Alliance for an Energy Efficient Economy

ENABLING COLD-CHAIN INFRASTRUCTURE DEVELOPMENT IN INDIA

EVOLUTION AND ASSESSMENT OF POLICIES AND INSTITUTIONAL MAPPING

OCTOBER 2025

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ABOUT THE REPORT

"Enabling Cold-chain Infrastructure Development in India: Evolution and Assessment of Policies and Institutional Mapping" is a comprehensive review of India's cold-chain policy landscape. It traces the evolution of policies through Five-Year Plans, missions, and legislative reforms, and maps the roles of key institutional actors—from central ministries to local agencies. The report serves as a key resource for policymakers, researchers, and stakeholders working to strengthen India's cold-chain ecosystem.

Edition 1 of the report (2021) was developed under the SHEETAL programme, a consortium of AEEE, TERI, and CEEW formed to advance the implementation of the India Cooling Action Plan (ICAP). The revised edition, developed under the India Cold Chain Programme (ICCP) jointly implemented by AEEE and UNEP, expands the institutional mapping (Section 2.1) and updates policies, missions, and schemes (Section 3.2) that promote energy efficiency and clean energy adoption in cold-chain development.

PREPARED BY: ALLIANCE FOR AN ENERGY EFFICIENT ECONOMY (AEEE)

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ABBREVIATIONS

ABD	Agri-Business Development
AMI	Agricultural Marketing Infrastructure
APEDA	Agricultural & Processed Food Products Export Development Authority
APLM	Agriculture Produce and Livestock Marketing
APMC	Agricultural Produce Market Committee
APMR	Agriculture Produce Marketing Regulation
ASTM	American Society for Testing and Materials
AWSA	Agrichemical Warehousing Standards Association
BEE	Bureau of Energy Efficiency
CDB	Coconut Development Board
CIH	Central Institute for Horticulture
DAC&FW	Department of Agriculture, Cooperation & Farmers' Welfare
DRSCs	Department Related Standing Committees
ECA	Essential Commodity Act
FDI	Foreign Direct Investment
FPCs	Farmer Producer Companies
FPOs	Farmer Producer Organisations
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GrAMs	Gramin Agricultural Markets
HMNEH	Horticulture Mission for North East & Himalayan States
ICAP	India Cooling Action Plan
ISAM	Integrated Scheme for Agricultural Marketing
KVKs	Krishi Vigyan Kendras
MIDH	Mission for Integrated Development of Horticulture
MMLPs	Multimodal Logistics Parks
MoCI	Ministry of Commerce and Industry
MoA&FW	Ministry of Agriculture and farmer's Welfare
MoFPI	Ministry of Food Processing Industries
MRIN	Marketing Research and Information Network
MT	Million Tonnes
NABARD	National Bank for Agriculture and Rural Development
NARS	National Agricultural Research System
NBM	National Bamboo Mission
NCCD	National Centre for Cold-chain Development
NCDC	National Cooperative Development Corporation
NHB	National Horticulture Board
NHM	National Horticulture Mission
NIAM	National Institute of Agriculture Marketing
NLA	National Level Agencies
PMKSY	Pradhan Mantri Kisan SAMPADA Yojana
PPP	Public Private Partnership
RKVY	Rashtriya Krishi Vikas Yojana
SAGF	Strengthening of Agmark Grading Facilities
SAMPADA	Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters
SDM	Sub-divisional Magistrate
SFAC	Small Farmers Agribusiness Consortium
TWh	Terawatt-hour
VGF	Viability Gap Funding
WDRA	Warehousing Development and Regulatory Authority

EXECUTIVE SUMMARY

India has seen a surge in the production of perishable high nutrition products in recent years. Fruits, vegetables, meat and poultry products top this list. However, large production volumes have not been able to address prevailing conditions of under-nutrition and hunger in the country. Additionally, India's current global share in farm trade is still negligible, owing to a considerable amount of food loss across the supply chain. A unidimensional focus on food production, without taking into consideration the importance and need of quality food supply to households has contributed to the problem manifold. The necessity to produce more will multiply further with India's growing population. Further, the increased production needs to be accompanied by a timely consumption of the produce to stop the food loss. In this regard, an efficient connectivity from farm to table to reduce food wastage is thus needed to develop and strengthen our cold-chain supply and storage facilities.

India has seen a surge in the production of perishable high nutrition products in recent years. Fruits, vegetables, meat and poultry products top this list.

A well-managed, temperature-controlled supply chain network has several benefits. It can reduce food wastage, minimise food inflation, ensure food quality, and improve shelf lives of perishable products, among other things. Additionally, cold-chain infrastructure will also benefit the farmers with timely connecting them to the market, thereby reducing their crop loss and increasing their net profit. However, given the energy-intensive nature of the current cold-chain infrastructure in India, the environmental implications and cost-effectiveness of the system are contentious. The negative ecological and economic impacts can be toned down by acting on some of the strategies indicated in the India's Cooling Action Plan (ICAP)[1] related to cold-chain infrastructure development. These strategies can also contribute to achieving the Sustainable Development Goal of "Zero Hunger", "Good Health and Well-being", "Responsible Consumption and Production", and "Climate Action".

Successful cold-chain implementation in various parts of the country requires a much-needed push through policies, access to finance, technology innovation. It is equally important to spread awareness around the importance of the cold-chain supply process(es) among the stakeholders responsible for planning, building, maintaining and monitoring these cold-chains. The Government of India recognises these essential steps and is proactively working towards developing a sustainable cold-chain across Indian states through five-year plans, missions, policies and dedicated agencies/departments. It is also provisioning financial assistance and capacity support to upgrade the cold-chain infrastructure. However, the existing reports and literature on cold-chain infrastructure indicate that institutional strengthening and development of the integrated cold-chain need a far more concerted effort. Moreover, lack of clarity around roles and responsibilities of the existing actors/stakeholders at the central, state and local level makes it difficult to implement and further capacity development. This report examines the various actors/institutions that play an essential role in cold-chain infrastructure development to bridge this gap.

This report briefly summarises the institutional and policy development of cold-chain in India, a) highlighting the various institutions/actors and their role(s)in cold-chain policy formulation and implementation b) mapping the past policies, plans and other government initiatives providing a historical context to the present policy narrative on cold-chain in India, and c) identifying the deficiencies/ gaps in the existing policies, missing links in policies and paving the way forward. The key findings of this report are briefly summarised on next page:

The negative ecological and economic impacts can be toned down by acting on some of the strategies indicated in the India's Cooling Action Plan (ICAP) related to cold-chain infrastructure development. These strategies can also contribute to achieving the Sustainable Development Goal of

1. The Indian plan (ICAP) was launched in March 2019 by the Ministry of Environment, Forests and Climate Change. The ICAP provides an integrated vision towards cooling across sectors encompassing inter alia reduction of cooling demand, refrigerant transition, enhancing energy-efficiency and better technology options with a 20 year time horizon.

01

Cold-chain institutional mapping at the policy formulation and implementation level highlight that a) central government play an important role in policy formulation, b) autonomous agencies at the national level strategise and facilitate these policies through various missions; and c) state and regional organisations aid and support in the actual implementation of these policies. While multiple ministries are already involved in implementing cold-chain across India, they operate in silos. They may need to combine their synergies to better plan and execute the development of cold-chain across India.

02

Past Five-Year plans, policies and missions are indicative of a heavy emphasis on food production with little or no measures to maintain production quality. Therefore, policies/guidelines on developing and maintaining cold-chain infrastructure are fewer and were formulated much later.

03

Examining the missions and policies about cold-chain development reveals that the central government's focus has been to support the cold-chain development by providing financial assistance, technological support, and capacity building. However, there is a scope to formulate policies/schemes that positively push towards building energy-efficient and low climate impact cold-chain infrastructure.

This report will be of particular interest to policymakers, research groups, and institutions trying to bridge India's cold-chain infrastructure gap. In addition, this may provide a starting point to the authorities within and outside India planning to develop the cold-chain infrastructure in identifying the various actors playing an essential role in planning and implementing the cold-chain infrastructure.

> In recent years, India has emerged as the second-largest producer of fruits and vegetables globally, with ~353.19 million MT (third advance estimate for FY 23-24)

Source: Press Information Bureau, "Highlights of 2023–24 (Third Advance Estimates) and 2022–23 (Final Estimates)," Government of India, May 22, 2024. [Online]. Available: https://pib.gov.in/PressReleasePage.aspx?PRID=2057249

01

CONTEXT OF COLD-CHAIN IN INDIA

1.1 BACKGROUND: HORTICULTURE IN INDIA

India is predominantly an agrarian economy, with nearly 50% of the population still dependent on agriculture and its allied sectors. These sectors contribute up to 14.4% to the country's overall GDP (2011–12)

India is predominantly an agrarian economy, with nearly 50% of the population still dependent on agriculture and its allied sectors. These sectors contribute up to 16% to the country's overall GDP (FY 2024)[2] However, India faced food deficiency post-independence, as horticulture development was not a priority in the immediate post-independence period. In the late 1980s and early 1990s, the country moved from being a food deficit country to a food surplus country. This change was brought about with improved access to fertilisers, seeds, irrigation, and financial assistance. In fact, in recent years, India has emerged as the second-largest producer of fruits and vegetables globally, with ~353.19 million MT (third advance estimate for FY 23-24)[3]. Despite these areas of progress, a significant proportion of the population is at risk of becoming food insecure. Furthermore, farmers/food producers, especially the smallholder farmers, account for 86% of all farmers in India and own about half the arable land[4], still struggle with low-income levels and huge food losses (nearly 4.6-15.9% in fruits and vegetables annually[5]) throughout the supply chain. Small-scale farmers cannot benefit from the post-harvest management facilities (consisting of pack houses, reefer vans, cold storages) because of limited access to cold-chain logistics, shortening the lifespan of their horticulture produce. Subsequently, the reduced lifespan causes a significant loss in their production value and livelihood.

Due to the absence of cold-chain infrastructure, the carbon footprint of food loss alone is estimated to be 3.3 GtCO2e (Gigatonnes of equivalent carbon dioxide).[6] Furthermore, the Central Institute of Post-Harvest Engineering and Technology has reported that the total post-harvest loss accounts for a loss of INR 1 lakh crore annually[7]. These losses are the result of weak agricultural marketing sectors, including inadequate and fragmented food

2. Ministry of Statistics and Program Implementation (MOSPI). https://pib.gov.in/PressReleaseIframePage. aspx?PRID=2079024
3. Press Information Bureau, "Highlights of 2023–24 (Third Advance Estimates) and 2022–23 (Final Estimates)," Government of India, May 22, 2024. [Online]. Available: https://pib.gov.in/PressReleasePage.aspx?PRID=2057249
4. Ministry of Agriculture & Farmers Welfare, Government of India. 2019. "Agriculture Census 2015-16 (Phase-1): All India Report on Number and Area of Operational Holdings". New Delhi. http://agcensus.nic.in/document/ agcen1516/T1_ac_2015_16.pdf.
5. NABARD Consultancy Services (NABCONS), Study to determine post-harvest losses of agri produce in India, Ministry of Food Processing Industries, Government of India, 2022. [Online]. Available: https://www.mofpi.gov.in/sites/default/files/study_report_of_post_harvest_losses.pdf
6. Food Agriculture Organization Retrieved from: www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/FWF_and_climate_change.pdf
7. Central Institute of Post-Harvest Engineering and Technology. (2019). Annual Report 2018-19. Ludhiana: ICAR.

processing and post-harvest logistics, storage, and marketing. Therefore, the agricultural marketing sector requires strengthening of the cold-chain system through investments in infrastructure for value addition to agricultural produce, reduction in post-harvest losses, etc.

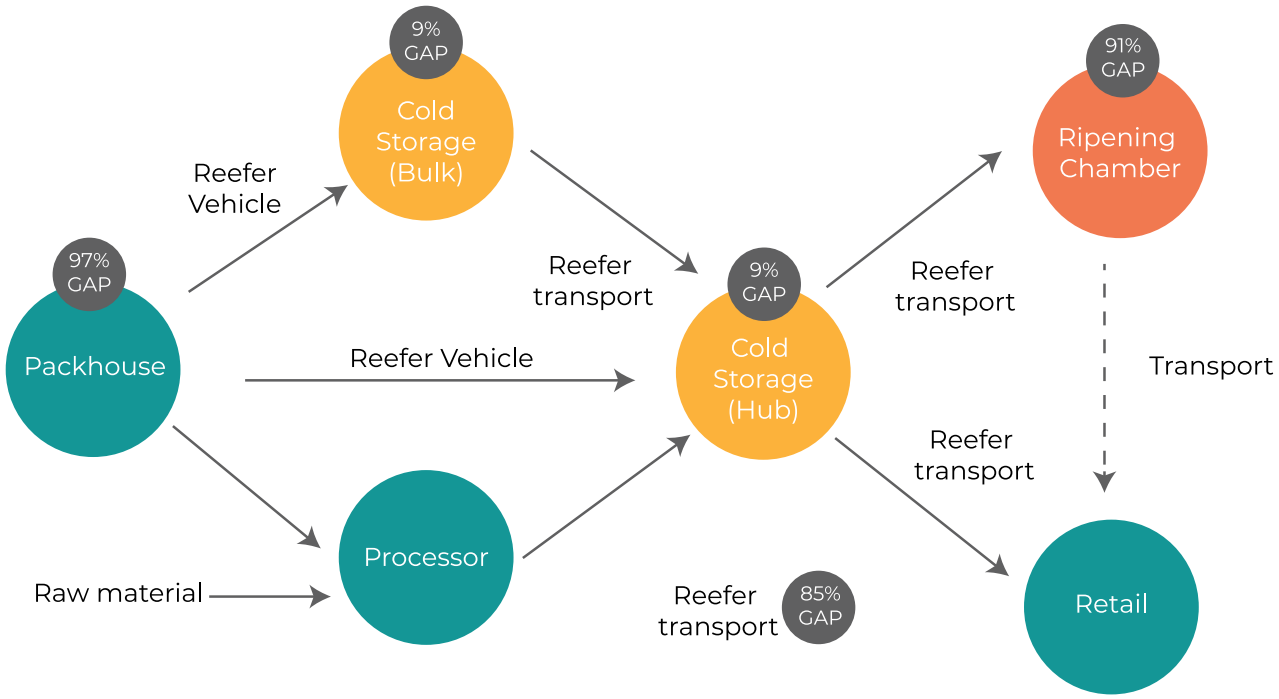
1.2. OVERVIEW OF COLD-CHAIN

While transporting food from farm to table, various factors, such as microbial, enzymatic, chemical, physical, and mechanical, lead to food spoilage[8,9]. These factors necessitate the development of cold-chain systems. The Cold-chain supply network needs to have a controlled condition to maintain product temperature in the adequate range, from storage to distribution. A typical cold-chain infrastructure (described in Figure 1) consists of four main components: pack-houses, reefer transport, cold storages, and ripening chambers. These components ensure a continuously monitored atmosphere till the product reaches the retail market. India is amongst the top producers of perishable products like fruits, vegetables, dairy etc.[10], necessitating a constantly controlled temperature for such products. The atmosphere maintained by the cold-chain increases the shelf-life of perishable products, which in turn reduces the emission of methane due to decomposition. The adequate atmosphere also allows the product to preserve its nutrition and quality for an extended period, reducing post-harvest losses. Some direct benefits of cold-chain development relate to reduced food loss, improved farmers income, and reduced emission levels. Additionally, proper management of agricultural produce can directly or indirectly contribute to achieving sustainable development goals of "Zero Hunger", "Good Health and Well-being", "Responsible Consumption and Production", and "Climate Action".

Additionally, proper management of agricultural produce can directly or indirectly contribute to achieving sustainable development goals

8. Rahman, M.S. Purpose of Food Preservation and Processing. In Handbook of Food Preservation; Marcel Dekker: New York, NY, USA, 2005; pp. 1–10.
9. Singh, R. Scientific Principles of Shelf-Life Evaluation; Man, C., Jones, A., Eds.; Blackie Academic and Professional: Glasgow, Scotland, 1994.
10. APEDA. (2021, March 4). Agricultural & Processed Food Products Export Development Authority. Retrieved from Fresh Fruits and Vegetables: http://apeda.gov.in/apedawebsite/six_head_product/FFV.htm

Figure 1: A typical cold-chain (Source: India Cooling Action Plan 2019)



1.3. STATUS OF COLD-CHAIN IN INDIA

Since independence, the combined efforts of farmers/ other Agri-producers, dedicated teams of agricultural scientists, and the constant endeavour of policymakers have contributed to transforming Indian agriculture from an importer to a major exporter of food grains. However, the marketing network and post-harvest marketing infrastructure are not adequate to keep up with the growing production and marketable surplus. India has a large inventory of cold storages or refrigerated warehouses. Yet, the other elements that make up an uninterrupted cold-chain – pack houses, reefer transport and ripening chambers – are largely missing. As of 2016, the cold-chain sector investment of the entire developed infrastructure could accommodate only 10% of the horticulture produce[11]. As per the assessment by NCCD, the gap in one or more cold-chain infrastructure components is as high as 99%[12]. The below table provides a gap analysis in cold-chain infrastructure and the investment potential for individual cold-chain elements.

With the present cold-chain infrastructure gap, growing population and the demand for food production, energy consumption in the cold-chain will increase to158.45 TWh by 2027-28

11. Madhu, S. (2016, December 1). Government's Role in India's Ailing Cold Storage Sector. Retrieved from Centre for Public Policy Research: https://www.cppr.in/?s=Government%E2%80%99s+Role+in+India%E2%80%99s+Ailing+Cold+Storage+Sector
12. Ministry of Environment, Forest & Climate Change. (2019). India Cooling Action Plan. New Delhi: MoEFCC

Table 1: Cold-chain Infrastructure Gap[13]

TYPE OF INFRASTRUCTURE	INFRASTRUCTURE REQUIREMENT	INFRASTRUCTURE CREATED	INVESTMENT POTENTIAL INR CRORES	% GAPS
Pack-house	70,080	249	66,339	99%
Cold Storage (Bulk)	341,64,411 Metric Ton	318,23,700 Metric Ton	2600	9%
Cold Storage (Hub)	9,36,251 Metric Ton		1260	
Reefer Vehicles	61,826	9,000	15,848	85%
Ripening Chamber	9,131	812	3,328	91%

GoI has launched several missions/schemes and formulated policies, recognising the importance of cold-chain to reduce the food losses and GHG emissions and the gap in the existing cold-chain infrastructure indicated in Table 1. Several initiatives have been launched to cater to the current cold-chain infrastructure gap and developing a more climate-friendly cold-chain infrastructure. The objective is to cater to majorly two types of markets: export and domestic consumption. Notwithstanding the several advantages of developing cold-chain infrastructure in India, the current energy-intensive framework results in high emissions, leading to environmental degradation. The annual energy consumption by the various components in cold-chain in 2017-18 was 71.84 TWh[14]. With the present cold-chain infrastructure gap, growing population and the demand for food production, energy consumption in the cold-chain will increase to 158.45 TWh by 2027-28[15]. In order to avoid high energy consumption in cold-chain infrastructure development and build sustainable cold-chain storage facilities, the India Cooling Action Plan recommends to a) apply appropriate policy measures to drive efficiency of equipment, b) periodic revision of energy efficiency norms, c) provide incentives for adoption of energy-efficient designs and d) develop Management Information System that would ensure inter-ministerial collaboration for tracking and monitoring the overall efficiency of cold-chain infrastructure.

The annual energy consumption by the various components in cold-chain in 2017-18 was 71.84 TWh. With the present cold-chain infrastructure gap, growing population and the demand for food production, energy consumption in the cold-chain will increase to 158.45 TWh by 2027-28

13. National Centre for Cold-chain Development. (2015). All India Cold-chain Infrastructure Capacity (Assessment of Status & Gap), Delhi. Retrieved from: https://nccd.gov.in/PDF/CCSG_Final%20Report_Web.pdf
14. Ministry of Environment, Forest & Climate Change. (2019). India Cooling Action Plan. New Delhi: MoEFCC
15. Ministry of Environment, Forest and Climate Change. (2019). India Cooling Action Plan (ICAP). Government of India. https://ozonecell.nic.in/home-page/resource-informations/reports-publications/india-cooling-action-plan/

1.4. ABOUT THE REPORT

This report provides an overview of the institutional and policy landscape in the development of the horticulture cold-chain sector, including:-

01

The role of organisations at the Centre, state and regional levels concerning cold-chain development indicating missing/ unknown links in the institutional landscape.

02

Highlighting the significant events in the evolution of cold-chain in India and limitations of the five-year plans.

03

Recent policy reforms that accelerated the development of cold-chain infrastructure in India.

04

Identifying the way forward for cold-chain development in the context of climate change and energy efficiency.

02

INSTITUTIONAL FRAMEWORK

The cold-chain sector is directly related to various other sectors like food, commerce, health etc. and hence needs to be governed by multiple ministries in coordination. This section briefly elaborates on the major governmental actors involved in carrying out the cold-chain sector's development. India complies with a three-tier governance structure with responsibilities distributed at horizontal and vertical levels. The Central-level organisations formulate policies. State and regional level organisations implement these policies.

2.1 CENTRAL, STATE AND LOCAL ORGANISATIONS

The central agencies frame policies, respective state governments implement these policies, and monitor their progress. Coordinated efforts between the Centre and the States will be significant for the effective implementation of policies. Table 2 summarises the roles and responsibilities of the governing authorities at the centre, state and local level, highlighting the various missions rolled out to advance the agricultural reforms and help develop agriculture and related sectors. The table also highlights the role of these organisations specific to cold-chain development in India.

Cold-chain sector is directly related to various other sectors like food, commerce, health etc. and hence needs to be governed by multiple ministries in coordination.

Table 2: Institutions and their Role and Responsibility

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Central Government: As per the seventh schedule of the Indian Constitution, the role of the Central Government in the cold-chain sector is to manage the export of products, inter-state trade, etc.			
Centre	**Ministry of Agriculture and Farmers Welfare (MoA&FW)**	The significant role of MoA&FW is to formulate policies and regulations for the agriculture sector in India. The Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) works directly for the well-being of farmers and implementation programs formulated by the ministry. The ministry has started major initiatives like Mission for Integrated Development of Horticulture (MIDH), Rashtriya Krishi Vikas Yojana (RKVY), Integrated Scheme for Agricultural Marketing (ISAM), etc.	The initiatives such as MIDH and ISAM aim to create a path for holistic growth of the agriculture sector, including the provision of adequate storage facilities to ensure the quality of the product; hence, the ministry has a significant role in developing the cold-chain infra-structure.
Centre	**Ministry of Food Processing Industries (MoFPI)**	MoFPI monitors and governs the aspects of food processing and post-harvest agriculture produce management, and the significant initiatives launched include the Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters, i.e. Pradhan Mantri Kisan SAMPADA Yojana.	MoFPI is one of the key agencies involved in the development of cold-chain infrastructure as major schemes launched by MoFPI such as Pradhan Mantri Kisan SAMPADA Yojana aims to enhance the food processing efficiency of agriculture and minimise food waste at the processing stage by providing adequate infrastructure for storage, transportation, and processing of agro-food produce.
Centre	**Ministry of Commerce and Industry (MoCI)**	MoCI aims to promote export and ensure product quality, which includes agriculture and allied activities. The Department of Commerce is responsible for formulating trade policies that provide strategies and guidelines for export and trade. MoCI directs APEDA, which is the critical agency in the trading of agricultural products.	The MoCI is indirectly related to the development of the cold-chain sector as it creates demand for high-quality agricultural produce for export. It creates the demand for the cold-chain to maintain the quality of perishable produce. Agencies such as APEDA is involved in developing an integrated packhouse facility to ensure quality for the export of fresh fruits and vegetables.

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Centre	**National Bank for Agriculture and Rural Development (NABARD)**	National Bank for Agriculture and Rural Development is an apex regulatory body for the overall regulation and licensing of regional rural banks and apex cooperative banks in India. It is under the jurisdiction of the Ministry of Finance, Government of India. NABARD has representation at the state and district level in each state.	NABARD's mission is to promote sustainable and equitable agriculture and rural development through participative financial and non-financial interventions, innovations, technology and institutional development for securing prosperity. NABARD offers post-harvest management support, which is credit and non-credit related: Credit-Related Support: • Provide loans to the state governments for developing rural infrastructure and strengthening Cooperative Credit Structure • Provide loans for warehousing infrastructure to State Governments, State/ Central government Owned/ assisted entities, Cooperatives, Federation of cooperatives, FPOs, Primary Agricultural Credit Societies (PACS) or similar institutions, Corporates/ Companies, Individual entrepreneurs, etc. Non-Credit Related Support: • Provide assistance in policy formulation to GoI, RBI and State Governments on matters related to agricultural credit and rural development

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Centre	**Ministry of New and Renewable Energy (MNRE)**	The Ministry of New and Renewable Energy (MNRE) is the central government body in India responsible for promoting the development and use of new and renewable energy sources. It aims to reduce dependence on fossil fuels and enhance energy security through clean energy sources like solar, wind, hydro, biomass, and more. MNRE facilitates research, development, and deployment of renewable technologies such as solar, wind, hydro, biomass, tidal, geothermal, and hydrogen energy. MNRE works to make renewable energy affordable, reliable, and accessible. Its goal is to ensure sustainable energy availability for all and position India as a global leader in clean energy.	MNRE has issued draft guidelines outlining design, specifications, performance, and testing procedures for solar cold storage systems with thermal energy storage (TES) backup. These guidelines establish standardised parameters for 2 metric tonnes (MT), 5 MT, 10 MT, and 20 MT capacity cold storage.
Autonomous Bodies	**National Centre for Cold-chain Development (NCCD)**	NCCD is an autonomous body that aims explicitly to develop the cold-chain sector across all the segments. Its objectives are: • To formulate policies, interventions, guidelines for India's perishable agriculture products • To be advisory to India's government in the matters related to reducing post-harvest losses of perishable farm produce, securing the remunerative price of farm produce to farmers, availability of fresh fruits & vegetables to consumers at affordable prices, and other cold-chain related aspects • To do certification of cold-storage and their ratings	NCCD is one of the critical organisations established to promote and develop integrated cold-chains in India. It plays its role by creating standards for cold-chain infrastructure, suggesting strategies for human resource development, and recommending policy frameworks to the government. NCCD operational guidelines specify the minimum investment required for the development and setting up of pre-cooling units and cold rooms. They set out the possible options focusing on materials, lighting system, cooling system and automation.

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Autonomous Bodies	**Small Farmers Agri-business Consortium (SFAC)**	SFAC is a society promoted by the Ministry of Agriculture and Farmers' Welfare to increase incomes of small and marginal farmers and pioneered Farmer Producer Organisations (FPOs)/ Farmer Producer Companies (FPCs).	SFAC focuses on the growth of farmers and aims towards the increased income of farmers. The objective is to increase agribusiness and increase price recovery for agricultural produce, indirectly related to the cold-chain sector.
Autonomous Bodies	**National Cooperative Development Corporation (NCDC)**	NCDC is a statutory corporation under the Ministry of Agriculture & Farmers Welfare with these objectives: • To plan, promote and finance interventions to promote agricultural production, marketing, storage, export, etc. • To be nodal agency of India's government for implementing schemes of various ministries and provide loan assistance at an appealing interest rate for creation of Cold-chain facilities and dovetail the same with the grant-in-aid assistance from the Government of India	NCDC provides financial assistance for developing infrastructures like processing units, adequate storage facilities and a marketing place and providing financial aid for storage facilities to become one of the leading entities directly linked with the development of cold-chain infrastructure.
Autonomous Bodies	**Agricultural & Processed Food Products Export Development Authority (APEDA)**	APEDA is an organisation established under the Ministry of Commerce & Industries. It has these objectives: • To develop/increase the export of products • To ensure the quality of products to be exported	APEDA is involved in developing an integrated packhouse facility to ensure the export of fresh fruits and vegetables. APEDA, as a part of the strategy, is setting up cold-chain to develop the industries relating to the scheduled products for export. The Scale of assistance is 40% subsidy subject to a limit of INR 75 lakhs for cold-chain projects with mechanised handling system.
Autonomous Bodies	**National Horticulture Board (NHB)**	On the "Group on Perishable Agricultural Commodities" recommendation, NHB was set up under the Ministry of Agriculture and Farmers Welfare administrative control. NHB focused on the integrated development of the horticulture industry and promoted research and development, new-age technology and awareness.	NHB is working towards developing an integrated and energy-efficient cold-chain infrastructure for horticulture produce to improve the horticulture sector. It also focuses on developing market facilities for fresh produce by providing an adequate environment to maintain its quality.

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
State Government: As per the seventh schedule of the Indian Constitution, agriculture, including agricultural education & research, protection against the pest, fisheries, trade & commerce within the state, markets & fairs, etc. are state subject; hence the Union Government can act as an advisory or guiding authority and prepare policies, mission and other interventions for supporting the development of the sector. In contrast, it is the State Government's responsibility to adopt the existing policy and develop its strategies accordingly.			
State	**State Horticulture Boards (SHB)**	State Horticulture Boards are registered societies established to implement the National Horticulture Mission in respective states. It also ensures end-to-end development of the horticulture sector, including processing, marketing, management etc.	As the functioning of National Horticulture Boards, SHBs are responsible for developing integrated and energy-efficient cold-chain infrastructure for fresh horticulture produce in their respective states.
State	**Agricultural Produce Market Committees (APMCs)**	APMC is a marketing board established to ensure that retailers do not exploit any farmer, and the price of the product does not become excessively high in the transition.	APMCs aim to ensure economic, legal and good infrastructural conditions for trading within their jurisdiction.
State	**State Agriculture Marketing Board**	State Agriculture Marketing Boards are statutory boards established in respective states to develop and coordinate the growth of the agricultural marketing system. It has two primary objectives: • To undertake state-level planning of the development of the agriculture markets • To make necessary arrangements for publicity related to marketing matters.	State Agriculture Marketing Boards provide a platform for trading agricultural produce to farmers. They are directly linked to the supply chain of agriculture and allied activities related to cold-chain infrastructure.

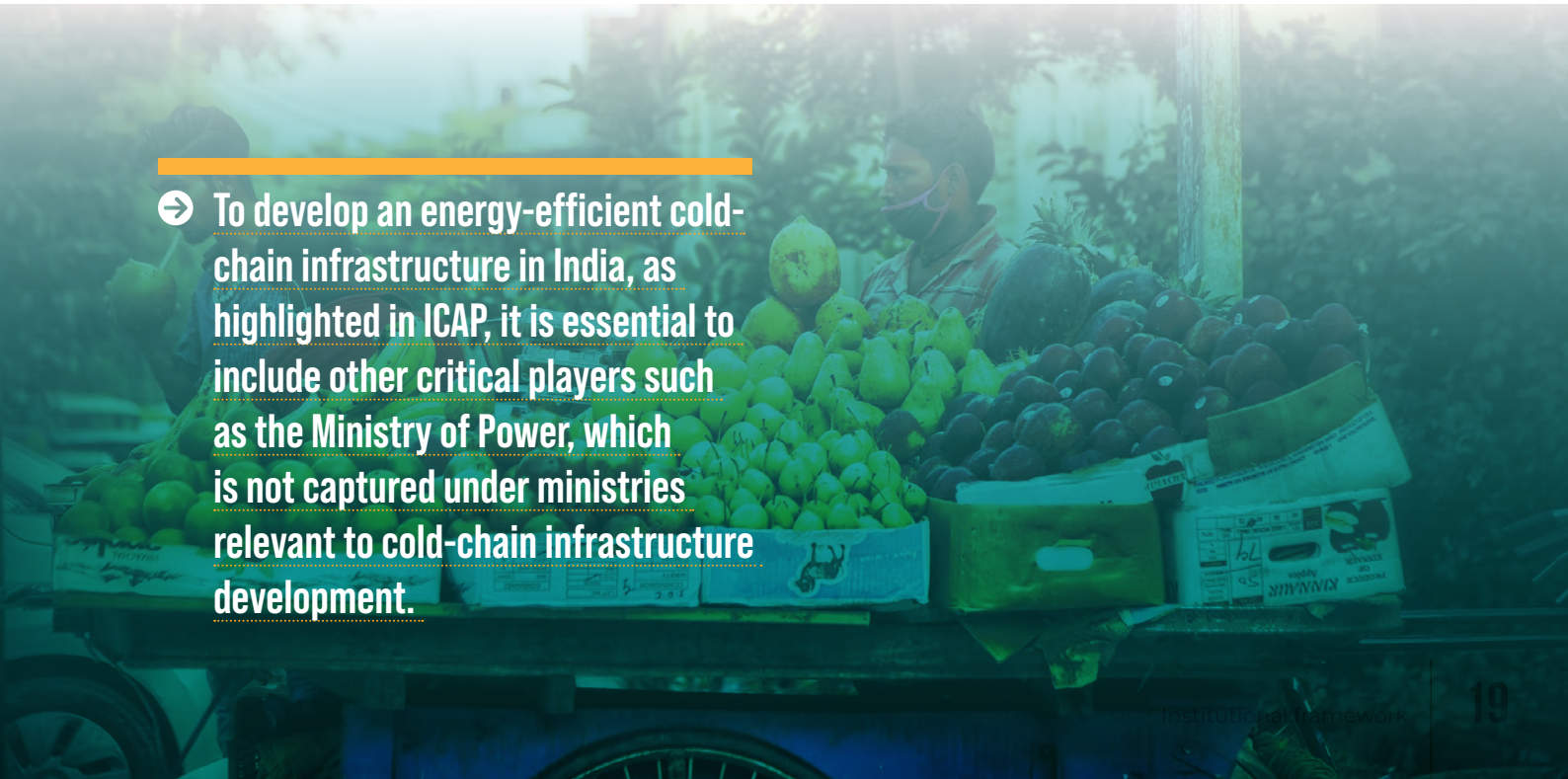
LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Statutory body	**Bureau of Energy Efficiency (BEE)**	The Bureau of Energy Efficiency (BEE), established on 1st March 2002 under the Energy Conservation Act, 2001, aims to reduce the energy intensity of the Indian economy. BEE develops policies and strategies based on self-regulation and market principles. It performs regulatory functions like setting energy performance standards, certifying energy managers, and mandating energy audits. Its promotional roles include creating awareness, promoting R&D, training, and supporting energy-efficient technologies. BEE also facilitates pilot projects and innovative financing. It collaborates with stakeholders and international agencies to implement energy conservation programs. Overall, BEE leads India's efforts in energy efficiency and conservation.	The Bureau of Energy Efficiency (BEE) plays a key role in enhancing energy efficiency in the cold-chain sector. BEE sets energy performance standards for refrigeration equipment and promotes efficient technologies such as advanced insulation and variable speed drives. Through its regulatory and promotional efforts, BEE drives the adoption of best practices, offers training, raises awareness, and supports pilot projects to demonstrate energy-efficient cold-chain solutions. By encouraging innovation and providing financial assistance, BEE helps reduce energy consumption, lower emissions, and improve the cost-effectiveness of cold-chain operations.
National standard body	**Bureau of Indian Standards**	BIS is the National Standard Body of India established under the BIS Act 2016 for the harmonious development of the activities of standardization, marking and quality certification of goods and for matters connected therewith or incidental thereto. BIS has been providing traceability and tangibility benefits to the national economy in several ways – providing safe reliable quality goods; minimizing health hazards to consumers; promoting exports and imports substitutes; controlling over proliferation of varieties etc. through standardization, certification and testing	BIS develops and enforces standards that ensure quality, safety, and efficiency across cold-chain infrastructure and operations. BIS formulates standards for refrigeration systems, cold storage construction, insulated transport, and temperature monitoring devices, which are crucial for maintaining product integrity in the supply chain.

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Cooperative organization	**National Cooperative Union of India**	NCUI is the apex organization representing the entire cooperative movement in India. Its primary objective is to promote and strengthen the cooperative movement by supporting cooperative education, training, and research across various sectors like agriculture, credit, housing, dairy, fisheries, and consumer services. NCUI also manages institutions like the National Centre for Cooperative Education (NCCE) to provide structured training programs to cooperative leaders and employees.	The key roles of NCUI are capacity building and training for FPCs. It has the potential to organize workshops and training programs focused on cold-chain management, energy efficiency, and best practices. This helps cooperatives develop the technical skills and operational knowledge required to run efficient cold-chain units.
Local	**Farmer Producer Organisations (FPOs)**	BIS role in certification and standardization enhances trust, reduces losses, and promotes sustainable growth in the cold-chain sector, especially for food and pharmaceutical products.	FPOs act as the first node to assess market demand and are an essential stakeholder, which indirectly impacts the cold-chain development in their jurisdiction area.
Local	**Krishi Vigyan Kendras (KVKs)**	KVKs are established under MoA&FW and are an integral part of the National Agricultural Research System (NARS) with the objective to: • To provide knowledge and resource of agricultural technology and allied initiatives available for local farmers of the district • To perform on-farm testing to access specific requirements and technologies of location-specific farmlands • To provide farm advisories subject(s) of interest for farmers and enhance the capacity of farmers by upgrading their skills and knowledge on modern agriculture technologies	KVKs disseminate information about government policy and help farmers be aware of the facilities and infrastructure available to them.

LEVEL	ORGANISATION'S NAME	ROLES AND RESPONSIBILITY	INDICATIVE ROLE IN COLD-CHAIN
Local	**Gramin Agricultural Markets (GrAMs)**	Gramin Agricultural Markets belong to the lowest level in the hierarchy of markets usually located at the village level, established to initiate and service transactions at terminal destination. Its objectives are: • To create a linkage between the supply-side and demand-side at the local level • To be an intermediary between primary, secondary and tertiary sectors	Gramin Agricultural Markets act as a first and last mile in the supply chain of agricultural produce and hence creates demand for a full-fledged cold-chain infrastructure.

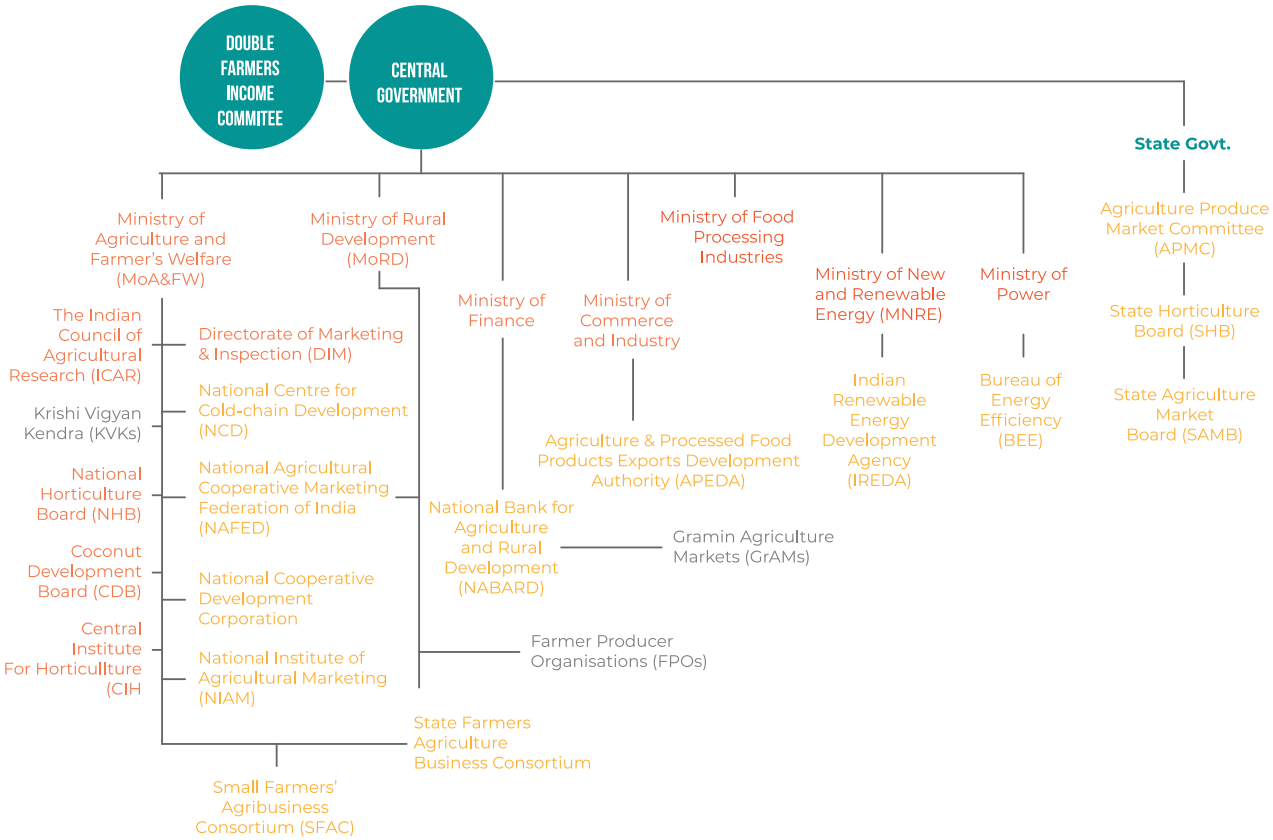
Table 2 briefly elaborates on major governmental actors involved in the development of policies and/or standards in advancing the agenda of sustainable cold chains in India. The cold-chain ecosystem is supported by a diverse range of stakeholders including ministries, statutory bodies, standard-setting agencies, and cooperative organizations each contributing uniquely to policy formulation, standardization, technology promotion, capacity building, and financial assistance. The table outlines these institutions, their responsibilities, and their indicative roles in enabling an energy-efficient, climate-resilient cold-chain infrastructure across India.

Figure 2 (next page) attempts to map the significant institutes at the central, state and local level that are majorly responsible in cold-chain infrastructure development, indicating that governance structure mainly works top-down where the producers/farmers have very little to say. Additionally, the ministries primarily work in silos and need to work in an integrated manner to bring changes in the cold-chain infrastructure. In this regard, Doubling Farmers' Income (DFI), a cross-ministerial initiative, is working towards addressing the cold-chain infrastructure gap, but further measures are needed to work collaboratively in developing infrastructure in India.



To develop an energy-efficient cold-chain infrastructure in India, as highlighted in ICAP, it is essential to include other critical players such as the Ministry of Power, which is not captured under ministries relevant to cold-chain infrastructure development.

Figure 2: **Institutional framework governing cold-chain in India**



2.2. SPECIAL COMMITTEES

Several committees have come up from time to time to help formulate new policies based on the market demand and assessment of existing policies to speed up the implementation process.

- High-Level Expert Committee (1998)
- Planning Commission Committee (2012)
- Task Force for Cold-chain Projects (2014)
- High Powered Committee for Agriculture Reforms (2019)

These committees may include members from one or more ministries, departments, or organisations for developing the cold-chain sector. The following subsections highlight some of these Committees and Task Forces that have shaped the cold-chain sector.

High-Level Expert Committee (1998)[16]

A High-Level Expert Committee was constituted in 1998 under the Additional Secretary Shri JNL Srivastava. The Committee assessed an infrastructure gap of 3.9 million tonnes in cold storage capacity for horticultural crops as of 1998. When the horticultural production stood at 130 million tonnes, the total available cold storage capacity was 11.1 million tonnes. Since 1998, horticultural production has more than doubled to about 300 million tonnes (in 2016-17), and the cold storage capacity has tripled to about 34 million tonnes of space. The report stated that a holistic approach to ensure appropriate supply chain management from farm to consumer needs to be studied for appropriate development.

Planning Commission Committee (2012)[17]

A committee headed by Shri Soumitra Choudhary, Member Planning Commission, produced a report on encouraging the investment for the provision of cold-chain to have a more efficient supply chain in the country. The Committee's key recommendation was that the cold-chain system would expressly not follow a pure price arbitrage business model but should aim to smoothen the episodic output with steady demand, resulting in greater price stabilisation and market connectivity. It also inferred that this was due to significant deficiencies in the logistics system between the farms to the final consumers. There must be a framework for the direct linkage of farmers to markets via the cold-chain. Moreover, the Committee emphasised the integration of logistics and food processing units for more effective market linkage. Some of the other recommendations are mentioned below:

- Inclusion of outside investors and encouraging FDI in the cold-chain sector.
- Increase in financial flexibility, meaning it was recommended that the Warehousing Development and Regulatory Authority (WDRA) help farmers obtain warehouse receipts, allowing farmers to raise funds from banks.
- Removal of perishable agricultural produce from the aegis of the APMC act giving farmers the freedom to sell their product directly to retailers, aggregators or food processing companies in addition to mandis.
- Simplification of the clearances and licenses required for setting up the cold storage.

Since 1998, horticultural production has more than doubled to about 300 million tonnes (in 2016–17), and the cold storage capacity has tripled to about 34 million tonnes of space

Task Force for Cold-chain Projects (2014)[18]

The Ministry of Food Processing and industries constituted a task force for planning and implementing cold-chain projects in September 2014. The task force included members from MIDH, the Department of Agriculture and Cooperation, and the likes. The objective of constituting the Task Force was to revisit the strategies of all schemes, recommend an institutional mechanism for enhancing the sector and identifying the role of various levels of government and private players. The task force put aside the NSEL report that recommended creating 61 million tonnes in cold storages in their discussions; it emerged that the gap in cold storage capacity, earlier assessed at 29 million tonnes based on the NSEL review, may not be accurate

16. Committee for Doubling Farmers' Income. (2017). Report of the Committee for Doubling Farmers' Income, Volume -III. Ministry of Agriculture & Farmers' Welfare.
17. ibid.
18. ibid.

and recognised the need for a more realistic assessment of cold storage/cold-chain capacity. Further, the task force agreed to target an additional capacity building of 7.5 million tonnes over the next five years (2015-2020). Some of the other recommendations mentioned were as below:

- The Task Force emphasised the Public-Private Partnership (PPP) mode with Viability Gap Funding (VGF) as the most appropriate catalyst for developing large scale investment and development in the sector.
- Exemption of specific processes undertaken on the agricultural produce to enhance the marketability or shelf life of the product from the purview of service tax.
- Reduction in the fees for registration of reefer vehicles for the national permit.

High Powered Committee for Agriculture Reforms (2019)[19]

The prime minister set up a nine-member High-Powered Committee of Chief Ministers for 'Transformation for Indian Agriculture' in 2019. It is serviced by NITI Aayog and comprises CMs of Maharashtra, Karnataka, Haryana, Arunachal Pradesh, Gujarat, Uttar Pradesh, Madhya Pradesh, and Agriculture Minister of Agriculture Rural Development & Panchayati Raj. The Committee was established to suggest measures for transforming agriculture and raising farmers' income; modalities for adoption and time-bound implementation of reforms such as APLM Act 2017 by states; offer changes in the Essential Commodity Act (ECA), 1955 to attract private investments; a mechanism for linking of market reforms with e-NAM, GRAM; policy measures to boost agricultural export; and steps to upgrade agri-technology to global standards.

Task force agreed to target an additional capacity building of 7.5 million tonnes over the next five years (2015–2020)

SECTION SUMMARY

Most committees and the task force groups described above recognized the cold-chain infrastructure gap and emphasised the need to build more cold-chain infrastructure and indicated the need to develop this cold-chain infrastructure in public-private manner but did not highlight the type of cold-chain infrastructure needed in the Indian horticulture and the need to develop more climate friendly and efficient cold-chain infrastructure which is currently the need of the industry.

19. Committee for Doubling Farmers' Income. (2017). Report of the Committee for Doubling Farmers' Income, Volume -III. Ministry of Agriculture & Farmers' Welfare.

03

EVOLUTION OF COLD-CHAIN IN INDIA

3.1 FIVE-YEAR PLANS

This section summarises the various five-year plans and their contribution to India's existing cold-chain infrastructure and the policies, missions, and other programs to strengthen India's cold-chain infrastructure further. Table 3 below discusses the five-year plans focusing on cold-chain infrastructure development in India. Additionally, the table highlights the primary propositions connected to the cold-chain elements, such as building more storage facilities and related targets in various five-year plans.

Table 3: Five Year Plans and Special Interventions Proposed

FIVE-YEAR PLAN	COLD-CHAIN SPECIFIC INTERVENTIONS PROPOSED	PLANNED TARGETS/ALLOCATION OF FUNDS
1951-1956	Identified the need to have a long-term storage mechanism	Bombay, Madras, Madhya Pradesh, Mysore, Hyderabad and Travancore rolled out their first-ever legislations to set up Licensed Warehouses
1956-1961	-	MoA&FW planned investment of INR 1.75 crores in setting up of storage facilities and canning industries
1961-1966	Proposed to increase the storage capacity with involvement of private players	The central government allocated a total of INR 33 crores for the construction of godowns for the storage of food grains and warehousing programmes
1966-1969	The government postponed the implementation of the 4th Five-Year Plan and instead introduced 3 annual plans. During these yearly plans, strategies like wide-spread distribution of high-yielding varieties of seeds, extensive use of fertilisers, exploitation of irrigation potential and soil conservation were used for enhancing agriculture productivity. Thus, the focus majorly remained on pre-harvest related activities.	
1969-1974	Identified the need for storage for end products and for seeds to be channelised through the Food department and Food Corporation of India, Central and State warehousing corporations, other cooperatives, State governments, etc.	Countrywide 'Save Grain Campaign' launched to enhance the storage of surplus production, which included: • Regulating licensing of food grain dealers and obligate them to make hygienic arrangements for storage • Improving storage for animal husbandry, and intended to develop 73 ice factories and 45 cold storages along with refrigerated rail vans

FIVE-YEAR PLAN	COLD-CHAIN SPECIFIC INTERVENTIONS PROPOSED	PLANNED TARGETS/ALLOCATION OF FUNDS
1974-1978	It did not emphasise specifically on the rising demand for storage facilities or investment targeted for the same	Launched the Construction of 'Godowns Scheme' to build and enhance storage capacity
1978-1980	With the change of government in power, the five-year plan was getting revised in this period.	
1980-1985	Extensively detailed the need for the storage facility, proposing a national grid of storage facilities at three levels, i.e. National Level, State/ regional level, and village level. Additionally, it highlighted the need for building cold storage and processing facilities for perishable commodities.	• Planned an additional facility of 131.60 lakh tonnes; provided an outlay of INR 259 crores • Proposed storage facilities for both perishable and non-perishable commodities under the 'Save Grain Campaign.' • Initiated a centrally sponsored scheme of Rural godowns which would aid market committees or State Warehousing Corporations to construct godowns with a capacity of more than 200 tonnes • Construction of additional storage for 35 lakh tonne and additional 151 cold storage for 5,34 lakh tonnes of storage capacity was set as a target to monitor the performance of agriculture cooperatives
1985-1990	For the first time, identified the need for a cold-chain to store vaccines/drugs and prevent food adulteration properly.	Allocated INR 307.08 crores for food processing, storage, and warehousing facilities.
1992-1997	Highlighted the status of cold storage in India, indicating the existing inadequacy of cold storage facilities.	NCDC launched a project called NCDC-III assisted by the World Bank, under which a total of INR 575.67 crores was sanctioned for storage units, processing units and capacity building.
1997-2002	Acknowledged the shortage of storage facilities and the importance of supporting the marketing infrastructure but highlighted the disadvantage of overstocking, leading to an unwarranted spurt in the process, laying the foundation of limiting the storage of agricultural produce.	• Encouraged the panchayats to play a significant role in setting up cold storage and processing facilities close to the production centres in rural areas. • The Central Government launched the 'Rural Godown Scheme' for providing the required assistance. • Announced fiscal incentives to entrepreneurs in the form of tax reductions, exemption on customs duty, low-interest loan etc. which was targeted to attract private players in enhancing the storage facility • Envisaged to construct 150 cold storage units

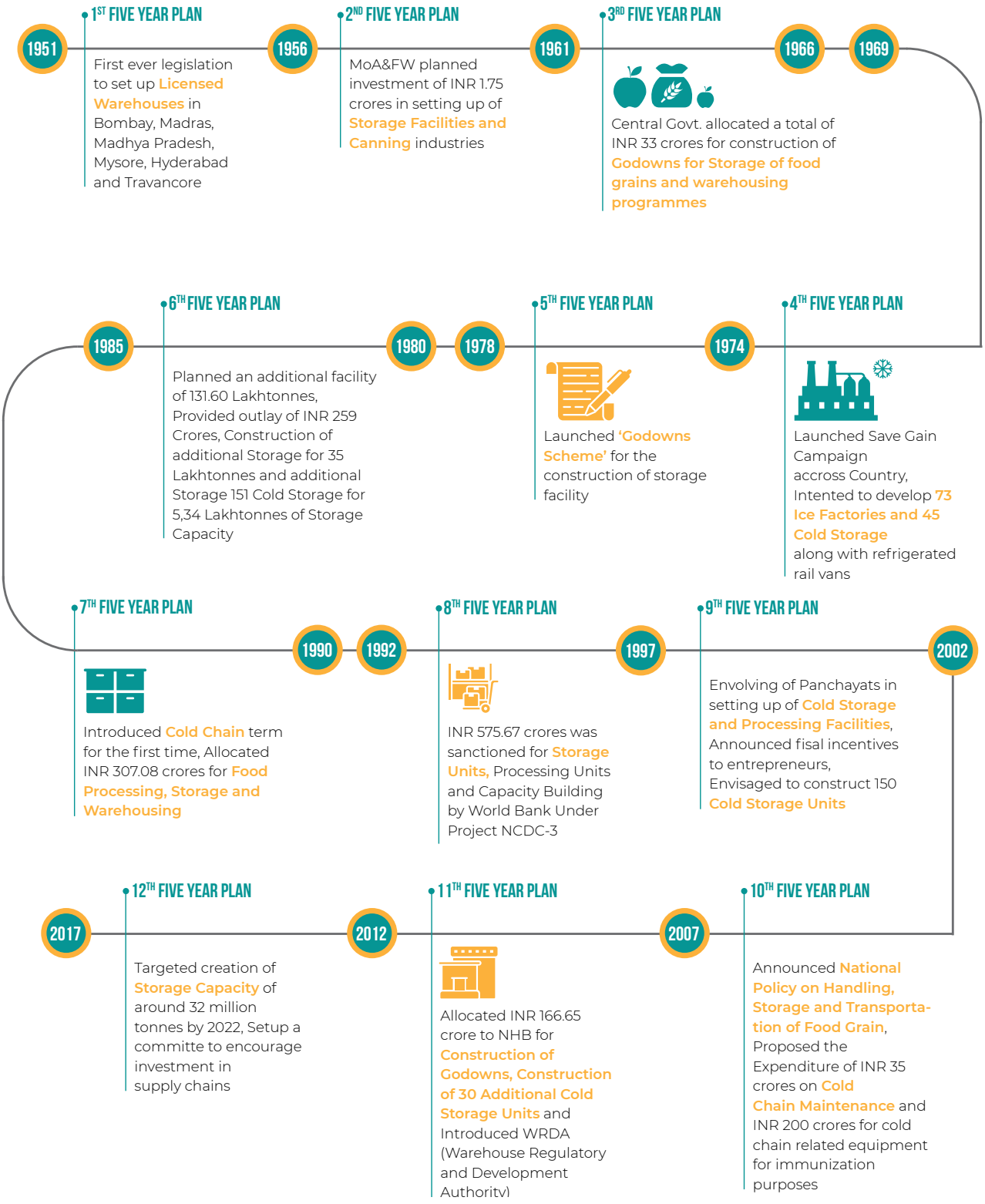
FIVE-YEAR PLAN	COLD-CHAIN SPECIFIC INTERVENTIONS PROPOSED	PLANNED TARGETS/ALLOCATION OF FUNDS
2002-2007	Identified 'cold-chain' as one of the 11 major thrust areas for horticulture development	▯ Announced National Policy on Handling, Storage and Transportation of Food Grain focusing on: ■ reduction in loss due to improper storage and transit system ■ encouraging scientific methods of storage to retail food quality and nutrition. ▯ Proposed expenditure of INR 35 crores on Cold-chain Maintenance and INR 200 crores for cold-chain related equipment for immunisation purposes.
2007-2012	Envisaged the development of food parks, integrated cold-chain facilities, strategic distribution centres and cluster-based preservation infrastructure, etc.	▯ Food Corporation of India allocated INR 632 crore to NHB and INR 166.65 crores for the construction of godowns ▯ Construction of 30 additional cold storage units and for enhancement of existing cold-chain infrastructure ▯ Introduced Warehouse Regulatory and Development Authority (WRDA) to set standards and modernise warehousing by the development of an e-trading system
2012-2017	Cold storage and related aspects were brought under the jurisdiction of WRDA	▯ Targeted creation of around 32 million tonnes by 2022 ▯ The Planning Commission had set up a committee to encourage investments in supply chains, including provision for cold storages for more efficient distribution of farm produce. The Committee recommended: ■ RIDF can be used to attract private players using the PPP model and Viability Gap Funding. ■ To facilitate the recommendations given by the Committee, an Inter-Ministerial Group on Cold-chain Infrastructure and Allied Sectors had been set up by the government. The Committee also proposed the addition of 17 million tonnes of storage by the Department of Food and Public Distribution. Set up a committee on encouraging private investments in Supply Chains.

Five-year plans have played an important role in the evolution of cold-chain infrastructure in India. Figure 3 provides a snapshot of this evolution. The figure indicates that although the elements of cold-chain and its need was introduced from the first Five-Year Plan in warehousing/storage houses, the term 'Cold-chain' was first mentioned in the Five-Year Plan of 1985-1990. Moreover, its role in horticulture development was only recognised another ten years later in the 2002-2007 Five-Year plan. Before this period, the major emphasis was on building storage houses at national, state, and regional levels. In the 2002-2007 Five Year Plan, developing a cold-chain infrastructure using scientific methods to maintain better quality standards was stressed upon. The cold-chain infrastructure development can be divided into pre-2000 and post-2000 periods. The pre-2000 period policies recognised the need to build cold-chain infrastructure. However, most actions/plans/policies emphasised pre-harvest provisions. On the other hand, post-2000 the plans/policies accelerated the development of cold-chain infrastructure and its maintenance, which will be discussed in the subsequent section.

The elements of cold-chain and its need was introduced from the first Five-Year Plan in warehousing/storage houses, the term 'Cold-chain' was first mentioned in the Five-Year Plan of 1985-1990

Existing Policies, Missions and Programs

Figure 3: **Evolution of Cold-chain in India**



SECTION SUMMARY

The five-year plans focused majorly on the pre-harvest management in agriculture, such as irrigation requirements, seeds/grains provision, etc. and there were only a few interventions related to post-harvest management facilities such as building cold storages, warehouses and godowns. This limited focus on post-harvest management facilities led to several limitations for farmers such as: fragmented and difficult access to markets, restriction in licensing, cap on higher limit of storage, information asymmetry and no major policy on developing more climate friendly cold-chain infrastructure.

3.2 POLICIES, MISSIONS AND PROGRAMS

Five-year plans provide a high-level goal towards developing cold-chain infrastructure. To achieve these goals, several missions/policies/schemes have been launched. This subsection briefly details schemes, missions, or programs to understand the present-day landscape of the cold-chain sector in the country.

Below Table 4 provides an overview of the major central and state government initiatives that have contributed to improving the state of post-harvest management in the country.

Five-year plans provide a high-level goal towards developing cold-chain infrastructure. To achieve these goals, several missions/policies/schemes have been launched

Table 4: Central Initiatives on Horticulture Cold-chain Development

INITIATIVES/POLICY AND LAUNCH YEAR	OVERVIEW OF THE INITIATIVE IN THE COLD-CHAIN CONTEXT	IMPLEMENTING AGENCY IN THE STATE
The Mission for Integrated Development of Horticulture (2025)	MIDH Operational Guidelines 2025 introduce significant changes aimed at enhancing horticulture development across all districts in India. These updated guidelines incorporate modifications in cost norms, fund allocation under NHM, the flow of funds, and the inclusion of new components to strengthen the horticulture value chain. Key revisions include the integration of solar-based technologies, the promotion of energy-efficient cooling systems, and an enhanced focus on post-harvest infrastructure.	State Department of Horticulture
National Horticulture Mission	A sub-scheme of MIDH, NHM is focused on providing financial assistance for cold-chain development. For instance, cold storage (long term storage and distribution hubs) up to 5,000 MT capacity are eligible for assistance under the open-ended scheme of NHM/ HMNEH (a sub-scheme of MIDH). The assistance is extended as subsidies to credit-linked projects @ 35% of the project's capital cost in the general area and 50% in the Hilly & Scheduled area.	State Department of Horticulture
Pradhan Mantri Kisan SAMPADA Yojana (PMKSY)	Launched by the Ministry of Food Processing Industries, the mission aims to create a modern and efficient supply chain to connect the farm gate with the retail outlet directly. The projects have been approved across Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh.	State Department of Horticulture
Integrated Scheme for Agricultural Marketing (2014)	Initiated by the Department of Agriculture and Cooperation, the primary objectives of ISAM are to promote agricultural marketing infrastructure, create scientific storage space, promote pledge financing to increase farmers' income, catalyse private investment, and facilitate training, research, and development. A substantial portion of the budget was allocated to Agricultural Marketing Infrastructure, Marketing Research and Information Network and Strengthening of Agmark Grading Facilities; Small Farmers Agribusiness Consortium (SFAC), to implement the sub-scheme of Agri-Business Development. Apart from these schemes, the Chaudhary Charan Singh National Institute of Agriculture Marketing sub-scheme was envisioned to provide the required training, research and consultancy.	State Agricultural Marketing Departments

INITIATIVES/POLICY AND LAUNCH YEAR	OVERVIEW OF THE INITIATIVE IN THE COLD-CHAIN CONTEXT	IMPLEMENTING AGENCY IN THE STATE
NABARD Warehouse/ Cold Storage Scheme	Under this scheme, loans are provided for projects involving: • Creation of storage infrastructure, with a minimum capacity of 5,000 MT, for agricultural and allied produce, including the construction of Warehouses, Silos, Cold storage, Controlled Atmosphere (CA) stores, other cold-chain activities like reefer vans, bulk coolers, etc • Modernisation/improvement of the existing storage infrastructure projects.	National Bank for Agriculture and Rural Development
Cold Storage and Fruits & Vegetables Development Program	Under this scheme, NCDC: • Provides financial assistance to the extent of 90% of the block cost to the State Governments for setting up/modernisation/ expansion/ rehabilitation of cold storage and Ice plants by cooperatives. • Has dovetailed its cold storage programme with National Horticulture Board (NHB). In such cases, the quantum of assistance provided by NCDC is reduced by the subsidy available under the Capital Investment Scheme (CIS) of NHB.	National Cooperative Development Corporation
Mega Food Park Scheme	Launched by the Ministry of Food Processing, this scheme aims to establish a "direct linkage from farm to processing and then to consumer markets" through a network of collection centres and primary processing centres. This scheme provides: • A capital grant at the rate of 50% of the eligible project cost in general areas (which excludes North Eastern regions such as Sikkim, Himachal Pradesh, Jammu & Kashmir and Uttarakhand) is subject to a maximum of USD 7 million per project. • Supports infrastructural facilities for food processing & allied industries along with the value chain from the farm to market, including creating infrastructure near the farm, transportation, logistics, and centralised processing centres. • As of June-2020, there are 19 operational Mega Food Parks.	State Industrial Development Authority
Agriculture Infrastructure Fund	Launched by the Ministry of Agriculture & Farmers Welfare, AIF aims to provide: • Medium - long term debt financing facility for investment in viable projects for post-harvest management Infrastructure and community farming assets. • For setting up cold stores and chains, warehousing, grading and packaging units, e-marketing points linked to e-trading platforms, and PPP projects for crop aggregation sponsored by central/state/local bodies.	

INITIATIVES/POLICY AND LAUNCH YEAR	OVERVIEW OF THE INITIATIVE IN THE COLD-CHAIN CONTEXT	IMPLEMENTING AGENCY IN THE STATE
Venture Capital	SFAC extends venture capital assistance in the form of equity to agribusiness projects. The quantum of SFAC support is 26% of the promoter's equity in the general area and 40% of the promoter equity. This venture capital is repayable to SFAC after the repayment of the term loan.	Small Farmer Agri-Business Consortium (SFAC)
Agricultural and Processed Food Products Export Development Authority (APEDA) assistance for cold-chain	Setting up of cold-chain are assisted by APEDA as a part of the strategy to develop the industries relating to the scheduled products for export. The scale of assistance is 40% subsidy for cold-chain projects with mechanised handling systems.	Agricultural and Processed Food Products Export Development Authority

3.2.1 Mission for Integrated Development of Horticulture (MIDH) Operational Guidelines 2025[20]

MIDH Operational Guidelines 2025 introduce significant changes aimed at enhancing horticulture development across all districts in India. These updated guidelines incorporate modifications in cost norms, fund allocation under NHM, the flow of funds, and the inclusion of new components to strengthen the horticulture value chain. Key revisions include the integration of solar-based technologies, the promotion of energy-efficient cooling systems, and an enhanced focus on post-harvest infrastructure. For the fiscal year 2024–2025, a total of ₹ 2,065.99 crore has been allocated under MIDH. This includes ₹ 1,038.64 crores for National Horticulture Mission, ₹ 435.99 crores for the National Horticulture Board, ₹ 375.60 crore for the Horticulture Mission for North Eastern and Himalayan States, ₹ 100 crore for the Coconut Development Board, ₹ 10 crore for institutions like the Central Institute of Horticulture and various directorates, and ₹ 105.76 crore for the National Bamboo Mission[21]. A significant policy change is the modification of the center-to-state funding ratio under NHM from 85:15 in the previous guidelines to 60:40 in the revised version. The table below lists the items that have been revised in the 2025 MIDH Operational Guidelines.

Table 5: MIDH operational guidelines (subsidy norms)

Cost norms and pattern of assistance under Mission for Integrated Development of Horticulture (MIDH) for National Horticulture Mission (NHM) and Horticulture Mission for North Eastern and Himalayan States (HMNEH) sub schemes

	ITEM	COST NORMS	PATTERN OF ASSISTANCE
C. Integrated Post Harvest Management			
C1	Farm gate packhouse with movable Handling Trolley, Sorting Table and Farm Gate Standalone Cold Storage	Upto a maximum of Rs.25.0 lakh/unit with size of 9MX6M per beneficiary	Assistance @ 50% admissible only
C2	Integrated Packhouse with facilities of size 18m x 22m with conveyor belt sorting, grading, washing, drying, weighing scale, HPT, stacking (crates), Dock Leveller System, Precooling (if required) #, cold room transit and Reefer van	Upto a maximum of Rs 160.00 lakh per Beneficiary	Credit linked back-ended assistance @ 35%
C3	Collection Aggregation Centre with facilities of size 22mx 26m with conveyor belt sorting, grading, washing, drying, weighing bridge, Automated computerised system, HPT, BOPT, stacking (crates), Dock Leveller System, Precooling (if required) # and cold room transit.	Upto a maximum of Rs 320.0 lakh per Beneficiary	
C4	Pre-cooling unit	Upto a maximum cost of Rs. 5 Lakh/MT.	
C5	Mobile precooling unit	Rs. 30.00 lakh	
C6	Cold rooms (Staging)	Upto Max cost of Rs 52 lakhs	
	Solar-powered cold rooms	May be taken on standalone basis as proposed in Farmgate packhouse, Integrated packhouse, Collection centre and cold rooms	

20 MIDH revised guidelines, 2025, retrieved from: https://midh.gov.in/PDF/2024-25/Revised%20MIDH%20Guideline.pdf

21 Ministry of Agriculture & Farmers Welfare, - Implementation of the Scheme d:urilag 2024-25 - Administrative approval – reg, https://midh.gov.in/PDF/2024-25/Administrative%20Approval%202024-25.pdf

C7	Cold Storage Type I (CS 1)		
	Cold Storage Type - I (construction in civil including PUF/PIR panels)	Rs 9600/MT (Max 5000 MT Capacity) Same for C.8 Cold Storage Type- I-Onion (CS-1-Onion)	Credit linked back-ended assistance @ 35%
	Cold Storage Type - I (construction in a combination of civil and PEB including PUF/PIR panels)	Rs 12000/MT (Max 5000 MT Capacity) Same for C.8 Cold Storage Type- I-Onion (CS-1-Onion)	
	CO2 Scrubber (need/produce based), unified control system, material conveying/hoist system, HPT, BOPT and dock leveller system	Upto Max Rs 50 lakh/project For onion - Up to Max Rs 278 lakh/project	
C9	Cold Storage Type- II (CS-2)		
	Cold Storage Type- II (construction in a combination of civil and PEB including PUF/PIR panels)	Rs. 12000/MT, (Max 5,000 MT capacity)	Credit linked back-ended assistance @ 35%
	CO2 Scrubber (need/produce based), unified control system, material conveying/hoist system, HPT, BOPT and dock leveller system	Upto Max Rs 49 lakh/project	
C9	Cold Storage Type- II-CA (CS-2-CA)		
	Cold Storage Type- II with CA (construction in a combination of civil and PEB including PUF/PIR panels)	Additional Rs 12000/MT (max capacity of 5000 MT)	Credit linked back-ended assistance @ 35%
	CA Add-on	Upto Max cost of Rs. 1345 lakhs/project (Max. subsidy for CA store may not exceed more than 900 Lakhs including add-ons)	
C10	Cold Storage Type- IV (CS-4)		
	Cold Storage for dry spices and raisins (construction in civil including PUF/PIR panels)	Rs 9600/MT (Max 5000 MT Capacity)	Credit linked back-ended assistance @ 35%
	Cold Storage for dry spices and raisins (construction in a combination of civil and PEB including PUF/PIR panels)	Rs 12000/MT (Max 5000 MT Capacity)	
C12	Technology Induction/Modernization of cold storage	Max. Rs. 125 lakh but not more than Rs. 3000/MT of the cold store capacity for refrigeration and Max. Rs. 120 lakhs but not more than 1800/MT for insulation resp	
C13	Refrigerated Transport Vehicle	Rs. 31.00 lakh for up to max capacity of 14 MT and on a prorate basis for smaller capacity but not below 4MT.	

Cost norms and pattern of assistance under Mission for Integrated Development of Horticulture (MIDH) for National Horticulture Board (NHB)			
Scheme No. 01: Development of Commercial Horticulture through Production and Post-Harvest Management (Integrated Projects)			
	All Post Harvest Management Components (C1 to C6 as per MIDH guidelines)	As per MIDH Cost Norms 2025	As per MIDH Cost Norms 2025
	Refrigerated Transport vehicles	Upto max. Rs. 80.00 lakh/ project in general areas	Credit linked back-ended assistance @ 35%
Scheme No. 02: Capital Investment subsidy scheme for Construction/ Expansion/ Modernization of Cold Storage			
CS 1	Cold Storage Type - I (construction in civil including PUF/PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 9120/MT capacity between 5001 to 6500 MT. @ Rs. 8640/MT capacity between 6501 to 8000 MT. @Rs 8160/MT for capacity between 8001 to 10,000 MT @Rs 4080/MT for capacity between 10001 to 20,000 MT. Same for C.8 Cold Storage Type- I-Onion (CS-1-Onion)	Credit linked back-ended assistance @ 35%
	Cold Storage Type - I (construction in a combination of civil and PEB including PUF/ PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 11400/MT capacity between 5001 to 6500 MT. @ Rs. 10800/MT capacity between 6501 to 8000 MT. @Rs 10200/MT for capacity between 8001 to 10,000 MT @Rs 5100/MT for capacity between 10001 to 20,000 MT. Same for C.8 Cold Storage Type- I-Onion (CS-1-Onion)	
	CO2 Scrubber (need/produce based), unified control system, material conveying/hoist system, HPT, BOPT and dock leveller system	Upto Max cost of Rs. 52.0 lakh/ project For Onion - Upto Max cost of Rs. 531.0 lakh/ project	

CS 2	Cold Storage Type- II (construction in a combination of civil and PEB including PUF/PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 11400/MT capacity between 5001 to 6500 MT. @ Rs. 10800/MT capacity between 6501 to 8000 MT. @Rs 10200/MT for capacity between 8001 to 10,000 MT @Rs 5100/MT for capacity between 10001 to 20,000 MT.	Credit linked back-ended assistance @ 35%
	CO2 Scrubber (need/produce based), unified control system, material conveying/hoist system, HPT, BOPT and dock leveller system	Upto Max cost of Rs. 52.0 lakh/ project	
CS 2 CA	Cold Storage Type- II with CA (Construction in a combination of civil & PEB including PUF/PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 11400/MT capacity between 5001 to 6500 MT. @ Rs. 10800/MT capacity between 6501 to 8000 MT. @Rs 10200/MT for capacity between 8001 to 10,000 MT @Rs 5100/MT for capacity between 10001 to 20,000 MT.	Credit linked back-ended assistance @ 35%
	CA Add-on	Upto Max cost of Rs. 1375 lakhs/project	
CS 4	Cold Storage for dry spices and raisins (construction in civil including PUF/PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 9120/MT capacity between 5001 to 6500 MT. @ Rs. 8640/MT capacity between 6501 to 8000 MT. @Rs 8160/MT for capacity between 8001 to 10,000 MT @Rs 4080/MT for capacity between 10001 to 20,000 MT.	Credit linked back-ended assistance @ 35%

	Cold Storage for dry spices and raisins (construction in a combination of civil and PEB including PUF/PIR panels)	NHB to take up projects with capacity above 5000 MT and up to 20,000 MT as per the following rates: @ Rs. 11400/MT capacity between 5001 to 6500 MT. @ Rs. 10800/MT capacity between 6501 to 8000 MT. @Rs 10200/MT for capacity between 8001 to 10,000 MT @Rs 5100/MT for capacity between 10001 to 20,000 MT.	Credit linked back-ended assistance @ 35%
	Technology Induction/Modernization of cold storage	Max. Rs. 125 lakhs but not more than Rs. 3000/MT of the cold store capacity for refrigeration and Max. Rs. 120 lakhs but not more than 1800/MT for insulation resp	

3.2.2 National Logistic Policy, (2022)[22]

The National Logistics Policy (NLP) 2022, launched by the Government of India, aims to develop a technologically enabled, integrated, cost-efficient, resilient, and sustainable logistics ecosystem. While not cold-chain specific, the policy has strong implications for cold-chain infrastructure through its emphasis on multimodal connectivity, warehousing, digital integration, and process optimization—all of which are critical for temperature-sensitive logistics like food and pharmaceuticals.

The NLP can support cold-chain growth through several key initiatives:

- PM GatiShakti National Master Plan: Enables better planning and development of cold-chain nodes (warehouses, logistics parks, terminals) with a focus on first and last-mile connectivity, crucial for perishable goods.
- Comprehensive Logistics Action Plan (CLAP): Includes standardization of temperature-controlled logistics, benchmarking service quality, and promoting energy-efficient warehousing solutions.
- Digital Enablement: Platforms like the Unified Logistics Interface Platform (ULIP) and Secured Logistics Document Exchange (SLDE) improve real-time visibility and traceability for cold-chain cargo, reducing delays and spoilage.
- Logistics Human Resource Strategy: Emphasizes capacity building and training, which supports skill development in cold-chain operations and maintenance.
- Support for State-level Engagement: Encourages state governments to develop city and state-level logistics plans with specific mention of improving warehousing and cold storage infrastructure.
- Promotion of Sustainable Practices: Through incentives and regulatory support, the policy promotes green logistics, energy-efficient systems, and modal shifts to reduce emissions—especially relevant for the energy-intensive cold-chain sector.

While the NLP is broad-based, its pillars infrastructure development, digital integration, standardization, and sustainability provide a strong enabling environment for scaling up cold-chain operations across India. It encourages cross-sectoral collaboration and public-private partnerships, which are vital for building resilient, climate-smart cold-chain systems.

3.2.3 NCCD Guidelines: Engineering Guidelines and Minimum System Standards for Implementation in Cold Chain Components (2025)[23]:

The National Centre for Cold Chain Development (NCCD), under the Ministry of Agriculture & Farmers' Welfare, revised its *"Engineering Guidelines & Minimum System Standards"* in 2025 to provide a comprehensive framework for the design, development, and management of cold chain components in India. These guidelines serve as a national reference document for implementing cold chain infrastructure in alignment with global standards, energy efficiency norms, and climate commitments. Recognizing the cold chain as a critical enabler for food security, post-harvest loss reduction, and income enhancement for farmers, the revised guidelines focus on both preserving product quality and extending the lifecycle of perishable commodities including fruits, vegetables, dairy, seafood, pharmaceuticals, and floriculture products. The guidelines address cold chain needs from farm-level packhouses to large-scale storage and distribution hubs, and emphasize sustainability, modernization, and indigenous manufacturing.

Key Features and Highlights:

- **Component-wise Engineering Standards**: Minimum system requirements are detailed for each cold chain segment including farmgate packhouses, integrated packhouses, aggregation centres, pre-cooling units, various cold storage types (CS-1 to CS-4), ripening chambers, refrigerated transport, and retail shelves.

22 National Logistic policy, 2022, retrieved from: https://www.investindia.gov.in/team-india-blogs/national-logistics-policy-india

21. NCCD guidelines, 2025, retrieved from : https://www.nccd.gov.in/PDF/2024-25/ENGINEERING%20GUIDELINES-%20Revised%20Final%20Edition_04.02.2025-2025.p

- **Sustainability and Climate Alignment**: The guidelines incorporate the use of solar-based cold storage, thermal storage, cold storage using biomass energy and absorption/adsorption technologies, variable frequency drives (VFD), energy-efficient insulation, low-GWP refrigerants, and promote green building practices. This aligns India's cold chain sector with international climate goals and the country's net-zero commitments.
- **Technological Upgradation**: Focus on replacing outdated technologies (e.g., bunker coil systems) with energy-efficient and digitally monitored alternatives. Introduction of smart monitoring systems, unified control panels, and data loggers for temperature and humidity tracking.
- **Capacity and Facility Norms**: Defines clear capacity norms for different cold storage applications—for example, space-to-MT conversions for fruits, onions, apples, and ripening chambers—ensuring consistency in planning and project proposals.
- **Project Design and Cost Norms**: Offers standardised project design formats, data sheets, and cost norms to streamline planning, implementation, and funding under government-supported schemes like MIDH, NHB, MoFPI, and APEDA.
- **Human Resource and Training Emphasis**: Encourages the development of a trained workforce with regular capacity-building initiatives, safety protocols, and certification systems for cold chain professionals.
- **Regulatory and Safety Compliance**: Outlines safety standards, energy audit requirements, and emission norms, and encourages alignment with BIS codes and international food safety regulations. It includes parameters for FSSAI-compliant artificial ripening chambers and thermal performance benchmarking.
- **Integrated Cold Chain Ecosystem Approach**: Emphasises seamless connectivity across production, aggregation, storage, processing, and retail, supported by appropriate handling equipment, docks, and transport refrigeration. Cold chain elements are envisioned as part of an interconnected ecosystem rather than an isolated infrastructure.

These revised guidelines provide a critical reference point for project developers, implementing agencies, investors, and policy planners aiming to build efficient, scalable, and sustainable cold chain infrastructure across India.

3.2.4 MNRE Guidelines on Design Specifications, Performance Guidelines, and Testing Procedure for Solar Cold Storage with Thermal Energy Storage (TES) Backup (2025)[24]

The Ministry of New and Renewable Energy (MNRE) has released detailed technical and performance guidelines for solar-powered cold storage systems integrated with Thermal Energy Storage (TES) to support off-grid and energy-resilient cold-chain solutions. These guidelines aim to standardize the design, deployment, and testing of solar cold storage units—essential for reducing post-harvest losses, ensuring food security, and improving farmer incomes, especially in remote and underserved regions.

Key Highlights of the Guidelines:

- **System Architecture**: Solar energy powers the refrigeration system during sunshine hours while storing excess cooling in TES using phase change materials (PCM). This allows the system to operate efficiently during non-solar hours or cloudy days, with optional grid connectivity as a backup.
- **Target Capacities**: The guidelines apply to systems with 2 MT, 5 MT, 10 MT, and 20 MT capacities, and are based on three different minimum temperatures - -5˚C, 1˚C and 4˚C, suitable for various agricultural, dairy, fishery, and pharmaceutical commodities.
- **Cold Room Specifications**:
  - » PUF insulated rooms with appropriate thermal resistance.
  - » Recommended body materials: PPGI or stainless steel based on the commodity.
  - » Minimum internal volume: 150 cubic feet per MT.
  - » Designed for 10 daily door openings with safety features like internal opening locks and PVC curtains.

24 Solar Cold Storage Guidelines, 2025, retrieved from: https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2025/02/2025021111110376370.pdf

- **Refrigeration and TES System**:
  - Uses air-cooled vapour compression systems with variable-speed compressors.
  - TES uses PCM (water or eutectic mixtures) with a minimum lifespan of 10 years.
  - Designed to support two-day autonomy, assuming daily pre-cooling of 10% of total storage capacity.
- **Solar PV System**:
  - PV module requirements include compliance with IEC/BIS standards.
  - Power capacities range from 4 kWp to 26 kWp, depending on storage and temperature.
  - Integrated with Maximum Power Point Trackers (MPPT) and equipped with surge protection, earthing, and remote monitoring systems.
- **Battery Bank**:
  - Supports auxiliary loads (lighting, fans, controllers).
  - Battery type: Lead-acid or Li-ion with a minimum 5-year warranty.
  - Sizing based on capacity, ranging from 5.2 kWh to 19.2 kWh.
- **Remote Monitoring**:
  - Real-time parameters tracked include room temperature, humidity, solar generation, battery voltage, TES level, and compressor status.
- **Performance Standards**:
  - Systems must achieve target temperatures (4°C, 1°C, -5°C) within 24 hours during pre-cooling.
  - TES must maintain temperature for up to 48 hours without solar/grid input.
  - Energy efficiency, autonomy, and system safety must meet prescribed testing protocols.
- **Testing Procedures**:
  - Performance validation includes cooling delivery tests, solar autonomy simulation, and power switching tests (solar to grid and vice versa).
  - Standardized measurement protocols ensure accuracy, consistency, and certification readiness.
- **Use Case and Impact**:
  - These systems promote energy access and reduce diesel dependency in off-grid areas.
  - As of the date of the guidelines, over 1,400 units have been deployed nationwide.
  - This document serves as a key reference for ministries, implementing agencies, and state departments while preparing bids and proposals under government schemes.

Union Budget, 2025[25]:

The Union Budget 2025 charts a transformative path for India's economic growth, aligning with the vision of 'Viksit Bharat' by 2047. The budget introduces several initiatives that directly and indirectly bolster cold-chain infrastructure, a critical enabler for reducing post-harvest losses and doubling farmers' incomes through targeted interventions in agriculture, investments, and exports. These initiatives have the potential to drive the expansion of modern cold storage facilities, refrigerated transport, and temperature-controlled warehousing.

25 Union Budget, 2025, retrieved from: https://www.india.gov.in/spotlight/union-budget-2025-2026

The budget introduces pivotal initiatives to enhance agricultural productivity and resilience, including:

- Prime Minister Dhan-Dhaanya Krishi Yojana, benefiting 1.7 crore farmers
- Mission for Aatmanirbharta in Pulses, launching a six-year plan to boost productivity
- Enhanced Kisan Credit Card loans, offering INR 5 lakh in short-term credit to 7.7 crore farmers, fishermen, and dairy farmers
- Establishment of the Makhana Board, promoting self-reliance and sustainable growth
- Setting up NIFTEM (National Institute of Food Technology, Entrepreneurship, and Management) in Bihar, strengthening food processing, value addition, and employment generation in the Eastern region

Budget 2025 places significant emphasis on areas that have the potential to strengthen cold-chain logistics, recognising its role in safeguarding perishable agricultural produce. Key measures include:

- Infrastructure and air cargo upgrades: The expansion of Patna airport and the development of a brownfield airport at Bihta will enhance the efficiency of high-value perishable exports.
- Cargo screening simplification: Faster clearance will ensure that perishable goods reach markets in optimal condition, reducing food losses.
- Public-Private Partnerships (PPPs) & PM Gati Shakti: These initiatives will drive investment in energy-efficient cold-chain systems, leveraging vital data and mapping tools for effective planning and execution.
- INR 500 crore allocation for the Mission for Vegetables and Fruits: This initiative will improve storage, streamline supply chains, and reduce post-harvest losses.
- INR 2,217.25 crore under the Ministry of Food Processing Industries (MoFPI): This fund will be used to modernise storage facilities, ensuring better preservation and a resilient supply chain.

The Union Budget 2025, alongside updated national policies and technical guidelines, reflects a renewed commitment to strengthening India's cold-chain infrastructure through climate-smart, energy-efficient, and inclusive interventions. From enhanced financial outlays to modernized engineering standards and solar-powered innovations, the policy momentum is clear. However, translating these advancements into on-ground outcomes requires more than policy intent—it demands streamlined implementation, effective stakeholder coordination, and responsive institutional support mechanisms. As the cold-chain ecosystem continues to expand, it becomes critical to understand and address the persistent challenges that hinder scheme uptake, infrastructure development, and access to finance at various levels. The following section outlines key barriers faced by beneficiaries, financiers, and implementing agencies, and offers actionable recommendations to unlock the full potential of India's evolving cold-chain ecosystem.

3.2.5 National Action Plan on Climate Change (NAPCC) and State Action Plan on Climate Change (SAPCC)[26]:

The Government of India launched the National Action Plan on Climate Change (NAPCC) in June 2008 as a comprehensive policy framework to address the multiple challenges posed by climate change. The plan recognises that India, while pursuing rapid economic growth, must also adopt a sustainable development pathway that reduces greenhouse gas emissions, enhances energy security, and strengthens resilience in key sectors such as agriculture, water, and health. NAPCC is built on the principles of sustainable development, energy efficiency, renewable energy adoption, and inclusive growth, with the aim of harmonising environmental sustainability with economic progress.

The NAPCC is structured around eight core national missions:

1. National Solar Mission (NSM): Promotes the use of solar energy to reduce dependence on fossil fuels.
2. National Mission on Enhanced Energy Efficiency (NMEEE): Focuses on demand-side management, efficiency improvements, and market-based mechanisms such as the Perform, Achieve, and Trade (PAT) scheme.

26 Ministry of Environment, Forest and Climate Change. (2018, April). National action plan for climate change, 2018 [PDF]. Government of India. https://moef.gov.in/uploads/2018/04/Pg01-52_2.pdf

3. National Mission on Sustainable Habitat (NMSH): Encourages energy efficiency in buildings, waste management, and urban planning.
4. National Water Mission (NWM): Aims to improve water use efficiency by 20% through integrated water resource management.
5. National Mission for Sustaining the Himalayan Ecosystem (NMSHE): Protects fragile mountain ecosystems and their biodiversity.
6. National Mission for a Green India (GIM): Targets afforestation and ecosystem services enhancement.
7. National Mission on Sustainable Agriculture (NMSA): Promotes climate-resilient agricultural practices, water use efficiency, and improved crop varieties.
8. National Mission on Strategic Knowledge for Climate Change (NMSKCC): Strengthens research, capacity building, and policy support for climate action.

Alongside these eight missions, the NAPCC also encourages states to prepare their State Action Plans on Climate Change (SAPCCs) and supports other sectoral and thematic programmes in transport, energy, and industry.

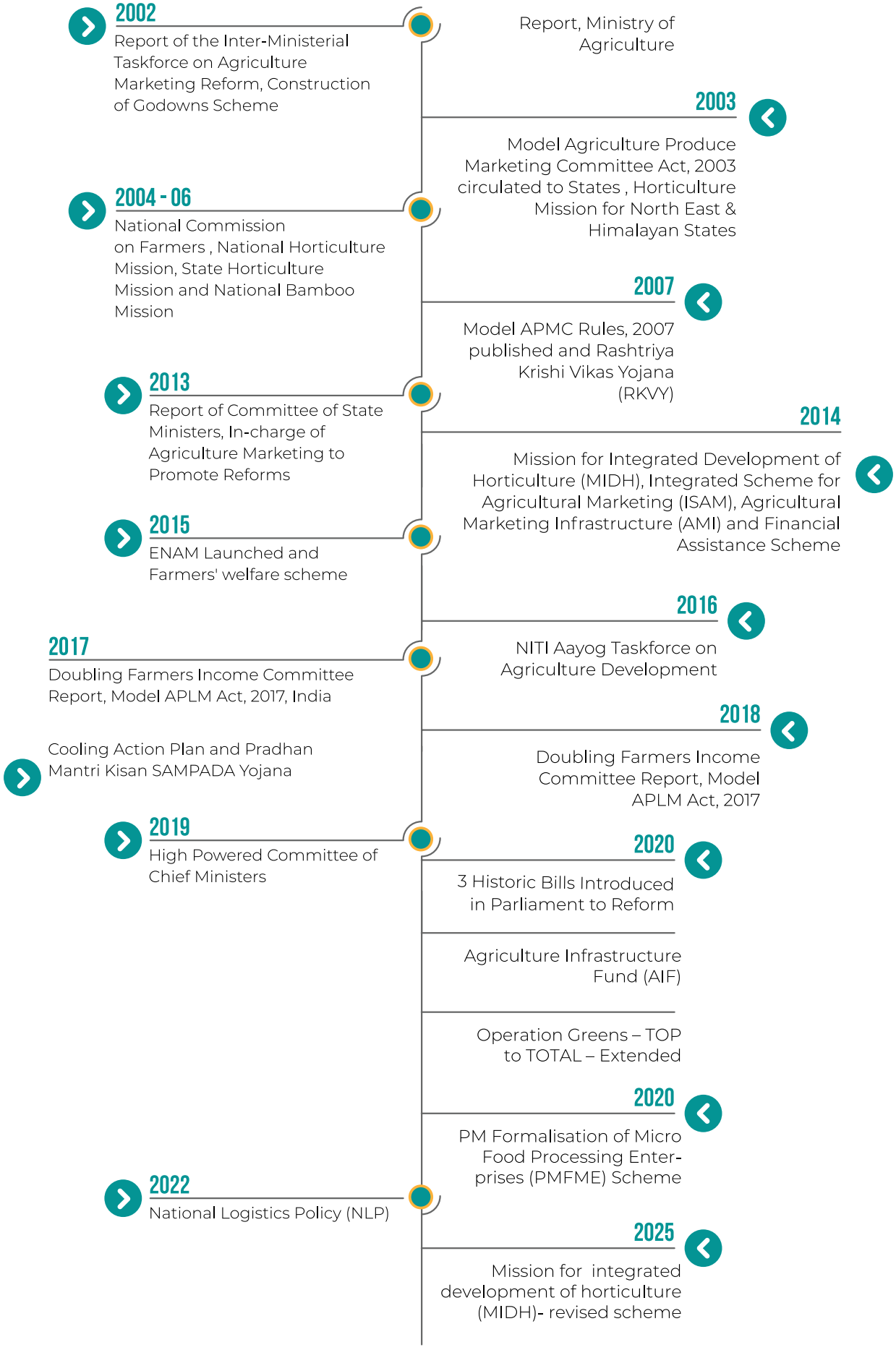
For the cold chain sector, the NAPCC holds direct and indirect significance. Cold storages are among the most energy-intensive components of the agri-food value chain, with refrigeration systems contributing a large share of operational energy demand. The NMEEE is particularly relevant as it promotes efficiency improvements and energy audits in industries, which can be extended to cold storage facilities through advanced insulation, efficient compressors, and smart energy management systems. The National Solar Mission offers opportunities for decentralised solar-powered cold storages, particularly in rural and peri-urban areas where access to reliable electricity is limited. Similarly, the National Mission on Sustainable Agriculture aligns with the development of cold chain infrastructure, as reducing post-harvest losses and improving storage of perishable crops contributes to climate-resilient agriculture and farmer income security.

Each of India's states (Assam, Andaman and Nicobar, Andhra Pradesh, Arunachal Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttarakhand and West Bengal) has prepared a State Action Plan on Climate Change (SAPCC), following the guidance of the NAPCC. These SAPCCs are state-specific frameworks designed to address both climate mitigation and adaptation, while reflecting local geography, resource constraints, and development priorities. The first generation of SAPCCs (2009–2015) largely focused on agriculture, water, forestry, and renewable energy, whereas the revised versions (post-2019) integrate India's Nationally Determined Contributions (NDCs) under the Paris Agreement, with greater emphasis on energy efficiency, sustainable transport, climate finance, and monitoring frameworks. For the cold chain sector, SAPCCs are particularly relevant because they highlight the vulnerabilities of agriculture to climate change and the need to build resilient post-harvest infrastructure. Several states such as Uttar Pradesh, Punjab, and West Bengal, where perishable agriculture and horticulture form a significant share of production, explicitly recognise cold chain modernisation, renewable-powered cold storages, and efficient refrigeration systems as important adaptation strategies. In this way, SAPCCs provide an enabling policy link between national climate missions and state-level interventions, creating opportunities to integrate cold chain development with broader goals of sustainable agriculture, energy transition, and climate resilience.

SECTION SUMMARY

The various policies discussed in this section and their timeline of introduction is shown in Figure 4, indicating that the emphasis on development of the cold-chain is very recent. Post 2000s, several market reforms coupled with economic stimulus presented a favourable environment for addressing the gap in post-harvest needs in the horticulture sector. Further, various scattered efforts (and organizations) were initiated to focus on the significant gap in India's cold-chain infrastructure with the introduction of schemes such as Construction of Godown Scheme, MIDH and Pradhan Mantri Kisan Sampada Yojana. However, bringing reforms to build more climate friendly cold-chain infrastructure. the government must work together with private and civil society organizations to ensure the best outcome.

Figure 4: **Recent reforms that shape cold-chain infrastructure in India**



04

CONCLUSION AND WAY FORWARD

India is the second-largest producer of fruits and vegetables globally, with fruit production of 92 MT and vegetable production of 178 MT

India is the second-largest producer of fruits and vegetables globally, with fruit production of 108 million MT and vegetable production of 213 million MT. The food loss in fruits is around 25-30%, mainly owing to the limited availability of cold-chain infrastructure. Most reports and literature highlight this lack of cold-chain infrastructure. However, little has been said around 'Why this is so?'. This report provided a brief context on the need for cold-chain infrastructure in India, discussing the various institutional actors and policies (programmes, missions, schemes, etc.) that have contributed to its development. Cold-chain is a cross-sectoral infrastructure governed by multiple ministries and funded through various schemes, as discussed in earlier sections. However, upon deeper investigation, it becomes evident that there is a disconnect between policy formulation and ground-level implementation.

Policy-making has been largely centralised, with the Central Government playing a dominant role in decision-making and scheme design. Figure 2 illustrated this top-down approach, wherein financial institutions and field-level organisations such as NABARD, FPOs, and KVKs, which directly engage with end-users, have limited say in policy design. Similarly, ministries such as Finance and Rural Development, which are essential in enabling grassroots-level financing and rural infrastructure, are often left out of institutional mapping exercises. As a result, schemes do not fully capture local realities, crop patterns, or market dynamics. Moreover, while implementation of cold-chain development is a state subject, state-level actors and stakeholders currently have little role in shaping policy or resource allocation. Private sector participation is also limited, even though private players can play a pivotal role in technology innovation, financing, and operations. This restricted role of private partners creates a dependency on subsidies and government-led projects, slowing down the scaling of modern cold-chain facilities. Hence, for the advancement of cold-chain infrastructure, a coordinated framework that balances top-down policy guidance with bottom-up participation of states, private players, and end-user groups is urgently required.

The challenges facing India's cold-chain sector are not uniform; they manifest differently across stakeholder groups:

1. Farmers and producer groups face multiple procedural and financial barriers. Awareness of government schemes and eligibility criteria remains low, while the application process is complex and lacks single-window facilitation. Even when subsidies exist, high upfront investment

requirements deter adoption, particularly among smallholders. Access to affordable credit is further constrained by lack of collateral and rigid formal lending requirements. Awareness and capacity-building initiatives through FPOs, KVKs, and digital platforms can bridge this gap. Establishing helpdesks at block or district levels would simplify application processes, while promoting blended finance products such as AIF and NABARD schemes can reduce capital barriers. Demonstrating public–private partnership–led model cold-chain projects will help build trust and visibility among small and marginal farmers.

2. Public sector agencies face their own set of challenges, including poor-quality applications from the field, misalignment of schemes with local crop patterns or infrastructure needs, and weak coordination between central and state schemes. Institutional fragmentation across ministries and departments often results in delays and inefficiencies. Government departments need to digitise application workflows by integrating schemes, approvals, and monitoring on one platform, enabling real-time visibility, reducing duplication, and improving coordination between central, state, and local agencies. Building internal capacity within horticulture and line departments will help in evaluating and fast-tracking projects. Establishing helpdesks at both central and state levels will improve applicant support and reduce incomplete submissions. Finally, creating interdepartmental working groups across agriculture, logistics, and finance will ensure greater policy convergence and faster execution.

3. Financing remains a systemic constraint as existing schemes rely heavily on capital subsidies, but small enterprises require access to low-cost loans, blended finance, and risk-sharing mechanisms to sustain operations. Cold-chains are highly energy-intensive, and with rising demand, electricity costs form a significant share of operational expenses. Over-reliance on grid electricity not only raises costs for operators but also increases the carbon footprint of the sector. Cold-chains are also highly energy intensive, and dependence on conventional grid electricity raises both costs and emissions. Financial constraints compound this problem, as enterprises struggle to invest in renewable energy integration or high-efficiency technologies. The government has taken significant steps to promote renewable energy and energy-efficient integration into cold-chains. MNRE has issued guidelines on the design, performance and testing of solar cold storage systems with thermal energy storage backup; the National Centre for Cold Chain Development (NCCD) updated its Engineering Guidelines and Minimum System Standards in 2025 to promote renewable/low-GWP refrigerant options and energy-efficient designs; and the Ministry of Food Processing Industries (through revised PMKSY guidelines) has created incentives for modernisation and solarisation of cold-chain infrastructure. Hence the financial instruments need to be explicitly linked to such initiatives, ensuring access to small enterprises for affordable capital to adopt renewable and energy-efficient technologies.

4. A key barrier in the cold-chain sector is the shortage of skilled manpower. Operating and maintaining cold-chain infrastructure requires technical expertise in refrigeration, storage management, and logistics, yet such skills remain limited. The government has recognized this gap and is actively implementing capacity-building programs through agricultural universities, training institutes, and specialized centers to train. These programs aim to equip operators, managers, owners of the facilities, FPO etc with practical knowledge and hands-on skills in cold-chain operations, maintenance, and post-harvest management. By strengthening technical capabilities, these initiatives not only improve the efficiency and reliability of cold-chain systems but also empower rural communities with new employment opportunities and enhance the overall resilience of the sector.

5. While government schemes provide financial assistance for setting up cold-chain infrastructure, there is a critical gap in the monitoring and evaluation (M&E) of these facilities once operational. Without structured M&E, infrastructure is often underutilized, technical breakdowns go unaddressed, and the quality of stored produce can deteriorate. To address this, the government could introduce targeted support or subsidies for M&E activities, including periodic audits, performance tracking, and adoption of IoT-enabled monitoring systems. Such support would ensure optimal utilization of facilities, maintain quality standards, and enhance the long-term effectiveness of cold-chain investments.

India requires a multi-pronged policy approach that integrates institutional reforms, innovative financing, and technological modernization to strengthen the cold-chain sector. Policies should promote cluster-

based cold-chain models to achieve economies of scale, reduce costs, and improve farm-to-market linkages. Public–private partnerships (PPPs) must be encouraged through incentives and risk-sharing frameworks to attract private investment, foster innovation, and enhance operational efficiency, while government support ensures stability and de-risks projects. Additionally, policy interventions should enable innovative financing mechanisms such as blended finance, viability gap funding, and climate-aligned investment products to expand access to affordable capital, encourage participation from diverse stakeholders, and support the sustainable growth of cold-chain infrastructure.

Stronger inter-ministerial convergence and centre–state coordination will be critical to reduce fragmentation and align cold-chain development with local needs. This must be complemented by targeted training and skilling programs for farmers, operators, and financial institutions, as well as awareness campaigns to drive adoption. On the sustainability front, policies should promote renewable energy integration, energy-efficient technologies, and climate-friendly refrigerants, while providing a regulatory push to phase out outdated technologies and encourage adoption of modern, energy-efficient solutions to reduce costs and emissions and improve operational resilience.

Integrating cold-chain development into broader agricultural and rural development strategies will ensure long-term viability, strengthen food security, enhance farmer incomes, and support India's sustainability and climate commitments. A coordinated policy framework that unites ministries, financial institutions, private players, and farmer organizations is therefore essential to create a cold-chain sector that is inclusive, efficient, and future-ready.

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