

# Research Report on Indian Cleanroom and HVAC Market

24<sup>th</sup> July 2024

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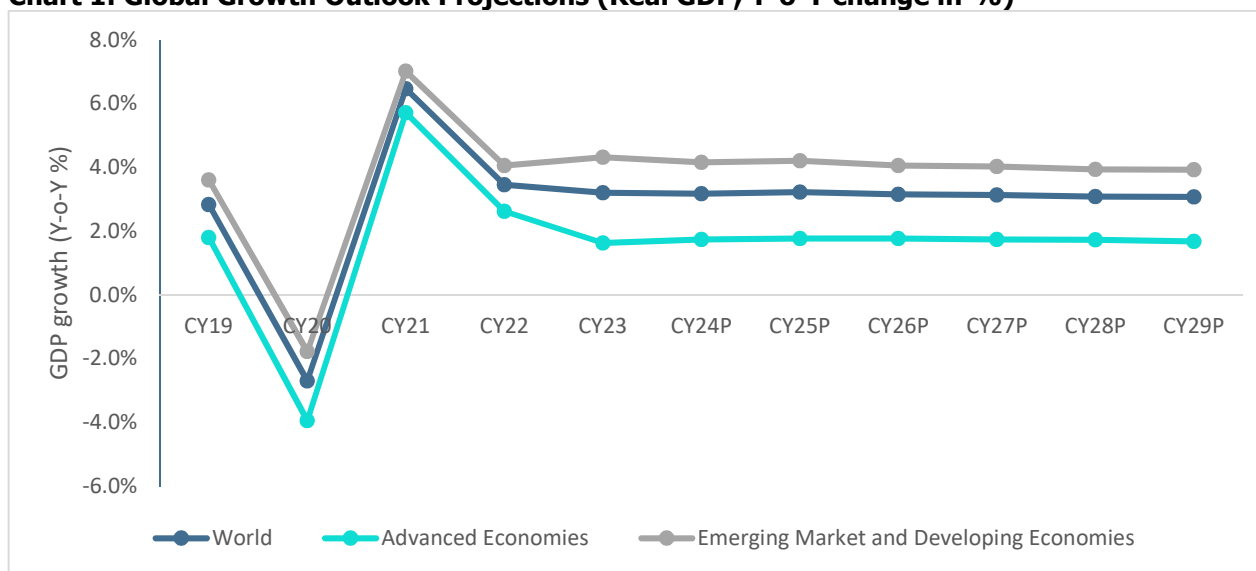
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# 1. Economic Outlook

## 1.1 Global Economy

Global growth, which stood at 3.2% in CY23, is anticipated to maintain this rate throughout CY24 and CY25. The CY24 forecast has been adjusted upwards by 0.1 percentage point compared to the January 2024 World Economic Outlook (WEO) Update, and by 0.3 percentage point compared to the October 2023 WEO. Despite this, the expansion remains historically low, attributed to factors including sustained high borrowing costs, reduced fiscal support, lingering effects of the COVID-19 pandemic and Russia’s Ukraine invasion, Iran–Israel Cold War, sluggish productivity growth, and heightened geo-economic fragmentation.

**Chart 1: Global Growth Outlook Projections (Real GDP, Y-o-Y change in %)**



Notes: P-Projection; Source: IMF – World Economic Outlook, April 2024

**Table 1: GDP growth trend comparison - India v/s Other Economies (Real GDP, Y-o-Y change in %)**

	Real GDP (Y-o-Y change in %)									
	CY20	CY21	CY22	CY23	CY24P	CY25P	CY26P	CY27P	CY28P	CY29P
India	-5.8	9.7	7.0	7.8	6.8	6.5	6.5	6.5	6.5	6.5
China	2.2	8.5	3.0	5.2	4.6	4.1	3.8	3.6	3.4	3.3
Indonesia	-2.1	3.7	5.3	5.0	5.0	5.1	5.1	5.1	5.1	5.1
Saudi Arabia	-3.6	5.1	7.5	-0.8	2.6	6.0	4.0	3.5	3.0	3.5
Brazil	-3.3	4.8	3.0	2.9	2.2	2.1	2.1	2.0	2.0	2.0
Euro Area	-6.1	5.9	3.4	0.4	0.8	1.5	1.4	1.3	1.3	1.2
United States	-2.2	5.8	1.9	2.5	2.7	1.9	2.0	2.1	2.1	2.1

P- Projections; Source: IMF- World Economic Outlook Database (April 2024)

### Emerging Market and Developing Economies Group

Emerging market and developing economies are forecasted to maintain stable growth at 4.2% in both CY24 and CY25. While there's a slowdown expected in emerging and developing Asia, this is counterbalanced by increasing growth in economies across the Middle East, Central Asia, and sub-Saharan Africa. Low-income developing countries are anticipated

to experience a gradual growth uptick, starting at 4.0% in CY23 and climbing to 4.7% in CY24 and 5.2% in CY25, as certain constraints on near-term growth begin to ease.

The economic forecast for emerging and developing Asia reveals a modest deceleration in growth, with projections indicating a decline from 5.6% in CY23 to 5.2% in CY24 and 4.9% in CY25. **China's** trajectory reflects a slowdown, transitioning from 5.2% in CY23 to 4.6% in CY24 and 4.1% in CY25 due to fading post-pandemic stimuli and ongoing property sector challenges. In contrast, **India's** growth remains robust, with anticipated rates of 6.8% in CY24 and 6.5% in CY25, bolstered by resilient domestic demand and a burgeoning working-age populace.

Despite the turmoil in the last 2-3 years, India bears good tidings to become a USD 5 trillion economy by CY27. According to the IMF dataset on Gross Domestic Product (GDP) at current prices, the nominal GDP has been estimated to be at USD 3.6 trillion for CY23 and is projected to reach USD 5.3 trillion by CY27 and USD 6.4 trillion by CY29. India's expected GDP growth rate for coming years is almost double compared to the world economy.

Besides, India stands out as the fastest-growing economy among the major economies. The country is expected to grow at more than 6.5% in the period of CY24-CY29, outshining China's growth rate. By CY27, the Indian economy is estimated to emerge as the third-largest economy globally, hopping over Japan and Germany. Currently, it is the third-largest economy globally in terms of Purchasing Power Parity (PPP) with a ~7.6% share in the global economy, with China [~18.7%] on the top followed by the United States [~15.6%]. Purchasing Power Parity is an economic performance indicator denoting the relative price of an average basket of goods and services that a household needs for livelihood in each country.

Despite Covid-19's impact, high inflationary environment and interest rates globally, and the geopolitical tensions in Europe, India has been a major contributor to world economic growth. India is increasingly becoming an open economy as well through growing foreign trade. Despite the global inflation and uncertainties, Indian economy continues to show resilience. This resilience is mainly supported stable financial sector backed by well-capitalized banks and export of services in trade balance. With this, the growth of Indian economy is expected to fare better than other economies majorly on account of strong investment activity bolstered by the government's capex push and buoyant private consumption, particularly among higher income earners.

## 1.2 Indian Economic Outlook

### 1.2.1 GDP Growth and Outlook

#### Resilience to External Shocks remains Critical for Near-Term Outlook

India's real GDP grew by 7.0% in FY23 and stood at ~Rs. 161 trillion, as per the First Revised Estimate, despite the pandemic in previous years and geopolitical Russia-Ukraine spillovers. In Q1FY24, the economic growth accelerated to 8.2%. The manufacturing sector maintained an encouraging pace of growth, given the favorable demand conditions and lower input prices. The growth was supplemented by a supportive base alongside robust services and construction activities. This momentum remained in the range in the Q2FY24 with GDP growth at 8.1%, mainly supported by acceleration in investments. However, private consumption growth was muted due to weak rural demand and some moderation in urban demand amid elevated inflationary pressures in Q2FY24. The GDP growth number improved for Q3FY24 at 8.6%.

#### GDP Growth Outlook

- Driven by fixed investment and improving global environment, domestic economic activity continues to expand. The provisional estimates (SAE) placed real GDP growth at 8.2% for FY24.

- Industrial activity led by manufacturing continues its momentum on the back of strengthening domestic demand. The eight core industries also show healthy growth. Moreover, services sector shows exhibit broad based buoyancy. The purchasing managers' index for both manufacturing and services continues to exhibit a sustained and healthy expansion.

Persistent geopolitical tensions and volatility in international commodity prices do pose risk to this outlook. Based on these considerations, the RBI, in its June 2024 monetary policy, has projected real GDP growth at 7.2% y-o-y for FY25.

**Table 2: RBI's GDP Growth Outlook (Y-o-Y %)**

FY25P	Q1FY25P	Q2FY25P	Q3FY25P	Q4FY25P
7.2%	7.3%	7.2%	7.3%	7.2%

Note: P-Projected; Source: Reserve Bank of India

### 1.2.2 Concluding Remarks

The major headwinds to global economic growth are escalating geopolitical tensions, volatile global commodity prices, and a shortage of key inputs. Despite the global economic growth uncertainties, the Indian economy is relatively better placed in terms of GDP growth compared to other emerging economies. According to IMF's forecast, it is expected to be 6.8% in CY24 compared to the world GDP growth projection of 3.2%. The bright spots for the economy are continued healthy domestic demand, support from the government towards capital expenditure, moderating inflation, investments in technology and improving business confidence.

Likewise, several high-frequency growth indicators including the purchasing managers index, auto sales, bank credit, and GST collections have shown improvement in FY23. Moreover, normalizing the employment situation after the opening up of the economy is expected to improve and provide support to consumption expenditure.

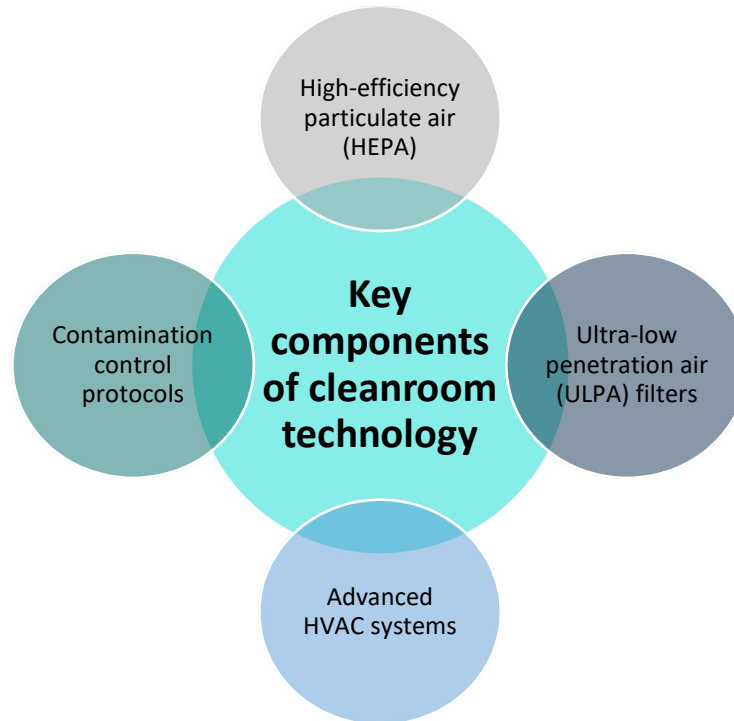
The India Meteorological Department (IMD) has made a significant forecast, predicting "above normal" rainfall for the upcoming monsoon season, marking the first time in a decade that such an optimistic outlook has been declared at the initial stage. This forecast, coupled with an anticipated eight-year-high rainfall, offers promising prospects for the agrarian economy and inflation. The weakening of El Nino to a neutral stage in the early monsoon season, followed by the likely development of La Nina conditions in the later part, adds to the positive outlook. El Nino typically leads to suppressed rainfall during the Indian monsoon, whereas La Nina tends to enhance rainfall activity. IMD's more optimistic prediction is expected to bolster agricultural growth and incomes, while also potentially alleviating stubborn food inflation pressures.

At the same time, public investment is expected to exhibit healthy growth as the government has allocated a strong capital expenditure of about Rs. 11.11 lakh crores for FY25. The private sector's intent to invest is also showing improvement as per the data announced on new project investments and resilience shown by the import of capital goods. Additionally, improvement in rural demand owing to good rabi crop and an expected normal monsoon will aid the investment cycle in gaining further traction.

## 2. Cleanroom Technologies Industry in India

### 2.1 Overview

Cleanroom technology refers to specialized engineering and production processes aimed at creating controlled environments known as cleanrooms. These environments minimize airborne particles, contaminants, and pollutants to extremely low levels. Cleanroom technology involves a combination of equipment, materials, and procedures designed to maintain strict cleanliness standards crucial for industries requiring high levels of sterility and precision, such as pharmaceuticals, biotechnology, electronics, and healthcare. Cleanrooms are essential for ensuring product quality and safety by minimizing the risk of contamination, making them indispensable in various industrial sectors.



The Indian cleanroom technologies market is witnessing robust growth, valued at USD 277.4 Million in 2023 and projected to reach USD 484.2 Million by 2030, with a CAGR of 8.3% from 2023 to 2030. The end users of the Indian Cleanroom Technologies market include Industries such as Pharmaceutical, Semiconductor and Electronic, Biotechnology, Foods and Beverage, Hospital and Healthcare, and others (including Automotive, Plastic, Optical, etc). In pharmaceuticals, cleanrooms ensure sterile environments, crucial for drug production and compliance with regulatory standards. Semiconductor and electronics industries rely on cleanrooms to prevent contamination and ensure product reliability. Biotechnology facilities utilize cleanrooms for sterile conditions in research and bioprocessing. In food processing, cleanrooms prevent microbial contamination and ensure product safety. Healthcare settings employ cleanrooms to minimize infections during medical procedures. Additionally, cleanroom technologies are vital in automotive, plastic, and optical industries to maintain product quality and meet cleanliness requirements.

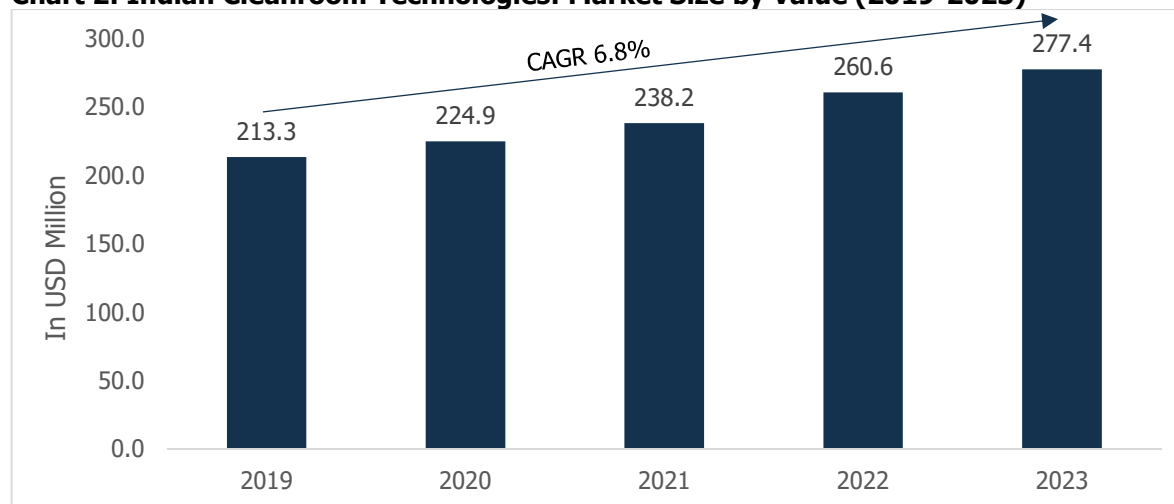
The factors driving market growth include expanding industries, stringent regulations, increased R&D investments, and the COVID-19 pandemic's emphasis on clean environments in healthcare. Technological advancements like modular cleanrooms and innovative filtration systems offer more efficient solutions, although challenges like high initial costs and regulatory compliance remain. Despite obstacles, the market is expected to continue growing, supported by industrialization, contamination control awareness, and the pursuit of stringent quality standards. The segmentation of the Indian Cleanroom Technologies market extends beyond end users to include differentiation based on Material and Design/Type. Cleanrooms come in various types, including Standard/Drywall Cleanroom, Modular Cleanroom, Mobile

Cleanroom, Soft Wall Cleanroom, and Terminal Boxes/Pass-through Cabinets. These cleanrooms are constructed using a range of materials, such as steel, stainless steel, epoxy resin, and high-density polyethylene (HDPE).

## 2.2 Market Size of the Industry by Value

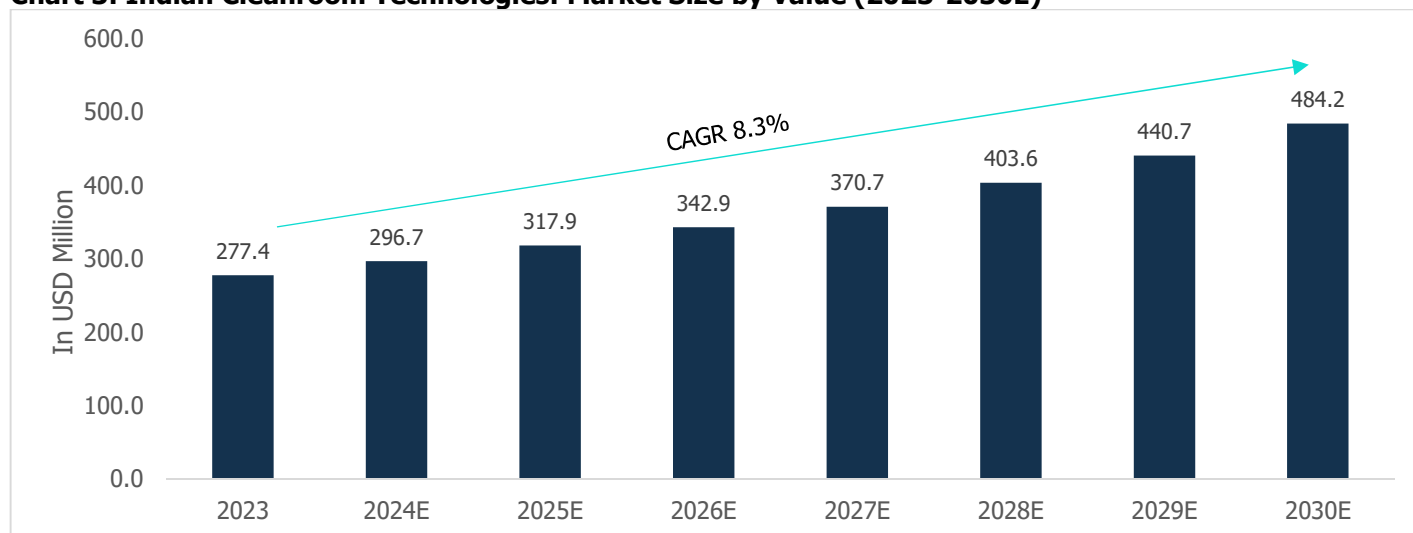
The Indian Cleanroom Technologies market size, by value, has been on an upward trend since 2019. It grew in value from USD 213.3 million in 2019 to USD 277.4 million in 2023 at a CAGR of 6.8%. This robust growth can be attributed to the increasing demand across various industries like pharmaceuticals, biotechnology, healthcare, and electronics. Additionally, stringent regulations and quality standards are driving adoption, while investments in R&D aim to enhance manufacturing processes and meet global benchmarks. The COVID-19 pandemic also emphasized the importance of clean environments, boosting demand, especially in healthcare and laboratories. Technological advancements, such as modular cleanrooms and innovative filtration systems, offering efficient solutions are further driving this market growth.

**Chart 2: Indian Cleanroom Technologies: Market Size by Value (2019-2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

The Indian Cleanroom Technologies market is expected to grow in an upward trend at a CAGR of 8.3%, from 2023-2030, gaining market size (by value) of USD 484.2 million by 2030. The India cleanroom technologies market is poised for continued growth despite challenges, buoyed by ongoing industrialization, heightened awareness of contamination control, and the imperative for stringent quality standards across sectors. In the pharmaceutical arena, India's emergence as a key player on the global stage, particularly in exports, has intensified demand for cleanroom services. As Indian pharmaceutical companies increasingly focus on exports, adherence to international regulatory standards becomes paramount. This shift towards global compliance has elevated the importance of cleanroom consumables and other critical services to meet world best practices, reflecting India's evolving role and reputation within the international pharmaceutical market.

**Chart 3: Indian Cleanroom Technologies: Market Size by Value (2023-2030E)**


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

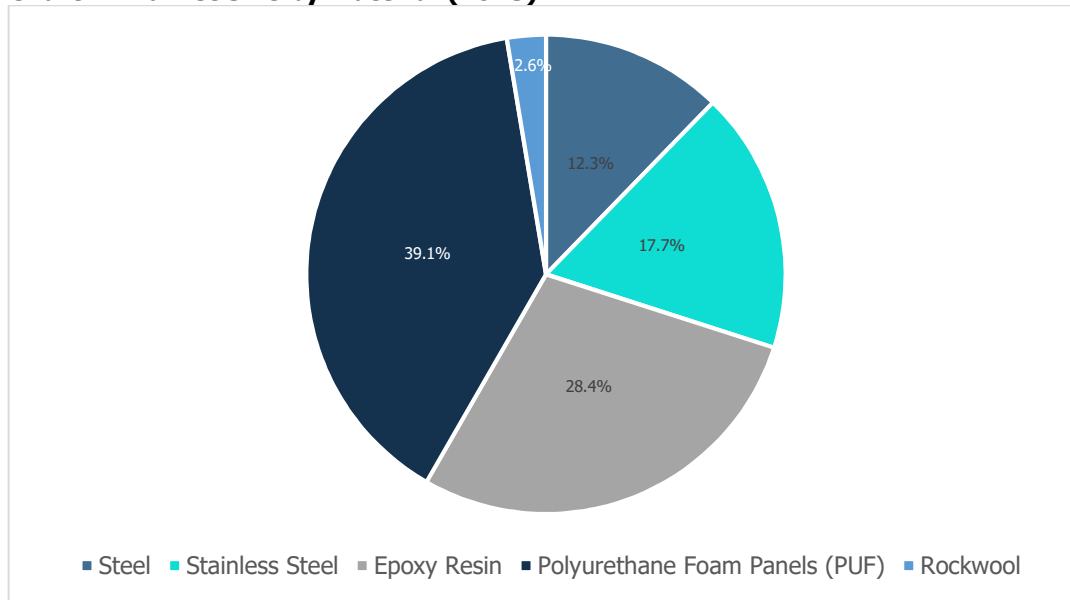
### 2.2.1 Market Size by Construction Material

Based on materials used in construction of cleanrooms, the Indian Cleanroom Technologies market can be divided into four segments: Polyurethane Foam Panels (PUF), Epoxy Resin, Stainless Steel, Steel and Rockwool.

- Polyurethane Foam Panels (PUF):** PUF is favored for cleanroom walls and ceilings because they are lightweight, provide effective thermal insulation, and maintain strong structural integrity. Their smooth surface finish and resistance to moisture help uphold controlled environments. These panels are commonly chosen for modular cleanroom setups due to their easy installation and design versatility.
- Epoxy Resin:** Epoxy resin is a robust and chemically resistant material extensively used in cleanroom flooring and coatings. Its superior resistance to chemicals, abrasion, and moisture makes it ideal for environments prone to spills and frequent cleaning. Epoxy resin surfaces are easy to clean and sanitize, enhancing the cleanliness and hygiene of cleanroom facilities.
- Stainless Steel:** Stainless steel, renowned for its corrosion resistance, is favored in cleanroom settings for its hygiene and cleanliness. Its usage is prevalent in industries like pharmaceuticals, biotechnology, and food processing where stringent cleanliness standards are imperative.
- Steel:** Steel is a widely used material in cleanroom construction due to its durability, strength, and corrosion resistance. It offers stability and support for cleanroom components and equipment, ensuring reliability and longevity in cleanroom environments.
- Rockwool:** Rockwool, or mineral wool, is used in cleanrooms primarily for its superior fire resistance and sound insulation properties, effectively enhancing thermal insulation and ensuring a safer, quieter environment. It offers effective thermal insulation and enhances the safety and acoustic comfort of the cleanroom environment.

As of 2023, PUF and Epoxy Resin together hold more than 65% of market share with each having market share of 39.1%, equivalent to USD 108.4 million, and 28.4%, equivalent to USD 78.7 million, respectively. This is followed by Stainless Steel and Steel holding market share of 17.7%, equivalent to USD 49.0 million and 12.3%, equivalent to USD 34.0 million, respectively. Rockwool holds the least market share of 2.6%, equivalent to USD 7.3 million.

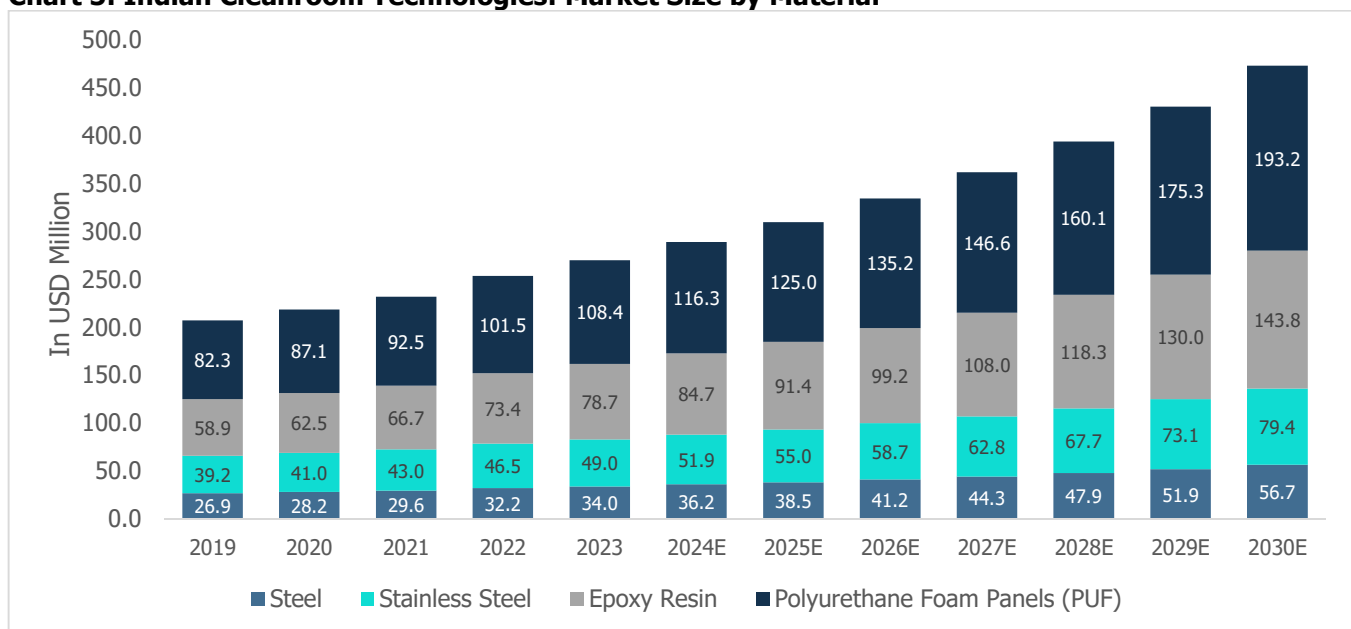
**Chart 4: Market Size by Material (2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

Epoxy Resin and PUF are anticipated to experience the most rapid growth, with a projected CAGR of 9.0% and 8.6%, respectively, between 2023 and 2030. Following them are Steel, Stainless Steel, and Rockwool forecasted to grow at CAGR of 7.5%, 7.1%, and 6.3%, respectively, during the same period. The dominance of PUF stems from their exceptional thermal insulation, lightweight structure, and strong integrity. They maintain precise temperature control, enhance energy efficiency, and reduce operational costs by conserving energy. These panels offer flexibility in design and installation for both permanent and modular cleanrooms, crucial for industries needing tailored configurations. Easy handling and installation speed up construction, minimize disruptions, and lessen structural load, enabling larger, safer cleanroom spaces. Their smooth, non-porous surface resists moisture and microbial growth, ensuring strict cleanliness standards are met, ideal for pharmaceuticals, biotechnology, and electronics.

**Chart 5: Indian Cleanroom Technologies: Market Size by Material**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

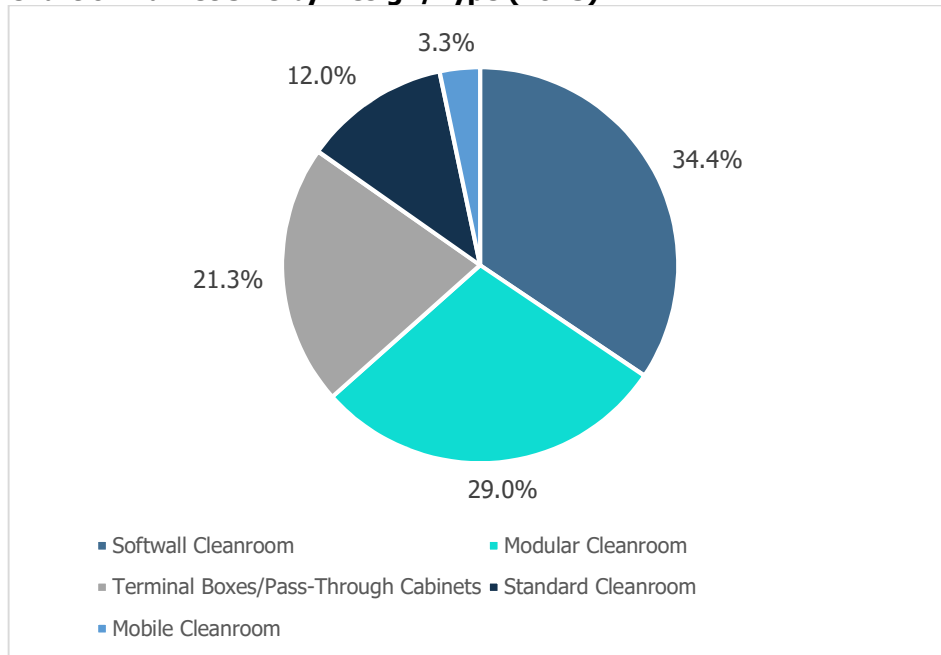
### 2.2.2 Market Share by Design/Type

Based on design/type, the Indian Cleanroom market is segmented into Standard/Drywall Cleanroom, Modular Cleanroom, Mobile Cleanroom, Soft Wall Cleanroom, and Terminal Boxes/Pass-through Cabinets.

- **Modular Cleanroom:** Modular cleanrooms are pre-made cleanroom units that are simple to put together, take apart, and adjust to meet particular needs. They provide flexibility in design and setup, enabling rapid installation and modification without the need for extensive building work. These cleanrooms are well-suited for industries with evolving cleanroom requirements or limited space, such as research labs and healthcare settings.
- **Softwall Cleanroom:** Softwall cleanrooms utilize flexible partitions, resembling curtains, crafted from materials like vinyl or PVC. These partitions establish enclosed areas within the cleanroom, serving as a shield against contamination while facilitating convenient access and movement. These are commonly deployed in settings with spatial constraints or frequent equipment and personnel interaction needs, like research labs, compounding pharmacies, or cleanroom testing sites.
- **Terminal Boxes/Pass-through Cabinets:** Terminal boxes or pass-through cabinets are installations within cleanroom walls or partitions designed to enable the transfer of materials or equipment between cleanroom and non-cleanroom areas without compromising cleanliness. Equipped with doors on both sides, these cabinets facilitate the passage of items while preserving the integrity of the cleanroom environment. They play a vital role in reducing contamination risks during material transfer operations in industries like pharmaceuticals, biotechnology, and electronics manufacturing.
- **Standard/Drywall Cleanroom:** A standard cleanroom is a controlled environment built with sturdy walls and ceilings, often using materials like steel or aluminum. These rooms meet defined cleanliness standards, like ISO classifications, and aim to reduce contamination through filtration and controlled airflow systems. They find widespread use in industries demanding high cleanliness levels, such as pharmaceutical production and semiconductor manufacturing.
- **Mobile Cleanroom:** A mobile cleanroom is a portable facility for maintaining cleanliness, typically enclosed in a movable structure like a trailer or container. These cleanrooms can be transported to various sites, offering temporary or on-location cleanroom solutions. They are frequently utilized in field operations, emergency responses, or scenarios requiring quick deployment of cleanroom facilities, such as construction sites or medical emergencies.

As of 2023, Softwall Cleanrooms dominate the Indian Cleanroom Technologies market with a substantial share of 34.4% (USD 95.5 million), followed by Modular Cleanrooms, Terminal Boxes/Pass-through Cabinets, and Standard Cleanrooms, holding market shares of 29.0% (USD 80.4 million), 21.3% (USD 59.1 million), and 12.0% (USD 33.2 million) respectively. Mobile Cleanrooms have the smallest share, accounting for only 3.3% (USD 9.1 million).

**Chart 6: Market Size by Design/Type (2023)**

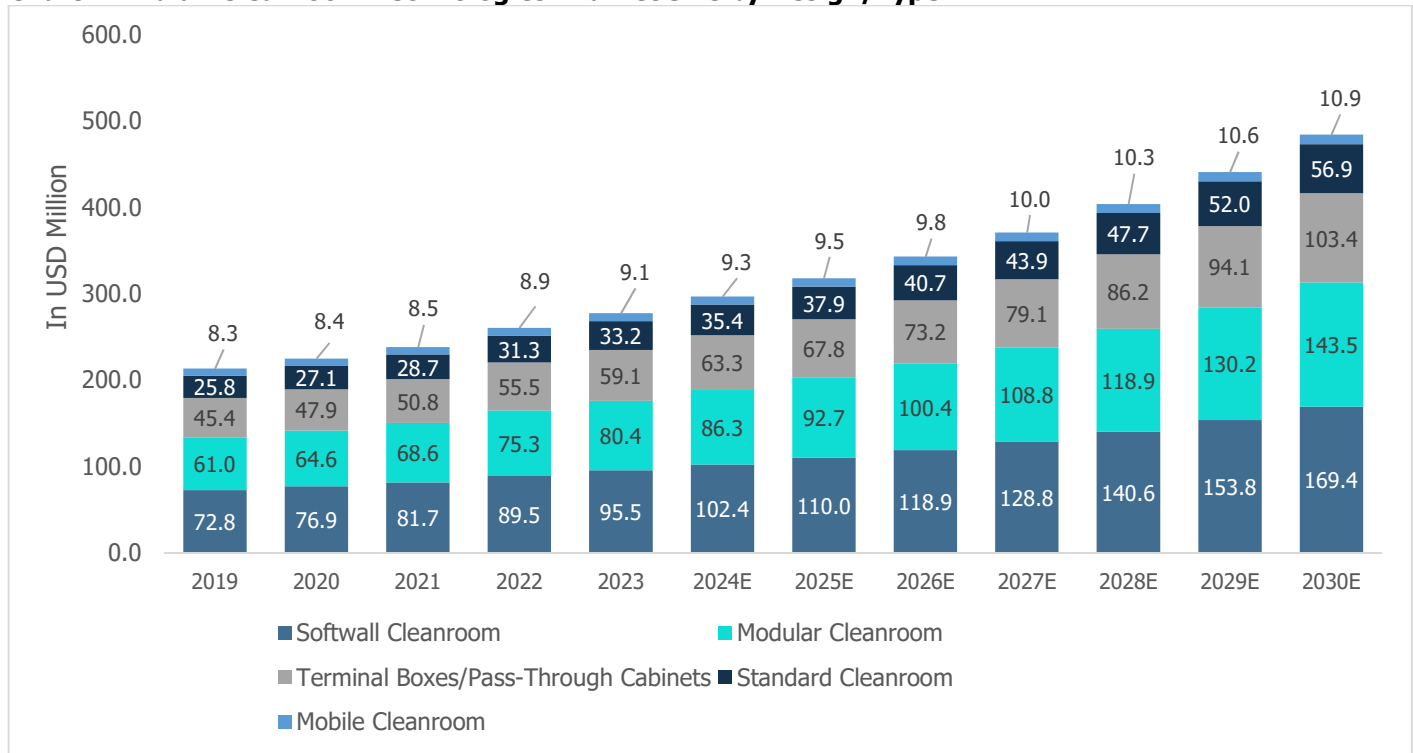


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

Over the period from 2023 to 2030, Modular and Softwall Cleanrooms are expected to experience significant growth with a CAGR of 8.6% and 8.5% respectively, followed by Terminal Boxes/Pass-through Cabinets and Standard Cleanrooms, projected to grow at a CAGR of 8.3% and 8.0% respectively. Meanwhile, Mobile Cleanrooms are anticipated to have the lowest growth rate with a CAGR of 2.6%. The modular cleanroom sector is projected to hold significant portion due to various compelling factors.

The India modular cleanroom market is poised for robust growth in the coming years, driven by expanding pharmaceutical, biotechnology, semiconductor, EV batteries, solar panel, and electronic sectors. These industries heavily rely on modular cleanrooms to maintain stringent contamination control standards. India's significant role as a global pharmaceutical supplier will further boost demand for modular cleanrooms due to increasing global drug demand. Growth will be propelled by rising investments in production and research & development within the pharmaceutical sector. Additionally, the surge in research and development spending by Indian pharmaceutical firms and the increase in hospital projects in tier II and tier III cities will escalate the demand for modular cleanrooms, fostering market expansion in India.

**Chart 7: Indian Cleanroom Technologies: Market Size by Design/Type**



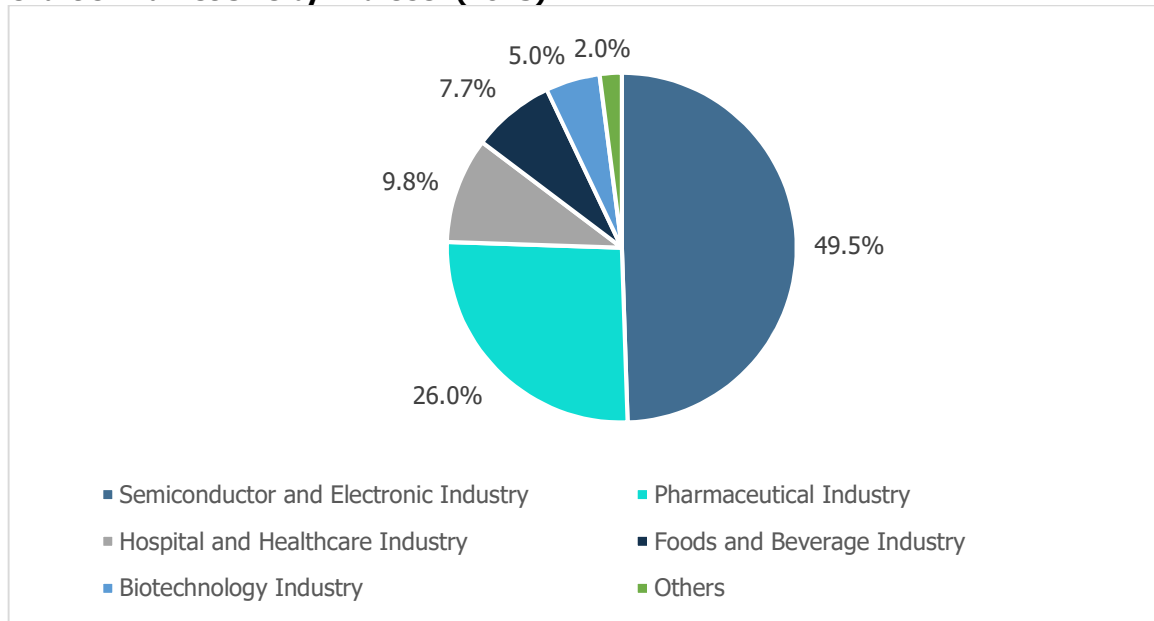
Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**2.2.3 Market Size by End User segment**

On the basis of end user, the Indian Cleanroom technologies market is segmented into a wide range of industries including Pharmaceutical, Semiconductor and Electronic, Biotechnology, Foods and Beverage, Hospital and Healthcare, and others (including Automotive, Plastic, Optical, etc). The pharmaceutical sector involves companies engaged in drug research, development, manufacturing, and distribution, relying on cleanroom technologies to uphold sterile conditions for drug production and packaging. Similarly, the semiconductor and electronics industry relies on these technologies to prevent contamination and ensure product reliability during fabrication and assembly processes. In the biotechnology field, cleanroom technologies are pivotal in maintaining sterile environments for research and bio-pharmaceutical production. Food processing companies utilize cleanroom technologies to prevent microbial contamination and maintain product quality. In healthcare settings, including hospitals and clinics, cleanroom technologies are essential for minimizing infections and ensuring sterile conditions during medical procedures and pharmaceutical compounding. Finally, various other industries, such as automotive, plastic, and optical, also utilize cleanroom technologies to control contamination and maintain product quality.

The two major end users of the cleanroom market, as of 2023, are Semiconductor and Electronic industry holding a market share of 49.5% (USD 137.2 million) and Pharmaceutical industry holding a market share of 26.0% (USD 72.2 million). These are followed by Hospital and Healthcare industry with a market share of 9.8% (USD 27.1 million), Food and Beverage industry with a market share of 7.7% (USD 21.2 million), Biotechnology industry with a market share of 5.0% (USD 13.9 million, and others such as Automotive industry, Plastic industry, Optical industry, etc together holding a meagre market share of 2.0% (USD 5.6 million).

**Chart 8: Market Size by End User (2023)**

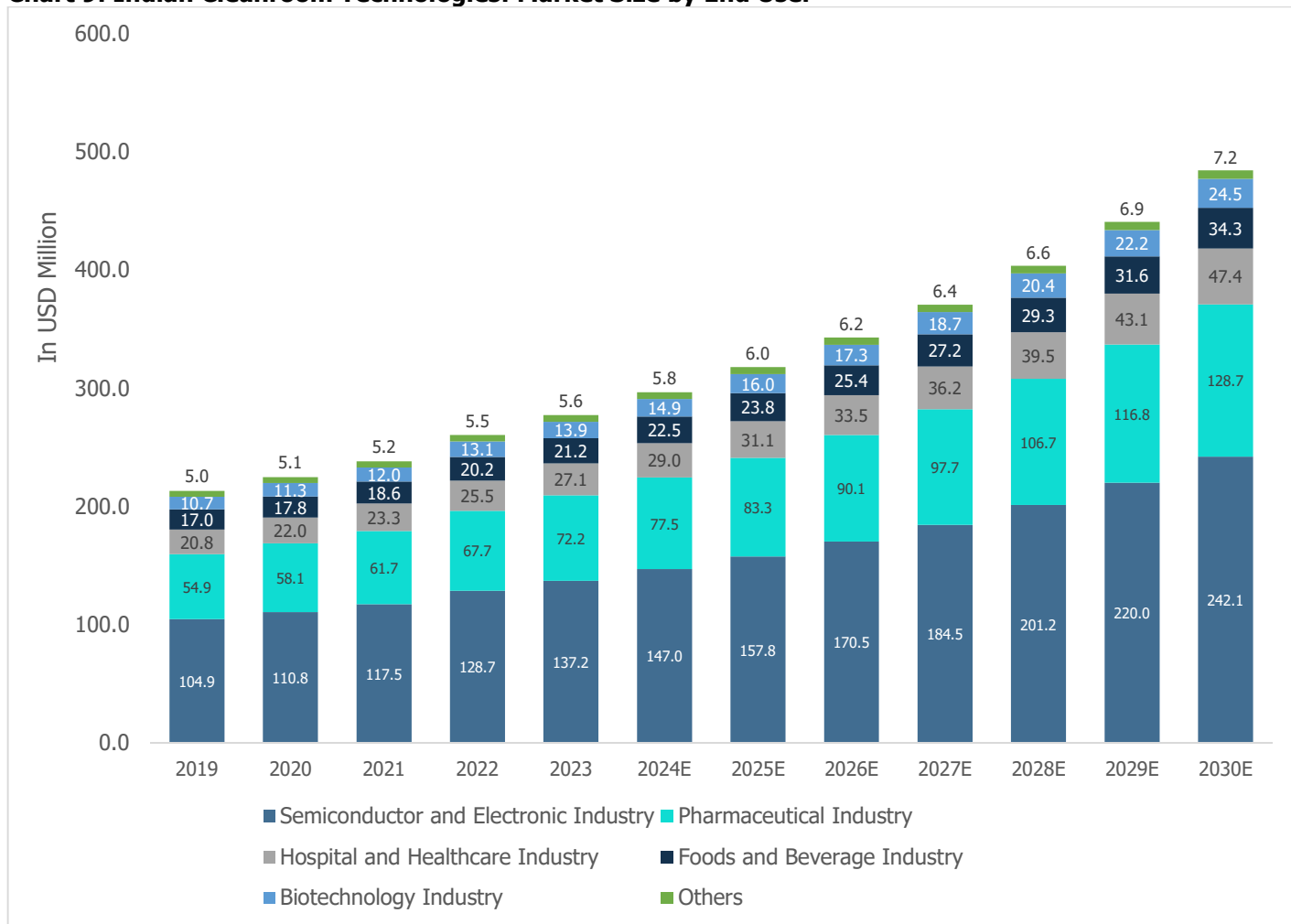


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

Pharmaceutical, Semiconductor and Electronic, Biotechnology, and Hospital and Healthcare industries are expected to grow the fastest, between 2023-2030, at CAGRs of 8.6%, 8.4%, 8.4%, and 8.3%. This is followed by the Foods and Beverage industry expected to grow at a CAGR of 7.1% and others expected to grow at a CAGR of 3.5% for the same time period.

Semiconductor is expected to keep holding a substantial market share for the period 2023-2030. It is forecasted to hold a market share of 50.0% (USD 242.1 million) by 2030. This growth expectations stem from Uttar Pradesh's strategic initiatives and economic growth propelling the semiconductor and electronics industry's significant share in India's cleanroom technologies market. As the largest exporter of consumer electronics and a burgeoning hub for semiconductor design and R&D, Uttar Pradesh's focus on fostering the semiconductor sector is accelerating electronic manufacturing and innovation. With a rapidly growing economy contributing substantially to the national GDP, the state's vision aligns with creating an environment conducive to the industry's expansion. This proactive approach attracts investments, enhances technological infrastructure, and drives advancements in cleanroom technologies vital for contamination-free environments in semiconductor manufacturing. Uttar Pradesh's efforts position India as a key player in driving growth and innovation in the semiconductor and electronics sector's cleanroom technologies market.

**Chart 9: Indian Cleanroom Technologies: Market Size by End User**

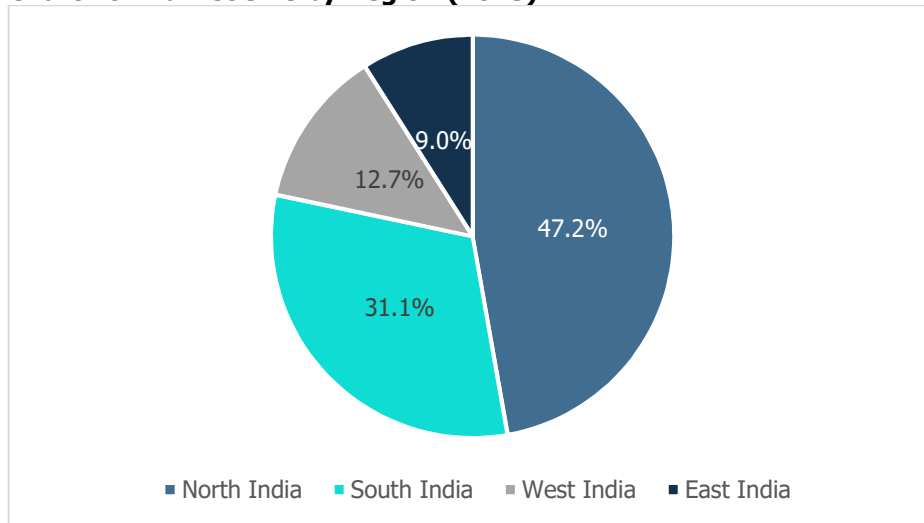


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**2.2.4 Market Size by Region**

Based on region, Indian Cleanroom market is segmented into North, South, East, and West. North and South India combined together hold more than 70% of market share as of 2023 with North India holding a market share of 47.2% (USD 131.0 million) and South India holding a market share of 31.1% (USD 86.3 million). This is followed by West India having a market share of 12.7% (USD 35.2 million) and East India having a market share of 9.0% (USD 25.0 million).

**Chart 10: Market Size by Region (2023)**

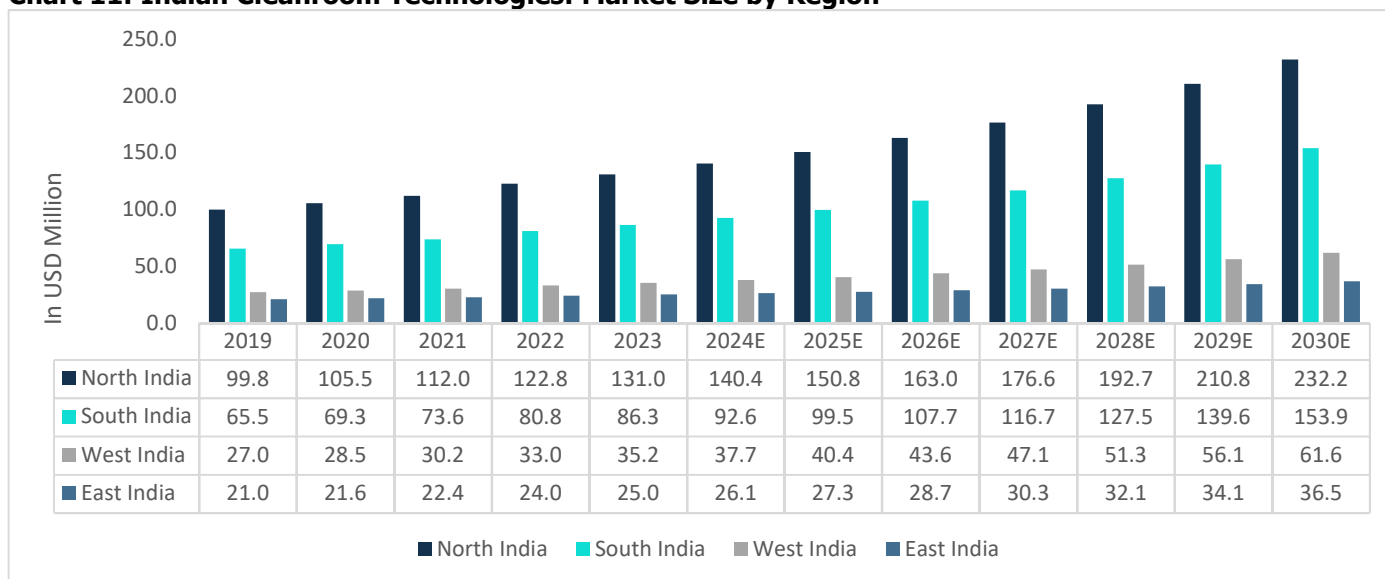


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

South India is forecasted to grow at a CAGR of 8.6% for the period of 2023-2030 followed by North, West, and East India growing at CAGRs of 8.5%, 8.3%, and 5.6% respectively. By 2030, North India is expected to hold a substantial share of 48.0% (USD 232.2 million), followed South, West, and East India holding market shares of 31.8% (USD 153.9 million), 12.7% (USD 61.6 million), and 7.5% (USD 36.5 million) respectively.

The dominance of North India stems from its robust industrial base, particularly in pharmaceuticals, biotechnology, and healthcare. Cities like Delhi, Noida, and Gurgaon, serving as industry hubs, bolster this demand. Government and private investments aimed at improving manufacturing capabilities and meeting quality standards further contribute to market growth. Stringent regulations in sectors like pharmaceuticals necessitate advanced cleanroom technologies for product sterility. Additionally, increased adoption across industries like electronics and food processing enhances market expansion. The region's well-developed infrastructure and collaborative efforts between academia and industry drive innovation and customization, positions North India as a significant player in the cleanroom technologies market's growth and development.

**Chart 11: Indian Cleanroom Technologies: Market Size by Region**

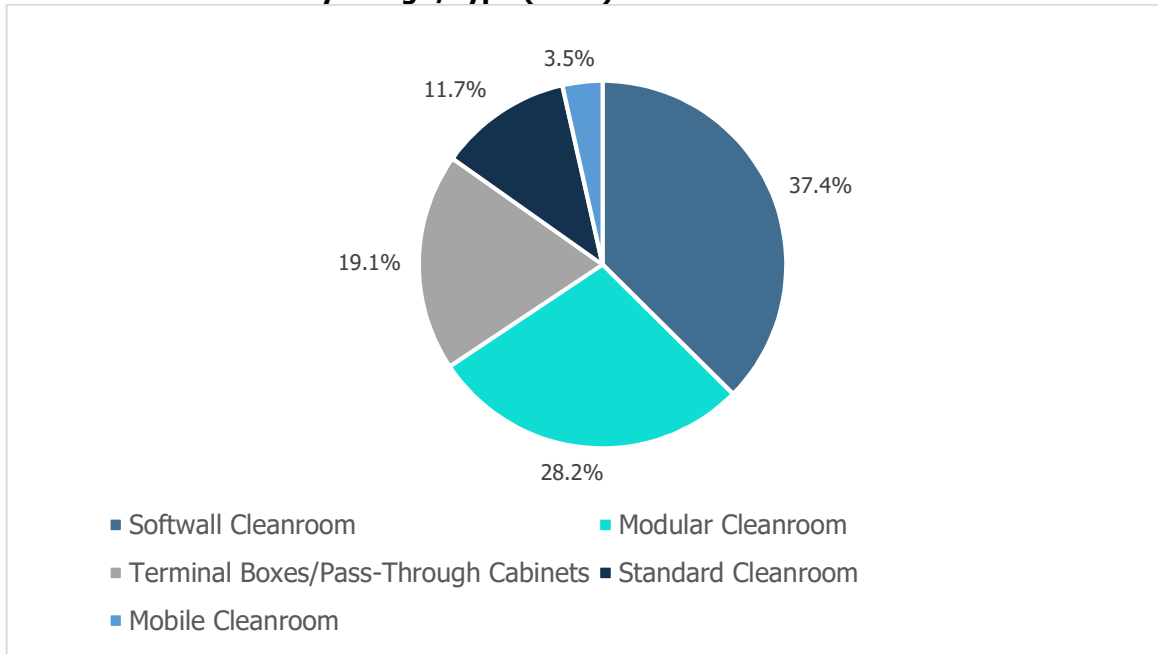


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**2.3 Market Size of the Industry by Volume**

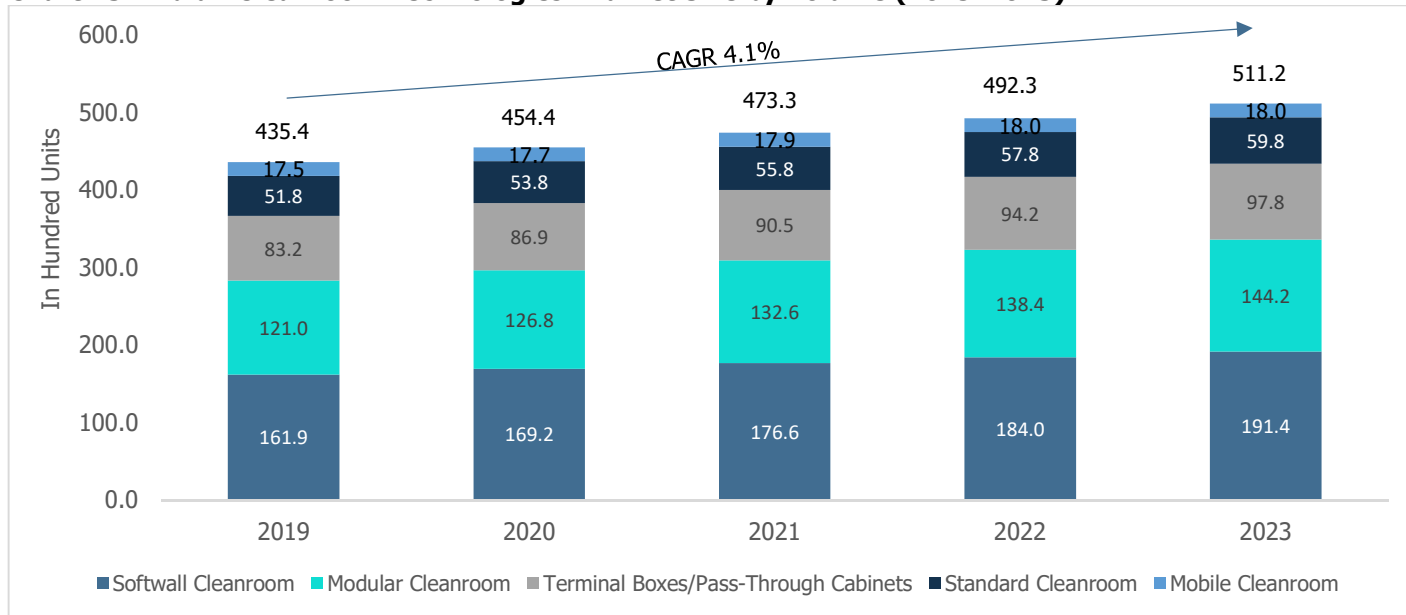
The Indian Cleanroom Technologies market has been growing in an upward trend, since 2019, at a CAGR of 4.1%. The market size, by volume, grew from 435.4 hundred units in 2019 to 511.2 hundred units in 2023. As of 2023, the softwall cleanroom and modular cleanroom segment dominate the market by volume with a market size of 37.4% (191.4 hundred units) and 28.2% (144.2 hundred units) respectively. This is followed by Terminal Boxes/Pass-Through Cabinets, Standard Cleanroom and Mobile Cleanroom each having a market size of 19.1% (97.8 hundred units), 11.7% (59.8 hundred units), and 3.5% (18.0 hundred units) respectively.

**Chart 12: Market Size by Design/Type (2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

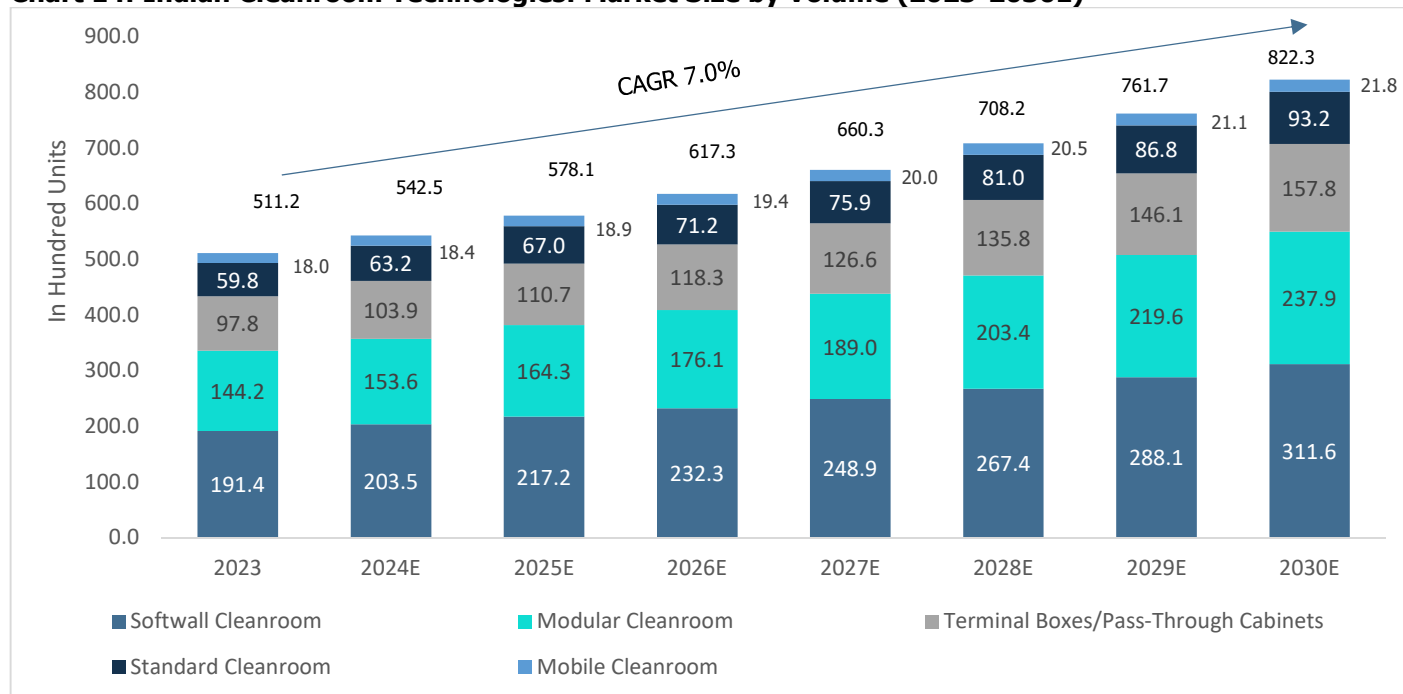
**Chart 13: Indian Cleanroom Technologies: Market Size by Volume (2019-2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

The Indian Cleanroom Technologies market is anticipated to grow steadily at a CAGR of 7.0% from 2023 to 2030, reaching a market size of 822.3 hundred units by 2030. This growth, by volume, is expected to be driven by Softwall Cleanroom, Modular Cleanroom, and Terminal Boxes/Pass-Through Cabinets each expected to have a market size of 37.9% (311.6 hundred units), 28.9% (237.9 hundred units), and 19.2% (157.8 hundred units), by 2030, respectively. The market size of standard and mobile cleanroom is expected to fall to 11.3% (93.2 hundred units) and 2.7% (21.8 hundred units), by 2030, respectively. The dominance of softwall cleanroom stems from a burgeoning emphasis on biotechnology and agricultural innovation in the regional market. Despite challenges, such as ongoing industrialization and heightened contamination control awareness, the sector is expected to flourish. In pharmaceuticals, India's expanding global presence, especially in exports, fuels demand for cleanroom services, necessitating adherence to international regulatory standards. This shift towards global compliance underscores the importance of cleanroom technologies in maintaining quality and meeting international best practices, further boosting market size.

**Chart 14: Indian Cleanroom Technologies: Market Size by Volume (2023-2030E)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

## 2.4 Overview of Cleanroom Partition market

Cleanroom partitions are integral components of cleanroom systems designed for the efficient and adaptable creation of air-tight and dust-free environments within commercial premises. They enable the construction of cleanrooms suitable for diverse applications in medical, laboratory, and specialized manufacturing settings. These partitions facilitate the segmentation of spaces while maintaining stringent cleanliness standards, crucial for industries requiring controlled environments to ensure product quality and safety.

The Cleanroom Partition market can be segmented by material used for construction:

- Aluminium Honeycomb Panels:** Aluminum honeycomb panels are highly advantageous for cleanroom partition construction due to their lightweight yet robust nature. They offer exceptional strength and stability throughout the panel, ensuring consistency and reliability in controlled environments. Their non-particulating and non-outgassing properties, along with resistance to chemicals, make them ideal for maintaining cleanroom integrity. These panels are pre-fabricated to precise specifications, reducing installation time and ensuring accuracy on-site. The lightweight properties of aluminum honeycomb panels not only facilitate easier and safer installation but also potentially reduce transportation costs.
- Rockwool:** Rockwool, or mineral wool, is a high-performance insulation material made from natural volcanic rock, ideal for cleanroom partitions. Its unique properties include excellent thermal insulation, sound absorption, fire resistance, moisture resistance, and low particle release, making it essential for maintaining stringent cleanliness standards. Rockwool panels are durable, customizable, and environmentally friendly, making them suitable for industries such as electronics, pharmaceuticals, food, and aerospace. Frequently used in cleanroom engineering, Rockwool sandwich panels are favored for walls and ceilings due to their superior insulation and fire-resistant characteristics.
- Polyurethane:** Polyurethane (PU) is highly valued in cleanroom partitions for its durability, chemical and moisture resistance. Utilized in PUF (Polyurethane Foam) partitions, these modular systems ensure controlled environments

with superior insulation and longevity. The closed-cell structure of PU foam prevents moisture absorption, crucial for maintaining cleanroom integrity. PUF partitions are known for their easy installation, disassembly, and reassembly, accommodating dynamic cleanroom needs such as layout adjustments and equipment integration. This flexibility, combined with PU's robust qualities, makes PUF partitions a cost-effective and dependable choice for creating versatile cleanroom spaces across various industries.

Other materials like fiberglass reinforced polyester (FRP) and gypsum are also employed in cleanroom walls and partitions, providing advantages such as fire resistance, minimal upkeep requirements, and customizable features.

The Cleanroom Partition Market is poised for substantial growth driven by escalating demand across diverse industries, particularly pharmaceuticals and healthcare. This surge is propelled by stringent regulatory standards mandating cleanroom adherence for product quality assurance. Technological advancements in materials and construction methods are further propelling market expansion, with manufacturers focusing on innovations enhancing performance, durability, and cost-efficiency. The increasing adoption of modular cleanrooms, offering flexibility and scalability, is also pivotal in driving market growth. Overall, the future outlook for the Cleanroom Partition Market is optimistic, fueled by the expanding demand for cleanrooms and advancements in cleanroom technologies.

## 2.5 Key Demand Drivers

- **Rising demand for cleanrooms in manufacturing units:** The demand for cleanrooms in manufacturing units across various industries in India is witnessing a robust upsurge. This growth is propelled by sectors such as pharmaceuticals, semiconductors, EV batteries, solar panels, electronics, food and beverage, and aerospace, which prioritize stringent cleanliness standards to ensure product quality and safety. Cleanrooms are essential in meeting these requirements, ranging from sterile product manufacturing in pharmaceuticals to preventing defects in electronics, semiconductors, solar panels, etc.. The increasing recognition of the significance of controlled environments underscores a sustained expansion in India's cleanroom technologies market. Additionally, the expansion of India's pharmaceuticals and electronics industries, driven by stringent regulations and rising domestic demand, further fuels the demand for cleanroom technologies. Adherence to Good Manufacturing Practices (GMP) in pharmaceuticals and the protection of sensitive electronic components from contamination are key factors driving this demand. The trend extends to other sectors like biotechnology, food processing, and aerospace, presenting lucrative opportunities for companies specializing in cleanroom design, construction, and equipment supply. Overall, the growth of these industries is reshaping manufacturing dynamics in India and contributing significantly to the expansion of the cleanroom technology market.
- **Rising quality and safety standards:** Cleanroom technologies are essential in sectors like pharmaceuticals, electronics, semiconductors, solar panels, EV batteries, and healthcare due to stringent quality and safety regulations. They ensure cleanliness, sterility, and contamination prevention, meeting consumer expectations for high-quality products. As global competition increases, companies invest in cleanroom facilities to maintain rigorous quality control and consumer trust. This emphasis on quality and safety standards is fueling the adoption of cleanroom technologies across various industries in India.
- **Increased adoption in healthcare:** Cleanrooms are essential in healthcare for maintaining sterile environments vital for infection prevention and patient safety. As concerns over healthcare-associated infections rise, healthcare facilities are increasingly investing in cleanroom technologies, utilized in operating theatres, intensive care units, and laboratories to regulate air quality and minimize contamination risks. The demand for cleanrooms is driven by the expansion of the pharmaceutical and biotechnology sectors, necessitating stringent contamination control for drug production. The COVID-19 pandemic has further emphasized the importance of cleanroom facilities in vaccine production. Regulatory bodies like CDSCO are enforcing stricter cleanliness guidelines, driving cleanroom technology

adoption and creating lucrative opportunities for manufacturers in India, setting the stage for significant market growth and innovation.

- **Government Initiatives:** Government initiatives are driving significant growth in India's cleanroom technologies market across various sectors. Initiatives like "Make in India" encourage domestic manufacturing, leading to investments in industries such as pharmaceuticals, electronics, and biotechnology, which require cleanroom environments for production quality and contamination control. Government schemes to enhance healthcare infrastructure, like the Ayushman Bharat program, necessitate advanced medical facilities including cleanrooms, boosting the market. In electronics and semiconductor sectors, policies aim to reduce import dependence and foster domestic production, requiring cleanroom integration for compliance and product reliability. Additionally, government regulations emphasizing quality and safety drive adoption of cleanroom technologies, shaping a regulatory environment conducive to market growth.
- **Increasing demand for sustainable healthcare:** The increasing focus on sustainability is creating opportunities in the cleanroom technologies market as industries prioritize eco-friendly solutions driven by regulations, corporate responsibility, and operational benefits. Sustainable cleanroom technologies, such as energy-efficient HVAC systems and recyclable materials, are gaining traction, particularly in sectors like pharmaceuticals and electronics. Government initiatives further support this trend, offering growth prospects. The demand for sustainable cleanroom technologies in India enables companies to meet regulations, customer demands, and enhance competitiveness.

## 2.6 Challenges

- **Complex cleaning process:** Complex cleaning processes pose a significant obstacle to the growth of India's cleanroom technologies market. Maintaining the stringent standards necessary for cleanrooms demands time-consuming and costly procedures, particularly in industries like pharmaceuticals and electronics. Specialized cleaning agents and techniques are required, leading to increased operational downtime and higher costs. The shortage of skilled labor further complicates matters, driving up training expenses and reliance on specialized cleaning services. These challenges can deter smaller companies from adopting cleanroom technologies, limiting market expansion to larger organizations with substantial resources. Thus, while cleanroom technologies are crucial for product quality and safety, the complex cleaning requirements present a notable barrier to market growth.
- **High cost:** The high costs of establishing and maintaining cleanroom technologies present a major obstacle for the India cleanroom technologies market, particularly for SMEs. Initial setup expenses include advanced HVAC systems, HEPA filters, and specialized construction materials. Ongoing operational costs such as energy consumption and skilled personnel further contribute to the financial challenge. Pharmaceutical firms such as Sun Pharma and electronics companies like Infosys and Wipro face substantial capital investments to meet regulatory standards and maintain product integrity through cleanroom facilities for drug manufacturing and research and production of susceptible electronic components respectively. The financial burden is worsened by the constant need for upgrades and meeting evolving industry regulations. Regulatory bodies such as the Central Drugs Standard Control Organization (CDSCO) in pharmaceuticals and Department of Electronics and Information Technology (DeitY) in electronics enforce stricter compliance, prompting companies to invest in costly cleanroom technologies. Additionally, limited financial resources and access to affordable credit options hinder many businesses from investing in these necessary facilities. This high-cost barrier deters new entrants and slows the expansion of existing companies, ultimately limiting the growth of the cleanroom technologies market in India.
- **Lack of trained manpower:** The shortage of skilled personnel is a major challenge in India's cleanroom technologies market, hindering growth and efficiency. Industries like pharmaceuticals, biotechnology, electronics, and aerospace require specialized expertise to maintain strict contamination control standards in cleanroom environments. However, there is a significant lack of trained professionals proficient in operating, maintaining, and managing cleanroom

facilities. This shortage is particularly acute in sectors such as pharmaceuticals and biotechnology, where precise tasks like environmental monitoring and sterile manufacturing are vital. Similarly, in electronics and semiconductor manufacturing, preventing electrostatic discharge and particulate contamination is crucial. The rapid industry expansion exacerbates this skills gap, necessitating substantial investments in training initiatives by companies. However, the complexity and high costs associated with training further strain resources, limiting the scalability and progress of cleanroom operations.

- **Fluctuations in raw material prices:** Fluctuations in the prices of specialized materials like stainless steel, polymers, and HEPA filters significantly impact the construction and maintenance of cleanrooms. Price volatility, driven by factors such as geopolitical tensions and supply chain disruptions, can raise production expenses and make cleanroom technologies less affordable for end-users, potentially slowing market growth. Uncertainty in raw material pricing complicates budgeting and financial planning for cleanroom technology providers, affecting pricing models, contracts, and project timelines. Additionally, ensuring high-quality materials that meet regulatory standards adds complexity, as reliable sources become more competitive, further driving up prices. Overall, these challenges in raw material pricing pose obstacles to the India cleanroom technologies market, impacting cost structures, financial planning, and market accessibility.
- **Infrastructure challenges:** Infrastructure challenges, including high construction costs, skilled labor shortages, geographical disparities, and unreliable power supply, pose significant hurdles to the development and expansion of the cleanroom technologies market in India. The high initial investment and complexity involved in constructing and maintaining cleanroom facilities deter smaller companies from entering the market. Additionally, the shortage of skilled labor leads to project delays and increased costs. Geographical disparities in infrastructure development limit the geographical expansion of cleanroom technology providers and restrict access to cleanroom solutions for industries in less developed areas. Unreliable power supply further disrupts cleanroom operations, impacting efficiency and risking contamination.

## 2.7 Industry Outlook

Indian cleanroom technologies market, valued at USD 277.4 million in 2023 is expected to reach USD 484.2 million by 2030 with a CAGR of 8.3%. This growth is expected to be supported by the expanding domestic and export manufacturing in pharmaceutical and biotechnology sectors, increasing awareness and demand for high-quality healthcare products, stringent regulatory standards, advancements in manufacturing processes, expansion of electronics and food processing industries that require contamination-free environments, and other technological advancements.

The pharmaceutical industry in India is experiencing a remarkable growth, with projections indicating a substantial expansion, reaching USD 65 billion by 2024 and doubling to USD 130 billion by 2030. Its prominence in the international arena is also increasing which is further expected to drive demand for cleanroom services as players are striving to be more compliant to global standards. With the launch of UP Pharmaceutical and Medical Device Policy 2023, Uttar Pradesh (UP) is emerging as a significant player in the pharmaceutical industry, contributing to India's production capacity and fostering innovation. Additionally, the company Lindström India's investment of 5 million euros in a cleanroom facility near Hyderabad further reinstates the burgeoning opportunities within the pharmaceutical industry. The facility aims to meet the increasing demand for advanced manufacturing environments by offering innovative cleanroom solutions across various industries, such as pharmaceuticals, food processing, healthcare, electronics, and automobiles reflecting the broader trend towards elevated standards of cleanliness and hygiene. This initiative not only fosters the adoption of cutting-edge technologies but also reinforces the region's reputation as a competitive player in the global cleanroom technologies market, attracting further investments and collaborations and fuelling market expansion.

### 3. HVAC Industry in India

#### 3.1 Overview

The Heating, Ventilation and Air Conditioning (HVAC) industry makes the use of principles of mechanical engineering such as thermodynamics, fluid mechanics and heat transfer to achieve thermal comfort and provide acceptable indoor air quality across residential, industrial and commercial segments. The industry incorporates various products such as portable air conditioners, industrial electric fan heaters, large heaters, commercial dehumidifiers, man cooler fans, warehouse fans, portable ventilation fans, extractor fans, evaporative coolers, fan coil units and portable boilers.

The Indian HVAC market is rapidly growing and is expected to reach USD 31.85 billion by 2030. As more and more people migrate to cities, the demand for comfortable living and working environment is rising, propelling growth in the market. In residential settings, it provides thermal comfort all year round with the heating component ensuring warm temperature indoors in the colder months and air conditioning component working towards cool temperature indoors during hotter months. In industrial settings, temperature control helps in protection of sensitive equipment from adverse temperature changes and ventilation component ensures optimal working condition and preservation of product quality. In commercial settings like offices, hotels, and hospitals, these systems are essential for employee productivity, patient well-being, and guest comfort.

Based on offering, the **Indian HVAC market can be divided into two broad categories: Equipment and Services.** Equipment includes various essential components designed to provide climate control and maintain indoor air quality such as furnaces, heat pumps, air conditioners, boilers, air handlers, ductwork, exhaust fans, and air purifiers. Services encompass a range of professional activities which are aimed at ensuring efficient operation, maintenance and longevity of the HVAC system. These include upgradation/replacement, installation, maintenance, repair and consulting services.

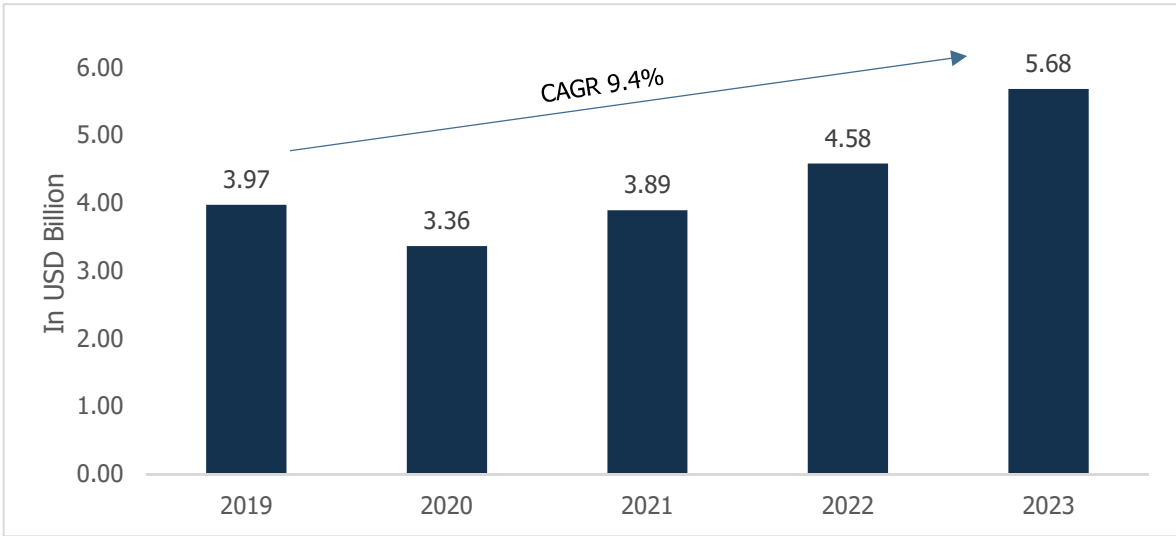
Equipment	Services
<ul style="list-style-type: none"> <li>• <b>Heating:</b> Heating systems involves the process of adding thermal energy to achieve and maintain warm temperatures in colder regions to ensure occupant comfort and productivity. This is achieved through heating systems, such as furnaces, boilers, heat pumps, and electric heaters.</li> <li>• <b>Ventilation:</b> Ventilation systems refers to the process of exchanging indoor stale air with fresh outdoor air to maintain air quality and comfort in an enclosed space. The introduction of fresh outdoor air dilutes and removes indoor pollutants, odours, and excess moisture, while also regulating temperature and oxygen levels.</li> <li>• <b>Cooling:</b> Cooling systems refers to the process of removing thermal energy to achieve and maintain cooler temperatures in hotter regions to ensure occupant comfort. This is achieved through various methods and technologies, such as air conditioners, chillers, and heat pumps which absorb heat from indoor air and expel it outside.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Upgradation/Replacement:</b> It involves upgradation or substitution of existing HVAC systems with newer, efficient models to enhance overall functionality. This includes systematic assessments of existing HVAC systems, identification of inefficiencies, selection of suitable replacement units, professional installation of new equipment, and post-installation testing and adjustments to ensure optimal operation.</li> <li>• <b>Maintenance and Repair:</b> It involves ensuring efficient and reliable system operation by conducting regular inspections, cleaning, and calibration. Tasks include filter checks, ductwork inspection, and electrical connection testing to identify and address minor issues. Repairs address malfunctions like faulty thermostats or compressor failures, restoring optimal functionality through skilled diagnosis and recalibration.</li> <li>• <b>Installation:</b> It involves the meticulous setup of HVAC systems for optimal performance and functionality. It begins with thorough planning and site evaluation, considering factors like building size and occupancy. Skilled technicians then install all components according to manufacturer specifications and local codes. Rigorous testing and adjustments ensure system integrity and performance. Finally, comprehensive documentation and client orientation</li> </ul>

	<p>are provided to ensure users understand system operation and maintenance.</p> <ul style="list-style-type: none"> <li>• <b>Consulting:</b> It involves expert guidance and advisory support provided by professionals to individuals, businesses, or organizations seeking optimized HVAC solutions. Consultants provide complete assessments of existing systems; collaborate closely with clients to understand all their requirements to meet their needs; assist with system design, equipment selection, technology integration, leveraging industry expertise and best practices to optimize performance and minimize operational expenses, and provide insights into regulatory compliance, industry standards, and emerging technologies, empowering clients to make informed decisions.</li> </ul>
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**3.2 Market size of the Industry by Value**

The Indian HVAC market grew at a CAGR of 9.4% from 2019-2023 from USD 3.97 billion in 2019 to USD 5.68 billion in 2023. Except for a slight dip in market value during the pandemic, the HVAC market has shown an upward trend in its market size. This is attributed to increasing urbanisation and higher disposable incomes. According to World Bank data in 2022, 36% of India’s population lives in urban areas, driving growth in this market as more and more people demand efficient and environmental-friendly modern HVAC systems to make living and working spaces comfortable.

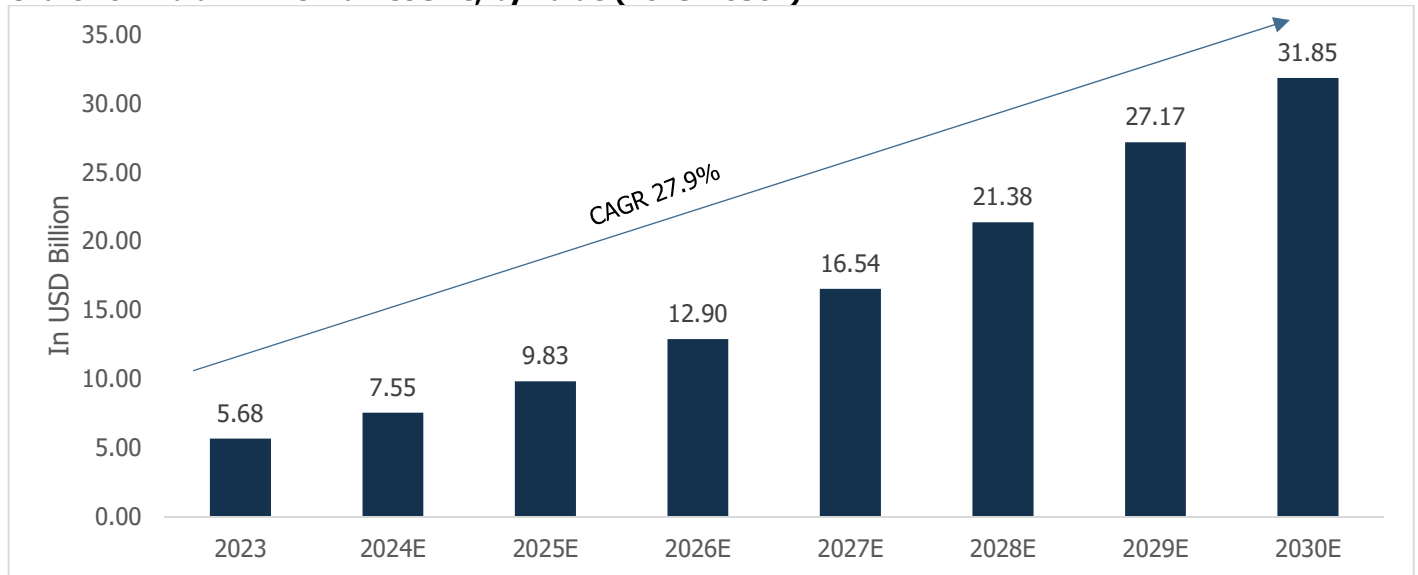
**Chart 15: Indian HVAC Market Size, by Value (2019-2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

The Indian HVAC market size is forecasted to grow in an upward trend at a CAGR of 27.9% from 2023-2030 gaining a market size of USD 31.85 billion by 2030. Increasing urbanisation, higher disposable incomes, growing awareness about indoor air quality and growing demand for energy efficient and technologically advanced modern HVAC systems are the major contributors to this forecasted growth. Also, the domestically manufactured HVAC products will enhance accessibility, expand the service network, and increase support to different channels further providing impetus to future growth.

**Chart 16: Indian HVAC Market Size, by Value (2023-2030E)**

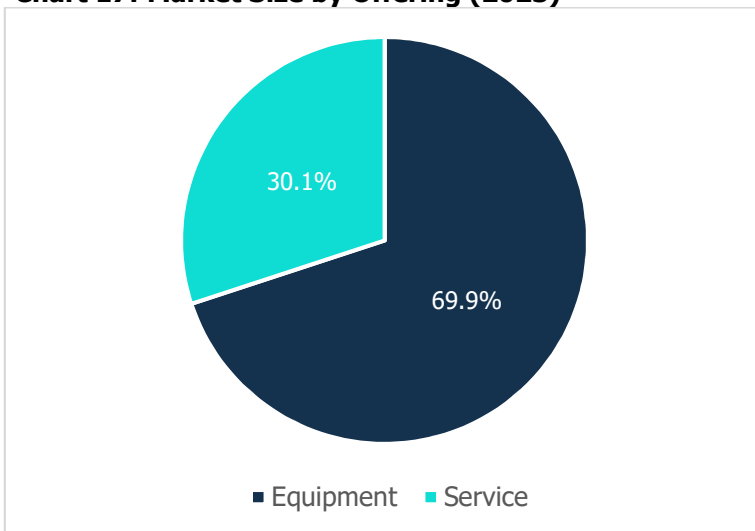


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**3.2.1 Market Size by Offering**

The India HVAC market can be divided into equipment and services based on offering. In 2023, equipment contributed USD 4.0 Billion (69.9%) in the Indian HVAC market while services contributed USD 1.7 Billion (30.1%). The share of equipment is expected to grow at a CAGR of 28.2%, faster than the services segment which is expected to grow at a CAGR of 27.2% from 2023-2030. The market share for equipment and services segment is forecasted to be 71.09% and 28.91% respectively, by 2030.

**Chart 17: Market Size by Offering (2023)**

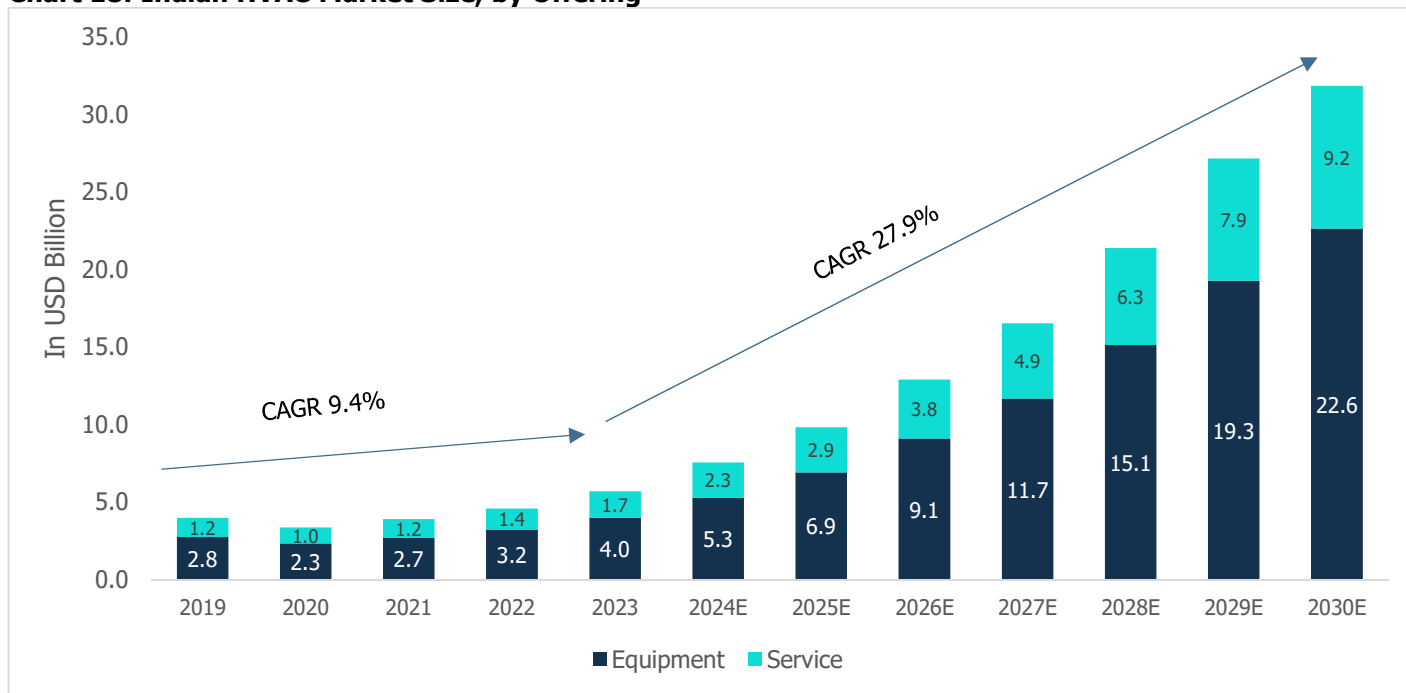


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

The equipment segment is poised for substantial growth due to the country's burgeoning infrastructure needs. Additionally, various initiatives taken by the government to boost infrastructural development in the country is expected to contribute to this growth. One such pivotal agreement was between the Dubai government and India in October 2021 which aims to target infrastructure enhancement in Jammu and Kashmir. This collaboration promises the

establishment of medical colleges, specialist hospitals, industrial parks, IT towers, and multifunctional towers, accentuating the demand for HVAC equipment to meet the evolving needs of various industries.

**Chart 18: Indian HVAC Market Size, by Offering**

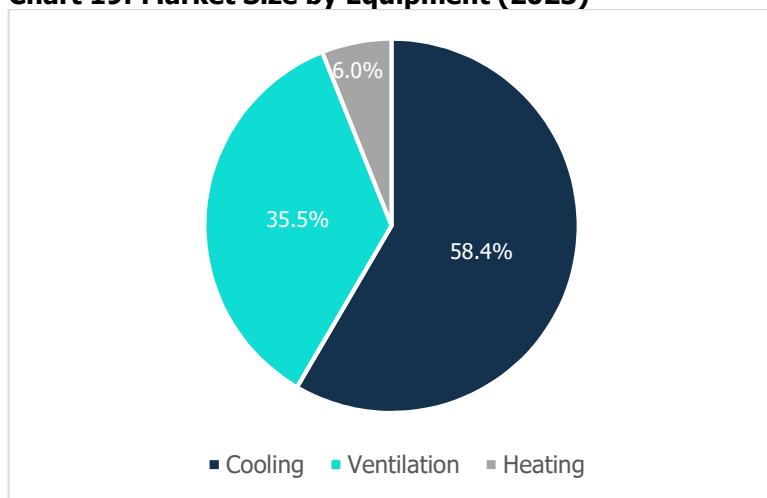


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**3.2.1.1 Market size by Equipment**

The equipment segment has historically (2019-2023) been growing at a CAGR of 9.7% and is expected to grow at a CAGR of 28.2% for the period 2023-2030. Cooling dominates the HVAC market in 2023 with 58.4% (USD 2.3 Billion) market share followed by Ventilation and Heating having market shares of 35.5% (USD 1.4 Billion) and 6.0% (USD 0.2 Billion) respectively.

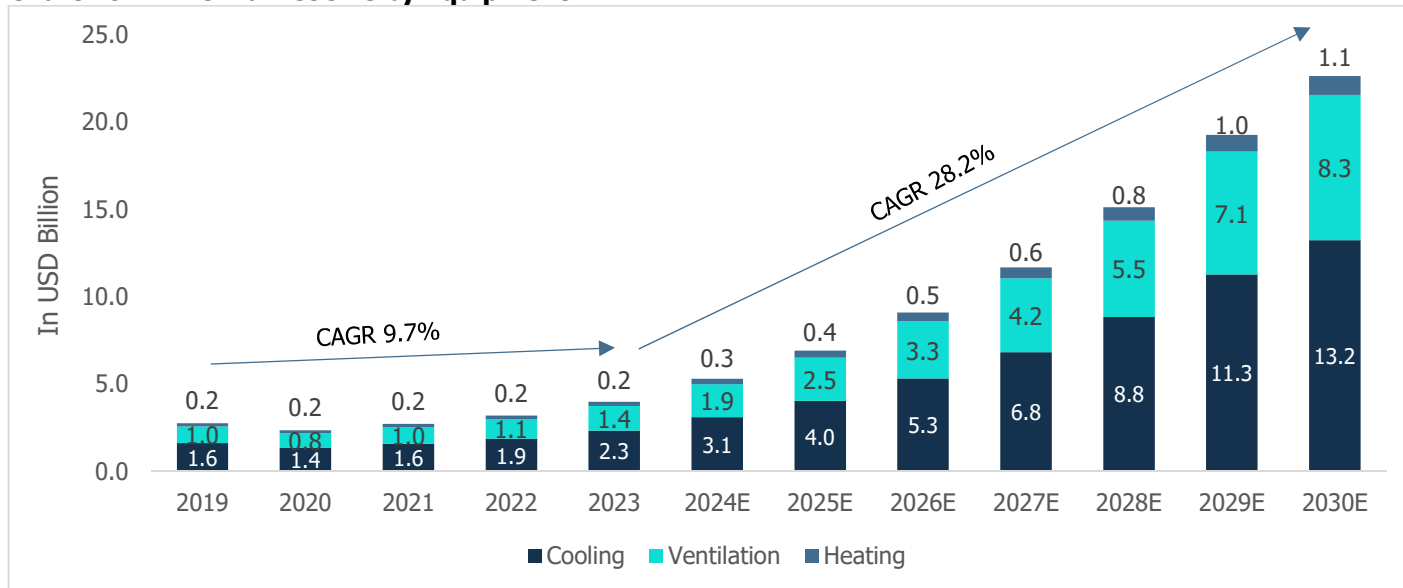
**Chart 19: Market Size by Equipment (2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

The dominance of Cooling stems from the robust expansion of India's residential real estate sector, particularly in major cities like Mumbai, Kolkata, Ahmedabad, and Pune. The surge in residential construction and sales underscores the pressing need for efficient cooling systems to ensure optimal indoor air quality and comfort for occupants. This trend is expected to propel the growth of the cooling segment within the HVAC market. Ventilation is forecasted to grow at a CAGR of 28.9% for the period of 2023-2030 followed by Cooling and Heating growing at CAGR of 28.2% and 23.8% respectively.

**Chart 20: HVAC Market size by Equipment**

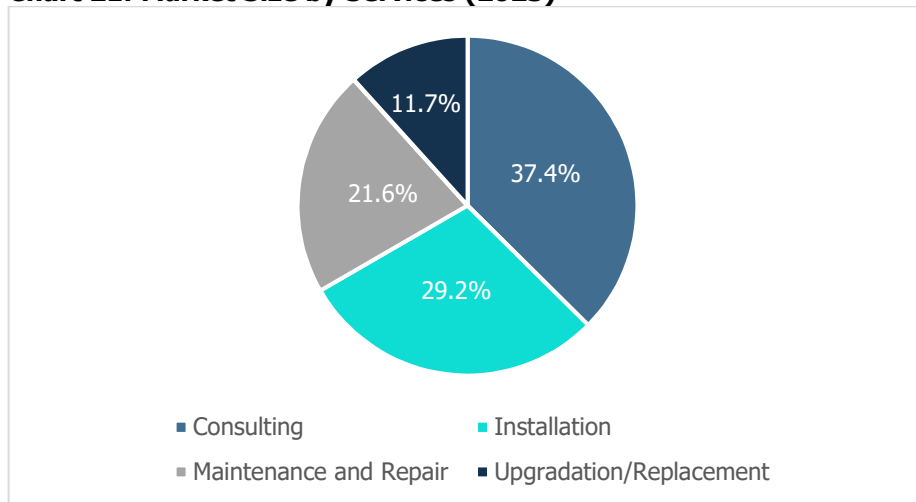


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

**3.2.1.2 Market size by Services**

The services segment has historically (2019-2023) been growing at a CAGR of 8.8% and is expected to grow at a CAGR of 27.2% for the period 2023-2030. Consulting dominates the services segment with a market share of 37.4% (USD 0.6 Billion) in 2023 followed by Installation, Maintenance and Repair, and Upgradation/Replacement having market shares of 29.2% (USD 0.5 Billion), 21.6% (USD 0.4 Billion), and 11.7% (USD 0.2 Billion) respectively.

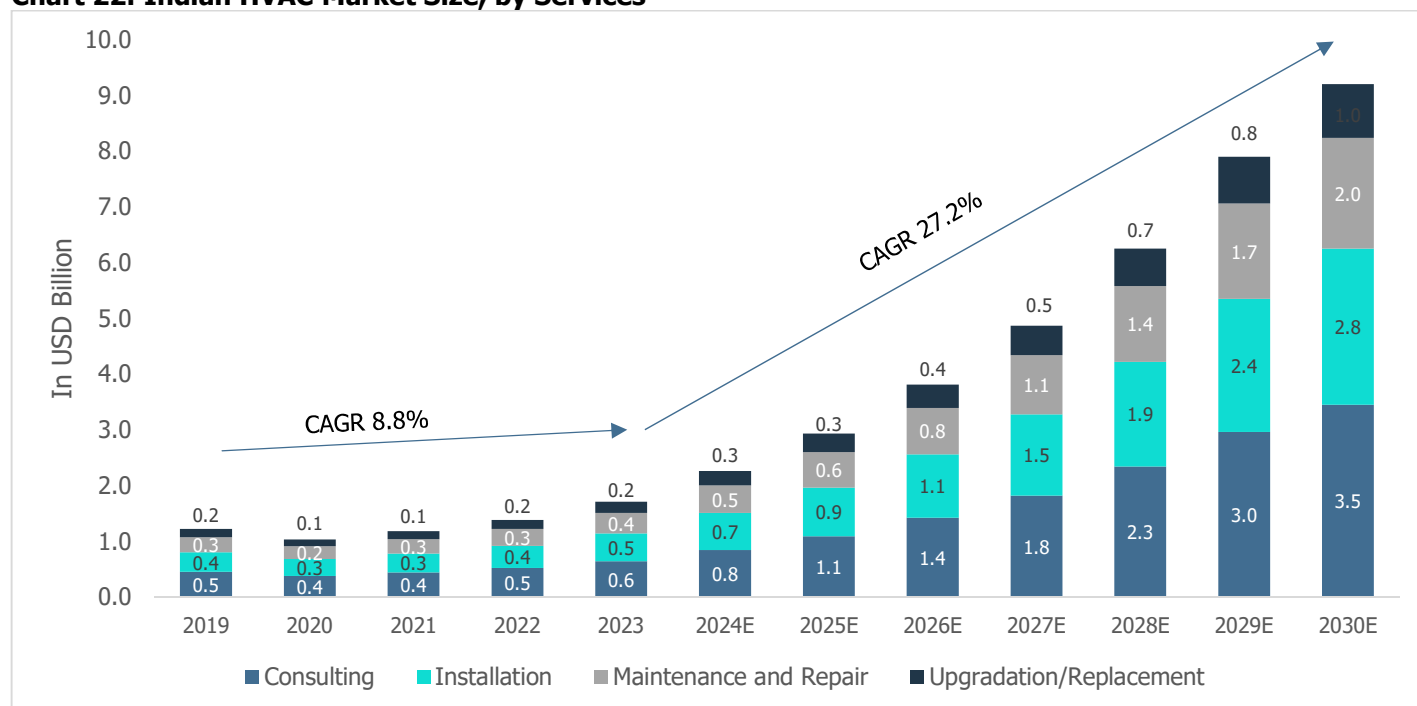
**Chart 21: Market Size by Services (2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

In the Indian HVAC market, the consulting segment is expected to hold a significant share due to the rapid urbanization of the country. As per World Bank, by 2036, it's projected that 40% of India's population, totaling 600 million people, will reside in urban areas. This demographic shift is fueling substantial demand for housing, commercial properties, and infrastructure, consequently driving remarkable growth in the Indian real estate market. The surge in real estate development is driving up the demand for HVAC systems, leading to an increased need for consulting services to provide expert guidance and advisory support. This trend is anticipated to significantly contribute to the growth of the consulting segment in the Indian market in the coming years.

**Chart 22: Indian HVAC Market Size, by Services**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

### 3.2.2 Market Size by End User

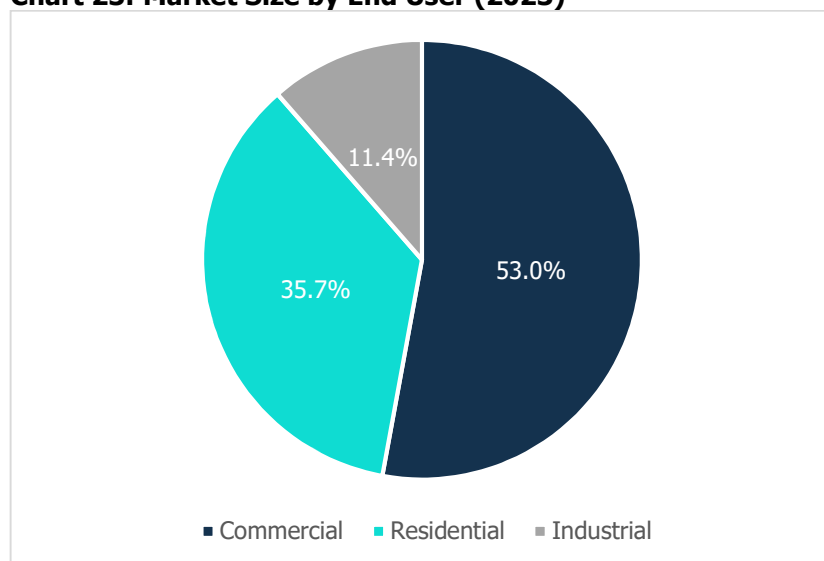
The Indian HVAC Market, by end user, can be divided into commercial, residential and industrial segments.

- Commercial:** In commercial environments, HVAC systems are essential for maintaining comfortable conditions and air quality. They control temperature, humidity, and ventilation, which are vital for ensuring employee efficiency and customer contentment. Energy-efficient HVAC systems help lower operational expenses and lessen environmental harm. Additionally, in sectors such as healthcare and food service, they uphold sterile environments and safeguard product quality. Routine maintenance is crucial for extending system lifespan and avoiding expensive malfunctions, ensuring continuous business operations. Ultimately, the widespread use of HVAC systems in commercial settings is crucial for fostering environments that support well-being, productivity, and sustainability objectives.
- Residential:** In homes, HVAC systems are essential for maintaining year-round comfort and indoor air quality. They control temperature, humidity, and airflow, ensuring a pleasant atmosphere despite external weather changes. Efficient HVAC systems not only enhance comfort but also lead to energy savings and lower utility costs. They also filter out pollutants and allergens, improving indoor air quality and promoting healthier living conditions. Regular maintenance is crucial for prolonging system life and avoiding expensive repairs, ensuring continuous comfort for residents. Overall, residential HVAC usage is vital for creating comfortable, healthy, and sustainable home environments.

- **Industrial:** In industrial settings, HVAC systems are crucial for creating ideal working conditions and safeguarding equipment and processes. They control temperature, humidity, and ventilation, ensuring employee safety, productivity, and comfort. These systems also prevent moisture accumulation, protecting sensitive machinery and materials from damage. Efficient industrial HVAC systems promote energy efficiency and cost reduction, particularly in large-scale manufacturing operations. Additionally, they are essential for controlling airborne contaminants and meeting health and safety standards. Overall, industrial HVAC usage is indispensable for maintaining product quality across various manufacturing environments.

As of 2023, Commercial segment holds the majority market size, as end user, of 53.0% (USD 3.0 billion). This is followed by Residential and Industrial segment holding market size of 35.7% (USD 2.0 billion) and 11.4% (USD 0.7 billion) respectively.

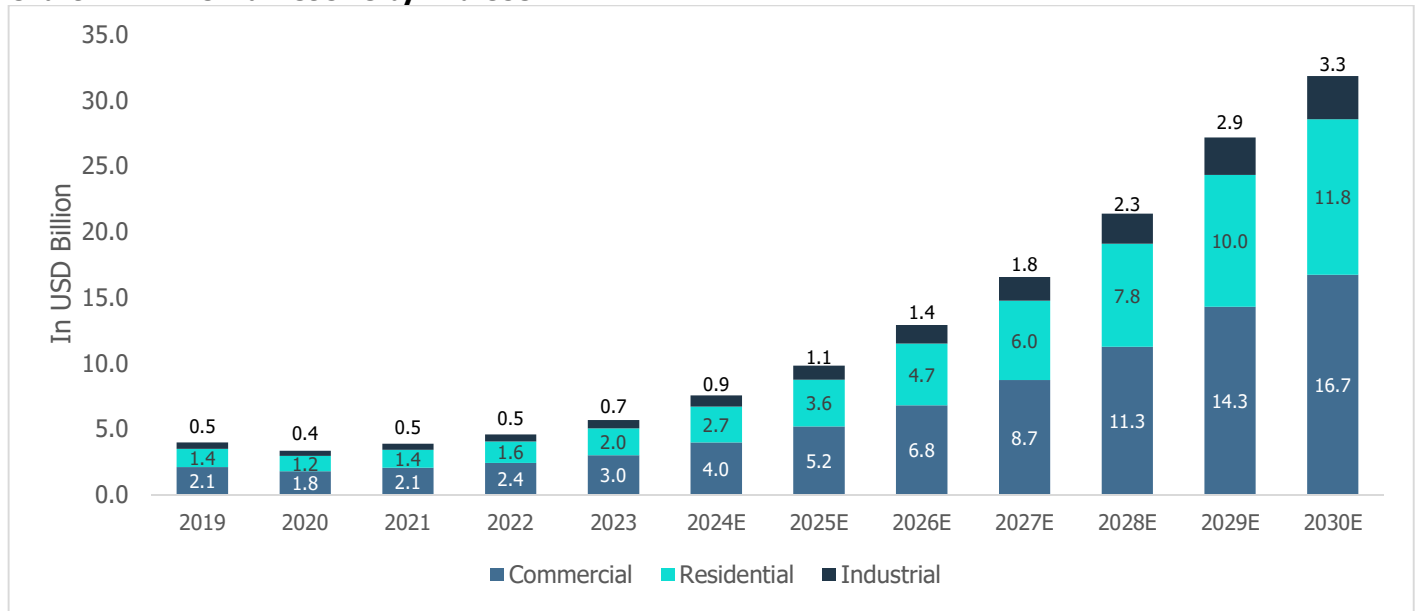
**Chart 23: Market Size by End User (2023)**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

Historically, from 2019-2023, commercial, residential and industrial segment have been growing at a CAGR of 9.3%, 10.1%, and 7.9% respectively. Given the expected growth in the Indian HVAC market, all three segments are expected to grow at the higher CAGRs of 27.8%, 28.6%, and 26.1% for the period 2023-2030. The commercial segment is projected to claim a significant share. This dominance is attributed to rapid urbanization, infrastructural growth, and a rising focus on comfort in commercial establishments. With government fiscal constraints, private sector involvement becomes pivotal in financing infrastructure projects. The National Infrastructure Pipeline (NIP), launched in 2020, forecasts substantial investments until 2025, fostering a conducive environment for commercial HVAC market growth. This initiative aligns with the market's upward trend and the escalating demand for HVAC solutions in commercial settings.

**Chart 24: HVAC Market size by End User**

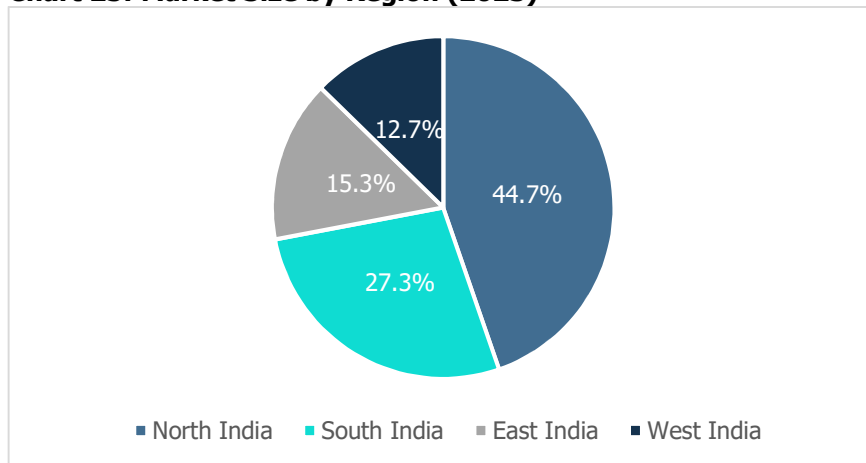


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

### 3.2.3 Market Size by Region

By region, the Indian HVAC market is segmented into North, South, West, and East India. North and South India together hold more than 70% of the market with each having 44.7% (USD 2.5 Billion) and 27.3% (USD 1.6 Billion) share respectively in 2023. The market share of East and West India, as of 2023, is 15.3% (USD 0.9 Billion) and 12.7% (USD 0.7 Billion) respectively.

**Chart 25: Market Size by Region (2023)**

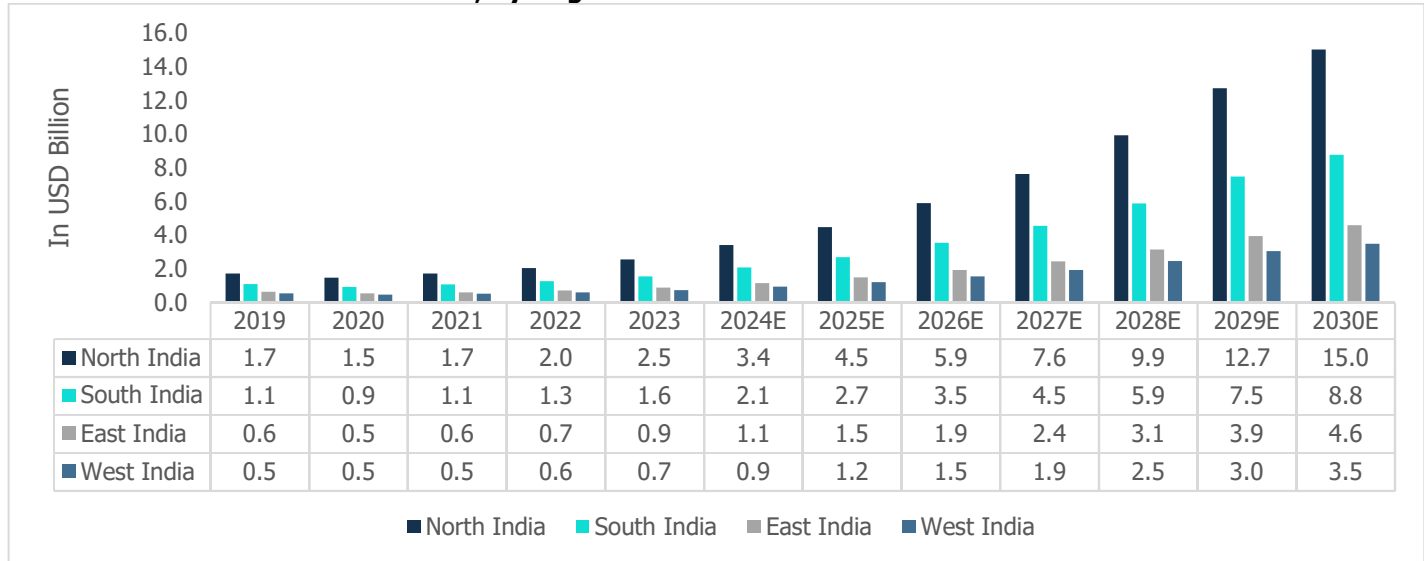


Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

North and South India are projected to grow most rapidly for the period 2023-2030 at CAGR of 28.9% and 28.1% respectively. This is followed by East and West India which are expected to grow at CAGR of 26.8% and 25.3%. North India experiences extreme and diverse climatic conditions necessitating the need for year round HVAC solutions. Additionally, the rapid urbanization in the region has led to increased construction of commercial complexes, residential buildings, and industrial facilities further boosting demand for HVAC systems. Moreover, Punjab and Haryana, host both agricultural and manufacturing industries which require HVAC systems to preserve agricultural produce and maintain

production efficiency. This heightened demand not only drives increased adoption of HVAC systems but also underscores the region's pivotal role in advancing the overall industry in India.

**Chart 26: Indian HVAC Market Size, by Region**



Notes: E- Estimates; Source: BlueWeave Consulting, CareEdge Research

### 3.3 Key Demand Drivers

- Increasing infrastructural development:** The increasing number of infrastructure development plans are significantly driving growth in the Indian HVAC market. As cities are expanding, new commercial complexes, residential towers, and industrial facilities are being constructed, thus surging demand for climate control systems to maintain comfortable indoor temperatures and air quality for occupants. Moreover, the modernization of existing infrastructure, including airports, railway stations, and hospitals, also fuels the demand for advanced HVAC systems. Upgrading these facilities often involves integrating modern HVAC solutions that enhance occupant comfort and improve energy efficiency, addressing the growing concerns about energy consumption in India. Additionally, the focus on cold chain infrastructure for food storage highlights the necessity for reliable refrigeration systems, benefiting India's agricultural sector.
- Government Initiatives:** Government initiatives regarding infrastructure development are further driving demand for HVAC systems. The Regional Connectivity Scheme UDAN, led by the Ministry of Civil Aviation, aims to enhance air links to smaller towns in India, inaugurating 58 airports in its first five years. With a notable budget increase in 2023–24, totaling INR 1,244.07 Cr, the government underscores its commitment to UDAN's expansion, including reviving 22 airports and revitalizing 50 more. This surge in airport projects, under the National Infrastructure Pipeline (NIP), emphasizes Public-Private Partnerships (PPP) as key drivers for infrastructure development, promising growth in the HVAC market. Another such initiative is the "Smart Cities Mission" which further boosts demand for energy-efficient HVAC solutions, promoting smart technologies like occupancy-based air conditioning adjustments.
- Rising focus towards energy-efficient systems:** The increasing emphasis on energy-efficient HVAC systems is driven by rising energy costs, environmental concerns, and government regulations. Both commercial and residential sectors prioritize energy efficiency to reduce costs and carbon footprints. Technologies like inverter-based air conditioners, Variable Speed Drives (VSDs), and smart thermostats adjust system output in real-time, minimizing energy wastage. Government policies, such as BEE's star rating system and initiatives like the Smart Cities Mission and ECBC, promote adoption of energy-efficient technologies. Commercial entities invest in building management systems

to optimize energy usage. These trends lead to significant energy savings, environmental benefits, and support India's sustainable development and energy security goals.

- **Growing awareness of Indoor Air Quality (IAQ):** The rising awareness of indoor air quality (IAQ) is driving the demand for advanced HVAC systems capable of managing and enhancing IAQ in various settings. Particularly in urban areas with high pollution levels, clean indoor air is a priority for both residential and commercial spaces. This has led to increased adoption of HVAC systems with advanced filtration and purification technologies to remove pollutants and allergens. Sectors like healthcare, education, and offices are investing in IAQ-focused HVAC solutions to protect occupants' health. The COVID-19 pandemic has further emphasized the importance of IAQ, accelerating demand for systems with enhanced ventilation, UV-C disinfection, and HEPA filters. Manufacturers like Carrier, Blue Star, and Daikin are innovating to meet these demands with multi-stage filtration and real-time air quality monitoring. With health and well-being becoming central concerns, IAQ is shaping consumer preferences and industry trends, indicating significant growth potential for the HVAC market.
- **Increasing focus on green buildings:** Green building certifications like LEED prioritize energy efficiency and sustainability, spurring demand for advanced HVAC systems in India. Companies such as Voltas and Blue Star employ technologies like Variable Speed Drives (VSDs) to optimize energy consumption. Daikin offers heat pumps using renewable energy sources like geothermal power to align with green building principles. Specialized HVAC solutions are gaining traction, with companies like Johnson Controls and Siemens focusing on energy-efficient technologies and building management systems. Indoor air quality is a key concern, addressed by companies like Carrier and Honeywell with HEPA filters and dedicated ventilation systems. Innovation is thriving, with companies like Thermax developing radiant cooling systems and Sorbent Technologies focusing on desiccant dehumidification. Green buildings with efficient HVAC systems offer long-term benefits such as lower operating costs and reduced environmental impact, exemplified by projects like the ITC Green Centre in Gurgaon certified by USGBC LEED.
- **Rising demand in Tier-I and Tier-II cities:** As urbanization extends to smaller cities and towns in India, there's a growing demand for HVAC solutions in Tier-II and Tier-III urban areas. Infrastructure development and commercial expansion drive the need for comfortable indoor environments in commercial spaces like malls, hotels, and offices. Similarly, residential construction is on the rise, with developers integrating HVAC systems into projects to attract buyers seeking modern amenities. Manufacturers like Blue Star and Voltas are expanding their offerings and presence in these markets, tailoring solutions to local needs. Government initiatives like the Smart Cities Mission further accelerate investments in HVAC infrastructure in Tier-II and Tier-III cities.

### 3.4 Challenges

- **Lack of access to credit for public and private investments:** In India, access to credit poses significant challenges for infrastructure development, including HVAC projects. Macroeconomic conditions and government policies influence credit availability, impacting banks' willingness to fund large-scale projects. Risk assessment criteria, collateral availability, and borrower creditworthiness further affect lending decisions. Concerns over non-performing assets (NPAs) in the banking sector can also limit financing options. Additionally, the high upfront costs and longer payback periods of HVAC projects deter some investors and lenders. Addressing these challenges requires supportive policies, financial incentives, and efforts to streamline financing processes to promote sustainable growth in the HVAC sector.
- **Competition from unorganized players:** Competition from unorganized players in the Indian HVAC market presents significant hurdles due to their informal operations and disregard for industry standards and regulations. These players often offer cheaper products and services, drawing price-sensitive customers and exerting pricing pressures on established HVAC firms. This dynamics undermines the market share and profitability of reputable companies that prioritize quality, reliability, and customer service. Moreover, the presence of unorganized players

tarnishes the overall reputation of the HVAC industry, as instances of substandard workmanship and inadequate support erode consumer trust. Furthermore, unorganized players typically do not invest in research and development or adopt innovative technologies to enhance energy efficiency and environmental sustainability. This technological disparity hampers the overall progress of the HVAC industry in India and limits the availability of advanced solutions for consumers.

- **Skilled workforce shortage:** A critical challenge in the Indian HVAC market is the scarcity of adequately trained technicians and engineers specialized in HVAC systems. The complexity of modern HVAC technologies demands skilled professionals proficient in installation, troubleshooting, and servicing. However, India faces a shortage of qualified HVAC personnel, leading to project delays and diminished service quality. This shortage also impedes the adoption of advanced HVAC solutions, such as variable refrigerant flow (VRF) systems and smart HVAC controls, which require specialized expertise. Additionally, the dearth of skilled technicians results in heightened maintenance costs and system downtime, as personnel may lack the proficiency to address complex issues promptly. The rapid growth of the construction and infrastructure sectors exacerbates this challenge, amplifying the demand for HVAC services and widening the skills gap further.
- **High maintenance and installation cost of HVAC systems:** Indian HVAC market faces a significant challenge due to the high maintenance and installation costs associated with HVAC systems, affecting both customers and industry players. For customers, the substantial initial investment required for purchasing and installing HVAC systems, especially in commercial and industrial settings, can be prohibitive. Ongoing maintenance expenses further add to the total cost of ownership. From the industry perspective, these high costs can deter potential customers and limit market penetration, especially in price-sensitive segments.
- **Geopolitical tensions:** Geopolitical tensions often disrupt the supply chain of HVAC components, affecting availability and increasing costs. With many components sourced internationally, conflicts or strained relations with major trading partners can lead to delays and higher expenses. Tariffs, trade restrictions, and embargoes further complicate procurement for Indian manufacturers. In response, the Indian HVAC market is prioritizing energy efficiency and sustainability to reduce dependency on imported materials and mitigate geopolitical instability's impact on energy prices. Government initiatives like star labeling and the Perform, Achieve and Trade (PAT) scheme promote efficient HVAC systems adoption. However, the recent geopolitical unrest has exacerbated input costs, with major raw materials prices rising by 18–63% y-o-y basis. Increased logistics costs due to rerouted shipments and enhanced security measures further inflate expenses, reducing the competitiveness of Indian air conditioners in the global market.

### 3.5 Industry Outlook

The Indian HVAC market, valued at USD 5.68 billion in 2023, is projected to soar to USD 31.85 billion by 2030, with a CAGR of 27.9% fuelled by increasing urbanization and the imperative for efficient climate control systems in residential, commercial, and industrial buildings. The market's offerings, segmented into equipment and services, are characterized by a strong demand for HVAC equipment like air conditioners, chillers, and ventilation systems, particularly in urban areas. The equipment segment is expected to dominate the market with a 71.1% market share in 2030, driven by urbanization, rising disposable incomes, and heightened awareness of indoor air quality. Among end-users, the commercial and residential segment are expected to dominate the market with market size of 52.6% (USD 16.7 billion) and 37.1% (USD 11.8 billion) respectively. This is going to be driven by the adoption of smart, energy efficient and sustainable HVAC systems in offices, retail spaces, households and healthcare facilities, spurred by the need for comfortable indoor environments, growing awareness about indoor air quality, and compliance with stringent regulations. Despite promising growth prospects, the industry grapples with challenges such as limited access to credit, competition from unorganized players, high maintenance and installation costs, and a shortage of skilled technicians. Addressing these challenges and leveraging drivers like increasing infrastructural development and rising demand in Tier-II and Tier-III cities will be critical for sustaining the India HVAC market's momentum and fostering its evolution.

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