NOVATEC SOLAR

Turnkey Solar Boiler

based on Fresnel Collector Technology, mass produced in industrial precision with performance guarantee

Competitive with Fossil Fuels

NOVATEC SOLAR has developed a patented reflector design, an automated manufacturing process and a cleaning regime for its solar boiler and undertakes manufacture, supply and turnkey delivery of solar boilers with performance guarantee.

Based on Fresnel collector technology, NOVATEC SOLAR significantly reduces material requirements compared to other concentrating solar systems. NOVATEC SOLAR's Fresnel Technology, the evolution of parabolic trough technology, only requires standard materials such as metal sheets and flat glass mirrors.

Local procurement when possible, built-in quality control, state-of-the-art robot manufacture and rapid construction even in remote locations reduce the cost of producing solar steam to a minimum.
Consequently, solar generated steam is competitive with fossil fuels such as oil and gas.

NOVATEC's solar boilers can be utilized in various applications:

Electricity: The solar steam can be used to produce electricity in a steam turbine generator. Along with our partner ABB, we offer scalable turnkey solutions for concentrating solar power plants.

Augmentation: Due to clearly defined interfaces, NOVATEC's solar boiler can be easily integrated into existing steam applications to save fuel and to reduce CO2-emission, e.g. conventional power plants, enhanced oil recovery, food, textile or chemical industries.

Cooling: NOVATEC's solar boiler can meet the growing demand for low cost district cooling by powering absorption chillers.

Desalination: Using solar steam to desalinate water is a logical step in regions with strong solar irradiation and a high demand for potable water.

Advantages - Costs

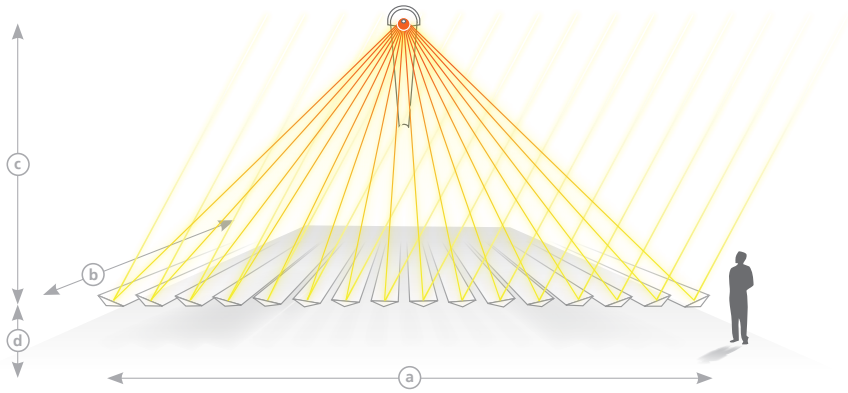
- Steam temperatures above 500°C
- Significant material reduction compared to parabolic trough technology
- Highly automated manufacture of key components
- Low construction costs as well as rapid and simple assembly
- Use of standard materials such as glass mirrors and metal sheets
- Automated cleaning system

Advantages - Environment

- Very low water use due to innovative cleaning system
- Highly efficient land use
- Direct steam generation, no need for thermo oil
- Low visual impact and low susceptibility to wind as mirrors are approximately one meter above ground

Fresnel Collector Technology

Principle: The solar boiler uses parallel rows of flat glass mirrors to focus direct solar irradiation onto a linear receiver. Feedwater conveyed through an absorber tube is evaporated and superheated to steam of up to 500°C and 100 bar by the concentrated solar energy.

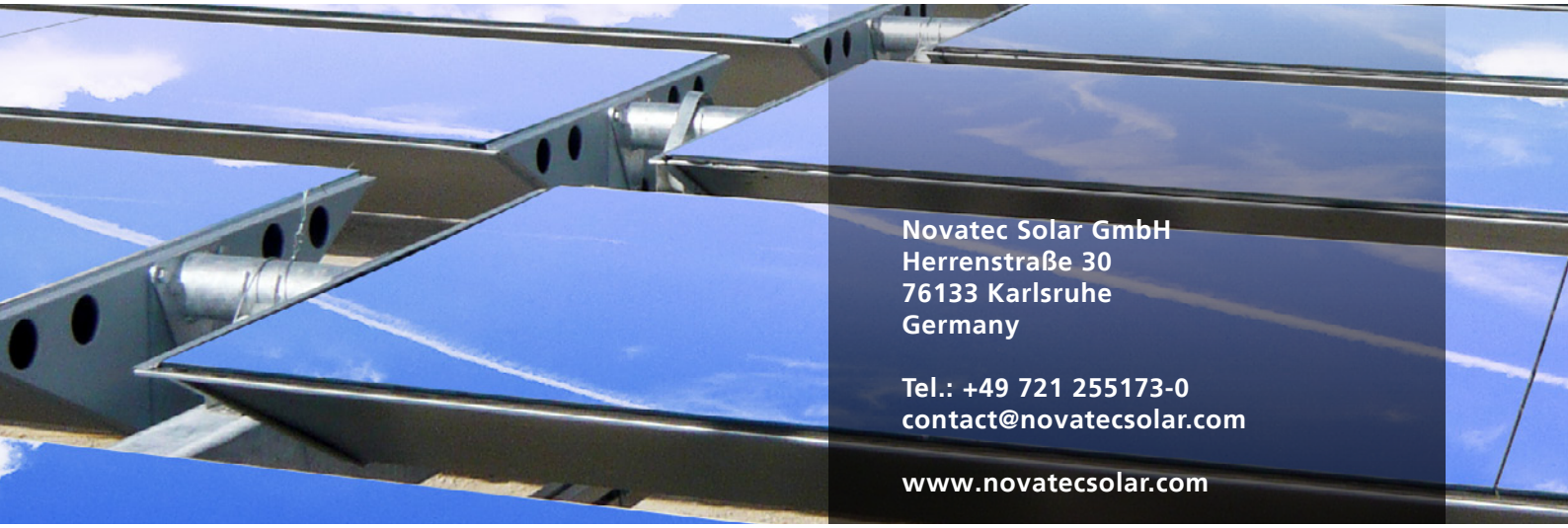


Simply modular: The solar boiler is a modular system that comprises all necessary components for generating steam. The main components are foundations, supporting structures, primary reflectors, radiation receivers as well as a tracking system.

One control unit is the smallest unit of the modular solar boiler. It comprises 128 primary reflector units with a total mirror surface area of 513.6 m². Five to 22 control units can be arranged in a longitudinal direction to form a collector row. These rows can then be arranged in parallel to form a solar boiler of any size.

Technical Data of Control Unit

Geometry	
Width (a)	16.56 m
Length (b)	44.8 m
Absorber tube height above primary reflector level (c)	7.4 m
Height of primary reflector level (d)	0.75 - 1.05 m above ground level
Recommended minimum clearance between parallel rows	4.5 m
Aperture surface of primary reflectors	513.6 m²
Minimum row length	5 control units, 224 m in length
Maximum row length	22 control units, 985.6 m in length



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Performance Guarantee

Thermal Performance Characteristics

Thermal power output of the solar boiler is the product of primary reflector surface, Direct Normal Irradiation (DNI) and optical efficiency factor, minus heat losses from receiver radiation.

$P_{th} = A \cdot (DNI \cdot \eta_{opt} - P_{loss})$

Angle-dependent optical efficiency with 100 % clean primary reflectors and receiver covers

The calculation of optical efficiency η_{opt} and product-specific correction values is as follows:

$\eta_{opt} = \eta_o \cdot K_\perp (\Theta_\perp) \cdot K_{||} (\Theta_i)$

Evaporating section			Superheating section		
$\eta_0 = 0.67$	Correction factor		$\eta_0 = 0.65$	Correction factor	
Θ	transversal $[K_\perp (\Theta)]$	longitudinal $[K_{||} (\Theta)]$	Θ	transversal $[K_\perp (\Theta)]$	longitudinal $[K_{||} (\Theta)]$
0°	1.00	1.00	0°	1.00	1.00
10°	0.98	0.98	10°	0.98	0.98
20°	0.95	0.92	20°	0.96	0.92
30°	0.95	0.83	30°	0.95	0.83
40°	0.91	0.70	40°	0.91	0.69
50°	0.86	0.53	50°	0.86	0.52
60°	0.70	0.33	60°	0.70	0.31
70°	0.48	0.12	70°	0.48	0.11
80°	0.24	0.01	80°	0.23	0.00
90°	0.00	0.00	90°	0.00	0.00

Thermal loss per m² of primary reflector

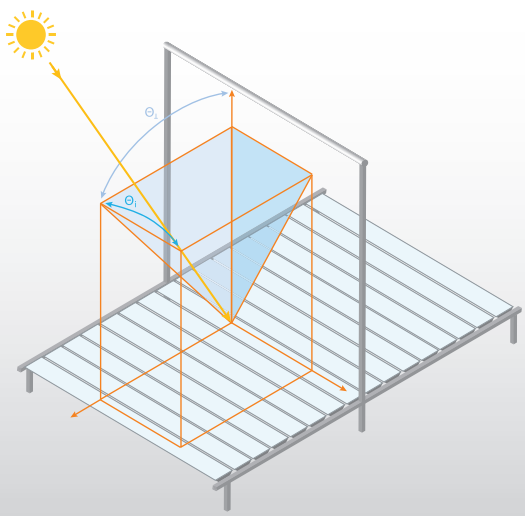
$P_{loss} = u_0 \Delta T + u_1 \Delta T^2$	$P_{loss} = u_0 \Delta T + u_3 \Delta T^4$
$u_0 = 0.056\ W/(m^2K)$	$u_0 = 0.013\ W/(m^2K)$
$u_1 = 0.000213\ W/(m^2K^2)$	$u_3 = 6.25 \times 10^{-10}\ W/(m^2K^4)$

Example for thermal output calculation

Reference conditions • 40 °C external temperature • 100 °C inflow temperature • 300 °C outflow temperature • no wind • 900 W/m² direct normal radiation • 30 ° transversal angle $\Theta_\perp$ • 10 ° incidence angle Θ_i	Reference conditions • 40 °C external temperature • 300 °C inflow temperature • 500 °C outflow temperature • no wind • 900 W/m² direct normal radiation • 30 ° transversal angle $\Theta_\perp$ • 10 ° incidence angle Θ_i
Performance 276 kW per control unit 537 W/m² of aperture surface area for primary reflectors	Performance 270 kW per control unit 525 W/m² of aperture surface area for primary reflectors

Performance Guarantee:
NOVATEC SOLAR supplies ready-for-use solar boilers with performance guarantees. The basis for these guarantees is the high precision of industrially-produced solar boiler components and quality-controlled solar boiler assembly. Performance guarantees allow clients to calculate precise steam yields dependent on solar altitude and radiation intensity. This means clients can perform future output planning similar to that of fossil-fuel steam generators.

Expected long-term performance:
After 25 years, at least 95 % of the original optical efficiency can be achieved if cleaning and care of the solar boiler components is carried out in accordance with the manufacturer's instructions and is set-up in a non-corrosive, non-abrasive atmosphere.



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