Enabling An Energy Efficient India
From Vision to Action to Traction

Cold Chain and Refrigeration: Solutions to Achieve Scale
India is predominantly an agrarian country with more than 50% of its people depending directly or indirectly upon agriculture and allied sectors.

But this important and big sector of our economy contributes only 17% to the GDP.

The proportion has declined over the years primarily due to growth in the manufacturing and services sectors but the growth within the agricultural sector hasn't been great either.
Important Role of Government

Ministry for Agriculture and Farmers’ Welfare

- Department of Agriculture Cooperation & Farmers Welfare
- National Centre for Cold-chain Development (NCCD)
- Committee on Doubling Farmers’ Income (DFI)
- Integrated Cold Chain Availability Platform
- Mission for Integrated Development of Horticulture (MIDH)
- National Horticulture Mission (NHM)
- National Horticulture Board (NHB)

Ministry of Food Processing Industries

- Pradhan Mantri Kisan SAMPADA Yojana
- Scheme on Cold Chain, Value Addition and Preservation Infrastructure
What is a Cold Chain?

Simply put Cold Chain is the link between the farmers and the retail markets / food processing industries (FPIs) and further between the retail markets / FPIs to the end consumers.
Benefits of an Uninterrupted and Integrated Cold Chain

Cold Chain is

• An enabler in giving impetus to the transformation of the Indian agricultural sector, and

• A means of addressing the key issues of the agricultural sector, such as

  marketability/handling of agricultural produce
  diversification and modernisation
  enhancing farmers’ earning through value addition
  strengthening its inter-linkages with food processing industry
  push to exports of horticulture and processed food items.
Food Loss and Waste: The Silent GHG Emitter

Source: FAO (2011) Global food losses and food waste-extent, causes and prevention, Rome: UN FAO
Alarming Food Loss in India: According to various GoI reports.
## Massive Shortage of Cold Chain infrastructure and associated Investment Opportunity

<table>
<thead>
<tr>
<th>Infrastructure Component</th>
<th>Shortfall, All-India</th>
<th>Unit Cost (Rs. Lakhs)</th>
<th>Investment (Rs. Crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated pack-houses (units)</td>
<td>70,000</td>
<td>95</td>
<td>66,339</td>
</tr>
<tr>
<td>Reefer transport (units)</td>
<td>62,000</td>
<td>30</td>
<td>15,848</td>
</tr>
<tr>
<td>Cold storage (bulk) (units)</td>
<td>650</td>
<td>400</td>
<td>2,600</td>
</tr>
<tr>
<td>Cold storage (hub)(units)</td>
<td>360</td>
<td>350</td>
<td>1,260</td>
</tr>
<tr>
<td>Ripening chambers (units)</td>
<td>8,000</td>
<td>40</td>
<td>3,328</td>
</tr>
<tr>
<td><strong>Total Investment (Rs. Crores)</strong></td>
<td><strong>89,375</strong></td>
<td></td>
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</tr>
</tbody>
</table>

*Source: NCCD (2016).*
India Cooling Action Plan (ICAP)

- Multi-stakeholder effort lead by MoEFCC – one of its kind initiative of the Govt. of India

- Lays out 20 year (2017-18 to 2037-38) outlook across sectors on India’s cooling demand, technology options, refrigerant use and energy consumption

- AEEE lead the work on Space Cooling and the Cold-chain sectors apart from conducting the background analysis, compiling and collating all chapters developed by different Thematic Working Groups

Key Goals of the ICAP

- Reduction of cooling demand by 20% to 25%
- Recognition of cooling as a thrust area of research
- Reduction of refrigerant demand by 25% to 30%
- Reduction of cooling energy requirements by 25% to 40%
- Training and certification of 100,000 servicing technicians
Key findings of the ICAP in the Cold Chain sector

• With around 500 pack-houses in India at present, the number is likely to grow to 55,000 in the next decade and to 1,25,000 in the subsequent decade attributing to an energy consumption of 2.4 TWh in 2028 and 5.2 TWh in 2038 respectively.

• The growth of reefer vehicles is related with increase in the pack-houses, and their estimated numbers will be 1,35,000 units in the next decade and 4,00,000 units in the subsequent decades from the present 15,000 units.

• Cold storages would grow at a marginal rate from the existing 35 Million Metric Tonne (MMT) to 40 MMT in 2028 and to about 48 MMT in 2038.

• There would be a steady growth in ripening chambers from current 1000 units to 9,000 units in the next decade and to 14,000 units in the subsequent decade.
ICAP Recommendations in Cold Chain

- Encourage **development of cold chain infrastructure** with **energy efficient cooling systems** and low-GWP refrigerants
- **Development of safety standards for flammable and toxic refrigerants** for cold storage and other segments of the cold chain
- Develop programme for **retrofitting of existing cold storages** to reduce cooling, refrigerant demand and energy consumption
- **Standardisation of all design, construction** and associated specifications for small, medium and large cold-chain infrastructure components.
- **Linking the incentives** being provided for development of cold-chain infrastructure with adoption of energy-efficient design, construction and maintenance practices and low GWP refrigerant and renewable technologies
- Provide **specialized training facilities for cold chain professionals** and **technicians** to promote proper utilization and operation of technology, as well as energy efficiency
- Provide **training to farmers** so that they can better manage their produce both pre-harvest and post-harvest
Suggested Approach: Lean, Mean and Green Strategy

1. **LEAN**
   - Reduce cooling load
   - Good design and construction
   - High performance insulation

2. **MEAN**
   - Achieve cooling efficiently
   - Efficient cooling appliances
   - Not-in-kind cooling technologies
   - Smart controls

3. **GREEN**
   - Reduce carbon footprint
   - Employ Climate-friendly refrigerants
   - Integrate Renewable Energy
   - Encourage R&D and reward disruptors

1. **LEAN**
2. **MEAN**
3. **GREEN**

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**Note:**
- The diagram visually represents the suggested approach with three levels: Lean, Mean, and Green. Each level focuses on different aspects of reducing energy consumption and environmental impact.
- **Lean:** Focuses on reducing the cooling load through good design and high performance insulation.
- **Mean:** Aims at achieving cooling efficiently by utilizing efficient cooling appliances and smart controls.
- **Green:** Emphasizes reducing the carbon footprint by employing climate-friendly refrigerants, integrating renewable energy, and encouraging disruptive innovation.

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**Further Reading:**
- [Energy Efficient Economy](https://www.energyefficienteconomy.org)
- [Climate-friendly Refrigerants](https://www.epa.gov/cfrs/climate-friendly-refrigerants)
- [Renewable Energy Integration](https://www.energy.gov/energy-efficiency/renewable-energy-integration)
- [R&D and Disruptors](https://www.nrel.gov/energy-efficiency/innovation-and-technology-disruptors.html)
Thank You!
We would be delighted to take this discussion onwards.