Mid-Term Review of the UNDP/GEF project:

"Market Development & Promotion of Solar Concentrators for Process Heat Applications in India" (PIMS 4284; GEF 4134)

Report
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Disclaimer

Please note that the analysis and recommendations of this report do not necessarily reflect the views of the United Nations Development Programme, its Executive Board or the United Nations Member States. This publication reflects the views of its authors.

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LIST OF ACRONYMS

AWP	Annual Work Plan
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
CBB	Central Boiler Board
CO_2	Carbon dioxide
CSH	Solar concentrating heat
CSP	Solar concentrating power
CST	Solar concentrating technology
DEA	Department of Economic Affairs
DPR	Detailed project report
EE	Energy efficiency
EOP	End-of-project
ESCO	Energy service company
FSP	Financed full-sized project
GW	Gigawatt, 1000 MW
GWh	Gigawatt-hours
GEF	Global Environment Facility
GHG	Greenhouse Gas
HL	Highly likely
HS	Highly satisfactory
HU	Highly unsatisfactory
IIT	Indian Institute of Technology
IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
INR	Indian Rupiah
ITI	Industrial Training Institute
JNNSM	Jawaharlal Nehru National Solar Mission
kW	kilowatt
kWh	kilowatt-hour
L	likely
lakh	100,000
m^2	square meter
M&E	Monitoring and Evaluation
ML	Moderately Likely
MoEF	Ministry of Environment and Forests
MS	Moderately Satisfactory
MNRE	Ministry of New and Renewable Energy
MTR	Mid-Term Review
MU	Moderately Unlikely
MU	Moderately Unsatisfactory
MW	Megawatt (million Watt)
NAPCC	National Action Plan on Climate Change
NGO	Non-Government Organization
NISE	National Institute of Solar Energy (f.k.a. SEC, Solar Energy Centre)
NPD	National Project Director
NPM	National Project Manager
O&M	Operation and maintenance
PIR	Project Implementation Review
PMU	Project Management Unit
PSAC	Project Steering and Advisory Committee
ProDoc	Project Document
PwC	PricewaterhouseCoopers
R	Relevant

RE	Renewable energy
R&D	Research and development
S	Satisfactory
SECI	Solar Energy Corporation of India
STFI	Solar Thermal Federation of India
tCO_2	ton of CO_2
ToR	Term of reference
U	Unsatisfactory
UN	United Nations
UNDAF	United Nations Development Assistance Framework
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
US	United States
USD	US dollar

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1. EXECUTIVE SUMMARY

Project information table

Project Title:	**Market Development and Promotion of Solar Concentrators based Process Heat Applications in India (CSH, India)**			
GEF Project ID:	4134		*Committed at endorsement (USD Million)*	*Realized co-financing / spent GEF budget at midterm review (USD 10^6)*
UNDP Project ID:	4284	GEF financing:	4.40	1.68
Country:	India	IA/EA own:		
Region:	South Asia	Government:	7.35	2.75
Focal Area:	Climate Change	Others (private):	12.00	12.10
FA Objectives, (OP/SP):	CCM-3: Promote investment in renewable energy technologies (GEF-5)	Total co-financing:	19.35	14.85
Executing Agency:	UNDP	Total Project Cost:		
Other Partners involved:	Ministry of New and Renewable Energy (MNRE)	GEF endorsement: Dec 2011		ProDoc Signature (date project began): March 2012
		(Operational) Closing Date:	Dec 2016	

Introduction and brief description of the project

The industrial sector is the second largest energy intensive sector in India. Process heat applications in sectors such as pharmaceuticals, metal plating, food processing, textiles and dairy require significant amount of heat in the low – medium temperature range of 90 to 350° C. They currently use fossil fuels (fuel, oil, diesel, coal) or biomass and electricity for their energy needs. The process heat needs can be met with Concentrating Solar Heat (CSH) systems along with suitable process integration and heat storage. Solar concentrator systems use lenses or mirrors to focus a large area of sunlight onto a small area and thus it is possible to achieve the temperatures mentioned above in the medium to be heated. There are about six Concentrating Solar Technologies (CST) with potential in India for heat applications (cooking, cooling, process heat) that differ in their output (temperature, specific thermal power), cost, module size and the installation area required.

As of 2011/12, there were about 200 industrial-commercial CSH applications worldwide, of which about 85 in India (not counting very systems, e.g. solar cookers). This places India as one of the leading countries in the practical CSH market, but concentrating solar technology cannot be considered as widely used neither globally nor in India. CSH is in a nascent stage only and a range of barriers exist that prevent the technology from becoming more widespread.

The Project "Market Development and Promotion of Solar Concentrator-based Process Heat Applications in India (CSH India)" aims to complement the efforts of the Government of India to promote the use of solar concentrators for process heat applications by overcoming existing barriers in technology, awareness, capacity, market and financial. The project is implemented by MNRE (Ministry of New and Renewable Energy) with support from the Global Environment Facility (GEF); the United Nations Development Programme (UNDP) acts as the GEF Executing Agency, providing overall management and guidance.

The project's Component 1 provides technology application packages, support for the introduction of four further CSH technologies, and standardization of CSH performance measurements; Component 2 provides

awareness and capacity building; Component 3 aims at supporting 30 demonstration projects (15,000 m^2) and 60 replication projects (30,000 m^2 of collector area); while Component 4 addresses financial barriers.

The project has been designed as a full-sized project with GEF financing of USD 4,400,000 and co-financing of USD 14,850,000, consisting of in-kind contribution from MNRE of USD 1,350,000, a MNRE contribution in the form of grant subsidy of USD 6,000,000 and contributions (in cash) from industries and financial institutions of USD 12,000,000. After signing the Project Document in March 2012, implementation started with the inception workshop in May 2012. The planned closing date is December 2016.

Project progress summary and MTR ratings

The main **findings** of the mid-term review are presented below:

Main criteria	Rating	Description
Progress towards results	HS	The Project has progressed most significantly in Component 1. Assessments of technology (field survey of 100 installations) as well as sectoral assessments and of manufacturers have consolidated the baseline information available on the options and issues with CST application in a range of heat applications for various end uses (cooking, cooling, process heat). To remedy the barrier of credibility of actual performance of CSH systems, a process of systematic monitoring of the CSH applications at 15 sites has been initiated. Testing facilities (both mobile and immobile) have been set up for this purpose. Quantified performance data will yield valuable info for prospective CSH users (confidence) and to manufacturers (suggestions for product improvement) alike[1]. Formulation of BIS standards for testing procedures are currently in progress. Meanwhile, performance norms for various CSTs have been made available of anticipated heat delivery in different regions and parts of India On capacity building (Component 2), the Project has advanced in a highly satisfactory manner, by holding 40 awareness workshops in different States, advertisements in dailies, supporting the publications of recurrent magazines and newsletters (Insolthermal Times; Sun Focus), and launching a dedicated website (www.cshindia.in). Technical skills and knowledge has been enhanced by a technical training programme on 'operation and maintenance and troubleshooting' with manuals for each of the 6 CSH technologies (in English and Hindi) In Component 3, technical support has been extended to the formulations of feasibility studies. Financial and technical support has been or is planned to be provided to 53 demonstration and replication projects with a total of 16,400 m^2 of collector area, of which 20 have been installed (about 8,500 m^2)[2]. In addition, the project has ensured that older (pre-project) systems that were non-functioning got repaired and operational again. Component 4 addresses financial barriers and this is where progress has been slowest. IREDA can provide loans for solar thermal systems, including CSH projects. However, no company has approached IREDA yet for loan requests, while a specific scheme for CSTs has not been announced. The import duty on mirrors for CST has been removed, thus lowering capital cost of CSH.
- Component 1 - Component 2 - Component 3 - Component 4	- HS - HS - HS - MS	
Design and relevance	- R	In India, a range of Indian organizations - from MNRE, academia, institutions to commercial entrepreneurs - have done a considerable amount of necessary

1 An assignment on 'Collection & Compilation of performance data on CST based systems through remote monitoring'' has been recently awarded to a consulting firm and is to provide data for 80 systems by the end of the project.

2 Data provided by PMU; most projects have been installed during 2014, some in 2013

		groundwork in terms of technology development and market promotion for solar concentrators for process heat applications (CSH) for cooking, cooling and industrial processes. Supporting this effort in the nascent market of CSH has been the target of the project and, given the lack of real experience worldwide with CSH, the Project thus has been supporting India in realizing a leap-frogging innovation. The project documentation we consider well-written, concise and encompassing the details needed, addressing the barriers and capacity strengthening needs and crafting these into an appropriate list of expected outcomes and outputs and activities (logframe), although the list of progress indicators in the logframe could have been improved.
Implementation and adaptive management	HS	In Components 1 and 2 the project has overachieved and Component 3 is advancing more or less as planned. Financially delivery (taking into account the USD 500,000 committed to demo project support, but not booked yet as expenditure) follows the achievements in the Components as mentioned above. Where needed, the Project team has undertaken a number of adaptive management measures in response to issues encountered. The Project has been working very well with the various stakeholders, including local entities (state nodal agencies), institutes and academia (such as NISE and University of Pune), CST manufacturers and their associations, consultant companies as well as beneficiaries (from various industrial sectors as well as non-profit).
- Management and reporting; M&E - Stakeholder involvement - Budget and co-finance	HS HS S	
Sustainability	ML	Supporting solar thermal (including CSTs) is part of the Indian policy on sustainable energy and climate change with formulated targets. The CSH sector shows a growing trend with more Indian manufacturers and more applications in various industrial subsector and more CSTs being installed (apart from the Scheffler dishes and ARUN systems available only at the project's onset). There is no indication that state support for CSH (and renewable energy in general) will be cut back on the short run, but of course long-run developments are difficult to predict. The rating of ML is largely due to the fact that many CSH applications will remain near-commercial for a long period, i.e. with relative high investment cost and payback times. It will take some time that the technology needs less subvention. The idea, however, is that as the market expands, economics of scale will eventually lead to a drop in CST prices, while financial institutions may have a more positive look at CSH for lending, evidenced by more installation Indian-wide. Meanwhile, the project should help MEMR explore possibilities to make subsidies more linked with the system's performance as to encourage manufacturers to seek ways to lower costs.
Impact	L	Prior to project initiation, the focus of CSH in India was on smaller systems for institutional cooking, using Scheffler technology mainly. The project has successfully been demonstrating applications of other CSTs in a range of industrial sectors for other applications (cooling and process heat)

HS: highly satisfactory, S: satisfactory, MS: marginally satisfactory, R: relevant, ML: moderately likely

In conclusion, the Project has been instrumental in lowering *barriers* to more widespread application of the CSH. Since project inception, the number of projects (installed and planned) has increased significantly, as well the number of annual installations (and corresponding CST area). Apart from Scheffler (and ARUN), other CST technologies are making in-roads.

Recommendations

1) Increased focus on removing the financial barriers

Less progress has been made in addressing financial barriers and issues. In the second half, the attention should shift therefore more towards financial and policy issues.

The current subsidy system (30% of benchmark price) lowers payback times to 4-8 years, which is still not deemed financially attractive enough by beneficiaries. On the other hand, high subvention levels will deter manufacturers to improve their product and for beneficiaries to integrate CST more efficiently into their processes. Eventually, as the market develops and sales volumes increase, the cost of CSH will come down. Meanwhile, the Project can support the subvention discussion by (when more performance data become available as a result of online monitoring and demo project evaluations) updating and documenting actual financial and payback performance indicators as a basis for formulation of a suitable framework for CSH (under the existing renewable energy and solar energy policies) with a revised subsidy system, taking into account the performance of various CST per climatic region and type of application, and more clearly stating the role of financial institutions.

The latter will require capacity building and awareness creation amongst banks and other financial institutions, who are in general not familiar with the CST technology. It will also require the identification of appropriate financing mechanisms, in which the subsidy element would decrease slowly over time. To raise confidence level of potential investors, setting up 'risk guarantee schemes' may be optional. The Project has only just started involving commercial energy service companies (ESCOs). The ESCO mode can potentially help the beneficiary in some risk sharing after the warranty period expires. The Project should explore the pros and cons of the ESCO route further. Up to now, there has been no much progress in the 'ESCO route'. The Project has been optimistic and expects some 5-10 ESCO projects coming in 2015, so the proof of the pudding will be in the eating.

2) Continuation of training

A number of technical trainings were provided at various locations on 'operation, maintenance and troubleshooting'. These trainings were typically of 3-day duration. As part of the contracts, usually manufacturers are required to train personnel 'on-the-job' of the unit or company where the CST will be installed. However, trained personnel may depart after a while, thus leaving a knowledge gaps. Second, staff trained by a particular manufacturer may not be fully knowledgeable of the designs of other manufacturers (even if the same CST is concerned). Third, a 3-day training may not be enough and periodic 'refresher' trainings may be needed. The training modules have potential for future replication and could be 'institutionalised' (implemented by one or more institutions as a course, possibly on a self-sustenance basis). Thus, a recommendation is to refresh the stocktaking of training needs (especially as more systems of different CSTs will get installed over 2015-16) and adapt, expand and extend training and short courses in accordance with the findings of this assessment.

3) Testing

Testing focusses on the performance of CST systems, although in the project these will be all recently installed systems. However, CSTs may reach a 15-20 year lifetime. As no old equipment is currently installed, testing could be expanded by adding methods of artificially aging of the equipment. Two such tests include salt spray tests and abrasion test. Another advanced testing set-up would be for measuring optical performance of the CST (e.g. photogrammetry). These were not part of the Project design and its budget will not allow more funds to be allocated for testing equipment. Even if funding would be available, we would like to caution against establishing an expensive testing infrastructure, which may be not be used in the end in a cost-effective way. The best approach would be to see how the existing test centres (Pune, NISE) will function over the coming years, not only from a technical viewpoint, but cost-effectiveness as well. To improve their economics these can double as testing and as training facility. Towards the end of the CSH India Project it could be investigated how the test facilities can be expanded, e.g. by acquiring more equipment (to do salt spray and abrasion tests). Given the fact that perhaps the testing at Pune and NISE are the only facilities in the region, it should be investigated, if these could function at a regional level. Pooling funding for such a regional function could enable financing of expensive testing infrastructure in a more cost-effective way.

4) International cooperation

There is need for continuing cooperation between the various institutions, associations and agencies working on concentrated solar. Such cooperation may include data sharing (respecting confidentiality), knowledge sharing, joint events and promotional events. Regarding research institutions and academia this could include a more intense cooperation with institutions (and companies) abroad. India can learn from the advanced test laboratories and facilities abroad and more fully understand international 'best practices'.

Given India's position as a pioneer worldwide in (commercial) CSH application, this offers scope for South-South cooperation. A provision should be made in the Project's work plans to transfer the 'lessons learnt' in CST and heat applications to abroad. The CSH India Project has the potential to be presented as a 'best practice' and UNDP might devote some resources to present the Project, internally as an example of the potential role of CST, and externally, at sustainable energy and climate change fora and events.

5) UNIDO/GEF "Promoting business models for increasing penetration and scaling up of solar energy"

The project was initiated in 2014 (approved by GEF in Dec 2013) with an expected 5-year duration, and will focus on solar-based technology for industry, focussing on processes in the temperature range of 150-400^{o}C in various industries, such as pulp and paper, food processing, fertilizer, pharmaceutical industries, textiles, desalination and tobacco industry. Its four components are similar to the CSH India Project, a) strengthening policy and institutional framework; b) technology investment and application (including 15-25 pilot demonstrations), c) scaling up (business models and financing; supply of quality components), and d) awareness raising and capacity building.

Supposedly, the focus will towards the lower temperature of the range 150-400^{o}C in SMEs (small and medium-sized enterprises), while arrangements have made to avoid overlapping ('coordination platform' and participation in each other's Steering Committee). However, it might be difficult to avoid duplication and it is recommended that the functioning of the proposed 'coordination platform' will be closely monitored.

6) Suggestions for end-of-project report (Sustainability)

Towards the end of the project (Dec 2016) it might be helpful to commission an 'end-of-project' *impact study* to analyse to what extent the before-mentioned barriers to CST (technical, market demand, financial, informational, etc.) got removed and indicate what important *gaps* are still remaining, accompanied by a plan with suggested post-project *actions* to be implemented by the various actors involved (government, local government, academia and institutions, associations/representatives of manufacturers and beneficiaries). This report should also address an exit strategy for certain activities initiated or supported under the project, once project funding dries up, e.g. maintaining and regular updating of the CSH India website, publications, monitoring of CST installations, toll-free support line, etc.

Lessons learned

Although concentrated solar technology for heat applications (CSH) is not a technology that globally has met much recognition as a commercially viable technology, India has managed to initiate a market for the near-commercial application of CSH. Although led by a small management team, the UNDP/GEF CSH India Project has had a significant influence in lowering barriers leading to a noticeable increase in the installation of CSH systems. One reason is that the Project has been embedded in a government policy promoting solar thermal technologies, and second, because it has been working closely with a range of stakeholders from other government entities, CSH suppliers, beneficiary industries and institution, an academia.

2. INTRODUCTION

2.1 Purpose of the mid-term review and objectives

The project *Market Development & Promotion of Solar Concentrators for Process Heat Applications in India* has been initiated with funding support from the Global Environment Facility (GEF) and UNDP (United Nations Development Programme) and implemented by the Ministry of New and Renewable Energy (MNRE). The project aims to increase the use and promotion of concentrating solar heat (CSH) systems for low and medium temperature process heat applications in industry.

The project started in March 2012 with a planned duration of almost 5 years (up to Dec 2016). Entering its third year, as per UNDP and GEF guidelines, a Mid-Term Review (MTR) needs to be carried out (as for all GEF-financed full-sized projects) by one or more independent consultants, 'independent' meaning not previously being involved in the project's design, management or implementation of activities. The consultants Jan Van den Akker (Netherlands) and Dinesh Aggarwal (India) were selected in consultation with the project implementing partner and contracted by UNDP India to carry out the review assignment.

Objective

The objective of this mid-term review is described in the Terms of Reference[3], which mentions that the MTR will assess progress towards the achievement of the project objectives and outcomes as specified in the Project Document, and assess early signs of project success or failure with the goal of identifying the necessary changes to be made in order to set the project on-track to achieve its intended results. The MTR will also review the project's strategy and its risks to sustainability.

2.2 Scope and methodology

Before undertaking the MTR, an *Inception Report* was presented, including the proposed tasks, activities and deliverables, as well as a table of main review questions that need to be answered to determine and assess project results, and to identify where the information is expected to come from (e.g. documents, interviews and field visits). This *table of mid-term review criteria and questions* is presented in Box 1.

Sources of data and data collection

The review has been based using the following *sources of data* and *data collection tools* to answer the MTR evaluation questions:

- Desk review of documents (see Annex C):
  - Progress reports and project documents; such as the UNDP Project Document (ProDoc), GEF CEO Endorsement Request, as well as progress reports, such as the annual UNDP/GEF Project Implementation Reviews (PIRs); data on project budget and expenditures;
  - Project technical reports; project manuals and guidelines
  - Background info (websites, reports, national policy papers, or other written info) from relevant government ministries and institutions, as well as other stakeholders; background info on application of solar thermal technology in industrial applications;
- Mission to India to hold interviews with stakeholders, beneficiaries and key informants to obtain in-depth information on impressions and experiences, explore opinions about the initiative and their suggestions for future action. The mission was carried out during 15-22 December 2014 with travel to Pune and Hyderabad to visit participating and beneficiary institutions. The mission schedule is given in Annex B.

[3] See Annex A

Box 1 Overview of the structure of the MTR report and main review questions

Contents	Main review criteria and questions
Title page with basic report info Table of contents Acronyms and abbreviations Executive summary	
1. Executive Summary • Project summary table • Brief project description • Table with overview of ratings[4] and achievements • Summary of conclusions and recommendations	
2. Introduction • Purpose of the MTR and objectives • Scope and methodology of the MTR • Structure of the MTR	
3. Project description and development context • Development context; Problems the projects seeks to address • Description of the project (objectives, project participants, objectives and main outcomes; duration and timing) • Main stakeholders • Project management arrangements	
Findings	
4. Project design and strategy 4.1 Relevance[5] and ownership ▪ Relevance and country drivenness ▪ UNDP programming and comparative advantage 4.2 Results framework and design ▪ Logframe; risks and assumptions; Indicators ▪ Stakeholder participation; linkages with other initiatives; replication approach ▪ Rating	• Does the project adequately take into account the national realities, both in terms of institutional and policy framework in its design and implementation? • Is the project country-driven? • If the project progress is not good, what changes could have been made (if any) to the project design in order to improve the achievement of the project's expected results during rest of the project implementation period
5. Progress towards results[6], 5.1 Attainment of outcomes and outputs 5.2 Attainment of project objective and impacts • GHG emission reduction estimates • Other impacts 5.3 Effectiveness; rating	• Review the logframe indicators against progress made towards the end-of-project targets using the Progress Towards Results Matrix, with progress indicators for outcomes/outputs, indicating baseline and target levels, as well as current level and/or reported in PIR linked with ratings[3] for each outcome • Results in terms of contribution to sustainable development benefits, as well as global environmental benefits (direct and indirect emission reduction); Compare and analyse the GEF Tracking Tool at the Baseline with the one completed right before the Midterm Review
6. Project implementation and adaptive management 6.1 Adaptive management and planning; monitoring and evaluation	• *Management:* appropriateness of the institutional arrangement and whether there was adequate commitment to the project? Review overall effectiveness of project management as outlined in the Project Document. Have changes been made and are they effective? Are responsibilities and reporting lines clear? Is decision- making transparent and undertaken in a

[4] Using a six-point scale that ranges from highly unsatisfactory (HU), unsatisfactory (U), marginally unsatisfactory (MU), marginally satisfactory (MS), satisfactory (S), highly satisfactory (HS)

[5] Rated as Relevant (R) or Not Relevant (NR)

[6] The underlined items in this table refer to the UNDP evaluation criteria of Relevance, Effectiveness, Efficiency, Results, Sustainability (see UNDP Handbook on Monitoring and Evaluation

Contents	Main review criteria and questions
▪ Management ▪ Work planning; reporting and communications ▪ M&E systems 6.2 Stakeholder engagement 6.3 Budget and co-financing	timely manner? Recommend areas for improvement; Review the quality of execution of the Executing Agency/Implementing Partner(s) and recommend areas for improvement; Review the quality of support provided by the GEF Partner Agency (UNDP) and recommend areas for improvement • *Work planning*: Review any delays in project start-up and implementation, identify the causes and examine if they have been resolved; Are work-planning processes results-based? If not, suggest ways to re-orientate work planning to focus on results?; Examine the use of the project's results framework/logframe as a management tool and review any changes made to it since project start. • *Reporting:* Assess how adaptive management changes have been reported by the project management and shared with the Project Board; Assess how well the Project Team and partners undertake and fulfil GEF reporting requirements (i.e. how have they addressed poorly-rated PIRs, if applicable?); Assess how lessons derived from the adaptive management process have been documented, shared with key partners and internalized by partners. How does the APR/PIR process has been helping to monitor and evaluate the project implementation and achievement of results? • *Communications:* Review internal project communication with stakeholders: Is communication regular and effective? Are there key stakeholders left out of communication? Are there feedback mechanisms when communication is received? Does this communication with stakeholders contribute to their awareness of project outcomes and activities and investment in the sustainability of project results? Review external project communication: Are proper means of communication established or being established to express the project progress and intended impact to the public (is there a web presence, for example? Or did the project implement appropriate outreach and public awareness campaigns?); • *M&E:* Review the monitoring tools currently being used: Do they provide the necessary information? Do they involve key partners? Are they aligned or mainstreamed with national systems? Do they use existing information? Are they efficient? Are they cost-effective? Are additional tools required? How could they be made more participatory and inclusive? • Examine the *financial management* of the project monitoring and evaluation budget. Are sufficient resources being allocated to monitoring and evaluation? Are these resources being allocated effectively? • *Stakeholders:* Has the project developed and leveraged the necessary and appropriate partnerships with direct and tangential stakeholders? Do local and national government stakeholders support the objectives of the project? Do they continue to have an active role in project decision-making that supports efficient and effective project implementation? To what extent has stakeholder involvement and public awareness contributed to the progress towards achievement of project objectives?
7. Sustainability[7] and risks ▪ potential impacts ▪ Institutional and governance, financial, economic, environmental	• Comment on the Sustainability of the project in view of the resources committed by the UNDP- GEF in the long term; Commitment on the expected scenario of the project sustainability subsequent to the conclusion of the project: ▪ *Socioeconomic:* Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public/stakeholder awareness in support of the long term

[7] Rated from likely (L), moderately likely (ML), moderately unlikely (MU) to unlikely (U)

Contents	Main review criteria and questions
	objectives of the project? Are lessons learned being documented by the Project Team on a continual basis and shared/ transferred to appropriate parties who could learn from the project and potentially replicate and/or scale it in the future? ▪ *Institutional:* Do the legal frameworks, policies, governance structures and processes pose risks that may jeopardize sustenance of project benefits? ▪ *Technology:* Description of status and issues with employing Concentrating Solar Heat (CSH) systems for low-medium temperature applications in selected sectors; ▪ *Financial:* What is the likelihood of financial and economic resources not being available once the GEF assistance ends (consider potential resources can be from multiple sources, such as the public and private sectors, income generating activities, and other funding that will be adequate financial resources for sustaining project's outcomes)? ▪ *Environmental:* Are there any environmental risks that may jeopardize sustenance of project outcomes?
8.Conclusions and recommendations 8.1 Conclusions ▪ Summary of main findings and of ratings; statements on strengths and weaknesses ▪ Remaining barriers 8.2 Recommendations ▪ Numbered recommendations and actions for follow-up 8.3 Lessons learned	▪ Identify remaining barriers to achieving the project objective in the remainder of the project, and by reviewing the aspects of the project that have already been successful, identify ways in which the project can further expand these benefits ▪ A MTR Ratings & Achievement Summary Table will be provided, summarizing the ratings[3] on a) results, b) implementation and adaptive management, c) sustainability with a short description of the rating's justification ▪ Recommendations: o Corrective actions for the design, implementation, monitoring and evaluation of the project o Actions to follow up or reinforce initial benefits from the project o Proposals for future directions underlining main objectives
Annexes • ToR • Itinerary, field visits and list of people interviewed • Documents reviewed and bibliography • Background information on solar concentrating technology and application in India • Signed UNEG code of conduct forms	

The review of documents provides the basic facts and information for developing a first draft mid-term review (MTR) report, while the mission is needed to verify the basic facts, get missing data and to learn opinions of respondents to help interpret the facts[8]. The individual interviews with key informants were based on open discussion to allow respondents express what they feel as main issues, followed by more specific questions on the issues mentioned. The list of mid-term review questions of Box 1 was used as a checklist to raise relevant questions and issues during the interviews that correspond to the level and type of involvement of the interviewee or the organization visited.

Regarding the *data analysis and methods for analysis*, the documents listed in Annex C were reviewed and analysed. The notes of the interviews with key informants were used to verify facts and information presented in reports and documents and helped to formulate the conclusions and recommendations. A seven-day mission has the limitation of potentially giving a snapshot impression only. Nonetheless, the mid-term reviewers feel that this mix of data collection and analysis tools has yielded viable answers to the evaluation/review questions within the limits of budget resources for the review and time availability.

[8] The Inception report mentions the use of a pre-determined questionnaire as an option. However, this was not deemed necessary in the end, as in the Evaluator's view the open-style interviews and documents reviewed provided sufficient and valid information.

This review has been conducted in accordance with the principles outlined in the United Nations Evaluation Group 'Ethical Guidelines for Evaluation' (see Annex G).

2.3 Structure of the mid-term review report

The review has been undertaken in accordance with the new UNDP guidelines on mid-term reviews (UNDP, 2014)[9] as well as general criteria of UNDP evaluations. This report is structured according to the table of contents that is given in Annex B of the MTR guidelines (UNDP, 2014), starting with an Introduction chapter, followed by Project description, Findings and ending with a chapter on Conclusions and recommendations, plus annexes. For the reader's easy reference, Box 1 shows where the main review criteria and questions of the MTR can be located in the various sections of the report.

[9] *Project-Level Monitoring: Guidance for Conducting Mid-term Reviews of UNDP-supported, GEF-financed projects* (UNDP, 2014), Also taking into account elements of the *Guidance for Conducting Terminal Evaluations of UNDP-supported, GEF-financed projects* (UNDP, 2012)

3. PROJECT DESCRIPTION AND CONTEXT

3.1 Development context; problems that the project seeks to address

The industrial sector is the second-largest energy using sector in India after the residential sector, accounting for about 37% of the total consumption. Key energy using industries (such as pharmaceuticals, chemicals. metal treatment, textiles, and food and dairy processing) have a significant requirement for low-medium temperature heat (of 90-250°C) as steam, hot water, hot air and hot oil in industrial production processes. For example, industries used 11,000 tons of oil products, 153,000 tons of coal and about 383,500 GWh of electricity[10] in 2012 at an estimated USD 12 billion in cost.

Significant quantities of low-medium temperature process heat are also required in the commercial sector in hotels, hospitals and other institutional buildings for space cooling, cooking and water heating. This low-medium temperature heat is primarily provided by fuel oil, coal and electricity for heating as well as cooling purposes. Low-cost natural gas is not widely available for process heat uses in India, as in most other major countries.

India, generally has a very good solar energy potential of around 5-7 kWh/m^2/day. A significant part of India's low-medium temperature process heat needs can be met by concentrating solar heat (CSH) technology systems, alongside appropriate process integration and suitable heat storage. Unlike flat-plate solar thermal systems (e.g., used in solar water heaters), solar concentrator systems use lenses or mirrors to focus a large area of sunlight onto a small area and thus it is possible to achieve higher temperatures than are possible with non-concentrator technologies. There are various CSH technologies that differ considerably in their output (temperature, specific thermal power), cost, module size and the installation area required. A short overview of the characteristics and variety in CSH systems is given in Annex D. By employing CSH technology, India will be avoiding the use of fossil fuels, and this would reduce global CO_2 emissions, local air pollution, and lessen India's growing dependence on expensive imports of oil and oil products.

Concentrating solar technology is not widely used, neither globally nor in India. By the time of project formulation, there were around 100 working industrial-sized CSH (concentrating solar heat) installations worldwide, of which about 70 in India (2010).) This places India as one of the leading countries in the practical CSH market and it still maintains that position. In 2011/12, there were about 200 industrial CSH worldwide, of which about 85 in India (see Annex D). The *Strategic Plan 2011-17 for the New and Renewable Energy Sector* aspires to have 1000 systems installed by 2022. The 12th Five-Year Plan (2012-2017) envisages the installation of 180,000 m^2 (for cooking, cooling and process heat)[11]. The 11th Plan (2007-2012) aimed at 250,000 m^2, but only succeeded in installing 15,000 m^2. These figures indicate that the CSH is in a nascent stage only and a range of barriers exist that prevent the technology from becoming more widespread (see Box 2).

3.2 Description of the project: objective, outcomes and outputs

The project *"Market Development and Promotion of Solar Concentrator-based Process Heat Applications in India"*, referred to shortly as "CSH India" or the "Project" in this text, aims to complement the efforts of the Government of India to promote the use of solar concentrators for process heat applications by overcoming

[10] Presentation at 4th PSAC Meeting; UNIDO/GEF PIF "Promoting business models for increasing penetration and scaling up of solar energy; IEA data on fuel consumption (2012; www.iea.org

[11] See Annexure 14,4 in Volume 2. It should be noted that the Plan was released after the project was designed. The Project Document assumes a business-as-usual scenario of 3,000 m^2 per year and aims to increase it to 15,000 m^2 in the alternative scenario.

existing barriers in technology, awareness, capacity, market and financial. The project concept was presented through the United Nations Development Programme (UNDP) to access Global Environment Facility (GEF) grant support.

The project's Component 1 provides technology application packages, support for the introduction of other types of CSH technologies, and standardization of CSH performance measurement; Component 2 provides awareness and capacity building; Component 3 aims at supporting 30 demonstration projects (15,000 m^2) and 60 replication projects (30,000 m^2); while Component 4 addresses financial barriers. The expected direct emission reductions from the demonstration and replication CSH projects during the 5-year GEF project duration will be 32,900 tCO_2. Over the economic lifetime of 20 years for the project-supported CSH applications, cumulative direct emission reductions will be 315,000 tCO_2.

Box 2 summarizes how the project's main outputs/activities address the barriers and gap identified in the project formulation stage. The list of progress indicators for each outcome and output is presented in Box 4.

Box 2 Summary of outcomes and outputs addressing main barriers to CSH application

Outcome	Output	Barrier addressed
Component 1: Technical capacity development		
1.1 Enhanced understanding of CSH technologies, applications and markets	1.1.1 Developed technology application information packages and characterised technologies, applications, and markets;	• Non-availability of performance measurement standards and protocols for measuring the performance of CSH (concentrated solar heat) applications (and making it difficult to compare CSH across different technologies and applications) • Non-availability of testing facilities for CSH technologies in India (independently verified performance characteristics are not available)
1.2 Adoption of standards and specifications for guidance of manufacturers and users for assurance of CSH quality, safety, and performance	1.2.1 Developed CSH performance standards and technology specifications	
Component 2: Awareness enhancement and capacity building		
2.1 Strengthened technical capacity and awareness of stakeholders of CSH systems for industrial/ institutional process heat applications	2.1.1 Trained manufacturers/ vendors, installers and CSH users 2.1.2 More trained technical consultants that provide technical services to both CSH system components & equipment manufacturers and users 2.1.3 Established and supported industry- academic partnership through research programmes to build future capacities 2.1.4 Trained staff at SEC and staff at regional testing centre 2.1.5 Completed awareness enhancement programmes for policy makers, academicians, industries, financial institutions, etc. to facilitate replications 2.1.6 Completed promotional campaign for CSH 2.1.7 Established Concentrating Solar Heat Technology Platform and is operational	• Lack of awareness amongst industry (including top level management levels) and policy makers on the potential of CSH applications to reduce process heat supply costs; • Limited capacity of the CSH technology supply chain (limited number of installers) to install on time and provide adequate maintenance; • Lack of knowledge of CSH technologies and system factors amongst technical consultants to applicable industries and sectors; • Limited availability of skilled and semi-skilled technical manpower in the CSH industry (each industrial subsector has its own set of process issues and its own technical experts and energy auditors and these general lack knowledge on how to apply CSH in their subsectors);

2.2	CSH Project deliverables facilitated and/or influenced the widespread replication of CSH technology applications in India	2.2.1 Documentations on the Project outputs, case studies, best practices and lessons learnt disseminated to ensure larger replication	• Limited interface between the CSH industry, experts and applicable academic institutes (apart from the Mumbai-Pune area there is no such interaction, which would benefit R&D and training of human resources)
Component 3: Pilot demonstration of CSH technologies for various applications			
3.1	Increased number of commercial and near- commercial CSH technologies for diversity of applications	3.1.1 Completed feasibility studies for demonstration and replication projects of various CSH technology applications 3.1.2 Completed Detailed Project Reports (DPRs) for demonstration projects 3.1.3 Developed and commissioned demonstration projects in at least 5 sectors 3.1.4 Results of the performance monitoring, analysis, and evaluation of demonstration projects	• A full set of CST (concentrated solar technologies) for process heat applications is yet to be demonstrated. Only two of the 5 technologies, ARUN and Scheffler (see Annex D) have been deployed; most CSH applications have been for institutional cooking (using Scheffler) • No public domain documentation available for existing CSH applications (a comparative assessment of CSH projects in India on performance, issues and lessons learnt would be of great value);
3.2	Improved technical and economic performance of commercial and near- commercial CSH technologies in an increased diversity of applications	3.2.1 Documentation of results of demonstration and replication projects 3.2.2 Completed performance monitoring, analysis and overall evaluation for demo and replication projects	
Component 4: Sustainable financial approach in the adoption of CSH technologies and applications in India			
4.1	Enhanced understanding of the financial viability of CSH technologies and measures to mitigate investment risks	4.1.1 Documented financial viability of CSH technologies, applications, and mitigation approaches of investment risks	• Low payback on CSH investments (over 4-10 years, while entrepreneurs generally want 2-4 years) • Lack of incentives based on CSH performance (subsidies for CSH are based on the area of installed CSH collectors and not on the actual quantity of process heat produce and this system favours low-cost and low-efficiency CSH technologies)
4.2	Promulgation of favourable financial policies that promote increased use and promotion of CSH for low and medium temperature process heat applications	4.2.1 Formulated recommendations for financial and promotional policies and strategies for adoption by Government of India	

The total budget for the project is USD 23,750,000, of which GEF: USD 4,400,000. The co-financing of USD 19.35 million MNRE (grants, mainly CSH subsidies) is USD 6,000,000; MNRE (in kind): 1,350,000; industries: USD 6,000,000 and financial institutions: USD 6,000,000.

The project concept (PIF, Project Identification Form) was approved by the GEF CEO in January 2010 and the project preparation grant (PPG) in May 2010. Endorsed by GEF in December 2011, the Project Document was signed in March 2012, after which implementation started for a period until December 2016.

3.3 Main stakeholders

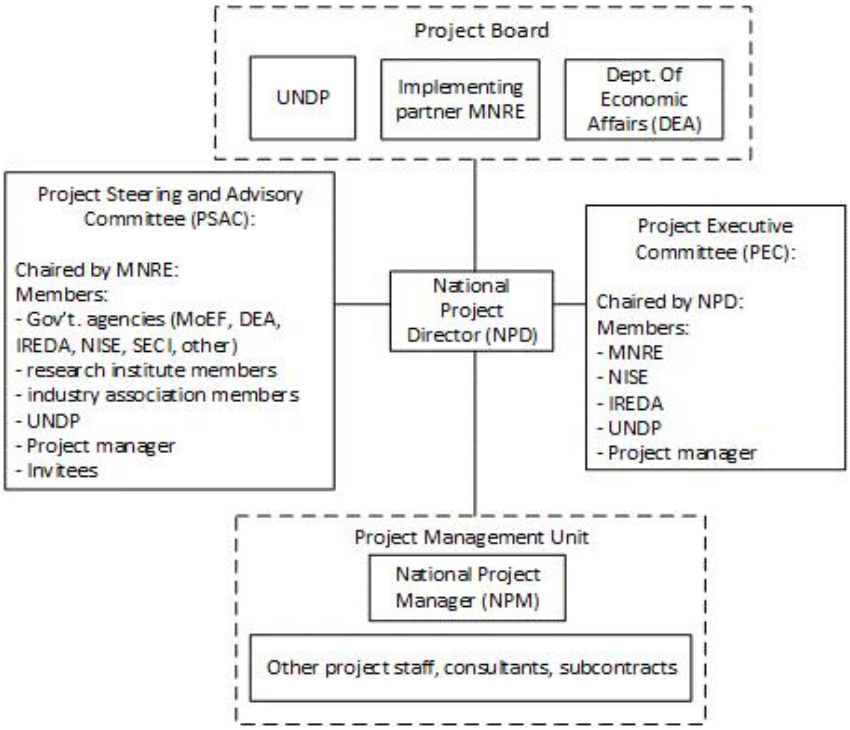
The *Ministry of New and Renewable Energy (MNRE)* is responsible for framing policy and implementing programmes for development and promotion of new and renewable energy sources in India. MNRE serves as the main client (Implementing Partner/Executing Partner) in this project. Apart from MNR, key stakeholders in the project are:

- *National Institute of Solar Energy* (formerly Solar Energy Centre, SEC) is a dedicated unit of MNRE with a focus on the development of solar energy technologies and to promote solar applications through product development;
- *IREDA* (India Renewable Energy Development Agency Ltd) is a state-owned enterprise under MNRE that provides financing for and promotes investment in renewable energy, energy efficiency and new and emerging technologies;
- *SECI (Solar Energy Corporation of India)* is another government enterprise under MNRE (established in 2011) with the overall view to facilitate implementation of the National Solar Mission (see Section 4.1 or Annex D) and achieving the targets set therein;
- *Ministry of Environment and Forests (MoEF)* is the GEF focal point for India and thus will liaise with GEF and provide overall coordination of the project;
- *Bureau of Indian Standards (BIS),* is the lead Indian agency concerning standardization, certification and quality control, as well as providing informational and training services in these areas; BIS is involved in the process of formulation of standards concerning solar concentrator technologies;
- *Department of Science and Technology (DST),* one of the three departments of the Ministry of Science and Technology is supporting the Solar Energy Research Initiative (SERI) in India. SERI supports research, development and demonstration of solar technologies and CSH technologies and applications are identified areas of DST work*;*
- *Central Boilers Board (CBB),* under the Department of Industrial Policy and Promotion, is responsible for regulations for boiler materials, design, construction and registration and inspection (CSH for steam generation in boilers falls under the purview of CBB);
- *Department of Economic Affairs (DEA)* of the Ministry of Finance, is in charge of relations with multilateral institutions and as such usually represented in the project boards of UNDP-supported projects;
- The *Confederation of Indian Industry (CII)* is a non-government, not-for-profit, industry led and industry managed premier business association. Solar thermal stakeholders are organised in the *Solar Thermal Federation of India*. Within this group, *solar concentrator manufacturers* responsible for the supply of CSH systems are important stakeholders. At the project's start there were about 10 solar concentrator manufacturers involved in producing CSH systems in India with several others planning to enter the CSH market; currently there are about 20 (as listed by MNRE; see Annex D);
- A number of technology institutes and academia have been involved in research, training and development work of CST, such as the University of Pune, Indian Institute of Technology (Mumbai, Chennai)

3.4 Project management arrangements

The project is implemented by MNRE, who assumes the overall responsibility for the achievement of project results as the Implementing Partner (GEF Local Executing Agency). UNDP acts as the GEF Executing Agency, providing overall management and guidance, and is responsible for monitoring and evaluation of the project as per GEF and UNDP requirements.

Box 3 Project management structure



The *Project Steering Committee (PSC*) is responsible for making management decisions. The PSC plays a critical role in project monitoring and evaluation by quality assuring these processes and products, and using evaluations for performance improvement, accountability and learning. The PSC approves the Annual Work Plans (AWPs). Based on the AWP, the PSC considers and approves the quarterly plans and also approves any essential deviations from the original plans. In the PSC meetings representatives from MNRE, MoEE, UNDP and DEA participate as well as invitees, as and when needed, from other institutions. The Project Document mentions the *Project Advisory Committee (PAC)*, composed of MNRE, Ministry of Environment and Forests (MoEF), BIS, BEE, industry associations' representatives, to which representatives from academia, industry associations and financial institutions can be invited on an as-needed basis.

MNRE has designated a senior official as the *National Project Director (NPD)* for the project[12]. The NPD is responsible for overall guidance to project management, including adherence to the achievement of planned results as outlined in the Project Document (ProDoc) and Inception Report, and for the use of UNDP funds. The NPD also ensures coordination with various ministries and agencies.

A *Project Management unit (PMU)* has been established to implement the project. The PMU is headed by a full-time *National Project Manager (NPM)*[13] and is responsible for implementing day-to-day activities in coordination with the National Project Director (NPD). The NPM is supported by Technical Officers and support staff. As needed, technical experts from different disciplines and project management consultants with expertise in project, finance, legal matters, etc. are recruited on a longer-term or short-term time basis depending upon the work load.

12 Sh. Tarun Kappor, Joint Secretary of MNRE

13 Mr.. A.K. Singhal has been NPM since project initiation.

At project inception, the project management structure was changed slightly. A *Project Executive Committee (PEC)* was formed that meets once in 2 months for day-to-day execution of the Project. The PEC is chaired by the National Project Director with representatives from MNRE, NISE, IREDA, PMU and UNDP. Following the signature of the Project Document, the PEC met first time in April 2012 and thereafter has met 12 times. The meetings of Steering and Advisory Committee were joined into the *Project Steering and Advisory Committee (PSAC)* chaired by the Secretary of MNRE. Participants have been senior staff members from MoEF, DEA, UNDP, IREDA, NISE, SECI, Ministry of Textile, Ministry of Food Processing Industries, Ministry of Micro, Small & Medium Industries, Bureau of Energy Efficiency, CII, Central Boiler Board, IIT Bombay as well as members from research institutions and industry associations. The PSAC meets usually once in 6 months for guidance and directions to the PMU. Three meetings have been held with the fourth meeting planned for January 2015.

4. FINDINGS: PROJECT DESIGN AND FORMULATION

This part of the report presents an overview of the evaluation findings. Due to the size of the text it has been divided over three chapters that cover a) project design & formulation, b) project implementation and c) project results and sustainability. The findings are based around the evaluation criteria and questions (see Box 1), so that the reader can make a link with what was asked and what was found.

This Chapter 4 evaluates the design of the Project, which was the result of consultations and background analysis during 2009-2011, and relevance in India's development context.

Mid-term review questions (see Box 1)

- Does the project adequately take into account the national realities, both in terms of institutional and policy framework in its design and implementation?
- Is the project country-driven?
- If the project progress is not good, what changes could have been made (if any) to the project design in order to improve the achievement of the project's expected results during rest of the project implementation period

4.1 Relevance and country ownership

Country drivenness

As explained in the previous Chapter 3 solar thermal energy has been a priority for the Ministry of New and Renewable Energy (MNRE) as expressed in various policy documents and plans (the reader is referred to Annex D for more details), such as the Eleventh Plan (2007-2012), Twelfth Plan (2014-2017), National Action Plan on Climate Change (NAPCC) and the Strategic Plan 2011-17 for the New and Renewable Energy Sector.

In this respect, the solar water heating industry (with flatbed solar collectors) in India is fairly well-developed and is already on an accelerated growth path. Solar concentrating technologies (CST) are mainly used for power generation in a few countries, such as USA or Spain; usage for heat applications is often limited to a few small-scale applications, for example Scheffler-type dishes for cooking.

In India, a range of Indian organizations – from MNRE, academia, institutions to commercial entrepreneurs have done a considerable amount of the necessary groundwork in terms of technology development and market promotion for solar concentrators for process heat applications (CSH) for cooking, cooling and industrial processes. This work has led to the commercial emergence of two concentrated solar technologies (CST) technologies in India, i.e. the fixed-focus parabolic dish (e.g. Scheffler dish) and the moving-focus parabolic dish (e.g. ARUN dish). Supporting this new market of CSH has been the target of the project and, given the lack of real experience worldwide with CSH, the Project is thus supporting India in realizing a leap-frogging innovation. Within the above-mentioned Plans specific targets are given for solar thermal energy, including CSH. For example, by 2011 installed capacity for solar thermal was an estimated 4.4 million m^2 (flatbed and concentrating technologies) with the aim to be expanded to 11 million m^2 by 2017 (Strategic Plan NRE) and 20 million m^2 by 2022 (Solar Mission of NAPCC[14]). Since over 15 years MNRE has been promoting solar thermal in general, but the results of CST have been negligible as compared to the flatbed solar thermal technology.

[14] The Jawaharlal Nehru National Solar Mission (JNNSM) was launched in January 2010 and has set ambitious targets in solar energy by 2022, including 20 GW of grid-connected solar power, 2000 MW of off-grid solar applications, 20 million solar lights in rural homes as well as 20 million m^2 of solar thermal collector area, including solar concentrating technologies,

UNDP programming and comparative advantage

The CSH India project fits with the UN Development Assistance Framework (UNDAF), 2008-2012 (Outcome 4: "By 2012, the most vulnerable, including women and girls, and government at all levels have enhanced abilities to prepare, respond and adapt/recover from sudden and slow onset of disasters and environmental changes". Under this UNDAF Outcome 4; the UNDP Country Programme (2008-12) refers to Output 4.3 "Strengthened capacity for low carbon development and sustainable management of natural resources", for which the Indicator 4.3a "Number of clean technologies/mechanisms piloted" has direct relevance to the Project.

The project also fits within priorities of the UNDAF and UNDP Country Programme 2013-2017 (that were formulated after CSH India's inception). UNDAF Outcome 3 refers to "Government, industry and other relevant stakeholders actively promote environmental sustainability and enhanced resilience of communities in the face of challenges of climate change, disaster risk and natural resource depletion" with as Indicator "Proportion of policies, plans and programmes that incorporate climate change, disaster risk reduction (DRR) and natural resource management (NRM) concerns". The Country Programme further mentions as areas in which UNDP can contribute "To adopt models for sustainable NRM, climate change adaptation, DRR and livelihood promotion through better access to clean energy" and "Innovative sector specific business models for scaling up cleaner technologies".

UNDP has quite some experience in implementing GEF-funded sustainable energy projects in India. Recent examples are: Effective Implementation of the State Level Climate Change Action Plans; Scale-up of Access to Clean Energy for Rural Productive and Domestic Uses; Low Carbon Campaign for Commonwealth Games 2010 Delhi; Energy Efficiency Improvements in Commercial Buildings; Improving Energy Efficiency in the Indian Railway System; Advanced Energy Efficiency Technology in Electric Motors; Energy Conservation in Small Sector Tea Processing Units; Energy Efficiency Improvement in the Steel Rerolling Mill Sector; Removal of Barriers to Biomass Power; Development of High Rate Bio-methanation Processes; Coal-bed Methane Capture and Commercial Utilization; and others.

4.2 Results framework and design

4.2.1 Results framework with risks and assumptions and list of indicators

The Project Document (ProDoc) we consider well-written, concise and encompassing the details needed. The ProDoc details the management arrangements (described in the preceding Chapter 3).

It addresses the barriers and addresses the capacity strengthening needs into an appropriate list of expected outcomes and outputs and activities needed to realize the results, referred as the Project Results Framework (or project logical framework, referred to as "logframe"). The ProDoc describes the numerous risks that would be encountered by a Project of this nature and scale and critical assumptions on their occurrence and strength in section 8 of Part B of the ProDoc on a general level and, per outcome, in the logframe. These risks are monitored in UNDP's ATLAS system and critical risks discussed in the progress reports. A description of risks, measurements taken and (probable) impact on sustainability is given in Section 6.3.

The logframe gives quite an extensive list of progress indicators for outcomes as well as outputs. The list meets the standard of SMART[15] indicators. However, we noted that various indicators at outcome level are repeated several times and the sheer multitude of indicators makes reading difficult in the progress reporting, such as the PIRs. Some outcome indicators are more output indicators and are sometimes copied in the output list as well and some output indicator could have been combined. This concern was also expressed by participants in

[15] Specific, Measurable, Achievable, Relevant and Time-Bound (SMART)

the Project's Inception workshop[16]. We can add that 'numbering' the indicators in the long list would also have been beneficial for the reader. Box 3 provides an overview of the progress indicators. These are based on the project documentation and subsequent progress reports (PIRs), but to which we took the liberty to put in small alterations:

- We numbered the Indicators in the following manner: A), B), for objective and outcome indicators and 1), 2), for output-related indicators; and sometimes grouped together, giving them numbering a, b, such as in 9a) and 9b)
- Repetitive indicators are deleted. To give an example, the indicator "no. of CSH replication projects" figures in Component 2 and 3, in Outcomes and then again at output level; we have kept it in one place *only* under Component 3.
- Although the order of presentation may have changed, *all* indicators of the latest PIR (2014) do appear in Box 4, so we can say that we have not omitted any results reported in the subsequent sections.

Box 4 Overview of project outcomes and outputs with progress indicators

Objective; outcomes and outputs	Indicators
Project objective and goal • Reduced GHG emissions from use of CSH systems for low and medium temperature process heat; • Increased use and promotion of CSH systems for low and medium temperature process heat applications	A. Cumulative CO2 emission reduced from start of project to End-Of-Project (EOP), (tCO2e) B. Cumulative installed area of CSH systems for process heat applications (m2) by EOP C. No. of companies that have installed CSH systems by EOP D. No. of CSH technologies available in India by EOP
Component 1 Technical capacity development	
1.1 Enhanced understanding of CSH technologies, applications and markets	E. No. of technology package suppliers that are available to market CSH technologies in India by EOP
1.1.1 Developed technology application information packages and characterised technologies, applications, and markets	1. Number of performance assessment reports of existing installations by yr 2 2. Number of technology assessment reports of CSH technologies by EOP 3. Number of market assessment reports for CSH process heat applications by EOP 4. Number of CSH technology application information packages developed by EOP
1.2 Adoption of standards and specifications for guidance of manufacturers and users for assurance of CSH quality, safety, and performance	F. Indian CSH system components & equipment manufacturers a. Number (No.); and that comply with: b. BIS standards and specifications by EOP G. No. of Indian CSH system component & equipment manufacturers that entered into the internal CSH business (export of CSH components & equipment) by EOP
1.2.1 Developed CSH performance standards and technology specifications	5. Documents of: a. performance measurement standard developed by yr 2 b. field performance monitoring guidelines developed by yr 2 6. No. of minimum performance norms developed by year 2 7. No. of technology specifications developed by EOP 8. No. of performance standards and specifications t a. Taken up for consideration and adoption as draft national standards by BIS by year 4 b. Submitted to ISO as draft international standards by year 4
1.3 Adequately capable and operational testing laboratories for verification of	H. No. of accredited testing facilities for CSH components and equipment in India by year 3

[16] See "project design' on page 4 in the Inception report (May, 2012)

Objective; outcomes and outputs	Indicators
manufacturer claims and guidance of CSH users to enable informed decisions	I. No. of Indian CSH system component & equipment manufacturers that approached testing laboratories for certification by EOP J. No. of international CSH manufacturers that approached Indian testing laboratories for certification to enable their systems sale in Indian market by EOP
1.3.1 Developed CSH system components and equipment testing facilities	9. Number of reports on proof-of-concept testing carried out at SEC for at least three technologies by yr 4 10. Established national test facility by yr2 11. Established regional test facility by yr3
Component 2: Awareness enhancement and capacity building	
2.1 Strengthened technical capacity and awareness of stakeholders of CSH systems for industrial/ institutional process heat applications	K. No. of trained participants of (test facilities) that are actively involved in the development of the CSH technology development by EOP L. No. of papers presented in conference that were used by policy makers in decision making on technology applications, in general, and CSH technology applications, in particular, by year 4
2.1.1 Trained manufacturers/ vendors, installers and CSH users	12. Training needs assessment completed by yr 2 13. Training implemented: a. No. of training modules (including all the training material) on CSH technologies developed by yr 2 b. No. of training courses on CSH technologies organized and conducted under the project by EOP c. Number of personnel trained in the training courses by EOP 14. No. of personnel that received training on specific aspects of CSH technologies from study tour conducted under the project by yr 2
2.1.2 More trained technical consultants that provide technical services to both CSH system components & equipment manufacturers and users	15. Training implemented: a. No. of training courses on CSH technologies organized and conducted under the project by EOP b. Number of trained technical consultants by EOP
2.1.3 Established and supported industry-academic partnership through research programmes to build future capacities	16. Number of Ph.D./M.Tech fellowships/research associates a. Supported by yr3 b. Completed by yr3 17. Number of institutions with fellowships supported
2.1.4 Trained staff at SEC and staff at regional testing centre	18. Number of personnel trained in international training programmes organized and conducted by yr 2 19. National training: a. No. of programmes organised b. No. of personnel trained
2.1.5 Completed enhancement programmes for policy makers, academicians, industries, financial institutions, etc. to facilitate replications	20. Conferences: a. Number organised b. Number of participants by yr4 c. Number organised (international) d. Number of international participants by yr4 21. No. of CSH system exhibitors in expos organized and held by yr 4 22. Awareness programmes: a. No. of awareness programmes b. No. of participants
2.1.6 Number of awareness programmes organized and conducted by EOP	23. Number of advertisements about CSH placed on print media under the project by year 3 24. Number of industrial clusters in which hoardings are displayed by year 3
2.1.7 CSH technology platform and is operational	25. An officially established platform by yr1 26. Number of meetings conducted by the Platform by EOP

Objective; outcomes and outputs	Indicators
	27. No. of users that make use of the platform in that make use of the platform in addressing issues/problems a. CSH system users b. Manufacturers/suppliers/distributors
2.2 CSH Project deliverables facilitated and/or influenced the widespread replication of CSH technology applications in India	M. Cumulative no. of newsletters and magazines a. Newsletters b. Magazines N. Website operational a. Established by yr1 b. No. of users starting yr1 O. No. of printed and disseminated compendium by EOP
2.2.1 Documentations on the Project outputs, case studies, best practices and lessons learnt disseminated to ensure larger replication	28. Audio-visual capsules uploaded and accessible form project website by yr3 a. Number b. No. of users by EOP 29. No. of brochures on CSH technology applications produced and disseminated by EOP
Component 3: Pilot demonstration of CSH technologies for various applications	
3.1 Increased number of commercial and near- commercial CSH technologies for diversity of applications	P. Number of projects planned and implemented a. Demonstration projects b. Replication projects c. Number of technology packages used Q. No. of implemented demo and replication projects whose performance data is as per feasibility study by EOP R. No. of implemented demo projects, whose a. Operational and energy performances are at least the same or better than as per design by EOP; b. whose financial and economic performances are at least the same or better than as per design by EOP
3.1.1 Completed feasibility studies for demonstration and replication projects of various CSH technology applications	30. Number of completed feasibility studies that were supported by the project by year 4
3.1.2 Completed Detailed Project Reports (DPRs) for demonstration projects	31. Number of completed DPRs for demonstrations (for projects > 750 m^2) that were funded and implemented under the project by year 4
3.1.3 Developed and commissioned demonstration projects in at least 5 sectors	32. Number of CSH technology application demonstration projects supported by EOP
3.1.4 Results of the performance monitoring, analysis, and evaluation of demonstration projects	33. Cumulative number of performance monitoring reports by EOP
3.2 Improved technical and economic performance of commercial and near-commercial CSH technologies in an increased diversity of applications	34. No. of replication and other CSH technology application projects supported by the Project
3.2.1 Documentation of results of demonstration and replication projects	34. No. of CSH technology projects included in the project database by EOP 35. Number of demonstration project profiles prepared by EOP
3.2.2 Completed performance monitoring, analysis and overall evaluation for demo and replication projects	36. No. of performance monitoring reports of demo and replication projects completed by EOP; 37. Overall evaluations of demonstration and replication projects completed by EOP
Component 4: Sustainable financial approach in the adoption of CSH technologies and applications in India	

Objective; outcomes and outputs	Indicators
4.1 Enhanced understanding of the financial viability of CSH technologies and measures to mitigate investment	S. No. of potential and feasible financial options for the application of CSH technologies T. No. of banks/financial institutions that agreed to finance CSH projects by EOP U. Number of projects developed in ESCO mode
4.1.1 Documented financial viability of CSH technologies, applications, and mitigation approaches of investment risks	38. No. of completed financial viability analyses of CSH technologies and applications by year 3 39. Analysis of alternative financial options by year 3
4.2 **Promulgation of favourable financial policies that promote increased use and promotion of CSH for low and medium temperature process heat applications**	V. No. of implemented CSH projects that benefitted from the enforced policy and regulatory regimes on CSH technology applications by EOP
4.2.1 Formulated recommendations for financial and promotional policies and strategies for adoption by Government of India	40. No. of policy studies completed for inputs in the formulation of policies supportive of CSH system and application projects by yr3

4.2.2 Stakeholder involvement and links with other past or ongoing initiatives; replication

MNRE has been supporting concentrating solar technology (CST) application in a small programme prior to the Project, which is meant to accelerate the efforts in India to apply CST in heat applications. The UNDP/GEF India CSH project has been fully integrated with the on-going MNRE programme on CSH and the Jawaharlal Nehru National Solar Mission (JNNSM) of Government of India.

As part of the project formulation and analysis energy audits in 11 sample units (in various industries) were carried out to have a better understanding on process heat requirements and the possible role of the various CST options. In addition, four case studies of CSH applications (about 70 at the time of writing the project document) were analysed. Thus, experiences and lessons from the implementation of CSH in India were taken into account. A range of stakeholders (from government ministries and agencies, research institutes and universities as well as CSH manufacturers and potential beneficiary industries) were consulted.

The replication approach is based on showcasing the various demonstration and replicated projects (about 90) of the Project as well as by promoting those CST that have not been commonly applied yet in India. With only a few CSH applications in the world, however, the Project is quite unique with hardly any lesson learned from abroad to be incorporated. In this sense, the project is of a pioneering nature. In fact, success in India for CSH could boost similar initiatives in other countries in the world.

4.2.3 Ratings

One review question is “If the project progress is not good, what changes could have been made (if any) to the project design in order to improve the achievement of the project’s expected results during rest of the project implementation period”. As will be discussed in Chapter 3, the project progress has been ‘good’, in fact with visible, results in its four components that range from marginally satisfactory to highly satisfactory. We conclude therefore that the design in terms of achievable results has been of sufficient quality The UNDP Midterm Review Guide (2014) does not mention that a rating needs to be given on project design, but if asked to do so we would provide a rating as satisfactory and we consider the project as highly relevant in the context of India’s sustainable energy practices and planning.

5. FINDINGS: PROGRESS TOWARDS RESULTS

The results of the project include outcomes and outputs. Changes between the planned and actual results are described and explained as well as factors that may have affected the achievement of the intended results.

Mid-term review questions (see Box 1)

- Review the logframe indicators against progress made towards the end-of-project targets using the Progress Towards Results Matrix, with progress indicators for outcomes/outputs, indicating baseline and target levels, as well as current level and/or reported in PIR linked with ratings for each outcome
- Results in terms of contribution to sustainable development benefits, as well as global environmental benefits (direct and indirect emission reduction); Compare and analyse the GEF Tracking Tool at the Baseline with the one completed right before the Midterm Review
- Description of status and issues with employing Concentrating Solar Heat (CSH) systems for low-medium temperature applications in selected sectors

5.1 Attainment of outcomes and outputs

The Boxes 5, 7, 9 and 13 provide an overview of results (outcomes and outputs) against a set of outcome and output indicators as listed in Box 4. The column with 'results reported' is based on the latest 2014 PIR, supplemented by other progress reporting and info from discussions with the project team and stakeholders during the MTR mission. An overview of ratings of progress towards results for each component is given in Box 17 in Section 8.1[17]. It should be noted that the 'mid-term value' is based on values given in the 2014 PIR (June), although updated for the period July-Dec 2014 where applicable with the latest data provided by the PMU.

Box 5 Progress towards results, Component 1

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
Component 1 Technical capacity development				
1.1 Enhanced understanding of CSH technologies, applications and markets	E. No. of technology package suppliers that are available to market CSH technologies in India by EOP	10	20	22
1.1.1 Developed technology application information packages and characterised technologies, applications, and markets	1. Number of performance assessment reports of existing installations by yr 2	10	19	22
	2. Number of technology assessment reports of CSH technologies by EOP	0	2	2
	3. Number of market assessment reports for CSH process heat applications by EOP	0	-	2
	4. Number of CSH technology application information packages developed by EOP	0	5	10

[17] The tables in Boxes 5, 7, 9 and 13 are modified versions of the Table proposed in the ToR (see Annex A, page 58, i.e. made simpler to keep the tables readable in the view of the large list of indicators. The table has also been split up in four tables (one per outcome) for this reason. On 'targets achieved', we rather present per outcome than individual targets. On average, indicators in Components 1 and 2 have been achieved (or over-achieved), in Component 2 on target to be achieved and Component 4 not on target yet. This is reflected in our rating as HS for Components 1, 2 and 3 and MS for Component 4 (see Chapter 8).

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
1.2 Adoption of standards and specifications for guidance of manufacturers and users for assurance of CSH quality, safety, and performance	F. Indian CSH system components & equipment manufacturers a. Number (No.); and that comply with: b. BIS standards and specifications by EOP G. No. of Indian CSH system component & equipment manufacturers that entered into the internal CSH business (export of CSH components & equipment) by EOP	 10 0 0	 19 - 2	 22 22 7
1.2.1 Developed CSH performance standards and technology specifications	5. Documents of: a. performance measurement standard developed by yr 2 b. field performance monitoring guidelines developed by yr 2 6. No. of minimum performance norms developed by year 2 7. No. of technology specifications developed by EOP 8. No. of performance standards and specifications: a. Taken up for consideration and adoption as draft national standards by BIS by year 4 b. Submitted to ISO as draft international standards by year 4	 0 0 0 0 0 0	 1 1 1 0 0 0	 1 1 1 5 1 1
1.3 Adequately capable and operational testing laboratories for verification of manufacturer claims and guidance of CSH users to enable informed decisions	H. No. of accredited testing facilities for CSH components and equipment in India by year 3 I. No. of Indian CSH system component & equipment manufacturers that approached testing laboratories for certification by EOP J. No. of international CSH manufacturers that approached Indian testing laboratories for certification to enable their systems sale in Indian market by EOP	0 0 0	2 5 -	2 20 5
1.3.1 Developed CSH system components and equipment testing facilities	9. Number of reports on proof-of-concept testing carried out at SEC for at least three technologies by yr 4 10. Established national test facility by yr2 11. Established regional test facility by yr3	0 0 0	- 1 1	3 1 1

Outcomes 1.1 and 1.2

As by November 2014, there were 20 active concentrating solar technology (CST) manufacturers, up from about 10 in 2011. These follow technical specifications as laid down by MNRE, but BIS standards are yet to be defined for CSH components (Indicators E and F). It should be mentioned that two manufacturers from India are also doing business abroad (Indicator G). A list of manufacturers is given in Annex E.

To know the status and issues in existing CST installations, a field evaluation study of existing installations on CSTs based systems for community cooking, process heat and cooling applications" was carried out by Apitco Ltd. of 96 installations in various sectors all over India. A *Compendium* (Dec 2013) describes each installation with the necessary details[18]. Nearly 80% of them were fully functional, the remaining either non-functional or partially functioning. For the non-functional systems, a decision was taken by the Project to provide partial support to make them functional (see Box 11).

[18] The profile provides information on plant location, type of technology, configuration, supplier, application, year of installation, system & application details, timing of operation, steam generation, operating temperature & pressure, quantity & type of fuel saved, status of equipment, functionality & key issues, operation & maintenance issues, beneficiary perception, financials in details with cost of system payback & IRR with and without MNRE subsidy, overall system performance, and beneficiary's contacts.

Regarding Indicators E, F, 1 and 2, the project commissioned EcoAxis Systems Pvt Ltd (based in Pune) for: :

- Technology assessment and performance evaluation of CST for cooking, process heat and cooling applications. The results are laid down in the following reports:
  - *Assessment of facilities of CST manufacturing* (May 2014)
  - *Assessment of Concentrating Solar Technologies for Off-Grid Applications* (Oct. 2014)
  - *Assessment of Technologies for Off-Grid Applications in the International Market* (Oct. 2014)
- Procurement and installation of equipment/instruments for on-line performance monitoring of selected Concentrating Solar Technology (CST) with the following reports:
  - *Status of instrumentation at 15 CST installations* (May 2014)
  - *Online performance monitoring at 15 sites of different CSTs* (Oct 2014).

The reports describe the characteristics, performance, potential application and advantages and disadvantages of six CSTs (see Annex D), a) Fixed focus elliptical dish (Scheffler), b) Parabolic through collector, c) Fresnel reflector-based dish (known as ARUN dish), d) Paraboloid dish, e) Linear Fresnel reflector concentrator; and g) Non-imaging concentrator.

About 20 sites were visited and in the end 15 were selected for assessment and online monitoring. Assessment parameters included completeness and correctness of the CST installation, component condition, instruments and control, operating practices and operator's/users' efforts. Equipment/instruments have been installed at all the sites and online performance monitoring has been carried out since December 2013 onwards. Data as regards to solar radiation, inlet & outlet temperature, pressure, fluid flow, etc. can be observed online at any time of the day for each system. Assessment studies of various sectors (Indicator 3) will be carried out in 2015.

Regarding the technology supply side, i.e. the manufacturers, 15 of them were visited and assessed, looking at management systems, quality control system, manufacturing facilities, product development capability, staff qualifications and resources allocated.

To make CS technologies more widely known, EcoAxis developed information packages for six different CSTs (see Annex D for a description of these technologies), which are available at www.cshindia.in/technology.html (Indicator 4):

Box 6 List of 15 sites for online monitoring of CST

	Beneficiary	Application	Technology
1 2 3 4 5 6	Bosch Ltd ,Bangalore JSS Suttur (Boys hostel), Bangalore Shantikunj, Haridwar MNIT (Hostel), Jaipur Bhashyam Public School, Guntur Ramrao Adik Public School, Shrirampur, Ahmednagar	Cooking	Fixed Focus Elliptical (Scheffler)
7	Mahindra Vehicle , Chakan	Cooling	
8 9 10	Gajraj Drycleaners ,Ahmednagar Purple Creation, Baramati B S Pulp & paper mill, Ludhiana	Process heat	
11	Ramkrishna Mission, Chennai	Cooking	Fresnel Reflector Paraboloid dish (ARUN)
12	Turbo Energy, Mahabalipuram (TN), Mysore	Cooling	
13	Mahanand Dairy,Latur	Process heat	
14	SKF Technology, Mysore	Process heat	Parabolic Trough Collector (PTC)
15	ITC Bangalore		Non-Imaging Collector (NIC)

A document titled '*Development of performance measuring standards, test procedures & test protocols for CSTs*' was developed by the consortium of GK Energy, Thermax, Akson Solar and Pune University in Oct 2013. It covers performance measurements for thermic fluid systems; high/pressure hot water systems and steam systems, and also provides a set of testing guidelines to be followed in the field for mobile test facilities (Indicator 5). Standards for testing and performance evaluations have been developed by Pune University and handed over to BIS for formalization.

Suggested minimum performance norms were developed and uploaded on the www.mnre.gov.in website[19] for the information and action by manufacturers and beneficiaries. The minimum specifications will be further revised by an Expert Group during the reporting period. Regarding technology (materials) specifications (Indicator 7), draft Terms of Reference have been developed to identify technology specifications for the six different CST technologies. These will be verified with the actual performance data collected from the two test centres (see Outcome 1.3). Thus minimum performance norms and specifications will be updated and in the future might be taken up for consideration and adoption as draft national standards by BIS (see Indicator 8).

Outcome 1.3

In two locations immobile test centres were established in the period June-August 2014:

- One is at MNRE's National Institute of Solar Energy – NISE (formerly called Solar Energy Centre) at Gurgaon. It will be used as a national centre for testing steam/pressurized hot water CST systems (see photo);
- The Centre for Energy Studies, University of Pune, is hosting a regional testing facility covering the western region for testing steam/pressurized water and thermic fluid systems. The justification for the choice of Pune has been that is becoming one of the major hubs for solar thermal

[19] mnre.gov.in/schemes/decentralized-systems/solar-systems/solar-cooking-steam-generating-systems/ The draft benchmarks were defined during the project and discussed in a working committee as part of the Project

systems including a sizeable number of CSH systems installed in that region and manufacturers in the Pune-Mumbai region.

In addition there is one mobile test facility available per centre (Indicators H, 10 and 11). The test centre have only recently been established, so it is too early to assess their functioning. To date, around five manufacturers have got their product tested from test centres (Indicator I).

An assignment on 'Collection & Compilation of performance data on CST based systems through remote monitoring'' has been recently awarded to a consulting firm APITCO (based in Hyderabad) and is expected to provide data for 80 systems by end of the project (Indicator 9).

Box 7 Progress towards results, Component 2

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
Component 2: Awareness enhancement and capacity building				
2.1 Strengthened technical capacity and awareness of stakeholders of CSH systems for industrial/ institutional process heat applications	K. No. of trained participants of (test facilities) that are actively involved in the development of the CSH technology development by EOP	0	5	10
	L. No. of papers presented in conference that were used by policy makers in decision making on technology applications, in general, and CSH technology applications, in particular, by year 4	0	15	20
2.1.1 Trained manufacturers/ vendors, installers and CSH users	12. Training needs assessment completed by yr 2	0	1	1
	13. Training implemented:			
	a. No. of training modules (including all the training material) on CSH technologies developed by yr 2	0	6	3
	b. No. of training courses on CSH technologies organized and conducted under the project by EOP	0	12	15
	c. Number of personnel trained in the training courses by EOP	0	300	300
	14. No. of personnel that received training on specific aspects of CSH technologies from study tour conducted under the project by yr 2	0	6	10
2.1.2 More trained technical consultants that provide technical services to both CSH system components & equipment manufacturers and users	15. Training implemented:			
	a. No. of training courses on CSH technologies organized and conducted under the project by EOP	0	-	9
	b. Number of trained technical consultants by EOP	0	-	100
2.1.3 Established and supported industry-academic partnership through research programmes to build future capacities	16. Number of Ph.D./M.Tech fellowships/research associates			
	a. Supported by yr3	0	9	10
	b. Completed by yr3	0	-	5
	17. Number of institutions with fellowships supported	0	1	5
2.1.4 Trained staff at SEC (now NISE) and staff at regional testing centre	18. Number of personnel trained in international training programmes organized and conducted by yr 2	0	-	5
	19. National training:			
	a. No. of programmes organised	0	-	1
	b. No. of personnel trained	0	-	1

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
2.1.5 Completed enhancement programmes for policy makers, academicians, industries, financial institutions, etc. to facilitate replications	20. Conferences:			
	a. Number organized (national)	0	2	2
	b. Number of participants by yr4	0	500	200
	c. Number organized (international)	0	-	-
	d. Number of international participants by yr4	0	0	20
	21. No. of CSH system exhibitors in expos organized and held by yr 4	0	0	20
	22. Awareness programmes			
	a. No. of awareness programmes	0	40	12
	b. No. of participants	0	900	1600
2.1.6 Number of awareness programmes organized and conducted by EOP	23. Number of advertisements about CSH placed on print media under the project by year 3	0	5	5
	24. Number of industrial clusters in which hoardings are displayed by year 3	0	0	10
2.1.7 CSH technology platform and is operational	25. An officially established platform by yr1	0	1	1
	26. Number of meetings conducted by the Platform by EOP	0	2	8
	27. No. of users that make use of the platform in that make use of the platform in addressing issues/problems			
	a. CSH system users	0	?	100
	b. Manufacturers/suppliers/distributors	0	10	15
2.2 CSH Project deliverables facilitated and/or influenced the widespread replication of CSH technology applications in India	M. Cumulative no. of newsletters and magazines			
	a. Newsletters	0	22	48
	b. Magazines	0	6	18
	N. Website operational			
	a. Established by yr1	0	1	1
	b. No. of users starting yr1	0	4400	2000
	O. No. of printed and disseminated compendium by EOP	0	800	1000
2.2.1 Documentations on the Project outputs, case studies, best practices and lessons learnt disseminated to ensure larger replication	28. Audio-visual capsules uploaded and accessible form project website by yr3			
	a. Number	0	13	14
	b. No. of users by EO	0	n.a.	2000
	29. No. of brochures on CSH technology applications produced and disseminated by EOP	0	18	90

Outcome 2.1

On capacity strengthening, a training requirement assessment was carried out by PMU and MNRE (Indicator 12). The consulting firm Anthropower Ltd was hired to:

- Develop training Manuals for Operation & Maintenance for 6 different CSH technologies in Hindi and English languages. The Manuals act as a source of reference for trainers and site engineers and will help to the dissemination of standard best practices for operation and maintenance. The six manuals together contain roughly 250 pages of original technical writing content and more than 50 original visuals and diagrams (the manuals can be downloaded from www.cashindia.in).
- Organize training programmes on Operation & Maintenance of CSH systems. Training materials have been organized and 12 trainings (of 3-day duration) were held in 12 states. A total of about 300 people participated in the training programmes conducted, most of them were students from ITIs (industrial training institutes). The trainings topics included: CST basics, CST technologies; CST operation; and maintenance& troubleshooting.

Two M.Tech fellows were awarded a fellowship to work on 'Performance assessment of data generated through online monitoring systems, data analysis & performance mapping of existing CSH technology' at the National Institute of Solar Energy (NISE) at Gurgaon. In addition, seven students have been working on their

M.Tech degree at NISE in a relevant area of CSH technology. It should be mentioned that no financial support is provided by the Project as they got fellowships from their respective institutions (Indicators 16 and 17).

Photos: Final Project Report (Anthropower, Nov 2014)
Left: 13-15 May, ITI, Indore (Madhya Pradesh). Centre: 19-21 June, MNIT, Jaipur (Rajasthan). Right: 4-6 Feb 2014, Muni Seva Ashram, Goraj (Gujarat)

Regarding Output 2.1.4, a national training programme on 'online performance monitoring of CSH systems is planned for 2015. The Brahakumaris Ashram, Mount Abu has been identified as training cum awareness centre for CSH. Their mandate includes organization of 9 programmes over the remaining project period (Indicator 15).

On indicator 13, the training has not been implemented yet. Apparently, there are some discussions discussion between manufacturers and consultants on training content, choice of technology, which have been reasons for delay. Also, we can observe that a series of trainings at one point in time may not be enough, as refresher courses may be needed. In the Section on "recommendations" we suggest, having reached midpoint in project implementation, to refresh the stocktaking of training needs (especially as more systems of different CSTs will get installed over 2015-16) and adapt, expand and extend training and short courses in accordance with the findings of this stocktaking, for engineers, consultants and ESCOs and updating the role of institutes such as NISE, Pune University and Mount Abu as well training consultants

On conferences, workshops, meetings and awareness programs, the following is reported:

- Two national conferences/workshops were conducted; first the project's Inception workshop (in May 2012) and a second National workshop in Dec 2013. Over 500 stakeholders from various parts of the country participated in the National workshops organized. The participants included representatives from state nodal agencies, manufacturers, experts, relevant ministry and MNRE officials, UNDP and others (Indicator 20). A total of 15 presentations were made at these conferences (Indicator L);
- A total of 40 awareness programmes were organized to create awareness amongst stakeholders and to entice potential investors to generate expression of interest in CSH projects (Indicator 22);
- A total of 5 advertisements have been placed in national dailies[20] with information on the benefits of CSH, schemes under the project and key contact details (Indicator 23);
- Meetings of CST manufacturers and experts with MNRE (in January and April 2014)

A CSH Technology Platform was formed (referred to as CSTEAM) in 2014. Up to now, only two CSTEAM meetings have been held., in which about 10 manufacturers participated (Indicators 25-27). The functioning of CSTEAM is hampered by the fact that participating manufacturers at times have different interest and want to promote their specific technology. Admitting that this manufacturers' association has just been set up, it may be too early to tell, but so far it is not clear to the Evaluators what the role of CSTEAM will be in practice and what is will or should contribute in addition to the existing organizations, such as STFI.

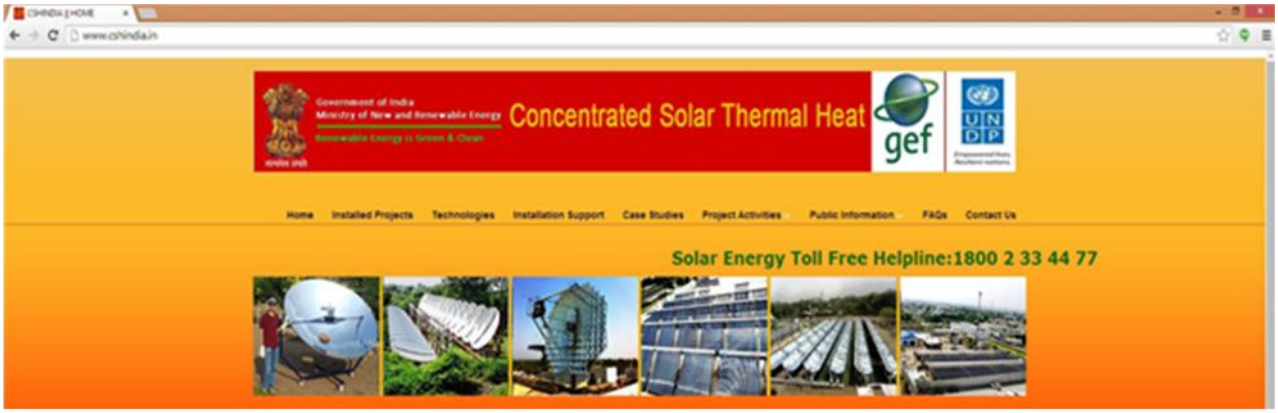
Outcome 2.2

[20] Such as HIndustan Times, Economic Times and The Hindu

The project website www.cshindia.in was officially launched in May 2014. It has uploaded information on the project and technology related information such as installation support, case studies, project activities, list of manufacturers, reports, FAQ etc. The counter of the website gives the number of about 4,400 viewers by early January 2015.

A total of 18 brochures on CST and applications have been developed by a number of organizations, namely

Box 8 CSH India project website



EcoAxis (as mentioned before; see Indicator 4) as well as PwC (Oct 2013; 4 info packages), WISE (World Institute of Sustainable Energy) and Ajay Chandhak (PRINCE, Suman Foundation). The brochures showcase the use of CSH systems in various sectors such as dairy, laundry, industries, space cooling and community and institutional cooking. The studies can be found at www.cshindia.in/case%20studies.html.

The case studies presented are:

Technology and application	Location
Process heat	
ARUN dish for washing application	Mahindra Vehicle Manufacturers, Chakan, Pune
Scheffler dish for steam pressing	Purple Creation, Baramati, Pune
Non-imaging concentrator for boiler feed water pre-heating	*ITC factory, Bangalore*
Scheffler dish for steam for dry cleaning	Gajraj Drycleaenres, Ahmednagar
Parabolic through for phosphating process	SKF Technologies, Mysore
Cooling	
Solar Concentrators installed for air cooling	CSM Hospital, Thane, Maharashtra
Scheffler dish for cooling and LPG vaporisation	Mahindra Vehicle Manufacturers, Chakan, Pune
Cooking	
Scheffler solar concentrators for community cooking	JNV school at Leh, Ladakh
Scheffler CST for steam cooking	Temple at Shirdi, Ahmednagar
ARUN solar concentrator for community cooking	Akshardham Temple, New Delhi
Scheffler solar concentrators for community cooking	SRM University
Scheffler solar concentrator for community cooking	SV School, Vankuva, Muna Sevi Ashram

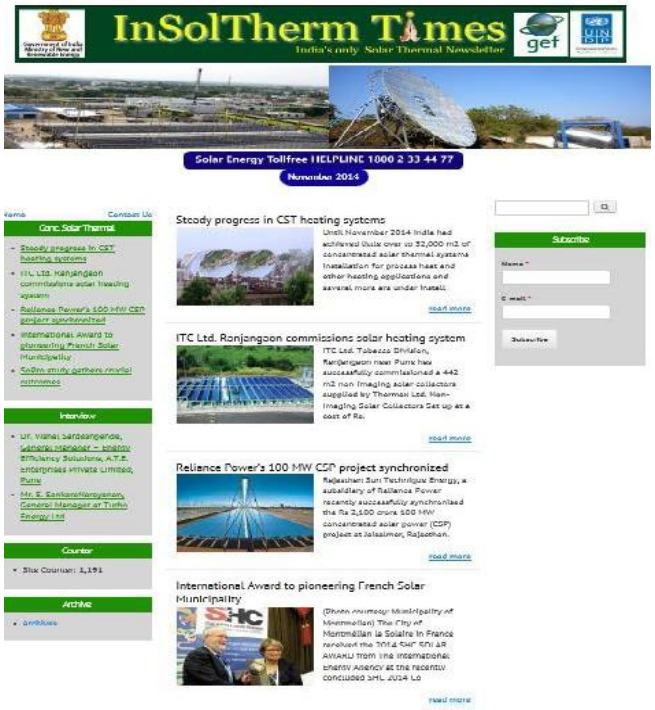
In addition the *Compendium* on existing CSH installations (2013, by APITCO; see Outcome 1.1) was put on the website. Over 800 copies of above brochures and document were printed and provided to various stakeholders (including participants of 2013 national workshop).

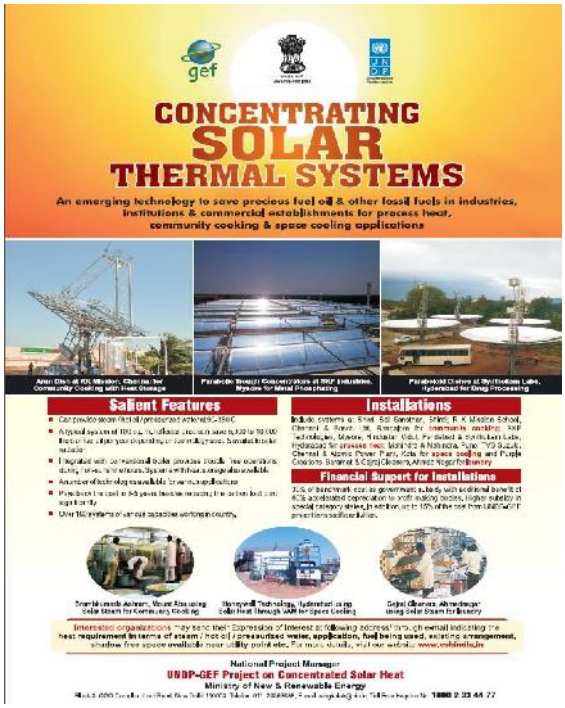
A total of 13 video capsules have been developed on various CSH sites, of which some have been uploaded on CSH website www.cshindia.in (and we can assume that a part of the website's visitors have had a look at the videos). The audio-visual capsules were also shown in all of the 31 awareness workshops and the two national workshops on CSH.

On recurrent and other written materials, the Project has supported the publication of:

- *Insoltherm Times*, a monthly newsletter available at www.insolthermtimes.in. The newsletter has a subscriber base of 4,000 and is expected to reach 11, 000 people by e-mail (there is no hardcopy version);
- *Sun Focus*, on a quarterly basis. The six issues released so far can be found at the MNRE website and www.cshindia.in;

InSolTherm Times is published by the the STFI (Solar Thermal Federation of India, www.stfi.in). STFI also operates a toll-free helpline (1800 233 477). To create awareness on the helpline, about 4 million SMS were sent. The Helpline was initiated under the UNDP Solar Water Heater Project (which ended in Dec 2012) and now answers questions on solar thermal plat-plate (solar water heaters), concentrated solar and solar PV.





Box 9 Progress towards results, Component 3

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
Component 3: Pilot demonstration of CSH technologies for various applications				
3.1 Increased number of commercial and near-commercial CSH technologies for diversity of applications	P. Number of projects planned and implemented a. Demonstration projects b. Replication projects c. Number of technology packages used Q. No. of implemented demo and replication projects whose performance data is as per feasibility study by EOP R. No. of implemented demo projects, whose a. Operational and energy performances are at least the same or better than as per design by EOP; b. whose financial and economic performances are at least the same or better than as per design by EOP	 0 0 0 0	 23 30 5 - - -	 30 60 7 90 15 15
3.1.1 Completed feasibility studies for demonstration and replication projects of various CSH technology applications	30. Number of completed feasibility studies that were supported by the project by year 4	0	41	90
3.1.2 Completed Detailed Project Reports (DPRs) for demonstration projects	31. Number of completed DPRs for demonstrations (for projects > 750 m^2) that were funded and implemented under the project by year 4	0	2	30 (?)
3.1.3 Developed and commissioned demonstration projects in at least 5 sectors	32. Number of CSH technology application demonstration projects supported l by EOP	0	23	30
3.1.4 Results of the performance monitoring, analysis, and evaluation of demonstration projects	33. Cumulative number of performance monitoring reports of demo projects by EOP	0	1	30
3.2 Improved technical and economic performance of commercial and near-commercial CSH technologies in an increased diversity of applications	34. No. of replication and other CSH technology application projects supported by the Project	0	30	60
3.2.1 Documentation of results of demonstration and replication projects	35. No. of CSH technology projects included in the project database by EOP 36. Number of demonstration project profiles prepared by EOP	0 0	121 12	90 30
3.2.2 Completed performance monitoring, analysis and overall evaluation for demo and replication projects	37. No. of performance monitoring reports of demo and replication projects completed by EOP; 38. Overall evaluations of demonstration and replication projects completed by EOP	0 0	1 -	90 2

Outcomes 3.1 and 3.2

The tables of Boxes 10 and 11 give an overview of the current status of demonstration and replication (and other) projects (Indicators P, 32 and 34), indicating the type of subsidy provided by MNRE and additional support by the UNDP/GEF project. Of the 53 project (16,373 m^2) supported under CSH India, 20 were installed during 2013-2014 (of which 8 demonstration projects and 12 replication units).

Box 10 Description of selected UNDP/GEF Project-supported CSH applications

Type of CSH application	Technology	Application description	Size (m^2)	Investment (INR lakh)	Subsidy MNRE (INR lakh)	Savings				Payback time (yr)		Emission reduction	
						Fuel	Amount	Unit	INR (Lakh)	w/o subs	w subs	tCO_2/yr	$tCO_2/m^2/yr$
Process heat													
Gajraj DryCleaner, Gajraj	Scheffler	Steam for washing, drying of cloths	240	23.00	12.00	Diesel	6500	liter	2.6	8.8	4.2	18.2	0.076
Purple Creation, Baramati	Scheffler	Steam for washing garments	480	90.00	25.92	LPG	11,280	kg	7.90	11.4	8.1	33.8	0.071
Synthoken Labs Hyderabad	Scheffler	Processing of chemical compounds	450	124.78	27.00	diesel	60,000	liter	24.00	5.2	4.1	168.0	0.373
CSM Hosital, Thane	Scheffler	Cooling, hot water, sterilization	2502	400.00	124.00	Electricity	750,000	kWh	60.00	6.7	4.6	667.5	0.267
Hotel ITC Maurya, New Delhi	Scheffler, ARUN	Steam for laundry, cooking, heating	297	165.00	54.00	Natural gas	33,000	m^3	33.33	12.0	3.3	59.2	0.199
Mahanad Dairy, Latur	ARUN	Hot water for milk pasteurization	160	51.70	32.76	Fuel oil	13,360	liter	7.35	7.0	2.6	39.3	0.246
Mahindra Vehicles, Chakan	ARUN	Steam for cleaning engine parts	169	39.00	10.14	Electricity	200,000	kWh	16.00	2.4	1.8	178.0	1.053
Salem Coop Milk Producers	ARUN	Milk pasteurization	338	101.00	20.28	Fuel oil	28,588	liter	15.72	6.4	5.1	84.2	0.249
SKF Technology, Mysore	PTC	Hot water for metal phosphating	256	70.55	13.85	Fuel oil	12,000	liter	6.60	10.7	8.6	35.3	0.138
Siddarth Surgicals, Valsad	PTC	Cleaning & bleaching of cotton	263	47.50	14.20	LPG	20,000	kg	14.00	3.4	2.4	60.0	0.228
ITC Bangalore	NIC	Processing tobacco leaves	680	140.00	24.48	Fuel oil	45,000	liter	24.75	5.7	4.7	132.5	0.195
ITC Pune	NIC	Processing tobacco leaves	442	79.52	15.91	Fuel oil	21,000	liter	11.55	6.9	5.5	61.8	0.140
Mahindra Vehicles, Nagpur	NIC	Hot water for cooling	442	88.41	15.91	Electricity	240,000	kWh	19.20	4.6	3.8	213.6	0.483
Cooling													
Mahindra Vehicles, Chakan	Scheffler	Chillers for cooling paint	1120	210.00	60.48	LPG	50,000	kg	35.00	6.0	4.3	150.0	0.134
Honeywell Technology, Hyderabad	PTC	Space cooling	821	213.41	44.28	Electricity	444,950	kWh	35.60	6.0	4.8	396.0	0.482
NPCIL, Power project, Kota	PTC	Space cooling	641	245.32	34.61	Electricity	625,000	kWh	50.00	4.9	4.2	556.3	0.868
Cooking													
Shirdi, Temple, Ahmednagar	Scheffler	Steam for cooking	1168	133.00	58.40	LPG	41,000	kg	28.70	4.6	2.6	123.0	0.105
		TOTALS	10469	2222.19	588.22	Energy	5,982	MWh	392.30	5.7	4.2	2976.8	0.284

Based on info provided by PwC brochures *CST in Industrial Sector* (Oct 2013), case studies prepared by WISE and PMU data

Payback periods are calculated using the following fuel prices:

Emission factors taken fro IGES and IPCC reports

Prices:			CO2 content		Energy value	
LPG	70	INR/kg	3.0	$kgCO_2/kg$	46.1	MJ/kg
Electricity	8	INR/kWh	0.9	$kgCO_2/kWh$		
Fuel oil	55	INR/liter	2.9	$kgCO_2/litre$	36.4	MJ/litre
Diesel	40	INR/liter	2.8	$kgCO_2/litre$	34.9	MJ/litre
Nat gas			1.8	$kgCO_2/m^3$	32.6	MJ/m^3

Box 11 Overview of CSH project supported under the UNDP/GEF CSH India project

Projects	Number	Aperture area (m^2)	Subvention system
			MNRE: Dish solar cookers & steam generating systems can receive the following capital subsidy (or 30% of project cost, whatever is less): • INR 2100/m2 - Concentrators with manual tracking; • INR 3600/m2 - Non-imaging concentrators; • INR 5400/m2 - Concentrators with single-axis tracking; • INR 6000/m2 - Concentrators with double axis-tracking
Demonstration projects	**23**	**11,847**	
- Process heat - Cooking - Cooling	19 2 2	8,321 2,064 1,462	UNDP/GEF support for > 250 m^2 (or dual-axis moving focus CST > 150 m^2): • 15% of MNRE benchmark cost up to INR 7.5 million; for all CSTs (Scheffler if innovating and/or above 16 m^2) with max up to 15,000 m^2 • Support released (50%) on submission of bank guarantee (BG; in case of no BG after submission of DPR and performance data); balance 50% released based on performance data Activities supported: • Feasibility study (<750 m^2) or detailed project report (DPR; > 750 m^2); • Performance monitoring for 2 yrs; O&M of the system
Replication and Other projects	**30**	**4,695**	
- Process heat - Cooking	8 22	1,737 2,958	*Replication projects:* UNDP/GEF support for > 250 m2 (or dual-axis moving focus CST > 150 m2): • INR 500,000 for projects < 500 m^2 and INR 1 million > 500 m^2; systems based on Scheffler dishes for providing regular performance and fuel data and O&M • Support released (50%) on submission of bank guarantee (BG); balance 50% released based on performance data Activities supported: • Providing performance and fuel data; O&M of the system *Other projects:* UNDP/GEF support for projects between 64 m^2 (Scheffler: 45 m^2) and 150/250 m^2: • INR 200,000 for providing regular performance and fuel data and O&M; • Support released (50%) on submission of bank guarantee (BG; in case of no BG after submission of DPR and performance data); *ESCO mode projects:* UNDP/GEF: 10% of benchmark cost up to INR 1.5 million in addition to above projects if done in ESCO mode *Repair and innovation projects:* UNDP/GEF: 20% of sanctioned project cost to a maximum of INR 1.5 million for 5 years old systems subject to the condition that equal amount is spent by the beneficiary.

Box 12 Examples of demonstration projects supported

SKF Technologies (P) Ltd., Mysore

(Bearings & Lubricating solution Manufacturers)

Technology	PTC each of 6.41 sq.m
System Size	256 Sq. m (40 nos. of PTCs)
Application	Metal Phosphating
Manufacturer	Thermax , Pune
Sanction Date	MNRE : 13-09-2012 UNDP : 31-03-2014
Installation Date	January 2013
Project Cost & Support	Rs. 70.55 Lakh; MNRE : 13.85 Lakh; UNDP : 3.50 Lakh
Remarks	System connected to Diesel Fired boiler generates pressurized hot water at 95c for heating chemical in a tank through coils for phosphating of metal bearings/ nuts,
Savings & CO2 reduction	12000 Litres of diesel saved in one year with 32.4 Tones of CO2 abatement.

ITC, Pune

(Cigarette manufacturers)

Technology	Non Imaging Concentrators each of 3.41sq.m
System Size	442 sqm (130 nos. of NICs)
Application	Processing of tobacco leaves connected to furnace oil boiler
Manufacturer	Thermax , Pune
Sanction Date	MNRE : 04-03-2014 UNDP : 31-03-2014
Installation Date	May 2014
Project Cost	79.52 Lakhs; MNRE :15.91 Lakhs; UNDP : 7.95 Lakhs
Remarks	Pre heating of boiler feed water at 95 c. Steam generated from boiler being used for flavouring of tobacco leaves
Savings & CO2 reduction	Expected to save 21,000 litres of fuel oil in a year with 63 Tones of CO2 abatement

Siddharth Surgicals, Valsad

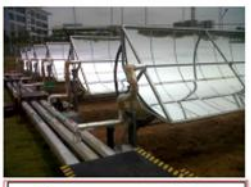
(Surgical Cotton Manufacturers)

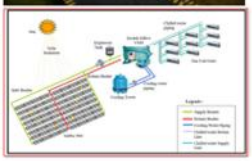
Technology	Parabolic Trough of 28.2 sqm
System Size	263 sqm (9 nos. of PTCs)
Application	Cleaning & bleaching of cotton
Manufacturer	Energy Guru (Leveragenet Solutions Pvt. Ltd.), Pune
Sanction Date	MNRE : 04-03-2014 UNDP : 04-04-2014
Installation Date	July2014
Project Cost	47.50 Lakhs ;MNRE: 14.20 Lakhs ; UNDP : 7.13 Lakhs
Remarks	Pressurized hot water at 110 c generated for cleaning & bleaching of cotton in vertical kier connected to LPG burner . New type of PTC installed using 3M film on trough & cost effective tracking arrangement
Savings & CO2 reduction	Expected to save approx. 20,000Kgs of LPG in one year with 46 Tones of CO2 emission.

Honeywell Technology Solutions, Hyderabad

(Automation & Control Systems Industry)

Technology	Parabolic Trough each of 6.41sqm
Size of the System	821 sqm (128 nos. PTC)
Application	Space cooling (100 TR triple effect VAM)
Manufacturer	Thermax , Pune
Sanction Date	MNRE : 11-02-2013 UNDP-GEF : 26-03-2014
Installation Date	May 2013
Project Cost	213.41 Lakhs ;MNRE : 44.28 Lakhs ; UNDP: 22.50 Lakhs
Remarks	Integrated with electrically operated existing chillers. Pressurised hot water at 165 c and 17 bar is supplied to VAM to generate chilled water at 7c which further cools air using fan coils.
Savings & CO2 reduction	44,495 units of electricity saved in a year with 32 tonnes of CO2 abatement





Mahindra and Mahindra, Nagpur

(Automobile-Tractor Factory)

Technology	Non Imaging Concentrators each of 3.41sq.m
System Size	442 sq. m (130 nos. of NICs) connected to the existing system of electrical heaters
Application	Cleaning & degreasing of engine parts
Manufacturer	Thermax India Ltd.
Sanction Date	MNRE : 14-03-2013 UNDP-GEF : 26-03-2014
Installation Date	April 2013
Project Cost	88.41 Lakhs; MNRE : 15.91 Lakhs ; UNDP :8.08 Lakh
Remarks	Pressurized hot water at 95 c being used for cleaning & degreasing of tractor engine parts before assembly.
Savings & CO2 reduction	Expected to save 24,000 units of electricity saved in one year with 17 tones of CO2 abatement

Synthokem Labs, Hyderabad

(Drug manufacturers)

Technology	Paraboloid Dishes each of 90 sqm.
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
Sanction Date	MNRE : 04-03-2014 UNDP : 12-03-2014
Installation Date	October 2014
Project Cost	124.78 Lakhs ; MNRE: 27.00 Lakhs ; UNDP : 13.50 Lakhs
Remarks	Hot water generated at 95 c through thermic fluid heated up to 180c by CST system being used for heating reactors for the purpose of chemical reactions.
Savings & CO2 reduction	Expected to save 60K litres of Diesel in one year with 138 Tones of CO2 abatement

Source: slides taken from *Presentation by MNRE and PMU at 4th PSAC Meeting (January 2015)*

The Project Document has a provision to support (in addition to the MNRE subvention) to up to 30 demonstration projects (and 60 replication projects), in which the project can provide 15% for demonstration units (increased from the 10% originally mentioned in the project documentation) and 5% to replication projects. During project implementation, additional support for projects operating in ESCO mode (see Component 4) was added, as well as support for non-functioning systems (see Outcome 1.1) for repair and putting these into operation. Details of the MNRE subsidy scheme and the additional support provided by the CSH India project is given in Box 11.

It was decided that feasibility reports would replace DPR for projects less than 750 m^2 (so the EOP value of Indicator 31 is not valid anymore); up to now only six projects have been > 750 m^2 for which DPRs will be prepared. About 40 feasibility studies have been prepared. With most projects installed only in 2014, most performance reports of demonstration (and replication) projects need to come in (see Indicator 33); up to date one full report has been received (from SKF Mysore). Hence, as a full analysis needs to be done yet, no values can be given for Indicators Q and R.

A database has been prepared of all MNRE-sanctioned projects (including CSH that were installed before or outside the UNDP/GEF project) with the cumulative number reported as 121 (Indicator 35) A profile of 12 project-supported demo projects has been prepared by the PMU (Indicator 36). Information on selected projects is presented in the Boxes 10 and 12.

There has been a relative slowness in replications. One reason is that replication projects are using Scheffler technology, which is an older and less efficient technology. Newer technology are under Demonstration category. Increasingly beneficiaries are interested in these newer technologies. Once the aim of 15,000 m^2 of projects in the Demo category have been completed, newer technologies will also move into replication category and projects are likely to increase.

The website www.cashindia.in provides a list of 9 consultants/consultancy organizations that have been scrutinized by a technical Committee to assist in the preparation of feasibility studies and detailed project reports (DPRs) for projects to be prepared under the under UNDP-GEF project on CSH. Ten manufacturers have been accredited for off-grid and decentralised solar application for supplying, installation and distribution of CST systems (under the JN National Solar Mission). See www.cshindia.in.

Box 13 Progress towards results, Component 4

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
Component 4: Sustainable financial approach in the adoption of CSH technologies and applications in India				
4.1 Enhanced understanding of the financial viability of CSH technologies and measures to mitigate investment	S. No. of potential and feasible financial options for the application of CSH technologies	0	2	2
	T. No. of banks/financial institutions that agreed to finance CSH projects by EOP	0	15	20
	U. Number of projects developed in ESCO mode	0	-	5
4.1.1 Documented financial viability of CSH technologies, applications, and mitigation approaches of investment risks	39. No. of completed financial viability analyses of CSH technologies and applications by year 3.	0	0	1
	40. Analysis of alternative financial options by year 3	0	0	1

Outcomes and outputs	Indicators	Base-line target	Mid-term value	EOP target
4.2 **Promulgation of favourable financial policies that promote increased use and promotion of CSH for low and medium temperature process heat applications**	V. No. of implemented CSH projects that benefitted from the enforced policy and regulatory regimes on CSH technology applications by EOP	0	-	28
4.2.1 Formulated recommendations for financial and promotional policies and strategies for adoption by Government of India	41. No. of policy studies completed for inputs in the formulation of policies supportive of CSH system and application projects by yr 3	0	1	1

Outcomes 4.1 and 4.2
The Component 3 deals with pilot demonstration and replication projects that receive a 'business-as-usual' financial incentive from MNRE (and additional support from the CSH India Project). A second financial mode (see Indicator S) being developed with Project support is by involving an energy service company (ESCO).

In theory, the ESCO mode can be a win- win position both for user and the service provider. The user pays for energy provided and is sure that the system will be maintained after warranties expire, while continuing paying less than otherwise would have spent on conventional fuels. The ESCO will maintains the system as he has to get money from user and by doing so will continue to receive money even after recovering investment. In the current (subsidy only) model the manufacturer has no responsibility of performance after the warranty period which might create an issue for the users if considerable repairs and maintenance is needed.

On the other hand, few manufactures are willing to operate in ESCO mode; most will want to have full investment recovered immediately after commissioning of the system and not get into the burden of operation and maintenance, even if the long-term profit would be less. The market is too nascent for third-party companies to have an ESCO role. Hence, the additional subsidy provided for ESCO mode projects (see Box 11). A request for proposals was floated in 2014, but generated limited interest with about 8 projects in the pipeline and 5 projects under preparation (Indicator U). In the coming years 2015-16, the proof of the ESCO pudding will be in the eating, after which is should be carefully evaluated on 'viability and potential' towards the end of the project.

A study was carried out in 2012 by Citran Consulting (Bhubaneshwar) providing inputs for the formulation of policies and solar thermal programmes (Indicator 40). Other activities (associated with the progress Indicators 39, 40 and V) are still pending. One achievement of the Project has been the removal of import duty on solar mirrors (for non-grid CST systems); according to PMU this may reduce overall capital cost by about 5-7%.

5.2 Global environmental and other impacts

Box 10 provide data of seventeen CSH projects that are supported by the CSH India Project for which information was readily available to the Evaluator by means of published case studies and data given by the PMU. Since performance and fuel saving data in general is not (yet) available from them (both installed and yet to be installed), 'educated guesses' were made by the Evaluators on expected CO_2 emissions, based on estimates of fuel consumptions (see Box 10). The total area of these 17 CSH projects (of which data were made available to the Reviewers) is 10,469 m^2 that will generate annual greenhouse gas emission reduction of

2,977 tCO_2/year. This implies average CO_2 savings of 0.284 tCO_2/m^2/year, slightly less than the assumed factor for CO_2 calculations in the Project Document (0.35 tCO_2/m^2/year).

Box 14 Project objective; global environmental impacts

Project Document	MTR status
Direct emission reduction target by EOP: 45,000 m^2 of CSH systems installed in 90 establishments resulting in 315 lifetime $ktCO_2$ emission reduction (assuming an average emission factor of 0.35 tCO_2/m^2/yr).	**Direct emission reductions:** 53 projects have been sanctioned by the Project (currently 20 installed and the remainder following in 2015) with a total aperture area of 16,542 m^2. Assuming emission factors[21] of 0.284 tCO_2/m^2/year, this implies annual GHG emission reduction of 4,704 tCO_2/yr or lifetime GHG reduction of 94,073 tCO_2. The corresponding energy substitution is 5,374 MWh/yr or equivalent lifetime energy savings are 107,489 MWh (equivalent to 331,253 MWh_{th}).
Indirect emission reductions follow from: • *Bottom-up*: using a 'replication factor' of 'three' gives GHG reduction attributable to the Project of 945 $ktCO_2$ • *Top-down:* this looks at how the use of CSH systems will develop in a 10-year post-project period. Assuming the Project's 'causality factor' as 80% and the emission reduction as 1,095 $ktCO_2$, this means GHG reduction of 0.945 $ktCO_2$	We have tried to make some 'guestimates' on market development, based on market data provided by PMU and own calculations. Partly due to the Project's intervention, the market has grown with 18% over mid-2012 to Dec 2013 and (if all 53 CSH India-supported projects would be installed) with 32% by mid-2015 and assumed to increase with 28% over mid-2015 to Dec 2016 (end date of the Project). Assuming conservatively that annual increase would be 10% over 2016-2026, this would imply an installed CSH area of 181,562 m^2 by 2026. Using the above-mentioned emission factors, this means lifetime emission reduction of 1.0-2.7 million tCO_2 for the top-down approach, slightly higher than the ProDoc's estimates. So we conclude that the ProDoc estimates might very well be achievable, even be a conservative estimate.

Installed CSH	Mid 2012	Dec 2013	Mid 2015	Dec 2016	Dec 2026
Total - number	85	160	253		
Process heat & cooling		24	48		
Cooking		136	205		
Total - area (m2)	25,000	32,000	48,500	70,000	181,562
Process heat & cooling		13,760	24,105		
Cooking		18,240	24,395		
Market growth		18%	32%	28%	10%/yr

Project objective and goal	Indicators	Base-line target	Mid-term value	EOP target
• Reduced GHG emissions from use of CSH systems for low and medium temperature process heat; • Increased use and promotion of CSH systems for low and medium temperature process heat applications	A. Cumulative CO_2 emission reduced from start of project to End-Of-Project (EOP), ($ktCO_2e$)	0	94.07[22]	315
	B. Cumulative installed area of CSH systems for process heat applications (m2) by EOP	25,000	40,000[23]	85,000
	C. No. of companies that have installed CSH systems by EOP	85	120[22]	175
	D. No. of CSH technologies available in India by EOP	2	6	6

[21] See Box 10. Installed projects with 10,469 m^2 have energy savings (fuel and electricity) of 3,401 MWh (=39.93 TJ), emission reduction of 2.98 $ktCO_2$ per year (or 0.284 tCO_2/m^2/yr)

[22] 4,704 tCO_2/yr gives lifetime emission reduction of 94,073 $ktCO_2$ per year over a 20-year lifetime

[23] In India, project-supported and (own) estimate of market size, extrapolated from on info (Dec 2013 status) provided by PMU, as explained in the Table

6. FINDINGS: PROJECT IMPLEMENTATION

This Chapter describes the appropriateness and functioning of project management and administration, work planning and monitoring and evaluation. A second section, discusses relations with stakeholders and communications, while the Chapter ends with an overview of planned and realized budget expenditures and of co-financing.

Mid-term review questions (see Box 1)

- *Management:* appropriateness of the institutional arrangement and whether there was adequate commitment to the project? Review overall effectiveness of project management as outlined in the Project Document. Have changes been made and are they effective? Are responsibilities and reporting lines clear? Is decision- making transparent and undertaken in a timely manner? Recommend areas for improvement; Review the quality of execution of the Executing Agency/Implementing Partner(s) and recommend areas for improvement; Review the quality of support provided by the GEF Partner Agency (UNDP) and recommend areas for improvement
- *Work planning*: Review any delays in project start-up and implementation, identify the causes and examine if they have been resolved; Are work-planning processes results-based? If not, suggest ways to re-orientate work planning to focus on results?; Examine the use of the project's results framework/logframe as a management tool and review any changes made to it since project start.
- *Reporting:* Assess how adaptive management changes have been reported by the project management and shared with the Project Board; Assess how well the Project Team and partners undertake and fulfil GEF reporting requirements (i.e. how have they addressed poorly-rated PIRs, if applicable?); Assess how lessons derived from the adaptive management process have been documented, shared with key partners and internalized by partners. How does the APR/PIR process has been helping to monitor and evaluate the project implementation and achievement of results?
- *M&E:* Review the monitoring tools currently being used: Do they provide the necessary information? Do they involve key partners? Are they aligned or mainstreamed with national systems? Do they use existing information? Are they efficient? Are they cost-effective? Are additional tools required? How could they be made more participatory and inclusive?

6.1 Adaptive management and planning; monitoring & evaluation

The implementation arrangements are described in Section 3.4. The project has been implemented by MNRE, assuming the overall responsibility for the achievement of the project results as the Implementing Partner (GEF Local Executing Agency). UNDP has been providing overall management and guidance from its New Delhi Country Office and the Asia Pacific Regional Centre (APRC) in Bangkok, and has carried out for monitoring and evaluation functions as per UNDP and GEF guidelines.

A Project Management Unit (PMU) has been established to implement the project, headed by a full-time National Project Manager (NPM), responsible for implementing day-to-day activities in coordination with the Joint Secretary of MNRE, acting as National Project Director (NPD) for the project. Originally, two Committees namely Project Advisory & Project Steering Committees were proposed in the Project Document to be formed that should meet once in 6 months for making management decisions and to advice & guide to Project Management Unit (PMU). It was suggested at Project Inception to have one joint Committee, namely the Project Steering & Advisory Committee (PSAC). To provide guidance and supervision to the PMU at more regular time intervals, it was decided to set up a Project Executive Committee (PEC), meeting at least once every two months. The PEC has met 13 times so far and four PSAC meetings have been held. Annual work plans and budgets (AWPs, annual work plans) are discussed at these meetings.

The Project has encountered a number of issues in Component 3 (demo and replication projects) and implemented some adjustments to overcome the issue:

- The ProDoc originally proposed to focus in on CSH installations larger than 250 m^2. But as many beneficiaries manifested heating needs that would require installations less than this size, the issue was discussed and the minimum downsized to 90 m^2 and above (64 m^2 for Scheffler dishes);
- The cap on technical assistance support was increased from 10 to 15% with the limit enhanced from INR 30 lakh to 75 lakh;
- After a survey identified 23 out of 75 assessed sites to be non-functional (see Outcome 1.1), this was discussed in the PSC and it was felt necessary to provide funding for repair and renovation, introducing a separate category (see Box 10) under which assistance can be provided up to INR 15 lakhs for projects 5 years and older;

Feedback for adaptive management has come from the technical reports of the projects (in particular the assessments (technology, application, manufacturers) of Component 1 as well as monitoring and evaluation reporting that have been released in accordance with the Monitoring and evaluation plan, presented in the original project documentation:

- Quarterly progress reports (QPRs)
- The annual mid-year UNDP/GEF Project implementation reviews (PIRs)
- Minutes of meeting of the PEC and PASC meetings.

The source of information for these reports and meetings has enabled the periodic oversight by UNDP India staff, along with the UNDP Programme Manager and responsible management in MNRE. UNDP, MNRE and PMU staff have visited CSH systems (e.g. in Pune region, Mount Abu, Hyderabad), while the Project Manager (NPM) has visited test facilities abroad (in Germany, Feb 2014).

6.2 Stakeholder engagement and communications

Mid-term review questions (see Box 1)

- *Stakeholders:* Has the project developed and leveraged the necessary and appropriate partnerships with direct and tangential stakeholders? Do local and national government stakeholders support the objectives of the project? Do they continue to have an active role in project decision-making that supports efficient and effective project implementation? To what extent has stakeholder involvement and public awareness contributed to the progress towards achievement of project objectives?
- *Communications:* Review internal project communication with stakeholders: Is communication regular and effective? Are there key stakeholders left out of communication? Are there feedback mechanisms when communication is received? Does this communication with stakeholders contribute to their awareness of project outcomes and activities and investment in the sustainability of project results? Review external project communication: Are proper means of communication established or being established to express the project progress and intended impact to the public (is there a web presence, for example? Or did the project implement appropriate outreach and public awareness campaigns?)

There has been engagement from a wide spectrum of stakeholders. In fact, the joining of PSC and Advisory Committee into one joint PASC meetings has enabled a close interaction at the project policy-making and guidance level between government institutions (MNRE, line ministries, autonomous agencies, such as NISE), academia and private sector representatives, both manufacturers as well as industries using CSH systems. On the more implementation level, awareness programs and pilot trainings have been organised with CST manufacturers, industries and experts (see Outcome 2.1).

The various conferences and state-level meetings (the latter organised with the State Nodal Agencies) has enabled formal and informal interaction between national and local government agencies, experts, CST manufacturers, beneficiary industries, etc. The online monitoring at the 15 sites almost by definition implies an info exchange between Project, monitoring organisation, manufacturer (interested in its CST's

performance) and company at which the CST is installed (interested in its performance and resulting fuel and monetary savings).

It is important to stress that stakeholders are engaged as for them the Project is not an isolated activity, but they see the Project as part of their operations and a useful opportunity in beefing up their efforts. For example, CST is promoted by MNRE as part of their overall programme on promoting solar energy under the National Solar Mission (see Chapter 3). The STFI (Solar Thermal Federation of India) has been working since 2010 on promoting solar thermal energy (flatbed as well as concentrating technology) by improving the interface with Government bodies, promoting product standards, collecting industrial data and communication and networking. For example, the InSoltherm Times is published regularly and STFI also operates a toll-free helpline for the general public on questions about solar energy. The project website itself, www.cshindia.in presents a wealth of info on status of technology and applications, contact addresses of institutions, manufacturers and consultants, case studies and potential MNRE support. As an example of engaging stakeholders, the around 40 awareness programmes organised by the Project (see Output 2.1.5; Indicator 22) not only created awareness but resulted in the commitments of investors of around 10,100 m^2 of CST collector area.

6.3 Budget and co-financing

Mid-term review questions (see Box 1)

- Examine the *financial management* of the project monitoring and evaluation budget. Are sufficient resources being allocated to monitoring and evaluation? Are these resources being allocated effectively?

The Project has a budget of USD 4.40 million to be utilised over 2012-2016. Box 15 provides an overview over the expenditures up to December 2014.

The disbursements largely reflect also the progress in the various Components:

- Many activities of Component 1 have been completed (e.g. technology assessment; setting up testing centres; install instrumentation for online monitoring), while some are under implementation (e.g. development of specifications for materials/components of various CSTs;
- Activities in Component 2 have been completed (e.g. development of training manuals and carrying out trainings; conducts awareness workshops), although the activity of development of Awareness-and-Training Centre on CSTs at Brahmakumaris, Mount Abu was delayed and has only recently been initiated (Dec 2014) so the corresponding expenditures have not been reflected yet;
- Regarding Component 3, most budget is available as grant to support demonstration, replication and other projects, as described in Box 11. Total committed support for the 53 projects is around USD 550,000. This will only be spent over time after the CSH proposals have been sanctioned, and as it is linked with the acceptance under the MNRE subsidy scheme and anyhow based on presentation of bank guarantees (BG) and of (online) performance data;
- Regarding Component 4, few expenditures have been made as various activities have not been undertaken yet; a call for proposals for ESCO mode was recently launched.

The total co-financing commitment for the Project was USD 19.35 million (see Box 16) on projects (see Component 3), which the PMU estimates as USD 7.7 million as equity contribution and USD 4.4 million to be made available to them in the form of soft loans. Up to now, IREDA has not provided loans to the Project-supported CSH initiatives yet.

Box 15 GEF project budget and expenditures 2012-Dec 2014

	Planned	Expenditures (USD)			
		Total	2012	2013	2014
Technical capacity development	**831,525**	**999,094**	**142**	**637,172**	**361,780**
- Consultants and contracts	554,925	843,296		606,545	236,751
- Equipment	175,000	125,004			125,004
- Grant		0			
- Supplies, rental, premises, misc	101,600	30,793	142	30,627	25
Awareness and capacity	**1,248,180**	**322,977**	**17,156**	**191,523**	**114,298**
- Consultants and contracts	910,700	254,266		164,730	89,536
- Equipment		0			
- Grant	86,400	4,822			4,822
- Supplies, rental, premises, misc	251,080	63,888	17,156	26,793	19,940
Pilot demonstration	**1,968,245**	**117,015**	**0**	**47,570**	**69,445**
- Consultants and contracts	586,745	56,886			56,886
- Equipment		0			
- Grant	1,380,000	9,600			9,600
- Supplies, rental, premises, misc	1,500	50,529		47,570	2,959
Sustainable financing	**104,100**	**1,159**	**0**	**0**	**1,159**
- Consultants and contracts	101,100	77			77
- Equipment		0			
- Grant		0			
- Supplies, rental, premises, misc	3,000	1,082			1,082
Project management	**247,950**	**184,783**	**16,908**	**98,956**	**68,918**
- Consultants and contracts	190,450	161,745	15,169	84,775	61,801
- Equipment		0			
- Grant		0			
- Supplies, rental, premises, misc	57,500	23,038	1,739	14,181	7,117
Other expenditures			**8,374**	**28,226**	**15,263**
TOTAL	**4,400,000**	**1,676,890**	**42,580**	**1,003,448**	**630,862**

Box 16 Overview of project financing status

GEF and co-financing (million USD)	**Planned**	**Realized Dec 2014**
GEF	4.40	1.68
MNRE (grant subsidy)	6.00	2.10
MNRE (in-kind)	1.35	0.65
Industries (cash)	6.00	12.10
Financial institutions	6.00	-
Total	23.75	16.53

Based on data and information provided by PMU

Cost effectiveness

We conclude that the cost effectiveness of the Project has been 'satisfactory', based on the fact that Project expenditures achieved so far reflect achievements that (in general) follow the results framework's targets, as described in Chapter 5. If 'cost effectiveness' is defined as GEF budget spent per m^2 or per tCO_2 we observe that, halfway, 53 projects 16,500 m^2 have been (sanctioned to be) installed, as compared with the EOP target of 45,000 m^2 in 90 projects. The project has been lagging behind a bit with replication projects, but as more (larger) projects, it is possible that the target can be met. One can ask if the EOP target itself was realistically designed. However, since this CSH project is quite unique (there are no other or few CST capacity building activities), it is difficult to compare with other projects to see if the targets were realistically defined, but our 'guestimates' of Table 14 indicate these are realistic.

7. SUSTAINABILITY

Mid-term review questions (see Box 1)

- Comment on the Sustainability of the project in view of the resources committed by the UNDP- GEF in the long term; Commitment on the expected scenario of the project sustainability subsequent to the conclusion of the project:
  - *Socioeconomic:* Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public/stakeholder awareness in support of the long term objectives of the project? Are lessons learned being documented by the Project Team on a continual basis and shared/ transferred to appropriate parties who could learn from the project and potentially replicate and/or scale it in the future?
  - *Institutional:* Do the legal frameworks, policies, governance structures and processes pose risks that may jeopardize sustenance of project benefits?
  - *Technology:* Description of status and issues with employing Concentrating Solar Heat (CSH) systems for low-medium temperature applications in selected sectors;
  - *Financial:* What is the likelihood of financial and economic resources not being available once the GEF assistance ends (consider potential resources can be from multiple sources, such as the public and private sectors, income generating activities, and other funding that will be adequate financial resources for sustaining project's outcomes)?
  - *Environmental:* Are there any environmental risks that may jeopardize sustenance of project outcomes?

Box 17 gives an overview of risks mentioned in the UNDP Project Document, which are mentioned at various places in the document (see its section 8 of Part B; Annex A; and in the outer right column of the results framework in Table 34). This scattered presentation is something that the format of project document writing requires, but it makes for difficult reading and understanding of the relative importance of barriers and risks. In the following table (Box 16) we have regrouped "risks" according to the main sustainability categories of "technology", "socioeconomic", "financial" and "environmental" that the UNDP MTR manual suggests. Internal risks are project-inherent or can be largely controlled by the project management, while external risks are policy-economy-international

In fact, many risks are in way or another related to the "barriers" given in large detail in Table 11 of the ProDoc). One can argue that some of the "risks' the Project might face is basically being unable to lower corresponding "barriers" substantially, thus negatively affecting the likeliness of "sustainability" of the project's interventions[24]. The critical "assumptions" then is that the "internal risks" (i.e. risks that can be mitigated or managed by Project management), and 'external risks' have a low incidence and/or impacts, in such a way that sustainability remains (moderately) likely. The quality of adaptive management (mentioned in Section 6.1) is determined by the mitigation response of Project management to these external and internal risk factors as these manifest themselves more intensely and/or more frequently than expected.

[24] For example, the barrier "limited availability of (semi-)skilled manpower in CSH industry" in table 11 of the ProDoc resurfaces in the list of risks in its section 8 as "shortage/unavailability of necessary experts to work in CSH research and industry". It is the project task to provide training in such a way that this barrier is substantially lowered under the assumption that manpower/experts has a willingness to be trained and that the trainings provided are sufficient to have a likely sustainability. Adaptive management implies that if during project implementation trainings would show not be sufficient, the project changes course by adding trainings or changing the scope or intensity of the training.

Box 17 Assessment of risks to project sustainability

Risk	Assessment of status
Institutional (and political) risks	
• Failure to secure effective support from MNRE (due to changes in MNRE leadership and/or reduced focus on CSH vis-à-vis CSP or solar thermal technologies) and/or frequent shifting/transfer of expert government staff across agencies and departments leading to the loss of capacity that has already been built for this GEF CSH project; • Support for and/or capacity to develop standards for CST systems is limited or unavailable	• MNRE has been extending financial and R&D support for quite some time. The Jawaharlal Nehru National Solar Mission (JNNSM), under which support is being extended, is also part of the Climate Change Action Plan (NAPCC) • Standards will be developed (as part of project activities or thereafter) once more data on performance in the project's monitoring activities becomes available. Standards have been developed for solar water heaters, while those for solar concentrating power are under way, so the capacity exits. The Standards Bureau (BIS) is involved and part of PSAC. For now, the likelihood of abrupt changes is considered minimal in terms of institutional support. *Institutional sustainability is likely*
Socioeconomic (and capacity risks)	
• The Indian renewable energy industry is growing at a very rapid pace and there exists strong competition to attract human resources. In the short run, this can directly affect project implementation (e.g. delays in encountering project staff or for; major escalation in the necessary remuneration rate for project staff or consultants placing pressure on project budgets). In the long run, there is a risk that the CSH field could lose (project-trained) human resources to the other renewable energy industries; • Failure to obtain cooperation from manufacturers (Indian and foreign) as well as from existing and prospective users of CSH systems (sharing of info; accessibility for discussions; willingness to participate in events and trainings); limited interest of academia and service providers/consultants to participate; • Failure to trigger a suitable positive response from manufacturers of solar concentrators (Indian and International) to expand the supply of CSH system types in India and to scale up manufacturing so that economies of scale effects lower CSH prices towards a point where simple paybacks are more attractive. As in the typical 'hen or the egg, who was first?' question, scaling up may not be obtained if not triggering a positive response from the Indian CSH user industries, which again is influenced by the cost of (and subvention available) of CSH systems (see below);	• This risk exists, but in the project trainings several persons will be trained, so if transferred, would be replaced (not leading to any stoppage). As the CSH industry grows so will the grow the pool of people with expertise on CSH development and application; • As part of the process of applying for MNRE's subsidy scheme, both manufacturers and users are already sharing basic information, although this will not be in the public domain. Also, various companies are participating in the performance monitoring at 15 sites and provided data for the Compendium (2013) and info packages on CST and heat applications in selected companies (see Outcomes 1.1/1.2 and 2.2). In meetings, awareness programs and conferences, in general a range of stakeholder participated; • The project's results so far already indicate a more improved perception of business opportunities in the CSH area. The project is supporting about 53 demo and replication projects (of which 20 installed) out of the 90 targeted at project's end. At this mid-point in project implementation, we consider the *socioeconomic sustainability as likely*.
Financial (and techno-economic)	
• A dramatic slowdown in the Indian economy, rising interest rates as well as the international price of oil or large subsidies for oil products such as furnace oil for process heat applications in India, and/or a significant reduction in the price of electricity and and/or a major improvement in the reliability of electricity supply – hence significantly undermining the economics of CSH in India;	• As mentioned, we do not consider likely that abrupt changes in the subsidy scheme will occur. A more important issue is that current MNRE CSH subsidy programme does not sufficiently distinguish between the performances of the different CSH technologies, and has been essentially developed for the Scheffler CSH technology, the most prevalent technology before

Risk	Assessment of status
• Demand is influenced by the costs of the systems with payback times between about 4-11 years. The demonstration and replication projects will be strongly reliant on the continued existence and accessibility of CSH subsidies from the MNRE solar support programme (that lower payback times to 3-8 years; see Table Box 10). This assumes that the subsidy scheme is not discontinued or drastically changed; • CST remains limited to the two technologies currently employed (Scheffler and ARUN) that may not be suitable for all applications, depending on thermal output, heating fluid temperature, space available for the CSH system, etc. • Banks do not really consider CSH for lending; an area that they are not familiar with or find too risky ort both	project initiation. We understand that the Project will look into the issue as part of Component 4. • Apart from Scheffler technology (for institutional cooking), other technologies are being demonstrated and showcased for a range of applications (cooling, process heat) with, (see Boxes 10, 11 and 12); • International price and currency exchange developments are outside the project's control and an external risk factor. However, investment decisions should be taken on a longer-term perspective rather than current fuel prices. Nonetheless, even without price fluctuations, the payback time on investment remains an issue with payback times typically between 4-8 years, even with subsidy. Companies generally will expect 2-3 years (or less) and consider CSH due to their corporate social responsibility (CSR) rather than out of financial motives. While technologically proven, CST in most applications is 'near-commercially' viable only. Out of 'social' or 'green' motives, larger companies may be interested. Smaller companies have the issue that, although CSH application may have a larger impact on their energy load than in larger ones, these are in general short of funds and find it difficult to invest in the absence of adequate loans with financial institutions generally being reluctant to provide loans for CSH We assess *financial and techno-economic) sustainability as moderately likely therefore.*

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Overall results and summary of ratings

Mid-term review questions (see Box 1)

- Identify remaining barriers to achieving the project objective in the remainder of the project, and by reviewing the aspects of the project that have already been successful, identify ways in which the project can further expand these benefits;'
- A MTR Ratings & Achievement Summary Table will be provided, summarizing the ratings on a) results, b) implementation and adaptive management, 3) sustainability with a short description of the rating's justification

Box 18 provides a summary of the ratings for a) progress towards results, b) project implementation and adaptive management and c) sustainability. Although not strictly required, a rating for 'design and relevance' has been added

Box 18 Mid-term review ratings and achievements summary table

Main criteria	Rating	Explanation
Progress towards results	HS	See Chapter 5. The Project has progressed most significantly in Component 1 by establishing two testing centres, mobile test stations and preparing a report on protocols and test procedures. Monitoring of CSH installations at 15 sites is ongoing in order to understand performance and in the end will provide input into performance benchmarking. A baseline report on CSH installations was prepared (Compendium) as well as information packages on CST available and showcasing in certain applications. On capacity building (Component 2), the Project has advanced in a highly satisfactory manner, by holding 40 awareness workshops in different States, advertisements in dailies, supporting the publications of regular magazines and newsletters, launching a dedicated website. Skills and knowledge has been enhanced by means of training workshops and publication of manuals. Under Component 3, the Project has supported feasibility studies and (where needed) detailed project reports and committed support for 53 demonstration and replication projects (with a total of 16,400 m^2 of collector area), of which 20 have been installed. Progress is slower than mid-term targets given in the ProDoc, but this can be attributed to external reasons (e.g. delays in sanctioning of subsidy requests by MNRE), while the Project budget available for project support will anyhow only appear in the 2015-16 budget sheets. Component 4 addresses financial barriers and this is where progress has been slowest. It can be mentioned that IREDA has concurred to finance CSH projects.
- Component 1 - Component 2 - Component 3 - Component 4	- HS - HS - HS - MS	
Design and relevance	- R	See Chapter 4. In India, a range of Indian organizations – from MNRE, academia, institutions to commercial entrepreneurs - have done a considerable amount of the necessary groundwork in terms of technology development and market promotion for solar concentrators for process heat applications (CSH) for cooking, cooling and industrial processes. Supporting this nascent market of CSH has been the target of the project and it should be noted that, given the lack of real experience worldwide with CSH, the Project is supporting India in realizing a leap-frogging innovation. The project documentation we consider well-written, concise and encompassing the details needed, addressing the barriers and capacity strengthening needs and crafting these into an appropriate list of expected outcomes and outputs and

		activities (logframe), although the list of progress indicators in the logframe could have been improved
Implementation and adaptive management	HS	See Chapter 5. In Components 1 and 2 the project has overachieved and in Component 3 is advancing more or less as planned. Financially delivery (taking into account the USD 500,000 committed to demo project support, but not booked yet as expenditure) follows the achievements in the Components as mentioned above. Where needed, the Project team has undertaken a number of adaptive management measures in response to issues encountered. The Project works very well with the various stakeholders, including local entities (state nodal agencies), institutes and academia (such as NISE and Pune University), CST manufacturers and their associations, consultant companies as well as beneficiaries (from various industrial sectors as well as non-profit).
- Management and reporting; M&E - Stakeholder involvement - Budget and co-finance	HS HS S	
Sustainability	ML	Supporting solar thermal (including CSTs) is part of the sustainable energy and climate change policies with formulated targets. The CSH sector shows a growing trend with more Indian manufacturers and more applications in various industrial subsector and more CSTs being installed (apart from the Scheffler dishes and ARUN). There is no indication that subsidies for CSH will be cut back on the short run, but of course long-run development is difficult to predict. The rating of ML is largely due to the fact that, even with subsidy many CSH applications will be near-commercial only for a long term. However, the idea is that as the market expands, economics of scale will eventually lead to a drop in CST prices, while financial institutions (other than IREDA) may have a more positive look at providing loans for CSH based on results evidenced by more and more installations.
Impact	L	Prior to project initiation, the focus of CSH in India was on smaller installations for institutional cooking, using Scheffler technology mainly. The project is successfully demonstrating applications of other CSTs in a range of industrial sectors for various applications (apart from cooking, cooling and process heat)

HS: highly satisfactory, S: satisfactory, MS: marginally satisfactory, R: relevant, ML: moderately likely

In conclusion, we can conclude that the Project has been instrumental in lowering *barriers* to the more widespread application of the CSH:

- *Technology package barriers*, by supporting the development of various information packages (on each of the 6 CST technologies and by presenting case studies) as well as by making other knowledge products available by means of the CSH India website, newsletters, etc. Assessments of technology (field survey of 100 installations), of manufacturers' facilities and sectoral case studies have consolidated the baseline information available on the options and issues with CST application in a range of heat applications for various end uses (cooking, cooling, process heat). To remedy the barrier of credibility of actual performance of CSH systems, a process of systematic monitoring of the CSH applications has been initiated. For the first time in India, testing facilities (both mobile and immobile) have been set up for this purpose. Quantified performance data will yield valuable info for prospective CSH users (confidence) and to manufacturers (suggestions for product improvement) alike. BIS standards for testing procedures are currently in progress. Meanwhile, performance norms for anticipated heat delivery in different regions and parts of Indiavfor various CSTs have been made available;
- *Awareness and capacity barriers*, by organising a technical training programme on 'operation and maintenance and troubleshooting' with manuals for each of the 6 CSH technologies (in English and Hindi), organisation of awareness raising workshops and supporting recurrent publications (Insolthermal Times; Sun Focus); and organisation of exposure trips;
- *Demonstration.* Technical support has been extended to the formulation of feasibility studies. Additional financial support has been or is planned to be provided to 53 demonstration and replication projects (of which 20 have been installed up to date).

Since project inception, the number of projects (installed and planned) has increased significantly, as well the number of annual installations (and corresponding CST area). Apart from Scheffler (and ARUN), other CST technologies are making in-roads. Nonetheless, less progress has been made in addressing financial barriers and issues, which will be discussed in the next Section 8.2.

8.2 Recommendations

Mid-term review questions (see Box 1)

- Recommendations:
  - Corrective actions for the design, implementation, monitoring and evaluation of the project
  - Actions to follow up or reinforce initial benefits from the project
  - Proposals for future directions underlining main objectives

1) Increased focus on removing the financial barriers (Component 4 and Sustainability)

The rating for achievement of results corresponds with our assessment of how the Project is on its way to lower barriers (technical, awareness) and how likely it will be have sustainability of the project-supported interventions after the project's end. In this respect, CSH India has focussed (with achievements) on technological and capacity and awareness barriers. In the second half, the attention should shift more towards financial and policy issues.

As indicated already in the Project Document, in present from the MNRE subsidy scheme does not sufficiently differentiate between different CSH technologies on the basis of their performance. The current subsidy system (30% of benchmark price) lowers payback times to 4-8 years, which is still not deemed financially attractive enough by beneficiaries[25]. On the other hand, high subvention levels will deter manufacturers to improve their product and for beneficiaries to integrate CST more efficiently into their processes. Eventually, as the market develops and sales volumes increase, the cost of CSH will come down, but this may take 15 years or so. Meanwhile, the Project can support the subvention discussion by (when more performance data become available as a result of the online monitoring and demo project evaluations) updating and documenting actual financial and payback performance indicators as a basis for formulation of a suitable policy for CSH (under the JN National Solar Mission) with a revised subsidy system, taking into account the performance of the various CST per climatic region and type of application, and more clearly stating the role of financial institutions.

The online monitoring provides info on the systems installed and, over time, and might enable setting performance benchmarks[26]. Benchmarks would enable MNRE to adapt its subsidy system from providing incentives based on m^2 installed to a more performance-based subsidy system.

The latter will require capacity building and awareness creation amongst banks and other financial institutions, who are in general not familiar with the CST technology. It will also require the identification of appropriate financing mechanisms, in which the subsidy element would decrease slowly over time. To raise confidence level of potential investors, setting up 'risk guarantee schemes' may be optional. The Project has only just started involving commercial energy service companies (ESCOs). The ESCO mode can potentially help the beneficiary in some risk sharing after the warranty period expires. The Project should explore the pros and cons of the ESCO route further. Up to now, there has been no much progress in the 'ESCO route'. The Project has been optimistic and expects some 5-10 ESCO projects coming in 2015, so the proof of the pudding will be in the eating.

[25] Given the fact that benchmark are often 5-7 years old, not representing current capital cost. It was mentioned that the MNRE subsidy works out at 20% of capital cost.

[26] If quality of data improve. Data reliability depends on various factors, e.g. cleanliness of pyranometers are cleaned every day, regular adjusting of the shading ring on the pyranometers, iii) cleaning of reflectors of CSTs, iv) repairs on part of the whole CST system; v) data transmission problems, etc. An assignment on 'Collection & Compilation of performance data on CST based systems through remote monitoring'' has been recently awarded to a consulting firm and is expected to provide data for 80 systems by end of the project. Methodology and format for collection of data are described in the ToR of the assignment.

3) Continuation of training (Components 1)

A number of technical trainings were provided at various locations on 'operation, maintenance and troubleshooting'. These trainings were typically of 3-day duration. As part of the contracts, usually manufacturers are required to train personnel 'on-the-job' of the unit or company where the CST will be installed. However, we have three observations. First, trained personnel may depart after a while, thus leaving a knowledge gaps. Second, staff trained by a particular manufacturer may not be fully knowledgeable of the designs of other manufacturers (even if the same CST is concerned). Third, a 3-day training may not be enough and periodic 'refresher' trainings may be needed. The training modules (developed by Anthropower) have potential for future replication and could be 'institutionalised' (implemented by one or more institutions as a course, possibly on a self-sustenance basis). One recommendation is to refresh the stocktaking of training needs (especially as more systems of different CSTs will get installed over 2015-16) and adapt, expand and extend training and short courses in accordance with the findings of this stocktaking.

4) Testing (Component 1)

Testing focusses on the performance of CST systems, although in the project these will be all recently installed systems. However, CSTs may reach a 15-20 year lifetime. As no old equipment is currently installed, testing could be expanded by adding methods of artificially aging of the equipment. Two such tests include salt spray tests and abrasion test. Another advanced testing set-up would be for measuring optical performance of the CST (e.g. photogrammetry). These were not part of the Project design and its budget will not allow more funds to be allocated for testing equipment. Even if funding would be available, we would like to caution against establishing an expensive testing infrastructure, which may be not be used in the end in a cost-effective way. The best approach would be to see how the existing test centres (Pune, NISE) will function over the coming years, not only from a technical viewpoint, but cost-effectiveness as well. To improve their economics these can double as testing and as training facility. Towards the end of the CSH India Project it could be investigated how the test facilities can be expanded, e.g. by acquiring more equipment (to do salt spray and abrasion tests). Given the fact that perhaps the testing at Pune and NISE are the only facilities in the region, it should be investigated, if these could function at a regional level. Pooling funding for such a regional function could enable financing of expensive testing infrastructure in a more cost-effective way.

5) International cooperation (sustainability)

There is need for continuing cooperation between the various institutions, associations and agencies working on concentrated solar. Such cooperation may include data sharing (respecting confidentiality), knowledge sharing, joint events and promotional events. Regarding research institutions and academia this could include a more intense cooperation with institutions (and companies) abroad. India can learn from the advanced test laboratories and facilities abroad and more fully understand international 'best practices'.

Given India's position as a pioneer worldwide in (commercial) CSH application, this offers scope for South-South cooperation. A provision should be made in the Project's work plans to transfer the 'lessons learnt' in CST and heat applications to abroad. The CSH India Project has the potential to be presented as a 'best practice' and UNDP might devote some resources to present the Project, internally as an example of the potential role of CST, and externally, at sustainable energy and climate change fora and events.

6) UNIDO/GEF "Promoting business models for increasing penetration and scaling up of solar energy

The project was initiated in 2014 (approved by GEF in Dec 2013) with an expected 5-year duration, and will focus on solar-based technology for industry, focussing on processes in the temperature range of 150-400°C in various industries, such as pulp and paper, food processing, fertilizer, pharmaceutical industries, textiles, desalination and tobacco industry. Its four components are similar to the CSH India Project, a) strengthening policy and institutional framework; b) technology investment and application (including 15-25 pilot

demonstrations), c) scaling up (business models and financing; supply of quality components), and d) awareness raising and capacity building.

Box 19 UNIDO/GEF Promoting business models for increasing penetration and scaling up of solar energy

The GEF-UNIDO project aims to facilitate the installation of 45,000 m^2 of installed CS collector area through 15-25 demonstration and 60 replication projects. Direct emission reductions from these projects during its 5 year period are estimated at 39,200 tonnes of CO_2. In addition the initiative aims to provide technology application information packages and standardization of CS performance measurement. Applications of solar heat at medium and high temperatures would be considered during the project in the following industrial sectors: Textiles (Weaving, Finishing), Pharmaceuticals, Tobacco, Breweries, Pulp & paper, Electroplating, Food processing (including Dairy & Sugar), Rubber, Chemical & Fertiliser, Petroleum Refineries, Desalination, Ceramic tile & pottery, Plaster of Paris, Steel re-rolling, Cement, Mining, Other industries including tertiary using steam or cooling.

The PMU has been coordinating with UNIDO on project design. The following had been worked out to avoid overlapping:

- Under UNIDO only:
  - Co-generation and tri-generation projects in all establishments
  - New projects on space cooling/ Replacement of electrical driven VCR systems with VAR systems & on industrial refrigeration
  - Stand-alone hybrid systems for process heat application with automatic operations & storage facility to take care of intermittent clouds
  - Projects based on heat pipes
- Under UNDP only:
  - Projects based on community cooking in all establishments
- Under both:
  - Normal projects for process heat applications in industrial & commercial sectors
  - Retrofitted space cooling projects

Finally, a regular monitoring of both projects and their respective results will be foreseen to identify potential issues and take appropriate action for more refined alignment between the projects as they move forward. Both the GEF-UNDP and GEF-UNIDO project will co-ordinate closely through MNRE. This will be ensured by having regular updates and representation in the respective Project Steering Committees and by the fact both projects have the same NPD (Mr. Tarun Kapoor). More specifically, for the future coordination of both projects a close consultation and "**coordination platform"** will be established at MNRE level in order to exchange information and progress on both projects and formulate recommendation for alignment where required (this platform will indicatively convene every 2 months; chaired by the NPD/Joint Secretary).

Supposedly, the focus will towards the lower temperature of the range 150-400°C in SMEs (small and medium-sized enterprises), while arrangements have made to avoid overlapping (as described in Box 19). However, it might be difficult to avoid duplication and it is recommended that the functioning of the proposed 'coordination platform' will be closely monitored.

6) Suggestions for end-of-project report (Sustainability)

Towards the end of the project (Dec 2016) it might be helpful to commission an 'end-of-project' *impact study* to analyse to what extent the before-mentioned barriers to CST (technical, market demand, financial, informational, etc.) got removed and indicate what important *gaps* are still remaining, accompanied by a plan with suggested post-project *actions* to be implemented by the various actors involved (government, local government, academia and institutions, associations/representatives of manufacturers and beneficiaries).

This report should also address an exit strategy for certain activities initiated or supported under the project, once project funding dries up, e.g. maintaining and regular updating of the CSH India website, publications, monitoring of CST installations, toll-free support line, etc.

8.3 Lessons learned

Mid-term review questions (see Annex E)

- Lessons learned, if any, in addressing issues relating to relevance, performance and success

Although concentrated solar technology for heat applications (CSH) not a technology that globally has met much recognition as a proven, let alone, viable technology, India has managed to initiate a market for the near-commercial application of CSH. Although led by a small management unit team, the UNDP/GEF CSH India Project has had a significant influence in lowering barriers leading to a noticeable increase in the installation of CSH systems. One reason is that is embedded in a government policy promoting solar thermal technologies, and second, because of working closely with a range of stakeholders from other government entities, CSH suppliers, beneficiary industries and institution, an academia.

ANNEX A. TERMS OF REFERENCE

1. INTRODUCTION

This is the Terms of Reference (ToR) for the UNDP-GEF Midterm Review (MTR) of the full sized project titled Market Development & Promotion of Solar Concentrators for Process Heat Applications in India (PIMS 4284) implemented through the Ministry of New & Renewable Energy (MNRE), which is to be undertaken in 2014. The project started on the 28th March 2012 and is in its third year of implementation. In line with the UNDP-GEF Guidance on MTRs, this MTR process was initiated before the submission of the second Project Implementation Report (PIR). This ToR sets out the expectations for this MTR. The MTR process must follow the guidance outlined in the document Guidance For Conducting Midterm Reviews of UNDP-Supported, GEF-Financed Projects link http://gef.undp.org/uploads/H- Jk1_dCXqGqaPG4BlccvA/Guidance_for_Conducting_Midterm_Reviews_of_UNDP-Supported_GEF- Financed_Projects_Final_June_2014.pdf

2. PROJECT BACKGROUND INFORMATION

The industrial sector is the second largest energy intensive sector in India accounting for about 37% of the total consumption. Process heat applications in sectors such as pharmaceuticals, metal plating, food processing, textiles and dairy require significant amount of heat in the low – medium temperature range of 90 to 250° C. They currently use fossil fuels such as furnace oil, diesel, coal, biomass and electricity for their energy needs. The process heat needs can be met with Concentrating Solar Heat (CSH) systems along with suitable process integration and heat storage.

The UNP-GEF-MNRE CSH project objective is to increase the use and promotion of CSH systems for low and medium temperature process heat applications. It aims to complement the efforts of MNRE to promote the use of Solar Concentrators for process heat applications by overcoming existing barriers in technology, awareness, capacity, market and financial. The overall project objective is to reduce the CO2 emission reductions by 32,900 tCO2 through technical support for setting up of demonstration and replication projects cumulating to 45,000 sq m of collector area. The project interventions will help in the tripling of the annual sales to 15,000 sq. m/ year by end of project. It will be implemented over a 5 year period until March 2017 across India. The key outcomes of the project are: (i) Technical Capacity Development, (ii) Awareness enhancement and capacity building, (iii) Pilot demonstration of CSH technologies for various applications, and (iv) Sustainable financial approach in the adoption of CSH technologies and applications. The total budget for the project is USD 23,750,000 – GEF: USD 4,400,000; MNRE (grants): USD 6,000,000; MNRE (in kind): 1,350,000; Industries: USD 6,000,000;
Financial Institutions: USD 6,000,000. Key stakeholders in the project are: National Institute of Solar Energy (formerly SEC), end users, CSH manufacturers and other subject experts/academic institutions.

3. OBJECTIVES OF THE MTR

The MTR will assess progress towards the achievement of the project objectives and outcomes as specified in the Project Document, and assess early signs of project success or failure with the goal of identifying the necessary changes to be made in order to set the project on-track to achieve its intended results. The MTR will also review the project's strategy, its risks to sustainability.

4. MTR APPROACH & METHODOLOGY

The MTR must provide evidence based information that is credible, reliable and useful. The MTR team will review all relevant sources of information including documents prepared during the preparation phase (i.e. PIF, UNDP Initiation Plan, UNDP Environmental & Social Safeguard Policy, the Project Document, project reports including Annual Project Review/PIRs, project budget revisions, lesson learned reports, national strategic and legal documents, and any other materials that the team considers useful for this evidence-based review). The MTR team will review the baseline GEF focal area Tracking Tool submitted to the GEF at CEO endorsement, and the midterm GEF focal area Tracking Tool that must be completed before the MTR field mission begins.

The MTR team is expected to follow a collaborative and participatory approach1 ensuring close engagement with the Project Team, government counterparts (the GEF Operational Focal Point), the UNDP Country Office(s), UNDP-GEF Regional Technical Advisers, and other key stakeholders.

Engagement of stakeholders is vital to a successful MTR.2 Stakeholder involvement should include interviews with stakeholders who have project responsibilities, including but not limited to executing agencies, senior officials and task team/component leaders, key experts and consultants in the subject area, Project Board, project stakeholders, academia, local government and CSOs, etc. Additionally, the MTR team is expected to conduct field missions to New Delhi, Gurgaon, Pune, and Bangalore/Mysore

The final MTR report should describe the full MTR approach taken and the rationale for the approach making explicit the underlying assumptions, challenges, strengths and weaknesses about the methods and approach of the review.

5. DETAILED SCOPE OF THE MTR

The MTR team will assess the following four categories of project progress. See the Guidance For Conducting Midterm Reviews of UNDP-Supported, GEF-Financed Projects (link http://gef.undp.org/uploads/H-Jk1_dCXqGqaPG4BlccvA/Guidance_for_Conducting_Midterm_Reviews_of_UNDP-Supported_GEF-Financed_Projects_Final_June_2014.pdf) for extended descriptions.

5.1 Project Strategy

Project design:

- Review the problem addressed by the project and the underlying assumptions. Review the effect of any incorrect assumptions or changes to the context to achieving the project results as outlined in the Project Document.
- Review the relevance of the project strategy and assess whether it provides the most effective route towards expected/intended results. Were lessons from other relevant projects properly incorporated into the project design?
- Review how the project addresses country priorities. Review country ownership. Was the project concept in line with the national sector development priorities and plans of the country (or of participating countries in the case of multi-country projects)?
- Review decision-making processes: were perspectives of those who would be affected by project decisions, those who could affect the outcomes, and those who could contribute information or other resources to the process, taken into account during project design processes?
- Review the extent to which relevant gender issues were raised in the project design. See Annex 9 of Guidance For Conducting Midterm Reviews of UNDP-Supported, GEF-Financed Projects for further guidelines.
- If there are major areas of concern, recommend areas for improvement.

Results Framework/Logframe:

- Undertake a critical analysis of the project's logframe indicators and targets, assess how "SMART" the midterm and end-of-project targets are (Specific, Measurable, Attainable, Relevant, Time-bound), and suggest specific amendments/revisions to the targets and indicators as necessary.
- Are the project's objectives and outcomes or components clear, practical, and feasible within its time frame?
- Examine if progress so far has led to, or could in the future catalyse beneficial development effects (i.e. income generation, gender equality and women's empowerment, improved governance etc.) that should be included in the project results framework and monitored on an annual basis.
- Ensure broader development and gender aspects of the project are being monitored effectively. Develop and recommend SMART 'development' indicators, including sex-disaggregated indicators and indicators that capture development benefits.

5.2 Progress Towards Results

Progress Towards Outcomes Analysis:

- Review the logframe indicators against progress made towards the end-of-project targets using the Progress Towards Results Matrix and following the Guidance For Conducting Midterm Reviews of UNDP- Supported, GEF-Financed Projects; colour code progress in a "traffic light system" based on the level of progress achieved; assign a rating on progress for each outcome; make recommendations from the areas marked as "Not on target to be achieved" (red).

Table. Progress Towards Results Matrix (Achievement of outcomes against End-of-project Targets)

Project Strategy	Indicator	Baseline Level	Level in 1st PIR	Midterm Target	End-of-project Target	Midterm Level & Assessment	Achievement Rating	Justification for Rating
Objective:	Indicator (if applicable):							
Outcome 1:	Indicator 1:							
	Indicator 2:							
Outcome 2:	Indicator 3:							
	Indicator 4:							
	Etc.							
Etc.								

Indicator Assessment Key

Green= Achieved	Yellow= On target to be achieved	Red= Not on target to be achieved

In addition to the progress towards outcomes analysis:

- Compare and analyse the GEF Tracking Tool at the Baseline with the one completed right before the Midterm Review.
- Identify remaining barriers to achieving the project objective in the remainder of the project.
- By reviewing the aspects of the project that have already been successful, identify ways in which the project can further expand these benefits.

5.3 Project Implementation and Adaptive Management

Management Arrangements:

- Review overall effectiveness of project management as outlined in the Project Document. Have changes been made and are they effective? Are responsibilities and reporting lines clear? Is decision- making transparent and undertaken in a timely manner? Recommend areas for improvement.
- Review the quality of execution of the Executing Agency/Implementing Partner(s) and recommend areas for improvement.
- Review the quality of support provided by the GEF Partner Agency (UNDP) and recommend areas for improvement.

Work Planning:

- Review any delays in project start-up and implementation, identify the causes and examine if they have been resolved.
- Are work-planning processes results-based? If not, suggest ways to re-orientate work planning to focus on results?
- Examine the use of the project's results framework/logframe as a management tool and review any changes made to it since project start.

Finance and co-finance:

- Consider the financial management of the project, with specific reference to the cost-effectiveness of interventions.
- Review the changes to fund allocations as a result of budget revisions and assess the appropriateness and relevance of such revisions.
- Does the project have the appropriate financial controls, including reporting and planning, that allow management to make informed decisions regarding the budget and allow for timely flow of funds?
- Informed by the co-financing monitoring table to be filled out, provide commentary on co-financing: is co-financing being used strategically to help the objectives of the project? Is the Project Team meeting with all co-financing partners regularly in order to align financing priorities and annual work plans?

Project-level Monitoring and Evaluation Systems:

- Review the monitoring tools currently being used: Do they provide the necessary information? Do they involve key partners? Are they aligned or mainstreamed with national systems? Do they use existing information? Are they

efficient? Are they cost-effective? Are additional tools required? How could they be made more participatory and inclusive?
- Examine the financial management of the project monitoring and evaluation budget. Are sufficient resources being allocated to monitoring and evaluation? Are these resources being allocated effectively?

Stakeholder Engagement:
- Project management: Has the project developed and leveraged the necessary and appropriate partnerships with direct and tangential stakeholders?
- Participation and country-driven processes: Do local and national government stakeholders support the objectives of the project? Do they continue to have an active role in project decision-making that supports efficient and effective project implementation?
- Participation and public awareness: To what extent has stakeholder involvement and public awareness contributed to the progress towards achievement of project objectives?

Reporting:
- Assess how adaptive management changes have been reported by the project management and shared with the Project Board.
- Assess how well the Project Team and partners undertake and fulfil GEF reporting requirements (i.e. how have they addressed poorly-rated PIRs, if applicable?)
- Assess how lessons derived from the adaptive management process have been documented, shared with key partners and internalized by partners.

Communications:
- Review internal project communication with stakeholders: Is communication regular and effective? Are there key stakeholders left out of communication? Are there feedback mechanisms when communication is received? Does this communication with stakeholders contribute to their awareness of project outcomes and activities and investment in the sustainability of project results?
- Review external project communication: Are proper means of communication established or being established to express the project progress and intended impact to the public (is there a web presence, for example? Or did the project implement appropriate outreach and public awareness campaigns?)
- For reporting purposes, write one half-page paragraph that summarizes the project's progress towards results in terms of contribution to sustainable development benefits, as well as global environmental benefits.

5.4 Sustainability

- Validate whether the risks identified in the Project Document, Annual Project Review/PIRs and the ATLAS Risk Management Module are the most important and whether the risk ratings applied are appropriate and up to date. If not, explain why.
- In addition, assess the following risks to sustainability:

Financial risks to sustainability:
- What is the likelihood of financial and economic resources not being available once the GEF assistance ends (consider potential resources can be from multiple sources, such as the public and private sectors, income generating activities, and other funding that will be adequate financial resources for sustaining project's outcomes)?

Socio-economic risks to sustainability:
- Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public/stakeholder awareness in support of the long term objectives of the project? Are lessons learned being documented by the Project Team on a continual basis and shared/ transferred to appropriate parties who could learn from the project and potentially replicate and/or scale it in the future?

Institutional Framework and Governance risks to sustainability:
- Do the legal frameworks, policies, governance structures and processes pose risks that may jeopardize sustenance of project benefits? While assessing this parameter, also consider if the required systems/mechanisms for accountability, transparency, and technical knowledge transfer are in place.

Environmental risks to sustainability:

- Are there any environmental risks that may jeopardize sustenance of project outcomes?

Conclusions & Recommendations

The MTR team will include a section of the report setting out the MTR's evidence-based conclusions, in light of the findings.8 Recommendations should be succinct suggestions for critical intervention that are specific, measurable, achievable, and relevant. A recommendation table should be put in the report's executive summary. See the Guidance For Conducting Midterm Reviews of UNDP-Supported, GEF-Financed ojects for guidance on a recommendation table.

The MTR team should make no more than 15 recommendations total.

Ratings

The MTR team will include its ratings of the project's results and brief descriptions of the associated achievements in a MTR Ratings & Achievement Summary Table in the Executive Summary of the MTR report. See Annex E for ratings scales. No rating on Project Strategy and no overall project rating is required.

Table. MTR Ratings & Achievement Summary Table for (*Market Development and Promotion of Solar Concentrator based Process Heat Applications in India (India CSH*)

Measure	MTR Rating	Achievement Description
Project Strategy	N/A	
Progress Towards Results	Objective Achievement Rating: (rate 6 pt. scale)	
	Outcome 1.1 Outcome 1.2 Outcome 1.3 Achievement Rating: (rate 6 pt. scale)	
	Outcome 2.1 Outcome 2.2 Achievement Rating: (rate 6 pt. scale)	
	Outcome 3.1 Outcome 3.2 Achievement Rating: (rate 6 pt. scale)	
	Outcome 4.1 Outcome 4.2 Achievement Rating: (rate 6 pt. scale)	
Project Implementation & Adaptive Management	(rate 6 pt. scale)	
Sustainability	(rate 4 pt. scale)	

6. TIMEFRAME

Total duration of the MTR will be approximately (5 weeks) starting 30th September 2014, and shall not exceed five months from when the consultant(s) are hired. The tentative MTR timeframe is as follows:

TIMEFRAME	ACTIVITY
12th September – 19th September 2014	Application closes
22nd September to 30th September	Select MTR Team
1st October to 10th October 2014	Prep the MTR Team (handover of Project Documents)
13th October to 17th October 2014	Document review and preparing MTR Inception Report
22nd October 2014	Finalization and Validation of MTR Inception Report- latest start of MTR mission
27th October to 3rd November 2014, 7	MTR mission: stakeholder meetings, interviews, field visits
3rd November 2014	Mission wrap-up meeting & presentation of initial findings- earliest end of MTR mission
3rd November to 18th November 2014	Preparing draft report
26th November 2014	Incorporating audit trail from feedback on draft report/Finalization of MTR report
1st December 2014	Preparation & Issue of Management Response
1st December 2014	Expected date of full MTR completion

Options for site visits should be provided in the Inception Report.

7. MIDTERM REVIEW DELIVERABLES

#	Deliverable	Description	Timing	Responsibilities
1	**MTR Inception Report**	MTR team clarifies objectives and methods of Midterm Review	No later than 2 weeks before the MTR mission	MTR team submits to the Commissioning Unit and project management
2	**Presentation**	Initial Findings	End of MTR mission	MTR Team presents to project management and the Commissioning Unit
3	**Draft Final Report**	Full report (using guidelines on content outlined in Annex B) with annexes	Within 3 weeks of the MTR mission	Sent to the Commissioning Unit, reviewed by RTA, Project Coordinating Unit, GEF OFP
4	**Final Report***	Revised report with audit trail detailing how all received comments have (and have not) been addressed in the final MTR report	Within 2 weeks of receiving UNDP comments on draft	Sent to the Commissioning Unit

*The final MTR report must be in English. If applicable, the Commissioning Unit may choose to arrange for a translation of the report into a language more widely shared by national stakeholders.

8. MTR ARRANGEMENTS

The principal responsibility for managing this MTR resides with the Commissioning Unit. The Commissioning Unit for this project's MTR is UNDP CO, India.

The commissioning unit will contract the consultants and ensure the timely provision of per diems and travel arrangements within the country for the MTR team. The Project Team will be responsible for liaising with the MTR team to provide all relevant documents, set up stakeholder interviews, and arrange field visits.

9. TEAM COMPOSITION

A team of two independent consultants will conduct the MTR - one team leader (with experience and exposure to projects and evaluations in other regions globally) and one team expert, usually from the country of the project.

The consultants cannot have participated in the project preparation, formulation, and/or implementation (including the writing of the Project Document) and should not have a conflict of interest with project's related activities.

The selection of International consultant will be aimed at maximizing the overall "team" qualities in the following areas:

- Recent experience with result-based management evaluation methodologies (10%);
- Experience applying SMART indicators and reconstructing or validating baseline scenarios (10%);
- Competence in adaptive management, as applied to (Climate Change Mitigation) (5%);
- Work experience working with the GEF or GEF-evaluations for at least 8 years (10%);
- Experience working in (South and South East Asia) (5%);
- Work experience in relevant technical areas for at least 10 years (10%);
- Demonstrated understanding of issues related to gender and (Climate Change Mitigation); experience in gender sensitive evaluation and analysis (2%).
- Excellent communication skills (5%);
- Demonstrable analytical skills (4%);
- Project evaluation/review experiences within United Nations system will be considered an asset (4%);
- A Master's degree in Engineering, Management, or other closely related field (5%). International consultant will act as team leader.

10. PAYMENT MODALITIES AND SPECIFICATIONS

10% of payment upon approval of the final MTR Inception Report 40% upon submission of the draft MTR report 50% upon finalization of the MTR report

ANNEX B. MISSION AGENDA AND ITINERARY

Day	Meeting and/or site visit	Relevance to the project
Sunday 14 Dec	Arrival of Mr. van den Akker in Delhi	
Mon 15 Dec Delhi	UNDP – kick-off-meeting (Mr. S.N. Srinivas)	India CSH is a GEF-UNDP-MNRE project. Mr. Srinivas is responsible at UNDP for the Project
	Anthro Power (Mr. Rama Siva, Mr. Srinivas)	Developed training manuals for O&M of 6 different CSH technologies; has conducted trainings at operators level across 12 different states
	PWC (Mr. Vibash Garg/Mr. Ishan Patel, Mr. Srinivas)	Working with potential end users in the industrial sector, and exploring their participation under project through awareness workshops & one-to-one interactions
	MNRE-PMU (Mr. R P Goswami, Mr. A K Singhal, Mr. Pankaj Kumar)	MNRE is the Implementing Partner for the project
Tue 16 Dec Gurgaon	NISE (Mr. Praveen Saxena, Mr. Sudhir Singh; Mr. Ramakrishna UNDP)	NISE is the technical partner for the project. The national test set up is also been set up here. It is also the institution which is supporting M. Tech & PhD students under the project
Wed 17 Dec Thu 18 Dec Pune area	Pune University, Test Centre (Prof. Ghaisas, Mr. Rahul Udawath, Mr. Adinath Pandey, Prof Jadkar; Ms. Manisha and Mr. Ramakrishna, UNDP)	Pune university is being supported under the project to set up a testing centre for CSH technologies.
	Solar Thermal Federation of India, STFI (Mr. Jaideep Malviya; Mr. Ramakrishna UNDP)	Outreach activities – STFI supports a toll free number for FAQs on CSH systems, and publish a monthly e-newsletter called Insoltherm Times
	Eco Axis Pvt. Ltd (Ms. Indu, Mr. Rajaram, Mr. Sirish), followed by visit to online measurements at CSH system installed at Mahindra & Mahindra Vehicles	Installed online monitoring systems in 15 CSH sites, and is assigned the task of performance monitoring & technology assessment of the 6 CSH technologies
	Thermax Pvt. Ltd (Mr. Pathak, Mr. Krishna Kumar, Mr. Raman)	One of the main vendors for Scheffler systems widely in use for cooking & laundry applications
	Mr. Sammer Maithal (by Skype) of Greentec Solutions	Was involved as a national consultant at the design state of the project
Fri 19 Dec Hyderabad	Synthokem (Mr. Sriram, Mr. Rajaram, Mr. Sirish)	Demonstration project at a drug manufacturing company – thermic fluid, parabolic dish collector
	Meeting at Synthokem's office with Mr. Siddarth Malik (Megawatt Solutions Pvt.)	Manufacturer of Parabolic dish systems
Sat-Sun Delhi	Report writing	
Mon 22 Dec	Debriefing at MNRE-PMU (Mr. Srinivas PNUD, Mr. A.K. Singhal, PMU)	
Tue 23 Dec	Departure of Mr. Van den Akker	

Mr. Mark Draeck (Project Manager at UNIDO, Vienna) was interviewed on 3 March (taking advantage of a visit by the International Consultant to Vienna) on the UNIDO/GEF project on solar (concentrating) energy.

ANNEX C. DOCUMENTS REVIEWED

Project documents, reports and UNDP-related documents

- GEF Project Identification Form (PIF)
- UNDP Project Document (with GEF CEO Endorsement Request)
- Project Inception report (May 2012)
- Annual Work Plans (2012, 2013, 2014)
- UNDP/GEF Project Implementation Reviews (PIR; 2013, 2014)
- Quarterly Monitoring Reports (2012: Q4; 2013: Q1, Q2, Q3, Q4; 2014: Q1, Q2)
- Combined Delivery Reports (2012, 2013, 2014)
- Various Back-to-Office Reports (BTORs)
- UN Development Assistance Framework (UNDAF) 2008-2012 and UNDAF 2013-2017
- UNDP Country Programme for India 2008-2012 and 2013-2017

Project-supported technical reports

- *Assessment of CST Technologies for Off-Grid Applications in the International Market* (EcoAxis Systems Pvt Ltd; Oct 2014)
- *Compendium888 on CSH Project for Community Cooking, Process Heat and Cooling Applications* (APITCO, Ltd)
- *Detailed Project Report on Development of Performance Measuring Standards, Test Procedures and Test Protocols for Concentrating Solar Technologies (CSTs) to be Used for Process Heat Applications* (University of Pune; GK Energy Marketers Ltd; Thermax India Ltd; Aksons Solar Equip. Ltd; Oct 2013)
- *Final Project Report Development of Skilled Manpower for Operation, Maintenance & Troubleshooting of CST Based System for Process Heat* (Anthropower, Nov 2014)
- *Market development of CSTs for Community Cooking / Cooling Applications in Institutional and Religious Sectors* (Ajay Chandak; Suman Foundation)
- *Pre-feasibility Report, Siddarth Surgicals, Valsad, Gujarat* (PwC, Nov 2013)
- *Process Mapping of Chemical Sector for CST Intervention* (PwC, Nov 2014)
- *Report on Assessment of CST in India* (EcoAxis Systems Pvt Ltd; Oct 2014)
- *Report on the Status of 20 CST Installations* (EcoAxis Systems Pvt Ltd; May 2014)
- *Report on the Status of Instrumentation at 15 CST Installations* (EcoAxis Systems Pvt Ltd; May 2014)
- *Report on Assessment of Facilities of CST Manufacturers* (EcoAxis Systems Pvt Ltd; May 2014)
- *Utility of Performance Monitoring of CST Systems to Various Stakeholders* (EcoAxis Systems Pvt Ltd; Oct 2014)

PowerPoint Presentations (presented during the MRT mission)

- *4th Project Steering and Advisory Committee Meeting, 5 January 2015: Project Progress and Plans for 2015* (PMU, UNDP-GEG CSH India Project)
- *Development of Skilled Manpower for the Operation, Maintenance and Troubleshooting of CST Systems* (Anthropower, Nov 2014)
- *Hybrid Solar Thermal Technologies for Polygeneration,* (NISE; S.K. Singh; Dec 14)
- *Independent Technology Assessment & Performance Evaluation of Concentrating Solar Technologies (CSTs) Based Systems for Community Cooking, Process Heat and Cooling Application* (EcoAxis Systems; 18 Dec 2014)
- *Performance Mapping and Characterization of Solar Thermal Technologies* (NISE; S.K. Singh; Dec 14)
- *Procurement and installation of equipment/instruments for on-line performance monitoring of selected Concentrating Solar Technology (CST) based installations* (EcoAxis Systems; 18 Dec 2014);

Information packages and info available at CSH India website

- *Concentrating Solar Technologies for Medium and High Temperature Application* (prepared by ExoAxis for MNRE under UNDP-GEF Project):
  - Fixed Focus Elleptical Solar Dish (Scheffler)
  - Fresnel Reflector Based Dish
  - Linear Fresnel Concentrator
  - Non-Imaging Concentrator
  - Parabolic Through Concentrator
  - Paraboloid dish
- Case studies:
  - Elaborated by PricewaterhouseCoopers (PwC):
    - Using non imaging concentrator for boiler feed water heating (ITC factory, Bangalore)
    - Using ARUN dish for washing application (Mahindra Vehicle Manufacturers, Chakan, Pune)
    - Using parabolic trough for phosphating process (SKF Technologies, Mysore)
    - Using Scheffler dish for cooking and LPG vaporisation application (Mahindra, Chakan, Pune)
    - Using Scheffler dish for steam pressing (Purple Creations, Baramati, Pune)
  - Elaborated by PRINCE, Suman Foundation:
    - Use of Scheffler Solar Concentrators for Community Cooking at SRM University Chennai
    - Use of Scheffler Solar Concentrators for Community Cooking at JNV, Leh
    - Use of ARUN 100 Solar Concentrator for Community Cooking at Akshardham Temple Delhi
  - Elaborated by WISE
    - A Case Study on Gajraj Drycleaners, Ahmednagar, for Solar Laundry
    - A Case Study on Shirdi Solar Steam Cooking System
    - A Case Study on Solar Concentrators Installed at Hotel ITC Maurya, New Delhi
    - A Case Study on Solar Concentrators Installed at CSM Hospital, Thane

Other publications and documents

- MNRE (Feb 2011)
  Strategic Plan for New and Renewable Energy Sector for the Period 2011-17
- Planning Commission (Govt of India; 2013)
  Twelfth Five Year Plan (2012-2017, Economic Sectors, Volume II
- Prime Minister's Council on Climate Change, Government of India
  National Action Plan on Climate Change

ANNEX D. INFORMATION ON SOLAR CONCENTRATORS FOR HEAT

D.1 Concentrated solar technologies

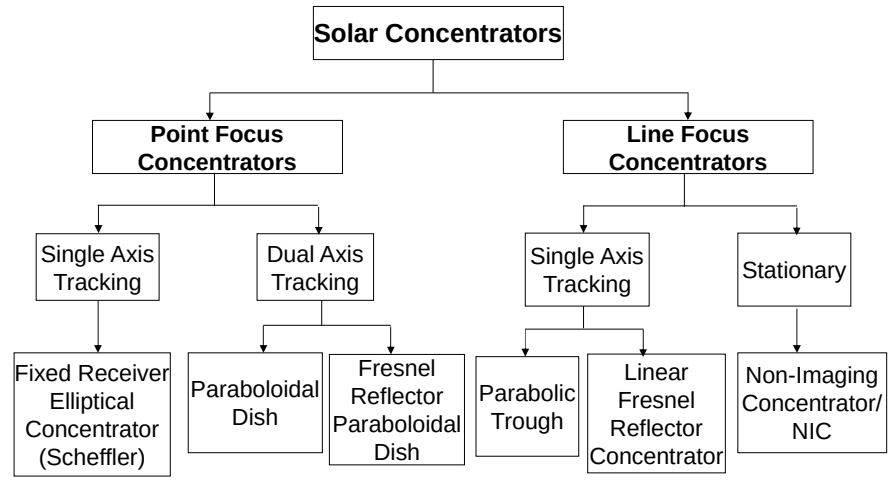
Overview

Solar thermal energy (STE) is a form of energy and a technology for harnessing solar energy to generate thermal energy or electrical energy for use in industry, and in the residential and commercial sectors. Solar thermal collector is the name for the device that collects heat by absorbing sunlight. Solar collectors are either non-concentrating (flat plate) or concentrating. The first type is used for low-temperature to medium temperature applications, usually for heating swimming pools of for heating water or air for residential or commercial use (solar water heaters) or to pre-heat water for steam production. In India, about 3.1 million of m^2 was installed by the beginning of 2010[27].

Because of the relatively high heat losses through the glazing, flat plate collectors will not reach temperatures much above 100-150°C. Where temperatures below about 95°C are sufficient, flat-plate collectors of the non-concentrating type are generally used. For temperatures over 95-120°C, concentrating solar technologies (CST) are preferred. These CSTs, also called concentrating, or concentrated solar thermal, systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. The terms Concentrated Solar Heat (CSH) is used in this report for fulfilling heat requirements in industries or other sectors, while Concentrated Solar Power (CSP) refers to applications where the heat collected is used for power generation (which is outside the scope of the CSH India Project).

CSP is only applied in a number of countries. The reader is referred to the IRENA publication on concentrating solar power[28]. By 2011/12, around 1924 MW of commercial CSP plants were operational, mainly in Spain (1331 MW) and the USA (518 MW), usually based on the parabolic through technology.

Box 20 Type of solar concentrator technologies (CSTs)



Source: EcoAxis

CSH applications use the type of CSTs as for power generation, but the technologies can be less expensive as the fluid temperature required are in the range of 120-250°C. India accounts for most of CSH applications. As of 2011/12, there were about 200 industrial CSH worldwide, of which about 85 in India[29].

There are six main solar collector technologies that are of relevance to the Project, as listed in Box 18.

[27] *Solar Water Heaters Usage in India – Current Scenario and Vision 2020-Review*, in International Journal of Recent Development in Engineering and Technology (Vol2-2; Feb 2014), by Gowda, N, et.al.

[28] *Concentrating Solar Power*, Vol 1 (Power Sector), Issue 2/5; International Renewable Energy Agency (IRENA; June 2012)

[29] EcoAxis report on CST technologies in international market; Presentation at 4th PSAC meeting (Jan 2015) (see Annex C);

Box 20 provides an overview of the features of the six solar concentrator collector technologies used in CSH applications. The CSTs differ considerably in their output (temperature, specific thermal power), cost, module size, area required and weight. Each of these parameters has a bearing on the selection of the CSH technology used for a particular application. Some CSTs, such as Scheffler (parabolic dish with fixed focus) are better suited for temperatures lower than 130°C and 150°C respectively, while other technologies can deliver higher temperatures of up to 350°C.

Application of CSH

The interest in promoting CSH technologies arises from the fact that two-third of industrial end energy consumption is thermal energy (process heat). One third of industrial process heat demand is below 200°C which suits the integration of solar concentrator systems in process heat applications. Typical temperature requirements of industrial processes are shown in Box 19.

Steam is the most widely used working fluid for providing industrial heat at up to 250ºC. Apart from steam, the other working fluids employed are pressurized hot water, hot oil and hot air. The heat-using sectors can be divided into those having large steam requirements (of > 5 tons/hour) and those having small steam requirements (of < 5 tons/hour). The industries with large steam requirements are characterized by the use of less expensive solid fuels (in particular coal) which results in a longer payback period for CSH systems; also the size and investment in a typical CSH installation would be too large to meet such a substantial steam demand. Most of the existing CSH installations in India are therefore in industries and for applications with small steam requirements and using higher cost fuels (in particular fuel oil).

Box 21 Temperature requirements of selected processes

Sector	Process	Process temperature range (ºC)
Food and beverages (hotels, hospitals, institutional cooking, dairy processing)	Drying Washing Pasteurising Boiling/cooking Sterilizing Heat treatment	30-90 40-80 80-110 95-105 140-150 40-60
Metal treatment (galvanizing, anodizing and painting)	Cleaning of the metal	60-90
Textile industry	Washing (laundry) Bleaching Dyeing	40-80 60-100 100-160
Chemical and pharmaceutical industry	Boiling Distilling Chemical processes	95-105 110-300 120-180
Rubber heating	Vulcanization	170
Cooling; air conditioning	Vaporisation	
All processes	Pre-heating of boiler feed-water	30-100

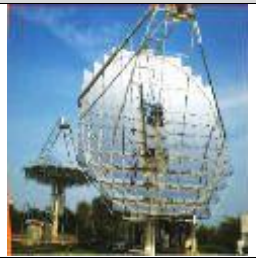
Source: Project document and other sources

D.2 Status of CSH application in India

At the time of writing the project documentation (2010), there were about 70 (semi-)commercial CSH applications (excluding very small systems, like solar cookers, comprising about 60% of all dishes) that used two CST technologies, mostly Scheffler (fixed-focus parabolic dish) and also ARUN (Fresnel reflector-based dish). Extensive efforts made researcher and solar industry, supported by the CSH India Project, have resulted in the promotion of four more CST technologies of different designs. A summary of some features the six CST technologies currently applied in India is given in Box 20. By March 2013, the number of installed CST installations had increased to 144 (again, excluding very small systems, about 280, i.e. 30% of the total):

- Steam cooking systems: 121,
- Solar cooling: 8,
- Process heat (laundry and industrial): 15

Box 22 Overview of various CST technologies

	Fixed focus elliptical dish (Scheffler)	Parabolic trough concentrator (PTC)	Fresnel reflector based dish (ARUN)	Linear Fresnel reflector concentrator (LRFC)	Paraboloid dish	Non-Imaging collector (NIC)
						
Temperature achieved (°C)	Max. 160	Max. 350	Max 350	250-400	Max 350	Max 120
Tracking Automation	Single axis Difficult	Single axis Good	Dual axis Very good	Single axis Very good	Dual axis Very good	Stationary Limited
Efficiency (%)	20-65	30-80	40-80	30-70	40-85	35-70
Manufacturers in India	10	5	1	1	2	3
Status of technology	Stabilised with scope for improvement	Stabilised	Indigenous – developing	Developing	Developing	Developing
Cost estimate (INR/m^2)[30]	18,000	18,000	20,000	18,000	20,000	16,000
Potential market in India	Institutions for cooking e.g. village schools where mid-day meals are served under the State of Central Government programmes. Market might exceed 3000 dishes.	Market in the industrial sector. Attractive if combined with a suitable thermal storage system.	Market in the industrial sector. Trade-off between cost & benefits to be addressed	Market in the industrial sector. Attractive if combined with a suitable thermal storage system. Large-scale desalination plants & large institutions may be the areas of interest.	Large users of heat at relatively high temperatures. Trade-off between size, cost and efficiency would have to be established	Applications which require hot water at temperatures < 120°C and where adequate contiguous area is available. Suitable for remote locations & schools, religious institutions, laundries, hotels, food processing
Examples	Purple Creations ITC Maurya, Delhi Mount Abu JNV, Leh Mahindra Vehicles	M. Ayurveda pharmac. SKF, Mysore	Hotel ITC Maurya Akshardam Temple Mahindra Vehicles Turbo Energy (Paiyannur)	Power supply, Gurgaon Desalination plant (Tamil Nadu)	Power supplu, Gujarat Pharmaceutical plant	ITC tobacco, Bangalore Bergen Electronics (Gurgaon)

[30] Auxiliary systems such as water treatment and storage system, piping and insulation may add additional cost of 15-30%. All data in the table compiled from EcoAxis reports (see Annex C).

Installed collector area of these 144 systems was 28,000 m^2, of which:

- Parabolic Schiffler dish, 23000 m^2,
- Parabolic ARUN dish, 2470 m^2,
- Parabolic through, 1000 m^2,
- Linear Fresnel reflector, 1500 m^2.

After March 2013, the Project has supported an additional with the preparation of 53 projects, of which 20 were installed by the end of 2014. It should be noted that the number of larger projects (i.e. > 250 m^2) has increased significantly.

In 2010 there were 10 existing CSH manufacturers in India (known to MNRE) with one manufacturer involved in the making of the locally developed ARUN parabolic dish, the rest being manufacturers of the simpler Scheffler CSH systems. The current list of manufacturers, empanelled by MNRE, for the installation of CSH systems (for cooking, cooling and process heat applications) contains 20 entries, as given below:

Box 23 List of manufacturers in India for CSH supply and installation

1. Unisun Technologies (Bangalore)	1. Single axis tracked; Scheffler dishes
2. Thermax Ltd (Chichwad, Pune)	2. Single axis tracked parabolic troughs; Scheffler dishes both single axis and double axis tracked; ETC based Non-imaging concentrating system
3. Clique Developents (Charkop, Kandivali)	3. Double axis tracked Fresnel based dishes
4. Megawatt Solutions Pvt Ltd (Chennai)	4. Double axis tracked paraboloid dishes
5. Taylormade Solar Soultion Pvt Ltd (Ahmedabad)	5. Single axis tracked Scheffler dishes
6. Essential Equipments (Deopur, Dhule; Maharashtra)	6. Single axis tracked Scheffler dishes
7. Airier Natura Pvt Ltd (Bangalore)	7. Single axis tracked Scheffler dishes
8. Sharada Inventions (Nashik)	8. Single axis tracked Scheffler dishes
9. Ultra Conserve Pvt Ltd (Mumbai)	9. Single axis parabolic trough; Non-imaging Concentrating system;
10. Bhagawatu International Ltd (Noida)	10. Single axis tracked; Scheffler dishes
11. Bergen Solar Power Ltd (Gurgaon)	11. ETC based Non-imaging concentrating
12. K Energy (Jodhpur)	12. Single axis tracked Scheffler dishes
13. Akson's Solar Equipment Pvt Ltd (Kothrud, Pune)	13. Single axis tracked Scheffler dishes
14. M/S Lveragenet Soultions Pvt Ltd (Pune)	14. Single axis Concentrated parabolic trough collector
15. M/S Forbes Solar PVt Ltd (Pune)	15. 2-axis concentrator dish
16. KG Design Services Pvt Ltd (Coimbatore)	16. Single axis tracked Linear Fresnel Reflector based systems
17. Oorja Energy Engineering (Hyderabad)	17. Dual axis parabolic trough collectors
18. Green Era Energy Pvt Ltd (Coimbatore)	18. Parabolic Trough Collectors (Single Axis)
19. ATE Enterprises Pvt Ltd (Pune)	19. Double axis Paraboloid dishes
20. M.S Jayanthi Plastics, Stellar Energy (Erode)	20. Line Focus Parabolic Trough Collectors

ANNEX E. ABOUT THE EVALUATORS

Mr. Johannes (Jan) H.A. VAN DEN AKKER is a technology management scientist with a Master's degree from Eindhoven University of Technology (Netherlands), specializing in international development cooperation. He is an expert on sustainable energy policy and technologies. Mr. Van den Akker specializes in studies and analytical work, project design and development, project coordination and implementation, project monitoring and evaluation, knowledge management, capacity strengthening and public-private partnerships in the field of sustainable energy strategies, energy efficiency, energy technologies and supply, climate change and the Clean Development Mechanism. He has lived and worked abroad for over 7 years in Zambia, Mexico and Thailand. In addition, has undertaken numerous short missions to about 45 countries in Africa, Latin America and Asia & the Pacific.

In 2003/2004 he founded ASCENDIS, as an independent office, and has been providing consultancy on sustainable energy and climate change, specializing in development issues. ASCENDIS is based in Westerhoven, Netherlands, but offers services in Africa, Asia and the Pacific, Europe and Latin America & the Caribbean, often by associating itself with local freelance experts, professionals and organizations. As a long-term expert with the United Nations system, Mr. Van den Akker has provided advice to governments and organizations on the design of investment and capacity building programs for UNEP, UNDP and UNIDO, mostly in GEF-funded activities, UNFCCC and for NGOs/consultancy companies (e.g., Practical Action Consulting, Winrock) in the area of renewable energy, energy efficiency and sustainable transportation.

Mr. Dinesh AGGARWAL is a climate change mitigation and sustainable development specialist. He has master's degree in Chemical Engineering from Indian Institute of Technology, Delhi (IIT, Delhi). In the area of climate change mitigation he has wide experience of working across different sectors ranging from waste management, energy efficiency, chemical processes to renewable energy, using financial, policy, technical and regulatory measures. He has more than 30 years of professional experience providing consulting services in the domain of business research, sustainable development, development studies, climate change mitigation and adaptation, monitoring and evaluation, development of standards etc. His past employers include TERI, Deloitte and, UNFCCC. He is presently working as an independent consultant. Apart from India he has experience of working in Germany and Tuvalu.

He has in the past worked on the projects funded by donor agencies like DFID, GIZ, CIDA and multilateral agencies like UNDP /GEF, UNICEF, UNIDO. Being a member of the methodologies panel of CDM Executive Board he has worked for United Nations Framework Convention for Climate Change (UNFCCC) for four years. He has experience for development of and implementation of projects having result based management framework.

ANNEX F. CONSULTANT CODE OF CONDUCT FORM

Evaluators/reviewers:

1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals, and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
5. Should be sensitive to beliefs, manners and customs and act with integrity and honesty in their relations with all stakeholders. In line with the UN Universal Declaration of Human Rights, evaluators must be sensitive to and address issues of discrimination and gender equality. They should avoid offending the dignity and self-respect of those persons with whom they come in contact in the course of the evaluation. Knowing that evaluation might negatively affect the interests of some stakeholders, evaluators should conduct the evaluation and communicate its purpose and results in a way that clearly respects the stakeholders' dignity and self-worth.
6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study limitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.

Evaluation/reviewer Consultant Agreement Form

Agreement to abide by the Code of Conduct for Evaluation in the UN System

Name of Consultant: J.H.A. VAN DEN AKKER (Team Leader, on behalf of the Team)
Name of Consultancy Organization (where relevant): _____
I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at Westerhoven, Netherlands
Signature: _____

(A) Projects supported under UNDP/GEF

	Expected at EOP	Total	Area
Demo			
- Process heat		19	8321
- Cooling		2	2064
- Cooking		2	1462
Subtotal	*30*	*23*	*11847*
Replication			
- Process heat		8	1737
- Cooking		22	2958
Subtotal	*60*	*30*	*4695*
Total	**90**	**53**	**16542**

Installed		
Total	20	8,509
demo	15	7,726
repli	5	783

20 Lifetime

Energy		
	9,452	11,635 MWh/yr
Factor	0.284	0.35
GHG		
	4703.641	5789.7 tCO2/yr
	94072.81	115794

Averages

Annual		Lifetime	
10,544	MWh/yr	210,872	MWh
5,247	**Mid-term value**	104,933	tCO2

(C) Situation India-wide

	Market estimates		Own estimations		
Installed CSH	Mid 2012	Dec 2013	Mid 2015	Dec 2016	Dec 2026
Total - number	85	160	253		
Process heat & cooling		24	48		
Cooking		136	205		
Total - area (m2)	25,000	32,000	48,500	70,000	181,562
Process heat & cooling		13,760	24,105		
Cooking		18,240	24,395		
Market growth		18%	32%	28%	10%/yr

10%

1032526

1270933.8

Type of CSH application	**Technology**	**Application description**	**Size (m^2)**	**Investment (INR lakh)**	**Subsidy MNRE (INR lakh)**	**Savings**				**Payback time (yr)**		**Emission reduction**		Monetary		
						Fuel	**Amount**	**Unit**	**INR (Lakh)**	**w/o subs**	**w subs**	**tCO_2/yr**	**tCO_2/m^2/yr**			
Process heat																
Gajraj DryCleaner, Gajraj	Scheffler	Steam for washing, drying of cloths	240	23.00	12.00	Diesel	6500	liter	2.6	8.8	4.2	18.2	0.076			
Purple Creation, Baramati	Scheffler	Steam for washing garments	480	90.00	25.92	LPG	11,280	kg	7.90	11.4	8.1	33.8	0.071			900 INR/47 kg cylinder
Synthoken Labs Hyderabad	Scheffler	Processing of chemical compounds	450	124.78	27.00	diesel	60,000	liter	24.00	5.2	4.1	168.0	0.373	138	0.31	40 INR/l
CSM Hosital, Thane	Scheffler	Cooling, hot water, sterilization	2502	400.00	124.00	Electricity	750,000	kWh	60.00	6.7	4.6	667.5	0.267			
Hotel ITC Maurya, New Delhi	Scheffler, ARUN	Steam for laundry, cooking, heating	297	165.00	54.00	Natural gas	33,000	m^3	33.33	12.0	3.3	59.2	0.199			
Mahanad Dairy, Latur	ARUN	Hot water for milk pasteurization	160	51.70	32.76	Fuel oil	13,360	liter	7.35	7.0	2.6	39.3	0.246			47.7 INR/litre
Mahindra Vehicles, Chakan	ARUN	Steam for cleaning engine parts	169	39.00	10.14	Electricity	200,000	kWh	16.00	2.4	1.8	178.0	1.053		22	8 INR/kWh
Salem Coop Milk Producers	ARUN	Milk pasteurization	338	101.00	20.28	Fuel oil	28,588	liter	15.72	6.4	5.1	84.2	0.249	77	0.23	
SKF Technology, Mysore	PTC	Hot water for metal phosphating	256	70.55	13.85	Fuel oil	12,000	liter	6.60	10.7	8.6	35.3	0.138			
Siddarth Surgicals, Valsad	PTC	Cleaning & bleaching of cotton	263	47.50	14.20	LPG	20,000	kg	14.00	3.4	2.4	60.0	0.228	32	0.1231939	
ITC Bangalore	NIC	Processing tobacco leaves	680	140.00	24.48	Fuel oil	45,000	liter	24.75	5.7	4.7	132.5	0.195	46	0.0676471	
ITC Pune	NIC	Processing tobacco leaves	442	79.52	15.91	Fuel oil	21,000	liter	11.55	6.9	5.5	61.8	0.140		30	55 INR/litre
Mahindra Vehicles, Nagpur	NIC	Hot water for cooling	442	88.41	15.91	Electricity	240,000	kWh	19.20	4.6	3.8	213.6	0.483	63	0.1425339	
Cooling														17	#DIV/0!	
Mahindra Vehicles, Chakan	Scheffler	Chillers for cooling paint	1120	210.00	60.48	LPG	50,000	kg	35.00	6.0	4.3	150.0	0.134			
Honeywell Technology, Hyderabad	PTC	Space cooling	821	213.41	44.28	Electricity	444,950	kWh	35.60	6.0	4.8	396.0	0.482			
NPCIL, Power project, Kota	PTC	Space cooling	641	245.32	34.61	Electricity	625,000	kWh	50.00	4.9	4.2	556.3	0.868		47	70 INR/kg
Cooking														32		
Shirdi, Temple, Ahmednagar	Scheffler	Steam for cooking	1168	133.00	58.40	LPG	41,000	kg	28.70	4.6	2.6	123.0	0.105	50		
		TOTALS	10469	2222.19	588.22	Energy	5,982	MWh	392.30	5.7	4.2	2976.8	0.284			

1025 2500 INR/t

Based on info provided by PwC brochures *CST in Industrial Sector* (Oct 2013),
case studies prepared by WISE and PMU data
Payback periods are calculated using the following fuel prices:
Emission factors taken fro IGES and IPCC reports

Prices:			**CO2 content**	**Energy value**
LPG	70	INR/kg	3.0 $kgCO_2$/kg	46.1 MJ/kg
Electricity	8	INR/kWh	0.9 $kgCO_2$/kWh	
Fuel oil	55	INR/liter	2.9 $kgCO_2$/litre	36.4 MJ/litre
Diesel	40	INR/liter	2.8 $kgCO_2$/litre	34.9 MJ/litre
Nat gas			1.8 $kgCO_2/m^3$	32.6 MJ/m^3

S 21535.69

0.498 tCO2/MWh

10469 2976.8 0.284

0.0326 GJ/m3 3664.15 0.35

GEF budget

(D)

	Planned	Expenditures			
		Total	2012	2013	2014
Technical capacity development	**831,525**	**999,094**	**142**	**637,172**	**361,780**
- Consultants and contracts	554,925	843,296		606,545	236,751
- Equipment	175,000	125,004			125,004
- Grant		0			
- Supplies, rental, premises, misc	101,600	30,793	142	30,627	25
Awareness and capacity	**1,248,180**	**322,977**	**17,156**	**191,523**	**114,298**
- Consultants and contracts	910,700	254,266		164,730	89,536
- Equipment		0			
- Grant	86,400	4,822			4,822
- Supplies, rental, premises, misc	251,080	63,888	17,156	26,793	19,940
Pilot demonstration	**1,968,245**	**117,015**	**0**	**47,570**	**69,445**
- Consultants and contracts	586,745	56,886			56,886
- Equipment		0			
- Grant	1,380,000	9,600			9,600
- Supplies, rental, premises, misc	1,500	50,529		47,570	2,959
Sustainable financing	**104,100**	**1,159**	**0**	**0**	**1,159**
- Consultants and contracts	101,100	77			77
- Equipment		0			
- Grant		0			
- Supplies, rental, premises, misc	3,000	1,082			1,082
Project management	**247,950**	**184,783**	**16,908**	**98,956**	**68,918**
- Consultants and contracts	190,450	161,745	15,169	84,775	61,801
- Equipment		0			
- Grant		0			
- Supplies, rental, premises, misc	57,500	23,038	1,739	14,181	7,117
Other expenditures			**8,374**	**28,226**	**15,263**
TOTAL	**4,400,000**	**1,676,890**	**42,580**	**1,003,448**	**630,862**

(E)

	GEF and co-financing	Planned	Realized Dec 2014
1	GEF	4.40	1.68
2	MNRE (grant subsidy)	6.00	2.10
3	MNRE (in-kind)	1.35	0.65
4	Industries (cash)	6.00	12.10
5	Financial institutions	6.00	-
	Total	23.75	16.53

Tracking Tool for Climate Change Mitigation Projects
(For CEO Endorsement)

Special Notes: reporting on lifetime emissions avoided

Lifetime direct GHG emissions avoided: Lifetime direct GHG emissions avoided are the emissions reductions attributable to the investments made **during the project's supervised implementation period** , totaled over the respective lifetime of the investments.
Lifetime direct post-project emissions avoided: Lifetime direct post-project emissions avoided are the emissions reductions attributable to the investments made outside the project's supervised implementation period, but supported by financial facilities put in place by the GEF project, totaled over the respective lifetime of the investments. These financial facilities will still be operational after the project ends, such as partial credit guarantee facilities, risk mitigation facilities, or revolving funds.
Lifetime indirect GHG emissions avoided (top-down and bottom-up): indirect emissions reductions are those attributable to the long-term outcomes of the GEF activities that remove barriers, such as capacity building, innovation, catalytic action for replication.
Please refer to the Manual for Calculating GHG Benefits of GEF Projects.

Manual for Energy Efficiency and Renewable Energy Projects
Manual for Transportation Projects

For LULUCF projects, the definitions of "lifetime direct and indirect" apply. Lifetime length is defined to be 20 years, unless a different number of years is deemed appropriate. For emission or removal factors (tonnes of CO2eq per hectare per year), use IPCC defaults or country specific factors.

General Data	Target at CEO Endorsement	Notes
Project Title	Market Development & Promotion of Solar Concentrators based Process Heat Applications in India	
GEF ID	4134	
Agency Project ID	4284	
Country	India	
Region	SAR	
GEF Agency	UNDP	
Date of Council/CEO Approval	January 20, 2010	Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)	4,400,000	
Date of submission of the tracking tool	May 30, 2011	Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?	1	Yes = 1, No = 0
Is the project linked to carbon finance?	0	Yes = 1, No = 0
Cofinancing expected (US$)	19,350,000	

Objective 1: Transfer of Innovative Technologies		
Please specify the type of enabling environment created for technology transfer through this project		
National innovation and technology transfer policy		Yes = 1, No = 0
Innovation and technology centre and network		Yes = 1, No = 0
Applied R&D support		Yes = 1, No = 0
South-South technology cooperation		Yes = 1, No = 0
North-South technology cooperation		Yes = 1, No = 0
Intellectual property rights (IPR)		Yes = 1, No = 0
Information dissemination		Yes = 1, No = 0
Institutional and technical capacity building		Yes = 1, No = 0
Other (please specify)		
Number of innovative technologies demonstrated or deployed		
Please specify three key technologies for demonstration or deployment		
Area of technology 1		
Type of technology 1		specify type of technology
Area of technology 2		
Type of technology 2		specify type of technology
Area of technology 3		
Type of technology 3		specify type of technology
Status of technology demonstration/deployment		0: no suitable technologies are in place 1: technologies have been identified and assessed 2: technologies have been demonstrated on a pilot basis 3: technologies have been deployed 4: technologies have been diffused widely with investments 5: technologies have reached market potential
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 2: Energy Efficiency		
Please specify if the project targets any of the following areas		
Lighting		Yes = 1, No = 0
Appliances (white goods)		Yes = 1, No = 0
Equipment		Yes = 1, No = 0
Cook stoves		Yes = 1, No = 0
Existing building		Yes = 1, No = 0
New building		Yes = 1, No = 0
Industrial processes		Yes = 1, No = 0
Synergy with phase-out of ozone depleting substances		Yes = 1, No = 0
Other (please specify)		
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Lifetime energy saved		MJ (Million Joule, IEA unit converter: http://www.iea.org/stats/unit.asp) Fuel savings should be converted to energy savings by using the net calorific value of the specific fuel. End-use electricity savings should be converted to energy savings by using the conversion factor for the specific supply and distribution system. These energy savings are then totaled over the respective lifetime of the investments
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 3: Renewable Energy		
Please specify if the project includes any of the following areas		
Heat/thermal energy production	1	Yes = 1, No = 0
On-grid electricity production	0	Yes = 1, No = 0
Off-grid electricity production	0	Yes = 1, No = 0
Policy and regulatory framework	4	0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)	2	0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building	4	0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Installed capacity per technology directly resulting from the project		
Wind		MW
Biomass		MW el (for electricity production)
Biomass		MW th (for thermal energy production)
Geothermal		MW el (for electricity production)
Geothermal		MW th (for thermal energy production)
Hydro		MW
Photovoltaic (solar lighting included)		MW
Solar thermal heat (heating, water, cooling, process)	31.50	MW th (for thermal energy production, 1m² = 0.7kW)
Solar thermal power		MW el (for electricity production)
Marine power (wave, tidal, marine current, osmotic, ocean thermal)		MW
Lifetime energy production per technology directly resulting from the project (IEA unit converter: http://www.iea.org/stats/unit.asp)		
Wind		MWh
Biomass		MWh el (for electricity production)
Biomass		MWh th (for thermal energy production)
Geothermal		MWh el (for electricity production)
Geothermal		MWh th (for thermal energy production)
Hydro		MWh
Photovoltaic (solar lighting included)		MWh
Solar thermal heat (heating, water, cooling, process)	919,800.00	MWh th (for thermal energy production)
Solar thermal power		MWh el (for electricity production)
Marine energy (wave, tidal, marine current, osmotic, ocean thermal)		MWh
Lifetime direct GHG emissions avoided	315,000	tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided	-	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)	945,000	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)	876,120	tonnes CO2eq (see Special Notes above)

Objective 4: Transport and Urban Systems		
Please specify if the project targets any of the following areas		
Bus rapid transit		Yes = 1, No = 0
Other mass transit (e.g., light rail, heavy rail, water or other mass transit; excluding regular bus or minibus)		Yes = 1, No = 0
Logistics management		Yes = 1, No = 0
Transport efficiency (e.g., vehicle, fuel, network efficiency)		Yes = 1, No = 0
Non-motorized transport (NMT)		Yes = 1, No = 0
Travel demand management		Yes = 1, No = 0
Comprehensive transport initiatives (Involving the coordination of multiple strategies from different transportation sub-sectors)		Yes = 1, No = 0
Sustainable urban initiatives		Yes = 1, No = 0
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Length of public rapid transit (PRT)		km
Length of non-motorized transport (NMT)		km
Number of lower GHG emission vehicles		
Number of people benefiting from the improved transport and urban systems		
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 5: LULUCF		
Area of activity directly resulting from the project		
Conservation and enhancement of carbon in forests, including agroforestry		ha
Conservation and enhancement of carbon in nonforest lands, including peat land		ha
Avoided deforestation and forest degradation		ha
Afforestation/reforestation		ha
Good management practices developed and adopted		0: not an objective/component 1: no action 2: developing prescriptions for sustainable management 3: development of national standards for certification 4: some of area in project certified 5: over 80% of area in project certified
Carbon stock monitoring system established		0: not an objective/component 1: no action 2: mapping of forests and other land areas 3: compilation and analysis of carbon stock information 4: implementation of science based inventory/monitoring system 5: monitoring information database publicly available
Lifetime direct GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct carbon sequestration		tonnes CO2eq (see Special Notes above)
Lifetime indirect carbon sequestration		tonnes CO2eq (see Special Notes above)

Objective 6: Enabling Activities		
Please specify the number of Enabling Activities for the project (for a multiple country project, please put the number of countries/assessments)		
National Communication		
Technology Needs Assessment		
Nationally Appropriate Mitigation Actions		
Other		
Does the project include Measurement, Reporting and Verification (MRV) activities?		Yes = 1, No = 0

Tracking Tool for Climate Change Mitigation Projects
(For Mid-term Evaluation)

Special Notes: reporting on lifetime emissions avoided

Lifetime direct GHG emissions avoided: Lifetime direct GHG emissions avoided are the emissions reductions attributable to the investments made **until the mid-term evaluation** , totaled over the respective lifetime of the investments.
Please refer to the Manual for Calculating GHG Benefits of GEF Projects.

Manual for Energy Efficiency and Renewable Energy Projects
Manual for Transportation Projects

For LULUCF projects, the definition of "lifetime direct" applies. Lifetime length is defined to be 20 years, unless a different number of years is deemed appropriate. For emission or removal factors (tonnes of CO2eq per hectare per year), use IPCC defaults or country specific factors.

General Data	Results at Mid-term Evaluation	Notes
Project Title	Market Development & Promotion of Solar Concentrators based Process Heat Applications in India	
GEF ID	4134	
Agency Project ID	4284	
Country	India	
Region	SAR	
GEF Agency	UNDP	
Date of Council/CEO Approval	January 20, 2010	Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)	4,400,000	
Date of submission of the tracking tool	May 30, 2011	Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?		Yes = 1, No = 0
Is the project linked to carbon finance?		Yes = 1, No = 0
Cumulative cofinancing realized (US$)		
Cumulative additional resources mobilized (US$)		additional resources means beyond the cofinancing committed at CEO endorsement

Objective 1: Transfer of Innovative Technologies		
Please specify the type of enabling environment created for technology transfer through this project		
National innovation and technology transfer policy		Yes = 1, No = 0
Innovation and technology centre and network		Yes = 1, No = 0
Applied R&D support		Yes = 1, No = 0
South-South technology cooperation		Yes = 1, No = 0
North-South technology cooperation		Yes = 1, No = 0
Intellectual property rights (IPR)		Yes = 1, No = 0
Information dissemination		Yes = 1, No = 0
Institutional and technical capacity building		Yes = 1, No = 0
Other (please specify)		
Number of innovative technologies demonstrated or deployed		
Please specify three key technologies for demonstration or deployment		
Area of technology 1		
Type of technology 1		specify type of technology
Area of technology 2		
Type of technology 2		specify type of technology
Area of technology 3		
Type of technology 3		specify type of technology
Status of technology demonstration/deployment		0: no suitable technologies are in place 1: technologies have been identified and assessed 2: technologies have been demonstrated on a pilot basis 3: technologies have been deployed 4: technologies have been diffused widely with investments 5: technologies have reached market potential
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)

Objective 2: Energy Efficiency		
Please specify if the project targets any of the following areas		
Lighting		Yes = 1, No = 0
Appliances (white goods)		Yes = 1, No = 0
Equipment		Yes = 1, No = 0
Cook stoves		Yes = 1, No = 0
Existing building		Yes = 1, No = 0
New building		Yes = 1, No = 0
Industrial processes		Yes = 1, No = 0
Synergy with phase-out of ozone depleting substances		Yes = 1, No = 0
Other (please specify)		
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Lifetime energy saved		MJ (Million Joule, IEA unit converter: http://www.iea.org/stats/unit.asp) Fuel savings should be converted to energy savings by using the net calorific value of the specific fuel. End-use electricity savings should be converted to energy savings by using the conversion factor for the specific supply and distribution system. These energy savings are then totaled over the respective lifetime of the investments.
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)

Objective 3: Renewable Energy		
Please specify if the project includes any of the following areas		
Heat/thermal energy production		Yes = 1, No = 0
On-grid electricity production		Yes = 1, No = 0
Off-grid electricity production		Yes = 1, No = 0
Policy and regulatory framework	4	0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)	2	0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building	4	0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Installed capacity per technology directly resulting from the project		
Wind		MW
Biomass		MW el (for electricity production)
Biomass		MW th (for thermal energy production)
Geothermal		MW el (for electricity production)
Geothermal		MW th (for thermal energy production)
Hydro		MW
Photovoltaic (solar lighting included)		MW
Solar thermal heat (heating, water, cooling, process)	11.58	MW th (for thermal energy production, 1m² = 0.7kW)
Solar thermal power		MW el (for electricity production)
Marine power (wave, tidal, marine current, osmotic, ocean thermal)		MW
Lifetime energy production per technology directly resulting from the project (IEA unit converter: http://www.iea.org/stats/unit.asp)		
Wind		MWh
Biomass		MWh el (for electricity production)
Biomass		MWh th (for thermal energy production)
Geothermal		MWh el (for electricity production)
Geothermal		MWh th (for thermal energy production)
Hydro		MWh
Photovoltaic (solar lighting included)		MWh
Solar thermal heat (heating, water, cooling, process)	210,872.00	MWh th (for thermal energy production)
Solar thermal power		MWh el (for electricity production)
Marine energy (wave, tidal, marine current, osmotic, ocean thermal)		MWh
Lifetime direct GHG emissions avoided	104,933	tonnes CO2eq (see Special Notes above)

Objective 4: Transport and Urban Systems		
Please specify if the project targets any of the following areas		
Bus rapid transit		Yes = 1, No = 0
Other mass transit (e.g., light rail, heavy rail, water or other mass transit; excluding regular bus or minibus)		Yes = 1, No = 0
Logistics management		Yes = 1, No = 0
Transport efficiency (e.g., vehicle, fuel, network efficiency)		Yes = 1, No = 0
Non-motorized transport (NMT)		Yes = 1, No = 0
Travel demand management		Yes = 1, No = 0
Comprehensive transport initiatives (Involving the coordination of multiple strategies from different transportation sub-sectors)		Yes = 1, No = 0
Sustainable urban initiatives		Yes = 1, No = 0
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Length of public rapid transit (PRT)		km
Length of non-motorized transport (NMT)		km
Number of lower GHG emission vehicles		
Number of people benefiting from the improved transport and urban systems		
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)

Objective 5: LULUCF		
Area of activity directly resulting from the project		
Conservation and enhancement of carbon in forests, including agroforestry		ha
Conservation and enhancement of carbon in nonforest lands, including peat land		ha
Avoided deforestation and forest degradation		ha
Afforestation/reforestation		ha
Good management practices developed and adopted		0: not an objective/component 1: no action 2: developing prescriptions for sustainable management 3: development of national standards for certification 4: some of area in project certified 5: over 80% of area in project certified
Carbon stock monitoring system established		0: not an objective/component 1: no action 2: mapping of forests and other land areas 3: compilation and analysis of carbon stock information 4: implementation of science based inventory/monitoring system 5: monitoring information database publicly available
Lifetime direct GHG emission avoided		tonnes CO2eq
Lifetime direct carbon sequestration		tonnes CO2eq

Objective 6: Enabling Activities		
Please specify the number of Enabling Activities for the project (for a multiple country project, please put the number of countries/assessments)		
National Communication		
Technology Needs Assessment		
Nationally Appropriate Mitigation Actions		
Other		
Does the project include Measurement, Reporting and Verification (MRV) activities?		Yes = 1, No = 0

Tracking Tool for Climate Change Mitigation Projects
(For Terminal Evaluation)

Special Notes: reporting on lifetime emissions avoided

Lifetime direct GHG emissions avoided: Lifetime direct GHG emissions avoided are the emissions reductions attributable to the investments made **during the project's supervised implementation period** , totaled over the respective lifetime of the investments.
Lifetime direct post-project emissions avoided: Lifetime direct post-project emissions avoided are the emissions reductions attributable to the investments made outside the project's supervised implementation period, but supported by financial facilities put in place by the GEF project, totaled over the respective lifetime of the investments. These financial facilities will still be operational after the project ends, such as partial credit guarantee facilities, risk mitigation facilities, or revolving funds.
Lifetime indirect GHG emissions avoided (top-down and bottom-up): indirect emissions reductions are those attributable to the long-term outcomes of the GEF activities that remove barriers, such as capacity building, innovation, catalytic action for replication.
Please refer to the Manual for Calculating GHG Benefits of GEF Projects.

Manual for Energy Efficiency and Renewable Energy Projects
Manual for Transportation Projects

For LULUCF projects, the definitions of "lifetime direct and indirect" apply. Lifetime length is defined to be 20 years, unless a different number of years is deemed appropriate. For emission or removal factors (tonnes of CO2eq per hectare per year), use IPCC defaults or country specific factors.

General Data	Results at Terminal Evaluation	Notes
Project Title		
GEF ID		
Agency Project ID		
Country		
Region		
GEF Agency		
Date of Council/CEO Approval		Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)		
Date of submission of the tracking tool		Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?		Yes = 1, No = 0
Is the project linked to carbon finance?		Yes = 1, No = 0
Cumulative cofinancing realized (US$)		
Cumulative additional resources mobilized (US$)		additional resources means beyond the cofinancing committed at CEO endorsement

Objective 1: Transfer of Innovative Technologies		
Please specify the type of enabling environment created for technology transfer through this project		
National innovation and technology transfer policy		Yes = 1, No = 0
Innovation and technology centre and network		Yes = 1, No = 0
Applied R&D support		Yes = 1, No = 0
South-South technology cooperation		Yes = 1, No = 0
North-South technology cooperation		Yes = 1, No = 0
Intellectual property rights (IPR)		Yes = 1, No = 0
Information dissemination		Yes = 1, No = 0
Institutional and technical capacity building		Yes = 1, No = 0
Other (please specify)		
Number of innovative technologies demonstrated or deployed		
Please specify three key technologies for demonstration or deployment		
Area of technology 1		
Type of technology 1		specify type of technology
Area of technology 2		
Type of technology 2		specify type of technology
Area of technology 3		
Type of technology 3		specify type of technology
Status of technology demonstration/deployment		0: no suitable technologies are in place 1: technologies have been identified and assessed 2: technologies have been demonstrated on a pilot basis 3: technologies have been deployed 4: technologies have been diffused widely with investments 5: technologies have reached market potential
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 2: Energy Efficiency		
Please specify if the project targets any of the following areas		
Lighting		Yes = 1, No = 0
Appliances (white goods)		Yes = 1, No = 0
Equipment		Yes = 1, No = 0
Cook stoves		Yes = 1, No = 0
Existing building		Yes = 1, No = 0
New building		Yes = 1, No = 0
Industrial processes		Yes = 1, No = 0
Synergy with phase-out of ozone depleting substances		Yes = 1, No = 0
Other (please specify)		
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Lifetime energy saved		MJ (Million Joule, IEA unit converter: http://www.iea.org/stats/unit.asp) Fuel savings should be converted to energy savings by using the net calorific value of the specific fuel. End-use electricity savings should be converted to energy savings by using the conversion factor for the specific supply and distribution system. These energy savings are then totaled over the respective lifetimes of the investments
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 3: Renewable Energy		
Please specify if the project includes any of the following areas		
Heat/thermal energy production		Yes = 1, No = 0
On-grid electricity production		Yes = 1, No = 0
Off-grid electricity production		Yes = 1, No = 0
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Installed capacity per technology directly resulting from the project		
Wind		MW
Biomass		MW el (for electricity production)
Biomass		MW th (for thermal energy production)
Geothermal		MW el (for electricity production)
Geothermal		MW th (for thermal energy production)
Hydro		MW
Photovoltaic (solar lighting included)		MW
Solar thermal heat (heating, water, cooling, process)		MW th (for thermal energy production, 1m² = 0.7kW)
Solar thermal power		MW el (for electricity production)
Marine power (wave, tidal, marine current, osmotic, ocean thermal)		MW
Lifetime energy production per technology directly resulting from the project (IEA unit converter: http://www.iea.org/stats/unit.asp)		
Wind		MWh
Biomass		MWh el (for electricity production)
Biomass		MWh th (for thermal energy production)
Geothermal		MWh el (for electricity production)
Geothermal		MWh th (for thermal energy production)
Hydro		MWh
Photovoltaic (solar lighting included)		MWh
Solar thermal heat (heating, water, cooling, process)		MWh th (for thermal energy production)
Solar thermal power		MWh el (for electricity production)
Marine energy (wave, tidal, marine current, osmotic, ocean thermal)		MWh
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 4: Transport and Urban Systems		
Please specify if the project targets any of the following areas		
Bus rapid transit		Yes = 1, No = 0
Other mass transit (e.g., light rail, heavy rail, water or other mass transit; excluding regular bus or minibus)		Yes = 1, No = 0
Logistics management		Yes = 1, No = 0
Transport efficiency (e.g., vehicle, fuel, network efficiency)		Yes = 1, No = 0
Non-motorized transport (NMT)		Yes = 1, No = 0
Travel demand management		Yes = 1, No = 0
Comprehensive transport initiatives (Involving the coordination of multiple strategies from different transportation sub-sectors)		Yes = 1, No = 0
Sustainable urban initiatives		Yes = 1, No = 0
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Length of public rapid transit (PRT)		km
Length of non-motorized transport (NMT)		km
Number of lower GHG emission vehicles		
Number of people benefiting from the improved transport and urban systems		
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 5: LULUCF		
Area of activity directly resulting from the project		
Conservation and enhancement of carbon in forests, including agroforestry		ha
Conservation and enhancement of carbon in nonforest lands, including peat land		ha
Avoided deforestation and forest degradation		ha
Afforestation/reforestation		ha
Good management practices developed and adopted		0: not an objective/component 1: no action 2: developing prescriptions for sustainable management 3: development of national standards for certification 4: some of area in project certified 5: over 80% of area in project certified
Carbon stock monitoring system established		0: not an objective/component 1: no action 2: mapping of forests and other land areas 3: compilation and analysis of carbon stock information 4: implementation of science based inventory/monitoring system 5: monitoring information database publicly available
Lifetime direct GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct carbon sequestration		tonnes CO2eq (see Special Notes above)
Lifetime indirect carbon sequestration		tonnes CO2eq (see Special Notes above)

Objective 6: Enabling Activities		
Please specify the number of Enabling Activities for the project (for a multiple country project, please put the number of countries/assessments)		
National Communication		
Technology Needs Assessment		
Nationally Appropriate Mitigation Actions		
Other		
Does the project include Measurement, Reporting and Verification (MRV) activities?		Yes = 1, No = 0