

Country Name	<b>Research Partnership for Application of Low Carbon Technology for Sustainable Development (SATREPS)<sup>1</sup></b>
India	

## I. Project Outline

Background	<p>In India, the high economic growth led the dramatic growth of energy demand. On the other hand, the expanding energy consumption brought about environmental burdens. For example, aged thermal power plants had lower efficiency of power generation and more emissions of hazardous substances causing air pollution than new power generation facilities with environmental-friendly technologies. Besides, emissions of the greenhouse gas (GHG) such as CO<sub>2</sub> considerably increased and it was concerned about further rapid deterioration of GHG emission in future. However, the introduction of low carbon technologies got behind for accelerating concrete countermeasures to reduce GHG emission was required..</p>				
Objectives of the Project	<p>Through selection of low carbon technologies (LCTs) to be applied, implementation and evaluation of pilot projects, and formulation of application schemes of LCTs, the project aimed at proposing a framework for promotion of LCTs in India, thereby contributing to promotion of application of LCTs in the country.</p> <ol style="list-style-type: none"> <li>Overall Goal: The applications of low carbon technologies are promoted.</li> <li>Project Purpose: A framework to promote low carbon technologies is proposed.</li> </ol>				
Activities of the Project	<ol style="list-style-type: none"> <li>Project site: India</li> <li>Main activities: 1) Identification, assessment and selection of LCTs to be applied, 2) Implementation and evaluation of pilot projects on application of LCTs, 3) Capacity building engineers and managers from small and medium size enterprises (SMEs) through pilot projects, 4) Formulation of application scheme of LCTs</li> <li>Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;"> <p>Japanese Side</p> <ol style="list-style-type: none"> <li>Experts: 30 persons</li> <li>Trainees received: 13 persons</li> <li>Equipment: 2 units of Gas Heat Pump (GHP), 2 units of Electric Heat Pump (EHP)</li> </ol> </td> <td style="width: 50%;"> <p>Indian Side</p> <ol style="list-style-type: none"> <li>Staff allocated: 18 persons</li> <li>Land and facilities: Office spaces for Japanese experts, etc.</li> <li>Local cost: Cost for personnel, workshops, utility, transportation and communication</li> </ol> </td> </tr> </table> </li> </ol>			<p>Japanese Side</p> <ol style="list-style-type: none"> <li>Experts: 30 persons</li> <li>Trainees received: 13 persons</li> <li>Equipment: 2 units of Gas Heat Pump (GHP), 2 units of Electric Heat Pump (EHP)</li> </ol>	<p>Indian Side</p> <ol style="list-style-type: none"> <li>Staff allocated: 18 persons</li> <li>Land and facilities: Office spaces for Japanese experts, etc.</li> <li>Local cost: Cost for personnel, workshops, utility, transportation and communication</li> </ol>
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Project Period	May, 2010 – March 2014	Project Cost	(ex-ante) 270 million yen, (actual) 255 million yen		
Implementing Agency	The Energy and Resources Institute (TERI)				
Cooperation Agency in Japan	Institute for Global Environmental Strategies (IGES), Kyoto University (KU)				

## II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

[Verifiable Indicator for the Overall Goal]

The Overall Goal of this SATREPS project is “promotion of application of LCTs” and the two verifiable indicators of “list of LCTs identified” and “Potential of energy efficiency and co-benefits of CO<sub>2</sub> reductions by identified technologies”. On the other hand, while two LCTs of the Gas Heat Pump (GHP) and the Electric Heat Pump (EHP) were identified by the project, the pilot projects to verify the effects of those technologies were delayed and implemented only four SMEs (two for GHP and two for EHP) since it took longer time than the expected to consider applicability of the candidate technologies and selection of SMEs to cooperate the pilot projects. Therefore, the number of seminars/workshops to promote GHP and EHP proposed and organized by the project were supplementarily used to verify the achievement level of the Overall Goal.

[Verification of status of the verifiable indicator for the Project Purpose at the time of ex-post evaluation]

Since the indicator for the Project Purpose is “Recommendations/suggestions regarding the promotion of low carbon technologies as a co-benefit are published”, the continuation status of the indicator was verified by the status of implementation or application of the recommendations/suggestions for promotion of low carbon technologies by the project as a part of efforts for utilization of the research outputs/outcomes.

### 1 Relevance

<Consistency with the Development Policy of India at the Time of Ex-Ante Evaluation and Project Completion>

The project was consistent with the India’s development policies to improve energy efficiency prioritized in the “National Action Plan on Climate Change (NAPCC)” (2008), “The 12<sup>th</sup> Five Year Development Plan” (2012-2017), and the “National Mission on Enhanced Energy Efficiency” (the first phase for 2012-2015). In addition, the Government of India has pledge to cut down GHG emission intensity by 20-25% from that of 2005 level at the COP 15 meeting<sup>2</sup>.

<Consistency with the Development Needs of India at the Time of Ex-Ante Evaluation and Project Completion >

The project was consistent with the India’s development needs of improvement of energy efficiency of small scale plants in the energy intensive sub-sectors for reduction of the growing GHG emission caused by the growing energy consumption.

<Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation>

The project consistent with the Japan’s ODA policy for India prioritizing support for improvement of poverty and environmental issues, which was set in “the Country Assistance Program for India” (2006).

<Evaluation Result>

In light of the above, the relevance of the project is high.

<sup>1</sup> SATREPS stands for “Science and Technology Research Partnership for Sustainable Development”.

<sup>2</sup> The Fifteenth Session of the Conference of Parties to the United Nations Framework Convention on Climate Change

## 2 Effectiveness/Impact

### <Status of Achievement of the Project Purpose at the time of Project Completion>

The Project Purpose was partially achieved by the time of project completion. The policy recommendations for the government of India and Japan for promotion of the low carbon technologies introduced by the project was drafted and a research paper and articles were published. In addition, research results of the project were presented at international conferences and domestic conference in India.

### <Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects have been partially continued by the time of ex-post evaluation. TERI and IGES have been widely disseminating the demonstrated technologies by the project through a large number of presentations at national and international workshops and conferences. In particular, the EHP system installed at Chandigarh was used as a demonstration plant during the workshop organized by TERI support from the Energy Conservation Center Japan (ECCJ). The workshop was a part of the India Japan Energy Dialogue in which heat pump technologies were identified as one of energy efficient technologies for promotion. However, the pilot GHPs (2 companies) and EHPs (2 companies) have stopped operation at the time of ex-post evaluation. There have been issues of maintenance and procurement of spare parts of the two technologies. In addition, for GHPs, it was because of rise in natural gas price.

In terms of research activities on LCTs, TERI has continued to undertake researches on the heat pump technologies under the support by IGES. Also, TERI and IGES have been disseminating the demonstrated heat pump technologies through articles and reports as well as a number of feasibility reports on energy saving effect and economic benefit of the technologies.

### <Status of Achievement for Overall Goal at the time of Ex-post Evaluation>

The Overall Goal was achieved at the time of ex-post evaluation. 7 LCTs were identified by TERI (Indicator 1). Also, significant energy savings by the identified LTCs were estimated in the range of 15-20% with co-benefits of reduction of CO<sub>2</sub> emissions as well as SO<sub>x</sub> and NO<sub>x</sub> (Indicator 2). On the other hand, the high capital and operation and maintenance (O&M) costs have been constraining against the application of the GHT and EHT technologies demonstrated by the project, which were based on the technologies by Japanese companies while the heat pump technologies from the Indian domestic and international players have been utilized by the Indian private sector.

As for utilization of research outcomes, TERI has been engaging with key stakeholders of policy makers, financial institutions and industries in order to promote the LCTs demonstrated by the project. For instance, the EHP demonstrated by the project has been included in the list of eligible technologies for financing under the two-step loan project by the Small Industries Development Bank of India (SIDBI) with support of JICA<sup>3</sup>.

### <Other Impacts at the time of Ex-post Evaluation>

There are some positive impacts of the project confirmed at the time of ex-post evaluation. The collaboration with TERI and the government institutions, such as the Gujarat Energy Development Agency (GEDA) and the Maharashtra Energy Development Agency (MEDA), have been promoted by the Japan-India Matchmaking Platform (JITMAP) initiative<sup>4</sup> for promoting Japan's LCTs in India through capacity building and awareness building workshop. In addition, the Bureau of Energy Efficiency (BEE) has been involved in promotion of energy efficient technologies at the national level under the partnership with the Japanese governmental institutions such as ECCJ and the New Energy and Industrial Technology Development Organization (NEDO). Also, BEE has been preparing energy conservation guidelines for industries with knowledge support from ECCJ. Besides that, the collaboration between India and Japan for promotion of LCTs which can be energy efficient as well at the industry level have made a mutually beneficial trade and commercial ties between the two countries.

### <Evaluation Result>

Therefore, the effectiveness/impact of the project is high.

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) A framework to promote low carbon technologies is proposed.	Recommendations/suggestions regarding the promotion of low carbon technologies as co-benefits are published.	Status of the Achievement: Partially achieved (partially continued/) (Project Completion) <ul style="list-style-type: none"> <li>● 1 research paper and 5 articles were published.</li> <li>● Research results of the project were presented at 4 international conferences and 4 domestic conferences, and verbally presented at 18 domestic conferences and 2 conferences in Japan.</li> <li>● But the framework to promote low carbon technologies was under formulation.</li> </ul> (Ex-post Evaluation) <ul style="list-style-type: none"> <li>● For the period from 2014/15 to 2017/18, 26 presentations on the promotion of GHT and EHT demonstrated by the project were made at seminars/workshops.</li> </ul>
(Overall Goal) The applications of low carbon technologies are promoted.	(Indicator 1) List of low carbon technologies identified.	(Ex-post Evaluation) achieved <ul style="list-style-type: none"> <li>● The following 7 LCTs were identified: Inverter air compressor, energy efficient induction furnace, high efficiency once through boiler, steam system optimization, energy efficient belts, factory energy management systems (FEMS), smart grid solutions (7 technologies)</li> </ul>
	(Indicator 2) Potentials of energy efficiency and co-benefits of CO <sub>2</sub> reductions by identified technologies.	(Ex-post Evaluation) achieved <ul style="list-style-type: none"> <li>● Significant energy savings, usually in the range of 15-20%, have been estimated by adoption of the energy efficient technologies with consequent reduction in CO<sub>2</sub> emissions, coupled with reduction in SO<sub>x</sub></li> </ul>

<sup>3</sup> The Micro, Small and Medium Enterprise Energy Saving Project (Phase III) (ODA loan project)

<sup>4</sup> JITMAP was established in 2016 under the collaboration between TERI and IGES with the support of the Ministry of Environment, Japan.

Source : Terminal Evaluation Report, information provided by TERI

### 3 Efficiency

The project cost and the project period were within the plan (the ratios against plan: 94% and 96%, respectively). The project outputs were produced as planned. Therefore, the efficiency of the project is high.

### 4 Sustainability

#### <Policy Aspect>

The promotion of LCTs has been endorsed by the government policy. “The National Mission for Enhanced Energy Efficiency (NMEEE)”, of which the third phase (2017-2020) has been under implementation, is one of the eight national missions under NAPCC. Also, India has committed to reduce its carbon emissions relative to its gross domestic product by 33-35% from 2005 levels by 2030 under the Paris Accord on climate change.

#### <Institutional Aspect>

As mentioned above, the collaborative network between India and Japan has been established for promotion of the LCTs in India. The JITMAP initiative has facilitated not only mutually beneficial transactions in LCTs between Japanese manufactures and the Indian end-users and institutional efforts for promotion of LCTs in India through dialogue between the research institutes of TERI and IGES, and the government agencies in India, such as GEDA and MEDA. For application of the LCTs demonstrated by the project, technical support for small and medium enterprises in India is essential. TERI and IGES have facilitated matchmaking of the Japanese equipment supplier and the Indian SMEs with necessity of the technical support for using LCTs. TERI has 18 researchers who have been engaged in the research activities on LCTs.

#### <Technical Aspect>

The researchers within TERI and IGES have built on the successful technology transfer model demonstrated under the project for promotion of LCTs. They have continued R&D, dissemination, capacity building and policy-level support on both demand and supply sides of LCTs through carrying new research projects, mainly those funded by the Ministry of Environment, Japan. Under the collaboration between TERI and IGES, the researchers at TERI have continued to sustain/improve their knowledge and skills by participating in a number of activities such as feasibility studies; capacity building, training of trainers (ToT); developing LCT project proposals for Indian end-users, and where necessary, developing bankable proposals for matching the end-users with appropriate funding agencies; field-level implementation of LCT projects and exploring the scaling-up of the implemented pilot projects of GHP and EHP jointly with experts from Japan.

As end-users of LCTs, SMEs have sustained their technical skills and knowledge through follow-up interactions with the Japanese equipment suppliers and TERI on the implemented pilot projects to ensure their continuous operation of the installed LTC equipment. They have also participated in capacity building workshops/international study tours organized by IGES and TERI after the project. SMEs had the opportunity to participate and that the benefit of on-ground activities like feasibility studies, capacity building/ ToT programs, bankable proposals preparation as well as web-based information sharing under the JITMAP initiative.

#### <Financial Aspect>

Actual costs of TERI for participating in JITMAP activities have been supported by Ministry of the Environment, Japan through IGES. In addition, TERI has got the support from other agencies like SIDBI, BEE, the United Nations of Industrial Development Organization (UNIDO), the United Nations of Development Programme (UNDP), the World Bank (WB), the International Finance Corporation (IFC), the Swiss Agency for Development and Cooperation (SDC), the Shakti Sustainable Energy Foundation, and so on, to promote LCTs amongst SMEs in India. Furthermore, several financial instruments such as the Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) and the Partial Risk Sharing Facility (PRSF) in Energy Efficiency supported by WB, have been formulated by the government to supplement the efforts under NMEEE. SIDBI has also established an Energy Efficiency Financing Scheme, with support of JICA to promote LCTs among MSME sector.

#### <Evaluation Result>

Therefore, the sustainability of the effects through the project is high.

### 5 Summary of the Evaluation

The project partially achieved the Project Purpose and achieved the Overall Goal through the collaborative research activities by TERI and IGES for promotion of LCTs. The collaborative network for matchmaking of Japanese manufacturers and Indian end-users of SMEs to promote LCTs has been sustainably established and functioning.

Considering all of the above points, this project is evaluated to be highly satisfactory.

## III. Recommendations & Lessons Learned

### Recommendations for Implementing Agency: (for TERI and IGES)

The application of GHP and EHP demonstrated by the project has been limited because of the expensive capital and/or O&M cost. In order to broadly promote LCTs in India for improvement of energy efficiency of SMEs, TERI and IGES need to conduct research activities on GHP and EHP technologies with lower costs which can be affordable for SMEs in India.

### Lessons Learned for JICA:

- Financial feasibility of introduction of LCTs should be also considered in identifying and selection of LCTs to be demonstrated and promoted so that the technology can be more prevailed on a market basis after project completion.
- A pilot project of gas heat pump, one of the energy efficient technologies, which has been identified in the project, was discontinued shortly after the project completion because of the price hike of natural gas. From this experience, it is recommended to carefully select technology for pilot project which will limitedly be affected by the fluctuation of resource price and carefully consider alternatives and/or countermeasures to minimize impacts of the fluctuation of resource prices on the implementation of the pilot projects.



GHP installed in SME in Rajkot



EHP installed in SME in Amul