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Ministry of New and Renewable Energy (MNRE)
Government of India

UNDP/GEF Project: The Country Programme of India under the Global Solar Water Heating Market Transformation and Strengthening Initiative (GSWH) (PIMS 3611)

Terminal Evaluation Report

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SYNOPSIS

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Implementing partner and other strategic partners: Ministry of New and Renewable Energy, Government of India

Evaluation team members: Mr Roland Wong, International Consultant; Mr Sandeep Tandon, National Consultant.

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EXECUTIVE SUMMARY

Background

This report summarizes the findings of the Terminal Evaluation Mission conducted during May 10-16, 2013 for the Indian component of the Global Solar Water Heating Market Transformation and Strengthening Initiative (hereby referred to as GSWH or the Project), that received a USD 2.0 million grant from the Global Environmental Facility (GEF). The Project was developed from between 2005 and 2008 as part of a UNEP/UNDP six-country project, with the knowledge management component managed as one project by UNEP, and the individual country implementation aspects managed by UNDP as six individual nationally executed (NEX) projects. The Indian GSWH project was approved within the overall 6-country (Global) consolidated project.

India has a large and growing demand for hot water in the approximate temperature range of 40^{o} to 80^{o}C. The hot water is used in:

- houses and apartment buildings for bathing particularly in urban areas;
- hotels and hostels in the growing hospitality sector; and
- the industrial sector for various cleaning and process needs.

The large and growing demand for hot water in India can be attributed to:

- significant geographical regions with cool or cold winters making ambient temperature bathing water uncomfortably cool or cold;
- a rising middle class, of which a significant fraction want warm water for bathing;
- a large and growing hospitality sector; and
- growing industrial activities where hot water is required for various cleaning activities and processes.

At the national level, more than 70% of India's energy generation is from fossil fuels. Within this 70%, 40% is from coal, 24% from oil and 6% from natural gas. In 2009, fossil fuel imports of crude oil amounted to 160 ktoe that represents 80% of its total crude oil consumption of 200 ktoe[13]. Recent trends indicate that the proportion of oil consumption in India is growing, and with fossil fuels being so heavily subsidized in India, there is a considerable impetus to reduce these subsidies by increasing diesel and furnace oil prices to world market levels.

Small capacity storage water heaters (called geysers in India) that provide most of the low temperature hot water for personal bathing in urban areas, use electricity that mainly uses coal as its primary energy source. Most hot water for large hotels and industrial facilities is fuelled using furnace oil since natural gas is not widely available in India. Biomass and fuel wood are the energy sources for water heating in rural areas. The process of producing hot water for rural areas is generally highly inefficient and polluting; moreover, the excessive use of firewood is unsustainable on the country's limited forestry resources, and smoke pollution from these inefficient stoves largely impacts the health of women and children.

A major challenge in India is adding new electricity capacity rapidly enough to keep pace with its steadily developing economy and its growing electricity demand. With widespread power cuts and rising electricity prices, several industries, commercial establishments, private residences and apartment buildings have standby diesel generation sets to sustain power supplies

[13] http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=IN

throughout the day, albeit at a high fuel cost. As such, electric geysers are associated with high energy costs and do not provide reliable hot water supplies unless they are supplied by expensive back-up diesel power generation.

From 2002 to 2008, the Government of India (GoI) was promoting the use of solar water heaters (SWH) through their support of a programme that subsidized interest rates for loans for SWH purchases and installations; the subsidy did not have desired impact to transform the market, resulting in less than 1% market penetration after 8 years. One explanation for this low impact was that only the smaller banks participated in the interest rate subsidy scheme, limiting the number of SWHs sold on the market[14].

On June 30, 2008, the Prime Minister of India launched India's National Action Plan on Climate Change, and raised the profile and importance of transforming the market for solar energy applications in India, of which SWH installations were being supported to offset the use of fossil fuels for hot water heating. Efforts to transform the SWH market received a further boost when the Ministry of New and Renewable Energy (MNRE) launched the Jawaharlal Nehru National Solar Mission (JNNSM) mission on 11th January 2010. JNNSM Phase I was a major initiative with the combined efforts of GoI and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge, and scoping India's contribution of solar energy generation to mitigate global climate change. The immediate aim of JNNSM Phase I was to focus on setting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level to the end of 2013. JNNSM Phase II is the scale-up phase for solar energy installations in India until 2017[15].

A component of JNNSM Phase I was to promote and increase the use of SWH through a financial mechanism with a subsidy scheme; the provision of testing facilities at MNRE's Solar Energy Center SEC; a range of activities to support SWH manufacturers and dealers; and the development and uptake of a range of policy and administrative measures to transform the SWH market. The GSWH Project which commenced in December 2008 was designed to accelerate the transformation of the SWH market through awareness raising on SWH technologies, and providing a structured approach for MNRE on the creation of the enabling investment environment for SWH installations. This Evaluation report provides a summary of the performance of this GEF-supported project in achieving this goal, and assesses the sustainability of GWSH activities to contribute to the 2017 goals of JNNSM Phase II.

Context and Purpose of the Terminal Evaluation

The purpose of the Terminal Evaluation (TE) for this Project is to *evaluate the progress towards the attainment of global environmental objectives, project objectives and outcomes, capture lessons learned and suggest recommendations on major improvements.* The TE is to serve as an agent of change and play a critical role in supporting accountability. As such, the TE will serve to:

- promote accountability and transparency, and to assess and disclose levels of project accomplishments;
- synthesize lessons that may help improve the selection, design and implementation of future GEF activities;

[14] Personal communication with Dr. Sameer Maithal

[15] http://mnre.gov.in/file-manager/UserFiles/draft-jnnsmpd-2.pdf

- provide feedback on issues that are recurrent across the portfolio and need attention, and on improvements regarding previously identified issues; and,
- contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on effectiveness of GEF operations in achieving global environmental benefits and on the quality of monitoring and evaluation across the GEF system.

Assessment of Project Outcomes and Sustainability

Table A provides a summary of the terminal evaluation of GSWH.

Table A: Evaluation Ratings

1. Monitoring and Evaluation	***Rating***[16]	**2. IA & EA Execution**	***Rating***
M&E design at entry	4	Quality of UNDP Implementation	5
M&E Plan Implementation	5	Quality of Execution - Executing Agency	5
Overall quality of M&E	4.5	Overall quality of Implementation / Execution	5
3. Assessment of Outcomes	**Rating**	**4. Sustainability**	**Rating**
Relevance	5	Financial resources	4
Effectiveness	4.8	Socio-political	3
Efficiency	4.7	Institutional framework and governance	3
Overall Project Outcome Rating	4.9	Environmental	4
		Overall likelihood of sustainability	3

The overall rating of the project results is satisfactory (S). This is based on the following outcomes:

- The Project meeting its target for incremental SWH installations of 2.4 million m^2. The number of incremental SWH installations was derived from an assumed baseline growth of 450,000 m^2 per year and actual annual installation reported by MNRE;
- The linking of SWH quality with the 30% subsidy with third party checks raises the level of compliance to minimum standards for SWH quality and quality of installations;
- The long periods required to disburse the 30% capital subsidies which need to be resolved if the SWH market is to meet the goals of JNNSM Phase II;
- An excellent website (*http://solarwaterheater.gov.in*) that provides technical and financial information on SWH technology as well as examples of SWH installations from around India and globally and electronic newsletters pertaining the SWH advances;
- A toll free helpline number (1-800-233-4477) was setup to responded to end user queries regarding all aspects of SWH and assist them in making informed decisions on their purchase and installation;
- The SWH monitoring system is still under development by MNRE where improvements are in progress to provide a more accurate estimate of the number of SWH systems installed since 2008 that are functional and reducing fossil fuel consumption.

[16] 6=*Highly Satisfactory (HS)*: The project has no shortcomings in the achievement of its objectives; 5=*Satisfactory (S)*: The project has minor shortcomings in the achievement of its objectives; 4=*Moderately Satisfactory (MS)*: The project has moderate shortcomings in the achievement of its objectives; 3=*Moderately Unsatisfactory (MU):* The project has significant shortcomings in the achievement of its objectives; 2=*Unsatisfactory (U)* The project has major shortcomings in the achievement of its objectives; 1=*Highly Unsatisfactory (HU):* The project has severe shortcomings in the achievement of its objectives.

The overall Project sustainability rating is moderately likely (ML). This is primarily due to:

- The financial and political commitment of MNRE to continue SWH promotional activities under its JNNSM Phase II ;
- Strong growth in SWH installations in the domestic market that is supported by MNRE systems for accreditation of SWH suppliers and installers, a strengthened SWH supply chain, the availability of fiscal resources for a 30% subsidy of the SWH capital cost, municipal by-laws to make SWH mandatory in new residential and commercial setups, accelerated depreciation for industrial installation; continuation of toll-free helpline and the availability of a plethora of SWH-related information on the Solar Water Heating website maintained by MNRE;
- The need to improve the prospects and grow SWH installations in the industrial sector for low or medium heat application as successfully demonstrated through an ESCO business model for SWH installations in the automobile sector. MNRE should consider the support of bi-lateral and multi-lateral agencies to demonstrate SWH installation in other industrial sectors such as textile, food processing, dairy, pulp and paper, and devise financial risk mitigating mechanisms that will facilitate approval of bank loans to prospective ESCO entrepreneurs to finance industrial SWH projects;
- The need to continuously improve minimum technical standards and capacity within MNRE to monitor and enforce these standards and the operating performance of SWH systems. These standards will need to be updated periodically and, to the extent that is practically feasible, harmonized with international standards. The absence of a strong monitoring system will place higher risks that the SWH installation targets of JNNSM Phase II will not be achieved as there will be no confident estimates of actual energy savings and corresponding GHG reductions.

Conclusions

- With regards to the design of the GSWH Project, its goals and objectives as expressed in the LFA were clear; however, the design or intended incremental impact of GEF activities on the Project was not clear. As a result, the Project was adaptively managed mainly through the AWPs and frequent PSC and PEC meetings to meet the overall Project goal of increasing SWH installations by 2.4 million m^2 over the baseline. This adaptive management also included an estimation of the baseline scenario of SWH growth in the absence of the Project which was only based on regional SWH sales figures; this estimate, however, did not have information on the number of functional SWH installations since 2002;

- This estimation of the baseline scenario did not address the MTR recommendation for a full baseline study. At the time the MTR recommendations were finalized in mid-2012, a significant portion of Project resources were already committed. Hence, with the manner in which the baseline estimation was characterised based on MNRE information, the Evaluators believe that a baseline scenario taken in 2013 is more accurate and valuable due to SWH installations being tied to the subsidy. As per the current SWH growth trends, the number of working SWH installed prior to subsidy will gradually become insignificant.

- The GSWH Project contributed to the accelerated growth of the SWH market in India since 2009:
  - This Project provided a structured approach to removing barriers to SWH market transformation by focusing GEF resources on improving the institutional and

regulatory framework, raising awareness, strengthening the SWH supply and the financial mechanisms, and sharing lessons learned and experiences (domestically and globally) on SWH installations;
  - Key stakeholders were brought together including city officials and SWH manufacturers to state and central government officials, to raise awareness and remove some of the identified barriers;
  - The Project generated useful SWH information products including excellent promotional materials, an informative SWH website, and a SWH toll-free helpline. These knowledge products and services helped to raise awareness of SWH systems to a wide range of stakeholders using the Project's structured approach during JNNSM Phase I;
  - Capacity of the SWH supply chain (from manufacturers to installation and maintenance personnel) was strengthened to meet certain level of product quality through the minimum technical criteria by the manufacturer to receive MNRE subsidy. MNRE confirmed that future sales of SWH will be backed by an after-sales service. For a manufacturer to be registered with MNRE under the JNNSM Phase II program, they will need to meet these criteria as well as provide a commitment to after-sales services which will be subject to third party verification. This should provide domestic end-user confidence of the SWH installation program;
  - The studies and stakeholder consultations through workshops conducted under the Project assisted MNRE in their formulation and implementation of financial mechanisms (both for the residential and industrial applications), certification of SWH suppliers and quality control of the installations, all of which are closely linked to the Government's 30% subsidy payments.

- The Project sponsored the preparation of a CDM-PoA project which has been registered for SWH installations. While this is an excellent outcome that provides a sound UNFCCC-approved monitoring plan for GHG reductions to be implemented by a private Coordination Management Entity (CME), the impact of this CDM project, unfortunately, is likely to be minimal unless there is a recovery from low global carbon prices.

- To meet JNNSM Phase II goals of an additional 8.0 million m^2 of SWH installations by the end of 2017, and a further addition of 5.0 million m^2 by 2022, more SWH suppliers and manufacturers will be required to meet this demand. Currently, based on 2010 to 2012 sales information from MNRE, an average of 92,000 m^2 was being installed on a monthly basis. Phase II targets will require an average installation rate of 166,000 m^2 per month, almost double the current installation rate. This will essentially require a doubling of the current SWH installation capacity in India which will require more SWH trainees. There will also be a need for further capacity improvements within MNRE to regulate and enforce Government Orders for SWH installations and monitor SWH installations for reductions in fossil fuel consumption and GHG emissions. MNRE are fully aware of these scale-up issues where JNNSM Phase II *targets at least 15-20 cities where solar water heaters would become the main source of heating water replacing electric geysers*. The MNRE strategic plan for SWH market expansion until 2017 outlines:
  - Division of a national SWH plan into appropriate geographic regions;
  - Determination of unique hot water demands and SWH end-user applications for each region;
  - Determination of appropriate technologies, prices and further segmentation of market potential;

  - Clearly defined strategies to provide strong growth by implementing prioritized high potential regions through utilities, mandatory regulations and strengthened supply chains.

- The Project's activities have been complementary to JNNSM Phase I activities in the identification and removal of financial barriers to increased market penetration of SWH and the provision of a partial Capital Subsidy (30% of capital cost of SWH) and additional 80% depreciation benefit to the industries for SWH installations;

- The Project has provided an excellent demonstration of a functional ESCO model for SWH installations in the industrial sector. Moreover, SWH applications in the industrial sector has demonstrated that fuel savings and GHG reductions are significant in these applications since hot water is required for more than 8 hours per day, in comparison to domestic hot water demand which is estimated to be 2 hours daily. The replication of this ESCO model, however, will require additional efforts mainly to assist in building the capacity of ESCO entrepreneurs and employees, and to improve the confidence of lending entities to finance SWH installations by ESCOs;

- GSWH project funds were exhausted on December 31, 2012, 6 months before the actual GSWH terminal date of June 30, 2013. This UNDP oversight and the lack of Project funds in 2013 affected some of the Project activities such as:
  - the ESCO not receiving all GSWH funds that were committed;
  - deployment of a 12.5 lpd SWH for the Himalayan Region for targeted end users after the prototype was modified on the basis of field tests;
  - follow-up with the city governments to obtain feedback on the impact of amending by-laws on SWH installations; and
  - tube collectors and fixed plate collectors at three different locations in India the opportunity to share results of comparative analysis of SWH efficiencies of evacuated which would help buyers as well as policy makers to make informed decisions.

  All of the aforementioned activities could have provided valuable inputs to the scoping of MNRE's scaled-up activities for SWH under JNNSM Phase II.

- Notwithstanding this oversight, the GSWH Project has provided good incremental value to India's National Solar Mission that has accelerated growth of the SWH after the launch of mission in 2010. MNRE's co-financing contribution after the launch of JNNSM Phase I increased significantly including USD 8.0 million (Rs 40 crore) in 2010-11 from its own budget and USD 12.0 million (Rs 64 crore) in 2011-12 from the National Clean Energy Fund towards the SWH subsidy. Overall, MNRE's co-financing contribution towards the Project greatly exceeded the original targets.

Lessons Learned

- A concise LFA with SMART indicators and a proper baseline assessment is required for effectiveness in measuring the incremental impact of a project. In the case of GSWH, a proper LFA would have identified that there was a lack of baseline information, and that Project resources could have been used to conduct some baseline surveys which could be improved during the term of the Project. More importantly, the baseline survey could

have also provided some information on the number of functional SWH systems; this would have provided improved confidence on the actual energy saved for SWH systems installed prior to the Project.

- Subsidies can be effectively linked with quality control of the items that are being subsidized. In the case of GSWH, the 30% subsidy was being paid from MNRE to the supplier or SWH manufacturer. Their qualification for the 30% subsidy was linked to SWH manufacturers submitting samples to MNRE appointed test centers, rating agencies, and third party quality assessments to ensure compliance of the SWH supplier and manufacturer on meeting minimal technical standards, efficiencies in their installation of SWH systems, after sale-services, and their response times to complaints and break-downs. To a large extent, compliance to these standards is self-enforced to qualify for the subsidy;

- Certain business pre-conditions are required for successful SWH installations by ESCOs in India:
  - Availability of financing of an ESCO business from lending institutions or equity partners. Aspiration Energy is equity financed with current bank loans that are written against their assets, and not the potential income from the ESCO projects. Given the lack of ESCO-implemented projects for SWH installations, there are no records of loans to ESCOs for SWH installations in India;
  - The prospective client is too busy to invest time to seek improvement to efficiencies in their energy consumption. This would characterize industrial clients who are often so entrenched in maintaining their production lines, and are unable to spend the required time to design measures to reduce their energy consumption. In the case of Aspiration Energy, they provided a service and measures for two small car part factories to reduce their fossil fuel consumption;
  - For industrial clients, the SWH system must be sufficiently complex to require ESCO services to identify the best SWH layout. In addition, the size of the industrial enterprise should be medium to large. In Viet Nam, there were a number of ESCO projects that did not work since the client was an SME and at a later stage, was unwilling to share energy savings with ESCO. Instead, these SMEs decided after the first ESCO contract to hire the ESCO as a consultant for the EE measures, and purchased the EE appliances with their own funds. Functional ESCOs in Viet Nam had larger industries as clients; this is parallel to the business model being followed by Aspiration Energy in Chennai that has more potential for replication of ESCO contracts;
  - For industrial clients, the SWH system must be implemented without significant costs to the factory owner. This would include the owner being able to minimize opportunity costs (resulting from down time required to install a SWH) or not being obligated to provide a large down payment to implement the project. In these cases, much of the Aspiration Energy installation was done during factory downtime on weekends, and using its own equity and working capital loan. The lack of available low interest loans is a barrier for entrepreneurs to operate as ESCOs and provide installation services for low-temperature hot water requirements in the industrial sector.

Recommendations

With the GEF-funded GSWH project terminating on June 30, 2013, the following recommendations are being provided:

Recommendation 1: Strengthen energy labelling to promote best SWH models. With the scale-up of SWH installations forecast over the next 24 months, MNRE needs to select a system for labelling the various approved SWH models within JNNSM Phase II. The current preference of the PSC is the development of a "Star Rating" on SWHs from various manufacturers for which MNRE should closely collaborate with the Bureau of Energy Efficiency (BEE) to define an appropriate labelling program applicable to SWH. During several PEC and PSC meetings, the discussion on developing Minimum Energy Performance Standard for SWH, had reached a certain stage; dialogue between MNRE and BEE needs to be resumed. The development of the Star Rating system will strengthen confidence among end-users and ensure the best quality products are deployed under the accelerated SWH program of JNNSM Phase II. Additionally, MNRE should review international trends in the development of the SWH technical standards and consider, to the extent practically feasible, harmonize them with international standards.

Recommendation 2: Improve programme management capacity of MNRE through setting up a system for information collection and monitoring energy performance of new SWH installations. With the establishment of a SWH energy labelling system, MNRE will need to capture the positive energy performance impact of the JNNSM Phase through the setup of a robust monitoring and reporting system. Since the Project had contributed to the setup of a proposed CME, Nuetech Solar Systems Pvt. Ltd., for a CDM-PoA for SWH installations, MNRE should link its MRV improvements with Nuetech as they have already have in place an MRV system approved by the UNFCCC. Their system as outlined in the PoA-DD[17], provides the structure to allow SWH managers to monitor, report and verify compliance of minimum technical criteria (MTC) for SWHs. Since compliance to these MTC is required to qualify the manufacturer for the MNREs capital subsidy of 30%, SWH MEPS compliance should be high. This recommendation should be implemented in close collaboration with capacity building efforts under Recommendation 2.

Recommendation 3: Re-assess and build state and municipal-level capacities to manage JNNSM Phase II SWH installations. Capacity building for local government personnel will be required in the 15-20 cities targeted under JNNSM Phase II. An assessment should detail the capacity building needed for scaled-up activities of Phase II that may include training on how SWH systems function and save energy, MRV systems for new SWH installations, database management, systems to facilitate diligent and timely reporting of sales and installations, and strengthening enforcement of Government Orders, local bylaws and quality control standards.

Recommendation 4: Increase the training of semi-skilled and skilled workers who will be needed for the additional SWH installations to meet the targets of JNNSM Phase II. By 2014, the number of installations will need to increase from the current 92,000 m^2 per month to more than 166,000 m^2 per month by the end of 2014. In addition to SWH installations, these trainees will also need to be able to provide after sales maintenance. Hence, a more intense SWH training program needs to be designed to train a sufficient number of installation technicians who will install SWH systems in the 15 to 20 cities defined under the JNNSM Phase II targets.

[17] http://cdm.unfccc.int/ProgrammeOfActivities/poa_db/N0SLBQPXCMY1EI5OHD87R9624VUJK3/view

Recommendation 5: Strengthen financial mechanisms for SWH under JNNSM Phase II. Financial support in the form of accelerated capital subsidy depreciation needs to be continued to encourage and catalyze SWH installations in the industrial sector for medium temperature hot water system. However, the subsidy should be phased out over a five-year period as the demand for solar water heater begins to grow. Efforts are required to support the ESCOs that offer and implement measures for industry to reduce energy consumption. The two pilots in Tamil Nadu supported under GSWH demonstrate the vast potential for the use of SWH in the automobile manufacturing sector. Some of these ESCO supportive efforts include informing and raising the confidence of lending institutions to provide financing to fledgling ESCO businesses. Due to the large potential of SWH applications for low process heat in the industrial sector, MNRE should consider the support of bi-lateral and multi-lateral agencies with experience to assist in the demonstration of SWH installations in other industrial sectors such as textile, food processing, dairy, pulp and paper, and device financial risk mitigating mechanism to the extent that prospective ESCO entrepreneurs can receive bank loans to finance SWH projects in the industrial sector.

Recommendation 6: Include solar water heaters as an option under the Solar specific Renewable Purchase Obligation (RPO) for industrial consumers with demand exceeding 1 MW. While the RPOs are being enforced by certain states by the state electricity regulatory commission through the electricity distribution company, this restricts and interferes with the industrial entity's choice of installing SWHs which provides reduced fossil fuel consumption versus a solar photovoltaic system which results in minimal reduction in electricity consumption. To encourage the growth of SWH in the industrial sector, it is suggested that MNRE review the RPO and Renewable Energy Certificate (REC) issuance requirements to include SWH installations.

Recommendation 7: MNRE should provide resources to conduct surveys and develop a 2013 or 2014 baseline for SWH installations in India in the domestic sector. This was not done formally during the Project, and would significantly contribute to more effectiveness in managing SWH expansion and added confidence in meeting JNNSM targets for 2017 and 2022. Such a survey needs to be disaggregated to different climatic regions and to a regional or city level. The survey should inform the current SWH knowledge base on the functionality of existing SWH systems, typical maintenance and operational problems that persist with certain SWH models, SWH service life, and energy savings realized. If possible, the survey could also provide baseline information on SWH systems that have been installed between 2002 and 2009 (if these sales records could be located) where the number of functional SWH systems is unknown. This would address the information gaps on functional SWH systems and bring more confidence to the reported energy savings of JNNSM Phase I and II.

ABBREVIATIONS

Acronym	Meaning
APR	Annual Project Review
AWPs	Annual Work Plans
BIS	Bureau of Indian Standards
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
DNA	Designated National Authority (for CDM)
DOE	Designated Operation Entity (UNFCCC accredited CDM PDD auditor)
ESCO	Energy Service Company
ETC	Evacuated Tube [SWH] Collector
FPC	Flat Plate [SWH] Collector
FSP	Full Scale Project (of GEF)
GEF	Global Environmental Facility
GEF-4	GEF 4th replenishment funding cycle
GHG	Greenhouse Gas
GO	Government Order
GOI	Government Of India
GSWH	Global Solar Water Heater (project)
ICPCI	International Copper Promotion Council of India
IREDA	Indian Renewable Energy Development Agency
JNNSM	Jaharawal Nehru National Solar Mission (of India)
ktoe	Kilotonnes of oil equivalent
LogFrame	Logical Framework
M&E	Monitoring and Evaluation
MCs	Municipal Corporations
MNRE	Ministry of New and Renewable Energy (an India Union Ministry)
MoEF	Ministry of Environment and Forests (the GEF focal point in India)
MoUD	Ministry of Urban Development
MTR	Mid Term Review
NGOs	Non Government Organisations
PEC	Project Executive Committee
PDF	Project Design Facility (a GEF project development funding mechanism)
PIRs	Project Implementation Reviews
PMU	Project Management Unit
PoA	Program of Activities (of CDM)
ProDoc	Project Document
PSC	Project Steering Committee
QPRs	Quarterly Progress Reports
SEC	Solar Energy Center (of MNRE)
SMART	Specific, Measurable, Achievable, Realistic and Time-Bound
SNAs	State Nodal Agencies
SWH	Solar Water Heater
ToR	Terms Of Reference
ULBs	Urban Local Bodies
UNEP	UN Environmental Programme

1. INTRODUCTION

This report summarizes the findings of the Terminal Evaluation Mission conducted during May 10-16, 2013 for the Indian component of the Global Solar Water Heating Market Transformation and Strengthening Initiative (hereby referred to as GSWH or the Project), that received a USD 2.0 million grant from the Global Environmental Facility (GEF). The project was developed from between 2005 and 2008 as part of a UNEP and UNDP six-country project, with the knowledge management component managed as one project by UNEP, and the individual country implementation aspects managed by UNDP as six individual nationally executed (NEX) projects. The Indian GSWH project was approved within the overall 6-country (Global) consolidated project.

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- the industrial sector for various cleaning and process needs.

The large and growing demand for hot water in India can be attributed to:

- significant geographical regions with cool or cold winters making ambient temperature bathing water uncomfortably cool or cold;
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1.1 Background

At the national level, more than 70% of India's energy generation is from fossil fuels. Within this 70%, 40% is from coal, 24% from oil and 6% from natural gas. In 2009, fossil fuel imports of crude oil amounted to 160 ktoe that represents 80% of its total crude oil consumption of 200 ktoe[18]. Recent trends indicate that the proportion of oil consumption in India is growing, and with fossil fuels being so heavily subsidized in India, there is a considerable impetus to reduce these subsidies by increasing diesel and furnace oil prices to world market levels.

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A major challenge in India is adding new electricity capacity rapidly enough to keep pace with its steadily developing economy and its growing electricity demand. With widespread power cuts and rising electricity prices, several industries, commercial

[18] http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=IN

establishments, private residences and apartment buildings have standby diesel generation sets to sustain power supplies throughout the day, albeit at a high fuel cost. As such, electric geysers are associated with high energy costs and do not provide reliable hot water supplies unless they are supplied by expensive back-up diesel power generation.

From 2002 to 2008, the Government of India (GoI) was promoting the use of solar water heaters (SWH) through their support of a programme that subsidized interest rates for loans for SWH purchases and installations; the subsidy did not have desired impact to transform the market, resulting in less than 1% market penetration in 2010[19]. One explanation for this low impact was that only the smaller banks participated in the interest rate subsidy scheme, limiting the number of SWHs sold on the market[20].

On June 30, 2008, the Prime Minister of India launched India's National Action Plan on Climate Change, and raised the profile and importance of transforming the market for solar energy applications in India, of which SWH installations were being supported to offset the use of fossil fuels for hot water heating. Efforts to transform the SWH market received a further boost when the Ministry of New and Renewable Energy (MNRE) launched the Jawaharlal Nehru National Solar Mission (JNNSM) mission on 11th January 2010. JNNSM Phase I was a major initiative with the combined efforts of GoI and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge, and scoping India's contribution of solar energy generation to mitigate global climate change. The immediate aim of JNNSM Phase I was to focus on setting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level to the end of 2013. JNNSM Phase II is the scale-up phase for solar energy installations in India until 2017[21].

A component of JNNSM Phase I was to promote and increase the use of SWH through a financial mechanism with a subsidy scheme; the provision of testing facilities at MNRE's Solar Energy Center SEC; a range of activities to support SWH manufacturers and dealers; and the development and uptake of a range of policy and administrative measures to transform the SWH market. The GSWH Project which commenced in December 2008 was designed to accelerate the transformation of the SWH market through awareness raising on SWH technologies, and providing a structured approach for MNRE on the creation of the enabling investment environment for SWH installations. This Evaluation report provides a summary of the performance of this GEF-supported project in achieving this goal, and assesses the sustainability of GWSH activities to contribute to the 2017 goals of JNNSM Phase II.

1.2 Terminal Evaluation

1.2.1 Purpose of the Evaluation

In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP support GEF financed projects are required to undergo a Terminal Evaluation (TE) upon completion of implementation of a project to *provide a comprehensive and systematic account of the performance of the completed project by*

[19] Less than 1% of all Indian households
[20] Personal communication with Dr. Sameer Maithal
[21] http://mnre.gov.in/file-manager/UserFiles/draft-jnnsmpd-2.pdf

evaluating its design, process of implementation and achievements vis-à-vis GEF project objectives and any agreed changes during project implementation. As such, the TE for this Project will serve to:

- promote accountability and transparency, and to assess and disclose levels of project accomplishments;
- synthesize lessons that may help improve the selection, design and implementation of future GEF activities;
- provide feedback on recurrent issues across the portfolio, attention needed, and on improvements regarding previously identified issues;
- contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on effectiveness of GEF operations in achieving global environmental benefits and on the quality of monitoring and evaluation across the GEF system.

This TE was prepared to:

⇒ be undertaken independent of project management to ensure independent quality assurance;

⇒ apply UNDP-GEF norms and standards for evaluations;

⇒ assess achievements of outputs and outcomes, likelihood of the sustainability of outcomes; and if the project met the minimum M&E requirements;

⇒ report basic data of the evaluation and the project, as well as provide lessons from the Project on broader applicability.

TE mission was fielded to India in the cities of New Delhi, Pune and Chennai between the 10th and 16th of May 2013. The Terms of Reference (ToRs) for the TE are contained in Appendix A.

Key issues addressed on this TE include:

- Assessing the impact of the Project notwithstanding the absence of a strong baseline on SWH installations prior to the commencement of GSWH in 2008, and the lack of knowledge on the performance of past SWH installations; and
- The state of the enabling environment for SWH market transformation after the completion of GSWH as it pertains to the goals for SWH during JNNSM Phase II.

Outputs from this TE will provide guidance in charting future directions on sustaining market transformation of solar water heaters in India.

1.2.2 Evaluation Scope and Methodology

The methodology adopted for this evaluation includes:

- Review of project documentation (i.e. APR/PIRs, meeting minutes of Steering and Advisory Committees) and pertinent background information;
- Interviews with key project personnel including the Project Manager, technical advisors (domestic and international), demonstration project proponents, potential investors and relevant UNDP staff;
- Interview with relevant stakeholders from Government;
- Field visits to selected project sites and interviews with beneficiaries.

A full list of documents reviewed and people interviewed is given in Annex B (with the list of questions prepared for various government and private stakeholders). A detailed itinerary of the Mission is shown in Appendix C. The Evaluation Mission for the UNDP-GEF project was comprised of one international expert and one national expert.

1.2.3 Structure of the Evaluation

This evaluation report is presented as follows:

- An overview of project achievements from the commencement of operations in December 2008;
- An assessment of project results based on project objectives and outcomes through relevance, effectiveness and efficiency criteria;
- Assessment of sustainability of Project outcomes;
- Assessment of monitoring and evaluation systems;
- Assessment of progress that affected Project outcomes and sustainability; and
- Lessons learned and recommendations.

This evaluation report is designed to meet GEF's "Guidelines for GEF Agencies in Conducting Terminal Evaluations, Evaluation Document No. 3" of 2008:

http://www.thegef.org/gef/sites/thegef.org/files/documents/Policies-TEguidelines7-31.pdf

The Evaluation also meets conditions set by the UNDP Document entitled "UNDP GEF – Terminal Evaluation Guideline" (http://erc.undp.org/resources/docs/UNDP-GEF-TE-Guide.pdf) and the UNDP Document entitled "Handbook on Planning, Monitoring and Evaluating for Development Results", 2009:

(http://www.undp.org/evaluation/handbook/documents/english/pme-handbook.pdf)

and the "Addendum June 2011 Evaluation":

http://www.undp.org/evaluation/documents/HandBook/addendum/Evaluation-Addendum-June-2011.pdf

1.2.4 Project Implementation Arrangements

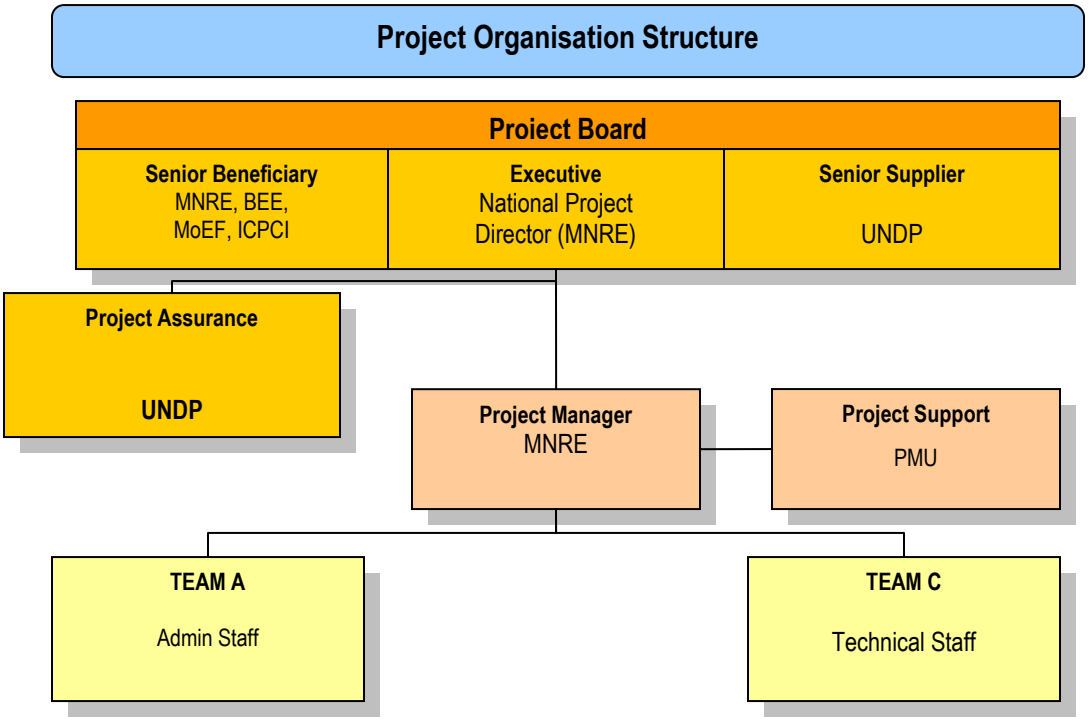
GSWH was executed by MNRE where Project operations were managed by a Project Management Unit (PMU) under UNDP India from its office in New Delhi. The Project was executed through MNRE's Solar Energy Centre under the UNDP's National Execution Modality (NEX). The Project's National Project Director (NPD) was appointed by MNRE, and assumed the overall responsibility for GSWH including the accountability

for the use of funds and for meeting the overall objectives of the Project. MNRE also appointed a full time National Project Manager (NPM).

A Project Steering Committee (PSC) was established for supervising and guiding Project implementation, with the participation of the MNRE, the Bureau of Energy Efficiency (BEE), Ministry of Environment and Forestry (MoEF), UNDP India as well as representatives of other institutions providing direct cost-sharing for the project activities. A Project Executive Committee (PEC), chaired by the NPD, was also constituted to oversee the implementation of the project.

An organogram of GSWH implementation arrangements is provide on Figure 1.

Figure 1: GSWH Project Implementation Arrangements



2. GSWH DESCRIPTION AND DEVELOPMENT CONTEXT

2.1 GSWH Start and Duration

The GSWH project document (ProDoc) was signed on 21st November 2008 with formal Project operations commencing with the Inception Workshop on 4 to 6 March 2009. The ProDoc indicated that GSWH was a 4-year project with a Project Terminal date of 31st December 2012. The programme was extended for another 6 months to its current terminal date of June 30, 2013; all project funds, however, were exhausted by 31st December 2012 with no activities in 2013 with the exception of Terminal Evaluation.

2.2 Problems that GSWH Sought to Address

The goal of this national component of the global UNDP/UNEP Solar Water Heating Market Transformation and Strengthening Initiative was to accelerate and sustain the SWH market growth in India and to use the experiences and lessons learnt in promoting similar growth in other countries. The goal of market growth acceleration was to be accomplished through the establishment of a supportive regulatory environment, build SWH market demand through increased consumer confidence in a strengthened supply chain, and targeting the installation of 10 million m^2 of installed SWH systems in India by the EOP.

GSWH project was focused on these three main problem barriers:

i) A generally unregulated SWH supply chain that needed a higher level of professionalism in delivery of its technologies and services;
ii) Low rate of awareness amongst stakeholders on the benefits of SWH systems; and
iii) Lack of capacity to replicate SWH incentives programs throughout India.

The Project had aimed to complete more than 2 million m^2 of new installed SWH capacity by the EOP over and above the estimated baseline growth of SWH systems which had been expected to stagnate at 450,000 m^2 annually from 2008. The Project also sought to increase GHG emissions reduction by replacing conventional fossil fuel use for water heating.

The impact of GSWH activities was expected to increase SWH installations and provide the following market transformation benefits:

- Reduced cost of producing hot water for residential use;
- Reduced national dependency on imported energy translating into reduced government costs on imported fossil fuels;
- Reduced demand peak load demands on the national electricity grid;
- Reduced environmental pollution produced by conventional energy sources;
- Enhanced employment opportunities and development of the country's SME sector in the SWH field, including increased export opportunities; and
- Enhanced SWH product quality and installation services.

The Project also sought to sustain SWH market development after the EOP by paying specific attention to the aforementioned quality issues.

2.3 Objectives of GSWH

The Project **objective** was to accelerate and sustain the solar water heating market in India as a part of the Global SWH Market Transformation and Strengthening Initiative.

2.4 Main Stakeholders

The main stakeholders of the Indian GSWH Project are listed in an approximate order of ownership and involvement:

- The Ministry of New and Renewable Energy as the Indian Executing Agency and its subsidiary bodies of Solar Energy Center (SEC) which undertakes SWH testing and R&D support. MNRE was the main co-financer with a USD 10.8 million co-financing commitment (USD 10 million for SWH grant subsidies and USD 0.8 million in-kind contribution);
- Ministry of Urban Development (MoUD) in promoting the use of SWH for the residential sector through the issuance of bylaws and regulations that would become mandatory for certain building categories;
- International Copper Promotion Council of India (ICPCI), with an in-kind co-financing commitment of USD 300,000;
- Solar Thermal Federation of India (STFI), a body supported by the SWH manufacturers for the promotion of their products in close collaboration with MNRE;
- Various academic institutions, as well as national and international experts for technical backstopping for country specific activities. This expertise was utilized to ensure that the quality of technical and marketing aspects of SWH technology and installations was implemented to the highest levels;
- Ministry of Environment and Forests (MOEF) acting as the GEF focal point in India, and the DNA on CDM issues on the Project;
- UNEP as the implementing agency for the Global GSWH project that covers 6 countries, in particular the Knowledge Management aspects of the Global project with a budget of USD 5.2 million (USD 3.45 million from GEF and USD 1.77 million co-financing);

The other key stakeholders involved in the implementation of the project include:

- State nodal agencies and municipalities to support or promote the use of SWH; and
- The Bureau of Energy Efficiency (BEE) responsible for national energy efficiency programs for buildings that includes solar water heating requirements in their Energy Conservation Code for Buildings.

While the Project had envisaged the engagement of 27 banks as well as the Indian Renewable Energy Development Agency (IREDA) to serve as a Fund Manager for MNRE, MNRE has undertaken the management of its financial mechanisms for SWH installations through its own departments.

2.5 Expected Results

To achieve this overall goal and objective, GSWH was designed for the removal of barriers with the following expected **project outcomes:**

Outcome 1: An enabling institutional, legal and regulatory framework to promote sustainable SWH market *through the following outputs*:

- Output 1.1: Enhanced capacity of public institutions to support sustainable SWH market;
- Output 1.2: Adoption of a system for standards, labels and adequate quality control of SWH systems (including regulations, recommended institutional set-up etc.).;
- Output 1.3: Adoption of new regulations to consider or oblige the integration of SWH systems into the design and construction of new buildings.
- Output 1.4 Adoption of additional, public financial and fiscal incentives to promote SWH market

Outcome 2: Enhanced awareness and capacity of the targeted end-users and building professionals to consider and integrate SWH systems into different types of buildings *through the following outputs:*

- Output 2.1: Materials for public awareness raising and marketing campaigns developed or adapted into Indians conditions;
- Output 2.2: Public awareness raising and marketing campaigns implemented in co-operation with relevant public entities and private SWH suppliers and manufacturers;
- Output 2.3: Broadening the application range of solar;

Outcome 3: Increased demand for SWH systems by the availability of attractive end-user financing mechanisms or other delivery models *through the following outputs:*

- Output 3.1: Enhanced awareness of the key financial sector stakeholder and local suppliers on the specific characteristics and financing opportunities in the SWH market.;
- Output 3.2: Design, the financial structuring and the implementation arrangements for the specific purpose financing vehicles responding to specific SWH market needs finalized and agreed with the key stakeholders, and integrated into the overall SWH marketing package;
- Output 3.3: Trained staff of the local financing institutions to finance SWH investments;

Outcome 4: A certification and quality control scheme applicable for Indian conditions in place and enhanced capacity of the supply chain to respond to the growing demand with good quality services sustaining the market growth *through the following outputs*:

- Output 4.1: Proceedings and physical facilities for adequate testing and quality control of SWH systems developed and effectively taken into use;
- Output 4.2: A certification and training system in place for SWH system installers**;**
- Output 4.3: SWH system installers trained and certified;
- Output 4.4: Trained local suppliers and manufacturers to produce and market their products;

Outcome 5: The provided support institutionalised and the results, experiences and lessons learned documented and disseminated (including monitoring, learning, evaluation and other feedback for adaptive management) *through the following outputs:*

- Output 5.1: The reporting framework and arrangements for SWH market monitoring established;
- Output 5.2: The national project web-site and network successfully established and marketed;
- Output 5.3: Mid-term and final evaluation.
- Output 5.4: Final report prepared and published;

Section 3 will provide details on the actual GSWH outcomes and outputs.

3. FINDINGS

3.1 Project Design and Formulation

3.1.1 Analysis of LFA / Results Framework

The LFA for GSWH was derived from the LFA on UNEP's Global Solar Water Heating Market Transformation and Strengthening Initiative. While the intent of the Indian component of GSWH is clear, there were a number of issues with the LFA including:

- Confusion within the LFA over outcomes and outputs as well as a lack of clarity of the nature of the outputs. Examples include Outputs 1.1 to 1.3, 2.1 to 2.2, 3.1, and 4.1 to 4.4 being expressed as outcomes, and Output 2.3 not specifying the nature of "broadening" the application range of solar;
- The lack of indicators that have SMART attributes[22] that could have been used for monitoring and recording the Project progress in an effective manner. For example, the Output 1.1 indicator of "availability of public support to promote the SWH market in up to now unexplored regions in India" is not measurable; an opinion poll with a target approval rating would have been a preferred indicator. The target for this output of "dissemination over main market regions of India" is neither specific nor is it time-bound; a target could have been a number of large cities where SWH dissemination programs were already in place such as Pune to Bangalore. Several other similar examples exist in the LFA;
- The absence of a detailed baseline analysis of SWH installations in 2008. The UNEP Six-Country ProDoc does acknowledge the absence of baseline information in developing countries, and as such, had specified baseline determination as a key design activity for each country programme. For the Indian GSWH project, there is no evidence of such a baseline study. Instead, MNRE data (derived from sales data) on SWH installations from 2002 to 2008 was used as a baseline; this data, however, does not provide information on the number of functioning SWHs that have been installed since 2002. Anecdotal information from stakeholders indicates that problems do exist with these SWHs[23] in the absence of any after-sales service. As a result, the installed capacity of SWHs to 2008 may not reflect true energy savings of these SWH systems.

One problem that the Project designers may have encountered was the perception that insufficient resources and time were available to determine a true baseline for SWH. Baseline determination could be quite complex given that electricity, oil and biomass are currently used for heating water, combined with several different hot water heating models with different energy consumptive intensities. Regardless of this complexity, a baseline analysis using a sampling design to a 90% confidence level could have been completed during the course of the Project.

3.1.2 Assumptions and Risks

Two key assumptions in the 2008 LFA included the "economic and financial feasibility of the SWH investments to be promoted" and the "continuing commitment of the key

[22] Specific, measurable, achievable, relevant/realistic, and time-bound

[23] One common problem is mineral deposits from heating hard water that line the tubes limiting the effectiveness of solar energy to heat the water.

partners, such as relevant public entities, financiers and other key interest groups to work towards meeting the project objectives".

The assumption of the indicator of "economic and financial feasibility of the SWH investments to be promoted" has been true. With the rising cost of electricity for residential and industrial clients since 2008, the financial feasibility of SWH systems has become increasingly attractive during the course of GSWH.

The LFA, however, should have included two other assumptions including:

- The political will to promote the SWH systems. The commencement of the JNNSM Phase I in January 2010 served to raise the profile of GSWH, and provided the necessary resources and commitment of the Government to reach specific SWH targets; and
- Active and committed local stakeholders are identified to act as "local champions" in promoting the project goals. In the case of ESCOs, Aspiration Energy has been identified as an ESCO champion in its successful demonstration of a large SWH system for industrial clients in Chennai.

3.1.3 Lessons from Other Relevant Projects Incorporated into GSWH Design

The GSWH project is the first project of its kind in India. Moreover, the role of the UNEP Global component was to feed information on global SWH experience into the design of the Indian component of the Project. While there is a wealth of global experience in SWH system development in other countries such as China and Turkey, none of these experiences were noted in the ProDoc. Hence, the GWSH Project was reliant on the information fed to it by the UNEP Global component.

3.1.4 Planned Stakeholder Participation

GSWH's planned stakeholder participation plans were holistic to include all levels of stakeholders from regulators to end-users. MNRE and other central government agencies improved their policies and Government Orders. More importantly, state government agencies, municipal corporations, development authorities, and utilities were engaged to implement the Central Government Orders. Supporting these orders were plans to involve financial institutions, industry associations, manufacturers, research and test centres, technical experts, architects, engineers, builders and NGOs to supply the necessary fiscal resources to and strengthen the SWH chain. All of these stakeholders were represented during the March 2009 Inception consultation, where they shared their experiences, perceptions and opinions on the accelerated development of the sector. This design approach was excellent representing a holistic approach to stakeholder engagement from regulators to financers, suppliers and installation personnel.

3.1.5 Replication Approach

The following activities of GSWH Project had a sound replication approach:

- Strengthening the supply side of the SWH market to boost consumer confidence on the quality of SWH materials and the professionalism of installation personnel. This would be done through a "learning and improving cycle of training" for all installation

personnel, and the setting and enforcement of relevant standards from the Bureau of Indian Standards (BIS);
- Enhancing SWH awareness and promotion into areas of India where there are no SWH installations;
- Focusing on the dissemination of current SWH support mechanisms in urban areas with demonstration projects and ESCOs;
- Coordination with green energy programs including carbon finance to reinforce investment in the SWH market; and
- Facilitating cooperation amongst various stakeholders seminars, workshops and other public events.

3.1.6 UNDP Comparative Advantage

The strength of UNDPs involvement to implement GSWH is its long-term involvement in providing technical assistance for renewable energy development to developing countries with a focus on poverty alleviation and energy security. With UNDP India having implemented more than 16 projects for over the past 15 years, it has developed a good relationship with the Government of India and unique experience in developing local capacity, and effectively working with multiple stakeholders from public and private sectors, technical experts, civil society, and grassroots level organizations. In the context of renewable energy technology deployment, UNDPs attributes include a multi-dimensional development perspective, and the ability to address cross-sectoral issues and inclusiveness in constituency building.

3.1.7 Linkages between GSWH and Other Interventions within the Sector

Other than the MNRE's own program of promoting solar water heaters through subsidy and soft loans, there were no other planned linkages with other renewable energy interventions in India.

3.1.8 Management Arrangements

This national subcomponent of the joint UNDP/UNEP Global Solar Water Heating Market Transformation and Strengthening Initiative was to be managed by MNRE under NEX modality. The MNRE-appointed NPD was to assume the overall responsibility for the project, accountability for the use of funds and meeting the overall objectives of the project. These arrangements are appropriate for the objectives of this Project.

For supervising and guiding the project implementation, a Project Steering Committee (PSC) was established with the participation of the MNRE, BEE, MoEF and UNDP India, as well as ICPCI. The responsibilities of the PSC were to:

- Provide the necessary political support to the project implementation;
- Provide guidance and direction to the project and provide feedback on project work plans and progress reports;
- Mobilize cost-sharing and follow-up financing;
- Approve main project outputs;
- Assure coordination between this project and other ongoing government activities and programmes;

- Assure all stakeholders are appropriately involved in the project planning and management;
- Facilitate linkages with high-level decision-making.

A PEC was also established to guide Project activities, closely monitor Project progress, support dissemination activities for the various SWH technologies, maintain technology neutrality, and augment delivery of GSWH outputs and objectives.

A Project Management Unit was established to oversee the day-to-day management of the Project, led by a full time NPM and supported by professional staff and an administrative assistant. The PMU's responsibility is to prepare plans and monitoring reports as per UNDP-GEF requirements.

The UNDP Country Office had the responsibility of monitoring the progress towards intended results through regular contacts with the PMU and monitoring visits, on implementation matters and problem solving. UNDP also provided administrative support upon request and ensure financial oversight.

3.2 Project Implementation

One of the challenges of the GSWH Project has been measuring its effectiveness without a clear LFA, and adaptively managing its activities based on results from the early stages of the Project. With a clear objective of achieving 2.0 million m^2 of installed SWH area by the EOP[24], and a lack of specific targets within the Project's five LFA outcomes, many of the activities of GSWH were implemented by "on-the-job learning" and the setup of proper targets and indicators with each AWP. In compensation for the lack of a clear LFA, the planning matrix within these AWPs has helped the Project achieve its targets with the development of a subsidized SWH installation programme, and the boosting of end-user confidence in SWH products and services on the market.

3.2.1 Adaptive Management

Since the commencement of GSWH in December 2008, the Project has had to adapt to changing circumstances resulting in a number of adaptive management measures being undertaken. Implementation of GSWH could be divided into two phases:

- Years 1 and 2 were mainly used to raise SWH awareness, train manufacturers and installation personnel, and conduct studies that would guide acceleration of SWH installations to a 2.0 million m^2 target. These studies provided guidance on the various SWH market characteristics, recommended SWH regulatory framework, financial mechanisms and subsidies to catalyze the SWH market, and an overview of a potential ESCO. The activities during this period were managed according to work plans with little or no adaptive management;
- Years 3 and 4 were mainly implementation activities where adaptive management was required to implement the recommendations from the studies of Years 1 and 2. Two examples of adaptive management included Project assistance to Aspiration Energy where an ESCO model was adapted and demonstrated to suit Indian business conditions. Another example included changing and adapting Project

[24] The 2.0 million m^2 of collector area is an incremental indicator above a baseline increase of area was assumed to be 3.0 million m^2. Details of incremental indicators of collector area are provided in Section 3.3.1 of this report.

activities to respond to demands for less expensive and low maintenance SWH that were designed to meet rural hot water needs in Himalayan communities.

Most of the adaptive management decisions were made at PEC and PSC meetings where Project implementation issues were discussed, and action taken to address the results of implementation.

3.2.2 Partnership Arrangements

GSWH fostered a number of strategic partnership arrangements including:

- ICPCI who provided assistance to the design of GSWH. This partnership provided excellent linkages with manufacturers and installers of flat-bed collector SWH units, and raised the profile of the SWH aspects of the Project through ICPCI promotional activities of FPC SWH units;
- STFI who are supported by its membership of solar water heater manufacturers and installation companies. STFI also maintain the MNRE SWH website and provide valuable services for the national toll-free helpline for SWH systems;
- Channelled partner suppliers who are MNRE-approved manufacturers that have met BIS and MNRE standards for products and service quality conditions;
- Several consulting organizations and technical experts who have assisted in the identification of SWH barriers in different regions of India, and formulation of policy measures, capacity building and training of all stakeholders, SWH market assessments, and awareness raising workshops.

While the UNEP Global Component was to feed information of global experience into GSWH, UNEP's linkages with GSWH were limited to the following:

- The GSWH Inception Mission in March 2009; and
- GSWH attendance to a UNEP global SWH workshop in Tunis, Tunisia in February 2010 which served to help the design of the Indian SWH programme, specifically the 30% MNRE subsidy scheme and financial arrangements for SWH installations.

Otherwise, there were no forms of assistance from the UNEP Global Component to GSWH. Moreover, due to the delays in the start of the UNEP Global component until November 2009, the GSWH Project progressed well ahead of the UNEP Global component and the other 5 countries in terms of implementing a national-scale solar water heater diffusion program.

3.2.3 Feedback from M&E Activities Used for Adaptive Management

There is evidence that M&E activities were discussed at PSC and PEC meetings and used as the primary means of adaptively managing GSWH and to overcome technical and administrative problems. Over 33 PEC meetings and 12 PSC meetings were held during the 4-year Project period, providing numerous management inputs into GSWH. Issues were raised in various projects reports such as PIRs, APRs, BTORs, mid-term reviews and were discussed during these meetings, with actions taken (based on PSC and PEC minutes).

3.2.4 Project Finance

GSWH had a GEF budget of USD 2.0 million that was utilized over its 4-year duration, managed by UNDP and provided to PMU under the management of the PSC for various technical assistance activities, training and workshops, and conducting studies to guide SWH market transformation. PSC meeting minutes show that the PMU and PSC monitored Project expenditures by the overall budget given under the AWPs and not by the ProDoc budget allocated to each outcome.

The only budgetary deviation worthy of discussion was the expenditure for Outcome 2 (Enhanced Awareness and Capacity Building) for which twice the budgeted amount was expended. An examination of these expenditures reveals that the costs for 10 studies were included under Outcome 2; this included four market assessment studies[25], an ESCO study, and building policy and regulator studies. Balancing this were the budgetary surpluses recorded in Outcome 4 (Enhanced capacity of the supply chain) and Outcome 5 (Lessons learned, documented and disseminated). There is no clear indication that the lesser amounts spent on these outcomes has had an adverse impact on the overall outcomes of GSWH. Moreover, the studies conducted under Outcome 2 are of satisfactory quality and should serve as valuable references in scaling up the SWH market towards the end of JNNSM Phase II in 2017.

The planned Project co-financing amounts were estimated to be in the order of USD 10.8 million, more than 5 times the GEF allocation. Prior to the commencement of the Project, co-financing was already committed from Government of India. During the course of the Project, the co-financing contributions made by MNRE in the form of direct subsidy to the SWH was USD 42.31 million, a figure that exceeds the planned figure by 4 times. The actual in-kind contributions made by International Copper Promotion Council of India (ICPCI) were estimated to be equivalent to the planned figure.

A summary of GSWH expenditures is provided on Table 2. The expenditures provided to the Evaluation Team were from UNDP's "Combined Delivery Reports" (CDRs) that were broken down into component expenditures. Co-financing details can be found on Table 3.

[25] These market assessments do not include any robust baseline information on solar water heater deployment in the study areas

Table 2: GEF Project Budget and Expenditures for 2001-2012 (in USD as of December 31, 2012)

Outcome	2008	2009	2010	2011	2012	2013	Total Disbursed	Total Planned for Project	Total Remaining
Outcome 1: Enabling framework		$25,921	$38,490	$53,209	$75,711	n/a	$193,331	$325,000	$131,669
Outcome 2: Enhanced awareness and capacity building		$140,028	$346,216	$289,038	$187,279	n/a	$962,560	$481,000	-$481,560
Outcome 3: Financing mechanism		$2,966	$101,841	$32,685	$81,471	n/a	$218,962	$250,000	$31,038
Outcome 4: Enhanced capacity of supply chain		$42,909	$48,954	$187,704	$37,470	n/a	$317,038	$458,000	$140,962
Outcome 5: Lessons learned documented and dissmenated		-$1,394	$18,356	$39,852	$70,794	n/a	$127,608	$356,000	$228,392
Project Management, M&E		$34,724	$35,520	$54,917	$52,492	n/a	$177,652	$130,000	-$47,652
TOTAL (actual)	$0	$245,154	$589,376	$657,405	$505,217	$0	$1,997,151	$2,000,000	$2,849
TOTAL (cumulative actual)	$0	$245,154	$834,529	$1,491,934	$1,997,151	$1,997,151			
TOTAL (planned)		**$292,000**	**$535,000**	**$578,000**	**$595,000**		$2,000,000		
% expended of Total Planned Disburs	**0%**	**12%**	**42%**	**75%**	**100%**	**100%**			

Table 3: Commitment, expenditure, balance left by different donors for GSWH project (as of December 31, 2012)

Co-financing (type/source)	UNDP own financing (mill. US$)		Government (mill. US$)		Partner Agency (mill. US$)		Total (mill. US$)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Grants	2,000,000	2,000,000	10,800,000	40,000,000			12,800,000	42,000,000
Loans/Concessions								
• In-kind support					300,000	310,000	300,000	310,000
• Other								
Totals	2,000,000	2,000,000	10,800,000	40,000,000	300,000	310,000	13,100,000	42,310,000

3.2.5 M&E Design at Entry and Implementation

Ratings of the Project's Monitoring and Evaluation system[26] are as follows:

- *M&E design at entry – 4*;
- *M&E plan implementation – 5*.

The design of the Project's M&E activities was moderately satisfactory based on an LFA design containing several qualitative indicators that were not measurable (see details in Section 3.1.1). As such, it was difficult to quantify the effectiveness of some of the Project activities. As mentioned earlier in this section, the targets and indicators in the planning matrix provided in the AWPs were much clearer than the LFA. More importantly, the SWH market had achieved an incremental instalment of more than the EOP targeted collector area of 2.0 million m^2. This achievement through improvement in the market conditions for installing SWH systems provides a good indicator that the Project's M&E activities were effective in improving the capacity of the MNRE and the SWH supply chain; otherwise, it is doubtful that the market would have experienced this growth acceleration without some form of end-user confidence in SWH systems.

The implementation of the M&E plan was satisfactory based on PMU reports to PEC and PSC members, approval for follow-up actions from the numerous PEC and PSC meetings, and the Project outcomes that meeting installation targets by the EOP.

3.2.6 UNDP and Executing Partner Performance

Ratings of UNDP (Implementing Agency) and the MNRE (Executing Agency) performance[27] are as follows:

- *Quality of UNDP Implementation – 5;*
- *Quality of Execution – MNRE – 5;*
- *Overall Quality of Implementation/Execution – 5.*

These satisfactory ratings are based on the evidence provided by the PEC and PSC meeting minutes on the discussions and approval for follow-up actions by MNRE and UNDP officers. One minor shortcoming of UNDP implementation worthy of mention was the exhaustion of Project funds by December 31, 2012, 6 months prior to the Project Terminal date of June 30, 2013, the impact of which were lost opportunities to fully complete ongoing work and to get feedback on ongoing activities. Details are provided in the Conclusions of this report (Section 4.2).

[26] 6 = HS or Highly Satisfactory: There were no shortcomings;
5 = S or Satisfactory: There were minor shortcomings,
4 = MS or Moderately Satisfactory: There were moderate shortcomings;
3 = MU or Moderately Unsatisfactory: There were significant shortcomings;
2 = U or Unsatisfactory: There were major shortcomings;
1 = HU or Highly Unsatisfactory.

[27] Ibid 29

3.3 Project Results

Assessment of GSWH achievements and shortcomings are provided in this section against the 2008 Project log-frame. Each outcome was evaluated against individual criterion of:

- *Relevance* – the extent to which the outcome is suited to local and national development priorities and organizational policies, including changes over time;
- *Effectiveness* – the extent to which an objective was achieved or how likely it is to be achieved;
- *Efficiency* – the extent to which results were delivered with the least costly resources possible.

The Project outcomes were rated based on the following scale:

- *6: Highly Satisfactory (HS)*: The project has no shortcomings in the achievement of its objectives;
- *5: Satisfactory (S)*: The project has minor shortcomings in the achievement of its objectives;
- *4: Moderately Satisfactory (MS)*: The project has moderate shortcomings in the achievement of its objectives;
- *3: Moderately Unsatisfactory (MU):* The project has significant shortcomings in the achievement of its objectives;
- *2: Unsatisfactory (U)* The project has major shortcomings in the achievement of its objectives;
- *1: Highly Unsatisfactory (HU):* The project has severe shortcomings in the achievement of its objectives.

3.3.1 Overall Results

Project Objective: To accelerate and sustain the solar water heating market in India as a part of the Global SWH Market Transformation and Strengthening Initiative.

Intended End of Project (EOP) Outcome: ⇒ 2 million m^2 market acceleration contributing to (10 million m^2/ 1 billion inhabitants); ⇒ A steady, average growth rate of >30 % in India reached by the end of the project and continuing growth toward the expected saturation point of 140 m^2 per 1,000 inhabitants towards 2025 ⇒ Over 90% customer satisfaction on new installations on the basis of problem free good quality products and installation services
Actual EOP Outcome: ⇒ *A satisfactory outcome has been achieved in the market acceleration target on which 2.4 million m^2 installations were achieved during the Project period.* ⇒ *A satisfactory outcome has been achieved in the growth rate of SWH installations. The average growth rate of 26.7% was achieved based on growth of SWH installed areas from 5.6 million m^2 (March 2012) to 7.1 million m^2 (March 2013), done in concert with the exceedance of the 2.0 million m^2 target of SWH installations* ⇒ *A moderately satisfactory outcome has been achieved based on the growth of SWH installations. While no customer satisfaction surveys have been conducted for SWH installations, good quality installation services are likely the norm given that MNRE has recently started to monitor this service as well as after-sales service using third party*

observers and non-compliance to MNRE norms by suppliers and installers would lead to manufacturer being dropped from the listing of MNRE channelled partners for SWH installations and consequently would not have access to capital subsidy.

Rating: *relevance: 5*
effectiveness: 4
efficiency: 5
overall rating: 5

Table 4 summarizes the GHG reduction estimates (using GEF guidelines) that were generated during GSWH (to March 31, 2013).

Table 4: Summary of CO_2 Reductions from the Project

Direct emission reduction, t CO_2	
Cumulative direct emission reductions, t CO_2	**1,656,735**
Direct post-project emission reduction, t CO_2	
Total direct post-project emission reduction, t CO_2	**0**
Indirect emission reduction, t CO_2	
Indirect bottom-up emission reductions, t CO_2	**49,702,050**
Indirect top-down emission reduction, t CO_2	**60,746,950**

Direct emission reductions were based on the following assumptions:

- Baseline growth of the SWH market was assumed to be 450,000 annually based on the actual SWH growth as reported by MNRE during 2007-08. This growth of 450,000 m^2 each year or 2.16 million m^2 cumulative was assumed in the absence of GSWH;
- Direct emissions were based on actual MNRE data showing growth of SWH installations less the baseline of 450,000 m^2 SWH installed annually. Table 5 shows the baseline versus the actual MNRE SWH sales data;
- Direct emission reductions were based on a grid emissions factor of 0.89 CO_2/MWh for the Indian electricity grid[28];
- the GEF method for calculating GHG emission reductions[29].

No post-project direct emission reductions were calculated since there are no financing instruments such as revolving fund or loan guarantee facility in the GSWH project.

[28] Grid emission factors were provided by the GoI's Central Electricity Authority under the Ministry of Power on January 2012: http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver7.pdf
[29] "Manual for Calculating GHG Benefits of GEF Projects: Energy Efficiency and Renewable Energy Projects, April 16, 2008 (GEF/C.33/Inf.18)"

Table 5: MNRE Data on SWH Growth in India (under JNNSM Phase I)

Year	m^2 of SWH installations				Growth rate (%)
	Yearly installed (Baseline in absence of GSWH)	Yearly installed (as reported by MNRE)	Cumulative (as reported by MNRE)	Annual contribution from GEF project	
Apr 06 to Mar 07			1,900,000		
Apr 07 to Mar 08			2,350,000		
Apr 08 to Sep 08			2,550,000		
Oct 08 to Mar 09*	360,000	360,000	2,910,000	0	
Apr 09 to Mar 10*	450,000	600,000	3,510,000	150,000	21%
Apr 10 to Mar 11*	450,000	1,000,000	4,510,000	550,000	28%
Apr 11 to Mar 12*	450,000	1,100,000	5,610,000	650,000	24%
Apr 12 to Mar 13*	450,000	1,500,000	7,110,000	1,050,000	27%
Subtotal	*2,160,000*	*4,560,000*		*2,400,000*	
Total target during project period, 2008-2012) Reference PIR 2010		5,000,000			
Target Business As usual		3,000,000			
Additional target due to GEF intervention		2,000,000			
Target for JNNSM Phase II (cumulative Apr 2013 to Mar 2017)			15,000,000		

* During GSWH Project period

Indirect emission reductions consist of:

- Bottom up reductions based on a 10-year service life of SWHs and a replication factor of 3 for market transformation; and
- Top-down reductions based on a 40% causality factor, considered weak since the regulatory measures are soft, and regulatory measures to a large extent being voluntary with poor enforcement.

3.3.2 Outcome 1: An enabling institutional, legal and regulatory framework to promote sustainable SWH market

Intended Outcome 1*:*

⇒ Enhanced capacity of public institutions to support sustainable SWH market that results in the expansion of solar program to other states of India

⇒ A system for standards, labels and adequate quality control of SWH systems (including regulations, recommended institutional set-up) has been adopted in main markets of India including a performance indicator for the EN and ISO standards and best practices, and government support should be linked to a certification system showing quality of products, systems, production and installation work

⇒ Adoption of new regulations to consider or oblige the integration of SWH systems into the design and construction of new buildings

⇒ Adoption of additional, public financial and fiscal incentives to promote SWH market

Actual Outcome 1:

⇒ *A moderately satisfactory outcome has been achieved in the enhancement of capacity of public institutions to grow the Indian SWH market. In 2011, public institutions at the local levels in 21 states were informed by MoUD of upcoming regulations and bylaws on the installation of SWH into buildings. In 2012, Government Orders were issued for the amendment of building bylaws for the installation of SWH. This resulted in over*

100 municipal corporations and development authorities in 8 states amending building bylaws to implement these orders. While local public institutions are now more aware of SWH as a means of promoting sustainable communities, their capacities to enforce these orders are still poor. Regardless of this finding, however, expansion of the SWH market has taken place in 8 states to the extent that the Project targets for 10 million m^2 of cumulative SWH expansion have been met;

⇒ *A moderately satisfactory outcome has been achieved in the partial completion of a system of standards, labels and quality control under MNRE. Currently, an association has been formed with the Quality Council of India for the development of a certification system with test procedures. Three SWH test centres have recently been opened where manufacturers can test their SWH systems for compliance to "Indian Standard IS:12933 for FPC SWH" as set by MNRE to qualify for the 30% subsidy. As such, the quality of SWH systems in the market has improved with this system;*

⇒ *A satisfactory outcome has been achieved in the adoption of public financial and fiscal incentives. This rating has been made despite this output not having any targets in the LFA. Moreover, this output is covered under Outcome 3 of this Project. However, in summary, Project assistance has had an impact on the additional financial and fiscal incentives under the JNNSM program managed by MNRE. This includes the 30% subsidy under which the Project has assisted in developing a robust institutional, legal and regulatory framework for catalyzing the SWH market in the residential sector. The 30% subsidy also extends to the industrial sector although this market segment has not yet been catalyzed. The Project has also developed a PoA for a carbon finance mechanism which unfortunately may not have the intended impact due to low global carbon prices.*

Rating:	*relevance:*	*5*
	effectiveness:	*4*
	efficiency:	*4*
	overall rating:	*4.3*

In general, the outcome of activities from this component has been that an institutional, legal and regulatory framework has been formed resulting in the acceleration of SWH installations in India from 2011 to date. While implementation of the framework has been strong at the central level of government, it is weaker at the local levels where municipal level government corporations and development authorities have been able to execute government orders. Enforcement of these orders, some of which include mandatory installations of SWH, has been weak mainly due to the dilution of available national resources and efforts to 21 states for training on SWH systems. The Evaluation team, however, was informed that MNRE are well aware of the problem, and are doing all that is possible to build the capacities of local government to enforce Government Orders to as many states in India as possible.

The growth of the SWH market has also been catalyzed despite the partial completion of a quality control system. MNRE's requirement for manufacturers to meet minimum technical standards for SWH does provide adequate quality controls for SWH systems installed since non-compliance will disqualify the manufacturer from the subsidy. A further "certification" requirement is compliance to MNRE's channelled partner system where SWH suppliers must meet minimum capacity standards including a minimum number of trained installation staff, efficiency of service, quality of after-sales service and complaint response. MNRE have a roster of third party inspectors who conduct regular performance audits of channelled partners.

The newly formed institutional, legal and regulatory framework, quality control system with the 30% subsidy in place has been the main drivers for the accelerated sales of domestic SWH system installations. As such, the activities from this component can be deemed satisfactory bearing in mind that more improvements to strengthen the system and its ability for monitoring are needed with some aspects in progress.

3.3.3 Outcome 2: Enhanced awareness and capacity of the targeted end-users and building professionals to consider and integrate SWH systems into different types of buildings

Intended Outcome 2*:* ⇒ Annual sale of SWH system results in >2,000,000 m^2 a year at the end of the project ⇒ Materials for public awareness raising and marketing campaigns developed or adapted into Indians conditions for different parts of India and showing certification system showing quality of products, systems, production and installation work ⇒ Public awareness raising and marketing campaigns implemented in co-operation with relevant public entities and private SWH suppliers and manufacturers ⇒ Application range of solar has been broadened to include awareness of possibilities for solar in industrial and agricultural applications in rural/industrial areas through 2 demonstration projects or one SESCO
Actual Outcome 2: ⇒ *A moderately satisfactory outcome has been achieved in the target of annual SWH sales of 2.0 million m^2 at the EOP. The Apr 2011-Mar 2012 sales figure was 1.1 million m^2. The Apr 2012-Mar 2013 sales was 1.5 million m^2* ⇒ *A satisfactory outcome has been achieved with the establishment of the www.solarwaterheater.gov.in website, dedicated to raising public awareness on the JNNSM goals and objectives as well as providing a wealth of information on SWH technology and past examples of installation work throughout India. The website is informative and appears to be the main source of information for SWH consumers and practitioners (based on interviews with a number of stakeholders throughout the Evaluation Mission)* ⇒ *A satisfactory outcome has been achieved in raising public awareness through the www.solarwaterheater.gov.in website, as well as a number of awareness workshops that targeted specific applications and economic sectors for the use of SWH systems. This included 2011 awareness workshops for the health, hospitality, education and industrial sectors, the Himalayan Region and urban centers where excellent knowledge products were distributed to participants and participant feedback on the proceedings was generally positive. Advertisements on the JNNSM programme were also placed at prominent places displaying the benefits of SWHs and advertisements. There is also a toll-free number operated by the Solar Thermal Federation of India (STFI) that fields calls for information on all SWH programmes on behalf of JNNSM. STFI also publishes "InSolTherm Times" an electronic newsletter that is linked to the www.solarwaterheater.gov.in website.* ⇒ *A satisfactory outcome has been achieved in the demonstration of ESCO modality for installing SWH systems in the industrial sector. Aspiration Energy based out of Chennai has completed two SWH systems for two ancillary factories in Chennai. The clients are satisfied with the SWH systems as it is reducing their fossil fuel costs for hot water used for degreasing and cleaning wheel rims and steering systems for export to car assembly plants.*

Rating: *relevance:* *5*
effectiveness: *4.5*
efficiency: *5*
overall rating: *4.8*

Project activities to raise public awareness have had the impact of boosting end-user consumer confidence in the JNNSM programme. The awareness workshops as well as advertising on mass media and the Government website have likely had an impact on the acceleration of the collector area in 2011 to date. Specific workshops included the "Potential of Solar Water Heating (SWH) in the Himalayan Region, Industrial Sector and 5 States/National Capital Region", the "Development and Implementation of Communication Strategy", "Development of Energy Service Company Models" and several training workshops.

Overall, the Project activities to raise awareness have been completed with satisfactory results and resulting in significant impact to the growth of SWH systems in India.

3.3.4 Outcome 3: Availability of attractive end-user financing mechanisms or other delivery models

Intended Outcome 3*:*

⇒ The agreed financial support mechanisms and new delivery models in operation to meet the announced MNRE target to reach 10 m^2 of installed SWH capacity by 2020

⇒ Enhanced awareness of the key financial sector stakeholder and local suppliers on the specific characteristics and financing opportunities in the SWH market (including all the key financial sector stakeholders and local suppliers informed on the specific characteristics and opportunities provided by the Indian SWH market, and on the experiences and lessons learnt from the financing models tested in other countries

⇒ New financing instruments and business models (such as specific purpose bank loans, vendor financing, SESCOs etc.) specifically tailored and marketed for the SWH purchase offered to the end users as a part of the overall marketing package and integrating the available public incentives

⇒ Staff of the local financing institutions to finance SWH investments has been trained

Actual Outcome 3:

⇒ *A satisfactory outcome has been achieved with MNRE allocating a 30% subsidy as per the requirements of the JNNSM programme that follows the lead from lessons learned from a similar but earlier SWH programme in Tunisia. This has led to the installation of 7.1 million m^2 of installed SWH capacity by the EOP and on target for 15 million m^2 by Mar 2017 (end of JNNSM Phase II). One issue that needs to be resolved is the processing time for subsidy payments from the ministry to the suppliers. A number of suppliers have said the payments can take anywhere more 6 months which has to be met from own sources or bank borrowing. This poses a risk to the viability of the SWH businesses of the channelled partners and the benefit of subsidy becomes suspect;*

⇒ *A satisfactory outcome has been achieved with enhanced awareness of key financial stakeholders and local SWH suppliers. Local SWH suppliers are aware of financial mechanisms through the Government's website link: http://solarwaterheater.gov.in/page.php?pid=HzbSvsc4tpXiDV3YzB:WTg where details of the mechanisms are provided. The webpage also provides links to case studies and success stories of SWH installations throughout India, and experiences to*

other SWH programmes in other countries through the "InterSolTherm Times" (http://mnre.gov.in/file-manager/solar-thermal-newsletter/voloume-1-issue-10/EN/international.php). Based on the number of channelled partners on the Programme, capacity of the suppliers and manufacturers has been built;

⇒ *A satisfactory outcome has been achieved with new SWH financing instruments and business models that are detailed on the aforementioned sites. This includes the demonstration of an ESCO model (as detailed in Box 1). In addition, the Project assisted the preparation of a CDM-PoA which was registered in December 2012 for SWH installations with the assistance of the Project. CDM revenue generated was proposed to be used for providing after sales services & performance guarantees to end-users, and possibly for future subsidies. However, due to current low carbon prices, the impact of this CDM financial mechanism is likely to be minimal until these prices recover;*

⇒ *A satisfactory outcome of trained staff from local financing institutions has been achieved. This includes staff of IREDA who attended the China study tour for SWH as well as a number of Project-sponsored workshops throughout the country. The effectiveness of the training has not been documented with feedback from the participants; however, with the lack of a qualitative indicator for training in the LFA, the training could be deemed to be satisfactory based on the Project reaching its target number of SWH installations and subsidies disbursed.*

Rating:	*relevance:*	*5*
	effectiveness:	*5*
	efficiency:	*5*
	overall rating:	*5*

The Project has had an impact on the formulation and operationalization of an SWH financing mechanism for the domestic sector as well as the industrial sector to a smaller extent. The dissemination of the financial mechanisms were supported by a number of awareness and consultative workshops on SWH that were conducted throughout India targeting the industrial, health, education and hospitality sectors in addition to the dominant residential sector. Financial institutions as well as public and private banks had also attended these workshops. Knowledge products related to SWH financing that was distributed included "Design and implementation of new financing mechanism and instruments for promotion of solar water heating systems" and "Capacity building in the financing sector and for utilities and regulators"; both studies were instrumental in formulating the financing mechanisms defined under JNNSM.

The financing mechanism has been able to provide direct support to beneficiaries with subsidies and soft loans from local banks. The subsidy is applied to all beneficiaries in general category states at 30% and in "special category states" at 60%. To exert more control over quality of the systems installed and the subsidies disbursed, MNRE included only SWH entities who are accredited under their channel partner program that included manufacturers, supplier system integrators, and ESCOs. To date, more than USD 40 million has been disbursed for subsidies under the JNNSM financing mechanism, a very successful outcome.

Box 1: Aspiration Energy, a demonstration of a successful ESCO business model for solar water heater installations for the industrial sector in India

Aspiration Energy (AE) was started in 2010 based on the need for industry to reduce their operating costs. Several industries do not have sufficient time or knowledge to properly implement an investment plan for reducing fuel usage such as solar water heaters. AE provides a service to industries by advising them on specific measures to reduce their energy consumption, designing the measure to the client's needs, providing the financial resources to purchase equipment, install and operate the system, and monitor operations to measure energy savings. This allows industries to "pay for energy services as they save".

The ESCO business model has been successfully demonstrated with Aspiration Energy with their two 5-year ESCO contracts for SWH installations for car parts manufacturing in Chennai:

- Sona Koya Steering Limited in Sriperumpudur, Tamil Nadu, where a SWH system with a 35,000 LPD capacity was installed in early 2012. With the 30% subsidy and 15% grant from the Project, Aspiration are able to comfortably finance the USD 100,000 SWH system. Sona Koya are satisfied with the system as it has offset their diesel costs for hot water heating; and
- Wheels India Ltd in Padi, Chennai where a 105,000 LPD capacity SWH system was installed in March 2013 at a cost of USD 320,000 (Rs 1,60,00,000) resulting in a monthly savings of over USD 8,000 (Rs 4,00,000). This was based on the consumption of 9,575 litres of furnace oil monthly at a cost of Rs 42 per litre. The overall payback by Wheels India to AE was as follows: Wheels India provided the initial 10% of the capital cost as a part of their investment; 20% of the total cost after delivery of materials (that will be reimbursed to Wheels India as a result of the first year accelerated tax depreciation benefit), with the balance of funds recovered by monthly energy payments that are equivalent to 50% of the monthly energy savings.

For the two ESCO contracts, AE monitors the energy savings through instrumentation of the system. The readings are jointly verified by AE and client staff. Since AE are helping their clients to save fossil fuel, they installed an "off-time totalizer" that monitors the number of hours the fuel supply for water heating is cut off. This has strengthened the client's confidence in the monitoring systems.

Within one year, AE expected to recover 60% of their total cost. This is based on the assumption that AE will receive the 30% MNRE subsidy within 12 months (the Project also provided an additional 15% subsidy). The remaining 40% will be recovered from the clients as monthly payments over the next 4 years after which AE expected to complete its ESCO obligations to the client. AE is planning to provide their clients with an option of providing maintenance services after the ESCO contract is complete for a fixed period. Typically, solar water heaters need to be periodically cleaned to remove dust and dirt from the tubes which would affect solar heat transfers to the water.

The AE ESCO demonstration needs more exposure for its excellent potential as a means install SWH systems to the industrial sector. AE is fielding a number of queries for ESCO services for dairy, automotive manufacturing, chemical and pharmaceutical industrial sectors.

3.3.5 Outcome 4: A certification and quality control scheme in place and enhanced capacity of the supply chain to sustain market growth

Intended Outcome 4*:*

⇒ Adequate testing facilities and proceeding for compliance checking developed and effectively taken into use aimed at updated standards and type of certification adopted

⇒ A certification and training system in place for SWH system installers including listings of dealer networks and rules for good after sales services

⇒ 500 SWH system installers trained and certified
⇒ 100 trained local suppliers and manufacturers to produce and market their products

Actual Outcome 4:

⇒ *A satisfactory outcome has been achieved with the recent opening of three SWH test centres where manufacturers can test their SWH systems for compliance to "minimum technical criteria" and other existing quality standards (these MNRE guidelines are available on the http://solarwaterheater.gov.in website to qualify for the 30% subsidy). As such, the quality of SWH systems in the market has improved with this system. According to MNRE, these centres will also be used to update SWH standards and to determine the type of certification to be adopted*

⇒ *A satisfactory outcome has been achieved in the establishment of a certification and training system for SWH installers. With excellent training materials prepared by ICPCI, a number of workshops on SWH installations conducted for the industrial and residential sector. A total of 77 trainers were trained who in turn trained another 351 students in SWH installations. As means to ensure the delivery of SWH systems that meet MNRE quality standards, only MNRE approved suppliers and channel partners are listed on the http://solarwaterheater.gov.in website. These suppliers and partners need to meet minimum standards of SWH installation services including number of trained and qualified personnel, efficiency of installation services, after-sales service, and compliant response time. In addition, 20 to 25 channel partners have also offered their ready-made training facilities for future training of SWH installers. This will form a significant portion of the training system after the completion of the Project*

⇒ *A moderately satisfactory outcome has been achieved in the 428 SWH installers who have been trained, short of the target of 500 by EOP*

⇒ *A satisfactory outcome has been achieved in the listing of 102 ETC manufacturers/suppliers and 34 manufacturers/suppliers of various ETC components on the http://solarwaterheater.gov.in website*

Rating:	*relevance:*	*5*
	effectiveness:	*5*
	efficiency:	*5*
	overall rating:	*5*

The outputs in this component overlap with those in Outcome 1, notably the "system for standards, labels and adequate quality control of SWH systems".

The Project has contributed to a SWH installation system that provides confidence to the end consumer of SWH systems that the quality of the system installed will sustainably and reliably produce hot water. The system includes a listing of suppliers, manufacturers and installers who meet MNRE standards for quality services. The manufacturers, suppliers and installers have benefitted from the numerous training workshops and technical seminars on SWH installations which has allowed them to qualify under MNRE's listing.

3.3.6 Outcome 5: SWH support institutionalized with results, experiences and lessons learned documented and disseminated

Intended Outcome 5*:*

⇒ Reporting framework and arrangements for SWH market monitoring established

⇒ The national project web-site and network successfully established with information on

the scope and results of the project ⇒ Final report prepared and published
Actual Outcome 5: ⇒ *A moderately satisfactory outcome has been achieved in the initial development of a reporting framework for SWH market monitoring by MNRE. The system for reporting SWH installations, however, is still in development with the MNRE aiming to have an interactive map available on their website on completed installations. Moreover, MNRE has said that a reporting framework is now being used although the Evaluation Team was unable to independently verify this claim* ⇒ *A highly satisfactory outcome has been achieved in the establishment of the national project website (http://solarwaterheater.gov.in) which provides the knowledge products produced by the Project* ⇒ *A satisfactory outcome has been achieved in the preparation and publication of the final reports of the Project. These are also posted on the http://solarwaterheater.gov.in website.*

Rating: *relevance:* *5*
effectiveness: *4.5*
efficiency: *4*
overall rating: *4.5*

MNRE do acknowledge their current needs for a modern monitoring system to track the SWH systems installed. There is a reporting system which is done manually on paper without entry into a database. There is an urgent need to develop a database, a database management system and an interactive map of SWH installations.

The need for a good database system for SWH installations cannot be underscored. A gap does exist in baseline information on SWH systems installed between 2002 and 2009 where the number of functional SWH systems is unknown. Anecdotal information indicates that a number of these SWH systems are not operational due to scaling of the water tubes from hard water that affects the thermal performance of the tubes. Moreover, there was a general absence of after-sales service during the 2002 – 2008 period of the installation program that has lead to SWH losing its effectiveness and in rare cases becoming dysfunctional after few years of commission and well before its full service life of 15 years. As such, the installed SWH area and reported energy savings may actually be less than currently reported.

More positively, all Project knowledge products are posted on the *http://solarwaterheater.gov.in* website which will be maintained by the Solar Thermal Federation of India (SFTI) after completion of the Project. Knowledge products include (1) A total of 10 study reports prepared under the GSWH project have been summarized as booklets which includes case studies, assessment of SWH potential in selected industrial segments, policies, regulatory and financial aspects; (2) Reference manuals for hospitality sector, training manuals for installers & local consultants; and (3) 133 Detailed Project Reports (DPRs) for a total capacity of 1,537,000 lpd - Himalayan region (58), urban cluster (40), industrial sector (6), and health sector (29) that have been prepared by consultants. A national workshop on SWH organised by MNRE in August 2012, with participation by 200 stakeholders will showcase all knowledge products published under the project.

3.3.7 Overall Evaluation of Project

The overall rating of project results is satisfactory (S) based on the following outcomes:

- The Project meeting its target for incremental SWH installations of 2.4 million m^2. The number of incremental SWH installations was derived from an assumed baseline growth of 450,000 m^2 per year and actual annual installation reported by MNRE;
- The linking of SWH quality with the 30% subsidy with third party checks raises the level of compliance to minimum standards for SWH quality and quality of installations;
- The long periods required to disburse the 30% capital subsidies which need to be resolved if the SWH market is to meet the goals of JNNSM Phase II;
- An excellent website (*http://solarwaterheater.gov.in*) that provides technical and financial information on SWH technology as well as examples of SWH installations from around India and globally and electronic newsletters pertaining the SWH advances;
- A toll free helpline number (1-800-233-4477) was setup to responded to end user queries regarding all aspects of SWH and assist them in making informed decisions on their purchase and installation;
- The SWH monitoring system is still under development by MNRE where improvements are in progress to provide a more accurate estimate of the number of SWH systems installed since 2008 that are functional and reducing fossil fuel consumption.

Overall project ratings are provided on Table 6.

3.3.8 Country Ownership and Drivenness

The main driver for the GSWH Project in India is the JNNSM which defines the main targets for SWH installations in India until 2020. The JNNSM programme is supported at the highest leadership levels in India.

Table 6: Ratings for Each Project Outcome[30]

	Rele-vance	Effective-ness	Effi-ciency	Overall Rating
Monitoring and Evaluation:				
M&E design at entry	-	-	-	4
M&E plan implementation	-	-	-	5
Overall quality of M&E	-	-	-	4.5
UNDP and Executing Partner Performance:				
Quality of UNDP implementation	-	-	-	5
Quality of Execution - RDPR	-	-	-	5
Overall quality of implementation/execution	-	-	-	5
Overall Results	5	4	5	5

[30] 6 = HS or Highly Satisfactory: There were no shortcomings;
5 = S or Satisfactory: There were minor shortcomings,
4 = MS or Moderately Satisfactory: There were moderate shortcomings;
3 = MU or Moderately Unsatisfactory: There were significant shortcomings;
2 = U or Unsatisfactory: There were major shortcomings;
1 = HU or Highly Unsatisfactory.

	Rele-vance	Effective-ness	Effi-ciency	Overall Rating
Outcomes:				
Outcome 1: An enabling institutional, legal and regulatory framework to promote sustainable SWH market	5	4	4	4.3
Outcome 2: Enhanced awareness and capacity of the targeted end-users and building professionals	5	4.5	5	4.8
***Outcome 3*:** Increased demand for SWH systems by the availability of attractive end-user financing mechanisms or other delivery models	5	5	5	5
***Outcome 4*:** A certification and quality control scheme applicable in place and enhanced capacity of the supply chain to sustain market growth	5	5	5	5
***Outcome 5*:** SWH support institutionalized with results, experiences and lessons learned documented and disseminated	5	4.5	4	4.5
Overall Rating:	5	4.5	4.7	4.8

3.3.9 Sustainability of Project Outcomes

In assessing Project sustainability, we asked "how likely will the Project outcomes be sustained beyond Project termination?" Sustainability of these objectives was evaluated in the dimensions of financial resources, socio-political risks, institutional framework and governance, and environmental factors, using a simple ranking scheme:

- *4 = Likely (L):* negligible risks to sustainability;
- *3 = Moderately Likely (ML):* moderate risks to sustainability;
- *2 = Moderately Unlikely (MU):* significant risks to sustainability; and
- *1 = Unlikely (U):* severe risks to sustainability.
- *Overall rating is equivalent to the lowest sustainability ranking score of the 4 dimensions.*

The overall Project sustainability rating is moderately likely (ML). This is primarily due to:

- The financial and political commitment of MNRE to continue SWH promotional activities under its JNNSM Phase II ;
- Strong growth in SWH installations in the domestic market that is supported by MNRE systems for accreditation of SWH suppliers and installers, a strengthened SWH supply chain, the availability of fiscal resources for a 30% subsidy of the SWH capital cost, municipal by-laws to make SWH mandatory in new residential and commercial setups, accelerated depreciation for industrial installation; continuation of toll-free helpline and the availability of a plethora of SWH-related information on the Solar Water Heating website maintained by MNRE;
- The need to improve the prospects and grow SWH installations in the industrial sector for low or medium heat application as successfully demonstrated through an ESCO business model for SWH installations in the automobile sector. MNRE should consider the support of bi-lateral and multi-lateral agencies to demonstrate SWH installation in other industrial sectors such as textile, food processing, dairy, pulp and paper, and devise financial risk mitigating mechanisms that will facilitate approval of bank loans to prospective ESCO entrepreneurs to finance industrial SWH projects;

- The need to continuously improve minimum technical standards and capacity within MNRE to monitor and enforce these standards and the operating performance of SWH systems. These standards will need to be updated periodically and, to the extent that is practically feasible, harmonized with international standards. The absence of a strong monitoring system will place higher risks that the SWH installation targets of JNNSM Phase II will not be achieved as there will be no confident estimates of actual energy savings and corresponding GHG reductions.

Details of sustainability ratings for GSWH are shown on Table 6.

Table 6: Assessment of Sustainability of Outcomes

Actual Outcomes (as of May 2013)	Assessment of Sustainability	Dimensions of Sustainability
Actual Outcome 1: An enabling institutional, legal and regulatory framework has been established resulting in the acceleration of SWH sales in select locations in India	• *Financial Resources:* Financial resources are being availed for subsidies in new SWH markets. MNRE are also considering subsidy removals where SWH sales are strong availing more resources for these new markets; • *Socio-Political Risks:* The institutional, legal and regulatory framework for SWH market expansion has been formed to support the high profile JNSSM Phase I that is backed by the highest politicians in India; • *Institutional Framework and Governance:* The central government institutional capacity to manage the expansion of the SWH market is strong. While there are some weaknesses with local government institutional capacities in terms of compliance to SWH Government Orders, it has not affected the Project from accelerating growth of the SWH market to 7.1 million m^2; • *Environmental Factors:* SWH is considered a green technology and beneficial to the environment and reduction of GHG emissions. ***Overall Rating***	4 4 4 4 **4**
Actual Outcome 2: Awareness of SWH systems is enhanced for domestic end-users as well as industrial and SWH professionals	• *Financial Resources:* SWH sales have met Project targets. As such, financial resources are available from domestic end-users to purchase SWH systems. Industrial clients also are interested in SWH systems based on the successful Aspiration Energy ESCO model. In addition, the Government will be continuing awareness raising after the EOP through its support for the www.solarwaterheater.gov.in website, a site to be maintained by STFI; • *Socio-Political Risks:* Sales strong due to domestic end-user awareness of energy savings from SWH systems. Awareness raising material also supports the high profile JNSSM Phase I that is backed by the highest politicians in India; • *Institutional Framework and Governance:* Awareness raising campaigns are backed with support from MNRE who are implementing the high profile JNNSM programme; • *Environmental Factors:* SWH is considered a green technology and beneficial to the environment and reduction of GHG emissions. ***Overall Rating***	4 4 4 4 **4**

Table 6: Assessment of Sustainability of Outcomes

Actual Outcomes (as of May 2013)	Assessment of Sustainability	Dimensions of Sustainability
Actual Outcome 3: Financing mechanisms for SWH installations are available for end-users for domestic, commercial and industrial applications of SWH systems	• *Financial Resources:* Financing for the 30% subsidy is being made available from the Government. Financing could also come from the CDM-PoA that was registered with the assistance of the Project; however, due to low global carbon prices, this may not have yet have any impact on the availability of fiscal resources to finance SWH expansion into JNNSM Phase II • *Socio-Political Risks:* Since JNNSM Phase I is supported at the highest levels of the Government of India, there are low risks to the removal of financial mechanisms which are credited with the current expansion of the SWH market. One area of concern is the constrained growth of the SWH-ESCO model for industrial applications: Aspiration Energy is able to finance its SWH system project demonstrations through its own equity and assets, precluding its need for bank loans. There are not likely many entrepreneurs who are in this positive financial position; hence, the need for bank financing for future ESCOs is highly likely. It is understood by the Evaluation Team that obtaining bank loans for ESCO operations will be difficult due to bank perceptions of high risk with ESCO operations; • *Institutional Framework and Governance:* MNRE are managing the subsidy payments through IREDA and quality control internally. The system has been functional to date with SWH sales reaching targets for the EOP. There have been complaints, however, over the time required for MNRE/IREDA to disburse subsidy payments to the suppliers and installers of SWH systems. This may have the effect of slowing down SWH sales, placing a higher risk of MNRE not reaching its JNNSM Phase II target of 8.0 million m^2 of SWH installations by 2017[31]; • *Environmental Factors:* SWH is considered a green technology and beneficial to the environment and reduction of GHG emissions. ***Overall Rating***	4 3 3 4 **3**
Actual Outcome 4: The supply chain for SWH systems has been	• *Financial Resources:* Fiscal resources are available under MNRE for the continued training and maintenance of the SWH quality control	4

[31] http://mnre.gov.in/file-manager/UserFiles/draft-jnnsmpd-2.pdf

Table 6: Assessment of Sustainability of Outcomes

Actual Outcomes (as of May 2013)	Assessment of Sustainability	Dimensions of Sustainability
strengthened in part from the certification system established to ensure SWH suppliers under JNNSM meet minimal technical standards and in part for employing personnel with training qualifications for SWH installations and service. This has provided SWH end-user confidence that should sustain SWH growth towards the targets set by JNNSM Phase II	systems; • *Socio-Political Risks:* Since JNNSM Phase II has political support at the highest levels of the Government of India, the continuance of the SWH certification and quality control system will be sustained after the EOP; • *Institutional Framework and Governance:* MNRE will continue to provide oversight to SWH installations under JNNSM Phase II carrying over the institutional arrangements from Phase I; • *Environmental Factors:* SWH is considered a green technology and beneficial to the environment and reduction of GHG emissions. ***Overall Rating***	4 4 4 **4**
Actual Outcome 5: SWH support has been institutionalized through the MNRE's "Solar Water Heating Solutions" website *(http://solarwaterheater.gov.in)* that contains a wealth of information on results, experiences, lessons learned as well as global experience in SWH installation and usage.	• *Financial Resources:* Financial resources are available from MNRE to STFI to maintain the website after EOP; • *Socio-Political Risks:* Since JNNSM Phase II has political support at the highest levels of the Government of India, the continuance of MNRE's website will be sustained after the EOP; • *Institutional Framework and Governance:* Information is still weak with regards to the monitoring of SWH installations from 2002 and their actual energy performance and GHG reductions. The current MNRE reporting framework and monitoring system for SWH systems installed still requires improvements. While there are current efforts by MNRE to internally improve its MRV capacity, there is still some uncertainty that MRV capacity can be internally developed to meet UNFCCC standards without external assistance. Although the CDM-PoA for SWH would improve MRV through carbon revenues, low global carbon prices may thwart this from occurring; • *Environmental Factors:* SWH is considered a green technology and beneficial to the environment and reduction of GHG emissions. ***Overall Rating***	4 4 3 4 **3**
	Overall Rating of Project Sustainability:	**3**

4. CONCLUSIONS, RECOMMENDATIONS AND LESSONS

4.1 Conclusions

- With regards to the design of the GSWH Project, its goals and objectives as expressed in the LFA were clear; however, the design or intended incremental impact of GEF activities on the Project was not clear. As a result, the Project was adaptively managed mainly through the AWPs and frequent PSC and PEC meetings to meet the overall Project goal of increasing SWH installations by 2.4 million m^2 over the baseline. This adaptive management also included an estimation of the baseline scenario of SWH growth in the absence of the Project which was only based on regional SWH sales figures; this estimate, however, did not have information on the number of functional SWH installations since 2002;

- This estimation of the baseline scenario did not address the MTR recommendation for a full baseline study. At the time the MTR recommendations were finalized in mid-2012, a significant portion of Project resources were already committed. Hence, with the manner in which the baseline estimation was characterised based on MNRE information, the Evaluators believe that a baseline scenario taken in 2013 is more accurate and valuable due to SWH installations being tied to the subsidy. As per the current SWH growth trends, the number of working SWH installed prior to subsidy will gradually become insignificant.

- The GSWH Project contributed to the accelerated growth of the SWH market in India since 2009:
  - This Project provided a structured approach to removing barriers to SWH market transformation by focusing GEF resources on improving the institutional and regulatory framework, raising awareness, strengthening the SWH supply and the financial mechanisms, and sharing lessons learned and experiences (domestically and globally) on SWH installations;
  - Key stakeholders were brought together including city officials and SWH manufacturers to state and central government officials, to raise awareness and remove some of the identified barriers;
  - The Project generated useful SWH information products including excellent promotional materials, an informative SWH website, and a SWH toll-free helpline. These knowledge products and services helped to raise awareness of SWH systems to a wide range of stakeholders using the Project's structured approach during JNNSM Phase I;
  - Capacity of the SWH supply chain (from manufacturers to installation and maintenance personnel) was strengthened to meet certain level of product quality through the minimum technical criteria by the manufacturer to receive MNRE subsidy. MNRE confirmed that future sales of SWH will be backed by an after-sales service. For a manufacturer to be registered with MNRE under the JNNSM Phase II program, they will need to meet these criteria as well as provide a commitment to after-sales services which will be subject to third party verification. This should provide domestic end-user confidence of the SWH installation program;
  - The studies and stakeholder consultations through workshops conducted under the Project assisted MNRE in their formulation and implementation of financial mechanisms (both for the residential and industrial applications), certification of

SWH suppliers and quality control of the installations, all of which are closely linked to the Government's 30% subsidy payments.

- The Project sponsored the preparation of a CDM-PoA project which has been registered for SWH installations. While this is an excellent outcome that provides a sound UNFCCC-approved monitoring plan for GHG reductions to be implemented by a private Coordination Management Entity (CME), the impact of this CDM project, unfortunately, is likely to be minimal unless there is a recovery from low global carbon prices;

- To meet JNNSM Phase II goals of an additional 8.0 million m^2 of SWH installations by the end of 2017, and a further addition of 5.0 million m^2 by 2022, more SWH suppliers and manufacturers will be required to meet this demand. Currently, based on 2010 to 2012 sales information from MNRE, an average of 92,000 m^2 was being installed on a monthly basis. Phase II targets will require an average installation rate of 166,000 m^2 per month, almost double the current installation rate. This will essentially require a doubling of the current SWH installation capacity in India which will require more SWH trainees. There will also be a need for further capacity improvements within MNRE to regulate and enforce Government Orders for SWH installations and monitor SWH installations for reductions in fossil fuel consumption and GHG emissions. MNRE are fully aware of these scale-up issues where JNNSM Phase II *targets at least 15-20 cities where solar water heaters would become the main source of heating water replacing electric geysers*. The MNRE strategic plan for SWH market expansion until 2017 outlines:

  - Division of a national SWH plan into appropriate geographic regions;
  - Determination of unique hot water demands and SWH end-user applications for each region;
  - Determination of appropriate technologies, prices and further segmentation of market potential;
  - Clearly defined strategies to provide strong growth by implementing prioritized high potential regions through utilities, mandatory regulations and strengthened supply chains.

- The Project's activities have been complementary to JNNSM Phase I activities in the identification and removal of financial barriers to increased market penetration of SWH and the provision of a partial Capital Subsidy (30% of capital cost of SWH) and additional 80% depreciation benefit to the industries for SWH installations;

- The Project has provided an excellent demonstration of a functional ESCO model for SWH installations in the industrial sector. Moreover, SWH applications in the industrial sector has demonstrated that fuel savings and GHG reductions are significant in these applications since hot water is required for more than 8 hours per day, in comparison to domestic hot water demand which is estimated to be 2 hours daily. The replication of this ESCO model, however, will require additional efforts mainly to assist in building the capacity of ESCO entrepreneurs and employees, and to improve the confidence of lending entities to finance SWH installations by ESCOs;

- GSWH project funds were exhausted on December 31, 2012, 6 months before the actual GSWH terminal date of June 30, 2013. This UNDP oversight and the lack of Project funds in 2013 affected some of the Project activities such as:
  - the ESCO not receiving all GSWH funds that were committed[20];
  - deployment of a 12.5 lpd SWH for the Himalayan Region for targeted end users after the prototype was modified on the basis of field tests;
  - follow-up with the city governments to obtain feedback on the impact of amending by-laws on SWH installations; and
  - tube collectors and fixed plate collectors at three different locations in India the opportunity to share results of comparative analysis of SWH efficiencies of evacuated [21] which would help buyers as well as policy makers to make informed decisions.

All of the aforementioned activities could have provided valuable inputs to the scoping of MNRE's scaled-up activities for SWH under JNNSM Phase II.

- Notwithstanding this oversight, the GSWH Project has provided good incremental value to India's National Solar Mission that has accelerated growth of the SWH after the launch of mission in 2010. MNRE's co-financing contribution after the launch of JNNSM Phase I increased significantly including USD 8.0 million (Rs 40 crore) in 2010-11 from its own budget and USD 12.0 million (Rs 64 crore) in 2011-12 from the National Clean Energy Fund towards the SWH subsidy. Overall, MNRE's co-financing contribution towards the Project greatly exceeded the original targets.

4.2 Recommendations

With the GEF-funded GSWH project terminating on June 30, 2013, the following recommendations are being provided:

Recommendation 1: Strengthen energy labelling to promote best SWH models.
With the scale-up of SWH installations forecast over the next 24 months, MNRE needs to select a system for labelling the various approved SWH models within JNNSM Phase II. The current preference of the PSC is the development of a "Star Rating" on SWHs from various manufacturers for which MNRE should closely collaborate with the Bureau of Energy Efficiency (BEE) to define an appropriate labelling program applicable to SWH. During several PEC and PSC meetings, the discussion on developing Minimum Energy Performance Standard for SWH, had reached a certain stage; dialogue between MNRE and BEE needs to be resumed. The development of the Star Rating system will strengthen confidence among end-users and ensure the best quality products are deployed under the accelerated SWH program of JNNSM Phase II. Additionally, MNRE should review international trends in the development of the SWH technical standards and consider, to the extent practically feasible, harmonize them with international standards.

[20] The ESCO project at Wheels India was delayed for reasons beyond control of the ESCO and could only be commissioned after December 2012. Consequently, the ESCO did not receive the full funds committed to it under the GSWH project.
[21] A one-year study was conducted at NIT, Hamirpur (Himchal Pradesh), the Solar Energy Centre Gurgaon and the University of Pune to compare the operational performances of a 100-litre Flat Plate Collector and an Evacuated Tube Collector SWH. Results were being analyzed by School of Energy Studies at Pune University at the time of Terminal Evaluation.

Recommendation 2: Improve programme management capacity of MNRE through setting up a system for information collection and monitoring energy performance of new SWH installations. With the establishment of a SWH energy labelling system, MNRE will need to capture the positive energy performance impact of the JNNSM Phase through the setup of a robust monitoring and reporting system. Since the Project had contributed to the setup of a proposed CME, Nuetech Solar Systems Pvt. Ltd., for a CDM-PoA for SWH installations, MNRE should link its MRV improvements with Nuetech as they have already have in place an MRV system approved by the UNFCCC. Their system as outlined in the PoA-DD[22], provides the structure to allow SWH managers to monitor, report and verify compliance of minimum technical criteria (MTC) for SWHs. Since compliance to these MTC is required to qualify the manufacturer for the MNREs capital subsidy of 30%, SWH MEPS compliance should be high. This recommendation should be implemented in close collaboration with capacity building efforts under Recommendation 2.

Recommendation 3: Re-assess and build state and municipal-level capacities to manage JNNSM Phase II SWH installations. Capacity building for local government personnel will be required in the 15-20 cities targeted under JNNSM Phase II. An assessment should detail the capacity building needed for scaled-up activities of Phase II that may include training on how SWH systems function and save energy, MRV systems for new SWH installations, database management, systems to facilitate diligent and timely reporting of sales and installations, and strengthening enforcement of Government Orders, local bylaws and quality control standards.

Recommendation 4: Increase the training of semi-skilled and skilled workers who will be needed for the additional SWH installations to meet the targets of JNNSM Phase II. By 2014, the number of installations will need to increase from the current 92,000 m^2 per month to more than 166,000 m^2 per month by the end of 2014. In addition to SWH installations, these trainees will also need to be able to provide after sales maintenance. Hence, a more intense SWH training program needs to be designed to train a sufficient number of installation technicians who will install SWH systems in the 15 to 20 cities defined under the JNNSM Phase II targets.

Recommendation 5: Strengthen financial mechanisms for SWH under JNNSM Phase II. Financial support in the form of accelerated capital subsidy depreciation needs to be continued to encourage and catalyze SWH installations in the industrial sector for medium temperature hot water system. However, the subsidy should be phased out over a five-year period as the demand for solar water heater begins to grow. Efforts are required to support the ESCOs that offer and implement measures for industry to reduce energy consumption. The two pilots in Tamil Nadu supported under GSWH demonstrate the vast potential for the use of SWH in the automobile manufacturing sector. Some of these ESCO supportive efforts include informing and raising the confidence of lending institutions to provide financing to fledgling ESCO businesses. Due to the large potential of SWH applications for low process heat in the industrial sector, MNRE should consider the support of bi-lateral and multi-lateral agencies with experience to assist in the demonstration of SWH installations in other industrial sectors such as textile, food processing, dairy, pulp and paper, and device financial risk mitigating mechanism to the extent that prospective ESCO entrepreneurs can receive bank loans to finance SWH projects in the industrial sector.

[22] http://cdm.unfccc.int/ProgrammeOfActivities/poa_db/N0SLBQPXCMY1EI5OHD87R9624VUJK3/view

Recommendation 6: Include solar water heaters as an option under the Solar specific Renewable Purchase Obligation (RPO) for industrial consumers with demand exceeding 1 MW. While the RPOs are being enforced by certain states by the state electricity regulatory commission through the electricity distribution company, this restricts and interferes with the industrial entity's choice of installing SWHs which provides reduced fossil fuel consumption versus a solar photovoltaic system which results in minimal reduction in electricity consumption. To encourage the growth of SWH in the industrial sector, it is suggested that MNRE review the RPO and Renewable Energy Certificate (REC) issuance requirements to include SWH installations.

Recommendation 7: MNRE should provide resources to conduct surveys and develop a 2013 or 2014 baseline for SWH installations in India in the domestic sector. This was not done formally during the Project, and would significantly contribute to more effectiveness in managing SWH expansion and added confidence in meeting JNNSM targets for 2017 and 2022. Such a survey needs to be disaggregated to different climatic regions and to a regional or city level. The survey should inform the current SWH knowledge base on the functionality of existing SWH systems, typical maintenance and operational problems that persist with certain SWH models, SWH service life, and energy savings realized. If possible, the survey could also provide baseline information on SWH systems that have been installed between 2002 and 2009 (if these sales records could be located) where the number of functional SWH systems is unknown. This would address the information gaps on functional SWH systems and bring more confidence to the reported energy savings of JNNSM Phase I and II.

4.3 Lessons Learned

- A concise LFA with SMART indicators and a proper baseline assessment is required for effectiveness in measuring the incremental impact of a project. In the case of GSWH, a proper LFA would have identified that there was a lack of baseline information, and that Project resources could have been used to conduct some baseline surveys which could be improved during the term of the Project. More importantly, the baseline survey could have also provided some information on the number of functional SWH systems; this would have provided improved confidence on the actual energy saved for SWH systems installed prior to the Project.

- Subsidies can be effectively linked with quality control of the items that are being subsidized. In the case of GSWH, the 30% subsidy was being paid from MNRE to the supplier or SWH manufacturer. Their qualification for the 30% subsidy was linked to SWH manufacturers submitting samples to MNRE appointed test centers, rating agencies, and third party quality assessments to ensure compliance of the SWH supplier and manufacturer on meeting minimal technical standards, efficiencies in their installation of SWH systems, after sale-services, and their response times to complaints and break-downs. To a large extent, compliance to these standards is self-enforced to qualify for the subsidy;

- Certain business pre-conditions are required for successful SWH installations by ESCOs in India:
  - Availability of financing of an ESCO business from lending institutions or equity partners. Aspiration Energy is equity financed with current bank loans that are

written against their assets, and not the potential income from the ESCO projects. Given the lack of ESCO-implemented projects for SWH installations, there are no records of loans to ESCOs for SWH installations in India;

- The prospective client is too busy to invest time to seek improvement to efficiencies in their energy consumption. This would characterize industrial clients who are often so entrenched in maintaining their production lines, and are unable to spend the required time to design measures to reduce their energy consumption. In the case of Aspiration Energy, they provided a service and measures for two small car part factories to reduce their fossil fuel consumption;
- For industrial clients, the SWH system must be sufficiently complex to require ESCO services to identify the best SWH layout. In addition, the size of the industrial enterprise should be medium to large. In Viet Nam, there were a number of ESCO projects that did not work since the client was an SME and at a later stage, was unwilling to share energy savings with ESCO. Instead, these SMEs decided after the first ESCO contract to hire the ESCO as a consultant for the EE measures, and purchased the EE appliances with their own funds. Functional ESCOs in Viet Nam had larger industries as clients; this is parallel to the business model being followed by Aspiration Energy in Chennai that has more potential for replication of ESCO contracts;
- For industrial clients, the SWH system must be implemented without significant costs to the factory owner. This would include the owner being able to minimize opportunity costs (resulting from down time required to install a SWH) or not being obligated to provide a large down payment to implement the project. In these cases, much of the Aspiration Energy installation was done during factory downtime on weekends, and using its own equity and working capital loan. The lack of available low interest loans is a barrier for entrepreneurs to operate as ESCOs and provide installation services for low-temperature hot water requirements in the industrial sector.

APPENDIX A – MISSION TERMS OF REFERENCE FOR PROJECT FINAL EVALUATION

TERMINAL EVALUATION TERMS OF REFERENCE FOR – INDIVIDUAL CONSULTANT (INTERNATIONAL)

1. Introduction

In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP support GEF financed projects are required to undergo a terminal evaluation upon completion of implementation. These terms of reference (TOR) sets out the expectations for a Terminal Evaluation (TE) of the Global Solar Water Heating Market Transformation and Strengthening Initiative **(PIMS 3611)**.

The essentials of the project to be evaluated are as follows:

2. Project Summary Table

Project Title:	Global Solar Water Heating Market Transformation and Strengthening Initiative (PIMS 3611).			
GEF Project ID:	00049818		*at endorsement (Million US$)*	*at completion (Million US$)*
UNDP Project ID:	00061121	GEF financing:	2,000,000	2,000,000
Country:	India	IA/EA own:		
Region:	Asia and Pacific	Government:	10,800,000	10,800,000
Focal Area:	Climate Change	Other:	300,000	300,000
FA Objectives, (OP/SP):	CCM-3: Renewable Energies	Total co-financing:	11,100,000	11,100,000
Executing Agency:	UNDP	Total Project Cost:	13,100,000	13,100,000
Other Partners involved:	N/A	ProDoc Signature (date project began):		1st November 2008
		(Operational) Closing Date:	Proposed: 31st December 2012	Actual: 31st May 2013

3. Objective and Scope

In order to achieve the project objective, the project key Components and Outcomes are as follows.

Component 1. Enabling institutional, legal and regulatory framework established to promote sustainable SWH market in 10 States.

Outcome 1.01: Expansion of solar program to other States of India.

Component 2. Enhanced awareness and capacity of the targeted end users and building sector professionals to consider and integrate SWH systems into different types of buildings.

Outcome 2.01: To reach a target of >2,000,000 m2 a year at the end of the project.

Component 3. Increased demand for SWH systems by the availability of attractive end-user financing mechanisms or other delivery models.

Outcome 3.01: The agreed financial support mechanisms and new delivery models in operation to meet the announced MNRE target to reach 10 m2 of installed SWH capacity by 2020.

Component 4. A certification and quality control scheme applicable for Indian conditions and enhanced capacity of the supply chain to offer products and services promoting sustainable SWH market in multiple

Outcome 4.01: Enhanced capacity of the supply chain to respond to the growing demand with good quality services sustaining the market growth.

Component 5. Provided support institutionalized and the results, experiences and lessons learned documented and disseminated (including monitoring, learning, evaluation and other feedback for adaptive management).

Outcome 5.01: To establish reporting framework and arrangements for SWH market.

The TE will be conducted according to the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects.

The objectives of the evaluation are to assess the achievement of project results, and to draw lessons that can both improve the sustainability of benefits from this project, and aid in the overall enhancement of UNDP programming.

4. Evaluation approach and method

An overall approach and method[23] for conducting project terminal evaluations of UNDP supported GEF financed projects have developed over time. The evaluator(s) is(are) expected to frame the evaluation effort using the criteria of **relevance, effectiveness, efficiency, sustainability, and impact,** as defined and explained in the UNDP Guidance for Conducting Terminal Evaluations of UNDP-supported, GEF-financed Projects. The international consultant will be the team leader and coordinate the evaluation process to ensure quality of the report and its timely submission. The international consultant will provide supportive roles both in terms of professional back up, translation etc. The evaluation team is expected to become well versed as to the project objectives, historical developments, institutional and management mechanisms, activities and status of accomplishments. Information will be gathered through document review, group and individual interviews and site visits. A set of questions covering each of these criteria have been drafted and are included with this TOR (Annex D). The evaluator(s) is(are) expected to amend, complete and submit this matrix as part of an evaluation inception report, and shall include it as an annex to the final report.
The evaluation must provide evidence-based information that is credible, reliable and useful. The evaluator is expected to follow a participatory and consultative approach ensuring close engagement with government counterparts, in particular the GEF operational focal point, UNDP Country Office, Project Management Unit, and other key stakeholders. The evaluator is expected to conduct a field mission as indicated in section 4 of this Procurement Notice i.e. Financial Proposal (page 2). Interviews will be held with the following individuals and organizations at a minimum, but not limited to:

- Relevant personnel at UNDP Country Office in New Delhi, India and Program Officer in-charge of the Project
- National Project Director (NPD)
- National Project Coordinator (NPC)
- Project Management Unit (PMU)
- Relevant project stakeholders, and personnel, but not limited to,
  - Industrial units using SWH systems under ESCO mode
  - Consultants: {WISE, RTC, GreenTech Pvt Ltd}
  - Municipal Commissioner Office (bye laws)

[23] For additional information on methods, see the Handbook on Planning, Monitoring and Evaluating for Development Results, Chapter 7, pg. 163

The evaluator will review all relevant sources of information, such as the project document, inception workshop report, annual work and financial plans, project reports – including Annual APR/PIR (until 2012), project budget revisions, quarterly reports, Minutes of Project Technical Committee/Project Steering Committee meetings, Back-to-Office Reports of UNDP staff (if any), Mid-Term-Review reports, Study reports/Conference proceedings/government guidelines, etc., midterm review, progress reports, GEF focal area tracking tools, project files, national strategic and legal documents, and any other materials that the evaluator considers useful for this evidence-based assessment such as terms of reference for past consultants' assignments and summary of the results; past audit reports (if any). A list of documents that the project team will provide to the evaluator for review is included in Annex C of this Terms of Reference.

5. Evaluation Criteria & Ratings

An assessment of project performance will be carried out, based against expectations set out in the Project Logical Framework/Results Framework (see Annex B), which provides performance and impact indicators for project implementation along with their corresponding means of verification. The evaluation will at a minimum cover the criteria of: **relevance, effectiveness, efficiency, sustainability and impact.** Ratings must be provided on the following performance criteria. The completed table must be included in the evaluation executive summary. The obligatory rating scales are included in Annex E.

Evaluation Ratings:			
1. Monitoring and Evaluation	***rating***	**2. IA& EA Execution**	***rating***
M&E design at entry		Quality of UNDP Implementation	
M&E Plan Implementation		Quality of Execution - Executing Agency	
Overall quality of M&E		Overall quality of Implementation / Execution	
3. Assessment of Outcomes	**rating**	**4. Sustainability**	**rating**
Relevance		Financial resources:	
Effectiveness		Socio-political:	
Efficiency		Institutional framework and governance:	
Overall Project Outcome Rating		Environmental :	
		Overall likelihood of sustainability:	

6. Project finance / cofinance

The Evaluation will assess the key financial aspects of the project, including the extent of co-financing planned and realized. Project cost and funding data will be required, including annual expenditures. Variances between planned and actual expenditures will need to be assessed and explained. Results from recent financial audits, as available, should be taken into consideration. The evaluator(s) will receive assistance from the Country Office (CO) and Project Team to obtain financial data in order to complete the co-financing table below, which will be included in the terminal evaluation report.

Co-financing (type/source)	**UNDP own financing (mill. US$)**		**Government (mill. US$)**		**Partner Agency (mill. US$)**		**Partner Agency (mill. US$)**		**Total (mill. US$)**	
	Planned	**Actual**	**Planned**	**Actual**	**Planned**	**Actual**	**Planned**	**Actual**	**Actual**	**Actual**
Grants										
Loans/Concessions										
• In-kind support										
• Other										
Totals										

7. Mainstreaming

UNDP supported GEF financed projects are key components in UNDP country programming, as well as regional and global programmes. The evaluation will assess the extent to which the project was successfully mainstreamed with other UNDP priorities, including poverty alleviation, improved governance, the prevention and recovery from natural disasters, and gender.

8. Impact

The evaluators will assess the extent to which the project is achieving impacts or progressing towards the achievement of impacts. Key findings that should be brought out in the evaluations include whether the project has demonstrated: a) verifiable improvements in ecological status, b) verifiable reductions in stress on ecological systems, and/or c) demonstrated progress towards these impact achievements.[24]

9. Conclusions, recommendations & lessons

The evaluation report must include a chapter providing a set of **conclusions**, **recommendations** and **lessons**.

10. Implementation arrangements

The principal responsibility for managing this evaluation resides with the UNDP CO in New Delhi, India. The UNDP CO will contract the evaluators and ensure the timely provision of per diems and travel arrangements within the country for the evaluation team. The Project Team will be responsible for liaising with the Evaluators team to set up stakeholder interviews, arrange field visits, coordinate with the Government etc.

Throughout the period of evaluation, the evaluation team will liaise closely with the UNDP Resident Representative/Deputy Resident Representative/Programme Analyst/Senior M&E Adviser/Project Manager, the concerned agencies of the Government, any members of the international team of experts under the project and the counterpart staff assigned to the project. The team can raise or discuss any issue or topic it deems necessary to fulfil its task, the team, however, is not authorized to make any commitments to any part on behalf of UNDP/GEF or the Government.

Logistics

The team will conduct a mission visit to New Delhi and selected project sites, to meet with relevant project stakeholders. This visit will also include meetings with the officials of UNDP, the Implementing Partner, stakeholders from other institutions and ministries related to the project.

After the initial briefing by UNDP CO, the review team will meet with the National Project Director (NPD), National Project Coordinator (NPC) and the GEF Operational Focal Point as required.

11. Evaluation timeframe

The total duration of the evaluation will be 21 days according to the following plan:

Activity	Working Days	Completion Date
Preparation	5 days	*20/03/2013*
Evaluation Mission	6 days	*25/03 to 30/03/2013*
Draft Evaluation Report	7 days	*10/04/2013*
Final Report	3 days	*20/04/2013*

12. Evaluation deliverables

The evaluation team is expected to deliver the following:

[24] A useful tool for gauging progress to impact is the Review of Outcomes to Impacts (ROtI) method developed by the GEF Evaluation Office: ROTI Handbook 2009

Deliverable	Content	Timing	Responsibilities
Inception Report	Evaluator provides clarifications on timing and method	No later than 2 weeks before the evaluation mission.	Evaluator submits to UNDP CO
Presentation	Initial Findings	End of evaluation mission	To project management, UNDP CO
Draft Final Report	Full report including TT sheet calculations, (per annexed template) with annexes	Within 3 weeks of the evaluation mission	Sent to CO, reviewed by RTA, PCU, GEF OFPs
Final Report*	Revised report	Within 1 week of receiving UNDP comments on draft	Sent to CO for uploading to UNDP ERC.

*When submitting the final evaluation report, the evaluator is required also to provide an 'audit trail', detailing how all received comments have (and have not) been addressed in the final evaluation report.

13. Team Composition

The evaluation team will be composed of 1 international and 1 national evaluator[25]. The individual experts in the team need to have good technical knowledge of Renewable Energy in general, specifically in the working and use of Solar Water Heater (SWH) systems and its national context, and program/project implementation in India, possess good evaluation experience, and writing skills to carry out the assignment. The consultants shall have prior experience in evaluating similar projects. Experience with GEF financed projects is an advantage. International evaluator will be designated as the team leader and will be responsible for quality and timely submission of the report. The allocation of tasks in the execution of this TOR shall be decided mutually between the International and National consultants. The evaluators selected should not have participated in the project preparation and/or implementation and should not have conflict of interest with project related activities.

The international consultant must present the following qualifications and professional background:

- Minimum of ten years accumulated and recognized professional experience in renewable energy and climate change projects, and knowledge of UNDP and GEF;
- Minimum of five years of project evaluation and/or implementation experience in the result-based management framework, adaptive management and UNDP or GEF Monitoring and Evaluation Policy; Knowledge of Tracking Tool sheet for carbon emission reductions calculations and preparation is essential.
- Technical knowledge in the targeted focal area(s);
- Post-Graduate in Engineering, Management or Business Administration;
- Demonstrated ability to assess complex situations, succinctly, distils critical issues, and draw forward-looking conclusions and recommendations;
- Ability and experience to lead multi-disciplinary and national teams, and deliver quality reports within the given time;
- Familiar with developing countries context or regional situations relevant to that of India;
- Experience with multilateral and bilateral supported renewable energy and climate change projects;
- Very good report writing skills in English.
- Comprehensive knowledge of international best practices in promotion of Solar water Heater Systems

The evaluation team shall conduct debriefing for the UNDP Country Office, NPD, NPC, Project Management Unit, in India towards the end of the evaluation mission. The international consultant shall lead presentation of the draft review findings and recommendations. Lead drafting and finalization of the

[25] Also called consultant

terminal evaluation report. The evaluation team shall review and prepare the tracking tool with the required information to complete the tracking tool as required for climate change mitigation projects.

14. Evaluator Ethics

Evaluation consultants will be held to the highest ethical standards and are required to sign a Code of Conduct (Annex E) upon acceptance of the assignment. UNDP evaluations are conducted in accordance with the principles outlined in the UNEG 'Ethical Guidelines for Evaluations'

15. Payment Modalities and Specifications

%	Milestone
10%	At work plan submission
30%	Following submission and approval of the 1ST draft terminal evaluation report
60%	Following submission and approval (UNDP-CO and UNDP RTA) of the final terminal evaluation report

APPENDIX B – MISSION ITINERARY (FOR MAY 10-16, 2013)

#	Activity	Stakeholder involved	Place
***May 9, 2013** (Thursday)*			
	Arrival of Mr Roland Wong / Mr. Sandeep Tandon		New Delhi
***May 10, 2013** (Friday)*			
1	Briefing with Ms. Chitra Narayanswamy, UNDP	UNDP India	New Delhi
2	Meeting with Dr. S.K. Singhal and Dr. Pankaj Kumar, MNRE	MNRE	New Delhi
***May 11, 2013** (Saturday)*			
	Travel to Pune		
3	Meeting with Prof. Ghaisas, Dr. Suresh Govasi, Prof. Atal and staff	School of Energy Studies, Pune University	Pune
4	Meeting with Mr. Virendra Gupta, ICPCI	ICPCI	Pune
5	Meeting with Mr Jaideep Malaviya	Solar Thermal Federation of India	Pune
***May 12, 2013** (Sunday)*			
	Travel to Chennai		
***May 13, 2013** (Monday)*			
6	Meeting at Wheels India facility with Mr. Bhoovarahan Thirumalai, Mr. K Manoharan	Wheels India and Aspiration Energy	Chennai
7	Travel to Sona Koya factory with Mr. Bhoovarahan Thirumalai, Mr. K Manoharan	Sona Koya and Aspiration Energy	Chennai
	Travel to Delhi		
***May 14, 2013** (Tuesday)*			
8	Meeting with Dr SN Srinivas and Ms. Chitra Narayanswamy	UNDP	New Delhi
9	Meeting with Mr. Srinivasan Iyer, Assistant Country Director	UNDP	New Delhi
10	Telephone discussion with Dr. Sudir Kumar	CTRAN	New Delhi (by phone)
11	Skype discussion with Dr. Sameer Maithel	GreenTech	New Delhi (by Skype)

#	Activity	Stakeholder involved	Place
***May 15, 2013** (Wednesday)*			
12	Mission de-briefing presentation with MNRE Director Ms. Veena Sinha, IREDA	UNDP, MNRE and IREDA	New Delhi
***May 16, 2013** (Thursday)*			
13	Skype discussions with Dr Butchaiah Gadde, UNDP Regional Technical Advisor (RTA)	UNDP Regional	Bangkok (by Skype)
14	Meeting with Mr. Shashi Sekhar (GEF-OFP) and Dr. Nayanika Singh	MoEF	New Delhi
***May 17, 2013** (Friday)*			
	Departure of Mr Roland Wong		
***May 23, 2013** (Thursday)*			
15	Telephone discussion with Mr Amr Abdelhai, Programme Officer, UNEP	UNEP	Paris (by phone)

Total number of meetings conducted: **15**

APPENDIX C – LIST OF PERSONS INTERVIEWED

This is a listing of persons contacted in India (unless otherwise noted) during the Final Evaluation Period only. The Evaluators regret any omissions to this list.

1) Mr. Srinivasan Iyer, UNDP, New Delhi
2) Dr. S.N. Srinivas, UNDP, New Delhi
3) Ms Chitra Narayanswamy, UNDP, New Delhi
4) Dr Butchiah Gadde, Regional Technical Advisor, UNDP, Bangkok
5) Mr.Amr Abdelhai, Programme Officer, UNEP, Paris, France
6) Mr. Shashi Sekhar, GEF Focal Point and MoEF, New Delhi
7) Dr. Nayanika Singh, MoEF, New Delhi
8) Ms. Veena Sinha, Director, MNRE
9) Dr. S.K. Singhal, NPM – GSWH, PMU, New Delhi
10) Dr. Pankaj Kumar, PMU – GSWH, New Delhi
11) Prof. S.V. Ghaisas, Director, School of Energy Studies, Pune University
12) Prof. Suresh Govasi, School of Energy Studies, Pune University
13) Prof. Atal, School of Energy Studies, Pune University
14) Prof. Adinath Funde, School of Energy Studies, Pune University
15) Mr. Rahul Udaiwant, Quality Control, School of Energy Studies, Pune University
16) Mr. Prasar Chaudry, Quality Control, School of Energy Studies, Pune University
17) Mr. Virendra Gupta, ICPCI, Mumbai
18) Mr Jaideep Malaviya, CEO, STFI, Pune
19) Mr. K Manoharan, CEO, Aspiration Energy, Chennai
20) Mr. Bhoovarahan Thirumalai, Aspiration Energy, Chennai
21) Ms. Kathya Manoharan, Aspiration Energy, Chennai
22) Ms. Radhika Baskar, Aspiration Energy, Chennai
23) Mr. S. Velamani, General Manager - PLE, Wheels India, Chennai
24) Dr. Sudir Kumar, CEO, CTRAN, New Delhi
25) Dr. Sameer Maithel, CEO, GreenTech, New Delhi

APPENDIX D – LIST OF DOCUMENTS REVIEWED

1. UNDP-GEF "Global Solar Water Heating Market Transformation and Strengthening Initiative: India Country Program", Project Document, October 2008;
2. GSWH Project AWP s from 2003 to 2012
3. GSWH Project CDRs from 2004 to 2012
4. GSWH Project Steering Committee meeting minutes from 2008 to 2012
5. GSWH Project Execution Committee minutes of (1^{st} to 26^{th} meetings) held from 2008 to 2011
6. UNDP Mission Summary Reports, BTORs (2008 to 2012)
7. Model Detailed Project Report for SWH installation in four urban clusters prepared by CTRAN Consulting Limited
8. Report on SWH Awareness Creation Workshops and "Building Sector Policies and Regulations for Promotion of SWH Systems" prepared by CTRAN Consulting Limited
9. Knowledge product prepared by Dalkia Energy Services Ltd
10. Knowledge product prepared by GreenTech Knowledge Solutions Private. Ltd
11. Knowledge product prepared by ITP Senergy Advisory Services Private Limited
12. Knowledge product prepared by TERI
13. Mid-term Evaluation of the UNDP-GEF project "GSWH"
14. Solar thermal Newsletter "InSolTherm Times"
15. CPA Validation Report – G.K. Energy Marketers Pvt Ltd and TUV Nord
16. Guideline for installation of SWH on High Rise Building – University of Pune
17. Report on Workshops and High Level Meeting in six states prepared by World Institute of Sustainable Energy, Pune
18. Study report on "Scheme and Framework for Promotion of SWH by utilities and regulators" and "Design and Implementation of New Financing Mechanisms and Instruments to promote SWH" prepared by ABPS
19. Study report on "Area based Energy Service Company (ESCO) model for SWH in India" prepared by Mercados Energy Markets India Private Ltd
20. User's Handbook on "Solar Water Heaters" prepared by International Copper Promotion Council India
21. ESCO contract documents, MOU between Wheels India Limited and Aspiration Energy Private Limited, and Sona Koyo Steering Systems Limited and Aspiration Energy Private Limited

APPENDIX E – COMPLETED TRACKING TOOL

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	Global Solar Water Heater Market Transformation	
GEF ID	PIMS 3611	
Agency Project ID	61121	
Country	India	
Region	EAP	
GEF Agency	UNDP	
Date of Council/CEO Approval	July 1, 2008	Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)	2,000,000	
Date of submission of the tracking tool	May 27, 2013	Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?	1	Yes = 1, No = 0
Is the project linked to carbon finance?	1	Yes = 1, No = 0
Cumulative cofinancing realized (US$)	40,000,000	
Cumulative additional resources mobilized (US$)	26,000,000	additional resources means beyond the cofinancing committed at CEO endorsement

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		Yes = 1, No = 0
Off-grid electricity production		Yes = 1, No = 0
Policy and regulatory framework	5	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)	5	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)	1,680.00	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)	27,922,500.00	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	1,656,735	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)	49,702,050	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)	60,746,950	tonnes CO2eq (see Special Notes above)

APPENDIX F – EVALUATION QUESTION MATRIX

Evaluative Criteria	Questions	Indicators	Sources[38]	Methodology[39]
Relevance: How does the project relate to the main objectives of the GEF focal area, and to the environment and development priorities at the local, regional and national levels?				
• Is the project relevant to National priorities and commitment under international conventions? Yes	• Is the project country-driven? *Yes, through the JNNSM Phase I or otherwise referred to as the National Solar Mission that was initiated in January 2010*	• Existence of JNNSM Phase I	• Official government websites	• Analysing website and discussions with MNRE
	• Does the project adequately take into account the national realities, both in terms of institutional and policy framework in its design and its implementation? *Yes, the Project design accounts for the National Solar Mission, which, however, commenced 14 months after GSWH was initiated in November 2008*.			
	• How effective is the project in terms of supporting and facilitating towards low carbon pathways, with promotion of Solar Water Heater Systems in all sectors? *The Project has been effective in supporting and facilitating low carbon pathways through augmenting MNRE activities for SWH market expansion under JNNSM Phase I.*			
	• What was the level of stakeholder participation in project design and ownership in project implementation? *MNRE participation in Project design and ownership has been high. They have credited the Project with providing MNRE with technical materials and Project advice with regards to transforming the SWH market.*			
• Is the project internally coherent in its design?	• Are there logical linkages between expected results of the project (log frame) and the project design (in terms of project components, choice of partners, structure, delivery mechanism, scope, budget, use of resources etc.)? *There are logical linkages between targets of the various outputs.*	• SWH collector area installed	• MNRE data and PIRs	• Data analysis

[38] Various sources, but not limited to project document, project reports, national policies & strategies, key project partners & stakeholders, needs assessment studies, data collected throughout monitoring and evaluation, data reported in project annual & quarterly reports etc.

[39] Various methodologies, but not limited to Data analysis, Documents analysis, Interviews with project team, Interviews with relevant stakeholders etc.

	The problem with these linkages is the lack of specificity of the targets/results, with no time bound indicators.			
	• Has the project achieved its expected outcomes? If not, enumerate the reasons. *Yes, the main outcome of 2.0 million m^2 of collector area installed by the EOP was achieved (the actual areas was 2.4 million m^2 over and above the baseline growth of SWH systems which was 3.0 million m^2 by EOP)*			
	• Did the project made satisfactory accomplishment in achieving project outputs vis-à-vis the targets and related delivery of inputs and activities? *Most of the Project outputs were delivered satisfactorily. The exceptions include the partial completion of a system of standards, labels and quality control under MNRE (Outcome 1), a shortfall of trained installers (Outcome 4); the impact of these shortfalls, however, is considered to be minor.*			
• Does the project provide relevant lessons and experiences for other similar projects in the future?	• Has the experience of the project provided relevant lessons for other future projects targeted at similar objectives? State the lessons learnt. *Yes. The relevant lesson learned is to ensure that there is adequate baseline information prior to project interventions. The value of this baseline is to confidently measure the incremental benefit of the Project*.	• n/a	• n/a	• n/a
Effectiveness: The extent to which an objective has been achieved or how likely it is to be achieved?				
• Does the project been effective in achieving the expected outcomes and objectives?	• Whether the performance measurement indicators and targets used in the project monitoring system are accomplished and able to achieve desired project outcomes within 31st December 2013? *GSWH has been effective in understanding and addressing the barriers that exist at different regions and among different sectors, and has utilized the project resource in removing those barriers, through awareness workshops throughout India; conducting studies to prepare DPR for SWM among different end-use; including city and state government officials; training of technicians for installation and maintenance; setting up of helpline number to provide clarification to SWH end users is one example linking the Project effectiveness to Outcomes 1 and 2. The Project contributions to avail the 30% capital subsidy through the National Solar Mission and accelerated depreciation to*	• No clear understanding on what prevents the usage of SWH • No financial incentive available to end users • No follow up with city and state government officials on ensuring local regulations support SWH installations.	• QPRs and PIRs, ProDoc and stakeholder interviews • PEC and PSC meeting minutes	• Document analysis, site visits, interviews with stakeholders

	industrial users from 2011 mid-way into GSWH helped to accelerate the deployment of SWH and address the Outcome 3. The planned activities for SWH supply side certification and quality control (Outcome 4) did not receive desired level of attention of the project although the outcome of the Project was a systems that was self-checking and thus self-sustaining.			
• How is risk and risk mitigation being managed?	• How well are risks, assumptions and impact drivers being managed? *Poorly. Without any baseline analysis, the project could not properly evaluate its risks and the ProDoc did not have Offline Risk Log for PMU and UNDP for reference and further mitigative actions*	• No discussions of risk in all progress reports	• QPRs and PIRs, ProDoc and stakeholder interviews • PEC and PSC meeting minutes	• Document analysis, site visits, interviews with stakeholders
	• What was the quality of risk mitigation strategies developed? Were these sufficient? *There is no evidence of any risk mitigation strategies on this Project.*			
	• Are there clear strategies for risk mitigation related with long-term sustainability of the project? *There are none*.			
• Consideration of recommendations and reporting of information	• Did the project consider Midterm Review recommendations conducted in February 2012 and reflected in the subsequent project activities? *The PMU took actions on the recommendations provided on the MTR. Details of action taken for each recommendation were shared by the PMU during the last GWSH PSC meeting on Dec.12, 2012.* • Validated reporting on the annual installed collector area (sq meters) and the corresponding carbon emission reductions. *Annual installed collector areas for 2011 and 2012 are based on sales figures collected from channelled partners who have qualified for the 30% subsidy. To this extent, these figures are reasonable and valid.*	• Increase in the installation of SWH based on the data provided by MNRE	• Official figures as reported by MNRE	• GHG analysis using information from MNRE
• What lessons can be drawn regarding effectiveness for other similar projects in the future?	• What lessons have been learned from the project regarding achievement of outcomes? *Baseline analysis in project design is extremely important to confidently estimate the incremental benefit of the activities of a project.*	• n/a	• n/a	• n/a
	• What changes could have been made (if any) to the project design in order to improve the achievement of the project's expected results? *Sufficient resources should be made*			

	available to develop independent baseline and project indicators to track and project progress and its achievements			
Efficiency: Was the project implemented efficiently, in-line with international and national norms and standards and delivered results with the least costly resources possible?				
• Was project support provided in an efficient way? *Yes. The project met its target of contributing to installation of SWH and corresponding GHG reduction and was completed within budget.*	• How does the project management systems, including progress reporting, administrative and financial systems and monitoring and evaluation system were operating as effective management tools, aid in effective implementation and provide sufficient basis for evaluating performance and decision making? *The project management was carried out the PMU which assisted in procurement process towards providing resources for capacity building using UNDP/GEF funds. Project Execution Committee and Project Steering Committee met regularly and took decisions on advancing the project towards its goal of SWH market transformation. The data analysis carried out shows signs that market transformation is beginning to happen and all project targets have been met. This is indicative of effective project implementation. One area that was lacking was the presence of a full time M&E officer within the PMU. With one person dedicated to this task, M&E would have been much more effective for a National Project where the geographic coverage is too large for a part-time M& E officer.*	• Number of PIRs and APRs with clear descriptions of Project progress • Number of PSC meeting minutes with issues and actions taken documented • Number of PEC meeting minutes with issues and actions taken documented.	• APRs and PIRs, ProDoc and stakeholder interviews • PEC and PSC meeting minutes	• Document analysis, site visits, interviews with stakeholders
	• How effective was the adaptive management practiced under the project and lessons learnt? *Effective given that the Project had reached its targets for SWH installations, and given that the Project did not have a proper LFA on which to base its activities*	• Number of SWH installations by EOP	• PIRs and APRs	• Document analysis
	• Did the project logical framework and work plans and any changes made to them used as management tools during implementation? *Changes to LFA were necessitated by the fact the original LFA in the 2008 was incomplete or vague*	• Increase in the installation of SWH based on the data provided by MNRE	• Discussion with program partners • PIRs and QPRs	• Document analysis • Review of QPRs and PIRs
	• Utilization of resources (including human and financial) towards producing the outputs and adjustments made to the project strategies and scope. *Project resources were used efficiently in providing Project outputs and defining the focus*			

	on awareness creation. Table 2 under Section 3 of this Evaluation report provides the details of financial resource utilization against commitment.			
	• Details of co-funding provided (Ministry of New & Renewable Energy and ICPCI) and its impact on the activities (Refer to Table in section 6. Project Finance / Co-Finance). *Refer Table 3 under Section 3 of this report.*			
	• How does the APR/PIR process helped in monitoring and evaluating the project implementation and achievement of results? *Project outcomes were reviewed and updated by the UNDP CO during annual reporting. The APRs and PIRs helped in keeping the project on track and results-oriented and ensuring proper utilization of GEF finances within its budgetary limits.*			
• How efficient are partnership arrangements for the project?	• Appropriateness of the institutional arrangement and whether there was adequate commitment to the project? *The institutional arrangement was appropriate for the project. Various project partners involved in the project were committed towards making positive contribution to the cause of SWH market transformation.*	• n/a	• Discussion with program partners.	• Document analysis • Site visits
	• Was there an effective collaboration between institutions responsible for implementing the project? *Yes. Various project partners involved in the project were committed towards making positive contribution to the cause of SWH market transformation. The final results of impact of GWSH measured in terms increase in SWH coverage area and GHG emissions avoided, both have met the target set at the start of the project.*	• Increase in the installation of SWH based on the data provided by MNRE	• AWP, CDR and ProDoc	• Document analysis • Results of GHG tracking tool
	• Is technical assistance and support received from project partners and stakeholders appropriate, adequate and timely specifically for project PMU? *ICPCI provided valuable in-kind contribution to GSWH in developing user's and designer's handbooks. It developed training manual which are available in nine Indian languages. ICPCI also conducted 1 week training of 77 trainers on installation of SWH. These*			

	trainers in turn, trained 350 students of Industrial Training Institutes (ITI)			
Sustainability: To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results?				
• Will the project be sustainable on its conclusion and stimulate replications and its potential? *Moderately sustainable*.	• How effective is the project in terms of strengthening the policy (building bye laws), quality assurance through standards on SWH systems, end user capacities through awareness and capacity building, enhancing skill sets for installation & operations of the systems. *Effective. Building bylaws have been passed in 21 states; this has resulted in 100 municipal corporations in 8 states amending building bylaws to implement these orders. In addition, the effectiveness of these bylaws can be somewhat measured by the number of subsidies that are claimed which are paid on the basis of installation companies meeting certain MNRE standards for SWH systems and installation service quality and technical backstopping.* • How well has the project impacted in promoting use of SWH systems in each of the targeted sectors – Industry, Domestic, Hospitality, Health and Hilly regions. *Promotion of SWH in these sectors has been excellent. Comprehensive marketing assessments and studies were prepared by the Project for distribution to these sectors.* • Will the current ESCO mode of operations to use SWH for industrial process heat sustain and be showcased to replicate the ESCO mode of industrial heat applications in other sectors. *Yes. The current ESCO has uncovered several opportunities to replicate its initial ESCO contracts. However, the issue that needs to be addressed to strengthen replication opportunities is to raise awareness and confidence of financial institutions to the ESCO model and the viability of SWH systems to significantly reduce energy costs.* • How relevant are the knowledge products developed under the project, to serve as dissemination and reference to sustain the overall project initiatives in promoting use of SWH systems. *Very relevant. The quality of these knowledge products should ensure that these products are used as*	• Number of SWH installations by EOP	• PIRs and APRs	• Document analysis

	reference material for the technical functionality of SWH systems, their installation and operation as well as their maintenance.			
	• Appropriateness of the institutional arrangement and whether there was adequate commitment to the project. *MNRE was the appropriate institution to implement this Project. Their commitment to the Project was adequate.*	• Number of SWH installations by EOP	• PIRs and APRs	• Document analysis
Impact: Are there indications that the project has contributed to, or enabled progress towards maximizing environmental benefits?				
• What was the project impact under different components?	(a) Enabling institutional, legal and regulatory framework established to promote sustainable SWH market in 10 States. *Impact has been moderately satisfactory since capacities of local government officials to enforce and monitor these orders remains weak* (b) Enhanced awareness and capacity of the targeted end users and building sector professionals to consider and integrate SWH systems into different types of buildings. *The impact has been satisfactory based on the Project reaching its target for cumulative number of SWH system installed, and the number of hits on the www.solarwaterheater.gov.in website* (c) Increased demand for SWH systems by the availability of attractive end-user financing mechanisms or other delivery models. *The impact has been satisfactory based on the cumulative number of SWH systems installed from MNRE of which the 2011 and 2012 installation numbers were based on the number of capital subsidies claimed* (d) A certification and quality control scheme applicable for Indian conditions and enhanced capacity of the supply chain to offer products and services promoting sustainable SWH market in multiple. *The impact of the certification and quality control scheme has been satisfactory due to the linkage between the installation company meeting MEPS and other existing quality standards for SWH with payment of the 30% capital subsidy. MNRE have third party compliance officer to ensure this system for quality control is functional. In addition, SWH manufacturers, suppliers and installation personnel have enhanced capacity based on MNRE's channelled partner list of SWH-approved companies.*	• Number of SWH installations by EOP	• PIRs and APRs	• Document analysis

	(e) Provided support institutionalized and the results, experiences and lessons learned documented and disseminated (including monitoring, learning, evaluation and other feedback for adaptive management). *The impact has been moderately satisfactory based on a monitoring framework that is still under development. The current gaps in this framework include the lack of information on the functionality of SWH systems installed prior to 2008. Feedback to stakeholders on the progress of SWH system installations nationally, however, has been excellent based on the establishment and maintenance of the national solar water heating website (http://solarwaterheater.gov.in)*			
	• What was the additional co-financing amount that was leveraged by the project and mobilized investments in India? The co-financing given by Ministry of New & Renewable Energy and ICPCI. *Co-financing from MNRE was 4 times the amount committed based on the number of 30% subsidies claimed by SWH companies. ICPCI also provided in-kind assistance equivalent to USD 310,000, just above their commitment of USD 300,000.*	• Co-financing amounts at EOP	• PIRs and APRs • Discussions with stakeholders	• Document analysis • Stakeholder discussions
• What are the indirect benefits that can be attributed to the project?	• What has been the impact of the various workshops held nationwide, and training guides produced under the project in building awareness and enhancing capacities? *The impact has been satisfactory based on the fact that all workshops were well attended. Though feedback surveys of the workshops were not completed, the outcome of the Project reaching its SWH installation targets indicates that these workshops have had an impact.*	• Number of SWH installations by EOP	• PIRs and APRs	• Document analysis
• Impacts due to information dissemination under the project	• Access the impact using innovative methods of dissemination through the use of toll free helpline, web portal and electronic newsletter. *The impact has been satisfactory based on the number of phone calls to the toll-free helpline (over 250 daily) and the number of hits on the web portal and electronic newsletter websites.*			

APPENDIX G – LOGICAL FRAMEWORK MATRIX

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
Objective: To accelerate and sustain the solar water heating market in India as a part of the Global SWH Market Transformation and Strengthening Initiative.	The total, estimated amount of installed SWH systems measured as m2 per 1000 inhabitants. Growth of the annual sale of SWH systems. The level of customer satisfaction with the systems installed.	Estimated 2 m2 in India per 1000 inhabitants by the end of the project following the current baseline development. 6 % in India being lower than previous years as a result of market mistrust Mixed.	2 million m2 market acceleration contributing to (10 million m2/ 1 billion inhabitants) A steady, average growth rate of >30 % in India reached by the end of the project and continuing growth toward the expected saturation point of 140 m2 per 1000 inhabitants towards 2025. Over 90% customer satisfaction on new installations on the basis of problem free good quality products and installation services.	Official import and company statistics and vendor/manufact. interviews See above, including eventual ex-post project evaluations Customer surveys incl. eventual ex-post project evaluations.	Economic and financial feasibility of the SWH investments to be promoted Continuing commitment of the key partners, such as relevant public entities, financiers and other key interest groups to work towards meeting the project objectives.
Outcome 1: An enabling institutional, legal and regulatory framework to promote sustainable SWH market.	The adoption and effective enforcement of new legal and regulatory provisions promoting sustainable SWH market	Currently only a minor part of India is affected by the institutional entities. The standards do not reflect all the needed quality issues. Listings of suppliers with products complying to the current BIS standards valid for interest subsidy. Regulations are not well disseminated throughout India.	Expansion of solar program to other states of India. Update current standards All government support should be linked to a certification system guaranteeing better quality Dissemination of existing regulations throughout India (states and cities).	Official government publications. Project monitoring and evaluation reports.	See above
Output 1.1: Enhanced capacity of public institutions to support sustainable SWH market.	Availability of public support to promote the SWH market in up to now unexplored regions in India.	Only a minor part of India is actively involved in support for SWH market.	Disseminated over main market regions of India.	Project reports	See above

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 1.2: Adoption of a system for standards, labels and adequate quality control of SWH systems (including regulations, recommended institutional set-up etc.).	Updated BIS standards. System for certification, labelling, branding or recognition based on the revised standards.	Current standards reflect mostly the collector. Listings ('recognition') in relation to the interest subsidy scheme.	Extensions towards the complete system, including a performance indicator looked at the EN and ISO standards and best practices. All government support should be linked to a certification system showing quality of products, systems, production and installation work.	Project reports	
Output 1.3 Adoption of new regulations to consider or oblige the integration of SWH systems into the design and construction of new buildings.	Dissemination and updates of currently existing (in some parts of India) mandatory building regulations.	Only valid for a limited number of bigger cities and states.	Wide spread implementation of these mandatory building regulations.	Project reports	See above
Output 1.4 Adoption of additional, public financial and fiscal incentives to promote SWH market.	t.b.d, as applicable	t.b.d, as applicable	t.b.d, as applicable	t.b.d, as applicable	t.b.d, as applicable
Outcome 2 Enhanced awareness and capacity of the targeted end-users and building professionals to consider and integrate SWH systems into different types of buildings.	Annual sale of SWH system	750,000 m2 a year	>2,000.000 m2 a year at the end of the project.	Project reports and market surveys.	
Output 2.1 Materials for public awareness raising and marketing campaigns developed or adapted into Indians conditions.	Availability of materials Certification system showing quality of products, systems, production and installation work.	Materials only fitted for a limited part of India. Government linked recognition system	Fitting materials for different parts of India. Self contained system to be effective after government incentives stop.	Project reports Market surveys	
Output 2.2 Public awareness raising and marketing campaigns implemented in co-operation	The visibility of the public awareness raising and marketing campaign.	Only parts of India are reached and mostly aimed at end users.	Create awareness for the whole of India, focussing on domestic, commercial, industrial or agricultural applications whatever is fitted for a	Project reports Market surveys	

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
with relevant public entities and private SWH suppliers and manufacturers.			certain region (geographical, cultural , urban or rural). Aim at state agencies, municipals, banks and end users.		
Output 2.3 Broadening the application range of solar.	Penetration rate of solar on rural and urban industrial areas	Mainly domestic and commercial buildings in cities	Awareness of possibilities for solar in industrial and agricultural applications in rural/industrial areas through demonstration projects or SESCOs. Two demonstration projects or one SESCO.	Project reports	
Outcome 3 Increased demand for SWH systems by the availability of attractive end-user financing mechanisms or other delivery models.	The amount of financing leveraged through new financing models specifically tailored for SWH market needs.	No specific longer term financing and new delivery mechanisms offered and marketed for the SWH purchase.	The agreed financial support mechanisms and new delivery models in operation to meet the announced MNRE target to reach 10 m^2 of installed SWH capacity by 2020	Project monitoring reports	Initial demand for the financial services created and interest of the local financing sector to enter new market areas.
Output 3.1 Enhanced awareness of the key financial sector stakeholder and local suppliers on the specific characteristics and financing opportunities in the SWH market.	The level of interest created.	Lack of information on the specific SWH market characteristics and financing models tested in other countries.	All the key financial sector stakeholders and local suppliers informed on the specific characteristics and opportunities provided by the Indian SWH market (by building on the results of the market analysis), and on the experiences and lessons learnt from the financing models tested in other countries.	Project reports	See above
Output 3.2 Design, the financial structuring and the implementation arrangements for the specific purpose financing vehicles responding to specific SWH market needs finalized and agreed with the key stakeholders, and integrated into the overall SWH marketing package.	New financing instruments and, as applicable, delivery models made available.	No financing and delivery models specifically tailored for SWH market requirements available.	New financing instruments and business models (such as specific purpose bank loans, vendor financing, SESCOs etc.) specifically tailored and marketed for the SWH purchase offered to the end users as a part of the overall marketing package and integrating the available public incentives.	Project reports	See above

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 3.3 Trained staff of the local financing institutions to finance SWH investments.	Dissemination of system for interest subsidies througout all regions of India.	Limited to south east part of India.	Implemented at an effective level.	Government reports	
Outcome 4 A certification and quality control scheme applicable for Indian conditions in place and enhanced capacity of the supply chain to respond to the growing demand with good quality services sustaining the market growth.	The level of marketing, product and installation services available in the market.	Generally, the supply side capacity is not up to the required level of professionalism.	Enhanced capacity of the supply chain to respond to the growing demand with good quality services sustaining the market growth.	Project reports and supply side surveys.	
Output 4.1 Proceedings and physical facilities for adequate testing and quality control of SWH systems developed and effectively taken into use.	Availability of adequate testing facilities and proceedings for compliance checking.	Testing facilities fitted to the current BIS standards.	Adequate testing facilities and proceeding for compliance checking developed and effectively taken into use aimed at the updated standards and the type of certification adopted..	Project reports	See above
Output 4.2 A certification and training system in place for SWH system installers	The availability of a training system. Design and engineering course or handbook for system designer's and engineers. Dissemination of available (global) technology regarding	Only a minor portion covered by a 'dealership' of a full service manufacturer. No specific accessible training system in place for SWH system installers. None Only minor (vacuum tube collectors)	Wide spread system for recognition (listings) and dealer networks, including rules for good craftsmanship for installing and after sales. Training infra structure in place for SWH system installers. Information regarding design and engineering in printing or electronically available. Integration of material in existing schooling Boosting demand for more scientific technology regarding solar thermal and high tech applications through	Project reports	

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
	solar applications for high temperatureas		creating joint ventures with foreign companies.		
Output 4.3 SWH system installers trained and certified	The number of SWH system installers trained.	None	500 at the end of the project	Project reports	
Output 4.4 Trained local suppliers and manufacturers to produce and market their products.	Availability of information Dissemination level. The number of SWH system suppliers and manufacturers trained. Monitored system performance on installed systems	None None Minor	Guidelines for design and engineering of (more) complex solar systems based on a scientific approach. 100 manufactures, technical consultants or (larger) installers) 100 manufactures, technical consultants or (larger) installers) Introduction of the 'learn and improve' cycle, by 200 systems monitored and reported to key stakeholders like manufacturers, technical consultants and (larger) installers	Project reports	
Outcome 5 The provided support institutionalised and the results, experiences and lessons learned documented and disseminated (including monitoring, learning, evaluation and other feedback for adaptive management).	Access to project related information by local and international experts.	No results and experiences documented and disseminated	The reports and other public material from the project can be easily found and accessed.	Project reports	
Output 5.1 The reporting framework and arrangements for SWH market monitoring established.	The reporting framework and arrangements for SWH market monitoring under implementation.	None	The reporting framework and arrangements for SWH market monitoring successfully under implementation.	Project reports	
Output 5.2 The national project web-site and network	Number of visits in the project website	None	Project web-site and network successfully established with		

Project Strategy	Indicator	Baseline	Target	Sources of Verification	Assumptions
successfully established and marketed.	The level and type of information in the website. The frequency of updating.		information on the scope and results of the project . (The details to be specified later)		
Output 5.3 Mid-term and final evaluation	Delivery of the mid-term and final evaluations	N/A	The mid-term and final evaluations finalized on time.		
Output 5.4 Final report prepared and published	Delivery of the final report	N/A	Final report delivered in the end of the project		

APPENDIX H– EVALUATION CONSULTANT AGREEMENT FORM

Evaluators:

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 imitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.

Evaluation Consultant Agreement Form[40]

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

Name of Consultant: __Roland Wong_____

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 *Surrey, BC , Canada* on *June 28, 2013*

Signature: 

Evaluation Consultant Agreement Form

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

Name of Consultant: __Sandeep Tandon_____

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 *Delhi, India* on *June 28, 2013*

Signature:

[40] www.unevaluation.org/unegcodeofconduct

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	Global Solar Water Heater Market Transformation	
GEF ID	PIMS 3611	
Agency Project ID	61121	
Country	India	
Region	EAP	
GEF Agency	UNDP	
Date of Council/CEO Approval	July 1, 2008	Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)	2,000,000	
Date of submission of the tracking tool	June 27, 2013	Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?	1	Yes = 1, No = 0
Is the project linked to carbon finance?	1	Yes = 1, No = 0
Cumulative cofinancing realized (US$)	40,000,000	
Cumulative additional resources mobilized (US$)	26,000,000	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	1	Yes = 1, No = 0
Innovation and technology centre and network	1	Yes = 1, No = 0
Applied R&D support	1	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	1	Yes = 1, No = 0
Institutional and technical capacity building	1	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	Renewable_Energy	
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	4	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
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		Yes = 1, No = 0
Off-grid electricity production		Yes = 1, No = 0
Policy and regulatory framework	5	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)	5	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)	1,680.00	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)	27,922,500.00	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	1,656,735	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)	49,702,050	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)	60,746,950	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?	1	Yes = 1, No = 0

Assumed that solar thermal would replace electricity	Values	Basic unit
Solar thermal collector area installed in 2008-09	0	m^2
Solar thermal collector area installed in 2009-10	150,000	m^2
Solar thermal collector area installed in 2010-11	550,000	m^2
Solar thermal collector area installed in 2011-12	650,000	m^2
Solar thermal collector area installed in 2012 - 13	1,050,000	m^2
Total installed solar collector area installed during the project duration	2,400,000	m^2
Average solar irradiance or solar radiation energy	775.63	kWh/m^2
Total electrical energy saved per year	1,861,500	MWh
The country specific emission factor	0.89	t CO_2/MWh
	0.69	t CO_2/m^2

Sandeep:The avg. solar irradiance corrected based on discussion with Dr Singhal on May 21,2013. The old figure of 450 kWH/m2 as per CDM AMS I.J is too low for India.

	m2	kWth	MW_{th}
	1	0.7	
	2,400,000	1,680,000	1,680

Particulars	1 October 2008 to 31 March 2009	1 October 2008 to 31 March 2010	1Oct 2008 to 31 March 2011	1 Oct 2008 to 31 March 2012	1 Oct 2008 to 31 March 2013
Installed solar thermal collector area (m^2)	0	150,000	700,000	1,350,000	2,400,000
Energy savings (assuming solar thermal replaces electricity) in KWhr (=1 unit)	0	116,344	542,938	1,047,094	1,861,500
Emission reductions achieved (t CO_2)	0	103,546	483,214	931,913	1,656,735

Cumulative total energy savings as on 22 May 2013 in million units	3,567,875	MWh	0	kWh	
			116,343,750	kWh	
Cumulative total emission reductions as on 30 June 2013	1,656,735	t CO_2	542,937,500	kWh	
Cumulative installed capacity as on 30 June 2012	2,400,000	m^2	1,047,093,750	kWh	
Assumed lifetime of the system	15	years	1,861,500,000	kWh	
Possible total units of electricity savings over lifetime of the installed solar thermal systems	**27,922,500**	**MWh OR**	28	million units	
Possible direct emission reductions over lifetime of the installed solar thermal system	**24,851,025**	**t CO_2**	24.856	million t CO_2	
Add emission savings from F.O. use avoided in industries	**4,632**				
Total emissions avoided from use of SWH	**24,855,657**	**t CO_2**			

Possible direct post-project emission reductions over lifetime of the installed solar thermal system	0	As there are no financing instruments (revolving fund or LFG etc.)
Lifetime indirect GHG emissions avoided (bottom-up)		
Replication factor	3	market transformation
Lifetime indirect GHG emissions avoided	**49,702,050**	tCO_2 (bottom-up); assumed 10 years
The contribution from the project influence to the overall target under JNNSM	22,000,000	m^2
Causality factor	40%	As most of the activities are soft measures
Lifetime indirect GHG emissions avoided	**60,746,950**	tCO_2 (top-down); assumed 10 years

	2005	2006	2007	2008
Total emissions for India (million tonne)	1,411	1,504	1,612	1,743
	4%	4%	4%	3%