Solar Heat for Industrial Processes (SHIP)

Finding Your Business Case

Carl-Maria Bohny, Mumbai, 2 November 2018

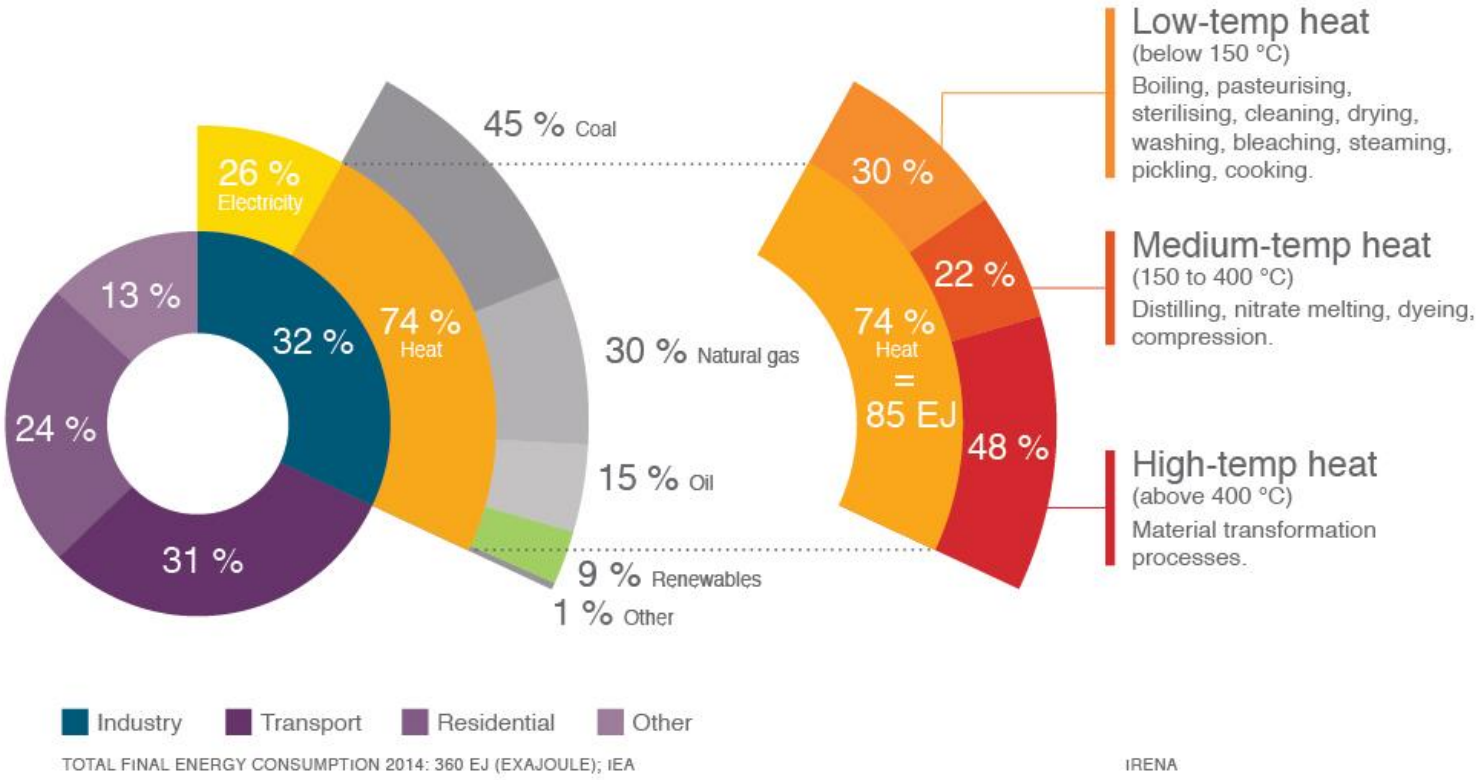
renac
renewables academy

In cooperation with:

Solar Payback

www.renac.de

The focus on electricity does not reflect the actual energy demand of industries



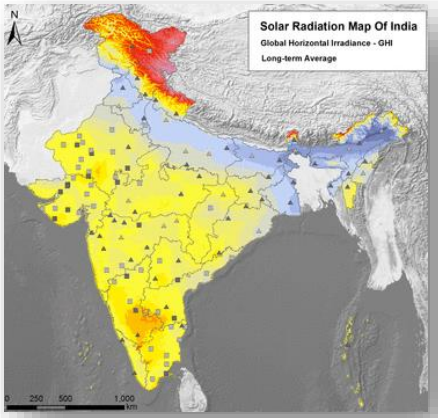
Source: IRENAC

Proof of concept is achieved but some ingredients seem still lacking

Solar Payback

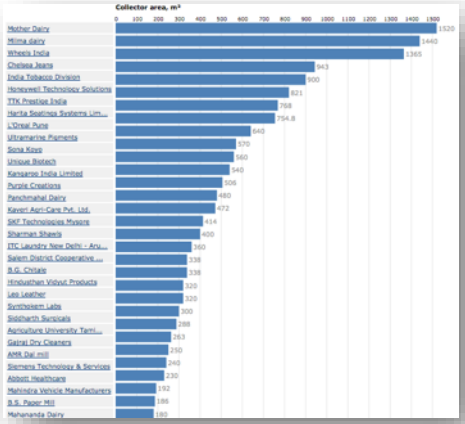
renac renewables academy

Resources



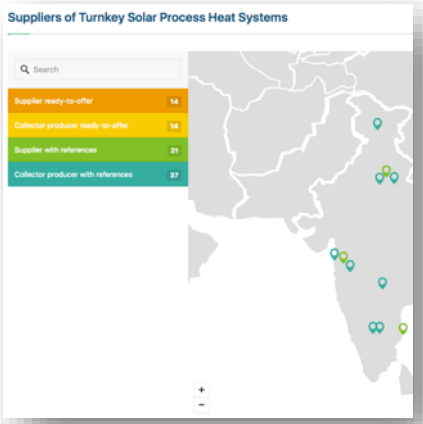
+

Applications



+

Suppliers



= ?

Sources: Suntrace, Solar Payback, AEE INTEC

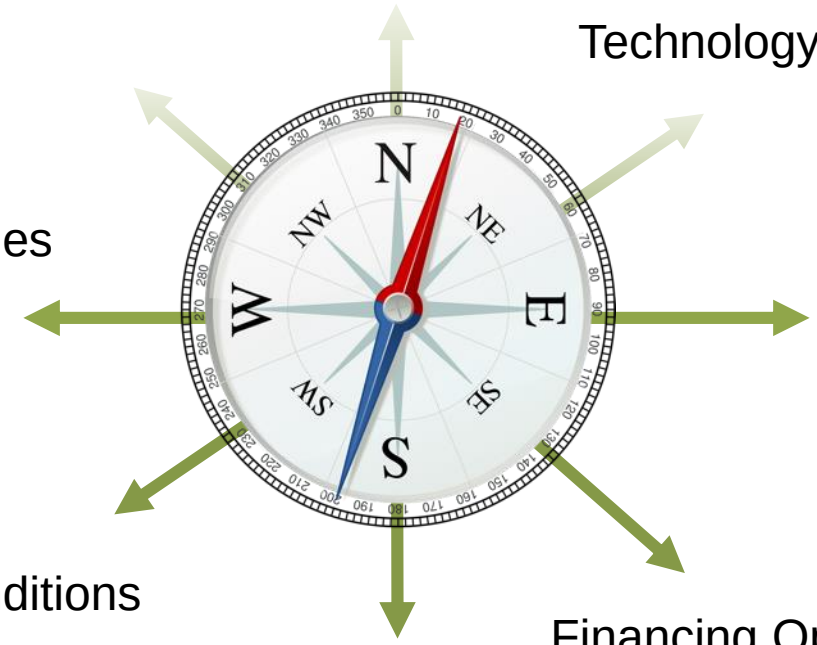
The goal is to learn to navigate through the SHIP business case scenarios

Equipment Availability

Sector and Products

Project Structure

Technology Options



Temperature Ranges

System Complexity

Site Conditions

Financing Options

Market Incentives

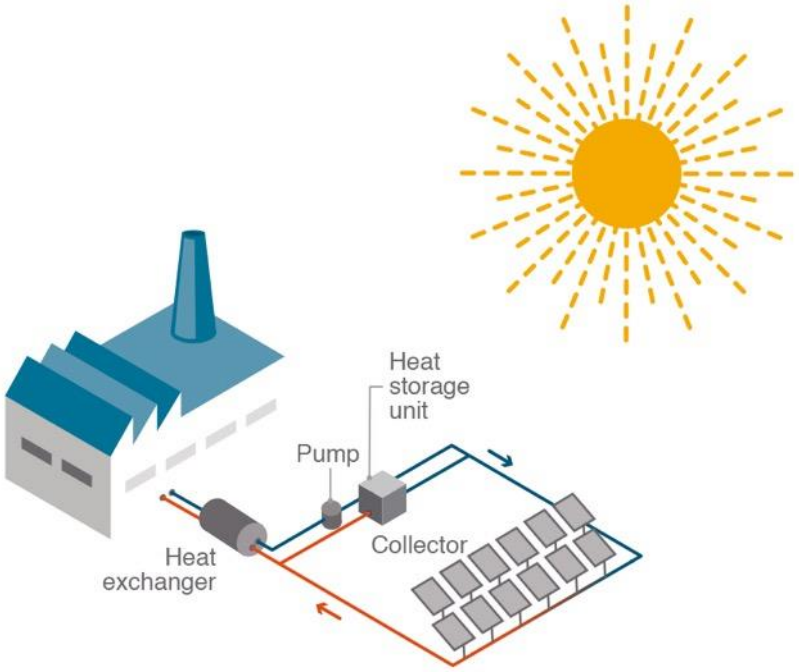
Agenda

1. The Technology in a Nutshell
2. Drivers, Barriers and Business Models
3. The Indian Market Prospects
4. Finding the Low Hanging Fruits
5. Conclusion

AGENDA

1 The Technology in a Nutshell

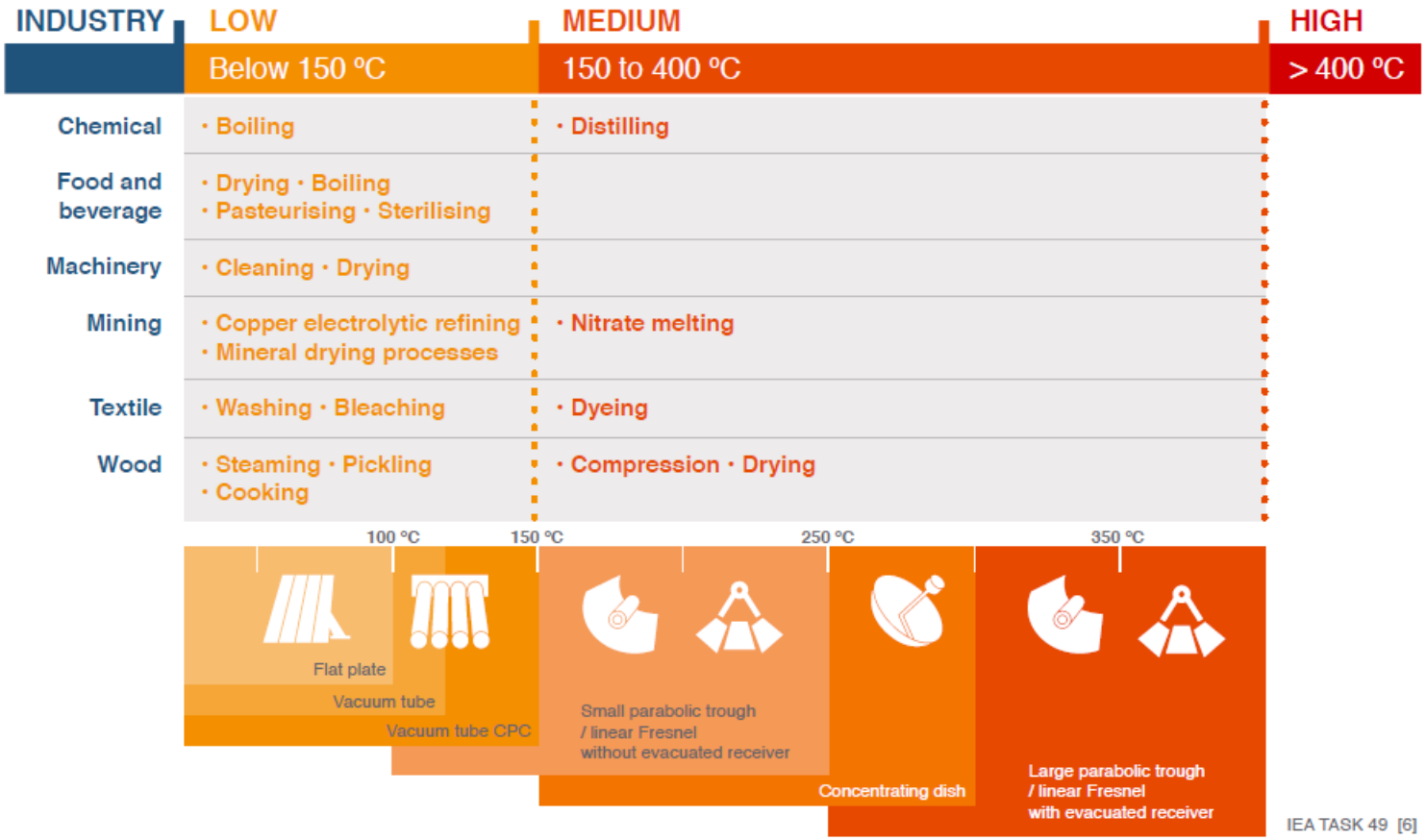
Integrating solar resources (GHI, DIN) into the thermal production process



- Heat vs. ~~Electricity~~
- Industrial vs. ~~Residential~~
- Large/medium scale vs. ~~small scale~~

Source: RENAC, MNRE

The choice of technology depends on the processes and temperature levels



Enormous Flexibility

Source: RENAC

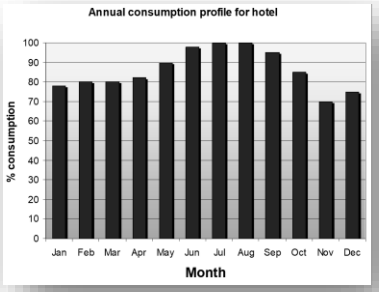
SHIP is no rocket science but requires precise engineering and tailoring

- One ore more points of consumption?
- Central heat supply?
- Energy demand on different temperature levels?
- Different types of energy (Steam, water, air, electricity)?
- Wide ore narrow temperature range?
- …

- Seasonal operation?
- Annual closing period?
- Work on Saturday, Sunday?
- Demand during night?
- Continuous / volatile demand
- Are there peaks in the demand profile?
- …

- Available space for solar installation
- Installation on the roof or on the ground?
- Statics of the roof need strengthening?
- Available space for storage
- Distance between collector field, storage and process
- …

- What is the economic references case i.e. the alternative costs for every MWh_{th}?
- What are the market expectations for the products of the company (external complexity)?
- How heterogeneous is the product structure and how frequently is it changing (internal complexity)?
- …



Source: RENAC, Pixabay

The technical particularities of solar heat need to be accounted for


Conventional Heat

Flexibility for timing of heat provision.

Smaller CAPEX, larger OPEX.

Volatile OPEX (PPP adjusted).


Solar Heat

Fluctuating resource, but storage option.

Larger CAPEX, small OPEX.

Stable OPEX (PPP adjusted).


Solar Photovoltaics (PV)

(Power) quality range limited, standardized product.

(Relatively) flexible to install and sell to other parties if grid and markets allow.


Solar Heat

Process specific heat requirements, system needs to be tailor-made but 3 x more energy.

Solar heat project tied to the technical performance of factory and economic performance of the company (higher offtaker risk).

Source: RENAC

2 Drivers, Barriers and Business Models

Ecologically and economically there is no way around solar heating technology

Solar Payback

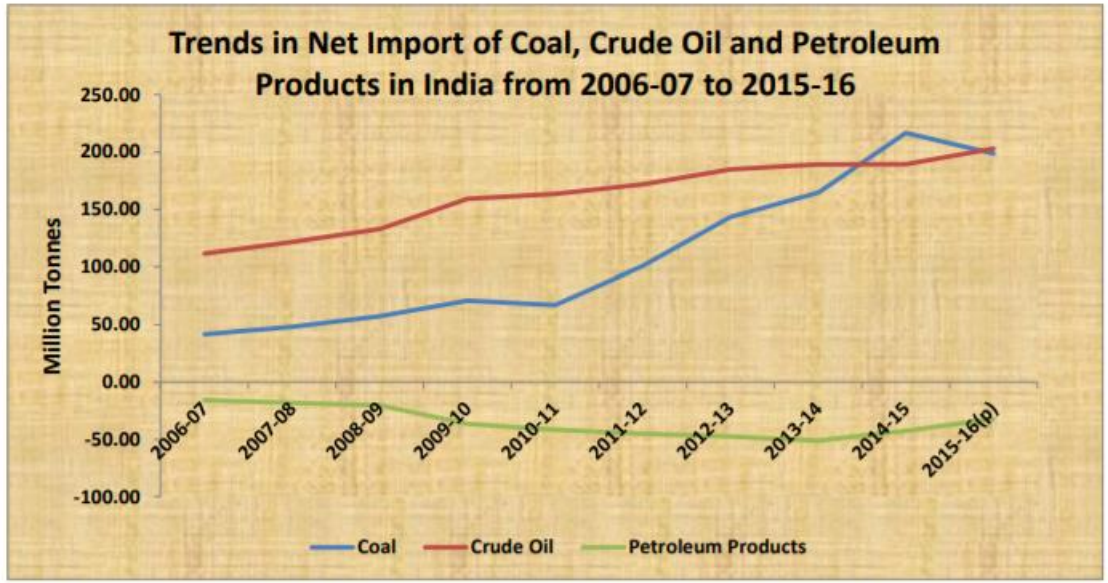
renac renewables academy

Table 2.2 ▷ **Final energy consumption by sector in India in the New Policies Scenario** (Mtoe)

	2000	2013	2020	2030	2040	Shares 2013	Shares 2040	2013-2040 Change	2013-2040 CAAGR*
Industry	83	185	263	417	572	35%	45%	388	4.3%
Transport	32	75	108	176	280	14%	22%	205	5.0%
Road	28	68	100	165	264	13%	21%	196	5.1%
Buildings	158	214	242	274	299	41%	23%	85	1.2%
Agriculture	15	24	31	43	51	5%	4%	27	2.9%
Non-energy use**	27	29	40	58	72	6%	6%	43	3.4%
Total	315	527	686	968					
*Industry, incl. transformation****	111	217	317	507					

* Compound average annual growth rate. ** Includes petrochem lubricants and bitumen). *** Includes energy demand from blast consumption) and petrochemical feedstocks.

4% Annual energy demand growth in industry with heat being the largest share of industrial energy demand



Import of coal tripled and of crude oil doubled in 10 Years

Source: IEA, Ministry of Statistics

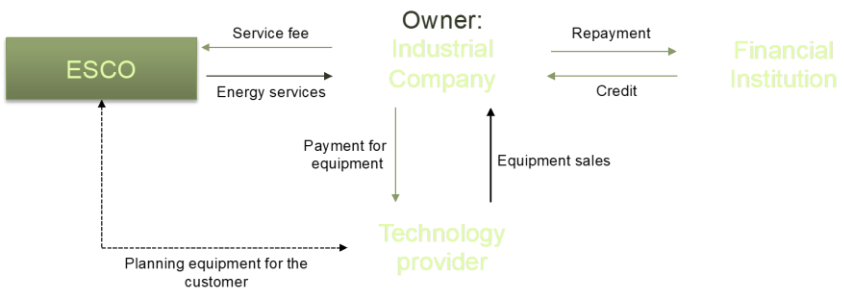
What are the main drivers and barriers of SHIP projects?

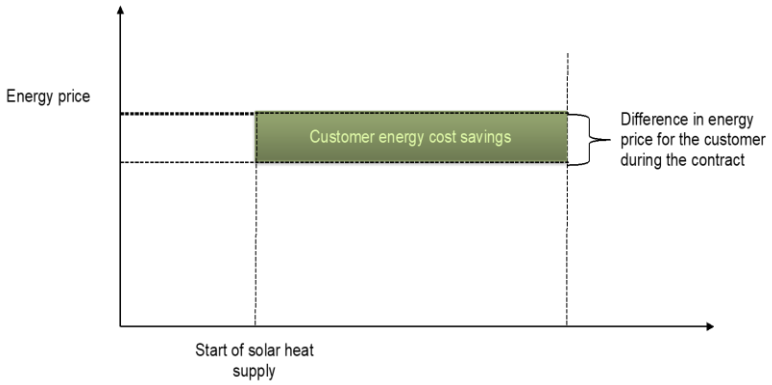
- Elimination of fuel costs
- Risk reduction associated with rising or volatile fuel prices
- Marketing purposes (environmentally-aware customers)
- Reduction of carbon emissions
- Outsourcing of non-core business with contracting-models
- …

- Low energy prices, subsidies for conventional energy
- High expectation on payback period
- Focus on investment instead of life-cycle cost
- Available space for collector field
- Limited knowledge about references costs
- …

Source: RENAC

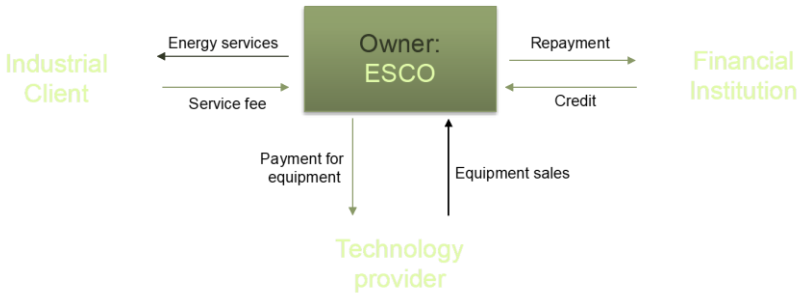
There are two main categories for project structure and contracting

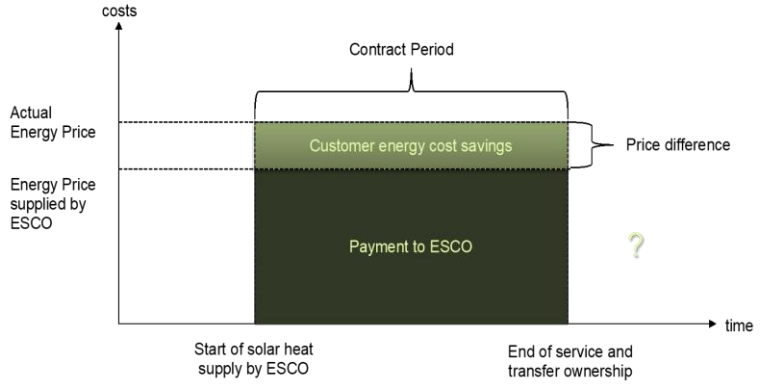




Classic "On the Balance Sheet"

New "Shared Risks"

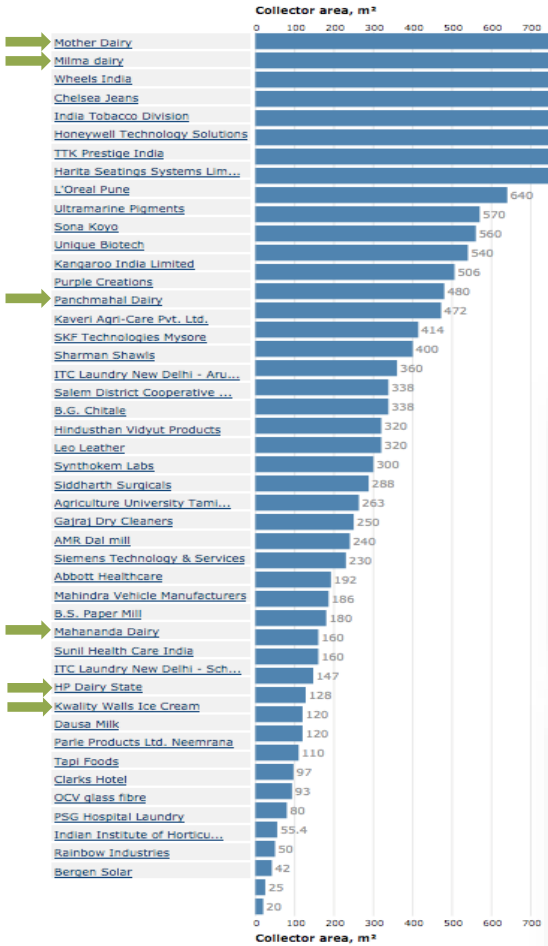




Source: RENAC

3 The Indian Market Prospects

The Indian market provides examples for different regions and sectors



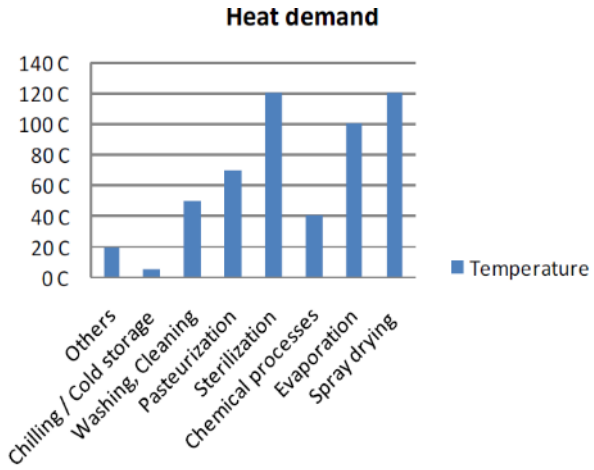
Source: SHIP Plants Info

India has favourable physical and economic conditions for SHIP projects

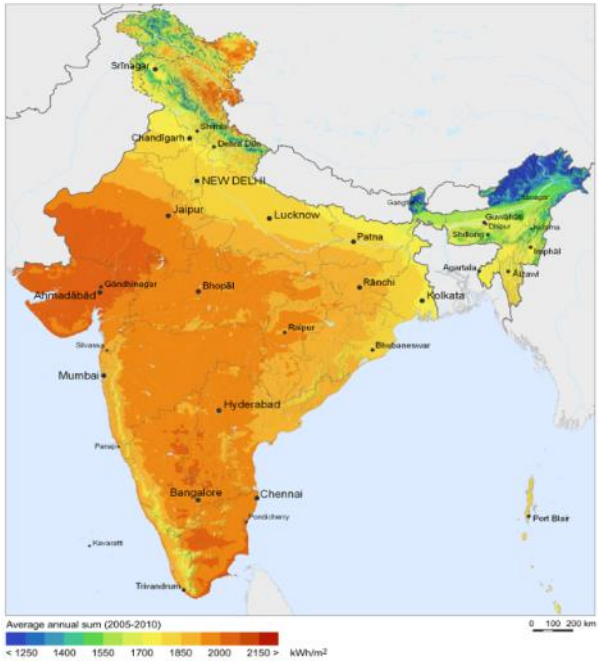




- Large market size (textile/laundry, dairy and food processing account for over 600 billion USD turnover).
- Most thermal applications need less than 150 °C (e.g. scouring, dyeing, pasteurisation, sterilization).



- Substantial solar resources both in terms of Global Horizontal Irradiance (GHI) and Direct Normal Irradiance (DNI)



Source: RENAC, MNRE STFI

Several technical and financial agencies promote SHIP technologies in India

- Solar Thermal Federation of India (STFI)
- Industry organisation
- Members constitute 80% of solar thermal market

- National Institute of Solar Energy (NISE)
- Assists Ministry for New and Renewable Energies (MNRE) in implementation of National Solar Mission (NSM)

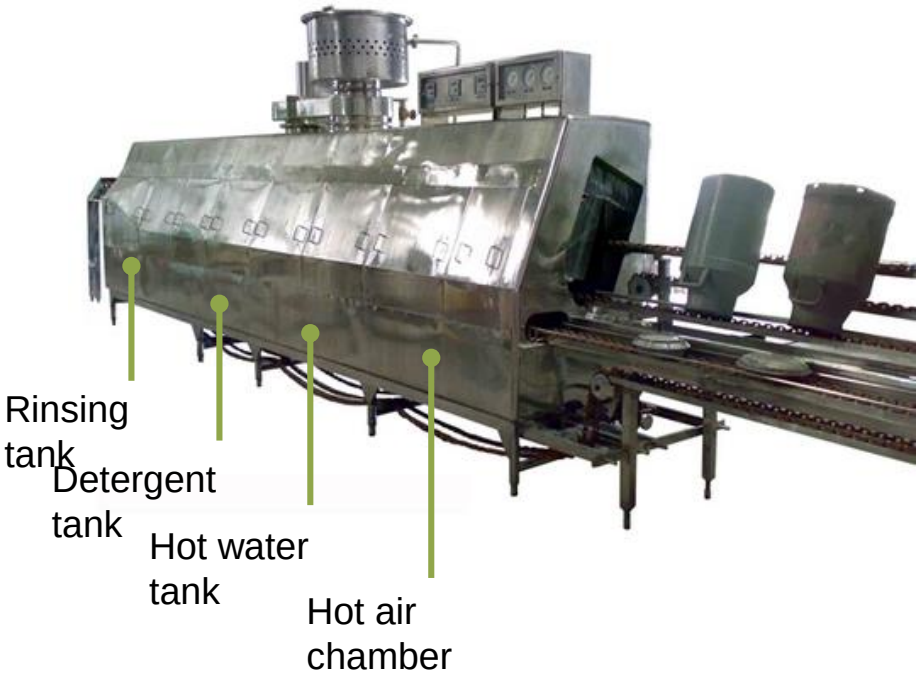
- Indian Renewable Energy Development Agency (IREDA)
- Non-banking financial institution for promoting financing for renewable energies
- CAPEX subsidies for SHIP projects (30%)

- Solar Energy Corporation of India (SECI)
- Central public sector undertaking under MNRE
- Encourage use of SHIP in domestic and industrial sector

Source: Solar Payback

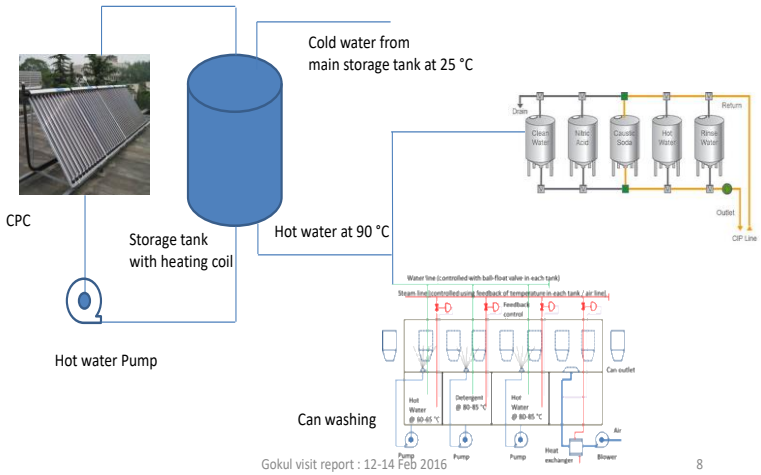
4 Finding the Low Hanging Fruits

Example Application: Dairy Centres, Comp. Parabolic Concentrators (CPC)



- The operating temperature for rinsing tank is about 60-65 °C, detergent tank 80-85 °C, hot water tank 80-85 °C and hot air 110 °C
- The operation of system starts typically at 8.30 am to 1 pm in 1st shift and 6.30 pm to 9.30 pm in 2nd shift

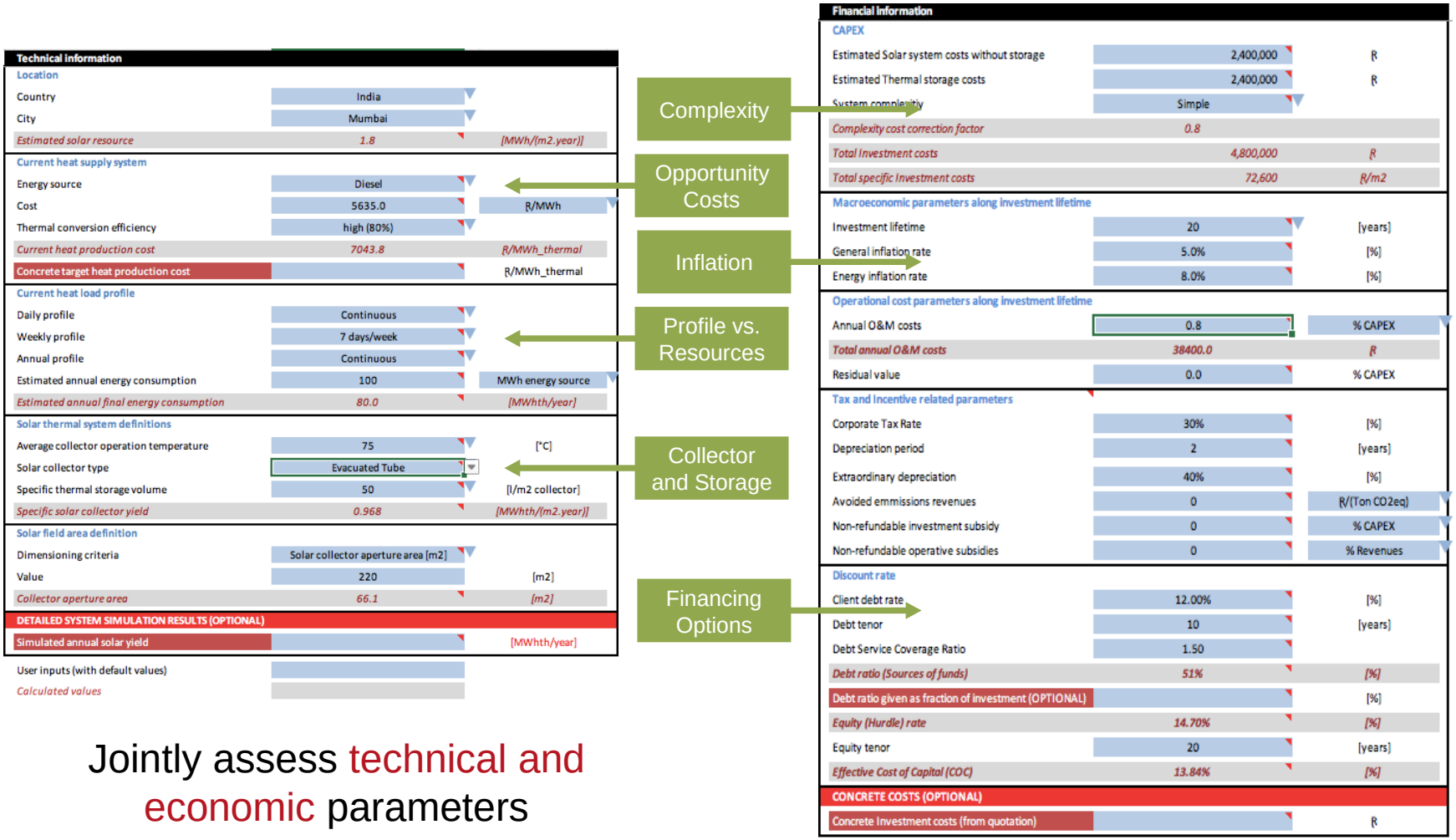
Example Application: Dairy Centres, Comp. Parabolic Concentrators (CPC)



- 220 m^2 collector area
- 4.8 million INR CAPEX
- 6 years payback period
- 80-90 °C Temperature
- 581 $kWh_{thermal}$/day

Source: AHK

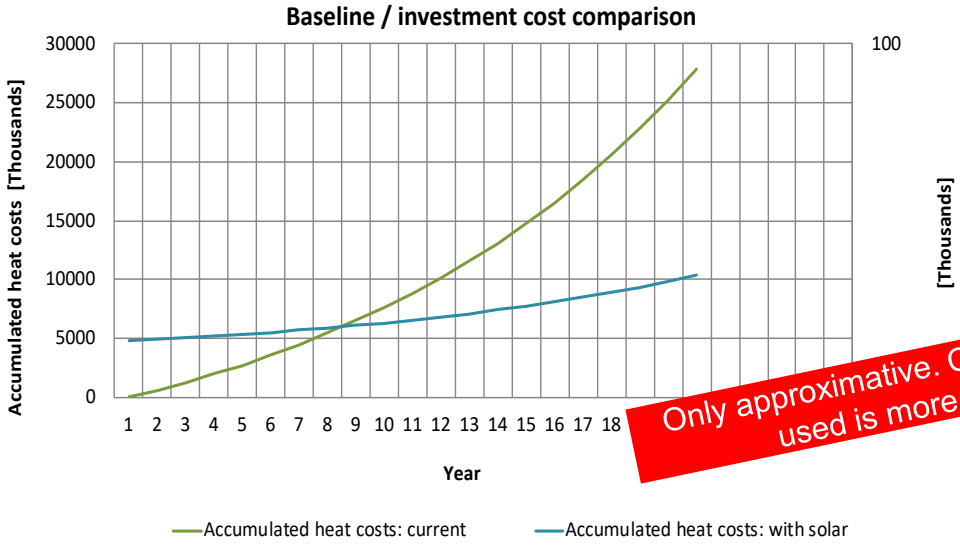
The Economics of SHIP: Lessons learned from Financial Modelling (1)



Jointly assess technical and economic parameters

Source: RENAC

The Economics of SHIP: Lessons learned from Financial Modelling (2)



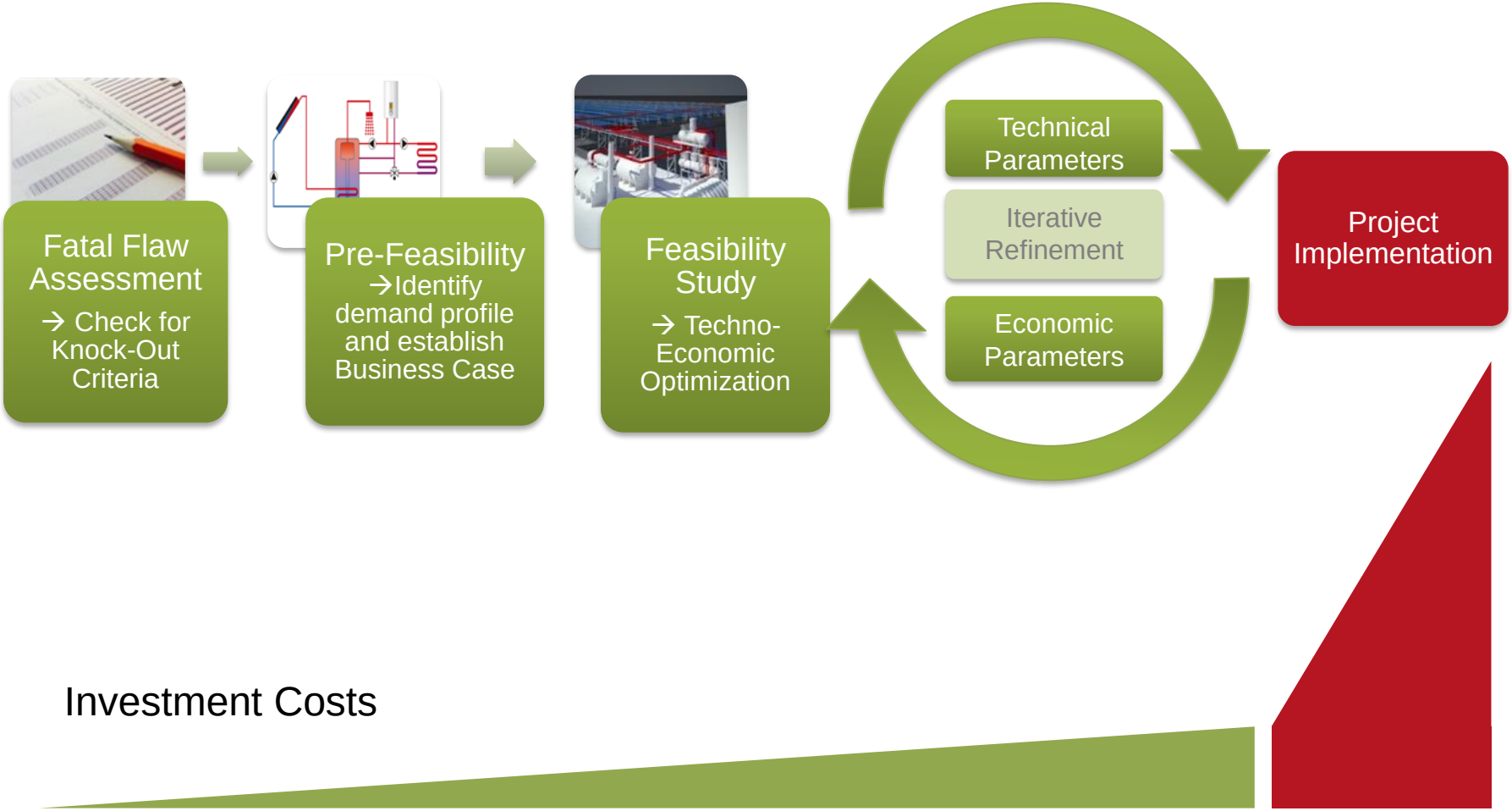
Only approximative. CPC technology used is more efficient

Financial summary			
Total Investment costs	4,800,000		R
Annual O&M costs	38,400		R/year
Investment lifetime	20		[years]
Effective Cost of Capital (CoC)	13.8%		[%]
General inflation rate	5.0%		[%]
Energy inflation rate	8.0%		[%]

Investment Assessment results			
Project IRR	13.0%		[%]
Equity IRR (given Input: 14.7%)	14.7%		[%]
SIMPLE PAYBACK	7		[years]
CURRENT LCOH	12,690		R/MWh_thermal
SOLAR LCOH	13,352		R/MWh_thermal
OPTION Value of fixing the price of heat	830,000		R

Source: RENAC

Use a step-wise structured de-risking approach to identify your business case



Source: RENAC

Aim for simple structures, technologies and processes

REDUCE COMPLEXITY!

- Suitable solar resources (DNI, GHI)
- Low and medium temperature ranges and low pressures
- Large reference LCOH (opportunity costs)
- Remote locations
- Simple production processes
- Offtaker with stable business prospects
- Regular demand profile matching resources
- In house financing + external expertise
- Access to subsidies and support schemes
- …

5 Conclusion

Conclusions

- Heating accounts for the largest share of energy demand from the industry both globally and in India.
- Solar heating technologies can supply heat for many industrial processes and temperature levels (high flexibility).
- Solar heating technologies need more detailed engineering than alternatives fuels both conventional and renewable.
- Bankable and market mature applications should focus on reducing complexity both in terms of technology and project (financing) structure.
- Opportunity costs are one of the most important factors when deciding on a SHIP project.

Thank you!

Carl-Maria Bohny

Suntrace GmbH – www.suntrace.de
carl.bohny@suntrace.de – Tel: +49 40 767 9638-216
on behalf of:

Renewables Academy (RENAC)

Schönhauser Allee 10-11
D-10119 Berlin
Tel: +49 30 52 689 58-71
Fax: +49 30 52 689 58-99
info@renac.de

renac
renewables academy

In cooperation with:

Solar Payback

www.renac.de