Energy Profile

Hooghly Cold Storage Cluster

September 2023 Draft Report

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Contents

Abbreviations

APP	Atactic Polypropylene
BLDC	Brushless Direct Current
CESC	Calcutta Electric Supply Corporation
CIPC	Isopropyl N-(3-chlorophenyl) carbamate
DG	Diesel Generator
DPL	Durgapur Projects Limited
HSD	High Speed Diesel
LED	Light Emitting Diode
LTS	Low Temperature Sweetening
MSME	Micro, Small and Medium Enterprise
PUF	Polyurethane Foam
RCC	Reinforced Cement Concrete
RH	Relative Humidity
SPV	Solar Photovoltaic
TERI	The Energy and Resources Institute
USDA	United States Department of Agriculture
UV	Ultra Violet
VFD	Variable Frequency Drive
WBCSA	West Bengal Cold Storage Association
WBSEDCL	West Bengal State Electricity Distribution Company Limited
WFLO	World Food Logistics Organization

Acknowledgements

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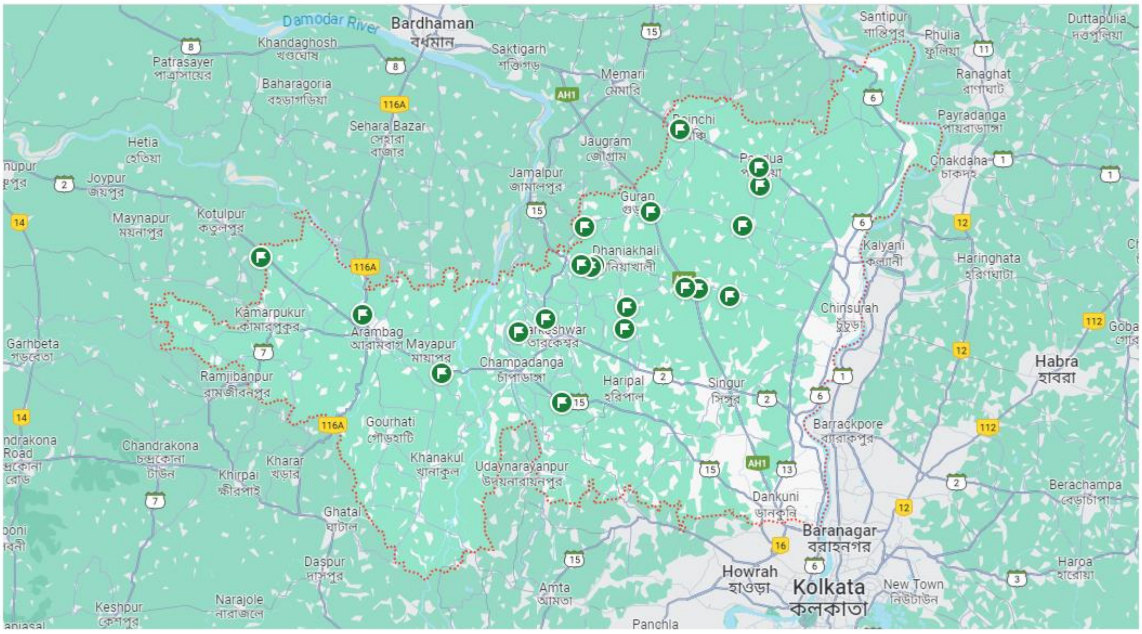
Last but not least, our sincere thanks to cold storage units and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Hooghly Cold Storage Cluster

Overview of cluster

Hooghly cold storage cluster in situated in West Bengal in eastern India. The cold storage industries were set up in Hooghly primarily due to wide cultivation of potatoes in this district as well as abundance of consumer market in Kolkata which is the state capital of West Bengal and its surrounding urban and suburban lacations. The purpose of cold stroage is to strengthen post-harvest storage and marketing infrastructure.



Location map of Hooghly District, West Bengal (Source: Google Map)

Leading cold storage facilities in the cluster includes Snehalata Cold Storage (P) Ltd., Matri Mandir Himghar (P) Ltd., Matribhumi Agritech LLP, Dhirendra Narayan Cold Storage (P) Ltd., Khanpur Cold Storage (P) Ltd., Bhaktimoyee Cold Storage (P) Ltd., Baba Kailashpati Agro Processing (P) Ltd. etc.

Product, market and production capacities

Cold storage facility is a temperature controlled supply chain network, with storage and distribution activities carried out in a manner such that the temperature of different products are maintained within a specified range and keep them fresh and edible for a longer time period. The post farming products, such as vegetables (potato) are directly sent to cold storage through farmers or through intermediate dealers. Hooghly cold storages are the main storing facilities for potatoes which are stored and sold round the year or when there is demand.

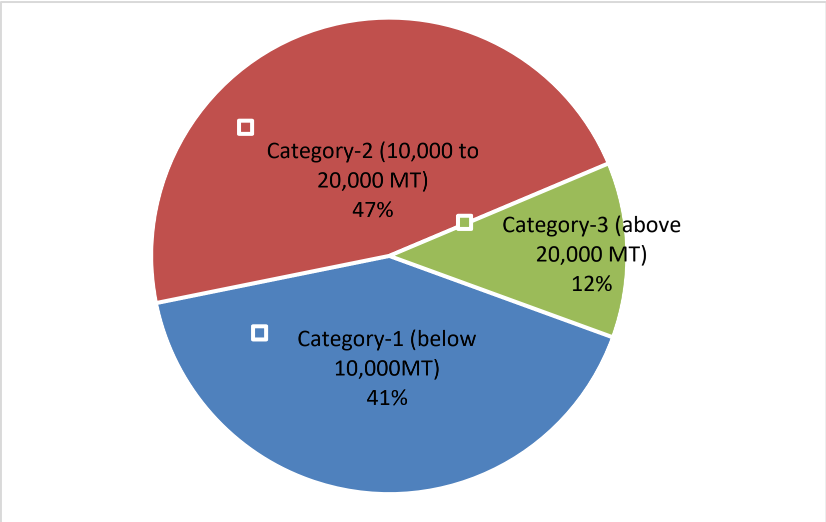
There are about 150 cold storage facilities in Hooghly district. The capacity of the cold storage facilities in Hooghly varies. Majority of the cold storages (67%) are between 5,000 MT to 15,000 MT. About

12% cold storages are of below 5,000 MT capacity and 21% cold storages are of above 15,000 MT capacity.

The average capacity of the Category-1 (Below 10,000 MT) cold storage facilities is estimated to be 6,237 MT, Category-2 (10,000 to 20,000 MT) is 13,704 MT for and for Category-3 (above 20,000 MT) is 23,522 MT. The storage capacity-wise distribution of cold storages facilities in Hooghly are is given in table and pie-chart.

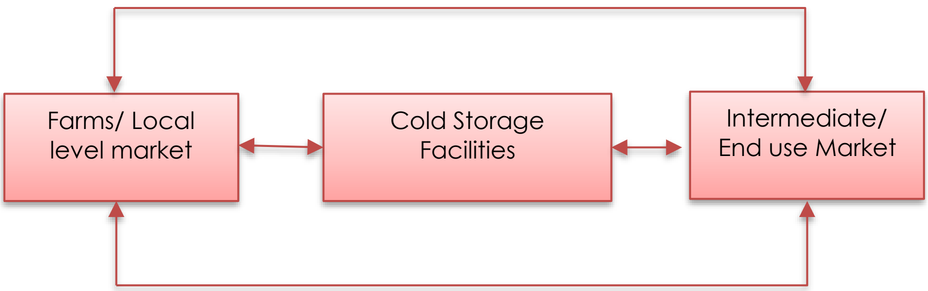
Capacity-wise distribution of cold storage facilities

Category	Capacity (MT)	Number of units
Category -1	Below 10,000 MT	62
Category - 2	10,000 to 20,000 MT	70
Category - 3	Over 20,000 MT)	18



Capacity-wise distribution of Cold StorageS in Hooghly cluster

The linkage between farms, cold storage facility and market is shown in the.



Linkage of units in cold storage

Cold storage process

The process adopted by a cold storage facility is defined from construction stage. Primarily, cold storage which required pre-cooling process before storing the material in constant atmosphere is designed to cater to fruits and vegetables. These facilities are meant for storing fresh fruits, vegetables and other horticulture products which require pre-cooling / rapid cooling to "seven-eighth cooling" in a short duration of 4-24 hours depending on requirements in order to preserve freshness, quality and life.

For storage chamber, product storage conditions must be defined in terms of critical storage conditions of temperature, relative humidity (RH), CO_2 levels, air circulation and light etc. As research level data to design as per Indian conditions are not available, most of the designing is referred from Commodity Storage Manual of World Food Logistics Organization (WFLO). The Committee formed to prepare technical standards and protocol for the cold chain in India has followed the recommendations made by U.S. Department of Agriculture (Tropical Products Transport Handbook, McGregor, B.M. 1989).

The general process adopted by cold storage facilities in Hooghly cluster is discussed below.

(i) Pre-cooling (limited to fruits and vegetables)

Pre-cooling process plays an important role to prolong the storage life of fruits and vegetables by removing heat and reducing metabolic activities. Pre-cooling is the first step of temperature management of fruits and vegetables after harvesting. It is an essential process in any cold chain management of horticultural produce. For fresh horticulture commodities, a delay by one hour at the field temperature of 35 °C between harvest and pre- cooling may reduce quality almost equal to 20 hours in storage. Delay in pre-cooling results in loss of moisture and weight from produce. These losses combined with active micro-biological organisms can result in deterioration of quality.

Precooling of apples

Source: www.coldchainexperts.com

There are multiple methods for rapid removal of heat from produce and are largely dependent on perishability and refrigeration equipment of the produce and its adaptability to a specific method and availability of facilities. The basic processes for pre-cooling of fruits and vegetables include the following.

- Hydro cooling
- Forced air cooling
- Evaporative room cooling
- Package ice cooling

Fruits and vegetables require pre-cooling at origin of produce (field or farm), if transportation time to reach cold storage is relatively longer. Fresh produce like grapes, berries, cherries, leeches, melons, sapotas, okra, tomatoes, capsicum, chilli peppers, cucumbers, green beans, peas, spinach should be cooled as soon as possible.

(ii) Storage

A multipurpose cold store is a building structure in the form of palletized storage, suitable for long term storage of fruit, vegetables and other commodities under the critical ambient conditions such as temperature, humidity, CO_2 and air circulation rate. The typical range of the parameters for multi commodities cold store chamber is given as follows.

Temperature

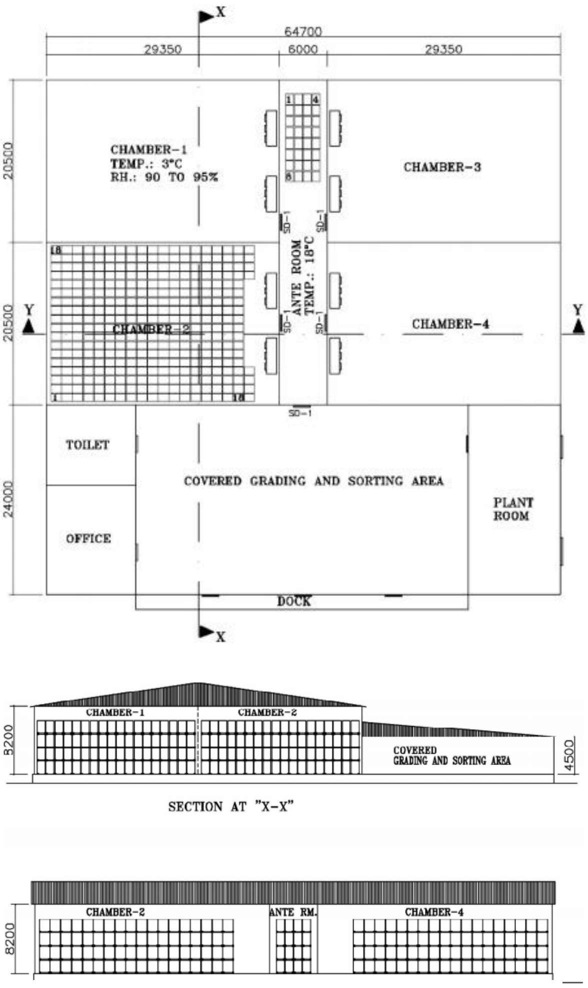
The variation in the temperature should not be more than +/-1 °C of recommended temperature for a particular product. Potatoes should be kept in the range of 2-4 °C.

Humidity

Relative humidity should be in the range of 95-98% for the fruits and vegetable. In some of the range of vegetables like onion and garlic, it should be in the range of 65-75%. The relative humidity range for potatoes should in the range of 90-95%.

CO_2 level

CO_2 level of cold store chamber should not be more than 4000 ppm during the loading and 2000 ppm during the holding. To maintain the CO_2 level less than 4000 ppm, 2-6 air changes per day is recommended.



Typical Layouts of Multi Commodity Cold Store Facilities

Source: National Horticulture Board

Air circulation

The recommended design for multi commodities cold store is 170 m^3/hr/MT of product holding. The air flow rate can be maintained in the range of 34-68 m^3/hr after the produce reached to the chamber or desired temperature. The variable air flow rate can be maintained by installation of 'variable frequency drive' (VFD) with feedback from chamber temperature. The general temperature requirements for common commodities handled in Hooghly cold storage facilities is given in table *(Source: McGregor, B.M. 1989. Tropical Products Transport Handbook. USDA Office of Transportation, Agricultural Handbook 668)*

Temperature requirements for common commodities

Product	Temperature		Relative Humidity (%)
	°C	°F	
Apples	-1-4	30-40	90-95
Apricots	-0.5-0	31-32	90-95
Bananas, green	13-14	56-58	90-95
Beans, dry	4-10	40-50	40-50
Beans, green or snap	4-7	4045	95
Beans, lima, in pods	5-6	4143	95
Blackberries	-0.5-0	31-32	90-95
Cabbage, early	0	32	98-100
Cabbage, late	0	32	98-100
Cashew apple	0-2	32-36	85-90
Cherries, sour	0	32	90-95
Cherries, sweet	-1 to -0.5	30-31	90-95
Garlic	0	32	65-70
Kiwifruit	0	32	90-95
Lychees	1.5	35	90-95
Mangoes	13	55	85-90
Mushrooms	0	32	95
Onions, dry	0	32	65-70
Peaches	-0.5-0	31-32	90-95
Pears	-1.5 to -0.5	29-31	90-95
Peas, green	0	32	95-98
Peppers, Chili (dry)	0-10	32-50	60-70
Plums and prunes	-0.5-0	31-32	90-95
Pomegranates	5	41	90-95
Potatoes, table	2-4	35-39	85-95
Potatoes, processed	10-12	50-54	85-95
Sweet potatoes	13-15	55-60	85-90
Tamarinds	7	45	90-95
Tomatoes, mature-green	18-22	65-72	90-95
Tomatoes, firm-ripe	13-15	55-60	90-95

The detailed process steps followed by cold storage facilities are given in following sections.

(iii) Product specific process (potato)

Providing potato cold storage conditions is very important in terms of providing quality products to the market. Potato is the most demanded product in cold storage. Its nutritive value and long-term storage are factors in this. Potatoes are made in large crates in cold storage or in silo-shaped containers up to 6 m high by giving cold air from the bottom. Approximately 600 kg of potatoes can be placed in 1 m^3 volume. Potato storage is done in following stages:

Drying

The main aim of potato drying is to keep the potato's interior moisture while removing its outer layer. The entire drying process of the potatoes is quite delicate. The main objective is to dry both the outer skin and any debris attached to it. It is preferable to preserve potatoes that are still a little soiled from the fields. It helps in preserving the potatoes for a longer period. It is preferable to cure them at a temperature of around 25 °C and a relative humidity of about 85%. To prevent the rotting of potatoes, the air is humidified in severe cases.

Healing

Potatoes are kept for 10-12 days in cold warehouses with 90% humidity between 15-18 degrees. In this way, the potatoes have had an opportunity to heal the minor skin sores formed that may have developed during harvest, transportation and the crusts thicken and harden. This recovery reduces water loss and possibility of infection. When the water loss in potatoes exceeds 8%, wrinkling occurs. During the treatment period, the air flow rate in the tank should be high. In this way, the top layer of the stacks is prevented from getting wet. Again in this period, the CO2 rate should not exceed 0.5%.

Cooling

The temperature of the potatoes, whose healing process is completed, is gradually reduced to 6-8 degrees in 12-15 days in the cold storage. At this stage, potatoes are prepared for cold storage by lowering the temperature by 0.5 °C per day, the air velocity is reduced and the ambient humidity is kept between 90-95%.

Cold Storage

At this stage, for table potatoes the temperature of the cold storage is maintained between 2-4^{o}C and the humidity of the storage is 90-95%, and the storage period in the cold storage can be up to 6-8 months, depending on the type of potatoes. At this stage, the temperature of the cold storage should not be lower than 6^{o}C for processed potatoes. The decrease in temperature causes development of sweetening in tubers. This phenomenon is known as "Low Temperature Sweetening" (LTS) resulting from conversion of starch into free sugars at low storage temperature. The sweetened potatoes are unsuitable for making processed products.

In case of processed potatoes, the temperature of the cold storage is maintained between 10-12ºC and the humidity of the storage is 90-95%. However, when stored at 10-12°C, potatoes sprout and it is necessary to check sprout growth to reduce storage losses. To check sprout growth, sprout suppressants have to be used which is done by the customers. Chlorpropham or CIPC (isopropyl N-(3-chlorophenyl) carbamate is widely used as a sprout suppressing agrochemical applied to stored potatoes. It works by interfering with cell division to inhibit sprout development. Application of CIPC also increases the shelf life of potatoes by 15 to 20 days more as compared to normal storage.

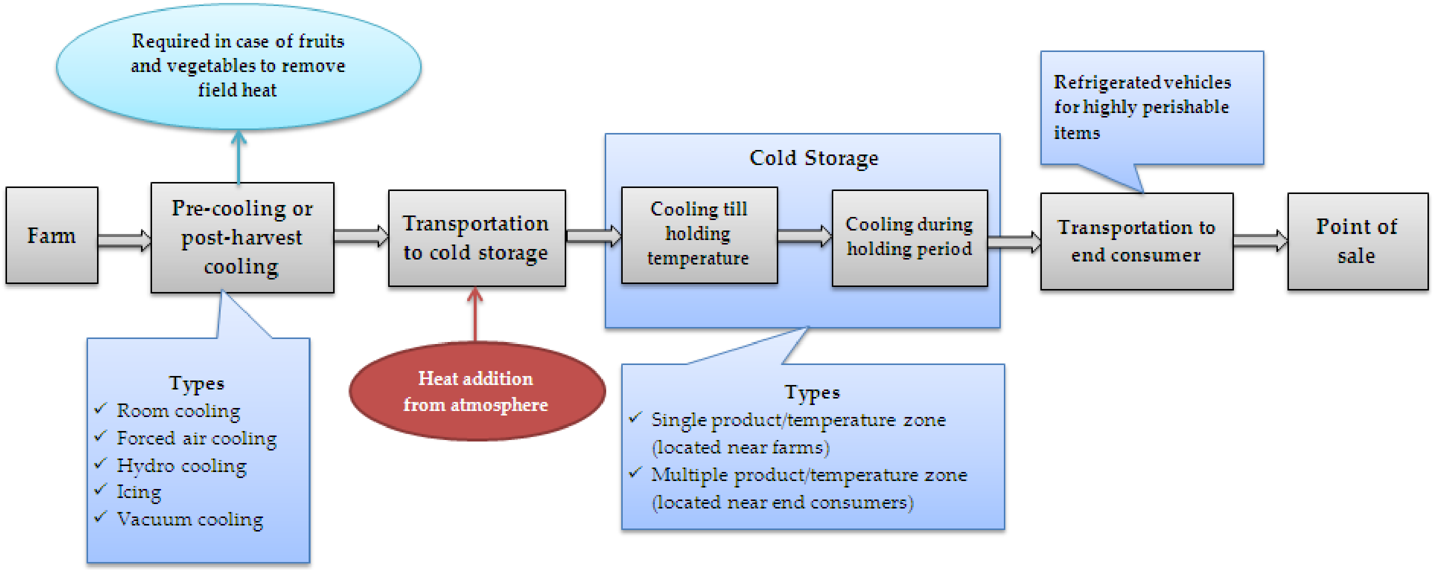
Relative humidity must be maintained at 90-95%. Higher RH reduces the shrinkage by about 3-4% over 5-6 months of storage. Loss of water from potato tubers during storage causes loss of quality and weight, which means loss of valuable mass which rapidly increases at relative humidity levels below 90%.

In an ideal potato cold Store, Carbon Dioxide level should be around 0-2 %, high CO_2 concentration reduces breathing thereby form dull and wrinkle skin, low skin shine and sweetness in potatoes and also reduces product Weight.

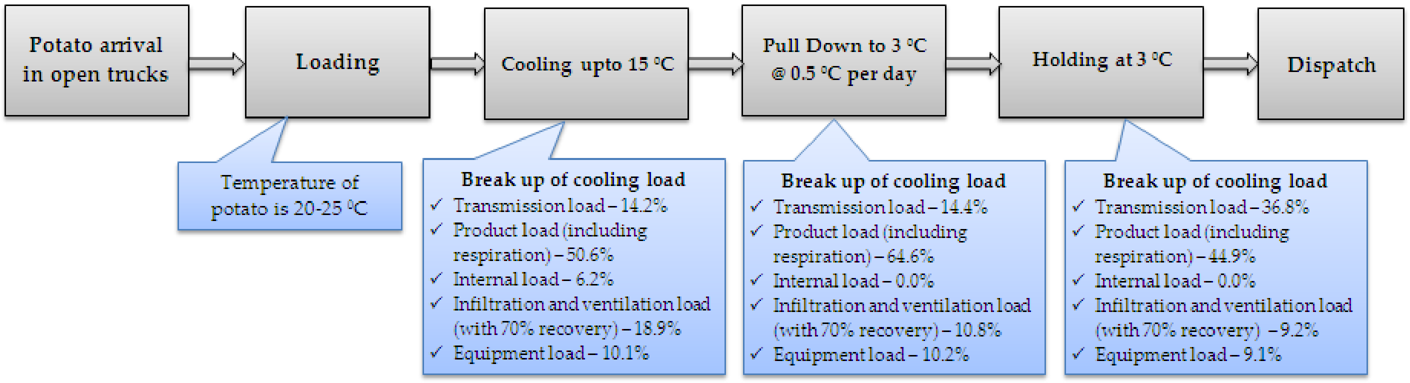
Preparation for Market

At the end of the cold storage period, potatoes begin to release more carbon dioxide, heat and steam compared to the previous stage. In this process, the air speed of the potato cold storage is increased, and the amount of fresh air taken into the warehouse increases. Cold potatoes are brittle and may easily bruise or shatter during handling, to avoid this and to prevent condensation, warehouse temperature is gradually increased to make the potatoes ready to be marketed.

General Process



Product Specific Process (Potato)



Technologies employed

Multi commodity cold storage facilities have multiple chambers of capacity ranging 30-1250 MT, anterooms, docking/ grading/ sorting area, crates/ palletized storage, machine room, toilets and changing room, electrical room etc. Some of the major areas/ equipment used in cold storage facility in cluster are described below.

(i) Refrigeration system

Most of the refrigeration units installed in the cluster are using ammonia as refrigerant, reciprocating type, multi cylinder, with accessories like oil separators, capacity control and unloaded start. Though ammonia based system is better for cold storage applications, it is toxic and precautions should be taken in its handling.

Ammonia compressor

The general assembly of ammonia based refrigeration system consist a reciprocating compressor, ammonia pump, evaporative condenser coil, which are installed in cold chamber area. In almost all units, all systems were operated at maximum load conditions and controlling of system is done manually. Electric motors associated with compressor are of standard efficiency class and mostly rewinded.

Ammonia tank

Manually controlled expansion valve

Mild steel piping is used to handle refrigerant (interconnecting compressor, condenser and cooling units). There are a large number of un-insulated areas/ locations have been observed. Most of valves and flange were found un-insulated in both old and new facilities.

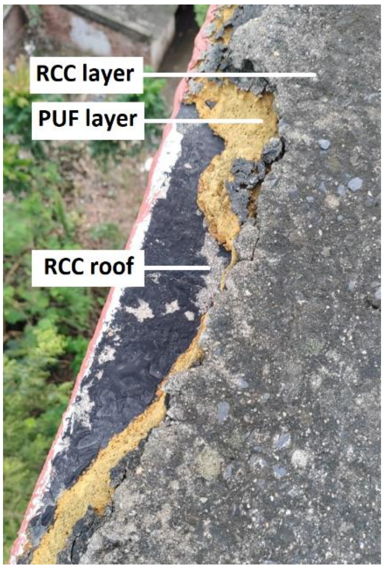
There are two types of evaporator coils have been observed in cold chambers, one is bunker type and another is fin coil type.

Bunker type cooling arrangements

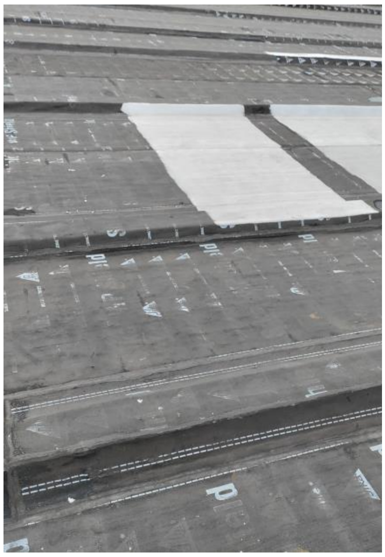
Fin coil type cooling arrangements

(ii) Cold chamber

Cold chambers usually have 4 to 5 floors with total height ranges from 50 to 60 ft. in some cases, a chamber divided into two by placing vertical or horizontal partition. The walls of cold storage are made from brick or solid concrete blocks with sand and cement plaster. The roof is made of 'reinforced cement concrete' (RCC). The floor comprises of base concrete. The inner walls including the roof have thermocol insulation or PUF insulation which further covered by sand & cement plaster. Top of the roof also has a layer of insulation upon which a thin layer of RCC applied which is further covered by a layer of sand and tar or gravels and tar or a layer of APP Membrane which is a plastomeric waterproofing membrane consisting layers manufactured from a rich mixture of bitumen and selected polymers (Atactic Poly-Propylene) blended together to obtain excellent heat & UV resistance and waterproofing properties.



Roof insulation



APP Membrane

Cold storage units use racks for storing and vertically stacking of the potatoes in the cold chamber. To prevent air infiltration in cold chamber during loading and unloading, strip curtains must be used. However, in all facilities, curtains were not available.

Potato bags stored in racks

Conventional ceiling fans for potato drying

Apart from cold chamber, cold storage units also product grading and sorting area. Product grading and sorting area is generally used for processing of arrived product through systematic classification process before moving it to cold chamber. Here ceiling fans are used to maintain airflow for precooling of potatoes before loading and drying of potatoes after unloading.

(iii) Fans

Ceiling fans and exhaust fans are used in cold chambers to circulate cold air. Some units also use ceiling fans for potato drying in their shed areas. The majority of the units use conventional ceiling fans; however, a few units have BLDC ceiling fans in their cold chambers.

(iv) Lighting/illumination system

The lighting provided in the cold chambers, grading and sorting area, machine room are mainly LED lamps. Some of the facilities still have 60W incandescent lamps in cold chambers and 40W and 36W fluorescent tube lights in grading and sorting area.

Energy scenario in the cluster

WBSEDL and CESC are the available power utility in Hooghly district and both have special tariff for Cold storages and Dairies with Chilling Plant. The applicable electricity tariff for cold storage facilities in Hooghly is shown in table below.

Electricity tariff for cold storage facilities

Power Utility	Consumer category	Tariff Code	Tariff scheme	Tariff details
WBSEDCL[1]	Other than Industrial, Commercial and	Rate C- ID	Normal	Demand Charges: INR 270 per kVA per month Energy Charges: INR 6.31 per kWh
	Domestic consumers except	Rate C- IDT	Normal - TOD	Demand Charges: INR 270 per kVA per month Energy Charges (INR/kWh):

[1] WBSEDCL Tariff chart dated 30.03.2023 for the year 2023-24

<table>
<tr><th>Power Utility</th><th>Consumer category</th><th>Tariff Code</th><th>Tariff scheme</th><th>Tariff details</th></tr>
<tr><td></td><td>Short-term/
Construction/
Emergency Power Supply
(50 KVA and above)</td><td></td><td></td><td><table><tr><td>Normal</td><td>5.90</td></tr><tr><td>Peak</td><td>8.23</td></tr><tr><td>Off-peak</td><td>3.92</td></tr></table></td></tr>
<tr><td></td><td rowspan="2">Cold storage/
Dairies with Chilling Plant</td><td>Rate S(F)</td><td>Normal</td><td>Demand Charges: INR 360 per kVA per month
Energy Charges: Summer – INR 6.36 per kWh
Monsoon – INR 6.35 per kWh
Winter – INR 6.34 per kWh</td></tr>
<tr><td></td><td>Rate S(FT)</td><td>Normal - TOD</td><td>Demand Charges: INR 360 per kVA per month
Energy Charges (INR/kWh):<table><tr><th></th><th>Summer</th><th>Monsoon</th><th>Winter</th></tr><tr><td>Normal</td><td>6.19</td><td>6.18</td><td>6.17</td></tr><tr><td>Peak</td><td>8.57</td><td>8.56</td><td>8.54</td></tr><tr><td>Off-peak</td><td>4.16</td><td>4.15</td><td>4.14</td></tr></table></td></tr>
<tr><td>CESC[2]</td><td rowspan="2">Cold storage or Dairy with Chilling Plant</td><td>Rate CP</td><td>Normal</td><td>Demand Charges: INR 384 per kVA per month
Energy Charges:
Summer – INR 6.88 per kWh
Monsoon – INR 6.83 per kWh
Winter – INR 6.78 per kWh</td></tr>
<tr><td></td><td>Rate CP (TOD)</td><td>Normal - TOD</td><td>Demand Charges: INR 384 per kVA per month
Energy Charges (INR/kWh):<table><tr><th></th><th>Summer</th><th>Monsoon</th><th>Winter</th></tr><tr><td>Normal</td><td>6.68</td><td>6.63</td><td>6.58</td></tr><tr><td>Peak</td><td>9.88</td><td>9.80</td><td>9.73</td></tr><tr><td>Off-peak</td><td>4.70</td><td>4.66</td><td>4.63</td></tr></table></td></tr>
</table>

** Note: Normal hours = 06.00 hrs - 17.00 hrs, peak hours = 17.00 hrs - 23.00 hrs, off-peak hours = 23.00 hrs - 06.00 hrs*

Here majority of the consumers are covered under WBSEDCL supply. Tariff rate S(F) and S(FT) of WBSEDCL are opted by almost all cold storages, few cold storages have lower demand (below 150 kVA) opted for tariff rate C- ID or C- IDT of WBSEDCL.

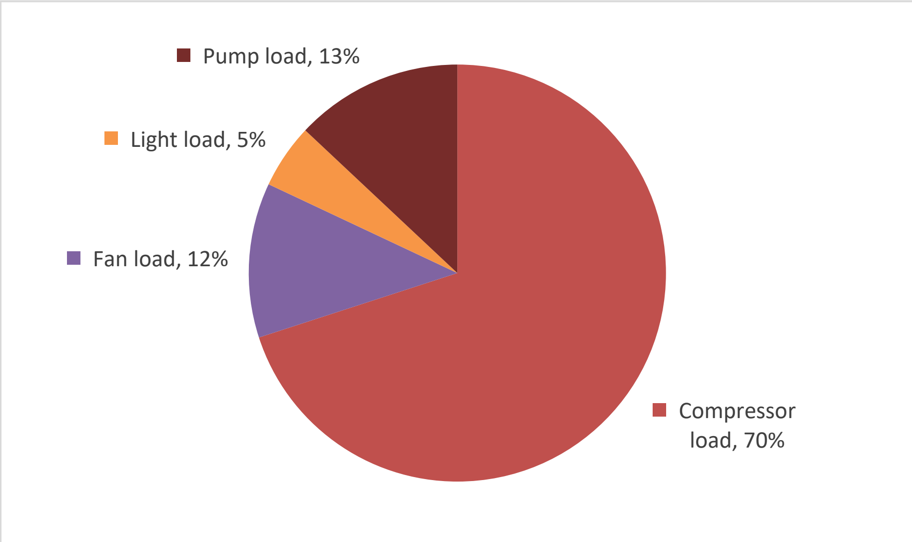
For backup purpose during power cut, these units use diesel generators for power generation and also diesel engines to run compressors. Cost of diesel is around INR 93.00 per litre.

[2] CESC Tariff and Associated terms and conditions for 2021-22

Energy consumption

Unit level consumption

Electricity is the only energy form used in cold storage facilities. Few facilities also use DG sets for backup power and diesel engines to run compressor during power cuts which use HSD. There is no significant effect on temperature of cooling room temperature during short periods of power cuts. The major energy consuming area is refrigeration unit which accounts for about 70% of total energy input to the facility. Electricity consumption of different capacities of cold storage facilities are given in the table below.



Share of operating loads

Energy consumption of different categories of cold storage facilities

Production category	Electricity (kWh/year)	Diesel (litre/ year)	Total energy (toe/ year)	Total CO_2 emissions (tCO_2/year)	Annual energy bill (million INR)
Category -1 (Below 10,000 MT)	5,54,182	4,700	52.4	405	4.37
Category – 2 (between 10,000 to 20,000 MT)	8,11,734	2,150	72.5	581	7.32
Category - 3 (Over 20,000 MT)	10,92,890	2,867	97.5	783	8.67

Cluster level consumption

The annual electricity consumption of Hooghly cold storage cluster is estimated to be 110.9 million kWh and 0.5 million litre diesel, equivalent to 10,073 tonne of oil equivalent (toe). The equivalent carbon emissions from the cluster are about 0.8 million tonne of CO_2. The overall energy bill of cluster is estimated to be INR 939.7 million. The share in energy consumption by of various capacities of cold storages shows that category-2 facilities (between 10000 to 20000 MT) consume about 50% of total energy consumption of the cluster (figure).

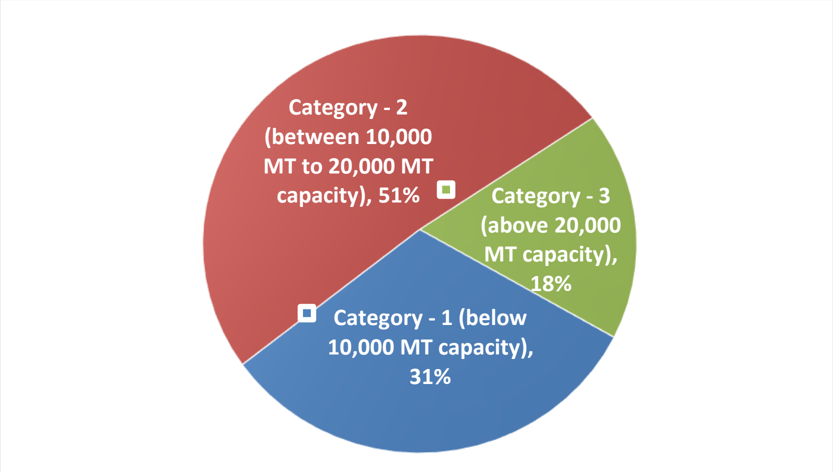


Figure 1: Share of energy consumption by various capacities

Table 1: Energy consumption of the Hooghly cold storage cluster

Energy type	Annual consumption	Equivalent energy (toe)	Equivalent CO_2 emissions (tCO_2)	Annual energy cost (million INR)
Electricity	110.9 million kWh	9,633	7,87,054	893.8
Diesel	0.5 million litre	440	1,251	45.9
Total	**-**	**10,073**	**7,88,306**	**939.7**

(Source: field survey and interaction with unit entrepreneurs)

Potential energy efficient technologies

Some of the major energy efficient technologies for Hooghly cold storage facilities in the cluster are discussed below.

(i) Re-piping of existing facilities

The cluster survey indicated that the cold storage facilities which were established before 2005 could be re-piped. Any refrigeration distribution network with a pressure drop between the evaporator and condenser of over 0.2 bar may require re-piping. A thumb rule indicates that about 0.1 bar pressure drop corresponds to almost two degrees in lower suction pressure and about 7% power consumption.

The pressure drops between generation and end- use points can be measured by installing two identical calibrated pressure gauges at the compressor and at the evaporator. Along with this, cold storage facilities having poor insulated pipes, particularly corrosive, should be examined. Improper insulation of pipes is quite common. Insulation also deteriorates due to poor maintenance practices. It is necessary to examine all pipes periodically with check list and master installation scheme. Frost piping or valves indicates that these required re-insulation or maintenance of existing insulation and the valves which is required to operate on regular basis may kept open/ uninsulated.

An uninsulated pipe may increase the load on refrigeration system up to 0.035 ton per m2. The estimated pipe length of typical installation in a cold storage facility in Hooghly cluster is about 200-400 feet. Replacement of pipe and the insulation, together with valves may reduce the electricity consumption up to 5-8% with payback period of 1 year maximum.

(ii) Refrigeration system controls

The major components of refrigeration system in a cold storage facility include compressors, evaporators and condensers. The role of a control system in refrigeration system is to operate the system based on minimum temperature requirements and maximum temperature changes in the chambers while maintaining specific power consumption (kW per TR) close to design values.

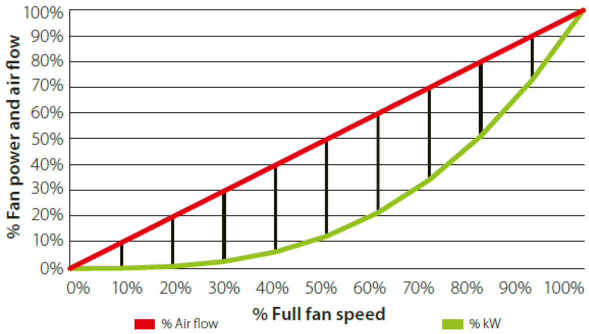


Figure 2 : Effect of fan speed on power & air volume

Source: Oxford Cold Storage Company

Cold storage facilities in Hooghly cluster do not have automatic control system for operation of evaporators, compressors and condensers. Older facilities use temperature display of chambers either in machine room or at entry door of chamber. The evaporator fans are operated on continuous basis and there is generally no provision to reduce or alter the speed. Control of evaporator fans is a key to reduce energy consumption in a cold storage facility. When the chamber reaches to the set temperature, the evaporator fans should be switched off or the speed must be minimised.

The input power to evaporator fan should be minimized, because it increases the load of entire system with additional heat. In absence of control system, motor heat from evaporator fans enters cold chambers and forces compressors and condensers to operate result in additional electricity consumption. To overcome this issue, a combination of evaporator variable frequency drives and ON/OFF system may be provided. This will allow evaporator fans to circulate air at lower speeds after upon achieving set temperature. For operation of compressor, condenser and evaporator in a closed loop system, the control assembly would require sensors to capture correct temperature of entire chamber, variable frequency drives and monitoring system. The estimated investment requirement for a 5000 MT cold storage facility is Rs 1.0-1.2 million with a simple payback period of 18-24 months.

(iii) Improved door design

In cold storage facilities, there are daily movements of materials from loading docks to the chambers which use forklifts and pallet trucks. The movements lead to multiple times door openings requiring defrosting on daily basis. The major heat loads in the cold chambers include (1) infiltration of hot and humid air from outside areas and (2) leakage of refrigerated air to atmosphere. To maintain optimum efficiency and cost effectiveness of refrigeration system, it is essential to control number and size of doors provided in the facilities.

To avoid heat losses from cold chamber or heat or air ingress into the chamber, all product receivables and load-outs must be undertaken in a refrigerated loading area and packets should be transported into the storage areas through mechanical conveyors and port holes in chamber walls. Some of the measures to reduce refrigerated air in newer cold storage systems and which may be retrofitted in older facilities are the following:

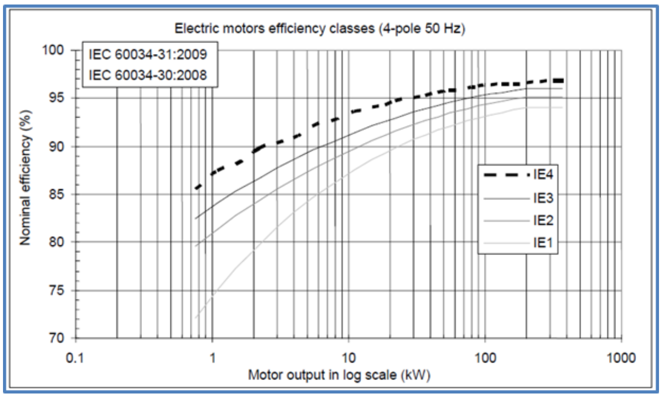
- Airlocks/ air curtains on all access doors
- Inter-locking of inflatable airbag operation to dock doors
- Periodic check and maintenance on door seals, door self-closers and air bags.

(iv) Create buffer area (ante rooms)

A significant amount heat is added to cold storage rooms during loading and unloading processes of materials which may be attributed to improper use of anteroom/ buffer area. The main reason for such large ingression of heat is significant temperature difference between cold storage room and the ambient. To avoid such air ingress, ante rooms need to be created which would act as buffer area between cold storage room and ambient. About 3-5% energy savings over baseline has been estimated with creation of anterooms. The implementation cost is negligible since anterooms have already been constructed in all new cold storage facilities as per guidelines of National Horticulture Board. However, at present a majority of cold storage facilities do not take benefits of buffer areas during loading and unloading.

(v) Installation of high efficiency motors

A majority of electric motors used in air compressors, pumps and fans of cold storage units are of standard efficiency type motors. In a number of units, re-wind motors are commonly used. These standard/rewound motors may be replaced with high efficiency IE-3 motors e.g. motors used in air compressors. Energy savings with high efficiency motors is estimated to be 5-7% over the standard motors. The simple payback period estimated based on the average operating house is 18-24 months.



(vi) Use of BLDC ceiling fans for evaporator coils and potato drying

BLDC fans are known for their energy efficiency. They consume less electricity compared to traditional ceiling fans. Moreover, generates less amount of heat compared to induction ceiling fans and hence results in more efficient refrigeration. Existing conventional fans observed have various rated power e.g. 55 W, 75 W and 90 W. Considering the lowest wattage of conventional fans i.e. 55 W, 40% of energy can be saved with a simple payback period of 18 to 36 months depending on hours of operation.

(vii) Use of high efficiency/low heat illumination system

The electricity share of illumination system in a typical cold storage is about 4-5%. Use of inefficient incandescent lighting/ lamps makes leads to heating which needs to be removed by refrigeration system. To avoid additional load due to illumination system, energy efficient lighting sources which produce low level of heat and equal lumen level may be installed. LED light is one of the best options which produces quite small quantity of heat but delivers equal lux level with comparatively very less power. LED lights are claimed to produce minimum 80% of original light output with a life of about 50,000 hours. Use of LED lighting will help in reducing electricity bills required for illumination system up to 55% with a simple payback period of 24 months.

(viii) Installation of rooftop SPV system

The expansive, shadow-free RCC roofs of all cold storages present a tremendous opportunity for harnessing solar power through rooftop SPV systems. While the financial gains in net metering systems are minimal, opting for SPV with zero export and DG synchronization proves advantageous. Advisably, the solar system's capacity should align with power demand during regular operation (excluding peak operation in loading) for swift returns. With the enticing government subsidy on the total investment for SPV installation, cold storage units can anticipate a payback period of 4.5 years, enhancing both sustainability and economic viability.

Major cluster actors and cluster development activities

The West Bengal Cold Storage Association stands as the nodal organization representing cold storages in the region of West Bengal. The association conducts annual general meeting and need based meetings/ seminars. It also shares/ disseminates information among members on energy saving and technology upgradation.