Grant Thornton

FICCI

Cold chain dynamics: Mapping India's logistics transformation





Contents

Section	Page
Executive summary	06
Cold chain industry – An overview	07
Integrated cold chain logistics and infrastructure development – Regulatory compliance and industry standards	14
Revolutionising cold chain logistics through innovative and sustainable technologies	21
Government initiatives and schemes on cold chain sector	32
Gaps, challenges and recommendations	34
Vision@2047	36

Foreword by FICCI



Rizwan Soomar
Chairman, FICCI Committee on Logistics &
CEO & Managing Director- North Africa & India Subcontinent
DP World

I am delighted to share this comprehensive report on **"Cold chain dynamics: Mapping India's logistics transformation"** released at the **Cold Chain and Logistics Summit,** organised by the Federation of Indian Chambers of Commerce and Industry (FICCI). The report articulates India's strategic roadmap towards establishing a seamlessly integrated cold chain logistics infrastructure, underpinned by cutting-edge technology and sustainable energy solutions. It highlights India's vision for modernising its logistics framework to ensure the efficient preservation and transportation of temperature-sensitive goods.

In recent years, India's logistics sector, particularly its cold chain infrastructure, has experienced significant expansion and evolution. This growth has been driven not only by technological advancements and strategic policy reforms but also by an increasing demand for high-quality perishable goods, both domestically and internationally. Additionally, the rising awareness of food safety standards and the need to reduce post-harvest losses have contributed significantly to the development of this sector. As we advance into an era characterised by heightened innovation, resilience and increasing focus on sustainability, the future of cold chain logistics emerges as a pivotal area of interest.

The report underscores the imperative of advancing India's cold chain network through integrated and sustainable infrastructure development. It emphasises the need for a comprehensive framework prioritising regulatory compliance, industry standards, and initiatives such as Multi Modal Logistics Parks (MMLPs) and cold chain solutions, while also emphasising connectivity enhancement. The inclusion of global interventions through case studies adds valuable perspective. The challenges faced by the industry are universal, and success stories from Norway and the US offer valuable lessons, allowing us to glean insights from global best practices.

The report further explores how technological advancements, particularly those driven by the private sector, are revolutionising cold chain logistics. It delves into trends in refrigeration technology, emphasising sustainability goals and efficiency gains. Additionally, it discusses the integration of cold chain perishable exports into MMLPs, highlighting their role in facilitating seamless international trade.

I hope you will find this report useful. We welcome your suggestions and feedback.

Warm regards

Foreword by Grant Thornton Bharat



Kunal Sood

Partner and National Transformation Consulting Leader
Grant Thornton Bharat



Chirag Jain

Partner Public Sector Consulting
Grant Thornton Bharat

Amid unprecedented shifts in global economies, industries, and environmental dynamics, the spotlight on sustainable cold chain logistics has never been more critical. It is with profound significance and enthusiasm that we present this comprehensive report, dedicated to forging a dependable and resilient cold chain logistics ecosystem in India's dynamic market landscape.

The report encapsulates multifaceted developments within the world of cold chain logistics, offering a macroscopic analysis of the current landscape while projecting future trends. In an era where the seamless preservation and transportation of temperature-sensitive goods drive economic growth, understanding the key drivers for cold chain operations is indispensable. Equally crucial is acknowledging the challenges and opportunities inherent in this vibrant sector.

Additionally, the report underscores the pivotal role of the government of India in shaping policies aimed at fostering a resilient cold chain logistics ecosystem. Initiatives such as the National Cold Chain Grid and supportive regulations exemplify the government's commitment to driving growth in this sector. Moreover, the report outlines various support measures extended to cold chain logistics, including incentives for infrastructure development and technology adoption.

A central facet of the report is the exploration of sustainable practices within the cold chain logistics industry, aligning with contemporary environmental imperatives. From the adoption of energy-efficient refrigeration systems to sustainable packaging and green transportation methods, a transformative shift towards environmentally responsible operations is observed. Energy efficiency, sustainable packaging, and location proximity emerge as pivotal factors driving this change and fostering a sustainable approach to cold chain management.

Undoubtedly, the success of the cold chain logistics industry relies on a skilled workforce. In this context, the report delves into skill development initiatives tailored for cold chain operations in India, emphasising the significance of investing in human capital.

Private sector participation assumes an instrumental role in driving innovation and growth within the cold chain logistics sector. The report comprehensively addresses the role of private investments, discussing both opportunities and challenges inherent in this domain.

Moreover, technological advancements are revolutionising every facet of cold chain logistics. The report explores the realm of automated cold storage facilities, robotics, temperature monitoring systems, and artificial intelligence, envisioning a future of more efficient, reliable, and sustainable cold chain operations.

We trust that this report will serve as an illuminating guide for policymakers, industry stakeholders, investors, and all those vested in nurturing a dependable, resilient, and sustainable cold chain logistics ecosystem. Together, let us seize the opportunities and navigate the challenges to create a better future for this vital industry and contribute to a more sustainable world.

1. Executive summary

To become the third-largest economy by 2027, India must bolster production capacity and efficiency while satisfying growing global and domestic demand. Initiatives such as Make in India, Cold Chain and PLI schemes are expected to boost industrial output, placing additional strain on the logistics sector. This sector, which already contributes significantly to GDP, faces unique challenges in cold chain logistics. Despite rapid growth, cold chain logistics struggle with issues such as inadequate infrastructure, lack of technology adoption, and regulatory hurdles.

These challenges lead to high logistics costs and inefficiencies, hindering the growth potential of industries reliant on temperature-sensitive goods such as pharmaceuticals, agriculture, and food. To address these challenges, the government has implemented initiatives such as the National Cold Chain Grid, aimed at modernising and expanding cold storage and transportation infrastructure across the country.

Additionally, regulatory reforms and incentives encourage private sector participation and investment in cold chain logistics. Investments in technology, including IoT sensors and blockchain, are enhancing transparency and traceability in cold chain operations, ensuring the integrity and safety of perishable goods throughout the supply chain. Furthermore, there is a growing awareness of the importance of sustainable practices in cold chain logistics, driven by concerns about food waste and environmental impact. Initiatives promoting energy-efficient refrigeration systems and renewable energy sources are gaining traction, aligning with India's broader sustainability goals. Despite these challenges, the cold chain logistics sector presents significant opportunities for growth and innovation.

By addressing infrastructure gaps, improving technology adoption, and fostering collaboration between the public and private sectors, India can unlock the full potential of cold chain logistics and strengthen its position as a global economic powerhouse.





2. Cold chain industry – An overview

Market outlook: Cold chain and logistics

India's food processing industry has grown robustly, averaging 8.3% annually over the past five years . The cold chain industry has played a vital role in this growth. The role of cold storage in the food industry in India is multifaceted and critical for ensuring food security. Despite its vital role in these sectors, India's cold chain industry, which is essential for maintaining product quality and reducing waste, faces infrastructural hurdles, high costs, technological gaps, and supply chain disruptions. These issues lead to high transaction costs and significant wastage, affecting food and health security.

The Indian cold chain market is segmented into cold chain storage and cold chain logistics, with the logistics segment accounting for 55.36% of the total market share in 2022. The Indian cold chain market has grown significantly in the last few years, driven by increased demand for temperature-sensitive products across various sectors. It was valued at USD 18 billion in 2022 and is projected to reach INR 45 billion by 2030, growing at a CAGR of ~12-14% between 2022 and 2030.

The Indian cold chain logistics market is rapidly growing, supported by government initiatives, technological advancements, and a shift in consumer behaviour. Despite facing challenges, the market presents substantial opportunities for investment and development, catering to a wide range of sectors, significantly reducing post-harvest losses, and ensuring the safety and integrity of temperature-sensitive goods.

This knowledge paper outlines current market trends, challenges, and opportunities, providing insights for stakeholders seeking a roadmap for building a robust cold chain industry in India.



2.1 Importance of cold chain logistics

Cold chain logistics is critical in India's economy, particularly in the agriculture, food processing, and pharmaceutical sectors. It ensures that temperature-sensitive products, such as fresh produce, dairy, meat, and vaccines, maintain their quality and safety from production to consumption. Here's why cold chain logistics is crucial in India:

Preservation of product integrity	– **Food safety** Cold chain logistics ensure that perishable items such as fruits, vegetables, dairy products, and meats are kept at controlled temperatures to prevent spoilage and maintain freshness from farm to table. – **Pharmaceutical efficacy** Many pharmaceuticals, including vaccines and biologics, require strict temperature control to maintain their effectiveness. Cold chain logistics preserve the integrity of these medicines throughout their journey.
Compliance with regulations	Cold chain logistics help businesses comply with the regulations set by governments and international bodies regarding the transportation and storage of temperature-sensitive products, thereby avoiding legal issues and fines.
Reduction of waste	By effectively maintaining product temperatures, cold chain logistics significantly reduce the risk of spoilage. This reduction in waste is beneficial from an economic standpoint and crucial for sustainability efforts.
Consumer safety	Ensuring that food and pharmaceuticals remain within their required temperature ranges throughout the supply chain minimises the risk of foodborne illnesses and ensures medications are effective when they reach consumers.
Market expansion	Cold chain logistics enable companies to expand their markets by shipping temperature-sensitive products over long distances, including internationally, without compromising product quality.
Economic impact	The cold chain logistics industry contributes significantly to the global economy. It supports the agriculture, food, and pharmaceutical sectors and creates numerous jobs in logistics, warehousing, and transportation.
Consumer confidence	High standards of cold chain logistics foster trust in food safety and pharmaceutical efficacy, enhancing consumer confidence in the products they purchase and consume.
Facilitating exports	India's merchandise exports reached an all-time high of USD 447 billion in Financial Year 2023. A significant portion of these exports includes perishable goods, pharmaceuticals, and processed foods, which require reliable cold-chain logistics to maintain quality during transportation.
Environmental impact	Effective cold chain logistics can contribute to environmental sustainability by reducing food waste and the carbon footprint associated with spoiled goods.

2.2 Cold chain industry - Global scenario

Cold chain logistics are crucial for preserving the integrity and quality of perishable goods, from food products to pharmaceuticals. The global cold chain market is experiencing significant growth, driven by various factors, including technological innovations, changing consumer behaviours, and increased demand for fresh, frozen, and pharmaceutical products as summarised below:

Technological innovations

- Innovations in cold chain technology include warehouse automation, bespoke packaging solutions, and data-informed software platforms for enhanced visibility and compliance.
- The use of sensors and Internet of Things (IoT) devices for monitoring the temperature of products throughout their transport and storage lifecycle is becoming increasingly important for maintaining cold chain custody.

Case study: Norway seafood industry

The cold storage interventions in the Norwegian seafood industry play a pivotal role in preserving the nutritional quality of seafood, extending shelf life, and meeting consumer demands for sustainable and minimally processed food products. The seafood industry in Norway currently utilises various cold storage interventions to ensure the preservation and quality of seafood products. These interventions are crucial for maintaining the cold chain and extending the shelf life of seafood products.

Situation before intervention

Before adopting advanced cold chain technologies, Norway's seafood industry faced challenges in maintaining seafood quality during long-distance transportation. The industry experienced up to 30% losses due to spoilage and deterioration during transit.

Interventions

Some of the critical cold storage interventions employed in the Norwegian seafood industry were:

- **Low-temperature technologies**

The industry employs low-temperature technologies to maintain the cold chain, ensuring the quality and safety of seafood products. The traditional methods for evaluating these technologies have limitations, leading to the prominence of non-destructive evaluation (NDE) technologies for real-time tracking.

- **Packaging interventions**

The industry uses various packaging interventions to protect seafood's quality, safety, and nutritional value during storage and transportation. These interventions include barrier packaging, vacuum packaging, modified atmosphere packaging (MAP), and smart packaging, which can significantly improve the shelf life of seafood products.

- **Super chilling and deep freezing**

Rapid chilling and super chilling are employed to extend the shelf life of fresh seafood, while deep freezing is widely used for long-term preservation with minimal organoleptic and nutritional degradation.

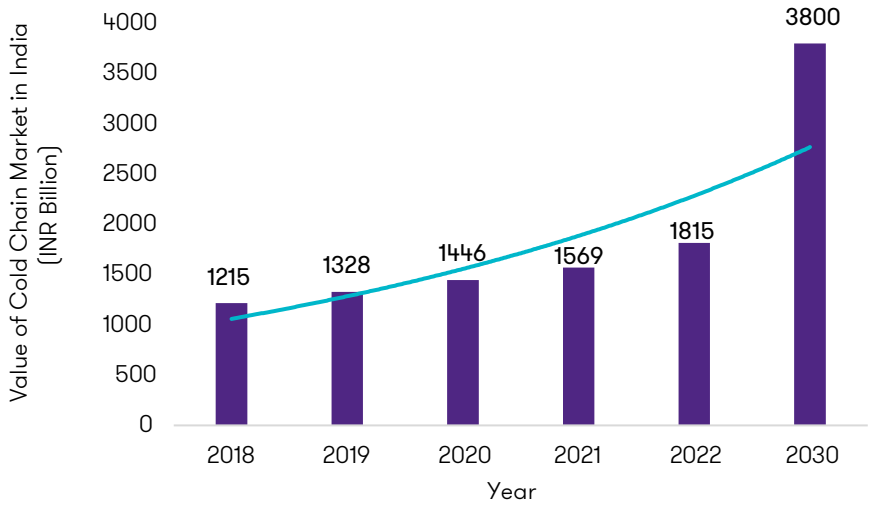
Impact

Adopting advanced cold chain technologies led to a decline in post-harvest losses to around 5-10%. Norway's seafood exports, especially salmon and cod, reached around 2.7 million metric tonnes in 2020, generating about USD 11 billion export revenue.

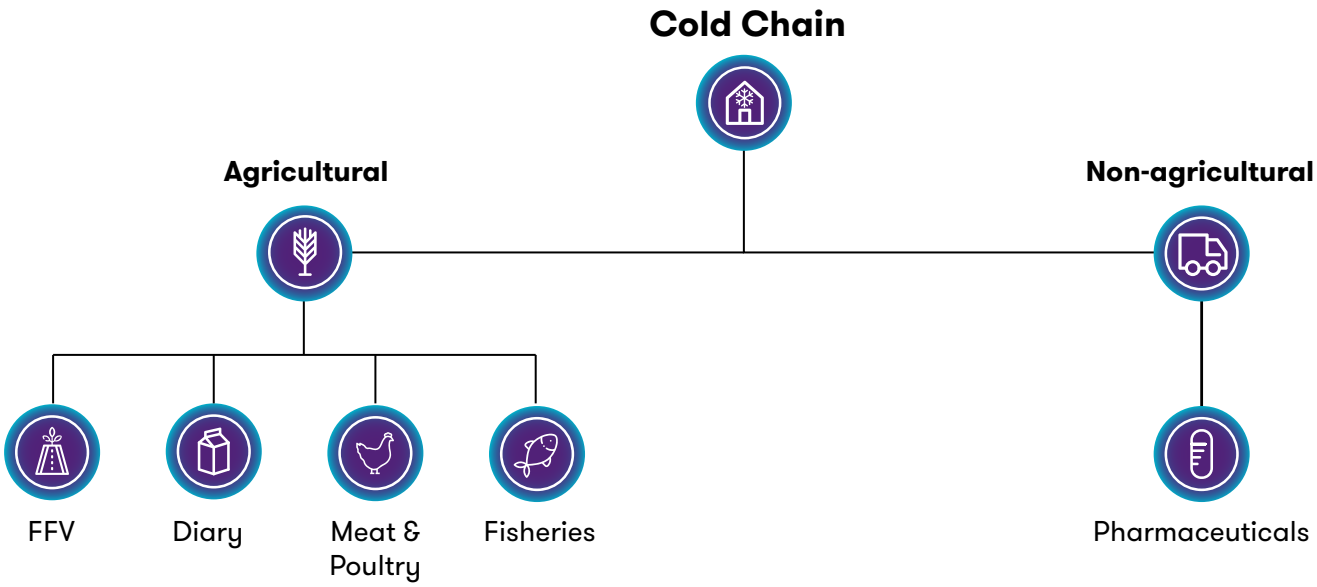
2.3 India's cold chain sector: Present state of affairs

The cold chain sector is a crucial part of India's economy. Over the past five years, the industry's market size has grown significantly, rising from about USD 12 billion in 2018 to roughly USD 18 billion by 2022. The cold chain sector is set for continued expansion with a robust compound annual growth rate (CAGR) of 12-14%. By the end of this decade, the sector's market value is expected to reach approximately USD 45 billion, highlighting its considerable growth potential within India.

Value of cold chain markets in India (INR billion)



The cold chain sector underpins two key areas in India: agricultural and non-agricultural industries.



In the agricultural domain, the cold chain industry supports preserving and distributing perishable products such as fresh fruits and vegetables, dairy items, meat, poultry, and fisheries. It plays a vital role in the non-agricultural sector by maintaining a range of products, including essential pharmaceuticals. This aspect highlights the sector's adaptability in ensuring the quality and integrity of various items, meeting the distinct needs of both agricultural and non-agricultural markets.

Cold chain infrastructure in India

India's cold chain infrastructure is essential for effectively preserving and transporting perishable goods across various sectors. It encompasses multiple components, including cold storage units, refrigerated vehicles, ripening chambers, and sophisticated monitoring systems, all of which contribute to reducing post-harvest losses, extending shelf life, and maintaining the safety and quality of perishable goods.

Despite significant progress, the cold chain infrastructure in India presents both opportunities and challenges. While storage capacity has grown substantially, focusing mainly on single-product cold storage, better integration is still needed across the entire cold chain ecosystem. Additionally, the industry faces issues such as energy efficiency, accessibility, and the inability to serve remote and underserved regions effectively. Addressing these issues requires technological innovations, policy support, and strategic initiatives to strengthen and expand this critical infrastructure. This will help India maximise its potential to ensure food security, minimise waste, and promote public health through more efficient pharmaceutical distribution.

India currently has 1,120 certified cold chain projects that are either operational or completed, supported by various programmes from the Ministry of Food Processing Industries (MoFPI) and the National Horticulture Board (NHB). However, the Indian cold chain sector predominantly focuses on cold storage facilities, which comprise around 40% of the entire cold chain infrastructure. These facilities often concentrate on specific commodities, primarily single products such as potatoes and onions . Significant gaps remain in the cold chain infrastructure despite progress, with deficiencies reaching a staggering 99%, as further detailed in the later sections.

Cold chain stakeholders

Government agencies	This includes government departments such as the Ministry of Food Processing Industries (MoFPI), Ministry of Agriculture and Farmers Welfare, and Food Safety and Standards Authority of India (FSSAI), which are responsible for policy formulation, implementation, regulation and enforcement of food safety standards related to cold chain infrastructure and development.
Private sector entities	These entities could be the storage and logistics providers, processing and packaging, retail, and marketing of temperature-sensitive products throughout the supply chain.
Industry associations and organisations	Organisations such as the National Centre for Cold-chain Development (NCCD) & Confederation of Indian Industry (CII) that aim to facilitate industry-government partnerships and promote best practices in the cold-chain sector.
Financial institutions and investors	This includes banks, private investors and venture capital firms, which provide funding and investment opportunities for the development of cold chain infrastructure and technologies.
Technology providers	This Includes cold chain monitoring, IoT companies, and refrigeration equipment manufacturers, which offer solutions for real-time monitoring of temperature, humidity, and other environmental variables in the cold chain.
Agricultural producers and farmers	These are the producers of perishable goods, including fruits, vegetables, dairy products, and seafood, and rely on the cold chain to maintain the quality and extend the shelf life of their products.

Value chain losses: The need for cold storage

A 2022 study by the MoFPI highlighted a critical issue: major perishable food crops suffer from post-harvest losses that average an alarming 47%. This problem is particularly acute in the case of fresh fruits and vegetables, where losses can range from 6% to 15% depending on the specific type of produce. These figures point to a significant economic burden and a shortcoming in the post-harvest handling of perishables, with inadequacies in the cold chain infrastructure being a major contributing factor.

Simultaneously, India's leadership, which is the source of nearly 60% of global vaccine demand, contrasts with another worrying reality. In the pharmaceutical sector, wastage rates are notably high, reaching 30-40% for vaccines, 20-30% for biologics, and 10-15% for other temperature-sensitive medications. These high levels of wastage seriously threaten healthcare accessibility and availability, emphasising the need for better cold chain management and pharmaceutical supply chains.

Notwithstanding the aforementioned challenges, there are encouraging trends on the horizon. By 2030, the agricultural and related sectors and the pharmaceutical industry are expected to see significant growth. Projections indicate that the production of perishables could rise to 11,207 lakh tonnes by 2030. Similarly, the pharmaceutical industry is on track to reach an impressive USD 130 billion by the same year. These forecasts highlight the urgent need for innovative solutions, technological advancements, and strategic interventions to ensure that growth is achieved in a way that reduces waste and promotes efficiency and sustainability in both the agricultural and pharmaceutical industries.



Bharat Rathi
Head Distribution and Logistics
Mankind Pharama Ltd.

"There is no doubt that we have come a long way in temperature-controlled logistics {In terms of Infra / Processes / trained manpower}, i.e., catching up with International standards, but there is still a long way to go, as development happened in patches.

Once the shipment is handed over to LSP, there are tracking mechanisms only for the road, but once the shipment is handed over to airport authorities, there is a complete blackout period. But that will be just information {damage has been done}. Not only that, giving a viable solution for small shipments is also a challenge, as we are passing inefficiencies to the customer for not adding any value. Also, warehousing infrastructure has been improved by private players that have standards comparable to features of all developed countries.

We need to have experienced trained manpower, and technology intervention {for logging details of data, for online tracking} will make the cold chain robust."



3. Integrated cold chain logistics and infrastructure development

Regulatory compliance and industry standards

Integrated cold chain logistics into infrastructure development involves incorporating facilities and transportation systems to maintain the temperature-controlled environment necessary to preserve perishable goods throughout the supply chain. The India Cooling Action Plan (ICAP) forecasts substantial growth across various components of the cold-chain infrastructure by 2038.

Envisioning cold-chain expansion: Infrastructure growth prospects (2017-18 to 2037-38)

The Ministry of Environment, Forest and Climate Change, government of India, through the Ozone Cell, has estimated the cold chain infrastructure target for 2037-38 under the vision document of ICAP.

Cold chain infrastructure	2017-18	Target (2037-38)
Pack houses (Nos)	500	100000
Cold storage (Volume)	35Mn MT	45 Mn MT
Ripening chamber (Nos)	1000	12000
Reefer vehicle (Nos)	13000	300000

To achieve this efficiently, expanding the number of **multi-modal logistics parks (MMLPs)** is crucial for efficiently integrating multiple modes of transportation. With strategically located MMLPs across regions, the seamless connection between various transportation modes can be enhanced, improving freight movement efficiency.

3.1 Multi-modal logistics parks (MMLP) and cold chain solutions and enhancing connectivity

Background

An MMLP is a freight-handling facility spanning at **least 100 acres**, equipped with access to multiple transportation modes, mechanised warehouses, specialised storage such as cold storage, and facilities for material processing and intermodal transfer. It also includes container terminals for intermodal transfer and bulk and break-bulk cargo terminals.

With an investment of INR 2 lakh crore sanctioned in 2017, these parks were expected to handle **50% of road freight** activity and reduce overall **logistics costs by 25%**. The government aims to bid out **6-7 MMLPs** in FY24, each requiring private investments ranging from **INR 700 to 1,000 crore**, as part of its strategic plan to enhance logistics infrastructure.

S. No.	Location	Prop. capacity (Area in acres)	Investment INR Cr.
1	Chennai	184.27	1423.5
2	Indore	255.17	1111
3	Bengaluru	400	1770
4	Nagpur	230.97	920

Importance of MMLP

- Integrated Infrastructure
- Efficiency and Cost Reduction
- Improved Connectivity
- Reduction of Environmental Impact

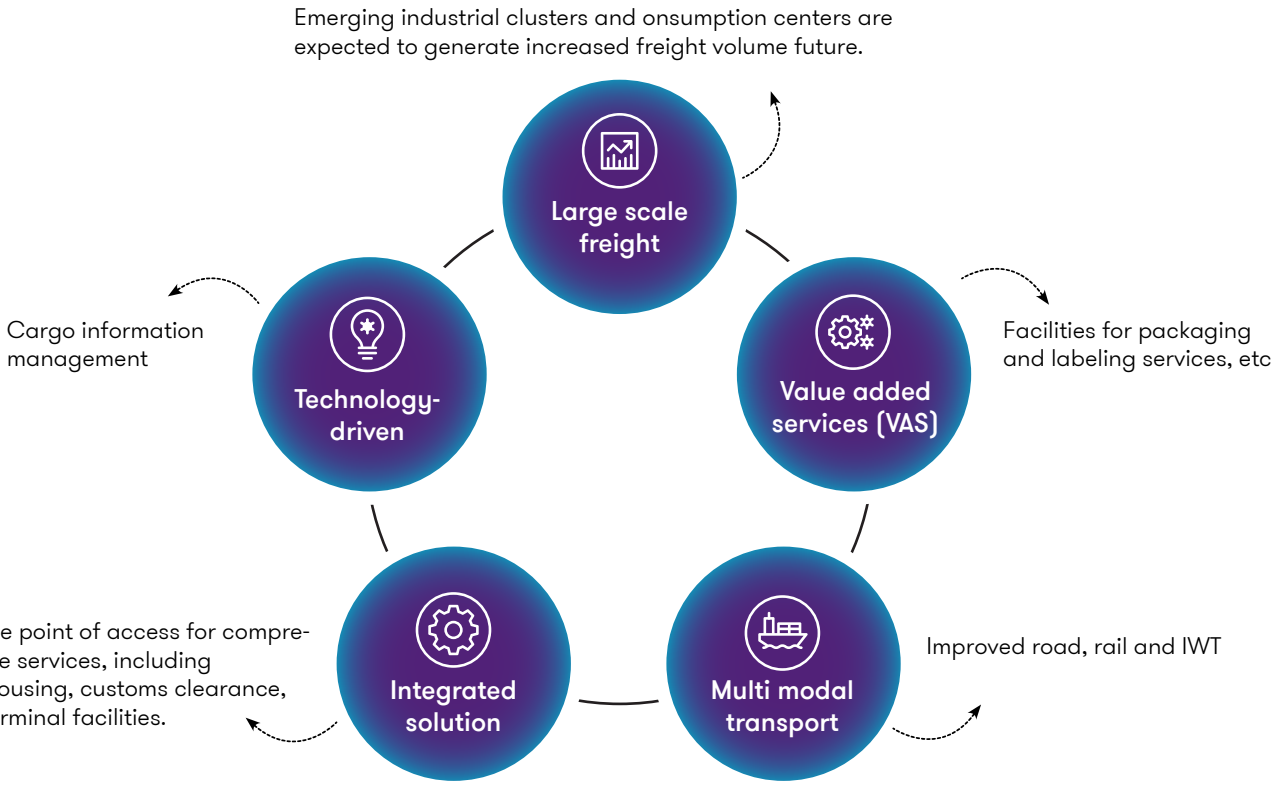
MMLPs are pivotal in promoting economic growth, trade facilitation, and environmental sustainability.

Primary factors attributed to higher logistics expenses in India

- Unfavourable intermodal
- Inefficient fleet mix
- Underdeveloped material handling infrastructure
- Underdeveloped road infrastructure
- Procedural complexities

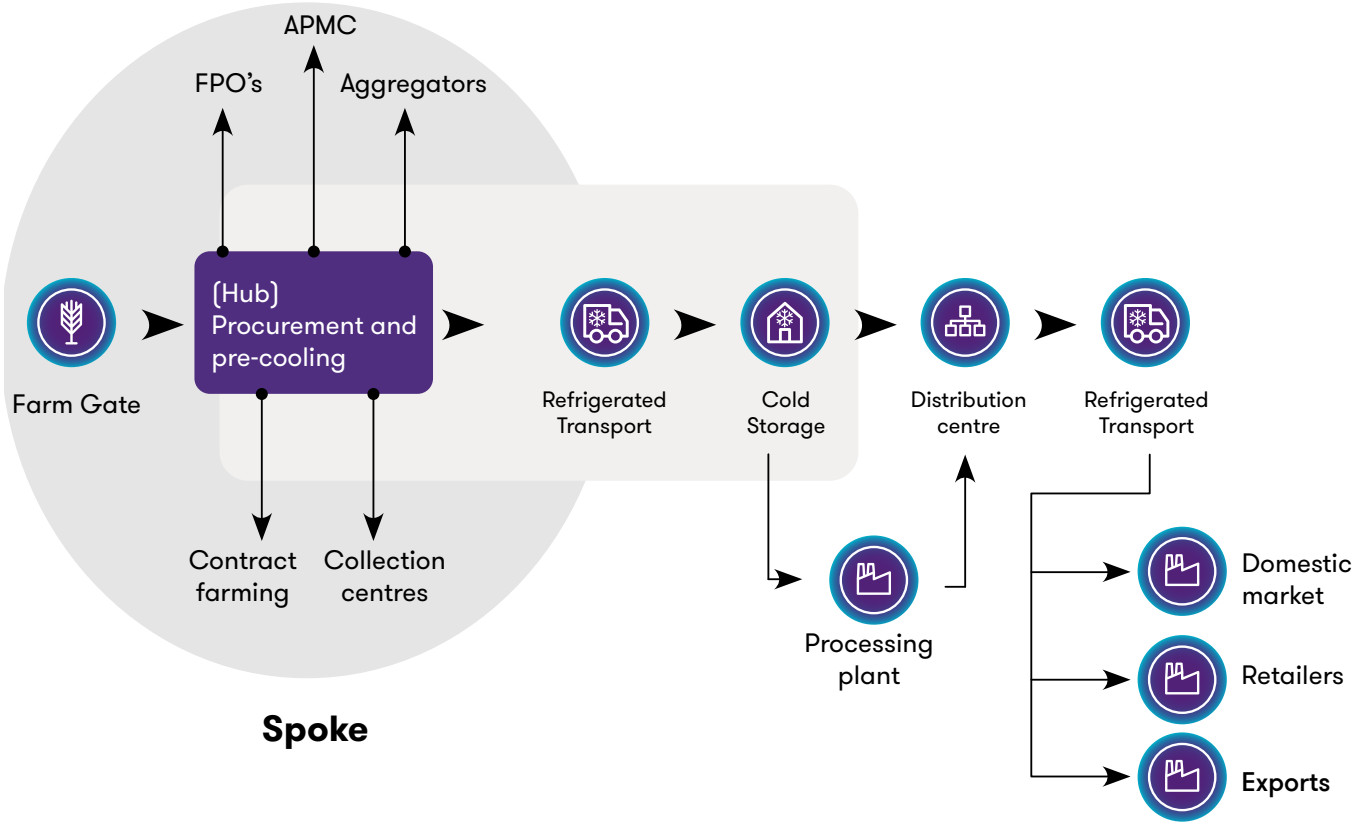
All the factors mentioned above can be addressed through crucial policy initiatives outlined in the national logistics policy by setting up **35 multi-modal logistics** parks across the country. MMLPs are targeted to reduce logistics costs to less than **10%** of the gross domestic product (GDP) and are planned on the country's highest freight movement regions.

Framework of an effective MMLP



Effective implementation of multi-modal logistics parks can reduce logistics costs and carbon footprint by optimising transportation modes and infrastructure, streamlining operations, and promoting sustainable logistics practices, which will then be undertaken through public-private partnerships (PPP).

Flow chart of Integration of cold chain Infrastructure with MMLP

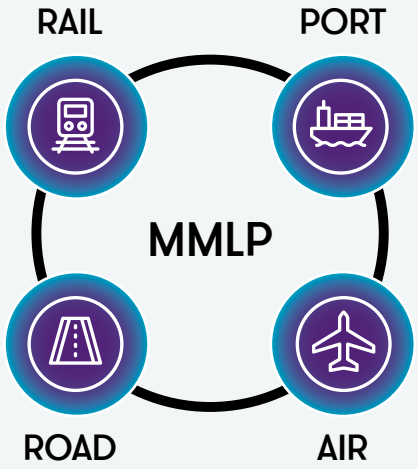




Soji Abraham Poovelil
CEO - International Business and Special Projects,
Rinac India Ltd

"The cold chain logistics sector is crucial for transporting perishable goods and medicines, especially in countries with tropical climates like ours. The India cold chain logistics market size is estimated at USD 11.64 billion (INR 1,164 crores) in 2024 and is expected to reach USD 18.19 billion (INR 1,819 crores) by 2029, growing at a CAGR of 9.72% during the forecast period (2024-2029) as per a report by Mordor Intelligence. Significant advancements are expected in 2025, driven by the rising global demand for pharmaceuticals, biologics, and perishable foods. The industry is anticipated to experience robust growth due to technological innovations and stricter regulatory standards. Key trends in the upcoming year include the widespread adoption of Internet of Things (IoT) devices and blockchain technology, which will provide improved transparency and traceability, reduce the risk of counterfeit goods, and ensure regulatory compliance. Sustainability will also be a major focus, with companies investing in eco-friendly refrigeration systems and electric vehicles to reduce their carbon footprint. Enhanced packaging solutions that offer better insulation and biodegradability will become more prevalent. Overall, 2025-2029 is set to be a transformative period for cold chain logistics, marked by technological innovation, heightened sustainability efforts, and an increased emphasis on regulatory compliance and product integrity."

Integrating multiple modes of transportation with MMLP



This involves establishing seamless connectivity between road, rail, air, and waterway networks to facilitate efficient movement of goods.

Benefits of multi-modal logistic park

Optimising transportation expenses: There is a 10% reduction in transportation cost for top 15 nodes.

Reduction in carbon footprint: A 12% reduction in CO2 emissions for top 15 nodes and rail freight movement has 65% loss of Co2 emissions compared to road.

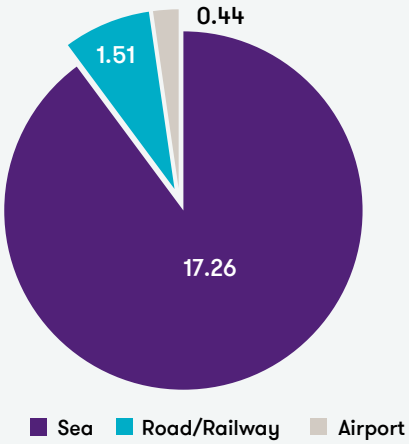
Reduction in congestion: Increase in large size trucks and rail will result in a 20% reduction in freight vehicles.

Warehouse cost reduction: Relocating warehouse operates in city limits to outside city boundaries, which will reduce the warehouse coast.

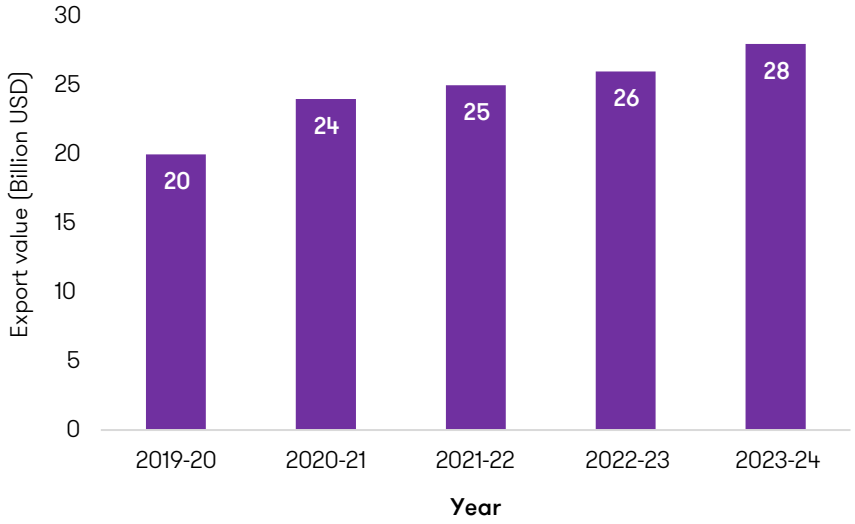
3.2 Integrating export of cold chain perishable products into MMLP (Infrastructure)

MMLP streamline logistics operations to ensure the efficient handling and transportation of temperature-sensitive goods.

Perishable exports in 2023 Value in USD billion



To boost perishable commodity exports from land-locked states, multi-modal logistic parks play a crucial role by serving as vital connectors, facilitating logistics from these states to the nearest seaports, thereby enhancing export volumes, particularly for regions with abundant perishable commodities.



India's rapidly expanding pharmaceutical sector, which serves over 200+ countries and generates significant export revenue, is bolstered by post-pandemic investments in cold chain infrastructure and sustainable, data-driven supply chain improvements, contributing to the forecasted market growth of USD 11.96 billion at an estimated growth of CAGR 2.46% from 2023 to 2028, driven by rising global pharmaceutical sales expected to reach USD 1.4 trillion by 2024.

Integrating the export of cold chain perishable products into MMLPs provides a comprehensive solution by leveraging the park's diverse transportation modes and specialised facilities, ensuring efficient handling, storage, and transportation of perishable goods from production centers to seaports, thereby enhancing the competitiveness and reliability of perishable exports. Now let us understand with an example of integrating the export of cold chain perishable products tailored to meat products.

3.3 Model for integrating cold chain logistics into a MMLP for export of perishable products: Tailored for meat exports

Integrating cold chain logistics into an MMLP requires careful planning and coordination to preserve temperature-sensitive goods throughout their journey. Here's a model outlining key components and considerations for integrating cold chain logistics into an MMLP:



- State-of-the-art refrigeration, temperature monitoring devices, adequate air circulation, and innovative and sustainable packaging solutions.
- Dedicated cold chain logistics corridors to prioritise perishable meat products.
- Electronic documentation systems and pre-clearance procedures to streamline customs formalities and documentation submission.
- Relevant certifications such as HACCP and ISO 22000 to demonstrate compliance with international food safety standards.
- Foster collaboration with key stakeholders to streamline operations and ensure compliance with quality and food safety standards.
- Provide specialised training programmes and capacity-building initiatives for MMLP staff for handling meat products.

3.4 Role of private sector

The private sector is pivotal in cold chain infrastructure by investing in, developing, and operating facilities such as cold storage warehouses, refrigerated transportation, and temperature-controlled processing centers. Additionally, private sector participation encourages investment in advanced technologies and value-added services, enhancing the overall effectiveness and attractiveness of MMLPs for domestic and international stakeholders.

A PPP's stakeholders for MMLPs include government entities, private investors, logistics firms, regulatory bodies, etc., who are collectively engaged in developing and managing integrated logistics infrastructure.

The public-private partnership (PPP) model in developing and maintaining integrated cold chain infrastructure has certain benefits:

Capital investment: Creating and managing cold chain facilities requires a large initial investment.

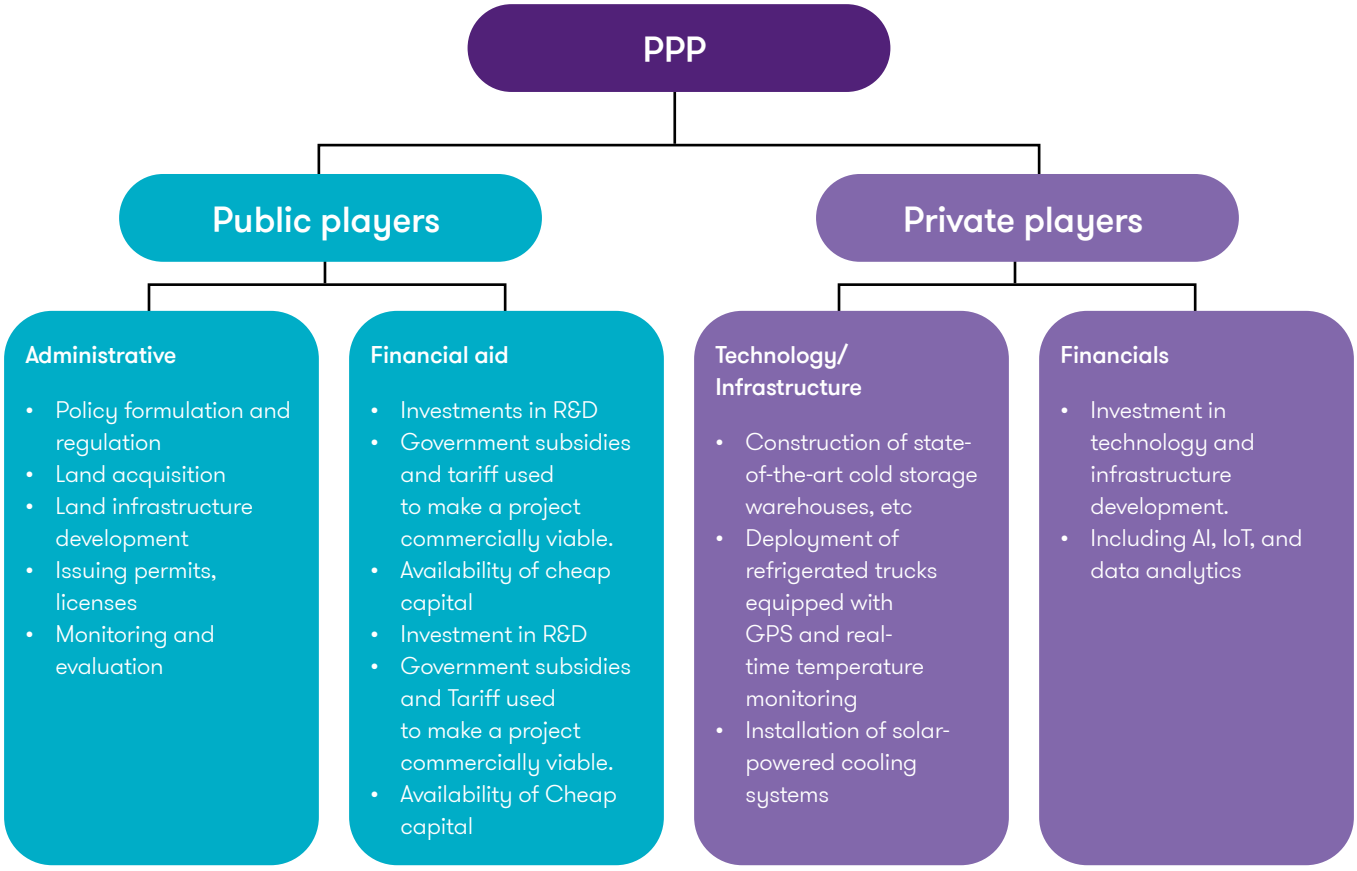
Efficiency and innovation: Private sector involvement brings efficiency and innovation to cold chain projects.

Risk sharing: PPPs distribute risks between public and private partners.

Long-term maintenance: PPPs often involve long-term contracts ensuring ongoing maintenance of cold chain infrastructure.

Flexibility: PPP models can adapt to specific needs and contexts, incorporating market changes, and technological advancements

Public and private institutional role in project implementation





4. Revolutionising cold chain logistics through innovative and sustainable technologies

In India's cold storage sector, technological advancements have become the focal point, revolutionising the preservation and distribution of perishable goods with a sustainable approach. The fusion of innovation and necessity has spurred the adoption of state-of-the-art technologies in these storage facilities, fundamentally reshaping the industry landscape. From intelligent monitoring systems to energy-saving solutions, incorporating these technologies is boosting operational efficiency and tackling long-standing challenges that have plagued the sector.

4.1 The road to net-zero - Shaping the future cold chain

As a participant in the Paris Convention and the Kigali Amendment, India must align its developmental objectives with its commitment to reducing greenhouse gas (GHG) emissions as outlined in its Nationally Determined Contribution (NDC). India has committed to **reducing the emissions intensity of its economy by 45% by 2030 relative to the 2005 level as per the updated NDC.**

India's historical contribution to the accumulation of GHGs is about 4%. India has implemented several measures and interventions to minimise the environmental impact within the cold value chain.

Benefits of multi-modal logistic park

The government of India has set ambitious targets to achieve the net zero emission target by 2070 .

Increasing the non-fossil fuel energy capacity of 500 GW by 2030.

Meeting a minimum of 50% of its energy requirements through renewable sources by 2030.

Decreasing CO2 emissions by 1 billion tonnes by 2030.

Strategies for Road to Net Zero

Energy efficiency

- A roof with adequate insulation. (polyurethane foam (PUF), mineral wool, rock wool). The energy saving potential is 1-2%.
- Low energy evaporative cooling system energy saving potential of 40-50%.
- Real-time monitoring of the refrigerated plant. System efficiency improvement by 8 to 10%.

Advanced emission-reducing technologies

- Transition to refrigerants with low global warming potential (GWP) and ozone depletion potential (ODP)
- E.g. transition from high-GWP hydrochlorofluorocarbon (HCFC) to low-(GWP) hydrofluoroolefin (HFO) refrigerants. GWP of HFCF is 3,770 times of Co2, while HFO is 6.
- Emission-free refrigeration technologies, such as cryogenic cooling or electric units, powered by renewable energy sources.

Sustainable packaging

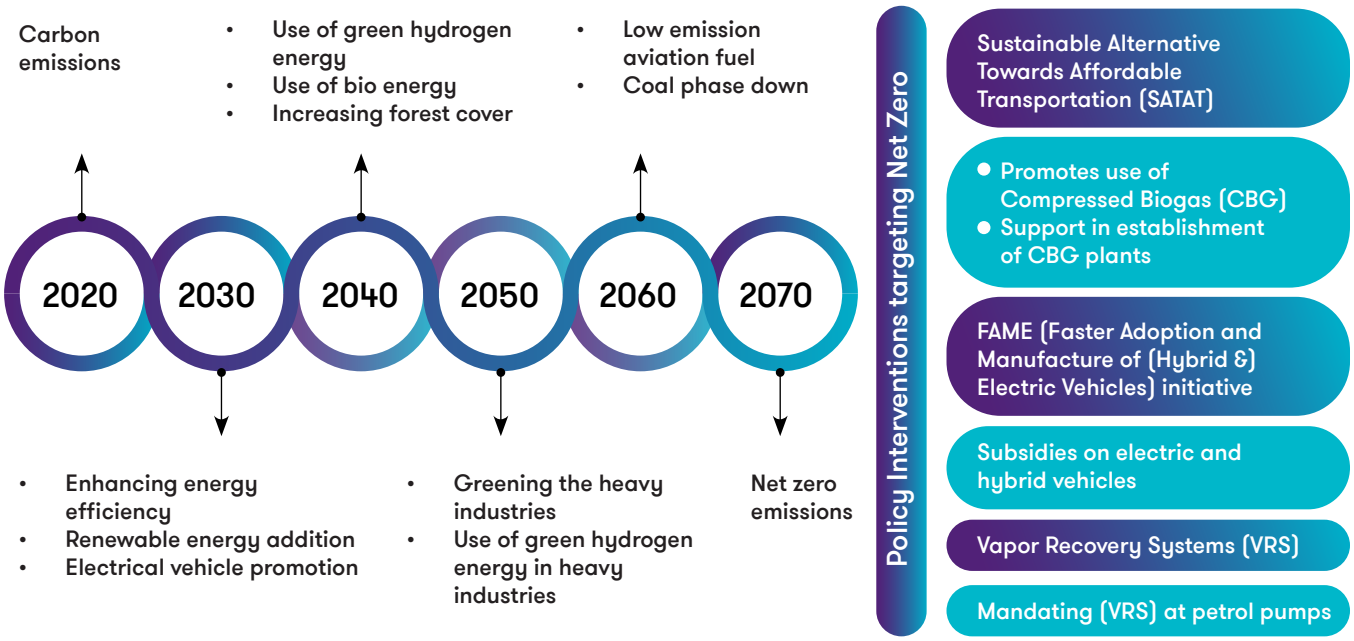
- Adopting biodegradable and compostable packaging materials bio-based plastics and natural fiber-based products.
- Establishment of a reverse logistics system within the cold chain for use of reusable packaging materials.

Green transportation and heat management

- Promoting various alternative fuels.
- Ethanol-gasoline blends (E-10, E-12, E-15, E-20), and ethanol blend for diesel vehicles (ED-95).
- Utilising low-emission vehicles, such as electric vehicles (EVs) and ethanol/methanol-fueled transport vehicles.

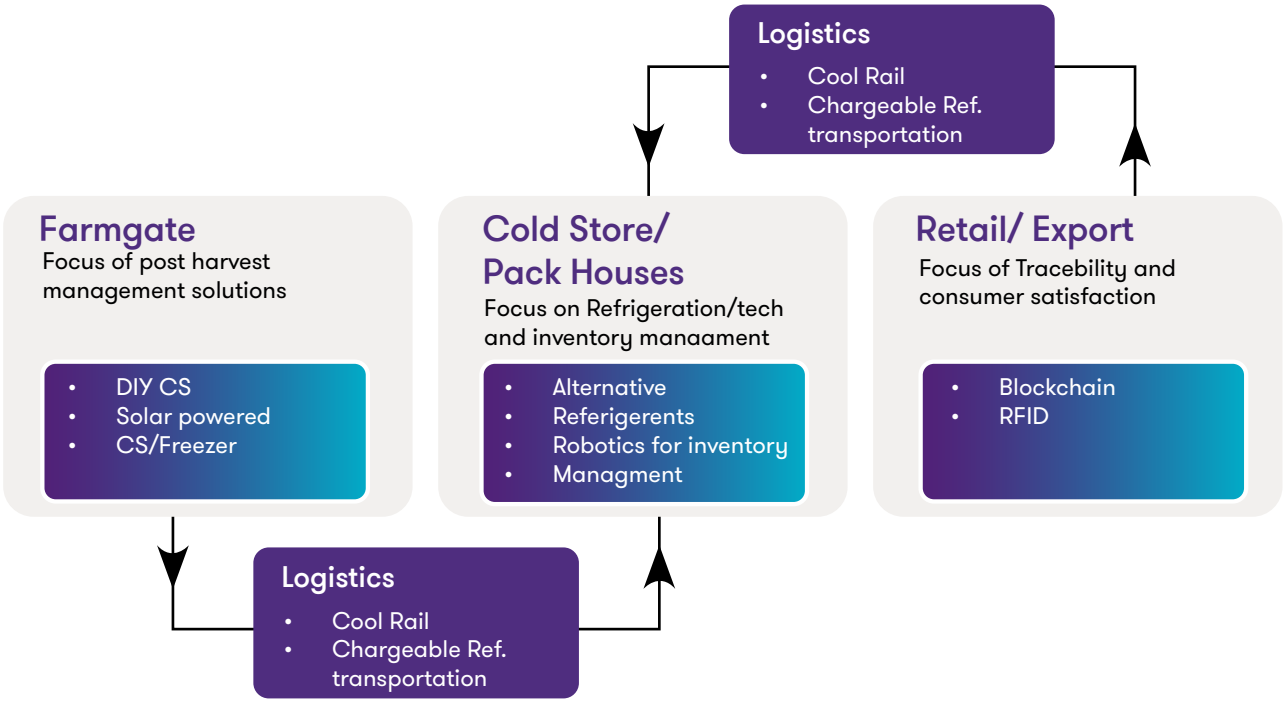
NITI AAYOG has provided the roadmap for achieving India's long-term goal to reach net-zero by 2070

India's long-term goal to reach net-zero by 2070 Green Initiatives



Integrating sustainability with innovation

As discussed in an earlier section, along with a focus on sustainability, emphasis on the adoption of novel, cost-effective, and user-friendly cold chain solutions is crucial for maintaining the end-to-end integrity of an effective cold chain. Considering the perishability of horticulture, livestock, and marine produce, the following solutions can be adopted on a broader scale for the growth of India's cold chain industry. Further, technical intervention at each level, i.e., from farmgate till the products reach their end user, is a necessary step in integrating the cold chain as follows:





1. Farmgate level: Improved post harvest management

Harvesting fruits at the right time and subjecting them to proper pre-cooling practices are critical to preserving fruit quality, maximising shelf life, and ensuring consumer satisfaction.

Effective pre-cooling helps in extending the shelf life of horticulture produce in the following ways:

- Rapidly lowering the field heat
- Physiological and biochemical changes
- Reduce moisture loss
- Ensures uniform cooling of fruits
- Freshness, flavour, and nutritional value for a longer period, improving marketability

Similarly, as seafood begins to deteriorate immediately after harvest due to microbial activity, enzymatic degradation, and chemical changes, effective pre-cooling minimises protein denaturation, lipid oxidation, and degradation of texture and flavour.

A 'farmgate solution' typically refers to technologies or systems designed to address challenges faced by farmers at the primary production level, where agricultural products are harvested or produced. These solutions are crucial for various reasons. Innovative, cost-effective technologies like DIY cold chambers and solar-based cold storage solutions can be game changers at the farmgate level as follows:

DIY cold storage solutions

A small room or chamber can be converted into a cold chamber for the transit storage of fresh produce using a room air-conditioner

- Affordable walk-in cooler with a standard air conditioning unit for farmers growing multiple crop varieties.
- It can be a great solution for at the farmgate level, production clusters, aggregation points, retail and outdoor food markets.

e.g. CoolBot

Highlights

- Relative Cost Saving: 30-70%
- Caters Multiple Commodities: Temp. range 3.3°C – 4.4°.
- Can works on Single Phase power supply



Solar powered temperature-controlled storage solutions

- Use of solar energy-based controlled storage technology can be a key cost effective and sustainable post-harvest management solution at the farm gate level.
- Further, after coupling it with IoT predictive technology, it ensures seamless operation and provides a battery-less backup for up to 30 hours.
- Containers can be directly loaded and transported from farm gate to mandis/ collection centres/ processing and exports

e.g. Ecozen

Highlights

- Relative Cost Saving upto ~20%
- Transit storage, transportation
- 30+ hrs battery less backup
- Upfront/lease/community model



2. Logistics and last-mile connectivity

Logistics and last-mile connectivity play a pivotal role in the cold chain by ensuring the seamless flow of perishable goods from production to consumption, safeguarding product quality, minimising wastage, and enhancing the overall supply chain efficiency. Adoption of cost-effective and sustainable logistics solutions is the need of the hour.

Eutectic fluids flexible solutions

- This technology uses eutectic fluid (refrigerant battery), which once frozen, can maintain constant temperature for an extended period, even without a continuous power supply.
- It offers an environmentally friendly alternative to existing reefer containers.
- Ranges from ice box, ice-battery truck, land/air/sea cargos will cater to different needs of cold chain.
- The Japan-based 'Innovation Thru Energy – IceBattery technology' is the leading tech developer. The RINAC recently came up with similar technology named ChillKart for reefer trucks.

Highlights

- 72 hours without power
- > 60% and 20% savings on OPEX and CAPEX
- Reduced CO2 emissions by about 70%



- CONCOR and ITE are unveiling Ice Battery-powered 40-feet containers and DX platforms to tackle cold chain logistics challenges, such as environmental impact, food waste, medical cold chain gaps, and rising logistics costs
- Ninjacart, Cloudtrack, and Crofarm provide cutting-edge real-time temperature monitoring software for the cold chain, ensuring product safety during transit with cloud-based tech and IoT sensors, minimising waste.



3. Processing technology

Refrigeration technology

Reducing carbon footprint in refrigeration involves upgrading to energy-efficient equipment and using low-GWP or natural refrigerants. Proper system design, maintenance, and waste heat recovery optimise energy usage. Integrating renewable energy sources and employing advanced control strategies enhance sustainability. These technical approaches help refrigeration systems significantly lower their carbon footprint, contributing to environmental goals.

Recently, there has been a move towards adopting refrigerants with lower global warming potential (GWP) and ozone depletion potential (ODP) due to environmental concerns. Some newer refrigerants gaining popularity for cold storage solutions include:

1 Alternatives to hydrofluorocarbons (HFCs): These encompass refrigerants such as R-448A, R-449A, and R-450A, which have lower GWPs compared to traditional HFCs such as R-404A and R-134a.
2 Hydrocarbons (HCs): Natural refrigerants such as propane (R-290) and isobutane (R-600a) are receiving attention for their excellent thermodynamic properties and minimal environmental impact.
3 Carbon dioxide (R-744): CO2 refrigeration systems, also known as transcritical CO2 systems, are used in some cold storage applications due to their low GWP and high energy efficiency.

Each refrigerant has its advantages and drawbacks, and the selection depends on factors such as the intended application, system design, safety considerations, and compliance with regulations. Consulting refrigeration experts and adhering to local regulations are crucial when selecting a refrigerant for cold storage solutions.

Case study on trans-critical CO2 refrigeration technology

1. Background
Supported by the Climate and Clean Air Coalition (CCAC), installation of refrigeration system utilising CO2 in a supermarket situated in Amman.

2. Challenge
Increasing greenhouse gas emissions and use of high GWP refrigerant contributing to climate change.

3. Solution
Use of green and sustainable refrigeration technology, such as trans-critical CO2 refrigeration.

Stakeholder in PPP model

4. Impact
- The annual electricity demand for the refrigeration unit is reduced by 40,000 kWh.
- Reduction in CO2 emissions of around 32 metric tonnes

5. Global presence of technology
The United States and European Union countries: Supermarkets and large-scale retailers, such as Walmart and Whole Foods, have implemented this technology.

6. Trans-critical CO2 refrigeration in India
The Interdisciplinary Centre for Energy Research (ICER) at the Indian Institute of Science (IISc) has tested the technology at a naval base in Maharashtra.

Refrigerant	HFC 404a	CO2	NH3
GWP (100 year)	3922	1	0

Packaging technologies

The Reusable Packaging Association (RPA) estimates that adopting reusable packaging material can contribute towards achieving net zero e missions goals.



4. Traceability: For enhancing product quality assurance

Food safety: Traceability allows for identifying the source of contamination or quality issues that may arise during transporting and storing perishable goods.

This enables stakeholders to monitor and track the handling and transportation conditions throughout the cold chain.

- **Recall management:** Allows for the swift and accurate identification of affected products.
- **Market differentiation:** With transparency and visibility into the origin and journey of their products, companies can build trust with consumers.

Ninjacart, FreshToHome, ColdEX and TATA Consultancy Services (TCS) and CropIn are major companies working with the technology in food cold chain logistics

Case study: Adoption of blockchain for development of IBM Food Trust Platform by Walmart

Background: Walmart faced issues tracing its commodities placed in different stores nationwide during outbreaks of diseases and flu. To ensure all the quality checks and balances for commodities served, a robust and quick responsive platform for management and transfer of data of all its stores was required.

Solution adopted: Walmart collaborated with IBM to implement a blockchain-based system to enhance food traceability and safety in its supply chain. The initiative, known as the 'IBM Food Trust platform,' leverages blockchain technology to create a transparent and immutable record of the journey of food products from farm to store shelves.

The system allows for real-time tracking of products from farm to store, ensuring transparency and accountability at every stage. Sensors and IoT devices monitor parameters such as temperature, humidity, and location, providing data that is recorded onto a blockchain ledger.





2016

2 POCs for blockchain based food tracking

- Mangoes in US
- Pork in China

2017

Post POCs success, work with IBM, Nestle and Unilever for IBM Food Trust

2018

Was able to trace 25 commodities with blockchain

Started with tracking of leafy vegetables post 2019

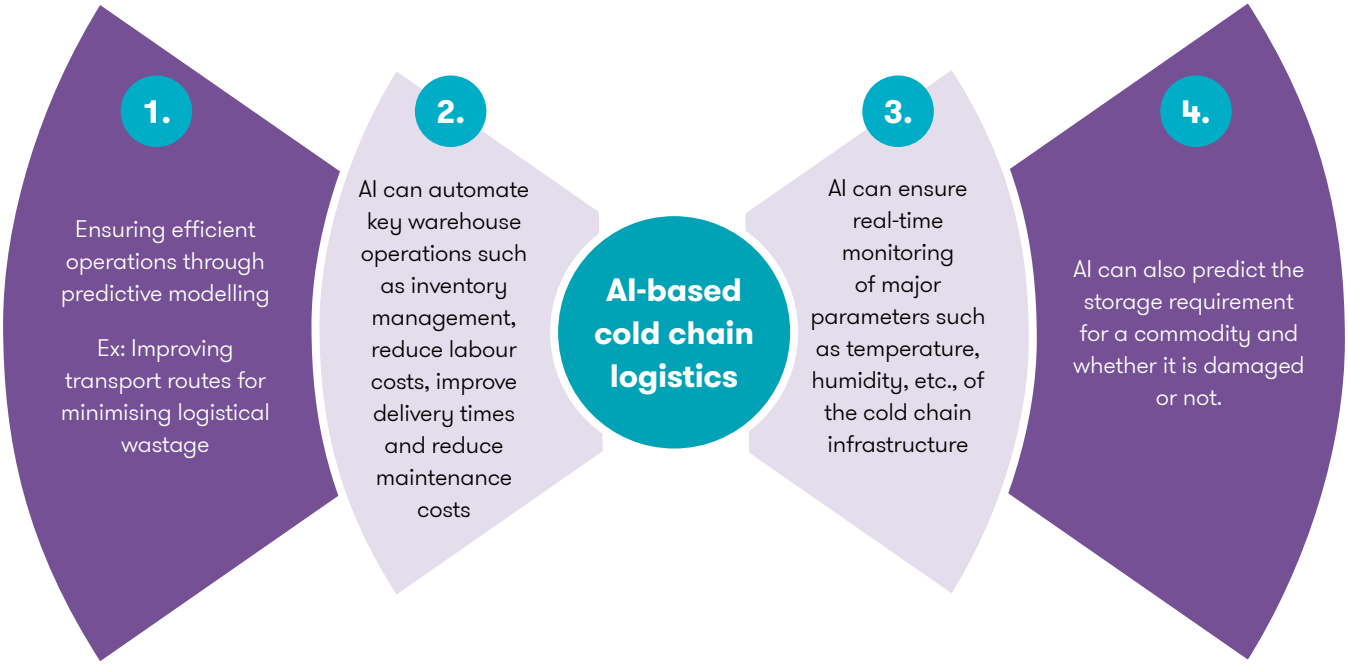
multistate outbreak of E coli-related illnesses linked to romaine lettuce

Tracebility solutions availble with Wallmart for following categories in 2024

- Fresh produce
- Dairy produce
- Meat and poultry
- Multi-ingredient products

- By 2040, at least half of all perishable food shipments will be tracked using blockchain technology, ensuring transparency throughout the supply chain and improving consumer trust and safety.
- Traceability in India is nascent, where transparency is lacking, suggesting considerable scope for incorporating blockchain on a larger level in the organised food processing sector.

5. Artificial intelligence-driven cold chain management





Chander Agarwal
Managing Director
TCI Express

"India's cold chain logistics industry is witnessing phenomenal growth, fueled by the rising demand for fresh produce, pharmaceuticals, and other temperature-sensitive products. Projected to reach USD 18.19 billion by 2029, this sector is integral to food security, reducing wastage, and ensuring timely delivery of vital goods.

The industry's expansion is driven by the adoption of technologies such as advanced refrigerated fleets, the Internet of Things (IoT), artificial intelligence (AI), and data analytics, which enhance real-time temperature monitoring, predictive analytics, and automated decision-making. These advancements improve supply chain visibility, optimise routes, and maintain product integrity.

Sustainable practices are also transforming the sector, with eco-friendly refrigerants, energy-efficient technologies, and renewable energy integration becoming standard. The use of electric and CNG vehicles, along with innovative packaging solutions, further minimises environmental impact.

Government initiatives such as PM Gati Shakti, Bharatmala Pariyojana, and Sagarmala are pivotal in driving infrastructure development and logistical efficiency. These programmes aim to streamline operations, improve connectivity, and reduce transit times, creating a more efficient cold chain ecosystem.

The future of India's cold chain logistics lies in continuous innovation, stakeholder collaboration, and a steadfast commitment to sustainability, ensuring a resilient and efficient sector capable of meeting growing demands."

Case study: Predictive analytics powered by artificial intelligence for cold chain logistics in the US

Predictive analytics powered by AI (via EROAD's core temp technology) enables QCD to deliver perishable products at optimal temperatures for freshness and maximum shelf life.



Leveraging AI technology for efficient cold chain logistics

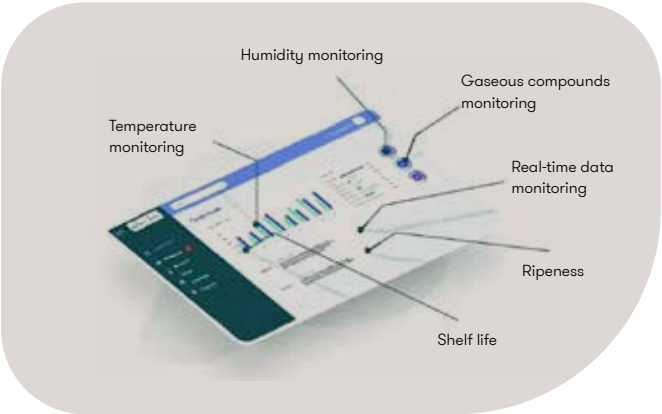
- Simulated product temperaure monitoring technology
- Predictive analytics-based fleet management
- Automation of route mapping, inventory management, etc.

Impact: AI-based technology has enabled QCD to cover 7,500 restaurants in the Unites States with more than 1.8 million deliveries per year.

QZENSE LABS: End-to-end technology solutions for food industry cold chain operations

An IoT-based platform applicable across various stages of the food supply chain, from farms to logistics, storage, and retail, introduces two distinct devices: Q-Scan and Q-log.

Q-Scan, an inspection device, utilises near-infrared spectroscopy to gauge the quality parameters of fresh produce. Meanwhile, Q-log serves as a logger, leveraging olfactory sensors to evaluate degradation rates, predict spoilage, and estimate shelf life for stored produce.





5. Government initiatives and schemes on cold chain sector

Ministry	Scheme	Support	Incentive
Ministry of Food Processing Industries	Integrated Cold Chain and Value Addition Infrastructure scheme (Cold chain)	For setting up of integrated cold chain and preservation infrastructure facilities	Maximum grant: INR 10 Cr @35% and 50% of project cost for general areas, and NE states, Himalayan states, ITDP areas and, islands, respectively
	Argo Processing Cluster (APC)	Establishment of modern infrastructure and common facilities to facilitate the setting up of food processing units	
	Creation/Expansion of Food Processing & Preservation Capacities (CEFPPC)	For setting up of new units and modernisation/ expansion of existing units	Maximum grant: INR 5 Cr @35% and 50% of project cost for the general area and NE states, Himalayan states, ITDP areas, and islands, respectively
	Pradhan Mantri Formalisation of Micro Food Processing Enterprises Scheme (PM FME)	Setting up of new/expansion of existing micro food processing units — up to INR 10 lakh. Setting up of common infrastructure/ value chain/ common incubation centre, maximum up to INR 3 Cr.	@35% of the eligible project cost
	Operation Green	Capital subsidy support for integrated value chain development of identified perishables - fruits, vegetables and shrimp	Maximum grant: INR 10 Cr. @35% in general areas @50% for projects in difficult areas, SC/ST, FPOs and SHGs
	Production-Linked Incentive Scheme for Food Processing Industry (PLISFPI)	Modernisation and enhancement of competitiveness of the food processing industry for RTC/ RTE, including millet-based foods, processed fruits and vegetables, marine products, and mozzarella cheese, innovative/organic products of SMEs, as well as branding and marketing support	
Ministry of Commerce and Industry	Agriculture and Processed Foods Export Promotion Scheme of APEDA	Pack-houses, reefer transport, and cold storages	Up to 40% of the total cost subject to a ceiling of INR 200 lakhs
Ministry of Agriculture & farmers Welfare	Capital Investment subsidy	Construction/expansion/ modernisation of cold storage and storage for horticulture produce	Grant-in-aid as per cost norms: @35% in general areas @50% for projects in difficult areas, SC/ ST, FPOs and SHGs
	Development of Commercial Horticulture through Production and Post-Harvest Management of Horticulture Crops	Credit-linked back-ended subsidy for the setting up of post- harvest management projects	@ 35% of the total project cost limited to INR 50.75 lakh per project in the general area and @ 50 % of project cost is limited to INR 72.50 lakh per project in the NE region, hilly states, and scheduled areas.
	Agriculture Infrastructure Fund	Setting up of cold storage units, warehousing, silos, assaying, grading and packaging units, e-marketing points linked to e-trading platforms and ripening chambers	Interest subvention of 3% per annum up to a limit of INR 2 crore
Ministry of Fisheries, Animal Husbandry & Dairying	Animal Husbandry Infrastructure Development Fund (AHIDF)	Setting up/expansion of dairy processing, veterinary vaccine production facilities, meat/poultry/ animal feed processing facilities	Interest subvention @3% for a maximum repayment period of eight years
	Fisheries and Aquaculture Infrastructure Development Fund (FIDF)	Development of identified eligible fisheries-based infrastructure activities	Interest subvention @3% for a maximum repayment period of 12 years
	Pradhan Mantri Matsya Sampada Yojana (PMMSY)	Umbrella scheme for the fisheries sector with a budget of INR 20,050 crore for five years, i.e., 2020-21 to 2024-25, for enhancement of production and productivity, establishment of post-harvest management facilities and fisheries management and regulatory framework	



6. Gaps, challenges and recommendations

Gaps	Challenges
Integration of cold chain Infrastructure (95% owned by private sector, 3% by cooperatives, 2% by public sector)	
• Lack of seamless integration of cold chain with logistic parks. • Coordination among different modes of transportation within the MML parks. • Limited connectivity in rural and Hilly areas. • Limited availability of temperature-controlled storage facilities in rural or remote areas.	• For integrated cold chain logistics, road transportation is primarily used (59%), followed by rail (35%), water (6%), and air transport (less than 1%). • Complex regulatory hurdles associated with land acquisition, permits, and approvals. • Developing large-scale infrastructure projects with integration of cold chain on account of initial high cost, lack of public private partnership and no cluster-based approach.
Adoption of modern technologies	
• Limited adoption of new technologies such as Blockchain, AI, robotics • Lack of skilled manpower for managing systems based on such technologies • Limited adoption of IT enabled solutions such as IoT-enabled sensors and monitoring systems to optimise temperature control, humidity levels, etc., in the cold storage.	• Limited awareness and technical know-how regarding these technologies • Infrastructure limitations – unreliable internet connectivity and power outrage in rural areas • Affordability: Cost constraints w.r.t technology adoption and risk of data breach
Clean and sustainable solutions	
• Lack of widespread adoption of alternative refrigerants with lower (GWP) and (ODP) in refrigeration systems. • Install on-site renewable energy systems, such as solar panels or wind turbines, to power cold chain facilities and reduce reliance on fossil fuels. • Insufficient infrastructure hinders the shift from conventional diesel vehicles to low-emission alternatives such as alternate fuel engines, hybrids, EVs, or HFVs. • Lack of awareness of energy-saving technologies such as variable frequency drives (VFDs) and energy management systems (EMS).	• Alternative/natural refrigerants have higher upfront costs. (refrigerant demand is to increase to reach **10,000 MT by 2037-38 from 2,000 MT (2017-18)** • Alternative fuel technologies such as EVs, and HFVs are cost intensive. • Lack of awareness regarding environmental benefits related to the adoption of related technologies. • Ambiguity/absence of clear regulations and standards specific to green practices. • **Fuel costs in India constitute around 45% of the operating expenses of cold storage, and in the West, it is only 10%)**

Recommnedations
1. Integration of cold chain Infrastructure
• Expanding the rail, water and air connectivity network between production and consumption hubs. • **Collaboration:** Foster collaboration between railways, airlines, and ports, cold chain logistics providers, and government agencies to streamline processes and reduce bottlenecks. • Linking existing and planned MMLPs with all four modes of transportation - roads, rail, sea, and air. Improving last mile connectivity – R&D and public sensitisation for adoption of DIY CS chambers, solar powered CS solutions, and small/ portable cold rooms.
2. Adoption of modern technologies
• Focused R&D and policy interventions for development of inhouse cost-efficient technologies. • Collaboration with th private sector for providing trainings and developing skilled workforce, trained for advanced technology such as AI, robotics, blockchain and complex logistics. • Collaboration with research/educational institutes for hands-on trainings and conducting training and capacity building for FPOs/SHGs.
3. Clean and sustainable solutions
• Policy interventions include capital subsidies and tax incentives for adopting alternative/natural refrigerants and alternative fuel-based vehicles. • Strategic interventions regarding developing and implementing regulations and standards specific to green practices. • Focused R&D for the development of cost-efficient green technologies. • Collaboration with leading global players for technology transfer. • Focus on generating mass awareness regarding using green and sustainable technologies through collaborating with research/ educational institutes/technology providers.



7. Vision@2047

By 2047, India's cold chain logistics envisions a seamlessly integrated network powered by cutting-edge technology and clean energy solutions. AI will play a central role in optimising routes, predicting equipment failures, and automating processes for unparalleled efficiency. Warehouses will utilise renewable energy such as solar power, while electric and hydrogen-fuelled vehicles will dominate the roads, minimising environmental impact. This transformation will unlock the sector's true potential, significantly reducing food spoilage by an estimated 25-30% and propelling agricultural exports. A highly skilled workforce, trained in advanced technology and complex logistics management, will ensure the smooth operation of this future-proof cold chain infrastructure.

What will India look like in 2047?

1.66 billion
population is projected for India by 2047, according to the UN.

2.44% annual
increase in food demand is anticipated until 2047-48

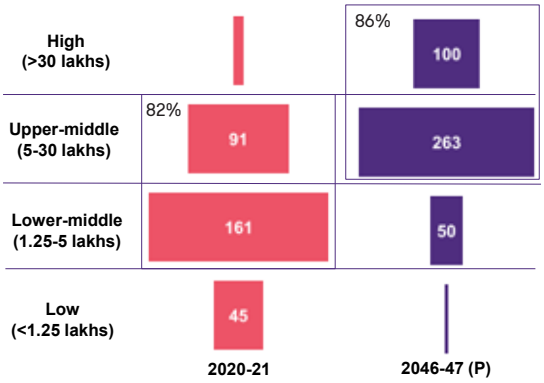
37 years
the median age of Indians by 2047

USD 18,072
the projected GDP per capital at the targeted GDP level

USD 30 trillion
Economy - target for Indian nominal GDP by 2047

2° C
forecasted rise in India's temperature by 2050, according to the World Bank

Projected household income class by 2047 (in Mn)

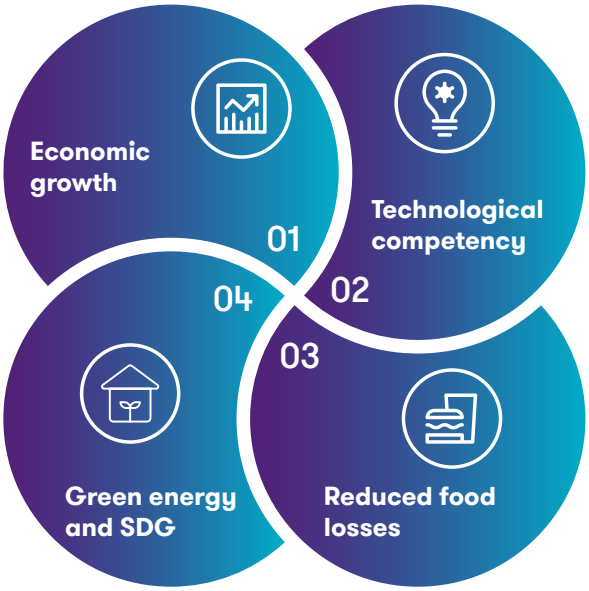




Pawan Mulukutla
Executive Director- Integrated Transport, Clean Air & Hydrogen
Sustainable Cities
WRI India

"India's formidable position in global commerce cannot be understated. Being a leading exporter of pharmaceutical, agricultural and chemical products, India needs a climate-driven approach for creating a robust cold chain logistics ecosystem to further enhance our global export prowess while meeting the national decarbonisation goals. Stringent temperature controls, quality assurances, real-time monitoring of goods and sustainable transportation practices are critical to meet the soaring demand for perishable goods. The integration of zero emission freight transportation in cold chain logistics will be a win-win solution for creating a sustainable cold chain infrastructure while aligning with India's target of net zero emissions by 2070. Supportive policy landscape and demand aggregation for zero emission trucks for cold chain logistics can further improve India's global standing as a leading sustainable exporter."

"A vision for Indian cold chain and logistics in 2047"



Enablers

- Centralised platform for showcasing best practices and sector's trends
- Training and capacity building
- Partnership with private players
- Policy interventions
- Knowledge transfer initiatives
- R&D and in-house technological advancement

Cold chain and logistics sector @2047

$ 100 Bn
Market size until 2047

50%
Improved integration of cold chain and logistics leading to a massive reduction of PH and handling losses by 50%

50%
-shipments tracked by Blockchain with enhanced traceability and food safety

20%
Cost Savings AI-powered logistics platforms optimizing route planning storage allocation, and predictive maintenance



Sunil Nair
CEO,
Snowman Logistics Ltd.

"Over the last few years, India has seen significant growth in the logistics sector, particularly in cold chain logistics. This expansion is driven by an increasing demand for temperature-sensitive products and a shift in consumer preferences towards quality and freshness. As the economy grows, the need for an efficient cold chain infrastructure becomes more critical, ensuring that perishable goods are stored and transported under optimal conditions. To achieve excellence in this industry, innovation and collaboration are essential. Embracing advanced technologies and fostering strong partnerships will aid us in addressing current challenges and seize new opportunities. This collective effort will enhance reliability and position India as a global leader in cold chain logistics. At Snowman Logistics, our commitment to adopting cutting-edge technologies and best practices ensures the highest standards of quality and reliability in our services. By continuously enhancing our capabilities, we play a pivotal role in enabling India's economic growth, safeguarding public health, and ensuring consumer satisfaction. Moving forward, we remain focused on delivering exceptional value and fostering trust among our stakeholders, driving progress and prosperity for all."

Key indicators for cold chain and logistics growth for Vision 2047

Ministry	Scheme	Support	Incentive	Incentive
Economic growth infrastructure development				
Agriculture economy	Share of agriculture in total GDP	USD 0.5 trillion (16.7% of total GDP)	USD 3 trillion (10% of total GDP)	China's agriculture accounts for ~7% of its total GDP globally. India, by growing at a faster rate, can reach USD 3 tn agri economy [FAO]
Agriculture exports	Share of global agricultural trade	2.4%	>15%	The US and Brazil account for ~17% of the global agricultural trade globally. India, with its focus on top-8 high-value commodities, should aim for global trade leadership [FAO].
Storage infrastructure gap	Gap in INR	1 lakh Cr+	Negligible	Cold storage capacity of more than 70.8 Mn tonnes in China, while around 39 Mn tonnes in India [China Federation of Logistics and Purchasing]
Food security				
Post-harvest losses	%	30-35 %	<15%	A fully developed integrated cold chain infrastructure will help achieve a 50% reduction in post-harvest losses. (World Bank's study)
Global Food Security Index	Rank	68 out of 113	Top 10 out of 113	• **Sufficiency of supply:** India ranks joint 102nd on this indicator due to the dependency of a large population on government support for access to food grains • **Agricultural research and development: India ranks 88th on this indicator.** Need to promote innovative agricultural technology [Economist]
Technological advancement				
Blockchain	Tracking of shipments	Nascent stage	50%	~Shipments tracked by Blockchain with enhanced traceability and food safety
Climate resilience and sustainability				
Annual greenhouse \gas emissions	Agriculture and livestock share of gross national emissions	18%	9%	By implementing the following: • Efficient use of fertilizer • Adoption of zero-tillage • Management of water used to irrigate paddy



Sumit Chitkara
Senior Director - SAP India

"By 2040, advanced data analytics, IoT, and AI will create hyper-efficient, transparent supply chains. Real-time visibility and predictive analytics, powered by solutions such as SAP's integrated business software, will enable shippers to optimise routes, reduce transit times, and minimise costs, fostering a new era of precision and responsiveness. Autonomous vehicles and drones will dominate freight and last-mile delivery, slashing labour costs and improving safety. Smart warehouses, equipped with robotics and AI, will handle tasks with unprecedented speed and accuracy, allowing freight forwarders to focus on value-added services. Integrated with SAP's supply chain solutions, blockchain technology will bring unparalleled transparency and security, automating customs processes and reducing fraud, thereby accelerating cross-border trade. These innovations promise faster, more reliable deliveries with lower environmental impact for consumers thanks to sustainable practices such as zero-emission vehicles and recyclable packaging. India's Gatishakti initiative will play a pivotal role in this transformation. By investing in infrastructure development, India will enhance its logistics capabilities, making it a global logistics hub."

About FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialisation, and its emergence as one of the most rapidly growing global economies. A not-for-profit organisation, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concerns of industry. It serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to over 250,000 companies. FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

Contact Us

Neerja Singh

Assistant Secretary General Infrastructure (Logistics Transport and Urban)
(Roads and Highways, Ports and Shipping, Railways, Urban Development, Real Estate and Smart Cities)

E: neerja.singh@ficci.com

Telephone: +91 11 2348 7326

About Grant Thornton Bharat

At Grant Thornton Bharat, we are committed to bringing positive change to all that we do. We are a founding member firm of the Grant Thornton international network and India's pre-eminent consulting firm. We offer a range of solutions in assurance, tax, technology, managed services, deals, ESG and risk consulting to mid-market companies, government, large corporates, and digital natives. We **#GoBeyond** for our people, clients, and communities to shape **Vibrant Bharat**.

19 offices | 10,000+ people
(as of 2024)

Part of GT international:
73,000 people | 150 countries

Our offerings

Our offerings include solutions for Governments, large corporates, middle market and digital natives across various industries and channels:

- Deals Consulting
- Tax, Regulatory & Finance Consulting
- ESG & Risk Consulting
- Transformation Consulting
- Global Delivery
- Assurance

Glossary

APMC	Agricultural Produce Marketing Committee
APC	Argo Processing Cluster
APEDA	Agricultural and Processed Food Products Export Development Authority
AHIDF	Animal Husbandry Infrastructure Development Fund
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditures
CBG	Compressed Biogas
CCAC	Climate and Clean Air Coalition
CEFPPC	Creation/Expansion of Food Processing & Preservation Capacities
CII	Confederation of Indian Industry
CONCOR	Container Corporation of India Limited
DIY	Do It Yourself
EMS	Energy Management Systems
EV	Electric Vehicles
FAME	Faster Adoption and Manufacture of (Hybrid & Electric Vehicles) Initiative
FICCI	Federation of Indian Chambers of Commerce and Industry
FIDF	Fisheries and Aquaculture Infrastructure Development Fund
FPO	Farmers Producer Organisation
FSSAI	Food Safety and Standards Authority of India
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global Warning Potential
HACCP	Hazard Analysis Critical Control Points
HEV	Hybrid Electric Vehicles
HFC	Hydrofluorocarbons
ICAP	India Cooling Action Plan
ICER	Interdisciplinary Centre for Energy Research
IIS	Indian Institute of Science
IOT	Internet of Things
ITE	Innovation Thru Energy
IWT	Inland Water Transport
MAP	Modified Atmosphere Packaging
MMLP	Multi-Modal Logistics Parks
MOFPI	Ministry of Food Processing Industries
NCCD	National Centre for Cold-chain Development
NDC	Nationally Determined Contribution
NDE	Non-Destructive Evaluation
NHB	National Horticulture Board
ODP	Ozone Depletion Potential
OPEX	Operating Expenses
PLISFPI	Production Linked Incentive Scheme for Food Processing Industry
PM FME	Pradhan Mantri Formalisation of Micro Food Processing Enterprises
PMMSY	Pradhan Mantri Matsya Sampada Yojana
POC	Proof of Concept
PPP	Public-Private Partnerships
PUF	Polyurethane Foam
RFID	Radio Frequency Identification
RPA	Reusable Packaging Association
SATAT	Sustainable Alternative Towards Affordable Transportation
SHG	Self Help Groups
VAS	Value Added Services
VFD	variable frequency drives
VRS	Vapor Recovery Systems

References

https://www.mofpi.gov.in/sites/default/files/food_processing_magazine_compressed_2.pdf

https://pib.gov.in/

https://www.mofpi.gov.in/sites/default/files/mofpi_annual_report_2023_eng_5-6-2023_new.pdf

https://ozonecell.nic.in/wp-content/uploads/2021/09/Cold-Chain-Sector-Report.pdf

https://morth.nic.in/sites/default/files/circulars_document/File2186.pdf

vgf-guideline_1691500048.pdf (pppinindia.gov.in)

pib.gov.in/PressReleaseIframePage.aspx?PRID=1847812

pib.gov.in/PressReleaseIframePage.aspx?PRID=1961797

India Climate & Energy Dashboard (niti.gov.in)

16012024_112431_102120474.pdf (loksabhadocs.nic.in)

Department of Agriculture, NITI Aayog, ICAR, World Bank

Acknowledgements

Authors

Chirag Jain
Partner, Public Sector Consulting
Grant Thornton Bharat
E: chirag.jain1@in.gt.com

Karan Sharma
Director, Public Sector Consulting
Grant Thornton Bharat
E: Karan.Sharma@IN.GT.COM

Editorial review

Akshay Kapoor

Design

Gurpreet Singh

For media enquiries, write to

media@in.gt.com

Contributors

Himanshu Sabharwal
Saurabh Sood
Ashish Yadav
Shweta Shinde
Anoop Jaiswal
Nitin Kumar
Pannagashree Nm
Sachin Aher
Varun Jain
Vighnesh Gaitonde

Notes

Notes

Notes

Great Place To Work. Certified DEC 2023 – DEC 2024 INDIA

Best Workplaces™ in Professional Services
Great Place To Work. INDIA 2023

We are
Shaping Vibrant Bharat

Our offices in India

Ahmedabad • Bengaluru • Chandigarh • Chennai
Dehradun • Delhi • Goa • Gurgaon • Hyderabad
Kochi • Kolkata • Mumbai • Noida • Pune

Scan QR code to see our office addresses
www.grantthornton.in

Connect with us on

@Grant-Thornton-Bharat-LLP
@GrantThorntonBharat
@GrantThornton_Bharat
@GrantThorntonIN
@GrantThorntonBharatLLP
GTBharat@in.gt.com

© 2024 Grant Thornton Bharat LLP. All rights reserved.

"Grant Thornton Bharat" means Grant Thornton Advisory Private Limited, a member firm of Grant Thornton International Limited (UK) in India, and those legal entities which are its related parties as defined by the Companies Act, 2013, including Grant Thornton Bharat LLP.

Grant Thornton Bharat LLP, formerly Grant Thornton India LLP, is registered with limited liability with identity number AAA-7677 and has its registered office at L-41 Connaught Circus, New Delhi, 110001.

References to Grant Thornton are to Grant Thornton International Ltd. (Grant Thornton International) or its member firms. Grant Thornton International and the member firms are not a worldwide partnership. Services are delivered independently by the member firms.

7148 | AK | GS3