a quarterly magazine on **concentrated solar heat**

SUN FOCUS

Completed 2 years of publication

Volume 2

Issue 4

April–June 2015

INTERVIEW

Shri Upendra Tripathy Secretary
Ministry of New and Renewable Energy,
Government of India

CST INDUSTRY

Manufacturers' Perspective

gef

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UNDP-GEF Project on CSH

Ministry of New and Renewable Energy
Government of India

SUN FOCUS

Volume 2 • Issue 4
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From the editor's desk...

Dear Readers,

I am pleased to share the eighth issue of SUN FOCUS magazine with you all. After covering various aspects of CST sector in first seven issues, the last issue was focused on the UNDP-GEF CSH Mid-term project progress and achievements. The current issue of the magazine is aimed at providing the manufacturers' perspective towards the current state of the sector and future opportunities.

This issue of SUN FOCUS presents with the perspective of CST manufacturers, who have a crucial role in the overall development of the sector, as the indigenous technologies are essential in terms of suitability to Indian conditions and affordability of technologies.

The article from Dr Sonde (Executive VP, Thermax Ltd) elaborates the importance of CST technologies in the overall energy mix of India and key enablers for the sector, i.e., manufacturing and policy support. The article from Megawatt solutions details out the new R&D project undertaken with the support from MNRE: Solar-biomass hybrid thermic oil heating application in Pharmaceutical industry. Clique Solar article gives a broad view of the huge opportunities in the CST sector and their business model to tap these opportunities. There is another article which outline the manufacturer's expectations from policy-makers and regulatory bodies, to achieve large scale growth of CST sector in India.

I am sure you will find this issue as interesting, relevant, and informative as all the previous issues. With this issue, we are completing 2 years of publication of 'Sun FOCUS'. I congratulate the project management unit, the Editorial board, TERI and the author of contributed articles of this magazine for running it successfully.

Sd/-

Tarun Kapoor
Joint Secretary, Ministry of New and Renewable Energy &
National Project Director, UNDP–GEF CSH Project

In Conversation with

Shri Upendra Tripathy, Secretary Ministry of New and Renewable Energy Government of India

In a one – on- one with SUN FOCUS, Shri Upendra Tripathy, shares his views, ideas, and efforts taken by the Ministry, to boost the solar thermal sector, especially concentrating solar technologies in the country.

Shri Upendra Tripathy, Secretary, Ministry of New and Renewable Energy (MNRE), Government of India, is an Indian Administrative Service officer of the Karnataka cadre with 34 years of service at various levels in the government.

Before taking over as Secretary, MNRE, Shri Tripathy was Additional Secretary in the Cabinet Secretariat. He was Adviser (Trade) in the Indian Embassy in Brussels and held various positions in the state of Karnataka in the areas of Revenue Administration, Agriculture and Horticulture, Rural Development, Environment, and Transportation.

Shri Tripathy has done his Masters' Degree in Political Science from Jawaharlal Nehru University, New Delhi, New Delhi, and in Public Administration from Carlton University, Ottawa, Canada. He was awarded the Prime Minister's Award for Excellence in Public Administration in individual category in 2009.

1. The new government has ambitious plans for solar and renewable energy mostly in power generation. However, solar thermal applications for industries and institutions are also an important area. Keeping this in view, what are the Ministries plans for developing this sector?

While the government is ambitiously pursuing renewable based electricity generation, solar thermal technology is also a promising option for India. Solar thermal technologies can definitely reduce fossil fuel considerably by catering a part of heating and cooling energy demand, which is one of the largest contributors to the final energy demand in the country. The solar thermal sector in India has grown considerably since last few years and numerous indigenous technologies have now come up. Government's focus in the early days was to promote the technology development and the new application areas for CST technologies. Now, to further developing the sector, government has planned to help the sector in the other important areas like market development and financing. The work is already underway to develop awareness amongst various user industries, baking and financing institutions etc. Standardization of technologies and testing procedures are also important in up scaling the sector, the efforts have already started for this as well.

> A huge amount of fuel oil is being consumed in industries to generate medium and high temperature heat for various process heat applications. This can be saved substantially using solar thermal technologies especially the CSTs

2. With over 20 manufacturers in solar CST sector, what are the plans to support them and develop this industry under skill development and "Make in India'' programs?

MNRE is already supporting manufacturers in various ways, apart from reducing the cost of system by providing direct subsidies to users for solar thermal installations. Some of the important initiatives are: Start of online data logging and monitoring systems, project to prepare information booklets on all types of technologies from operation and maintenance point of view, additional funding for various demonstration projects, under UNDP-GEF CSH project, standardization of technical specifications CSH technologies and so on. Additionally, IREDA also offers loans to the manufacturers for developing manufacturing facilities. We have established a training- cum-awareness centre for CSTs at Mount Abu with Brahmakumaris who are organizing training programmes on skill development for entrepreneurs and the employees of manufacturers from time to time. Operation & Maintenance manual for CSTs have also been developed for the benefits of manufacturers and beneficiaries.

3. What are the prospects for solar thermal technologies in India? What are the most promising areas for implementation of solar thermal technologies in India?

Recently, Concentrated Solar Power (CSP) is facing lot of pressure due to decline in solar PV prices but the same is not true for Concentrated Solar Thermal (CST). CST definitely has its own niche market in the energy scenario i.e. heating and cooling applications. The heating application especially is important to so many areas such as: large scale cooking applications and various industry applications. CST technologies are also evolving fast to suit the industry needs by being able to deliver heat up to 250°C and in various heat mediums such as pressurized water, steam and thermic oil, which will increase their applicability. The industrial applications are very promising considering the fuel saving opportunities in the long term. However, CST technology providers needs to work more on improving the reliability of the systems in terms of performance and operation in order to realize this potential.

> CSTs have good potential for community cooking in hostels, ashrams, para-military/ defence units, prisons, hotels, hospitals, industrial canteens, etc which needs to be taped to save precious fuel oil and LPG. Among the industries dairy, textile, pharmaceutical, chemical, metal treatment and food processing needs to be targeted first.

4. How can research and application activities in solar thermal technologies be further strengthened?

MNRE has always recognized the importance of technology development and R&D activities, and has so far funded various activities related to development and demonstrations of new technologies and CST installations for new applications. Still there is lot be done especially in the areas like integration with existing systems and heat storage. These two areas are very important to enhance CST's reliability and applicability to various applications. MNRE encourages industry to come forward in doing research in these area on 50% cost sharing basis in PPP mode. To institutions projects are being supported on 100% basis.

5. With international agencies like UNDP, GEF and UNIDO coming forward to support CST sector development in India, how do you foresee the development in the coming 5 years?

Yes, UNDP, GEF and UNIDO have recently started contributing towards accelerating the development of CST sector. Under a UNDP-GEF project in implementation, we have been able to develop the Test facilities for CSTs (both mobile & immobile) in the country which is probably first in Asia. The project has also helped in developing a large number of knowledge documents for the benefit of various stakeholders. UNIDO project has just started where we are looking for some larger CST projects to be established in the industry. We hope to increase the installations of CSTs in the country 5 times of that is what is available now.

> Use of high grade fossil fuels especially the fuel oil & electricity for thermal applications needs to be minimized by using solar thermal devices/ systems in a country like ours where 80% of fuel oil is being imported and over 35% people in rural areas have little or no access to electricity

6. Are special financing schemes being considered for this sector?

MNRE is already providing 30% support for installation of CSTs based systems. Higher support is available in special category states. In addition, under UNDP-GEF project some additional support is available for performance monitoring and after installation Operation & Maintenance. An assignment has also been undertaken in the project to create awareness in banking and financing institutions for providing loans to various stakeholders of CSTs. Based on the feedback received from this exercise, we will analyse the major issues and bottlenecks for the sector. We will then work along with IREDA to develop mechanisms to address these issues.

> MNRE-UNDP-GEF project on Concentrated Solar Heat has helped developing a large number of knowledge documents apart from establishing the test set ups for CSTs first time in the country

SOLAR THERMAL TECHNOLOGIES: 2ND RENAISSANCE WAITING TO BE UNLEASHED (A BOOST TO INDIAN MANUFACTURERS & RE TECHNOLOGIES THROUGH CSTs)

Dr R R Sonde

India's energy security lies in maximizing its primary energy resources and leveraging renewable energy resources to meet its enormous demand of energy. The major need of energy is in the form of electricity (power) and fuel (oil & gas). The most credible and easily one of the most elegant way to secure this energy resource is to examine alternate sources of energy which can substitute the energy being supplied by oil and gas sector. Closer observation in oil and gas consumption show that of 3.7 mbpd—220 bn litres, 25% goes for industrial heating purposes, another 10% goes for kitchen and cooking applications making a third of our O&G being used for non-transport segment. Possibility exists to replace this segment by alternate energy forms and take off the pressure of import of this critical energy. If such a possibility can be explored using a renewable energy resource, then, it would bring double advantage of securing India's energy security and also doing it in most climate friendly manner.

It is here that the concentrated solar thermal technologies (CST) actually fill this gap in most elegant manner. CST is more powerful than solar PV due to its efficiency of conversion, compatibility to get it manufactured locally, and the saving of fuel potential.

CST—Use of advanced optical devices to focus solar rays into a receiver —generates thermal energy. The thermal energy can be generated at various temperature scales from 100°C to 1,000+°C (1,000°C) using different optical designs. Most of the industrial thermal energy needs are between 100°C–400°C, most cooking needs are between 80°C–150°C, hydrogen can be generated by thermal or electro thermal cracking at 800°C, and most of the advanced power generation cycles can be operated at 600°C–800°C (advanced super critical CO_2) making this energy as a complete form of renewable energy from power to fuel and CST does it at high efficiency levels.

Experience of Thermax — A natural leader in this technology because of its pioneering work in process heating and commercial energy sector—is shared as an anecdotal manner. These capabilities can be inspirational to many others in India so that the country stands to benefit from such a new technology with vast potential.

Expertise in CST Technology

Thermax, over the last several years has developed considerable expertise in CST technology. Figures 1 and 2 give the summary of devices built by Thermax R&D and engineering for meeting different temperature scales from 100°C–450°C and plans for taking this to 600°C through research collaboration work under SERIIUS program (Solar energy Research Institute for India & the US).

At the lower end of this design is CPC collectors (compound parabolic concentrators) which is based on secondary mirrors supporting the EVTs (evacuated vacuum tubes) integrated in a frame like structure with pressure tubes carrying heat transfer fluid. CPC is designed to receive even the non-direct radiations and generate the thermal energy at 55% plus efficiency—efficiency much higher than even the best of PV.

Next to CPC is Industrial Parabolic Troughs (IPT). Based on PT technology, IPT's are smaller in aperture & receive size compared to the conventional power PT designs, and, hence can be installed at roof tops and restricted land locations and provide temperature of 200 –220 °C. The design of mechanical frame, its drive mechanism, simple receiver design without vacuum tubes, and the housing of the reflectors in the frame are all developed so as to make IPT very appropriate for the medium temperature applications. Industrial heating, solar-biomass hybrid are the two dominant applications where IPTs find their maximum use.

Moving on and remaining in linear receiver systems, Industrial Linear Fresnel Reflectors (ILFR), designed for meeting higher than 200°C and can go up to 300°C. The ILFR designed by Thermax as part of Indo-German Program is perhaps one of very few designs in Fresnel technology being used at this scale. The current ILFR plant is being established at the Captive Power Plant (CPP) of one of the Atomic Energy Facilities.

The moving receiver and stationary receiver dish in paraboloid shape is the next generation technology. As part of Indo-Australian program on solar energy, Thermax has developed a 12 square meter dish which can generate temperature in excess of 400°C–450°C. Figure 2 indicates the petal design philosophy of the dish with a cavity receiver where the concentrated rays are absorbed and the desired thermal flux is generated at considerable efficiency in excess of 50%. A simpler dish with stationary design provides a lower thermal level at 150°C which is used for intermediate applications and is proliferated for cooking systems. Of course the IPT can also be used for the cooking applications and a simpler east-west oriented IPT with coarser tracking system can generate the 150°C heat like a stationary receiver dish but at considerable higher efficiency.

The author is Executive Vice President, Research Technology and Innovation Center, Thermax Ltd.; E-mail: rsonde@thermaxindia.com

Solar Thermal Product Portfolio

SolPac™ NI30
Non-Imaging Collector

- Non-Imaging Collector which can serve applications in industrial as well as commercial segments
- This product can give temperatures up to 120 °C
- It does not require tracking mechanism thus reducing costs and can be easily mounted on flat as well as inclined roof

SolPac™ D160
Parabolic Dish

- Thermax has re-engineered conventional dish technology for medium temperature process heating & cooling applications
- This product can give temperatures up to 150 °C
- This dish comes with a automatic dual axis tracking mechanism and completely boltable structure

SolPac™ P60
Parabolic Trough

- Thermax has developed Industrial Parabolic Trough in-house
- Complete indigenization resulted in significant cost reduction
- This product can give temperatures up to 200–220 °C
- Modular design allows for easy scalability & economies of scale

Figure 1: Thermax's Optical Devices from 100 – 450 °C for Diverse Applications

CLPR
Compact Linear Fresnel Reflector

- Compact fresnel reflector which can produce 200 °C
- Can use water or thermic fluid

Parabolic Dish
Moving Focus with 2 axis

- Thermax has created the two axis tracking solar Dish for use with concentrated receives such as Thermoelectric Generators (TEGs) or Conc PhotoVoltaics
- This product can give temperatures up to 400° C
- The moving focus receiver can generate heat as well as electricity
- The Dish along with TEGs is under testing at CSIRO Australia

Heliostat
Heliostat with 1MWe scalable field

- Thermax is in the process of developing a heliostat
- The system will modularize electricity generation with 1MWe towers
- High temperatures reduce the overall losses giving high efficiencies
- Modular design allows for easy scalability & economies of scale

Figure 2: Industrial Grade LFR, High temperature moving Dish and Heliostats

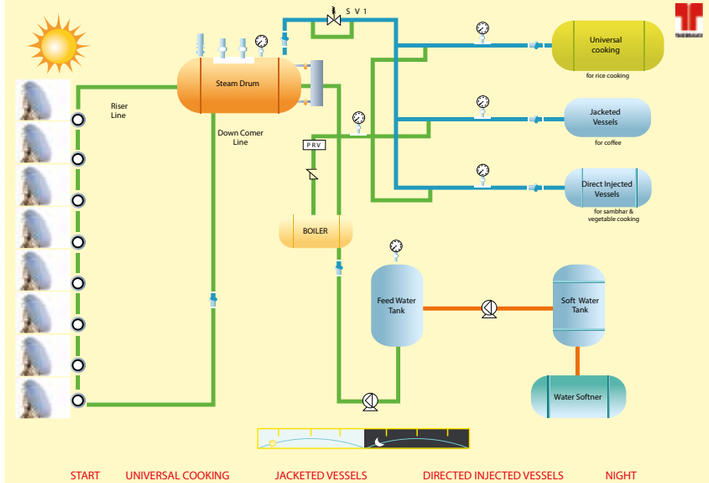


Figure 3: Typical Process integration of solar boiler with the industrial process heating applications

Thermax has developed the optical devices from CPC, IPT, ILFR, DISH, St.-DISH and now in the advanced stage of developing heliostats. The applications for these are also already being developed by Thermax for various industrial and commercial applications including cooking. Figure 3 presents the typical schematic of the industrial application of CST.

CST technology development discussed above can substitute oil and gas used in the industrial and commercial sector. One square metre aperture area of CST can generate thermal energy (say at 200°C) and save upto 67 litres of diesel (oil) over one year. Even assuming that in the current suppressed oil market, diesel or fuel oil is ₹50 per litre, a 1 m² area of CST can generate ₹3,350 per year. The current consumption of oil is 3.7 mbpd (220 billion litres every year) and even if CST can replace at least 20% level (44 bn litres); by proliferating CST technologies by building a base of nearly a 500 million square metre solar concentrators and the balance of system components. The investment required for building such a base of CST will be approximately $50 bn over next few years, and, savings in O&G export bill will be $15 bn every year. This is on par with our 100,000 MW solar power programme and in terms of fuel savings this is superior due to the higher efficiency of conversion of solar energy from these concentrating devices compared to PV conversion systems. 44 bn litres of oil mean 0.5 TWH (terawatt hours) of energy savings and saving of 20% of oil import. This is indeed substantial.

Manufacturing Technology for CST

Concurrent with the technology for CST needing nearly 500 million square metres of optical manufacturing, needs a strategy for manufacturing at such a large scale. Therefore, this should be called as a period of second renaissance for India after our foray into software and emerging as a global leader in that field. The technologies from CPC, IPT, ILFR, Dish, Tower technologies form the base for manufacturing for meeting the above demand. The components like mirror (aluminium & glass), selective coatings, structural steel, galvanized steel, and such basic materials which form core of CST technologies, will also need scaling up in indigenous manufacturing capabilities Indigenous manufacturing will ensure low cost, and will also enable building of O&M practices.

Figure 4 shows example of the frugal way in which CST technologies can be manufactured and once its acceptability is proven, CST technology can be manufactured at cluster level close to its point of usage, which can then lead to high scale trajectory. The fundamental need of this technology is on manufacturing with very high precision in critical components, life cycle evaluation of all the major parts and then carrying out error free installations.

Figure 4: Simplicity of parabolic trough technology

Quality Control Aspects in CST Technologies

To realize the full potential of CST technologies — and as mentioned in the earlier paragraphs, the potential being vast if we get the applications right—the basic requirements will be to develop the quality systems in manufacture of the components and sub systems. The physics of optical design demands accuracies in mili-radians and measurements of such fine tolerances require sophisticated instruments. The figures 5,6, 7 show some aspects of testing the components for CST. Thermax is developing facilities for such quality control equipment and systems.

Figure 5: Solar simulators

Figure 6: Solar component testing salt chambers

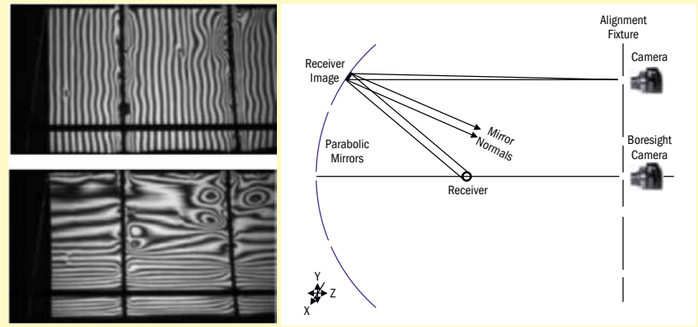


Figure 7: Interference (fringe lines methodology) metre for measuring the mirror accuracy

Figure 8 given below shows the complete concept of manufacturing needs of CST technology in India. It needs multiple skills and also multiple disciplines to be involved. The accuracy of manufacture, availability of all components of desired quality, testing, and quality controls and finally field installation skills and its integration to the existing systems are necessary to successfully build CST technologies.

Policy Needs to Convert CST into a Reality for India

The title of the paper talks about the second renaissance after software boom and about unleashing the manufacturing sector from this technology. Clearly, the preceding paragraphs have elaborated the reason for the same. Energy needs, energy security, O&G sector, import vulnerability, industrial heating and fuels, large scale manufacturing needs (done through a cluster mode and, finally the fact that all the components of CST being indigenously available makes CST a right candidate as India's 'Make in India' mascot. But, it requires initial policy support till the current thousand square metres of CST reach a million mark. This would mean support at R&D level for many sub systems like glass bending, corrosion free painting, selective coatings; setting up centres of excellence in manufacturing precision components using laser and robotic systems; providing subsidies to the industries who will change over to solar boiler systems; and finally mandate shifting to solar-based heating systems using some sort of Renewable Purchase Obligation (RPO) kind of provisions.

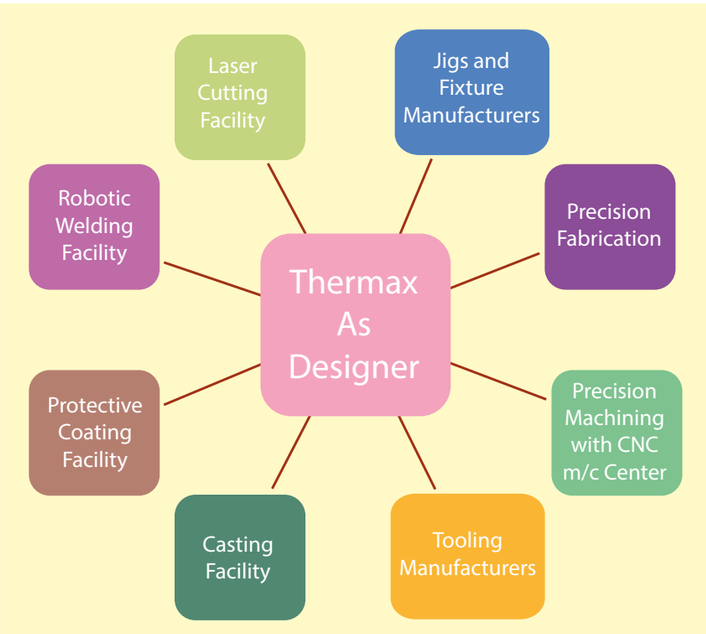


Figure 8: CST manufacturing cluster concept quality & manufacturing under one umbrella

Conclusion

The CST technology is a critical technology whose importance need to be understood by energy professionals. This article has elaborated the nature of CST technology, its importance for India as a substitute to O&G fuels. The article also gives some glimpses of the developments done by Thermax and also gives a national perspective on CST as one strong pillar in our quest of energy security. By giving adequate support in the form of policy, involving R&D institutions, and developing CoEs in manufacturing, India can achieve global leadership.

HIGH TEMPERATURE SOLAR THERMAL BIOMASS HYBRID SYSTEM AT PHARMACEUTICAL PACKAGING INDUSTRY IN GUJARAT

Siddharth Malik

Megawatt Solutions Private Limited (MWS) is an industrial energy solutions company providing solutions for reducing fossil fuels used in industries for energy. Among others, the company's solutions are based on its proprietary technology platform of Concentrated Solar Thermal (CST) paraboloid dish technology that is fully dual-axis tracking and high efficiency across a wide range of operating temperature and Direct Normal Irradiance (DNI).

Universal Medicap Limited (UML) is a manufacturer of pharmaceutical parenteral packaging material which is manufactured from rubber. The company has its manufacturing facilities located in Vadodara, Gujarat where the thermic fluid heating is performed for moulding rubber into moulds at elevated temperatures exceeding 200°C. Currently, a biomass-fired boiler is used for thermic fluid heating. However, given the issues associated with biomass such as supply chain, pricing, storage, sulphur content, and ash disposal, it becomes critical to seek alternative concentrated solar thermal heating source that can be hybridized and reduce biomass consumption.

To promote mid-scale CST intervention in industries, MWS and UML have undertaken a joint research and development project supported by the Ministry of New and Renewable Energy (MNRE) under Research and Development (R&D) programme on 50% cost-sharing basis. Under R&D programme, the project is non-commercial and is intended to address all issues relating to integration of industrial-scale CST systems into conventional industrial heating systems. The project consisted of installation and integration of 16 nos of M90 (each 90 m^2 area) dish concentrators integrated in a solar field together to heat thermic oil up to 200°C and transfer this energy to process circuit. The total cost of the project is ₹310.48 lakh out of which the MNRE's share is 50%.

Photograph of Solar Field at Universal Medicap Limited, Gujarat

Solar Field Configuration-Biomass Hybrid Thermic Fluid Heating Configuration

The MWS Solar Field is configured as 16 nos units of M90 paraboloid dishes in parallel that feed a central header which is connected to balance the thermal system including expansion tanks, overflow arrangements and so on. This energy by solar field is transferred to the process circuit by an oil-to-oil heat exchanger. This process circuit of heat exchanger increases the temperature of incoming press return prior to going to biomass heater, thereby reducing the biomass consumption to the extent of solar field energy yield. The details of the system are given in Table 1.

Table 1: System details

Process Configuration	Biomass-based thermic oil heating system of name plate rating of 6 lakh kcal/hr
Biomass	Briquettes combustion in closed chamber with Induced Draft (ID) Fan
Solar Field Peak Capacity at Standard Test Conditions	6 lakh kcal/hr
Peak Operating Temperature in Solar Field	250°C
Solar Field Configuration	16 nos of M90 dishes in parallel
Solar Field Circulation	Centrifugal Pump with independent expansion tank
Process Circulation	Centrifugal Pump with independent expansion tank

The author is Managing Director and CEO of Megawatt Solutions Pvt. Ltd.; E-mail: smalik@megawattsolutions.in

Both solar and process circuits are integrated vide an oil-to-oil Heat Exchanger (HE) as shown Figure 1. Such a configuration allows complete mechanical isolation of two circuits while thermally coupling them efficiently.

The oil-to-oil heat exchanger is specially configured equipment for transferring solar energy to the process. To account for the variations in temperature on either side of the HE, a special in-line body expansion bellow in the shell has been incorporated. In addition, additional in-line pipeline bellows have also been incorporated as process side inlet to HE to account for thermal expansions of long pipe lengths.

MWS Paraboloid Dish Concentrator M90

Salient Features

M90 is a fully two dual-axis tracking paraboloid dish concentrator with salient features as shown in the Table 2.

Safety Aspects of MWS Solar Field

In order to minimize the impact on existing process, the MWS solar field has been configured to provide following automated in-built safety features as shown in the Table 3.

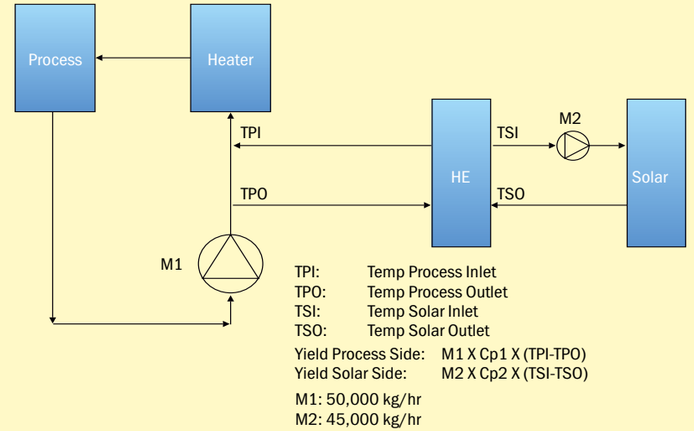


Figure 1: Block diagram of hybridized CST system with biomass-based process heating system

Table 2: Salient Features

M90 Concentrator Area	90 m^2
Solar Tracking	2 Axis Automated
Dead Weight on foundation	4 Tonnes
Peak Thermal Rating at Standard Testing Conditions (STC)	40,000 kcal/hr at 250°C
Reflectors	UV-rated, low iron, Solar grade (Imported)
Operating Temperature	200°C
Concentration Ratio	~ 600:1
Structure	100 % Galvanized Steel
Structural Hardware	Stainless Steel
Thermal Receiver	Cavity Type with SS 304 Jacketing
Wind Withstanding Capability	200 km/hr
Wind Defocus	Automated with Anemometer

Table 3: Safety Aspects

Condition	Solar Field Auto Action
High Wind Conditions	Dishes in safety position by anemometer signal
Low Oil Flow	Alarm indicators and defocusing of dishes
Low Oil Level	Triple contingency design including automatic top up by drawing oil from overflow and expansion tanks; reverse flow condition prevention, U loop configuration
High Temperature Conditions	Defocus of solar field as per schedule
Low pressure	Pump and circuit pressures linked by pressure switches to provide alarm
Intermittent Cloudy Conditions	Temporary defocus and refocus routines
Permanent Cloudy Conditions	Defocus and safety positions, alarm indicators
Process Condition	Auto detection of process status

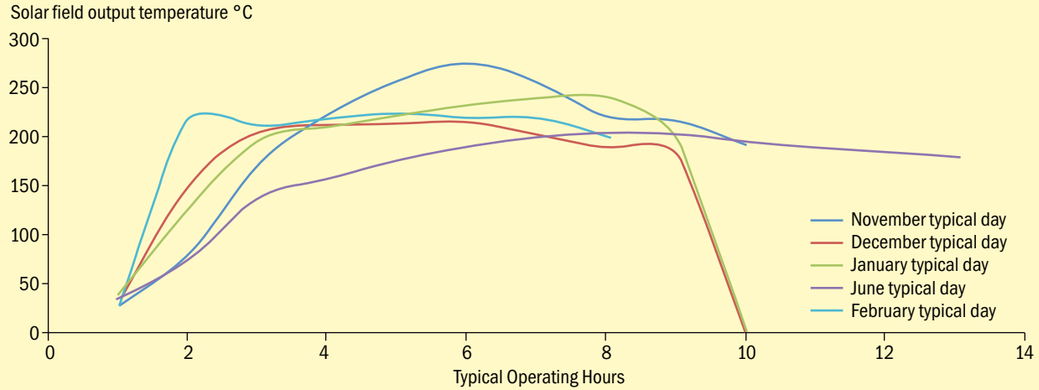


Figure 2: Typical Solar Field Performance

Full view of MWS Parabolic Dish (M10)

Performance Measuring Instruments

Various performance measuring instruments have been installed that include anemometer, 2 pyrheliometers with and without a shadow band, temperature indicators, pressure switches, and an online performance measuring system with remote access.

Performance Monitoring System

A performance monitoring system has been specifically developed that interfaces with the anemometer and other instrumentations, solar field instrumentation including temperature sensors, pressure switches, and logs the data and transmits it to the GSM unit for online monitoring and access.

System Performance

While solar field yield has been recorded up to a peak of 35–38 lakh kcal per day, the actual reduction in biomass has been reported as a function of process shut down and batch cycles.

The aim and objectives of R&D project was to specifically address the integration issues of a CST system with existing fossil-based industrial system. These have been duly met. The average solar field yield has been recorded upto 38 lakh kcal/day. The biomass savings realized are a function of process start-up, shut-down, and batch cycles.

INDUSTRIAL PROCESS HEATING: THE NEXT BIG OPPORTUNITY AND THE ROLE OF CLIQUE SOLAR IN INDIAN INDUSTRY

Abhishek Bhatewara

What We Do?

Clique Solar provides low cost, turnkey solar thermal solutions in the form of LP/MP steam, pressurized hot water or even hot air for diverse applications such as industrial process heating, community cooking, and comfort cooling through its patented ARUN solar concentrator to a variety of industries across geographies.

Why We Exist?

The Market Need

The thermal energy needs which account for majority of industries' energy bills are currently fulfilled by burning non-renewable fuel sources such as coal, furnace oil, diesel, etc. In oil-importing countries like India, the increasingly prohibitive cost of these fuels will make, and in some cases, is already making businesses uncompetitive. The solar thermal solutions available till recently were either developed for large-scale power generation or low temperature hot water for requirements such as bathing, etc. There were no commercially viable solar concentrator technologies to cater to low to medium pressure steam generation, which accounts for bulk of the industrial thermal energy requirement.

The Innovation

The ARUN solar concentrator, developed from first principles by alumni of the Indian Institute of Technology (IIT), Bombay, India's premier R&D and Engineering institute, combines ingenious technology and engineering inputs while considering practical constraints, making it a commercially viable solar thermal solution for industrial applications. The first ARUN solar thermal system was installed with financial support from the Government of India and technical support from IIT Bombay for a dairy for providing thermal energy for milk pasteurization in 2006. Since then, ARUN systems have been installed on pilot basis at a hotel for laundry purposes, chemical industry for effluent evaporation, automobile manufacturer for degreasing process, and educational institute and religious place for cooking. The patented ARUN® dish is a Fresnel paraboloid solar concentrator with a point focus. Optics, Tracking, and Receiver are the key components of any solar concentrator system, and ARUN boasts of excellence in each of them. ARUN technology is based on the basic principles behind a magnifying glass and a sunflower. Although solar concentrator technology is not new, it is probably the only fresnelized solar concentrator in the world. The advantages of fresnelization are multifold — (a) better structural stability, (b) ease of manufacturing, (c) better accuracy resulting in higher efficiencies, and (d) ease of maintenance. ARUN's dual-axis, completely automated tracking is based on both, chronological tracking as well as light sensing tracking mechanism, ensuring high tracking accuracy. The cavity shaped receiver ensures minimal thermal losses from the receiver mounted at the focus of the paraboloid. All these result in system efficiency of 60–65%, highest in the industry.

ARUN Variants

ARUN160

ARUN100

ARUN30 (older version)

The author is Director, Clique Solar; E-mail : adb@cliquesolar.com

The Future Potential

The increasing awareness and economic viability have helped in creating demand for solar concentrator systems, not only in India, but also in almost all regions of the world including Europe, Middle East, Australia, and North America. Studies indicate that while starting from a small base, the market is set to increase at an exponential rate over the next decade.

What's Our USP?

Any end-user bases his/her decision on: (a) lifetime cost of energy, (b) space required for installation, and (c) performance guarantees.

The lifetime cost of energy is a result of: (i) manufacturing cost, (ii) system efficiency, and (iii) life of the system. Having conceptualized and developed the ARUN technology in-house and with field experience of over a decade, significant optimization in cost has been achieved. The system efficiency is one of the highest in the industry. Since ARUN uses components like steel and Reinforced Cement Concrete (RCC), life is greater than 25 years.

ARUN dish is mounted on a single column, occupying little ground area making it ideal for industries with space constraints.

Having been developed by scientists from first principles, tested over a decade in labs at IIT Bombay and in the field, the thermal output from ARUN can be accurately predicted, enabling Clique Solar to give financial guarantees on the output commitment.

The thermal storage battery is the first-of-its-kind in the world. Being dual-axis tracking, it can operate at any location on the earth, including the poles equally well. Also, being a robust technology, the breakdowns are minimal, reducing the necessity of after sales service.

What's Our Business Model?

Clique Solar has optimized its project execution mechanism, its business model, and the sales model. Being a technology company, Clique Solar has tied up with top Engineering Procurement & Construction (EPC) players to execute the projects whenever required (on a case to case basis), while Clique Solar can continue to focus on technology development.

New version of Arun30 dishes at the Police Training Centre for cooking application in Ongole, Andhra Pradesh

Being a capital heavy investment and given the high interest rate regime (in India), clients are anxious to invest in solar projects. As a result, Clique Solar is developing a 'Build-Own-Operate-Transfer' (BOOT) model, where the client only pays for the thermal energy delivered. The thermal energy measurement mechanism at low volumes become a challenge and Clique Solar has done some incremental innovation in this area.

Again, being a nascent industry, project enquiries come from across the globe. Carrying a heavy sales force on company roles is not capital efficient. Clique Solar has developed business associates across India and a few in Middle East to ensure 'last mile connectivity'.

Whom Do We Sell To?

A boiler is an industrial equipment that is needed in most manufacturing industries. Clique Solar targets industries that use liquid fuel for their thermal energy needs. In India, these have primarily been in the dairy, auto, pharma, food processing, and mass-cooking sectors.

After completion of its first project, which was for Mahanand dairy, Clique Solar earned two more projects for same application in other dairies in India, viz., Chitale Dairy and Salem Dairy, each of these projects larger in size than the previous one. Having established its presence successfully, it is also in talks with a large number of dairies for bigger projects.

Similarly, Clique Solar has worked with some of the top automobile manufacturing companies such as Mahindra, TVS Group, Bajaj Auto, and Hero Motocorp after establishing itself as a company providing thermal energy solutions for the auto sector. It is also establishing a similar reputation in the mass-cooking segment with its ingenious thermal storage battery, a need for this application. It has commissioned projects for the Akshardham Temple and the Ramkrishna Mission.

Also, Clique Solar is trying to break into the pharmaceutical, textile, and the food processing sectors, which have big potential. Some of Clique Solar's other customers include reputed names such as National Thermal Power Corporation (NTPC), Department of Defence, Indian Tobacco Company (ITC), Christian Medical College, etc.

The Challenges We Face

Clique Solar currently faces market barriers on the following three fronts:

- *Awareness and Confidence*: Most potential users are not aware that steam can be generated by using solar energy. Even in institutions that are aware of this fact, being a relatively new application of solar energy and the large capital cost of the project, potential clients are not able to feel confident about the technology and solution.
- *Creation of Demand:* The Indian solar PV industry is a global success story. This was achieved mainly by the government that created demand on a large scale when solar PV was not economical. This helped to drive down costs and create a sustainable ecosystem. Similar initiatives need to be taken by the government for solar thermal industry.
- *Funds Availability*: Since the market is being created, aggressive and innovative marketing strategies are required. Innovative business models where the technology provider takes technology risk needs to be evolved. Further R&D is required for making improvements in the efficiencies on an ongoing basis. All these activities require funding, especially at a cheap rate.

ARUN® INSTALLATIONS

S. No	Client details	Application	Thermic Fluid	Type of dish	Nos	Aperture Area (in sqm)	Peak Delivery	Usage
1	Mahanand Dairy, Maharashtra	Industrial Process Heat	Pressurized Hot Water	ARUN®160	1	160	15 bar and 150˚C	Pressurized hot water for milk pasteurization with storage
2	Chitale Dairy, Maharashtra	Industrial Process Heat	Steam	ARUN®160	2	338	5 bar	Steam generation for pasteurization, Milk chilling, cleaning in place (CIP), etc.
3	ITC Maurya, New Delhi	Industrial Process Heat	Steam	ARUN®160	2	338	8 bar	Steam generation cooking, washing, laundry, etc.
4	Heavy Water Board, Government of India, Rajasthan	Industrial Process Heat	Steam	ARUN®160	4	676	5 bar	Steam generation for effluent treatment plant
5	Mahindra, Maharashtra	Industrial Process Heat	Pressurized Hot Water	ARUN®160	1	169	15 bar and 150˚C	Hot water generation for degreasing
6	Turbo Energy Limited (TVS Group), Tamil Nadu	Cooling	Pressurized Hot Water	ARUN®160	2	338	15 bar and 150˚C	40 TR Air-Conditioning by VAM (Vapor Absorption Machine)
7	NTPC (NETRA), Delhi	Cooling	Steam	ARUN®160	2	338	8 bar	50TR HVAC (Heating, ventilation, and air conditioning) system with 2-day storage
8	Akshardham Temple, Delhi	Cooking	Steam	ARUN®100	1	104	5 bar and 150˚C	Solar cooking. for preparing around 4,000 meals a day.
9	Ram Krishna Mission, Tamil Nadu	Cooking	Steam	ARUN®100	1	104	10 bar	Steam cooking for cooking including storage for non-solar hours
10	Christian Medical College, Tamil Nadu	Industrial Process Heat	Pressurized Hot Water	ARUN®100	1	104	5 bar and 120˚C	Boiler feed water heating
11	Police Training Centre, Anantpur, Andhra Pradesh	Cooking	Steam	ARUN®30	2	68	7 bar, 170˚C	Steam generation for cooking
12	Police Training Centre, Ongole, Andhra Pradesh	Cooking	Steam	ARUN®30	2	68	7 bar, 170˚C	Steam generation for cooking
13	Salem Dairy, Tamil Nadu	Industrial Process Heat	Steam	ARUN®160	2	338	5 bar, 150˚C	Steam generation for milk pasteurization
14	Anandvan, Maharashtra	Cooking	Steam	ARUN®100	1	104	7 bar, 170˚C	Steam generation for cooking
15	Bajaj Auto, Maharashtra	Industrial Process Heat	Pressurized Hot Water	ARUN®160	1	169	5 bar and 120˚C	Hot water generation for degreasing

The Risks We Face

Like any other solar business, Clique Solar faces the following risks:

- Investment in solar becomes viable only when the cost of the substitute form of energy is expensive. In Clique Solar's case, it is the cost of furnace oil, diesel, natural gas, coal, etc. A fall in the cost of substitute fuels will make solar concentrators unviable.
- Investment in solar system is a discretionary spending even today. The manufacturing process does not shut down if solar is not available. Any economic downturn will cause companies to cut down budgets on such discretionary spending, thereby reducing the market demand drastically.

The Awards We Have Won

- WWF – Climate Solver 2013 award
- Intersolar
- 'Best Technology' award at Intersolar Europe 2013
- 'Best Solar Project' award at Intersolar India 2012
- CSP Today
- Amongst the top three in 'Best Technology Supplier' award category at CSP Today Awards at Spain in 2012
- 'Most Innovative Energy Efficient Solution' Award by CII in 2013 and 2014.

WHAT MANUFACTURERS' WANT TO TAKE UP CST MARKET AT LARGE SCALE IN INDIA?

Geetanjali Patil Choori

LeverageNet Solutions Pvt. Ltd (Energy Guru) is an empanelled Concentrated Solar Technology (CST) manufacturer and channel partner with MNRE. The team of Energy Guru designed SharperSun, the largest aperture parabolic trough in the world used in process heat applications. The SharperSun trough is a high performance parabolic trough concentrating solar thermal collector.

The design was devised after best and proven utility-scale parabolic trough designs with important innovations to improve performance and significantly reduce capital, installation, and operating costs. Energy Guru® has been operating out of Pune to serve its client project needs.

Pune is becoming a hub of Concentrating Solar Thermal Heat manufacturers with major players like Thermax, Forbes Marshall, and Energy Guru. Pune is also a major testing centre for Solar Thermal systems. As Pune is well known for its automotive manufacturing hub, well-trained resources are enrolled for manufacturing of CSTs.

If China's can Provide PV to the World, India can Supply CSP and CST.

Slow and steadily, India has emerged as highly innovative and cost competitive nation in Concentrating Solar Thermal systems. India has great engineering resources and many innovative brains to solve the nation's real needs. Considering that the country is blessed with abundance of solar energy, Concentrating Solar Thermal has a great potential in India to significantly displace industrial fossil fuel using solar heat.

Manufacturers like Thermax, Energy Guru, Megawatt, Clique, etc., have come up with many innovative ideas in their efforts to make Solar Thermal commercially viable. On CSP manufacturing front, Thermosol Solar (Cargo Solar) has started manufacturing parabolic glass in order to support the CSP growth in India. Many global players in CST like Ausra/Arvea Solar, Sopogy, or Cogenra have been going down due to their high cost operations. However, Indian players are surviving due to their lower cost of operations although the market has not taken off.

The Ministry of New and renewable Energy (MNRE) along with the United Nations Development Programme (UNDP) are focused on market development efforts through various nationwide workshops and newspaper advertisements. The MNRE, along with the UNDP, is supporting CST projects up to 45–50% project cost in the form of subsidy and grant, respectively.

Despite many efforts, the adoption to CST has been a slower than expected in India. Awareness of CST systems and availability of financing of projects is definitely challenging.

Similarly, CSP also has been hit due to some policy related in its initial stages of the Jawaharlal Nehru National Solar Mission (JNNSM).

SharperSun at a surgical cotton factory using solar thermal process heat, Valsad, Gujarat

So What do Manufacturers Want? Solar, Make in India

Energy Guru here shares its manufacturers' perspective through its wish list to help CST market take off in India so that the country becomes the supplier of CST systems globally.

- Enough research has been going on Concentrating Solar and the same will continue. However, more efforts should be made to understand the manufacturers' perspective. Just like the way China supported Solar PV manufacturers by financing, Solar Thermal manufacturing sector should be supported by the Indian Government to take leap into this niche crucial sector. Working capital and other financing should be provided to manufacturers to protect India's interest to become a leader of CST manufacturing.
- Indigenously developed, scalable, and suitable CST technologies should be included in larger CSP projects. There has been a PV policy to protect local manufacturers; PV is a open market now as the scale of PV market has exponentially gone up. We need similar short-term policy to protect local CST manufacturing.
- Solar Renewable Energy Certificate (REC) for Concentrating Solar Thermal projects should be made possible. This would help us scale up the CST projects and make them more viable for larger projects.
- Project financing activities should be promoted and banks should be educated or incentivized to have them finance CST projects. Indian Renewable Energy Development Agency (IREDA) should also step up its efforts and reduce paperwork to support CST projects.
- The government should create and implement a policy for including CST for any entities utilizing fossil fuel in their energy mix.
- Within Solar RPO, it should create a segment for CST/CSH component.
- The government should create and implement policy to implement CST through CSR funds.
- Wood in industrial heating should be banned or its usage should be reduced as India does not have enough trees to be used by factories. The beneficiaries should be incentivized specially for moving to Concentrating Solar Thermal from wood. Payback for wood-based projects is not great because of the cheaper availability of wood. Double environmental benefit!
- Although marketing development workshops by consultants have been helpful, more support is needed for market development effort by the manufacturers.
- Last but not least, the MNRE and the UNDP both should expedite their process of disbursing subsidy/grant funds so that working capital for manufacturers does not get stuck due to which new projects cannot be taken easily.

Shri Piyush Goyal inaugurates New Solar Passive Building of the National Institute of Solar Energy

Shri Piyush Goyal, Union Minister of State (IC) for Power, Coal and New and Renewable Energy, inaugurated "Surya Bhawan" the New Solar Passive Building of the National Institute of Solar Energy (NISE) situated in Gurgaon, Haryana on 14th May, 2015. The NISE is the apex National Centre of research and development in Solar Energy under administrative control of the MNRE, Government of India. It coordinates solar energy research & technology related work in the country under the Jawaharlal Nehru National Solar Mission (JNNSM). On the occasion, Shri Goyal said "in coming days, role of the NISE will take quantum growth particularly when energy security of the country is intrinsically linked with success of Renewable Energy mission." He further said that our efforts to reach 175000MW of RE shouldn't be completed by 2022 but by 2019-20 by putting all of our efforts.

The author is CEO & Co-Founder, LeverageNet Solutions Pvt. Ltd; E-mail: contact@energy-guru.com

CST (SCHEFFLER TYPE) – READY FOR LARGE-SCALE PROMOTION IN INDIA

Sanjeev Kachhwaha

Since the transformation from Kachhwaha Enterprises to **K Energy** in 2009, we have focused more on research and development (R&D) and implementation of various marketing skills to increase the presence of CSH technologies. The expected growth of these CSH technologies was still low as compared to SPV & SWH which made its chances of survival doubtful. The market growth of SPV & SWH was enhanced as major market shares were utilized in government buildings and building byelaws by various state governments with assistance from the Ministry of New and Renewable Energy (MNRE); whereas, not many efforts were made in the case of CSH technologies.

CSH was initially introduced in India for mainly community cooking purpose. It was later realized that the same can be used in industrial applications too. This resulted in the introduction of many more technologies in the CSH basket but then we lost our goal as we kept on adding more and more CSH technologies rather than focusing on core issues of the technology. The number of manufacturers increased but we didn't know how many of them were serious.

By looking at past, we are also not sure if all the system are still in working conditions. Many old systems may not have been functioning well. This is not because of the failure of technology but due to unnecessary exploitation of technical humbleness of the system by some of our industry players resulting in landing on no men's land where we have not moved further as expected.

As **K Energy**, we have installed our systems in almost all the terrains of the country in past 4–5 years ranging from the hot desert of Rajasthan to the cold desert of Leh, Ladakh, J&K, from far East till Tawang in Arunachal Pradesh to the coastal belt of Odisha and Andhra Pradesh. All these places have different topographies with positive and negative stories. The dish moves like a sunflower and delivers its optimum output based on the DNI of that day unlike SPV & SWH which remain static and can work on low solar radiations.

We salute its inventor **Mr Scheffler** who introduced this technology with a vision to reach the village level, where with the help of this technology, mass cooking is possible without wasting wood or other fossil fuel and the system can be maintained by the locally available parts. Motive got its feather for urbanization with its first installation at Brahmakumaris' Ashram, Mount Abu followed by another at Tirupati Temple in Andhra Pradesh and slowly spread its presence throughout the country with the efforts of **Mr Deepak Gadhia** and the **MNRE**.

Indoor cooking at China border

The author is Chief Executive of K Energy, Jodhpur, Rajasthan; E-mail: sanjeevkachhwaha@gmail.com

Solar steam cooking system at girls hostel of University of Rajasthan

Today, the MNRE has taken necessary steps by providing technical support to maintain these systems which is appreciable. Along with providing technical support the ministry also takes the initiative to attract more buyers by either enhancing the capital support or by increasing the IT benefit from present 80% to 125% for the under privileged CSH technologies which could be a landmark achievement in terms of saving fossil fuel of our country. For involving more and more manufacturers, the MNRE can also support them by providing interest subsidy on capital investment so as to ease the cost burden on buyers.

Looking at our past experiences we realized that this technology is only successful if operated and maintained (O&M) properly unlike some of our fellow industry players who have tried making it fully automatic which will do nothing but increase its capital cost. We feel that the MNRE should promote more of **ESCO/PPP** version models where the promoter or its **SPV** (special purpose vehicle) takes the responsibility to invest, install, operate, and maintain the system and recover the system cost with its profitability within 10–15 years by sharing its profit with the beneficiary. It will not only increase the presence of such technologies, but also increase the confidence of beneficiary as well investor in such mission.

K Energy has installed a number CST-based systems using Scheffler technology and our experience on the performance of the technology at all the places has been very good. I propose that the MNRE should not lose focus from this established technology of Scheffler while promoting the newer technologies.

TAYLORMADE SOLAR SOLUTIONS: A DEDICATED PROMOTER OF CSTS IN THE COUNTRY

Dharmendra Gor

Taylormade Solar Solutions Pvt. Ltd (TSSPL) is an ISO 9001–2008 registered company. First Generation Entrepreneurs, who have the world's most experienced team in solar thermal technology, are its promoters.

TSSPL's primary objective is to provide solar thermal parabolic concentrators for various thermal applications by using the technology of parabolic concentrators as a competitive, non-subsidized source of energy. The company is operational in installing various CST-based systems for more than 12 years. The company has also acquired experience in various applications such as cooking, heating, air conditioning, process heating, producing steam, thermic fluid heating, pressurized hot water, and many more.

The company's manufacturing plant has been inspected and certified by the Gujarat Energy Development Agency (GEDA) and the Ministry of New and Renewable Energy (MNRE). TSSPL has also undertaken research, design, development, and promotion of improved technologies on concentrated solar heat. It has tie-ups with the Sardar Patel Renewable Energy Research Institute, Gujarat, Madanjeet School of Green Technologies, Pondicherry University, The Kalgidhar Trust, Baru Sahib, Himachal Pradesh, Eternal University, Himachal Pradesh, and IIT-BHU, Varanasi, UP. The company is also a channel partner of the MNRE. The company is well represented all over India though a strong network of dealers and distributors.

Dealer and Distributor Network

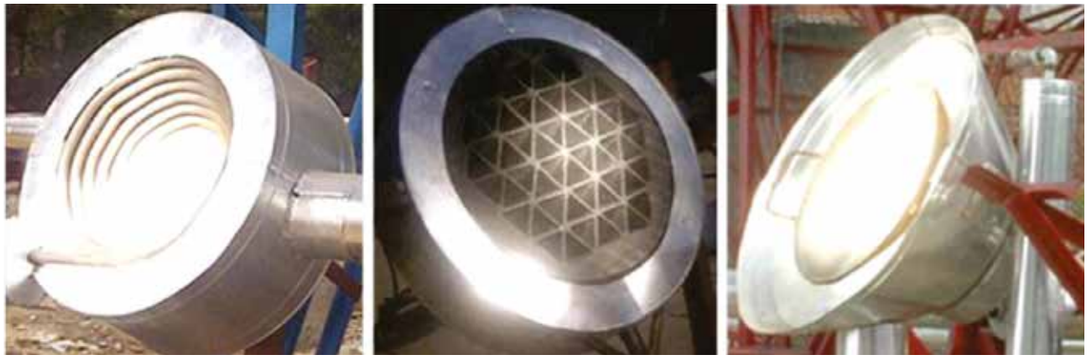
Scheffler Dishes

Technologies in Promotion

TSSPL is promoting dish solar cookers of various sizes for direct cooking to individuals as well as in institutions. It is also promoting Scheffler dishes of 16 and 32 sq. m sizes for the purpose of community cooking in institutions and process heat applications in industries and commercial establishments. It has its manufacturing facilities at Valsad, Gujarat.

The author is MD, Taylormade Solar Solutions Pvt. Ltd., Ahmedabad, Gujarat

Dish Solar Cookers



Different types of receivers

Company's Experience

TSSPL has immense experience in the development and promotion of CSTs and has been involved in manufacturing, installing, and commissioning of almost all the prestigious projects all over India such as:

- World's single largest order for 22 solar cooking systems in various Akal Academies of The Kalgidhar Trust
- Pressurized hot water system for VAM for air-conditioning plant
- World's first thermic fluid cooking system for all cooking applications
- Thermic fluid heating system for heating water for vulcanization of Sioplas Cables
- Solar hot water system for boiler feed water in paper industry
- World's first steam cooking system at Gurudwara Shri Maan Dhan Dhan Baba DeepSingh Ji Shaheed, Punjab for 6,000 meals per day

Manufacturing Facilities at Valsad, Gujarat

Some of TSSPL's Prestigious Clients

- Space Application Centre, ISRO, Ahmedabad
- Jindal Power Ltd, C.G
- Vardhman Yarns, Distt. Raisen, MP
- Radhakrishna Realty Pvt. Ltd, Ahmedabad, Gujarat
- Ramrao Adik Public School, Distt. Ahmednagar, Maharashtra
- Gurudwara Cheema Sahib, VPO. Distt. Sangrur, Punjab
- Police Training College, Distt. Kangra, HP
- Gurdwara Karamsar Rara Sahib Trust, Village & PO Karamsar, Punjab
- The Kalgidhar Trust, Baru Sahib, Distt. Sirmore, HP
- Gurudwara Shri Maan Dhan Dhan Baba Deep Singh Ji Shaheed, Ropar, Punjab
- Grauer & Weil (INDIA) Limited, Village, Dadra (D & NH)
- Hindustan Vidyut Products Ltd, Faridabad
- Haryana Police Housing Corporation Ltd, Haryana
- B. S. Paper & Board Mills, Ludhiana, Punjab
- HIMURJA, Shimla, H.P. & KREDA, Kargil, J&K
- Vardhman Fabrics, Dist. Sihore, MP
- Anant Spinning Mills, MP
- IIT Roorkee, Uttarakhand

EVENTS UPDATE

TRAINING PROGRAMME AT MOUNT ABU ON APRIL 17-19, 2015

A training programme dedicated to 16 sq m Scheffler paraboloid reflector was organized by the World Renewal Spiritual Trust (WRST) under MNRE-UNDP-GEF Concentrated Heat Technologies Project. The programme gathered 21 participants representing 11 manufacturers, installers, consultants, industrialists, and institutional users from all over India. The three days of training were a fusion of theoretical and practical field sessions combined with visits to number working CST projects employing Scheffler dishes in Abu. Participants got the chance to learn and visit number of Scheffler dish applications, where solar heat was being generated and used for various institutional applications such as cooking, laundry, and sterilization of instruments in the hospital. The participants showed great interest, expressed by active interaction and high level engagement during sessions and networking time.

FIRST MEETING OF CSH PLATFORM AT MNRE ON APRIL 21, 2015

A CSH platform was formed for all the CSH stakeholders to address issues related to CSTs and find solutions for their large scale promotion in the country. This was the first meeting held at MNRE office, New Delhi was attended by 30 participants representing manufacturers, consultants, financial institutions, project management teams and MNRE officials, SNAs and other agencies. The matters related to the promotional tools such as *Sun Focus magazine*, electronic newsletter, and toll-free number were discussed. The stakeholders also conversed regarding the financing and implementation of projects. It was also recommended to approach the HRD and Health Ministry for promotion of CSH projects and applications.

WORKSHOP AT BENGALURU ON MARCH 13, 2015

The Peenya region workshop was the final workshop of the six workshop assignment on "Market development of CSTs for process heat/cooling applications in the industrial sector" awarded to PwC. The workshop was in the Peenya Industrial region of Bengaluru and was organized in association with the Peenya Industrial Association (PIA). PIA is amongst the biggest associations in South Asia, with a membership of about 6,000 industries including major several automotive and textile industries. The event was well supported by the industry, with more than 50 participants, considering the higher solar irradiance in the region. The participants raised issues in terms of integration of solar based systems within their existing processes, which were convincingly addressed by the suppliers and PwC.

BUSINESS MEET AT DHARAMSHALA ON APRIL 17, 2015

A half day Business Meet on 'Concentrating Solar Technologies for Community Cooking, Space Cooling & Process Heat Applications' was organized by HIMURJA at Hotel Dhauladhar, Dharamshala, Distt Kangra. This meet was sponsored by UNDP-GEF Concentrated Solar Heat Project under the Ministry of New and Renewable Energy, Government of India.

As per the guidelines various stakeholders were invited to participate in the business meet and was attended by a 70 participants from the Educational Institutions, Welfare Department, Industries, Health, Police Departments and a number of manufacturers associated with manufacturing of systems based on the Concentrating Solar Technologies. Representatives from MNRE emphasized the usage of renewable devices and the CSTs available in the market. During the question and answer session many of the participants showed keen interest in the technology and requested the manufacturers to visit the site so that proposals could be generated and forwarded to the Ministry for approval.

FORTHCOMING EVENTS

NATIONAL

Solar South
June 19–21, 2015 | Chennai, India
Website: http://10times.com/solar-south

Govt Achievements & Schemes Expo
July 29–31, 2015 | New Delhi, India
Website: http://10times.com/govt-achievements-schemes

World Renewable Energy Technology Congress & Expo
August 21–23, 2015 | New Delhi, India
Website: http://10times.com/wretc

Renewable Energy India
September 23–25, 2015 | Greater Noida, India
Website: http://10times.com/renewable-energy-india

INTERNATIONAL

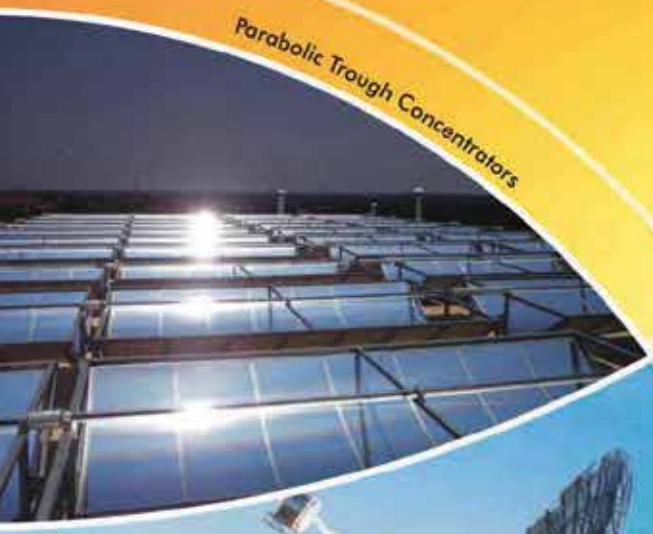
Shanghai Solar Cum Photovoltaic Solar Thermal & Building Integrated Exhibition
30 June–2 July 2015 | Shanghai, China
Website: http://10times.com/esbuild

Intersolar North America
July 14–16, 2015 | San Francisco, USA
Website: http://10times.com/intersolar-north-america

Green Expo
August 4–6, 2015 | Olinda, Brazil
Website: http://10times.com/green-expo-olinda; http://10times.com/wretc

Asia Pacific Clean Energy Summit and Expo
August 24–26, 2015 | Honolulu, USA
Website: http://10times.com/asiapacific-cleanenergy-summitexpo

Solar Energy UK: Energy Plus
October 13–15, 2015 | Birmingham, UK
Website: http://uk.solarenergyevents.com/energy-plus



gef

Government of India

UNDP

CONCENTRATING SOLAR THERMAL SYSTEMS

A call to industries, institutions & commercial establishments for installing Concentrating Solar Technologies to save fossil fuel & reduce carbon foot print

SALIENT FEATURES

- Can provide steam/hot oil/ pressurized water at 90-350 C
- Integrated with conventional boiler provides trouble free operations during non-sunshine hours. Systems with heat storage also available
- Gives economic return in 3-5 years besides getting a green tag
- Around 200 systems of various capacities working in country.

FINANCIAL SUPPORT AVAILABLE

- 30% of benchmark cost as government subsidy
- Higher subsidy in special category states
- 80% accelerated depreciation to profit making bodies
- Up to 15% of cost limited to Rs. 75 lakhs from UNDP-GEF project for specific activities.

Interested Organizations may contact our Channel Partners (**Clique Solar, Mumbai** : 09665055059; **Essential Equipment, Dhule** : 09822187693; **Leverage Net Solutions, Pune** : 09970319054; **Megawatt Solutions, Delhi** : 09654451401 ; **Taylormade Solutions, Ahmadabad** : 097129 33390; **Thermax, Pune** : 020-67308885 or 67308880; **Ultra Conserve, Pune** : 9004445530; **Unison, Bangalore** : 080- 22289663/ 22355239;) and **Consultant- PwC** : 081-30322334 or write to us at following address. For more details, visit our website www.cshindia.in.

National Project Manager

UNDP-GEF Project on Concentrated Solar Heat

Ministry of New & Renewable Energy

Block 3, CGO Complex, Lodi Road, New Delhi-110003. Telefax: 011- 24363638, E-mail: singhalak@nic.in,

Toll Free Helpline No. **1800 2 33 44 77**