



Solar
Payback



Solar Heat for Industrial Processes (SHIP)

Jan Knaack, German Solar Association
Bengaluru / Mumbai 24/25 April 2019

Agenda

- **BSW-Solar**
- SHIP - State of Play
- Solar Payback Project

German Solar Association



TASK To represent the solar industry in Germany in the thermal, photovoltaic and storage sectors

VISION A sustainable global energy supply, provided by solar (renewable) energy

ACTIVITIES Lobbying, political advice, public relations, market observation, standardisation

EXPERIENCE Active in the solar energy sector since 40 years

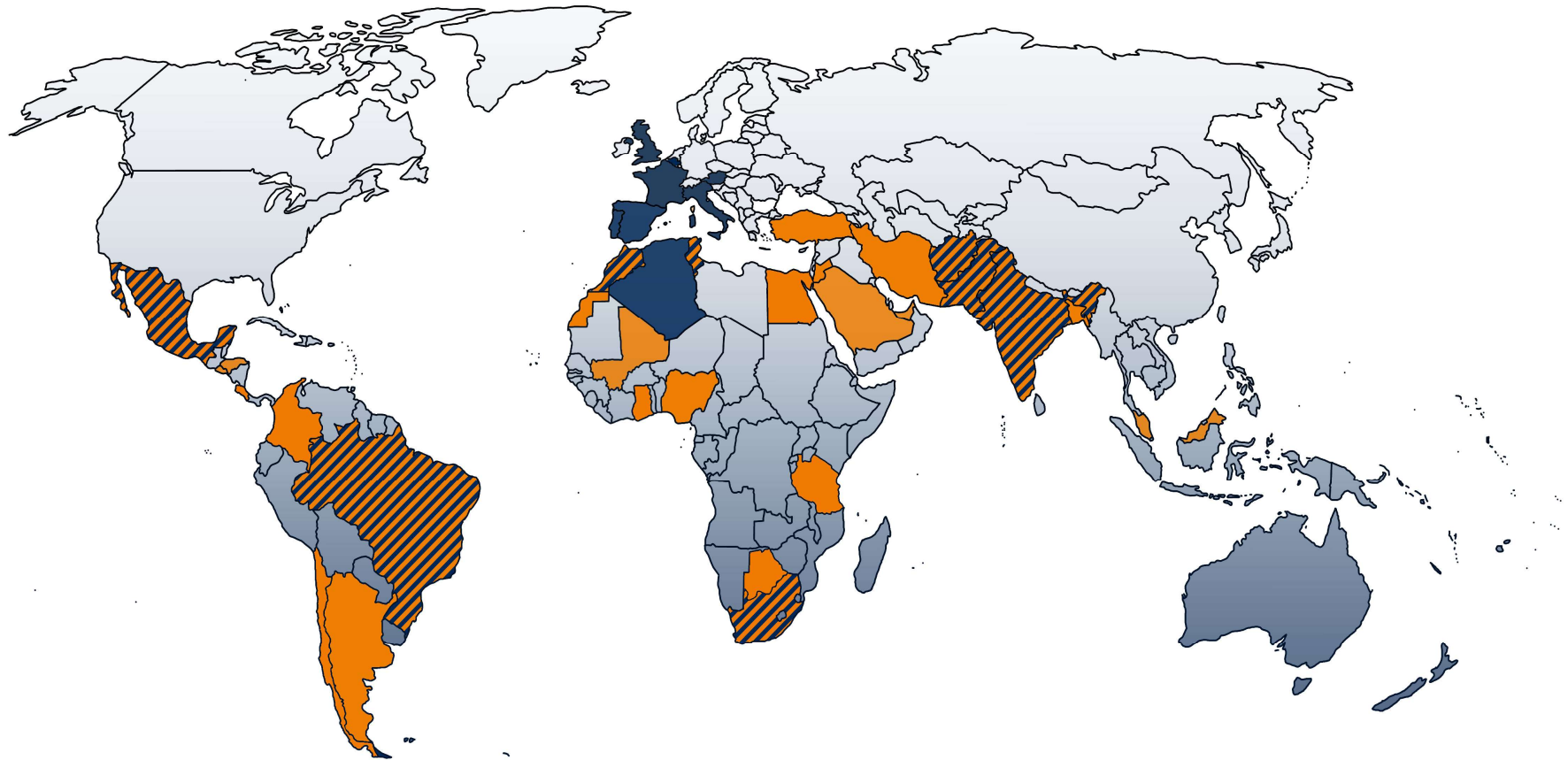
REPRESENTS **More than 800** solar producers, suppliers, wholesalers, installers and other companies active in the solar business from all over the world


HEADQUARTERS Berlin


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BSW-Solar: Working world wide to improve frameworks for the use of solar energy!



 Partnerships,
business networks

 Projects, Market reports,
esp. "Enabling PV"

 both

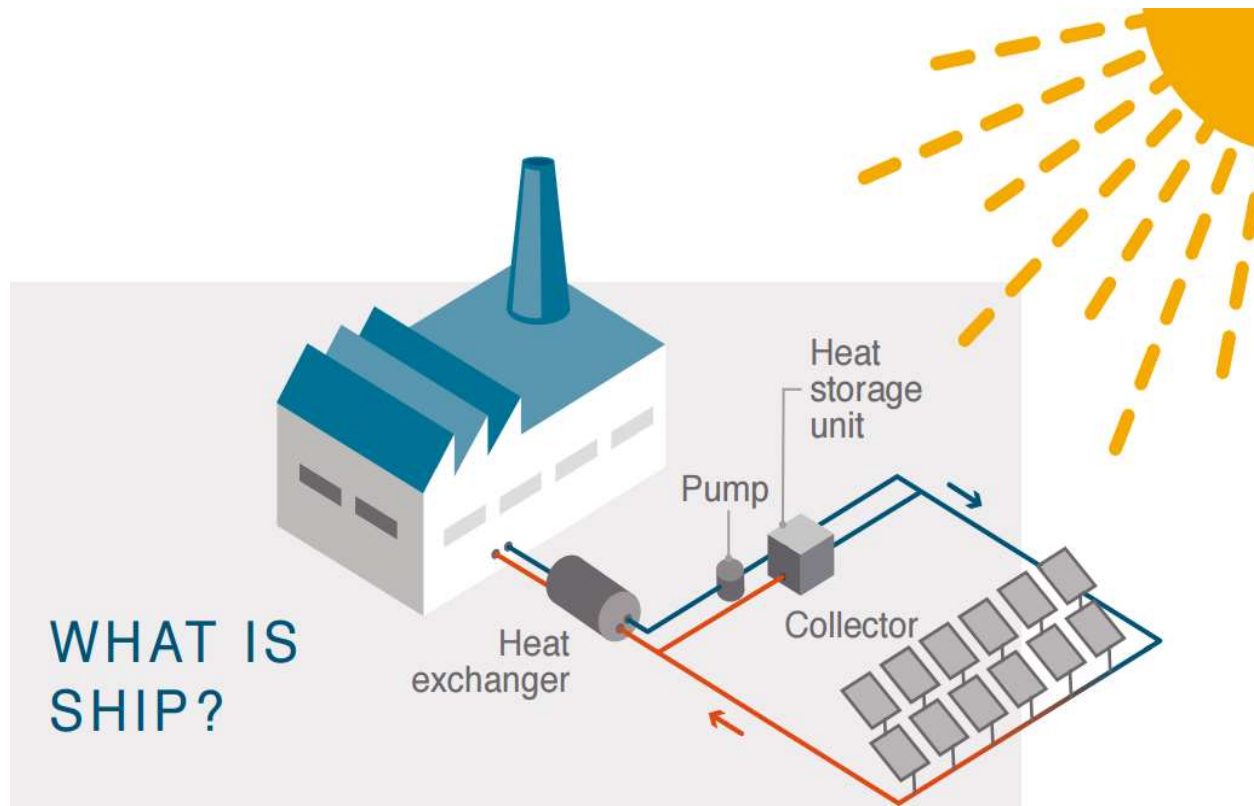


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- **SHIP - State of Play**
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Solar thermal energy for industrial processes (SHIP)

Solar energy can be a low and medium temperature heat source.



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There is enormous potential for SHIP and strong growth, but so far there are around 740 plants worldwide (2018).

Increase SHIP Deployment



Solar Heating for Industry Processes (SHIP)



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Potential: The final consumption of thermal energy in industry is greater than the consumption of electricity worldwide.

Photos: Cape Brewing Company, Zehnder Group, Inventive Power, CSP-F Solar

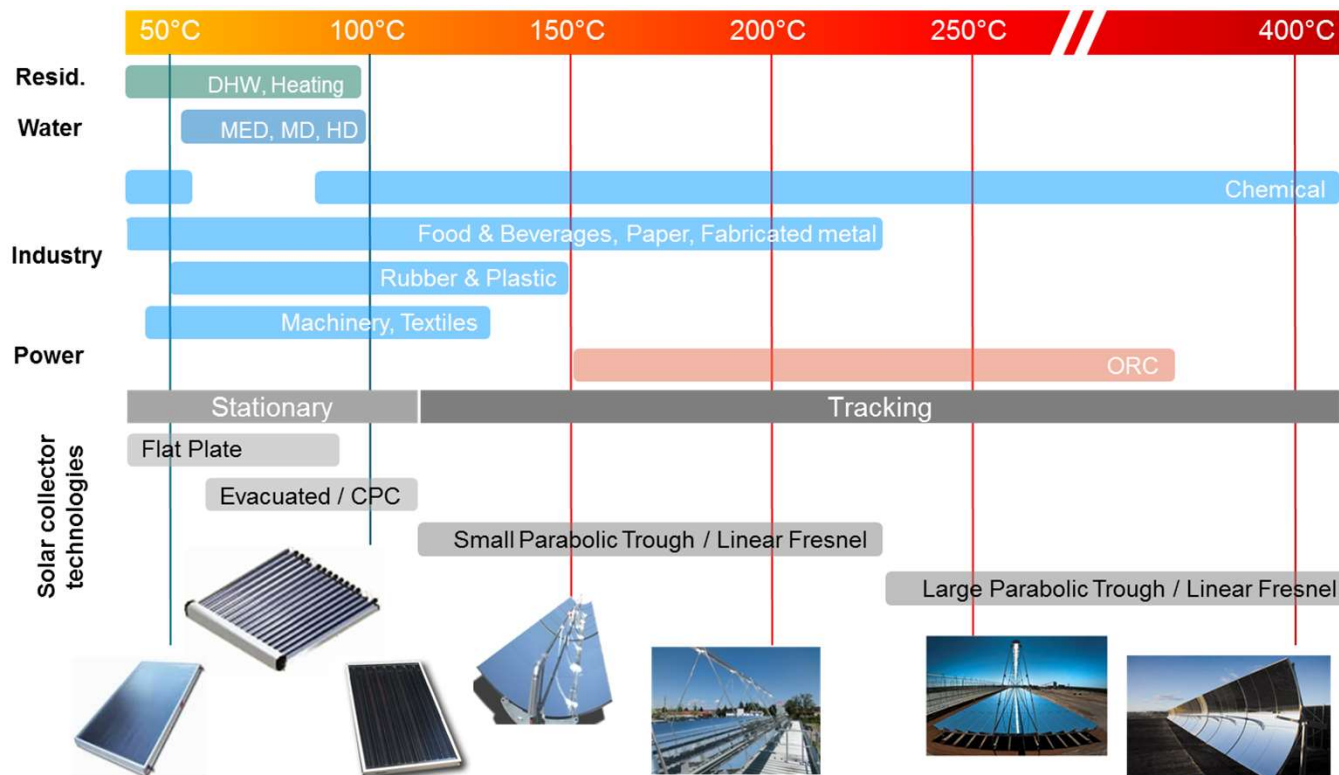
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Suitable Solar Thermal technologies

Heat for Industrial Processes

Solar collector technology vs. required process temperature



Suitable processes

Heat for Industrial Processes

Suitable industrial processes

- Drying and dehydration
- Preheating (input or raw material)
- Pasteurization and Sterilization
- Washing and cleaning
- Chemical reactions
- Surface treatment
- Space heating
- Supply of hot water or steam

Main industrial sectors

- Chemicals
- Food & Beverages
- Paper
- Fabricated metal
- Rubber & Plastic
- Machinery & Equipment
- Textiles
- Wood

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Solar Process Heat – State of Play



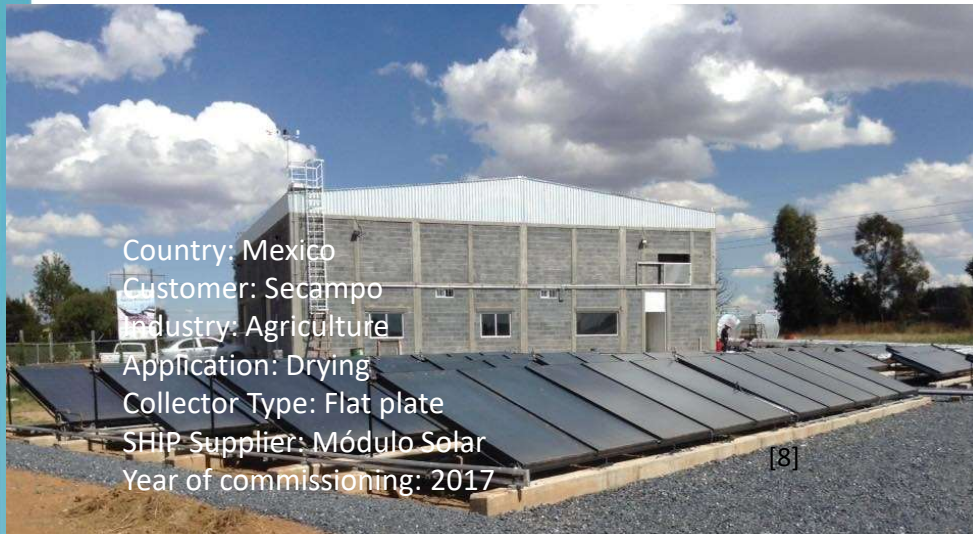
World largest plant – enhanced oil extraction with steam in Oman – 1 GWth (under construction)

Source: Glaspoint

Existing projects

Examples

Stationary Technologies



Country: Mexico
Customer: Secampo
Industry: Agriculture
Application: Drying
Collector Type: Flat plate
SHIP Supplier: Módulo Solar
Year of commissioning: 2017

© : Modulo Solar



Country: India
Customer: Hindustan Unilever Limited
Industry: Food and Beverage
Application: Pasteurization
Collector Type: Evacuated tube
SHIP Supplier: Thermax
Year of commissioning: 2017

© : Hindustan Unilever Limited

Existing projects

Examples

Tracking technologies



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[10] <http://www.industrial-solar.de/content/en/referenzen/fresnel-kollektor/>

[11] http://ship-plants.info/solar-thermal-plants/155-dairy-plant-el-indio-mexico?collector_type=5

Existing projects

Examples

Amal Solar EOR Pilot Project, Oman

Parabolic Trough in greenhouse

Thermal Power (full plant): 1 GWth

Current production (pilot): 6 ton steam / day

[12]

© Industrial Solar © Petroleum Development

AAalborg CSP's tomato growing CSP plant, Australia

Central receiver CSP + SHIP system

Thermal Power (full plant): 36 MWth

Growing tomatoes in the Australian desert
with sunlight and seawater

[Find out more >](#)

© AALBORG CSP [23]

[12] MIT, 2016. Technology Review, Arab Edition. <http://technologyreview.me/en/energy/oman-explores-solar-powered-oil-recovery/>

[23] <http://www.aalborgcsp.com/>

Assessment of the SHIP world market 2017 and 2018*

The figures for 2017 were updated again, since three projects were postponed to 2018.

	2017	End of year 2017 total	2018	End of year 2018 total
No of commissioned SHIP systems	107	632	107	739
Minimum newly installed collector area [m2]	190,708	n/a	199,819	n/a

Source: Solar Payback SHIP Supplier Survey 2018

*Preliminary figures

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Number and collector field size of SHIP plants added on key markets (outside Oman)*

	No. of systems installed in 2018	Total collector area installed in 2018 m ²	Average collector system size in m ²
Mexico	51	9,216	181
China	15	6,422	428
India	10	8,124	812
Germany	9	7,849	872
Spain	3	1,317	439
South Africa	3	1,135	378
France	2	5,543	2,772

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Argentina, Austria, Cyprus, Greece, Israel, Italy, South Korea, Turkey, UAE, USA

Source: Solar Payback SHIP Supplier Survey 2018

*Preliminary figures



New SHIP installations in 2018 and the related collector type.

These figures do not include the enhanced oil recovery plant in Oman.

	SHIP collector area installed in 2018 in m ²	Percentage of total collector area
Vacuum tube	30,498	54%
Flat plate	11,840	21%
Parabolic trough	11,414	20%
Dish	2,775	5%
Linear Fresnel	360	1%
Total	56,888	

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Source: Solar Payback SHIP Supplier Survey 2018
Title of the presentation



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- SHIP - State of Play
- **Solar Payback Project**

Solar Payback Project

- Funding by the BMU within the framework of the International Climate Initiative (IKI)
- Implementing countries: Mexico, Brazil, South Africa, India

Main targets:

- Presentation of application fields of solar technologies and potentials of solar process heat in the target countries
- Increasing the attention of industrial users for the large market potential of solar process heat



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Solar Payback: Funding

- Part of the International Climate Initiative (IKI)
- Funded by Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

Supported by:



Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety

based on a decision of the German Bundestag

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Solar Payback: Fact Sheet

COORDINATOR



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GERMAN IMPLEMENTING PARTNERS



www.ise.fraunhofer.de



www.deginvest.de



www.solrico.com

DURATION

10/2016
to 6/2020

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Solar Payback: Partners in the target countries



ASSOCIAÇÃO BRASILEIRA DE ENERGIA SOLAR TÉRMICA

www.abrasol.org.br



Asociación Nacional de Energía Solar

www.anes.org



www.stfi.org



South African National Energy
Development Institute (SNDI) Ltd.

www.sanedi.org.za



www.ahkbusiness.de



www.mexiko.ahk.de



www.indien.ahk.de



www.suedafrika.ahk.de

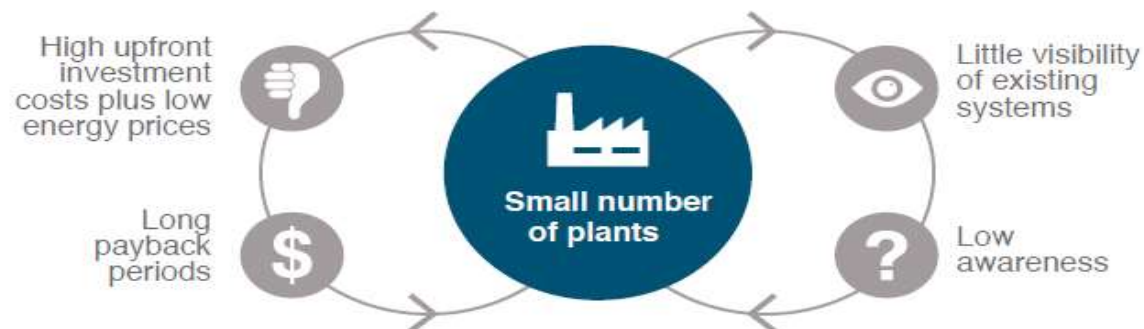
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Solar Payback: Objectives

- **increase awareness** of the technical and economic potential of SHIP-technology
- **increase willingness to invest** in and to promote this promising technology in four partner countries: Brazil, India, Mexico and South Africa
- **Break the vicious circle** of small deployment rates

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www.solar-payback.com

https://www.solar-payback.com 50% Suchen

Solar Payback Home Potential Technology Markets Suppliers Demonstration Investors About Solar Payback English

Solar Heat for Industry
**EFFICIENT
PROFITABLE
SUSTAINABLE**

Welcome to Solar Payback

The objective of the three-year Solar Payback project: Promoting the use of Solar Heat for Industrial Processes (SHIP) across four partner countries – South Africa, India, Mexico and Brazil.

As part of the German International Climate Initiative (ICI), it is raising awareness of the technical and economic potential of SHIP technologies by clear and transparent information on the costs and benefits of SHIP applications and by helping to build selected reference systems. Solar Payback also cooperates with financial institutions to develop models which will assist stakeholders and investors in securing access to financing.

Suppliers Map
Suppliers of turnkey solar process heat systems in 35 countries

Latest News

April 23, 2018
SHIP newsletter in Brazil
In February 2018 the first Solar Payback newsletter in Portuguese was sent out in Brazil. You can download the newsletter here. It informed about upcoming trainings in the field of...

April 25, 2018
First heliostat field made in Brazil
The University of São Paulo in Pirassununga is about to get its own field of heliostats on campus. Once completed, the sea of mirrors will focus sunlight onto a receiver...

March 15, 2018
India: Financial support for concentrating solar systems extended until 2020
The "order" published by the Indian Ministry of New and Renewable Energy on 26 February 2018 put an end to the uncertainty which had pervaded the industry. In the 2-page...

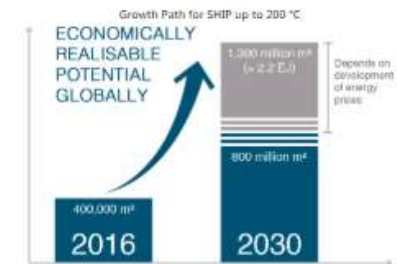
February 21, 2018
MCTIC requires 30 % emission reduction in industrial sector
The industrial sector is the largest energy consuming sector in Brazil and the fastest growing as well. In 2016 energy at 84.18 Mtoe (equal to...

February 15, 2018
CBENS to discuss solar heat for industry
Brazil's solar energy association ABENS has invited about 500 experts to the solar energy conference CBENS taking place...

www.solar-payback.com Potentials



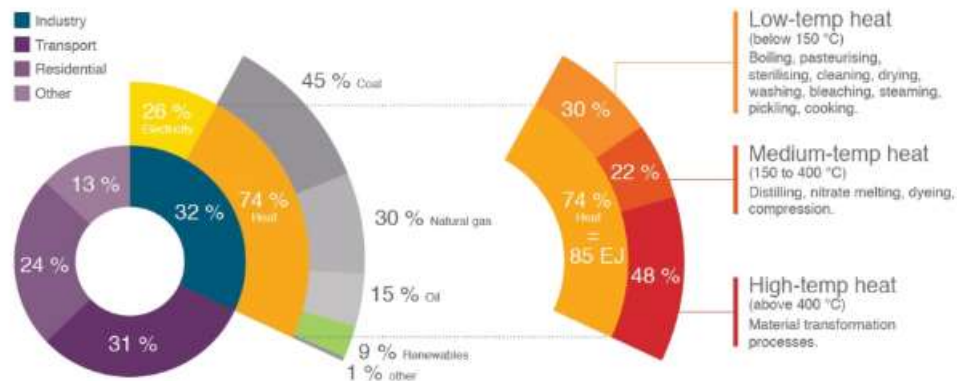
Potential



Source: IRENA

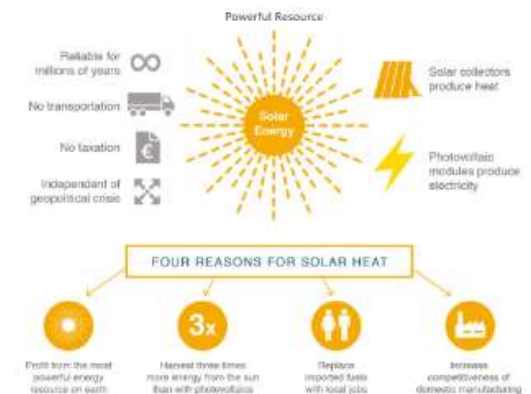
Demand

Enormous Global Heat Demand in Industry



Total Final Energy Consumption 2014: 260 EJ; Source: IEA / IRENA

Four Good Reasons



6.45 GWth potential for CST according to GEF UNIDO, 2018

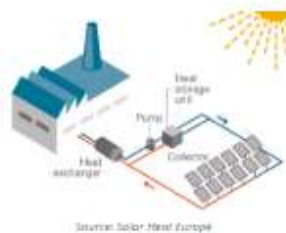
www.solar-payback.com Technology description



What is SHIP?

SHIP is the acronym for Solar Heat for Industrial Processes and describes systems which provide solar heat in a factory.

A collector field heats a process fluid by means of solar radiation and a heat exchanger transfers this heat to a supply system or production process in the factory as hot water, air flow or steam. Storage units make it possible to use the generated heat at night-time.



Collector

A solar thermal collector captures solar radiation hitting a surface, the absorber, to heat a fluid in a hydraulic circuit.

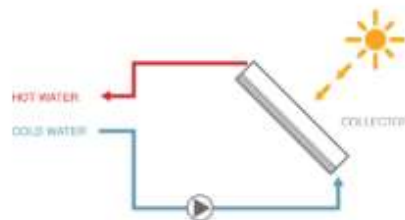


Photo Gallery

Free download of photos from SHIP reference projects around the world.



[View photos](#)



[Download Charts](#)

Solar Collectors

Collector Types: Stationary

Fixed tilt or seasonally adjusted:



Flat plate collector or vacuum tube collector



Vacuum tube collector with CPC

Collector Types: Tracking

Linear or two-axis tracking:



Parabolic trough collector



Linear Fresnel collector



Concentrating dish collector

WHAT TO CONSIDER WHEN CHOOSING A COLLECTOR TYPE

- Typical operation temperature of the collector type meets the requirements for the industrial heat
- Design accommodates chosen heat transfer fluid
- Certified according to national or international standard, such as:
 - Solar KEYMARK (Europe)
 - Solar Rating & Certification Corporation (SRCC, USA)
 - Bureau of Indian Standards (BIS)
 - NMX-ES-001-NORMEX (Mexico)*
 - South African Bureau of Standards (SABS)*
 - National Institute of Metrology, Quality and Technology (NIMQTD (Brazil)*
 - Chinese National Standard *
- Energy output certified by accredited third party
- Enough pressure resistance
- Adequate stagnation handling and overheating protection
- Suitable weight for rooftop installation or appropriate use for ground-mounting

* These standards do not yet include concentrating collectors

www.solar-payback.com – Photo Gallery

Photo Gallery

Planning to hold a presentation on the solar process heat potential in your country? Thinking about posting news articles to your website? Download royalty-free images of SHIP systems around the world from our photo gallery.

Photo Search

by Supplier	<input type="text"/>	by Year	-Please Select-	by Application	-Please Select-
by Country	<input type="text"/>	by Industry	-Please Select-	by Collector Type	-Please Select-



Thailand, Retanning Process, 2012



Mexico, Painting workshop, 2017



Mexico, Painting workshop, 2017



Mexico, Painting workshop, 2017



Mexico, Painting workshop, 2017



Austria, Steam for test lab, 2017

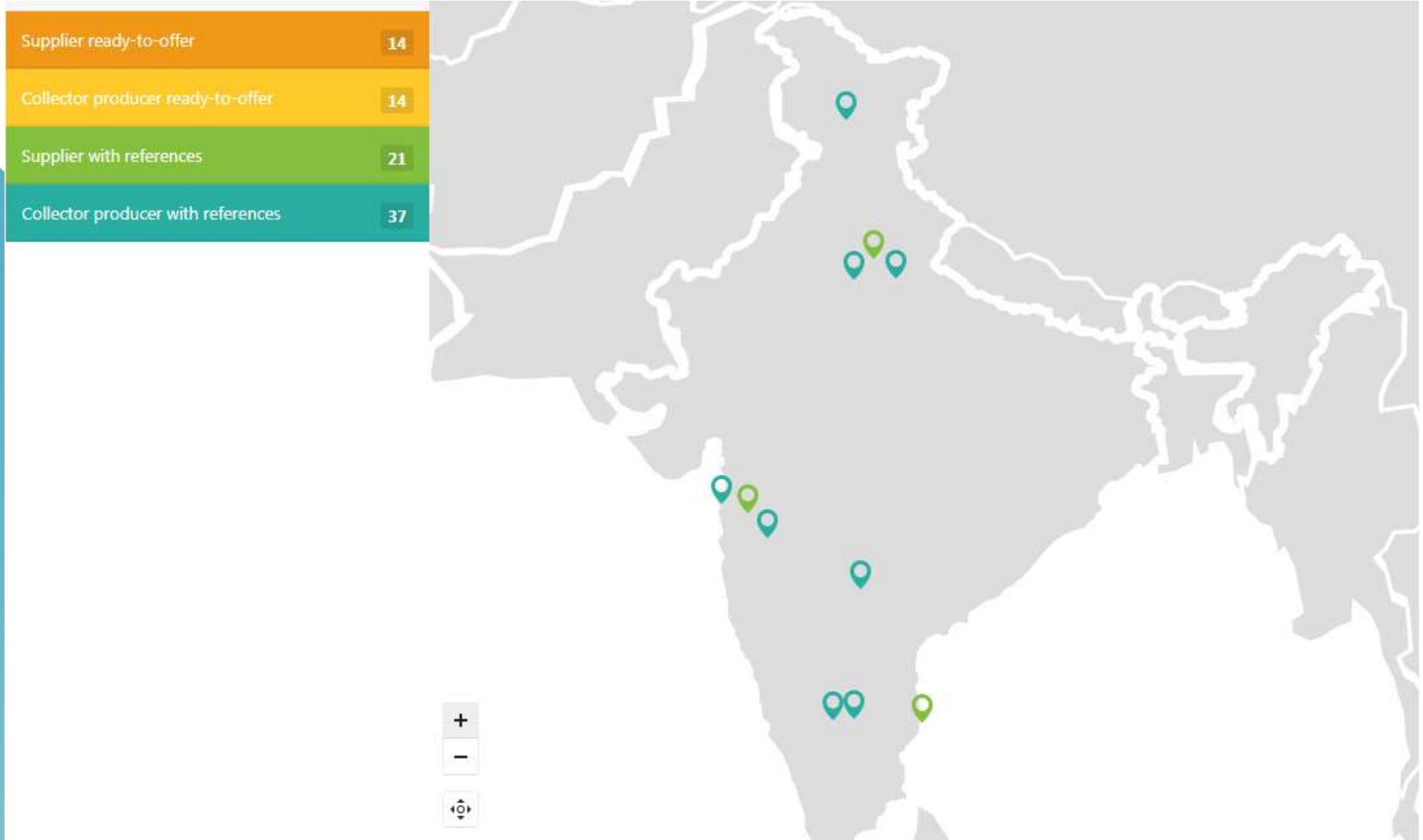
To be updated
with 40 further
examples!

You have
examples, too?


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Contact:
Epp@solrico.com


www.solar-payback.com – Supplier world map! Updated in 2019!



www.solar-payback.com Testimonials


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India

Arvind Kumar Dhaquet
Senior General Manager





Photo: Amul Fed Dairy


"We strongly believe green energy to be the future of sustainable development. The concentrating solar thermal project was implemented as it pathbreaking showcase, with more to come. It delivers the projected output, and we are exploring to replicate this at several other union member's dairy plants."

Investors in India




[View Investors](#)

Investors in Mexico



[View Investors](#)


Amul Fed Dairy



Green heating for milk pasteurization, evaporation and sterilization
140 °C

561 m²
aperture area in use
DHW 15,002,035
kWh (2014-2015)
Investment cost: 100 Lakhs

Year of Installation 2016	
Solar fraction:	8.58% of total steam demand of dairy plant
Subsidy:	INR 1,322,944 (USD 46,500)
Annual savings:	53,000 m ³ natural gas
Turnkey supplier:	Thermax India



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Materials: Solar Payback Brochure



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Download from www.solar-payback.com

Materials Country Study with detailed analysis of Indian market and potentials – soon to come



SOLAR HEAT FOR INDUSTRY
INDIA



1. **Macroeconomic framework, energy policy and industrial energy consumption in India**
2. Description of **solar thermal market** for industrial processes
3. **Industry landscape** at low- and mid-temperature levels
4. **Project development** process for SHIP plants
5. **Profitability Analysis** of SHIP projects
6. Conclusions and **recommendations**

Calculation tool – to be published end of May 2019

<https://stage.iki.ise.fhg.de/#/tec>

Technical information

Location

Country

City

Estimated Solar system costs without storage

Estimated solar resource

System configuration

Estimated annual final energy consumption

Solar collector type

Specific solar collector yield

Average operation temperature

Specific thermal storage volume

Collector aperture area

Thermal storage volume

Estimated annual solar yield

Estimated solar fraction

Estimated avoided emissions

Financial summary

Total investment costs

Total investment costs including maintenance

Heat production costs (current or target)

Residual value

Annual O&M costs

Non-refundable investment subsidy

Non-refundable operative subsidies

Avoided emissions revenues

Investment lifetime

Client debt

Debt tenor

Debt service

Effective Cost of Capital (CoC)

General inflation rate

Energy inflation rate

Corporate Tax Rate

Financial information

CAPEX

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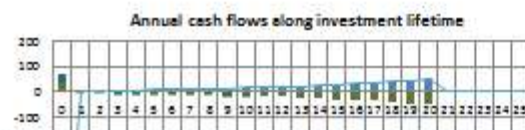
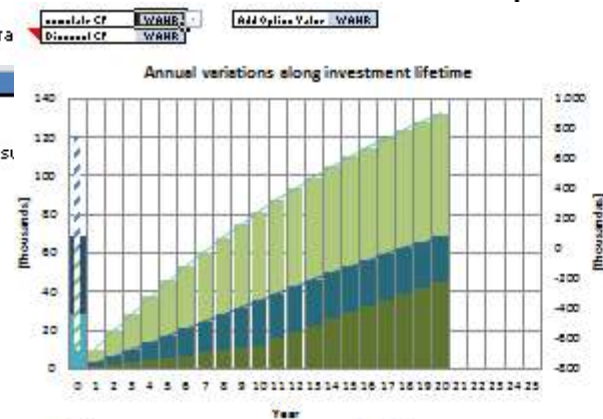
Debt service

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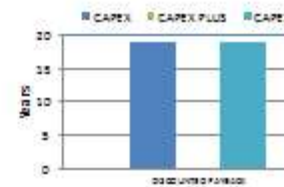
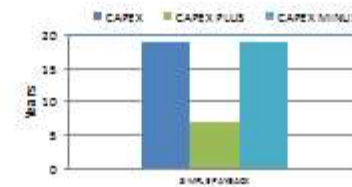
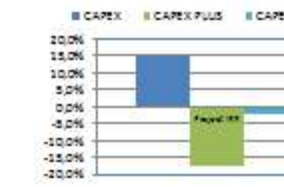
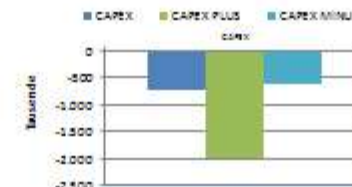
General inflation rate

Energy inflation rate

Corporate Tax Rate



CAPEX: Result based on CAPEX estimation
 CAPEX PLUS: Result based on higher end of CAPEX estimation affected by operating temperature and system complexity
 CAPEX MINUS: Result based on lower end of CAPEX estimation affected by operating temperature and system complexity
 CURRENT: Result based on current heat production system



Activity: Prequalification and energy audits at interested factories for an refurbishment of SHIP-systems

[illegible]

	Food	Rating	Rating with Sister Cove
IPG		0.95	0.88
Dorset		0.95	0.80
IPG		0.80	0.77
BPZ oil		0.71	0.72
IPG		0.70	0.71
Gas		0.70	0.60
IPG (?)		0.75	0.67
Westcott (?)		0.61	0.66
Gas		0.67	0.60
Westcott		0.60	0.60
Gas		0.61	0.57
Westcott (?)		0.60	0.55

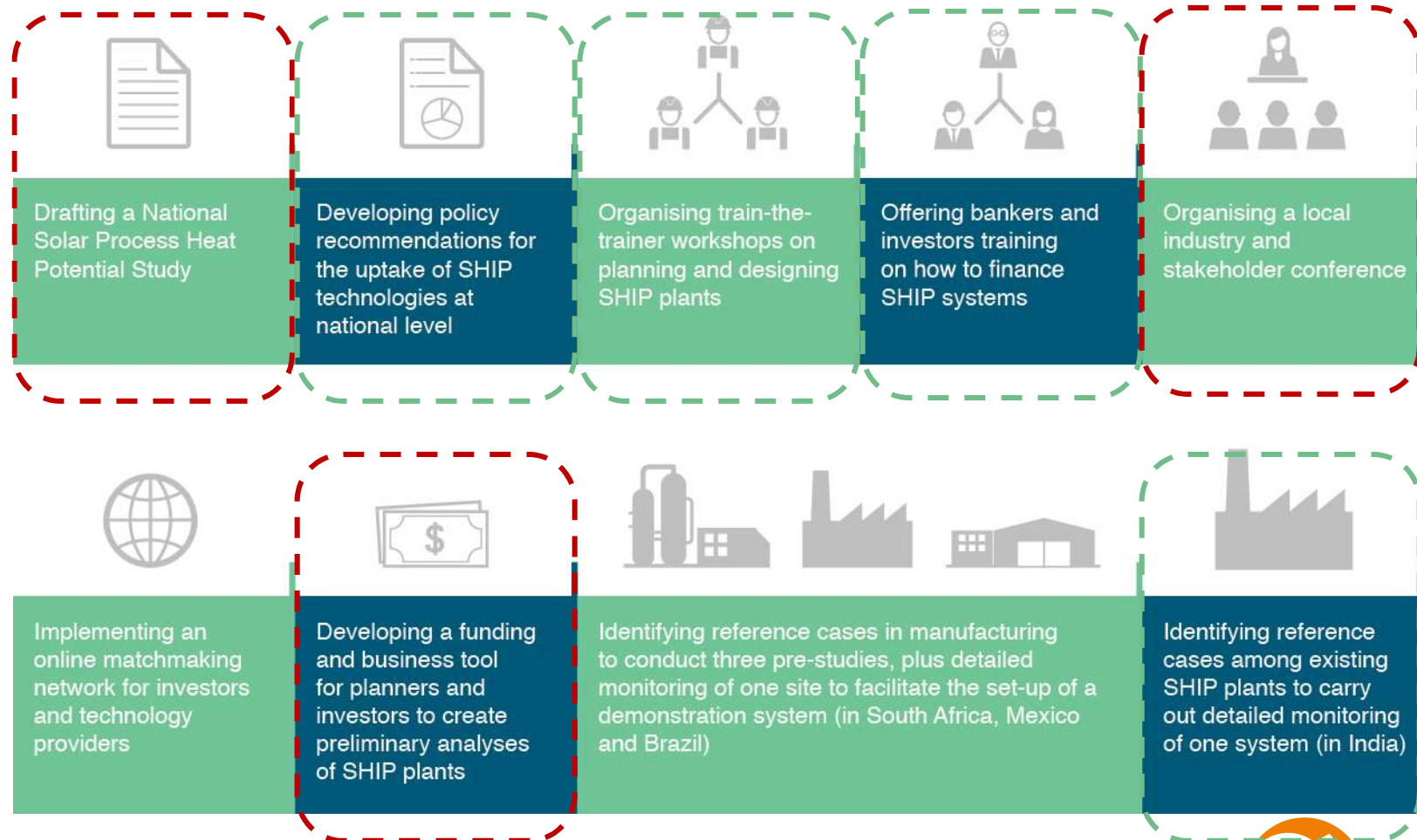


Activities: Financial trainings and Workshops

- Side-Event at the Renewable Energy Investment and Finance Forum (**REIFF**) in **Mumbai** on **02 November 2018**
- To come: **Technical training by Fraunhofer, preferably for trainers!**
- To come: **Guidelines for planning of SHIP projects**
- To come in autumn: **Policy paper with potentials analysis**
- **Webinar for potential clients with case studies for India and the Online tool**

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Solar Payback: Activities



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Further Information: www.solar-payback.com

- Market studies (BR, MX, ZA, India (soon))
- Marketing brochure
- Overview of SHIP-Industry and suppliers!
- Online calculator (early June 19)

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Let's bring the message out there

SHIP technology is on the RISE!



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Thank you • Obrigado • Gracias

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www.solarwirtschaft.de

www.solar-payback.com