a quarterly magazine on **concentrated solar heat**

SUN FOCUS

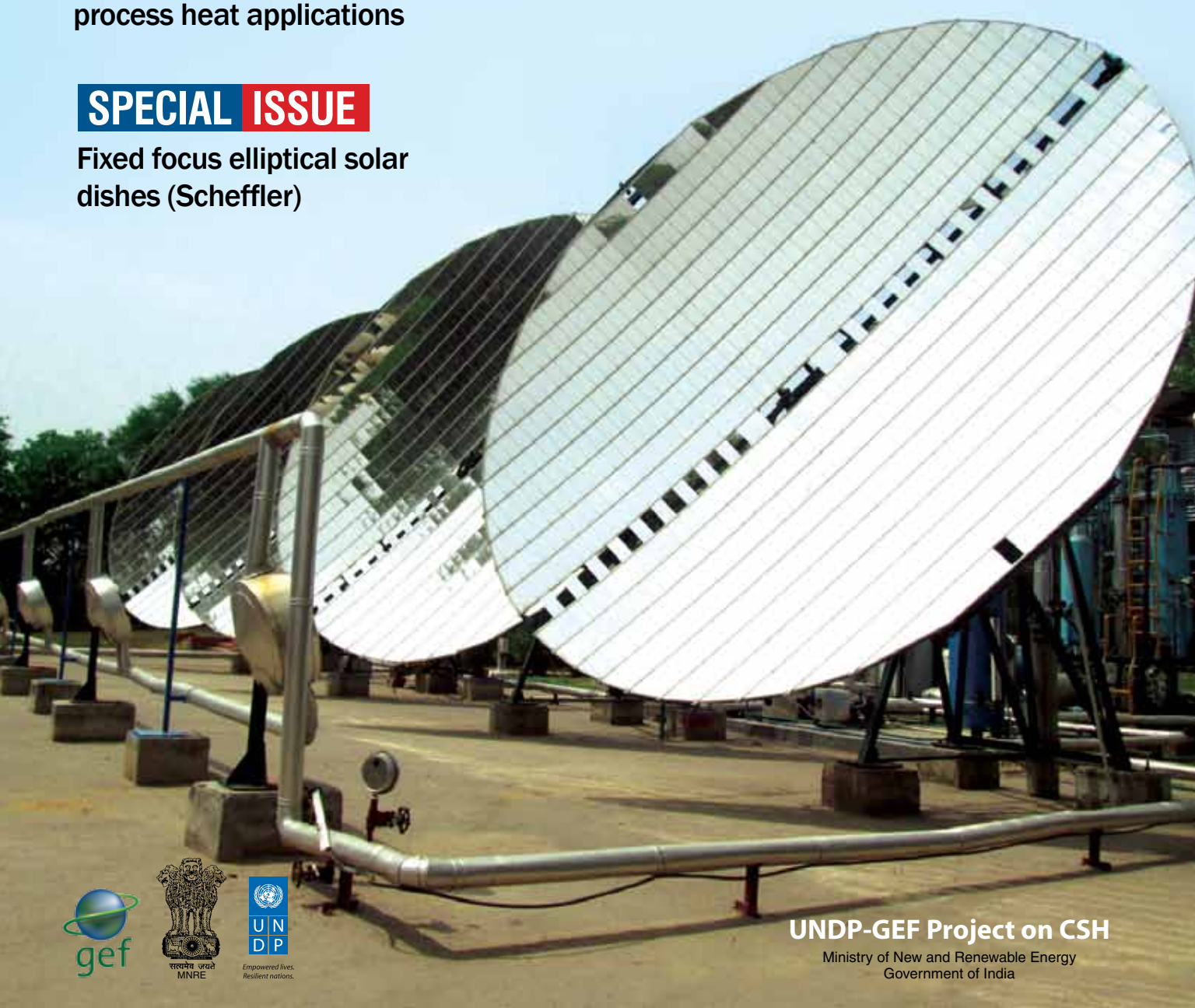
Issue 2 | October–December 2013

INDIA'S QUEST FOR SOLAR STEAM AND PROCESS HEAT

Concentrating Solar Technologies for process heat applications

SPECIAL ISSUE

Fixed focus elliptical solar dishes (Scheffler)



UNDP-GEF Project on CSH

Ministry of New and Renewable Energy
Government of India

Learning by Sharing

Inviting Authors to contribute for

SUN FOCUS

Editorial Desk

What we require

Special Features

Policies

Case Studies

Technology Focus

For response on the magazine, you may contact

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Jawaharlal Nehru National Solar Mission (JNNSM)

The Jawaharlal Nehru National Solar Mission was launched on 11 January 2010 by the Prime Minister. The Mission has set an ambitious target of deploying 20,000 MW of grid connected solar power by 2022 and is aimed at reducing the cost of solar power generation in the country through (i) long-term policy; (ii) large-scale deployment goals; (iii) aggressive R&D; and (iv) domestic production of critical raw materials, components, and products, with a target of achieving grid tariff parity by 2022.

The Mission will create an enabling policy framework to achieve this objective and make India a global leader in solar energy. Major objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating policy conditions for its diffusion across the country as quickly as possible. Goals of deployment include:

- 20,000 MW of grid connected solar power;
- 2,000 MW of off-grid solar applications;
- 20 million solar lights in rural homes; and
- 20 million sq. m. of solar thermal collector area in various establishments.

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Issue 2 • October–December 2013
a quarterly magazine on
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Produced and Published by
Project Management Unit
UNDP-GEF project on CSH
Ministry of New and Renewable Energy
Government of India
New Delhi
and
TERI Press
TERI, Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi - 110 003
Tel: +91 11 2468 2100, 4150 4900
Fax: +91 2436 3035, 2436 2288
Email: teripress@teri.res.in
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Printed at
SVS Press
116, Patparganj Industrial Estate,
New Delhi - 110 092, India

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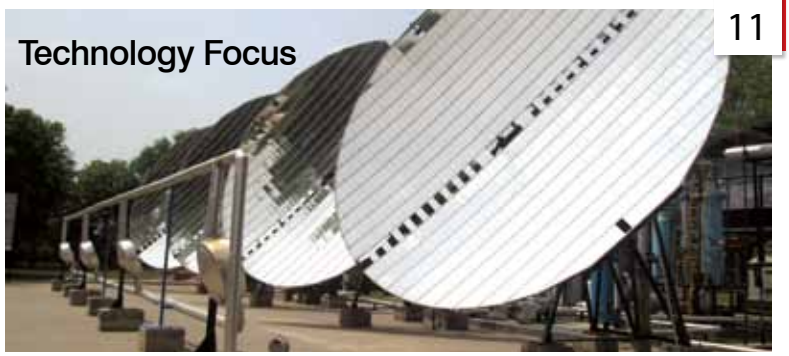

Launch of Sun Focus

The first issue of SUN FOCUS magazine (July–September) was released by the Hon'ble Minister for New and Renewable Energy, Dr Farooq Abdullah, at his office on 27 August 2013. Under the UNDP-GEF project on "Market Development and Promotion of Solar Concentrator based Process Heat Applications" being implemented by the Ministry of New and Renewable Energy, Government of India, this quarterly magazine on Concentrated Solar Technologies (CSTs) has been started through The energy and Resources Institute (TERI).

While releasing the magazine, Dr Abdullah said that it will focus on off grid applications of CSTs for the purpose of saving fuel oil, firewood, LPG, and so on, in industrial and commercial establishments using heat between 80 °C and 250 °C. A massive amount of fossil fuels is being consumed for thermal applications such as water or air heating, community cooking, process heat, and space cooling in various establishments. Estimates say that 15 million tonnes of fuel oil per year is being consumed in industries alone for process heat requirements below 250 °C. Over 5,000 trillion units of electricity are also being used for hot water and air heating applications. These need to be conserved in a country such as ours where 35 per cent of the population has no access to power and 80 per cent of the fuel oil is being imported. India is full of sun energy and the use of CSTs at places of direct utility for such applications can help save a significant amount of fossil fuels.

Keeping this in mind, SUN FOCUS will cover CST developments, events, interviews, schemes, installations and success stories, popular articles, project activities, and other related activities worldwide but with an emphasis on India. It will be useful for potential beneficiaries, manufacturers and industrialists, policy formulators and implementers, and other stakeholders involved in market development of CSTs in the country. The UNDP-GEF project, in its 5 year duration, is expected to install systems in about 90 industries with 45,000 sq. m of reflector area, resulting in annual CO_2 emission reductions to the tune of 39,200 tonnes and fuel savings of 3.15 million litres of fuel oil.

Readers' Responses

Congratulations on starting the informative quarterly magazine on off grid CSTs. I wish the programme all the best.

Dr SP Viswanathan, President, KGDS Renewable Energy Pvt Ltd

Thanks for sharing and compliments to the team and your leadership. It is impressive and informative.

Kiran Deshpande, Thermax India

The first issue of Sun Focus caught my interest. I am looking forward to more issues like this in the near future.

Babasaheb Mukane, Chief Manager – CSP, EnerSun Power Tech Pvt Ltd

From the editor's desk...

Dear Readers,

I am pleased to inform you that the first issue of SUN FOCUS was very well received and appreciated. It was circulated to around 450 stakeholders working in the area of CSTs. We are now bringing you a Special Issue of the magazine on fixed focus single axis automatically tracked elliptical dishes, popularly known as 'Scheffler dishes', under the UNDP-GEF Project on Concentrated Solar Heat.

These dishes were developed by Mr Wolfgang Scheffler, a German scientist for the purpose of indoor cooking. The dishes are now being manufactured indigenously by over 10 manufacturers in the country and are being used for steam generation for the purpose of community cooking, process heat, and cooling applications. The technology, which started with an aperture area of 7 sq.m. in 1990 with a crude clockwork mechanical arrangement for east-west tracking, has gone through a lot of developments during the past two decades. The dishes are now available with 16 sq. m. aperture area and with state-of-the-art technology in the tracking arrangement. Dual axis tracked Scheffler dishes have also been developed recently, which has improved the overall efficiency of the dishes by reducing the manpower earlier required for manual north-south adjustment.

The present issue is devoted to this technology and covers detailed information on its development and performance. Some case studies in laundry and community cooking in industries have also been presented. You will also find an update on the activities of the UNDP–GEF project in the Special Feature, which highlights the good work being done to propagate the use of CSTs in India. The financial support available from MNRE and under the Project for installation of CST based systems at beneficiaries' sites has also been highlighted.

I am sure you will find this issue quite interesting and it will help you understand the technology of fixed focus single axis automatically tracked elliptical dishes. I look forward to your valuable suggestions and inputs to improve the quality and content of the magazine.

Sd/-
Tarun Kapoor
Joint Secretary, Ministry of New and Renewable Energy

PROMOTING CSTs IN INDIA: THE ROLE OF THE MNRE

Dr RP Goswami

India needs a radical transformation of its energy system to accommodate the use of renewable energy, especially solar energy, to end India's "addiction" to oil. So what can India do to meet its future energy demands and help reduce huge energy shortage in the future? One step in the right direction was the establishment of the Jawaharlal Nehru National Solar Mission (JNNSM) in early January 2010. The mission strengthens the ongoing Central and State level programmes to promote use of solar energy in various sectors. One of its focus areas is solar thermal systems, including concentrating solar thermal technologies.

The industrial, institutional, hospital, and hospitality sectors which require commercial comfort cooling and community cooking should take full advantage of this golden opportunity because solar energy can be used for various applications in these areas. Concentrating Solar Technology (CST) based solar heating systems are increasingly becoming the most cost effective option to reduce fossil energy consumption in these sectors.

Since the launch of JNNSM, a journey of three years through the first phase of the Solar Mission from January 2010 to March 2013 has been completed during which CSTs have made significant contributions in the sector of medium temperature applications. This article discusses the salient features of the MNRE programme for promotion of CSTs. The proposed action plan under Phase II is also discussed.

Implementation Through Channel Partners

To improve the market reach and to accelerate the pace of implementation under the first phase of JNNSM, the Off Grid Solar Scheme of the programme has been implemented through approved channel partners. These channel partners include the following categories:

- Renewable Energy Service Providing Companies (RESCOs)
- Financial Institutions including microfinance institutions acting as Aggregators
- Financial Integrators
- System Integrators
- Programme Administrators

The pattern of the subsidy scheme extended till March 2013 is as follows.

Funding Patterns

Typical funding pattern for the projects under Phase I was as follows:

- 30% of the system cost as CFA to beneficiaries all over the country
- 60% of the system cost as CFA in all special category states, north-east states, and union territories for non-commercial establishments
- Support available to users through state nodal agencies (SNAs) or direct to beneficiary
- Subsidy released on reimbursement basis after complete installation, commissioning, and inspection of the system
- In addition to above, 80% accelerated depreciation (AD) benefits

Amount of subsidy and benchmark costs are as follows:

The capital subsidy per unit collector area, as given above, is based on 30% of the benchmark costs, which would be reviewed annually. Capital subsidy would be computed based on the applicable type of solar collector multiplied by the collector area involved in a given solar thermal application or project.

Solar Collector Type	CFA per Square Metre Area (Rs/ sq. m.)	Benchmark Cost (Rs/sq. m.)
Solar Collector Systems for Direct Heating	3,600	12,000
Concentrator with Manual Tracking(dish solar cookers)	2,100	7,000
Non Imaging Concentrators	3,600	12,000
CST based on Single Axis Tracking	5,400	18,000
CST based on Double Axis Tracking	6,000	20,000

The first phase of JNNSM is over and the second phase is awaiting approval and continuation. In the meantime, the Ministry has got funds allotted from the National Clean Energy Fund (NCEF) for implementation of CST based systems in institutional and commercial establishments for process heat, community cooking, and cooling applications under the Off Grid Solar Thermal Programme for the financial years 2013–14 to 2016–17 along with an approximated

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annual target allocation of 20,000 sq. m, 22,500 sq. m, 25,000 sq. m, and 32,500 sq. m area respectively.

Industry Base and Market

There are about 20 suppliers of dish cookers, eight of fixed focus E-W tracked dishes, and one of fully tracked dishes. Over 10,000 dish cookers, 100 indoor cooking systems, and 80 steam generating systems have been installed so far in the country with a cumulative collector area of 40,000 sq. m. The systems have been used for a variety of applications, including cooking, cooling, and process heat or steam requirement.

Proposed Plan for JNNSM Phase II

Cooking Applications

The second phase would target at least 100 institutions for deployment of solar dish cookers and about 25,000 installations for solar cooking applications in schools for mid-day meal schemes.

Industrial Process Heat

There is tremendous scope for CST applications in industries. It is estimated that over 15 million tonnes of fuel oil is consumed annually in industries for process heat applications below 250°C. Likewise, over 35 million tonnes of fuel oil is consumed annually for industrial applications above 250°C. In JNNSM Phase II, at least 400 systems of 250 sq. m each on average (total 100,000 sq. m collector area) would be installed.

Air Conditioning/Refrigeration

Cooling through solar systems is most relevant for India as it is most required during the high solar availability period. CST based solar cooling technologies are now available. Phase II of JNNSM would target at least 200 systems with an average capacity of 30 TR each (60,000 sq. m area) for air conditioning and refrigeration applications.

The thrust areas for R&D are:

- Development of complete value chain
- Thermal storage systems
- Solar concentrated glass
- R&D in materials and components

As part of its effort to strengthen solar R&D, MNRE has also announced the establishment of the National Institute of Solar Energy (NISE).

Challenges

One of the most significant challenges for the installer is in the form of frequent design changes as part of technology improvements. Apart from design change, there are several additional requirements from the client which can make design and installation challenging. This is overcome through efficient coordination and networking among manufacturer/supplier, installers, and beneficiary.

Quality Control

The project is executed to the fullest satisfaction of the client. After commissioning, a third party inspection called the Joint Inspection is conducted. This involves representatives of State Nodal Agencies (SNAs)/Regional Test Centres (RTCs)/third party, the manufacturer/suppliers/installer, and the beneficiary. The Ministry has also initiated studies to develop standards for design and testing of the systems. The National Solar Mission has catalysed solar energy growth in India, but much more needs to be done to scale up sustainably. Implementing three key policy priorities will help support the development of the CST industry as well as the broader solar industry. These are building a solar roadmap, strategic finance, and encouraging innovation. In my opinion, the Central government, State governments, and all the stakeholders should play a greater role in realizing India's solar energy potential. Off grid CST based installations in India so far:

Total Installed Systems as on 30 August 2013	**150 nos. with 30,000 sq. m (approx.) CST Area**
Direct and steam cooking systems	126
Hospitality, commercial cooling, industrial, and other applications	24 installations
Solar Cooling Systems	
Systems based on Scheffler dish	5 nos., 5,540 sq. m
Systems based on Parabolic Trough	2 nos., 1,461 sq. m
Systems based on ARUN dish	2 nos., 676 sq. m
Systems based on evacuated tube heat pipe	1 no., 290 sq. m
Total Number of Systems	**10 nos., 7,967 sq. m**

In addition to the above, the following prototypes for research, development, and demonstration of solar thermal air conditioning systems have been installed and commissioned at the MNRE's Solar Energy Centre (SEC):

100 Kw LiBr vapour absorption systems	48 parabolic trough concentrators (PTC), each with 6 sq. m collector area
15 Kw LiBr vapour absorption systems	16 parabolic trough concentrators (PTC), each with 6 sq. m collector area
5 Kw LiBr vapour absorption systems	30 modules, each with 1.05 sq. m collector area
5 Kw Zeolite based vapour adsorption system	18 modules, each with 3.41 sq. m collector area

ON-GOING ACTIVITIES UNDER UNDP-GEF PROJECT ON CONCENTRATED SOLAR HEAT

Dr A K Singhal

The UNDP-GEF project on 'Market Development and Promotion of Solar Concentrator Based Process Heat Applications in India' is being implemented by the Ministry of New and Renewable Energy (MNRE) since April 2012. The objective is to promote and commercialize the use of Concentrating Solar Technologies (CSTs) for industrial process heat applications through demonstration and replication projects, besides developing knowledge documents, test standards and test protocols, and removing barriers in promoting these technologies. The project is being executed by a Project Management Unit (PMU) formed by the Ministry which is responsible for undertaking all the activities envisaged in the project and achieving the overall goals and targets.

Out of the over 250 known working examples of the use of concentrated solar heat (CSH) for process heat applications worldwide, India, with a total of about 145 steam generating systems installed so far with a cumulative figure of 28,000 sq. m of dish area, is leading the world. This includes very small systems of 2–3 dishes, which could be 30% of the total number. Another 23 systems with 8,100 sq. m of CST area are at the execution stage. The project's objective to bring about an increase in the use of CSH systems for low and medium temperature process heat applications is realized by addressing the key barriers faced with technological, financial, institutional, and existing capacities. During the last one and a half years of project implementation, various initiatives have been undertaken, including assignments given to some consultants, the details of which are given below.

Field Evaluation Study of Existing Systems by APITCO, Hyderabad

The objective of the assignment is to help generate data on existing systems with respect to their functionality, component status, performance, cost economics, suitability of different technologies for various applications, and so on. The data should further help improve the performance of technologies and their components for developing markets of CSTs in the country. Over 95 installations have been reported to be surveyed by APITCO. A booklet with two pages on each installation covering all the information along with photographs should be ready by the end of September, 2013.

Preliminary Report by APITCO

State	Plants Visited	Functio-ning	Systems Partially Functioning
Andhra Pradesh	6	4	2
Gujarat	25	13	12
Karnataka	22	16	6
Maharashtra	12	10	2
Tamil Nadu	7	7	0
Rajasthan	5	4	1
Delhi	3	3	0
Haryana	3	3	0
Chhattisgarh	1	1	0
Uttar Pradesh	4	4	0
Uttarakhand	1	1	0
Himachal Pradesh	2	2	0
J & K	1	1	0
Punjab	4	4	0
Total	**96**	**73**	**23**

Development of Performance Standards, Test Procedures, and Protocols through Consortium of GK Energy, Thermax, Akson Solar, and University of Pune

The purpose of the assignment is to ascertain the performance and durability of the CSTs being manufactured and installed by various industries in the field so as to help develop confidence among the beneficiaries. Under the assignment a Detailed Project Report (DPR) has been prepared and finalized through an Expert Group formed by the Ministry which met a number of times during the last year. Based on this DPR, a Request for Proposal (RFP) has been floated for awarding the work of establishing two test setups (both mobile and immobile) at the Solar Energy Centre of the MNRE at Gurgaon and at the University of Pune to some

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suitable consultancy organization. The establishments are expected to be completed by March 2014.

Independent Technology Assessment and Performance Evaluation by EcoAxis (P) Ltd, Pune

The work involved in the assignment is:

- Assessment of technologies available in country and abroad
- Assessment of manufacturing facilities of CST industry
- On-line performance of 15 identified installations
- Pamphlets on CSTs giving their details, photograph, schematic diagram, utility, performance, cost, savings, etc

The study and work undertaken in the assignment is expected to help develop confidence among beneficiaries for CSTs besides helping MNRE to decide on participation of the manufacturers in its programme.

The preliminary reports on CSTs available in the country and abroad are under preparation and should be ready by December 2013. The final report will be ready by March 2014. The report on manufacturing facilities of various manufacturers is ready. This has been prepared by making actual visits to industries and is expected to be made available to MNRE soon. Four-page pamphlets on each CST technology are also ready and will be available in October. As regards on-line performance monitoring of the 15 identified installations of different technologies and applications, the instruments/equipment have been procured and are under installation at all the sites. At a couple of places, these have already been installed and on-line data have been made available to MNRE and the PMU.

Market Development of CSTs in Industrial, Hospitality/Hospitals, and Institutional/Religious Sectors by PwC, WISE, and Dr Ajay Chandak

Under this assignment, 29 awareness workshops are being organized in different states/sectors. Of these, 19 have already been organized at Pune, Delhi, Dehradun, Bangalore, Thane, Bhilwara, Mysore, Vadodara, Ahmedabad, Chennai, Coimbatore, Nagpur, Leh, Ludhiana, Gurgaon, Hyderabad, Guntur, Ghaziabad, and Jaipur. These workshops have the dual purpose of building awareness on CSH systems as a viable option to replace costly and polluting fuels such as furnace oil, diesel, or electricity, and also evoke interest in potential end users and investors in the use of CSH systems. There are 38 ready to sanction proposals with 9,000 sq. m which are expected to be generated through the workshops by the end of the year. Twelve video films on successful installations with case studies have also been prepared which are being used for awareness generation in workshops.

Video Films on CST Based Systems

Industrial Sector

- Gajraj Drycleaners, Ahmednagar for laundry
- Mahindra and Mahindra, Pune for cooling and component washing (two installations)
- Tapi Food Industry, Vapi, Gujarat for food processing
- Purple Industry, near Pune for ironing of clothes
- SKF Industries, Bangalore for phosphate processing

Institutional and Religious Sectors

- Shirdi Sai Baba Sansthan for community cooking
- Muni Sewa Ashram, Vadodara for cooking
- Vankul School, Gujarat for cooking

Hospitality and Hospitals Sectors

- Muni Sewa Ashram, Vadodara for space cooling in hospital
- Civil Hospital, Thane for space cooling
- ITC Maurya, Delhi for boiler feed and laundry

Sun Focus Quarterly Magazine by TERI

This magazine focuses on activities related to CSTs within and outside the country, including developments, events, news, installations, success stories and case studies, popular articles, interviews, Government schemes on subsidies and fiscal incentives, solar radiation assessment data, CSH project activities, and so on. It is a magazine which could be useful to potential beneficiaries, industrialists/manufacturers, policy formulators and implementers, and other stakeholders involved in the market development of CSTs. The first issue of the magazine was released in August 2013 by Dr Farooq Abdullah, Hon'ble Minister (MNRE) and sent to around 500 people (see page 4.)

National Toll-free Helpline and Monthly Newsletter by STFI, Pune

A National Toll-Free Helpline Number 1800 2334477 is in place which operates from Monday to Friday between 9.30 am and 6.30 pm and on Saturdays between 9.30 am and 1.30 pm. This Toll Free Number is being publicized through advertisements in national newspapers and also through an SMS campaign. The Helpline has also shown a marked increase in the calls received concerning CSTs. During the period January–June 2013, 6,783 calls were received and close to 65 per cent of these calls were concerning solar thermal technology—a notable success. A monthly newsletter is also in operation since January 2013 and is being mailed to over 2,000 people every month. It is also available at www.insolthermtimes.org.

Development of Skilled Manpower for Operation, Maintenance, and Troubleshooting of CSTs by Anthropower (P) Ltd, Delhi

The assignment includes the development of Operation, Maintenance, and Troubleshooting Manuals for all kinds of CSTs to promote their use to beneficiaries and technicians. Separate manuals will be prepared for each technology. It also includes the organization of 12 training programmes for students of ITIs, practicing workers (high school passed), and maintenance persons of systems at beneficiary sites in states with a minimum of 25 participants in each programme. The training will be held for a period of three days, including field visits to installations in nearby areas followed by one day of exposure to teachers of ITI students of the respective states. The focus of these programmes will be on operation, maintenance, and troubleshooting of CST based systems. It is yet to take place.

ESCO Scheme on CST Based Systems

A scheme on the installation of systems in ESCO mode has been developed wherein additional support is available to ESCOs to encourage manufacturers/entrepreneurs to execute projects on CSTs. Projects generated in ESCO mode are expected to help develop confidence among beneficiaries and generate more proposals as they will be win-win positions for both the manufacturers/entrepreneurs and beneficiaries.

Repair and Renovation Scheme

Another scheme has been developed for repair of 5 year old non-functioning systems. The support to such systems is on cost sharing basis, wherein 10 per cent of the project cost subject to a maximum of Rs 15 lakh can be provided to beneficiaries with the proviso that an equal amount or more is also spent by them.

Demonstration and Replication Projects

30–60 projects (each of 250 sq. m and above, with a total of 15,000 sq.m) based on emerging technologies/applications are proposed to be taken up as **demonstration projects** during the project duration. The focus is on sectors such as dairy, hotels, hospitals, textiles, pharmaceuticals, metal treatment, chemicals, food processing, and institutional cooking. The technology will be decided on the basis of the temperature requirement. The performance is to be ensured through ESCOs/incentive on yearly performance. Other than MNRE subsidy, additional support of 15 per cent to a maximum of Rs 30 lakhs for each project can be granted. This includes preparation of DPR/feasibility report, performance monitoring, and O&M for a few years. As regards **replication projects**, 60-90 projects (each of 250 sq. m and above with total 30,000 sq. m) based on i) technologies already in promotion (Scheffler/Arun), and ii) replication of projects sanctioned as demonstration projects are proposed to be taken up. Support of Rs 4 lakhs is available for each of the replication projects for the purpose of performance monitoring and O&M for a couple of years.

The document for inviting EOI/Proposals was prepared and uploaded on the website both for demonstration and replication projects. Three advertisements given in the print media generated over 40 queries. All these are being addressed by the PMU. A couple of demonstration projects sanctioned by the PMU are as follows:

- Solar steam cooking system at Shirdi Sai Baba Sansthan (1,168 sq. m): This is IBR Compliant and is being developed as a unique showcase project.
- Solar steam system using two Arun dishes (338 sq.m) for milk pasteurization at Salem District Co-operative Milk Producers Union Ltd (Tamil Nadu): An improved version of a non-IBR receiver is proposed to be demonstrated in this system.

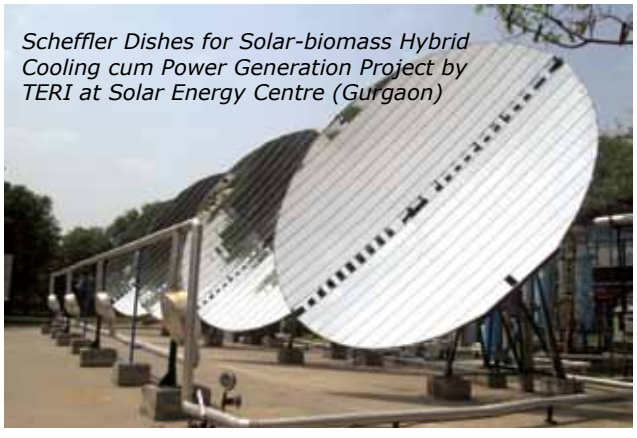
Two MNRE sanctioned projects during 2012–13 have also been taken up as replication projects:

- Akal Academy Baru Sahib, Rajgarh (320 sq.m of Scheffler dishes for community cooking)
- Gurudwara Shri Baba Deep Singh Ji Shaheed, Ropar (320 sq. m of Scheffler dishes for community cooking)

Thus, the UNDP-GEF project to develop and promote the use of CSTs in India is thriving and doing good work to increase the use of this sustainable technology providing renewable energy for process heat applications. ■

SCHEFFLER SOLAR CONCENTRATORS IN INDIA

Dr Ajay Chandak



Scheffler Dishes for Solar-biomass Hybrid Cooling cum Power Generation Project by TERI at Solar Energy Centre (Gurgaon)

Scheffler concentrators have been in use in India for about 15 years. A total area of 15,000 m² of Scheffler concentrators has already been installed in India, mainly for cooking applications, and recently for industrial applications such as steam generation and air conditioning, among others. Wolfgang Scheffler[1] launched the idea of oblique paraboloidal solar reflectors, now known as Scheffler concentrators. The fixed focus of the concentrator makes it ideal for direct cooking applications.

Principle

The reflector is a small lateral section of a much larger paraboloid. This section of the paraboloid, which is used as a reflector, lies away from the axis of the parabola, as shown in Figure 1 below.

The inclined cut produces the typical elliptical shape of the Scheffler reflector. Inclined cuts on either side of the axis produce two reflector dishes focusing at a single focus on the axis of the paraboloid. A line passing through the focus and perpendicular to the axis of the larger paraboloid forms the axis of rotation for the Scheffler dishes. This axis of rotation is kept parallel to the axis of the earth. Hence, the inclination of axis of rotation at the site of installation makes an angle equal to the latitude angle of the location with the horizontal. At the equator, the axis of the paraboloid makes zero angle with the vertical and the axis passing through both the dishes will be in the horizontal plane. At any location away from the equator, the angle between the axis of the paraboloid and the vertical will be equal to the latitude angle of the location. As can be seen from the figure below, when the axis of the paraboloid is inclined, one dish will be more vertical, referred to as the standing dish, while the other dish is much flatter and is thus referred to as the sleeping dish. The aperture of this elliptical section is circular on equinox day and is approximately 70% of the area of the ellipse. The solar radiation that falls onto this section of the paraboloid is reflected sideways to the focal point of the paraboloid located at twice the focal distance from the centre of the reflector. The paraboloid has to perform the same change of inclination as that of the sun in order to stay directed at the sun to obtain a sharp focal point. The centre of the reflector and the position of the focus are not allowed to move. Figure 2 shows the typical arrangement which permits installations to have the focus inside the kitchen, with special orientation of the kitchen itself.

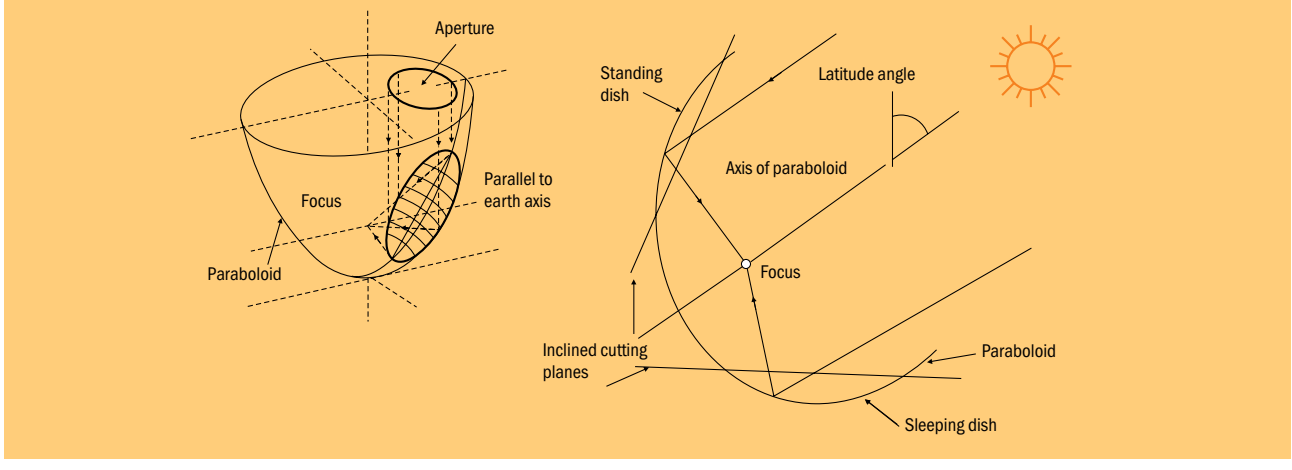


Figure 1: Principle of Scheffler Solar Concentrator with Arrangement of Standing and Sleeping Dishes

The author is an expert on Scheffler technology. EMail: renewable.consultant@gmail.com

[1] Wolfgang Scheffler (2009), 'Introduction to the Revolutionary Design of Scheffler Reflectors', International Solar Food Processing Conference, Indore, India, 14–16 January 2009, pp. 1–4.

The heat load, which may be direct cooking vessels, is to be kept at the focus where it is heated using a secondary reflector or steam receivers. Such an arrangement can be installed on rooftops and hence, space can be saved.

been used to drive 100 tonne vapour absorption machines to run air conditioning systems at Muni Seva Ashram near Baroda as well as at the TVS Suzuki centre near Chennai. New applications such as solar industrial ovens have been

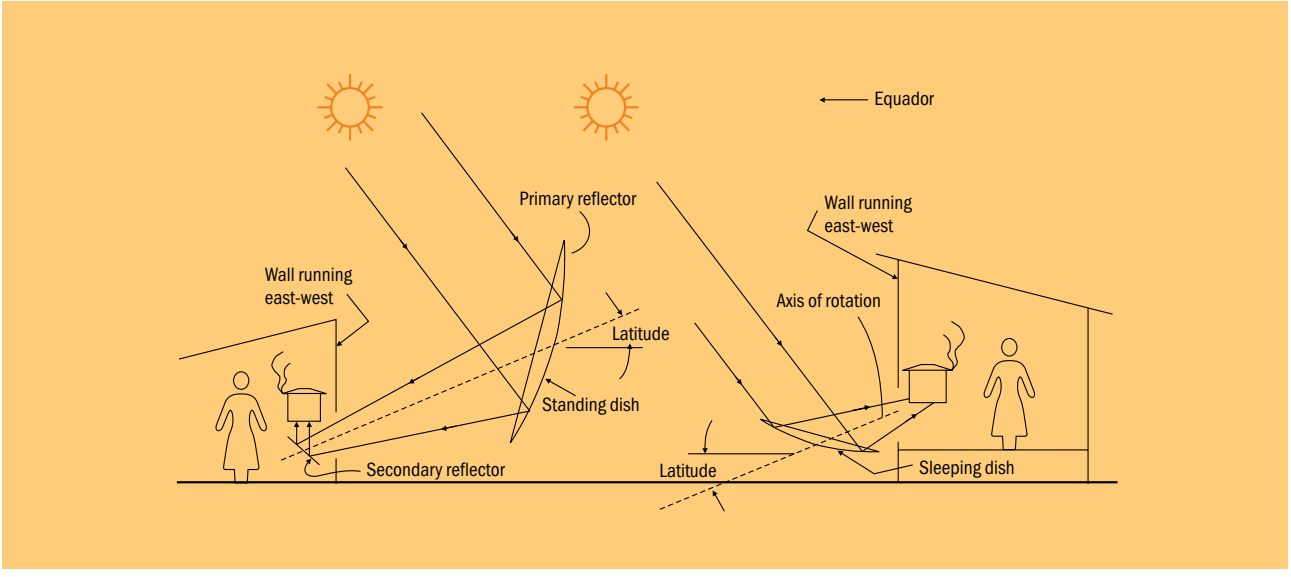


Figure 2: Standing and Sleeping Dishes Bringing Focus Inside the Kitchen

Tracking Mechanism

To track the sun, the solar concentrator has to be moved in two directions in real time. Scheffler concentrators are polar mounted reflectors and need to be tracked continuously for the day tracking, and intermittently — every 3–4 days — for seasonal tracking. The majority of systems in use today have automated day tracking and manual seasonal tracking.

Applications

Scheffler concentrators are available in various sizes such as 7m², 10m², 16m², and recently, 32m² and 60m², and have been used for a variety of mid temperature applications. The major installations till date are in direct cooking and steam cooking applications. McGilligan[2] established central India's first solar kitchen at the Barli Rural Women Institute in Indore, Madhya Pradesh with three units of 9.3m² concentrators, each in direct cooking mode with heat storage system. Shirdi has the world's largest steam based community kitchen with the installation of 640m² of solar concentrators[3]. A few installations have been developed with thermic fluid heating which extends the capability to frying and roti making. Steam generators have developed by the author. Thus, the main advantages of the technology are:

- Unique ability of direct use in indoor kitchens, bringing the sun into kitchen technology
- Flexibility in installation: rooftop installations are easily possible
- Fixed receiver on the ground eliminates need for rotating piping joints and keeps piping and integration costs low
- Simple and low cost fabrication

Some of the limitations of the technology are:

- High cosine losses reduce effective usable aperture area (average 70% of the area is usable)
- Low efficiency limits the operating temperature range to 120°C–140°C
- Reflector dish has to be flexed every 3–4 days as per seasonal movement of the sun. This has to be done manually.
- Systems are prone to wear and tear during operation, thus require maintenance. Rigorous training is required for the operators

[2] McGilligan Jimmy (2006), 'Establishing First Solar Kitchen in Madhya Pradesh and Centre for the Awareness Generation and Dissemination of Solar Cooking Technology among Rural Women of Central India', Proceedings of International Solar Cookers Conference, Granada, Spain, 12–16 July 2006, pp. 1–6.

[3] Gadhia Deepak (2009), 'Parabolic Solar Concentrators for Cooking and Food Processing', International Solar Food Processing Conference, , Indore, India, 14–16 January 2009, pp. 1–5.

Recent Developments In Scheffler Concentrator Systems

Scheffler concentrators in their current form do face challenges in terms of fixing mirrors, accuracy, and consistency in tracking, and so on. The author made an effort to resolve these problems as well as to add new features to the design of the concentrator.

New System for Fixing of Mirrors

Mirrors are conventionally glued to the aluminium flat or channel which are laid down on the reflector dish, or tied to the aluminium flat with the help of copper wires. Mirrors fall off when the glue gets hardened in winter and the copper wires can get cut because of the sharp edges of mirrors. For this reason a special aluminium track section was designed and developed, with a 'T' section integrated on the web of the standard aluminium channel used for curtains. A special extrusion die was developed and this section was commercially manufactured and the technology disseminated.

Universal Fixture for Scheffler Concentrators

Most of the existing stand designs used in Scheffler reflectors are welded structures with fixed geometries as per the latitude of the location of installation. This requires different stand designs for different locations, and any error in manufacturing or installation results in malfunctioning of the system. Chandak et al[4] designed a simplified fixture which permits adjustment in the vertical as well as horizontal direction so that any error committed in south marking or latitude angle setting can be easily corrected at site. Figure 3 shows the pictorial view of the innovation.

Development of New Tracking Mechanism

Scheffler concentrators, when launched, were provided with a clock mechanism with pendulum. There were lots of field complaints and so most of the old systems were replaced with the timer based DC motor along with a large mechanical reduction. This system is more reliable as compared to the clock mechanism. However, even with this modification, the system had issues due to change in friction of the rotary parts. Also, over- or under-charging of the batteries affected the speed of the wiper motor. These issues were dealt with by a simple innovation by the author. A wiper motor controller of the wiper DC motor, as used in cars, was added after the timer. The timer triggers the control circuit at a predefined time interval. The time interval between two triggers can be very precisely set using an on-off timer. This innovation ensures that the final effective speed of the rotating arm is 15° per hour.

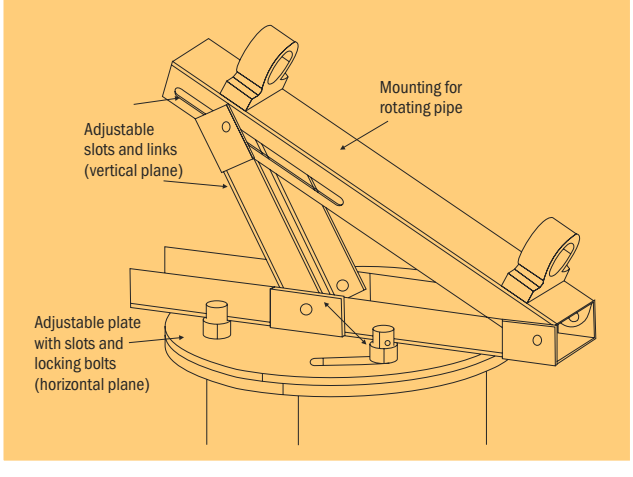


Figure 3: Modified Support Design for Scheffler Dishes

Future of Scheffler Technology

Scheffler concentrators are an excellent source of heat for industrial and commercial applications. Maintaining focus at a fixed location is their most innovative feature, which permits easy extraction of heat in direct heating or steam generation mode. Being a fixed focus system, Scheffler concentrators will always enjoy applications such as indoor cooking and small scale steam generation. With new innovations adding better concentration ratios and precise tracking systems, Scheffler concentrators can be used for low to medium temperature industrial applications. ■

Solar steam cooking system for 3,000 students at Girls' Hostel, Suttur, JSS Mahavidyapeeth, Mysore being inaugurated by Hon'ble Chief Minister of Karnataka Shri Jagadish Shettar in the presence of Shri Shri Shivarathreshwar Deshikendra Swamiji, JSS Math, Suttur

[4] Chandak Anurag, Chandak Ajay, Gulve Vikas (2010a), 'Universal Fixture for Polar Axis Mounted Solar Concentrators', Patent application no. 2520/MUM/2010, registered with Controller of Patents, Mumbai, India.

SCHEFFLER CONCENTRATOR WITH DUAL AXIS AUTOMATIC TRACKING

Dr (Mrs) Anagha Pathak and Mr Shivanand Nashi

Fixed focus dish concentrators (Scheffler) are being successfully used for medium temperature applications in different parts of the world. While installing a fixed focus reflector at any site, the axis of rotation is fixed very precisely at an angle equal to the latitude of the site aligned with the horizontal in the north-south direction. For daily tracking, these reflectors rotate along an axis parallel to the polar axis with an angular velocity of one revolution per day to counterbalance the effect of daily earth rotation. This is achieved through an automated east-west (E-W) tracking system through the Programmable Logic Controller (PLC).

In order to adjust the reflector with respect to changing solar declination, the existing reflectors are provided with two manual telescopic actuators to adjust the inclination of the reflector by half of the change of the solar declination angle and to attain the required shape of the parabola for any day of the year. This correction or apparent movement of the sun is also called north-south (N-S) movement of the sun (seasonal adjustment). Each dish must be individually adjusted such that it is precisely aligned to reflect the optimum concentration of solar radiation to the receiver. The tracking system is therefore semi-automatic in nature. Figure 1 shows the presently used Scheffler dish in the field.

Major Problems in Existing Technology

The major problems in manual N-S tracking through existing technology are as below:

- **Manual Operation:** It is necessary to manually adjust the actuators on a daily basis. Figure 2 shows the manual adjustments being done in the dish.
- **Inefficient Functioning of System:** There is no continuous feedback mechanism since the existent system is manually operated. Therefore, adjustment of focus depends entirely upon the judgment and skill of the operator. Due to this, the system may perform at a lower than predicted performance level, thereby increasing the risk of inefficiencies in the system.
- **Increased Operational Cost:** One fitter and one helper are constantly needed to do the adjustment which adds to the operational cost of the system.
- **Time-Consuming and Cumbersome:** For each dish, five to ten minutes are required to do the adjustment. Hence, as the number of dishes increases, the task becomes more cumbersome and time-consuming.
- **Reluctance of Operator:** Due to the tedium of the job, it is observed that the operator is often reluctant to adjust the focus frequently, resulting in lower output and efficiency.

Figure 1: E-W Automatically Tracked Scheffler Dish

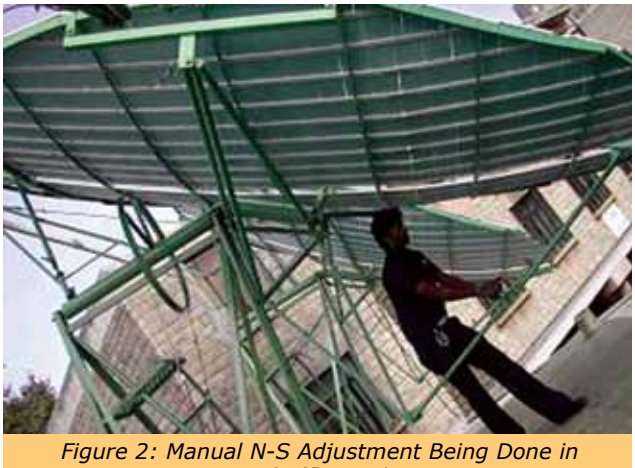


Figure 2: Manual N-S Adjustment Being Done in Scheffler Dish

Dr (Mrs) Anagha Pathak is Senior Manager in Thermax Ltd, Pune, and Mr Shivanand Nashi is from M/s Unisun, Bangalore, a manufacturer of CSTs.

Overcoming Shortcomings

The shortcomings in the semi-automatic tracking system are overcome by a new design which comprises of a closed loop tracking system that monitors the focus on the receiver. Any misalignment between receiver and focus is automatically corrected by this system. The system works on a feedback loop for which the signal is taken from the image on the receiver. The image processing software analyses the image and the position of focus and an algorithm especially developed for Scheffler dishes is used to convert the signal to the actual rotation of the dish in E-W and N-S directions. To take care of any mechanical errors and instrument lag, the system is self-calibrating. The motor with gearbox takes care of E-W tracking while two actuators with motors take care of rotation in N-S direction. A combination of image processing and tracking programmes is built into the controller to give precise signals to the motors for correct positioning of the dish and hence the focus. The system has the following components with various advantages:

Figure 3: Dish Showing Linear Actuators at its Back

- **Fully Automatic:** It is a fully automatic tracking system with no manual intervention required, thus reducing the operational cost of the system.
- **Closed Loop Feedback System:** Any misalignment between receiver and focus will be automatically corrected by this system.
- **More Accurate E-W Tracking:** The new closed loop tracking system is more accurate even for E-W tracking as compared to existing PLC tracking system.
- **Auto Start:** The new tracking system will start automatically in the morning at a pre-specified time. Similarly, in the evening, it will automatically go to parking (home) position.
- **Tracking under Cloudy Conditions:** The tracking system is also capable of detecting cloudy conditions. Therefore, no manual intervention is required to control the dish under cloudy conditions. The dish will refocus again as soon as sunny conditions are detected by the tracking system.
- **Additional Safety:** The tracking system will also take care of the overall safety of the system. Any unhealthy signal due to no flow of water or low water level/high pressure of steam will be detected by the tracking system and the dish will be defocused. It will refocus as soon as it receives a healthy signal.

It is estimated that by introducing this new arrangement, the efficiency of the system would improve to the tune of 40 per cent on the current efficiencies where the systems are being tracked manually (assuming the tracking is very precise and is carried out regularly). The capital cost impact of the linear actuator on each concentrator in the initial stage is up to Rs 30,000, which is expected to reduce with higher volumes of such dishes installed in the field. The Balance of System cost for an array of six concentrators works out to Rs 50,000–1,30,000 depending on the level of automation and parameters to be monitored. The improved efficiencies and savings on labour cost for manual tracking adjustment, however, justify the increased capital cost and would, in turn, not affect the payback period on investment compared with the manual tracking system. ■

Solar steam cooking system for 600 students per day installed at Malaviya National Institute of Technology, Jaipur using the new design of Scheffler dishes being inaugurated by Dr Farooq Abdullah on 22 August 2013

BOSCH LTD: USING SCHEFFLER DISHES FOR COOKING

Mr John George Painumkal

Bosch as a corporate entity is committed to environmental protection and has a clear energy and CO_2 management policy that is deployed across all its plants worldwide.With the intent to reduce greenhouse gases through CO_2 abatement and carbon footprint reduction, and to be a benchmark for industries in the local region, a project was set up at the Bangalore plant. This also complements Bosch's various initiatives on its Corporate Social responsibility (CSR) front.

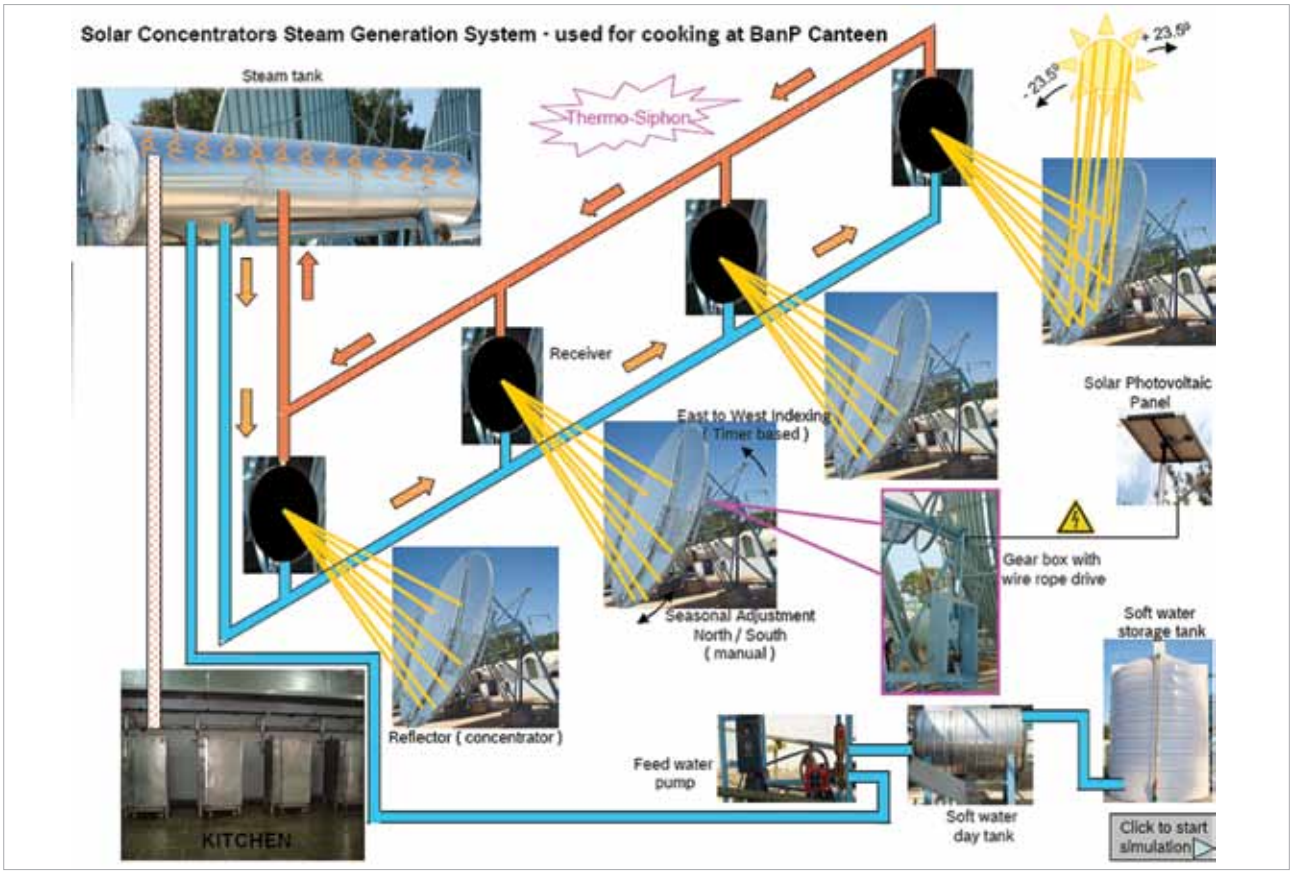
Diesel fired boilers — two generating 500 kg per hour, and one producing 600 kg per hour — were being used for generation of steam at a pressure of 10 bar at 180°C, which was required for cooking purposes at the plant's canteen kitchen. An average consumption of 290 litres of diesel per day was required earlier.

The type and average quantity of food cooked per day in the canteen is as mentioned in the table:

Type of Food Cooked	Quantity (kg)		
	Lunch	Dinner	Total
Rice	400	130	530
Sambar	1200	1200	2400
Rasam	1200	1000	2200
Vegetables	800	400	1200

With a focus on reducing the burning of fossil fuels, the possibility of using renewable solar energy as an alternative to diesel fired boilers was evaluated. Scheffler technology was selected for the application due to its suitability to the cooking application and the flexibility offered in the installation location. A total of 18 concentrators (16 sq. m each) are installed for the application. Each Scheffler concentrator typically generates around 44 kg of steam per day.

Schematic



The author is Manager–Maintenance Planning at Bosch Ltd, Bangalore.

Operation

Water from an overhead tank (half-filled) circulates by thermo-siphoning through the receiver for each of the concentrators. This heats the water continuously so as to generate steam, upto a maximum pressure of 10 bar. The axis of rotation of the concentrator is located parallel to the polar axis (north–south) and runs through its centre of gravity. Inclination of this rotation axis is as per the latitude of the site location (12°36'). The concentrator is rotated around its axis from east to west to track the sun during the day.

Performance of the System

The system has been implemented during December 2009 and is located on the roof of the canteen kitchen building. The system operates for approximately seven hours per day, and for a minimum of 200 days a year. At present, about 31 per cent of the everyday steam requirement for cooking is now met by the solar thermal system. This caters to approximately 1,500 meals each day. Thus, due to the solar thermal system, Bosch Ltd has been able to save around 90 litres of diesel per sunny day (about 4.8 litres of diesel per concentrator per day), thereby conserving natural resources and reducing emissions of greenhouse gases such as CO_2 to an extent of approximately 50 tonnes per annum. The annual fuel savings due to the solar thermal system are about 18,000 litres per annum.

Economics

Investment for the project was approximately Rs 32 lakh, with Rs 10 lakh of the project cost being financed by the Ministry of New and Renewable Energy (MNRE), Government of India, through Karnataka Renewable Energy Development Ltd (KREDL). Additionally, there are also savings in electrical power consumed by the boilers (approximately 1,400 kWh per annum) due to the reduction in run hours for motors used for diesel, feed water pumps, and the exhaust system. Based on the diesel savings and Central Government financing, the simple payback period of the fund is approximately 3.6 years.

"The implementation of this project has also enhanced our clean and green image and reinforced our commitment to environmental protection."

Challenges During Installation of System

- The entire canteen kitchen roof had to be replaced since the building was about 40 years old.
- The Scheffler concentrators were integrated in such a way that during maintenance or breakdown of a single dish, the rest of the system would remain unaffected.
- The piping layout was designed to ensure that pressure drops were kept to a minimum up to the usage point of steam.
- The cooking timings were synchronized and optimized to suit the energy generation pattern of the solar thermal system. This ensured maximum utilization of solar steam and, hence, maximum diesel savings. ■

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GAJRAJ DRYCLEANERS: USING SCHEFFLER DISHES FOR IRONING OF CLOTHES

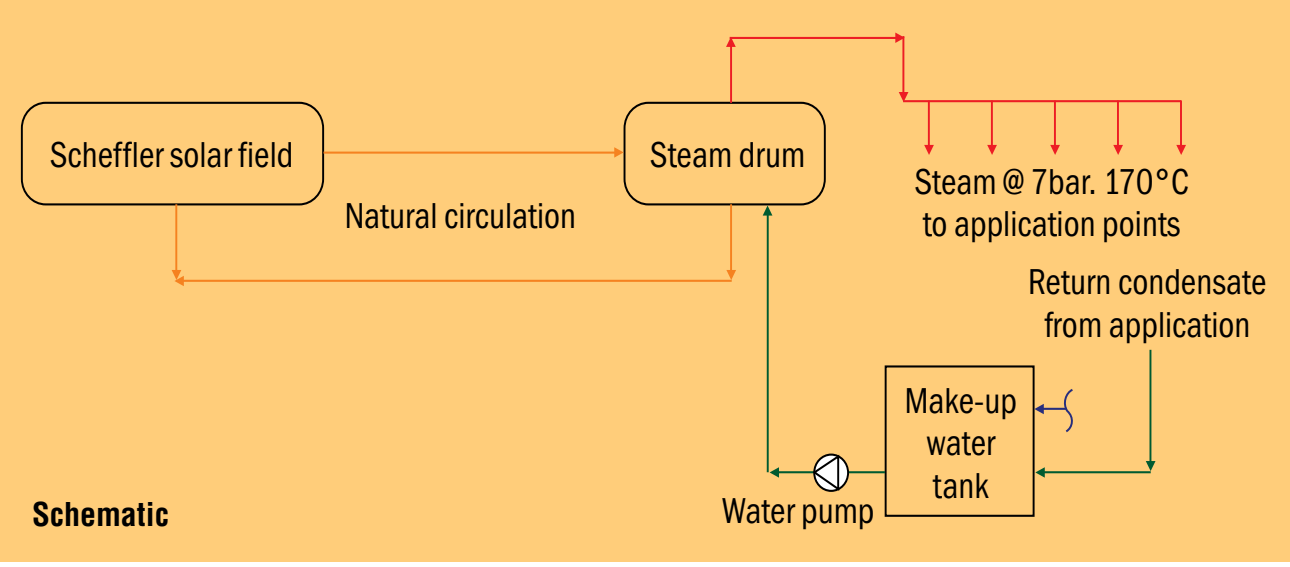
Mr Suresh Chavan and Mr Rajan Uttekar

Gajraj Drycleaners is a laundry in Ahmednagar, Maharashtra, which processes about 2,000–2,500 clothes per day. The laundry is run on a steam based system, which requires about 2,000 kg of steam per day at 7 bar pressure and 170 °C for operations. The process is suitable for the integration of the concentrated solar thermal system. The firm decided to install Scheffler concentrators in 2006 due to the low cost and flexibility offered by Scheffler technology in installation. Until then, Scheffler concentrators and, in general, concentrated solar technologies (CSTs) were mostly limited to mass cooking system applications in India. This application has become one of the pioneering applications of CSTs in industrial applications other than cooking. A total of 15 Scheffler dishes (16 sq. m each) are installed for this application.

Operation Philosophy

The concentrated solar thermal system here supplies steam at 7 bar and 170 °C directly to the application points with steam ironing machines and presses. The water is circulated through the receivers of the Scheffler dishes by natural circulation by means of gravity. The steam drum collects the steam generated by the solar system. The steam is supplied to the application points when the desired pressure (7 bar) is built up in the system. Thus the only pump required in the system is a feed water pump, which pumps the return condensate into the steam drum. The pump is operated on the basis of a level switch mounted in the steam drum. The use of a single pump in the system keeps the parasitic power consumption to a minimum.

Mr Suresh Chavan is the Founder Director and Mr Rajan Uttekar is Partner and Managing Director of Gajraj Drycleaners, Ahmednagar.



Indicative Schematic of the Scheffler Solar Thermal System at Gajraj Drycleaners in Ahmednagar

Diesel fired boilers are used as a back-up system. The back-up system is completely independent of the solar system, and when solar system is operational, the back-up system is kept off. The operational hours of the laundry are 9 hours per day, and on a typical clear sunny day, the solar system supplies steam for 4.5–5 hours. The back-up boilers are used for the rest of the time.

Performance of the Solar Thermal System

The solar system is operated for about 200–220 days a year and typically generates about 600–800 kg steam in five hours of operation. This is equivalent to a daily energy output of 1,300–1,800 MJ/day. Assuming an average daily beam normal solar radiation of 5–5.5 kWh/day at Ahmednagar, the average solar thermal efficiency of the system is in the range of 35–38 per cent. Thus, the solar system generates about 50 to 60 per cent of the total heat requirement on a typical clear sunny day. It was observed that the system saves about 30–35 litres of diesel during summer and about 40–45 litres of diesel during the winter season. This is expected for Scheffler technology, as the incident angles of solar radiation are higher in summer, resulting in more cosine losses.

It was observed that the reflectivity of the mirrors degraded considerably in four years, which resulted in lower optical and thermal efficiency of the system. The mirrors were, therefore, replaced with high reflectivity mirrors to restore the energy output to the original level.

Economics

The total cost of the system at the time of installation was about Rs 27 lakhs (without subsidy). The Ministry of New and Renewable Energy (MNRE) provided approximately 30 per cent subsidy (Rs 8.5 lakhs). The average annual fuel savings are observed to be about 6,000–6,500 litres per annum. Thus, the solar thermal system has a simple payback period of about 5.5 years. ■

"The installation of the solar thermal system has enabled us to use a completely free and clean form of energy. Our diesel consumption has reduced considerably due to the solar system, and it makes us increasingly happier day by day, with the steep rise in diesel prices. We feel that the funds and space invested in the system are worth it!"

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MEETINGS AND WORKSHOPS

MEETINGS

13 August 2013

STEERING CUM ADVISORY COMMITTEE MEETING OF CSH PROJECT

The second meeting of the Project Steering cum Advisory Committee on the UNDP-GEF Project on Concentrated Solar Heat was held at MNRE under the Chairmanship of Secretary, MNRE. Over 25 senior officials from various central Ministries/Departments, PSUs, and industry who are members of the Committee participated in the meeting. Major activities undertaken in the project were highlighted in the meeting apart from playing video films on successful installations. The first issue of this quarterly magazine on CSTs started in July 2013 was also circulated to the members. Based on the discussions held among members on the project activities, various action points emerged from the meeting which included letters to be addressed by Secretary, MNRE to concerned Ministries asking them to use CST based systems in their industrial establishments, and establishment of test standards and facilities for CSTs at the Solar Energy Centre in the next six months.

9 September 2013

BRAINSTORMING MEETING WITH SUPPLIERS/MANUFACTURERS AND EXPERTS OF CSTs

To discuss issues related to the development of large scale proposals on CST based systems for process heat and cooling applications and to find solutions under the MNRE programme and UNDP-GEF project, a brainstorming meeting was held at MNRE with the major suppliers/manufacturers and technical experts of CSTs. The meeting was chaired by Secretary, MNRE. The major points emerging from the meeting were as below:

- There is a need to standardize the components of CSTs
- Benchmark costs need to be reviewed
- There has to be a continuous publicity and awareness programme on CSTs
- Manufacturing and cutting of solar grade mirrors need to addressed adequately
- Testing and certification facility for CSTs needs to be developed urgently
- RPO for heat/energy generation on fuel saved through use of RETs may be developed
- 20 to 30 reference projects on different technologies and applications need to developed and demonstrated
- Security risk funds may be generated

To address all these issues in detail, two committees were formed which will submit their report in a month's time.

WORKSHOPS

28 June 2013, Hyderabad

SEMINAR ON CSTs

The Energy Conservation Mission of the Institution of Engineers, Andhra Pradesh organized a one day seminar on Concentrating Solar Technologies for Industrial and Commercial Applications at Hyderabad. The objective was to promote awareness among industrial and commercial users of energy about the possibility of using CST systems at their establishments and help develop some concrete projects. The programme included presentations by senior officials and experts from the Government, technology providers, and manufacturers. Participants of the seminar were drawn from textile, food processing, chemical, pharmaceutical, dairy, and other industries, as also from hotels, hospitals, and institutions. Over 120 participants attended the workshop.

31 July 2013, Ghaziabad

EMERGING SOLAR ENERGY TECHNOLOGIES FOR INDUSTRIAL PROCESS HEAT APPLICATIONS

The objective of the event was to forge a roadmap to embark on the use of solar power and its potential to use hybrid technologies and easily added storage which could unlock dispatchable and base-load power, setting the stage for larger renewable energy penetration. The workshop witnessed presentations on the latest technologies and applications of solar power generation and storage. The event was well attended by over 60 representatives from government, industry, and academia.

1 October 2013, Jammu

USE OF CSTs FOR COMMUNITY COOKING, SPACE COOLING AND LAUNDRY APPLICATIONS IN HOSPITALS AND HOSPITALITY SECTOR

The participants at this WISE business meet discussed the technicalities of CSTs after an introductory lecture by Mr Prabhuram Subramanian, Senior Research Associate, WISE. Dr RP Goswami, Director, MNRE elaborated the MNRE subsidy for CST installation and some success stories of this scheme. Dr Sudhir Kumar spoke about the UNDP-GEF project and additional incentives by these international organizations. Some participants evinced interest in installing CSTs, thus the meet was successful.

3 October 2013, Chennai

MARKET DEVELOPMENT OF CSTs FOR PROCESS HEAT/ COOLING APPLICATIONS IN THE INDUSTRIAL SECTOR

The interactive workshop, with over 45 participants, was organized by PwC in association with the Indian Leather Industry Foundation (ILIFO). ILIFO highlighted the challenges that the industry faces to secure its energy needs. The MNRE initiative of market development was much appreciated and discussed in detail. The inaugural session was followed by the technical session with presentations by PwC and Clique Solar, including successful case studies.

FORTHCOMING EVENTS

CSP Today Sevilla 2013
7th International Concentrated Solar Thermal Power Summit
Seville, Spain, 12–13 November 2013
www.csptoday.com

InterSolar India
Mumbai, India
Exhibition November 12–14, 2013
Conference November 11–14, 2013
www.intersolar.in

MNRE National Workshop on Solar Thermal Systems
New Delhi, India
November 2013

A half day National Workshop on Solar Thermal Systems is being organized by the Ministry of New and Renewable Energy under the UNDP-GEF Project on Concentrated Solar Heat. This will be the second time MNRE will be hosting such a workshop, and is one of the occasions for the solar thermal industry to gather and showcase their achievements.

Over 250 stakeholders from various parts of the country are expected to participate in the workshop. On the occasion, awards for 2013 will be presented to various stakeholders by Dr Farooq Abdullah, Hon'ble Minister for New and Renewable Energy. The awards will be in the categories for Solar Water Heating Systems and Concentrating Solar Technologies. Over 28 awards are proposed to be given under various categories. Knowledge documents developed under UNDP-GEF Project on CSH will also be released. These will include video films, fliers, case studies on CSTs, and compendiums on existing installations.

ADDITIONAL SUPPORT AVAILABLE FOR CST BASED SYSTEMS UNDER UNDP-GEF PROJECT*

Project Size of 250 sq. m. and Above

Demonstration Projects

- 15% of system cost to a maximum of Rs. 30 lakhs (Revised on 11.10.2013)
- Maximum 30-60 projects with 15,000 sq. m. of CST area. For each application/technology/sector, the number may be restricted to a few)

These will be those projects which are different from conventional CST based systems already in promotion for many years. Projects with emerging technologies/newer applications or improved versions of existing technologies and innovative ideas leading to improved performance/durability/user friendly techniques or reduction in cost, etc., will come under this category. Justification is required to be given by the beneficiary in their covering letter as well as in the proposal for considering it as a demonstration project by the PMU of the project. Support is available to share owner's expenses for the following, which otherwise is also to be done in MNRE programme to avail subsidy:

- ✤ Preparation of Feasibility Report for project with CST area below 750 sq.m. and Detailed Project Report (DPR) for project above 750 sq. m.
- ✤ Performance monitoring of the system for minimum 2 years with instruments and equipment procured and installed *(2 Pyranometers with and without shading ring, pressure transducer, temperature sensors, steam/thermic fluid/hot water flow meter and a control panel for on-line monitoring will be the minimum requirement which will be the responsibility of the supplier)*
- ✤ Operation and maintenance of the system *(AMC for at least 4 years after completion of warranty period will be necessary except in cases where some amount is earmarked by the organization for keeping the system functional and well maintained)*

Part support could be utilized for installation of the system subject to meeting the above requirements.

Replication Projects

- Rs. 4 lakhs for each project
- 60–120 projects with 30,000 sq. CST area

Projects not coming under the demonstration category will be considered as replication projects. Support is available to share owner's expenses for the following:

- ✤ Providing performance and fuel savings data on regular basis with essential equipment installed *(Temperature sensors, pressure gauge/transducer and fluid flow meter will be the minimum requirement which will be the responsibility of the supplier)*
- ✤ Operation and maintenance of the system *(AMC for at least 2 years after completion of warranty period will be necessary except in cases where some amount is earmarked by the organization for keeping the system functional and well maintained)*

Part support could be used for installation of the system subject to meeting the above requirements.

Project Size of Below 250 sq. m. but Not Less Than 90 sq. m.

Rs. 2 lakhs for each project for providing performance and fuel savings data on a regular basis and for Operation and Maintenance of the system.

ESCO Mode Projects

10% of the cost to a maximum of Rs. 15 lakhs for each project in addition to the above. Support available for all the above projects (demonstration/replication/other projects) may be combined with this support and provided to implementers if the projects are done in ESCO mode.

Preparation of Feasibility Report/ DPR

PMU of the project will help prepare the Feasibility Report/DPR for beneficiaries, if required, before generation of proposals

through a consultant, subject to sharing of the cost involved by private bodies to a maximum of Rs. 25,000. For government bodies/PSUs, it may be fully borne by PMU. The maximum support for a DPR could be up to Rs. 1 lakh.

Repair and Renovation

Up to Rs. 15 lakhs for 5 year old systems is available for repair and renovation subject to the condition that an equal amount is spent by the beneficiary. A proposal covering the following information would be required to be submitted for availing this support:

1. Name of establishment with complete postal address, telephone, fax, mobile numbers, and e-mail address for correspondence purposes
2. Type and size of solar technology installed
3. MNRE sanction letter number and date with approved cost of the system
4. Place of installation
5. Date of commissioning of the system
6. Name of manufacturer who installed the system
7. Application for which the system is being used
8. Since when the system is lying non-functional
9. Reasons for lying non-functional
10. Whether approached the manufacturer who installed the system: If yes, response from them
11. Major components requiring repair/replacement
12. Details of supplier identified for repair of system
13. Budget estimate on repair of system (Details to be provided in a separate sheet with quotation from supplier attached)
14. Budget sought from UNDP-GEF project as per scheme
15. Commitment share from beneficiary (Letter of commitment to be indicated in covering letter)
16. Expected date of getting the system repaired

Release and Sanction of UNDP-GEF Support

50% could be released in advance based on Bank Guarantee for private bodies/Indemnity bond for registered institutions subject to issue of Sanction/'In Principle' Approval letter from MNRE. The rest will be released in 1–2 instalments after commissioning of the system, subject to satisfactory performance of the system and submission of the requisite documents+. For repair/renovation, no Sanction/'In Principle' Approval is required. A request letter for sanction and release of UNDP-GEF support from the beneficiary, especially for demonstration projects, and from implementer in case of ESCO projects would be required to be submitted to PMU, UNDP-GEF CSH project, MNRE along with a copy of the proposal and Sanction/'In Principle' letter issued by the Ministry. For projects in ESCO mode, a copy of the Detailed Project Report giving the following documents/information would be required:

- Copy of MoU signed with beneficiary on stamp paper
- Details of investment to be made by ESCO, beneficiary/any other in the beginning
- Whether equity of various parties or availing loans
- If loans, details to be provided with name of FIs providing loans
- Monthly/quarterly instalment to be paid by beneficiary on savings
- Time period of agreement with beneficiary
- An Affidavit that system installed will not be dismantled without the permission of MNRE

Note: The above support is in addition to the subsidy available from MNRE for installation of the systems under the off-grid scheme of JNNSM and will be calculated on the basis of sanctioned cost by the MNRE. In addition, depreciation benefit is available to profit making bodies. The support is for the year 2013 and may be reduced gradually in subsequent years.

+ Details of equipment, copy of AMC with supplier/budget earmarked for O&M, Feasibility Report/DPR, data logbook, fuel savings, etc., to be submitted as the case may be.

**** For queries contact DPM, Project Management Unit, UNDP-GEF Project, MNRE at pankaj.kumar74@nic.in or at 011-24363638.***

Concentrating Solar Thermal Systems

A technology to save precious fuel oil & other fossil fuels in industries, institutions & commercial establishments for process heat, community cooking & space cooling applications using solar energy

Salient Features

- ✓ Can provide steam/hot oil/ pressurized water at 90-350 C
- ✓ A smallest system of 100 sq. m. reflector area requiring double the land space can save 5,000 to 10,000 liters of fuel oil per year during day time
- ✓ Is integrated with conventional boiler to have trouble free operations during non-sunshine hours
- ✓ A number of technologies suitable for various applications are available
- ✓ Pays back the cost in 3-5 years depending on sunshine, application & fuel being used
- ✓ Over 150 systems of various capacities working in country

30% subsidy to all category of beneficiaries with additional benefit of 80% accelerated depreciation to profit making bodies available from Ministry for installations. Higher subsidy for special category states. In addition, 10% support is available from UNDP-GEF project for systems sizing 250 sq. m. & above for specific activities.

Interested beneficiaries may contact our Consultants (**Sh. Amit Kumar** of PWC for industrial sector : e-mail: amit2.kumar@in.pwc.com, Mob:09899452400; **Dr. Sudhir Kumar** of WISE for hospitality & Hospitals sectors: e-mail: drsudhirkumar@wisein.org Mob: 09665020206 & **Dr. Ajay Chandak** for Institutional & Religious Sectors: e-mail: renewable.consultant@gmail.com Mob: 09823033344) or write to us at following address indicating the heat requirement, fuel being used, space availability etc:

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- 32314365 /24363638, E-mail: **singhalak@nic.in / pankaj.kumar74@nic.in**

Toll Free Helpline No. 1800 2 33 44 77 could also be accessed during Monday to Friday between 9.30 am to 6.30 pm & on Saturday : 9.30 am to 1.30 pm

SHARAD