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

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

The DASTII Project

Reduction of CO₂ emissions through increased utilisation of solar thermal installations in the Tunisian industry

- Technology transfer
  - Realisation of one SHIP Installation
- Knowhow transfer
  - Technical trainings, Networks
- Regulatory support scheme
  - Analysis of Framework Conditions/Economics
- Awareness raising
  - Information, Communic.
SHIP Installation Project

- Realisation of a SHIP installation in a Tunisian industrial company
- Objectif: Fuel Savings equivalent to 250 t CO2 / year
- Utilisation of a concentrating collector technology at medium temperature level (> 150°C)
- Potential branches: Food, Beverage, Textile, Chemics, others
**Selection process of industry partner for SHIP Project**

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<tbody>
<tr>
<td>1. Preselection</td>
<td>• Preselection of 20 industrial companies based on prior analysis (Potential Study)&lt;br&gt;• Representation of most relevant branches (Food, Textile, Chemical, Brick)</td>
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<tr>
<td>2. Site Visits</td>
<td>• Verification of site conditions, level of interest&lt;br&gt;• Collection of technical data via questionnaires&lt;br&gt;→ Selection of 5 most favorable candidates</td>
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<td>3. Energy Audits</td>
<td>• Thermal energy measurements on site&lt;br&gt;• Set-up of daily and annual energy demand profile</td>
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<td>4. Prefeasibility Study</td>
<td>Techno-economic assessment of SPH integration on 5 sites (Conducted by: Fraunhofer ISE)</td>
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<td>5. Feasibility Study</td>
<td>Selection of industry partner through detailed study</td>
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Prefeasibility Study - Assumptions

→ Solar plant saves gas/fuel equivalent to 250t CO2/year
→ Payback Period for company/client: 5 years
→ Use of a concentrating collector technology

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<thead>
<tr>
<th>Technical Assumptions</th>
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<tbody>
<tr>
<td>Collector technology</td>
<td>Fresnel</td>
</tr>
<tr>
<td>Degradation (%)</td>
<td>0.5</td>
</tr>
<tr>
<td>Life Time (a)</td>
<td>20</td>
</tr>
<tr>
<td>O&amp;M costs/ Inv. Costs (%)</td>
<td>1</td>
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<tr>
<td>Specific Costs (€/m²)</td>
<td>550</td>
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<th>Financial Assumptions</th>
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<tbody>
<tr>
<td>Equity Share</td>
<td>80%</td>
</tr>
<tr>
<td>Debt Share</td>
<td>20%</td>
</tr>
<tr>
<td>Cost of Equity</td>
<td>14%</td>
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<tr>
<td>Cost of Debt</td>
<td>8%</td>
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<th>Energy Prices</th>
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<tr>
<td>Nat. Gas Cost [€ct/kWh]</td>
<td>1.76*</td>
</tr>
<tr>
<td>Fuel Oil Cost [€ct/kWh]</td>
<td>2.5*</td>
</tr>
<tr>
<td>Energy Price Increase per year [%/a]</td>
<td>10%</td>
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<th>Solar Irradiation</th>
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<td>DNI (kWh/m²/a)</td>
<td>1850 (North)</td>
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<td>2000 (Center)</td>
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</table>

→ 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 m²
- System Utilisation: 34%
- Solar Fraction: 3%
- Total Investment: 740,000 €
- Payback Period: 18 years
- Required Subsidy (PBP = 5 y): ca. 88%
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 m²
- System Utilisation: 29%
- Solar Fraction: 10%

- Total Investment: 1.070.000 €
- Payback Period: 22 years
- Required Subsidy (PBP = 5 y): ca. 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 CO2 reduction of 250 t/a:

Solar Field Size: 3.150 m²
System Utilisation: 12%
Solar Fraction: 25%

Total Investment: 1,780,000 €
Payback Period: 27 years
Required Subsidy (PBP = 5 y): ca. 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