Alliance for an Energy Efficient Economy

Improving Rural Livelihoods Through Energy Efficient and Renewable Energy-Powered Cold Chain

Context

The lack of cold chain infrastructure adversely impacts horticulture productivity and farmer incomes due to post-harvest losses, distress selling of excess produce, limitations in storing seasonal produce for year-round supply at good prices, and reduced opportunities to access distant and premium markets.

Small and marginal land-holder farmers, who constitute 86%[1] of all farmers in India and own about half the arable land, are most affected by the lack of affordable post-harvest management facilities. The estimated annual value of post-harvest losses is about Rs 1 lakh crore due to estimated losses of 6% in cereals, 8% in pulses, 10% in oilseeds and 15% in fruits and vegetables.[2] Further, every wasted ton of fruit and vegetable decomposes into approximately 1.5 tons of greenhouse gases (GHG).[3]

The India Cooling Action Plan (ICAP) 2019 highlights considerable gaps in cold chain infrastructure: a shortfall of 97% in packhouses with cold rooms, 91% in ripening chambers, 85% in reefer transport and 9% in cold storage. These gaps present an opportunity to integrate energy-efficient, climate-friendly and sustainable technologies in new and upcoming cold chain infrastructure. Per ICAP 2019, an energy-efficient cold chain has an energy-saving potential of around 30% and would reduce the refrigerant demand by 11% from business-as-usual / conventional cold chain. An energy-efficient cold chain, including energy-efficient and renewable energy-powered cold rooms, lowers operational expenses and reduces energy-related emissions compared to conventional cold chain solutions.

About the project

The project is a catalyst to reduce post-harvest losses and increase business opportunities and income for farmers, Farmer Producer Organisations (FPO), Farmer Producer Companies (FPC) and farmer cooperatives by advancing the development and implementation of energy-efficient cold chain infrastructure. It also fosters the implementation of ICAP 2019 recommendations associated with energy-efficient refrigeration technologies by promoting and adopting low-cost refrigeration technologies. The project includes capacity building and training for technicians, farmers, and other stakeholders who will be end-users or operate the deployed technology.

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1 Government of India. Ministry of Agriculture & Farmers Welfare, “Agriculture Census 2015-16 (Phase-1): All India Report on Number and Area of Operational Holdings,” 2019, https://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf.

2 ICAR-Central Institute of Post-Harvest Engineering &Technology, “Annual Report 2018-19,” 2019, https://www.ciphet.in/upload/files/CIPHET AR 2018-19.pdf.

3 Kohli Pawanexh, “Stop Food Loss To Stop Climate Change,” 2016, https://www.researchgate.net/publication/341609223_Stop_Food_Loss_To_Stop_Climate_Change.

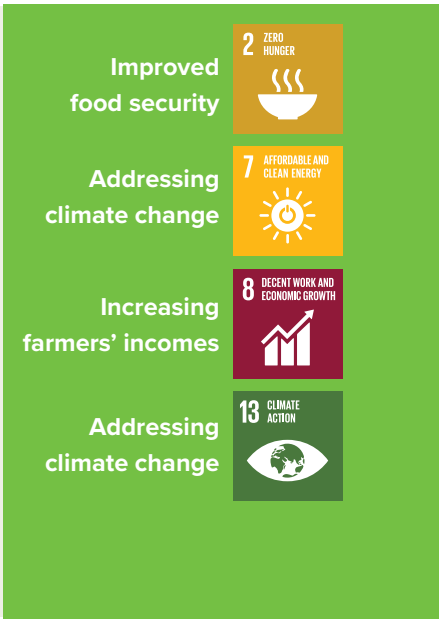
Project goals, objectives, and outcomes

The project objectives are centred around the use of energy-efficient cold chain solutions/ technology for off-grid and weak-grid rural communities to:

- Reduce food loss and improve agricultural incomes through the uptake of cost-effective, energy-efficient and renewable energy-powered cold chain solutions
- Build additional income opportunities for productive rural businesses

The expected long-term outcomes of the project are:

- Increased availability and access to low-cost, low-energy cold chain solutions/ technologies for off-grid/weak-grid rural communities
- Increased interest from manufacturers for meeting the cold chain demand in off-grid/ weak-grid rural communities
- Programmes/action plans for replicating and scaling up well-designed, low-cost, low-energy cold chain technologies for off-grid/weak-grid rural communities
- Increased consumer awareness and labour capacity towards low-cost, low-energy cold chain solutions for off-grid/weak-grid rural communities



Key stakeholders and activities

1. Need assessment of cold chain for agriculture

The project team assessed 80 FPCs and farmer cooperatives across 6 states—Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Uttar Pradesh – to identify their need for cold chain solutions for horticulture. After conducting field visits to 14 shortlisted FPCs and farmer cooperatives and identifying potential use cases for cold chain solutions, the team selected two farmer cooperatives in Bihar and one FPC in Karnataka to deploy energy-efficient, renewable energy-powered cold chain solutions.

2. An evidence-based approach for deploying cooling solutions

To select optimal solutions for the selected FPC and farmer cooperatives, AEEE assessed products from 9 vendors anchored on the following principles:

EFFECTIVENESS
The solution should meet the requirements of the FPC and farmer cooperative.

SUFFICIENCY
The solution should be designed for the required capacity and cooling (temperature, humidity).

ENERGY EFFICIENCY
The solution should be designed to minimise energy consumption, operating costs and emissions.

RENEWABLE ENERGY
The solution should use renewable energy to minimise energy costs and emissions.

AEEE supported the procurement, installation, testing and commissioning of the cold chain solutions. AEEE is monitoring the effectiveness of the deployed cold chain solutions in enhancing the FPC and farmer cooperatives' business operations. AEEE is also monitoring the energy performance of the deployed solutions.

3. Policy and regulatory recommendations

AEEE conducted state-level stakeholder meetings to increase awareness about energy-efficient & climate-friendly cold chain, discuss viable business and financing models, and enable the inclusion of energy efficiency & climate-friendly criteria in cold chain policies and schemes. AEEE has supported government with specifications for cold chain tenders, specifically on energy efficiency and renewable energy criteria.

4. Awareness and skill development

AEEE developed and published guidelines for procuring sustainable cold rooms for horticulture applications, accessible here, and a training module on post-harvest management and cold room operations for farmers, which is publicly available on YouTube. AEEE conducted webinars on energy-efficient cold chain solutions and financing schemes for cold chain for FPOs, FPCs, farmer cooperatives, agribusinesses and other stakeholders.

Technology assessment and deployment

AEEE followed a well-defined process to assess and select optimal energy-efficient, renewable energy-powered cold chain solutions for the selected FPC and farmer cooperatives. The deployed solutions are being monitored.

Vendor & technology landscape	Define cold chain solution	Vendor evaluation & procurement	Installation, Testing, Commissioning	Training	Monitoring
• Cold chain solutions • Energy efficiency, Renewable energy, zero/ low-GWP refrigerant • Market domain - sectors	• Design intent • Technical specs • RfP	• Technical evaluation • Financial evaluation • Procurement	• Factory inspection • Testing • Commissioning	• O&M • User training	• Business impact • Environment impact – energy, emissions • Other socio-economic impacts
• Vendor – solution – technology mapping	• Technical specifications • RfP • Technical evaluation framework • Financial evaluation framework		• Inspection checklist • Testing and commissioning checklist	• Training modules • Tip sheets	• Monitoring template

Cold room at Singhwara Primary Vegetable Society (PVCS), Darbhanga district, Bihar

Singhwara Primary Vegetable Cooperative Society (PVCS), Darbhanga district, Bihar, was established in January 2021 with 208 farmer shareholders. PVCS members cultivate green vegetables like brinjal, okra, tomato, potato, chilli, cauliflower, cabbage, etc., and fruits like mango, papaya, and banana. It is a fairly new PVCS established under Mithila Vegetable Processing and Marketing Cooperative Union (Mithila Union) under Bihar State Vegetable Processing and Marketing Cooperative Federation Ltd (Vegfed).

Use case:

- Manage daily fluctuation in local supply and demand of vegetables to avoid distress sales and produce loss
- Develop market linkage to premium markets (aggregation of produce)
- Develop a “trader model” – buy produce from other markets for sale in the local market

Solution: One 10 MT (metric ton) energy-efficient solar cold room from Inficold

AEEE provides technical assistance to the PVCS and is monitoring the cold room to assess its effectiveness and energy performance.

Singhwara PVCS, Darbhanga, Bihar

Cold room at Harlakhi Primary Vegetable Society (PVCS), Madhubani district, Bihar

Harlakhi Primary Vegetable Cooperative Society (PVCS), Madhubani district, Bihar, was established in July 2022 with 201 farmer shareholders. PVCS members cultivate green vegetables like pointed gourd, lady finger, brinjal, etc. It is a new PVCS established under Mithila Vegetable Processing and Marketing Cooperative Union (Mithila Union) under Bihar State Vegetable Processing and Marketing Cooperative Federation Ltd (Vegfed).

Use case:

- Manage daily fluctuation in local supply and demand of vegetables to avoid distress sales and produce loss
- Develop market linkage to premium markets (aggregation of produce)
- Develop a “trader model” – buy produce from other markets for sale in the local market

Solution: One 10 MT two-chambered energy-efficient solar cold room from Inficold. Following learnings from the storage of diverse produce in Singhwara PVCS, this cold room was designed with two chambers of equal capacity (5 MT each).

AEEE provides technical assistance to the PVCS and is monitoring the cold room to assess its effectiveness and energy performance.



Harlakhi PVCS, Madhubani, Bihar

Passive cooling solution at Sahaja Samrudha Organic Producer Company Limited (SSOPCL), Bengaluru, Karnataka

Sahaja Samrudha Organic Producer Company Ltd (SSOPCL) is an FPC with 744 farmer shareholders, incorporated in 2010. SSOPCL procures 1-3 metric tons of organic vegetables and fruits from its farmer members daily and supplies fresh organic produce and food products to retailers.

Use case: Reduce point-of-sale losses of leafy greens

Solution: Five Subjee-Coolers, each of 100 kg capacity, from RuKart Technologies

Case study published: Preserving Quality and Freshness of Horticulture Produce Using Passive Cooling Solutions




SSOPCL Subjee-Cooler deployment

Cold room at Sahaja Samrudha Organic Producer Company Limited (SSOPCL), Bengaluru, Karnataka

Use case: Long-term storage of seasonal produce (e.g., potato)

Solution: One 10 MT two-chambered energy-efficient solar cold room from Inficold

AEEE is monitoring the cold room to assess its effectiveness and energy performance

About AEEE

Alliance for an Energy Efficient Economy (AEEE) supports policy implementation and enables the energy efficiency market with a not-for-profit motive. AEEE promotes energy efficiency as a resource and collaborates with industry and government to transform the market for energy-efficient products and services, thereby contributing toward meeting India's goals on energy security, clean energy, and climate change.

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