



## Dissemination of Innovative Solar Thermal Applications in the Tunisian Industry (DASTII)

# Results of Prefeasibility Studies for Solar Heat in Industrial Processes (SHIP) in Tunisia

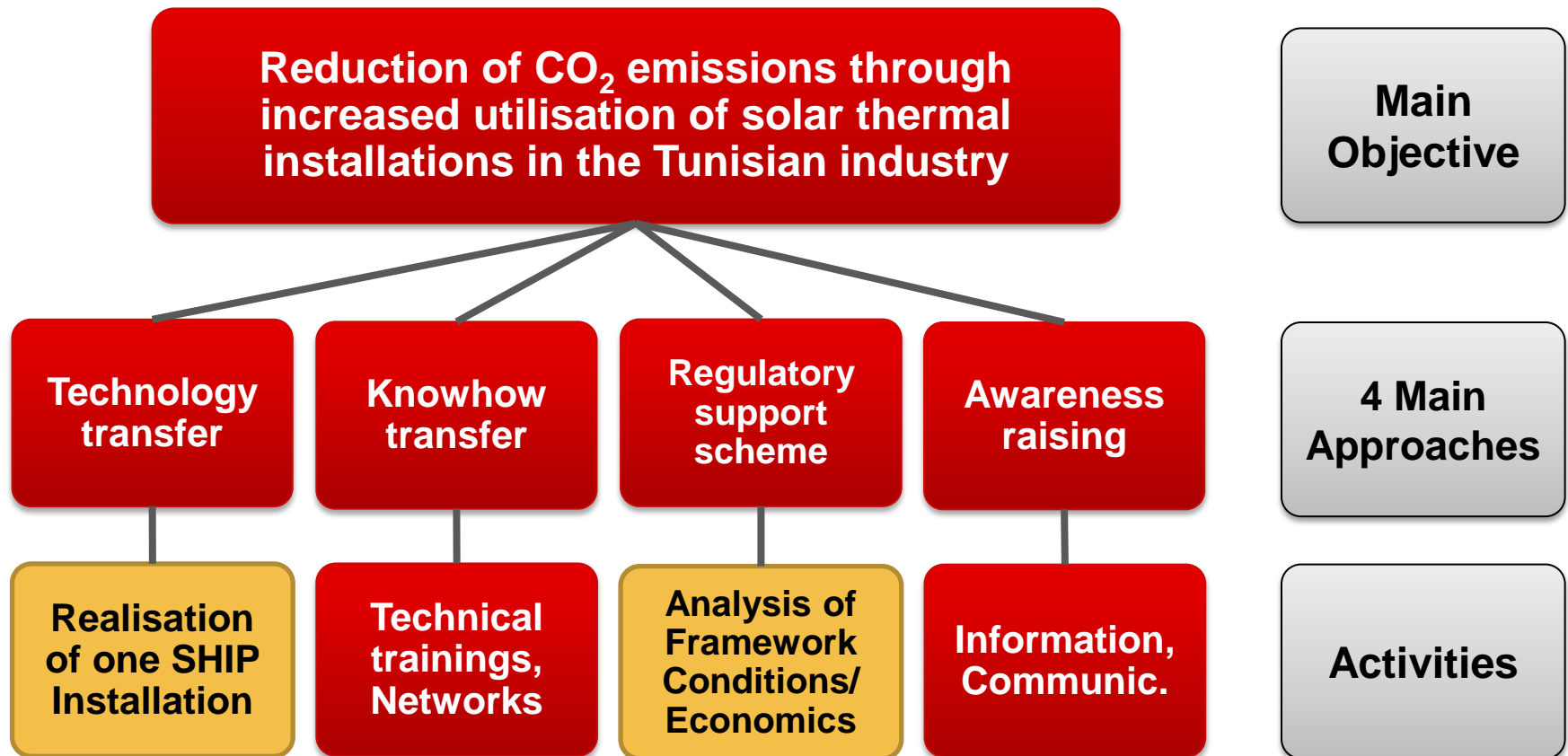


Kick-off Opportunity Study

26.09.2014



# The DASTII Project





# SHIP Installation Project

- Realisation of a SHIP installation in a Tunisian industrial company
- **Objectif: Fuel Savings equivalent to 250 t CO<sub>2</sub> / year**
- Utilisation of a concentrating collector technology at medium temperature level (> 150°C)
- Potential branches: Food, Beverage, Textile, Chemicals, others





## Selection process of industry partner for SHIP Project

1. Preselection	<ul style="list-style-type: none"><li>• Preselection of 20 industrial companies based on prior analysis (Potential Study)</li><li>• Representation of most relevant branches (Food, Textile, Chemical, Brick)</li></ul>
2. Site Visits	<ul style="list-style-type: none"><li>• Verification of site conditions, level of interest</li><li>• Collection of technical data via questionnaires</li></ul> → Selection of 5 most favorable candidates
3. Energy Audits	<ul style="list-style-type: none"><li>• Thermal energy measurements on site</li><li>• Set-up of daily and annual <b>energy demand profile</b></li></ul>
<b>4. Prefeasibility Study</b>	Techno-economic assessment of SPH integration on 5 sites
5. Feasibility Study	Selection of industry partner through detailed study



## Prefeasibility Study - Assumptions

- Solar plant must save gas/ fuel oil equivalent to 250 t CO<sub>2</sub>/ year
- Payback Period for company/client: 5 years
- Use of a concentrating collector technology

Technical Assumptions	
Collector	Fresnel
Optical efficiency	0,635
Degradation (%)	0,5
Life Time (a)	20
O&M costs/ Inv. Costs (%)	1
Specific Costs (€/m <sup>2</sup> )	550

Financial Assumptions	
Equity Share	80%
Debt Share	20%
Cost of Equity	14%
Cost of Debt	8%

Energy Prices	
Nat. Gas Cost [€ct/kWh]	1,76*
Fuel Oil Cost [€ct/kWh]	2,5*
Energy Price Increase per year [%/a]	10%

Solar Irradiation	
DNI (kWh/m <sup>2</sup> /a)	1850 (North) 2000 (Center)

→ 17 ct/kWh after 20 years

\* Current Tunisian energy prices incl.VAT (09/2014) plus 10% (assumed energy price increase in 2015)



# 1. Food Production Company

**Sector:** Food Industry

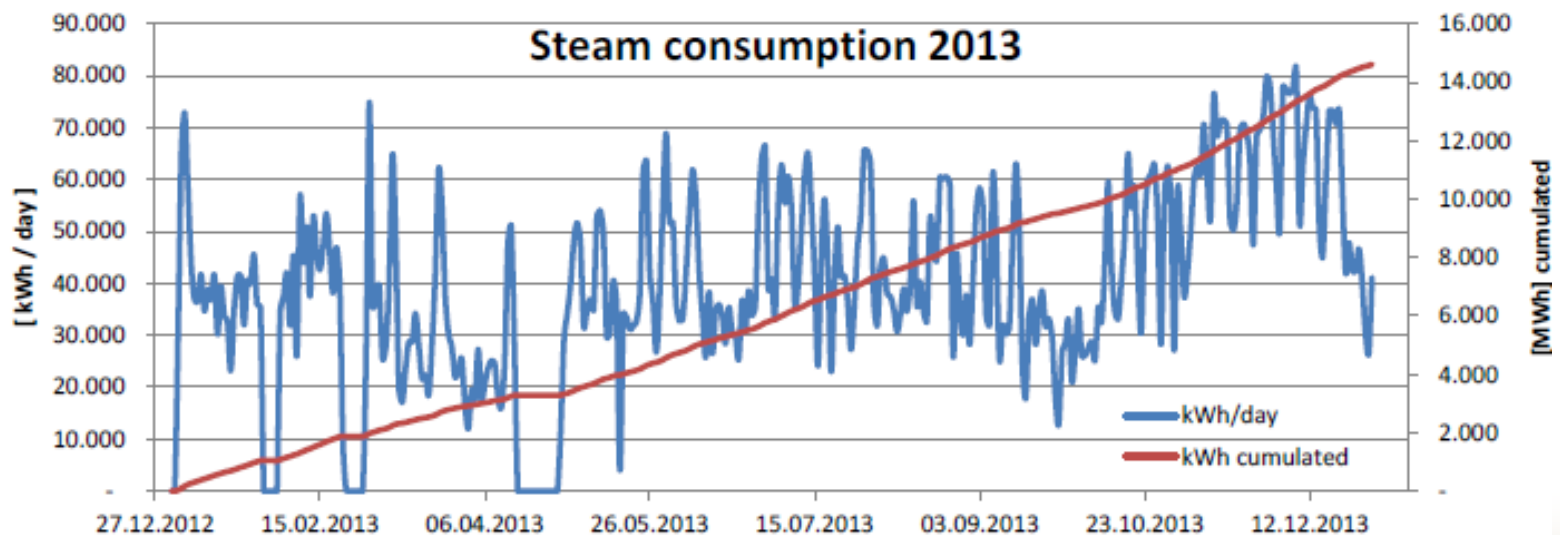
**Location:** North Tunisia

**Heat source:** Fuel Oil

**Heat supply:** Steam at 180°C

**Processes:** Drying (110°C), Sterilisation (130°C)

**Energy Profile:** 24h/d, 7 d/w., 339 d/a  
**Energy demand:** High, fairly constant





# 1. Food company - Results

**For CO2 reduction of 250 t/a:**

**Solar Field Size: 1.250 m<sup>2</sup>**

**System Utilisation: 34%**

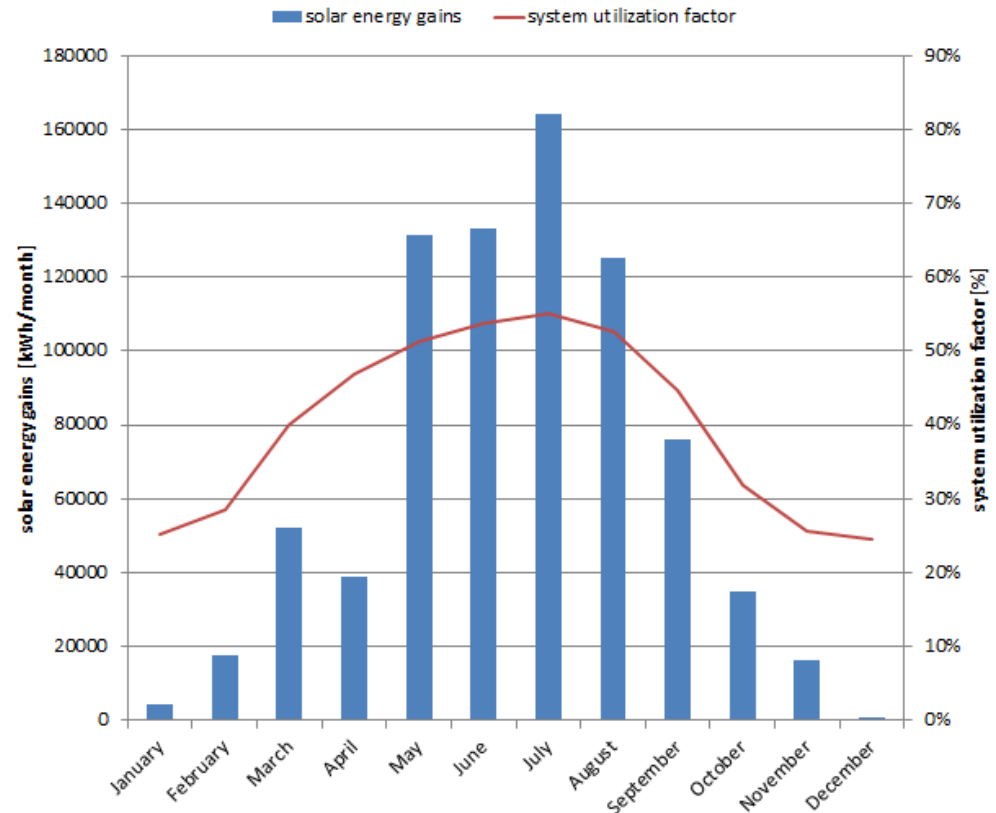
**Solar Fraction: 5%**

**Total Investment: 740.000 €**

**Payback Period: 18 years**

**Required Subsidy (PBP = 5 y): 88%**

**Solar Energy Gains & System Utilization Factor**





## 2. Textile Company

**Sector:** Textile industry

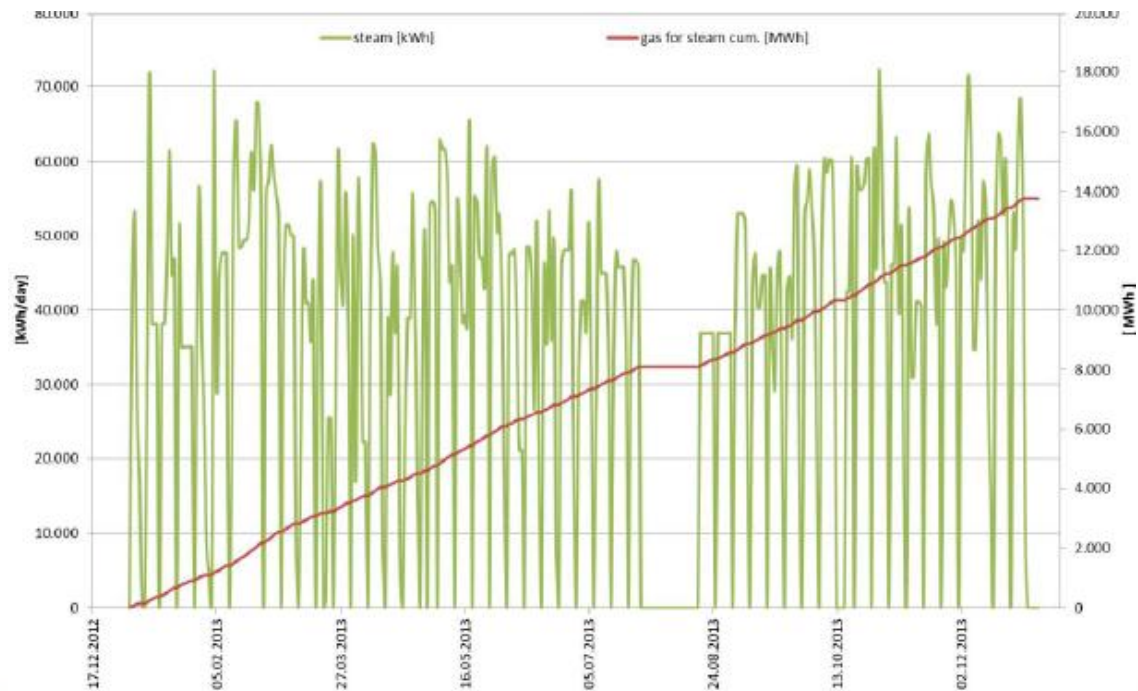
**Location:** North Tunisia

**Heating source:** Natural Gas

**Heat supply:** Steam at 165°C

**Processes:** Washing (90°C),  
Whitening (90°C), Dyeing (90°C)

**Energy Profile:** 16h, 6 d/w., 283 d/a  
**Energy demand:** Medium, fluctuating







## 2. Textile company - Results

**For CO2 reduction of 250 t/a:**

**Solar Field Size: 1.850 m<sup>2</sup>**

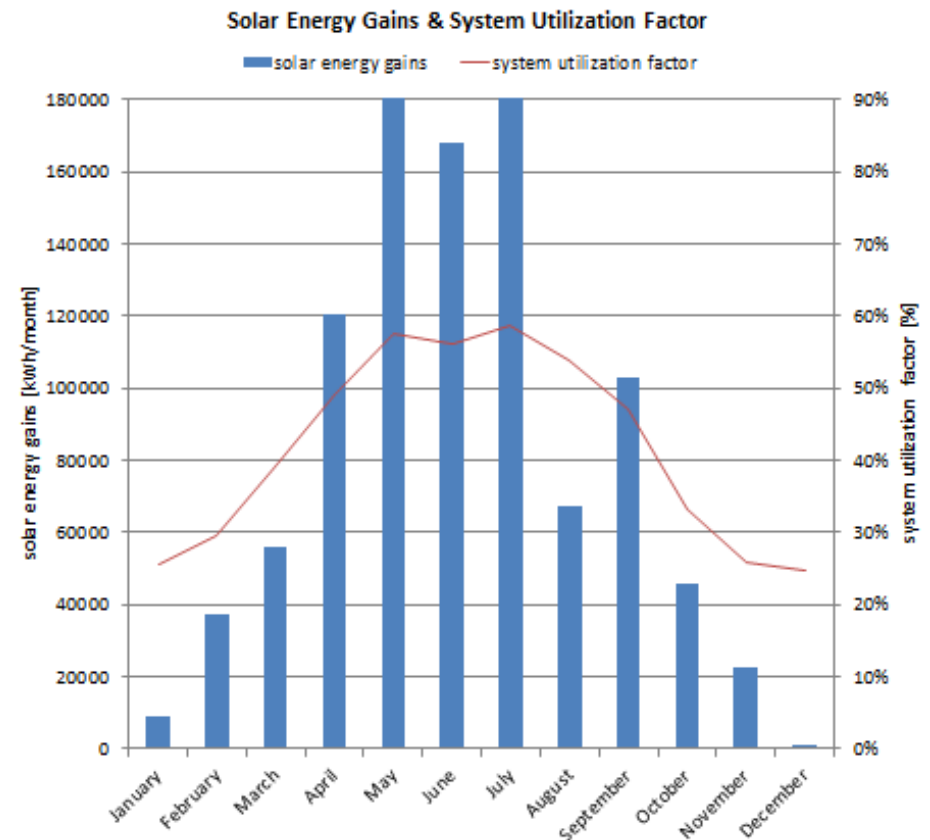
**System Utilisation: 29%**

**Solar Fraction: 10%**

**Total Investment: 1.070.000 €**

**Payback Period: 22 years**

**Required Subsidy (PBP = 5 y): 92%**





### 3. Tobacco Company

**Sector:** Tobacco production

**Location:** Central Tunisia

**Heating source:** Heavy Fuel

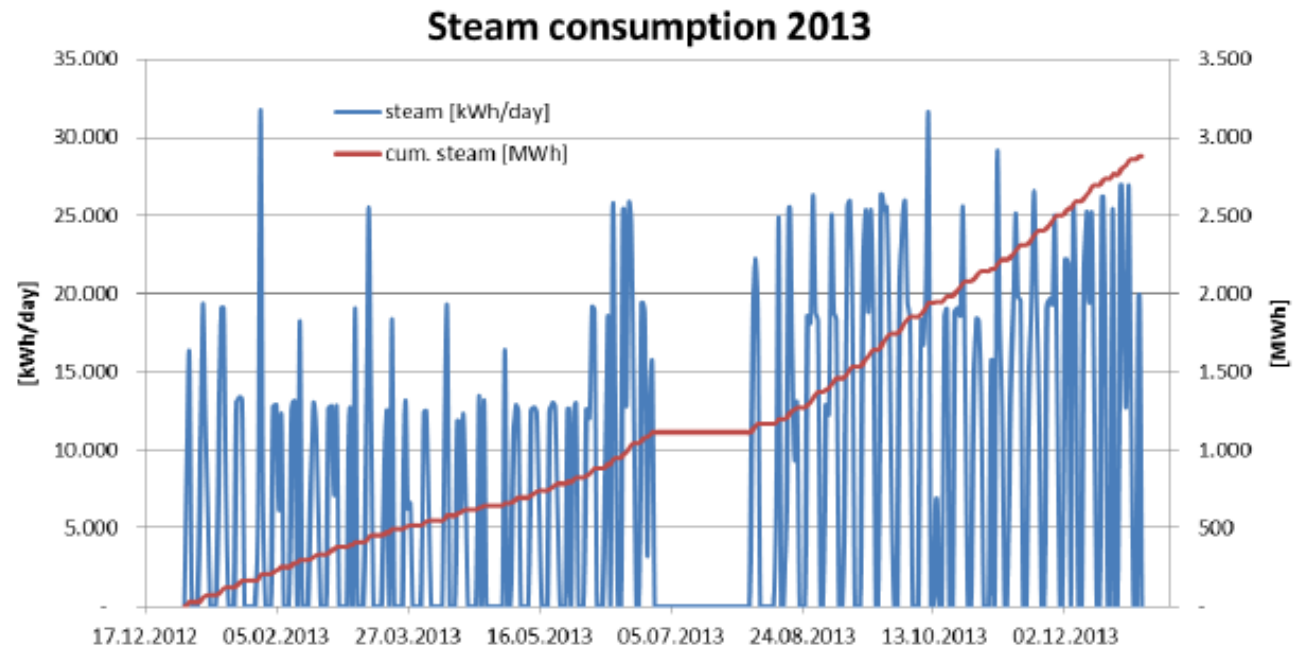
**Heat supply:** Steam at 180°C

**Processes:** Humidification (90°C),  
Drying (90°C)

**Production Profile:** 10h, 5 d/w., 178 d/a

**Daily profile:** 5 a.m. – 14:30 p.m.

**Energy demand:** Low, highly fluctuating





### 3. Tobacco company - Results

For CO<sub>2</sub> reduction of 250 t/a:

**Solar Field Size:** 3.150 m<sup>2</sup>

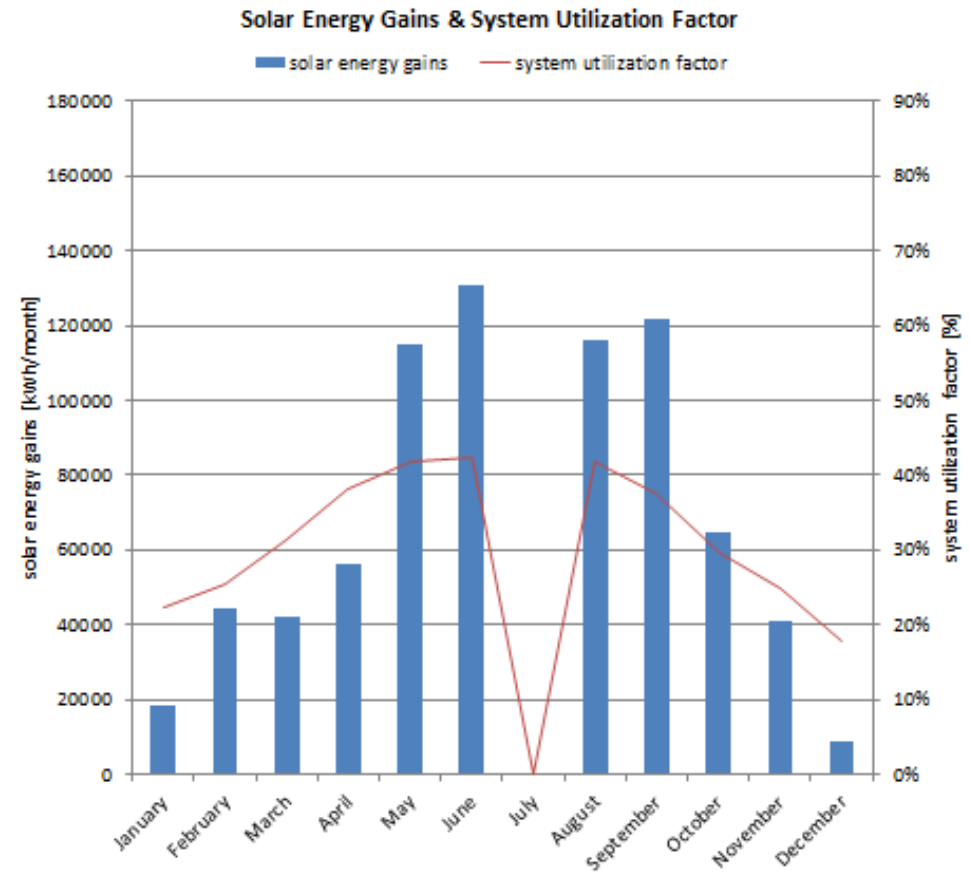
**System Utilisation:** 12%

**Solar Fraction:** 25%

**Total Investment:** 1.780.000 €

**Payback Period:** 27 years

**Required Subsidy (PBP = 5 y):** 94%





## Expected results of the opportunity study

- Details on current SHIP system costs and cost distribution
- Influence of collector technology, integration method, application (energy profile), storage on economics → Simulation
- Identification of potential market niches
- Definition of minimum framework conditions for market development



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