



Federal Ministry
for Economic Affairs
and Energy



MITTELSTAND
GLOBAL
ENERGY SOLUTIONS
MADE IN GERMANY

Solar Process Heat & Steam for the Food & Beverage Industry in India



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Protarget AG

Facilitator





Structure of the presentation

1. DCSP (German Association for Concentrated Solar Power)
2. Protarget AG





Introduction to Deutsche CSP

AHK India, February 2020



German Association for
Concentrated Solar Power

Content



I

Portrait of DCSP

II

Competence profile of German CSP industry

Scope of DCSP



Leading German CSP companies and research institutes founded „Deutsche CSP“ with **3 key objectives**

- **Foster research, development and demonstration** of technologies for solar-thermal generation of electricity and heat
- Raise public **awareness** of the particular **benefits of CSP technologies** for energy-economics and socio-economics
- Establish a **close interaction** among the **association members** and other organizations on **national, European and international level**, such as ministries, official bodies and other industry associations

Members of DCSP



German Association for
Concentrated Solar Power

Deutsche CSP represents 28 German companies and institutes
with activities in CSP



Board of the Association

Board of Deutschen CSP

Chairman
Politics + Society

Dr. Joachim Krüger



Co-Chairman

Jürgen Hogrefe



Analysis

Prof. Dr.-Ing. Robert Pitz-Paal



Finance

Martin Schlecht



Markets

Oliver Baudson



What does DCSP offer?



As an association, Deutsche CSP represents German companies and institutes engaged in CSP technology

- **Represent** on a broad basis **German companies** and **institutes** that are active in the **CSP market**
- **Provides** a consolidated **overview** about the **competences** of German CSP industry
- We are a competent **discussion partner** regarding all aspects of energy generation from solar thermal power plants
 - Markets + regions
 - Technology + roadmaps
 - Potentials + projects
- Provides detailed insight into **boundary conditions of CSP projects**. Thus we are able to explain critical success factors to all actors in politics and energy economics

Content



I Portrait of DCSP

II Competence profile of German CSP industry

Activity fields of German CSP companies



German Association for Concentrated Solar Power

German companies and institutes address all relevant applications and technologies in the market

<p>Technology option</p>	<ul style="list-style-type: none"> ▪ Parabolic trough ▪ Fresnel ▪ Tower
<p>Application</p>	<ul style="list-style-type: none"> ▪ Utility-scale electricity generation ▪ De-centralized electricity generation ▪ Process heat / cooling ▪ Sea water desalination ▪ Water treatment
<p>Configuration</p>	<ul style="list-style-type: none"> ▪ Stand-alone Solar without storage ▪ Stand-alone Solar with storage ▪ Hybrid (solar combined with fossil or biogene fuels)
<p>Heat transfer fluid</p>	<ul style="list-style-type: none"> ▪ oil ▪ molten salts ▪ direct steam ▪ air (for tower technology)

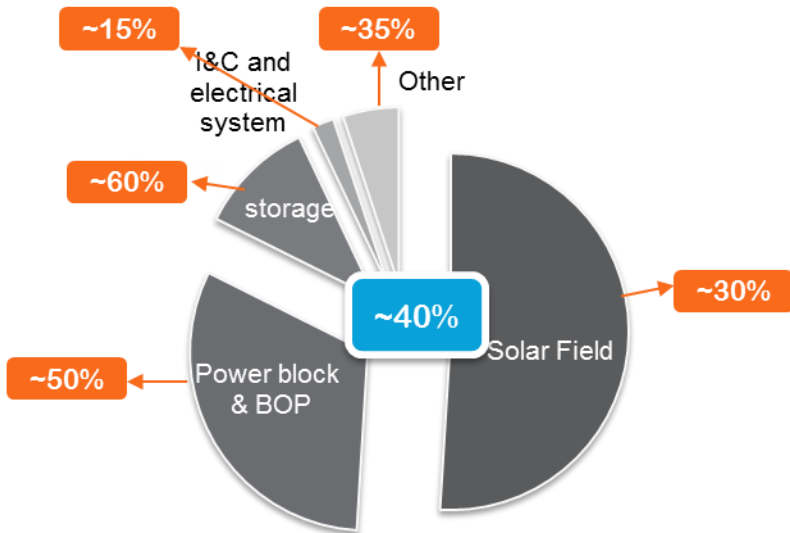
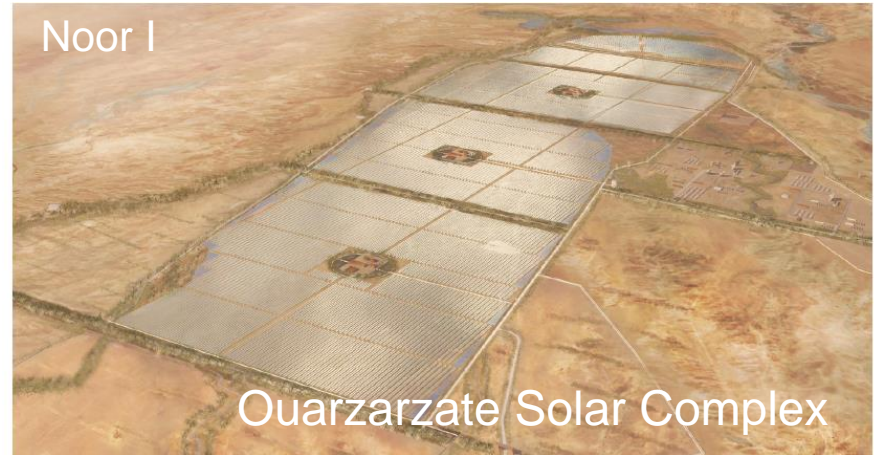
Services by German companies



German Association for Concentrated Solar Power

Example Noor 1, Morocco:

- 160 MW, 3 hours storage
- Approx. 40% of the overall services were provided by German companies



- Schott
- Siemens
- BASF
- FLABEG
- Alstom
- ABB
- KSB
- MunichRe
- Flowserve
- Schneider
- Krohne
- WIKA
- VEGA
- GEA
- Fichtner
- Schlaich Bergemann
- Receiver tubes
- Turbine
- Salt
- Mirrors
- HV busbars
- Circuit breaker
- Pumps
- Insurance
- Pumps and valves
- Solar field control system
- Rotameters, Flowmeters
- Pressure gauges and temperature elements
- Level transmitters
- Condenser
- Consultant
- Consultant

List may not be complete

Examples of German companies



German Association for
Concentrated Solar Power

Shagaya, Kuwait:

- Parabolic Trough
- Gross Power Capacity: 50 MWe
- Net annual energy generation limit: 180 GWh/a
- No. of Loops / Net Aperture Area: 206 / 673,620 m²
- Thermal Energy Storage (TES): 1200 MWh (~10 h operation); 2 Tank Molten Salt System
- Type of Cooling: Dry cooling with ACC
- Heat Transfer Fluid (HTF): Thermal oil (eutectic mixture out of diphenyl oxide and diphenyl)
- TSK: LSTK EPC + O&M; TSK Flagsol: Collector license and Engineering



Photo: Grupo TSK, Spain / Germany

Examples of German companies



German Association for
Concentrated Solar Power

NOOR Midelt CSP & PV Hybrid, Morocco:

- Phase 1 with 2 Projects with 2x400 MW
- Combined Capacity from CSP and PV
- Minimum 5 hours thermal storage
- Solar energy during day and evening peak hours



German Contribution:

- Technical Advisor (Suntrace and Gopa-intec)
- Feasibility Study & Hybrid Concept development
- Grid Impact Assessment
- Technical Specification / Technical Tender Documents
- Bid evaluation & Award



Photo: Solar Reserve, Redstone CSP and PV Projects, Rendering, South Africa

Examples of German companies

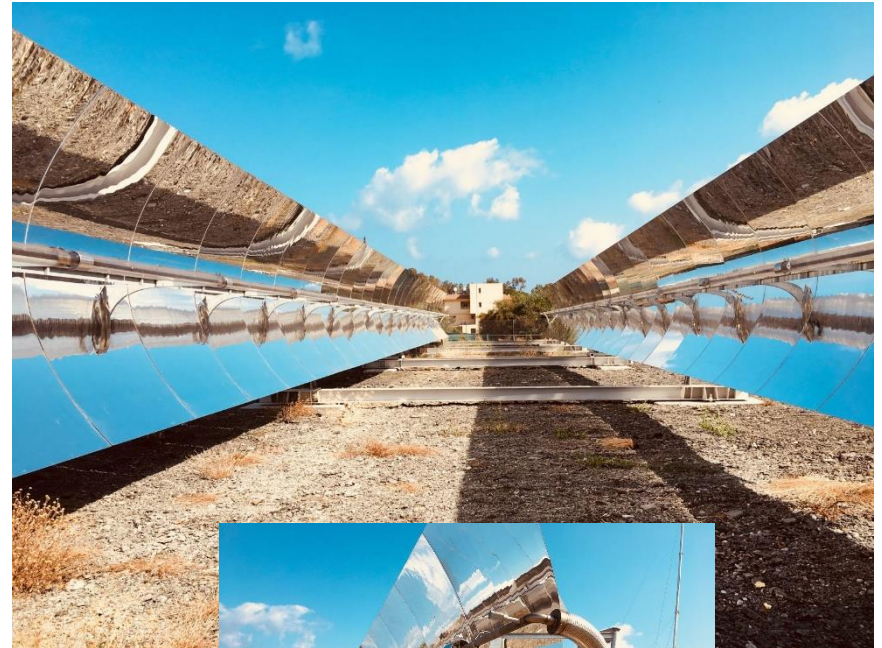


German Association for
Concentrated Solar Power

KEAN Juice Co., Limassol, Cyprus

- Steam at 188°C, 11 barg
- Silicon oil as HTF
- 140kWth Nominal power with 600 kWh storage (TES)
- 1.500 m² Parabolic trough
- Payback time: 3,3 years
- CO₂ savings: 700 t/a
- Gas savings: 165 T€

- **Conventional steam cost: 50 €/t**
- **Solar steam cost: 10 €/t**



Source: Protarget



German contribution to market success



German Association for
Concentrated Solar Power

Engineering +
Quality

Competitiveness+
Bankability

Political support

Technological development of CSP

- German companies drive all relevant innovation topics in the scope of components and engineering
- Quality criteria and methods developed in Germany are applied in many CSP markets

German companies...
... enable excellent yields by supplying highly efficient components
... facilitate successful projects based on a highly professional supply chain

German politics is strongly engaged in supporting CSP technology within Germany and abroad



German Association for
Concentrated Solar Power

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Protarget AG

Company Presentation



February 2020

Solar Process Heat and Steam
for the Food & Beverage
Industry in India



Content

Protarget AG



Background – Global industrial heat demand

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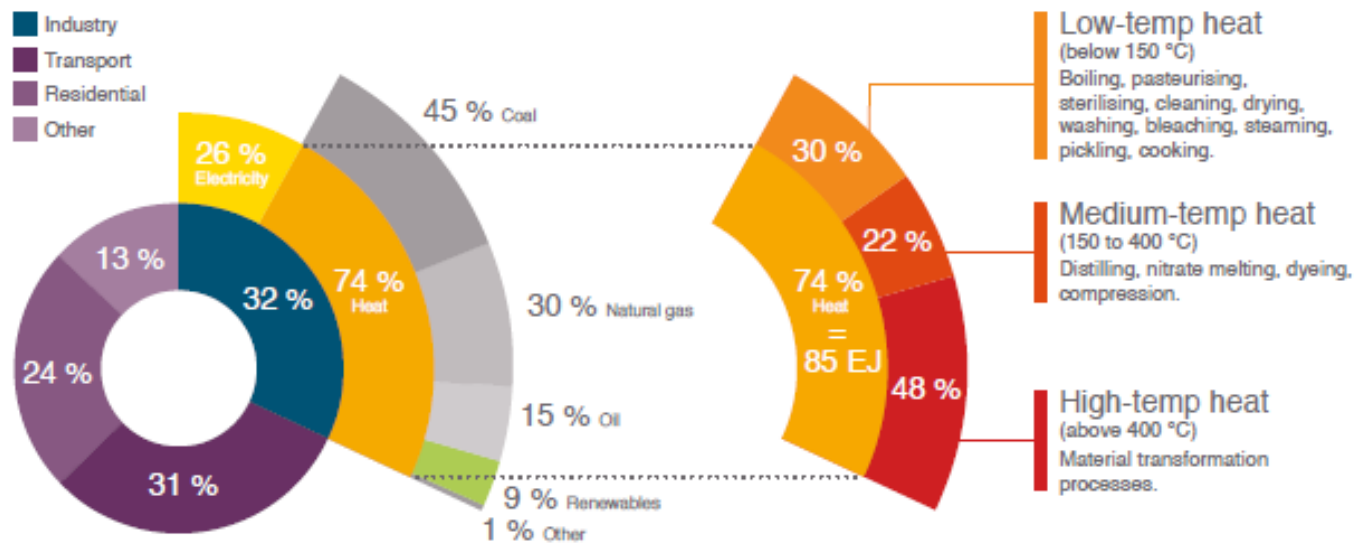
protarget

SOLAR POWER SYSTEMS

Background

Global Industrial heat demand

- 74% of the industrial energy is used for process heat and steam
- 90% of that is generated by burning coal, oil and gas
- **1,7%** annual increase of industrial energy consumption

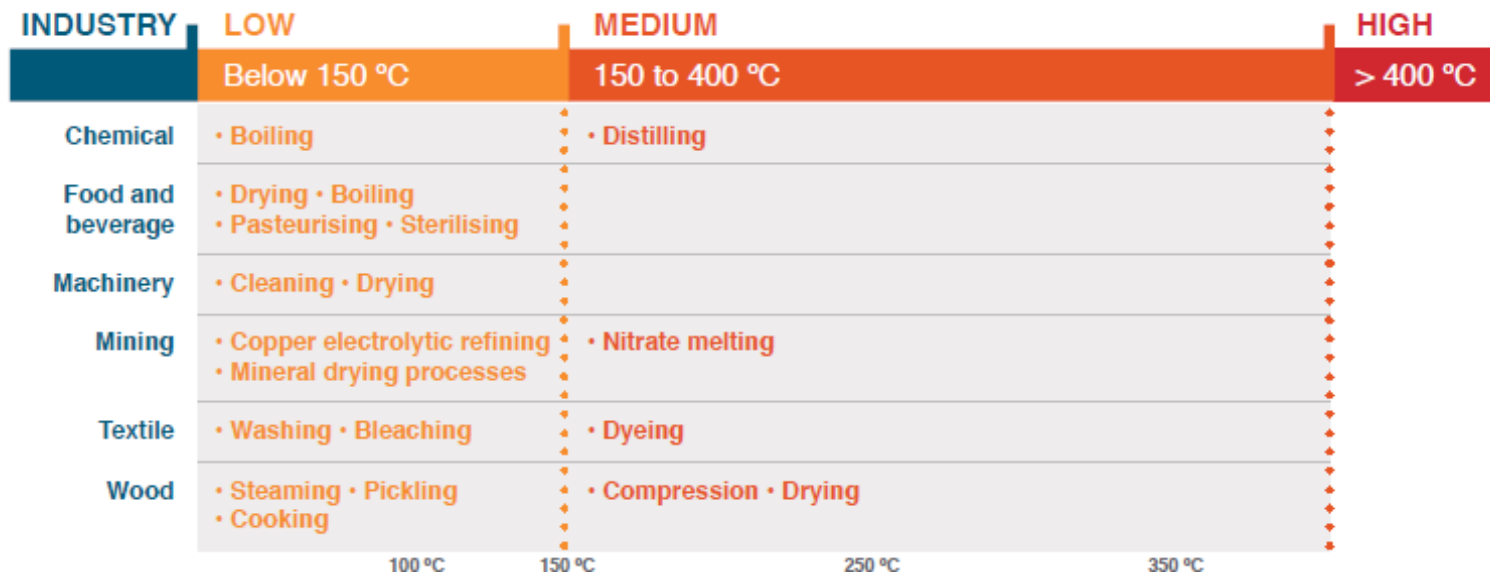


Source: Solar Payback 2017, Solar Heat for Industry

Background

Global Industrial heat demand

- Branches and applications in demand of thermal energy
- Most of the thermal processes in the industry requiring **steam** at **100-250°C**
- The food & beverage, chemical and textile industry are the main consumers of thermal energy



Source: Solar Payback 2017, Solar Heat for Industry

Protarget AG

About the company



protarget

SOLAR POWER SYSTEMS

- Protarget AG was founded in **2009** to develop, produce and **sell turn-key** Concentrated Solar Thermal (**CST**) systems
- Manufacturing partners in **Europe, India and Chile** for the production of CST components and construction of plants
- All equipment **designed** in accordance with the applicable **standards and norms** and especially: the **European pressure directive (PED)**, Machinery directive, Eurocode and **ASME standards**.
- Technology qualified by the German Aerospace Centre (**DLR**). Design approved by **TÜV**
- CST plants in Germany, Cyprus, India and Brazil. With further projects in Chile, Cyprus and India at the advanced planning stage.
- The key **business objectives** of Protarget are:
 - **Solar steam systems** to supply process steam for industrial applications
 - **Solar heating systems** providing hot water for industrial applications
 - Solar power plant **engineering** and **project management** world-wide

➤ Germany



➤ India



➤ Cyprus



➤ Brazil



Solar Technology

Technologies for steam and hot water

Parabolic trough solar collector

- Ideal for industrial process steam applications
- Industrial process heat up to 425°C
- Normally ground mounted
- With / without storage



Evacuated tube type collectors

- Ideal for industrial hot water applications
- Efficient up to 100°C
- Can be roof or ground mounted



Solar Technology

Concentrated Solar Thermal system

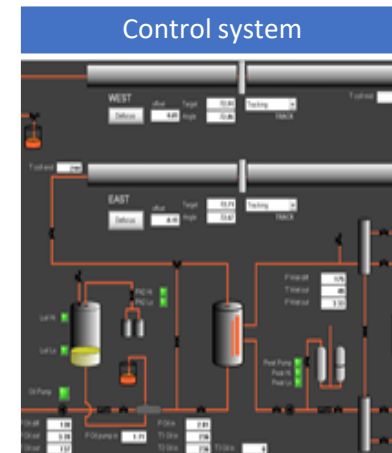
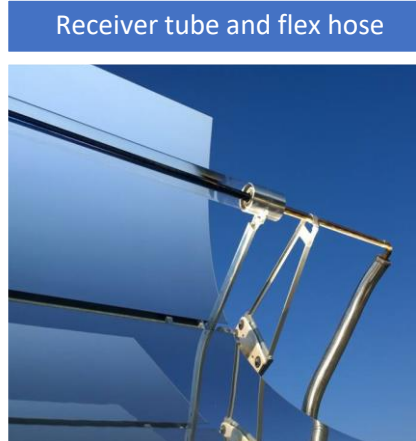
- Process **heat or steam** applications
- **24/7** supply when equipped with Thermal **Energy Storage (TES)** system
- Can be **integrated in parallel** with traditional boiler
- PT950 Solar collector ideal for applications up to **20MWThermal**
- Automatic operation
- Routine maintenance limited to mirror cleaning and general inspection
- Approved **by TÜV Germany**, in accordance to **the European Pressure Equipment Directive PED, Indian Boiler Regulation IBR, MNRE** empaneled and eligible for Indian subsidies



Solar CST system in Salem, Tamil Nadu

Solar Technology

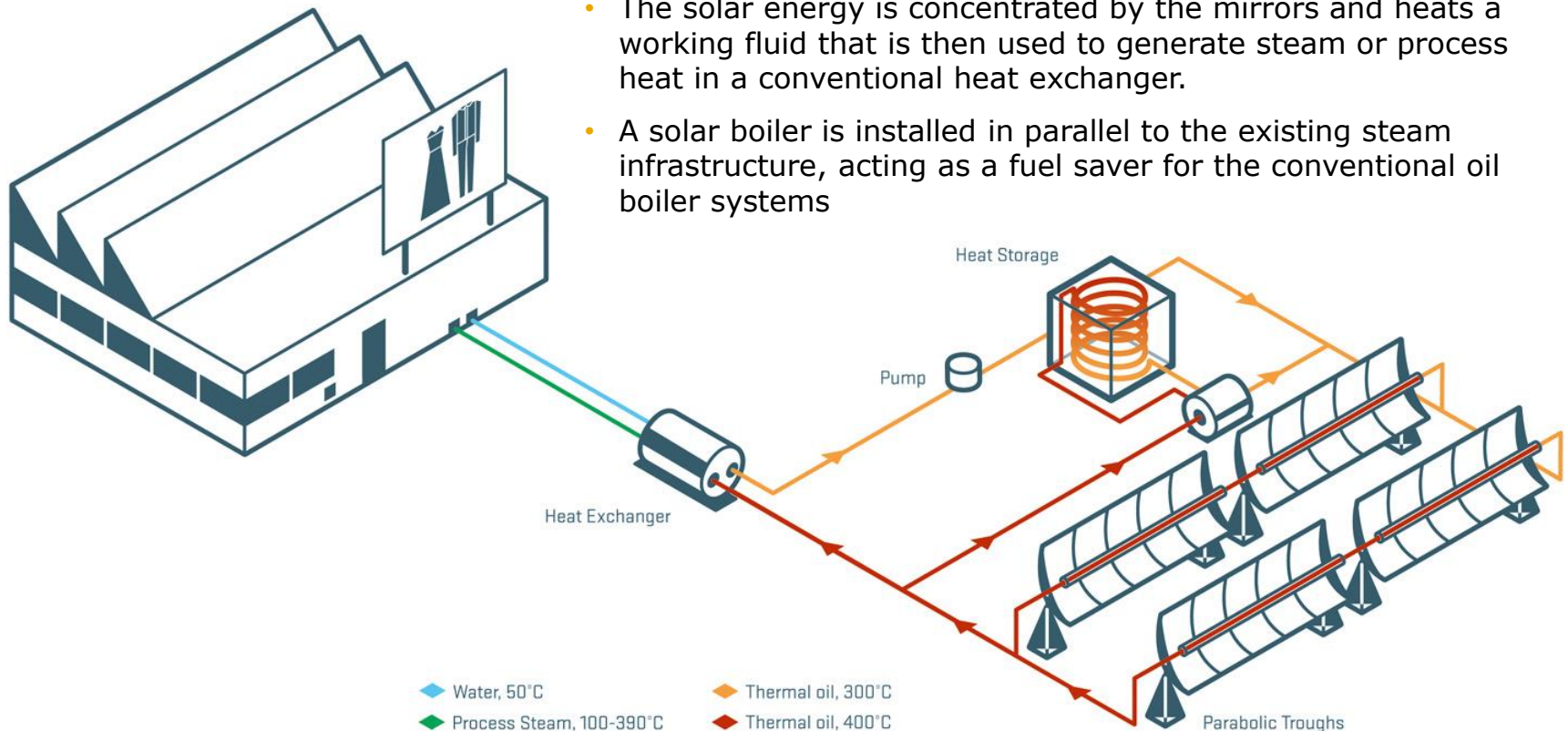
PT950 Solar CST system – Key components



Steam Technology

Solar Boiler for Process Steam Generation

- A solar steam boiler system employs rows of large mirrors called parabolic troughs that move about one axis in order to track the sun throughout the day.
- The solar energy is concentrated by the mirrors and heats a working fluid that is then used to generate steam or process heat in a conventional heat exchanger.
- A solar boiler is installed in parallel to the existing steam infrastructure, acting as a fuel saver for the conventional oil boiler systems



Protarget AG

Experience in the Indian Market



Some of Protarget's key activities in the country:

2013

- Protarget AG started its activities in the Indian market with a **local presence** for the manufacturing, construction and operation of solar thermal plants

2017

- Protarget has successfully designed and constructed a solar steam boiler system for **HATSUN, India's largest private dairy**
- Protarget's Solar Thermal Technology has been empanelled by the Ministry of New and Renewable Energy **MNRE** and is therefore eligible for Indian subsidies

2018

- Protarget has officially been announced as advisor to **UNIDO** (United Nation Industrial Development Organisation) for their Solar Thermal Program in India

2019

- Protarget has been assigned as advisor to **NISE India** (National Institute for Solar Energy)
- In October 2019 Protarget has signed an agreement for the construction of a second, large scale solar steam boiler system for a **HATSUN dairy in Tirunelveli, Tamil Nadu**



Protarget AG



Why Renewables in India?

India is one of the principal signatories of the Paris Treaty is obliged to cut emissions. As a result, the industry is asked to invest in **efficient** and **sustainable production technologies** while dealing with **increasing fuel prices** at the same time.

The United Nations Industrial Development Organization (**UNIDO**), in association with the Ministry of New and Renewable Energy in India (**MNRE**), has started the implementation of the project entitled "Promoting Business Models for increasing penetration and scaling of solar energy in India" especially for **thermal energy use**. The project is funded by the Global Environmental Facility (**GEF**). The Government has implemented three policies to support CST projects in the industry:

➤ **MNRE – CST subsidy**

- MNRE supports parabolic trough applications with Rs.5400/m².
- This reduces the investment cost of Protarget Solar Steam Systems by -20%

➤ **UNIDO – IREDA loan facility**

- Industrial companies get favorable loan terms
- Interest rate at approx. 5% for the financing of CST systems for industrial process heat applications.

➤ **Tax Credit through accelerated depreciation**

- Companies investing in solar energy can claim 80% of the total investment in the first year
- 20% in the second year of operation as tax credit.

Protarget AG

Why Renewables in India?



“Promoting Business Models for increasing penetration and scaling of solar energy in India”

Solar Thermal Energy for Industrial Applications (STEIA)

- Financial support for projects
- Technical Feasibility study by **UNIDO**
- Support for improving the manufacturing of CST systems/components
- Support from **MNRE** for quarries regarding CST projects and financing
- Main contact **Dr Anil Mishra**, National Project Manager, **UNIDO**
- Website: **www.steia.in**



Source: www.steia.in. Last visited: 03.02.2020

Protarget AG

Comparison conventional vs. solar boiler

Conventional steam boiler systems

- + Low investment cost
- + Operated with oil or gas
- + Standardised sizes
- + Proven and reliable
- Operating cost (fuel)
- CO₂ emissions

Fuel boiler example

- Capacity: 5 ton oil boiler
- Output: Steam@170, 10 bar
- Load profile: 10 hours/day, 5 days/week
2.200 hours/p.a.
- Fuel cost: 700 EUR/ton (Oil)
- **Annual cost: 550.000 EUR**



Protarget Solar Boiler System

- + Integrated in parallel to the existing boiler
- + Operating as a fuel saver
- + Providing process steam of up to 400° C
- + With thermal storage system 24/7 supply
- + Lifetime 20 years and more
- + Zero emissions

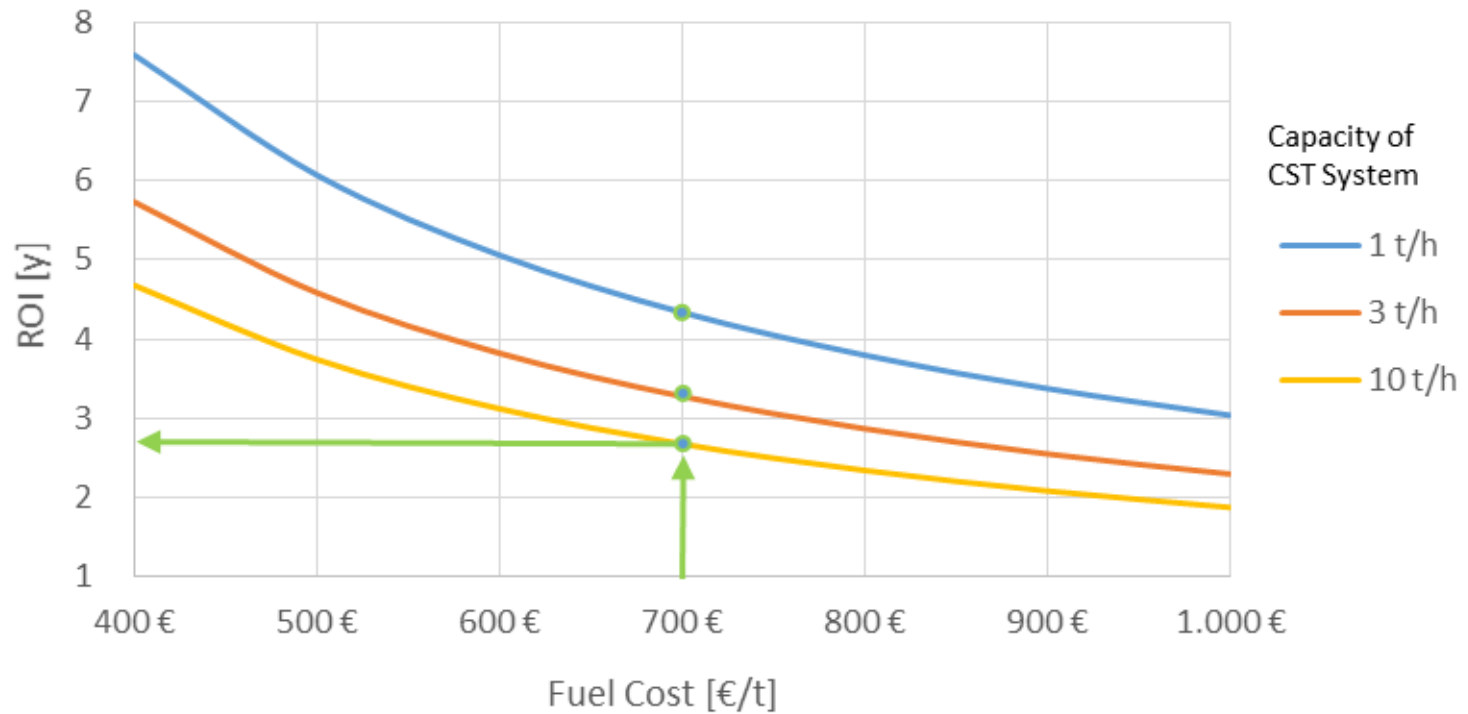
Solar Boiler example

- Capacity: 5 ton solar steam boiler
- Output: Steam@170, 10 bar
- Load profile: 10 hours/day, 5 days/week
2.200 hours/p.a.
- Fuel cost: 0 EUR
- **Annual cost: 30.000 EUR**



**Annual fuel savings
520.000 EUR**

Amortisation of a CST System in relation to fuel cost



* Cost of financing are not considered in the amortisation graph above

Protarget AG

Business models



There are two business models for the acquisition of the system

- **Purchase of the system** – Including the following options if required
 - **O&M agreement**
 - Protarget being responsible for operation and maintenance of the system
 - **Performance warranty**
 - Guarantees that, for a given amount of solar radiation, the system will deliver a pre-agreed quantity of steam or thermal energy

- **Energy contracting**
 - **Protarget owns and operates the system on customer premises**
 - Customer only **pays for the delivered energy**
 - Based on a **power purchase agreement** (PPA) for a defined period of time
 - Customer has the possibility to purchase the system **at any time** of the contract

Protarget AG

Summary



- Where steam is produced in conventional boilers, **using diesel or fuel oil** at for example 700 EUR/ton, this results in steam costs of **50 EUR/ton**
- With Protarget's Solar Boiler Technology, steam is generated at **10 EUR/ton** of steam, which is **80%** cheaper compared to conventional fuels
- With the **O&M agreement** or the **energy contracting model** we are offering, our technology has **low technical risks** at **minimum financial** burdens to the customer
- Our solar boiler systems are designed to **last 20 years and more**, insulating you from the **inevitable price increase of fossil fuels** and other externalities such as **carbon tax**

**Where sunshine and land is available, and fuel has a value,
CST is the best technology for thermal energy generation**



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THANK YOU