Concentrated Solar Technologies for Industrial Applications

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UNDP-GEF Concentrated Solar Heat Project
Ministry of New & Renewable Energy
Government of India
Website: www.mnre.gov.in
Energy Scenario in Industries

- Huge amount of fossil fuels especially electricity and fuel oil being consumed in industries for thermal applications e.g. water /air heating, community cooking, process heat, space cooling etc.
- 50% of total commercial energy use in country is in industries. And further 50% of that is for thermal applications only.
- At most places heat requirement in the form of steam/ pressurized hot water/ air or oil is between 90 to 350 C.
- 15 million tones of oil/ year in industries for heat up to 250C. 5000 trillion units of electricity for water /air heating in various sectors including industry.
- About 35000 MW of electricity being used for cooling. 50% being generated through DG sets.
## Heat Requirement for Various Processes

<table>
<thead>
<tr>
<th>Industry</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food processing &amp; Dairy</td>
<td>Chilling/cold storage, cooking, extraction, baking, pasteurization, sterilization, bleaching, drying etc.</td>
</tr>
<tr>
<td>Breweries</td>
<td>Boiling, mashing, cold conditioning, fermentation etc</td>
</tr>
<tr>
<td>Rubber</td>
<td>Heating, digestion, vulcanizing</td>
</tr>
<tr>
<td>Pulp &amp; paper</td>
<td>Pulping, washing, bleaching, evaporation &amp; drying,</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Steam conditioning, drying &amp; softening</td>
</tr>
<tr>
<td>Electroplating</td>
<td>Post plating treatment, water heating, drying etc</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>Distillation, drying, evaporation, fermentation &amp; molding</td>
</tr>
<tr>
<td>Textiles(Spinning &amp; weaving, Finishing)</td>
<td>Preparing warps, sizing, de-sizing, scouring, bleaching, mercerizing, dyeing, drying &amp; finishing</td>
</tr>
<tr>
<td>Chemicals &amp; Fertilizers</td>
<td>Distillation, effluent treatment, primary reforming, ammonia synthesis, CO2 removal, methanation, steam stripping</td>
</tr>
<tr>
<td>Refining</td>
<td>Desalting, thermal cracking, cleaning, wastewater treatment</td>
</tr>
<tr>
<td>Ceramic tile &amp; pottery</td>
<td>Beneficiation, drying, presenter thermal processing, glazing</td>
</tr>
<tr>
<td>Desalination</td>
<td>Multiple effect distillation, multi stage flash distillation</td>
</tr>
<tr>
<td>Steel re-rolling, Cement, Mining</td>
<td>Augmenting steam to boilers, boiler feed water heating</td>
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</tbody>
</table>
CSTs

• CSTs can help reducing the fuel oil/electricity during day time by way of integrating them with their existing units.
• It's a device which can concentrate solar radiation using mirrors/lenses to produce high temperatures in the range of 100 to 450°C or more even.
• These devices, however, need automatic tracking so as to focus Sun rays on to a receiver all the time. They can also tap only direct normal radiation and not the diffuse.
• Solar water/air heaters are already in promotion at commercial level but these are limited to temperatures below 90°C.
• They also require larger space for desired heat delivery, but have advantage of collecting both diffuse & direct radiation.
• Use of CSTs at places of direct utility make them viable subject to availability of good DNI.
CSTs in Promotion Under MNRE Scheme

- Fixed focus single & dual axis tracked elliptical dishes (Scheffler) for direct indoor cooking (50-100 people) & for steam generation (cooking, laundry, space cooling etc. of any capacity)
- Fully tracked Fresnel based dishes (Arun) for process heat, cooling, laundry applications
- Parabolic troughs, Paraboloid dishes & LFR introduced recently

- Active Suppliers: Dish cookers- 20; Scheffler dishes- 10 & Arun technology -1, Other Technologies - 5
- 20,000 dish cookers, 150 indoor direct cooking & 140 steam cooking/ process heat systems installed with 50,000 sq. m. area
Scheffler Dish for Direct Cooking
Solar Steam/Process Heat Delivery Systems

Concentrating solar collectors produce high temperature & convert water into steam/deliver heat for process heat

**Use**: Can supplement conventional steam systems for
- Community cooking
- Industrial process heat
- Sterilization & Laundry
- Cooling through VAR

**Fuel saving & payback**
- A 100 sq. m. system can save 5,000-10,000 liters of diesel/600-1200 LPG cylinders/year depending on type of technology used
- Pays back the cost in 4-6 years depending on application
- Over 140 systems of different capacities installed so far.
Scheffler Dishes for Process Heat

Tapi food industry for process heat, Gujarat

Thermic fluid based system at Hindustan Vidyut, Faridabad
Scheffler Dishes for Laundry

Gajaraj Drycleaners for laundry, Maharashtra
Scheffler Dishes for Cooling

100 Ton integrated heat recovery system at Mahindra & Mahindra vehicle manufacturers Pune

92 Ton system at TVS Suzuki factory near Chennai

VAM for cooling
Scheffler Dishes for Community Cooking

Sabarmati Jail, A’bad

Bosch factory, Bangalore

Sringeri Mutt, near Bangalore

Cooking Vessels
Solar Steam Cooking System at Shirdi

**Shirdi, Maharashtra for 20,000 people**

<table>
<thead>
<tr>
<th>Project Consultant</th>
<th>Maharashtra Energy Development Agency, Pune</th>
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<tbody>
<tr>
<td></td>
<td>Dr. M. G. Talawale (Ex. Vice Chancellor, Shirdi University, Kollapur)</td>
</tr>
<tr>
<td></td>
<td>Dr. A. M. Patil (Pune University)</td>
</tr>
<tr>
<td>Project Technology designed &amp; manufactured</td>
<td>Gadhvi Solar Energy Systems Pvt. Ltd.</td>
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<tr>
<td>Specialty of Project</td>
<td>Valad (Gujarat), World Largest Solar Cooking System in Present</td>
</tr>
<tr>
<td>Cost of Project</td>
<td>38.68 Lakh (Ministry of New Renewable Energy, New Delhi)</td>
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<tr>
<td>Financial Aid</td>
<td>1.33 Crore</td>
</tr>
<tr>
<td>Project Completion Period</td>
<td>150 days</td>
</tr>
<tr>
<td>Area of the Project</td>
<td>2569 sq. mtr</td>
</tr>
<tr>
<td>Total Solar Dishes</td>
<td>73 No.</td>
</tr>
<tr>
<td>Area of Dish</td>
<td>16 sq. mtr</td>
</tr>
<tr>
<td>Total Dish collection Area</td>
<td>1168 sq. mtr</td>
</tr>
<tr>
<td>Energy created by one Dish during 8 hr. Period</td>
<td>37,640 Kcal</td>
</tr>
<tr>
<td>Total Energy Created From all dishes in Steam Formation</td>
<td>27.62,320 Kcal/day</td>
</tr>
<tr>
<td>Steam Generation Capacity Per day</td>
<td>3500 Kg/day</td>
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<tr>
<td>Fuel used at Present</td>
<td>L.P. Gas</td>
</tr>
<tr>
<td>Calorific Value</td>
<td>10,500 Kcal</td>
</tr>
<tr>
<td>Total calories generation from Solar Project</td>
<td>27.62,320 Kcal</td>
</tr>
<tr>
<td>Saving if Gas</td>
<td>10,500 (Calorific value of Gas)</td>
</tr>
<tr>
<td>Commercial gas rate</td>
<td>Rs. 76.59/Kg</td>
</tr>
<tr>
<td>Saving per Day</td>
<td>Rs. 265.68/Kg/day</td>
</tr>
<tr>
<td>Saving per Month</td>
<td>Rs. 8,0.578</td>
</tr>
<tr>
<td>Carbon Credit from Project</td>
<td>19561 MT CO₂ x 155 = Rs. 293415</td>
</tr>
<tr>
<td>Subsidy of Carbon credit from International Organization</td>
<td>Rs. 2,93,415/- Per Year</td>
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</table>

Executive Officer, Shri Sai Baba Sansthan Trust, Shirdi.
Performance on a particular day of system at Mount Abu

- Direct Solar Insolation
- Feedwater Injection
- Water Boiling
- Lunch
- Tea
- Dinner

Total:
- 33800 meals (rice, lentils, vegetables)
- 3000 litres boiled water
- Tea and milk for 18000 people
Arun Dish for various Applications

Chitaley Dairy, Sangli

Mahindera & Mahindera, Pune

ITC Maurya, Delhi

ARUN® 100 at Akshardham temple, New Delhi

ITC Maurya, Delhi
Other Developments

State of Art Paraboloid Dish

100 kW Solar air-conditioning plant at SEC

MNRE

UNDP

Empowered lives. Resilient nations.

gef
Other Developments

60 sq. m. fully tracked Scheffler dish with heat storage

Linear Fresnel Reflector by KG Design, Coimbatore
Some Installations
Process Heat

• B. S. Paper & Board Mills (P) Ltd., Bhamain Kalan, Tajpur Road, Ludhiana (10 Scheffler dishes each of 16 sq.m.)
• Hindustan Vidyut, Faridabad (20 dishes of 16 sq. m.)
• SKF Technologies, Mysore (40 PTCs each of 6.41 sq.m.)
• Purple creations, MIDC Baramati, Maharashtra (30 Scheffler dishes, each of 16 sq. m.)
• ITC Maurya, Delhi (2 Arun dishes each of 169 sq.m. & 11 Scheffler dishes of 16 sq. m. each)
• ITC, Bangalore (Non-imaging CSTs for hot water use)
• Bergen Electronics, Gurgaon (Non-imaging CSTs -20 sq. m)
• Mahanand Dairy, Latur, Maharashtra (2 nos. of Arun dishes each of 169 sq.m.)
Some Installations
Solar Cooling

- Mahindra & Mahindra vehicle manufacturers Chakan, Pune (100 TR integrated heat recovery system; 70 nos. of Scheffler dishes, each of 16 sq.m. area)
- TVS Suzuki factory near Chennai (92 TR using Scheffler dishes)
- Civil Hospital, Thane (212 TR; Scheffler dishes of 13.5 sq.m.)
- Siemens, Bangalore (15 TR; 10 nos. of Scheffler dishes)
- Turbo Energy Ltd (TVS Group Company), Paiyanoor, Chennai (50 TR; 2 Nos. of Arun dishes each of 169 sq. m.)
- NTPC, Noida (50 TR; 2 Nos. of Arun dishes each of 169 sq.m.)
- Magnetic Marelli, Gurgaon (30 TR using Scheffler dishes)
- Muni Sewa Ashram, Vadodara (100 TR System; Scheffler dishes)
Some Installations
Community Cooking

- Titan Industries, Hosur, Bangalore (5,000 people)
- BOSCH Ltd, Hosur Road, Bangalore (2500 people)
- Sanghi Industries, Andhra Pradesh (500 people)
- Boys Hostel, JSS Mahavidyapeetha, Mysore (5000 meals)
- Shanti Kunj, Haridwar, Uttrakhand (1000 people)
- SRM University, Chennai (7,500 students)
- Satyabhama University, Chennai (15,000 students)
- Avinashilingam University, Coimbatore (1000 Meals)
- Dayalbagh Education Institute, Agra (2 systems; one for 500 & other for 1500 students in Girls’ & Boys’ hostels)
- Mount Abu (10,000 people; Tirupathi (15,000 people)
- Jawahar Navodaya Vidyalaya, Leh (500 students)
### CSTs Based Installations in India

<table>
<thead>
<tr>
<th>Total Number of Systems</th>
<th>144</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Cooking Systems</td>
<td>121</td>
</tr>
<tr>
<td>Solar Cooling</td>
<td>8</td>
</tr>
<tr>
<td>Process Heat &amp; Laundry Applications</td>
<td>15</td>
</tr>
</tbody>
</table>

Installed as on 31st March, 2013 28000 (approx.)

Under Execuation 23 Nos. with 8100 sq. m.

<table>
<thead>
<tr>
<th>Type of CST Collector</th>
<th>Collector Area m²</th>
</tr>
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<tbody>
<tr>
<td>Parabolic Schfeller Dish</td>
<td>23000 m²</td>
</tr>
<tr>
<td>Paraboloid/ Arun Dish (Moving Focus)</td>
<td>2470 m²</td>
</tr>
<tr>
<td>Parabolic Trough</td>
<td>1000 m²</td>
</tr>
<tr>
<td>Linear Fresnel Reflector</td>
<td>1500 m²</td>
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</tbody>
</table>
Financial Support under NSM

- 30% of system cost as capital subsidy in general category states. Higher subsidy (60% of cost) in special category states including islands & UTs except to commercial establishments
- Support available to users through different channel partners participating in the scheme
- Release of subsidy on back end basis after inspection
- Amount of subsidy (Rs./sq. m. of collector area)
  - Non imaging concentrators: 3600
  - Concentrating solar systems
    - Single axis tracking: 5400
    - Double axis tracking: 6000
- Additional support of 10% of the cost of system also available under UNDP-GEF project of CSTs
Major Barriers in large scale promotion of CSTs

- Lack of awareness about the technologies & their benefits. Information on successful projects through case studies & video films not available for public.
- Space constraints for installations. Technologies requiring less space now developed & being promoted.
- Dependence on import of reflectors increases the cost.
- Low cost technologies with indigenous materials developed but with larger maintenance.
- Low returns on investments as compared to SWHs.
- Less examples in industries. Major projects are for community cooking in institutional & religious sectors.
- Actual performance data on CSTs installations not available due to non-availability of test standards & test set ups.
UNDP-GEF Project on CSTs

Goal & Objective
• To reduce GHG emissions from low & medium temperature process heat applications through increased use of CSTs

Major Outcome Envisaged
• 45,000 sq. m. of Concentrating Solar Technologies installed in around 90 industries & commercial establishments through Demonstration & Replication projects
• 39,200 tonnes of CO2 emission reduced/year at EoP
• 3.15 million liters of fuel oil saved per year at EoP

Project Duration : 5 years (April 2012-March 2017)
GEF Grant : USD 4,40,000
Initiatives taken under UNDP-GEF project

- Development of Test Standards & Test Protocols
  - DPR prepared & being finalized through an Expert group.
  - Based on DPR, 2 Test setups (both mobile & immobile) expected to be established at SEC & Univ. of Pune by March 2014

- Field Evaluation Study of existing CST installations
  - Over 100 installations surveyed. Compendium with 2 pages on each covering all information with photographs prepared.

- Technology Assessment & Performance Evaluation of CSTs
  - Assessment reports on CSTs available in country & abroad & on manufacturing facilities of various manufacturers under preparation
  - On-line performance monitoring of 15 identified installations on different technologies & applications to be started by September end. Instruments procured & under installation at all such places
- 4 page pamphlet on each technology giving details, photographs, schematic diagram, utility, performance, cost, savings etc developed

• **Market Development programmes in**
  i) Institutional & Religious
  ii) Industrial & iii) Hospitality & Hospitals sectors

- 28 workshops being organized in different states/sectors. 17 at Pune, Delhi, Dehradun, Bangalore, Thane, Bhilwara, Mysore, Vadodara, A’bad, Chennai, Coimbatore, Nagpur, Leh, Ludhiana, Gurgaon, Hyderabad & Guntur already done.

- 38 ready to sanction proposals with 9,000 sq. m. area to be generated

- 12 video films on successful installations with case studies prepared

• **Training programme & Manuals on ‘O, M & Trouble shooting’**

- 12 training programmes in different states with Manuals for each of 6 technologies both in English & Hindi under implementation
Contd..

• National Toll free Helpline  1800 2 33 44 77 in place  (Monday to Friday : 9.30 am to 6.30 pm & on Saturday : 9.30 am to 1.30 pm)
• Monthly Newsletter  www.insolthermtimes.in
• Quarterly magazine  on CSTs (1st issue being relaesed)
• Performance norms for various CSTs in terms of anticipated heat delivery in different regions : Prepared & available on website
• Information for users on suitability of technology for their application including cost & payback : Prepared & available on MNRE website
• Minimum technical requirements for installations alongwith list of manufacturers & inspection requirements : Available on MNRE website
• All information related CSTs : Available at home page of MNRE website  www.mnre.gov.in at click of Concentrating Solar System
Additional Support in UNDP Project

• 15% of system cost to a maximum of Rs. 30 lakhs for demonstration projects (Newer applications & recently developed CSTs in different sectors. Maximum projects 30-60 Nos. with 15,000 sq. m. of CST area)

• Rs. 4 lakhs for replication projects (Based on technologies & applications already in place with 30,000 sq. CST area) (Minimum CST area for both categories: 250 sq. m. Mainly for preparation of DPR/ feasibility report, performance monitoring & O&M for few years)

• Additional 10% to a maximum of Rs. 15 lakhs for projects in ESCO mode.

• Rs 2 lakh for project 90-250 sq. m. concentrator area

• Up to Rs. 15 lakhs for 5 years old systems for repair & renovation if equal amount is spent by the beneficiary
Thank You