source for greener, more energy-efficient industrial processes.

We designed and implemented our Solar Steam System in two industrial pilots while allowing a flexible and easy integration of the system into existing industrial environments.

Solar steam generation is designed to save energy costs and reduce CO2 emissions by reducing the overall consumption of fossil fuels.

A 4-year innovation action project funded by the EU’s Horizon 2020 programme
ECOTHERM® developed its pilot project for solar steam in 2015 as the first on-roof Fresnel system in Austria.
ECOTHERM® Solar Steam System - References

ECOTHERM® Solar Steam System: 800 m² Mirror Area
for Givaudan (Chemical Industry) in Sant Celoni, Spain
ECOTHERM® Solar Steam System: 400 m² Mirror Area
for Bo de Debò (Food Industry) in Barcelona, Spain
Locations

Minimum solar radiation: 1800kWh/m²/year (Direct Normal Irradiation – DNI)