Solar Heat for Industrial Processes in Malaysia

From awareness to implementation

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Solar Heat for Industrial processes (SHIP) has a huge potential in Malaysia.
Solar Irradiation Malaysia

Malaysia’s average solar irradiation: 1,600 kWh/m² year
Starting point

Source: Solar Thermal Roadmap for Malaysian Industries, UNIDO
SHIP potential and targets

- **Roadmap target - 2025 (total)**

  - **Solar thermal capacity:**
    - Industries: $4,300 \text{ MW}_{th}$
    - Hotels: $398 \text{ MW}_{th}$
    - Hospitals: $159 \text{ MW}_{th}$
    - Total: $4,857 \text{ MW}_{th}$
  
  - **Collector area:** $1,340,000 \text{ m}^2$
  
  - **Investment needed:** $385 \text{ [Mio}\euro\text{]}$
  
  - **CO2 savings:** $1,738 \text{ [ktoe]}$
  
  - **Jobs creation:** $6,120 \text{ [-]}$

**Solar thermal capacity potential**
But how without a solar community?
Training setup

- **Local experts - PMU**
  - 1-day awareness training
  - 2-day basic training

- **Trainee group**
  - T1, T2, T3, T4, T5

- **Host company**
  - 4-day training EE
  - 4-day training SHIP
  - Training on the job

- **Support by AEE INTEC**
Appropriate tools for SHIP identification and quick design

- Expertise SHIP linked to EE
- Accompanying tools used along training and in future SHIP community in Malaysia and Egypt

- Demand
  - quick design of SHIP
    - including process/supply demand, components, collector types, placement, orientation
  - as basis for
    - detailed system simulation so called pre-design
    - first assessment on technical and economic feasibility
    - convincing and support of industry in decision on further design towards implementation
  - double check of received concepts from external experts and offers from solar companies
Key sections of SHIP Tool

(1) Process integration
   - Integration concept
   - Process heat exchanger
   - Yearly process load profile

(2) Solar concept
   - Collector definition
   - Climate definition
   - Key component sizing (collector field, storage)
   - Yearly analysis for system evaluation and KPIs

(3) Techno-economic comparison
   - Levelised cost of heat
   - Comparison of up to 10 scenarios
Process Load Profile

**load profile "monday"**

- Yearly profile with hourly values

**load profile "week"**

- Yearly profile with weekly values

**load profile "year"**

- Yearly profile with hourly values
**Collector selection, sizing and placement**

### Definition of solar thermal collectors

<table>
<thead>
<tr>
<th>Collector efficiency coefficients</th>
<th>Length</th>
<th>Width</th>
<th>Aperture area</th>
<th>Gross area</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c_0$</td>
<td>$c_1$</td>
<td>$c_2$</td>
<td>$L$ (m)</td>
<td>$W$ (m)</td>
</tr>
<tr>
<td>[·]</td>
<td>[W/(K·m²)]</td>
<td>[W/(K²·m²)]</td>
<td>[m]</td>
<td>[m]</td>
</tr>
</tbody>
</table>

**Arcon HT-A 28/10**
- $c_0$: 0.839
- $c_1$: 3.2
- $c_2$: 0.0137
- $L$: 2.27
- $W$: 5.96
- $A_{ap}$: 12.54
- $A_{gr}$: 13.57

**Arcon HT-SA 28/10**
- $c_0$: 0.817
- $c_1$: 2.205
- $c_2$: 0.0135
- $L$: 2.27
- $W$: 5.96
- $A_{ap}$: 12.52
- $A_{gr}$: 13.57

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**Collector efficiency curves**

![Collector efficiency curves diagram](chart.png)

- ΔT (mean collector temp. $T_m$ - ambient temp. $T_a$)
- Nominal efficiency of chosen collector
- Arcon HT-A 28/10
- Arcon HT-SA 28/10
- Ritter XL Solar - CPC 45 XL
- Ritter XL Solar - Aqua Plasma 19/50
- Kingspan DF400
- Kingspan FPW25
- [Other curves]
Climate framework


Define location

Hourly Data!!!

Define slope and azimuth

Ensure other settings are as shown here!
Yearly analysis and KPIs

Solar yield [kWh/a]: 1,948,929
Spec. solar yield [kWh/m².a]: 743
Solar heat delivery [kWh/a]: 1,697,508
Spec. solar heat delivery [kWh/m².a]: 737
Solar fraction: 61.5%
Utilization rate (weighted yearly collector efficiency): 49.2%
Heat losses storage [kWh/a]: 14,963
Stagnation losses: 3.5%
Yearly analysis as basis for scenario analysis
Implementations in Malaysia

- Energy efficiency → 95 single measures

- SHIP investment procedure
  - Up to 30% of investment costs funded
  - Applying SHIP tool → standard project development
  - Presented to industry and investors
  - Concept presented to industry
  - Call for tender and received offers
  - Confirmation by Task Force
  - Investment by industry, „re-financing“ after commissioning and paid invoice
Implementation SHIP and project pipeline

- Project focus: industry, hospitals, hotels

- Implementations
  - 3 finished
  - 4 pending

- Beside implementations achieved / envisaged
  - Tender phase: 7 projects
  - Decision phase: 14 projects
  - Concept phase: 26 projects
  - Technical support: 5 projects

- Monitoring phase in 2 companies ongoing
The existing hot water system is supplied by an electric boiler. The solar thermal system covers 80% of the thermal process demand, producing hot water at a temperature of 91°C.

- Collector Area: 119 m²
- Storage volume: 8 m³
- Annual savings: RM 71,700
- ROI: 3.2 years
- CO₂ savings: 266 t/a

1st Runner Off-grid: Thermal Category
Financing via TrustEE

- Transaction costs to be minimised
- Risk management
- Assessment of developed projects
- Due diligence
- Standardised and semi-automated project assessment
- Based on high-level background simulation
- Service for investors

TrustEE stamp

PROJECT LIFECYCLE

DEVELOP & INSTALL
Outlook

- **Malaysia**
  - Overcome COVID-19 phase
  - Roadmap deployment as part of upcoming green legislation act
  - Expert certification requested by government in order to follow standardised procedures
  - Frontrunners push industry
  - TrustEE implemented in Malaysian financing scheme
SHIP has a huge potential not only in Malaysia

…but worldwide!
Renewable Heating and Cooling in Integrated Urban and Industrial Energy Systems

#ISEC2020 - a Forum for Research, Business and Energy Policy

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