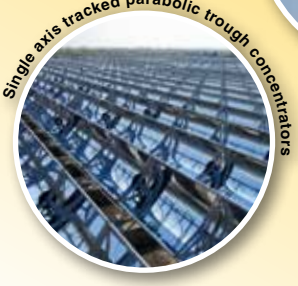
a quarterly magazine on concentrated solar heat

SUN FOCUS

Volume 2 | Issue 3 | January–March 2015


Single axis tracked parabolic trough concentrators


Fresnel reflector based square dish


Fixed focus automatically tracked elliptical dish


Dual axis tracked paraboloid dish


Non-imaging concentrators


TEST SETUP

MAJOR ACHIEVEMENTS

- Both Mobile & Immobile Test Setups in Place
- 53 Demonstration & Replication Projects Supported
- 18 No of Knowledge Documents Developed

MID-TERM PROGRESS & ACHIEVEMENTS

CSH PROJECT

gef
सत्यमेव जयते
MNRE
UNDP
Empowered lives.
Resilient nations.

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

INside...

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From the editor's desk...

Dear Readers,

I am pleased to share the seventh issue of SUNFOCUS magazine with you all. Previous six issues of the magazine were planned so as to cover various aspects, such as policy, technology developments, and new applications, of concentrated solar thermal sector in India and latest national and international developments relevant for the sector. These issues have played important part in awareness generation and information dissemination about the CST sector.

The current issue is designed to give an overall progress and achievements made in the "UNDP-GEF project on Market Development of Concentrated Solar Technologies for Process Heat Applications", which was started in April 2012. This issue aims to highlight to readers the numerous initiatives and activities undertaken in the project. A mid-term review was also undertaken by the UNDP and the outcome of the review is also highlighted.

The main article of the magazine, by Dr. A. K. Singhal (National Project Manager, UNDP-GEF CSH Project), gives the overview of the activities undertaken and achievements made under CSH project. There is also an article giving status on demonstration and replication projects completed and being developed under the project. While the efforts are ongoing for development and expansion of CST sector, the reliability of the technologies also needs to be improved by performance monitoring and testing standards. Considering this, two articles are presented covering these issues namely 'Online performance monitoring of selected CST installations' and 'development of Asia's first CST test set-up'. Lastly there is one article covering the outreach and awareness generation initiatives under the project named as 'National Solar Energy Helpline and Newsletter'

I hope you will find this issue quite interesting and informative as all previous issues. I look forward to your valuable comments, suggestions and most importantly 'contributions' for upcoming issues of the magazine.

Sd/-

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

OVERVIEW OF ACTIVITIES UNDERTAKEN AND ACHIEVEMENTS MADE UNDER CSH PROJECT

Dr A K Singhal

The UNDP-GEF Project on 'Market Development of Concentrating Solar Technologies for Process Heat Applications' was started in April 2012 by signing the Project Document by the MNRE and the UNDP on 28th March, 2012 with Inception workshop held on 18th May, 2012 in Delhi.

The workshop was attended by over 200 stakeholders from various parts of the country. It gave a platform to participants to discuss about barriers, limitation, opportunities and potential for CSTs. It also helped the participants in understanding various components and activities planned in the Project.

Project Objective

The basic objective of the project is to accelerate activities of the MNRE programme on CSTs by removing barriers and develop market through awareness generation, capacity building & other required measures. It is a 5 year project to be completed in March 2017 with GEF support of USD 4.40 million made available to the MNRE through UNDP. The major outcome expected from the project are as below with baseline on CST installations taken as 85 systems having 25,000 sq. m of concentrator area:

- Knowledge documents, test setups and standards developed with barriers removed for large-scale promotion of CSTs
- 45,000 sq.m of CST based systems installed in 90 establishments through Demonstration and Replication projects resulting to 39,200 tonne of CO_2 emission reduced and 3.15 million litres of fuel oil saved per year.

Implementation

To implement the project, a Project Management Unit (PMU) was established in the MNRE which comprised of National Project Manager (NPM), 2 Technical Officers and some support staff. A Project Executive Committee (PEC) chaired by Joint Secretary, MNRE as National Project Director with Members from the MNRE, NISE, IREDA, PMU & UNDP was also formed which meets almost once in two months. Project Steering and Advisory Committee (PSAC) chaired by Secretary, MNRE with Senior Members from MoEF, DoE, UNDP, IREDA, NISE, SECI, Ministries of Textile, Food Processing, Medium & Small Scale Industries, BEE, BIS, CII, Central Boiler Board, IIT Bombay, etc., was also formed for the purpose of having guidance and directions to the PMU. The PSAC meets once in 6 months or as & when required. During last 45 months of time, 13 meetings of PEC and 4 of PSAC have been held besides conducting 6 Review meetings with consultants on various assignment undertaken with them, 12 Technical Evaluation Committee (TEC) meetings to finalize the award of assignments and 4 Expert Group/other meetings to discuss important issues related to CSTs. These included brainstorm meeting held with CST manufacturers and mirror suppliers to understand barriers for large-scale promotion of CSTs in the country and meeting with experts to decide about the subsidy based on heat output of various types of CSTs.

Barriers in Market Development

Major barriers listed in large scale promotion of CSTs at the start of project were as per below:

- Lack of awareness about technologies and their benefits
- Lack of confidence on technologies. Performance and fuel-saving data of projects installed was not available
- Mainly Scheffler technology was in promotion which had lower efficiency and installation issues
- No test standards and test setups for measuring performance
- Space constraints for installations
- Non-availability of solar grade mirrors in required sizes at reasonable prices
- Non-availability of soft loans to beneficiaries and manufacturers
- Low returns on investments as compared to SWH
- Very few manufacturers, not much competition and mostly on Scheffler technology

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Activities undertaken in Project

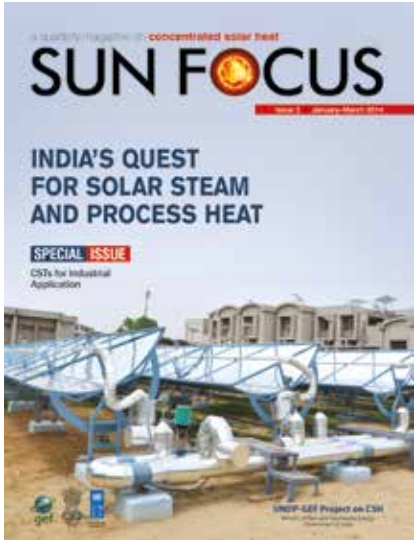
To address these barriers and achieve the set goal of installing 45,000 sq.m of CST based systems in 90 establishments, various activities were undertaken as per the project components outlined in the documents with outcomes given as per below:

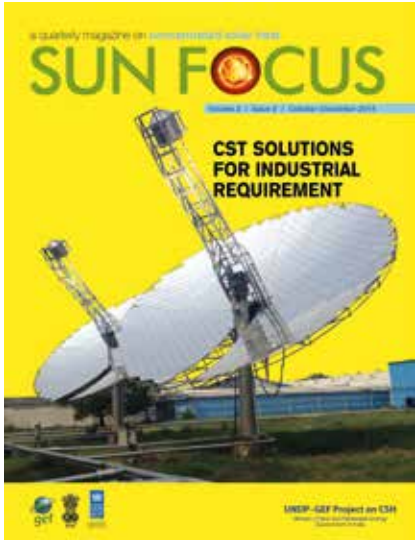
Awareness Generation and Capacity Development

Market Development Programme was undertaken in Industrial, Commercial and Institutional sectors. Under the programme, 40 workshops were organized. A number of video films on successful projects with case studies were prepared and placed on website. All these efforts helped in generating a significant number of DPRs & CST proposals. **Monthly Electronic Newsletter** was developed and is made available at www.insolthermtimes.in. So far 24 Newsletters have been developed under the project. **Quarterly magazine on CSTs was started.**

Seven issues of the Magazine 'SUN FOCUS' have been developed and distributed to over 500 to 750 stakeholders so far. **Advertisements** are also being released on CSTs in National News papers and concerned magazines. So far 4 Ads in National Newspapers and 3 Ads in 12 Magazines have also been released. A **National Toll free Helpline 1800 2 33 44 77** was also started which could be accessed during Monday to Friday between 9.30 am to 6.30 pm and on Saturday 9.30 am to 1.30 pm.

New website on CSH project www.cshindia.in was developed and is in place for last one year. **Information for users on suitability of technology including cost and payback** has also been made available on the MNRE/ CSH websites. **A Calendar for financial year 2014-15** was prepared to showcase CST installations and distributed to various stakeholders to generate awareness about the technologies. **Exposure trips to showcase installations** for potential





Calender 2014–15

CSH Website

Table: Anticipated Heat delivery from various type of CST based systems in different regions of the country

Region	Indicative average DNI/sq. m / day* (In kWh)	Sunshine days	Fixed focus elliptical dish^ / PTC/ LFR with non-evacuated heat receiver		Two axis tracked dishes with moving focus	
			Efficiency at 150 °C**	Heat delivery***/sq.m of aperture area / year (in lakh of Kcal)	Efficiency at 150 °C**	Heat delivery***/sq.m of aperture area / year (in lakh of Kcal)
Leh Ladakh	6.5	320	40%	7.16	60%	10.73
Gujarat Rajasthan & western M.P.	6.0	300	45%	6.97	65%	10.07
North–West including Himalayas	4.5	250	40%	3.87	60%	5.81
North–East & eastern part of Orissa & A. P.	4.0	250	40%	3.44	60%	5.17
Southern & Central	5.0	280	45%	5.42	65%	7.83

* *Can vary by ± 10% at a particular location in the region*

** *It is average annualized efficiency and is linked with ambient temperature and wind conditions of particular region. It reduces in the regions having lower ambient temperature and high wind velocity. It also reduces marginally for CSTs working at higher temperatures due to higher heat losses, thereby reducing the heat delivery*

*** *Heat delivery will (i) increase if the fluid temperature goes down due to less heat losses. Likewise it will also decrease if working temperature is raised high say up to 350 °C or so especially in case of Paraboloid dishes which are designed for such temperatures & (ii) decrease by 10 per cent or more if the mirrors are not of solar grade quality.*

beneficiaries are also organized through the University of Pune.

Technical Capacity Development

An assignment on **Development of Test Standards and Test Protocols** was taken up. Based on the DPR prepared and finalized through an Expert group, 2 Test setups (both mobile & immobile) have been established at NISE and University of Pune first time in the country. The test setups are expected to help improving performance of CST components and system, thereby developing confidence among users and improving capabilities of industry. A **Field Evaluation Study of existing CST installations** was also undertaken. Over 100 installations were surveyed in actual resulting to a compendium with 2 pages on each installation covering all information with photographs. **Performance norms for various CSTs in terms of anticipated heat delivery in different regions** were developed and made available on the website for the knowledge of beneficiaries and manufacturers.

Minimum technical requirements for installations of CST based systems in the field were also prepared and placed on website so as to help users to know their system performance in advance before going for installation. They can even check the quality of components on their own during installations. Under an assignment on **Training programme and Manuals on 'O, M & Trouble shooting',** 12 training programmes for the students of it is were organized in different states with Manuals for each of the 6 CSTs prepared both in English and Hindi. The training programmes have helped generating a manpower of around 100 trained operators and maintenance people of CSTs all over the country.

An assignment on **Technology Assessment and Performance Evaluation of CSTs** was also undertaken and Assessment reports were prepared on CSTs within India and abroad. The reports prepared are expected to help policy makers to know salient features and limitations of CSTs for developing strategies on their large-scale promotion**. On-line performance monitoring of 15 identified installations** on different technologies and applications started later in 2013 by installing required instruments and sim based data loggers. It is expected to help users to know performance on daily basis. Faults identified, if not performing well, thereby will get rectified by the manufacturers. A report on manufacturing facilities of various manufacturers of CSTs is in place. Four page pamphlets on each technology giving details, photographs, schematic diagram, utility, performance, cost, savings, etc., were also developed under the assignment are available at CSH website for the benefit of users. A **Training cum Awareness Generation Center on CSTs at Brahmakumaris Ashram, Mount Abu** has been established for skill improvement in manufacturing and installations and large-scale promotion of CSTs. An **Assignment on Market Development of CST based systems in the Industrial Sector** is under implementation which has resulted in developing information packages for industries providing mapping of their industrial processes and possible intervention of CSTs. Ready to use financial instrument for industries to understand economic feasibility of CSTs on entering their requirements have also been developed for the

benefit of potential beneficiaries. An **International exposure trip to test set ups in Germany** was organized for officials of the MNRE, UNDP and industry stakeholders.

New Assignments

An assignment on **Development of material and component specifications of 6 standard CSTs** is under execution, which will act as reference document for maintaining quality in the field by manufacturers. Assignment on **Collection and Compilation of performance data of CST based system through remote monitoring** has also been taken up. The objective is to collect and compile data on performance of CST based systems in the field through remote monitoring using sim based data loggers for the purpose of knowing the heat delivery, fuel savings and Greenhouse gas (GHG) abatement. Eighty systems commissioned till August 2016 spread over in different states will be remotely monitored till December 2016. These systems will also be visited at least once in actual to ensure proper installation of equipment/ instruments and also obtaining other relevant information. **Organization of Training Programmes/ workshops for the senior officials of banks/FIs** has been taken up for the purpose of educating them to provide loans to the manufacturers and beneficiaries of CST based system and convince at least 4 banks to start providing the loans to various stakeholders. **State-wise and sector-wise potential assessment of CST based projects in industrial, institutional and commercial sectors** is in progress by State Nodal Agencies. The nodal agencies of four states - Tamil Nadu (TEDA), Uttar Pradesh (UP NEDA), Odisha (OREDA) and Chhattisgarh (CREDA) already showed interest to whom sanction letters were issued for providing the financial support. The state of Chhattisgarh has already done the survey showing that 119 establishments have potential of installing CST based systems to the extent of 12,360 sq. m. Most of them are in institutional and religious sectors. Follow up is being made with other states also. The PMU may hire a consultant for those states who show interest but are not able to do on their own.

Comparative Status on Installation

Installed (Cum.)	**No.**	**Area (Sq.m)**
March 2012 (Start of Project)	85	25,000
March 2013	144	28,000

Includes small systems of 2/3 Scheffler dishes (about 20%). 32% are below 96 Sq.m

Application Wise Break up		
Cooking	121 (85%)	16,000 (57%)
Process heat/ Cooling	23 (15%)	12,000 (43%)

Project Supported under CSHP after March 2013		
Cooking	25 (47%)	5,126 (31%)
Process heat/ Cooling	28 (53%)	11,247 (69%)
Total	53	16,373

Only 13% are below 96 Sq.m

Field Projects with Additional Support

Support up to 15 per cent of bench mark is being provided for specific activities to different type of projects, e.g., Demonstration, Replication and Repair/ Renovation. Focus on demonstration projects is on sectors related to dairy, textile, pharmaceutical, metal treatment, chemical, food processing, institutional cooking, etc. Maximum 5 projects of a technology/application of each manufacturer (other than 16 sq.m Scheffler technology) is supported under this category. Additional support of 10 per cent limited to Rs 15 lakh has also been made available for projects to be implemented in ESCO mode. A total of 53 Demonstration and Replication projects with 16,373 sq.m have been supported so far in the project. Cumulative installations in the country are expected to be around 1,154 systems with 32,000 sq.m, which excludes very small systems of direct heating/cooking and systems installed under the MNRE R&D and other support.

Conclusion

The major achievements made so far in the project could be indicated as per below:

- A large number of Knowledge documents have been developed for various stakeholders and made available on CSH website www.cshindia.in
- First time, the test setups (both Mobile and Immobile) are in place
- BIS Standards on test procedures for CSTs are in process
- Number of projects from industry have increased significantly
- Larger size projects (>250 sq.m) have increased significantly
- Yearly installations and CST area have also increased significantly
- Custom duty exemption on solar mirrors is now available for off-grid systems also
- Systems with heat storage and using thermic fuel are also in operation
- On-line performance monitoring systems have started for larger projects
- 53 Demonstration and Replication projects with 16,373 sq.m have been supported
- New technologies other than Scheffler are in promotion to address issue of space constraint
- First time EoI for ESCo projects have been received. Eight projects are in pipeline.
- Non-functioning systems are getting repaired and put in operation
- Subsidy provision based on heat output of CSTs has been developed.■

STATUS ON DEMONSTRATION & REPLICATION PROJECTS UNDER CSH PROJECT

Pankaj Kumar and Somesh Shah

To boost the use of Concentrating Solar Technologies, the Ministry is implementing the UNDP-GEF supported project on "Market Development and 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 45,000m^2 of installed solar collector area by March 2017 through the implementation of Demonstration and Replication Projects. Direct emission reduction from these projects during its 5 years period is expected to be 39,200 tonne of CO_2.

Baseline Status

During the project initiation period in 2012, it was noted that around 85 CST based systems with 25,000 sq.m of collector area had already been installed in the country. Major part of the systems were on community cooking using fixed focus single axis tracked Paraboloid dishes (Scheffler). Some systems were also installed on process heat and space cooling using both Scheffler and Arun dishes 9 LFR based dual axis tracked moving focus of 16 sq.m and 169 sq.m respectively. Hardly any systems were installed on technologies related to Parabolic Trough, Parabolid dishes, Linear Fresnel Reflectors and Non-imaging concentrators. The systems installed with Arun dishes were also in small number. These technologies, however, were in development stage with various institutions and manufacturers.

Demonstration and Replication Projects

Keeping in view of above, the Project Executive Committee of CSH project decided that the technology on Scheffler dishes with 16 sq.m area, which was largely in promotion and was understood to be an established and commercialized technology, may be taken under Replication category and the other technologies which were yet to be established and commercialized may be taken under Demonstration category for some time. Ministry of New & Renewable Energy already implementing a National Programme on CSTs and is providing 30 per cent of the project cost as subsidy to the beneficiaries. It was, however, decided that all these projects may further be supported with some additional budget (as envisaged in Prodoc) for the purpose of knowing their performance by installing some measuring equipment/instruments and sharing some expenses of beneficiaries towards Operation and Maintenance for their long-term satisfactory performance. The criteria decided for supporting such project is as below:

Technology and Applications

Replication projects: CST Systems based on Scheffler dishes (16 sq.m single axis tracked) for all applications

Demonstration projects*:* All other projects with CSTs of different sizes for various applications in different sectors/ type of establishments. Replication projects with newer applications or improved version of existing technologies and innovative ideas leading to improved performance/durability/user friendly techniques or reduction in cost, etc., will also come under this category. The focus will be in sectors related to dairy, textile, pharmaceuticals, metal treatment, chemical, food processing, institutional cooking, etc.

Maximum 5 project of particular technology of particular size/design for 5 different applications in different sectors/ types of establishments, may be considered from a particular manufacturers for demonstration projects. After this, all such projects will come in replication category. Technologies to be supported are Paraboloid dish, Arun dish Scheffler (16 sq.m dual axis tracked), Scheffler dish (above 16 sq.m size), PTC (Non-evacuated receiver), PTC (Evacuated receiver), LFR, Non-Imaging concentrators. The projects size will be of 250 sq.m and above, except projects with dual axis tracked dishes having moving focus where the lower limit will be 250 sq m.

Financial Support

The additional support being provided for demonstration and replication projects in addition to the MNRE subsidy is as below:

Demonstration Projects: 15 per cent of MNRE benchmark cost to a maximum of Rs 75 lakh (Restricted to a few projects for support above Rs 30 lakh).

Replication projects: Rs 5 lakh for projects up to 500 sq.m and Rs 10 lakh for projects above that.

Smaller Projects : Rs 2 lakh have been kept for each project having size below 250/150 sq.m as the case may be (refer above) but not below 64 sq.m of Scheffler dishes and 45 sq.m of other concentrators to the beneficiary.

The support is available for preparation of feasibility/detailed project report, online performance monitoring and Operation and Maintenance of the system for Demonstration projects;

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whereas for Replication and Smaller projects, the support is available for providing fuel savings data on regular basis and Operation and Maintenance.

Status of Projects

A total of 53 projects have been sanctioned so far with CSH projects. Out of this 23 are demonstration projects 5 are replication projects and 25 smaller projects. Details of these projects are given below :

Technology and Application Wise Status

	Application (Area in Sq m)					
	Process Heat/ Cooling		Cooking		Total	
Technology	No.	Area	No.	Area	No.	Area
Demonstration Projects						
Scheffler Dishes	1	256	2	2,064	3	2,320
Parabolic Trough	9	3,333	–	–	9	3,333
Arun Dish	4	1,014	–	–	4	1,014
Paraboloid Dish	4	3,515	–	–	4	3,515
Non-Imaging	3	1,496	–	–	3	1,496
Total	**21**	**9,614**	**2**	**2,064**	**23**	**11,678**
Replication & Other Projects						
Scheffler Dishes	1	480	16	2,432	17	2,912
Parabolic Trough	3	460	–	–	3	460
Arun Dish	3	611	4	416	7	1,027
Paraboloid Dish	1	186	2	110	3	296
Total	**8**	**1,737**	**22**	**2,958**	**30**	**4,695**
Grand Total	**29**	**11,351**	**24**	**5,022**	**53**	**16,373**

State-wise Break up

	Application (Area in Sq m)					
	Cooking		Process Heat/ Cooling		Total	
State	No.	Area	No.	Area	No.	Area
Andhra Pradesh	1	55	6	4,796	7	4,851
Chhattisgarh and Odisha	2	192	–	–	2	192
Gujarat	3	311	4	958	7	1,269
Haryana	1	96	2	887	3	983
Himachal Pradesh	2	1,216	1	186	3	1,402
Karnataka	–	–	3	688	3	688
Madhya Pradesh	3	256	–	–	3	256
Maharashtra	5	1,648	6	1,739	11	3,387
Punjab	4	960	–	–	4	960
Rajasthan	1	104	2	897	3	1,001
Tamil Nadu	3	288	4	1,096	7	1,384
Total	**25**	**5,126**	**28**	**11,247**	**53**	**16,373**

Highlight of Some Projects

Technology	Parabolic Trough Collector each of 6.41 sq.m
System size	256 sq.m (40 nos of PTCs)
Application	Metal Phosphating
Manufacturer	Thermax, Pune
Installation date	January 2013
Remarks	System connected to diesel fired boiler generates pressurized hot water at 95 °C for heating chemical in a tank through coils for phosphating of metal bearings/nuts
Savings and CO_2 reduction	12,000 litres of diesel saved in one year with 32.4 tonne of CO_2 abatement.


System


Application

SKF Technologies (P) Ltd., Mysore (Bearings and Lubricating solution Manufacturers)

Technology	Non-imaging concentrators each of 3.41 sq. m
System size	442 sq.m (130 nos of NICs)
Application	Processing of tobacco leaves connected to furnace oil deaerator/boiler
Manufacturer	Thermax, Pune
Installation date	May 2014
Remarks	Pre heating of boiler feed water at 95 °C. Hot water is generated from the deaerator at 105 °C tank being used for flavouring, cleaning of tobacco leaves
Savings and CO_2 reduction	Expected to save 21,000 litres of fuel oil in a year with 63 tonne of CO_2 abatement


System


Application

ITC, Pune (Cigarette manufacturers)

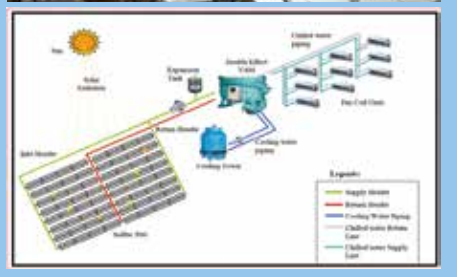
Technology	Parabolic trough of 28.2 Sq. m
System size	263 sq.m (9 nos of PTCs)
Application	Cleaning and bleaching of cotton
Manufacturer	Energy Guru (Leveragenet Solutions Pvt Ltd.)
Installation date	July 2014
Remarks	Pressurized hot water at 110 °C generated for cleaning and bleaching of cotton in vertical kier connected to LPG burner. New type of PTC installed using 3M film on through and cost effective tracking arrangement
Savings and CO_2 reduction	Expected to save approx. 20,000 kgs of LPG in one year with 46 tonne of CO_2 emissions.


System


Application

Siddharth Surgicals, Valsad (Surgical Cotton Manufacutrers)

Technology	Parabolic trough each of 6.41 sq. m
System size	821 sq.m (128 nos PTCs)
Application	Space cooling (100 TR triple effect VAM)
Manufacturer	Thermax, Pune
Installation date	May 2013
Remarks	Integrated with electrically operated existing chillers, Pressurized hot water at 165 °C and 17 bar is supplied to VAM to generate chilled water at 7 °C which further cools air using fan coils.
Savings and CO_2 reduction	44,495 units of electricity saved in a year with 32 tonne of CO_2 abatement.



Honeywell Technology Solutions, Hyderabad (Automation and Control Systems Industry)

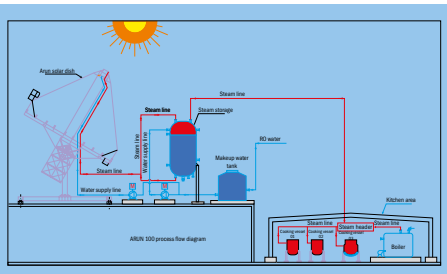
Technology	Parabolic dishes each of 90 sq. m
System size	450 sq.m (5 nos of dishes) connected to diesel fired boiler
Application	Processing of chemical compounds for preparation of medicines
Manufacturer	Megawatt Solutions, Noida
Installation date	October 2014
Remarks	Hot water generated at 95 °C through thermic fluid heated up to 180 °C by CST system being used for heating reactors for the purpose of chemical reactions
Savings and CO2 reduction	Expected to save 60K litres of diesel in one year with 138 tonne of CO_2 abatement.

5 Nos of Paraboloid Dishes

Chemical Reactor

Synthokem Labs, Hyderabad (Drug manufacturers)

R. K. Mission School, Chennai



Cooks 4 times a day for 700 students: breakfast (early morning 4.30 am to 6.30 am), lunch (10.00 am to 11.30 am), evening tiffin, and dinner (afternoon 2.30 pm to 5.30 pm)

Conclusion

To develop, 53 projects in different categories of Demonstration/ Replication, market development programmes were undertaken during last 2½ year of the project in the area of industrial, hospitality and hospital, religious and institutional sectors. Advertisements in National Newspaper and Industrial/Institutional Magazines were also given from time to time to generate interest for CST based system and potential beneficiaries. Under the programmes, 40 workshops were organized all over the country which resulted in preparation of DPRs/FR and needs to sanction proposal for the MNRE & UNDP support. These projects where completed are expected to saving 1.23 million litres of fuel oil and reducing 5,730 tonne of CO_2 per year, respectively. It has also been noted that number of projects from industries have increased significantly with new technologies other than Scheffler also in promotion. ■

ONLINE PERFORMANCE MONITORING OF SELECTED CST INSTALLATIONS BY ECOAXIS, PUNE

Dr Indu R Keoti (Pillai)

EcoAxis, Pune is one of the pioneers in implementing IoT (Internet of Things) based remote monitoring solutions for renewable energy sector in India. The company offers cloud based solutions for monitoring processes within a plant as well as across the geographically distinct plants.

EcoAxis has expertise in providing a complete turnkey solution where instruments, hardware and software required for the project is developed in-house.

The highly configurable system - **SUPERAxis™** consists of electronic hardware and software connectors for logging data from various machines, instruments and sensors. Using cloud-based computing, it delivers analytics and alerts in the form of dashboards, emails and SMSs on ***Any device, Anytime, Anywhere*** basis.

The solutions are deployed for various applications in industrial sectors like Renewable Energy, Power, Sugar, Water and Waste-water treatment, Textile and many more.

EcoAxis was awarded the contract for ***"Procurement and Installation of Instruments/Equipment for On-Line Performance Monitoring of selected CST based installations in the country for process heat, community cooking and cooling applications"***. This was a component of the UNDP-GEF assisted project on CSH (Concentrated Solar Heat). EcoAxis has successfully implemented remote monitoring solution for CST based steam generation system, thermic fluid and pressurized hot water system at 15 different site locations under the project. The remote monitoring solution is designed to capture data from the multiple locations and produce reports on overall system performance. The scope of the project not only included engineering, procurement and supply of instruments, but also web-based application for performance evaluation along with hardware and requisite software. Table 1 depicts the list of sites finalized so as to represent a mix of CST technologies, manufacturers, applications and geographically spread locations across the country.

EcoAxis Technology

EcoAxis remote monitoring system consists of the following:

Data Acquisition and Transfer

EcoAxis web-enabled data-loggers are deployed at remote sites to acquire data from field sensors and instruments and then transfer it to remote server through the internet.

Data Management

Remote server data-base is hosted on a high performance server located in a professionally managed data-centre where:

- All remote site location with their equipment and models, parameters with their measuring units, authorized users for viewing data, and the access rights defined for a particular user are configured using a web-based configuration tool.
- Raw data received from the data loggers is pumped to the server which can be viewed, as well as exported to MS Excel or PDF form.
- Suitable security and protection software is installed to prevent data loss. Suitable physical and geographical redundancy is maintained to protect data from local mishaps.

Advanced Analytics

The software is deployed on the remote server and used to analyze and present the data in the form of various reports, charts and dashboards. Alerts and notifications through e-mail and SMS are sent on registered mobile number in case of deviation from the defined range.

Advantages of Technology

- Critical data of various processes from multiple sites is made centrally available.

Table 1: List of sites finalized

Re	Technology	Application	Site	State
1	Scheffler	Community Cooking	Bosch, Bangaluru	Karnataka
2			Boys Hostel JSS Mahavidyapeeth, Suttur	Karnataka
3			Shanti Kunj, Haridwar	Uttrakhand
4			Ramrao Adik Public School, Ahmednagar	Maharashtra
5			Bhashyam Public School, Guntur	Andhra Pradesh
6			MNIT, Jaipur	Rajasthan
7		Cooling	MVML, Chakan	Maharashtra
8		Process Heat	B S Paper, Ludhiana	Punjab
9			Gajraj Drycleaners, Ahmednagar	Maharashtra
10			Purple Creations, Baramati	Maharashtra
11	ARUN	Community	Ramakrishna Mission Hostel, Chennai	Tamil Nadu
12		Cooling	Turbo Energy, Chennai	Tamil Nadu
13		Process Heat	Mahananda Dairy, Latur	Maharashtra
14	Parabolic Trough	Process Heat	SKF, Mysore	Karnataka
15	Non-Imaging	Process Heat	ITC, Bangaluru	Karnataka

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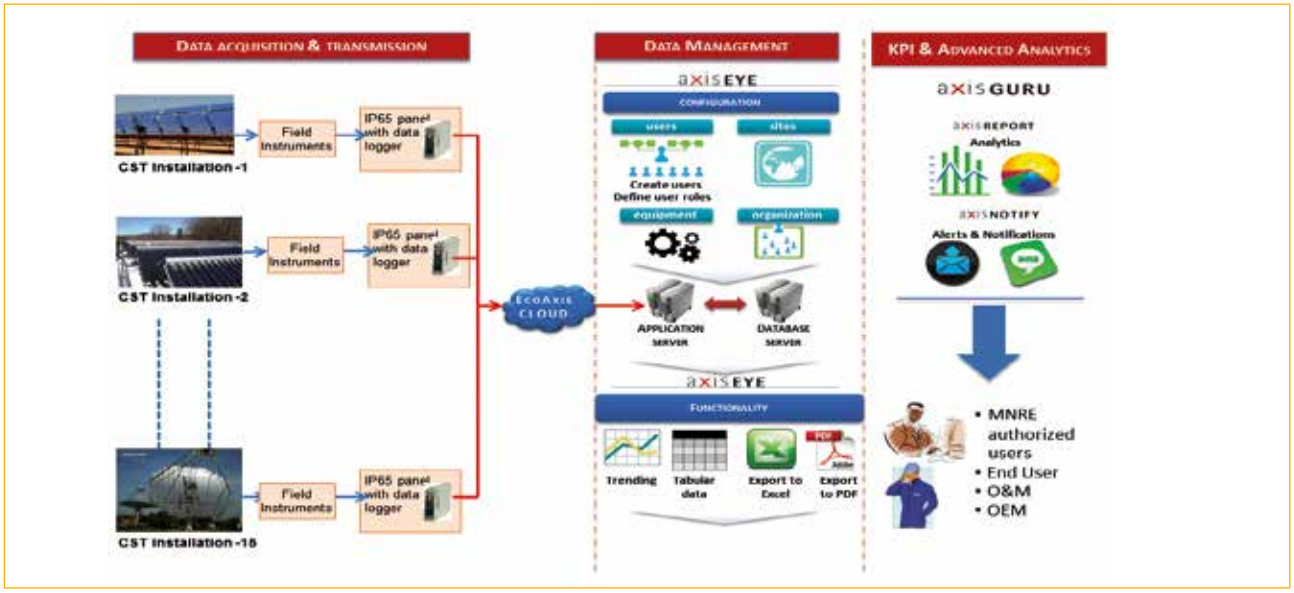


Figure 1: Solution architecture of EcoAxis system for monitoring multiple CST systems

- Automated IoT technology ensures integrity of data – from data acquisition to data analytics.
- Professional hosting service ensures high availability of the server and hence high availability of data.
- Authorized users can access the data on Any Device, Anytime, Anywhere.
- EcoAxis data-loggers are designed to meet industry standards so that sensors and instruments can be easily connected to reduce the deployment time and effort.

Solution Architecture for Remote Monitoring of CST systems

EcoAxis remote monitoring solution acquires data from 15 different CST sites and makes the data available at NISE, Gurgaon and the consultant's organization over the web.

Figure 1 explains the solution architecture for acquiring data of key parameters from the sites.

Measurement of Weather and Performance Parameters

The weather parameters which define the input energy to the CST system and which affects the performance of the CST system are monitored using the instruments given in Table 2.

Table 2: Weather instruments and measuring parameters

Parameter	Global Radiation	Diffused Radiation	Wind Speed	Ambient Temperature
Significance of Parameter of CST Performance	Both the parameters are used to derive the DNI (Direct Normal Radiation). DNI is the measure of incident solar energy to the CST system.		Wind affects the performance of CST system due to the effect on the thermal losses.	Ambient temperature affects the performance of CST system due to the losses and initial condition of working fluid.
Instrument/ Sensor	Black Body Pyranometer	Black Body Pyranometer with Shading Ring	3 Cup Anemometer	Temperature Sensor PT1000
				

Table 3: Thermal output and measuring parameters of CST system

Parameter	Inlet Temperature	Outlet Temperature	Pressure	Flow Meter	
Significance of Parameter on CST Performance	Defines the initial heat content of working fluid	Defines the final heat content of working fluid	Defines the performance of the system	Defines the quantity of working fluid	
Instrument/ Sensor	Temperature Transmitter RTD PT100		Pressure Transmitter	Vortex Flow Meter for Steam	Electromagnetic Flow Meter for Hot Water & Thermic Fluid
					

Measurement of Thermal Output

The thermal output of a CST system can be captured by measuring the flow of working fluid and initial heat content and final heat content of the working fluid using equipment given in Table 3 .

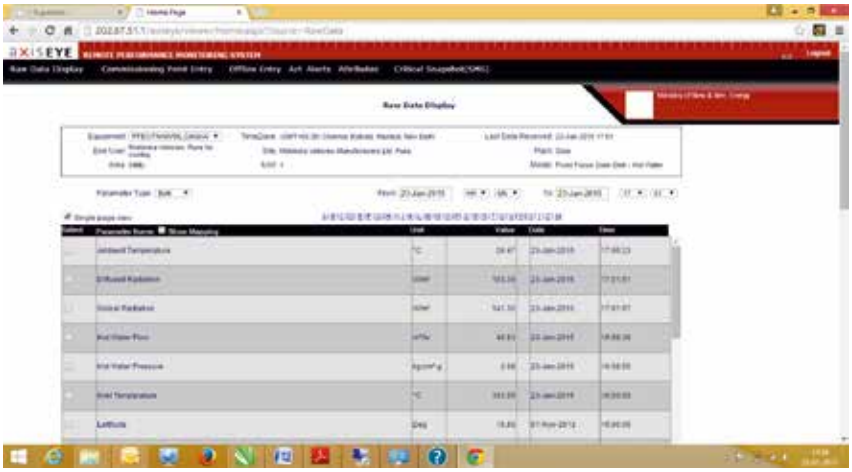
Performance Reports

The data acquired from each of the CST system can be viewed online and can be saved in MS Excel, PDF or trend for further evaluation. A typical logbook of one of the sites is presented below.

Along with the facility of raw data viewing, EcoAxis has developed automated monthly report showing the daily system performance, and daily report showing trend of critical parameters of the CST system. Following are the screenshots of the reports developed for monitoring operations and performance of the CST system.

The quality of the data from the site is highly dependent on the support from the operators at the site. Keeping this in view, MNRE had arranged for a training programme for the all the beneficiaries, where EcoAxis gave the details of the instruments installed at site and the support required from the site.

EcoAxis has developed an application such that in case shading ring is not adjusted at any site for more than 3



days, an email alert is generated to the concerned site personnel and the EcoAxis project manager. EcoAxis also keeps a view on the data quality and communicates with the site operator to ensure quality of data by cleaning of pyranometer and shading ring adjustment.

Key Benefits of Monitoring

Remote monitoring of CST system is beneficial for all the stake holders like policy makers, manufacturers and end users. The benefits are as below:

Policy Makers

- Information about performance of various systems useful for framing appropriate policies for various technologies
- Ease in identification of appropriate technology for variety of applications
- Database of weather parameters for resource assessment
- Field validation of R&D, demonstration and replication projects
- Data available for monitoring and analyzing actual performance/output vis-a-vis expected performance in DPR, basis for subsidy
- Potential estimation of solar energy utilization

Manufacturers

- Field validation of new designs
- Identification of scope of improvement
- Design and tracking of operating and maintenance practices
- Sizing and selection of CST systems
- Deeper understanding of usage pattern – help in improving system/ product design
- Actual insolation data of locations

Users of CST system

- Demand v/s supply analysis
- Maintenance schedule management
- Continuous performance measurement
- Pain and gain area identification
- Identifying opportunities for maximizing thermal output and speeding up payback

Monitoring of CST systems

The monitoring of CST systems is essential for continuous development and promotion of such systems. The extent of monitoring requirement for CST system depends upon the size of the installation and the purpose of monitoring.

Large Installations

For large installations, extensive detailed continuous monitoring covering the weather and thermal energy parameters is suggested for:

- Design verification
- Operation and maintenance
- Performance assessment
- Cost-benefit analysis

Medium-sized Installations

For medium-sized systems, continuous monitoring of few critical parameters like inlet temperature, outlet temperature and flow of working fluid is suggested for:

- Necessary insight into the operation and output of the system, and
- Cost-benefit analysis. ■

ASIA'S FIRST TEST SETUP DEVELOPED AT SAVITRIBAI PHULE PUNE UNIVERSITY (EARLIER- UNIVERSITY OF PUNE)

Prof. S V Ghaisas and Dr Anagha Pathak

The Ministry of New & Renewable Energy, Government of India is implementing Jawaharlal Nehru National Solar Energy Mission (JNNSM) under which subsidy to the extent of 30 per cent of the cost of CST based systems is available to the beneficiaries for installation at their places. Higher subsidy is available in special category states. The Ministry, however, did not have any test set up or test procedures for testing their performance either at the test centers or in the field except checking the component qualities and the workmanship as per the technical requirements laid down by them. In order to render the transparency of the trade for this technology, a standard quality assurance process must be in place. This is both, in the interest of buyers and sellers.

Under an UNDP-GEF CSH project being implemented by the Ministry, it was therefore, decided to develop test set ups and test procedures for CSTs in the country. Bids were invited to prepare the DPR for establishing the test centers, standards and procedures suitable under Indian weather conditions. The bid was won by the consortium of UOP, AKSONS Pvt Ltd, Thermax India, and GK ENERGY Marketers. The consortium prepared the DPR by discussing with various stakeholders, industry professionals and academicians. Existing international standards and procedures were resourced. The DPR was finalized in August 2013 by the expert committee constituted by MNRE. Based on this DPR, it was proposed to develop test set ups for CSTs at University of Pune and also at Solar Energy Center, Gurgaon of the Ministry.

Considering the enduring experience of School of Energy Studies (SES), Savitribai Phule Pune University (SPPU) in testing the solar thermal technology, MNRE entrusted the SES for establishing the CST test setup on the SPPU campus. The "Regional Test Center cum Technology Back-up Unit for Solar Thermal Devices" (abbreviated as RTC), SES, has been providing services in testing of solar thermal devices since 1994. It has been duly accredited by NABL for certification of Flat plate collectors and solar cookers. It has also been involved in testing the solar concentrating thermal systems on request from MNRE. Besides the technological aspects, the research environment at the University is also conducive to the establishment of the center on the University campus. The SPPU allocated a 2000 m^2 land for setting up the test equipment on the campus. The land development work began in February 2014. The test center has a weather station and CST test equipment. The weather station was provided by SGS Weather and Environment Pvt. Ltd. The equipment for the test setup was procured and installed by Thermax Ltd, Pune. The installation was completed in September 2014.

Features of Test Setup

Immobile Test Set-up

There are 2 Nos of immobile test setups; one is based on steam/ pressurized water and the other based on thermic fluid. The testing temperature range is 100 to 250^0 C. Both the systems can withstand temperature up to 300^0 C. The steam/ pressurized water test system is designed to withstand the maximum pressure of 60 bar. Various CST technologies, Scheffler, LFTR, PTC, paraboloid Fresnel Dish etc. will be tested. It has been realized that the precise incident radiation energy for single axis and double axis technologies differ given the geometric aperture area. In particular, different technologies employing single axis tracking show different dependence on the sun's azimuth and elevation angle. The test center is working to establish standards and protocols suitable for testing such technologies.

Presently, the performance of the given technology is evaluated by carrying out the tests that determine the optical efficiency and the efficiency at an expected highest output temperature of the fluid. Knowing the annual average DNI at the given place, the useful thermal output can be predicted for the thermal device under test. Passive tests, reflectivity, absorption, emission, characterizing reflectors and receiver are also performed indoors using UV-visible-IR spectroscopy on the reflector and receiver material samples.

Thermal tests on the CST based solar collector are performed to evaluate the extent of their capability to provide useful thermal output under given climatic condition. The test methods are based on quasi steady state conditions of operation. Thermal performance data generated out of these tests provide valuable information for system output. The thermal tests are performed to obtain values of efficiency as a function of solar irradiance, ambient air temperature and inlet fluid temperature, to determine the time response

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characteristics of collector and to find out the dependence of efficiency on the incidence angle at various sun and collector positions. This test is applicable for all types of CSTs including:

- Manually tracked Dish solar cooker.
- Fixed focus E-W automatically tracked dishes for direct indoor cooking, steam generation for the purpose of community cooking, laundry, space cooling etc. popularly known as Scheffler Concentrator.
- Reflecting Fresnel Dish Type Solar Concentrator (Dish Dual axis fully tracked Fresnel dish type solar concentrator for process heat, cooling, laundry application etc.)
- Parabolic Trough Collector.
- New technologies such as paraboloid dish and linear Fresnel reflectors.

The test configuration for testing CST based solar collector using i) thermic fluid and ii) Hot water/steam as a heat transfer medium is shown in the Figures 1 & 2 respectively which are self-explanatory. The figures are schematic representation and is not drawn to scale.

The tests consist of i) thermal performance via efficiency measurement ii) reflectivity of reflector and, iii) absorptivity, emissivity of the receiver. Following measurements shall be obtained for efficiency measurement:

- Collector aperture area (A_a)
- Global solar irradiance (I_g)
- Diffused solar irradiance at the collector aperture (I_d)
- Direct normal irradiance (beam normal irradiance) (I_{bn})
- Surrounding wind speed(W.S.)
- Surrounding air temperature (T_a)
- Temperature of heat transfer fluid at the receiver inlet.(T_i)
- Temperature of heat transfer fluid at the receiver outlet (T_o)
- Mass flow rate of the heat transfer fluid($\dot{m}$)
- Pressure of fluid in receiver (Pr) (please refer to thermic fluid data sheet for variation in C_f with temperature. Depending on the fluid used variation of CF with temperature must be obtained from the manufacture of the fluid.)

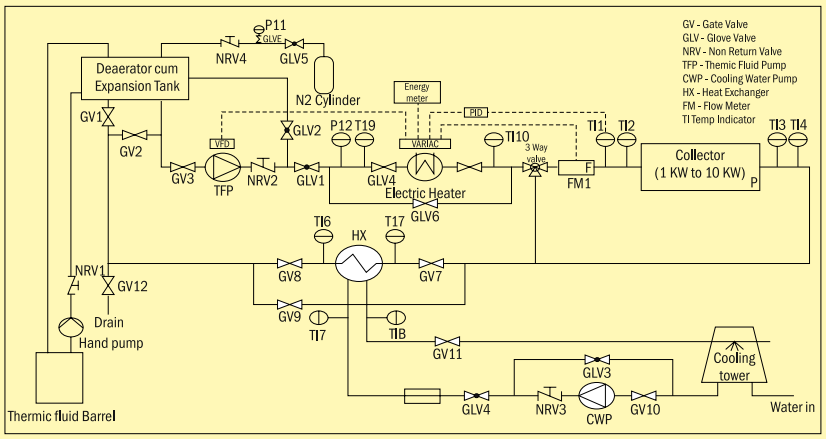


Figure 1: Test set-up of CST-based on thermic fluid

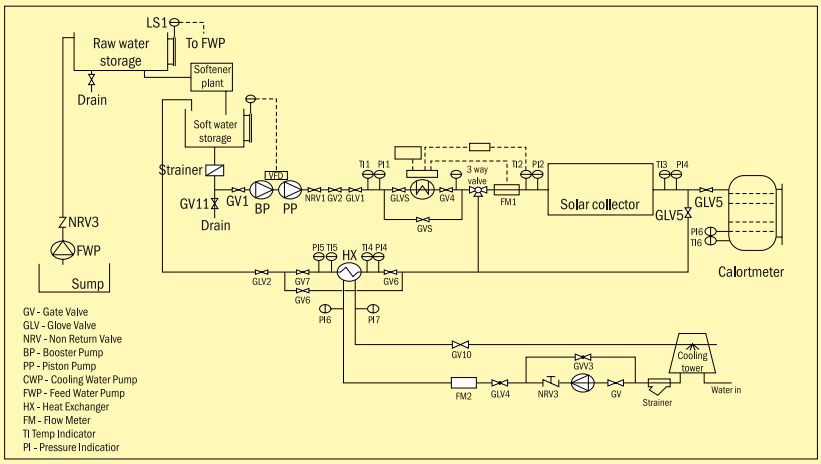


Figure 2: Test set-up of CSTs for steam and pressurized hot water

Photograph of Test Set Up

The test procedures for both, immobile and mobile setups are devised so that the measurements are adapted to the type of the fluid heated (thermic fluid, high pressure water or steam). Corresponding additional measurements are included to satisfy the efficiency measurement process. Presently, 24 m^2 PTCs from Thermax India are under testing at the test center.

Further, an array of 10 m^2 at Chandrapur installed by Green Life Energy Solutions Pvt Ltd has already been tested for thermic.

Weather Station

A weather station has also been developed at the Center. It comprises a high precision sun tracker, 2 pyranometers with and without shading stand and a wind anemometer. The Pyranometrs comply with ISO9060 and WMO standards. The mast on the right carries wind and humidity sensors. The data are collected in the remotely accessible data logger continuously at variable time intervals.

Mobile Test Set Up

There are typically individual systems or arrays of solar concentrators, which are installed at beneficiaries place and are large in size and hence cannot be shipped to the test centers. For such systems, tests are performed at the location of installation. A mobile set-up is also in place for the site testing of some of the larger systems. The party desiring for their testing is informed of the requirements of the test parameters measurements. The prescribed equipment would be fitted by the customer in the system before the testing. Various sensors will be provided to measure fluid flow rate, temperatures and weather parameters. The manufacturer or beneficiary of the system must ensure appropriate arrangements to incorporate all the sensors complying with recommended pipe dimensions and lengths for faithful indication of measured parameters.

For the Mobile testing, the system need not be closed loop one. The manufacturer or beneficiary should provide an arrangement to supply fluid for the working system. The systems installed by the beneficiary need to test for a committed performance after commissioning. The systems as installed do not have all instrumentation and their calibration facilities since such instruments are expensive, adding unnecessary cost to solar system and are not viable in smaller installation. A mobile test setup will serve this purpose and manufacturer or beneficiary can hire these services as and when required.

Testing of CSTs in Field

Measurements to carried out on various parameters to determine the thermal performance of the system installed in the field are as below:.

- Intensity of solar radiations (DNI),
- Ambient temp,
- Wind velocity,
- Inlet and outlet temperature of the fluid going through the receiver,
- Flow rate of heat extracting fluid,
- Data collection during the starting time of the system to the end time and on the clean days (No cloud Coverage) all data is to be recorded using a data logger having data logging facility to log the data at a minimum 1 minute time interval.

So far a mobile test has been carried out at Chandrapur in Maharashtra state, installed by Green Life Energy Solutions Pvt Ltd. The inquiries for testing at immobile test setup are already floating. Some of the inquiries have also been received for site testing. The test center at SPPU is engaged in research aimed at improving the efficiency, longer life of concentrators, reducing the time for cleaning and other related problems.■

Indian Delegation led by Sh. Upendra Tripathy, Secretary MNRE visiting Solar Test Facility at Fraunhoffer ISE, Germany during 1-7 September, 2014

NATIONAL SOLAR ENERGY HELPLINE AND NEWSLETTER: A SUCCESS STORY

Jaideep N Malaviya

Solar Energy Helpline

Imparting the right education is the first step for any line of business to succeed and with this intention the Solar Energy Toll Free Helpline No. 1800 2 33 44 77 was initiated jointly by Ministry of New and Renewable Energy (MNRE) and Solar Thermal Federation of India (STFI) way back in July 2011 under the UNDP-GEF project. The number is toll free to facilitate the masses to get free information. It started as solar water heater Helpline and is now a full-fledged solar energy Helpline with no distinction to any form of solar energy technology.

The objective was to create awareness and address to consumers requirements and complaints. Its operational timings are from 0930 to 1830 hours, Monday – Friday and 0930 to 1330 hours on Saturdays. The medium of language for communication presently is Hindi and English. It is catering to all forms of solar energy hence called as "Solar Energy Helpline". This should be probably the first such dedicated National Helpline on solar energy by any Federal government in the world.

Outcome of the Helpline

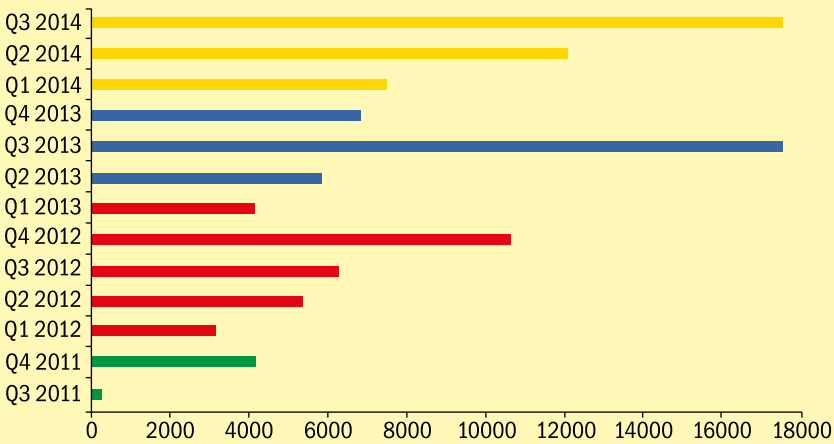
After more than 36 months the total numbers of call units received are close to 1,00,000 and with time the awareness is rapidly growing. Graph 1 below indicates the quarterly traffic of call units received since inception. The quarter begins in January of any given year.

The tall bars seen during each year are on account of the SMS publicity undertaken, which has helped vastly to connect to the masses to instruct them on the advantages of solar energy.

State Nodal Agencies (SNA's) of MNRE have also benefitted from this Helpline. Callers often enquire about state based policies and municipal corporation incentives for installing solar energy systems. Although the updated information is shared but when they are given their respective SNA contact they probably get a more satisfied reply. It is observed that any information in vernacular language helps them understand their query better. Another advantage the Helpline has offered is that the publicity about SNA has also increased as we ensure to share the phone number of SNA from the state they call. Thus a closer interaction between the SNA and the beneficiary has been established and achieved.

One of the important objectives of Helpline was to seek complaints for non performance of systems and other issues. The Helpline has proved useful to resolve the complaints and most of the manufacturers have appreciated this. With the growing market size and large-scale manufacturers having dealers all over the country, who have informed that it is very difficult to track the complaints. As a result, this scores as one stop source to register complaints. The complaints received largely comprise of non-receipt of subsidy amount and maintenance assistance for systems more than 5 years old when the warranty is over. STFI has designed an online complaint form and complaints received are forwarded to the respective manufacturer. On the other hand large manufacturers have also praised the Helpline service as they are able to track their complaints where systems are often supplied by the dealers and often go un-attended.

Whenever caller wants in-depth understanding of any particular technology the Helpline directs them to visit the Frequently Asked Questions (FAQ's) available on the MNRE and Solar Thermal Federation of India websites. The FAQ's cover all forms of solar energy technologies, i.e., Concentrated Solar Thermal, Solar Water Heater and PV. They are periodically updated with latest information. It has immensely helped the masses to resolve their queries.



Graph 1: Quarterly calls received on helpline

The author is the Secretary General, Solar Thermal Federation of India, Pune; Email: info@stfi.org.in

Doing good to Institutions and Entrepreneurs

Interestingly calls from students of technical institutions are on the rise and they enquire about solar energy technology for the projects they desire to undertake. This aspect is observed from the urban areas. A student Jhanvi from Bangaluru heaped high praises for the Helpline as it helped solve her problem of locating an ideal manufacturer for her academic project. She plans to make a career in solar energy. In February 2014, few smart students from New Delhi called the Helpline to get answers for questions and at the end of call revealed it was for a quiz programme to be conducted in their school.

Another advantage the Helpline has offered is enquiries from entrepreneurs who wish to start their venture. This is observed particularly from those states that do not have sufficient manufacturers, i.e., Odisha, West Bengal, Bihar, Himachal Pradesh, Uttarakhand and Uttar Pradesh.

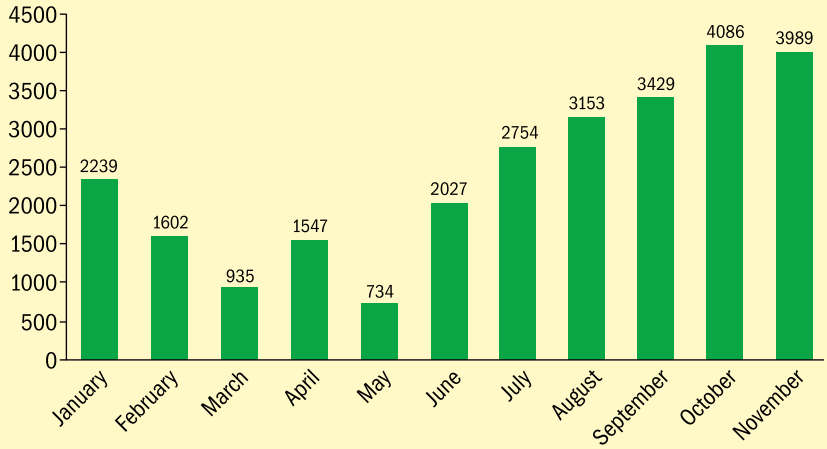
Success Case Study of SMS/ WhatApp Publicity

India has the world's second largest Mobile phone density (84%). Taking advantage of this fact it was found to be the most cost effective tool for publicizing the Toll-free Solar Energy Helpline and reach the masses. Hence on a pilot basis a Short Messaging Service (SMS) awareness campaign on Solar Helpline was undertaken and was sent to 20 lakh Mobile users in these 36 months. The targets were architects, hotel owners, salaried people, builders, real estate developers, industry owners, high net worth individuals, Doctors and Chartered Accountants. The cities chosen were New Delhi, Thane, Chennai, Kolkata, Bengaluru, Hyderabad, Pune, Chandigarh, Rajkot, Jaipur, Noida and Ahmedabad and states of Haryana, Madhya Pradesh and Chhattisgarh where local municipality and/or state incentives on solar thermal and solar PV systems are available, besides the various government incentives. The SMS publicity resulted in high call traffic and further helped spread awareness as already mentioned earlier and can be seen in Graph 1 with long bars.

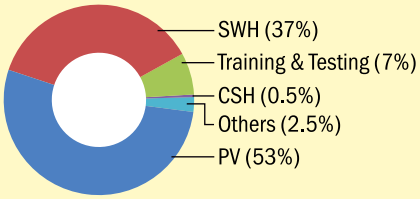
2014 Scenario

The year 2014 has already witnesses over 40,000 calls and has been the most aggressive so far and is a testimony of the success of the initiative. Graph 2 below denotes the monthly calls traffic. Interestingly owing to the operational UNDP-GEF programme on concentrated solar thermal heating and several advertisements appearing in leading dailies and industry magazines, the Helpline has also witnessed close to 1,000 calls from the industries for process heat applications and its benefits.

During 2014 the break-up of calls received for the 3 categories of solar energy systems, i.e., Concentrated Solar thermal (CST) Systems, Solar Photovoltaics (PV) and Solar Water Heater (SWH) during 2014 is shown below in Graph 3.



Graph 2: Month-wise calls received in 2014



Graph 3: Break-up of calls received sector-wise in 2014

InSolTherm Times -India's only Solar Thermal E-Newsletter

Ever since the e-newsletter made its first appearance in August 2011 (www.insolthermtimes.in) it has received global appreciation for the admirable solar thermal development of India covered in one window. The e-Newsletter is presently free to subscribe and individual news can also be downloaded.

It covers topics on latest developments occurring in Concentrated Solar Thermal systems and projects besides other solar thermal systems. In fact testimonials from several manufacturers show that it is now a vital medium to connect to potential clients as it shares the first hand information and provides valuable knowledge.

Between 4 to 5 news are published every month. The categories of news published are as follows:

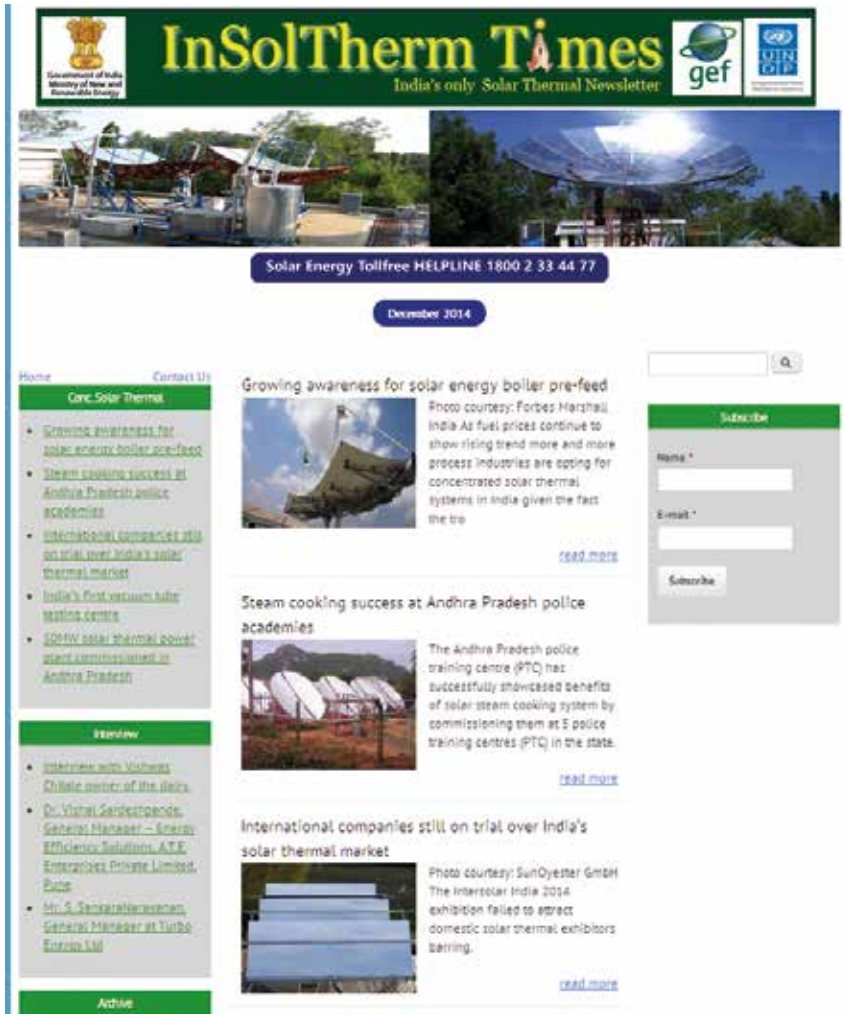
- Latest developments by manufacturers
- Research survey and analysis of policies and announcements
- Information shared at prominent events in the country and globally
- International developments related to solar thermal process heat

The researched surveys that are published in newsletter is also quoted at several events and conferences and is welcomed by analysts. Presently there are over 4,500 hits to the Newsletter from all over the world and the list of visitors is growing every month. During 2015, it is proposed to carry interviews of successful manufacturers and end users of some of the large scale installations.

Conclusion

Solar Energy Helpline is presently widely publicized in India as well as globally. The several search engines available presently on internet has made it possible for masses to immediately track the number and gives an opportunity to interact for their requirements. Most essentially it acts as a vital tool for business development by unraveling the difficulties of a caller and enables them to take decision for considering a solar energy system. With time the Solar Helpline is becoming a one stop window for all needs concerning solar energy and is likely to play key role in generating awareness. In other words it is the **"Lifeline of Solar Energy in India."**

The monthly e-Newsletter has also created a vast awareness on CSTs and CSH project activities all over the world. ■



UPDATE ON THE PROGRESS OF UNDP-GEF CSH PROJECT AND ITS MID-TERM REVIEW

Dr S N Srinivas and Butchaiah Gadde

The project, "Market development and promotion of Solar Concentrator based Process Heat Applications in India" (India CSH), recently completed its mid-term review. The review noted that India CSH project is continuing to strive a difference in a large number of establishments that require low-medium temperature process heat using concentrating solar heat (CSH) technology systems. When the project was started in 2011, the CSH systems sales have been only 2,000 to 3,000 m^2 per year. The project aims to increase this by five times to 15,000 m^2 per year in project duration of five years. In other words, it is aiming to add 90 CSH systems cumulating to an installed concentrator area of 45,000 m^2 when compared to a baseline of 71 systems with 20,000 m^2 in the year 2011. This installed capacity of CSH systems will result in greenhouse gas (GHG) emissions reduction of 32,900 tCO_2 by the end of the project. Considering an economic lifetime of 20 years, these systems are expected to reduce a cumulative direction GHG emissions reduction of 315,000 tCO_2.

To meet the above objectives, the project designed components and outcomes on which a significant progress has been made by the Project Management Unit at MNRE during last 2 ½ years. A mid term review on the project was undertaken by hiring 2 consultants; one each International and National who reviewed the project activities and the progress made by the Project Management Unit during 15-23 December, 2014.

The authors are proud to highlight some of the achievements of the project as on date that were highlighted by the mid-term reviewers.

Highlights of Progress

The project has four components and the component wise results are presented as follows.

Component 1 : Technical Capacity Development

The project has established performance monitoring at 14 sites as per BIS standards. This is to ensure sufficient data is available to assess performance standards and technology specifications as well as benchmark cost for solar concentrator systems. Subsequently, performance monitoring is expected to be replicated across all the systems that will be installed in India. With the project support, five more CSH manufacturers have entered CSH business in India. With this, altogether, now there are 19 manufacturers for solar concentrator systems in India. The project also brought back some of the dysfunctional systems into operation through its technical assistance. So far, the project supported establishment of test facilities for CSH systems at National Institute of Solar Energy (NISE), Gurgaon and Pune University, Pune. Test facilities at these two institutions are perhaps the state of the art in Asia. A training cum awareness center was also established at Mount Abu.

Component 2 : Awareness Enhancement and Capacity Building

The project developed training manuals, information packages including audiovisuals and brochures on the six CSH technologies. Subsequently conducted 12 training workshops so far on the operation and maintenance, and online performance monitoring. Disseminated information for public that includes suitability of technology for selected industrial applications, financial viability including payback details, and a national toll-free helpline number to address related queries. The project is also conducting forum meetings regularly through establishing a technology platform involving private sector associations. The project has established a dedicated website, www.cshindia.in, and regularly publishing newsletters such as the SUN FOCUS magazine, and Insolthermal Times.

Component 3 : Demonstrating & Replication of CSH Projects

In this regard, the project has supported the preparation of 41 pre-feasibility studies. Further, the project supported the implementation of 53 projects on ground with a total concentrator area of 16,640 m^2 (23 demonstration projects and 30 replication projects), where six demonstration and one replication projects are under operation. The project is at its midpoint in implementation, and much effort is under progress. Therefore, it is expected that the project will achieve its targeted concentrator area of 45,000 m^2 by the end of the project, which is additional to its baseline 15,000 m^2. The project also established a database for 120 CSH systems in India. The project is supporting Energy Service Company (ESCO) modality for the development and implementation of CSH projects, where eight projects are in pipeline under this modality.

Component 4 : Sustainable Financial Approach

Cost of CSH systems are high and without financial subsidy, the payback

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period is about 5 to 8 years depending on the fuel that is being presently used. Therefore, two financing modalities are being adopted for its promotion i.e. (a) investment subsidy in the form of grant assistance from MNRE and the project, and (b) ESCO modality. The project has initiated a study to review appropriate policies and financial mechanisms for the promotion of CSH systems. IREDA is also closely involved in this effort of the project.

Mid Term Review

Project mid-term reviewers have identified three key areas for improvement i.e. (1) awareness is an area that still needs improvement, (2) efforts are needed to bring down the cost of CSH systems, and (3) supply chain needs further improvement as it is not established enough to meet the industrial energy demand and required service quality. The project is sufficiently responding to these observations and planned to take a number of actions. To improve awareness, and address cost barrier, in the short term, investment grant subsidy will continue from the Ministry. However, on the long run, the project is aiming to improve the performance, encourage large-scale applications of CSH systems thereby cost optimization can be achieved. Towards improving the supply chain, a number of actions are being undertaken. The project is encouraging more manufacturers to come forward, expand the technology package offers, and comply with BIS standards. Further, encourage ESCOs to deploy *pay as you use CSH system* instead of making upfront investments modality. Energy input-output benchmarks are being developed, which will be used while providing financial incentives and to encourage manufacturers develop systems that perform better.

The mid-term review provided[1] the following ratings for the project:

- Component 1: Technical capacity development – Highly Satisfactory
- Component 2: Awareness enhancement and capacity building– Highly Satisfactory
- Component 3: Pilot demonstration of CSH technologies for various applications – Highly Satisfactory
- Component 4: Sustainable financial approach in the adoption of CSH technologies and applications in India – Marginally Satisfactory

Further, the mid-term review identified that, adaptive management, monitoring and reporting, and stakeholder's involvement in the project as highly satisfactory.■

[1] The ratings are provisional and final ratings may change once the MTR report is finalised

Financial Support Available for CST Based Systems

MNRE

- 30% of system benchmark cost as capital subsidy in general category states. Higher subsidy (60%) in special category states, including hilly states, islands, and union territories except to commercial establishments.
- 80% accelerated depreciation benefit available to profit making bodies in the first year.

UNDP–GEF Project (Details available at MNRE website: http://www.mnre.gov.in/)

- 15% of the system benchmark cost to a maximum of Rs 75 lakh for demonstration projects of 250 sq. m and above mainly for online performance monitoring, O&M expenses, feasibility report/DPR, etc. For dual axis tracked dishes, the support is available for project of 150 sq.m and above.
- Rs 5–10 lakh for replication projects of 250 sq.m and above mainly for providing performance/fuel saving data, O&M expenses, etc.
- Rs 2 lakh for projects below 250 sq.m but not less than 64 sq.m for Scheffler dishes and 45 sq.m for other concentrators mainly for meeting part O&M expenses.
- Additional 10 per cent of cost to a maximum of Rs 15 lakh for projects done in ESCO mode.
- 20% of the system cost to a maximum of Rs 15 lakh for 5-year-old systems for repair and renovation, subject to the condition that an equal amount is spent by the beneficiary.

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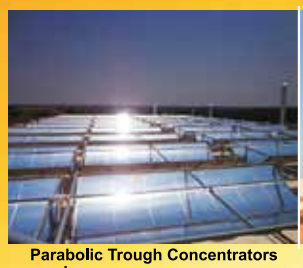
CONCENTRATING SOLAR THERMAL SYSTEMS

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


Parabolic Trough Concentrators


Arun Dish


Paraboloid Dishes


Scheffler DIshes

TECHNOLOGIES

APPLICATIONS


Community Cooking


Space Cooling


laundry / Process Heat

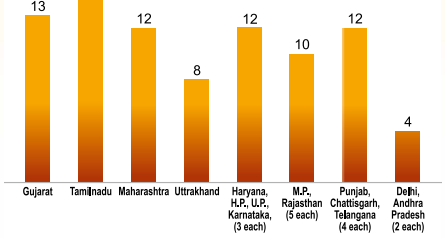
MAJOR PROJECTS

Include systems at Shirdi Sai Sansthan, Shirdi; R K Mission School, Chennai & Bosch Ltd, Bangalore for **community cooking**; SKF Technologies, Mysore; Hindustan Vidut, Faridabad & Synthokem Labs, Hyderabad for **process heat**; Mahindra & Mahindra, Pune; TVS Suzuki, Chennai & Atomic Power Plant, Kota for **space cooling** and Purple Creations, Baramati & Gajraj Cleaners, Ahmad Nagar for **laundry**

PROJECTS INSTALLED IN LAST 3 YEARS

Total Installed so far : 160

Anticipated Fuel Savings & CO_2 Abatement per year : 3 million litres of fuel oil & 14,000 tons of CO_2



FINANCIAL SUPPORT

30% of benchmark cost as government subsidy with additional benefit of 80% accelerated depreciation to profit making bodies. Higher subsidy in special category states.

In addition, 15% of MNRE benchmark cost to a maximum of ₹75 lakhs for demonstration projects under UNDP-GEF project for specific activities. For other projects support up to ₹10 lakhs is available depending on type and size of the project.

Interested Organizations may contact our Channel Partners (**Clique Solar, Mumbai :** 09665055059; **Essential Equipment, Dhule :** 09822187693; **Leverage Net Solutions, Pune :** 09970319054; **Megawatt Solutions, Delhi :** 09654451401 ; **Taylormade Solutions, Ahmadabad :** 097129 33390; **Thermax, Pune :** 020-67308885 or 67308880; **Ultra Conserve, Pune :** 9004445530; **Unison, Bangalore:** 080- 22289663/ 22355239;) or write to us at following address indicating the heat requirement in terms of steam/hot oil/ pressurized water, application, fuel being used, existing arrangement, shadow free space available near utility point etc: For more details, visit our website **www.cshindia.in.**

National Project Manager

UNDP-GEF Project on Concentrated Solar Heat

Ministry of New & Renewable Energy

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