

INDEPENDENT EVALUATION DIVISION
OFFICE OF EVALUATION AND INTERNAL OVERSIGHT

INDEPENDENT TERMINAL EVALUATION

INDIA

PROMOTING BUSINESS MODELS FOR INCREASING
PENETRATION AND SCALING-UP OF SOLAR ENERGY IN INDIA

UNIDO PROJECT ID: 130149

GEF PROJECT ID: 4788



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Distr. GENERAL

ODG/EIO/IED/21/R.5

May 2022

Original: English

This evaluation was managed
by the responsible
UNIDO Evaluation Officer
with quality assurance by the
Independent Evaluation Division

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This document has not been formally edited.

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Acknowledgements

The Evaluation Team would like to express their gratitude to all persons met and contributed to this evaluation, especially the UNIDO and project staff in India and Vienna. Special thanks go to Ms. Thuy Thu Le of UNIDO Independent Evaluation Division, for her valuable guidance and support provided in preparing and conducting this evaluation.

The Evaluation Team hopes that the findings, conclusions and recommendations will contribute to the successful completion of the Project and to the continuous improvement of similar projects in other countries.

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List of Acronyms and abbreviations

Acronym	Definition
COVID-19	Coronavirus Disease 2019
CST	Concentrated Solar Thermal
DPR	Detailed Project Report
GEF	Global Environment Facility
GHG	Greenhouse Gas
GNFL	Gujarat Narmada Fertilizers Limited
IREDA	Indian Renewable Energy Development Agency
ITE	Independent Terminal Evaluation
M&E	Monitoring and Evaluation
MNRE	Ministry of New and Renewable Energy
MSMEs	Micro-, Small and Medium-sized Enterprises
MTR	Mid-Term Review
NDC	Nationally Determined Contribution (Paris Climate Agreement)
NDDB	National Dairy Development Board
NISE	National institute of Solar Energy
ODG/EIO/IED	The UNIDO Independent Evaluation Division
ONGC	Oil and Natural Gas Corporation
PEC	Project Executive Committee
PSAC	Project Steering-cum-Advisory Committee
PV	Photovoltaic
SEQI	Solar Energy Quality Infrastructure
ToC	Theory of Change
TOR	Terms of Reference
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organisation

Currency equivalent (UN Rate of Exchange)
 Nov 2013 (Design) USD 1: INR 61.24
 July 2021 (TE) USD 1: INR 74.19

Glossary of evaluation-related terms

Term	Definition
Baseline	The situation, before an intervention, against which progress can be assessed.
Effect	Intended or unintended change due directly or indirectly to an intervention.
Effectiveness	The extent to which the development intervention's objectives were achieved or are expected to be achieved.
Efficiency	A measure of how resources/inputs (funds, expertise, time, etc.) are converted to results.
Impact	Positive and negative, intended and non-intended, directly and indirectly, long term effects produced by a development intervention.
Indicator	Quantitative or qualitative factors that provide a means to measure the changes caused by an intervention.
Lessons learned	Generalizations based on evaluation experiences that abstract from the specific circumstances to broader situations.
Log frame (logical framework approach)	A management tool used to facilitate the planning, implementation, and evaluation of an intervention. It involves identifying strategic elements (activities, outputs, outcome, impact) and their causal relationships, indicators, and assumptions that may affect success or failure. Based on RBM (results-based management) principles.
Outcome	The likely or achieved (short-term and medium-term) effects of an intervention's outputs.
Outputs	The products, capital goods, and services which result from an intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Relevance	The extent to which the objectives of intervention are consistent with beneficiaries' requirements, country needs, global priorities, and partners' and donor's policies.
Risks	Factors, generally outside the scope of an intervention, which may affect the achievement of an intervention's objectives.
Sustainability	The continuation of benefits from an intervention, after the development assistance, has been completed.
Target groups	The specific individuals or organizations for whose benefit an intervention is undertaken.
Theory of Change	A set of hypotheses on how and why an initiative works.

Executive Summary

Evaluation purpose and methodology

This independent terminal evaluation (ITE) assesses the performance of the project 'Promoting business models for increasing penetration and scaling-up of solar energy in India'. The ITE has two objectives: i) accountability/results: to assess the project performance in terms of relevance, effectiveness, efficiency, coherence, sustainability and progress to impact; and ii) learning/improvement: to develop a series of findings, lessons and recommendations for enhancing the design of new, and implementation of ongoing, projects by UNIDO.

The project 'Promoting business models for increasing penetration and scaling-up of solar energy in India', which was funded by Global Environment Facility (GEF), was implemented between 2014 to 2021, with a focus on concentrated solar thermal (CST) technologies. The key executing partner identified at design was the Ministry of New and Renewable Energy (MNRE). The Project was approved in 2013 with an initial expected completion date of 31st January 2020; later extended for project operations to 31 January 2021 and for independent terminal evaluation to 30 June 2021. The Project received an approved grant amount of USD 4.365 million from the GEF with an expected co-financing contribution of USD 21.825 million, an expected total project cost of USD 26.19million.

The project's overall objective was to develop business models for promoting solar energy-based heating and cooling applications in selected industrial sectors to reduce greenhouse gas (GHG) emissions. Four project outcomes were identified to contribute to this objective, overcome barriers to the development of a CST market, and capitalize on identified market potential. These expected outcomes were i) favourable policy and regulatory environment created for solar energy applications in industry, ii) improved technological capabilities, strengthened viability demonstration and increased CST investment, iii) multiplied CST investment and assured quality of components, iv) enhanced capacity, technology transfer and information sharing.

The ITE of the project adopted an independent, participatory, Theory of Change (ToC) approach and used a mixed methods approach to data collection. The evaluation team developed an evaluation framework including key evaluation questions aligned with UNIDO's Evaluation Manual to assess the OECD-DAC¹ criteria of relevance, efficiency, effectiveness, sustainability and coherence as well as overall progress to impact, gender mainstreaming, monitoring and evaluation, results-based management and performance of partners. Data was initially collected from a document review of relevant project documents. The findings from this review were then triangulated, contextualised, and deepened through a series of interviews with key stakeholders to ensure the robustness and validity of a credible assessment. In view of the ongoing COVID-19 pandemic which hit India hardly at the time of the evaluation, no field mission was possible, consequently virtual interviews with stakeholders were conducted.

¹ The Organisation for Economic Co-operation and Development, Development Assistance Committee

Key findings

Effectiveness. The Project achieved satisfactory progress in several outputs but did not attain the targeted project outcomes so is assessed as less than effective overall.

Component 1 activities conducted to facilitate an enabling policy environment for solar technology resulted in generation of a roadmap for solar thermal technology. This was well-received and has been instrumental in stimulating further action. However, the support for CST technologies did not significantly reduce the policy barriers to solar thermal energy uptake that were identified at design.

Component 2 results in terms of technology installation and viability demonstration were limited, with only two of the intended 25 demonstration sites fully installed at the time of ITE. The workshops conducted to raise awareness were positively received, resulting in an active pipeline of 22 proposals at the time of the ITE; but did not generate the expected benefits in terms of CST system installation.

Component 3 expected outcomes in terms of scale-up that were dependent on positive achievements in components 1 and 2. Given the limited results on preliminary outcomes, little progress was achieved. Some progress has been made towards outcome four, increased awareness and built capacity, however, targets were not reached.

Progress to impact. The limited progress towards stated outcomes inhibited the potential for broader impact as identified at design. The Project was envisioned to contribute to reductions in greenhouse gas emissions because of the transition to CST from more polluting energy sources. However, the lower-than-expected levels of installation meant that the potential for significant emissions reductions was not attained. Project design also identified the potential for economic impact through the demonstrated viability of CST to encourage scale up of installation. However, the low installation rate constrained opportunities for demonstration and hindered scale up.

Design. Project design had a wide scope of fourteen sectors and all Micro-, Small & Medium-sized Enterprises (MSMEs) within these sectors. Such a broad approach was not aligned with the need for CST technologies to be contextualised to the needs and pre-existing systems. The Project logframe included similarly broad indicators and did not contain sufficient detail to effectively guide implementation. A more focused approach, building on initial success and a demonstration effect of those successes would have been more consistent with the need for CST technology installation to be tailored to specific requirements by sector and location.

Relevance. The Project was broadly aligned with a national push on renewable energy and the Project approach was appropriate to address the identified development challenges of policy, technical, financial and capacity barriers. A major impediment to relevance of the approach was that the CST technology was perceived as not being in high demand within the Ministry of New and Renewable Energy (MNRE). The project design had been based on the potential of a subsidy scheme that CST technologies would be eligible for but which did not proceed as designed. Industry partners were attracted by

the Photovoltaic (PV) subsidies so were less likely to engage with CST technologies, even where the technology would be more relevant to their needs. The loan interest subvention scheme adopted through Indian Renewable Energy Development Agency Limited (IREDA) had potential in terms of reducing costs of CST financing but was constrained by the barriers faced by MSME's in terms of CST technology awareness and in responding to the rigorous lending conditions and without subsidy to reduce the debt burden. Also, the design of the scheme was not fully relevant to the project target groups. Relevance varied at the state level, depending on the legislative requirements, stipulating the use of renewable energy sources.

Coherence. The Project was based on a specific request from the national government but a detailed scope to avoid duplication with similar solar energy initiatives was not clearly articulated. Attempts to link with other projects were narrow and decreased potential for broader coherence and impact. The lack of specificity included at design contributed to a less-than-coherent internal project approach. The focus on MSMEs did not acknowledge the variations present within the industries and the eligibility criteria for support were not sufficient tailored to the needs of the Project.

Efficiency. The lengthy loan application processes and its reliance on parallel capital grant from Government contributed to lower-than-expected mobilization of funds. The Project's disbursement rate is approximately 40% of the total available grant amount reflecting the challenges with activation of the interest subvention scheme and national level procurement delays. This was tied to Central Financial Assistance (CFA) grant through MNRE. This scheme did not eventuate as planned and hence the level of overall expected expenditure for three of the four project components was less than projected. Without this constraint, the level of expenditure of funds directly under the control of the project was 82%, demonstrating the capacity of the project to deliver on other activities.

Sustainability of benefits. Where technology has been installed the benefits are likely to continue but these examples are isolated and threats to project's sustainability exist. Capacity gaps for ongoing maintenance and troubleshooting hinder the potential for ongoing use. The isolated nature of installations undermines the positive capacity and awareness changes generated towards longer term attitudinal change. Threats to sustainability are also evident due to a lack of national ownership and the unlikelihood of continuing financial mechanisms.

Gender mainstreaming. Gender was not significantly considered at design. Project design identified women as indirect beneficiaries resulting from broader change envisioned under the Project. However, the limited effectiveness of the Project undermines the potential for these flow-on benefits. Nonetheless, there are some isolated examples of benefits for women such as in the Uttarakhand Cooperative Resham Federation Case Study. However, the Project did not integrate gender considerations at design or during implementation.

Performance of Partners. UNIDO’s experience and expertise was sufficient to implement the Project. UNIDO support reached beyond the Project Management Unit (PMU) to provide technical support but relied on the added value of external partners. UNIDO’s role as PMU and the oversight provided by the Delhi office and the main contractors were moderately effective. However, the overall project approach designed by UNIDO was less than effective. The GEF execution ministry was not directly involved in day-to-day execution but could have played a stronger oversight role. Changes in priority of MNRE as an executing agency constrained Project potential. Changes in the availability of financial support from the ministry was a further hindering factor. The National Institute of Solar Energy (NISE) had multiple roles in implementation. NISE was active in the Steering Committee and in developing training material, with plans also to support testing. Numerous delays in contract signing were experienced resulting in technical outputs and activities expected to be undertaken by NISE remaining incomplete. IREDA had an integral role in the provision of Project support, but the activities did not proceed as expected. The decision by GEF to approve the Project was strategically effective but did not require sufficient adjustments in response to technical review. The joint oversight during implementation was insufficient to identify and address constraints when appropriate.

Monitoring and Evaluation. The Framework included sources of verification and suitable assumptions and was sufficiently comprehensive to inform an assessment of progress. Nonetheless, some duplication of indicators and lack of clarity of data collection processes is evident and some indicators included at design decreased in relevance over time increasing the reporting burden. Furthermore, data collection was moderately unsatisfactory with some gaps present, particularly in relation to the specified collection of gender disaggregated data. Reporting at times lacked sufficient detail with a preference for broad statements as opposed to an account of activities and contributing or hindering factors.

Results-based management. Management in general was sufficient but with weaknesses in implementation, narrow in scope and focussed on individual outputs, its impact and sustainability. There was a lack of strategic oversight required to facilitate changes in response to poor progress. There were no significant adaptive actions by the PMU taken despite identified challenges in terms of disbursement of funds and slow project progress.

Project ratings

#	Evaluation criteria	Rating
A	Progress to impact	3 (Moderately Unsatisfactory)
B	Project design	4 (Moderately Satisfactory)
1	• Overall design	4 (Moderately Satisfactory)
2	• Logframe	4 (Moderately Satisfactory)
C	Project performance	4 (Moderately Satisfactory)
1	• Relevance	5 (Satisfactory)
2	• Effectiveness	3 (Moderately Unsatisfactory)
3	• Efficiency	3 (Moderately Unsatisfactory)

#	Evaluation criteria	Rating
4	• Sustainability of benefits	4 (Moderately Likely)
5	• Coherence	4 (Moderately Satisfactory)
D	Cross-cutting performance criteria	3 (Moderately Unsatisfactory)
1	• Gender mainstreaming	3 (Moderately Unsatisfactory)
2	• M&E: ✓ M&E design ✓ M&E implementation	3 (Moderately Unsatisfactory)
3	• Results-based Management (RBM)	3 (Moderately Unsatisfactory)
E	Performance of partners	3 (Moderately Unsatisfactory)
1	• UNIDO	3 (Moderately Unsatisfactory)
2	• National counterparts	2 (Unsatisfactory)
3	• Donor	4 (Moderately Satisfactory)
F	Overall assessment	3 (Moderately Unsatisfactory)

Overview of key conclusions and recommendations

Summary conclusion. There is ongoing interest in CST technologies demonstrated through a growing pipeline of proposals stimulated by the project. Yet, assumptions made at design regarding national government and industry commitment and resources available to support project initiatives have not eventuated, constraining project progress. Commitment at State level appears to be a critical success factor that could be given stronger attention.

Outcome 1: Favourable Policy Environment The policy work supported through the project has been of value and further identifies the potential of a well-functioning CST industry. However, the enabling environment and resource commitments required to substantially progress the road map recommendations have not yet been available.

Outcome 2: Technology Installation and Viability Demonstration The slow uptake of the CST technology due to a broad-scale approach, lack of expected subsidy and the challenges in accessing loan financing, inhibited achievement of installation and sufficient functional examples of CST operation.

Outcome 3: Scale Up in investment and assurance of quality As a result of the small number of installations, the demonstration effect expected to be generated by the Project has not reached sufficient momentum to achieve scale up.

Outcome 4: Increased Awareness and Capacity Tools and approaches to raise awareness of CST technologies have generated interest in the technology and contributed to the development of an active pipeline of proposals. It was found that due to the customized installation requirements for CST technologies, lack of local capacity has been an impediment to preparing investment-ready proposals. The Project, through contracted

technical assistance responded well to this challenge by adjusting the technical support to include assistance to individual business to prepare feasibility assessments. However, this capacity development approach is not yet sustainable to support further CST development.

Recommendations

Recommendation 1: UNIDO to extent the project duration at no-cost for about two years. The revised action plan for the extension period should include:

1. Alternative government partnerships to ensure active implementation, and improved access to resources (expertise and finance) capable of supporting viable proposals in the pipeline.
2. Allow sufficient time to pursue the substantial demand in the current pipeline for effective national procurement, installation and commissioning of the CST systems.
3. Ensure the availability of technical support to develop modular approaches to several key focus industries.
4. Strengthened capacity development approaches for local service providers.

Recommendation 2: UNIDO should ensure improved project management and communications support to address current implementation weaknesses. The project management unit should:

5. Establish demonstration sites and respective skills transfer processes for scale up relevant to current and prospective industries where installations are available (not only project-supported sites).
6. Establish sustainability mechanisms for operation beyond the project.

1. Introduction

1.1. Evaluation objectives and scope

The 'promoting business models for increasing penetration and scaling-up of solar energy in India' project was implemented between 2014 to 2021. An independent terminal evaluation (ITE) is conducted with two objectives: i) accountability/results: to assess the project performance in terms of relevance, effectiveness, efficiency, sustainability and progress to impact; and ii) Learning/improvement: to develop a series of findings, lessons and recommendations for enhancing the design of new and implementation of ongoing projects by UNIDO.

The evaluation covers the whole project period between the GEF CEO Endorsement and Approval on December 22nd, 2013,² the project start date in January 2014 and the project closing date. The Mid-Term Review (MTR) was submitted on January 29, 2018. The project was expected to be completed in January 2020,³ however, this was extended to January 31, 2021 for project operations and to June 30th 2021⁴ for reporting and evaluation. During the one-year extension period project activities were adversely impacted by COVID-19 pandemic, both through the lockdowns as well as from the financial crisis which impacted business capability to invest in CST.

1.2. Overview of the Project Context

India is a lower-middle income country, with a population of 1.366 billion. India was until 2019 the fastest-growing trillion-dollar economy in the world and the fifth-largest overall, with a nominal GDP of USD2.87 trillion in 2019.⁵ India's economic growth declined to an 11 year low in FY 2019-2020 of 4.4%. India's economy and society have been severely impacted by the onset of the COVID-19 pandemic in 2020 due to the prolonged national lockdown and resultant losses of business, incomes and livelihoods.

India's industrial sector is responsible for 40% of national energy consumption.⁶ In the manufacturing sector segment, globally approximately 74% of energy is used for heating and cooling. Under its Nationally Determined Contributions (NDCs) to the Paris Climate Agreement, India has committed to reduce the greenhouse gas (GHG) intensity of its economy by 33-35% by 2030, relative to 2005 levels. Moreover, through the NDC India has committed to have by 2030 40% of its installed power generation capacity from non-fossil fuels.⁷ Therefore, India has stepped up its policy drive and regulatory and market incentives to scale up and speed up both energy efficiency as well as transition to

² GEF, *Promoting Business Models for Increasing Penetration and Scaling Up of Solar Energy*, <https://www.thegef.org/project/promoting-business-models-increasing-penetration-and-scaling-solar-energy>

³ GEF, 2013, *Request for CEO Endorsement: promoting business models for increasing penetration and scaling up of solar technology*

⁴ UNIDO, *Open Data Platform: Promoting business models for increasing penetration and scaling up of solar energy*, <https://open.unido.org/projects/IN/projects/130149>

⁵ India Ministry of Statistics and Programme Implementation, 2020, National Statistics

⁶ Government of India, Central Statistics Office, 2018, Energy Statistics

⁷ UNFCCC, 2015, India's Intended Nationally Determined Contribution

renewable energy. The Ministry of New and Renewable Energy (MNRE) initiates and coordinates the development of the renewable energy sector in India.

Of the heating and cooling demand in the manufacturing sector, about half is required in low to medium heat range, not exceeding 380-400°C. This includes diverse 'light' manufacturing sectors which exclusively require low and medium heat typically for heating, drying, sanitizing and alike processes, in sectors as diverse as food processing, textile and garments, leather, pharmaceuticals, metal finishing etc. These low to medium heat applications were of particular interest for the Project, as candidates for installation of solar process heating and cooling, using Concentrated Solar Thermal (CST) technologies (also referred to as Concentrated Solar Heating (CSH)).

CST systems use mirrors to concentrate sunlight onto a receiver, which collects and transforms solar energy into heat which is then transferred into a heat transfer fluid – typically hot water, steam or another thermal fluid. Different designs and shapes of mirrors and receivers are in use and can achieve different temperatures for the heat transfer fluid. This fluid is then conveyed to the heat requiring process for heating or fed into absorption chiller for cooling. Optionally, the heated thermal fluid can be stored in insulated tanks for use during night hours, i.e., thermal energy storage.

1.3. Overview of the Project

The project confirmed a market potential for CST for process heating and cooling in India of 6.5 GW_{th}, whereas in 2017 the cumulative installed capacity was in the range of 50 MW_{th}, hence, less than 0.1% of assessed market potential.⁸ Widespread application of CST faced several challenges including: unfamiliarity of the technology and its applications; the requirement for custom design and engineering of CST systems to specific heating and cooling requirements (heat 'integration engineering'); reliance on imports for specialized components (shaped mirrors, receivers, etc.); and high costs and associated long payback times (despite competitive project lifetime heating and cooling costs). The project was therefore conceived to initiate a market transformation for CST for process heating and cooling in India to overcome some of these challenges. As such, the project's overall objective was to develop business models for promoting solar energy-based heating/cooling and, where feasible, tri-generation projects through different concentrating solar thermal technologies in industries and commercial sectors with a view to replace fossil fuel and reduce greenhouse gas emissions.

To achieve this objective, the project applied an approach that focussed on light industrial sectors that, given the technical performance range of solar thermal technologies and the sector's specific heating and cooling requirements, provide the best match, and, hence, offer best potential for short to medium term techno-economic feasibility. The Project's main emphasis was hence on developing and demonstrating CST applications in these priority sectors, supported by enabling activities aimed at policy and (industry) capacity building through awareness and skills initiatives. Accordingly, the Project had four components as illustrated in Table 1 and Annex 2.

⁸ <https://open.unido.org/api/documents/12714793/download/India%20CST%20Roadmap%202022.pdf>

Table 1. Project Components

Component 1: Strengthening of policy and institutional framework
Outcome 1: Favorable policy and regulatory environmental created for solar energy applications.
Output 1.1: Set of policy recommendations and guidelines for policy makers developed.
Component 2: Technology investment and application
Outcome 2: Technical and financial viability of projects confirmed, local manufacturing capability for solar energy systems in industrial applications enhanced and investments in solar energy application in industry increased.
Output 2.1: Detailed technology application tools developed, such as: integrated CST with energy storage; detailed project reports (DPRs); CST demonstrations selected, installed and performance evaluated; qualified consultants; and case studies.
Output 2.2: Investment in solar energy applications in industry increased.
Component 3: Scale up.
Outcome 3: Investment in solar energy applications in industry multiplied and quality of solar energy components assured.
Output 3.1: Business models for CST leading to sustained replication of solar thermal applications in industry and quality assurance and certification framework in place.
Output 3.2: Financing facility for scale-up established.
Component 4: Awareness raising and capacity building
Outcome 4: Capacity of key players in target industries enhanced and technology transfer and information sharing tools established.
Output 4.1: Trained manufacturers, suppliers and installers.
Output 4.2: Awareness raised among the business community.
Output 4.3: Technical capacity built through the promotion of industry academic partnership.
Output 4.4: CST and project information shared.
Output 4.5: Documented project outputs, case studies, best practices and lessons learned.

1.4. Theory of Change

Based on the Project rationale and design, a theory of change (ToC) was retrospectively constructed during the inception phase of the evaluation (see Figure 1). The ToC illustrates causal and transformational pathways from project outputs to outcomes and longer-term impacts. It also identifies potential drivers and barriers which may facilitate or hinder progress from outputs to impact. The ToC provides a tool to analyze the extent to which the expected causal pathways required for the Project to contribute to the high-level objective of reduced GHG emissions were followed by the project.

1.5. Evaluation Methodology

This ITE was conducted in accordance with the UNIDO Evaluation Policy and the UNIDO Guidelines for the Technical Cooperation Project and Project Cycle. In addition, the GEF Guidelines for GEF Agencies in Conducting Terminal Evaluations, the GEF Monitoring and Evaluation Policy and the GEF Minimum Fiduciary Standards for GEF Implementing and Executing Agencies were applied.

The evaluation team leader liaised with the UNIDO Independent Evaluation Division (ODG/EIO/IED) on the conduct of the evaluation and methodological issues. The ITE was intended to be carried out during May 2021 using an independent, participatory approach whereby all key parties associated with the project were informed and consulted throughout the evaluation. In view of the ongoing COVID-19 pandemic, no mission for the international evaluator was possible, and, in lieu thereof, virtual fact-finding interviews with stakeholders were conducted, with the assistance and participation of the national evaluation consultant.

The evaluation team developed an evaluation framework which identified key evaluation questions based on the UNIDO evaluation manual. This framework is available in Annex 2. The framework is based on the OECD-DAC criteria for evaluation and as such includes questions related to relevance, efficiency, effectiveness, sustainability and coherence to guide the evaluation approach. In addition to these globally recognised evaluation criteria, the framework also includes UNIDO's key evaluation questions in relation to progress to impact, performance of partners, gender mainstreaming, monitoring and evaluation, results-based management and quality of project design.

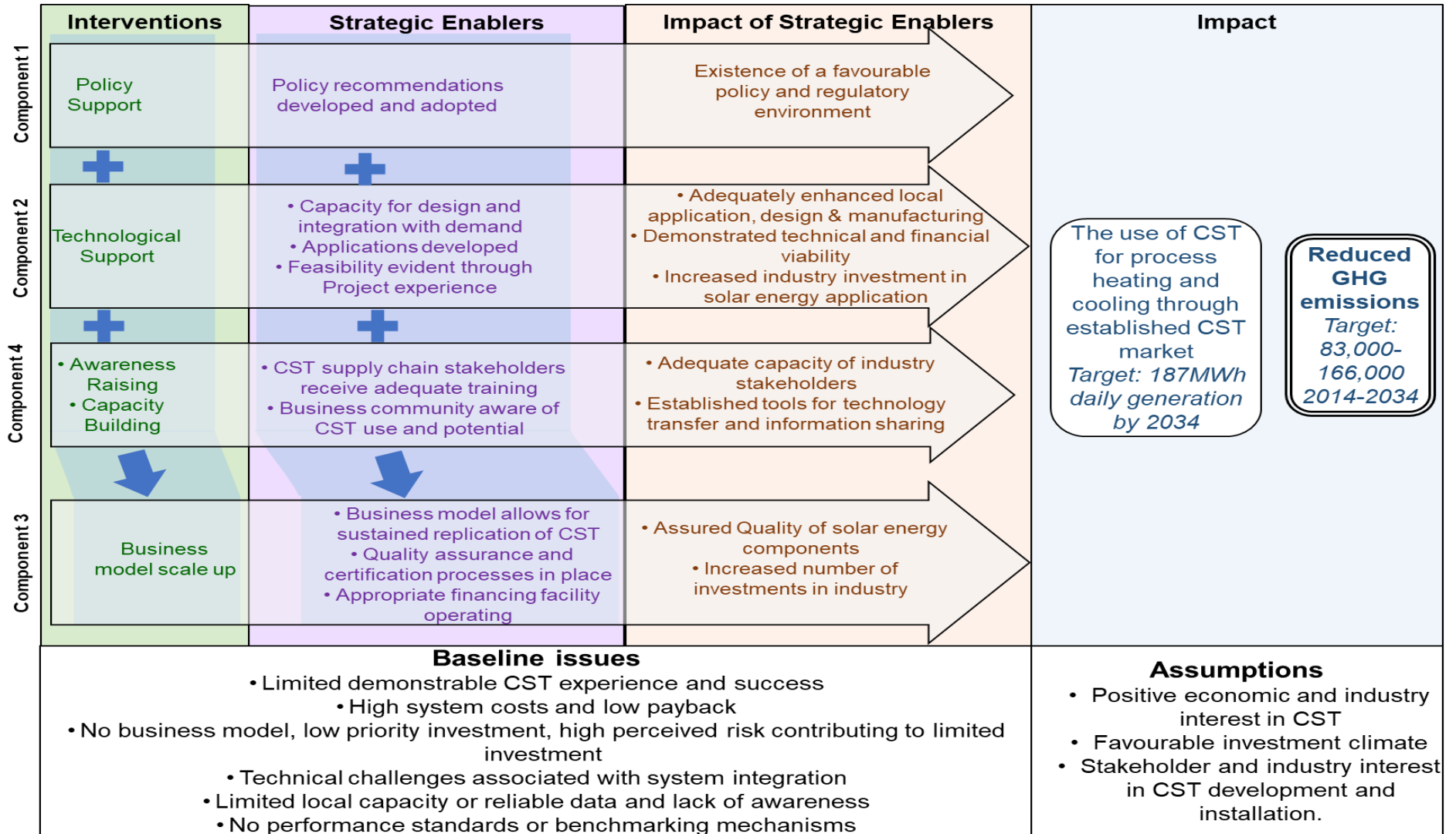
The ITE adopted a ToC approach and used a mixed methods approach to data collection. This approach allowed for the collection of data and information from a range of sources and informant that was then triangulated to ensure the robustness and validity of a credible assessment. Firstly, data was collected from a document review of all relevant project documents (see list in Annex 3). The findings from this review were then triangulated, contextualised and deepened with a series of interviews with key stakeholders (Annex 4).

These criteria have been assessed and rated according to UNIDO's six-point scale with the exception of the likelihood of sustainability which is rated on a four-point scale (Annex 5) in alignment with GEF requirements. In addition to providing ratings for these key criteria, the ITE also assesses but does not provide a rating for the need for follow-

up, materialisation of co-financing and environmental and social safeguards as is a requirement for GEF funded projects.

Data analysis, development of emerging findings, UNIDO and GEF criteria rating and evaluation report preparation was undertaken collectively by the evaluation team with the initial report drafting led by the evaluation team leader. The draft report was submitted to UNIDO's IED and the Project manager, who circulated to key stakeholders with the commenting process managed by IED. The evaluation team considered stakeholder comments, adjusted the draft report where appropriate and then submitted a final version to IED that was then quality assured and a UNIDO management response will be solicited for inclusion in the final product.

Figure 1. Reconstructed Project Theory of Change



1.6. Limitations of the Evaluation

Challenge/Limitation	Mitigation plans
Variation of approaches across the project area may not be adequately represented.	Contacted key sites that were recorded as supported by the project through project documents or referred to by key informants. Phone/videoconference contact was made where physical field visits were not possible.
Limited scope of the evaluation could result in difficulties in attribution to project activities	Engaged all stakeholder groups where possible in the evaluation process to assist with triangulation and verification of findings.
Consider how individual perceptions and opinions may result in bias in the analysis of quantitative and qualitative data.	Triangulation of information, using more than one data source to verify and validate data.
COVID-19 travel restrictions meant that the team leader will remotely attend in country consultation and no field trips of national consultant can be undertaken.	As field visits are not possible video/phone meetings were held to capture in-depth qualitative information.

2. Project's contribution to Development Results - Effectiveness and Impact

2.1. Project's achieved results and overall effectiveness

Effectiveness rating: Moderately unsatisfactory

The Project achievements heading in a positive direction but achievements to date are lower than targeted. The main objective for the project was to reduce greenhouse gas (GHG) emissions through the use of CST for process heating and cooling by about 83,000 -166,000 t_{CO2-eq} over the period 2014-2034, with 187 MWh daily energy generated from CST through projects installed over the period 2014-2034. In order to achieve this result, the project effectiveness is assessed by the level of progress for each of the four expected outcomes. A detailed results framework for all indicators is available in Annex 6 and a summary is provided at the beginning of the below sections. The following paragraphs explain the results per component towards achieving each outcome. Based on the lower-than-expected results across each outcome, the effectiveness is assessed as moderately unsatisfactory.

Outcome 1: Favourable policy and regulatory environment

Policy support activities were expected to be conducted to overcome policy and regulation barriers for the creation of a favourable environment for solar thermal energy applications in industry. In order to achieve this outcome, the Project design identified key outputs as a set of recommendations and guidelines for policy makers. The specific outputs are identified in Table 3. These outputs were identified at design to overcome a lack of incentives based on CST performance, lack of alignment of incentives

at local, regional and national levels, and a lack of a specific policy for CST (Annex 1). The stated outcome for this component highlights all solar applications whereas the intended focus of the Project was for CST technologies specifically. The indicators to develop a Policy for heating and cooling and the Solar Energy Quality and Infrastructure (SEQI) Report do not specify that these outputs should exclusively include CST. As a result, the outputs did not provide sufficient direction to enable the policy environment specifically for CST technologies.

Table 2. Performance towards Outcome 1

Project strategy	Indicator	Achievement		
Outcome 1 Favourable policy and regulatory environment created for solar energy applications in industry				
Output Set of recommendations and guidelines for policy makers developed	Solar heating and cooling policy and roadmap	Roadmap released in August 2019 but no solar heating and cooling policy developed		
	State specific policy to incentivize CST manufacturing	Review conducted that includes policy recommendations but no specific policy generated		
	Due diligence guidelines for project approval	Due diligence guidelines available		
	Proposal to modify boiler regulations and acts	Review of regulations conducted		
	Proposal to modify building regulations to consider the use of CST	Review of regulations conducted and recommendations made		
	Solar Energy Quality Infrastructure	Solar Energy Quality Infrastructure Report prepared and available		
Data unavailable	Not achieved	1-50% achieved	50-99% achieved	Fully achieved

The roadmap developed under this component is a flagship publication that is appreciated and has increased the profile of the Project and of CST technologies, but few related outputs have been delivered. The outputs that have been delivered under component 1 are the national CST roadmap, due diligence guidelines and the Solar Energy Quality Infrastructure (SEQI) report. This represents less than half of the seven specified outputs under the component. Other outputs have been generated but as yet are not widely available. Of the outputs generated, the roadmap has generated significant interest and has been picked up by other stakeholders in the CST sector. The information in the roadmap has been used in a publication of the German Solar Association in relation to the Solar Payback Project operating in South Africa, India, Mexico and Brazil. In particular, the information regarding demand and feasibility generated as part of the roadmap are referenced heavily.⁹ While the roadmap was developed and is of good

⁹ BSW - Bundesverband Solarwirtschaft e.V. – German Solar Association, 2020, *Solar Heat for Industry India*, <https://www.solar-payback.com/wp-content/uploads/2020/06/SHIP-india-26-06-20.pdf>

quality, there is limited national ownership of the final product and its broader effectiveness in terms of enabling environment has so far remained limited by this.

Delays with national level procurement processes and quality issues have limited the progress of component one. Delays in the approval of the road map by national partners delayed the overall release of the final product by approximately 2 years and required adjustments to be made to a final draft. The draft roadmap was finalised in 2016 and outlined a pathway to 2020.¹⁰ However, the final product generated by the Project was not released until August 2019 and the timeframe was extended to 2022. Similar delays were experienced with the manufacturing policy and modifications to boiler and building regulations. The initial contract to deliver these outputs was retracted and reissued following poor deliverables.

Few changes in the policy and regulatory environment have been achieved which has hindered progress on other project components. Building national interest and demand in both industry and government was an important part of the project approach. Despite the road map and awareness-raising material under this component, there are as yet, few demonstrated shifts in the enabling environment to facilitate a growth in the CST industry to the level expected at design. Generating government interest could have facilitated that effectiveness of the financing mechanism (including subsidy considerations) to be developed under component 2 and encourage broader uptake. However, without sufficient government interest, CST technology was not prominently featured in the policy work such that the level of engagement with CST technology incentives at national level did not materialize.

A change in national government staffing during project implementation has resulted in a loss of technical CST knowledge and expertise. At design there was an internal team that was knowledgeable about CST technology and its benefits. With staff turn-over, the Project faced difficulties in re-orienting new staff and building understanding of the value of investing in CST technologies within the executing government agency. This created challenges for the project team in attempting to elevate the case for policy changes and subsidies for CST technologies. This was also reflective of changes in the national attention on PV technologies that translated into the creation of number of support systems in place for PV technology specifically. The Project provided a mechanism to support CSTs but with staff changes, less attention was given to supporting the project than envisaged at design.

Outcome 2: Technology Installation and Viability Demonstration

Technological support was successfully delivered. The technology support that was expected to overcome technical, financial and demonstration barriers for improved outcomes relating to technological capabilities, viability demonstration and CST investment proceeded well but experienced issues in implementation. The barriers identified included integration challenges, a lack of package applications and testing

¹⁰ MNRE, 2016, *Minutes of the 2nd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO project held at MNRE on 14 December 2016*

facilities, high system costs, perceived financial risk and few examples of domestic CST installations. The project primarily focussed on MSMEs where viability and technical capacity was less certain. It also supported three large scale CST projects (at NISE, ONGC and GNFL). Both ONGC and GNFL took UNIDO's support for moving from conventional energy to CST technologies, on a pilot basis, at selected sites. The Project supported the development of feasibility studies for both of their planned projects, which if successfully implemented would be upscaled respectively. UNIDO's support to NISE was to support a technical review of activities for refurbishing of a defuncted CST system they had installed at IIT Bombay, to make it operational. This review was completed but at the time of the evaluation, implementation works had not proceeded.

Overcoming these barriers for confirmation of technical and financial viability, enhanced local manufacturing capability and increased investment in solar energy applications was the outcome of project component 2. Specific activities identified to contribute to these positive outcomes are listed in Table 3. These include the development of knowledge products such as case studies for demonstration purposes, targets for the installation of new systems and developing a financial model among other outputs.

Table 3. Performance towards Outcome 2

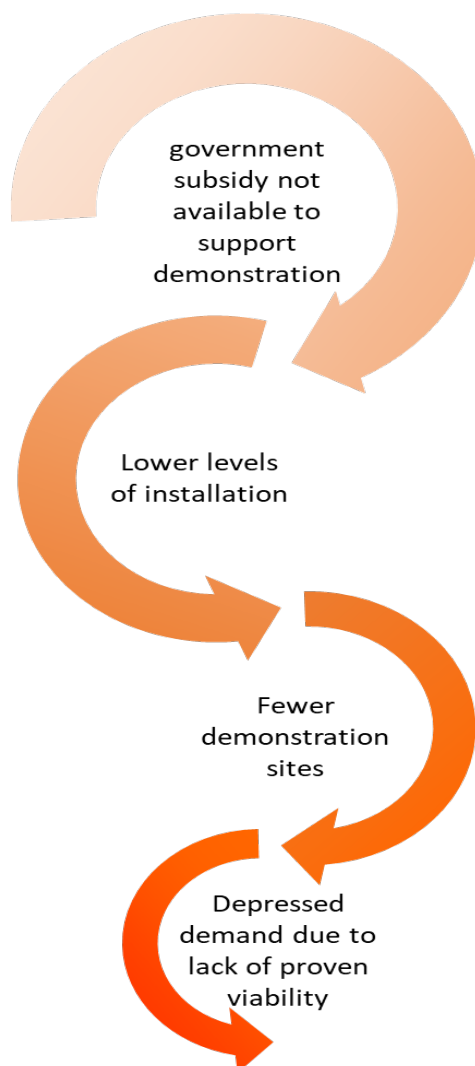
Project strategy	Indicator	Achievement
Outcome 2		
<ul style="list-style-type: none"> • Technical and financial viability of projects confirmed • Local manufacturing capability for solar energy systems in industrial applications enhanced • Investment in solar energy applications in industry increased 		
Output 2.1 Detailed technology application tools developed: integrated CST with storage; detailed project reports (DPR); CST demonstration project selected; qualified consultants selected; 25 demonstration projects installed; performance	# industry specific reporting parameters for CST systems	Not achieved
	# performance benchmarks	A comparison of technologies in five different locations have been conducted which could inform the development of benchmarks but not yet achieved.
	# standardised financial models for CST	A report recommending a restructure of the subsidy scheme was developed but no follow-up action occurred to date
	# CST packages developed	Information packages developed for seven technologies (70% achieved)
	# process information booklets	Process mapping was undertaken for 12 sectors to inform the development of the roadmap. Report is available.

Project strategy	Indicator	Achievement		
monitoring and analysis of projects; and case studies prepared	# CST projects implemented with support from GEF	2 projects implemented with Project support ¹¹ (1 additional project entered the pipeline but was implemented without support) (8%)		
	Installed capacity of new CST projects (MW and area)	0.58 MW (4.4%) and 871m ² (4.6%) installed with Project support (additional 1,590m ² and 1.06 MW without support)		
	Performance monitoring, evaluation reports and case studies on each GEF supported project	2 case studies published (8%)		
2.2 Investment in solar energy applications in industry increases	# pilot systems of solar technologies installed Investment mobilized (USD)	3 systems installed (2 with project support) (12%)		
Data unavailable	Not achieved	1-50% achieved	50-99% achieved	Fully achieved

The technology was not installed at the scale intended due to several factors which hindered opportunities for demonstration and further depressed demand based on a lack of proven viability. The Project approach relied on the installation of technology in order to demonstrate effectiveness and viability to encourage broader uptake. However, given that only two of the 25 intended sites were established with Project support, opportunities for demonstration were limited (Figure 2). This was exacerbated by delays in installation whereby the first site was only completed in 2017, three years into the Project. The two sites established with project financial support represent less than 10% of the target area or capacity expected. A further CST demonstration occurred through the Amul Dairy in Gandhinagar (supported under parallel GEF 4 energy efficiency and renewable energy efficiency project of UNIDO) which contributed to the activities of the Dairy Development Board in CST promotion that has resulted in replication of CST at 13 dairies around the country with total collector area of 7,809 m². The Project used external sites for field visits included in workshop and awareness raising activities. UNIDO also supported the NDDDB with technical reviews of their DPRs that helped reduce the cost of planned systems and develop systems that were better tailored for their requirements. With fewer than expected sites for demonstration to generate additional interest in the project, component 3: scale-up has been constrained.

¹¹ UNIDO, 2020, *CST Project Pipeline under GEF UNIDO MNRE project on promoting business models for uptake and scaling up of solar energy in India*

Figure 2. Contributing factors to low performance of component 2



The level of interest generated by the project was not sufficient to leverage the investment nor effort required for successful completion of applications for project support. The broad scale approach of the project which resulted in less intense engagement with a larger number of sectors was not sufficient to generate the required level of interest and demand. This gap was further compounded by the lengthy and overly bureaucratic nature of the application process for the project’s financial support (that tied the release of the project’s financial contribution to obtaining approval of government’s financial support). One stakeholder noted that the process from project concept to receipt of first loan payment could take up to 18 months. This acted as a disincentive for installation and applying for support especially in MSMEs with limited available time to devote to such processes. These delays were further exacerbated by the expectation that the CST technology would transfer smoothly between sectors and would not require additional expertise or effort to contextualise and integrate with existing systems.

As a part of the demonstration aspect of this component the Project did generate some useful knowledge products but these were not sufficient to build the required technical knowledge. At design, a project assumption was that sufficient technical capacity for design and application would be built under this component. However, the available capacity in the areas supported by the Project was lower than expected. This required the project technical support to operate at a more basic level of operation to assist in development, rather than review of proposals. Furthermore, the documentation burden for applications for Project support was high and required high level technical understanding to complete. As a result, the technical organisation engaged to review applications provided a large amount of technical assistance and coaching to support the development of application that were of quality. The process mapping, geographical comparison and operating standards which were produced by the Project were useful and appreciated but not adequate to build the required capacity. The use of these products was also limited given the small-scale installation recorded.

The priority sectors identified through project documentation were not the same that were identified at design. At design the project noted that “the industries showing good potential for implementation of solar concentrators are food processing, paper and pulp, fertilizer, breweries, electroplating, pharmaceutical, textiles, refineries, rubber, desalination and tobacco sectors.” Yet, the roadmap produced by the project in 2020 indicates that these sectors are not the most financially viable applications of CST. For example, in the roadmap pharmaceuticals receives a financial viability score of 11, food processing, breweries and rubber are scored 14, tobacco 15, and textiles 16. The sector identified at design which was still found to be viable was pulp and paper with a financial viability score of 32. However, cement and other sectors were still noted to be more financially viable. This reflects a departure from design expectations and suggests that further research could have provided more robust assessments of viability. Nonetheless, the subprojects that the Project has supported have been in the sectors identified at design demonstrating the potential for successful CST installation.

Outcome 3: Scale Up in investment and assurance of quality

Business model scale up activities to be delivered as part of outcome three were designed to capitalize on the progress of other project components for the multiplication of investment in solar thermal energy applications and the quality assurance of components. The specific outputs envisioned at design to achieve these outcomes are listed in Table 4. These outputs focus on financial mechanisms for investment but also include the development of standards and certification schemes for quality assurance. There was sound technical work carried out through the project to generate a potential certification scheme, through the preparation of a Solar Energy Quality Infrastructure Report generated as part of Output 3.1. Similarly, a financing mechanism was established with IREDA but uptake of the financing opportunities has been low due to the challenges with preparing acceptable proposals, with required credit guarantees.

Table 4. Performance towards Outcome 3

Project strategy	Indicator	Achievement		
Outcome 3				
<ul style="list-style-type: none"> Investment in solar energy applications in industry multiplied Quality of solar energy components assured 				
Output 3.1 Business models for CST leading to sustained replication of solar thermal applications in industry Quality assurance and certification framework in place	Business models in place	A soft-loan mechanism was established but was not highly effective and is unlikely to be maintained		
	# MNRE standards developed	Not achieved		
	# recommended certification schemes	Certification scheme recommended in Solar Energy Quality Infrastructure Report.		
3.2 Financing facility for scale up established	Financing facility established	3 projects (6%) with 0.77 MW _{th} (3%) and 1,153m ² (2.9%) installed with Project support		
Data unavailable	Not achieved	1-50% achieved	50-99% achieved	Fully achieved

Without the intended results under components one and two, component three activities could not be undertaken as planned and results were severely hampered.

The risks of non-achievement were greatest for this component given that the project logic identified the reliance on other results. The Project made some progress on indicators not explicitly related to scale up with the recommendation of a certification scheme successfully developed in the SEQI report. However, the outcomes of this component were to multiply investment in CST and assure the quality of solar energy. These outcomes have not been met. There is limited evidence that the Project contributed to an increase in investment in solar but there is evidence that there is a greater likelihood of uptake where there are other positive external influencing factors such as enabling state level legislations and industry support. For example, the 2015 Solar Policy in Andhra Pradesh State provided incentives over a ten-year period for the installation of solar power projects, not specifically linked to PV or solar thermal. Similarly, the support of the NDDB resulted in the extension of support for 13 dairy sector CST installations. This demonstrates that where there is both financial and policy/strategic support, scale-up can occur.

Outcome 4: Increased Awareness and Capacity

Activities designed to achieve outcome four included workshops and other awareness raising activities, the development of knowledge products, and training activities. The specific outputs are listed in Table 5. These outputs were intended to help overcome awareness and capacity barriers such as gaps in CST knowledge amongst sector specific technical consultants, a lack of qualified researchers and staff, limited interface between industry and academic institutions among other identified at design (see Annex 1).

Table 5. Performance towards Outcome 4

Project strategy	Indicator	Achievement
Outcome 4 <ul style="list-style-type: none"> • Capacity of key players in target industries enhanced • Technology transfer and information sharing tools established 		
Output 4.1 Trained manufacturers, suppliers and installers	# installation, operation, maintenance and trouble-shooting manuals for CST	Manuals included in the technology information packages for six CST technologies.
	# training sessions targeted at manufacturers, suppliers, installers and academics	Delays in establishing partnership mechanisms meant no training activities were undertaken.
	# trained manufacturers, suppliers and installers	Delays in establishing partnership mechanisms meant no training activities were undertaken.
	# training sessions for it is and maintenance staff	Delays in establishing partnership mechanisms meant no training activities were undertaken.
	# trained ITI students and maintenance staff	Delays in establishing partnership mechanisms meant no training activities were undertaken.
4.2 Awareness raised among the business community	# workshops and field visits targeted at industry	21 workshops or business meets targeting industry stakeholders conducted ¹² 22 field visits conducted, unclear how many targeted industry
	# organisations attending awareness raising sessions	More than 1,700 individual participants but number of organisations not recorded
4.3 Technical capacity built through promotion of industry-academic partnerships	# field visits for academics	22 field visits conducted, unclear how many targeted industry
	# academic institutions attending field visits	Field visits were conducted but participant data was not sufficiently detailed
	# guest lectures given on CST	24 guest lectures ¹³
	Knowledge platform establishment	Knowledge products developed available on UNIDO project website: https://open.unido.org/projects/IN/projects/130149

¹² 11 state level workshops conducted between January and July 2016, Business Meet on CST in Pondicherry in February 2018, Workshop on potential for CST in India in September 2017, National Workshop for application/integration of CST technologies to save cost and promote renewable energy in dairy sector in India in October 2015, Workshop on Applications of Solar Thermal Technologies in the Industrial Sector in February 2016, National Workshop in August 2019, Four business meets in June 2018.

¹³ PIR 2018-2019 and 2019-2020

Project strategy	Indicator	Achievement		
	# knowledge platform users	Data not available		
	# industry-academic applied research projects initiated	Not commenced due to contractual delays.		
4.4 CST and project information shared	CST webportal established			
	# users of website per year	Data not available		
4.5 Documented project outputs, case studies, best practices and lessons learned	# newsletters produced	3 issues of CST times published ¹⁴		
	# recipients of newsletters	Data unavailable		
	# brochures developed	3 issues of Sun Focus Magazine ¹⁵ and one technology information package published. (15%)		
	# industrial clusters advertising CST	Information about Project available on the websites of: Council of Leather Exporters and India Filings and has been covered by Indian industrial Association ¹⁶ (20%)		
	# adverts in national press	47 responses from advertisements placed ¹⁷		
	National workshop	National workshop in 2019		
Data unavailable	Not achieved	1-50% achieved	50-99% achieved	Fully achieved

The workshops and field visits conducted under this component were satisfactory and appreciated but there were many targets that were not met in relation to promotion and building capacity. The three major aspects of this component relate to awareness raising, capacity building and promotion. The Project conducted the expected number of workshops and field visits to raise awareness. Stakeholder feedback suggests that these were of a good quality and appreciated but there was limited direct follow-up from the Project. Similarly, the manuals produced as a form of capacity building were relevant and helpful but there were some key gaps with an emphasis on installation and operation of systems without adequate focus on maintenance and troubleshooting. The training activities intended to build technical capacity were not undertaken due to contractual delays between partners. In addition, the promotion activities intended to generate additional interest in the Project were only partially completed with three of the intended 20 newsletters or brochures being developed.

There is demonstrated increased industry awareness and demand in CST technologies compared with the beginning of the project but the extent that this increase is attributable to the Project is not clear. Stakeholders indicated an increased

¹⁴ July-August 2019, September-October and November-December 2019, and January to June 2020

¹⁵ July-September 2019, November-December 2019, and December 2020.

¹⁶ IndiaFilings is India's largest cloud-based business services platform.

¹⁷ PIR 2017-2018,2018-2019,2019-2020

awareness and willingness to invest in CST technology compared with the limited industry demand identified at design. Stakeholders noted that the workshops and events conducted by UNIDO were engaging and appreciated but that there was limited follow-up after events. Participants were therefore less likely to pursue CST and this represents a missed opportunity for the Project.

Project Management

The Project Executive Committee (PEC) and Project Steering Advisory Committee (PSAC) met less regularly than anticipated at design. Table 6 lists the meetings of the PEC and PSAC held over the Project duration. These meetings were held less frequently than articulated at design with PSAC meetings expected to be held annually and PEC expected to meet every six months.¹⁸ The PEC in particular was not held as expected with 2016 being the only year to have the expected number of meetings. Feedback from MNRE as part of this evaluation stated that project reviews were held weekly and that requests to the PMU for remedial action and more regular updates were not adequately actioned. There is no project documentation available to confirm the meetings or regular correspondence to trace the actions conducted or the findings of such internal review meetings. Nonetheless, it is clear that communication between the PMU and MNRE was not active or well documented and as such was an impediment to project progress.

While the COVID-19 pandemic hindered opportunities for face-to-face meetings in 2020 and 2021, the limited frequency of meetings prior to this point represents decreased opportunities for problem solving, progress sharing and adaptive management as required. In addition, despite the lower-than-expected frequency of meetings, limited follow-up from members of the PEC or PSAC and the focus on PV technologies for Ministry support suggested a low level of interest from key stakeholders.

Table 6. Frequency of Project Management Meetings

Conducted scheduled meetings												Scheduled meetings not conducted									
	2015			2016			2017			2018			2019			2020			2021		
PSAC	11-Apr			3-May			13-Jul					6-Nov									
PEC				13-May	14-Dec					12-May, 14-Jun				20-Sep							

Reduced meeting frequency undermined coherence with other initiatives. In particular the delays in holding PEC meetings at the beginning of the Project undermined opportunities for knowledge sharing and gaining contextualised understanding from the pre-existing United Nations Development Programme (UNDP) CST project (see section 3.3 Coherence for more details regarding the UNDP project). The minutes from the first PEC meeting in 2016 indicated a joint meeting between the UNIDO and UNDP Project's PECs which allowed for discussion relating to the added benefit of the UNIDO project and

¹⁸ GEF, 2013, *Request for CEO Endorsement: promoting business models for increasing penetration and scaling up of solar technology*

distinction between the two Projects. Holding these discussions at an earlier point in the Project may have assisted in demonstrating the value of the UNIDO project for increased engagement and understanding of national stakeholders.

2.2. Progress towards impact

Impact rating: Moderately Unsatisfactory

2.2.1. Behavioural change

Economically competitive - Advancing economic competitiveness.

The Project has demonstrated the viability of CST to a portion of the business community but further and more targeted demonstration activities and follow-up of those undertaken could have maximised progress towards impact. The potential for progress to impact of the Project was somewhat undermined by the scattergun approach adopted. This limited opportunities for clear and undeniable demonstration of the benefits of CST and presentation of the comparative advantages of CST complementary to other renewable options. Furthermore, without adequate follow up of workshops, business meets and other awareness raising activities the potential for deeper engagement and sale of CST technology viability was lost.

Environmentally sound – Safeguarding environment.

The Project has contributed to increased awareness of CST technologies as an alternative to more polluting heat sources. Feedback from stakeholders indicated that workshops and networking events organised by the Project, as well as publications such as the SunFocus magazine increased awareness of CST technologies and encouraged businesses to consider installation. This represents progress towards impact along the causal chain of component 4 of the Project identified in Figure 1. Reconstructed Project Theory of Change. However, the number of participants in Project workshops who were interested in installing CST or who did install the technology was not tracked. Only two sub-projects have been reported as being installed with financial assistance from the Project. The scope of environmental impact is therefore limited. As such, the amount of CO_{2eq} emissions avoided by the Project is substantially below targets. The Project Tracking Tool developed at design includes a target of 249,000 tonnes of CO_{2eq} avoided over the lifetime of the Project. The two project supported installations have resulted in 766.25 tonnes of avoided CO_{2eq} emissions.

Socially inclusive – Creating shared prosperity.

The Project did not include any specific outcomes or impacts related to social inclusivity. There are, however, examples of positive social impacts such as in the Project supported installation sub-project at the Uttarakhand Cooperative Resham Federation (UCRF). This installation has demonstrated positive results through increased profits and employment, especially of women. As such, there is isolated evidence to suggest that there may have been potential for broader social impact but that the limited achievement of the project hindered mainstreaming efforts. A case study related to UCRF is available in Annex 7.

2.2.2. Broader adoption

Mainstreaming

There appears to have been an increase in interest of industrial stakeholders but the extent to which this has translated to increased use of the technology is not evident. Project activities conducted under component four were described as useful and interesting by participants. However, there has been limited follow up and so the extent to which these activities contributed to decisions to install CST is not clear. There has however, been an increase in industry interest generally but the extent to which this is attributable to the Project compared with external factors is uncertain. Stakeholders feel that barriers to installation remain as CST continues to be less well known in comparison to solar PV technologies.

There has been less of a shift in the interest of government stakeholders with a demonstrated preference of solar PV evident. There is a concerted national emphasis on solar energy power generation in general. However, the profile of CST within the government remains low compared with PV alternatives. For example, the voluntary national review (VNR) submitted by the Government of India (GoI) to track progress against the Sustainable Development Goals (SDGs) in 2020 discusses solar energy and the progress India has made but almost exclusively discusses solar PV technology with no mention of CST.¹⁹ Similarly, the Indian Nationally Determined Contributions (NDCs) highlights the role of solar in India's contribution to achievement of the Paris Agreement but with reference almost exclusively to solar PV technologies and not CST.

Replication

Less than expected demonstrability, in part due to the absence of a standard financial model, exacerbated pre-existing challenges for replication associated with the nature of CST installations. The replication potential for CST technologies is difficult even with a sufficient enabling environment given the requirement for tailoring of solutions to context and the integration with the heat utilizing process systems that is required. In addition to these pre-existing challenges, the project was unable to develop and demonstrate a financing process that was easily replicable. There was potential for the Project to address these challenges by developing models targeting specific sectors that would more easily translate to similar contexts. This approach was successful for replication of CST to 13 dairy units, but this was not given sufficient attention to progress outcomes towards impact. As a result, there was limited demonstrability of the viability of CST in different contexts to encourage replicability. Replication could have been facilitated by developing sector-specific packages that were tailored, had been trialled with means of replication built in and could demonstrate effectiveness and viability.

Scaling-up

Despite attempts at design, project experience has shown that the potential for truly scalable CST technologies is limited given the need to tailor systems to context. The project attempted to develop a blueprint that could develop technologies and financial models that could be applied across several industrial sectors. However,

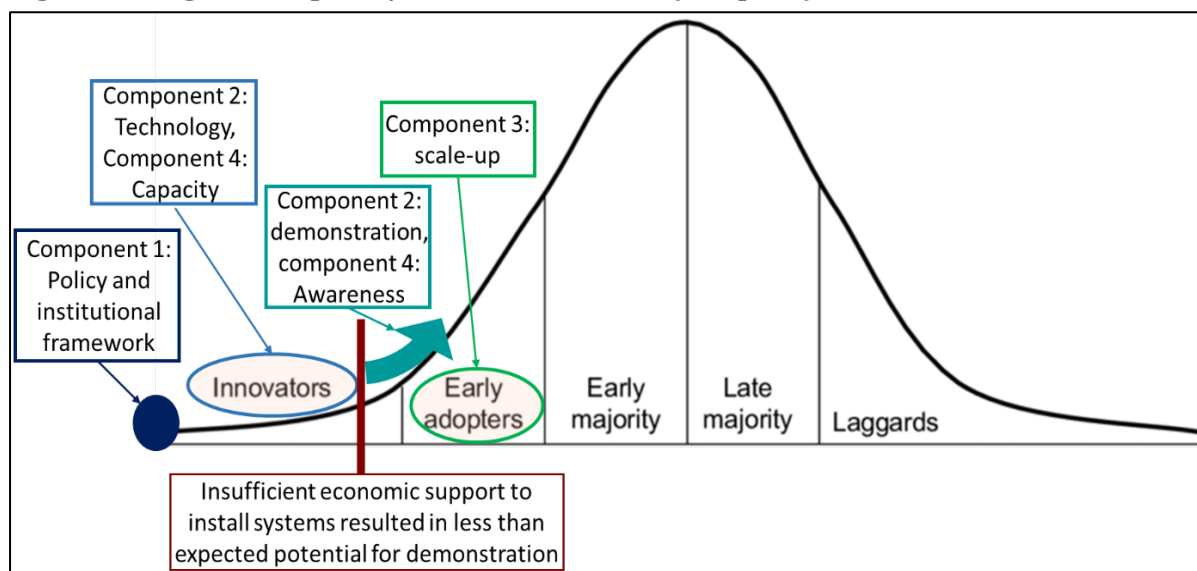
¹⁹ Government of India, 2020, *India VNR Decade of Action Taking SDGs from Global to Local*, https://sustainabledevelopment.un.org/content/documents/26279VNR_2020_India_Report.pdf

technical experts have suggested that this is not possible and that the amount of adjustment to a system for each new sectoral context is akin to developing a new system. The effects of this learned experience are that the potential for economies of scale and the relevance of particular systems to new sectors is inhibited and there is a need to build technical capacity within relevant institutions to facilitate customization of CST application to the user's specific heat demands. The installations that have occurred have been niche and as a result of targeted and prolonged activities by the Project. There has not been evidence of larger-scale uptake.

Furthermore, scaling up requires presenting viable models that encourage investment. Component 3 of the project was designed to support scaling up, using lessons learned through the demonstration installations established through the other component activities. This was a valid approach and was expected to provide a fertile opportunity for the project to learn the models of operation that are viable and scalable. This opportunity still remains and offers a potential for capitalizing on the investments made in the project.

The inefficiency and uncertainty associated with the loan interest subsidy scheme also inhibited potential for scale up. Figure 3 illustrates the usual pathway for new technologies from introduction to adoption (the Rogers innovation curve). The Project effectively identified the initial barriers to adoption as low visibility and a less than conducive policy environment. The design appropriately relied on the indicative success of CST applications and on the funding scheme that was planned as an investment facilitation. In line with the innovation process, the technology was adopted by some early innovators. However, the loss of the policy subsidy created a barrier to scale-up.

Figure 3. Rogers Adoption/Innovation Curve (Adapted)



Source: Adapted from: Hovav, Anat & Page, David & Schuff, David. (2003). *Global Diffusion of the Internet V-The Changing Dynamic of the Internet: Early and Late Adopters of the IPv6 Standard. Communications of the AIS. 15. 10.17705/1CAIS.01514.*(diagram initially adapted from Rogers, 1995)

The beneficiaries of the project so far have largely been individuals with pre-existing solar knowledge and a willingness to take business risks with CST. Furthermore, the added uncertainty of the loan scheme that was known to be difficult to access increased the risk associated with installation of a new technology. While the loans were

unavailable some stakeholders delayed decisions to install and opted to wait for the assistance to become available again. In the late stages of the project, the COVID-19 pandemic also slowed interest in investment due to economic contraction. These delays combined with the time taken to tailor systems to the specific context contributed to less than expected availability of systems for demonstration.

3. Project's quality and performance

3.1. Design

Overall Design rating: Moderately Satisfactory
Logframe rating: Moderately Satisfactory

3.1.1. Overall design quality.

Project design adequately incorporated the identified sequence of achievements required for attainment of outcomes. The project logic flow included at design (Annex 1) effectively identified the requirement for policy, technology installation, demonstration, awareness raising and capacity building activities prior to any scale-up attempts. The design simultaneously realised the potential for these activities to contribute to a strengthened Indian CST market and the overall project impact of reduced GHG emissions. The limited effectiveness of components 1 and 2 in particular accordingly hindered project progress in relation to scale up.

Project design effectively identified barriers to a CST market and broad activities to address these but lacked the required specificity. The review of the Project Identification Form (PIF) by the Scientific and Technical Advisory Panel (STAP) indicated that the Project concept was appropriate and confirmed the presence of the identified development challenges.²⁰ The project document (ProDoc) effectively identified the rationale for engagement and the potential impacts of this technology as well as broad alignment with relevant government legislations and the national push on solar. However, the ProDoc did not discuss the intricacies of the national demand specifically for solar thermal or adequately sell the benefits of CST to generate sufficient interest. Other areas that lack adequate explanation include the specific business models to be explored despite comments from the STAP review noting the lack of clarity.²¹ The inclusion of “possible options” in the ProDoc “including ESCOs and leasing options” still lacks specificity in response to the STAP comments and does not provide adequate detail to guide implementation.²²

Relevance was affected by the broad scope of the project approach. Since CST technology is largely limited to areas where there is sufficient direct sunlight available, while awareness creation workshops throughout India and working across various

²⁰ UNEP Scientific and Technical Advisory Panel, 2012, *STAP Scientific and Technical Screening of the Project Identification Form (PIF)*.

²¹ UNEP Scientific and Technical Advisory Panel, 2012, *STAP Scientific and Technical Screening of the Project Identification Form (PIF)*.

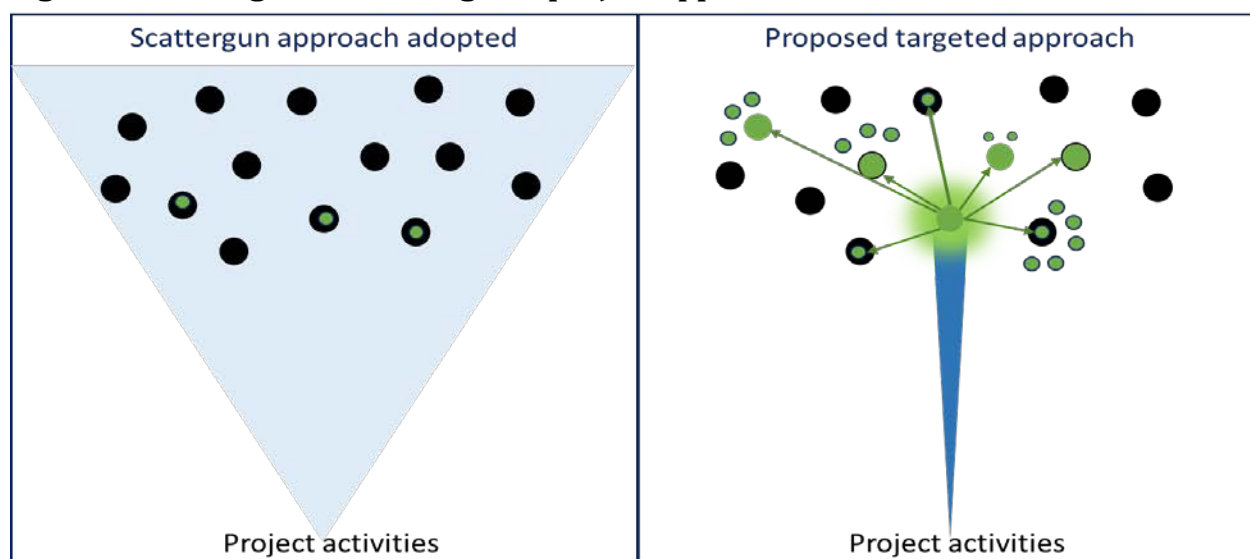
²² GEF, *Request for CEO Endorsement (ProDoc)*

sectors and industries may have had value, as this is a relatively unknown technology, limiting activities and efforts to a fewer geographical areas and industries may have created greater success and could have provided more targeted support.

During project preparation, the STAP identified a need to prioritise and specifically target activities to increase effectiveness, but the design did not adequately address this feedback. The STAP review noted that it was not clear if the target for the Project was on large industries or small and medium enterprises (SMEs) noting that the required activities and the barriers facing these industries varied greatly. The ProDoc indicates that the focus of the Project is on micro-, small and medium-sized enterprises (MSMEs) in the response to STAP comments but does not clearly integrate this focus into the remainder of design considerations nor consider the variations that exist within a category as large as MSMEs. The focus on MSMEs was not fully consistent with the expectation that industry would have the capacity to invest in CST. A more productive approach may have been to target larger industries with internal expertise and financial resources to prepare for and manage CST installation. A similarly broad scope was adopted in terms of geographical targeting. The national focus of the Project aimed at broadly increasing use of CST technology. This broad scope did not reflect the differing levels of efficiency of CST technology based on geographic location and the availability of sunshine.

Similarly, there was little evidence of sectoral focus based on specific criteria such as feasibility or potential for positive impacts to prioritise project activities. The PIF included consideration of activities in 16 sectors. This was noted by the STAP to be too broad and a need for prioritisation based on specific criteria was identified. The ProDoc maintained a scope of 14 sectors which undermined a generally effective approach based on demonstration of feasibility and viability. This was exacerbated given the identified need during implementation for technological solutions that are custom-engineered to specific application needs. Demonstrating the success and viability of CST technologies very clearly in one sector through focused and deeper engagement would have encouraged further uptake through effective demonstration as illustrated in Figure 4. The potential of such an approach was demonstrated through the dairy sector expansion from the initial technical support and with on-going encouragement through the NDDDB. Such an approach could also have helped to develop a blueprint for a stepwise approach to custom-engineer technology and develop suitable business models. However, the number of sectors was not significantly reduced in response to the STAP comments resulting in a scope that was too broad and that diluted action to result in isolated uptake of technology.

Figure 4. Scattergun versus targeted project approach



Source: Evaluation team 2021

3.1.2. Logframe.

The Logframe includes some indicators with quantitative targets but also nebulous and overlapping indicators. Component four in particular and component two to some extent contain quantifiable indicators. These indicators facilitate tracking of project progress for ease of reporting. However, more detailed indicators in some cases would have helped to guide project activities. For example, the target for the indicator “number of installation, operation, maintenance and troubleshooting manuals for CST” is simply 11 without providing an expected breakdown of the manuals developed under each topic. Feedback from participants indicates that while manuals regarding operation are available further material to guide installation, maintenance and troubleshooting would improve overall performance. Similarly, under component four, the indicator target “knowledge platform established” provides little detail regarding what type of platform, who the platform should be targeting nor how many users can be expected. A further example is the indicator, “certification scheme recommended” as evidence of the output, “quality assurance and certification framework in place.” This indicator does not include reference to the adoption of the scheme nor who the recommendation should be addressed to.

The absence of baselines and targets and duplication of output level indicators at the outcome level results in vague statements that hinder efforts to attribute outcome or impact level results to Project interventions. A lack of specific targets for indicators at the outcome level makes assessment of progress to impact difficult and results in some gaps. Despite the quantitative nature indicators for outcome four, there are no quantitative targets against which to compare achievement. Furthermore, the stated outcomes for outcome two are: i) technical and financial viability of projects confirmed, ii) local manufacturing capability for solar energy systems in industrial applications enhanced, and iii) investment in solar energy applications in industry increased. However, the indicators are i) volume of investment mobilised and ii) tonnes of CO_{2eq} avoided. The indicator relating to emissions is not sufficiently linked with the stated outcomes. In addition, the baselines and targets do not reflect the indicators or the

outcomes in all instances. The output level indicators are related to industry standards and benchmarks, financial models, information packages, installed capacity and case studies. These indicators do not measure and promote viability, local manufacturing capacity nor actual investment is identified in the outcome statements. Without relevant and accurate indicators and targets, measurement of progress towards outcome two is difficult.

3.2. Relevance

Relevance rating: Satisfactory

The Project was designed at a relevant time for the national government and was appropriately aligned with national priorities. As part of the National Action Plan on Climate Change (NAPCC) launched in 2008, the GoI launched eight national missions, including the Jawaharlal Nehru National Solar Mission. This mission identified targets for installed capacity for solar generation of 20,000MW by 2022.²³ India and France jointly launched the International Solar Alliance (ISA) in 2015 to increase use of solar technology globally reflecting GoI's prioritisation of solar energy.²⁴ The GoI submitted its first NDC in response to the Paris Climate Agreement and the United Nations Framework Convention on Climate Change in 2016.²⁵ Stakeholder feedback suggests that this was under preparation before this date and that the Project was aligned with the increased emphasis on lowering GHG emissions that arose during this preparation process.

The project approach was relevant at design to address the identified development challenge of the low visibility of CST technologies. The low visibility of CST technologies, especially in comparison to solar PV technologies in the early years of the project is demonstrated by the list of mitigation technologies included in India's NDC. This list includes five solar PV technologies but does not mention solar CST.²⁶ The technical demonstration of the complementary advantages of CST to PV included in design was important for generating national interest and acceptance of the Project. Project design also effectively identified the need for demonstration of the technology as important for promoting viability and generating interest. This aspect of design is still relevant with stakeholder feedback suggesting that witnessing technological demonstration was an important factor in decisions to install CST technology.

The loan interest subsidy scheme was a relevant mechanism to generate interest at the beginning of the Project but the limited effectiveness and barriers to access that have arisen has decreased relevance. Stakeholders suggested an interest in

²³ Indian Power Sector .com, 2012, *Jawaharlal Nehru national Solar mission targets 20,000MW by 2022*, <http://indianpowersector.com/electricity-regulation/national-solar-mission/>

²⁴ Government of India, 2020, *India VNR Decade of Action Taking SDGs from Global to Local*, https://sustainabledevelopment.un.org/content/documents/26279VNR_2020_India_Report.pdf

²⁵ UNFCCC, *NDC Registry*, <https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=IND>

²⁶ Government of India, 2016, *India's Intended Nationally Determined Contribution*, <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf>

applying for the loans was an initial contributor to the decision to look more closely at CST technologies. Given the high initial investment outlay required for CST technologies, a mechanism such as the loan interest subvention scheme was required to offset some risk and make CST an attractive renewable option. The subvention scheme was designed to be complementary to the government's financial assistance package. However, (1) linking both schemes caused multiple delays due to consecutive approvals; and (2) the scheme was first interrupted and then from April 2020 terminated. This undermined the main trust of the loan interest subvention scheme. Yet, the overall Project concept to promote CST is still relevant with 20 EOIs and 70 additional queries being received following an advertising campaign in February 2020.²⁷ However, the delays experienced with approval of applications and disbursement of loans, combined with the need for high levels of technical expertise, has made the scheme less attractive and less relevant to profit-making entities.

The Project approach has been increasing in relevance with an increased focus on renewable energy enabled by state level legislations. One project participant noted that the state-level requirement for businesses to account for a certain amount of energy requirements with renewable energy sparked the interest to investigate potential energy sources. This enabling environment created in some states, including Haryana, Chattisgarh, and Uttar Pradesh provided the Project with an opportunity to identify areas most likely to invest in renewable energies and thus could have prioritised demonstration activities. However, the Project did not adequately respond to these areas of increased relevance instead maintaining a broad focus for implementation.

3.3. Coherence

Coherence rating: Moderately Satisfactory

The focus of the Project was based on a request from the national government related to solar thermal technology but was not clearly and consistently supported. The STAP review during project preparation noted that the added advantage of the proposed project over other initiatives was not clear. In response, the ProDoc states that "The specific focus of the proposed project, in relation to similar initiatives, will be to focus on steam (or thermic fluid) industrial applications (for both heat and cooling) to replace fossil fuels wherever possible. This request was specifically indicated by the Indian Government and worked out accordingly by UNIDO, in order to allow for maximum compatibility with related initiatives."²⁸ The project documentation with a focus on CST technologies carried the specificity of solar thermal applications, nonetheless the understanding from particularly government stakeholders interviewed during the evaluation implied that the scope and needs of the project were not clear and that there was no clear focus on specific sectors, business size, geographical area or fuel use.

²⁷ UNIDO, 2020, *CST Project pipeline under GEF UNIDO MNRE Project on Promoting Business models for Uptake and Scaling Up of Solar Energy in India*

²⁸ GEF, *Request for CEO Endorsement (ProDoc)*

A lack of clarity surrounding the specific scope of the Project resulted in an incoherent approach with internal contradictions. The stated focus on MSMEs represents a broad scope in terms of enterprise size with large variations in terms of characteristics such as available capacity and economic turnover within this category²⁹. As such, to align with this stated focus, the Project adopted an approach that attempted to cater to enterprises of all sizes without acknowledging the variations present which undermined accessibility for many proponents. For example, the adoption of a loan scheme favours enterprises with a financial turnover that is large enough to finance repayments which was reflected in the eligibility criteria for loan assistance. However, the Project did not adopt an approach that was conducive to providing the level of technical assistance that is required by enterprises of this size in installing a new technology. Similarly, the Project could have done more to address the variations in capacity associated with enterprise size and capacity. The interviews during the evaluation demonstrated that smaller enterprises are less likely to have available capacity to devote to understanding new and innovative technologies or the time and knowledge available to complete the application process. Furthermore, smaller enterprises are also likely to make smaller contributions to overall GHG emissions due to lower levels of activities. However, these enterprises were included in the Project. Targeting enterprises of sufficient capacity to address the technical and financial requirements may have facilitated the installation process.

Project attempts to links with other initiatives were narrow in scope and did not acknowledge the potential for broader coherence. The Project followed a UNDP project titled 'Market Development & Promotion of Solar Concentrators for Process Heat Applications in India' and identified at design opportunities for coherence given shared objectives.³⁰ The Project built upon some pre-existing activities to strengthen connections with industry associations and other stakeholders. It also operated from the UNIDO office that combined one Project Management Unit also covering biogas initiatives that provided opportunities for synergy. For example, the UNDP Project had been publishing *Sun Focus* magazine since 2013. Once the UNDP project ended, the UNIDO Project continued this activity.³¹ However, the Project did not adequately seek to identify broader opportunities for coherence such as with other renewable energy technologies and initiatives or state level solar initiatives. This is a missing aspect of coherence that may have facilitated improved results for the Project. Furthermore, the Project did not have sufficient connection with government and activities were too dispersed to gain

²⁹ Ministry of Micro, Small and Medium Enterprises. Classification 2020 - Manufacturing Enterprises and Enterprises rendering Services Investment in Plant and Machinery or Equipment:

Micro - Not more than Rs.1 crore and Annual Turnover ; not more than Rs. 5 crore Investment in Plant and Machinery or Equipment:

Small - Not more than Rs.10 crore and Annual Turnover ; not more than Rs. 50 crore Investment in Plant and Machinery or Equipment:

Medium - Not more than Rs.50 crore and Annual Turnover ; not more than Rs. 250 crore

³⁰ Ibid.

³¹ MNRE, <http://www.cshindia.in/Sunfocus.html>

traction. As such the results of the Project were lower than expected and the UNDP project has maintained a higher profile.

At design the Project noted alignment with several national government policies which in turn aligned with global frameworks. For example, the ProDoc notes alignment with the NAPCC and the Jawaharlal Nehru National Solar Mission. The NAPCC is also noted to be aligned with India's commitments to the UNFCCC.³² Given that this Project was designed prior to the establishment of many global framework such as Agenda 2030 assessment of coherence with such frameworks is difficult. Nonetheless, India's VNR submitted in 2020 highlights the important role of solar energy for progress towards SDG 7: Affordable and Clean Energy and SDG 13: Climate Action.³³

3.4. Efficiency

Efficiency rating: Moderately Unsatisfactory

Project expenditure is well below expected levels despite a two and a half year extension. The Project's disbursement rate is approximately 40% of the total available grant amount due to the lengthy loan application processes and its reliance on parallel capital grant from Government.

Without the expected co-financing, the project was constrained in achieving its expected results. The main cause of the low mobilization of co-finance was the interest subvention scheme that was tied to a Central Financial Assistance (CFA) grant through MNRE that was identified as a co-financing contribution to the project at design. UNIDO and IREDA jointly developed an innovative financing scheme that packaged the Government subsidy as per the approved design with the IREDA loan. With the grant and the project fund from UNIDO, IREDA hoped to lower its loan interest rate by 5% to support CST projects. This was expected to act as an incentive to promote manufacturing of solar systems and components and facilitate the installation of systems.

The expected co-financing for the CST projects was a total of USD 21,825,870, comprising USD 14,943,678 in loan financing through IREDA, USD 6,732,192 through the CFA as interest subvention and USD 150,000 through UNIDO to facilitate the application pipeline as shown in Table 7. An agreement for USD 1.87 million was signed on 27th July 2016 between UNIDO and IREDA with IREDA as fund manager.³⁴ However, this agreement was unable to proceed as expected and the grant funds were de-obligated and returned to the project budget. Consequently, the level of co-financing that was expected to underpin the loan program for financing did not proceed.

³² GEF, *Request for CEO Endorsement (ProDoc)*

³³ Government of India, 2020, *India VNR Decade of Action Taking SDGs from Global to Local*, https://sustainabledevelopment.un.org/content/documents/26279VNR_2020_India_Report.pdf

³⁴ IREDA-UNIDO project "promoting Business Models for Increasing penetration and scaling up of Solar Energy under MNRE-GEF-UNIDO (Ref. UNIDO Contract No 3000031818 with IREDA on 27 July 2016).

Table 7. Frequency of Project Management Meetings

Source of Co-financing	Type of Co-financing	Co-financing amount - Expected (US\$)	Co-financing amount Actual (US\$)	Status
MNRE	Grant	6,432,192	-	Grant funds were not approved for project.
MNRE, MSME, others	In-kind	300,000	100,000.00	Estimated in-kind resources for partial completion of activities.
IREDA	Loan	14,943,678	-	Loan funds were at commercial rates and not attractive to project proponents
UNIDO	Grant	75,000	75,000.00	UNIDO resources fully unutilized.
UNIDO	In-kind	75,000	75,000.00	UNIDO resources fully unutilized.
Total		21,825,870	250,000.00	<i>Co-financing did not proceed as per design due to unavailable of grant as expected.</i>

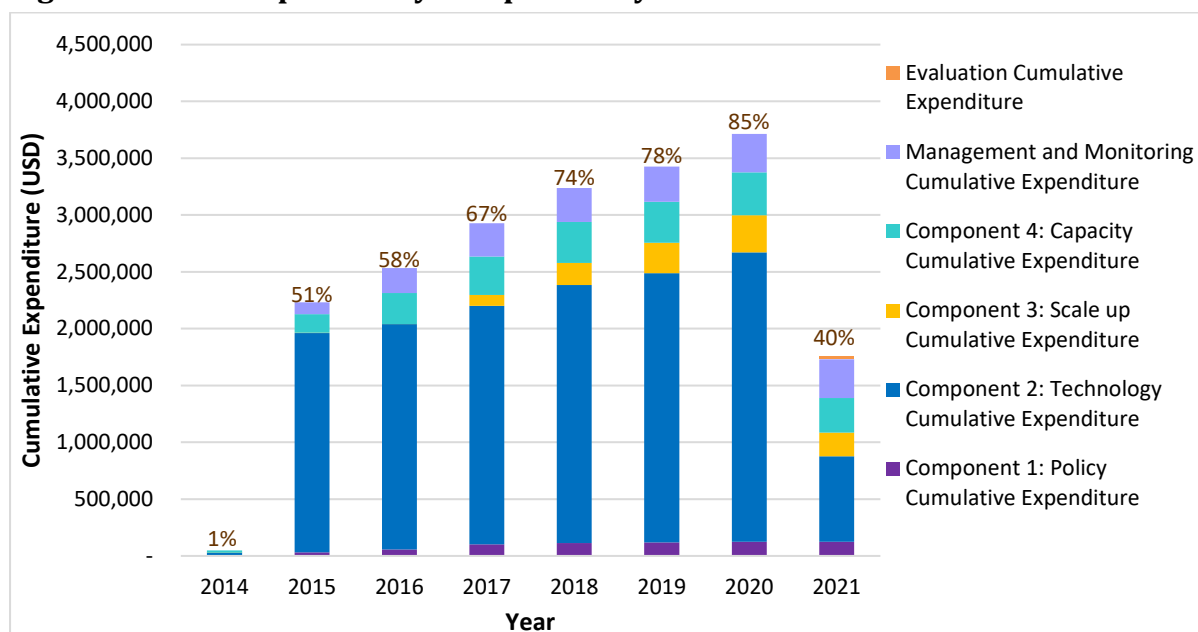
Source: UNIDO Internal financial database, December 2021

NB. Detailed in-kind financing had not been recorded at the time of the evaluation so in-kind amounts were estimates only.

The project continued to work with IREDA until close to project closure to try and to promote the IREDA loan funds, even without the interest subvention scheme but there was limited interest, given the lower financing costs for other energy solutions for potential participants. Eventually, when it was clear that the loan funds would not be disbursed, IREDA decided to return the funds to the project budget for re-allocation. The agreement was de-obligated and the remaining funds were successfully returned to the Project.

With the inclusion of the de-obligated funds, this resulted in a total project disbursement rate of 40%, as shown in Figure 5.

Figure 5. Funds Expended by Component by Year



Source: UNIDO Internal Database

Expenditure has been less than expected for three of the four project components. Given that expected budget obligation by year is not available, total budget allocation and cumulative annual expenditure for each component is reflected in Figure 6.

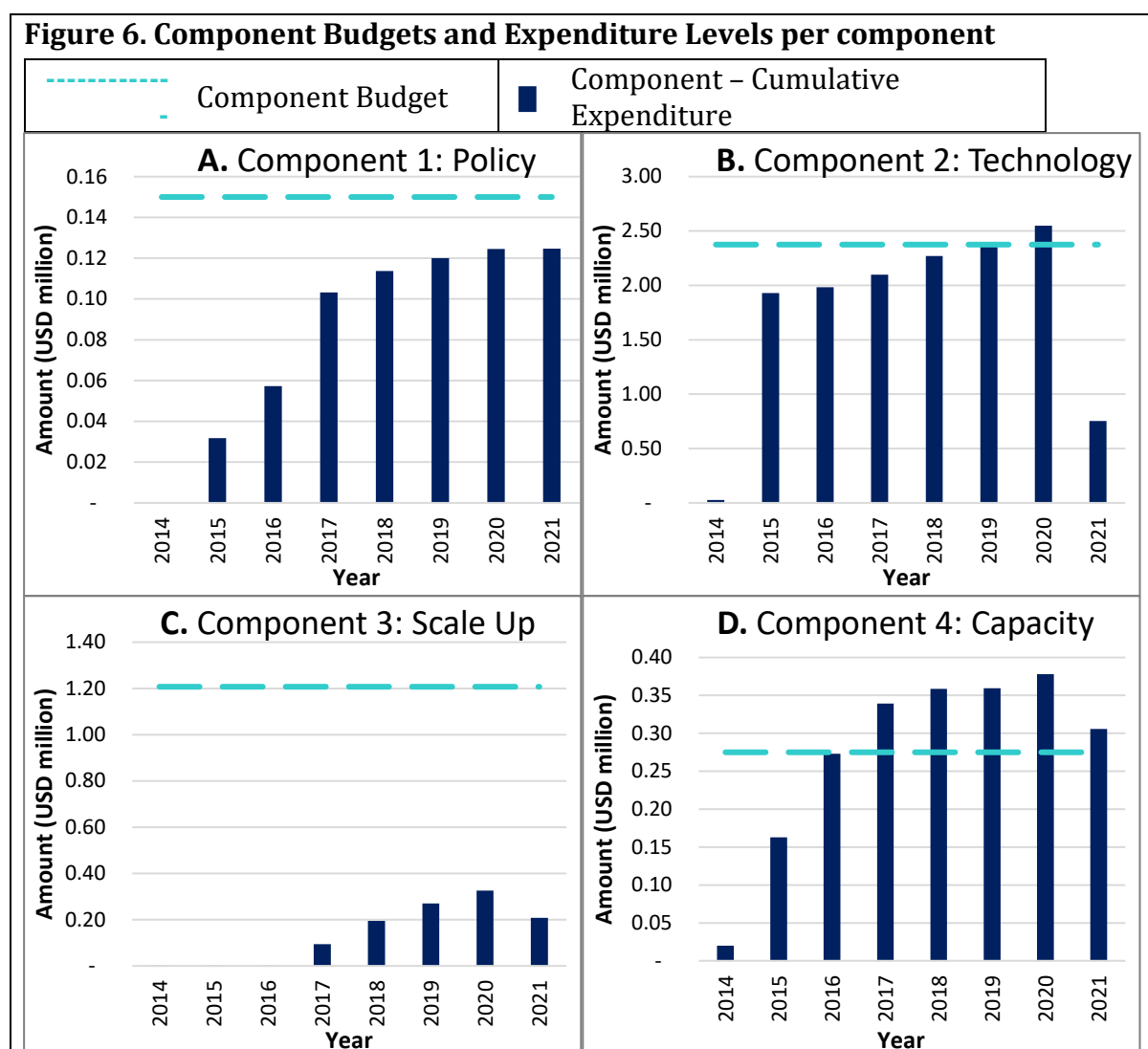
The small amount of expenditure of component one in 2014 and the pattern of disbursement that increases sharply in 2017 does not reflect the expected program logic identified at design (Annex 1) that recognised the need for progress on policy prior to other Project activities. The disbursement pattern for component two which saw the first large disbursements in 2015 reflect the timeline for finalising partnership agreements with executing agency. This timeline is supported by the publication of information about the MNRE/IREDA/UNIDO loan interest subvention scheme³⁵ in 2016 following development and agreement by all parties.

Similarly, the disbursement pattern for component three is reflective of the progressive nature of the Project that required activities under components one, two and four prior to any scale up activities. However, overall disbursements of funds allocated for component three is very low with only 17% of the allocation having been used by 2021. This low disbursement reflects the limited progress of other components that hindered potential for scale up. Lastly, component four was the only component to over-disburse the allocated budget. This reflects the findings that component four was the component to generate the highest volume of outputs with the publication of Sunfocus magazine, the organisation of several workshops and the development of knowledge products. Nonetheless, the budget was noted to have been exceeded in 2018, prior to approval for the national workshop.³⁶ However, despite the over-disbursement of funds, several

³⁵ MNRE, IREDA and UNIDO, 2016, *Loan Scheme to Promote the Concentrating Solar Thermal Projects in India for Industrial Heat Applications*.

³⁶ MNRE, 2019, *Minutes of the Fourth Project Steering-cum-Advisory Committee (PSAC) of MNRE-GEF-UNIDO Project: "Promoting Business Models for Increasing Penetration and Scaling Up of Solar Energy"*

targets were not achieved under component four. This includes the absence of training activities envisioned at design.



Project timeframe has been substantially extended. The Project was extended for two and a half year from expected duration of 60 months, finishing in January 2019 to be completed by June 2021. PEC and PSAC identified several reasons for this extension including delays in project launch, the time taken to develop the loan interest subvention scheme and the technical advisory for larger pilot proposals.³⁷

Overall, the Project had disbursed more than 80% of the total budget to 2020 but only 30.3% of targets have been fully achieved by Project end (see Annex 6). However, there was a large amount of funds originally obligated to project executing partners (specifically IREDA) which have not been utilised. These have been returned to the Project in 2021 and have resulted in an apparent significant underutilisation of the available funds. The barriers experienced in disbursement were beyond the control of

³⁷ MNRE, 2018, *Minutes of the 3rd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO Project*

the project office, being largely due to MNRE not progressing with the subsidy scheme through interest subvention in line with the project design.

The design decision to broadly increase the use of CST technology across several sectors was inefficient. Conducting activities across 14 sectors diluted focus and hindered potential for impact as discussed in section 3.1.1. Adopting such an approach requires significant outreach resources but lacks the opportunity to deepen contact for more productive relationships and to generate results. A more focussed approach for effectiveness in one sector through targeted support could have maximised the potential for demonstration and scale-up. A more targeted approach may have been more effective and improved economic return on investment. Such an approach was suggested by the PASC and the PEC at varying stages of implementation. In 2016, the Joint Secretary of the PSAC recommended that UNIDO could adopt an innovative approach to go beyond traditional capacity building and awareness generation. This approach would have involved adoption of five manufacturers and through in-depth engagement strengthen manufacturing and integration capabilities. Such an approach may have helped to overcome some of the challenges experienced through implementation associated with the transferability of CST technology between application settings. A similar targeted ‘adoption-like’ approach was suggested by the PEC chairman in 2016 but was not sufficiently followed through.³⁸ Another sector-specific approach was proposed at the PEC meeting in 2018 which suggested sector specific presentations at the national workshop and separate spaces for more informal and higher engagement.³⁹

The financial model included in design did not generate the expected results or return on investment. A large amount of the funding released to IREDA to support the CST installations was not utilised suggesting that this mechanism was not effective and was an inefficient allocation of resources. Feedback from MNRE suggests that the financing package was not well designed to support the CST sector and that UNIDO could have done more to ensure that specific guidelines were produced. This could have entailed appointment of a suitably qualified consultant to assess whether the scheme was appropriately design and assist to streamline the procedures.

IREDA received a total of USD 1.875 million to support sub-projects and promote and support domestic manufacturing of CST components.⁴⁰ It is estimated that upon finalisation of and termination of contracts at the end of the Project, approximately USD 1.8 million of the allocated amount will be returned to the Project having not been utilised. This return to the Project is accounted under component 2 resulting in a large underspend on this component as illustrated in Figure 6B. Furthermore, it was originally envisioned that the financing mechanism would “bundle a MNRE subsidy and the soft

³⁸ MNRE, 2016, *Minutes of 1st Joint Meeting of the Project Executive Committee of UNDP- & UNIDO-GEF CSH Projects*

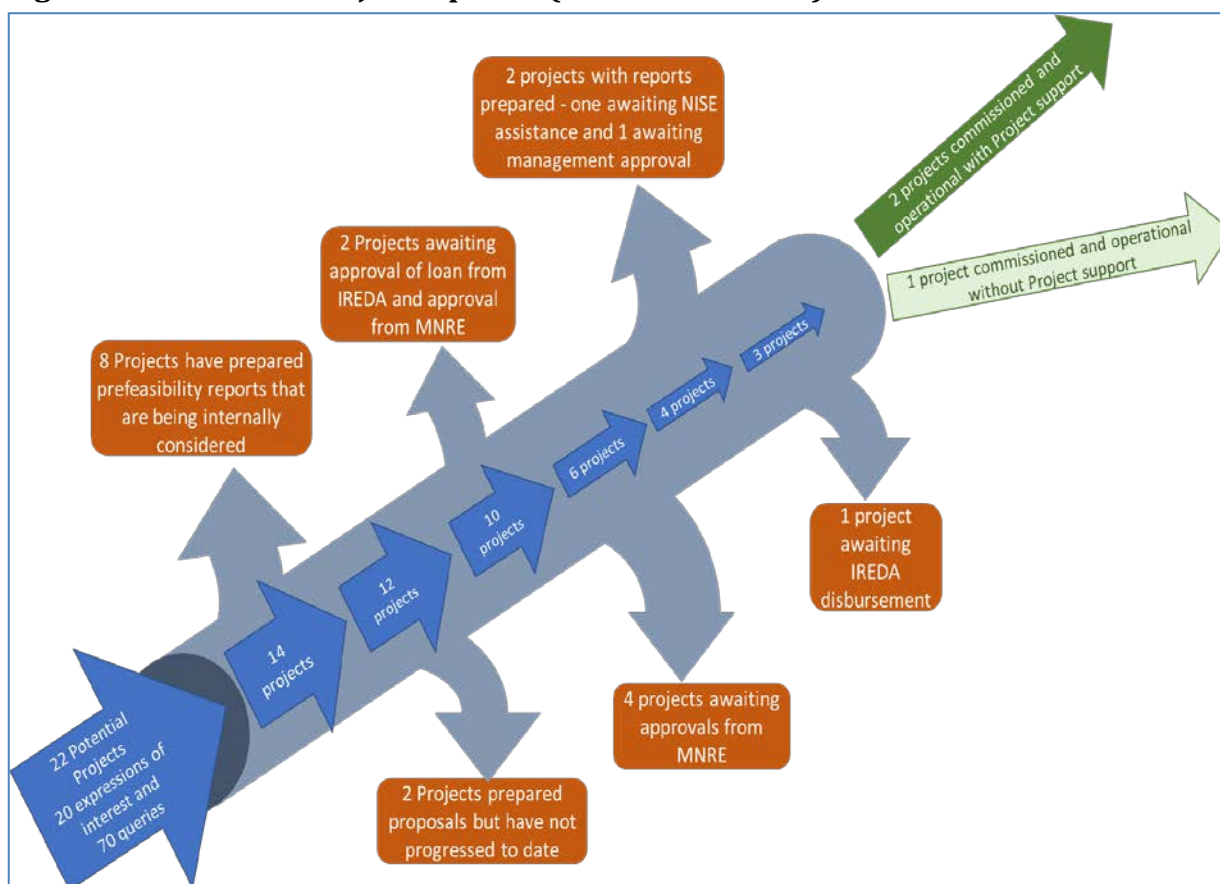
³⁹ MNRE, 2018, *Minutes of the 3rd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO Project*

⁴⁰ MNRE, 2016, *Minutes of 2nd Meeting of Project Steering-cum-Advisory Committee (PSAC) for MNRE-GEF-UNIDO Project.*

loan thereby providing upfront access to 75% of CST project cost.”⁴¹ The subsidy did not proceed as expected. It was planned to be an interest subvention, such that the effective financing costs for the borrower would be reduced.

An evaluation of MNRE’s support to CST was conducted in 2020 and found that the scale of support intended was not provided.⁴² However, the expected financial support from the Government through MNRE did not materialise (being interrupted in 2018 and abandoned in 2020). This detracted substantially from the overall level of support available because the project financing was tied to approval of the government support. The lengthy application process acted as a further barrier which prevented MSMEs from proceeding with applications and inhibited opportunities for project assistance. Bureaucratic processes combined with lengthy and intensive documentation requirements meant that some targeted beneficiaries did not complete the processes. As a result, significantly less support was provided than envisioned at design and approximately USD 1.8 million of the USD 1.875 million allocation to IREDA will be returned to the Project upon finalisation of the contract. Nonetheless, there is evidence of increasing use of CST technology in India, some of which has been stimulated by project activities.

Figure 7. Illustrated Project Pipeline (as of March 2020)



⁴¹ MNRE, CST Division, 2017, *Minutes of the 3rd Project Steering-cum-Advisory Committee (PSAC) Meeting of MNRE-GEF-UNIDO Project: promoting business models for increasing penetration and scaling up of solar energy*, pg. 2.

⁴² GERMI, 2020, *Final Report of “Technical and Performance Evaluation of MNRE CST Scheme”*

Source: UNIDO, CST Pipeline under GEF-UNIDO-MNRE project on promoting business models for uptake and scaling up of solar energy in India (status 24 March 2020)

Delays in contracting and procurement process as well as delays associated with poor consultant outputs contributed to poor project performance. Contractual delays contributed to delayed implementation of some activities. This is most evident in the example of the intended training activities. Minutes of the second PSAC meeting in February 2016 note that approval was given for capacity building and training activities to begin in the last quarter of 2016. The proposed partnership between NSIE and UNIDO for training activities was approved in 2017.⁴³ However, at Project end, these activities have not begun. By November 2018 the delays in training activities totalled more than nine months. This was noted to be due to the government's internal contract approval processes which was transferred between ministries. Procurement delays of external consultants to undertake the training activities were also noted to have occurred.⁴⁴ Further delays were experienced in relation to the expected outputs of component one which were expected to be delivered in January 2017.⁴⁵ The company contracted to develop state-specific policies, modified boiler regulation and recommended changes to building regulations did not produce these outputs to the quality expected.⁴⁶ As a result, the outputs were re-contracted and delivered significantly later than expected.

Testing activities have been effective and were undertaken as expected but are duplicative of national processes. The testing laboratory has been established and testing activities undertaken. This has resulted in the approval of high-quality technology and systems despite some perceived feedback to the contrary. Some stakeholders noted that decreased effectiveness of the technology due to user error was sometimes wrongly attributed to testing downfalls. However, the testing process was noted by some stakeholders to be onerous and somewhat duplicative representing an inefficiency for the Project (Figure 8).

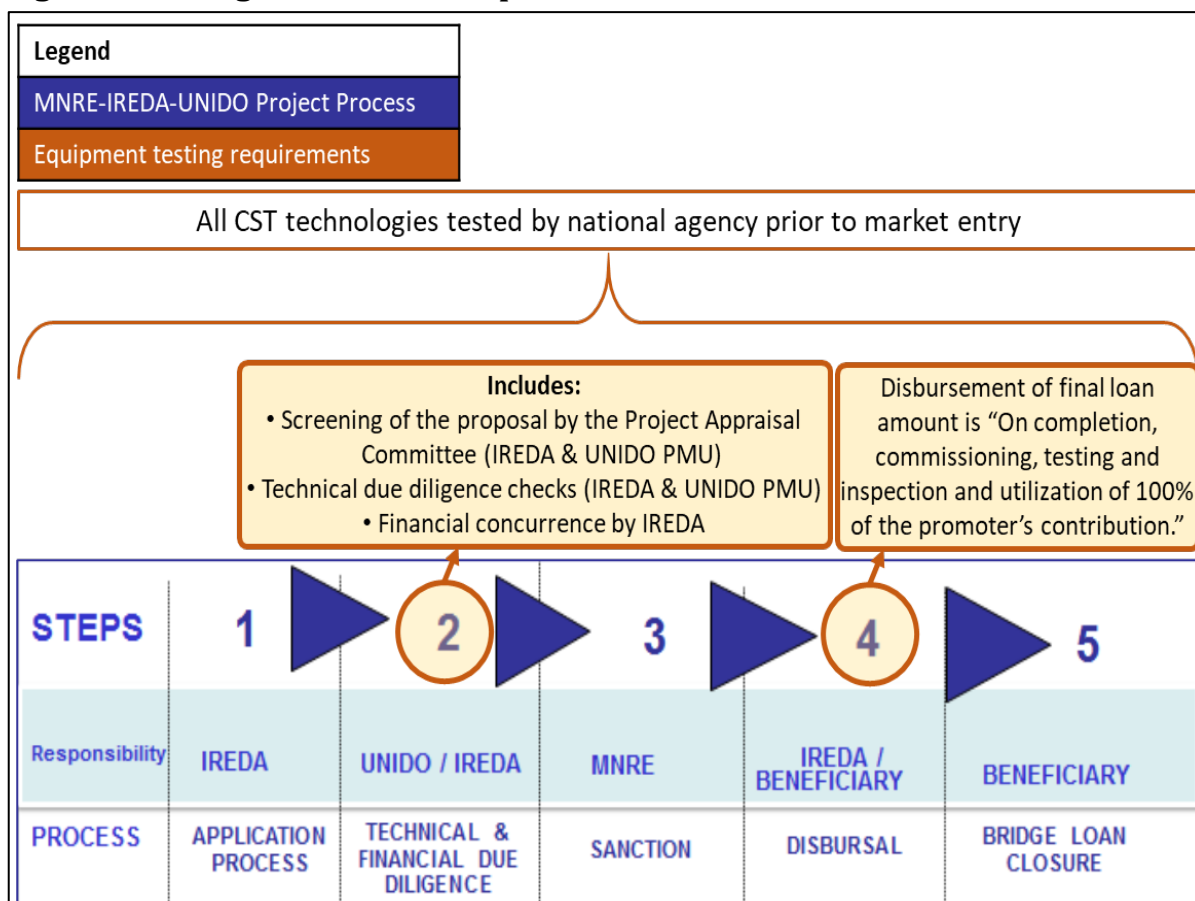
⁴³ MNRE, CST Division, 2017, *Minutes of the 3rd Project Steering-cum-Advisory Committee (PSAC) Meeting of MNRE-GEF-UNIDO Project: promoting business models for increasing penetration and scaling up of solar energy.*

⁴⁴ MNRE, 2019, *Minutes of the 4th Meeting of the Project Executive Committee (PEC)*

⁴⁵ MNRE, 2016, *Minutes of the 2nd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO Project held at MNRE on 14 December 2016*

⁴⁶ MNRE, 2019, *Minutes of the Fourth Project Steering-cum-Advisory Committee (PSAC) of MNRE-GEF-UNIDO Project: "Promoting Business Models for Increasing Penetration and Scaling Up of Solar Energy"*

Figure 8. Testing burden for receipt of loan



Source: UNIDO, MNRE & IREDA, 2016, *Loan Scheme to promote the Concentrating Solar Thermal (CST) Projects in India for Industrial Process Heat Application (adapted)*

The potential for alignment with national BIS standards was noted in the first PSAC meeting in March 2015⁴⁷ but separate testing procedures and standards were later pursued. The need for efficiency during financial due diligence processes were also identified during the third PEC meeting in 2018.⁴⁸ It was recommended that deadlines be put in place for the different stages of the process for both technical and financial processes. However, stakeholder feedback suggests that this did not significantly change the length of the processes.

3.5. Sustainability

Sustainability of benefits rating: Moderately Likely

Where technology has been installed as a part of the project, benefits are likely to continue subject to continued maintenance and ongoing troubleshooting. Technology installed with Project support is appreciated and the effectiveness of the technology is evident. As such the benefits accrued by this technology are likely to

⁴⁷ MNRE, 2015, *Minutes of the First Meeting of Project Steering Committee-cum Advisory Committee (PSAC) for GEF-UNIDO Project Promoting Business Models for Increasing Penetration and Scaling-Up of Solar Energy.*

⁴⁸ MNRE, 2018, *Minutes of the 3rd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO project*

continue. However, some stakeholders noted that while technical knowledge regarding operation, and to some extent manufacturing of the technology had improved, there remained technical knowledge gaps in terms of ongoing maintenance and troubleshooting of errors which are key risks to ongoing benefits. The development of manuals for operation of CST technologies are likely to facilitate ongoing use of the technology where it has been installed. However, without the capacity to address issues as they arise, the ongoing benefits are less clear.

The awareness and interest generated by the Project is a positive aspect of sustainability but the technology that has been installed is limited and the isolated nature of installation undermines potential for an overall longer-term increase in uptake of CST envisioned by the Project. The awareness raising events conducted by the Project have generated interest in CST and increased understanding of the technology. However, without follow-up from these events, the potential for installation by participants is less likely. The limited scale of installation inhibited demonstration ability and hence the likelihood of ongoing, self-propelled decisions to install CST technologies. Nonetheless, there is latent demand and there is a momentum for continued interest in the technology. However, the extent to which this is attributable to the Project is not clear.

Another risk to the sustainability of project benefits is a lack of national ownership and unclear likelihood of continuation of loan interest subvention scheme. Ongoing benefits from the Project would require continued engagement of the industry sectors where CST technologies can be viable and beneficial. The indication from national stakeholders met during the evaluation has been that CST is not a national government priority for the renewable energy transition. There appear to be an increased understanding and demonstrated preference within the solar domain for PV technologies. The CST technology is an important contribution to solar heating applications. As such, the project loan interest subvention scheme was a key consideration in many installations where viability is uncertain. At present, the roadmap generated by the Project has limited national ownership and is unlikely to be progressed unless alternative champions, understanding and committed to the value of CST technologies are identified to lead its implementation.

3.6. Gender mainstreaming

Gender mainstreaming rating: Moderately unsatisfactory

There were no specific gender-related targets outlined in the Project design and there is no indication of any negative impacts on gender. The secondary impacts outlined in the ProDoc relate to women generally as “a significant part of the work force in many of the target manufacturing plants” that would result in flow on benefits as an impact of innovation, increased competitiveness, reduced energy costs, employment and economic wellbeing. There are some positive gender examples relating to these identified gender impacts, but these are isolated and not widespread. Furthermore, the ProDoc identified that the training and capacity building activities would be especially relevant but the participation data available for these activities is limited and overall figures of approximately 10-15% female participation are reported.

4. Performance of partners

4.1. UNIDO

Performance of UNIDO rating: Moderately Unsatisfactory

UNIDO had sufficient experience and expertise to implement this project. UNIDO's previous experience in the energy sector in India, included previous work with MNRE and provision of technical assistance. This provided the necessary background to work with various agencies including the national counterpart ministries and at the state level. The arrangements for implementation with UNIDO was effective to bring global technical expertise in country and capitalise on UNIDO's previous experience implementing GEF projects in the country. However, this level of experience did not reach its full potential.

UNIDO's role as PMU and the oversight provided by the Delhi office was less than effective. UNIDO supported project partners, guided interested industries and worked with MNRE to progress project activities and aims. However, some stakeholders suggested that UNIDO was not very well known or present at the state level, hence may have lost some traction in attracting greater interest in the technology. This low profile may have hindered opportunities for increased engagement, particularly in states with pre-existing and emerging renewable energy regulations as part of the enabling environment.

UNIDO's role in communication with stakeholders was not sufficiently effective. The documented feedback from MNRE and NISE demonstrates significant communication issues between the PMU and the key partners.⁴⁹ MNRE states that UNIDO was asked to submit Action Taken Reports and conduct weekly meetings on the points raised in the PEC and PSC meetings. These were duly submitted by the PMU and reported that arranging meetings with MNRE were held but MNRE assessed the follow-up by the PMU as insufficient.

UNIDO support reached enabled the provision of technical advice. to MNRE at the pre-feasibility stage of pipeline projects through the technical advisory services from specialized German CST company Protarget. The decision to engage Protarget was beneficial, and the technical support provided through this arrangement has been appreciated by various stakeholders and worked to build national technical expertise both within the Ministry and for industry stakeholders. The provision of technical advice has been of great value in developing a pipeline, the identification of appropriate technologies for the tendering process and the production of good quality applications.

The workshops conducted by UNIDO in 11 states were valuable to disseminate information and raise awareness of CST technologies. The workshops also identified interested industries to partner with appropriate technology solution providers.

⁴⁹ Emails MNRE to UNIDO January 3, 2020; March 11, 2020,

However, there was insufficient follow-up of these activities to create adequate momentum for wider installation as identified at design.

The overall project approach that aimed to increase application of CST technologies nationally across several industries was broad and inhibited potential for deeper engagement for transformative results. As implementing agency and as the applicant for funding based on this design, the responsibility for quality of design and implementation falls with UNIDO. Despite the flaws in design and the limitations for the installation of technology in areas with sufficient direct sunlight, some results have been achieved and the profile of technology has been increased where the Project has had direct contact.

4.2. National counterparts

Performance of national counterparts rating: Unsatisfactory

GEF's operational focal point (OFP) in India is MoEFCC, however, MoEFCC was not directly involved in implementation limiting potential for oversight and direct reporting to GEF. Despite the limited direct involvement, MoEFCC was a member of the Project Steering Committee and as the GEF OFP had the potential to influence both the Project's reporting and implementation activities. Furthermore, MoEFCC's potential to provide knowledge, utilise networks and generate additional resources was not completely taken advantage of in the Project context. A more active role by MoEFCC in the Project could have assisted in channelling GEF's global influence and improved Project outcomes.

The Ministry of New and Renewable Energy (MNRE) as an executing agency initially demonstrated a keen interest in the potential of CST but this changed over time. Initially, MNRE was interested in working on CST as this was broadly in line with the objectives of the National Solar Mission, which though only set targets for solar power generation (through PV) not for solar heat generation (through CST). Given this common interest and alignment with GoI objectives, the MNRE played an active role in starting off the project, providing direction to the project and chairing the Steering Committees. The groundwork undertaken by MNRE helped to establish the project and also bring together various partners. MNRE also played a crucial role at the beginning of the Project to align its own national agencies, IREDA and NISE to support the project. However, stakeholder feedback suggests that there was a shift in focus within the ministry from a demonstrated interest in CST to an increasing predominance of solar PV. The feedback from MNRE is that there was evidence that CST was not in demand as a preferred technology and that industry feedback to the Ministry was that sufficient technical support for the industry was not available. As a result of this shifting focus, many pipeline demonstration projects received insufficient attention and support and were not progressed.

Shifts in interest were accompanied by changes in personnel which resulted in a loss of technical CST expertise and support. In order to fill expertise gaps that arose during the project, UNIDO successfully procured and managed technical assistance contractors. One of the main project partners (Protarget) that was originally engaged to review pipeline proposals submitted for feasibility, actually provided intensive technical

support to applicants to ensure that submissions were of a good standard. This was not only helpful to generate a solid pipeline but also was noted by respondents during the evaluation to help build their knowledge and capacity.

Changes to the availability of financial support through the pipeline was linked to changes in the environment within MNRE and created uncertainty. The interrupted and then terminated MNRE capital subsidy and other mechanisms of financial support created some confusion and influenced some decisions by industry stakeholders to delay installation. The financial support would have assisted in counteracting some hesitation surrounding installation due to the high upfront costs of CST. Furthermore, given that it would take longer for MSMEs to reach the breakeven point compared with cheaper alternatives, financial support from MNRE could have brought this point forward and increased the financial viability of CST installation. The lack of clarity around this support reduced interest and delayed implementation where interest was still apparent. These delays in turn contributed to delays in installation of demonstration sites.

Several internal shifts within MNRE resulted in reduced support for the Project during crucial implementation stages. The decreased interest within the Ministry was timed with the development of the project pipeline, when a demonstration of national alignment and priority would have assisted in garnering support and strengthening the pipeline. This shift in interest has not only impacted the results that were achieved but also severely hampered the potential for sustainability of project benefits. The financial mechanisms that could have been established under the Project is not expected to be available beyond the end of the project. Therefore, while solar power and addressing India's Paris Commitment of GHG reduction continues to be important to the country, the solar focus is now mainly addressed by solar PV.

As a technical agency of the MNRE, NISE had roles in the training and testing aspects of the Project as well as a member of the Steering Committee but implementation was severely delayed and did not proceed as planned. NISE was provided with a contract for training activities to support project activities. However, the confirmation of the agreement and implementation was greatly delayed. The agreement was signed by UNIDO on November 8, 2017 and only countersigned by NISE 2019, with reasons for the delay unclear. Furthermore, UNIDO and NISE discussed an amendment to the agreement prior to implementation, which was agreed by UNIDO in January 2020, yet was unable to proceed. Feedback from NISE notes that NISE is an autonomous body under Government for India and has to abide by rules and regulations. With respect to receipt of foreign funds, decisions cannot be taken by NISE without procedural approval.

NISE also received technical support through the project for feasibility study and business plan for refurbishment of a 1 MW CST system. Discussions suggest that the agency has had a lot of interest in the development and promotion of the CST technology, yet practical implementation was not easily pursued. NISE did provide guidance on testing criteria and requirements for manufacturers through its testing laboratory at its facilities. Yet this was not covered by a formal agreement and as such, the arrangements with NISE as an implementing partner did not proceed as planned.

IREDA was envisioned to be an integral stakeholder for the success of the Project however this role was less effectual. IREDA's specific mandate to support the promotion of new and renewable energy projects through project financing made the organisation an important part of developing viable financial mechanisms. However, stakeholder feedback suggests that IREDA did not adequately fulfil this role and contributed to some delays and less than expected uptake. There is evidence that demand for loans from IREDA for CST installation was high given an enabling environment created by state-level renewable energy regulations and the high installation costs of CST technologies. However, approval processes for financial support were lengthy. Eligibility criteria was specified for companies with a turnover of greater than 50 lakhs being eligible for support, and this led to a range of smaller enterprises attempting to join the pipeline when they did not have the technical or financial resources required. As a result, only the largest of MSMEs in the pipeline were managed to complete the eligibility criteria and find the necessary counterpart for the loan funds. These factors combined to form barriers to CST installation for some companies, and circumstances where others installed CST without Project support.

4.3. Donor

Performance of donor rating: Moderately Satisfactory

The Project was strategically effective given the choice of implementing agency, and alignment with national priorities and GEF objectives. The Project represented an opportunity for GEF to address its climate change objectives while simultaneously identifying and creating opportunity for scale-up of solar thermal energy in India in line with national objectives and commitments to global frameworks. The proposed approach to upscale the use of CST with awareness raising and demonstration was strategically sound and aligned with government interest in CST at the time of design. Similarly, partnering with UNIDO for implementation was a good decision based on UNIDO's industry connect, its experience in implementing GEF projects, the organisation's presence in India as a regional hub, connections with industry in-country and previous demonstrated knowledge and experience in the energy sector.

Despite satisfactory financial performance, there was insufficient follow-up of design flaws identified during the STAP review and oversight in terms of poor performance during project implementation. All funds were released as expected. However, concerns were raised during the STAP review regarding the number of target sectors, lack of specificity regarding business models to be explored and limited clarity regarding the pathways to scale-up. As required, responses to these concerns were submitted at the CEO endorsement stage of the application but provided little further justification of design decisions nor consolidation of target sectors. Despite this, the Project was approved, and these challenges persisted through implementation contributing to poor overall progress. Similarly, despite demonstrated poor progress during implementation and evidence of collaboration difficulties between the implementing and executing agencies, no corrective action is evident from GEF.

5. Factors facilitating or limiting the achievement of results

5.1. Monitoring & evaluation

Monitoring and evaluation rating: Moderately Unsatisfactory

The Project Framework adequately included sources of verification and suitable assumptions but limited articulation of data collection processes and responsibilities as well as some duplication in the results framework increased reporting burden. The design of the project framework included risks and assumptions and PIRs provided an update on these risks and mitigations taken. The project results framework was large with 40 individual indicators requiring data collection and specific reporting. Such a large results framework requires more time and effort to collect data and report comprehensively at each annual report compared with a more consolidated framework. For example, the number of projects installed is reported against several indicators in the framework as the evidence of achievement is linked.

Overall, the logframe is comprehensive and can inform an assessment of progress but some indicators included in the Project results framework at design have since been shown to be less than relevant to the project context. For example, in the 2020 Project Implementation Report (PIR) states in relation to the number of pilot systems installed that “the number of projects depends on the project sizes. The effort has been to target the total collector area and not the number of projects.”⁵⁰ Similarly, targets related to developing standard financial or operating models have been difficult to achieve given that project experience has demonstrated the need for contextualised solutions on a case-by-case basis. As such, reporting against the indicator “business models in place” or number of standardised financial models for CSH” has been difficult and would be less than relevant to Project experience.

Data collection was moderately unsatisfactory, which made tracking of progress difficult. For example, in the Prodoc gender mainstreaming is related to women’s participation in training and capacity building activities. However, this is not reflected in the results framework as no indicators require the collection of gender disaggregated data. Another example is that on one occasion data was meant to be collected on the number of organisations attending an awareness raising sessions, but data was only collected on the number of people, and it is not known how many organisations were represented. On several occasions, when recording the number of field visits, the project did not specify who the targeted attendees were to the level required by the indicators in the results framework. Only a list of visiting sites was recorded, not the participants of the field visits.

Reporting at times lacked sufficient detail to adequately understand project progress. Project implementation activities were limited in the early stages of the Project due to slow development of an enabling policy and regulatory environment.

⁵⁰ UNIDO, 2020, *Project implementation Report 1 July 2019 – 30 June 2020* pg. 4

There was not consistent monitoring and self-evaluation of project performance and results to record challenges associated with this. For example, reporting often stated that activities had been initiated or similar without providing further detail relating to milestones of implementation, adequate detail of progress or challenges faced. The M&E system was not robust, and data was not regularly collected for all indicators. However, monitoring and reporting against the indicators improved over the life of the project as activities increased.

5.2. Results-Based Management

Results-based management rating: Moderately Unsatisfactory

Management strategies were sufficient but narrow in scope. In general, management was satisfactory with individual challenges addressed sufficiently to progress individual activities. For example, the decision to retender the contract for the development for recommendations for modifications to boiler and building recommendations was a positive adaptive management action to increase the quality of outputs. However, this decision also delayed project progress in component 1 which in turn represented increased challenges for other components.

Management did not facilitate required changes in the face of poor project progress. Oversight from a more overarching perspective was not applied which hindered opportunities for adaptive management. For example, demonstrated poor progress was reported throughout the project in relation to the number and capacity of installed CST plants. However, despite identified challenges and the acknowledgement that the successful installation of equipment was important for other Project components, sufficient action was not taken to address this. Similarly, despite uneven progress between Project components, corrective action is not evident. For example, the awareness raising activities conducted under component 4 were noted to be appreciated and effective in generating interest. However, there was also an opportunity for the Project to capitalise on this increased interest as a means to counteract the lower-than-expected levels of installation through the Project pipeline. Despite this opportunity, there is no evidence of a restructure of project activities to take advantage of this. A restructure of the Project which prioritised and reallocated funds for the component activities which were successful to maximise effectiveness could have been undertaken to improve overall performance.

PSAC and PEC raised concerns regarding slow progress and expenditures but these were not adequately addressed. The PSAC had identified opportunities for deeper engagement with industry stakeholders through an ‘adoption-like’ program as a means of generating additional interest and progress. However, this approach was not adopted. Slow disbursement of funds was flagged as early as 2016 by members of the PEC.⁵¹ Other financial concerns were raised when the budget for component four had been exceeded but approval was still sought for additional activities, including the national workshop.

⁵¹ MNRE, 2016, *Minutes of 1st Joint Meeting of Project Executive Committees of UNDP- & UNIDO-GEF-CSH Projects*

MNRE raised concerns that communications were not sufficient or efficient when they did occur.

6. Overall assessment and rating table

#	Evaluation criteria	Summary Assessment	Rating ⁵²
A	Impact	Some progress towards impact is evident in the increased awareness and industry interest in CST technologies. However, the project did not sufficiently capitalise on this and major challenges were faced in upscaling benefits.	3 (MU)
B	Project design		4 (MS)
1	Overall design	The project design was appropriate and a logical response to identified barriers and challenges. However, the technical aspects of the project, particularly related to scope, were not sufficiently rationalised.	4 (MS)
2	Logframe	Overall, the logframe contains indicators and targets that are relevant to the project approach and are sufficient to track progress. An absence of indicators at the outcome level combined with duplicative and vague indicators results in some gaps.	4 (MS)
C	Project performance		4 (MS)
1	Relevance	The Project was relevant to the national context in terms of an emphasis on renewable energy transition and to respond to development challenges but there was less interest in CST as a form of renewable energy given its use for process heating rather than power generation.	5 (S)
2	Effectiveness	The enabling environment was not developed nor was technology installed to the level expected at design. Some positive awareness raising outcomes were evident but the effectiveness of these were hindered by limited follow-up. Potential for scale-up was limited given other poor progress.	3 (MU)
3	Efficiency	The Project has significantly under-disbursed project funds as a result of delayed implementation. The application processes for Project support were lengthy and inefficient and delays in implementation resulted from this and several other factors.	3 (MU)
4	Sustainability of benefits	Technology installed as part of the Project is likely to continue to be of use and the project has contributed to some increased industry interest in CST. However,	4 (ML)

⁵² Based on UNIDO's 6-point scale, 1 = Highly unsatisfactory (HU), 2 = Unsatisfactory (U), 3 = Moderately unsatisfactory (MU), 4 = Moderately satisfactory (MS), 5 = Satisfactory (S), and 6 = Highly satisfactory (HS). Sustainability is assessed on a 4-point scale of likelihood.

#	Evaluation criteria	Summary Assessment	Rating ⁵²
		installation is isolated and a lack of national ownership and under-developed financing mechanisms into the future represent risks to sustainability.	
*	Coherence	The project was designed with a narrow scope to avoid duplication with other initiatives. The Project also effectively identified opportunities to progress the results of a previous similar project but this was constrained by limited effectiveness.	4 (MS)
D	Cross-cutting performance criteria		3 (MU)
1	Gender mainstreaming	There were limited gender considerations with impacts noted to be a flow-on from some activities. Despite this there are some isolated examples of positive gender outcomes.	3 (MU)
2	Monitoring and Evaluation (M&E): -M&E design -M&E implementation	M&E tools were identified at design but lacked sufficient detail to guide follow-up. The framework is large and lacks specificity in some instances making effective tracking of progress difficult. Data collection efforts were not always aligned with the specified indicators.	3 (MU)
3	Results-based Management (RBM)	General management strategies were adequate but narrow in scope, experienced serious communication and coordination issues and lacked a more strategic overarching perspective.	3 (MU)
E	Performance of partners		3 (MU)
1	UNIDO	UNIDO had sufficient experience and connections to successfully implement this Project. Technical support provided through the project was positive. However, flaws in the Project design proposed by UNIDO hindered the potential for progress, the project did not adequately focus its efforts on critical bottlenecks and the communication with national partners was not effective.	3 (MUS)
2	National counterparts	Despite demonstrated interest in CST at design, significant policy and staffing shifts during implementation undermined project activities. Delays and low implementation by some national counterparts constricted project progress.	2 (U)
3	Donor	The general strategic decision to fund the project was appropriate but specific design flaws identified by the STAP were not sufficiently addressed and undermined project success.	4 (MS)
F	Overall assessment	Based on the combined ratings, project performance has been assessed as moderately unsuccessful.	3 (MU)

7. Conclusions, Recommendations and Lessons Learned

7.1. Conclusions

Despite overall project progress that is much less than targets, there is demonstrated ongoing interest in CST through the thriving pipeline. There are isolated examples where technology has been installed, stakeholders trained, and the installation is used for demonstration. However, these examples are at a much lower scale than envisioned at design. Despite this, the pipeline received more than 20 EOIs and 70 queries following advertising efforts in February 2020. This suggests that momentum has been building during the Project.

Assumptions made at design regarding national government and industry capacity were not well-founded and hindered project progress. A lack of local expertise contributed to applications for support that were not complete nor technically sound as well as insufficient technical expertise for the timely assessment of submissions. These capacity gaps were not considered during design and challenges were experienced in converting awareness and interest into the ability to prepare and review submissions. The Project approach to develop standardised models to overcome this expertise gap was appropriate but insufficiently followed through.

Outcome 1: Favourable Policy Environment

The value and potential of a well-functioning CST industry was not properly demonstrated at the policy level. This inability to demonstrate the value of CST (for heat generation) compared to PV (for power generation), did not generate sufficient support or attract the required level of technical expertise to national stakeholder organisations. The ongoing limited interest in CST at the national level combined with a lack of technical expertise is likely to contribute to limited sustainability of results. Without a CST champion at the national level there was a leadership gap in progressing the Project which will worsen without project support.

Outcome 2: Technology Installation and Viability Demonstration

The Project approach to target a large number of sectors inhibited opportunities for deeper engagement hindering the level of installation as well as overall effectiveness and efficiency. Adopting such an approach resulted in superficial engagement with many sectors and limited the potential for deeper and more productive engagement. Attempting to engage with so many sectors did not provide opportunity for custom engineering to specific sector's heat demand profiles of different sectors. The small number of project-supported installations resulted in limited opportunity for demonstration to encourage broader uptake contributing to lower-than-expected impact. Demonstration of the viability and potential of CST technologies was an important determinant in decisions by industry stakeholders to install applications.

Outcome 3: Scale Up in investment and assurance of quality

Demonstration has proven to be an effective approach but has not been expanded to key industries due to minimal overall progress. Overall project progress that resulted in isolated examples of supported installation did not allow for the careful

identification of sites most suitable for demonstration. Without broader project progress a targeted approach to establishing demonstration sites was not possible. This also hindered project intentions to develop standard models for specific sectors.

The availability of financial support for installation was important for the Project concept but didn't materialise as planned hindering opportunities for scale-up. The availability of financial support, though loan interest subvention scheme was important to overall project success given the high level of initial outlay required for installation and the burden this represents for MSMEs. Despite this importance, the processes established to apply for financial support were lengthy and not sufficiently tailored to the capacities of industry stakeholders with overly cumbersome documentation requirements that acted as barriers to application.

Outcome 4: Increased Awareness and Capacity

Prolonged engagement for increased awareness and capacity was not maintained. Awareness raising activities such as business meets and workshops were appreciated and raised the profile of the CST applications. However, there was opportunity for the Project to follow-up with participants to discuss more specific CST applications and encourage investment and installation. This was not undertaken but would have been welcomed. Similarly, some training related to manufacturing and installation were conducted but without follow-up training regarding ongoing maintenance and troubleshooting there is a risk that the sub-projects installed will not be maintained

7.2. Recommendations

Recommendation 1: UNIDO should extend the project for a targeted two years at no cost. The plan for extension should incorporate the following points:

- 1 Consider alternative government partnerships, particularly with an engaged executing agency to ensure active implementation, and improved access to resources (expertise and finance) capable of supporting viable proposals in the pipeline.** The uncertainty associated with the availability of the subsidy contributed to poor Project progress. Given that all contracts have been de-obligated, UNIDO should emphasise to industry stakeholders that there is not financial assistance available to manage expectations and reduce uncertainty. Instead, UNIDO should promote the financial viability of CST as well as the availability of technical support for identifying and integrating technological solutions which represents important in-kind support and will save time and effort for MSMEs. operating under a different government executing agency that is committed to the project and convinced of its benefits to the industry, rather than continue under MNRE which clearly has its primary focus on renewable electricity and renewable fuels (not on renewable heating and cooling).
- 2 Pursue the substantial demand in the current pipeline, allowing sufficient time for national procurement, installation and commissioning of the CST systems.** There are sufficient remaining funds for the Project to continue support to the Projects in the pipeline based on a prioritization process. A no-cost extension would allow the Project to use the remaining funds to further progress CST and capitalise on the emerging momentum from activities already conducted.

- 3 **Ensure the availability of technical support to develop modular approaches to several focus industries and to prepare for sustainable avenues of support.** The generation of knowledge products and further training for the ongoing management of installations is important to safeguard the benefits of the Project. The Project could also consider establishing a technical support centre ensure ongoing benefits. Given the role that Protarget played in implementation, there is sufficient demand to establish a technical support centre to assist industry stakeholders in identifying the correct CST technological solution to meet their individual needs and to assist with capacity building for installation, maintenance and troubleshooting as well as the application process. Ensuring the availability of manuals for manufacturing, installation, maintenance and troubleshooting will also be important. Furthermore, a targeted approach with a finite number of focus sectors should be adopted. A focussed approach can provide more in-depth support to ensure successful tailoring and installation for broader demonstration that would be an effective pathway for upscaling.
- 4 **Strengthen capacity development approaches for local service providers.** Capacity needs assessments should be conducted and reflected in all phases at Project design. A comprehensive capacity assessment at design or linking with the previous UNDP CST technology to further investigate and understand the existing capacities would have either substantiated or disproved the assumption upon which the overall project approach was based. Such assessments would also help to focus Project activities where the capacity for implementation exists as an added assurance for viability and demonstration. Linking with existing technology institutes or commercial providers could provide a fee-for-service approach to technology support.

Recommendation 2: UNIDO should ensure improved project management and communications support to address current implementation weaknesses. The project management unit should focus on the following:

- 5 **Establish demonstration sites and respective skills transfer processes for scale up relevant to current and prospective industries where installations are available (not only project-supported sites).** Support to potential demonstration sites should be prioritized. The Projects with the strongest pre-feasibility studies should be prioritised and support planned specifically to highlight the financial and technical viability of CST. Prioritising support will allow for the deeper engagement which has been missing from the project to date to ensure the success of these sites. Where demonstration sites have not been established or applications received for a viable industry, UNIDO should approach external stakeholders to utilise installations not supported by the project for demonstration.
- 6 **Establish sustainability mechanisms for operation beyond the project.** Manuals for operation of CST technologies need to be developed and training conducted to facilitate ongoing use of the technology where it has been installed. CST needs to be promoted as a priority for renewable energy generation with awareness raising events and ongoing follow up required to increase understanding of the technology, increase national ownership and maintain momentum for continued interest in the technology.

7.3. Lessons Learned and Good Practices

Business meets (workshops) are appreciated and are a positive way to introduce new technologies to industry but require specific follow up. The overall effectiveness of the meets to achieve Project objectives was compromised by a lack of follow up engagement but stakeholder feedback suggests that they were a good format to attract initial interest.

When a new technical and innovative technology is introduced, it is important to build the demonstration effect in a focussed way to encourage scale up rather than adopting a broad scale approach.

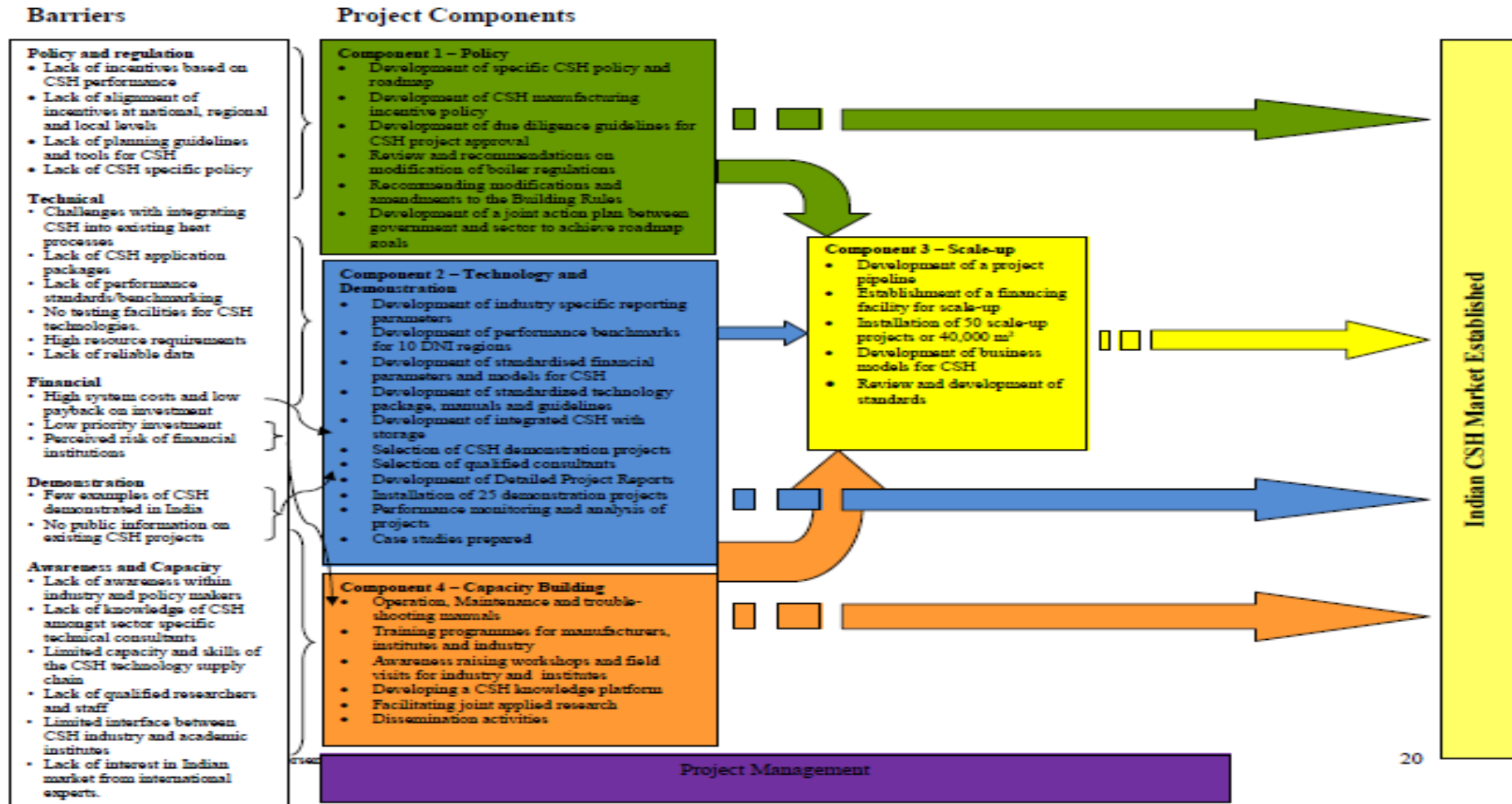
Where the lead ministry doesn't sufficiently engage, efforts need to be taken to identify a new partner to provide the strategic support required. Effective engagement at the national level is integral to project relevance, progress and sustainability. As seen in the states with an enabling environment, creating an environment that is conducive to new technologies and innovation is imperative.

Synergies with pre-existing national processes should be pursued wherever possible as a matter of coherence and efficiency. The Project could have taken advantage of opportunities for such synergies such as with the national BIS standards testing to avoid duplication and reduce the length of project processes which acted as a barrier to application for some industry stakeholders.

The application processes for financial support should be developed as part of Project design in collaboration with project partners to ensure they are agreed prior to partnership agreements and are streamlined and fit-for-purpose. Agreeing such processes at design would assist in ensuring the selection of partners is correct. Writing into the contract expected processes can assist with ensuring such processes are aligned with the objectives of both organisations as well as the national context.

Annexes

Annex 1. Project components to address identified barriers, included in design



Annex 2. Evaluation framework

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
RELEVANCE			
1. How relevant was the project to UNIDO?	<ul style="list-style-type: none"> Was the project a technically adequate solution to the development problem? Did the project respond to the cause of the problem? Did the project utilize UNIDO's comparative advantage? 	<ul style="list-style-type: none"> Training and capacity development activities (design, delivery and uptake) Satisfaction with training and results of uptake Review of assumptions & constraints. 	<ul style="list-style-type: none"> Document review Project records on training, # of participants (by gender) and any feedback results Stakeholder & participant Interviews
2. To what extent was the project suited to the priorities and policies of the target group, recipient and donor?	<ul style="list-style-type: none"> How did the project fulfil target group needs? To what extent was the project aligned with the development priorities of India? How did the project reflect donor policies and priorities? Are the original project objectives still valid and pertinent for the target group? 	<ul style="list-style-type: none"> Strategic assessment of India, donor and UNIDO priorities. Needs assessments and project response 	<ul style="list-style-type: none"> Strategic documents Supervision mission & project reports Government representative interviews UNIDO staff and stakeholder interviews Participant interviews & FGD
EFFICIENCY			
3. How economically were resource inputs converted to results?	<ul style="list-style-type: none"> How economically were resources used to produce results? 	<ul style="list-style-type: none"> Budget allocation and expenditure review 	<ul style="list-style-type: none"> Project and UNIDO financial & workplan records
4. Has the project done the right things, with good value for money?	<ul style="list-style-type: none"> To what extent were expected results achieved within the original budget? 	<ul style="list-style-type: none"> Comparison with other projects for approach and costs per participant. Counterfactual analysis 	<ul style="list-style-type: none"> Project staff and stakeholder interviews

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
	<ul style="list-style-type: none"> • What factors impacted the efficiency of achievement of results? • Did the project efficiently achieve results compared with alternative approaches? • What measures were taken during planning and implementation to ensure efficient use of resources? • Was there potential for greater results with the same resource inputs? • Were expected inputs from UNIDO, GEF and counterparts provided as planned? 		
5. How timely was the delivery of expected results?	<ul style="list-style-type: none"> • To what extent were expected results achieved within the original timeframe? • What factors impacted the efficiency of achievement of results? • Were project activities in line with scheduling in work plans? 	<ul style="list-style-type: none"> • Timeline review 	<ul style="list-style-type: none"> • UNIDO documents • Project documents • Project staff interviews • Stakeholder interviews • KPI Table
EFFECTIVENESS			
6. How well has the project performed? 7. Has the project done the right things?	<ul style="list-style-type: none"> • What is the quality of results? • How do stakeholders perceive results achieved? 	<ul style="list-style-type: none"> • Performance by component, activity & indicators • Stakeholder and participant perceptions on performance 	<ul style="list-style-type: none"> • Project documents • Progress reports & project database

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
	<ul style="list-style-type: none"> • Are results achieved attributable to the project? • Were intended target groups reached by project results? • Is there valid evidence of results achieved? 	<ul style="list-style-type: none"> • Field level assessment of targeting • Stakeholder and participant perceptions on targeting 	<ul style="list-style-type: none"> • Relevant government policies • Solar thermal energy industry documents • Stakeholder interviews • Participant interviews
<p>8. To what extent have the expected results been achieved or are likely to be achieved?</p> <p>9. What have been the project's key results (outputs, outcome and impact)?</p>	<ul style="list-style-type: none"> • For each project component were targets achieved? • What are the main results of the project at the output and outcome level? • What are the quantifiable results of the project? • Were different results achieved in different areas? What are the reasons for any variance? 	<ul style="list-style-type: none"> • Performance by component, activity & indicators • Project staff, stakeholder and participant feedback on results 	<ul style="list-style-type: none"> • Project documents • Progress reports & project database • Relevant government policies • Solar thermal energy industry documents • Promotional materials • Project social media • Evaluator observation at project sites • Staff and stakeholder interviews
<p>10. What are the key drivers and barriers to achieve the long-term objectives?</p>	<ul style="list-style-type: none"> • What factors have affected the achievement of expected results? • What factors have assisted towards the achievement of expected results? 	<ul style="list-style-type: none"> • Project staff, stakeholder and participant feedback on results 	<ul style="list-style-type: none"> • Project documents • Progress reports & project database • Solar energy industry documents • Evaluator observation at project sites • Staff and stakeholder interviews
COHERENCE			

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
11. To what extent was the project aligned with the global sustainable development agenda?	<ul style="list-style-type: none"> • To what extent was the project aligned with global frameworks? • Has the extent of alignment with global agendas changed over time? 	<ul style="list-style-type: none"> • Document review • Interviews with project staff 	<ul style="list-style-type: none"> • Project design documents • Staff and stakeholder interviews
12. To what extent does the project avoid duplication with other similar interventions?	<ul style="list-style-type: none"> • To what extent did the project design acknowledge the work of other development actors in the sector? • To what extent did project implementation address gaps in other interventions? 	<ul style="list-style-type: none"> • Document review\Interviews with project staff 	<ul style="list-style-type: none"> • Project design documents • Staff and stakeholder interviews
PROGRESS TO IMPACT			
13. Are there opportunities for broader impact from project results?	<ul style="list-style-type: none"> • To what extent are lessons and results from the project incorporated into broader stakeholder mandates and initiatives? • Has institutional change resulted from the project? • To what extent are the project's results replicable? • To what extent could the project's approach and results be implemented at a larger scale? 	<ul style="list-style-type: none"> • Strategic review of context • Institutional assessment 	<ul style="list-style-type: none"> • Document review • Relevant government policies • Staff and stakeholder interviews
14. What long term effects have been produced by the project?	<ul style="list-style-type: none"> • What difference has the project made for beneficiaries? 	<ul style="list-style-type: none"> • Project outcome indicator performance 	<ul style="list-style-type: none"> • Document review • Staff and stakeholder interviews

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
	<ul style="list-style-type: none"> • To what extent are changes attributable to project activities? • What are the social, economic and environmental effects, either short-, medium- or long-term, on a macro and micro level? 	<ul style="list-style-type: none"> • Strategic analysis of context for contribution to impact 	<ul style="list-style-type: none"> • Participant interviews and FGDs
15. What effects from the project were intended and unintended, both positive and negative?	<ul style="list-style-type: none"> • What environmental safeguard effects resulted from the project? • What economic performance effects resulted from the project? • What social inclusiveness effects resulted from the project? • Were any results transformational? What was the key change and causes? • Were project assumptions valid? 	<ul style="list-style-type: none"> • Contribution analysis from Theory of Change 	<ul style="list-style-type: none"> • Project documents • Staff and stakeholder interviews • Participant interviews and FGDs
16. To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long-term objectives?	<ul style="list-style-type: none"> • To what extent has the project contributed to reduced policy barriers? • To what extent has the project contributed to the application of new Solar Energy knowledge? • To what extent has the project contributed to Promoting business models 	<ul style="list-style-type: none"> • Contribution analysis from Theory of Change 	<ul style="list-style-type: none"> • Project documents • Staff and stakeholder interviews • Participant interviews and FGDs • Government stakeholder interviews

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
	for increasing penetration and scaling-up of <ul style="list-style-type: none"> • solar energy in India? • To what extent has the project contributed to the increased availability of new technology and infrastructure? 		
SUSTAINABILITY			
17. To what extent are the achieved results likely to sustain after the completion of the project? 18. To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long term objectives? 19. What are the key drivers and barriers to achieve the long term objectives?	<ul style="list-style-type: none"> • Will project results be sustained after the end of donor funding? • Does the project have an exit strategy? How likely is it this strategy will succeed? • To what extent have results and outputs been institutionalized? • What is the rate of uptake of new instruments and technologies? Will these rates be sustained/ improved? • Have improved systems been incorporated into state budgets? • Is adequate staffing and support being applied to continue processes? • What progress was made towards the conditions needed to address the long-term objectives? 	<ul style="list-style-type: none"> • Institutional assessment • Stakeholder feedback on sustainability initiatives • Project outcome indicator performance • Institutional assessment • Stakeholder feedback and documentation on budget allocations • Contribution analysis from Theory of Change 	<ul style="list-style-type: none"> • Project documents • Stakeholder and participant interviews/FGDs • Project documents • Document review • Stakeholder interviews • Synthesis of data sources

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
20. How resilient to risk are project benefits?	<ul style="list-style-type: none"> • What is the likelihood of financial and economic resources not being available beyond the end of the project? • Are there any social or political risks that may jeopardize the sustainability of project outcomes? • Is the level of stakeholder ownership sufficient to allow for the continuation of project benefits and outcomes? • Are stakeholders aware of the potential of continuing project benefits? • Is there sufficient public and stakeholder awareness of project activities and benefits to support the project's long-term project objectives? • Have risk management plans been established, including monitoring actions? 	<ul style="list-style-type: none"> • Risk analysis • Contribution analysis • Stakeholder and participant feedback on ownerships and risks 	<ul style="list-style-type: none"> • Synthesis of data sources • Stakeholder and participant interviews and FGDs.
PERFORMANCE OF PARTNERS			
21. What was the quality of implementation?	<ul style="list-style-type: none"> • To what extent did project executing entities deliver effectively? • To what extent did project executing entities focus on elements that were within 	<ul style="list-style-type: none"> • Feedback from project staff and donor representatives • Document review 	<ul style="list-style-type: none"> • Project documents • Interviews with project staff • Interviews with donor representatives

Key evaluation questions	Guiding sub-questions	Means of Measurement	Data Sources
	their control as a GEF implementing agency? <ul style="list-style-type: none"> • How well did the project executing entities identify and manage risks? 		
22. What was the quality of execution?	<ul style="list-style-type: none"> • Were funds used appropriately? • How successful was the procurement and contracting of goods and services? 	<ul style="list-style-type: none"> • Feedback from project staff and donor representatives • Document review 	<ul style="list-style-type: none"> • Project documents • Interviews with project staff • Interviews with donor representatives
LESSONS LEARNED			
23. What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?	<ul style="list-style-type: none"> • Has UNIDO and its partners documented and addressed the lessons in potential follow-on activities? • Have lessons learned identified during the mid-term review been actioned? 	<ul style="list-style-type: none"> • Performance by component, activity & indicators • Staff and stakeholder feedback on implementation lessons • Project staff, stakeholder and participant feedback on results 	<ul style="list-style-type: none"> • Document review • Project staff and stakeholder interviews • Synthesis of data sources

Annex 3. List of documentation reviewed

<i>Concentrating Solar Thermal System using Cocoon process at Uttarakhand Resham Federation Cooperation in Dehradun, Uttarakhand</i>
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<i>Karner, A & Verma, H, 2018, Mid-term Review of the UNIDO-supported GEF-financed project “Promoting business models for increasing penetration and scaling up of solar energy – India”</i>
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<i>Luit Renewable Pvt. Ltd. and Protarget, Solar effluent treatment and water recovery – Rajasthan, India</i>
<i>Luit Renewable Pvt. Ltd., Concentrated Solar Thermal Based Zero Liquid Discharge System</i>
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<i>Marsol Solar Pvt. Ltd, 2020, DPR for Loan under GEF-UNIDO-MNRE Project</i>

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MNRE Solar Thermal Division, 2016, <i>Minutes of the 2nd Project Executive Committee (PEC) Meeting of MNRE-GEF-UNIDO project</i>
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Annex 4. List of stakeholders consulted

1. Mr. Chintan Shah, Director (Technical) and P K Roy, IREDA, Delhi
2. Gaurav Patel, GERMI, Ahmedabad, Gujarat
3. Sharat Parihar, Ministry of Environment, Forests and Climate Change, Government of India
4. Sunil Mundra, National Capsules
5. Vibhas Garg, PwC Consultant
6. Dr. A. K. Tripathi, Director General, NISE
7. Mr. Y Raj, CEMCOT
8. Prof K Deshpande
9. Prakash Bhalekar, Quadsum
10. Shishir S Gaud, TERI
11. Sharad Pustake, Project Adviosur, Thane Municipal Corporation
12. Mr. Kandhari, UCRF, Uttarakhand
13. S Shanker Narayan, GM-TEDA
14. Mr. Arun Kamboj, Luit Renewables
15. Mr. J. S. Gandhi, Mr. Chandrashekhar, Mr. Prakash Makwana and Mr. Alark Kulkarni, National Dairy Development Board, Anand, Gujarat
16. Uday Shankar, Chief GM, ONGC
17. J Arunprakesh, Technical Officer, REAP, Puducherry
18. John Mitchell, Progtarest AG, German Echnical Consultancy
19. Mr. M A Aravindh, Ministry of New and Renewable Energy, Government of India

UNIDO team

1. Dr. Rene Van Berkel
2. Dr. Ashish K Sharma
3. Sailender Mishra
4. Pankaj Kumar

Annex 5. Rating System for Evaluation Criteria

Score		Definition	Category
6	Highly satisfactory	Level of achievement presents no shortcomings (90% - 100% achievement rate of planned expectations and targets).	SATISFACTORY
5	Satisfactory	Level of achievement presents minor shortcomings (70% - 89% achievement rate of planned expectations and targets).	
4	Moderately satisfactory	Level of achievement presents moderate shortcomings (50% - 69% achievement rate of planned expectations and targets).	
3	Moderately unsatisfactory	Level of achievement presents some significant shortcomings (30% - 49% achievement rate of planned expectations and targets).	UNSATISFACTORY
2	Unsatisfactory	Level of achievement presents major shortcomings (10% - 29% achievement rate of planned expectations and targets).	
1	Highly unsatisfactory	Level of achievement presents severe shortcomings (0% - 9% achievement rate of planned expectations and targets).	

UNIDO Rating	UNIDO Rating: Sustainability	GEF Rating: Sustainability
6	Highly likely (HL)	Likely (L)
5	Likely (L)	Moderately likely (ML)
4	Moderately likely (ML)	Moderately likely (ML)
3	Moderately unlikely (MU)	Moderately unlikely (MU)
2	Unlikely (U)	Moderately unlikely (MU)
1	Highly unlikely (HU)	Unlikely (U)

Annex 6. Results Framework

Data unavailable	Not achieved	1-50% achieved	50-99% achieved	Fully achieved
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Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
Objectives of the project - To reduce greenhouse gas (GHG) emissions through the use of CST for process heating and cooling	CO ₂ -eq emission reduction (tonnes of CO ₂ -eq) Energy generated from solar concentrators (in Kcal/KWhrs)	Direct CO ₂ -eq emission reductions Indirect CO ₂ -eq emission reductions 91 projects generating approximately 28,000,000 kcal daily (baseline energy generated from solar concentrators)	Cumulative reductions of GHG by about 83,000 - 166,000 tCO ₂ -eq over the period 2014-2034 187 MWh daily energy generated from CST through projects installed over the period 2014-2034	766.25 tCO ₂ -eq over the Project duration
Project component 1: Policy				
Outcome 1 - Favourable policy and regulatory environment created for solar energy applications in industry	Extent to which relevant policies and regulations are proposed and adopted			
Outputs - Set of recommendations and	Solar heating and cooling policy and roadmap	No of specific policy for CST for industrial purposes	Clear solar heating and cooling policy and roadmap published	Roadmap released in August 2019 but no solar heating and cooling policy developed

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
guidelines for policy makers developed	State specific policy to incentivize CST manufacturing	No of incentives for CST manufacturers	Clear manufacturing policy for CST	Review conducted that includes recommendations
	Due diligence guidelines for project approval	No of due diligence guidelines for MNRE project approval Limited number of projects approved and no of clear criteria for approval	Due diligence guidelines published	Due diligence guidelines available
	Proposal to modify boiler regulations and acts		Clear modifications to boiler regulations incorporating CST	Review or regulations conducted
	Proposal to modify building regulations to consider the use of CST	No of regulations to consider CST for new industry	Proposal for consideration of CST for new designated industry	Review of regulations conducted and recommendations made
	Solar Energy Quality Infrastructure			Solar Energy Quality Infrastructure Report prepared and available
Project component 2 Technology and Demonstration				

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
Outcome 2 - Technical and financial viability of projects confirmed Local manufacturing capability for solar energy systems in industrial applications enhanced Investment in solar energy applications in in industry increased	Volume of investment mobilized Tonnes of CO2-eq avoided	No of project 15 channel partners	25 projects 14 industry associations 20 channel partners	
Output 2.1 - Detailed technology application tools developed: integrated CST with storage; detailed project reports (DPR); CST demonstration project selected; qualified consultants selected; 25 demonstration projects installed; performance monitoring and analysis of projects; and case studies prepared	Number of industry specific reporting parameters for CST systems	No performance standards for CST	Standards developed for all 5 CST technologies from all channel partners	
	Number of performance benchmarks	No benchmarks	Benchmarks developed for 10 zones	A comparison of technologies in five different locations have been conducted which could inform the development of benchmarks
	Number of standardised financial models for CST	No standard model	Standard financial model developed	A report recommending a restructure of the subsidy scheme was developed but there has been no follow-up action on this
	Number of CST packages developed	No of CST packages and guidelines	10 CST packages and guidelines	Information packages developed for seven technologies (70% achieved)

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
	Number of process information booklets	No of process information booklets	11 process information booklets	Process mapping was undertaken for 12 sectors to inform the development of the roadmap. Report is available.
	Number of CST projects implemented with support from GEF	91 systems installed	25 additional projects implemented with direct support from GEF	2 projects implemented with Project support ⁵³ (1 additional project entered the pipeline but was implemented without support) (8%)
	Installed capacity of new CST projects (Kw and area)	0 installed	Installed capacity of more than 12.5 MW and 20,000m ²	0.58 MW (4.4%) and 871m ² (4.6%) installed with Project support (additional 1,590m ² and 1.06 MW without support)
	Performance monitoring, evaluation reports and case studies on each GEF supported project	No dissemination material on CST	25 case studies	2 case studies published (8%)

⁵³ UNIDO, 2020, *CST Project Pipeline under GEF UNIDO MNRE project on promoting business models for uptake and scaling up of solar energy in India*

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
Output 2.2 - Investment in solar energy applications in industry increases	Number of pilot systems of solar technologies installed Investment mobilized (USD)	Limited pilots and investment on solar thermal applications in industry	Up to 25 pilot systems	3 systems installed (2 with project support) (12%)
Project Component 3 - Scale up				
Outcome 3 - Investment in solar energy applications in industry multiplied Quality of solar energy components assured	No of CST projects installed and operating No of organisations applying to financing facility for CST projects			
Output 3.1 - Business models for CST leading to sustained replication of solar thermal applications in industry Quality assurance and certification framework in place	Business models in place	No business models	Up to 3 models developed	A soft-loan mechanism was established but was not highly effective and is unlikely to be maintained
	Number of MNRE standards developed	5 standards developed	Up to 8 standards developed	“The reports on a technology-wise standard of CST developed under the MNRE-GEF-UNDP project with the help of NISE, BIS, UNIDO, and the University of Pune.”
	Number of recommended certification schemes	None	Certification schemes recommended	Certification scheme recommended in Solar Energy Quality Infrastructure Report.

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
Output 3.2 - Financing facility for scale up established	Financing facility established	No financing facility available for CST	50 projects with 25 MW _{th} installed and approximately 40,000m ² 124 MW _{th} energy daily from projects A financing facility established	3 projects (6%) with 0.77 MW _{th} (3%) and 1,153m ² (2.9%) installed with Project support
Project Component 4 - Awareness raising and capacity building				
Outcome 4 - Capacity of key players in target industries enhanced Technology transfer and information sharing tools established	No of trained personnel No of training sessions provided Advice given to stakeholders			
Output 4.1 - Trained manufacturers, suppliers and installers	No of installation, operation, maintenance and trouble-shooting manuals for CST	No manuals	11 manuals	Manuals included in the technology information packages for seven technologies (63.6%)
	No of training sessions targeted at manufacturers, suppliers, installers and academics on CST	0	6	Delays in establishing partnership mechanisms meant no training activities were undertaken.

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
	No of trained manufacturers, suppliers and installers	0	120	Delays in establishing partnership mechanisms meant no training activities were undertaken.
	No of training sessions for it is and maintenance staff	0	10	Delays in establishing partnership mechanisms meant no training activities were undertaken.
	No of trained ITI students and maintenance staff	0	200	Delays in establishing partnership mechanisms meant no training activities were undertaken.
Output 4.2 - Awareness raised among the business community	No of workshops and field visits targeted at industry	none	20	21 workshops or business meets targeting industry stakeholders conducted ⁵⁴ 22 field visits conducted, unclear how many targeted industry
	Number of organisations attending awareness raising sessions	none	1000	More than 1,700 individual participants but data not recorded at the organisation level.

⁵⁴ 11 state level workshops conducted between January and July 2016, Business Meet on CST in Pondicherry in February 2018, Workshop on potential for CST in India in September 2017, National Workshop for application/integration of CST technologies to save cost and promote renewable energy in dairy sector in India in October 2015, Workshop on Applications of Solar Thermal Technologies in the Industrial Sector in February 2016, National Workshop in August 2019, Four business meets in June 2018

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
Output 4.3 - Technical capacity built through promotion of industry-academic partnerships	No of field visits for academics	none	20	22 field visits conducted, unclear how many targeted industry
	No of academic institutions attending field visits	0	200	Field visits were conducted but participant data was not sufficiently detailed
	No of guest lectures given on CST	0	20	24 guest lectures ⁵⁵
	Knowledge platform establishment	no	Knowledge platform established	Knowledge products developed available on UNIDO project website: https://open.unido.org/projects/IN/projects/130149
	Number of users of knowledge platform	none	200	Data not available
	Number of joint industry-academic applied research projects initiated	none	5	Not commenced due to contractual delays.
Output 4.4 - CST and project information shared	CST web portal established	none	1	Website not currently available
	Number of users of website per year	0	1000	Data not available
Output 4.5 - Documented project	Number of newsletters produced	0	20	3 issues of CST times published ⁵⁶ (15%)

⁵⁵ PIR 2018-2019 and 2019-2020

⁵⁶ July-August 2019, September-October and November-December 2019, and January to June 2020

Project strategy	Objectively verifiable indicators			Achievement
	Indicator	Baseline	Target	
outputs, case studies, best practices and lessons learned	Number of recipients of newsletters	0	2000	Data unavailable
	Number of brochures developed	0	20	3 issues of Sun Focus Magazine ⁵⁷ and one technology information package published. (15%)
	Number of industrial clusters advertising CST	0	15	Information about Project available on the websites of: Council of Leather Exporters and India Filings and has been covered by Indian industrial Association ⁵⁸ (20%)
	Number of adverts in national press	0	10	47 advertisements ⁵⁹
	National workshop	0	1	National workshop in 2019

⁵⁷ July-September 2019, November-December 2019, and December 2020

⁵⁸ IndiaFilings is India's largest cloud-based business services platform

⁵⁹ PIR 2017-2018,2018-2019,2019-2020

Annex 7. The Uttarakhand Cooperative Resham Federation Case Study

Introduction

The CST system at the Uttarakhand Cooperative Resham Federation (UCRF), is one of the four CST systems that was identified under the UNIDO CST project. It brings together a number of different actors for the project implementation process. These include UCRF, the organisation that has installed the CST system and its central department the Department of Sericulture, the central ministry MNRE, and the State department Uttarakhand Renewable Energy Development Agency (UREDA). Technical support was provided by UNIDO, and part funding was provided by UNDP. The system installer is Ultra Conserve of Mumbai. This project thereby brings together different government and UN agencies to help demonstrate the technology in the textile sector in Uttarakhand.

The Department of Sericulture, under the Textile Ministry, aims at promoting the silk industry in the country. UCRF, of the Department of Sericulture is headquartered in Dehradun of Uttarakhand and is engaged in the promotion of sericulture for the state. Presently 22 silkworm rearing cooperative societies, 10 reeling cooperative societies, 112 self-help groups and 16 nongovernment organizations are functioning under the umbrella cover of this federation.

Process

As a part of initial awareness activities for the promotion of the CST technology, UNIDO, partnered with a number of state energy departments, such as UREDA for awareness workshops to promote the technology and its benefits. In Uttarakhand, an awareness workshop was held in January 2016. The workshop created awareness on the CST technologies and brought together different stakeholders in Haridwar for idea exchange and learning. This was followed by field visits to two organizations that have used the CST technology. In the Dehradun-Haridwar region, there has been activities by the state government to encourage transition from fuelwood to alternative and more environmentally friendly fuels in response to concerns of deforestation. These factors contributed to keen interest in the workshop. This resulted in three agencies coming forward to express their interest in setting up a CST system. Of the three, UREDA selected UCRF to further support the setting up of a CST system.

Following this, UNIDO provided technical support and undertook a feasibility study to identify the most appropriate CST technology for UCRF. This feasibility study was a crucial part of the process and has supported the MNRE, and its state arms, given that there are often no specialized personnel within these agencies. A non-imaging concentrating system, or the compound parabolic concentrator was identified as the most suitable technology. Based on the identified technology, UREDA called for tenders, from all MNRE empaneled CST manufacturing firms. Of the responding manufactures, Ultra Conserve Pvt Ltd.'s technical and financial proposals were accepted. After installation, UCRF identified a group of women who were then trained by Ultra Conserve for the day-to-day maintenance of the system. Ultra Conserve was also given a 5-year annual maintenance contract within which they would also prepare the identified group of women to manage the system properly.

As a government agency, there were some concerns around UCRF applying for loans. As an alternative, UCRF instead made use of government subsidies. As part of this process, UNIDO worked with the Department of Sericulture to finalise the possible sources of

funding. The financial support was a combination of support from UREDA of INR 21,25,440 and UNDP of another INR 7,08,000.

System Description

This sub-project has 90 Compound Parabolic Concentrators (CPCs) with 295.5m² of collector area, with an operating temperature of 90°C at a 1 bar pressure and a thermal output of 103,000 kcl/day. The CPC with a reflector fabricated in the shape of two meeting parabolas, and non-imaging collector, is deemed to be the collector with the highest concentrating ratio at this scale. This technology combines the high-efficiency evacuated system plus solar-radiation concentrating system with copper U-tube aluminium fins for heat transfer. A closed loop with the solar collector array consists of a Plate Heat Exchanger (PHE) with a cold-water line passing through, series and parallel connection with an expansion tank, pump and other components. The water passing through the PHE is then heated to 90°C to be used in the silk reeling process. It is estimated that this can save up to 50% of fuelwood for water heating, on days where the system is used between seven and eight hours a day. The system is installed directly on the ground and the total cost was INR 62,30,000.

Initial studies conducted in May suggested that this CST system could operate from 8.00 AM to 4.30 PM with an average operating time of between seven and eight hours depending on availability of sunshine. The study then expanded for a period of 4 months between May and August 2017 on the actual functioning of the CPC system at the UCRF. This study suggested a hot water range of between approximately 4.5 hours and 7.7 hours a day equating to between 4.19 and 2.74 kWh/m²/day. Given that this study included the monsoon month of August with skies that are likely to be at least partially cloudy, the study suggests that the system can run all year round, even though its working may not be constant. Based on a 15-day study with the CST system working between seven and eight hours, about 415 kg of fuelwood was saved in a day.

Use of the System

The members of the cooperatives, bring their cocoons at the UCRF centre for drying and reeling. The cocoons brought here are first sorted for quality, and then as appropriate they are dried and with the use of a pressure stream degummed, and finally reeled. For this process the Federation has a total of 20 women. Women also maintain the CST system developed for UCRF at Dehradun.

Success and Benefits

This project, while responding to the increasing pressure to reduce fuelwood consumption in the Dehradun area, is also reducing wood consumption and the release of carbon into the atmosphere. This also has a positive impact on the local hill areas, from where the wood is sourced, and are facing increasing denudation and risk of landslides with increasing use of wood. Clean energy also results in a better working environment in the silk reeling unit and its surroundings, and therefore better health.

It is also the first CST system maintained by women in the UNIDO project's portfolio. The women have been trained by the installer, Ultra Conserve, for the systems day-to-day management. Therefore, apart from improving the working conditions of at the UCRF centre, this has also supported employment of additional women for system management.

As the Silk Federation works at low margins, reduced recurring costs, such as that of fuelwood, improves financial outcomes for the Federation through increased profits.

Challenges

There however, continue to be some challenges with the management of the system. Such challenges have increased recently due to the unforeseeable COVID-19 pandemic. While the women have been trained in the regular maintenance activities, specific issues and annual maintenance requires specialists, equipment and in some cases part replacement. However, in Uttarakhand CSTs are a relatively new concept, and therefore there are limited number of users, resulting in limited availability of service providers and parts locally. As such, running and maintenance costs are high, and trained specialists must travel from other areas, increasing costs.

Annex 8. Project Terms of Reference



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

TERMS OF REFERENCE

Independent terminal evaluation of project

[Title]

UNIDO ID: [Status]

GEF Project ID: 4788

March 2021

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I. PROJECT BACKGROUND AND CONTEXT

1. Project factsheet⁶⁰

Project title	[Title]
UNIDO ID	[Status]
GEF Project ID	4788
Region	South Asia
Country(ies)	India
Project donor(s)	GEF
Project implementation start date	15 January 2014
Expected duration	60 months (as at CEO endorsement. So far 96 months)
Expected implementation end date	31 January 2021
GEF Focal Areas and Operational Project	GEF 5- CCM3: Promote investments in renewable energy technologies
Implementing agency(ies)	UNIDO
Government coordinating agency	Ministry of New and Renewable Energy (MNRE), Government of India
Donor funding	US\$ 4,365,174
Project GEF CEO endorsement / approval date	15 January 2014
UNIDO input (USD)	US\$ 75,000 (grant) and US\$ 75,000 (in kind)
Co-financing at CEO Endorsement, as applicable	US\$ 21,825,870
Total project cost (USD), excluding support costs and PPG	US\$ 26,191,044
Mid-term review date	November 2017
Planned terminal evaluation date	March – June 2021

(Source: Project document)

2. Project context

India is a lower-middle income country, having population of 1.366 billion. India was until 2019 the fastest-growing trillion-dollar economy in the world and the fifth-largest overall, with a nominal GDP of USD2.87 trillion in 2019. India's economic growth declined to an 11 year low in FY 2019-2020 of 4.4%. India's economy and society have since then been severely impacted by the onset of the COVID-19 pandemic in 2020, the 2.5 months national lockdown resulting in declines and losses of business, incomes and livelihoods.

⁶⁰ Data to be validated by the Consultant

Under its Nationally Determined Contributions (NDCs) to the Paris climate agreement, India has agreed to reduce the greenhouse gas (GHG) intensity of its economy by 33-35% by 2030, relative to 2005 levels. Therefore, India has stepped up its policy drive and regulatory and market incentives to scale up and speed up both energy efficiency as well as transition to renewable energy. The Ministry of New and Renewable Energy (MNRE) initiates and coordinates the development of the renewable energy sector in India.

The industrial sector is responsible for 56% of final energy consumption in India. In manufacturing sector segment, some 74% of energy is used for heating and cooling. Of this heating and cooling demand, about half is required in low to medium heat range, not exceeding 380-400°C. This includes diverse '*light*' manufacturing sectors which exclusively require low and medium heat typically for heating, drying, sanitizing and alike processes, in sectors as diverse as food processing, textile and garments, leather, pharmaceuticals, metal finishing etc. These low to medium heat applications are particularly targeted in the present project, as candidates for installation of solar process heating and cooling, using so called Concentrated Solar Thermal (CST) technologies (also referred to as Concentrated Solar Heating (CSH)).

CST systems use mirrors to concentrate sunlight onto a receiver, which collects and transforms solar energy into heat which is then transferred into a heat transfer fluid – typically hot water, steam or another thermal fluid. Different designs and shapes of mirrors and receivers are in use and can achieve different temperatures for the heat transfer fluid. This fluid is then conveyed to the heat requiring process for heating or fed into absorption chiller for cooling. Optionally, the heated thermal fluid can be stored in insulated tanks for use during night hours, i.e. thermal energy storage.

The project confirmed a market potential for CST for process heating and cooling in India of 6.5 GW_{th}, whereas by 2017 the cumulative installed capacity was in the range of 50 MW_{th}, hence, less than 0.1% of assessed market potential. Widespread application of CST is still hampered by: unfamiliarity of the technology and its applications; the requirement for custom design and engineering of CST systems to specific heating and cooling requirements ('integration engineering'); reliance on imports for specialized components (shaped mirrors, receivers, etc.); and high costs and associated long payback times (despite competitive project lifetime heating and cooling costs). The project was therefore conceived to initiate a market transformation for CST for process heating and cooling in India.

3. Project objective and expected outcomes

The overall project's objective is to develop and promote business models for implementation of solar energy-based heating and cooling applications in selected industrial sectors to reduce greenhouse gas (GHG) emissions. The project deploys a focused approach by zooming in on those (light) industrial sectors that given the technical performance range of solar thermal technologies and the sector's specific heating and cooling requirement, provide the best match, and, hence, offer best potential

for short to medium term techno-economic feasibility of solar thermal technologies, particularly of CST. Developing and demonstrating CST applications in those priority sectors constitutes the core of the project, supported by enabling activities aimed at policy and (industry) capacity building through awareness and skills initiatives.

Component 1: Strengthening of policy and institutional framework

Outcome 1: Favorable policy and regulatory environmental created for solar energy applications

Output 1.1: Set of policy recommendations and guidelines for policy makers developed

Component 2: Technology investment and application

Outcome 2: Technical and financial viability of projects confirmed, local manufacturing capability for solar energy systems in industrial applications enhanced and investments in solar energy application in industry increased

Output 2.1: Detailed technology application tools developed, such as: integrated CST with energy storage; detailed project reports (DPRs); CST demonstrations selected, installed and performance evaluated; qualified consultants; and case studies.

Output 2.2: Investment in solar energy applications in industry increased

Component 3: Scale up.

Outcome 3: Investment in solar energy applications in industry multiplied and quality of solar energy components assured

Output 3.1: Business models for CST leading to sustained replication of solar thermal applications in industry and quality assurance and certification framework in place

Output 3.2: Financing facility for scale-up established

Component 4: Awareness raising and capacity building

Outcome 4: Capacity of key players in target industries enhance and technology transfer and information sharing tools established.

Output 4.1: Trained manufacturers, suppliers and installers

Output 4.2: Awareness raised among the business community

Output 4.3: Technical capacity built through the promotion of industry academic partnership

Output 4.4: CST and project information shared

Output 4.5: Documented project outputs, case studies, best practices and lessons learned

4. Project implementation arrangements

UNIDO is the GEF implementing agency and leading the project in terms of planning, strategic guidance and coordination. MNRE is the execution agency. Project oversight is being provided by the Project Steering and Advisory Committee (PSAC), chaired by the Secretary MNRE, with participation of the Ministry of Environment, Forest and Climate Change (MoEFCC, also GEF Operational Focal Point), Department for Promotion of Industry and Internal Trade (DPIIT, line ministry for UNIDO) and the India Renewable Energy Development Agency (IREDA). Furthermore, a Project Executive Committee (PEC) was established between MNRE and UNIDO, chaired by the Joint Secretary.

At the request of MNRE and with approval of the PSAC, UNIDO provided execution support services, in particular for entering into contracts with service providers for agreed work-packages, including as fund manager for provision on financing support to pilot projects (through IREDA, as previously determined in the project preparation phase and included in the Project Document (/CEO Endorsement Document)) and for technical support and communication and publication services (based on competitive tendering). Within the framework of its execution support services, UNIDO also operated the project management unit (PMU), including its staffing and hosting.

In view of the continued perceived low interest in and techno-economic viability of solar thermal technology, particularly in comparison to the rapid advancement and deployment of photo-voltaic (PV) solar electric technology, CST did, over the project period, become a posteriority for MNRE, leading to its termination of the solar thermal capital grant support scheme as of 31 March 2020. Moreover, in 2020, the onset of COVID19 pandemic, the necessary lock down and resulting economic crisis, seriously dented both interest in and financial capability of pilot project proponents to invest in CST and complete installations of agreed CST pilot projects. In view thereof, MNRE desired to effectuate the earlier approved end date of 31 January 2021, in preference to requesting a further final extension to allow adequate time for full completion of all planned project activities.

5. Main findings of the mid-term review

In accordance with GEF and UNIDO requirements an independent Mid Term Review (MTR) was conducted by international and national evaluators during November 2017-January 2018. The key findings of the MTR were as follows:

- **The overall rating of the Project at MTR stage was Moderately satisfactory.**
- The Project had made **satisfactory progress on outcomes 1-2** so far, although outcome 2 has been delayed, as a major output has still to be realised. **Under outcome 3, progress was only moderately satisfactory**, due to the missing investment projects. **Outcome 4 was also rated as moderately satisfactory**, since the Project had yet to provide visible outputs such as a central knowledge management platform on the promotion and capacity building concerning CST technologies across the country. The project had until then decided to use the UNIDO global website (<https://open.unido.org/projects/IN/projects/130149>) instead of creating a project specific website. However, the website provided only limited information on the UNIDO-GEF project and was lacking the functionality and contents of an overarching online information platform on CST technology and applications in the country.
- **Overall, the progress towards outcome achievement followed the project log frame and indicators provided with the Work Plan.** Special attention was paid until then to the Recommendations and guidelines for policy makers developed under Outcome 1 including e.g. the submission of a draft CST Roadmap, and draft policy documents (e.g. boiler regulations) as well demonstration projects (Outcome 2), where a higher number of projects than initially foreseen were then expected to lead to the achievement of direct energy savings as planned.
- **Nevertheless, it was reasonably expected that the project could achieve the implementation of demonstration projects with a target of 45,000 m² of CST plants to be installed**, with a 187 MWh daily energy generated from CST through projects installed over the period 2014-2034 and a cumulative reduction of GHG by about (83,000+ 166000) tCO₂-eq over the period 2014-34.
- Scaling-up activities was expected to result in the establishment of a financing facility for the installation of at least another 50 CST projects with 25 MW_{th} installed and approximately 124 MWh energy produced daily from projects
- **The Project was considered Relevant** mainly because of Government's Policy and promotional measures, as well as the catering to the high potential of CST available within the targeted industry sectors in India. Although the Project was not fully on track regarding implementation, the relevance of the topic remained high for the Indian government. Project stakeholders and cooperation partners were fully committed to proceed with the activities according plan, although timing was lagging. Stronger co-ordination between project management and political decision-makers (e.g. through the PSAC and PEC) was considered to be required in the second period to get the necessary political commitments and strategies (e.g. CST Roadmap) off the ground. IREDA had a full-fledged soft loan scheme for supporting CST systems in place which seemed properly for addressing the needs of the market, especially of larger industries. Yet, the number of projects and a confirmed pipeline were lacking and required the Project's deep focus in the remaining implementation period.
- **The Project was Appropriately Designed** providing reasonable coverage to the needful requirements of CST ecosystem in India and positioning of key stakeholders.

- **Project efficiency was rated Moderately Satisfactory**, even with the successful precedence of the UNDP-GEF CST project. Government subsidy scheme, supportive financing and R&D institution, and ample opportunity for the CST in industrial applications would then still need to be realised. The cost effectiveness of the Project had been ‘satisfactory’, based on the fact that Project expenditures achieved so far reflect achievements that (in general) follow the results framework’s targets, and seemed to be largely achievable by end of project.
- **The project was overall professionally managed and administered, and had delivered satisfactory results by now.** As for the planned remaining activities, continuous review of work plan against available resources and likelihood of timely implementation needed to be properly taken care of and results evaluated and monitored against their outcomes and impacts.
- **The likelihood of CST Project achieving its expected impact was Moderately Likely (ML).** Given its focus on addressing policy and technical capacity barriers, this project would be expected to generate the biggest share of GHG emission savings after the project implementation period, when the CST Roadmap, new guidelines and policies would be in place, capacity built, and the training programmes established that will deploy their full impact in terms of new CST projects.
- Taking into consideration the prevailing risks and the mitigation strategies to be considered by the Project, the **sustainability prospects are rated Likely**. Factors affecting sustainability in the long-term were identified as a fully supportive policy and institutional framework being in place, continued focus on industrial sectors’ needs (awareness, capacity, financing models, standards) and knowledge management platform in place (“one-stop-shop” information source about CST). Manufacturers and Suppliers had progressed with installations even during the no subsidy period. A few activities on awareness raising and capacity building had been implemented. UNIDO had partnered with National Institute for Solar Energy (NISE) to propose a skill development programme for the CST sector under the capacity building initiatives, which was delayed but seemed to be moving forward at time of MTR. Under the partnership with NISE, an international organization would be expected to be involved in the capacity building activities towards industrial integration of CST.
- The completion date of the Project had been initially foreseen for December 2018. Given the previous delays in the project launch, resulted delays during implementation so far and longer gestation time required for the larger-scale pilots to be implemented, a project extension opportunity would seem necessary. A date for realistic finalization would need to be proposed by the PMU in accordance with the executing partners and UNIDO. MTR experts suggested at least 12 months (considering 10 months delayed project start the overall duration will increase from 60 to 72 months).

The MTR team provided the following recommendations

1. The Project had been acknowledged as Highly Relevant from all the corners, and is well positioned to facilitate a sustainable growth for the industrial sector. The **Project however required a higher visibility and support from its partners and stakeholders.**
2. In addition, **parallel progress on all the project components would be required moving forward** to avoid a risk of ‘time run outs’ for its lagging components and improve on its overall efficiency.

3. **The Project would require greater engagement of stakeholders** so as to capitalise upon active and synergistic multi-stakeholder dynamics to achieve its planned outcomes and ensure lasting effectiveness. Specifically, from Ministry of MSME, NISE, Industry Associations and successful technology suppliers.
4. **Project has High Sustainability prospects, however the same required successful pilots to showcasing** on a broad geographic & sectoral landscape and not just on limited horizon.
5. **Project needed to directly reach out to industrial units**, building their confidence, to realize and demonstrate synergistic and successfully engineered approach in bringing together contributing actors and making initial pilots take off successfully on the ground.
6. The **Project would have to demonstrate technical solutions and technical assistance support** to overcome initial technology barriers by **providing engineering specifications for different CST systems integrated into industrial processes, standardised equipment and technical standards** for them to comply with and all consideration regarding maintenance works
7. Like the case of Indian Tea Association (ITA), the **Project could reach out to various targeted sector specific associations in the Industrial Clusters for assessing opportunities for CST applications and work out innovative business models** over and above the present financing model.
8. Industrial sector could be engaged to utilise CST applications within their mandatory Corporate Social Responsibility (CSR) projects. This might help industry to gain technical confidence on CST for direct integration within their industrial applications.

Specifically, in regards to project management, the MTR experts highly recommended:

1. To formally revise project log frame to be in line with component/output descriptions in CEO Endorsement Document, and align the structure of Project Implementation Reports (PIRs) and Annual Work Plans (AWPs) accordingly;
2. Generally, to improve the AWPs: the timeline for the different tasks are very generic and not specific time-bound (e.g. no dates when individual tasks shall be achieved, tasks repeating over years);
3. To develop a Monitoring and Evaluation (M&E) strategy for the pilot projects and keep an eye on monitoring results, included targeted indicators **Develop a specific awareness and public outreach strategy considering the development of a CST web portal and overall knowledge management platform**. This mainly, in order to increase the public perception of CST technologies and improve awareness and knowledge.

6. Budget information

Table 8. Financing plan summary

USD\$	<i>Project Preparation</i>	<i>Project</i>	<i>Total (US\$)</i>
Financing (GEF /)	80,000	4,365,174	4,445,174
Co-financing (Cash and In-kind), UNIDO and others	55,766	21,825,870	21,881,636
Total (US\$)	135,766	26,191,044	26,326,810

Source: CEO endorsement document

Table 9. Financing plan summary - Outcome breakdown

Project components	Donor (GEF/) (US\$)	Co-Financing (US\$)	Total (US\$)
PC1- Policy framework	150,000	750,000	900,000
PC2- Technology investment and application			
• Technical assistance	500,000	2,500,000	3,000,000
• investment	1,875,000	9,375,000	11,250,000
PC3- Scaling up			
• Technical assistance	207,309	1,036,545	1,243,854
• Investment	1,000,000	5,625,000	6,625,000
PC4- Awareness and capacity building	275,000	1,350,000	1,625,000
PC5- Monitoring, Evaluation and knowledge management	150,000	150,000	300,000
Total (US\$)	4,365,174	21,825,870	26,191,044

Source: CEO endorsement document

Table 10. Co-Financing source breakdown

Name of Co-financier (source)	In-kind	Cash	Total Amount (US\$)
MNRE			
<i>National Government</i>	300,000	6,432,192	6,732,192
IREDA			
<i>National Government</i>		14,943,678	14,943,678
UNIDO			
<i>Implementing Agency</i>	75,000	75,000	150,000
Total Co-financing (US\$)	375,000	21,450,870	21,825,870

Source : Project document

Table 11. UNIDO budget execution in USD (Grant 2000002554)

	Payments (d)	Expenditure (c+d)
Year	USD	USD
2014	46,248.83	49,736.13
2015	1,50,843.69	21,83,091.77
2016	2,32,312.49	3,01,005.34
2017	2,89,699.35	3,94,646.01
2018	2,97,646.07	3,08,479.77
2019	2,17,074.60	1,89,576.59
2020	2,55,727.36	2,88,668.45
2021	14,847.86	29,243.50
total	15,04,400.25	37,44,447.56

Component	Budget	Payments made	Expenditures (incl payments)	Funds Available	% expended
Evaluation	45,000			45,000	0.0%
Output 1	1,48,583	1,00,084	1,24,729	23,854	83.9%
Output 2	27,13,357	5,88,200	25,69,865	1,43,492	94.7%
Output 3	6,08,895	1,95,799	3,29,052	2,79,844	54.0%
Output 4	4,50,501	2,59,781	3,59,199	91,302	79.7%
Output 5	,98,838	3,60,536	3,61,603	37,235	90.7%
Grand Total	43,65,174	15,04,400	37,44,448	6,20,726	85.8%

Source: UNIDO DATABASE, as of 31 January 2021 (accessed 19 Feb 2021)

II. Scope and purpose of the evaluation

The purpose of the evaluation is to independently assess the project to help UNIDO, Government of India and GEF to improve performance and results of ongoing and future programmes and projects. The independent terminal evaluation (TE) will cover the whole duration of the project from its starting date in January 2014 until its mid-course operational discontinuation as of 31 January 2021.

The evaluation has two specific objectives:

- (i) Assess the project performance in terms of relevance, effectiveness, efficiency, sustainability and progress to impact; and
- (ii) Develop a series of findings, lessons and recommendations for enhancing the design of new and implementation of ongoing projects by UNIDO.

III. Evaluation approach and methodology

This TE will be conducted in accordance with the UNIDO Evaluation Policy⁶¹ and the UNIDO Guidelines for the Technical Cooperation Project and Project Cycle⁶². In addition, the GEF Guidelines for GEF Agencies in Conducting Terminal Evaluations, the GEF Monitoring and Evaluation Policy and the GEF Minimum Fiduciary Standards for GEF Implementing and Executing Agencies will be applied.

The evaluation will be carried out as an independent in-depth evaluation using a participatory approach whereby all key parties associated with the project will be informed and consulted throughout the evaluation. The evaluation team leader will liaise with the UNIDO Independent Evaluation Division (ODG/EIO/IED) on the conduct of the evaluation and methodological issues. *In view of ongoing COVID19 pandemic, no mission of international evaluator is foreseen. The national evaluator will conduct fact finding interviews with stakeholders and field visits to project sites. Whenever it is necessary the interviews will be conducted virtually, with the participation of the international evaluator.*

The evaluation will use a theory of change approach and mixed methods to collect data and information from a range of sources and informants. It will pay attention to triangulating the data and information collected before forming its assessment. This is essential to ensure an evidence-based and credible evaluation, with robust analytical underpinning.

The theory of change will identify causal and transformational pathways from the project outputs to outcomes and longer-term impacts, and drivers as well as barriers to achieve them. The learning from this analysis will be useful to feed into the design of the future projects so that the management team can effectively manage them based on results.

1. Data collection methods

Following are the main instruments for data collection:

- (a) **Desk and literature review** of documents related to the project, including but not limited to:
- The original project document, monitoring reports (such as progress and financial reports, mid-term review report, output reports, back-to-office mission report(s), end-of-contract report(s) and relevant correspondence.
 - Notes from the meetings of committees involved in the project.

⁶¹ UNIDO. (2015). Director General's Bulletin: Evaluation Policy (UNIDO/DGB/(M).98/Rev.1)

⁶² UNIDO. (2006). Director-General's Administrative Instruction No. 17/Rev.1: Guidelines for the Technical Cooperation Programme and Project Cycle (DGA1.17/Rev.1, 24 August 2006)

- (b) **Stakeholder consultations** will be conducted through structured and semi-structured interviews and focus group discussion. Key stakeholders to be interviewed include:
- UNIDO Management and staff involved in the project; and
 - Representatives of donors, counterparts and stakeholders.
- (c) **Field visit** to project sites in India, subject to assessment and clearance of COVID associated travel risks.
- On-site observation of results achieved by the project, including interviews of actual and potential beneficiaries of installed pilot projects;
 - Interviews with the representatives of the UNIDO Regional Office to the extent that he/she was involved in the project, and the project's management members and the various national [and sub-regional] authorities dealing with project activities as necessary.

2. Evaluation key questions and criteria

The key evaluation questions are the following:

- (b) What are the key drivers and barriers to achieve the long-term objectives? To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long-term objectives?
- (c) How well has the project performed? Has the project done the right things? Has the project done things right, with good value for money?
- (d) What have been the project's key results (outputs, outcome and impact)? To what extent have the expected results been achieved or are likely to be achieved? To what extent the achieved results will sustain after the completion of the project?
- (e) What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?

The evaluation will assess the likelihood of sustainability of the project results after the project completion. The assessment will identify key risks (e.g. in terms of financial, socio-political, institutional and environmental risks) and explain how these risks may affect the continuation of results after the project ends. Table 12 below provides the key evaluation criteria to be assessed by the evaluation. The details questions to assess each evaluation criterion are in annex 2 of the UNIDO Evaluation Manual.

Table 12. Project evaluation criteria

#	Evaluation criteria	Mandatory rating
A	Impact	Yes
B	Project design	Yes
1	• Overall design	Yes
2	• Logframe	Yes
C	Project performance	Yes
1	• Relevance	Yes
2	• Effectiveness	Yes
3	• Efficiency	Yes
4	• Sustainability of benefits	Yes
D	Cross-cutting performance criteria	

#	Evaluation criteria	Mandatory rating
1	• Gender mainstreaming	Yes
2	• M&E: ✓ M&E design ✓ M&E implementation	Yes
3	• Results-based Management (RBM)	Yes
E	Performance of partners	
1	• UNIDO	Yes
2	• National counterparts	Yes
3	• Donor	Yes
F	Overall assessment	Yes

Performance of project partners

The assessment of performance of partners will ***include*** the quality of implementation and execution of the GEF Agencies (hence UNIDO) and project executing agencies (EAs, hence MNRE) in discharging their expected roles and responsibilities. The assessment will take into account the following:

- Quality of Implementation, e.g. the extent to which the agency delivered effectively, with focus on elements that were controllable from the given GEF Agency's perspective and how well risks were identified and managed.
- Quality of Execution, e.g. the appropriate use of funds, procurement and contracting of goods and services.

Other Assessments required by the GEF for GEF-funded projects:

The terminal evaluation will assess the following topics, for which ***ratings are not required:***

- Need for follow-up:** e.g. in instances financial mismanagement, unintended negative impacts or risks.
- Materialization of co-financing:** e.g. the extent to which the expected co-financing materialized, whether co-financing was administered by the project management or by some other organization; whether and how shortfall or excess in co-financing affected project results.
- Environmental and Social Safeguards⁶³:** appropriate environmental and social safeguards were addressed in the project's design and implementation, e.g. preventive or mitigation measures for any foreseeable adverse effects and/or harm to environment or to any stakeholder.

⁶³ Refer to GEF/C.41/10/Rev.1 available at: http://www.thegef.org/sites/default/files/council-meetingdocuments/C.41.10.Rev_1.Policy_on_Environmental_and_Social_Safeguards.Final%20of%20Nov%2018.pdf

3. Rating system

In line with the practice adopted by many development agencies, the UNIDO Independent Evaluation Division uses a six-point rating system, where 6 is the highest score (highly satisfactory) and 1 is the lowest (highly unsatisfactory) as per **Error! Reference source not found.**

Table 6. Project rating criteria

Score		Definition	Category
6	Highly satisfactory	Level of achievement presents no shortcomings (90% - 100% achievement rate of planned expectations and targets).	SATISFACTORY
5	Satisfactory	Level of achievement presents minor shortcomings (70% - 89% achievement rate of planned expectations and targets).	
4	Moderately satisfactory	Level of achievement presents moderate shortcomings (50% - 69% achievement rate of planned expectations and targets).	
3	Moderately unsatisfactory	Level of achievement presents some significant shortcomings (30% - 49% achievement rate of planned expectations and targets).	UNSATISFACTORY
2	Unsatisfactory	Level of achievement presents major shortcomings (10% - 29% achievement rate of planned expectations and targets).	
1	Highly unsatisfactory	Level of achievement presents severe shortcomings (0% - 9% achievement rate of planned expectations and targets).	

IV. Evaluation process

The evaluation will be conducted during March – June 2021. The evaluation will be implemented in five phases which are not strictly sequential, but in many cases iterative, conducted in parallel and partly overlapping:

- i. Inception phase: The evaluation team will prepare the inception report providing details on the methodology for the evaluation and include an evaluation matrix with specific issues for the evaluation; the specific site visits will be determined during the inception phase, taking into consideration the findings and recommendations of the mid-term review.
- ii. Desk review and data analysis;
- iii. Interviews, survey and literature review;
- iv. Field visit;
- v. Data analysis and report writing.

IED will be responsible for the final evaluation report issuance and distribution with the respective management response sheet and further follow-up, and publication of evaluation report in UNIDO intra/internet sites

V. Time schedule and deliverables

The evaluation is scheduled to take place from March to June 2021. The tentative timelines are provided in Table 7.

The evaluation team will give an online debriefing and presentation of the preliminary findings of the terminal evaluation to the relevant stakeholders. The draft TE report is to be shared with the Government executing agency (MNRE), UNIDO PM, UNIDO Independent Evaluation Division, the UNIDO GEF Coordinator and GEF OFP and other stakeholders for receipt of comments. The TE leader is expected to revise the draft TE report based on the comments received, edit the language and form and submit the final version of the TE report in accordance with UNIDO ODG/EIO/EID standards.

Table 7. Provisional planning

Timelines	Tasks
February 2021	Recruitment of the evaluation team
March – Mid April 2021	Desk review Writing of inception report and online briefing with UNIDO project manager and the project team based in Vienna/Delhi On line consultations and fact finding with project stakeholders and beneficiaries
Mid April 2021	Field visits – subject to COVID19 travel and site access clearances
Mid May 2021	Preparation of first draft evaluation report Online debriefing Internal peer review of the report by UNIDO's Independent Evaluation Division and other stakeholder comments to draft evaluation report
Mid June 2021	Final evaluation report

VI. Evaluation team composition

The evaluation team will be composed of one international evaluation consultant acting as the team leader and one national evaluation consultant. The evaluation team members will possess relevant strong experience and skills on evaluation management and conduct together with expertise and experience in innovative clean energy technologies. Both consultants will be contracted by UNIDO.

The tasks of each team member are specified in the job descriptions annexed to these terms of reference. The ET is required to provide information relevant for follow-up studies, including terminal evaluation verification on request to the GEF partnership up to three years after completion of the terminal evaluation.

According to UNIDO Evaluation Policy, members of the evaluation team must not have been directly involved in the design and/or implementation of the project under evaluation.

The UNIDO Project Manager and the project team in India will support the evaluation team. The UNIDO GEF Coordinator and GEF OFP(s) will be briefed on the evaluation and provide support to its conduct. GEF OFP(s) will, where applicable and feasible, also be briefed and debriefed.

An evaluation manager from UNIDO Independent Evaluation Division will provide technical backstopping to the evaluation team and ensure the quality of the evaluation. The UNIDO Project Manager and national project teams will act as resourced persons and provide support to the evaluation team and the evaluation manager.

VII. Reporting

Inception report

This Terms of Reference (ToR) provides some information on the evaluation methodology, but this should not be regarded as exhaustive. After reviewing the project documentation and initial interviews with the project manager, the Team Leader will prepare, in collaboration with the national consultant, a short inception report that will operationalize the ToR relating to the evaluation questions and provide information on what type of and how the evidence will be collected (methodology). It will be discussed with and approved by the responsible UNIDO Evaluation Manager.

The Inception Report will focus on the following elements: preliminary project theory model(s); elaboration of evaluation methodology including quantitative and qualitative approaches through an evaluation framework (“evaluation matrix”); division of work between the International Evaluation Consultant and national consultant; people to be interviewed and possible surveys to be conducted and a debriefing and reporting timetable⁶⁴.

Evaluation report format and review procedures

The draft report will be delivered to UNIDO’s Independent Evaluation Division (the suggested report outline is in Annex 4) and circulated to UNIDO staff and national stakeholders associated with the project for factual validation and comments. Any comments or responses, or feedback on any errors of fact to the draft report provided by the stakeholders will be sent to UNIDO’s Independent Evaluation Division for collation and onward transmission to the project evaluation team who will be advised of any necessary revisions. On the basis of this feedback, and taking into consideration

⁶⁴ The evaluator will be provided with a Guide on how to prepare an evaluation inception report prepared by the UNIDO ODG/EVQ/IEV.

the comments received, the evaluation team will prepare the final version of the terminal evaluation report.

The ET will present its preliminary findings to the local stakeholders and take into account their feed-back in preparing the evaluation report. The presentation of preliminary findings will take place through virtual platform.

The TE report should be succinct, to the point and easy to understand. It must explain the purpose of the evaluation, exactly what was evaluated, and the methods used. The report must highlight any methodological limitations, identify key concerns and present evidence-based findings, consequent conclusions, recommendations and lessons. The report should provide information on when the evaluation took place, the places visited, who was involved and be presented in a way that makes the information accessible and comprehensible. The report should include an executive summary that encapsulates the essence of the information contained in the report to facilitate dissemination and distillation of lessons.

Findings, conclusions and recommendations should be presented in a complete, logical and balanced manner. The evaluation report shall be written in English and follow the outline given in annex 4.

VII. Quality assurance

All UNIDO evaluations are subject to quality assessments by UNIDO Independent Evaluation Division. Quality assurance and control is exercised in different ways throughout the evaluation process (briefing of consultants on methodology and process of UNIDO Independent Evaluation Division, providing inputs regarding findings, lessons learned and recommendations from other UNIDO evaluations, review of inception report and evaluation report by UNIDO's Independent Evaluation Division).

The quality of the evaluation report will be assessed and rated against the criteria set forth in the Checklist on evaluation report quality, attached as Annex 5. The applied evaluation quality assessment criteria are used as a tool to provide structured feedback. UNIDO Independent Evaluation Division should ensure that the evaluation report is useful for UNIDO in terms of organizational learning (recommendations and lessons learned) and is compliant with UNIDO's evaluation policy and these terms of reference. The draft and final evaluation report are reviewed by UNIDO Independent Evaluation Division, which will submit the final report to the GEF Evaluation Office and circulate it within UNIDO together with a management response sheet.

Annex 1: Project Logical Framework

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
Objectives of the project	To reduce greenhouse gas (GHG) emissions through the use of CST for process heating and cooling	CO ₂ -eq emission reduction (tonnes of CO ₂ -eq) Energy generated from solar concentrators (in Kcal/KWhrs)	Direct CO ₂ -eq emission reductions Indirect CO ₂ -eq emission reductions 91 projects generating approximately 28,000,000 kcal daily (baseline energy generated from solar concentrators)	Cummulative reductions of GHG by about 83,000 - 166,000 tCO ₂ -eq over the period 2014-2034 187 MWh daily energy generated from CST through projects installed over the period 2014-2034	GEF project tracking tool	The Government of India remains committed in the medium and long term to development of renewable energy. Implementation of project activities will foster investment in CST and reduce CO ₂ emissions. Execution of planned activities with adequate resources mobilized.
Outcome 1	Favourable policy and regulatory environment created for solar energy applications in industry	Extent to which relevant policies and regulations are proposed and adopted				Institutional and policy barriers can be overcome through analysis and tailored proposals Sustained government support to agreed project activities

Project strategy		Objectively verifiable indicators				Risks and assumptions
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	
Outputs	Set of recommendations and guidelines for policy makers developed	Solar heating and cooling policy and roadmap	No of specific policy for CST for industrial purposes	Clear solar heating and cooling policy and roadmap published	Projects reports MNRE	Sustained government support to agreed project activities Effective collaboration with industry regarding proposed changes
		State specific policy to incentivize CST manufacturing	No of incentives for CST manufacturers	Clear manufacturing policy for CST	MNRE	
		Due diligence guidelines for project approval	No of due diligence guidelines for MNRE project approval Limited number of projects approved and no of clear criteria for approval	Due diligence guidelines published	MNRE website	

Project strategy	Objectively verifiable indicators				
	Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
	Proposal to modify boiler regulations and acts		Clear modifications to boiler regulations incorporating CST	CBB records	
	Proposal to modify building regulations to consider the use of CST	No of regulations to consider CST for new industry	Proposal for consideration of CST for new designated industry	Project reports	

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
Outcome 2	Technical and financial viability of projects confirmed Local manufacturing capability for solar energy systems in industrial applications enhanced Investment in solar energy applications in industry increased	Volume of investment mobilized Tonnes of CO2-eq avoided	No of project 15 channel partners	25 projects 14 industry associations 20 channel partners	GEF project tracking tool Financing partner data Independent evaluation reports Project reports Project websire	Fossil fuel prices remain high in the medium and long term Beneficiary industries have co-finance to implement projects and there is technical capacity to install projects Industrial associations engage with project
Output 2.1	Detailed technology application tools developed: integrated CST with storage; detailed project	Number of industry specific reporting parameters for CST systems	No performance standards for CST	Standards developed for all 5 CST technologies from all channel partners	Copies of standards developed	Availability of DNI data for selected zones Cooperation between users and suppliers to develop standard conditions

Project strategy	Objectively verifiable indicators				
	Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
reports (DPR); CST demonstration project selected; qualified consultants selected; 25 demonstration projects installed; performance monitoring and analysis of projects; and case studies prepared	Number of performance benchmarks	No benchmarks	Benchmarks developed for 10 zones	Report on benchmarking for 10 DNI zones	Agreements on financial parameters to be included
	Number of standardised financial models for CST	No standard model	Standard financial model developed	Copy of financial model	
	Number of CST packages developed	No of CST packages and guidelines	10 CST packages and guidelines	Copies of the CST packages and guidelines	Cooperation between users and suppliers to develop guidelines
	Number of process information booklets	No of process information booklets	11 process information booklets	Copies of the process information booklets	
	Number of CST projects implemented with support from GEF	91 systems installed	25 additional projects implemented with direct support from GEF	GEF project tracking tool Project implementers' records	

Project strategy		Objectively verifiable indicators				Risks and assumptions
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	
		Installed capacity of new CST projects (Kw and area)	0 installed	Installed capacity of more than 12.5 MW and 20,000m ²	Independent evaluation reports Project reports	
		Performance monitoring, evaluation reports and case studies on each GEF supported project	No dissemination material on CST	25 case studies	Copies of case studies	
Output 2.2	Investment in solar energy applications in industry increases	Number of pilot systems of solar technologies installed Investment mobilized (USD)	Limited pilots and investment on solar thermal applications in industry	Up to 25 pilot systems	GEF project tracking tool Financing partner data	

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
Outcome 3	Investment in solar energy applications in industry multiplied Quality of solar energy components assured	No of CST projects installed and operating No of organisations applying to financing facility for CST projects				
Output 3.1	Business models for CST leading to sustained replication of solar thermal applications in industry Quality assurance and certification framework in place	Business models in place Number of MNRE standards developed Number of recommended certification schemes	No business business models 5 standards developed None	Up to 3 models developed Up to 8 standards developed Certification schemes recommended	Report on business models for CST and case studies of examples Project reports and copies of proposed standards Copies of proposed certification schemes	Alternative business models trialled Sufficient interest from industry and MNRE in developing standards and certification schemes

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
Output 3.2	Financing facility for scale up established	Financing facility established	No financing facility available for CST	50 projects with 25 MW _{th} installed and approximately 40,000m ² 124 MW _{th} energy daily from projects A financing facility established	Project implementers' records Independent evaluation reprot Details of financing facility and deal flow	Co-finance is available for each project and there is the technical capacity to install the project Interest from beneficiaries in accessing a financing facility and from FI in establishing
Outcome 4	Capacity of key players in target industries enhanced Technology transfer and information sharing tools established	No of trained personnel No of training sessions provided Advice given to stakeholders				

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
Output 4.1	Trained manufacturers, suppliers and installers	No of installation, operation, maintenance and trouble-shooting manuals for CST	No manuals	11 manuals	Participants logs and evaluation forms Copies of training material Copies of manuals	Targeted stakeholders show willingness for training Growth in industry leading to growth in training demand Training programme successfully implemented
		No of training sessions targeted at manufacturers, suppliers, installers and academics on CST	0	6		
		No of trained manufacturers, suppliers and installers	0	120		
		No of trainig sessions for it is and maintenance staff	0	10		

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
		No of trained ITI students and maintenance staff	0	200		
Output 4.2	Awareness raised among the business community	No of workshops and field visits targeted at industry	none	20	Participants logs and evaluation forms	Targeted stakeholders show willingness for training Growth in industry leading to growth in training demand Training programme succesfully implemented Beneficiaries happy to receive visitors
		Number of organisations attending awareness raising sessions	none	1000		
Output 4.3	Technical capacity built through promotion of industry-academic partnerships	No of field fisits for academics	none	20	Participants logs and evaluation forms Knowledge platform and user statistics Dicussion archieve and	Growth in industry leading to growth in training demand Academia will be interested in CST research areas Sufficient topics are identified by industry and academica
		No of academic institutions attending field visits	0	200		
		No of guest lectures given on CST	0	20		

Project strategy		Objectively verifiable indicators				
		Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
		Knowledge platform establishment	no	Knowledge platform established	membership lists Institution report on no of researchers in CST Annual reports of MNRE	Stakeholders will engage with knowledge platforms
		Number of users of knowledge platform	none	200		
		Number of joint industry-academic applied research projects initiated	none	5		
Output 4.4	CST and project information shared	CST webportal established	none	1	Website and use statistics	Web portal established
		Number of users of website per year	0	1000		
Output 4.5	Documented project outputs, case studies, best practices and lessons learned	Number of newsletters produced	0	20	Copies of newsletters and distribution list	Project information captures and results documented for publicity Industrial clusters engage with the project to advertise CST
		Number of recipients of newsletters	0	2000		

Project strategy	Objectively verifiable indicators				
	Indicator (quantified and time bound)	Baseline	Target	Source of verification	Risks and assumptions
	Nuber of brochures developed	0	20	Copies of brochuers Advertising agency records Copies of adverts MNRE project records Participants logs and evaluation forms	
	Number of industrial clusters advertising CST	0	15		
	Number of adverts in national press	0	10		
	National workshop	0	1		

Annex 2: Job descriptions



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
TERMS OF REFERENCE FOR PERSONNEL UNDER INDIVIDUAL SERVICE AGREEMENT
(ISA)

Title:	International evaluation consultant, team leader
Main Duty Station and Location:	Home-based
Start of Contract (EOD):	1 March 2021
End of Contract (COB):	31 May 2021
Number of Working Days:	28 days spread over the above-mentioned period

1. ORGANIZATIONAL CONTEXT

The UNIDO Independent Evaluation Division (ODG/EIO/IED) is responsible for the independent evaluation function of UNIDO. It supports learning, continuous improvement and accountability, and provides factual information about result and practices that feed into the programmatic and strategic decision-making processes. Independent evaluations provide evidence-based information that is credible, reliable and useful, enabling the timely incorporation of findings, recommendations and lessons learned into the decision-making processes at organization-wide, programme and project level. ODG/EIO/IED is guided by the UNIDO Evaluation Policy, which is aligned to the norms and standards for evaluation in the UN system.

2. PROJECT CONTEXT

Detailed background information of the project can be found the terms of reference (TOR) for the terminal evaluation.

MAIN DUTIES	Concrete/ Measurable Outputs to be achieved	Working Days	Location
1. Review project documentation and relevant country background information (national policies and strategies, UN strategies and general economic data); determine key data to collect in the field and adjust the key data collection instrument if needed; Define technical issues and questions to be addressed prior to the field visit.	<ul style="list-style-type: none"> Adjust table of evaluation questions, depending on country specific context; Prepare a map of stakeholders to interview during the field missions; 	3	Home-based

MAIN DUTIES	Concrete/ Measurable Outputs to be achieved	Working Days	Location
<p>Determine key data to collect in the field and adjust the key data collection instrument if needed.</p> <p>In coordination with the project manager, the project management team and the technical evaluators, determine the suitable sites to be visited and stakeholders to be interviewed.</p>			
<p>2. Briefing with the UNIDO Independent Evaluation Division, project managers and other key stakeholders to prepare for the evaluation inception workshop online.</p> <p>Prepare materials, tools and method to collect data in the field visits by the national consultant, detailed evaluation methodology confirmed, draft theory of change, and tentative agenda for field work.</p>	<ul style="list-style-type: none"> • The inception report. Submitted to evaluation manager. • Detailed evaluation schedule with tentative mission agenda (incl. list of stakeholders to interview and site visits); mission planning; • Division of evaluation tasks with the team members. 	3	Home-based, online
<p>3. Provide technical support to the national evaluator while conducting field mission.</p> <p>Participate in interviews, as agreed with the team member online, when possible</p> <p>Take part as a resource person to answer questions and provide clarification to the focus group meetings on identifying conditions necessary for transformational changes to take place</p> <p>Review meeting and workshop notes prepared by the national evaluator during field work; provide national evaluator substantive advice to collect appropriate data and information in a real time manner; and to keep abreast with feedback from the stakeholders from the field.</p>	<ul style="list-style-type: none"> • Agreement with the national evaluator on the structure and content of the evaluation report and the distribution of writing tasks; 	6	Home-based
<p>5. Prepare the evaluation report, with inputs from the team member, according to the TOR;</p> <p>Coordinate the inputs from the national evaluator and combine with her/his own inputs into the draft evaluation report;</p>	<ul style="list-style-type: none"> • Draft evaluation report. 	12	Home-based

MAIN DUTIES	Concrete/ Measurable Outputs to be achieved	Working Days	Location
Share the evaluation report with UNIDO HQ and national stakeholders for feedback and comments.			
4. Prepare and present overall findings and recommendations to the stakeholders online.	<ul style="list-style-type: none"> After field mission(s): Presentation slides, feedback from stakeholders obtained and discussed 	2	Home-based, online
6. Revise the draft project evaluation report based on comments from UNIDO Independent Evaluation Division and stakeholders and edit the language and form of the final version according to UNIDO standards.	<ul style="list-style-type: none"> Final evaluation report. 	2	Home-based

MINIMUM ORGANIZATIONAL REQUIREMENTS

Education:

Advanced degree in business management, value-chain, environment, energy, engineering, development studies or related areas.

Technical and functional experience:

- Minimum of 15 years' experience in evaluation of development projects and programmes
- Good working knowledge in (renewable) energy and/or environmental management
- Knowledge about GEF operational programs and strategies and about relevant GEF policies such as those on project life cycle, M&E, incremental costs, and fiduciary standards
- Experience in the evaluation of GEF projects and knowledge of UNIDO activities an asset
- Knowledge about multilateral technical cooperation and the UN, international development priorities and frameworks
- Working experience in developing countries

Languages:

Fluency in written and spoken English is required.

All reports and related documents must be in English and presented in electronic format.

Absence of conflict of interest:

According to UNIDO rules, the consultant must not have been involved in the design and/or implementation, supervision and coordination of and/or have benefited from the programme/project (or theme) under evaluation. The consultant will be requested to sign a declaration that none of the above situations exists and that the consultants will not seek assignments with the manager/s in charge of the project before the completion of her/his contract with the UNIDO Independent Evaluation Division.

REQUIRED COMPETENCIES

Core values:

WE LIVE AND ACT WITH INTEGRITY: work honestly, openly and impartially.

WE SHOW PROFESSIONALISM: work hard and competently in a committed and responsible manner.

WE RESPECT DIVERSITY: work together effectively, respectfully and inclusively, regardless of our differences in culture and perspective.

Core competencies:

WE FOCUS ON PEOPLE: cooperate to fully reach our potential –and this is true for our colleagues as well as our clients. Emotional intelligence and receptiveness are vital parts of our UNIDO identity.

WE FOCUS ON RESULTS AND RESPONSIBILITIES: focus on planning, organizing and managing our work effectively and efficiently. We are responsible and accountable for achieving our results and meeting our performance standards. This accountability does not end with our colleagues and supervisors, but we also owe it to those we serve and who have trusted us to contribute to a better, safer and healthier world.

WE COMMUNICATE AND EARN TRUST: communicate effectively with one another and build an environment of trust where we can all excel in our work.

WE THINK OUTSIDE THE BOX AND INNOVATE: To stay relevant, we continuously improve, support innovation, share our knowledge and skills, and learn from one another.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
TERMS OF REFERENCE FOR PERSONNEL UNDER INDIVIDUAL SERVICE AGREEMENT (ISA)

Title:	National evaluation consultant
Main Duty Station and Location:	Home-based; field mission in India to be separately confirmed
Start of Contract:	1 March 2021
End of Contract:	31 May 2021
Number of Working Days:	28 days spread over the above-mentioned period

ORGANIZATIONAL CONTEXT

The UNIDO Independent Evaluation Division (ODG/EIO/IED) is responsible for the independent evaluation function of UNIDO. It supports learning, continuous improvement and accountability, and provides factual information about result and practices that feed into the programmatic and strategic decision-making processes. Independent evaluations provide evidence-based information that is credible, reliable and useful, enabling the timely incorporation of findings, recommendations and lessons learned into the decision-making processes at organization-wide, programme and project level. ODG/EIO/IED is guided by the UNIDO Evaluation Policy, which is aligned to the norms and standards for evaluation in the UN system.

PROJECT CONTEXT

The national evaluation consultant will evaluate the project according to the terms of reference (TOR) under the leadership of the team leader (international evaluation consultant). S/he will perform the following tasks:

<u>MAIN DUTIES</u>	Concrete/measurable outputs to be achieved	Expected duration	Location
Desk review Review and analyze project documentation and relevant country background information; in cooperation with the team leader, determine key data to collect in the field and prepare key instruments in English (questionnaires, logical models); Adjust the evaluation framework and Theory of Change in order to ensure their understanding in the local context.	Evaluation questions, questionnaires/interview guide, logic models adjusted to ensure understanding in the national context; A stakeholder mapping, in coordination with the project team.	5 days	Home-based

<u>MAIN DUTIES</u>	Concrete/measurable outputs to be achieved	Expected duration	Location
<p>Carry out preliminary analysis of pertaining technical issues determined with the Team Leader.</p> <p>In close coordination with the project staff team verify the extent of achievement of project outputs prior to field visits.</p> <p>Develop a brief analysis of key contextual conditions relevant to the project</p>	<ul style="list-style-type: none"> • Report addressing technical issues and question previously identified with the Team leader • Tables that present extent of achievement of project outputs • Brief analysis of conditions relevant to the project 	5 days	Home-based
<p>Support the Team Leader in prepare materials, tools and method to collect data in the field.</p> <p>Coordinate the evaluation mission agenda, ensuring and setting up the required meetings with project partners and government counterparts, and organize and lead site visits, in close cooperation with project staff in the field.</p>	<ul style="list-style-type: none"> • Key tools and materials • Detailed evaluation schedule. • List of stakeholders to interview during the field missions. 	3 days	Home-based, online
<p>Conduct the field mission to meet and discuss with project key-stakeholders and beneficiaries, to the extent possible these meetings should be organized so that the Team Leader could participate online.</p> <p>Consult with the Team Leader on the meeting/interview protocol and guide to collect data and information in the format agreed in advance with the team leader.</p> <p>Design, administer, and analyze open-ended interviews and focus groups to gather qualitative information</p> <p>Prepare meeting notes and data based on the format requested by the team leader.</p> <p>Close exchange and discussion with the team leader on data and information collected from the field</p>	<ul style="list-style-type: none"> • Agreement with the Team Leader on the structure and content of the evaluation report and the distribution of writing tasks. • Systematic data and information from the field 	7 days (including travel days)	India (the sites to be identified later)
<p>Follow up with stakeholders regarding additional information promised during interviews</p> <p>Prepare inputs to help fill in information and analysis gaps (mostly related to technical issues) and to prepare of tables to be included in the evaluation report as agreed with the Team Leader.</p>	<ul style="list-style-type: none"> • Part of draft evaluation report prepared. 	8 days	Home-based

MAIN DUTIES	Concrete/measurable outputs to be achieved	Expected duration	Location
Revise the draft project evaluation report based on comments from UNIDO Independent Evaluation Division and stakeholders and proof read the final version.			

MINIMUM ORGANIZATIONAL REQUIREMENTS

Education: Advanced university degree in agriculture, environmental science, engineering or other relevant discipline like developmental studies.

Technical and functional experience:

- Experience in evaluation, or monitoring and evaluation.
- Excellent knowledge and competency in the field of agriculture and environmental management.
- Evaluation experience, including evaluation of development cooperation in developing countries is an asset.
- Exposure to the needs, conditions and problems in developing countries.
- Familiarity with the institutional context of the project is desirable.

Languages: Fluency in written and spoken English and local language is required.

Absence of conflict of interest:

According to UNIDO rules, the consultant must not have been involved in the design and/or implementation, supervision and coordination of and/or have benefited from the programme/project (or theme) under evaluation. The consultant will be requested to sign a declaration that none of the above situations exists and that the consultants will not seek assignments with the manager/s in charge of the project before the completion of her/his contract with the UNIDO Independent Evaluation Division.

REQUIRED COMPETENCIES

Core values:

WE LIVE AND ACT WITH INTEGRITY: work honestly, openly and impartially.

WE SHOW PROFESSIONALISM: work hard and competently in a committed and responsible manner.

WE RESPECT DIVERSITY: work together effectively, respectfully and inclusively, regardless of our differences in culture and perspective.

Core competencies:

WE FOCUS ON PEOPLE: cooperate to fully reach our potential –and this is true for our colleagues as well as our clients. Emotional intelligence and receptiveness are vital parts of our UNIDO identity.

WE FOCUS ON RESULTS AND RESPONSIBILITIES: focus on planning, organizing and managing our work effectively and efficiently. We are responsible and accountable for

achieving our results and meeting our performance standards. This accountability does not end with our colleagues and supervisors, but we also owe it to those we serve and who have trusted us to contribute to a better, safer and healthier world.

WE COMMUNICATE AND EARN TRUST: communicate effectively with one another and build an environment of trust where we can all excel in our work.

WE THINK OUTSIDE THE BOX AND INNOVATE: To stay relevant, we continuously improve, support innovation, share our knowledge and skills, and learn from one another.

Annex 3:- Outline of an in-depth project evaluation report

Executive summary (maximum 5 pages)

Evaluation purpose and methodology

Key findings

Conclusions and recommendations

Project ratings

Tabular overview of key findings – conclusions – recommendations

1. Introduction

1.1. Evaluation objectives and scope

1.2. Overview of the Project Context

1.3. Overview of the Project

1.4. Theory of Change

1.5. Evaluation Methodology

1.6. Limitations of the Evaluation

2. Project's contribution to Development Results - Effectiveness and Impact

2.1. Project's achieved results and overall effectiveness

2.2. Progress towards impact

2.2.1. Behavioral change

2.2.1.1. Economically competitive - Advancing economic competitiveness

2.2.1.2. Environmentally sound – Safeguarding environment

2.2.1.3. Socially inclusive – Creating shared prosperity

2.2.2. Broader adoption

2.2.2.1. Mainstreaming

2.2.2.2. Replication

2.2.2.3. Scaling-up

3. Project's quality and performance

3.1. Design

3.2. Relevance

3.3. Efficiency

3.4. Sustainability

3.5. Gender mainstreaming

4. Performance of Partners

4.1. UNIDO

4.2. National counterparts

4.3. Donor

5. Factors facilitating or limiting the achievement of results

5.1. Monitoring & evaluation

5.2. Results-Based Management

5.3. Other factors

5.4. Overarching assessment and rating table

6. Conclusions, recommendations and lessons learned

6.1. Conclusions

6.2. Recommendations

6.3. Lessons learned

6.4. Good practices

Annexes (to be put online separately later)

- Evaluation Terms of Reference
- Evaluation framework
- List of documentation reviewed
- List of stakeholders consulted
- Project logframe/Theory of Change
- Primary data collection instruments: evaluation survey/questionnaire
- Statistical data from evaluation survey/questionnaire analysis

Annex 4: Checklist on evaluation report quality

Project Title:

UNIDO ID:

Evaluation team:

Quality review done by:

Date:

Report quality criteria	UNIDO IEV assessment notes	Rating
a. <u>Was the report well-structured and properly written?</u> <u>(Clear language, correct grammar, clear and logical structure)</u>		
b. <u>Was the evaluation objective clearly stated and the methodology appropriately defined?</u>		
c. <u>Did the report present an assessment of relevant outcomes and achievement of project objectives?</u>		
d. <u>Was the report consistent with the ToR and was the evidence complete and convincing?</u>		
e. <u>Did the report present a sound assessment of sustainability of outcomes or did it explain why this is not (yet) possible?</u> <u>(Including assessment of assumptions, risks and impact drivers)</u>		
f. <u>Did the evidence presented support the lessons and recommendations? Are these directly based on findings?</u>		
g. <u>Did the report include the actual project costs (total, per activity, per source)?</u>		
h. <u>Did the report include an assessment of the quality of both the M&E plan at entry and the system used during the implementation? Was the M&E sufficiently budgeted for during preparation and properly funded during implementation?</u>		
i. <u>Quality of the lessons: were lessons readily applicable in other contexts? Did they suggest prescriptive action?</u>		
j. <u>Quality of the recommendations: did recommendations specify the actions</u>		

Report quality criteria	UNIDO IEV assessment notes	Rating
<u>necessary to correct existing conditions or improve operations ('who?' 'what?' 'where?' 'when?'). Can these be immediately implemented with current resources?</u>		
k. <u>Are the main cross-cutting issues, such as gender, human rights and environment, appropriately covered?</u>		
l. <u>Was the report delivered in a timely manner?</u> <u>(Observance of deadlines)</u>		

Rating system for quality of evaluation reports

A rating scale of 1-6 is used for each criterion: Highly satisfactory = 6, Satisfactory = 5, Moderately satisfactory = 4, Moderately unsatisfactory = 3, Unsatisfactory = 2, Highly unsatisfactory = 1, and unable to assess = 0.

Annex 5: Guidance on integrating gender in evaluations of UNIDO projects and projects

A. Introduction

Gender equality is internationally recognized as a goal of development and is fundamental to sustainable growth and poverty reduction. The UNIDO Policy on gender equality and the empowerment of women and its addendum, issued respectively in April 2009 and May 2010 (UNIDO/DGB(M).110 and UNIDO/DGB(M).110/Add.1), provides the overall guidelines for establishing a gender mainstreaming strategy and action plans to guide the process of addressing gender issues in the Organization's industrial development interventions.

According to the UNIDO Policy on gender equality and the empowerment of women:

Gender equality refers to the equal rights, responsibilities and opportunities of women and men and girls and boys. Equality does not suggest that women and men become 'the same' but that women's and men's rights, responsibilities and opportunities do not depend on whether they are born male or female. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of different groups of women and men. It is therefore not a 'women's issues'. On the contrary, it concerns and should fully engage both men and women and is a precondition for, and an indicator of sustainable people-centered development.

Empowerment of women signifies women gaining power and control over their own lives. It involves awareness-raising, building of self-confidence, expansion of choices, increased access to and control over resources and actions to transform the structures and institutions which reinforce and perpetuate gender discriminations and inequality.

Gender parity signifies equal numbers of men and women at all levels of an institution or organization, particularly at senior and decision-making levels.

The UNIDO projects/projects can be divided into two categories: 1) those where promotion of gender equality is one of the key aspects of the project/project; and 2) those where there is limited or no attempted integration of gender. Evaluation managers/evaluators should select relevant questions depending on the type of interventions.

B. Gender responsive evaluation questions

The questions below will help evaluation managers/evaluators to mainstream gender issues in their evaluations.

B.1. Design

- Is the project/project in line with the UNIDO and national policies on gender equality and the empowerment of women?
- Were gender issues identified at the design stage?
- Did the project/project design adequately consider the gender dimensions in its interventions? If so, how?
- Were adequate resources (e.g., funds, staff time, methodology, experts) allocated to address gender concerns?
- To what extent were the needs and priorities of women, girls, boys and men reflected in the design?
- Was a gender analysis included in a baseline study or needs assessment (if any)?
- If the project/project is people-centered, were target beneficiaries clearly identified and disaggregated by sex, age, race, ethnicity and socio-economic group?
- If the project/project promotes gender equality and/or women's empowerment, was gender equality reflected in its objective/s? To what extent are output/outcome indicators gender disaggregated?

B.2. Implementation management

- Did project monitoring and self-evaluation collect and analyse gender disaggregated data?
- Were decisions and recommendations based on the analyses? If so, how?
- Were gender concerns reflected in the criteria to select beneficiaries? If so, how?
- How gender-balanced was the composition of the project management team, the Steering Committee, experts and consultants and the beneficiaries?
- If the project/project promotes gender equality and/or women's empowerment, did the project/project monitor, assess and report on its gender related objective/s?

B.3. Results

- Have women and men benefited equally from the project's interventions? Do the results affect women and men differently? If so, why and how? How are the results likely to affect gender relations (e.g., division of labour, decision making authority)?
- In the case of a project/project with gender related objective/s, to what extent has the project/project achieved the objective/s? To what extent has the project/project reduced gender disparities and enhanced women's empowerment?