SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

VOLUME 15 | ISSUE 4 | DECEMBER 2024

SAMEEEKSHA NEWSLETTER

www.sameeeksha.org

Inside...

Promoting Energy Efficiency in SMEs

SAMEEEKSHA

VISION

SAMEEEKSHA envisages a robust and competitive SME sector built on strong foundations of knowledge and capabilities in the development, application, and promotion of energy-efficient and environment-friendly technologies.

Bureau of Energy Efficiency

SHAKTI SUSTAINABLE ENERGY FOUNDATION

The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

MSME
MICRO, SMALL & MEDIUM ENTERPRISES

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

The theme of this issue is the cold storage sector, which is critical for supporting and ensuring the productivity and sustainability of the entire agricultural value chain from the producers to the consumers. As the theme article explains, the inadequate and uneven distribution of existing cold storage capacity and related infrastructure continues to be a primary cause of the very high levels of post-harvest losses in agricultural produce across the nation. These losses are not only devastating for the farmers/producers, but also have serious and far-reaching impacts on the entire economy: price volatility, food inflation, shortages in commodities that impact entire value chains, job losses, lost export opportunities, and so on.

Also, studies on existing cold storages have revealed that many of them deploy low-efficiency technologies and practices and consume significant amounts of energy; and these problems are often compounded by unreliable grid power supply and the resulting dependence on diesel generator (DG) sets for electricity. Hence, there is significant need and scope for increasing energy efficiency and reducing greenhouse gas emissions in the cold storage sector through the introduction of energy-efficient, low-emissions technologies and practices.

The article outlines the salient elements of the India Cooling Action Plan (ICAP) launched by the Government of India in 2019 to meet the entire national cooling requirements by 2037–38, including meeting the projected increase in energy demand of the expanding cold storage sector. It also presents snapshots of some of the major government policies and schemes that have been launched in this direction, and the initiatives and achievements in a few states.

SAMEEEKSHA Secretariat

COLD STORAGE SECTOR: POLICIES FOR GROWTH AND TECHNOLOGY IMPROVEMENT

Context

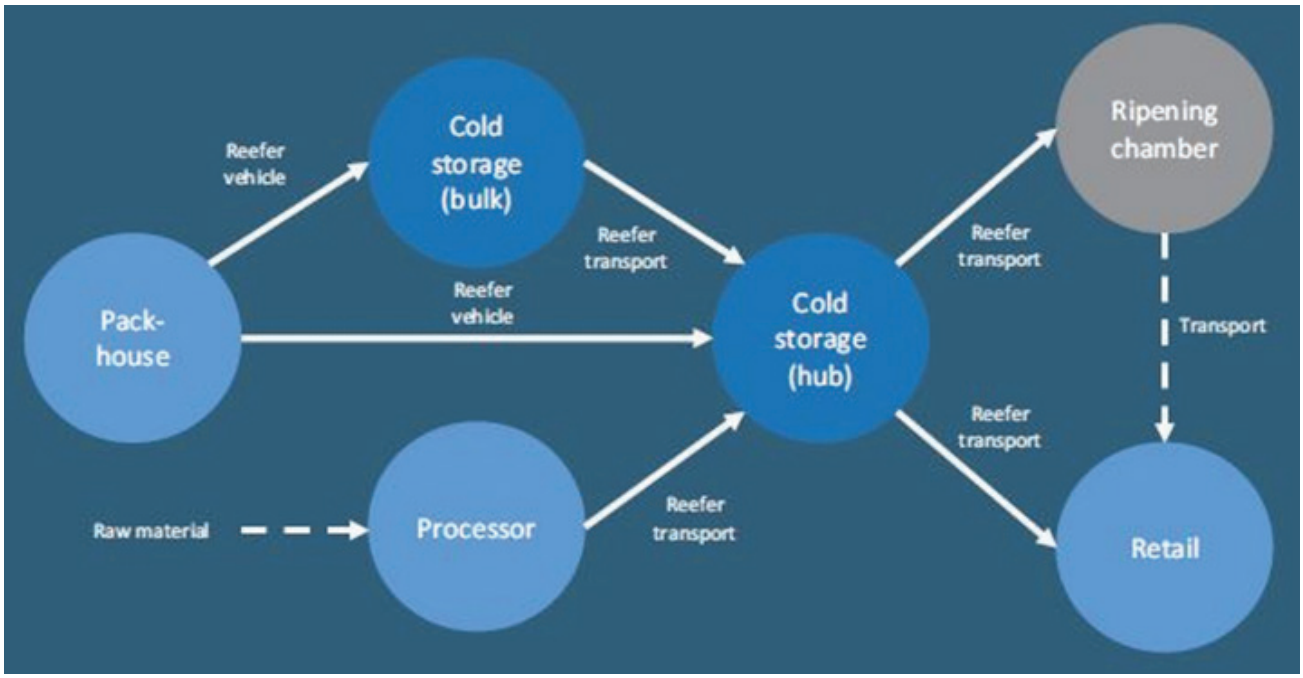
Among the many MSME sectors in India, the cold storage sector has a largely unperceived yet profound impact on the lives and well-being of the vast majority of India's 1.4 billion-plus population. Cold storage units (also known as cold stores, cold rooms or cold chambers) ensure the availability, freshness, quality and variety of much of the foods that we consume daily—vegetables, fruit, dairy products, poultry and meat, aquatic /marine produce, and other products—which are often sourced from locations far away. Cold storages are generally located in the proximity of the farmers/producers as well as of major consumption centres like cities and towns, and linked through 'cold chains' (see Box), which include the infrastructure for packaging and transport of the perishable commodities over long distances by road, rail, air and water under refrigerated conditions.

With effective cold chains in place, the food products can be stored for long periods of time while preserving their quality and nutritional value, and then sold at convenience in markets that are far away from the centres of production, that too during 'off-season' periods when market demand is high and prices are attractive. The cold storage sector is hence critical for supporting and improving the livelihoods of farmers and ensuring the productivity and sustainability of the entire agricultural value chain from the producers to the consumers.

On the face of it, India has an adequate number of cold storages. However, the distribution of cold storages across the country is not even, and their capacities are not sufficient to cover all perishable agricultural commodities. A 2015 study by National Centre for Cold Chain Development (NCCD) underlined the capacity shortfalls in all components of cold chain infrastructure—particularly, in pack houses, ripening chambers and reefer vehicles (table 1).

Cold storages and cold chains

Cold storages are used to store large quantities of perishable materials at low temperatures to preserve their quality, safety, efficacy and nutritional value. Cold storages are equipped with refrigeration units and insulated walls, and can be multi-purpose or dedicated to a single commodity.



Flow of produce in typical cold chain [Source: ICAP e-brochure, 2019]

Pack houses process and pre-cool temperature-sensitive products for short or long term cold storage. Pack houses involve a range of operations such as sorting, washing, grading, drying, and packaging. **Ripening chambers** are specialized cold storages equipped to control temperature, humidity, and other parameters and bring about slow ripening of certain fruits and vegetables.

Reefer vehicles are the refrigerated vehicles (e.g. trucks, vans, railway wagons) used to carry perishable goods.

The food industry—including agricultural producers, food processors, distributors, and retailers—relies critically on cold chains. Other sectors that rely on cold chains include:

- Pharmaceuticals, healthcare, biotechnology, life sciences—for temperature-sensitive medicines, vaccines, biological materials, etc.
- Floral industry—for cut flowers, potted plants, etc.
- Chemical industry—certain chemicals require temperature-controlled storage and transportation to maintain their stability and properties
- E-commerce and grocery delivery—to deliver perishable food items etc., to consumers' doorsteps.

Table 1. Cold chain infrastructure and gaps as of 2015[1]

Component	Requirement (Mt)*	Created (Mt)	Gap (%)
Pack houses	1.12	0.004	97%
Cold storages (bulk)	34.16	31.82	9%
Cold storages (hub)	0.94		
Ripening chambers	0.09	0.001	91%
Reefer vehicles	0.49	0.07	85%

*figures rounded off; Mt— million tonnes

Recent years have seen an increase in overall cold storage capacity; but their distribution and coverage of commodities is still far from adequate. According to a 2021 study, there were about 7600 cold storages in India with a total storage capacity of 34.9 million tonnes; but around 59% of the total cold storage capacity was located in just the four states of Punjab, Uttar Pradesh, Madhya Pradesh and Gujarat; and furthermore, about 75% of all the cold storages in the country were dedicated solely to potatoes, pointing to the dearth of cold storage facilities for other perishable agro-products.

The insufficient capacity and uneven distribution of cold storages and related infrastructure continues to be a primary cause of the very high levels of post-harvest losses in agricultural produce across the nation. These losses are not only devastating for the farmers/producers, but also have serious and far-reaching impacts on the entire economy: price volatility, food inflation, shortages in commodities that impact entire value chains and often necessitate imports of these commodities at high prices (thereby depleting foreign exchange reserves), job losses, lost export opportunities, and so on. A 2015 assessment study by Indian Council for Agriculture Research–Central Institute of Post-Harvest Engineering and Technology (ICAR–CIPHET) on post-harvest losses of major crops and commodities in India estimated that the overall annual losses ranged from 3.2% to nearly 10% in fruits & vegetables, and from 4.5% to nearly 16% in food grains (cereals, pulses and oilseeds), representing monetary loss of about Rs 93,000 crores.[2] A 2022 study by the Ministry of Food Processing Industries, Government of India (MoFPI, GOI), found that India lost 5% to 13% of its fruits and vegetables between harvesting and consumption.[3] The Ministry of New and Renewable Energy, Government of India, estimated post-harvest losses at 25–30% due to lack of proper storage and transit facilities.[4] Other studies point to the fact that post-harvest losses can go as high as 40% in the case of commodities like onion.[5]

Clearly, there is significant need and scope for increasing the overall capacity of cold storages and related infrastructure. Also, studies on existing cold storages have revealed that many of them deploy low-efficiency technologies and practices; and that these problems are often compounded by unreliable grid power supply and the resulting dependence on diesel generator (DG) sets for electricity. Hence, there is significant need and scope for increasing energy efficiency and reducing greenhouse gas emissions in cold storages through the large-scale deployment of

1 India Cooling Action Plan – e-brochure, 2019. Table 4.2, 'Cold-chain – Current Infrastructure & gap (NCCD, 2015)'. Available at https://ozonecell.nic.in/wp-content/uploads/2019/03/INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf

2 ICAR-CIPHET. 2015. 'Assessment of harvest and post-harvest losses of major crops and commodities in India'. ICAR-CIPHET News, April–June 2015. https://ciphet.icar.gov.in/wp-content/uploads/newsletter/Ciphet-News-April-June-2015-[Vol-XVI-No-2]-Curve.pdf

3 UNDP, India. 2024. 'Sunlit future: Harnessing Solar Power to help women farmers combat climate change'. March 12, 2024. https://www.undp.org/india/stories/sunlit-future-harnessing-solar-power-help-women-farmers-combat-climate-change

4 MNRE. 2014. Presentation at 'NCCD National Level Conclave with State Officers on Cold-chain Development', 9-May-2014. https://www.nccd.gov.in/PDF/MNRE.pdf

5 Saikia, B and Nookathoti, T. 2023. Post-harvest losses of onion cultivation in Kalaburagi, Karnataka. The Journal of Research ANGRAU. 51(2): 148-156

Inside cold storage

energy-efficient (EE) technologies and practices and renewable energy (RE) options.

India Cooling Action Plan

A significant initiative towards addressing the challenges and needs of the cold storage sector was taken in 2019 when the Government of India launched the 'India Cooling Action Plan' (ICAP)[6]. This is a comprehensive action plan aimed at addressing the national cooling requirements within a 20-year time frame, i.e., by 2037–38. ICAP has seven thematic groups of which one group is 'cold chain and refrigeration'. The primary focus areas of ICAP are: (1) reduction of cooling demands in all sectors of the economy; (2) refrigerant transition, i.e., switching from the use of refrigerants like hydro fluorocarbons (HFCs) to more environment-friendly refrigerants in heating, ventilation, and air-conditioning (HVAC) systems; and (3) enhancing energy efficiency through better technology options. The broad goals that ICAP sets to achieve by 2037–38 are:

- Reduce cooling energy requirements by 25–40%
- Reduce cooling demand by 20–25%
- Reduce refrigerant demand by 25–30%
- Recognize cooling as a thrust area for research

ICAP is being implemented through a multi-stakeholder inclusive process that involves government ministries and departments/organizations, industry and industry associations, think tanks, and R&D and academic institutes

Need and scope for increasing energy efficiency

ICAP focuses on the fact that with the rapid expansion of the cold storage sector and its related infrastructure in coming years, the energy demands from cold chains too will increase sharply. Projections by ICAP are that between 2022–23 and 2037–38:[7]

- Cold storage capacity will grow at a marginal rate from 38–41 million tonnes (Mt) to about 48 Mt.
- Ripening chambers will increase in number from 2000–3500 units to 12,000–15,000 units.
- Pack houses will increase in number from around 15,000–20,000 to 100,000–150,000.
- Reefer vehicles will increase in number from 50,000–60,000 to 300,000–500,000.

Table 2 shows ICAP estimates for the projected growth in energy consumption by cold storages, pack houses and ripening chambers, from 2022–23 to 2037–38 (figures are shown for the 'reference' scenario). The

6 PIB Press Release, 14 March 2022, Ministry of Environment, Forest and Climate Change (MoEFCC). https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1805795

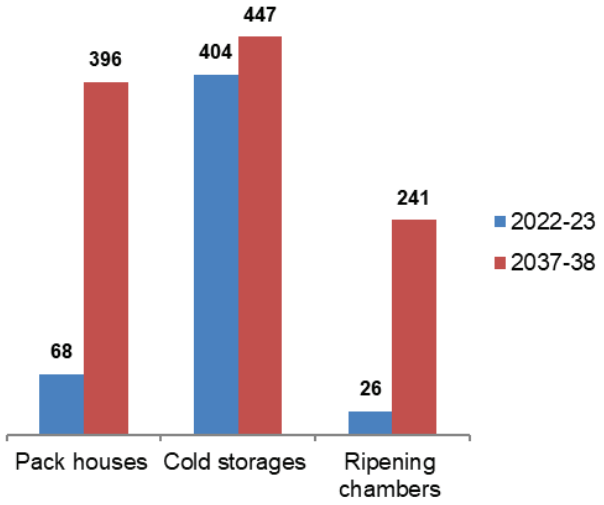
7 India Cooling Action Plan – e-brochure, 2019. Appendix B, 'Stock'.

graphic compares the projected increases in energy consumption for each component, based on the higher range values.

Table 2. Projected growth in annual energy consumption by cold chain components[8]

Component	Unit*	2022–23	2037–38
Pack houses	TWh	0.7–0.8	4.5–4.6
	toe	60,200–68,800	387,000–395,600
Cold storages	TWh	4.3–4.7	4.6–5.2
	toe	369,800–404,200	395,600–447,200
Ripening chambers	TWh	0.2–0.3	2.4–2.8
	toe	17,200–25,800	206,400–240,800

*TWh—terawatt hours; toe—tonnes of oil equivalent



Projected increases in energy consumption by cold storages, pack houses and ripening chambers ('000 toe)

As the table and graphic indicate, the combined annual energy consumption by cold storages, ripening chambers and pack houses is projected to increase by over 0.5 million tonnes of oil equivalent (Mtoe) from current levels by 2037–38 in the reference scenario. ICAP estimates that cold chains will account for only about 2% of the total primary energy supply for cooling in 2037–38.[9] However, given the sheer importance of the agriculture sector in India's economy, and the critical need to establish an efficient and reliable cold chain system for agricultural productivity, growth and sustainability, it is imperative to undertake interventions that ensure that the existing cold storages as well as the newly added cold storage facilities deploy the best available EE and RE-based technologies.

There are certain RE and alternate energy technologies that are especially promising for cold chain applications. It is important to note that these technologies will require excellent engineering and installation, high quality components, and stringent commissioning and O&M services in order to deliver on their potential over long periods of time. The technologies include:

- Solar PV systems
- Solar thermal systems
- Biomass gasifiers
- Solar/biomass co-generation (waste heat recovery)
- Thermal energy storage by application of phase change materials (PCM)

ICAP envisages that suitable technological interventions such as employing EE compressors, improved insulation, optimized operations, and retrofitting measures can help avoid 12% of refrigerant usage and around 8–12% of associated energy consumption.

Snapshots of government initiatives in cold storage sector

A few examples of recent/ongoing government initiatives to strengthen the cold storage sector are summarized below.

Government of India

- The Pradhan Mantri Kisan Sampada Yojana (PMKSY) is a scheme launched in 2017 with the aim of creating modern infrastructure with efficient supply chain management from farm gates to retail outlets. A key component scheme of PMKSY is 'Integrated Cold Chain and Value Addition Infrastructure', which is implemented by the Ministry of Food Processing Industries, GOI. Under the scheme, financial assistance in the form of grant-in-aid is provided at the rate of 35% for general areas and 50% for North East and Himalayan states, Integrated Tribal Development Project (ITDP) areas, and islands for storage and transport infrastructure; and at the rate of 50% and 75% respectively for value addition and processing infrastructure subject to a maximum grant-in-aid of Rs 10 crores per project for setting up of integrated cold chain projects including irradiation facilities. (Standalone cold storages are not covered under the scheme.)
- The Pradhan Mantri Matsya Sampada Yojana (PMMSY), launched in 2020, addresses critical gaps in fish production, productivity, quality, technology, and post-harvest infrastructure — with emphasis on seamless cold chains.

8 India Cooling Action Plan – e-brochure, 2019. Appendix B, 'Annual energy consumption'.

9 India Cooling Action Plan – e-brochure, 2019. Figure C: 'India's Total Primary Energy Supply (TPES) for Cooling'

- The Department of Agriculture & Farmers Welfare, under the Ministry of Agriculture & Farmers Welfare, is implementing 'Mission for Integrated Development of Horticulture (MIDH)' under which financial assistance is provided for various horticulture activities including construction/expansion/ modernization of cold storages of capacity up to 5000 tonnes in the country, on the basis of Annual Action Plans received from states/Union Territories. Government assistance in the form of credit-linked back-ended subsidy is available at the rate of 35% of the project cost in general areas and 50% of the project cost in hilly and scheduled areas through the respective State Horticulture Missions.
- The National Horticulture Board (NHB) is implementing a scheme titled 'Capital Investment Subsidy for Construction/Expansion /Modernization of Cold Storages and Storages for Horticulture Products' under which credit-linked back-ended subsidy is available at the rate of 35% of the capital cost of the project in general areas and 50% in case of North East, hilly & scheduled areas for construction/ expansion/modernization of cold storage and controlled atmosphere (CA) storage of capacity above 5000 tonnes and up to 10000 tonnes. In case of North East region, the units with capacity above 1000 tonnes are also eligible for assistance.
- GOI has launched Agriculture Infrastructure Funds (AIF) of Rs 100,000 crores, under which there is provision for collateral-free term loans up to Rs 2 crores and interest subvention of 3% on the term loan availed for creation of post-harvest infrastructure including establishment of cold storages.[10]
- Bureau of Indian Standards (BIS) has published standards for ammonia-based refrigeration system titled 'IS 17773 : 2022: Closed-Circuit Ammonia Refrigeration System —Code of Practice for Design and Installation (ANSI/IIAR 2 : 2014, NEQ).[11]

State governments

Himachal Pradesh

Himachal Pradesh is renowned for the high quality of its fruits and vegetables, in particular, its apples which are in demand across India as well as abroad. Himachal Pradesh Horticultural Produce Marketing & Processing Corporation (HPMC), a state government undertaking, provides facilities and assistance to the fruit growers of the state for the harvesting, storage, packaging and marketing of their produce. Besides establishing apple grading & packing lines, fruit processing plants, controlled atmosphere stores and other post-harvest facilities across the state, HPMC has created cold storage facilities with total capacity of about 11,500 tonnes in terminal markets like Delhi, Mumbai, Chennai, and Parwanoo (Himachal Pradesh). Also, two modern pack houses with cold room facilities have been commissioned at Ghumarwin (Bilaspur district) and Nadaun (Hamirpur district) with the financial assistance of Agricultural and Processed Food Products Export Development Authority (APEDA), Government of India, for grading/packing of fruit and vegetables grown in low lying areas of Himachal Pradesh.[12]

Odisha

Odisha, on India's eastern seaboard, is renowned for its seafood as well as agricultural produce. Odisha has 104 cold storages with a total installed capacity of 274,175 tonnes. All the cold storages are privately owned or cooperative enterprises, with capacities ranging from less than 100 tonnes to 15,000 tonnes. Among the cold storages, the majority are dedicated to storing potatoes while some store multiple commodities including marine products. As locally grown potatoes meet only about 20% of Odisha's annual demand of 1.3 million tonnes (Mt), in October 2024 the Agriculture and Farmers' Empowerment Department, Odisha announced a 50% electricity subsidy scheme from 2024–25 to 2026–27 for cold storages with the capacity of 500 tonnes or more, to encourage cold storage owners to stock potatoes. Also, in November 2024 the Odisha government announced the establishment of 58 new cold storages across the state's sub-divisions to increase the state's cold storage capacity.[13]

Bihar

The Bihar government, in partnership with United Nations Development Program (UNDP) with support from the Government of Japan, has established 15 solar-powered cold storages in the state. These units harness renewable energy from solar panels at much lower rates than grid-based electricity, and are particularly advantageous in regions with limited grid electricity infrastructure or irregular power supply. The cold storages allow farmers to store their goods for extended periods without spoilage, thus helping them access more markets to secure better prices for their produce. [14]

Maharashtra

The Maharashtra State Agricultural Marketing Board IMSAMB) undertook the first initiative in the state (in

10 PIB Press Release, 6 August 2024. Ministry of Agriculture & Farmers Welfare. See https://pib.gov.in/PressReleseDetailm.aspx?PRID=2042243&reg=3&lang=1

11 Bureau of Indian Standards. https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/standard_review/Standard_review/Isdetails?ID=Mjc2OTA%3D

12 For details, visit https://hpmc.in/cms/home-index

13 For details, see (1) https://pragativadi.com/odisha-government-announces-58-new-cold-storages-to-boost-agriculture/; (2) https://www.hindustantimes.com/cities/others/odisha-announces-50-subsidy-for-cold-storage-of-potatoes-101727753208253.html

14 https://www.undp.org/india/stories/sunlit-future-harnessing-solar-power-help-women-farmers-combat-climate-change

Refrigeration system in cold storage

1990), and even in the country, to promote the use of Temperature Management Technology (TMT) by setting up of pre-cooling and cold storage (PC & CS) facilities under the co-operative sector. The principle objective was to promote exports of fresh fruits and vegetables from the state. Since then, under the technical guidance of MSAMB, 32 PC & CS facilities have been set up in the co-operative sector in the state. Due to this pioneering effort by the MSAMB, today Maharashtra is the largest exporter of fresh grapes from the country, and also accounts for nearly 70% of all exports of fresh fruits and vegetables. The state has also successfully exported fresh pomegranate and mango using the PC & CS facilities. In addition, MSAMB, with financial assistance from APEDA and Rashtriya Krishi Vikas Yojana (RKVY), has undertaken projects to establish 20 Export Facility Centres (EFCs) on the land of Agriculture Produce Marketing Centres (APMCs), co-operative societies and Institutions; construction of 2 more EFCs is under progress. These EFCs include PC & CS facilities, pack house facilities, and ripening chambers in some places. In order to promote the export of flowers from the state. MSAMB has established two Flower Export Facilities, and the setting up of a third such facility is under way.[15]

Key stakeholders

Some of the key stakeholders in the cold storage sector are listed below.

Government

- Agricultural and Processed Food Products Export Development Authority (APEDA), GOI
- Indian Council of Agricultural Research (ICAR)
- Relevant Ministries and Departments (Centre and State) such as Agriculture & Farmers Welfare, Food Processing Industries, Industry, MSME, New and Renewable Energy, Power, Rural Development, etc.
- National Centre for Cold-chain Development (NCCD), an autonomous think-tank for cold chain and agro-logistics established by GOI in 2012

15 https://www.msamb.com/Projects/PreCoolingAndColdStorage

Apples in cold storage

- National Fisheries Development Board (NFDB)
- National and State Horticulture Boards
- National Bank for Agriculture and Rural Development (NABARD)
- Ozone Cell, Ministry of Environment, Forest and Climate Change, GOI

Industry

- Federation of Cold Storage Associations of India—apex body for the cold storage and cold chain sectors in India
- Indian Society for Heating Refrigeration and Air-conditioning Engineers (ISHRAE)
- Refrigeration and Air-conditioning Manufacturers Association (RAMA)
- Refrigerant Gas Manufacturers Association (REGMA)
- Refrigeration & Air-conditioning Servicing Sector Society (RASSS)
- Resource Centre for Cold Chain Logistics, CII—an industry-led resources centre to support the development of integrated cold chain networks across the country

---

ABOUT SAMEEEKSHA

SAMEEEKSHA is a collaborative platform aimed at pooling the knowledge and synergizing the efforts of various organizations and institutions—Indian and international, public and private—that are working towards the common goal of facilitating the development of the Small and Medium Enterprise (SME) sector in India, through the promotion and adoption of clean, energy-efficient technologies and practices.

SAMEEEKSHA provides a unique forum where industry may interface with funding agencies, research and development (R&D) institutions, technology development specialists, government bodies, training institutes, and academia to facilitate this process.

For more details, please contact

SAMEEEKSHA Secretariat
Industrial Energy Efficiency Division
TERI, Darbari Seth Block
IHC Complex, Lodhi Road,
New Delhi - 110 003, India
Tel: (+91 11) 2468 2100
Fax: (+91 11) 2468 2144, 2468 2145
Email: sameeeksha@teri.res.in
Website: http://sameeeksha.org