Energy efficiency policy measures and their impact on Cold Storages in India

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Efficient cold chain have multiplier effect: reduced food losses, environmental impact and enhanced farmers’ income

Agriculture is a critical pillar of India’s economy
- Contributing ~20% of GDP and providing livelihood to 44% of population
- Largest producer of milk and dairy products
- 2nd largest producer of fruits and vegetables, fish

However
- Only 4% of the country’s produce benefits from cold-chain
- Approximately 30% of fruit and vegetables are lost or wasted each year
- Only 1% of India's horticulture produce is exported

Efficient cold chain can
- Reduce harvest and post harvest losses which are estimated to be around INR 440 billion annually
  - Reduce food loss
  - Create a positive ecological / environmental impact
  - Directly impact and enhance farmers’ income
Cold Chain: Overview of key components

Packhouse
Handling sorting, grading, washing, drying, weighing, packaging, pre-cooling and staging.

Ripening Chambers
Completes the ripening process of some fruits to make further palatable.

Retail
Large retailers may use Walk-in cold room to store goods.

Cold Storages
Refrigerated facility or warehouse used for the storage of temperature-controlled substances.

Reefer Trucks
Refrigerated truck used for transporting goods.

Transport
May or may not be Reefer.
Cold Chain capacity in India: 2017-18

Total Installed: 35.19 Million Tonnes (MT)

**Cold Storages, 99.4%, 35 MT**

- **Vapor Compression Cycle, 95%**
  - **By Technology**
    - Ammonia based, 74.6%
    - HFC/HCFC based, 25.4%
    - Pack house: 0.015 MT, 0.01%
    - Reefer vans: 0.135 MT, 0.3%
    - Ripening chambers: 0.04 MT, 0.1%
  - **By refrigerant**
    - Sorption
    - Evaporative cooling
    - Ice making

- **Cold Chain capacity in India: 2017-18**
  - Based on ICAP study, capacity factor for cold chain facilities taken from NCCD

**Overview**

- 75% of the cold storage capacity is Ammonia based, these are largely bulk cold storages
- Ammonia based systems are centralized systems consisting of a compressor, condenser, evaporators and expansion valves
- Ammonia based systems are dominated by the unorganized players (80-85%), where different components such as (compressors, evaporators, condensers, controls etc.) are procured from different vendors and are assembled at site

- ~25% of the cold storage capacity is HFC/HCFC based, largely modular type
- Pack house, reefers and ripening chamber use HFC/HCFC based refrigeration systems only
### Cold Chain Capacity – growth estimates

- **Cold Storages**, 99.4%, 35 MT
  - 2017:18: 35.19 MT
  - 1.69 X increase
  - 2037-38: 59.74 MT

- **Reefers**, 7%, 4 MT, entirely based on HFC/HCFC systems

- **Pack houses**, 8%, 5 MT, entirely based on HFC/HCFC systems

### Takeaways

<table>
<thead>
<tr>
<th>Market</th>
<th>Technology</th>
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<tbody>
<tr>
<td>Cold Storages</td>
<td>- Would continue to dominate the segment till 2037-38</td>
</tr>
<tr>
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<td>- Need to focus on creating new efficient capacity as well as explore options for retrofitting existing capacity</td>
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<tr>
<td>Pack houses</td>
<td>- Need to focus on Vapor compression technologies</td>
</tr>
<tr>
<td>Ripening chambers</td>
<td>- Need to focus on HFC/HCFC based systems (others)</td>
</tr>
<tr>
<td>Reefers</td>
<td>- Most of the capacity is expected to be created in next decade</td>
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<td>- Accordingly, there is need focus on new capacity addition to avoid lock in of inefficient infrastructure</td>
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<td>- Technologies such as zero energy cooling chambers (ZECC), solar based cold storages are still nascent and evolving, potential to promote such technologies</td>
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Cold Chain: Annual energy consumption, split by facility type (conservative scenario)

% share of annual energy consumption

Pack houses, 0.04%
Reefers, 19.42%
Cold Storage, 78.34%
Ripening chamber, 2.20%

2017-18: Total annual energy consumption: 5.284 Twh

2037-38: Total annual energy consumption: 18.78 Twh

Total: 3.61 X increase

Takeaway

Need to prioritise policies across Cold Storages, Reefers and Pack-house segment

- All number sourced from ICAP study, except for reefers.
- For 2037-38, reefer stock of 100K units has been taken for calculations, instead of 400K taken in ICAP study.
Policy options for Cold Chain Energy Efficiency

Opportunities
- 30+ opportunities across technologies, equipment, system, envelope, materials etc.

Shortlisting principles
- Energy saving potential
- Market readiness, technology profile
- CLASP’s expertise

Policy options
- Equipment / appliance specific policies
- Program that focuses on technology upgrades
- Guidelines for Operation and Maintenance (O&M), system design, equipment and material selection
Prioritisation of Energy Efficiency Opportunities

- S&L of walk-in cold rooms
- S&L of HFC/HCFC compressors
- Inclusion of cold storages into PAT
- S&L of evaporator fans
- S&L of Reefer/Truck refrigeration unit
- Technology replacement program Thermal to electronic expansion valve
- Guidelines for design, O&M of cold chain facilities
- Guidelines for materials (envelope, door etc)
- Guidelines / awareness for energy efficient post-harvest practices
- Energy Efficiency guidelines, performance standards for Ammonia Chillers
- S&L of PUF / Insulation materials
- S&L of Ammonia Chillers
- Technology upgradation – electronic Controls, automation etc

Notes:
- Savings are based on 2037-2038 ICAP reference scenario
- Size of circle indicates relative energy saving potential
- For guidelines, a flat savings of 0.1 Twh has been assumed (except ammonia)
- Ease of execution is assessed on market readiness, technology profile, dependance on other govt. agencies etc

Bubble of this size represents energy savings of 0.72 TWH
#1: Energy Efficiency Labelling of refrigerant compressors used in Cold Chain applications

**S**
- India already has a well-developed S&L ecosystem
- Bureau of Indian standard (BIS) has standards on refrigerant compressors

**W**
- Ongoing revision of ISO standards, Non-existent lab capacity
- Lack of consensus among stakeholders on efficiency indicators, high variability of refrigerants used

**O**
- Organized market, dominated by select OEMs
- Global supply chains – potential for harmonization and replication elsewhere

**T**
- Program to be introduced as voluntary
- Variation in use compressor use cases / ambient conditions may be difficult to normalize

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**Preliminary assessment has been encouraging**

**Policy Options**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Annual sales</td>
<td>~ 40,000</td>
</tr>
<tr>
<td>2 Annual growth</td>
<td>10% – 15%</td>
</tr>
<tr>
<td>3 Energy saving potential</td>
<td>~ 20%</td>
</tr>
<tr>
<td>4 Cumulative energy saving potential (2024 - 2030)</td>
<td>&gt; 0.25 Twh</td>
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</tbody>
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**1**
- Enabling set of BIS standards (IS 5111)

**2**
- As per limited consultations, there is potential to adopt COP as energy efficiency indicator
#2: Energy Efficiency Labelling of Walk-in Cold Rooms (WICR)

**S**
- India already has a well-developed S&L ecosystem
- Bureau of Indian standard recently released for Walk – in Cold Rooms

**W**
- Limited lab capacity for testing
- WICR are complex systems with multiple equipment / envelope components

**O**
- Rapid / exponential market growth due to formalization of Agri supply chains in India

**T**
- Market is dominated by unorganized players
- There may be a need to build capacity of unorganized players – may be resource intensive

**Preliminary assessment has been encouraging**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>1 Installed stock (units)</td>
<td>~ 1,50,000</td>
</tr>
<tr>
<td>2 Annual sales</td>
<td>~ 23,000</td>
</tr>
<tr>
<td>3 Annual growth</td>
<td>10% – 15%</td>
</tr>
<tr>
<td>4 Baseline annual energy consumption (existing stock)</td>
<td>~3 TWh</td>
</tr>
<tr>
<td>5 Cumulative energy saving potential (2024 - 2030)</td>
<td>&gt; 1.5 TWh</td>
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**BIS is already conducting stakeholder consultations to explore inclusion of energy efficiency parameter in the standard**

**Precedence of WICR labelling exists in other countries – best practices can be adopted**
#3: Inclusion of Cold Storages under Perform Achieve and Trade (PAT) Program

**S**
- PAT program is operational, energy saving certificates are being traded
- Provides opportunity to cold storages to undertake efficiency improvement at own pace

**W**
- Seasonality of operations, operating characteristics may vary by crop type stored
- Baseline audit and target setting is time taking, followed by 3-year long performance cycle

**O**
- PAT targets may drive energy efficiency as well as adoption of renewable energy
- Technology neutral approach, empowers owners to identify and implement EE measures

**T**
- Significant portion of the cold storages are unorganized, compliance may not be effective

### Strong case for inclusion under PAT, feasibility study needs to be conducted

1. **Description** | **Created**
   - 1 Cold Storage capacity (TR) | 5,21,705
   - 2 Total number of cold storage (Nos) | 7,901
   - 3 Specific power consumption of compressor (estimated, KW/TR) | 1.2
   - 4 Total Electrical connected load (MW) | 612
   - 5 Annual energy consumption (TWh) | 4.02

2. **Energy saving potential as per past studies: >10%**
3. **Cumulative energy saving potential (2024 - 2030): ~2 TWh**
Key takeaways

Standards and Labelling (S&L) of cold chain components with high market growth

Why:
• To avoid lock-in of inefficient stock
• Can form the basis of Minimum Energy Performance Standards (MEPS) in future

What:
1. Compressors:
   - Used in almost every cold chain system
   - Highly organized market
   - Potential to harmonize polices across countries
2. Walk-in Cold Rooms (WICR):
   - Increasing adoption in India
   - Ongoing global efforts to label WICR

Energy saving targets for select large Cold Storage facilities

Why:
• There is a huge variation in cold storage technology type and vintage: technology neutral approach required to address the diversity
• Cost efficient energy saving measures may vary by type of technology, commodity stored

What: Inclusion of Cold Storages under PAT program
• Mandated entities can go for energy efficiency interventions as per respective marginal cost of efficiency improvement; or
• Simply buy certificates from the market
Thank you!

Any questions?

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