a quarterly magazine on **concentrated solar heat**

SUN FOCUS

Volume 3
Issue 3
Jan–Mar 2016

INDIA'S QUEST FOR **SOLAR STEAM & PROCESS HEAT**

UNDP–GEF CSH Project
Ministry of New and Renewable Energy
Government of India

SUN FOCUS

Volume 3 • Issue 3
January–March 2016
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concentrated solar heat

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Cover image: UCPL Parabolic Trough installed at Zytex Biotech Pvt. Ltd, Vadodara

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MESSAGE

India is a country with rich solar resource and Government of India has modified Jawaharlal Nehru National Solar Mission (JNNSM) target of 20 GW Solar power to ambitious 100 GW solar power by 2022. Government's emphasis on solar energy is due to the fact that it produces clean and emission free energy while reducing country's dependence on fossil fuels. Apart from power generation, solar energy can also play an important role in saving fuel used for heating and cooling applications in industrial, institutional and residential sectors through Concentrated Solar Thermal (CST) technologies. The Ministry of New and Renewable Energy (MNRE) has initiated couple of projects in association with UNDP and UNIDO to promote CST applications through financial and fiscal support to users and technology providers/ manufacturers. MNRE has also taken steps to develop Renewable Energy (RE) Policy in this regard.

CST technologies, both in India and on global scale, are in nascent stage but have huge potential to impact carbon footprint of global industrial sector in a significant manner. For a developing country like India, CST technologies offer very attractive proposition. The clean and emission free source of energy will help reduce fossil fuel consumption significantly. This will also reduce carbon footprint of industrial sector assisting India's commitment to reduce its greenhouse emissions.

The Government of India (GoI) through Bureau of Energy Efficiency (BEE) has initiated massive program for energy conservation across all sectors and promotion of CST technologies to further reduce fossil fuel consumption is next logical step in this direction. These technologies offer opportunities for development of indigenous technologies which can create local jobs and take forward 'Make in India' initiative launched by the Hon'ble Prime Minister Sh. Narendra Modi.

The MNRE has recognized this potential and has taken systematic efforts for development and support of CST sector. These efforts have culminated into installation of approximately 42,000 m² of aperture area of CST systems into community cooking, process heating and cooling applications. Publication of SUNFOCUS magazine is one of such initiatives by MNRE, which is spreading awareness about CST technology all over the country.

I wish SUNFOCUS well for its continued journey and further progress.

Piyush Goyal

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Message

Concentrated Solar Thermal (CST) Technologies for heating and cooling applications is a promising and emerging sector for Indian Industry having potential for large scale investments in manufacturing and user industries.

India is bestowed with high solar radiation potential and with its overall industrial development it offers good market opportunities for CST industry. Industries like food, beverage, dairy, textile, machinery, and pulp and paper industries, where predominant heat requirement is below 250°C, are most suitable for CST implementation. CST sector in India has progressed well since last few years under the leadership of MNRE with support from UNDP, GEF and UNIDO. However, it is still far away from commercial maturity. Our focus for coming years is to develop market through sector specific interventions.

It is also important to improve applicability of CST technologies to large, energy intensive, industries and smaller MSME industries. The MSME sector has tremendous potential for CST in India, provided customized technology solutions are provided and industry specific issues such shortage of space and lack of capital for high upfront costs are catered.

Ministry of New and Renewable Energy has undertaken the efforts for growth and development of CST sector since long time and various initiatives covering all important aspects of the sector. There are efforts towards standardization and indigenization of important CST technologies, awareness generation of various stakeholders such as user industries, financial institutions, and improvement in performance reliability of CST technologies and off course financial incentives through various schemes.

To accelerate the growth of CST technology, the Ministry is also implementing a UNDP-GEF supported project on "Market Development & Promotion of Solar Concentrator based Process Heat Applications in India". The objective of the project is to promote and commercialize Concentrating Solar Technologies for industrial process heat applications in India and facilitating the installation of 45,000 m^2 of installed solar collector area by March 2017 through demonstration and replicated projects. This year it has initiated another multiyear project in association with UNIDO for promotion of CSTs which is an initiative for reaching out to various stakeholders in India.

Sd/-

Shri Upendra Tripathy

Secretary
Ministry of New and Renewable Energy,, Government of India

From the editor's desk...

Dear Readers,

I am pleased to share the eleventh issue of *SUN FOCUS* with you all. Each issue is designed based on a theme to cover a particular aspect of Concentrated Solar Thermal sector. So far, the magazine has covered various aspects, such as policy, technology developments, new applications, and national and international scenario for the concentrated solar thermal sector.

The current issue of *SUN FOCUS* is themed 'India's Quest for Solar Steam and Process Heat' and covers various recent and interesting developments. The special feature of this issue covers a really promising development by Thermosol Glass Pvt. Ltd, 'Indigenous Solar Grade Mirror Manufacturing in India'. Importing high quality solar grade mirrors has always been an important bottleneck and economic constraint for solar collectors. Indigenous manufacturing of mirrors could definitely pave the way for cost reduction and easy availability of mirrors—a key component of solar thermal collectors.

The article from Ultra Conserve Pvt. Ltd discusses the indigenous technology development of OptiTrough 300, a parabolic trough type concentrator. The article from Quadsun Solar introduces the development of high efficiency combined concentrated solar heat and power systems. There is also an article about the experience of solar steam cooking system working in the tribal area of Chhattisgarh. The article by Mr Amit Kumar elaborates on schemes and finance models from banks, developed specially for the CST sector. Lastly, there is a case study of the CST installation in the Laundry industry, Goa.

I am sure you will find this issue interesting, relevant, and informative as always. I also look forward to your valuable contribution in the magazine—in the form of comments, suggestions, and articles, which will help us improve the quality of the magazine even further.

Sd/-

Tarun Kapoor

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

INDIGENOUSLY MADE SOLAR GRADE PARABOLIC TROUGH MIRRORS BY THERMOSOL GLASS PVT. LTD

Biswas Kumar[1] and Sapna Hemani[2]

The Cargo group was incorporated under the dynamic vision and leadership of founder Late Mr Y P Nanda. Since then, the company has grown over the last five decades to become a conglomerate with diverse ventures spanning across automobile, hospitality, manufacturing, logistics, glass processing, renewable energy, and infrastructure.

First and only-of-its-kind in India, M/s Thermosol Glass Pvt. Ltd (A Cargo Group Company) located in Kutch, Gujarat, is a technology oriented company equipped with ultra-modern, renowned European and American machines producing parabolic tempered mirrors (PTM), reflectors, and heat concentrators.

About the Plant

With investment of over ₹850 mn, the plant is equipped with one of the global best facilities comprising the tempering and bending furnace from Glasstech USA, mirroring line from Kloepper, Germany, fully automatic robotic and PLC controlled conveyors from Gudel (Switzerland). A sizable investment is also made to associate a highly modernized indigenous test lab facility involving environmental test chambers from Kohler (Germany), Memmert (Germany), online optical test equipment ISRA (Germany), offline latest equipment LAMBDA 1050 UV/Vis/NIR Spectrometer from Perkinelmer, USA. The lab is equipped to test environmental ageing, decay, optical performance and mechanical correctness for solar efficiency. Clubbing all this, makes the plant one of the best facility globally, having 1.1 million sq. m annual production capacity.

Picture 1: Plant view

Product Specifications

The product specifications compete for long-term reliability and performance. The process line is highly precise and standardized sizes assure production repeatability and availability of similar product during Operation and Maintenance period of installed project life cycle. The key features of the product are assured durability coating, lasting 20 years and above; best in class reflectivity, i.e., 94 per cent and above using solar grade low iron glass; highly optically efficient and mechanically correct; dimensionally controlled—made with tempered and heat strengthened glass—making the mirrors safe and up to five times rouged than normal glass mirrors.

Putting all the above together, makes the product revolutionary for Indian solar thermal and power sector requirements. More than seven million such mirrors produced by limited global players having similar plant facilities are already functional in various environmental conditions since decades.

Encouraged by the MNRE and appreciated by established channel partners and start-ups, these solar grade mirrors will be the turnaround milestone for solar, such as water and waste water management, brine and seawater desalination, steam augmentation and steam enhancement cycles, enhanced oil recovery (EOR) application, and other off-grid and decentralized solar applications under JNNSM.

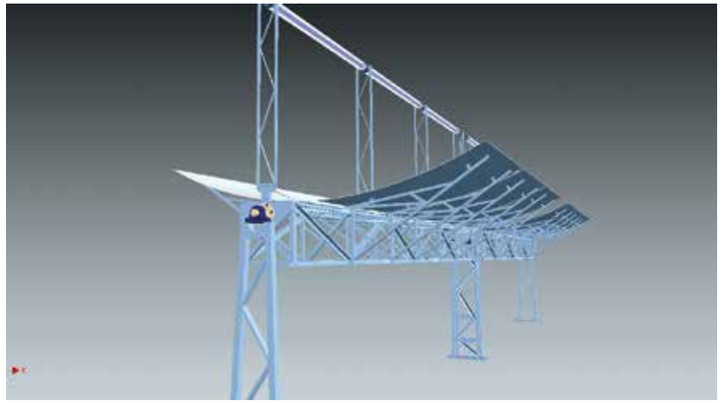

Figure 1: Engineering drawing of mirror application

Picture 2: Actual installed mirrors with structure

Picture 3: Equipment for making parabolic trough mirrors

Government Support and Policy

The Government is taking several proactive measures to infuse growth in green energy dependence. There is need for hand-holding to encourage manufactures to bring a highly capital intensive advanced technology in India. There shall be provisions in policy for accelerated depreciations, deemed export criteria for selling these mirrors manufacturing in domestic tariff area, technology, funding and partnering support for engineering while commissioning of initial commercial demonstration projects in the mentioned area.

We are optimistic that these mirrors will fulfil the crucial need of Indian CST/CSP sector, standardizing specifications thereof, to bring back the trust of industries. The optimized engineering integration and technology standardization with the help of Apex agencies and regulatory bodies will enhance the acceptance of these products in the sector.

[1] *DGM-Projects, Cargo Power & Infrastructure Pvt. Ltd; Email: bks@cpil.co.in*

[2] *AGM – Finance, Thermosol Glass Pvt. Ltd; Email: sh@thermosolglass.com*

OptiTrough 300: AN INDIGENOUSLY DESIGNED GLASS REFLECTOR BASED PARABOLIC TROUGH CONCENTRATOR

Vivek Mahajan[1]

Ultra Conserve Private Limited (UCPL) is a solar thermal company focussed on increasing profitability of its customers by reducing conventional fuel consumption and increasing thermal energy efficiencies. The company manufactures the OptiTrough 300 and executes turnkey projects for Industrial customers. They also provide solar thermal energy solutions to industries for their process heat requirements, catering to temperatures up to 350 °C, using a variety of heating media, such as water, steam, thermic fluid, or air. Each solar thermal energy system is engineered for the specific requirements of the customer.

UCPL's OptiTrough 300 is an indigenously designed Parabolic Trough Concentrator, conceptualized and designed by its Founder and Director, Mr Siddharth Udas. The OptiTrough 300 is approved by the MNRE for Capital subsidy.

Salient features of OptiTrough 300

The OptiTrough 300 is a single axis tracking, fully automatic, high efficiency Parabolic Trough Concentrator. At the heart of the OptiTrough 300 are parabolic shaped glass mirrors that move with the sun, focussing the Solar Radiation onto a tubular absorber. The circulating fluid (water/oil) inside the absorber gets heated and carries the heat to the process. Peripherals such as pumps, storage/expansion tanks, and temperature/pressure sensors complete the thermal loop. This entire solar thermal energy system is automatically controlled and monitored remotely using the Performance Monitoring System (PMS).

Picture 1: The OptiTrough 300

Solar Tracking

Of foremost importance to any client is the ease and minimal recurring cost of operation. Keeping this in mind, the system is designed for complete automated functioning, with all the requisite controls in place (pyranometer, flowmeter, RTDs, pumps, Control Panel) such that no manual intervention is required after the system is commissioned.

The energy consumed for tracking is as low as 0.1 kWh per OptiTrough 300 module per day, keeping the operating cost low as well.

Light Weight

Understanding the area constraints for all industries, it has been designed as a light weight system, so that it can be installed on RCC rooftop, metal sheet rooftop, and the ground as well. Overall weight distribution of the system is around 40 kg/m^2.

On-line Remote Monitoring System (RMS)

It is critical that the customer knows the heat output from the OptiTrough 300 modules installed. Hence, a Remote Monitoring System (RMS) has been incorporated in the solar system.

[1] *Director, Ultra Conserve Private Limited (UCPL); Email: vivek@conserve.co.in*

Picture 2: System installed at M/s Zytex Biotech Pvt. Ltd, Vadodara

The RMS is a combination of instrumentation, communication hardware and software, culminating in graphically represented data, on-line.

This is critical information (hourly kcal output, DNI, temperatures at various points in system, tracking, system on/off, pump on/off, flow-rate, etc.) for the customer, from the system health and the system heat output perspective.

Below is a snapshot of the on-line RMS. Graphical representation for analysis is also available.

Safety Features

The system has in-built safety features, such as manual over-ride, auto focus/de-focus controls, safety valves, tracking limit switches, high temperature controls, oil level indicators, stand-by pumps to ensure safe and efficient working of the system.

Materials Used

The OptiTrough 300 is built using the best solar technology components sourced from leaders in their respective fields. These key components, such as curved glass mirrors, metal absorber tubes, and tracking drives have a long and proven history of sustained performance in the field. This is what differentiates the OptiTrough 300 and ensures optimal performance over the entire 20-year life cycle of the solar thermal system.

Installation at Zytex Biotech Pvt. Ltd, Vadodara for Process Heat

UCPL has commissioned a system comprising four OptiTrough 300 modules with RMS, for their client M/s Zytex Biotech Pvt. Ltd, Vadodara for process heat application.

The client requires air at 180°C for their spray drying process. Prior to UCPL's installation, this heat was generated by heating ambient air with steam produced by an LDO fired boiler.

The system has been designed to cater to 75 per cent of the heat requirement for this process. The

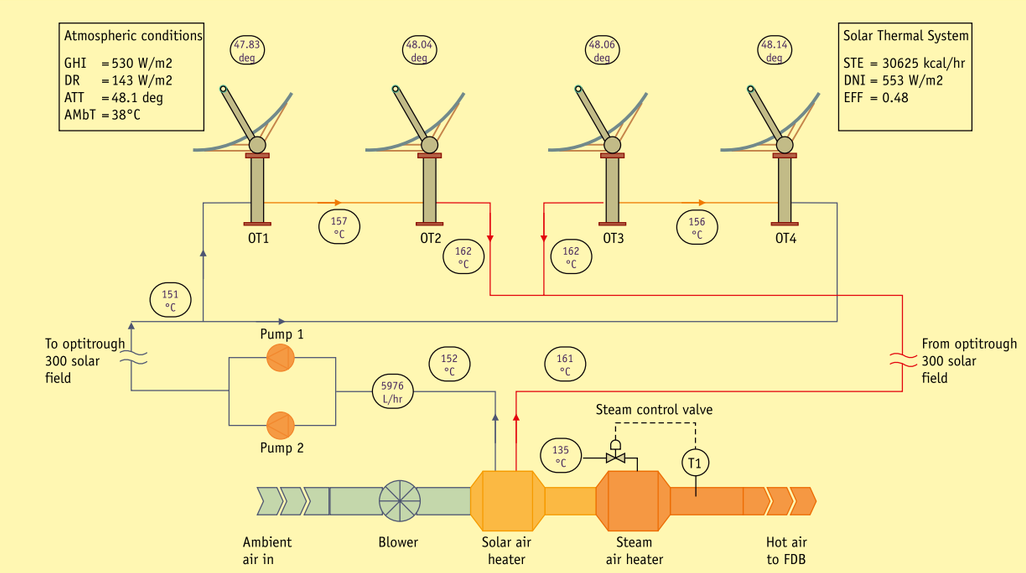

Figure 1: Snapshot of Remote Monitoring System

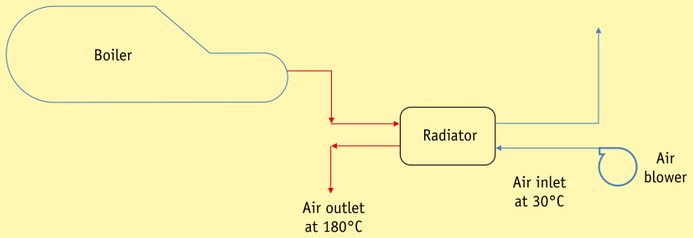

Figure 2: Before CST augmentation

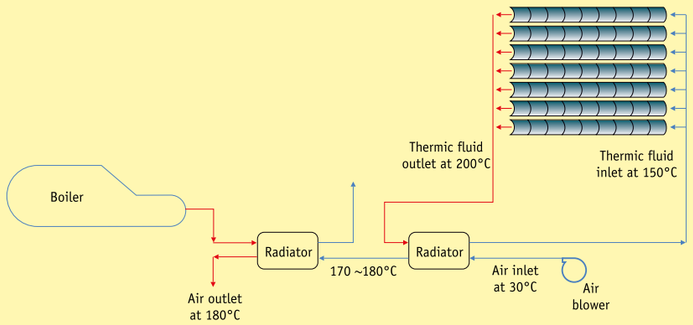

Figure 3: After CST augmentation

solar thermal heating system is fully integrated with the existing air heating process. This is done by installing a solar air heater before the existing steam based air heater. The two air heaters are placed in series, thus ensuring maximum utilization of solar thermal energy for the process. Thermic fluid circulated through the OptiTrough 300 collectors is heated up to 180°C using solar energy and flows through the solar air heater, thereby heating the air required for the process. The air is effectively pre-heated before entering the team based air heater, thus reducing steam consumption for the process. By integrating the solar thermal system in this way, closely with the air heating process, its operating efficiency is maximized.

The cost of the system to the client was ~₹27 lakh, supported with MNRE subsidy of ₹6.48 lakh and a support of ₹2.0 lakh under UNDP–GEF project. The payback of the system is expected to be less than four years.

QUADSUN SOLAR: HIGH EFFICIENCY COMBINED CONCENTRATED SOLAR HEAT AND POWER SYSTEMS

Prakash Bhalekar[1] and Puneet Saini[2]

QuadSun solar is an innovation driven company at Gurgaon, Haryana, which sets new standards in terms of efficiency and output in CST Industry. QuadSun offers the most cost effective solar heating and combine heat and power solution. This is enabled by our unique design and production methods with that combines space grade innovation with proven commercial technologies to deliver the lower cost of energy. Quadsun is headed by technocrats with expertise and experience in solar Field.

Concentrated Solar Thermal Systems have been long used to provide high temperature solar energy in the form of heat. These systems have always fought the challenge of managing the development of precise reflectors, accurate tracking and maintaining competitive costs and high levels of reliability and durability. These systems, so far, have yet to demonstrate viability in the absence of substantial subsidies.

In addition, several attempts have been made worldwide to develop cost-effective concentrator solutions that leverage the advantages of high efficiency multi-junction cells and tracking. Concentrated power systems have been split along the dense array approach—concentrating light on a small module by reflectors and the lens-based concentrator systems which focus light on tiny highly efficient cells. While several systems have demonstrated performance, not many have proven to be commercially viable against the backdrop of rapidly declining costs of silicon and thin-film module prices.

Picture 1: The QuadSun System.

QuadSun Products

Quadsun offers two products—a concentrated solar thermal and a combined heat and power system.

Products have the same concentrator and the difference is in the receiver.

The Concentrator

The QuadSun concentrator is an extremely precise glass-based reflector with an area of 4 m^2. The precise shape and curve of the mirrors allows us to achieve very high levels of concentration. This precision is guaranteed as the production process checks all the mirrors. The precise mirrors help achieve 800x concentrations. This concentration also requires very precise tracking. The QuadSun electronic control unit allows tracking efficiency to 0.01 mrad. This is achieved using very fine controls on the motors and sophisticated algorithms that correct small changes in the installation that may affect the precision of the concentrator. Besides the high accuracy, the Concentrator is designed around the use of simple manufacturing processes.

Receiver

The CST receiver is a very simple construction that leverages the high concentration ratio and cavity design to reduce the conduction and convectional losses. It uses highly absorptive coating to absorb maximum energy coming from reflectors. System is rated at 3.5 kW

[1] *Co-Founder and CEO, Quadsun Solar; Email: prakash@quadsunsolar.com.*

[2] *Engineer, Quadsun Solar; Email: puneet@quadsunsolar.com*

at 1,000 DNI. System is tested for thermal and optical performance at National Institute of Solar energy with extremely promising results.

CHP Receiver

It has unique low-cost design that uses a small thermo—photovoltaic module of 55 cm^2 triple junction cells with 33 per cent efficiency.

The CHP receiver uses the idea of using inexpensive and highly accurate optics to concentrate light on very small and efficient solar cell which is 1/800th of the area of focussing optics. Thus, the cell area reduced significantly, leading to the creation of a cost-effective system, even though costlier cells are used. The receiver is built to use the heat of the solar cell by circulating fluid on the back side, thereby providing thermal energy for different applications. System generates 1 kW electricity that would be grid synchronized and 500 litres per day of hot water (20°C above ambient) at 1,000 DNI. Quadsun next generation cells are already breaching 40 per cent efficiency and will be available commercially by mid-2017.

QuadSun Advantages

QuadSun system is extremely efficient. The optical efficiency of the CST system is 80 per cent and this drops modestly even as temperature increases. The electric efficiency of the CHP receiver has been measured at 23 per cent. QuadSun maximizes the generation of solar energy through tracking. It is also very light and easy to install as well as service when required. Each system weighs around 90 kg.

The system is scalable to various sizes as per project need and is commercially viable due to its cost effectiveness and innovative design. Installation is simply an exercise in tightening bolts and a lot of the subsystems are factory assembled. QuadSun also has its own proprietary field monitoring and control system.

This system requires only half the space required to generate the same amount of energy as compared to other technologies. Minimum footprint area allows customers to continue using their land for agriculture and other purposes, unlike conventional PV panels. The tracking system that is generally the point of great reliability and durability is designed elegantly to provide years of trouble free working. The system can be easily integrated into existing systems to use as topping cycle for heat generation. Quadsun offers ease of operations using commercial designs and materials that have proven their longevity in several applications. Customers investing in QuadSun systems should expect very quick returns. Typically, CST system payback is less than 1.5 years replacing diesel. The CHP system has a payback that is about three years.

Commercialization

QuadSun is initially focussing on commercializing the CST product with a focus on hospitals, hotels, dairies for low grade steam and other process heat applications. In addition, QuadSun is integrating its system for developing VAM applications. Quadsun has early installations in Delhi, Gurgaon, Spain, and Italy. These systems have collectively clocked over 10,000 hours of operation with the longest operating installation covering 4,000 hours. Installations are with fully automated systems, with no operator requirement on the site. The collector automatically starts in the morning and generates power and heat. It comes to the home position during sunset.

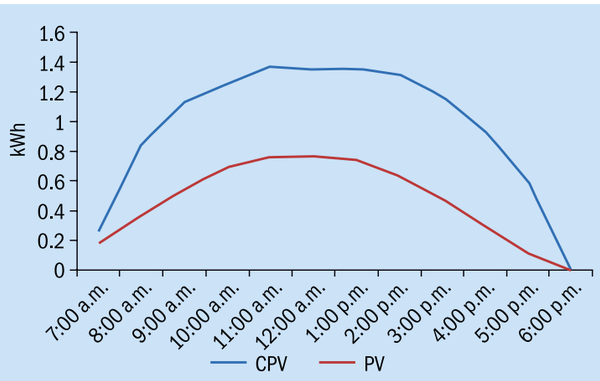

Figure 1: P&ID for system integration for heat and power

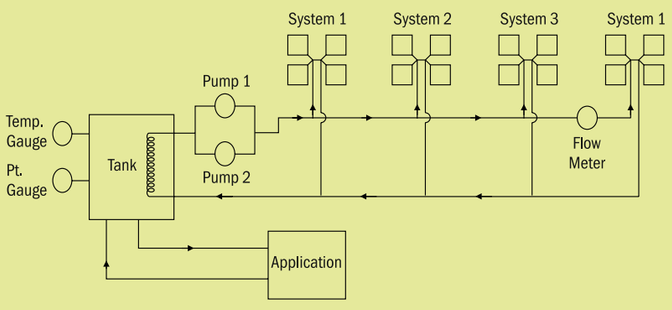

Figure 2: Power generation comparison of CPV and PV of same capacity on a typical day.

SOLAR STEAM COOKING SYSTEM WORKING IN THE TRIBAL AREA OF CHHATTISGARH

Saurabh Motiwala[1]

The system has been installed at Ramakrishna Mission, Narainpur, Chhattisgarh. Started in 1985, the Ramakrishna Mission Ashram, Narainpur, along with its six service centres inside villages of Abhujmarh jungle of Chhattisgarh, has been rendering service to the tribals of the area. It is located 250 km away from the state capital, Raipur. Abhujmarh has a tribal population of about 34,000 inhabiting some 233 far-flung villages over a sprawling area of 4,000 sq. km. Due to the meritorious and philanthropic services rendered towards the tribal community in the domain of education, healthcare, and economic upliftment, the Mission has so far received many national awards. The Mission has installed Chhattisgarh's first and largest solar cooking system with support from CREDA (Chhattisgarh Renewable Energy Development Agency) for their educational institute.

Picture 1: Solar steam cooking system installed at Ramakrishna Mission, Narainpur

Highlights of the System	
Year of commissioning	2010
Project developer	Sharada Inventions Pvt. Ltd
Project cost	₹44 lakh with 26 lakh subsidy from CREDA
Operating temperature and pressure	180°C, 10 bar
No. of dishes	22 (11 sleeping + 11 standing); 13.6 m^2 each
Total collector area	300 m^2
Average yearly operation	1,200 hour/yr
Annual savings	₹1,56,000

Table 1: Cooking item details	
Type of food cooked daily using solar cooking	Quantity (in kg)
Rice	200 kg
Dal	25 kg
Vegetables	25 kg

The System

The photograph shows Scheffler dishes with receivers. The steam generated in receivers, due to the solar thermal energy goes to the header.

The system does not consist of automated tracking system. The system is connected with feed water and steam pipelines with specially designed steam receiver cum pressure reducing station, that in turn are interconnected with the backup boiler (wood based) and three (50 litre each) steam cooking vessel system (Picture 2).

[1] *Student, M Tech, Renewable Energy Engineering and Management, TERI University, New Delhi*

Working Schedule

Food is prepared for about 1,000 people per day, including school students as well as staff. Breakfast is prepared in the backup boiler (wood based) till 10 a.m. and later steam cooking system is used for about four hours daily to prepare lunch. Following this routine, 4,600 kg of fuel wood is saved per month accounting to ₹13,000/month.

"The system works consistently throughout the year, except rainy and cloudy days. Also, food can be prepared quickly using this system as compared to conventional cooking system", says Swami Aliptatmananda Maharaj. This system is an example of successful and efficient solar thermal cooking systems which, if integrated with thermal storage, could be implemented in various parts of the country, he adds.

CREDA works actively with Ramakrishna Mission in keeping a monthly performance report of this system. According to Mr Ravikant Bhardwaj, Assistant Engineer, CREDA, "A centralized database with techno-financial parameters along with monthly performance report of such systems should be made available to all SNAs. This would help in improving the system performance. Keeping this experience in mind, we are working on few more such proposals in this tribal region".

Problems/Challenges

Ramakrishna Mission is located in a remote area of Chhattisgarh. Therefore, no service provider or trained manpower was available for operation and maintenance. Under UNDP–GEF's repair and renovation scheme, Taylormade Solar Solutions Pvt. Ltd has been appointed for providing maintenance services.

Picture 2: Steam cooking in kitchen

- The reflecting mirrors get damaged frequently due to the thermal stresses. During the recent maintenance of the system done by Taylormade Solar Solutions Pvt. Ltd, the reflecting mirrors were replaced by aluminium sheets.
- Both manual as well as automatic tracking of the system is difficult. Manual tracking needs lot of physical effort and accuracy while automatic tracking systems are costly.
- Annual maintenance of the system is expensive.

Picture 3: A view of the entire system from the rooftop

CST BEING USED IN LAUNDRY AT LAKAKI DRYCLEANERS, GOA

Vinay V Gadikar[1] and Sarvesh Devraj[2]

Established in 1962, Lakaki was the first power laundry in Goa. This laundry was established by Mr Venkatesh Naik Dalal at Margaon, South Goa. Since its inception Lakaki had crossed many milestones in terms of quality. Presently, it handles around 1,000 clothes per day. Earlier the fuel used for boilers was diesel and electrical energy was required for ironing. The daily fuel consumption was 20 litre/day and 80 units/day of electricity. Diesel is a costly fuel and not environment-friendly. Around 2011, Mr Venkatesh thought of replacing its conventional fuel operated system with renewable energy resources. He wanted to switch to solar technology for meeting steam requirement for various processes in laundry. In February 2015, solar steam generating system was commissioned with the help of Goa Energy Development Agency (GEDA) and the Ministry of New and Renewable Energy.

Operation Philosophy

Project developer—ATE enterprises has installed a 25 m^2 paraboloid dish at the premises of Lakaki. It is a dual axis automated system. The steam generated at 5 bars is sent to the laundry application points through a common steam header. So this solar system caters hot water for washing clothes and starch preparation, and steam for ironing process at 2–4 bar pressure. In Lakaki, total steam requirement at peak hour is 100 kg/hour and hot water requirement is around 400 litre/day.

Cleaning and drying of around 1,000 clothes per day takes place in the laundry with eight hours of work every day. There are 20 workers who are trained to operate the solar steam powered system. There are five tables for steam pressing, four tables for electric ironing, and about two lengthy tables for the sarees. Generally, the plant runs for eight hours and steam is required for all eight hours of the day. On the basis of this schedule, the installed solar system completely replaces diesel and 50 per cent of electrical energy.

Table 1: Details about the installation at Lakaki Drycleaners

Name of Installation	Lakaki Drycleaners
Year of commissioning	February 2015
Project developer	ATE Enterprises Private Limited
Project cost	₹12.5 lakh with 1.5 lakh MNRE subsidy
Operating temperature	120°C
No. of dishes	1 dish (25 m^2)
Total collector	25 m^2
Daily steam requirement	90–100 kg/day
Payback of project	4.5 years
Annual saving	₹340,200
Average operation/day	6-8 hours
Daily heat delivery	72,000 kcal/day.

Picture 1: Steam ironing process

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[2] *Research Associate, Renewable Energy Technology Applications, TERI; Email: sarvesh.devraj@teri.res.in*

Picture 2: Solar Concentrator at Lakaki Drycleaners

Picture 3: Dalal family with solar concentrators

Total annual saving of diesel is 5,400 litre and electricity saving on ironing process is 10,800 units.

Performance

In Goa, average 240–250 days are good sunny days. During this time, the solar system can generate sufficient steam for laundry. Total operation hour is 6–8 hours/day. Figure 1 depicts the working of the solar system throughout a day. In the figure shown, three high peaks are the steam requirement periods and the lower ones are hot water generation through steam. Steam at 2 bar is used for hand ironing and 4 bar steam is maintained for ironing by calendaring machine. Automated steam pressure regulation system ensures the required pressure at the user end. The provision to convert the extra steam into hot water, which can then be used for washing, is excellent. This way there is no wastage.

Overall, there were no issues in operation and maintenance. Only once, they faced a problem and the service provider came from Pune within two days and fixed it. Cost of maintenance is very low around, i.e., ₹2600/year.

Feedback by User

Sweta Dalal, daughter-in-law of Venkatesh Dalal said, "We are very satisfied. It is very economical. Earlier, we were using diesel and had to spend ₹30,000 per month. This money is saved entirely now." Lakaki installation is a green initiative that hopefully will be taken up by the rest of the industry in the future. The Dalal family added, "The plus point about this technology is that earlier in case of power outage, our production would drop, which is not the case anymore."

Challenges

Clouds and monsoon are challenges for this technology. Generally in Goa, there are 90 monsoon days which are non-sunny and during this time the CST does not work. So, to meet the steam requirement demands is a challenge which is currently being fulfilled by the existing electrical system. Also, dust coming from nearby industrial area also cause soot deposition on mirrors. Therefore, daily cleaning of mirrors is essential.

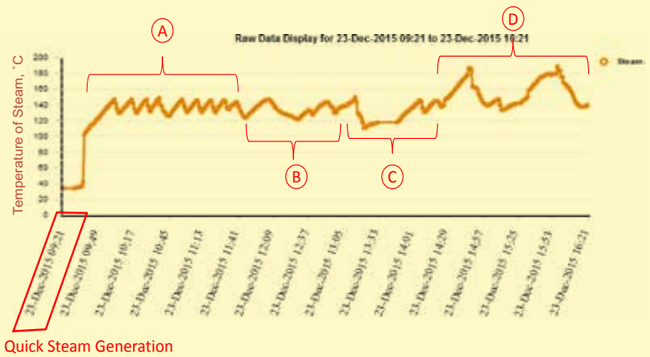

Figure 1: Performance data of CST operated laundry on a typical day with operator defined periods of activities as below

A. Steam ironing by hand irons. B. Steam ironing by calendar machine C. Hot water generation
D. Steam ironing by hand operated irons and automatic hot water generation when steam is not used for ironing

Figure 2: Performance data of CST operated laundry on a typical day

FOUNDATION STONE OF THE INTERNATIONAL SOLAR ALLIANCE (ISA) HEADQUARTERS LAID AT NISE, GURGAON

India moved a step closer to positioning itself as an emerging global powerhouse in solar energy when the Prime Minister of India Shri Narendra Modi, and the President of France Mr François Hollande, jointly laid the foundation stone of the International Solar Alliance (ISA) Headquarters and inaugurated the interim Secretariat of the ISA in the National Institute of Solar Energy (NISE), Gual Pahari, Gurgaon on January 25, 2016. The ISA will be the First International and Inter-Governmental Organization of 121 countries to have Headquarters in India with the United Nations as Strategic Partner.

The Government of India has dedicated five acre land in NISE campus for the ISA Headquarters and has also contributed 175 crore for ISA corpus fund and also for meeting expenditure for the initial five years. The ISA is part of the Prime Minister's vision to bring clean and affordable energy within the reach of all and create a sustainable world.

It will be a new beginning for accelerating development and deployment of solar energy for achieving universal energy access and energy security of the present and future generations. Speaking on the occasion, Prime Minister Shri Narendra Modi stated that ISA will be dedicated to promotion of solar energy for making solar energy a valuable source of affordable and reliable green and clean energy in 121 member countries.

Unveiling the plaque, Prime Minister Shri Narendra Modi said that although the ISA will be headquartered in India, it will function as a global and independent institution meant to benefit entire mankind.

LOANS NOW AVAILABLE FROM BANKS FOR CSTs AT PRIORITY LENDING RATE

Amit Kumar[1]

Under the UNDP–GEF project on Concentrated Solar Heat of the Ministry of New and Renewable Energy (MNRE) PricewaterhouseCoopers (PwC) was hired to increase awareness of bank officials on CSTs and facilitate relaxed lending for implementation of CST projects.

Workshops Organized

As per the assignment mandate, PwC (with help of Bharathiya Vikas Trust) conducted workshops-cum-capacity building trainings for bank officials across four cities of India including Ahmedabad, Bengaluru, Chennai, and Pune. More than 30 participants representing at least 10 banks attended each of the workshops-cum-trainings, in which sessions were undertaken by the MNRE, system manufacturers/ integrators, beneficiaries, and PwC, to build bank officials' capacity on appraisal of CST projects. Cumulatively, 138 participants from over 25 private and commercial banks participated in all four workshops combined.

Picture 1: Bank officers' workshop at Bangalore

Picture 2: Participants visiting a CST installation on 26th May, 2015

Loan Schemes Developed

PwC in association with the MNRE designed a lending scheme for CSTs and persuaded several banks through these workshops-cum-trainings (and otherwise also) to issue a circular for lending of CSTs. As a result, four banks issued circulars, and one of them has issued a circular with detailed terms and conditions in line with the scheme designed by PwC/MNRE. Table 1 briefly highlights the issued circulars. A detailed description of SBoP's circular and its terms and conditions has also been given.

Lending Scheme of State Bank of Patiala

- **Eligibility**: Any industrial/ commercial/religious entity getting project implemented by MNRE channel partners for CST
- **Hurdle rate**: Minimum state bank hurdle rate: SB 10
- **Project cost**: As per the MNRE benchmark and sanction letter
- **Loan quantum**: Minimum ₹10 lakh and maximum 85 per cent of project cost/6 times cash accruals
- **Promoter margin**: For loan less than ₹ 50 lakh = 15 per cent, else 20 per cent

[1] *Partner, PwC; Email: amit2.kumar@in.pwc.com*

Table 1: Details about the installation at Lakaki Drycleaners

Sl. No.	Issuing Bank and Branch	Issuing Department and Date	Circular No.	Key Features	Contact Person
1	State Bank of Bikaner and Jaipur, Jaipur	Commercial and Institutional September 17, 2015	CNI/10/15-16	CST recognized as priority lending technology and MNRE/UNDP subsidy scheme mentioned. Branches are advised to lend to CST	Mr SK Pradhan, GM, Jaipur Branch, Email: gmjprnw@sbbj.co.in Tel: 0141 510555
2	Syndicate Bank, Bengaluru	MSME September 11, 2015	387-2015-BC-MSME-16	CST recognized as priority lending technology. Detailed renewable energy (RE) lending terms and conditions specified in circular	Mr B Ganesh Pai, GM, Bangalore Branch Tel: 080 23410523 Email: gmmcd@ syndicatebank.co.in
3	United Bank of India, Kolkata	MSME January 5, 2016	MSME/Solar CST/22/ OM-610/15-16	CST recognized as priority lending technology and MNRE/UNDP subsidy scheme mentioned. Branches are advised to lend to CST	Mr Sanjib Mandal, Email: cmsme@ unitedbank.co.in, Tel: +919674860070
4	State Bank of Patiala, Patiala	SME February 2, 2016	ADV/ SME/75/15-16	Read "Lending Scheme of State Bank of Patiala"	Mr Rajesh Gupta Email: cmsme@sbp. co.in, Tel: 0175 2395238

- **Repayment Period**: Maximum repayment period of 10 years with six months of moratorium
- **Rate of interest**: Base rate + 1 per cent (currently 9.65 per cent + 1 per cent)
- **Security**: Assets created/ implemented out of bank loan will be considered as primary security while collateral for 50 per cent of project cost as tangible assets. Alternatively, guarantee under CGTSME can be provided subject to borrower paying the guarantee fees
- **Loan upfront fee**: Starting from 0.15 per cent of project cost to maximum of ₹50,000
- **Documentation charges**: Waived
- **Bank's inspection charges**: Waived for first year
- **Treatment of MNRE/UNDP subsidy**: To be paid directly to the bank as per the process mentioned below and considered as loan pre-closure amount reducing number of EMIs
  - » Step 1: Project developer/ beneficiary files an application to MNRE for setting up CST project under the scheme
  - » Step 2: MNRE performs due diligence of application and after successful assessment issues subsidy sanction letter
  - » Step 3: PMU UNDP-GEF CSH Project also issues sanction letter for additional support as applicable
  - » Step 4: Project developer/ beneficiary applies for loan with sanction letters from MNRE and UNDP
  - » Step 5: Bank provides loan after project appraisal for maximum period of 10 years with EMIs fixed
  - » Step 6: MNRE releases subsidy to bank after third party inspection of the commissioned system. UNDP also releases support to bank as per scheme provisions
  - » Step 7: Bank reduces the loan tenure/EMIs of project developer/ beneficiary.

Re-revised w.e.f February 5, 2016
Applicable for new proposals

GUIDELINES FOR SEEKING FINANCIAL SUPPORT FOR INSTALLATION OF CST BASED SYSTEMS FROM MNRE, UNDP, AND UNIDO–GEF CSH PROJECTS

MNRE Subsidy

Subsidy at the rate of 30% of benchmark cost is available as subsidy from the MNRE for systems based on various types of CSTs. In special category states/districts, e.g., Jammu & Kashmir, Himachal, Uttrakhand, NE region, island and districts with international border, 60% subsidy is available to non-profit making bodies. In addition, accelerated depreciation (80 per cent in 1st year) is available to profit-making bodies. The present benchmark costs (under revision) are as follows:

Single axis automatically tracked CSTs	: ₹18,000 per sq. m
Dual axis automatically tracked CSTs	: ₹20,000 per sq. m
Non-Imaging CSTs	: ₹12,000 per sq. m

Generation of Proposals

Proposals generated in prescribed format (Annexure-I) needs to be submitted by the beneficiaries to Director (CSTs), Ministry of New and Renewable Energy, B-14, CGO Complex, Lodhi Road, New Delhi-110003 either through respective State Nodal Agency or through Channel Partners of MNRE at the following address. List of State Nodal Agencies and Channel Partners are available on the websites www.mnre.gov.in/www.cshindia.in. Whereas proposals submitted through State Nodal Agencies may require to go through tendering process by them, the proposals generated through Channel Partners will be left to beneficiaries to go or not go through that process.

Sanctioning of Subsidy

Proposals received in MNRE (complete in all respect) will be put up for approval to the Project Approval Committee, where after sanctions, it will be issued with the concurrence of Internal Finance Division of MNRE.

Release of Subsidy

The subsidy will be released on reimbursement basis after successful commissioning of the system based on 3rd party inspection done as per prescribed format. The required documents, complete in all respect, should be received in MNRE (Formats available on websites).

UNDP and UNIDO–GEF Support

In addition to MNRE subsidy, 20% of benchmark cost from UNDP–GEF project is available. More support is there for space cooling projects with new VAM and projects in ESCO mode. Details of support available under UNDP–GEF project for different types and sizes of CST-based systems is as follows:

Category	Type and applications of CSTs	Support under CSHP
Demonstration	All types and applications with sizes 500 sq. m & above	20% of MNRE benchmark cost to a maximum of ₹75 lakh
Replication	All types & applications with sizes below 500 sq. m (excluding Scheffler dishes for direct cooking)	20% of MNRE benchmark cost but not less than ₹2 lakh for projects of sizes 45 sq. m & above on dish and 64 sq. m & above on other CSTs. For projects below that ₹1.5 lakh will be available.
Space cooling where new VAM is installed (Max. 5 projects)	All types of CSTs with minimum 30 tonne capacity of VAM	10% of MNRE benchmark cost in addition to above
Projects in ESCO mode	All types and applications of CSTs	10% more of MNRE benchmark cost to a maximum of ₹15 lakh in addition to above only for systems availing 30% MNRE subsidy and not higher in special areas

Soft loans at special interest rates are also available through IREDA under UNIDO–GEF project scheme. Projects availing such loans will not be eligible for additional support from UNDP–GEF project.

Sanctioning of UNDP–GEF Support

A copy of proposal prepared in prescribed format (available on www.cshindia.in) and submitted to MNRE for subsidy simultaneously to Project Management Unit (PMU), also of UNDP-GEF CSH project at the following address:

National Project Manager
UNDP–GEF Concentrated Solar Heat Project
Ministry of New and Renewable Energy
B-3, CGO Complex, Lodhi Road, New Delhi-110003

The proposals received will be examined by the PMU and if found complete in all respect will be placed before the Project Executive Committee on bimonthly basis for approval. Following points will be ensured before putting the proposals to the Committee:

i Details of beneficiary with complete address, contact person's name, designation, mobile, and e-mail address will have to be provided with the application and signed by the head of organization.
ii Manufacturer's letter for providing 5 years guarranty on mirrors to beneficiary is submitted. The mirrors will be of solar grade quality.
iii A minimum of 3 year old systems of selected manufacturer, sanctioned by MNRE/ PMU-CSHP, are functioning satisfactorily with no complaint from beneficiaries. List of such systems with beneficiary's contact details (mobile and e-mail) will be provided by the manufacturer along with the proposal so as to have verification by the PMU.

Approved proposals will then be processed for the approval of competent authority based on which sanctions for providing additional support from UNDP–GEF project will be issued to the beneficiaries.

Release of UNDP–GEF Support

Sanctioned support will be available on reimbursement basis after third party inspection on completion and commissioning of the system subject to submission of the following. The support may not be released/reduced as per the recommendation of PEC in case of not meeting any of the requirements.

i Third party inspection report along with 15 days performance data in prescribed format. The inspection will ensure at least the following by the team spending the whole day at the beneficiary's place:
  (a) Number of CSTs installed with total sq. m of area should be the same as mentioned in the sanction
  (b) There is no shadow on dishes between 9 a.m. to 4 p.m.
  (c) All the receivers of various CSTs are fully illuminated with sun rays reflected from dishes not going out of the receivers.
  (d) Performance data recorded for 15 days is as per that committed by the manufacturer in the proposal/ purchase order and the beneficiary is fully satisfied.
ii 5 year warranty for solar mirror/reflectors given by Supplier
iii 5/3 years Annual/Operation Maintenance Contract as applicable, including 1 year warranty taken by the beneficiary or an assurance given by him that they themselves will take care of the system without any complaint to MNRE/PMU and keep the system functional.
iv The system is installed as per MNRE specifications available on its website.
v Online performance monitoring established by installing the instruments, such as 2 pyranometers; with and without shading ring for measuring DNI, flow meter, temperature and pressure sensors, and sim-based data logger as the case will, e.g., Demonstration/Replication projects.

Online performance establishment for providing data in prescribed format with web link, providing user ID and password to the PMU will be necessary and if not done at the time of third party inspection, only 50% of the support will be released with balance to be released on completion of online establishment.

Fifty per cent of the support could be released in advance, based on the bank guarantee submitted from any scheduled commercial bank within 6 months, having validity for at least one year, subject to placement of the order to supplier or issuing of MNRE sanction. This could also be released to the supplier, subject to having no objection from the beneficiary. Final installment will, however, be released to the beneficiary only.

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WORKSHOP ON CONCENTRATING SOLAR THERMAL TECHNOLOGIES IN INDUSTRIES, AHMEDABAD, FEBRUARY 26, 2016

In an effort to promote Concentrating Solar Thermal (CST) Technologies beneficial to various industrial sectors, Global Environment Facility and United Nations Industrial Development Organization (GEF-UNIDO) in partnership with the Ministry of New and Renewable Energy (MNRE), Government of India, has launched the project 'Promoting Business Models for Increasing Penetrations and Scaling up of Solar Energy'. Wider participation and support from industry was ensured through close cooperation with the State Nodal Agency—Gujarat Energy Development Agency (GEDA), and Confederation of Indian Industry (CII) for the workshop organized at Ahmedabad on February 26, 2016 and site visits to the Sabarmati Jail and the Mother Dairy facility. The Sabarmati Jail showcased the Scheffler Dish CST technology while at the Mother Dairy site the Parabolic Trough CST system was demonstrated. The workshop, which focussed on promotion of 'CST technologies for industries'—provided a platform to a large number of senior industrial representatives in and around Gujarat to have open discussions with the consumers and manufacturers of CST systems.

MEETING WITH CST MANUFACTURERS AND CONSULTANTS AT MNRE, NEW DELHI, FEBRUARY 10, 2016

A meeting with CST manufacturers and consultants was held at MNRE on February 10, 2016. There were presentations made by the National Project Manager (NPM), UNDP–GEF (CSHP) on CST potential and its present status in the meeting. Developing guidelines for introducing Renewable Heating Obligation (RHO) for industrial establishments were discussed. A roadmap for CSTs for the next five years was planned. New ideas for preparing national policy on CSTs were discussed. The meeting also discussed long term satisfactory performance of systems in fields, best possible implementation and financial models for Govt./ PSU institutions and the private sector.

INTERACTION MEET WITH POTENTIAL BENEFICIARIES OF CSTs FOR COMMUNITY COOKING AND PROCESS HEAT APPLICATIONS ORGANIZED AT ANERT HEADQUARTERS, THIRUVANANTHAPURAM, JANUARY 4, 2016

As a follow up of a workshop organized by ANERT on CST in September 2014, an interaction meet with potential beneficiaries of CSTs for community cooking and process heat applications was organized at Thiruvananthapuram on January 4, 2016. The meet was chaired by Shri Tarun Kapoor, Joint Secretary, MNRE and witnessed the participation of the Principal Secretary (Power), Government of Kerala. It was decided in the meet that ANERT will identify areas/clusters of establishments having potential for CSTs and organize business meets in association with manufacturers/technology providers. Some of the places could be Kochi, Kottayam, and Palakkad where owners of spices and coconut oil/minerals and metal extraction units, rubber manufacturers, food and fish processing units, etc., using boilers may be invited and convinced for installation of CST based systems.

FORTHCOMING EVENTS

NATIONAL

North India Solar Summit
March 11–13, 2016 | Lucknow, India | Website: http://niss.org.in

Global Conference on Renewable Energy
March 4–6, 2016 | Patna, India | Website: http://10times.com/renewable-energy-patna

India Smart Grid Week 2016
March 15–19, 2016 | New Delhi, India | Website: http://www.isgw.in

International Conference on Sustainability
March 17–19, 2016 | Shillong, India | Website: http://www.iimshillong.in/sus-con/sus-con.asp

Renewtech India
April 26–28, 2016 | Mumbai, India | http://10times.com/renewtech-india-mumbai

Renewable Energy World India
May 18–20, 2016 | New Delhi, India | http://10times.com/renewable-energyworld-india

INTERNATIONAL

7th Solar Power PV Conference and Expo
Feb 24–25, 2016 | Boston, MA, USA | Website: www.events.solar/pvconferenceexpo

Conference and Exhibition: Solar Middle East
March 1–3, 2016 | Dubai, UAE | Website: www.solarmiddleeast.ae

Intersolar Summit USA East
March 24, 2016 | New York, United States | Website: http://www.intersolarglobal.com/

5th Intersolar China 2016: Conference and Exhibition
March 29–31, 2016 | Beijing, China | Website: www.intersolar.asia

Solar Electric Power Association Events
April 11–14, 2016 | Colorado, United States | Website: http://www.solarelectricpower.org

Solar Power Southeast
May 25–26, 2016 | Atlanta, Georgia | Website: https://www.xpressreg.net

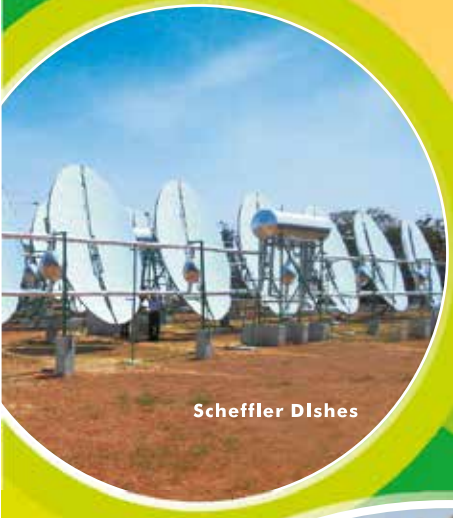
सत्यमेव जयते
Government of India


Paraboloid Dishes

Make your Establishment green by reducing the carbon foot print

CONCENTRATING SOLAR TECHNOLOGIES

can meet a significant amount of your heat requirement for community cooking & Industrial process applications


Scheffler DIshes

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

- 30% of benchmark cost as government subsidy
- Higher subsidy in special category states
- 80% accelerated depreciation to profit making bodies
- 20% of cost limited to Rs. 75 lakhs from UNDP-GEF project for specific activities.


Parabolic Trough Concentrators


Arun Dish

Interested Organizations may contact our Channel Partners (**Clique Solar, Mumbai:** 09665055059 / adb@cliquesolar.com; **LeverageNet Solutions, Pune:** 09970319054 / contact@energy-guru.com; **Megawatt Solutions, New Delhi:** 09654451401 / smalik@megawattsolutions.in; **Taylormade Solutions, Ahmedabad:** 09712933390 / dharam@tss-india.com; **Thermax, Pune:** 020-67308880 or 8885 / kdeshpan@thermaxindia.com; **Ultra Conserve, Mumbai:** 09004445530 / vivek@conserve.co.in; **Unisun, Bangalore:** 09880022272 / shivanand.nashi@unisun.net;) and **Consultant- PwC, Gurgaon:** 08130322334 / vibhash.garg@in.pwc.com) For more details, visit our website **www.cshindia.in** or contact at **011-24363638 / singhalak@nic.in**

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