



Updated Market Assessment of Deep Freezers in India

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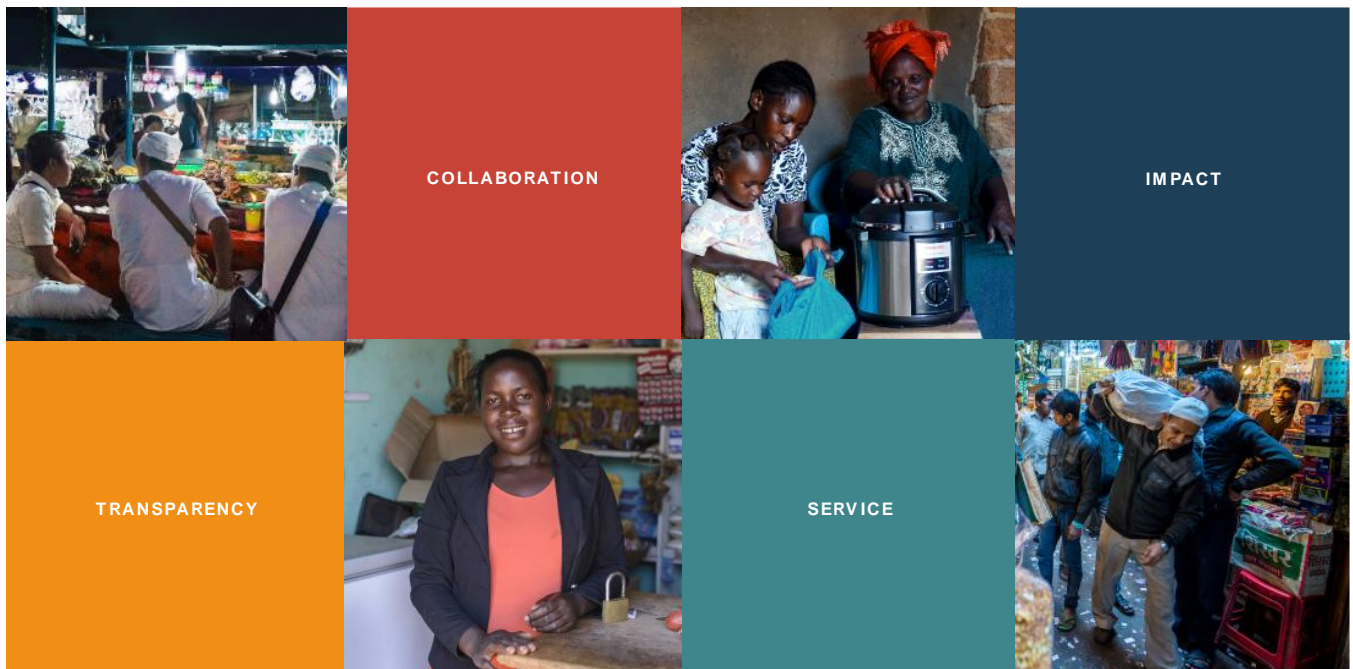
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List of Abbreviations

AEC	Annual Energy Consumption
BEE	Bureau of Energy Efficiency
CAGR	Compound Annual Growth Rate
CO ₂	Carbon di-oxide
EE	Energy Efficiency
FY	Financial Year
GHG	Greenhouse Gas
IS	Indian Standard
ICAP	Indian Cooling Action Plan
kWh	Kilowatt-hour
MtCO ₂	Million Tons of CO ₂
NABL	National Accreditation Board for Testing and Calibration Laboratories
OEM	Original Equipment Manufacturer
TWh	Terawatt-hour

Executive Summary

Deep freezers are refrigerating appliances in which food products are frozen to increase shelf life. The typical examples of foods which are stored in deep freezers include ice creams, frozen meats (fish, poultry, livestock), frozen foods, frozen processed commodities. Deep freezers constitute a significant market share in the refrigeration segment after household refrigerators. These appliances are adopted in retail, hospitality, and residential sectors. The growing use of deep freezers is expected to increase the refrigeration load, and thus energy consumption in India. Recognizing an expected growth, the Bureau of Energy Efficiency (BEE), a statutory body under India’s Ministry of Power, decided to develop an energy efficiency labeling program for chest-type deep freezers to enable a transition to efficient deep freezers. Therefore, BEE developed the efficiency policy for chest-type deep freezers and announced the voluntary program in March 2020.

Given the massive opportunity for potential GHG emissions reductions and energy consumption from deep freezers, BEE now aims to make the labelling program mandatory to comply with the India Cooling Action Plan (ICAP), which includes short term recommendations on promoting energy efficiency for commercial refrigeration appliances. CLASP, with support from PwC India, is providing technical assistance to BEE in transitioning the efficiency policy for deep freezers to a mandatory stage. The team reached out to key industry players to estimate the current market size of deep freezers in India, the state of energy performance of the appliances available in the country and the extent of voluntary label penetration. The structured questionnaire and in-depth interviews provided the following insights:

1. Current market size for chest-type deep freezers for FY 20-21 is ~**5.5 lakhs** as reported by manufacturers, out of which ~ **3 lakh units are imported**
2. The market size for chest-type deep freezers is envisaged to grow at 12% for the next 5 years and is expected to reach 9.4 lakhs by FY 2025-26
3. Capacity ranges of more than 300L constitute 81% of market share
4. Primary data received from leading manufacturers indicate an availability of 94 models with 62 hard-top and 32 glass-top models respectively
5. 2 of the largest manufacturers have registered their models under the voluntary phase with BEE
6. Out of 94 models submitted by manufacturers, 25 models are registered in the voluntary phase (<30% penetration for registration of models in voluntary phase with BEE)¹
7. As per NABL, 3 manufacturers and 3 test labs have accredited test facilities as per IS 7872:2020

The Bureau of Energy Efficiency has proposed to make the chest-type deep freezer labeling program **mandatory from 01 July 2023, with a star rating table validity period of 2 years – 01 July 2023, to 30 June 2025**, with the following table:

Star Rating	Chest Freezers (Hard Top)	Chest Freezers (Glass Top)
Validity January 01, 2023 – December 31, 2024		
AEC (Annual Energy Consumption) (kWh/year)		
1 star	$4.23*V + 126.65 \leq AEC < 5.07*V + 151.98$	$7.68*V + 511.17 \leq AEC < 9.21*V + 613.40$
2 stars	$3.52*V + 105.54 \leq AEC < 4.23*V + 126.65$	$6.40*V + 425.97 \leq AEC < 7.68*V + 511.17$
3 stars	$2.82*V + 84.43 \leq AEC < 3.52*V + 105.54$	$5.12*V + 340.78 \leq AEC < 6.40*V + 425.97$
4 stars	$2.25*V + 67.55 \leq AEC < 2.82*V + 84.43$	$4.09*V + 272.62 \leq AEC < 5.12*V + 340.78$
5 stars	$AEC < 2.25*V + 67.55$	$AEC < 4.09*V + 272.62$

¹ As on March 23, 2022, as available on BEE website

A cumulative savings of ~ **14.9 TWh** and ~ **11.7 MtCO2** is estimated (by FY 2030) from the mandatory labeling program of deep freezers.

1. Deep Freezer Technology & Categories

that is funnelled away by an electric fan. The refrigerant, acts as the transfer medium, absorbing and rejecting heat with the expansion valve regulating the amount and thermodynamic state of the refrigerant. The operating principle for a deep freezer is depicted in the Figure 1.

INTRODUCTION

Deep freezing is a technique in which food items are cooled rapidly (in less than an hour) by exposing them to intense cold temperatures. Commercial and household deep freezers are thermally insulated cabinets. They are intended for storing frozen food when the food is brought in at the same or a lower temperature than $-18\text{ }^{\circ}\text{C}$, which is the product coverage of the BEE labelling program.

Deep freezers are electrical equipment in which food products are frozen to increase their shelf life. The typical examples of foods which are stored in deep freezers are ice creams, frozen meats (fish, poultry, livestock), frozen processed foods, and some frozen processed commodities. The temperature requirements and technology employed for cooling vary as per the nature and perishability of the product.

OPERATING PRINCIPLE

Deep freezers work on the principle of vapor compression. The vapor compression uses a circulating liquid refrigerant as the medium which absorbs heat from one place and subsequently rejects it elsewhere. Key functional components of a deep freezer include condenser coil, evaporator coil, compressor, expansion valve and electric fan.

During the vapor compression cycle, the refrigerant generally undergoes 4 stages i.e., compression, condensation, throttling, and evaporation through various thermodynamic state changes. The refrigerant absorbs the heat inside the freezer when it flows through the evaporator coils. Due to the heat absorbed by the saturated low-pressure refrigerant; a state change of refrigerant occurs as per the thermodynamic laws leading to production of freezing temperatures outside the coil. This air blowing with the help of an electric fan results in a mist of cold air throughout the volume of the freezer compartment. The refrigerant then passes into the compressor. The compressor converts the low pressure gas into a pressurized liquid that enters the condenser coil. A state change of refrigerant takes place again, as per thermodynamic laws, which produces heat behind the freezer

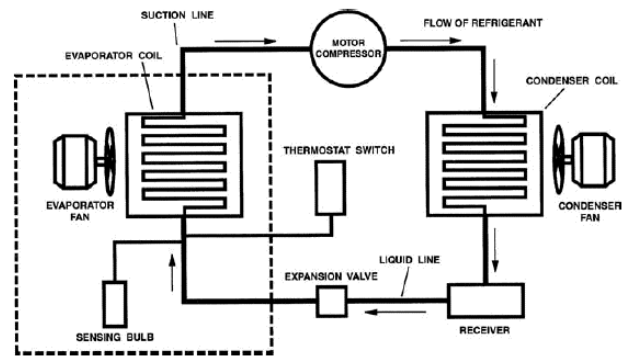


FIGURE 1: WORKING PRINCIPLE OF A DEEP FREEZER

APPLICATION

Deep freezers have a variety of applications, such as:

- Retail and hospitality
- Food and beverage processing
- Cold storage and warehouses
- Labs, hospitals, pharmacies

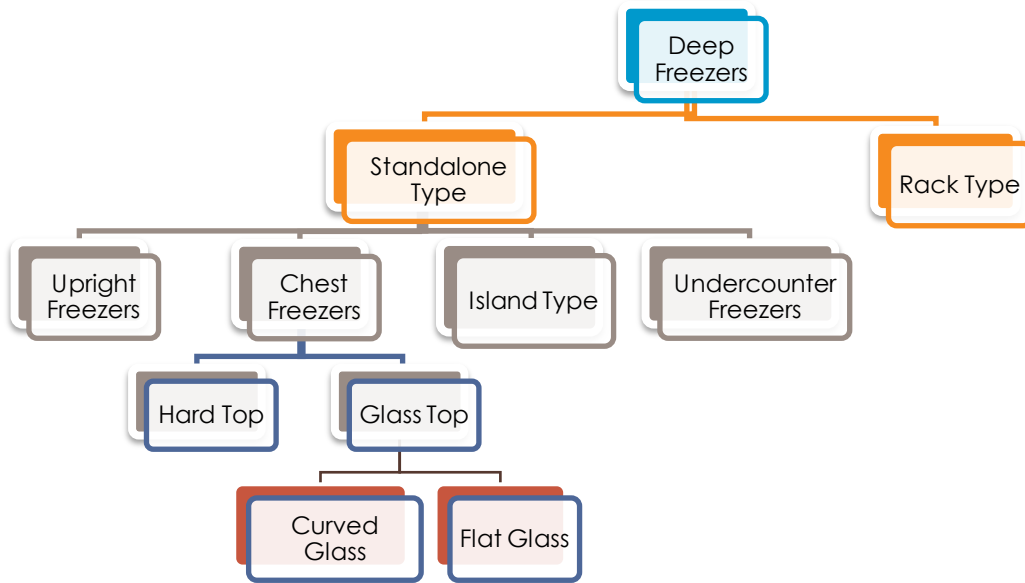
Each application of the deep freezer has different temperature requirements such as in restaurants and hospitality sectors, depending on what is being stored, temperatures may range between $-17\text{ }^{\circ}\text{C}$ to $24\text{ }^{\circ}\text{C}$. Deep freezers should ideally be kept between $0\text{ }^{\circ}\text{C}$ – $9\text{ }^{\circ}\text{C}$ to prevent growth of bacteria. These temperature ranges are critical to prevent food-borne illness. Cold storage or warehouses require temperature between $2\text{ }^{\circ}\text{C}$ – $8\text{ }^{\circ}\text{C}$. Whereas for medical purposes, the temperature range for deep freezers is usually set between $-10\text{ }^{\circ}\text{C}$ – $0\text{ }^{\circ}\text{C}$. The temperature of freezers that are used in laboratories and medical industries can be set up to $-60\text{ }^{\circ}\text{C}$. This report focuses on deep freezer applications in retail and residential sectors.

CLASSIFICATION

There are various types of deep freezers available in the Indian market. They can be classified based on their capacity, type, and application.

sizes ranging from 50 to 1000 liters. Standalone freezers can be categorized into the following sub types:

FIGURE 2: CLASSIFICATION BASED ON TYPE



Capacity

Deep freezers come in various capacities ranging from 50 to 1000 liters. Based on their capacity, they are broadly divided into 4 segments:



Type

Deep freezers are broadly classified into two categories i.e., stand alone and rack type, with further sub-categorizations as depicted in Figure 2. The choice of deep freezer for an application depends on the capacity, design, application, cost, place of installation etc. The appliances currently covered under BEE’s labelling program are those shown in Figures 4 to 7.

Standalone Freezers

Standalone systems are plug and play units with the evaporator, condenser, compressor, and expansion valve housed in a compact single assembly. They come in various

Upright Deep Freezers

As the name suggests, these are vertical in shape and have access from the front. These are not as prevalent in the market as their chest type counterparts.

FIGURE 3: UPRIGHT TYPE DEEP FREEZER



Chest Freezer

These are horizontal in shape with access from the top. They are the most common type of freezers in the Indian market and are further classified into the following categories:

Hardtop

These deep freezers have a door, which is the same material as the body. These could be single door, double door or triple door (which are rare) as shown in figure 4 and 5. In the case

of double door, there could be two separate compartments having different temperature settings depending upon the user convenience and need.

FIGURE 4: SINGLE DOOR HARD TOP



FIGURE 5: DOUBLE DOOR HARD TOP



➤ **Glass Top**

The door in this type of freezers is made up of hard glass with a sliding mechanism enabling the customers to view the products without opening the door. These are of two types

i.e., flat glass and curved glass as shown in figure 6 and 7.

FIGURE 6: CURVED GLASS DEEP FREEZER



FIGURE 8: ISLAND TYPE FREEZER



FIGURE 7: FLAT GLASS DEEP FREEZER



- **Island Type**

These are generally found in supermarkets and very large convenience stores. These are used for displaying large amounts of frozen foods especially meats, fish and seafood allowing customers to browse through the products at display. They come in large capacities and generally have multiple compressors and heat exchangers. They are not very popular in the Indian market.

- **Under Counter**

Under counter freezers are like chest freezers but are often built with aluminum interior walls and stainless-steel floors. The main purpose of an under counter deep freezer is to provide quick access to products through multiple drawers and doors. Most of the under-counter freezers conform to 0.90 m height, which allows them to roll underneath 0.91 m high countertops. These are mostly used by chefs for keeping the cooked food fresh as per different temperature requirements of the foods.

FIGURE 9: UNDER COUNTER FREEZER





2. Voluntary Program

VOLUNTARY PROGRAM

BEE launched the voluntary labelling program for chest type deep freezers in March 2020, to comply with the **ICAP recommendations on promoting energy efficiency** in commercial refrigeration appliances. Deep freezers constitute a significant market share in the refrigeration segment after household refrigerators. These appliances find application in retail, hospitality, and even residential sector. The scope and other details of the voluntary labelling program are mentioned in the table 1.

The voluntary star rating table in table 2 was initially valid till 31st December 2021, which was further extended till 31st December 2022 due to some compelling factors primarily on account of COVID Pandemic. The star labelling program for chest type deep freezers has been proposed to be made mandatory from **1st January 2023** by BEE.

TABLE 1: SNAPSHOT OF VOLUNTARY PROGRAM

Appliance	Scope	Standard	Testing Parameters	Efficiency Metric
Deep Freezer	Top access or chest type (Both hard top and glass top type) having storage volume up to and including 1000 liters and their rated voltage not exceeding 250 V ac 50 Hz for single phase and 415 V ac 50 Hz for three phase ac	IS 7872: 2020 IS / IEC 60335 -2 - 89 (Safety standard)	Performance Tests: Pull down time, Energy Consumption, Volume Safety Tests: Leakage current, Creepage Distance, Earthing Connection, High Voltage, Protection against electric shock.	Annual Energy Consumption (kWh/year)

TABLE 2: VOLUNTARY STAR RATING TABLE

Star Rating	Chest Freezers (Hard Top)	Chest Freezers (Glass Top)
Validity 1 st January 2020 – 31 st December 2022		
AEC (Annual Energy Consumption) (kWh/year)		
1 star	$4.23 * V + 126.65 \leq AEC < 5.07 * V + 151.98$	$7.68 * V + 511.17 \leq AEC < 9.21 * V + 613.40$
2 Star	$3.52 * V + 105.54 \leq AEC < 4.23 * V + 126.65$	$6.40 * V + 425.97 \leq AEC < 7.68 * V + 511.17$
3 Star	$2.82 * V + 84.43 \leq AEC < 3.52 * V + 105.54$	$5.12 * V + 340.78 \leq AEC < 6.40 * V + 425.97$
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5 Star	$AEC < 2.25 * V + 67.55$	$AEC < 4.09 * V + 272.62$

A sample label for Deep Freezers is presented below:

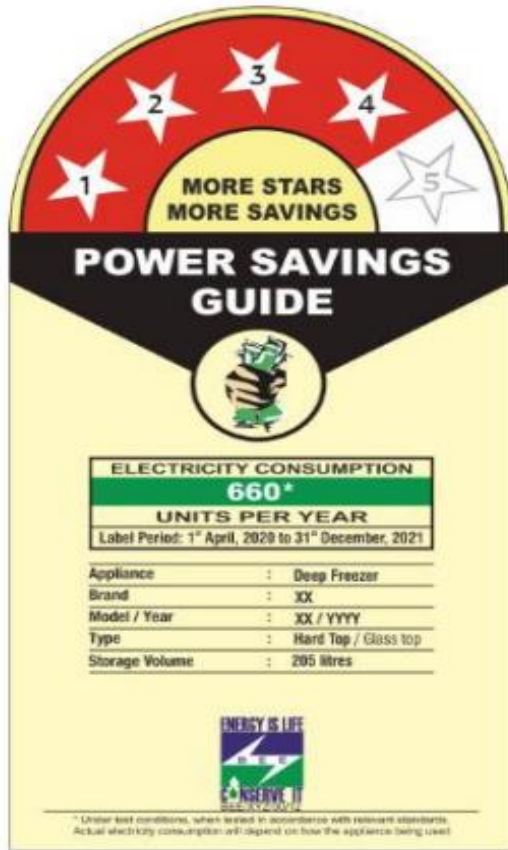


FIGURE 10: STAR RATING SAMPLE LABEL

Star Rating is the number of stars displayed on the energy label. The available stars are between a minimum of one and a maximum of five shown at a one-star interval. The star rating is calculated from the Star Rating Band as shown in Table 2. The Star Rating determination will vary for different models based on the storage volume. The Star Rating Band is stems from the annual energy consumption (kWh/Year), which is arrived at by the calculation and is used for determining the number of stars to be displayed on the energy label.

The following equation is used to determine the Star Rating Bands for a particular model:

$$\text{Star Rating Band (SRB)} = Kdc * V + Cdc$$

Where, Kdc = Constant Multiplier (kWh/Liter/Year), V = Storage Volume (Liter) and Cdc = Constant Fixed Allowance (kWh/Year)

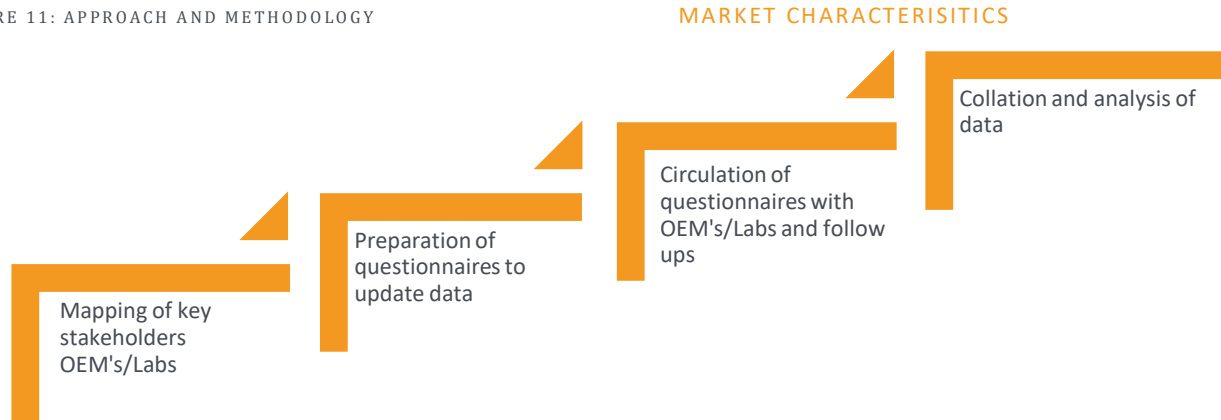


3. Market Assessment

APPROACH & METHODOLOGY

The market assessment for chest type deep freezers was earlier conducted in 2018-19 through a comprehensive questionnaire for the voluntary phase of the program. The current market assessment is built upon the earlier market assessment data to complete the tasks at hand. A robust approach comprising both primary and secondary data collection was adopted for collecting relevant market data necessary to understand the market and the product performance. The overall methodology for updating the market assessment of deep freezers is depicted in Figure 11.

FIGURE 11: APPROACH AND METHODOLOGY



The information about the market for chest-type deep freezers was collected from both primary and secondary sources, as explained below:

- Primary research was conducted through
 - Intensive individual interviews and interaction with manufacturers
 - Questionnaire-based survey: A structured questionnaire was shared with all major manufacturers to collate the required information. The questionnaire included questions on the following key parameters (as listed in Annexure A):
 - **Market size:** Manufacturer sales / market data (units sold)
 - **Model penetration under voluntary program:** Number of models registered in the voluntary phase with BEE
 - **Testing capacity:** Availability of in-house and third-party testing laboratories, accreditation status, test standards followed
 - **Performance Testing Data:** Energy performance test standard, energy consumption

- Secondary research and analysis including market reports available in the public domain, articles, journals, and web-based sources.

MARKET CHARACTERISTICS

Major Market Players

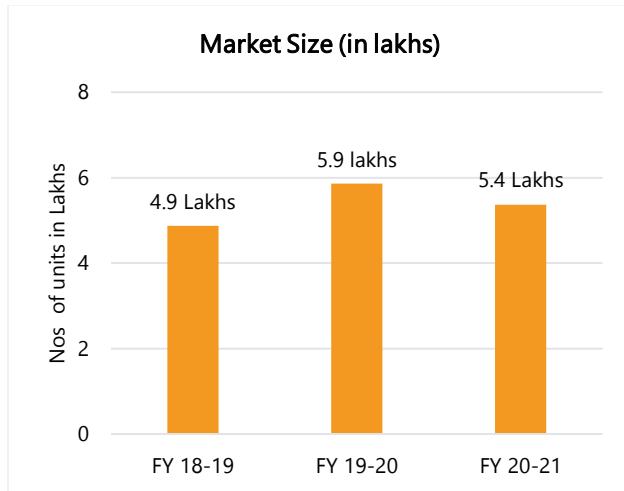
The chest-type deep freezer market in India presents a mixed scenario with a variety of players from across the world. Predominantly, the deep freezer market is import-driven but some Indian manufacturers such as Voltas, Blue star, Godrej, Frigoglass and Western have their manufacturing facilities in India (although a significant number of their models are still being imported). Other players such as Elanpro, Whirlpool, and Panasonic import their units wholly from China. Key players in the deep freezer market are listed below:

Blue Star
Voltas
Frigoglass
Whirlpool
Elanpro
Lloyd
Haier
Western
Godrej
Panasonic

Market Size

As per our discussion with various manufacturers, the total average market size for chest-type deep freezers for FY 2020-21 is about 5.4 lakh units. The market size increased by 20% from FY 2018-19 to FY 2019-20. However, the market size decreased by 8% from FY 2019-20 to FY 2020-21 due to the COVID19 pandemic.

FIGURE 12: MARKET SIZE OF CHEST TYPE DEEP FREEZERS



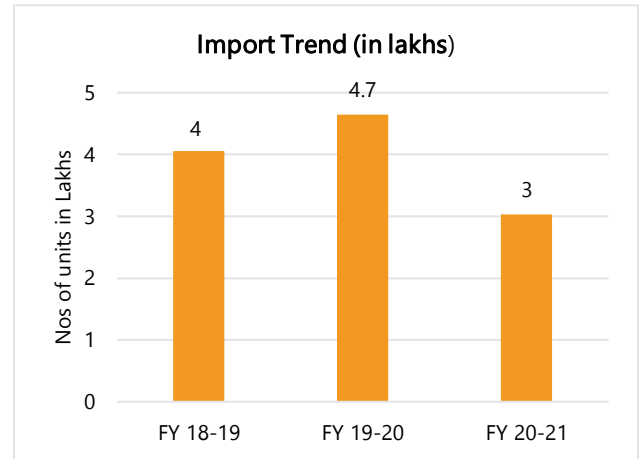
Import / Export Data

As per data from the Ministry of Trade and Commerce, 3 lakh chest-type deep freezer units were imported, which means the indigenous manufacture was approximately 2.4 lakh units. The export component for chest-type deep freezers is miniscule – merely 9000 units were exported in FY 20-21.

Since the deep freezer market is mostly import-driven, a comprehensive analysis on Import / Export data for FY 2020-21 has been carried out to understand market trends. The import/export data for each year has been sorted using Harmonized System (HS) codes from one of the online providers of commercial and import / export information known as Trademap.org and Ministry of Trade and Commerce website. Trademap.org is a popular source for import / export data and a lot of businesses use its data for Management Information Systems (MIS) and other purposes. To cross check the authenticity of the data, the total import and export quantity for FY 2020-21 from trademap.org was validated against the Ministry of Commerce, indicating that there was no variation in annual import quantities.

The figure below illustrates the major countries of import and export for FY 2020-21

FIGURE 13: IMPORT TREND OF CHEST TYPE DEEP FREEZERS



Exports

FY 2020-21 (Total units exported: 9000)

Nepal-39%
 Bhutan-11.8%
 UAE-9%, Liberia- 8%, Libya-7.3%, Qatar-6.8%
 Others-18%

Imports

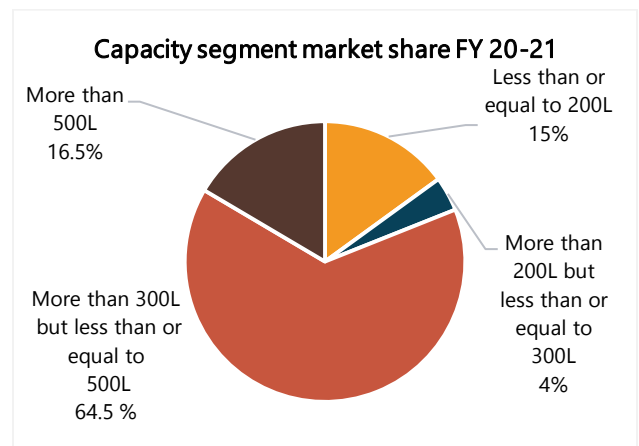
FY 2020-21 (Total units imported 3 lacs)

China - 98 %
 Others-2%

Capacity Segment market share

Figure 14 depicts the market share of chest type deep freezers by capacity. Capacity ranges of more than 300L constitute 81% of the market share.

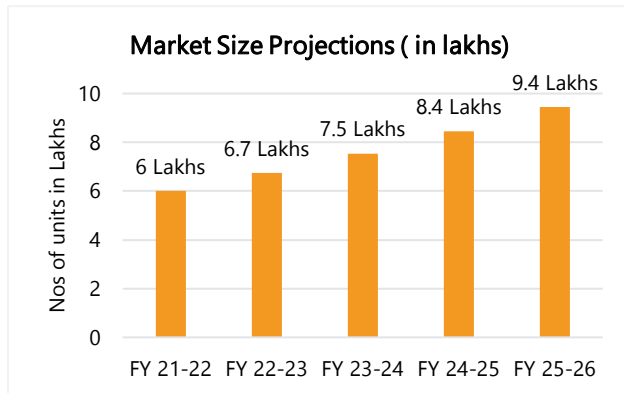
FIGURE 14: CAPACITY SEGMENT MARKET SHARE FY 20-21



Market Size Projections

The chest-type deep freezers market grew at ~20% prior to FY 2019-20, COVID19 led to a decrease of ~8% market size in FY 2020-21. Conservatively, the market size is envisaged to grow at ~12% in the next 5 years, as shown in the figure below. The market is expected to reach 9.4 lakhs by FY 2025-26.

FIGURE 15: CHEST TYPE DEEP FREEZER MARKET SIZE PROJECTIONS



Performance Data

This section discusses the methodology adopted for gathering energy performance data for chest-type deep freezers (hard top and glass top). The following information was requested for all models of the chest freezers from all the manufacturers:

- Energy consumption data
- Net / storage volume and gross volume data

The total data for 94 models of chest freezer was received from the manufacturers (Annexure B). The bifurcation of 94 models is:

- 62 hard top models
- 32 glass top models

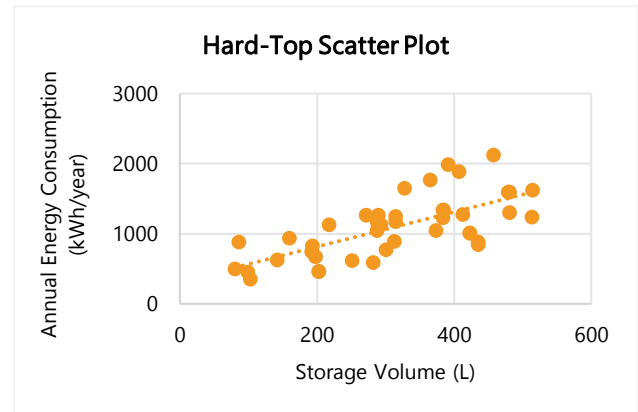
Hard Top - Performance Data

The graph in Figure 16 shows the relation between Annual Energy Consumption (kWh/year) with storage volume (L) for 42 hard top models.

Out of the 62 hard top models received, 20 hard top models were not considered in the analysis:

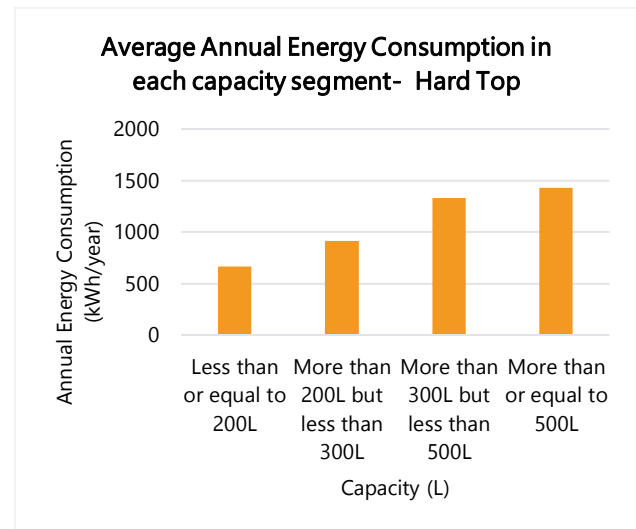
- 12 models of Voltas as performance data received is not based on testing as per relevant Indian standards
- 8 models (7 models of Western Equipment and 1 model of Lloyd) due to unavailability of performance data

FIGURE 16: HARD TOP SCATTER PLOT



The figure below shows the relationship between average annual energy consumption and capacity. As the capacity increases, the annual energy consumption increases.

FIGURE 17: AVERAGE ANNUAL ENERGY CONSUMPTION IN EACH SEGMENT-HARD TOP



The range of annual energy consumption for each capacity in hard top is given in table below:

TABLE 3: RANGE OF ANNUAL ENERGY CONSUMPTION -HARD TOP

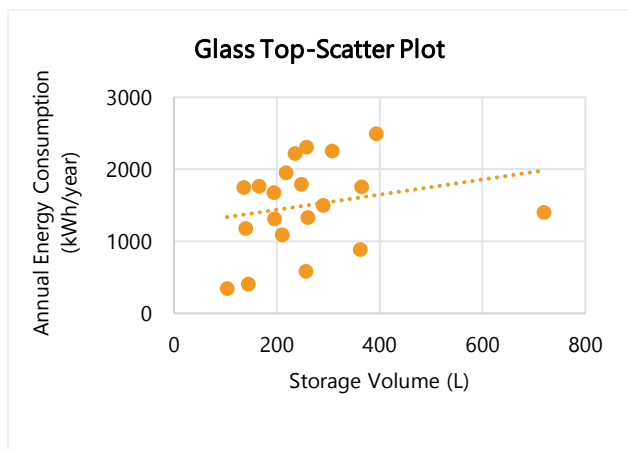
Capacity (L)	Range of Annual Energy Consumption in kWh
Less than or equal to 200L	350 to 935.5
More than 200L but less than 300L	465 to 1268.5

More than 300L but less than 500L	774 to 2127
More than or equal to 500L	1236 to 1621

Glass Top - Performance Data

The graph in Figure 18 below shows the relation between Annual Energy Consumption (kWh/year) with storage volume (L) for 20 models.

FIGURE 18: GLASS TOP-SCATTER PLOT

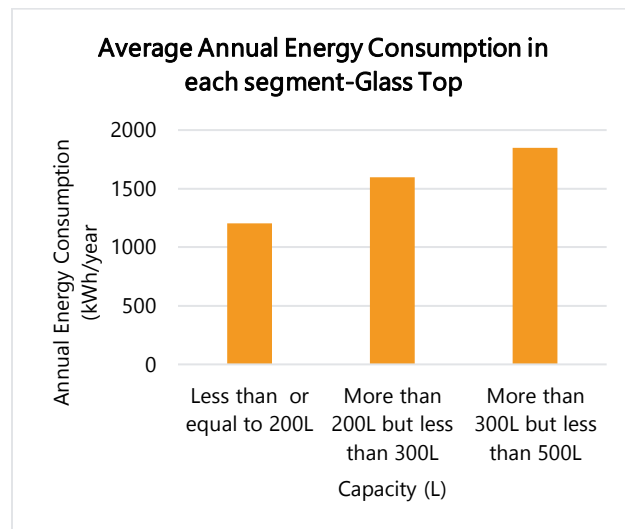


Out of the 32 glass top models received, 12 glass top models were not considered in the analysis:

- 3 models of Voltas as performance data received is not based on testing as per relevant Indian standards
- 9 models (8 models of Western Equipment and 1 model of Lloyd) due to unavailability of performance data

The figure shows the relationship between average annual energy consumption and capacity. As the capacity increases, the annual energy consumption increases.

FIGURE 19: AVERAGE ANNUAL ENERGY CONSUMPTION IN EACH SEGMENT-GLASS TOP



The range of annual energy consumption for each capacity in glass top is given in table below:

TABLE 4: RANGE OF ANNUAL ENERGY CONSUMPTION -GLASS TOP

Capacity (L)	Range of Annual Energy Consumption in kWh
Less than or equal to 200L	350 to 1768
More than 200L but less than 300L	590 to 2309
More than 300L but less than 500L	885 to 2496

The analysis points to a significant difference of 1.5-2 times in energy consumption between hard top and glass top models of the same capacity. It was therefore recommended to continue to define separate star rating bands for hard top and glass top models.

Testing Facilities and Infrastructure

As per our interactions with manufacturers, a majority of the chest type deep freezers in India are tested as per IS 7872 standard either in the manufacturer-owned test labs or 3rd party labs. As per NABL, currently 3 manufacturers / OEMs Western, Godrej, Voltas have NABL accreditation for testing as per IS 7872:2020 standard. Most of the manufacturers have NABL accreditation for refrigerator standards which require similar lab infrastructure for carrying out performance testing of deep freezers. Major manufacturers such as Frigoglass and Bluestar have stated that they are in the process of receiving their NABL accreditation, expected by the second quarter of 2022.

There are third party labs such as UL, Hi Physix Laboratory, Delhi Test House etc. which have NABL accreditations for conducting performance testing of deep freezers as per IS 7872:2020. Further, there are third party labs as well such as Intertek, Bharat Test House, Type Test Laboratory. However, as per NABL these labs currently do not have the accreditation for IS 7872:2020. It was also reported by the labs the NABL accreditation process for IS 7872 takes 3-4 months.

VOLUNTARY PROGRAM PENETRATION AND CHALLENGES FACED

Out of 94 models submitted by manufacturers, 25 models are registered in the voluntary phase (< 30% penetration of the registered models with BEE). These 25 models are by 2 manufacturers:

- Godrej - 3 models
- Haier - 22 models

Table 5 below shows the registered models with BEE and their corresponding range of Annual Energy Consumption in different capacities.

TABLE 5: RANGE OF MODELS REGISTERED WITH BEE IN VOLUNTARY PHASE

Manufacturer	Capacity (L)	Number of Models in each capacity	Range of Annual Energy Consumption in kWh/year
Godrej	Less than or equal to 200L	0	1045
	More than 200L but less than 300L	1	1045
	More than 300L but less than 500L	2	1228-1301
	More than or equal to 500L	0	1236
Haier	Less than or equal to 200L	3	350-405
	More than 200L but less than 300L	6	465-1333
	More than 300L but less than 500L	10	695-1760
	More than or equal to 500L	3	1060-1405

As per manufacturers, the low participation in the voluntary program can be attributed to the following reasons:

- Onset of COVID19 pandemic just after the voluntary label program launched in 2020 led to uncertainty of supply chain and market behaviors
- Awaiting the NABL accreditation for in-house laboratories
- Costly third-party testing at independent labs
- Import-dominated product (~60%)

COMPARISON OF PERFORMANCE DATA COLLECTED IN 2018-19 FOR TRANSITIONING TO VOLUNTARY PHASE WITH CURRENT DATA

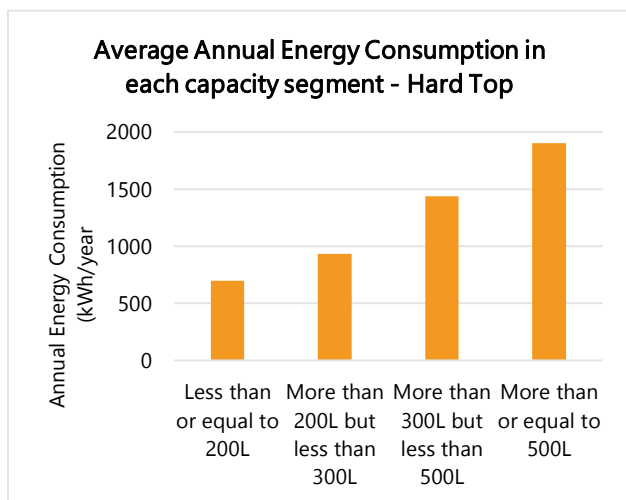
CLASP conducted the policy development for Deep Freezers in 2018-19 for transitioning it to the voluntary phase. The program was launched in the voluntary phase by BEE in March 2020. The key highlights of the performance data then collected is discussed below:

The following information was requested for all models of the chest freezers from all the manufacturers:

- Energy consumption data
- Storage volume and gross volume data

The data for 62 models of chest freezers (45 hard top and 17 glass top) was received from most manufacturers in 2018-19 (shown in annexure C). The figure below shows the relationship between the average annual energy consumption and capacity for hard top models received in 2018-19 from manufacturers.

FIGURE 21: AVERAGE ANNUAL ENERGY CONSUMPTION IN EACH SEGMENT (2018-19 DATA)-HARD TOP



In comparison to the data received in the current market assessment (shown in market characteristics in the section above), the difference observed in average annual energy consumption for hard top models in each capacity segment is shown below:

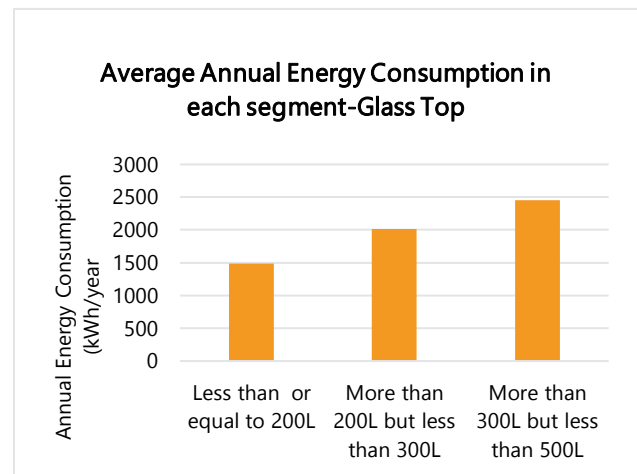
TABLE 6: IMPROVEMENT IN AVERAGE ANNUAL ENERGY CONSUMPTION-HARD TOP

Capacity (L)	Difference observed in average Annual Energy Consumption from 2018-19 levels
Less than or equal to 200L	5%
More than 200L but less than 300L	2%

More than 300L but less than 500L	7%
More than 500 L	25%

All capacity ranges have shown improvements in average annual energy consumption however, maximum improvement is observed in > 500 L category. This suggests that the lower efficiency models might have been discontinued by manufacturers after launch of voluntary program. The figure below shows the relationship between the average annual energy consumption and capacity for glass top models received in 2018-19 from manufacturers.

FIGURE 20: AVERAGE ANNUAL ENERGY CONSUMPTION IN EACH SEGMENT (2018-19 DATA)-GLASS TOP




In comparison to the data received in the current market assessment (shown in market characteristics above, the difference observed in average annual energy consumption for glass top models in each capacity segment is shown below:

TABLE 7: IMPROVEMENT IN ANNUAL ENERGY CONSUMPTION - GLASS TOP

Capacity (L)	Difference observed in average Annual Energy Consumption from 2018-19 levels
Less than or equal to 200L	19%
More than 200L but less than 300L	21%
More than 300L but less than 500L	24%

All capacity ranges have seen an improvement in average annual energy consumption; However, maximum improvement is observed in greater than 500 L category. This suggests that manufacturers may have discontinued lower efficiency models after the launch of voluntary program.



4. Transition to Mandatory Star Rating - Impact of Energy Saving & GHG Emissions Reduction

MANDATORY LABELLING

Given the huge opportunity in terms of GHG emission reduction potential and energy consumption from deep freezers, BEE took an informed decision based on the updated market assessment presented by CLASP on this report to comply with the Indian Cooling Action Plan (ICAP) **short term recommendations on promoting energy efficiency in commercial refrigeration appliances**. CLASP also shared the market assessment analysis shown in section 3 with Government of India and BEE held Technical Committee Meetings in January 2022 to update and discuss with manufacturers about the analysis. Based on the successful Technical Committee meeting, Bureau of Energy Efficiency decided to transition to the mandatory labelling program from January 01, 2023. The validity of the star rating table is decided as from January 01 2023 to December 31, 2024, with the energy efficiency matrix shown in Table 8:

TABLE 8: MANDATORY STAR RATING TABLE

Star Rating	Chest Freezers (Hard Top)	Chest Freezers (Glass Top)
Validity 1 st January 2023 – 31 st December 2024		
AEC (Annual Energy Consumption) (kWh/year)		
1 star	$4.23*V + 126.65 \leq AEC < 5.07*V + 151.98$	$7.68*V + 511.17 \leq AEC < 9.21*V + 613.40$
2 Star	$3.52*V + 105.54 \leq AEC < 4.23*V + 126.65$	$6.40*V + 425.97 \leq AEC < 7.68*V + 511.17$
3 Star	$2.82*V + 84.43 \leq AEC < 3.52*V + 105.54$	$5.12*V + 340.78 \leq AEC < 6.40*V + 425.97$
4 Star	$2.25*V + 67.55 \leq AEC < 2.82*V + 84.43$	$4.09*V + 272.62 \leq AEC < 5.12*V + 340.78$
5 Star	$AEC < 2.25*V + 67.55$	$AEC < 4.09*V + 272.62$

ENERGY CONSUMPTION AND PROJECT SAVINGS

This section projects the energy and GHG savings from the proposed mandatory labeling program, based on the following assumptions shown in table below:

Based on the data received from manufacturers and assumptions considered in table 9, the energy savings and corresponding GHG emissions reductions are presented in

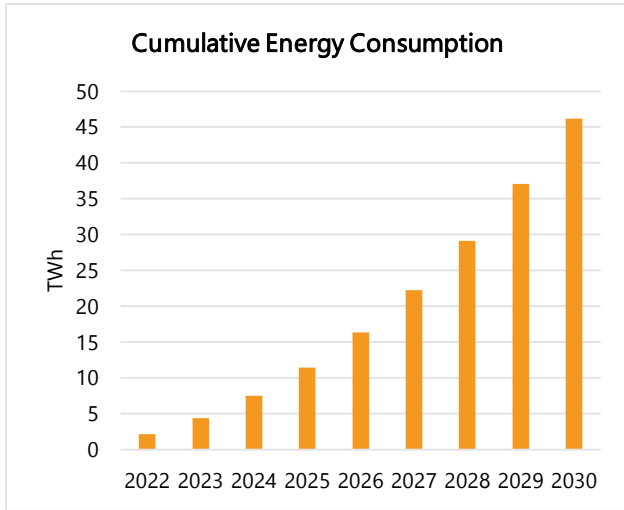
TABLE 9: ASSUMPTIONS FOR BASELINE SCENARIO

Baseline Scenario 2022-23				
Capacity (L)	AEC (Annual Energy Consumption) (kWh/year)	Market share (%)	Sales figure for all segments	Year over year growth till 2030 for all segments
< 200 L	667	15		
200L – 300L	915	4		
300L – 500L	1333	64.5	~5.5 lakhs	12%
> 500 L	1428	16.5		

- The market share for each segment has been considered similarly as the baseline scenario for the subsequent years till 2030.
- Sales figures for all segments is rounded off to the nearest 50,000 to 5.5 lakhs for practical purpose.
- Average consumption (kWh/year) for each capacity is an average figure based on the data we have received for different segments and a 6% improvement in efficiency YOY has been considered as per past labelling programs by BEE.
- Grid emissions factor of 0.79 Kg/kWh has been considered for GHG saving calculations.

Figure 22 shows that currently, the cumulative energy consumption from the sale of chest-type deep freezers is 2.18 TWh and it is expected to reach 46 TWh by 2030.

FIGURE 22: ENERGY CONSUMPTION PROJECTIONS FOR THE CHEST FREEZER LABELING PROGRAM



Figures 23 and 24 show a cumulative energy savings of ~ 14.9 TWh and ~ 11.7 MtCO₂ is envisaged (by FY 2030) from the mandatory labeling program of chest type deep Freezers.

FIGURE 24: SAVINGS PROJECTIONS FOR THE CHEST FREEZER LABELING PROGRAM

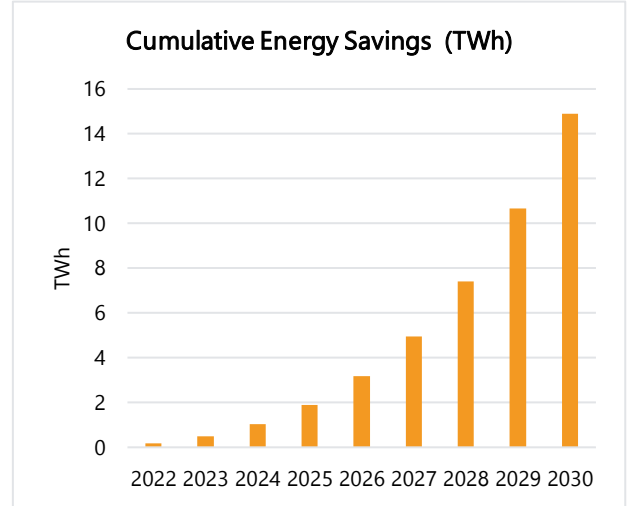


FIGURE 23: GHG EMISSIONS REDUCTIONS (MTCO₂)

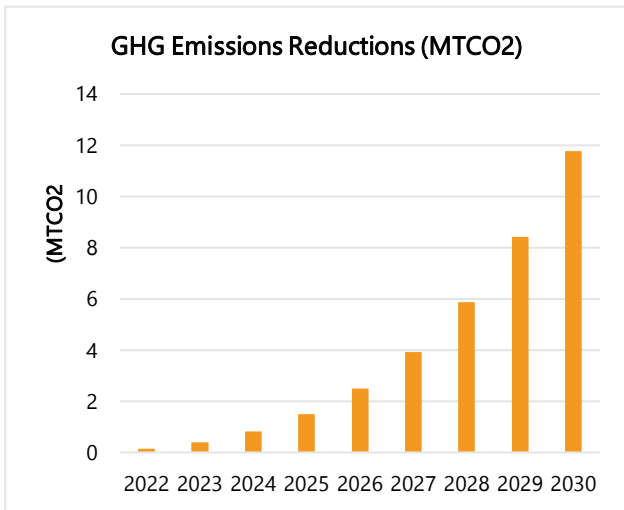


TABLE 10: CUMULATIVE ENERGY SAVINGS AND GHG EMISSIONS REDUCTIONS

	CUMULATIVE ENERGY SAVINGS (TWH)	CUMULATIVE GHG EMISSIONS REDUCTION(MTCO ₂)
DEEP FREEZER	14.9	11.7

CONCLUSION

The commercial refrigeration segment in India was valued at INR 3,000 crore in 2021 and estimates indicate a rising demand that is expected to touch INR 5,000 crore by 2024. In terms of predicted market growth rates for commercial refrigeration, the market is estimated to grow at a CAGR of over 5% in terms of revenue over the forecast period of 2018-2024². The India Cooling Action Plan (ICAP) estimates total energy consumption from commercial refrigeration in India to be at ~22 TWh in the year 2022-2023. Deep freezers constitute a significant market share in the commercial refrigeration segment after household refrigerators and it will continue to rise. These appliances find application in retail, hospitality and even residential sectors. The rise in usage of deep freezers is expected to increase the refrigeration load, and thus energy consumption. The current market size for chest-type deep freezers for FY 20-21 is ~5.4 lakhs and the market size is envisaged to grow at 12% for the next 5 years and is expected to reach 9.4 lakhs by FY 2025-26.

Recognising anticipated growth in the usage of deep freezers, Bureau of Energy Efficiency (BEE), a statutory body under the Ministry of Power, developed the efficiency policy for chest-type deep freezers and announced the voluntary program in March 2020. CLASP conducted the policy development for deep freezers in 2018-19 to transition appliances to a voluntary phase. In comparison to the data received in the current market assessment with 2018-19 data, all capacity ranges have shown an improvement in average annual energy consumption and maximum improvement is observed in > 500 L category. This suggests that the lower efficiency models might have been discontinued by manufacturers after the launch of voluntary program.

Given the massive opportunity, in terms of GHG emissions reductions potential and energy consumption from deep freezers, BEE took a decision based on the updated market assessment presented by CLASP on this report to comply with the Indian Cooling Action Plan's (ICAP) short term recommendations on promoting energy efficiency in commercial refrigeration appliances. CLASP also shared the market assessment analysis shown in Section 3 with the Government of India and BEE held Technical Committee Meetings in January 2022 to update and discuss the analysis with manufacturers. Based on the success of the Technical Committee Meetings, BEE decided transition of the chest-type deep freezer's labeling program to mandatory from January 01, 2023 with a star rating table validity period of 2 years – January 01, 2023 to December 31, 2024 with the energy efficiency matrix shown in Table 11:

TABLE 11: MANDATORY STAR RATING TABLE

Star Rating	Chest Freezers (Hard Top)	Chest Freezers (Glass Top)
Validity 1 st January 2023 – 31st December 2024		
AEC (Annual Energy Consumption) (kWh)		
1 star	$4.23*V + 126.65 \leq AEC < 5.07*V + 151.98$	$7.68*V + 511.17 \leq AEC < 9.21*V + 613.40$
2 Star	$3.52*V + 105.54 \leq AEC < 4.23*V + 126.65$	$6.40*V + 425.97 \leq AEC < 7.68*V + 511.17$
3 Star	$2.82*V + 84.43 \leq AEC < 3.52*V + 105.54$	$5.12*V + 340.78 \leq AEC < 6.40*V + 425.97$
4 Star	$2.25*V + 67.55 \leq AEC < 2.82*V + 84.43$	$4.09*V + 272.62 \leq AEC < 5.12*V + 340.78$
5 Star	$AEC < 2.25*V + 67.55$	$AEC < 4.09*V + 272.62$

A cumulative savings of ~14.9 TWh and ~11.7 MtCO₂ is envisaged (by FY 2030) from the mandatory labeling program of deep freezers.

² Global Market Insights, "Commercial Refrigeration Equipment Market Size by Product, By Application, Industry Analysis Report, Regional Outlook, Growth Potential, Competitive Market Share & Forecast, 2018-2024", published in 2017.

Annexure A: Survey Questionnaire

Manufacturer Details

Deep freezer manufacturer details						
Name of Manufacturer	Manufacturing facility address (in case of multiple facilities enter address in the next row)	Manufacturing facility capacity (of each facility in case of multiple)	Name of concerned representative for deep freezer	Designation of the representative	Contact Number of the representative	Email_Id of representative

General Details and estimate of market size of chest type deep freezers

S. No.	Freezer type	FY 18-19	FY 19-20	FY 20-21
1	Market size for Chest Type (Quantity in nos.)			

Manufacturer market / sales data

Manufacturer market size (in nos.) basis volume					
S. No.	Freezer type	Volume segment (Gross Volume in litres)	FY 18-19	FY 19-20	FY 20-21
1	Chest Type	Less than or equal to 200L			
		More than 200L but less than 300L			
		More than 300L but less than 500L			
		More than or equal to 500L			

Manufacturer import quantity (in nos.) basis volume					
S. No.	Freezer type	Volume segment (Gross Volume in litres)	FY 18-19	FY 19-20	FY 20-21
1	Chest Type	Less than or equal to 200L			
		More than 200L but less than 300L			
		More than 300L but less than 500L			
		More than or equal to 500L			

Manufacturer Export quantity (in nos.) basis volume						
S. No.	Freezer type	Volume Segment (Gross Volume in Litres)	Major countries of Export	FY 18-19	FY 19-20	FY 20-21
1	Chest Type	Less than or equal to 200L				
		More than 200L but less than 300L				
		More than 300L but less than 500L				
		More than or equal to 500L				

Voluntary Program Penetration

Voluntary program penetration for Chest Type Deep Freezers			
S. No.	Freezer type	Total no of models in product portfolio	Total no. of models labelled as per voluntary program
	Hard Top Type		
	Glass Top Type		

Performance Data

Manufacturer Efficiency Data								
Model No.	Standard IS-7872 followed? (Please choose option from drop down)	Product labelled under the voluntary phase? (Please choose option from drop down)	Star rating if the product is labelled under the voluntary phase (Please choose option from drop down)	Hard Top / Glass Top (Please choose option from drop down)	Gross Volume (Litres)	Storage Volume (Litres)	Approx. Annual Energy Consumption (kWh/year)	Refrigerant used

Laboratory and test standard details

Type of tests conducted				
	Type tests	Acceptance tests	Routine tests	Tests as per international standards, if applicable
<i>Please choose type test from drop down</i>	In house laboratory	In house laboratory	In house laboratory	
<i>Please choose type test from drop down</i>	Other labs in India	Other labs in India	Abroad	

Test standard details

Test standards category	IS No.	ISO No.	IEC No.	others
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Please mention standard numbers

Annexure B: Manufacturer Volume and Annual Energy Consumption Data

Deep Freezer Type	IS 7872 Followed	Storage Volume (L)	Annual Energy Consumption (kWh/year)
Hard Top	Yes	99	458
		142	626
		198	671
		293	1129
		391	1285
		457	2127
	Yes	288	1015
		384	1228
		481	1301
	Yes	80	503.7
		86	879.285
		160	935.495
		192	748.25
		217	1128.215
		272	1264.725
		288	1178.95
		328	1654.18
		365	1766.6
		384	1339.55
		407	1891.065
Yes	479	1595.05	
	282	590	
	435	885	
		435	850

Deep Freezer Type	IS 7872 Followed	Storage Volume (L)	Annual Energy Consumption (kWh/year)
Hard Top	Yes	193	832
		289	1269
		315	1179
		315	1245
		385	1343
		413	1274
		481	1596
		514	1621

		513	1236
		103	350
		203	465
		203	465
		251	618
	Yes	301	774
		313	896
		373	1050
		423	1010
		423	1010
Total Hard Top models analyzed			42

Deep Freezer Type	IS 7872 Followed	Storage Volume (L)	Annual Energy Consumption (kWh/year)
`Glass Top	Yes	136	1746
		166	1768
		218	1958
		235	2218
		258	2308
		307	2259
		394	2497
	Yes	139	1184.425
		194	1678.27
		248	1794.705
	Yes	256	660
		362	775
	Yes	196	1310
		290	1497
	Yes	103	350
		145	405
		211	1090
		365	1760
		260	1333

	719	1405
Total Glass Top models analyzed	20	

Annexure C: Old Manufacturer Volume and Annual Energy Consumption Data received in 2018-19

Deep Freezer Type	Storage Volume (L)	Annual Energy Consumption (KWh/year)
Hard top	99	459.9
	142	627.8
	198	671.6
	293	1127.85
	391	1985.6
	457	2127.95
	217.14	1127.85
	271.54	1266.55
	327.81	1653.45
	365.11	1766.6
	406.57	1890.7
	86	879.65
	160.1	934.4
	93	310.25
	192	467.2
	296	591.3
	304	992.8
	476	974.55
	490	766.5
	66	390.55
	103	430.7
	146	463.55
	203	489.1
	259	547.5
	429	1007.4
	519	1058.5
	319	762.85
	379	949
	719	1219.1
	315	1178.95
	315	1244.65
	413	1273.85
	514	1620.6
	265.55	1193.55
	339.31	1540.3
404.3	1620.6	

	489.92	1887.05
	99.22	923.45
	169.54	1116.9
	287	1105.95
	369	1430.8
	96	959.95
	168	1164.35
	453	2292.2
	630	3712.05
	45	

Deep Freezer Type	Storage Volume (L)	Annual Energy Consumption (KWh/year)
Glass Top	136	1744.7
	166	1766.6
	218	1956.4
	235	2219.2
	258	2306.8
	307	2259.35
	394	2496.6
	139.47	1186.25
	193.87	1679
	248.16	1795.8
	304	1682.65
	196	1310.35
	290	1496.5
	165.97	1219.1
	244	2310.45
	336	2200.95
	428	3613.5
	17	

