



# Facility for Low Carbon Technology Deployment

## Progress Report

For

## 1<sup>st</sup> Innovation Challenge on Waste Heat Recovery

Submitted to:



**United Nations Industrial Development Organization (UNIDO)**

Submitted by



**Confederation of Indian Industry**

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## 1.0. Executive Summary

### Introduction

Facility for Low Carbon Technology Deployment (FLCTD) is a 5-year project to facilitate deployment and scaling up of low-carbon technologies in India to can promote use of clean energy applications in selected sectors and address technology gaps to mitigate climate change. The main function of the 'Facility' will be to identify high-impact opportunities that have potential for energy saving as well as large-scale carbon emission reductions. This function will be achieved through a series of "Innovation Challenges", an open award competition calling for solutions in the areas of low-grade industrial waste heat recovery (WHR), space conditioning (HVAC, cold storage) and pumping (agricultural). The Innovation Challenges will be instrumental in providing peer-to-peer networks and attracting private investments in research to meet the goals stated under the award competition conditions.

### The Waste Heat Recovery Challenge – Summary

The first FLCTD innovation challenge on "waste heat recovery" was launched in 1 November 2017 and application were accepted till 18 February 2018. 5,000 emails were sent to Indian technical institutes/ universities, research institutes, startups, large industries, micro, small & medium enterprises, R&D units in public center enterprises and government laboratories to spread awareness about the projects.

Four roadshows were organized in the cities of Ahmedabad, Chennai, New Delhi and Pune, along with a social media campaign, to promote the waste heat recovery innovation challenge and create awareness about the project around the country. These roadshows presented the opportunity to interact with over 100 potential applicants. Additionally, meetings were organized with a number of academic institutions with research interest and industry associations to encourage them to submit applications for the challenge and to encourage them to share information about the program in their networks.

107 applications were received by the challenge deadline. After the initial screening for completeness, 44 applications were shortlisted, in the presence of PMU and CII in New Delhi on 9 March, 2018. Expert panel members finally selected 5 innovations for the final round; these 5 shortlisted applicants gave a detailed presentation to the expert panel members, Director General of BEE and UNIDO representatives on 20 June 2018 in New Delhi.

After reviewing all the 5 innovations, the expert panel members finally selected three innovations from following companies:

- 1) **M/S Oorja Energy Engg Services Pvt. Ltd**
- 2) **M/S Promethean Energy Pvt Ltd**
- 3) **M/S Village Industrial Power**

With the support of CII, these companies are currently in discussions with different industrial units for the pilot deployment of their technologies. Pilot implementation is expected to be completed by the three companies by the end of 2018.

CII is in the process of developing a technology verification template, for evaluating the outcomes of the pilot implementation. The PMU and CII will jointly monitor the progress of the technology deployment and the resultant energy and cost savings.

### **Program benefits**

India currently has no formal innovation ecosystem for clean technologies which connects different agencies, incubators and other support agencies, and entrepreneurs. The FLCTD program is attempting to develop this ecosystem, and we are confident that such an ecosystem will be in place by the end of the program period.

The following are some of the beneficial outcomes of the activities during the waste heat recovery challenge:

1. A large number of stakeholders are now aware of the FLCTD program and the three challenges under it. In particular, much interest has been generated among academic institutions, which we believe will result in a large number of applications from this group in future challenges.
2. It is also expected that over the next few years, this program will foster academia-industry interaction for problem solving, a link which is sorely missing at present.
3. Tools like webinars and online campaigns have proven themselves to be useful to reach out to more stakeholders, without the geographic constraints of physical roadshows, and will be utilized for future challenges also.
4. The UNIDO PMU is reaching out to leading incubators, entrepreneurship support programs and technical networks such as **Sangam Ventures, Social Alpha and ISHRAE** to create long-term opportunities for low carbon innovators and support the development of an innovation ecosystem in India.
5. The senior technical experts who are part of the expert panel have been very enthusiastic about their support to the program. This, it is hoped, will translate into them supporting other innovation activities in various roles in the future.

## 2.0. Project Introduction

### 2.1. Objectives

Facility for Low Carbon Technology Deployment (FLCTD) is designed to identify over a hundred winning energy-efficient cleantech innovations over a five-year period. The program aims to locate and link critical connections between the stakeholders in the ecosystem; the innovators who provide the technical solutions; the experts and academia who fine-tune these solutions; investors who support the market-based dissemination of the new solutions - to support replication of these energy saving technologies in the industry.

The following are the key activities that will be pursued under this project:

- Facilitate the engagement of subject experts in three technology verticals: Waste heat recovery, Space conditioning and Pumping
- Organize roadshows to publicize the Innovation Challenge in 15 cities across India covering all the three verticals
- Identify stakeholders for cleantech innovations who can be engaged in the roadshows
- Ensure participation from the Industry and local technical institute, local entrepreneurs, and R&D institutes/laboratory, financial institutions, etc.
- Provide publicity through media platforms: agency's website and in technical and or energy sector magazines (at least 2 advertisements per challenge vertical), advertisements in social media
- Screen and shortlist applications as per the criteria (developed by PMU) through a screening committee approved by the PMU
- Identify industries / firms where the selected winning innovations can be installed to demonstrate energy savings;
- Liaison with industries/firm willing for pilot demonstration and the innovator and obtain periodic progress update on implementation
- Develop a Technology Verification Template in consultation with the PMU
- Conduct verification of the efficacy of innovative technologies post commissioning by applying the Technology Verification Template

### 2.2. Proposed Action Plan

The action plan for implementing the facility for low carbon technology deployment will be following:

*Table 1: Proposed Action Plan*

S. No	Tactics	Outputs
1.	<b>Facilitate Engagement of Experts in three technology Verticals</b>	
a)	Coordination support to the PMU for Expert Panel Meeting	➤ The CII team will facilitate the participation and outputs of the Expert Panel. It is expected that the Expert Panel will be chosen and finalized by the PMU

		<ul style="list-style-type: none"> <li>○ The team will liaise with the Expert Panel throughout the project period, through regular update emails</li> <li>○ One team member will also accompany the Expert Panel on its site visits, and will also be present during all Expert Panel meetings</li> <li>○ 5 Expert Panel meetings will be conducted per year per vertical (i.e., a total of 15), with 6 members per Expert Panel</li> </ul>
<b>2.</b>	<b>Support in conducting Innovation Challenges</b>	
<b>a)</b>	Organize 18 half-day events with a minimum participation of 50 persons	<ul style="list-style-type: none"> <li>➤ Organizing total of 15 workshops, with a minimum participation of 40, to reach out to potential applicants</li> <li>➤ If participation is low or the required target audience does not participate, we propose to organize more workshops, up to a total maximum of 18</li> <li>➤ Sending Invitation letters to the identified individuals/ organizations; phone calls will be used to follow-up with them for participation confirmation</li> </ul>
<b>b)</b>	Develop Communication Materials and Outreach	<ul style="list-style-type: none"> <li>➤ The following communication material will be developed: <ul style="list-style-type: none"> <li>○ Brochure (for the entire program, to be circulated among workshop participants and others)</li> <li>○ Program advertisement (to be printed twice per challenge, in relevant (technical and/or non-technical) magazines; also to be used on CII, UNIDO and BEE websites for promotion of the program)</li> <li>○ Flyers (one each for each of the challenges, to be circulated among workshop participants and others)</li> <li>○ One advertisement would be published in two magazines (technical/ non-technical depending on the challenge and the nature of stakeholders), for each of the three challenges</li> <li>○ Hard copies of the brochures/ flyers would also be sent out to research laboratories and technical institutes, for display on their notice boards</li> <li>○ Soft copies of the brochures/ flyers will be circulated to potential target stakeholders through emails, as part of email invitations.</li> </ul> </li> <li>➤ Utilizing the services of an external social media expert/ agency to extensively promote the challenge online. This expert/ agency will be hired by CII on contract post award of this project</li> </ul>

c)	Screen and shortlist applications as per the criteria (developed by PMU) through a screening committee approved by the PMU	<ul style="list-style-type: none"> <li>➤ Developing a basic screening criteria for all the innovation challenges</li> <li>➤ Developing a basic criteria for selection of winners for all the innovation challenges</li> <li>➤ Organizing expert panel meeting for each challenge</li> <li>➤ Post the selection of winners, preparation a brief on them</li> </ul>
d)	Facilitate travel of expert panel members' and visit to sites of prototype demonstration	<ul style="list-style-type: none"> <li>➤ Facilitate expert panel members visit to the prototype/ pilot sites                             <ul style="list-style-type: none"> <li>○ Up to 5 technology prototype/pilot demonstration site-visits per innovation challenge vertical are expected</li> <li>○ Up to 5 Expert Panel members are expected to travel per visit</li> <li>○ Each site visit duration will be for a maximum of 2 nights and 3 days</li> </ul> </li> </ul>
3.	<b>Support Deployment of innovative Low-Carbon Technologies</b>	
a)	Develop a Technology Verification Template in consultation with the PMU	<ul style="list-style-type: none"> <li>➤ Developing a technology verification template, to review and understand the efficacy of the winning technologies</li> <li>➤ The template so developed would be credible enough that banks and other investors are able to make decisions based on the reports prepared using the templates</li> </ul>
b)	Liaison with industry for deployment of winning technologies	<ul style="list-style-type: none"> <li>➤ Liaison with industry to identify sites for demonstration of the winning technologies.</li> <li>➤ Facilitation of interactions of the winning applicants with those firms which are willing to undertake pilots of the technologies</li> <li>➤ Verification of technologies post commissioning, using the technology verification template</li> <li>➤ submission of the technology verification report to the PMU</li> </ul>
c)	Introduction and support to PMU to liaison with financial institutions (FIs)	<ul style="list-style-type: none"> <li>➤ providing details of various FIs for the PMU to contact to further the FLCTD activities</li> </ul>

## 2.3. Deliverables

The following will be submitted during the course of this project:

*Table 2: Key deliverables in the project*

SI No	Name of the Report	Date of completion (Approx.)

<b>1</b>	Inception report	31 <sup>st</sup> Decemebr 2017
<b>2</b>	4 Publicity programs – WHR	31 <sup>st</sup> December 2017
<b>3</b>	Screened list of applicants-WHR	28 <sup>th</sup> February 2018
<b>4</b>	Support to Expert Panel to discharge their duties and select winners	28 <sup>th</sup> February 2018
<b>5</b>	Technology verification template-WHR	28 <sup>th</sup> February 2018
<b>6</b>	Facilitation of deployment in industry, where possible-WHR	30 <sup>th</sup> April 2018
<b>7</b>	Report on the Innovation challenge – WHR	30 <sup>th</sup> November 2018
<b>8</b>	11 Publicity programs – Space Conditioning and Pumps	30 <sup>th</sup> April 2017
<b>9</b>	Screened list of applicants-Space Conditioning and Pumps	31 <sup>st</sup> May 2018
<b>11</b>	Support to Expert Panel to discharge their duties and select winners	31 <sup>st</sup> August 2018
<b>12</b>	Technology verification template-Space Conditioning and Pumps	31 <sup>st</sup> August 2018
<b>13</b>	Facilitation of deployment in industry, where possible-Space Conditioning and Pumps	31 <sup>st</sup> August 2018
<b>14</b>	Contact details of FIs for further action by PMU	30 <sup>th</sup> September 2018
<b>15</b>	Reports on the two challenge – space conditioning and pumps	31 <sup>st</sup> March 2019
<b>16</b>	<b>Closure report</b>	<b>31<sup>st</sup>March 2019</b>

It may be noted, at this point, that some activities of the waste heat recovery challenge were delayed due to non-availability of some key stakeholders at the expected time. However, with the space conditioning and pumps challenges being on track, it is expected that the overall project (first year cycle of challenges) will be completed within the overall schedule.

### 3.0. Waste Heat Recovery Innovation Challenge - Summary

The first FLCTD challenge, on Waste Heat Recovery (WHR), was announced on November 1 2017, and open until 18 February, 2018. The following were the key activities under this challenge:

	<b>Activity</b>	<b>Date/Period</b>
<b>1</b>	WHR Innovation Challenge Launched	1 November,2017
<b>2</b>	Reach out through Emails and phone	30 November, 2017
<b>3</b>	Designing of Flyers and brochures	1 December, 2017
<b>4</b>	Information Dissemination Roadshows in 4 cities	19 December, 2017
<b>5</b>	Reach out through social media	5 January, 2018
<b>6</b>	Information Dissemination webinars	18 January, 2018
<b>7</b>	Application Deadline	18 February, 2018
<b>8</b>	Initial Screening of applications by PMU(UNIDO and CII)	7 March, 2018
<b>9</b>	Final Screening and shortlisting by Expert panel	9 March, 2018
<b>10</b>	Site visit with expert panel members to 3 shortlisted innovators	April, 2018
<b>11</b>	Final presentation by shortlisted applicants to expert panel	20 June, 2018

The above activities are detailed in the following section.

#### 3.1. Reach out through emails and phone

5,000 emails were sent to Indian technical institutes/Universities, Research institutes, startups, large industries, Micro, Small and medium enterprises, R&D units in public center enterprises and Government Laboratories to spread awareness about the projects. We circulated the emails to all the relevant CII members as well, through CII's state and regional office. Phone calls were also made to all the relevant stakeholders to highlight the key program features and to gauge their interest in participating in the program.

### 3.2. Development of flyers and brochures

Flyers and brochures were designed for the WHR innovation challenge and the overall program schedule and circulated through emails. 1,000 hard copies were also printed and distributed during various meetings with industry associations, research institutes and manufacturing industries.

### 3.3. Information dissemination roadshows

The objective of the roadshows was to create awareness and publicize the FLCTD program and the WHR innovation challenges across India, with the intent of soliciting a large number of entries into the challenges. These roadshows presented the opportunity to interact with over 100 potential applicants in the following cities:

4 roadshow events were planned as part of the outreach activities for the first challenge. These roadshows presented the opportunity to interact with over 100 potential applicants. The schedule for these events was as indicated below:

	<b>Date</b>	<b>City</b>	<b>Venue</b>
<b>1</b>	12 December 2017	Ahmedabad	Hotel Fern Ecotel
<b>2</b>	15 December 2017	Pune	Hotel Crowne Plaza
<b>3</b>	18 December 2017	New Delhi	India Habitat Centre
<b>4</b>	19 December 2017	Chennai	Hotel Crowne Plaza

Each roadshow/ workshop was for a duration of 2 hours, from 18:00 hours to 20:00 hours. At each event, CII introduced the workshop, followed by UNIDO providing more details about the workshop. This was followed by a brief presentation by CII, highlighting the support that FLCTD would provide to participants through liaising with industry. The presentations were followed by an open Q&A session, with participants requesting for clarifications regarding the FLCTD program. This was followed by a networking dinner.

### 3.3.1 Roadshow -Ahmedabad

The roadshow event in Ahmedabad was organized on 12<sup>th</sup> December 2017 at Fern Ecotel hotel and 12 participants attended the evening workshop.

The event saw participation from representatives of industry associations, and manufacturing units. The event began with a welcome address from Ms. Nisha Jayaram, Counsellor, and CII GBC. Thereafter, Mr. Sandeep Tandon, National Project Coordinator, UNIDO gave a detailed



*Figure 1: Roadshow in Ahmedabad*

presentation on the FLCTD program and its objectives. The audience was updated on the launch of 1<sup>st</sup> Innovation challenge for the Waste Heat Recovery Vertical and were requested to circulate the information in the network so that the project may receive potential innovative technology applications before 31<sup>st</sup> January 2018.

The presentation on the project innovation and challenge was followed by robust discussions. The AmulFed Dairy, one of the largest dairies in the country, was represented by Mr. Prashant Sheth, Senior Manager of Utilities of the chilling plant in Gandhinagar. He shared the urgent need for WHR technologies in dairies, given the opportunities in heat recovery in the Chilling Plants, but indicated the challenges in utilizing the recovered heat for efficient use in dairies. He indicated the potential partnership opportunities for deployment of successful WHR technologies in AmulFed dairies. Mr. Manish Kothari, Founder, Rhino Machines who participated in UNIDO's Global Cleantech Innovation Programme (GCIP) brought attention to the importance of mentoring programmes and advised that FLCTD consider offering similar support to its innovators. The meeting saw a participation of 12 people (despite confirmations from 35+ persons) owing to the state assembly elections rallies that led to severe traffic issues.

Additionally, in Ahmedabad, meetings were facilitated with Entrepreneurship Development Institute of India (EDII) and Ahmedabad Textile Industry's Research Association (ATIRA) to discuss and interact with their incubatees/ researchers/ innovators about the project and understand their perspectives. UNIDO and CII also met with Centre for Innovation Incubation and Entrepreneurship (CIIE) at IIM Ahmedabad.

The list of participants is attached in Annexure 1.

### 3.3.2 Roadshow-Pune

The Pune workshop was organised on 15<sup>th</sup> December 2017 at Crowne Plaza hotel and more than 30 participants from industries and educational institutions attended the workshop in the evening.

The event began with a welcome address from Ms. Nisha Jayaram, Counsellor, CII GBC and special remarks from Mr. Milind Deore, Director, and BEE. Thereafter, Mr. Sandeep Tandon, National Project Coordinator, UNIDO gave a detailed presentation on the FLCTD programme and its objectives. The audience was updated on the launch of 1<sup>st</sup> Innovation challenge for the Waste Heat Recovery Vertical and were requested to circulate the information in the network so that the project may receive potential innovative technology applications before 31<sup>st</sup> January 2018.



*Figure 2: Roadshow in Pune*

Prof. Milind Rane from IIT Mumbai who participated in UNIDO's Global Cleantech Innovation Programme (GCIP) brought attention to the importance of mentoring programmes and advised that FLCTD consider offering similar support to its innovators and also made a detailed presentation on the potential opportunities in waste heat recovery in Indian industry.

These presentations were followed by robust discussions.

A meeting was facilitated with Symbiosis Institute of International Business (SIIB) to discuss and interact with their professors and students about the project, its benefits and the role of SIIB in promoting the initiative in their networks. UNIDO and CII also met with Maharashtra Chamber of Commerce Industries & Agriculture (MCCIA) to promote FLCTD among the MCCIA members.

The list of participants is attached in Annexure 2.

### 3.3.3 Roadshow-New Delhi

The roadshow in New Delhi was organized on 18<sup>th</sup> December 2017 at India Habitat Centre and more than 35 participants attended the workshop to understand more about the project.

The event saw participation from representatives of industry associations, and manufacturing units. The event began with a welcome address from Mr. K S Venkatagiri, Executive Director, CII GBC. Thereafter, Mr. Sandeep Tandon, National



*Figure 3: Roadshow in New Delhi*

Project Coordinator, UNIDO gave a detailed presentation on the FLCTD programme and its objectives. The audience was updated on the launch of the 1<sup>st</sup> Innovation challenge for the Waste Heat Recovery vertical and were requested to circulate the information in their networks so that the project could receive potential innovative technology applications before the scheduled deadline. The presentation on the project innovation and challenge was followed by robust discussions

Sharing more insights into the wider opportunities of WHR technology innovation, Dr. A.K. Asthana, Sr. Technical Expert, GIZ pointed out that industrial furnaces are low hanging fruits, and there are several such opportunities across various industries, especially those with Chiller technologies. FLCTD was relevant as innovative WHR technologies would need commercialization and scale-up to tap into energy conservation opportunities.

Mr. Karthik Chandrashekar, CEO, Sangam Technologies, a Venture Capital fund, emphasized the increasing demand for resource productivity solutions and the need to enumerate technologies from commercialization perspective. He pointed out that the success of an innovation would also rely on smaller deployment cycles and the need for validation of these technology business models. He also pointed out that the challenges lie in the fragmented target markets. Dr. H Purushotam, MD, NRDC discussed the key role NRDC played in technology validation in UNIDO's cleantech programme and the support offered for patent filing, which he shared can be extended to FLCTD. The event wrapped up with concluding remarks and the audience were requested to circulate the information in the network so that the project may receive potential innovative technology applications before 31st January 2018.

The list of participants is attached in Annexure 3.

### **3.3.4 Roadshow-Chennai**

The roadshow in Chennai was organized on 19<sup>th</sup> December 2017 at Crowne Plaza hotel and more than 25 participants attended the workshop.

The event saw participation from representatives of industry associations, and manufacturing units and educational institutions. The event began with a welcome address from Mr. P V Kiran Ananth, Principal Counsellor, CII GBC. Thereafter, Mr. Sandeep Tandon, National Project Coordinator, UNIDO gave a detailed presentation on the FLCTD programme and its objectives. The audience was updated on the launch of the 1<sup>st</sup> Innovation challenge for the Waste Heat Recovery vertical and were requested to circulate the information in the network so that the project may receive potential innovative technology applications before 31<sup>st</sup> January 2018. The presentation on the project innovation and challenge was followed by robust discussions.

The vibrant discussions saw various queries and questions from participants, including cleantech innovators from the IIT-Madras Research Park incubation centre, IIT-Madras faculties from the mechanical department, and technology and development consultancies among others. The officials from TN Electricity Inspectorate indicated their keen interest in WHR innovations that could be adopted and deployed as a part of the PAT Scheme that is been rolled out in Tamil Nadu under their supervision.



*Figure 4: Roadshow in Chennai*

Mr. Vijay Sarathi, Jury, CII Innovation Awards stressed upon the importance of lower end Waste Heat Recovery technologies as there is lot of potential in the industry. He mentioned that FLCTD programme would not only help the innovators in re-tuning their technologies but also take them to market to become commercially successful. Mr Ram Ramarathnam, a semi-finalist from UNIDO's GCIP programme shared his experiences of benefitting from the project. The roadshow concluded with closing remarks from Mr. Kiran Ananth, who encouraged the innovators to apply in the challenge and also spread the word in their network.

A meeting was also organized at IIT Madras Incubation Cell to discuss and interact with the incubatees/ researchers/ innovators about the project and understand the potential for future engagement with IITM for further spreading awareness about FLCTD.

The list of participants is attached in Annexure 4.

### **3.4. Reach out through social media**

CII ran an online campaign on social media through the CII –GBC official Facebook webpage to promote the waste heat recovery innovation challenge and posted regular updates about the different events of the waste heat recovery innovation challenge.

### **3.5. Information dissemination webinars**

CII also hosted two webinars to reach out to more potential participants across the country, with the intent of covering those who were unable to attend the roadshows. The webinars were conducted on 10<sup>th</sup> January and 18<sup>th</sup> January, 2018. The format of the webinar was similar to that of the roadshows, with presentations by UNIDO and CII, followed by a Q&A session. The webinars enabled participation from an additional 60 participants.

### 3.6. Developing screening criteria

A set of detailed screening criteria was developed to shortlist the applications based on different parameters like originality of the innovation, energy recovery and GHG reduction potential, return on investment, replication potential and readiness for commercial application.

The breakup of marks for each parameter is given below:

*Table 3: Innovation parameters marks*

S No.	Description	Maximum Marks
<b>1</b>	<b>Originality of the Innovation</b>	<b>25</b>
	1. New Technology - First time Globally: 25 Marks 2. New Technology -First time in India: 20 Marks 3. Improvement in Existing Technlgy:15 Marks	
<b>2</b>	<b>Energy Recovery and GHG Reduction Potential</b>	<b>30</b>
	1. Energy Recovery Above 20%: 30 Marks 2. Energy Recovery 15% to 20%: 25 Marks 3. Energy Recovery 10% to 15%: 15 Marks 4. Energy Recovery 5% to 10%: 10	
<b>3</b>	<b>Return on Investment</b>	<b>20</b>
	1. Payback Less than 2 years: 20 Marks 2. Payback Above 2 to 3 years: 15 Marks 3. Payback Above 3 to 5 years: 10 4. Payback period above 5 years: 5	
<b>4</b>	<b>Replication Potential</b>	<b>15</b>
	1. Applicable more than 1 sector: 15 Marks 2. Applicable within sector, more than 50% of the sector: 12 Marks 3. Applicable within sector, 30% to 50% of the sector: 8 4. Applicable within Sector less than 30%: 4	
<b>5</b>	<b>Readiness for Commercial Application</b>	<b>10</b>
	1. Commercially available in market: 10 Marks 2. Prototype/Pilot demonstration: 7 Marks 3. R&D Stage: 5 Marks	

### 3.7. Initial screening of applications

The initial screening of applications for completeness of in all respect, was done by the project

management unit (PMU). A total of 107 applications were received, out of which 57 were incomplete, 6 were partially filled and remaining 44 were complete for the next round of shortlisting by the expert panel. Since waste heat recovery is a fairly niche technology, the number of applications received and shortlisted is very encouraging.

### 3.8. Evaluation of applications by expert panel

Post the initial checks for completeness of applications by the PMU, the members of the expert panel evaluated all the 44 completed applications, in the presence of PMU and CII in New Delhi on 9 March, 2018. The screening exercise looked at the originality of the innovation, energy recovery, and return on investment, replication potential and readiness for commercial application, and marks were allotted based on the screening criteria explained in an earlier section. The following innovations were selected for the next round:

1. **Stirling CHP Adsorption Chiller** by Grassroots Energy Technologies India Pvt. Ltd.
2. **Heat Recovery from Rotary Kiln Surface** by Oorja Energy Engg Services Pvt. Ltd.
3. **Heat Recovery from Air Compressors** by Promethean Energy Pvt. Ltd.
4. **VIP Heat Recovery Boiler** by Village Industrial Power
5. **Chiller Performance Improvement Project** by SEE Tech Solutions Pvt. Ltd.

A brief description of the innovations and company is given below:

#### 3.8.1. Grassroots Energy Technologies India Pvt Ltd

The Grassroots Energy innovation utilizes a Micro-Combined Heat and Power (mCHP) Stirling Adsorption Chiller to create a novel Cold Storage Solution for Small and Medium Industries to cut down on energy expenses. This system captures the low-grade waste heat in the temperature range of 60 to 80 degrees Celsius to drive an adsorption chiller that utilizes modern materials to improve the chiller efficiency. The Stirling mCHP generator can run continuously (24/7), providing a corresponding, continuous chilling effect that further improves efficiency by eliminating the need for expensive battery or ice storage technology. The overall lower operating cost reduces the overall cost of chilling per metric ton by nearly a factor of two, in comparison to available solar/battery and solar/ice solutions that use conventional vapor compression or electricity driven chillers. Most conventional chillers utilize electricity to drive a vapor compression cycle to create the chilling effect. The proposed innovation replaces this electricity intensive process with the heat driven adsorption chilling process using novel materials which provide superior performance.

The primary target market for the GRE invention is to provide cold storage access to agro-SMEs with limited or unreliable electricity access. In tropical country like India, the lack of cold chain infrastructure limits the market opportunities for SME to capitalize on the energy expenses. No thermally driven solutions working at such low temperatures like the GRE proposal exist in the market today. The initial set of industries would be food and agri-processing Industry, dairy industry, pharma Industry, water processing and hotels.

### **3.8.2. Oorja Energy Engg Services Pvt. Ltd**

A rotary kiln that is used in cement, paper board and sponge iron industries has high surface temperature from which heat is lost to the ambient. These losses can vary from 5-10% of the energy input to the kiln and add a significant cost to the energy cost of the product. There are different solutions available to recover heat from the flue gases of the kiln, but there are no solutions implemented so far for recovery of heat from the kiln surface. The heat recovery system involves using heat transfer panels that absorb heat radiated by the kiln surface. Heat thus recovered can be used for various purposes like preheating for feed water of the captive power plant, operate heat based absorption/adsorption cooling or operating an ORC based turbine for power generation.

### **3.8.3. Promethean Energy Pvt Ltd**

Most industries use inefficient heating systems using fuels like diesel, furnace oil or electricity, all of which contribute to high costs and high carbon emissions. Simultaneously, there is a lot of wastage of energy in these industries on the cooling and air utilities, a large proportion of energy is wasted via cooling towers or radiator panels. Similarly, in air compressors, over 90% of the total energy input is wasted as heat to the environment. In this sense, compressed air is one of the most expensive uses of energy in a manufacturing plant. This offers an excellent opportunity to recovery heat from cooling utilities and use it at the site of hot water use.

The solution proposed by Promethean Energy is a waste heat recovery from air compressors, to recover anywhere between 35% 100% of the air compressor power consumption as hot water between 40 and 80 degrees Celsius. For oil free air compressors, 50% of the motor capacity can be recovered as hot water at up to 70 degree Celsius and for oil flooded screw compressors, 70% of the motor capacity can be recovered as heat energy at up to 80 degree Celsius.

### **3.8.4. SEE-Tech Solutions Pvt. Ltd.**

There are many situations when a great technology becomes non/less feasible and this is specifically true in energy source conversion projects when thermal fuel is relatively cheaper and electricity is costlier (situation in Maharashtra). Heat pump becomes very sought or project when electrical tariff is in single digit (less than Rs. 10/ kWh for commercial consumption) as the payback works out to be mostly less than 2 years, but in states like Maharashtra, commercial tariff is too high (Rs. 12 to Rs. 14/kWh), the payback goes as high as 40 month or even more than that. Water source heat pump utilizes waste heat from condenser and delivers chilled water as well, thus takes COP from 4 to 6. Some load of chiller is shared which results in lower load on chillers finally resulting in improved COP of the chillers.

### **3.8.5. Village Industrial Power**

Village Industrial Power (VIP) has developed a portable combined heat and power plant, the VIP 10-40, that converts agro-biomass such as bagasse into 10kW of three-phase electricity or 12kW of mechanical power and 40kW of low pressure steam. VIP found an opportunity to design a heat recovery boiler for jaggeries to increase their productivity and generate excess bagasse which can be used as fuel in the

VIP10-40 and in other rural industries. Typically exhaust temperatures are 400 degree Celsius for multi-pan jaggeries and 600 C for single pan jaggeries, providing attractive opportunities for waste heat recovery. Multi-pan jaggeries have adequate exhaust temperature for preheating and boiling juice in combination with their existing flue gas fired pans, easily increasing their productivity by 20%. The heat transfer efficiency is increased from 65% to 78% (an increase of 20%) when using the heat recovery boiler. Single pan jaggeries have two options: using our VIP heat recovery boiler/evaporator to increase productivity by up to 30%, or to use flue gas to make power in the VIP10-40, thereby powering the jaggeries' cane crusher and using exhaust steam to preheat juice. The latter option would displace the diesel used for the cane crusher in jaggeries that do not have grid power. Village Industrial Power believes that traditional jaggeries serve India well, both because they provide more employment and because they are often owned by small sugar cane farmers, who are trying to add value to their crop. Being more decentralized, jaggeries expend less diesel fuel in transport of cane than the large mills. They often operate during the monsoon season, when the large sugar mills are shut down due to inadequate supply of sugar cane. The waste heat recovery boiler and juice evaporator is easily retrofitted to existing jaggeries, which will continue to make full use of their existing equipment.

### 3.9. Final presentations by shortlisted applicants to expert panel

The final presentations by the semi-finalists shortlisted for Waste Heat Recovery (WHR) innovation challenge under the Facility for Low Carbon Technology Deployment (FLCTD) was held at the Bureau of Energy Efficiency (BEE) office in New Delhi on 20 June 2018. These semi-finalists were selected for the final presentations after an extensive screening and shortlisting processes. A sample presentation format was shared with the semi-finalists, for the presentation. The following details were requested for in the presentation:

- **Brief description of the company;** Type of ownership, Management details and Partnership with R&D or institutes if any
- **Brief information about the innovation**
- **Why is your product innovative;** How it is different and comparison with other technologies
- **How it is applicable for the case of WHR**
- **Status of Innovation;** Whether the technology is under – Commercial, Prototype, Pilot and Any installation done with detail reference of the installation
- **Cost of the technology;** Total project cost/ economics end to end / what is anticipated also required
- **Technical/Onsite viability;** Collaboration with existing technology suppliers and Impacts on existing technology/ O&M, guarantees, etc.
- **Financial Viability;** Investment cost (all aspects to be considered), Payback and ROI/IRR
- **Market for the Innovation;** Replication potential of the Product (Investment, Savings, etc.), Major sectors to be targeted and Cross sectoral potential
- **Impacts;** Environment impact reduction(Energy and GHG)
- **Business plan for Scaling up;** About Business, Market Development, Implementation framework and Funding
- **Support required from FLCTD for upscaling**

The meeting commenced with welcome remarks by meeting Chair, Mr. Abhay Bakre, Director General, BEE. In his remarks, DG stressed on expediting the innovation challenges in all the 3 verticals of the FLCTD. He said that the approvals granted in experts' meetings are BEE's endorsements to the decisions taken in the meetings. He reminded the members of the meeting that the project is expected to identify 120 innovations where at least 40 of them shall be supported for technology deployment.

The FLCTD National Project Manager (NPM) also presented a status update of the FLCTD project. He provided the background for the meeting and presented the scoresheet of the selection round qualifying decisions in shortlisting the semi-finalists. The NPM also presented the steps in distribution of funds for supporting the finalist innovations.

Regarding the financial support offered by FLCTD to finalist innovators, Mr Bakre suggested that FLCTD shall adhere to stringent norms in the monetary distribution, adhering to standards similar to those used by entities like DST/DSIR. UNIDO Representative suggested that the incentives offered to the innovators shall cover up to 50% of the deployment cost of the innovation. He suggested that exceptional cases may be considered for 60% financial support (of the total cost in deploying the technology).

The five shortlisted applicants of WHR Innovation Challenge individually gave a detailed presentation on the idea submitted and responded to clarifications sought by expert panel members, DG BEE and UNIDO representatives.

After reviewing all the 5 innovations, expert panel members finally selected three innovations from following companies:

- 1) **M/S Oorja Energy Engg Services Pvt. Ltd**
- 2) **M/S Promethean Energy Pvt Ltd**
- 3) **M/S Village Industrial Power**

The above companies qualified based on merits and replication potential and shall be supported under the FLCTD project. This was agreed by the DG BEE and UNIDO NPM. The NPM clarified that the template for appraisal has been prepared, which will be used to gather the financial details of projects to be supported, and it will be used by UNIDO, expert panel members and BEE as a base document.

### **3.10. Site visit with expert panel members to 3 shortlisted innovators**

The project management team along with expert panel members visited the pilot installations of the innovations done by the shortlisted companies at different locations/sites. The expert panel members and PMU witnessed the innovations of Oorja Energy Engg Services Pvt. Ltd, Promethean Energy Pvt Ltd and Village Industrial Power.

### **3.11. Technology Deployment**

The innovators are currently in various stages of pilot deployment of their technologies under FLCTD.

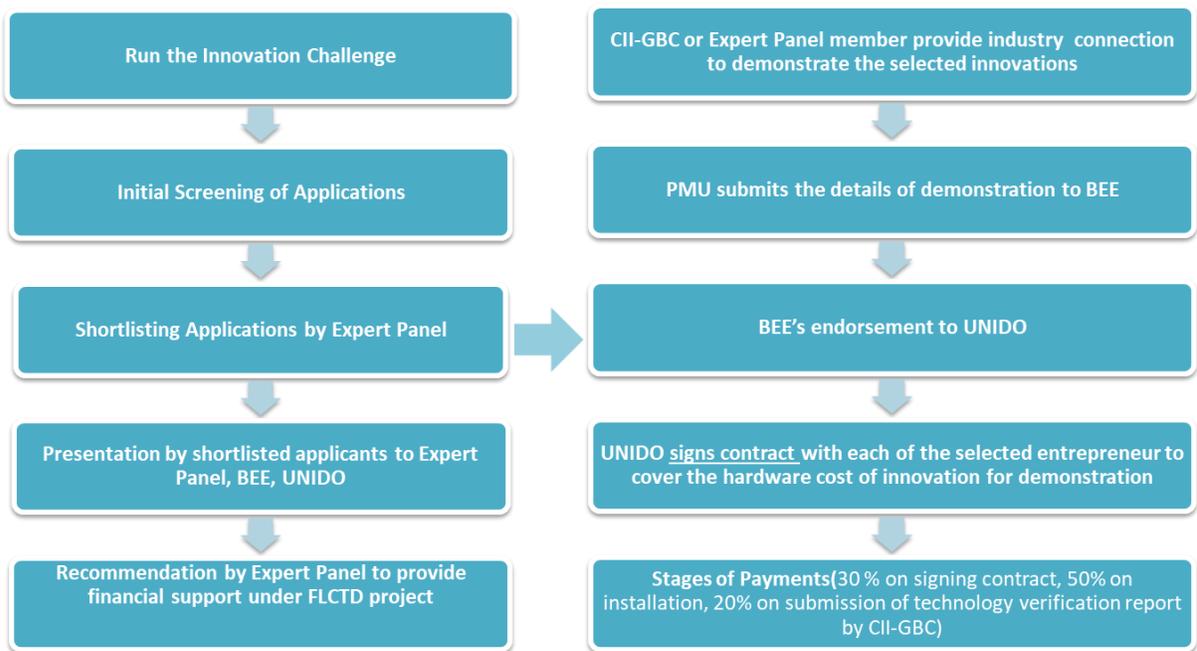
- 1) **M/S Oorja Energy Engg Services Pvt. Ltd.** is in discussion with 5 cement plants, with the support of CII, for implementation of the innovation. One pilot site will be finalized soon.

- 2) **M/S Promethean Energy Pvt Ltd** is being supported by CII in identifying a pilot site in the dairy and textile sectors (MSME clusters). The same will be finalized soon.
- 3) **M/S Village Industrial Power** will also identify a pilot site shortly. Since they already have extensive inroads in the Maharashtra jaggery belt and have already shortlisted sites for their pilot implementation.

### 3.12. Disbursement of financial support

A financial assistance form was also developed to obtain more information from the 3 finalists for their expected usage of the funds granted by FLCTD. The detailed form is attached in Annexure 4.2. The completed forms have been received from the finalists. Legal agreements are yet to be signed with the innovators for fund disbursement. UNIDO shall disburse the funds as per the milestones indicated in the agreements.

Key steps in the overall mechanism for the financing process is as follows:



The PMU and CII will jointly monitor the progress of the technology deployment and the resultant energy and cost savings. CII-GBC shall submit a final report of the technology verification from the field test and its energy savings and payback.

## 4.0. Annexures

### 4.1. Annexure: Roadshow Participants

#### List of Participants in Ahmedabad

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**List of Participants in Chennai**

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## 4.2. Annexure: Financial Assistance Form



Annexure C

# Facility for Low Carbon Technology Deployment

## BEE UNIDO Initiative

Application form for Financial Assistance to Innovations

### PART A: Brief about the Innovator

#### 1.1 Particulars of the Enterprise

1	Name of the company	
2	Type of ownership (Proprietorship, Partnership firm, Company, Micro / Small / Medium / Large Enterprises etc.)	
3	Year of incorporation / commencement of operations	
4	Address of registered office and site of operations	
5	Location of Demonstration	
6	Main Promoter(s) names & contact details (tel. / email)	

#### 1.2 Particulars of promoters

Name & Age	Educational / professional qualification	No of Years of professional experience	No of Years of entrepreneurial experience	% Stake in

#### 1.3 Present line of business and technology / product successfully developed by the entity?

--

#### 1.4 Technology know-how partner of the innovation/technology, if any (name designation with educational and professional background affiliation address, telephone, fax, e - mail etc.)

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## **PART B: Technical Information**

2.1 Name of the innovation:

2.2 Brief about the innovation:

2.3 Innovation objectives:

2.4 Major Targets to be achieved during the demonstration of innovation:

2.5 What is the specialty /novelty /uniqueness /innovation about the proposed technology?

2.6 Work already carried out for proof of concept / validation of technology & at what scale :

2.7 Whether the technology has been already patented. If yes, provide the details:2.8 Process flow - charts / schematic diagram etc.:

---

2.9 Source of raw materials and their availability:

2.10 Comparative advantages/disadvantages of proposed technology over the conventional / emerging technologies and brief comments on competitions / challenges

2.11 Techno-economics, cost benefit analysis and demand statistics in next 2/3 years (please provide list of potential customers/Sectors along with proof of documents)

2.13 Total Duration for demonstration of innovation (in months):

2.14 Work plan indicating important activities / milestones & duration, time scheduling (bar-chart):

2.15 What is the advantage of the proposed technology in terms of business opportunities?

**PART C: Financial Requirement**

**3.1 Total Project Cost:**

Project head	Area / Qty ./ specifications / Capacity	Company / Firm Contribution (Rs. lakh)	Contribution from Fund (Rs. lakh)	Total Cost (Rs. lakh)
Technology Know-how fee / patent / licensing				
<i>Detailed break-up of cost:</i>				
Equipment / machinery / Utilities				
<i>Detailed break-up of cost:</i>				
Consumables / Raw Materials				
<i>Detailed break-up of cost:</i>				
Equipment for Testing & Evaluation/Quality Control				
<i>Detailed break-up of cost:</i>				
Manpower Salaries				
<i>Detailed break-up of cost:</i>				
Marketing related expenses towards demonstration of innovation				
<i>Detailed break-up of cost:</i>				
Others (implementation related expenses)				
<i>Detailed break-up of cost:</i>				
Contingency				
<i>Detailed break-up of cost:</i>				
<b>Total</b>				

3.2 Means of Finance:

Means of finance	Amount (Rs. lakh)
Additional Share capital	
Unsecured loans from	
Assistance sought under FLCTD	
Assistance from other FIs, if any	
Others (pls. specify)	
<b>Total</b>	

3.3 Whether this proposal has been submitted to any other agency for funding support (if yes, give details)