

Minutes of Meeting

The final presentations of semi-finalists shortlisted for 1st Waste Heat Recovery (WHR) innovation challenge under the Facility for Low Carbon Technology Deployment (FLCTD) was held at Bureau of Energy Efficiency on 20th June 2018. These semi-finalists were shortlisted for the final presentations after extensive screening and shortlisting processes. The meeting was chaired by the DG, BEE.

List of participants

	Name	Designation & Organization
1	Mr Abhay Bakre	Director General, BEE
2	Mr. Bibek Pattanaik	PE, BEE
3	Dr. G.C. Datta Roy	Founder and Advisor, DESL Energy (FLCTD-WHR Expert)
4	Mr. A.K. Asthana	Senior Technical Expert, GIZ (FLCTD-WHR Expert)
5	Dr. Milind Rane,	Professor (Mech. Engineering), IIT, Mumbai (FLCTD-WHR Expert)
6	Dr. Rene Van Berkel	Regional Representative, UNIDO
7	Mr. Suresh Kennit	National Project Manager, BEE-UNIDO project on EE&RE in MSME
8	Mr. Sandeep Tandon	National Project Manager, FLCTD, UNIDO
9	Ms. Reshmi Vasudevan	Programme Expert, FLCTD, UNIDO
10	Mr. Rishabh Goel	Project Associate, FLCTD, UNIDO
11	Mr. P.V. Kiran Ananth	Senior Counsellor, Confederation of Indian Industries
12	Ms. Nisha Jayaram	Counsellor, Confederation of Indian Industries
13	Mr. Ashwin K.P.	Promethean Energy (Semi-finalist, FLCTD-WHR 2018)
14	Mr. Carl Bielenberg	Village Industrial Power (Semi-finalist, FLCTD-WHR 2018)
15	Mr. Madhusudhan Rapole	Oorja Energy (Semi-finalist, FLCTD-WHR 2018)
16	Mr. Milind Chittawar	SEETech Solutions (Semi-finalist, FLCTD-WHR 2018)
17	Mr. Pradeep Podal	Grassroots Energy (Semi-finalist, FLCTD-WHR 2018)

Background: The Project Management Unit, along with CII evaluated 44 applications that met the criteria of the WHR innovation challenge. The screening exercise looked at the originality of the innovation, energy recovery, return on investment, replication potential and readiness for commercial application. The applications that qualified the screening round were reviewed by the WHR expert panel. The experts scrutinized the applications for the technology soundness, paybacks and replication potential in target industries. The shortlisted innovators/entrepreneurs were invited for the final presentation round under the challenge, on 20th June at the Bureau of Energy Efficiency. The applications selected by the expert panel members in the final presentation round for funding support under the FLCTD to demonstrate the innovation.

1. The meeting commenced with welcome remarks by Shri Abhay Bakre, Director General, Bureau of Energy Efficiency. 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. DG, BEE 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.
2. The FLCTD National Project Manager (NPM) presented a status update of the FLCTD project. NPM, UNIDO 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.
3. Regarding the financial support offered by FLCTD to finalist innovators, DG, BEE suggested that FLCTD shall adhere to stringent norms in the monetary distribution such that the standards used by entities like DST/DSIR could be followed here. UNIDO Representative suggested that the incentives offered to the innovators shall cover up to 50% of the deployment cost of the innovation. UNIDO is not carrying back the IPR of the technologies. Hence the innovator should leverage the FLCTD support to identify other means to meet the remaining expenses. He suggested that exceptional cases may be considered for 60% financial support (of the total cost in deploying the technology).
4. 5 shortlisted applicants of WHR Innovation Challenge individually gave a presentation on the proposal submitted and responded to clarifications sought by DG, BEE, Expert panel members and UNIDO Representative, which is summarized below:
 - a) Mr. Pradeep Podal of Grassroots Energy, Inc. (GRE) presented about 'micro Stirling Adsorption Chiller Cold Storage Systems' - the concept for capturing waste heat from Stirling micro Stirling engine which is being used to power mini-grids. The recovered energy is proposed to be used in adsorption chiller for cold-storage of agri-produce in farm lands. He shared that GRE is already generating and supplying electricity on-demand to mini-grid operators. The proposal included the details of how the waste heat generated from sterling engine will be recovered through a series of heat exchangers designed specifically to is handled by a radiator – which can be gainfully used for cold-storage systems. GRE was seeking funding support of approximately INR 16 lakhs from FLCTD project the development of waste heat recovery system to integrate a vapour adsorption chilling system which will serve the purpose of storing farm produce. This would be a value-added service which will be in addition to the electricity being provided through the sterling generator of GRE. In response to query on micro-grids, Mr. Podal clarified that due to unreliable grid conditions northern states are expected to have 12,000 mini-grids by 2020, primarily in the agrarian region. He further clarified that systems that generate 10KVA and below does not require licensing under the Electricity Grid Code 2010 in the state of Bihar where GRE has setup its micro-grid.

Experts' Conclusions: The experts indicated that the claim of achieving coefficient of performance of 0.65 using exhaust heat temperature of 80 degree Celsius appeared to be much higher than achievable. Mr. Podal responded that unlike an absorption chiller, adsorption chiller gave better performance using low grade heat recovery. Further, GRE is still at the concept stage where at least 10 - 12 months' time-frame was required before it could install and commission the heat recovery system. One of the key concerns that was raised in the discussions was the cost viability of the proposed heat exchange systems and the integration of vapour adsorption based cold-storage at INR 9 lac per unit. Also, the entire innovation was confined to heat recovery from Stirling micro-CHP electricity generators which has a limited market and therefore has a low replication potential. The proposal was considered weak due to the above reasons as well as the model was built around micro-grid which severely limits the business viability of installing a sterling engine in the rural areas and integrating waste heat recovery for cooling application.

- b) Mr. Madhusudhan Rapole of Oorja Energy, gave a presentation on proposal submitted on 'Radiant Heat Recovery from Rotary Kilns'. His innovation takes advantage of the heat losses from rotary kilns where surface temperatures of kilns are between 150°C to 400°C across Cement and Paper & Pulp industries. He shared that a pilot demonstration at Ultratech Cements, in Tamil Nadu with average kiln temperature of 240 degree Celsius provides heat recovery potential of 4KW/sqm heat recovery, which translates to a savings of 7.2 tonnes of coal/sqm annually which costs INR 30,000. The heat recovered can be used for power generation using Organic Ranking Cycle (ORC) turbines, heating boiler feedwater, VAM based cooling or for drying coal. Mr. Rapole informed about his recent interaction with cement firms (arranged by CII) and interest was expressed more for power generation using waste heat. He presented that that the actual savings may vary (between Rs. 20,000 –30,000/sqm annually) depending upon the final usage of the heat generated. If the heat recovery is used for power generation close to kiln then the payback is faster. Depending on the size of the installation, Mr. Rapole shared that the panels can be manufactured and delivered to the site within 8-10 weeks. From FLCTD, he sought financial support for pilot demonstration of WHR technology at full scale.

Experts' Conclusions: The experts unanimously acknowledged the uniqueness of the proposal and its relevance and opportunities in cement sector for heat recovery using radiant heat panels. The experts were of the opinion that this demonstration project could offer much insight into the heat recovery from kilns which has not been tapped. The experts sought extensive clarification about the impact of heat recovery on kiln operations especially the equilibrium temp which is critical for maintain the quality of final product as well as operation of kiln. The total costing that was presented to the experts for financial support from FLCTD, the experts opined that instead of ORC turbine for power generation, VAM application was less complex. After deliberation it was agreed that FLCTD should cover the waste heat recovery system up to the point where heat is transferred to the end system for productive use (in chilling or power generation). The cost of end use system should be covered by the cement company.

- c) Mr. Ashwin K.P. of Promethean Energy presented 'Heat Recovery in Milk Chilling Centres' to generate hot water for cleaning in place (CIP), which is required to maintain hygiene. His presentation demonstrated the innovative application of heat exchangers to capture waste heat from ammonia-based compressors in milk chilling centres to generate hot water at a certain for cleaning milk cans. The innovation is aimed to replace the systems like electric heaters, oil heaters, solar heaters and biomass-based water to generate hot water. He shared that ammonia-based compressors are widely used in milk chilling plants in the country. Using the waste heat from these compressors, the innovative heat exchangers can capture up to 40kW heat to deliver hot water at 50°C or higher temperature at zero operating cost. In most case the WHR system has payback of less than 2 years.

Experts' Conclusions: The experts acknowledged the relevance and the feasibility in heat recovery in ammonia-based chillers in milk chilling plants and its replication potential. It was however suggested that hot water at 50°C was not sufficient for meeting the standards prescribed for cleaning milk cans (to avoid future contamination of milk), and it was necessary to offer water at 80°C. Mr Ashwin indicated that this could be easily achieved with minor integration of electric heaters. From FLCTD, he sought a financial support of INR 21 lac for installing and commissioning the heat exchanger in milk chilling plants.

- d) Mr. Carl Bielenberg and Mr. Shashi Bhatt of Village Industrial Power (VIP) presented the 'Heat Recovery Evaporator (HRE)' that captures waste heat from jaggery exhausts and use it to generate steam at 1 bar pressure which is utilized in the jaggery making process. This reduces bagasse consumption by up to 15 - 20% and leads to increasing the availability of approximately 60-80 tons of dry bagasse for sale per year thus resulting in additional income for the farmers. VIP has developed one HRE prototype for a jaggery unit in Uruli-Kanchan near Pune. They are targeting jaggery units in Maharashtra, especially in Kolhapur district. The jaggery making is an informal sector which uses a rudimentary design and operation practise thus leaving vast scope of improvement and energy saving. There was discussion around the design aspects and possibility of integrating a baggase drying unit to reduce the labour involved and make the entire system more attractive for the jaggery producers to adopt.

Experts' Conclusions: The experts agreed that that the opportunities were large among approximately 40,000 jaggeries across India to improve the operational efficiency through waste heat recovery and bagasse drying, which can improve operating margin and provide additional income. Technology interventions in jaggeries was not prioritized under any schemes and programme of Government of India, and therefore FLCTD support should be provided as the energy conservation opportunity is large. VIP has sought FLCTD financial support of INR 32 lakh to develop HRE into a product, refine the product design based on pilots and build a sales pipeline.

- e) Mr. Milind Chittawar of SEETech Solutions presented the 'Chiller Performance Maximizer', to improve chiller performance by capturing the heat generated by the

chiller and utilized it to generate hot water using an off-the-shelf heat-exchanger. Mr Chittawar shared that though newer chiller models have better COP, a majority of buildings have chillers which are more than 10-year old and still in operation due to high replacement cost. Thus, there is significant scope for this intervention for waste heat recovery. He pointed out that as per the results obtained from the Chiller Performance Maximiser have been encouraging in terms of improving the chiller performance and reducing power requirement to generate hot water. He shared that pilot project on a 250 TR chiller gave cost savings of INR 25.4 lac with paybacks within 12 to 18 months and the market consists of the building sector.

Experts' Conclusions: Experts acknowledged Chiller Performance Maximizer offered large energy saving opportunities in buildings. However, they pointed out that it was not a technology innovation and more of a business innovation which SeeTech as an Energy Service Company is able to offer. Since, Seetech's proposal is indicative of integrating bought out items to capture heat, it does not complete fulfil the FLCTD innovation challenge requirements.

5. **Conclusions and Next Steps:** The expert panel members opined that out of the 5 shortlisted proposals that were presented, WHR innovation proposed from M/s Oorja Energy, Promethean Energy and Village Industrial Power qualifies based on merits and replication potential and should be supported under the FLCTD project. This was agreed by the DG BEE and UNIDO Representative. DG BEE directed the PMU to share the presentations with the expert panel members and also prepare templates for appraisal which can be submitted to BEE after expert panel members' approval. In response to a query the National Project Manager clarified that the template for appraisal has been prepared, which will be used to gather the details of projects being supported, and it will be used by UNIDO, expert panel members and BEE as a base document. DG BEE further directed to complete the exercise expeditiously so that after BEE's approval UNIDO may providing financing for the demonstration project to start. The qualitative and quantitative scoresheets are attached herewith as Annexure A and Annexure B respectively. The template developed by the PMU for appraisal is attached as Annexure C.
6. The meeting concluded with a vote of thanks to all the participants.