Solar heating for industrial processes

- Assessing the potential role for SHIP in meeting energy demands of industry in developing countries.

Options in ECOWAS

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Outline

What is the current status of solar heating in the industrial sector?

How much energy does the industrial sector use for heat?

What is the general technical procedure for installing solar heating in industry?

What are the economic considerations?

Potential applications in ECOWAS.

Introduction – Why pursue solar heat for industry?

1. Demand for heat energy in industrial sector in developing countries

2. Matching appropriate energy source and technology with energy service

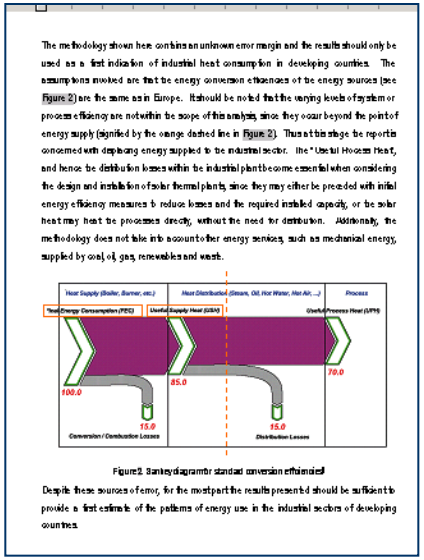
3. Benefits of solar thermal technology may contribute to solving several problems
   - Industrial efficiency and competitiveness
   - Climate change
   - Value addition at the local/decentralised level
   - Niche markets – bio products

4. Niche market for UNIDO to apply its expertise, services and networks

Methodology

Desk study

- Literature review
- Data collection
- Consultation within UNIDO
- Consultation with other partners



The methodology shown here contains an unknown error margin and the results should only be used as a first indication of industrial heat consumption in developing countries. The assumptions invoked are that the energy conversion efficiencies of the energy sources (see Figure 2) are the same as in Europe. It should be noted that the varying levels of system or process efficiency are not within the scope of this analysis, since they occur beyond the point of energy supply (signified by the orange dashed line in Figure 2). Thus at this stage the report is concerned with displacing energy supplied to the industrial sector. The "Useful Process Heat, and hence the distribution losses within the industrial plant become essential when considering the design and installation of solar thermal plants, since they may either be preceded with initial energy efficiency measures to reduce losses and the required installed capacity, or the solar heat may heat the processes directly, without the need for distribution. Additionally, the methodology does not take into account other energy services, such as mechanical energy, supplied by coal, oil, gas, renewables and waste.

Figure2. Sankeydiagramfor standard conversion efficiencies

Despite these sources of error, for the most part the results presented should be sufficient to provide a first estimate of the patterns of energy use in the industrial sectors of developing countries.

			Coal				
			Coking coal	Other Bit. Coal	Sub-Bit. Coal	Lignite	Peat
Non-OECD		**Textile and Leather**	**3,198**	**450,523**	-	**25,106**	-
		Industry - Textile and Leather [% of Ind.]	***0%***	***4%***	***0%***	***5%***	***0%***
		Industry - Machinery [Unit]	533	11,101	-	8	2
		Machinery	**####**	**264,925**	-	**139**	**32**
		Industry - Machinery [% of Ind.]	**2%**	**2%**	**0%**	**0%**	**5%**
		Industry - Chemical and Petroleum [Unit]	2,356	47,798	83	1,490	
		Industry - Chemical and Petroleum [TJ]	**####**	**######**	**1,714**	**####**	**16**
		Industry - Chemical and Petroleum [% of Ind.]	**8%**	**10%**	**2%**	**9%**	**2%**
		Domestic Supply					
		Final Consumption [Unit]	841	107,396	18,019	14,369	1,763
		Final Consumption [TJ]	**####**	**######**	**####**	**####**	**###**
		Industry - Total [Unit]	521	89,175	13,997	7,209	1,073
		Industry - Total [TJ]	**####**	**2,128,161**	**####**	**####**	**###**
		Industry - Total [% of Fin. Cons.]	63%	83%	78%	50%	61%
		Industry - Food and Tobacco [Unit]	70	6512	3027	963	4
		Industry - Food and Tobacco [TJ]	**1,671**	**155,409**	**####**	**16,790**	**736**
		Industry - Food and Tobacco [% of Ind.]					
		Industry - Textile and Leather [Unit]	0	645	105	36	
		Industry - Textile and Leather [TJ]	-	**15,393**	**2,168**	**628**	-
		Industry - Textile and Leather [% of Ind.]					
		Industry - Machinery [Unit]	-	558	98	66	-
		Industry - Machinery [TJ]	-	**13,317**	**2,024**	**1,151**	-
		Industry - Machinery [% of Ind.]					
		Industry - Chemical and Petroleum [Unit]					

Current applications

99.97%

Source: Aspen Core

Residential Sector

Domestic hot water
Swimming pools

164,000,000 m²
115,000 MW_{th}

0.03%

Source: IEA

Industrial Sector

Process heating
Space heating

33,991 m²
24 MW_{th}

Question:

How much heat does the industrial sector use?

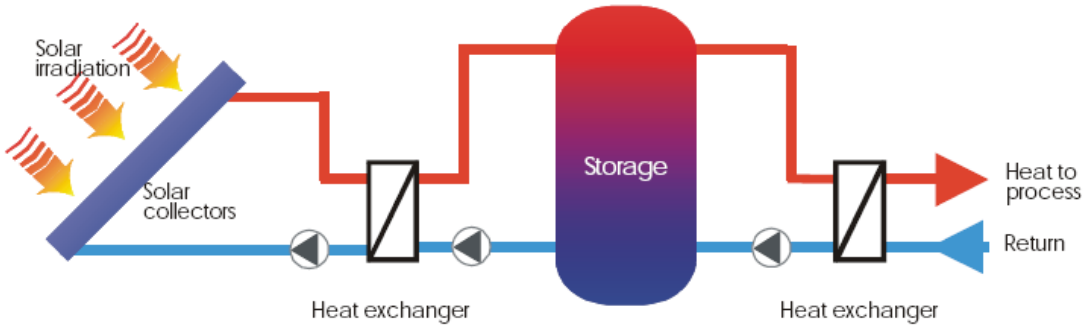
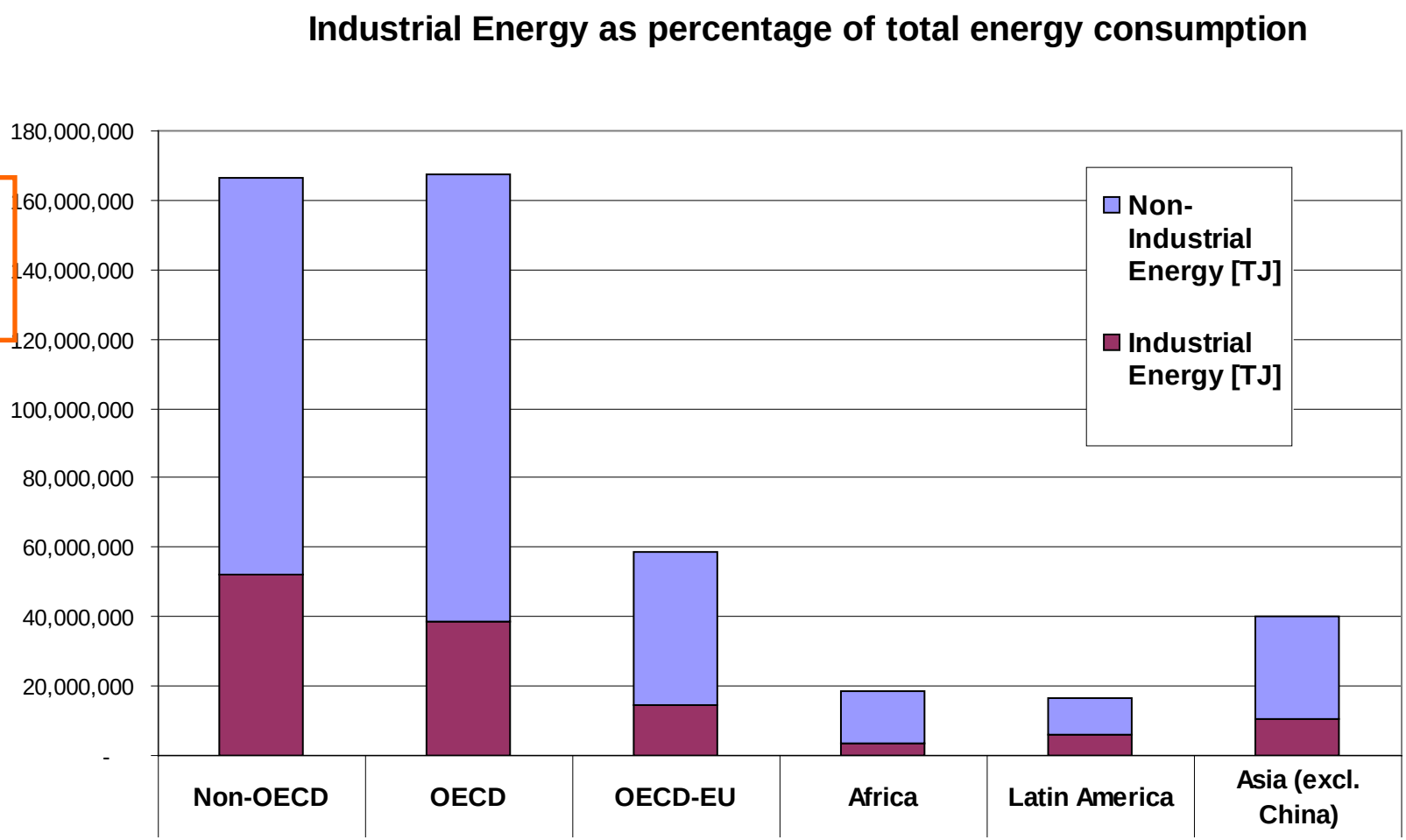


Figure 9. Solar system with heat storage.

Source: POSHIP

Industrial Energy consumption

- National Energy
- Indust. Energy
- Heat Energy
- Low temp. Energy



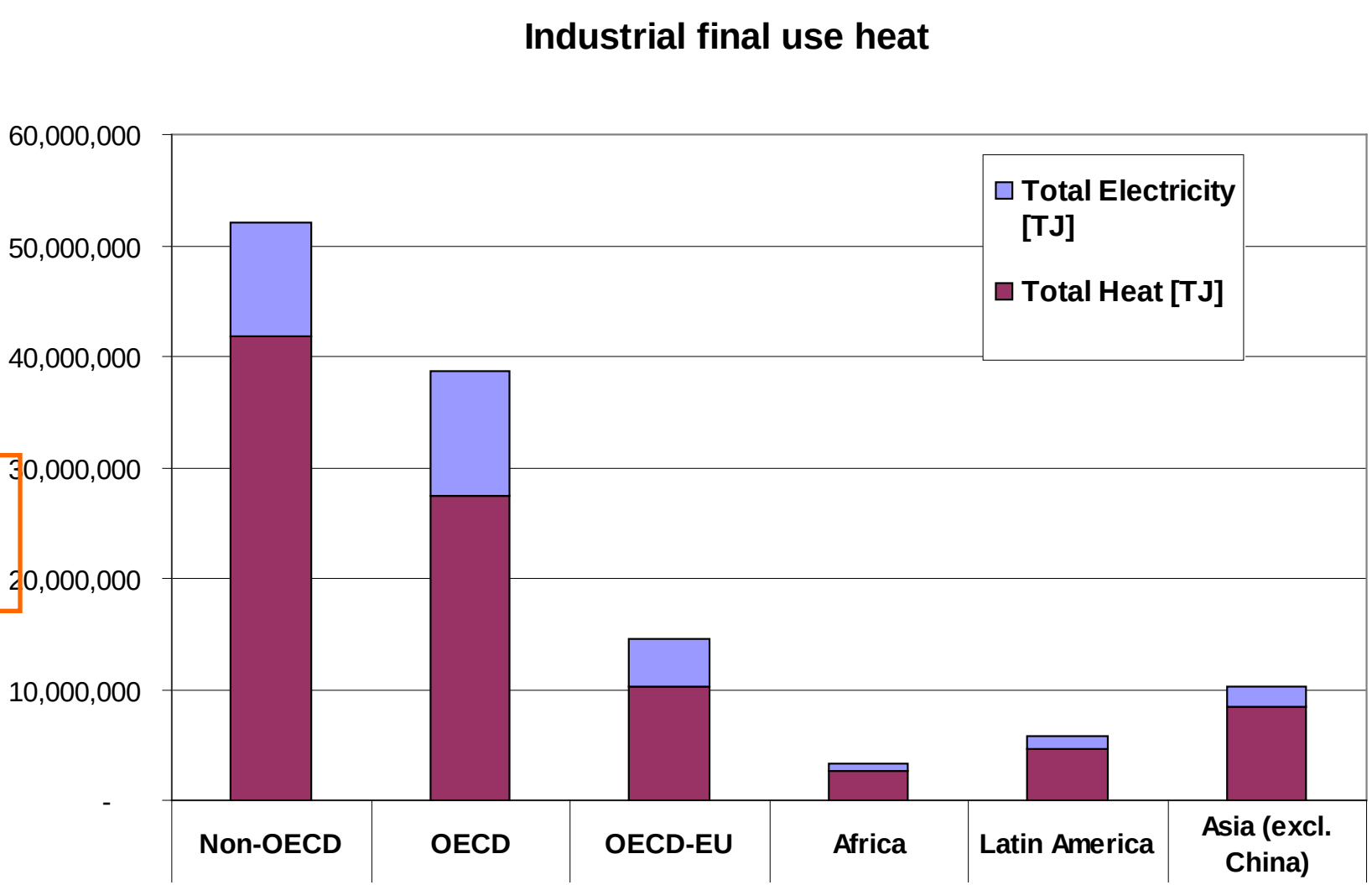
Industrial sector heat consumption

National Energy

Indust. Energy

Heat Energy

Low temp. Energy



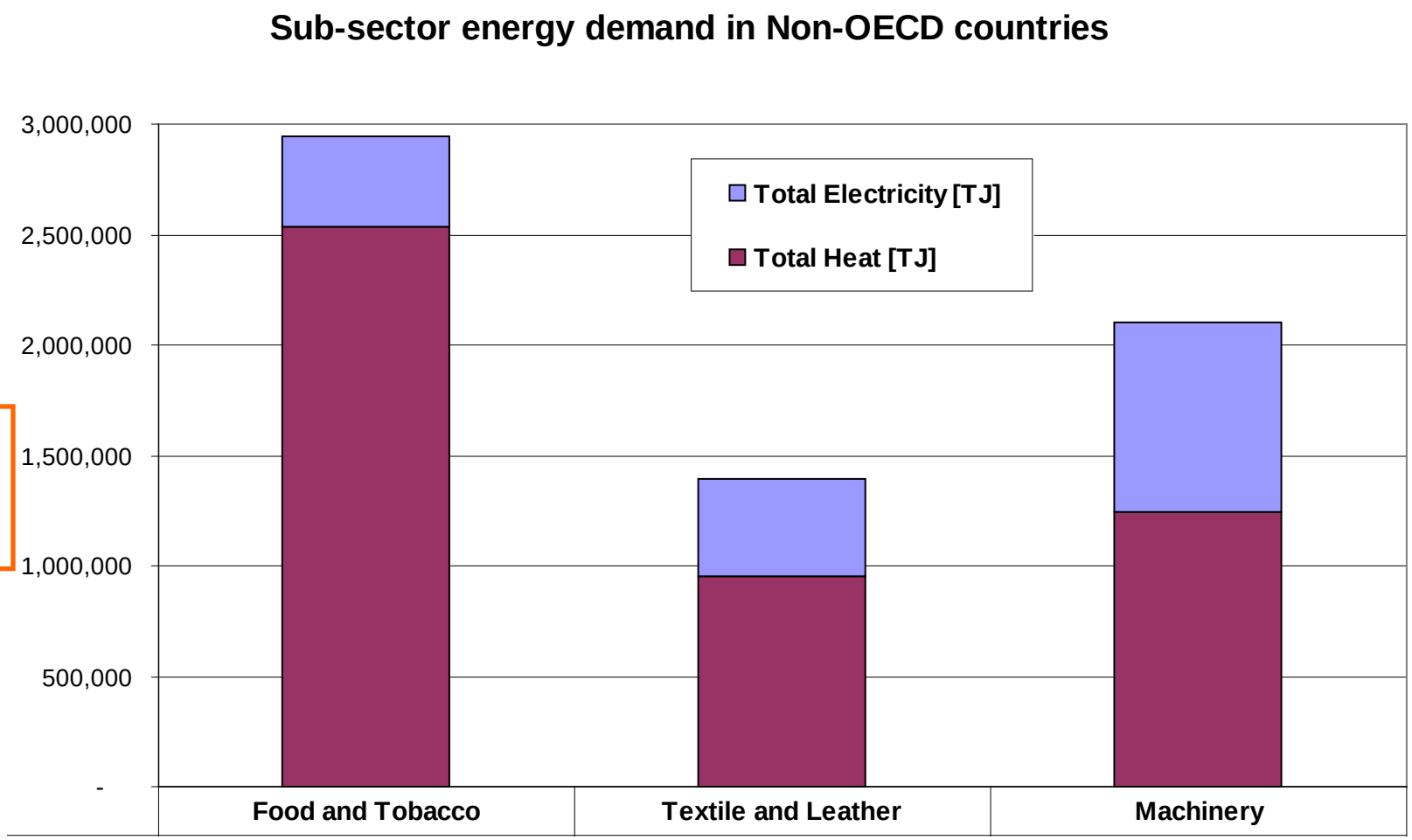
Industrial Sub-sector Energy Consumption

National Energy

Indust. Energy

Heat Energy

Low temp. Energy



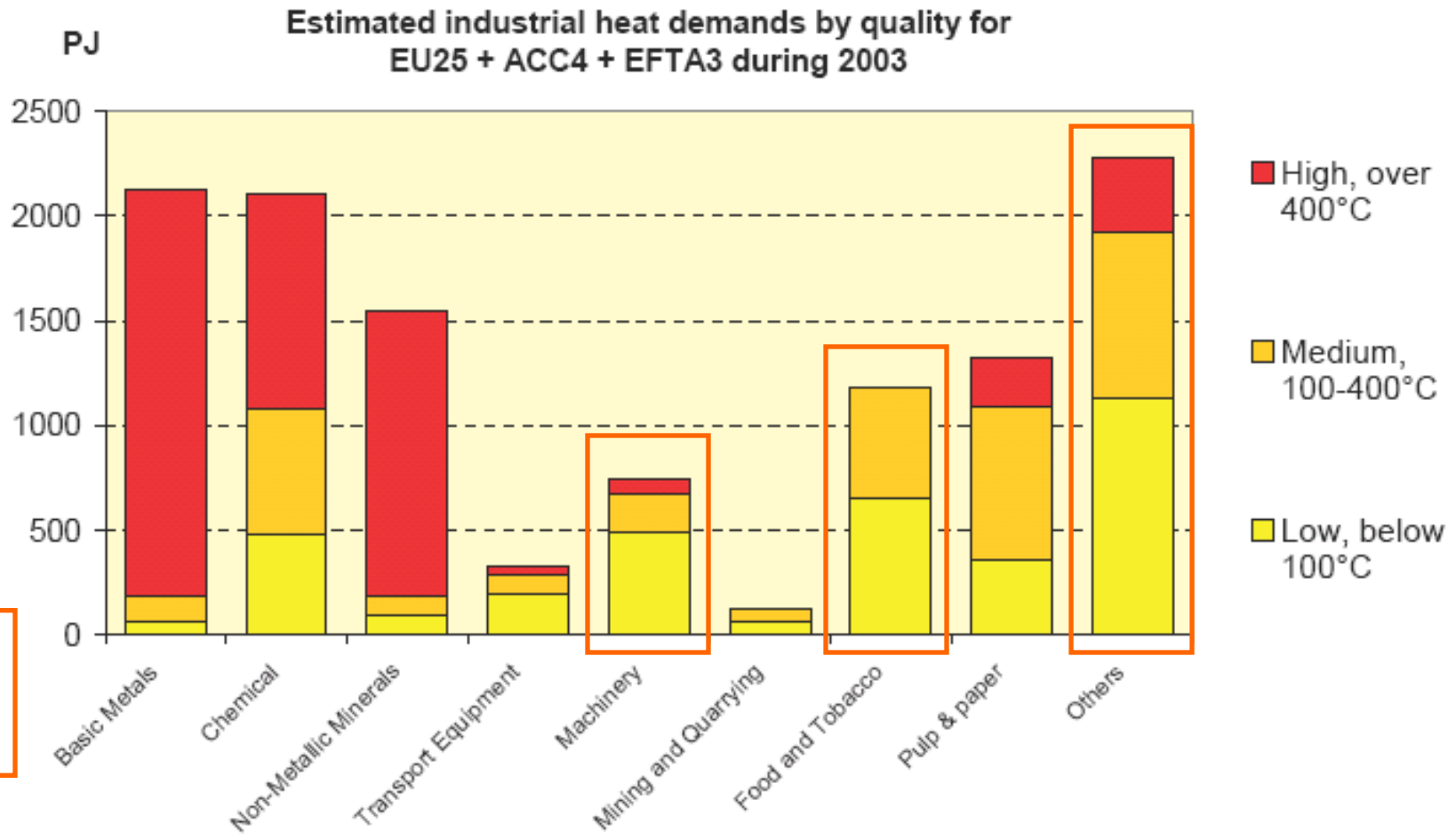
Sub-sector low temperature heat demand

National Energy

Indust. Energy

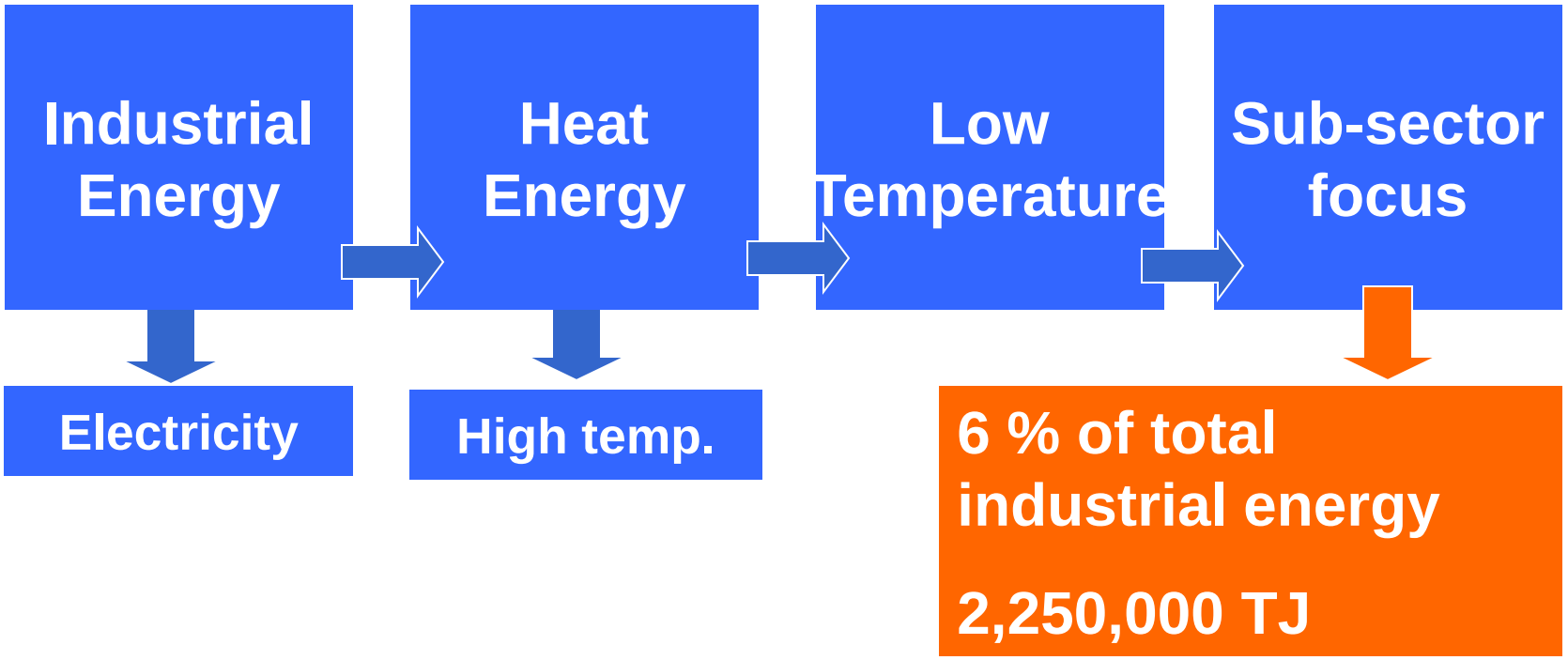
Heat Energy

Low temp. Energy

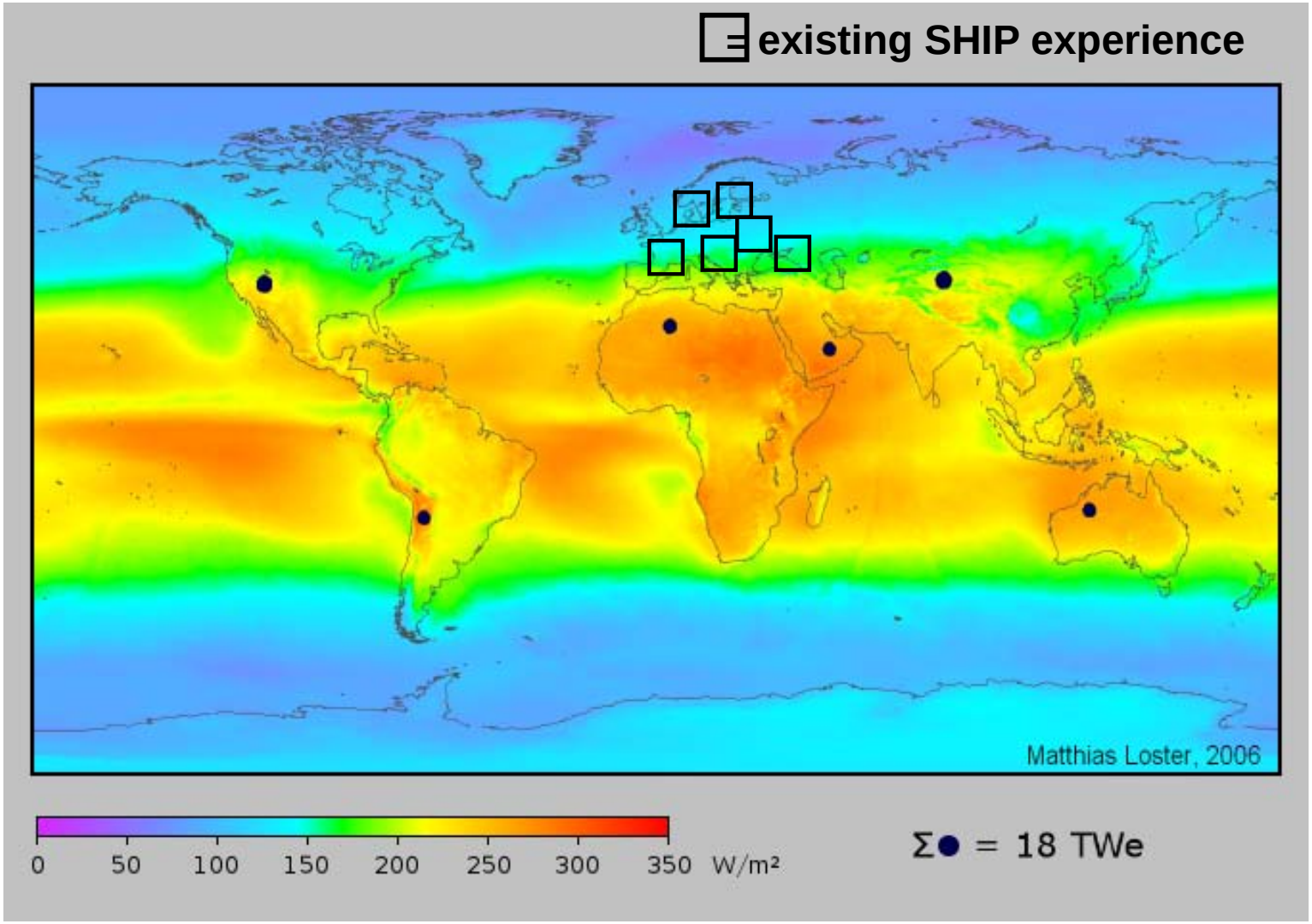


Source: The European Heat Market, EcoHeatCool Working Package 1, 2006

…the potential in Non-OECD countries?



Distribution of solar resources



Procedure for Industrial Solar Heat Integration

Energy efficiency

1. Conduct energy analysis
2. Energy efficiency measures
3. Heat recovery measures

…then

4. Technical design
5. System integration

Solar thermal energy

Economic Considerations

Cost-effectiveness

= *f* (Climate, Cost of conventional energy, Demand profile)

0.04 – 0.12 €/kWh, payback period of 4 – 12 years **in Iberian Penninsula**

Economic impact

= *f* (Cost-effectiveness, Industry energy intensity, Industry contribution to GDP)

1 new job for every 100 m² installed over the next 10 years.

Solar heating for industrial processes – Opportunities in ECOWAS.

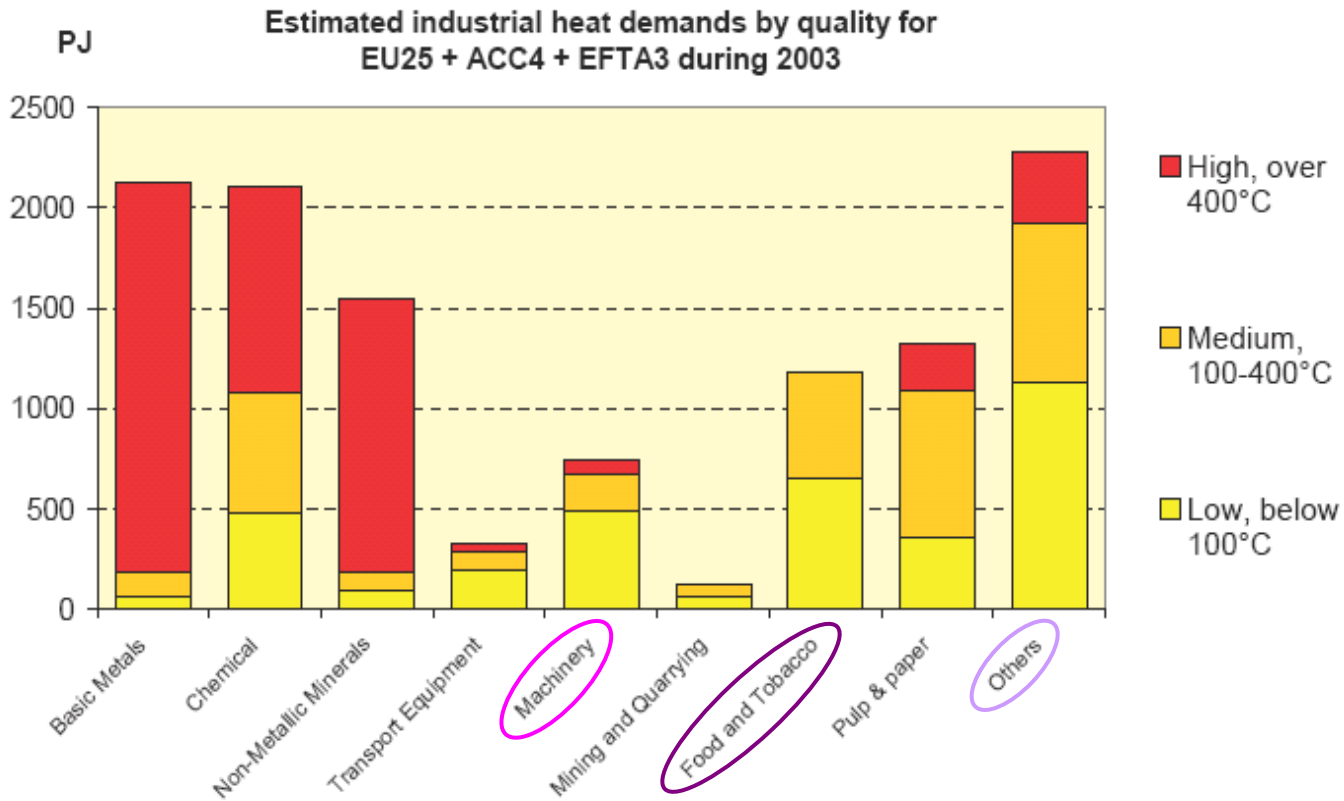
1. SHIP in Agro-industries.

2. CDM/JI – Methodologies for industrial sub-sectors

3. South-South cooperation – technology transfer

4. GEF – UNIDO Comparative Advantage

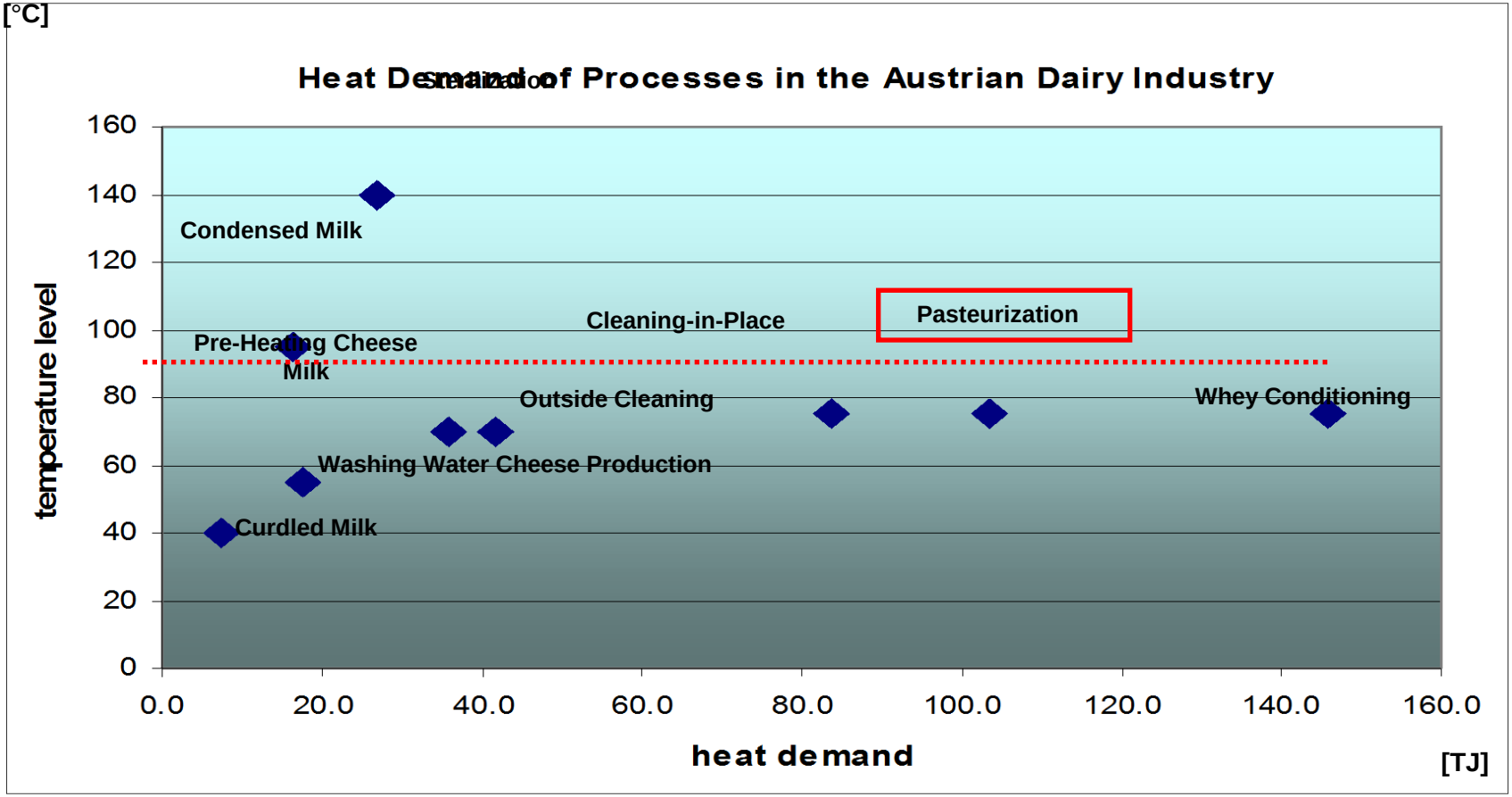
1. Agro-processing



Industrial heat demands by temperature quality and by manufacturing branch

Source: The European Heat Market, EcoHeatCool Working Package 1, 2006

1. Agro-processing



Heat demand and temperature levels of processes in Austrian DAIRY Sector

Source: Joanneum Research Forschungsgesellschaft mbH, Graz, Austria

2. CDM/JI – Methodologies for industrial sub-sectors?

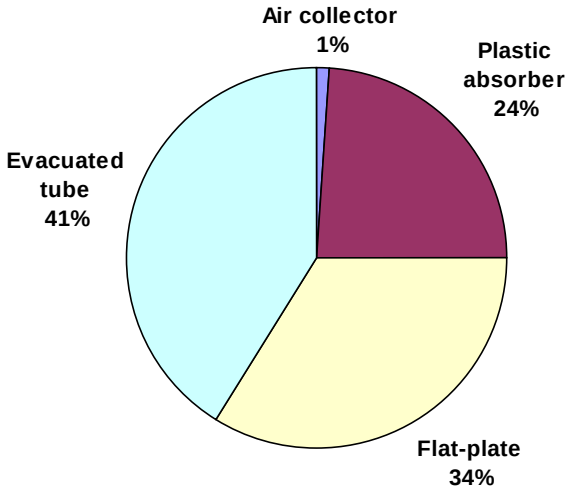
- Demonstrated interest in SHIP and CDM for industry.

- UNIDO's experience can be applied in developing methodologies for specific sub-sectors.

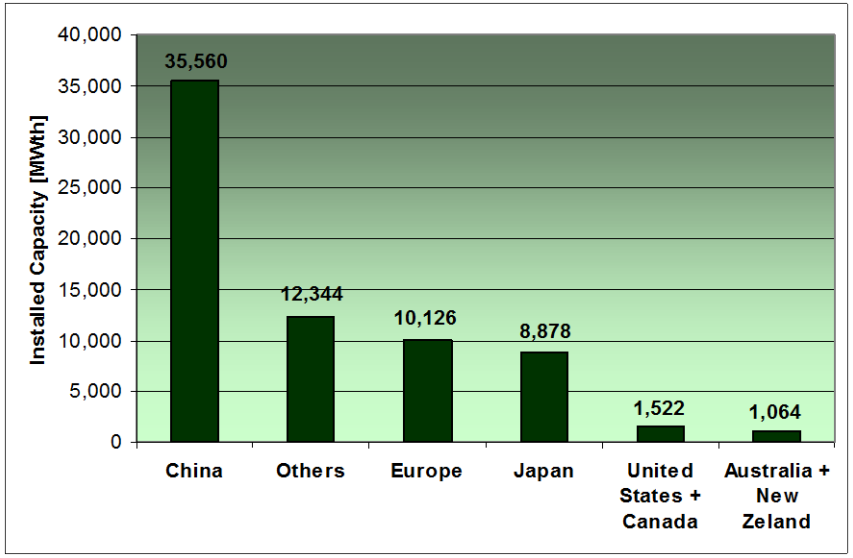
3. South-South / North-South Cooperation

CHINA is the biggest market and producers of solar thermal technology in the world and there is demand in Africa.

Demonstration projects, local manufacture & quality assurance, targeted research.



Distribution of the installed capacity by collector type



Glazed flat plate and evacuated tube collectors in operation in 2003 by economic region

Source: SOLAR HEATING WORLWIDE - Markets and contribution to the energy supply 2003

4. SHIP in GEF – UNIDO's Comparative Advantage

Adaptation ?

Climate Change

Industrial Energy Efficiency

- Industrial process heat efficiency
- Solar heat for hot water preparation
- Solar heat for direct process heat
- Solar heat for direct drying
- Solar heat for cooling & refrigeration

RE for Rural Energy Service

- Solar heat for small cottage industries (hot water preparation and direct drying).
- Our **trusted** solar dryers
- Others..

SHIP :Environmental, Social and Technological synergies

Technology

Solar hot water heating technology is a robust and well understood technology. NOT “complicated”. Easy assembling and production of some components.

Social

Employment and business creation.

Environmental

Developing countries – cottage industries and small facilities using biomass for water heating and drying processes

UNITED NATIONS
INDUSTRIAL DEVELOPMENT
ORGANIZATION

THANK YOU

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