Megawatt Solutions Private Limited

Indigenous Innovations In Solar Thermal

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Managing Director and CEO

The Forgotten Solar: Solar Thermal and Its Development
Center For Science and Environment
New Delhi, February 4, 2016
About Megawatt Solutions Pvt. Ltd. (MWS)

• MWS is an Integrated Technology and Solutions Company which provides Efficient Energy Solutions for Heat & Power requirements

• Indigenously Developed and Patented Proprietary Thermal & Power Solutions Offering for commercial, industrial & institutional customers

• MWS Systems Qualify for Subsidy from MNRE*

• Turnkey Supplier of Efficient Thermal & Power Solutions providing Design, Engineering, Manufacturing and Turnkey Delivery

• A vast experience and reference base of projects across India, including India’s largest Concentrated Solar Thermal Industrial Heating System in Gujarat

* Ministry of New and Renewable Energy, Government of India
Agenda

• “Forgotten Solar Thermal” - Lets Find Out Why

• Megawatt Solutions CST Solutions

• Opportunities Ahead
Concentrated Solar 101

Concentrated Solar Thermal (CST) System Overview

- Sun
- Concentrator
- Heat Collection
- Heat Delivery
- Thermal Storage
- Power Blocks
- Thermal Energy Conditioning
- Power (CSP)
- Thermal Energy Applications (CST)
- Solar Fields (55-60% of project capex)
- Complimentary fuel boiler

Technology Classified According to Collector and Receiver Types

- Absorber Tube
- Central Receiver
- Reflector
- Receiver/Engine
CSP – Technical Missing Link Overlooked?

Parabolic Trough

(a) Efficiency Vs. Solar Insolation

Reducing Industrial Carbon Footprint
Critical Importance Of Technology Suitability

Two Locations Across Globe May Have Similar Cumulative DNI ~ 1600 kWh/m²/yr

Location 1
Parabolic Trough ‘A’

Location 2
Parabolic Trough ‘A’ ~ 30% less output

Both Quality and Quantity of DNI Are Critical For Particular CST Technology
MWS Solutions Offerings

**Heat**

- **MWS Solar Field™**
  For Industrial Process Heating Applications

**Power**

- **MWS SmarTree™**
  For Smart Cities, Malls, Public Parks, Plazas, etc.

- **MWS Smart Kitchen™**
  For Industrial & Institutional kitchens

- **MWS SmarTrack™**
  For high yield offgrid & utility scale Power Plants

Smart Solutions • Smart Energy • Smart Planet
MWS Solar Dish Concentrator
For Reducing Fuel Consumption In Industries

Heating • Cooling • Cooking • Power Generation

Dishes take very small ground space
System Cost covered in less than 3 years
Can be retrofitted to any existing system
Fully automated systems
Can heat up to 400°C
Reduces your carbon footprint emission

Reducing Industrial Carbon Footprint
MWS Solar Dish Concentrator
For Reducing Fuel Consumption In Industries

1. Incoming Solar Radiation gets concentrated by high efficiency MWS Paraboloid Dish Concentrator onto a cavity receiver with minimum losses
2. The concentrated energy is heat-transferred to various working fluids like hot water, Thermic Oils, etc.
3. Piping system routes energy from each receiver to end application for integration
4. Entire process is fully automated and dish tracks the Sun in two axis all year long

Reducing Industrial Carbon Footprint
MWS Solar Dish Concentrator Is Practically Feasible

Reducing Industrial Carbon Footprint

2-Tap Integration Philosophy To Eliminate Any Disruption In Industrial Process
MWS Solar Field™
Creates Long-Term Value In Industries

<table>
<thead>
<tr>
<th>Application</th>
<th>M95</th>
<th>M55</th>
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<tbody>
<tr>
<td>Hot Water (90°C, ΔT= 30°C)</td>
<td>10,000 liters</td>
<td>5,000 liters</td>
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<tr>
<td>Steam Generation</td>
<td>450 kg</td>
<td>225 kg</td>
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<tr>
<td>Cooking</td>
<td>1500 meals</td>
<td>750 meals</td>
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<tr>
<td>Hot Air (120°C)</td>
<td>800 cfm</td>
<td>400 cfm</td>
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<tr>
<td>Effluent Evaporation</td>
<td>500 liters</td>
<td>250 liters</td>
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<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Fuel Saved per day</th>
<th>Fuel Cost (Rs./unit)</th>
<th>Savings (Rs./day)</th>
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<tbody>
<tr>
<td>Electricity</td>
<td>290 kWh</td>
<td>8</td>
<td>2,326</td>
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<tr>
<td>Diesel</td>
<td>26 Liter</td>
<td>52</td>
<td>1,354</td>
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<tr>
<td>Furnace Oil</td>
<td>25 Liter</td>
<td>26</td>
<td>676</td>
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<tr>
<td>Coal</td>
<td>62.5 kg</td>
<td>8</td>
<td>500</td>
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<tr>
<td>LPG/Natural Gas</td>
<td>35 kg</td>
<td>60</td>
<td>2,100</td>
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Clean Industrial Processes for Sustainable Manufacturing
MWS Solar Field™ Integration In Industries

Schematic of MWS Solar Field for direct heat delivery

Schematic of MWS Field for indirect heat delivery

Clean Industrial Processes for Sustainable Manufacturing
Road Ahead For CST

• Proper Mapping of CST Potential Across Industrial Clusters In India

• Towards Standardization Of Applications At Industry Level (Pharma, Rubber etc.)

• Renewable Heat Certificate Mechanism for Level Playing Field for PV and CST

• Continue Great Work By MNRE and UNDP-GEF

Clean Industrial Processes for Sustainable Manufacturing
<table>
<thead>
<tr>
<th>S No.</th>
<th>Project Location</th>
<th>Configuration</th>
<th>MWS Concentrator Model</th>
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<tbody>
<tr>
<td>1</td>
<td>Vadodara, Gujarat</td>
<td>CST + Biomass</td>
<td>M90</td>
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<tr>
<td>2</td>
<td>Waghodia Gujarat</td>
<td>CST + Diesel</td>
<td>M55</td>
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<tr>
<td>3</td>
<td>Medak, Telangana</td>
<td>CST + Coal</td>
<td>M90</td>
</tr>
<tr>
<td>4</td>
<td>Turkapalli, Telangana</td>
<td>CST + Furnace Oil</td>
<td>M90</td>
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<tr>
<td>5</td>
<td>Madanpalli, AP</td>
<td>CST + LPG</td>
<td>M55</td>
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<tr>
<td>6</td>
<td>Vijaywada, AP</td>
<td>CST + Biomass</td>
<td>M55</td>
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</tbody>
</table>
Model M90 Paraboloid Dish Concentrator: Rating 40,000 kcal/hr at 750W/m² DNI
THERMIC FLUID HEATING SYSTEM, SAVLI, VADODARA, GUJARAT
CAPACITY: 6 LAC KCAL/HR
CONFIGURATION: 16 nos. of M90 dishes in parallel to provide 6 lac kcal/hr of heat at 250degC of operating temperature
THERMIC FLUID HEATING SYSTEM, SAVLI, VADODARA, GUJARAT
CAPACITY: 6 LAC KCAL/HR
THERMIC FLUID HEATING SYSTEM, TELANGANA
4 nos of M90 dishes integrated to provide 1.6 lac kcal/hr at 180degC
THERMIC FLUID HEATING SYSTEM, TURKAPALLY, TELANGANA
5 nos of M90 dishes to provide 2 lac kcal/hr of energy in form of Thermic fluid at 180degC
THERMIC OIL HEATING SYSTEM, HYDERABAD
6 dishes each of 90m² to provide 2.5 lac kcal/hr of heat at 200degC
MWS Solar Field™ consists of all required sub-systems for performance measurement to establish the daily solar energy yield. These include measuring solar radiation, fluid flow, wind, temperature etc. This is fully remotely-accessible over GPRS/GSM. This ensures complete transparency and field-data verification.