FROST & SULLIVAN

Industry Report On

Community Industrial Gases Generation & Distribution in India

SUBMITTED TO

STEAMHOUSE INDIA LTD

28th NOVEMBER 2025

ACRONYMS

AAS	Advance Authorization Scheme	IIOT	Industrial Internet of Things
Bn	Billion	IIP	Index of Industrial Production
BTP	Biotechnology Park	kW	Kilowatt
CAGR	Compound Annual Growth Rate	LOP	Letter of Permission
CIS	Competitiveness Incentive Support	MEIS	Merchandise Exports from India Scheme
CAPEX	Capital Expenditure	MNC	Multi-National Company
CMTI	Central Manufacturing Technology Institute	MSME	Micro, Small, and Medium Enterprises
CPI	Consumer Price Index	NPSDE	National Policy for Scheme Development and Entrepreneurship
DDS	Duty Drawback Scheme	NSDM	National Skill Development Mission
DFIA	Duty-Free Import Authorisation	PMKVY	Pradhan Mantri Kaushal Vikas Yojana
DTA	Domestic Tariff Area	PLI	Production Linked Incentive

EHTP	Electronic Hardware Technology Parks	PMP	Phased Manufacturing Plan
EOU	Export Oriented Units	R&D	Research and Development
EU	European Union	RBI	Reserve Bank of India
FDI	Foreign Direct Investment	RoDTEP	Rebate of Duties & Taxes on Export Products
FTA	Free Trade Agreements	SaaS	Steam as a Service
F&S	Frost and Sullivan	SEIS	Service Export from India Scheme
GDP	Gross Domestic Product	SEZ	Special Economic Zone
GEDA	Gujarat Energy Development Agency	SME	Small and Medium Enterprise
GST	Goods and Services Tax	SSIs	Small Scale Industrial Undertakings
GVA	Gross Value Add	STP	Software Technology Park

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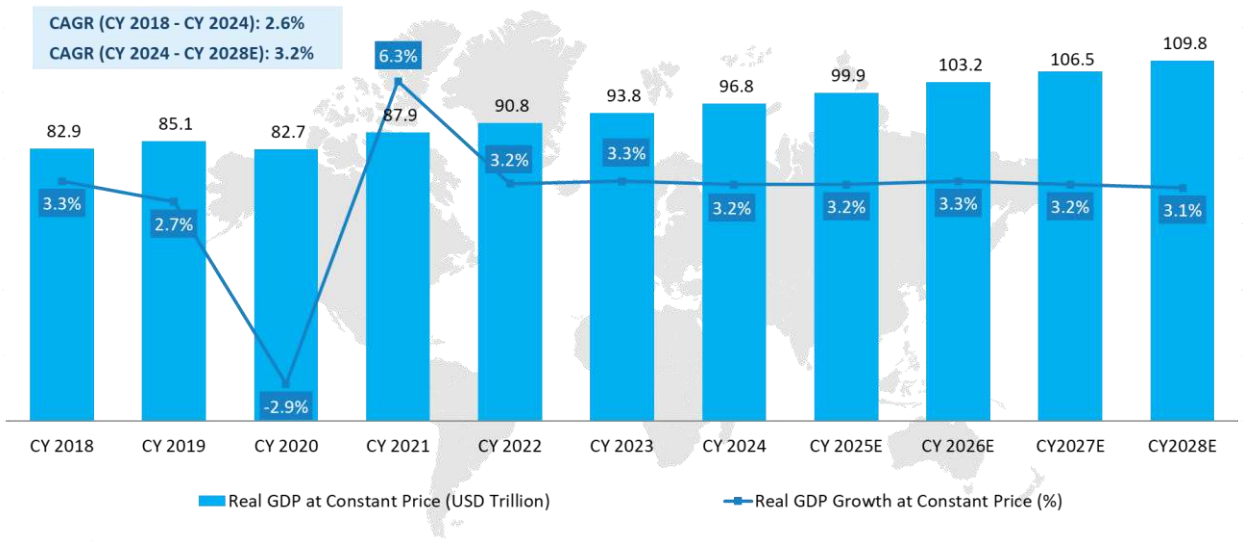
1 MACROECONOMIC OVERVIEW

1.1 Global Macroeconomic Overview

In recent years, the global economy has shown remarkable resilience and adaptability. After rebounding strongly in CY2021 following the challenges of the COVID-19 pandemic and the recession of CY2020, the recovery faced new obstacles in CY2022, including the Russia-Ukraine conflict, inflationary pressures, and supply chain disruptions. These challenges highlighted the need for continued vigilance and innovation to sustain growth. By CY2023, the global economy stabilized, achieving a GDP growth rate of 3.3%. Growth is projected to remain steady at 3.2% over the next two years, rise slightly to 3.3% in CY2026, then return to 3.2% in CY2027 before easing to 3.1% in CY2028. In 2024, the global economy experienced modest growth, with the International Monetary Fund (IMF) reporting a Gross Domestic Product (GDP) increase of approximately 3.2%, consistent with the previous year's performance.

1.1.1 Global[1] Real GDP and Growth Outlook

Exhibit 1.1: Real GDP and real GDP growth (annual percentage change), Global, growth in %, CY2018-CY2028E, (Value in USD trillion)



Note: E refers to Estimate

Source: IMF; World Bank; Frost & Sullivan Analysis

World Bank, IMF and other financial institutions projected a stable growth outlook for the global economy till CY2028. However, the global economy recorded only 3.2% growth in CY2024, which is well below the market expectations.

In CY2024, the global economy faced several significant factors that influenced its performance:

1. **Geopolitical Tensions**: Renewed trade disputes, particularly between the United States and China, led to the imposition of tariffs, affecting global trade flows and contributing to economic uncertainty.

[1] *Global includes various market regions such as North America, Latin America, Europe, Middle East, and Africa, Asia Pacific and South-East Asia*

2. **Monetary Policies**: Central banks, including the European Central Bank (ECB), implemented interest rate cuts to stimulate growth amid stagnation concerns. The ECB reduced its key rate by 0.25 percentage points to 2.75% in an effort to support the eurozone economy.
3. **Energy Market Volatility**: Geopolitical tensions, especially in the Middle East, posed risks to oil supply, potentially leading to higher energy prices and impacting global economic stability.
4. **China's Economic Slowdown**: China's economy faced challenges, including a struggling real estate sector and cautious consumer behaviour, contributing to a slowdown that affected global trade dynamics.

These factors collectively influenced the global economic landscape in 2024, contributing to a modest growth rate of approximately 3.2%.

The global economy in CY2025 is expected to maintain a moderate but uneven growth trajectory. Advanced economies will continue to experience slower expansion due to tight monetary conditions, although gradual interest-rate easing in the US and EU is likely to support investment sentiment from mid-year. The US economy is projected to remain resilient, driven by sustained consumer spending and stable labor markets, while Europe's recovery will be more subdued as manufacturing activity faces persistent structural challenges.

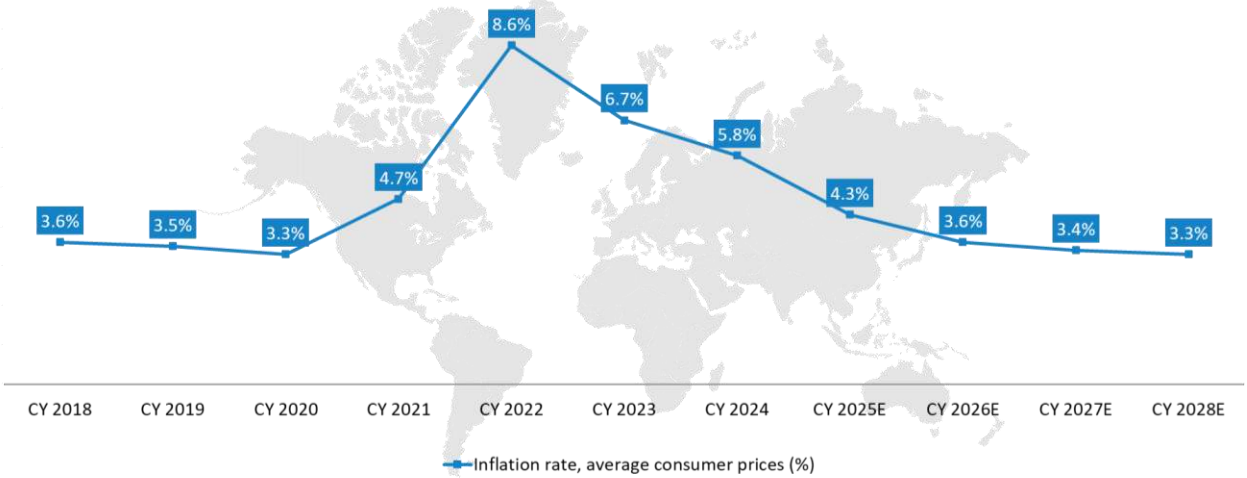
1.1.2 Global Inflation

Global inflation, which peaked at 8.6% in CY2022, moderated to 6.7% in CY2023 and declined further to 5.8% in CY2024. This reduction is attributed to tighter monetary policies and a decrease in international commodity prices. This decrease was primarily driven by lower energy prices, slower consumption growth, and the normalization of manufactured goods prices.

Despite the overall decline, global inflation remained above pre-pandemic levels, posing ongoing challenges for policymakers aiming to balance economic growth with price stability

The global economic outlook has improved significantly since inflation peaked in 2022. After reaching a year-on-year high of 9.4% in Q3 2022, inflation is forecast to drop to approximately 3.4% by the end of 2027.

Exhibit 1.2: Global Inflation rate, average consumer prices (annual percentage change), growth in %, CY2018-CY2028E



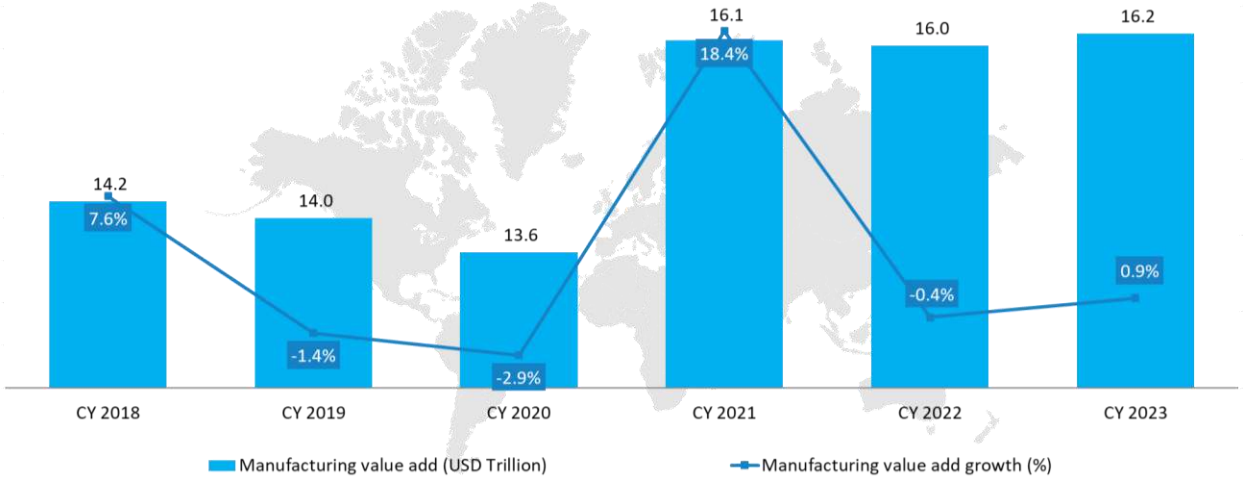
Note: E refers to Estimate

Source: IMF; World Bank; Frost & Sullivan Analysis

1.1.3 Manufacturing Value Added (At current USD)

Manufacturing value added (MVA) of an economy is the total estimate of net-output of all resident manufacturing activity units obtained by adding up outputs and subtracting intermediate consumption. Measurement of MVA requires appropriate demarcation of the type of economic activity and of the territory in which the activity takes place.

Exhibit 1.3: Manufacturing value added at current prices, CY2018 – CY2023, (Value in USD trillion)



Note: E refers to Estimate

Source: IMF, Frost & Sullivan Analysis

Manufacturing Value Added (MVA) remained a critical economic metric in 2023. Global MVA grew modestly in 2023 due to the economic recovery following the COVID-19 pandemic and the Russia-Ukraine conflict. Several nations prioritized sustainable manufacturing and green technology initiatives to boost industrial productivity.

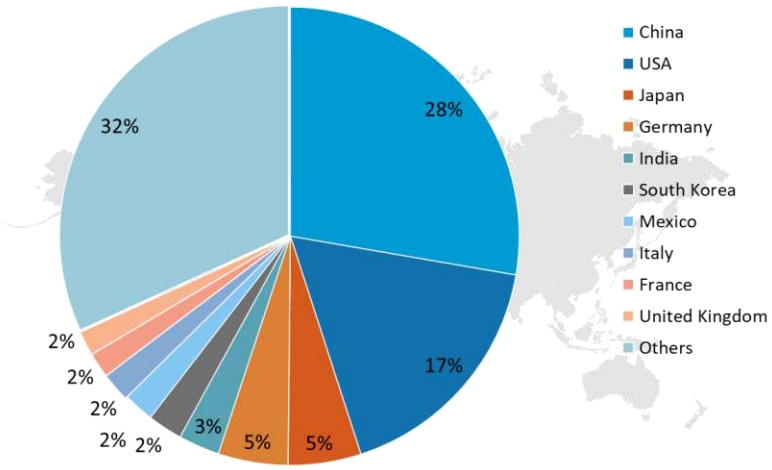
1.1.4 Share of Major Economies To Global Manufacturing Output

Emerging economies, particularly in Asia, have witnessed a significant rise in the share of manufacturing in their GDP. Countries like China, India, and several Southeast Asian nations have become manufacturing powerhouses, attracting foreign investments, and capitalizing on lower labour costs. These countries have established themselves as global manufacturing hubs, driving their economic growth and development.

China: China, home to the approximately 1.4 billion people, leads the globe in manufacturing, accounting for 27.7% of total global output. In 2024, this represented nearly USD 5 trillion of China's economic activity. With low production costs, a vast workforce, and high-quality manufacturing standards, China remains a dominant force in the industry. Its unmatched manufacturing value plays a pivotal role in global supply chains.

China's advanced manufacturing sectors include electronics, machinery, and textiles, solidifying its position as the world's top manufacturer and maintaining its leadership in global manufacturing rankings.

Exhibit 1.4: Top 10 manufacturing countries in the world, share in %, CY2024



Source: Frost & Sullivan Analysis

United States: Manufacturing is a vital component of the United States' GDP, contributing over USD 2.9 trillion in 2024 and accounting for 17% of the nation's economic activity. This sector also represents a significant portion of U.S. exports. The country is renowned for its advanced manufacturing techniques and the production of high-quality goods.

Despite challenges such as the need to diversify manufacturing bases due to global supply chain disruptions, the U.S. remains a major player in global manufacturing. The World Bank recognizes the United States as a leader in innovation and technology, which continues to drive its manufacturing industry forward.

India: India is emerging as a reliable hub for various business sectors, supported by its population of over 1.4 billion and a manufacturing output of USD 490 billion in 2024. Renowned for its IT workforce and customer service centers, India is also strengthening its manufacturing capabilities, making it a competitive force in the global market.

The country's manufacturing value added has been steadily increasing, driven by government initiatives and a large, skilled workforce. Key industries in India's manufacturing sector include textiles, automotive, chemicals and pharmaceuticals, making it a diverse and dynamic destination for business expansion.

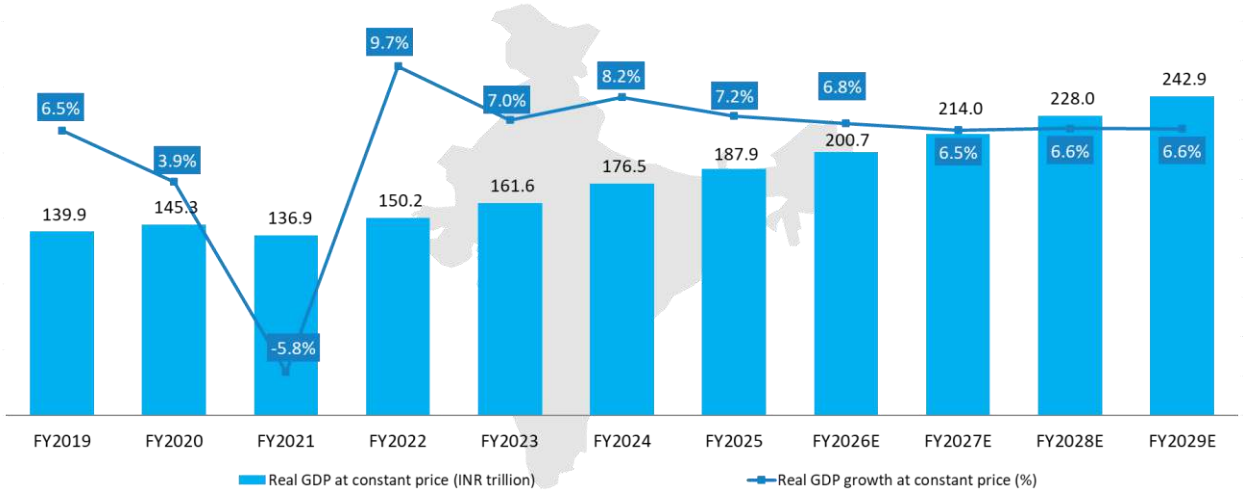
The Government of India (GoI) has launched several manufacturing schemes to boost industrial growth, enhance exports, and strengthen the **"Make in India"** initiative.

Indian Macroeconomic Overview

1.1.5 Real Gross Domestic Product (GDP) and outlook

Indian economy has shown robust performance in the last three financial years and achieved 7.2% real GDP growth in FY2025, outperforming many other major economies and least impacted by the inflationary pressure globally.

Exhibit 1.5: Annual Real GDP and Real GDP growth (Annual % Change), Growth in %, India, FY2019-FY2029E, (Value in INR Trillion)



Note: E refers to Estimate

Source: MoSPI (Annual Estimates of GDP at constant price, 2011-12 series), IMF; Frost & Sullivan Analysis

India has introduced several structural reforms to strengthen its manufacturing sector post-pandemic. These include disinvestment, raising FDI limits, and implementing initiatives and schemes such as Make in India, Production Linked Incentives (PLI), the National Logistics Policy, the PM Gati Shakti National Master Plan, and the Ease of Doing Business framework.

In the Union Budget for FY26, the Government of India has introduced several key initiatives aligned with the **Viksit Bharat 2047** vision, aiming to transform India into a developed nation by its centenary of independence.

1. Economic Growth and Fiscal Prudence:

- **GDP Growth Projections:** The Economic Survey forecasts a GDP growth rate between 6.3% and 6.8% for FY26, reflecting cautious optimism amid global uncertainties.
- **Fiscal Deficit Reduction:** The fiscal deficit is budgeted at 4.4% of GDP for FY26, indicating a commitment to fiscal consolidation.

2. Tax Reforms and Consumption Boost:

- **Income Tax Reforms:** Significant tax reforms have been introduced to increase disposable income for the middle class, aiming to revitalize consumption-led growth.

3. Infrastructure Development:

- **Capital Expenditure:** The government has allocated INR 11.2 lakh crore for capital expenditure in FY26, a 10% increase from the previous year, focusing on infrastructure projects to stimulate economic growth.

4. Support for MSMEs:

- **Credit Guarantee Enhancement:** The credit guarantee cover for Micro, Small, and Medium Enterprises (MSMEs) has been increased from INR 5 crore to INR 10 crore, facilitating greater access to credit for these significant employment generators.

5. Regulatory Reforms:

- **Simplification of Regulations:** A high-level committee has been established to review all non-financial sector regulations, certifications, licenses, and permissions, aiming to enhance the ease of doing business.

6. Financial Sector Expansion:

- **Banking Sector Capitalization:** To support the ambitious GDP targets, India's banking sector will need to raise approximately USD 4 trillion in capital over the next two decades, ensuring adequate financial support for economic expansion.

These initiatives reflect the government's comprehensive strategy to foster sustainable economic growth, enhance infrastructure, and promote social welfare, steering the nation towards the **Viksit Bharat 2047** vision.

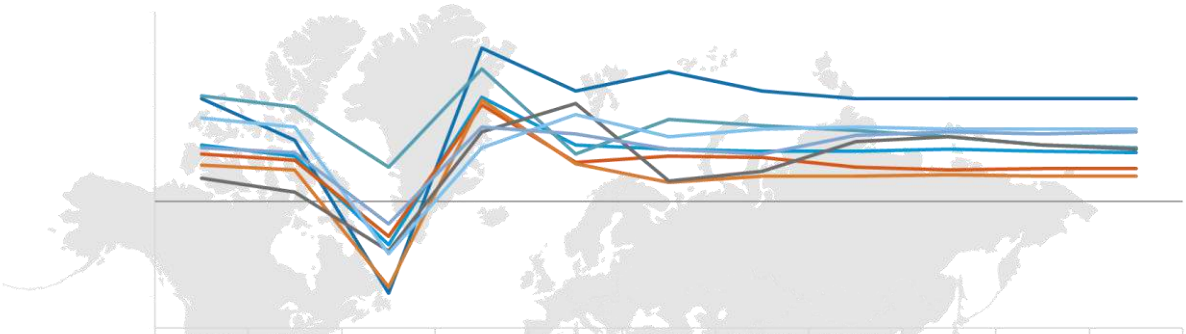
The country is likely to reach the USD 5 trillion milestone within the next 2-3 years, barring any major unforeseen challenges. Achieving this target would position India as the world's third-largest economy, surpassing Germany and Japan.

1.1.6 Growth in Real GDP – India vs leading global economies

The Russia-Ukraine war, which began in February 2022, had an impact on the global economy, with shortages of essential goods from Russia and Ukraine. Sharply rising commodity prices and fluctuations in the global fuel price were the most immediate economic consequences, and the global economy grew by a moderate 3.2% in CY2022.

By CY2023, these challenges eased, establishing global GDP growth at 3.3%. The global economy is projected to grow at 3.2% for the next two years, 3.3% in CY2026, back to 3.2% in CY2027 before moderating to 3.1% in CY2028. However, there are associated risks due to higher interest rates and reduced government spending. India has been the fastest-growing major economy since last three years, with 8.2% real GDP growth in CY2023. In contrast, the US grew by 2.9%, China by 5.2%, while Europe struggled with just 1.2% growth, affected by the ongoing war and high energy prices.

Exhibit 1.6: India vs. Global - Real GDP growth (annual percentage change) in key economies (India, USA, Europe, China, Middle East, South East Asia and Africa), growth in %, CY2018-CY2028E



	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024	CY2025E	CY2026E	CY2027E	CY2028E
World (%)	3.6%	2.9%	-2.7%	6.6%	3.6%	3.3%	3.2%	3.2%	3.3%	3.2%	3.1%
India (%)	6.5%	3.9%	-5.8%	9.7%	7.0%	8.2%	7.0%	6.5%	6.5%	6.5%	6.5%
USA (%)	3.0%	2.6%	-2.2%	6.1%	2.5%	2.9%	2.8%	2.2%	2.0%	2.1%	2.1%
Europe (%)	2.3%	2.0%	-5.4%	6.4%	2.4%	1.2%	1.6%	1.6%	1.7%	1.6%	1.6%
China (%)	6.7%	6.0%	2.2%	8.4%	3.0%	5.2%	4.8%	4.5%	4.1%	3.6%	3.4%
Middle East (%)	1.5%	0.6%	-3.1%	4.4%	6.2%	1.3%	1.9%	3.8%	4.1%	3.6%	3.3%
South East Asia (%)	5.3%	4.7%	-3.3%	3.4%	5.5%	4.1%	4.6%	4.7%	4.6%	4.6%	4.6%
Africa (%)	3.4%	3.1%	-1.4%	4.7%	4.3%	3.3%	3.0%	4.2%	4.4%	4.3%	4.4%

Note: E refers to Estimate

Source: IMF, World Economic Outlook, October 2024; Frost & Sullivan Analysis

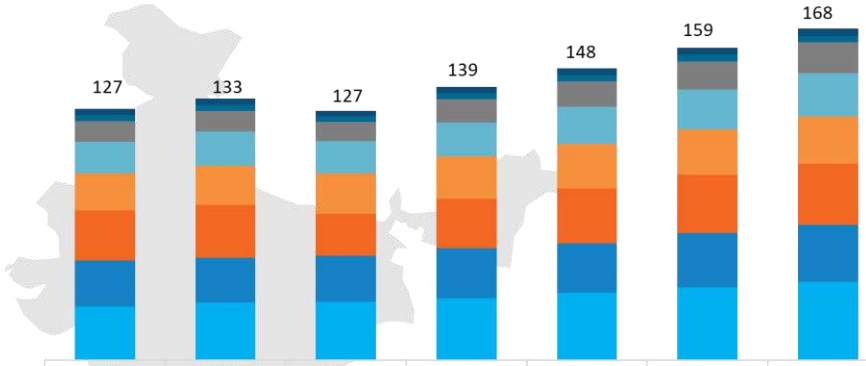
India remains the fastest-growing large economy, achieving a real GDP growth rate of 8.2% in 2023, up from 7.0% in 2022. This momentum is expected to continue over the next five years, fueled by stable domestic demand, increased private investments, favorable demographics, a declining dependency ratio, steady urbanization, advancements in IT, and greater penetration of mobile and internet infrastructure. Post-pandemic, India has consistently outpaced the global average GDP growth rate.While major economies like the U.S. and China are also expanding, India's strong economic performance is driven by factors such as a young population, government reforms, rising domestic consumption, and foreign direct investment. However, challenges like infrastructure bottlenecks and income inequality must be addressed to sustain this growth trajectory.

India is currently the fifth-largest economy globally by nominal GDP (FY2025) and ranks third in purchasing power parity (PPP). With its robust economic performance, India is projected to become a USD 5 trillion economy by FY2026 and is expected to surpass Germany and Japan to emerge as the third-largest economy by FY2030.

1.1.7 Sectoral Share of Gross Value Added (GVA)

India's gross value added (GVA) has shown consistent growth following a 4.5% decline in FY2021. The GVA increased by 9.6% in FY2022, 6.8% in FY2023, 7.1% in FY2024 and 6.1% in FY2025. According to the advanced estimate, it has grown by 6.1% in FY2025. Among various sectors, the construction sector has recorded the highest growth, with nearly 9% CAGR since FY2020 (pre-COVID levels), while the financial, real estate, and professional services sectors have grown at an approximately 6.0% CAGR over the same period.

Exhibit 1.7: India - Gross value added (GVA) at basic price by economic activity, FY2019-FY2025, (Value in INR trillion)



	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025
Electricity, Gas, Water supply & Other utility	2.9	3.0	2.9	3.2	3.5	3.7	3.9
Mining & Quarying	3.3	3.2	2.9	3.1	3.2	3.4	3.4
Construction	10.3	10.4	9.6	11.9	13.0	14.4	15.5
Public administration, Defence & Other services	16.2	17.6	16.3	17.2	18.8	20.2	22.1
Agriculture, Forestry & Fishing	18.9	19.7	20.5	21.7	22.7	23.0	23.9
Trade, Hotels, Transport & Communication services	25.4	27.0	21.5	24.8	27.8	29.6	31.2
Manufacturing	23.3	22.6	23.2	25.7	25.0	27.5	28.9
Financial, Real estate & Professional services	27.2	29.2	29.6	31.2	34.1	36.9	39.6

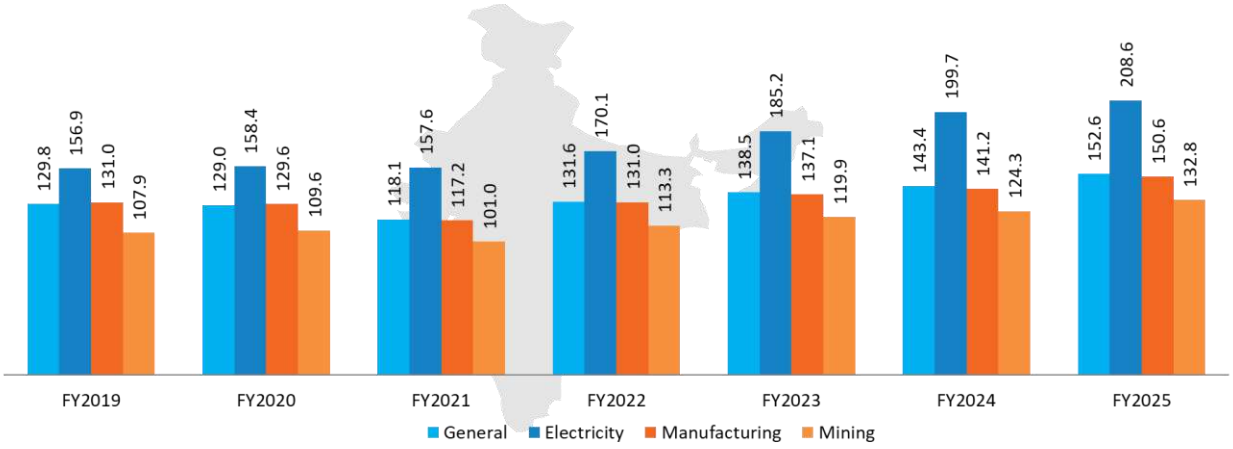
* FAE for FY2025

Source: National Statistical Office; Frost & Sullivan Analysis

1.1.8 Index of Industrial Production (IIP)

Post-pandemic, since June 2021, industrial activity in the country started picking up and continued its momentum through FY2022 – FY2025 with industrial output recording a strong growth across all the four constituent sectors in the last four consecutive years. FY2025 IIP provisional data indicates nearly 4% cumulative growth in FY2025 and 4.1% growth for the manufacturing sector. The other three segments i.e., Mining, Electricity, and General have grown by 3.0%, 5.2%, and 4.0% respectively in FY2025. India's Business Confidence Index (BCI) has also increased to 139.3 slightly higher than 138.4 in the previous quarter.

Exhibit 1.8: India - Index of Industrial Production (IIP) by Sectors, FY2019-FY2025

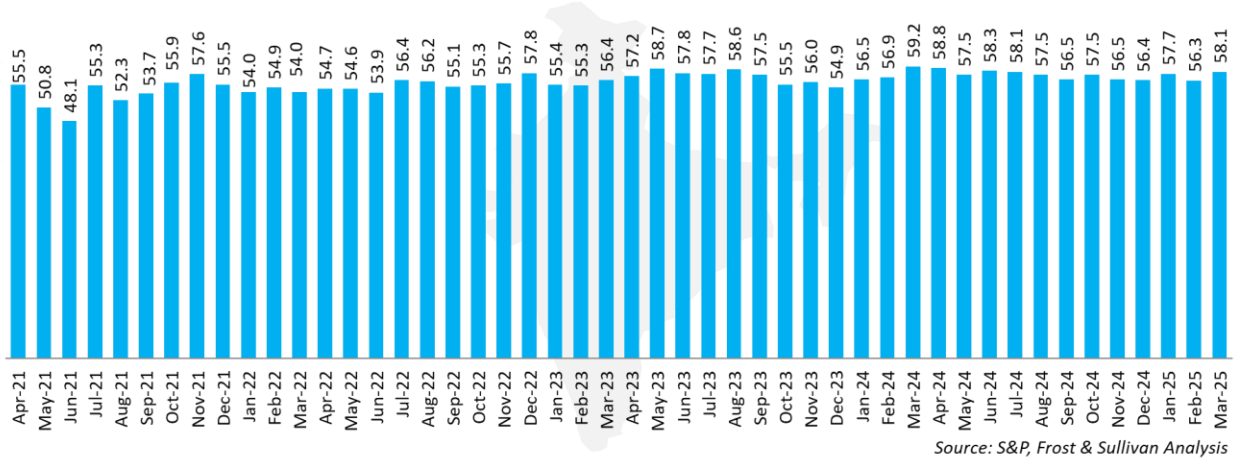


Source: MoSPI (Annual Estimates of GDP at constant price, 2011-12 series); RBI (Reserve Bank of India); Frost & Sullivan Analysis

1.1.9 India Manufacturing PMI (Purchase Managers Index)

The S&P Global India Manufacturing Purchasing Managers' Index (PMI), which gauges the manufacturing sector's performance through a survey of 500 companies, dropped to 56.3 in February however showed signs of recovery in March 2025 with a PMI of 58.1. While this indicates positive growth, but export gains lag. India's manufacturing activity recorded its slowest growth of 2024 in December, as the Manufacturing Purchasing Managers' Index (PMI) declined slightly to 56.4 from 56.5 in November. The data suggests moderating demand in the sector, even as cost pressures eased and job growth remained strong.

Exhibit 1.9: Indian Manufacturing PMI, Apr 2021 – March 2025



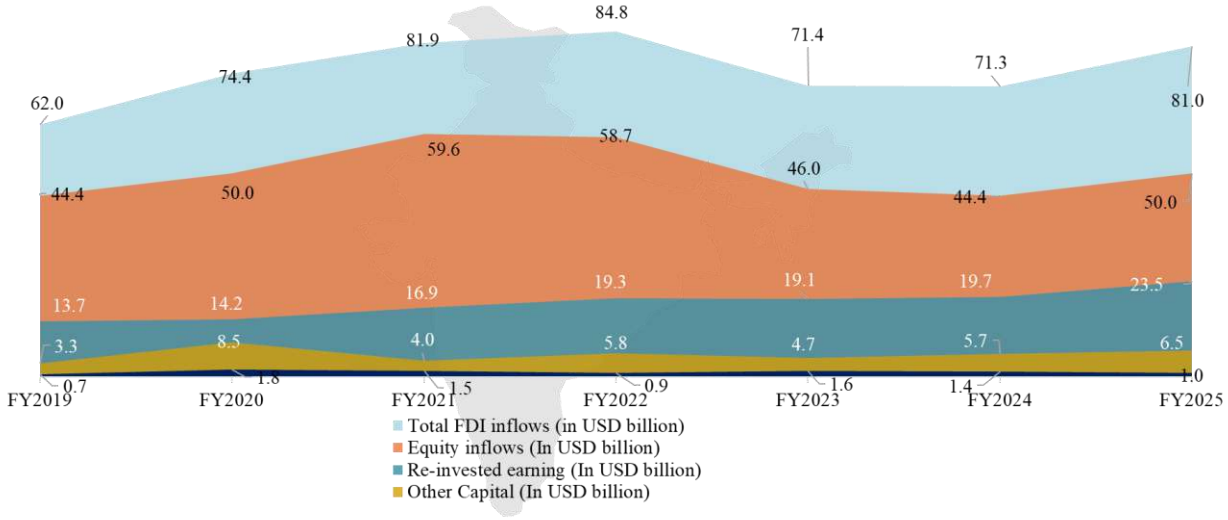
Source: S&P, Frost & Sullivan Analysis

1.1.10 Foreign Direct Investment (FDI)

Foreign Direct Investment (FDI) in India has seen a significant rise in recent years, driven by improvements in the 'Ease of Doing Business' rankings and proactive manufacturing policies introduced by the Indian government. Between FY2018 and FY2023, India received a record FDI inflow of approximately USD 435 billion. FY2022 marked the highest annual FDI to date, reaching ~USD 85 billion. Although FDI inflows declined to ~USD 71.3 billion in FY2023 and 71.0 billion in FY2024 but increased to 81.0 billion in FY2025.

India has maintained its position as a resilient and attractive economy despite challenges such as global uncertainties, the Russia-Ukraine conflict, recessionary trends, and the lingering impacts of the COVID-19 pandemic. Restrictions on FDI from neighboring countries, including China, did not deter the country from achieving remarkable inflows.

Exhibit 1.10: FDI inflow in India, in US$ billion, FY2019 to FY2025



Source: RBI, Frost & Sullivan Analysis

In FY2025, India recorded gross FDI inflows of approximately USD 81.0 billion. Despite high global interest rates, India's FDI inflows remained stable compared to other developing economies, driven by the strong domestic demand of its economy.

India attracted Foreign Direct Investment (FDI) inflows totaling INR 6,93,864.5 crore (USD 81.04 billion) in FY25, representing a 14% increase compared to the previous fiscal year. The services sector emerged as the largest recipient, accounting for 19% of total FDI equity inflows, followed by computer software and hardware at 16%, and trading at 8%. Among states, Maharashtra received the highest share of FDI equity (39%), trailed by Karnataka (13%) and Delhi (12%). Singapore remained the leading source of FDI, contributing 30% of the total, followed by Mauritius (17%) and the United States (11%). Over the past eleven financial years (2014–25), India garnered FDI worth INR 64,11,054.4 crore (USD 748.78 billion), marking a 143% surge compared to the preceding eleven-year period (2003–14). Additionally, the number of FDI source countries grew from 89 in FY14 to 112 in FY25.

1.2 Notable Trends in the Indian Manufacturing Sector

1.2.1 India Emerging As A Global Manufacturing Hub

In FY2025 India exported manufacturing goods worth USD 437.4 billion[2]. It is well on its course to becoming a global manufacturing hub with the potential to export goods worth USD 1 trillion by 2030 (source: IBEF). The manufacturing sector plays a significant role in the Indian economy, accounting for 17% of GDP and employing more than 62 million people. The Indian government plans to increase the share of manufacturing in the economy to 25% by 2025 through the implementation of various programmes and policies.

Government of India has undertaken various steps to promote manufacturing sector and to boost domestic and foreign investments in India. These include introduction of Goods and Services Tax, reduction in corporate tax, interventions to improve ease of doing business, FDI policy reforms, measures

[2] Source: https://tradestat.commerce.gov.in/eidb/ecom.asp

for reduction in compliance burden, policy measures to boost domestic manufacturing through public procurement orders, Phased Manufacturing Programme (PMP), to name a few.

Keeping in view India's vision of becoming 'Atmanirbhar', PLI schemes for 15 key sectors / product baskets with an incentive outlay of INR 2,130 billion are under implementation to enhance India's manufacturing capabilities and exports. PLI scheme across these key specific sectors started to make Indian manufacturers globally competitive, attract investment in the areas of core competency and cutting-edge technology, ensure efficiencies, create economies of scale, enhance exports and make India an integral part of the global value chain.

The Indian manufacturing sector in FY25 showcased resilience and adaptability, leveraging domestic demand, export opportunities, and government support. With ongoing investments in technology, sustainability, and infrastructure, the sector is poised for continued growth in the coming years.

1.3 India's focus on boosting domestic manufacturing

1.3.1 Government Policies and Schemes Driving Manufacturing in India

The manufacturing sector of India is going through a major transformation. The government of India has undertaken several schemes/initiatives to promote India as a global manufacturing hub. Some of the notable initiatives are:

A. Make in India initiative

'Make in India' is an initiative that was launched on 25th September 2014 to facilitate investment, foster innovation, build best in class infrastructure and make India a hub for manufacturing, design, and innovation. Vocal for local is a unique initiative that has promoted India's manufacturing domain to the world. 'Make in India' initiative is not a state/district/city/area specific initiative, rather it is being implemented all over the country.

B. Production Linked Incentive (PLI) scheme

The Production Linked Incentive (PLI) Scheme, introduced by the Government of India in 2020, aims to boost domestic manufacturing, attract foreign investments, and reduce import dependency across various sectors.

Keeping in view India's vision of becoming 'Atmanirbhar', PLI schemes for 15 key sectors / product baskets with an incentive outlay of INR 2,130 billion are under implementation to enhance India's manufacturing capabilities and exports. PLI scheme across these key specific sectors started to make Indian manufacturers globally competitive, attract investment in the areas of core competency and cutting-edge technology, ensure efficiencies, create economies of scale, enhance exports and make India an integral part of the global value chain.

The government continues to refine and introduce new PLI schemes across various sectors, including electronics, pharmaceuticals, and automotive, to further stimulate domestic manufacturing and export growth.

In summary, the PLI Scheme has significantly contributed to India's manufacturing sector by attracting substantial investments, creating jobs, and enhancing production capacities across multiple industries.

The government's ongoing efforts to expand and refine these schemes underscore its commitment to fostering a self-reliant and robust manufacturing ecosystem.

Exhibit 1.11: Approved financial outlay under Production Linked Incentive (PLI) scheme

Sectors	Implementing Ministry/Department	Approved financial outlay over a five-year period (INR billion)
Large Scale Electronics Manufacturing	Ministry of Electronics and Information Technology	386.5
Automobiles & Auto Components	Department of Heavy Industries	259.4
High Efficiency Solar PV Modules	Ministry of New and Renewable Energy	240.0
Green Hydrogen and Electrolyzer	Ministry of New and Renewable Energy	174.9
Advance Chemistry Cell Batteries	NITI Aayog and Department of Heavy Industries	181.0
IT Hardware	Ministry of Electronics and Information Technology	170.0
Pharmaceuticals	Department of Pharmaceuticals	150.0
Telecom & Networking Products	Department of Telecom	122.0
Food Processing	Ministry of Food Processing Industries	109.0
Textile Products	Ministry of Textiles	106.8
Key Starting Materials/ Drugs Intermediaries, APIs	Department of Pharmaceuticals	69.4
Specialty Steel	Ministry of Steel	63.2
White Goods (Air Conditioners and LED Lights)	Department for Promotion of Industry and Internal Trade	62.4
Medical Devices	Department of Pharmaceuticals	34.2
Drone and Drone components	Department of Civil Aviation	1.2
	TOTAL	**2,130.0**

Source: DPIIT, Invest India, Frost & Sullivan Analysis

C. Goods and Services Tax (GST) and Corporate Tax rebate

While GST has helped to improve India's 'Ease of Doing Business' ranking, the government has also modified direct taxation to help Indian companies grow profitably. To promote growth and investment, the government introduced a provision in FY2020 that allows any domestic company an option to pay 22% income tax instead of 30% with certain conditions. The government also allowed any new domestic company incorporated on or after 1st October 2019 making fresh investments in manufacturing, an option to pay income tax at the rate of 15%. This concessional rate is in effect till the end of FY2025.

D. Credit support to Micro, Small and Medium Enterprises (MSMEs)

MSMEs are the backbone of the Indian economy, contributing approximately 30% of the country's GDP, 45% of manufacturing output and providing employment to 110 million people. The Government of India has been proactive to ensure that the credit facilities are always available to MSMEs.

Towards this, the Indian government initiated a mission named 'Atmanirbhar Bharat Abhiyan' to make India a Self-Reliant nation. The main purpose of launching this program was to support the country during the pandemic, one of which was to provide emergency credit lines to businesses. For MSME, there was no guarantee fee and no fresh collateral. A subordinated debt of INR 200 billion was issued for stressed MSMEs. Besides, the government announced an INR 500 billion equity infusion for the MSMEs who had an available business but could not accomplish it due to lack of funds.

E. Export promotion schemes

Exports play a major role in the economic development of a country. More the exports more will be the inward foreign remittance, more jobs & employment, lower current account deficit, and hence greater overall economic growth. The Indian government in the past years have introduced multiple schemes to

promote exports to boost domestic manufacturing and to make India a global manufacturing hub such as MEIS Scheme, RoDTEP, EOU etc.

F. National Industrial Corridor Program (NICP)

The National Industrial Corridor Program (NICP) is an infrastructure program of the Government of India aiming to develop industrial cities in the country. The government of India envisages to develop new industrial cities as "Smart Cities" and to converge the next-generation technologies in the infrastructure sector.

The overall objective of NICP is to "enhance India's competitiveness in manufacturing through the creation of world-class infrastructure and reduced logistics costs". The broad objective of the program is to provide plug and play infrastructural facilities for setting up large scale manufacturing units and to create futuristic Indian cities that can become global manufacturing and investment destinations. This will create employment opportunities and lead to the overall socio-economic development of the country.

Major Industrial Corridors under NICP:

1. **Delhi-Mumbai Industrial Corridor (DMIC):** Connecting Delhi and Mumbai, this corridor is designed to enhance manufacturing and logistics capabilities.
2. **Chennai-Bengaluru Industrial Corridor (CBIC):** Linking Chennai and Bengaluru, focusing on automotive and electronics manufacturing.
3. **Amritsar-Kolkata Industrial Corridor (AKIC):** Connecting Amritsar and Kolkata, aiming to boost trade and manufacturing in the eastern region.
4. **East Coast Economic Corridor (ECEC):** Spanning the eastern coastline, this corridor focuses on port-led industrialization.
5. **Bengaluru-Mumbai Industrial Corridor (BMIC):** Linking Bengaluru and Mumbai, emphasizing information technology and biotechnology industries.
6. **Chardham Highway Corridor:** Enhancing infrastructure around the Char Dham pilgrimage sites.
7. **Kolkata-Vizag-Chennai Industrial Corridor:** Connecting Kolkata, Visakhapatnam, and Chennai to boost trade and manufacturing.

2 OVERVIEW OF INDUSTRIAL GASES IN INDIA

Industrial gases consist of individual gases or gas mixtures utilized across diverse industries for various manufacturing processes and operations. They play an essential role throughout the industrial value chain, from the procuring of raw materials to intermediate processing in industries such as metals, chemicals, pharmaceuticals, and ceramics, ultimately contributing to the production of industrial, consumer, and food products. Industrial gases are indispensable to large-scale industries such as pharmaceuticals, chemicals and textiles, where they play a critical role in optimizing production efficiency and ensuring operational stability.

With the continuous expansion of industries reliant on these gases and the broad spectrum of applications within the sector, the industrial gases market is expected to maintain its strong growth momentum well into the future. This growth has been driven by rapid industrialization, infrastructure development, and advancements in gas production, storage, and distribution that improve efficiency and reduce costs.

Traditionally, oxygen, nitrogen, and argon are extracted from air through the air separation process and supplied via on-site production or merchant distribution using tanks, cylinders, and containers. In contrast, steam has historically been generated on-site for captive use in industries such as textiles, food & beverages, chemicals, pharmaceuticals, and tires.

However, certain companies like Steamhouse India Limited (Steamhouse) are working towards transitioning steam production from an on-site generation to a service-based model by introducing community boilers. This innovation eliminates the need for industries to invest in and maintain steam boilers, making "steam as a service" an emerging opportunity. Companies in this up-coming sector with community boiler-based steam-as-a-service model, and ability to deliver industrial gases through a pipeline network, are enabling industries to focus on their core-production as well as achieve higher energy efficiency, reduce capital expenditure on in-house equipment, and enhance operational efficiencies. A shift towards community industrial gas generation and distribution systems also contributes to sustainability by centralizing boiler operations, leading to lower emissions and improved fuel utilization. Additionally, industries benefit from a more flexible and scalable steam supply without concerns about maintenance, regulatory compliance, and fuel procurement. Steamhouse and its promoters have been pioneers of the community boiler system in India, which was first introduced in 2014

As of FY25, cylinder-based supply accounts for 42.0% of India's industrial gas (excluding steam) demand by value. This presents significant potential for players like Steamhouse to offer cost-effective pipeline supply, enabling savings on logistics, ensuring uninterrupted flow, and improving operational efficiency for end users. As the Indian industrial sector continues to expand, the supply of industrial gases through pipelines is emerging as a preferred alternative. This shift also contributes to sustainability by centralizing industrial gas generation, which leads to lower emissions and improved fuel utilization.

Being a pioneer in this sector, Steamhouse targets higher energy efficiency and enables their customers to reduce capital expenditure on in-house infrastructure, lowers compliance burdens and enhances safety and operational reliability. In the landscape of industrial gases in India, Steamhouse has emerged as a key

player as a community industrial gas provider, poised to address the evolving needs of modern industrial processes.

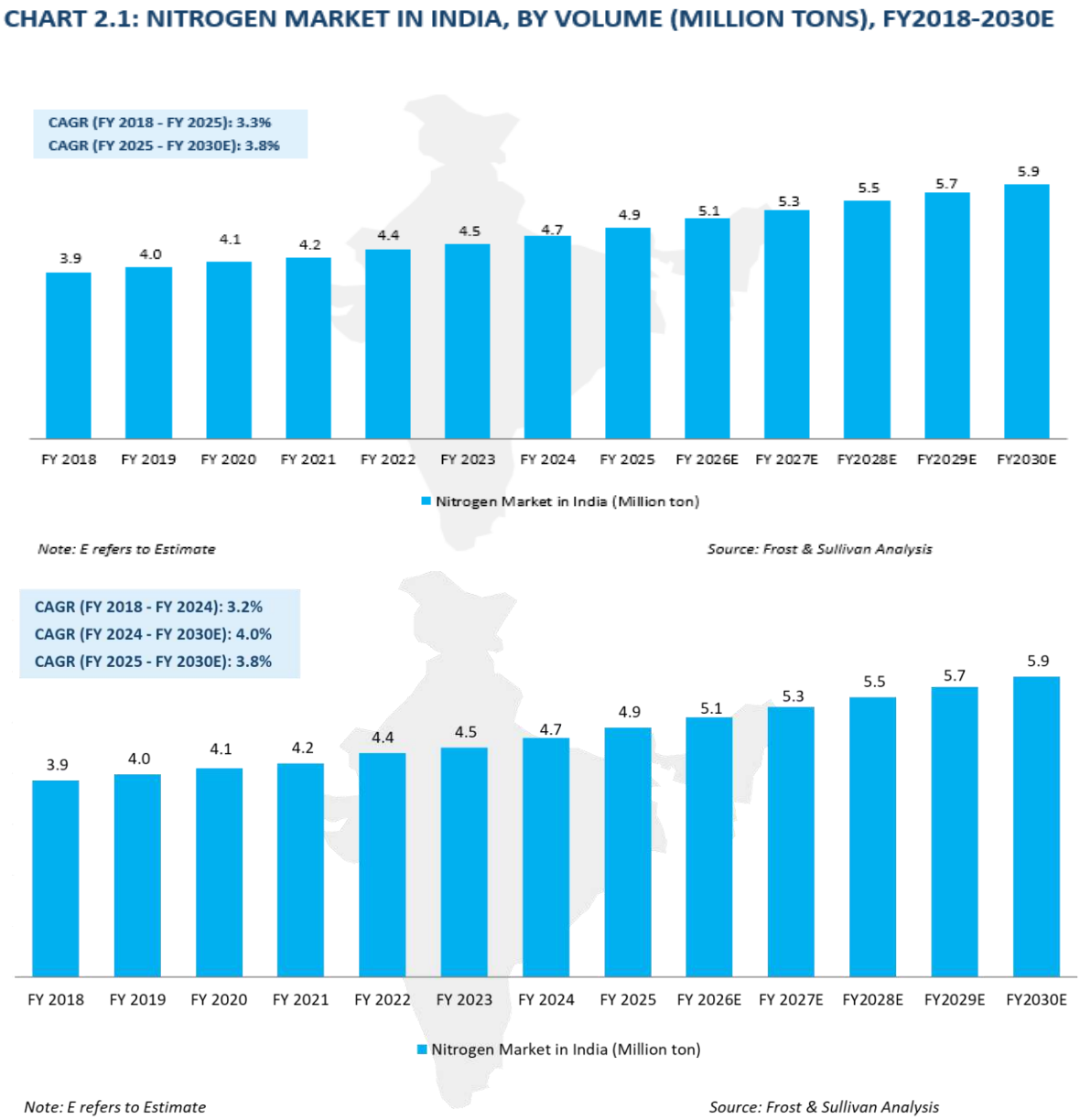
2.1 Nitrogen

Nitrogen gas (N_2) is a colorless, odorless, tasteless, and inert diatomic gas that constitutes approximately 78% of Earth's atmosphere. Nitrogen gas is a vital industrial gas in India, produced through air separation processes. It is available in gaseous and liquid forms, until now, it was supplied via on site production, cylinders, or bulk storage tanks. However, Steamhouse India Limited has commissioned its nitrogen plant in Ankleshwar, whereby the nitrogen is distributed through installing a common facility and distributing nitrogen through distributed pipeline network, making it India's first and only common nitrogen facility. A dedicated pipeline network for nitrogen can enhance supply reliability, reducing logistical complexities, and improving cost efficiencies for customers. In addition to ensuring uninterrupted availability for industrial consumers the dedicated pipeline for an industrial gas like Nitrogen can also demonstrate the scalability of pipeline-based distribution for other industrial gases.

Steamhouse is the only company in India that supplies nitrogen using a distributed pipeline network instead of the common practice of supplying in cryogenic tanks and onsite nitrogen generation

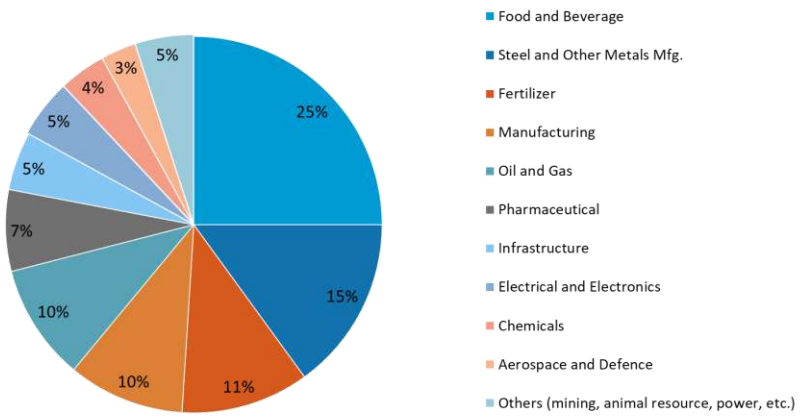
Market size: The demand of nitrogen in India has increased from 3.9 million tons in FY2018 to become 4.9 million tons in FY2025 with CAGR of 3.3% owing to growth in fertilizer production, rapid growth of food packaging industry, consistent consumption in steel production, etc. It is projected to become 5.9 million tons in FY2030. The market size by value has increased from USD 0.22 billion in FY2018 to USD 0.32 billion in FY2025 and is projected to expand to USD 0.44 billion in FY2030. The major driving factors for such advances are India's push for self-sufficiency in fertilizer sector, rapid improvement in population and urbanization that has increased the crop yield demand, innovations and advancements in emerging applications, investments in manufacturing sector owing to immense support from government in terms of incentives, etc.

Exhibit 2.1 Nitrogen Market in India, by Volume (Million tons), FY2018-2030E



Market segmentation by application: In FY2025 , the food and beverage industry led nitrogen demand in India, accounting for 25%, primarily for food preservation and gas flushing. Steel and other metal manufacturing also consumed 15%, utilizing nitrogen for strengthening and alloying. The fertilizer sector, with 11% share, relied on nitrogen for ammonia production. The manufacturing, oil & gas, and pharmaceutical industries together accounted for a significant portion, using nitrogen in processes like heat treatment, refining, and reactor cooling. Other industries, including electronics, infrastructure, chemicals and aerospace, contributed smaller shares, utilizing nitrogen for inert atmospheres, purging, and safety applications.

Exhibit 2.2 Nitrogen Market Segmentation by Application, by Volume (Million tons), FY2025



Source: Frost & Sullivan Analysis

Driving factors for growth: India's nitrogen market is growing due to evolving lifestyle trends, industrial expansion, and government support. The increasing demand for packaged food, driven by fast-paced lifestyles, has boosted nitrogen usage in food packaging. The steel sector, accounting for 7.6% of global production, is witnessing capacity expansion, supported by government incentives and the China+1 strategy, further driving nitrogen demand. Rising food demand has also led to increased use of nitrogenous fertilizers, backed by government policies promoting self-sufficiency in fertilizer production. Additionally, the shift of global pharma and chemical supply chains from China to India, driven by cost advantages and quality standards, has further fueled nitrogen consumption across industries.

2.2 Hydrogen

The demand was around 0.18 million ton in FY2025. It is estimated to increase to 0.27 million tons by FY2030, growing at a CAGR of 8.5%. The market size by value has increased from USD 0.15 billion in FY2018 to USD 0.24 billion in FY2025 and is projected to expand to USD 0.39 billion in FY2030. This growth is driven by steady demand from the steel and oil & gas sectors, high traction from the fertilizer industry due to the rising population, and the utilization of hydrogen in new applications such as automotive and power. With the declaration of energy independence by FY2047, India has shifted its focus towards developing a hydrogen economy.

2.3 Carbon dioxide

Carbon dioxide (CO_2) is a versatile industrial gas used across various sectors, including food and beverages, chemicals, healthcare, and manufacturing. It is primarily sourced as a byproduct from industrial processes like ammonia and ethanol production. The demand for CO_2 has remained steady in urea production, while its use in refineries for enhanced oil recovery and the beverage industry has grown significantly over the past five years. The food and beverage sector remains the largest consumer of CO_2 in India by market share. Driven by consistent demand from key end-use industries, CO_2 demand increased at a CAGR of 3.4% from 3.4 million tons in FY2018 to 4.3 million tons in FY2025. India, the fourth-largest refining hub globally with a capacity of 250 million tons per annum across 23 refineries, has seen substantial and sustained growth in CO_2 consumption within the refinery sector. The demand for carbon dioxide in India is expected to reach 5.3 million tons by FY2030, growing at a CAGR of 4.0%. The market size by value has increased from USD 0.11 billion in FY2018 to USD 0.15 billion in FY2025 and is projected to expand to USD 0.21 billion in FY2030. This growth is driven by increasing applications in fuel production (methane and

methanol), plastic components, fire extinguishers, pharmaceuticals, soda ash, food & beverages, and building materials, among other industries.

2.4 Argon

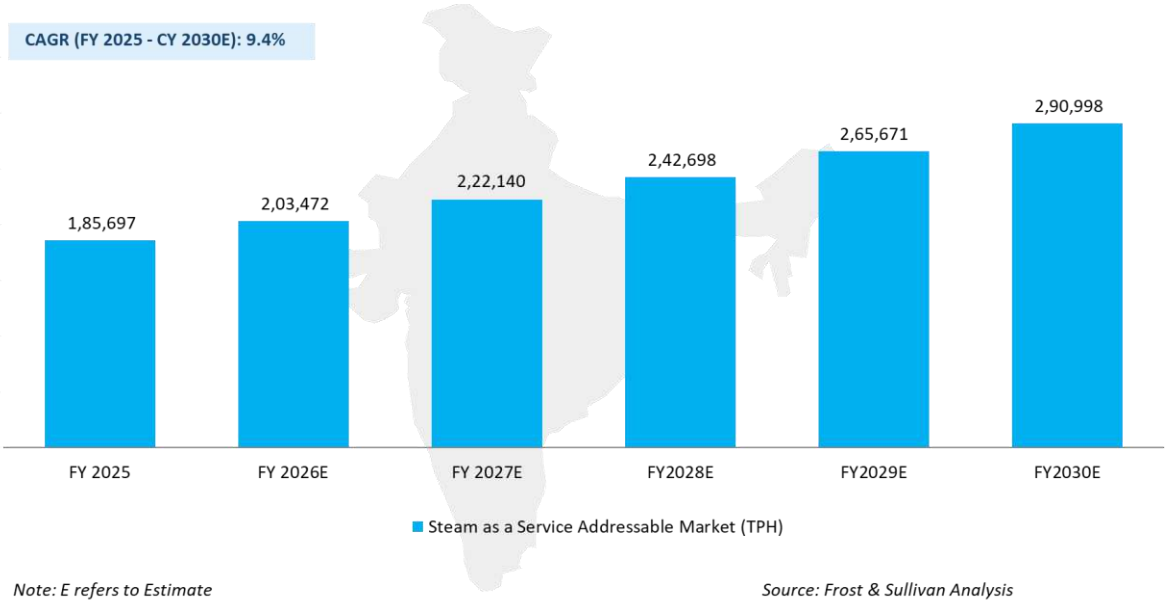
The Indian argon industry has been expanding rapidly, driven by its applications in welding, steel manufacturing, automotive, and other industrial sectors. In volume terms, consumption rose from 0.16 million tons in FY2018 to 0.23 million tons in FY2025. Argon is widely used in welding techniques like resistance welding and metal inert gas welding, catering to industries such as aerospace, automotive, and construction. The market is projected to grow at a CAGR of 6.2% to 0.31 million tons in FY2030. The market size by value has increased from USD 0.08 billion in FY2018 to USD 0.15 billion in FY2025 and is projected to expand to USD 0.23 billion in FY2030.

2.5 Steam

Traditionally, industries have relied on on-site steam generation for captive use, with steam being a critical requirement across industrial sectors such as pharmaceuticals, textiles, food processing, paper and pulp, rice mills, distilleries, dairy, urea production, wood processing, chemicals, and tyre manufacturing. However, the emergence of community boilers and steam-as-a-service models, provided by companies like Steamhouse India Limited, is transforming the landscape of industrial steam supply by bringing Steam-as-Service. These centralized boiler systems enable industries to procure steam through pipelines, reducing their capital investment in boiler infrastructure, improving energy efficiency, and lowering operational costs. This transition has created new revenue streams, enabling steam producers to sell steam as a service rather than limiting it to captive use. This model presents a significant market potential, encouraging industries to opt for outsourced steam supply and drive the growth of the industrial steam distribution network.

In FY2025, India's total process steam demand was approximately 186,000 TPH. With a projected CAGR of 9.5% from FY2025 to FY2030, the market is poised for significant expansion. Assuming an annual operation of 8,000 hours, the total process steam demand is estimated at 1,373 million tons. The average cost of steam varies between INR 2.2 to 3.5 per kg, influenced by multiple factors such as the end-use industry (power plants, pharmaceuticals, food processing, etc.), boiler type, fuel type, water quality, feedwater treatment requirements, condensate recovery efficiency, and operational maintenance costs. Considering an average steam cost of INR 2.5 per kg, the addressable market potential for the "Steam-as-a-Service" model in India is estimated at approximately ₹3,74,684 crore for FY2025.

Exhibit 2.3: Steam as a Service Addressable Market in India, by Volume (TPH), FY2025-2030E)



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

Market segmentation by application: Steam consumption across various industries, highlighting the percentage share of each sector in the total industrial steam usage. Here's a detailed breakdown:

Pharmaceuticals (24%) – The largest consumer of steam, the pharmaceutical industry relies heavily on steam for sterilization, cleanroom environments, and process heating in drug formulation and production.

Textiles (18%) – The textile sector utilizes steam in dyeing, bleaching, and finishing processes. It is essential for controlling fabric moisture content and improving quality.

Food Processing (18%) – Steam is used for cooking, drying, pasteurization, and sterilization in food production. It plays a key role in ensuring hygiene and maintaining product quality.

Paper and Pulp (5%) – Steam is used in pulping, drying, and pressing of paper to ensure proper consistency and smoothness in paper production.

Distillery (5%) – A significant share of steam consumption is in distilleries, where it is used for fermentation, distillation, and evaporation processes in alcohol and beverage production.

Dairy (4%) – Steam is utilized in dairy processing for pasteurization, sterilization, and cleaning-in-place (CIP) systems to ensure hygiene in milk and milk-based product manufacturing.

Urea (2%) – The fertilizer industry requires steam for chemical reactions in urea production, as well as for process heating.

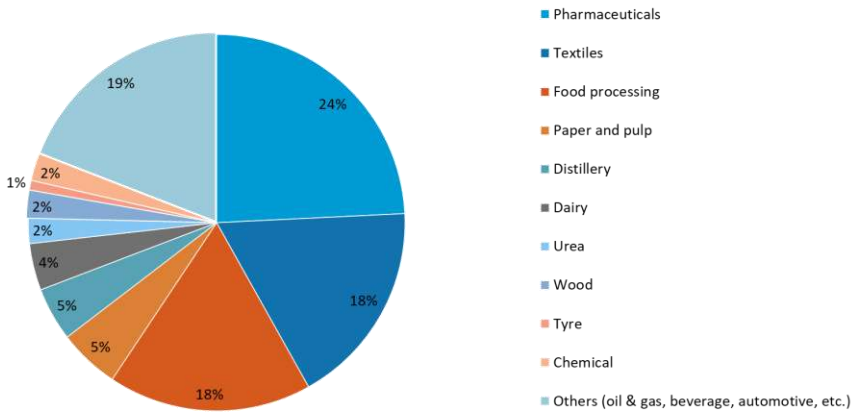
Wood (2%) – Steam is used in seasoning and drying of wood to reduce moisture content, improving durability and strength.

Tyre (1%) – The tyre industry uses steam for vulcanization, which enhances the elasticity and durability of rubber.

Chemical (2%) – Steam is widely used in the chemical industry for reaction heating, distillation, and solvent recovery in various chemical manufacturing processes.

Others (19%) – This category includes industries like power plants, refineries, and other small-scale industries where steam plays a vital role in heating, cleaning, and manufacturing.

Exhibit 2.4: Steam as a Service Addressable Market Segmentation by Application, by Volume (TPH), FY2025



Source: Frost & Sullivan Analysis

Driving factors for growth: The growth of steam use in India from FY2025 to FY2030 will be driven by rising industrial demand, energy efficiency advancements, and sustainability initiatives. The pharmaceutical sector, the largest consumer, will see increased steam utilization due to expanding drug production, stringent sterilization standards, and the growth of cleanroom facilities.

In textiles, steam demand will rise with modernization efforts, process automation, and the push for sustainable fabric treatment. The food processing industry will continue to rely on steam for cooking, pasteurization, and sterilization, driven by growing food safety regulations and increasing consumer demand for processed foods. Distilleries will witness higher steam consumption as alcohol production scales up and energy-efficient distillation techniques gain traction.

2.6 Key Growth Drivers for Industrial Gases Market

The industrial gases market in India is witnessing strong growth, driven by several key factors:

Rising demand from healthcare and pharmaceuticals: The healthcare and pharmaceutical sectors have become significant consumers of industrial and medical-grade gases, with the COVID-19 pandemic highlighting the vital role of medical oxygen infrastructure. Demand remains strong for gases like oxygen, nitrous oxide, and carbon dioxide across hospitals, diagnostics, biotechnology, and pharmaceutical manufacturing. India's pharmaceutical industry is projected to grow from USD 73 billion in FY2025 to USD 130 billion by FY2030, further driving gas consumption in the sector.

Clean energy and green hydrogen initiatives: India's clean energy transition, led by the National Green Hydrogen Mission, is emerging as a major growth catalyst. With rising emphasis on green hydrogen production and building a hydrogen-based economy, industrial gas producers are set to play a central role—supporting hydrogen generation, storage, and infrastructure for renewable energy and fuel cell technologies.

Infrastructure development and refinery expansion: India's continued investments in infrastructure and the expansion of its refining and petrochemical sectors are driving robust demand for industrial gases across multiple applications—ranging from nitrogen for purging and blanketing, to oxygen for combustion, and hydrogen for hydrocracking. Leading oil and gas companies are ramping up investments in new refinery projects and capacity expansions, reinforcing the need for dependable gas supply. The

country aims to increase its refining capacity from 274 million tons in FY2025 to 439 million tons by FY2030.

Electronics and semiconductor manufacturing push: India's push to become a global hub for electronics and semiconductor manufacturing is unlocking a significant growth opportunity for industrial gases. Semiconductor fabs and electronics assembly units require ultra-high-purity gases like nitrogen, argon, silane, and hydrogen—driving long-term demand for specialty gas suppliers in this sector. The India Semiconductor Mission (ISM), under the SEMICON India program, is backed by a substantial budget outlay of ₹76,000 crore.

2.7 Key Threats and Challenges for Industrial Gases Market

The industrial gases market in India faces several challenges that could impact its growth and sustainability:

Supply chain challenges: The supply chain for industrial gases is fraught with several challenges that affect their availability and distribution. The sector suffers from inadequate storage and handling infrastructure, leading to bottlenecks and increased costs. Poor road infrastructure, specialized transportation needs for cryogenic and high-pressure gases, and fragmented distribution networks result in delivery delays and higher costs. A shortage of skilled professionals and the need for continuous training affect operational efficiency. The unavailability of cylinders and containers were affecting the supply of oxygen to impacted parts of the nation.

Logistical challenges may arise from stringent laws concerning the shipping of hazardous chemicals. Strict safety regulations, which can be difficult to implement logistically, must be followed when transporting gases like hydrogen. Use of specialized vehicles is also required along with expertise in the operation and maintenance of specialized vehicles used to transport cryogenic gases. Complying with transportation rules, maintaining temperature and pressure control throughout transit, and comprehending the workings of cryogenic tankers and cylinders are all crucial.

Safety and environment: When it comes to handling, storing, and transporting industrial gases, strict safety and environmental standards are crucial. Proper training is essential for anyone handling industrial gases. This includes understanding the properties of different gases, safe handling procedures, and emergency protocols. Users must follow safety guidelines, store gases properly, and use appropriate equipment. Meeting emissions standards and minimizing environmental impact requires investment in cleaner technologies and sustainable practices. By transitioning from cylinder-based delivery to a pipeline distribution system, end-users can minimize the environmental impact as well as enhance safety by reducing the need for handling of high pressure storage vessels.

Energy intensive process: Producing industrial gases involves energy-intensive processes, such as air separation, compression, and purification. These steps require significant electricity or fuel. Fluctuations in energy prices, whether due to geopolitical events, supply-demand dynamics, or seasonal variations, directly impact production costs. Sudden spikes can strain profitability. Some industrial gases companies enter long-term energy contracts to stabilize costs. However, these contracts may not always align with market fluctuations. Investing in energy-efficient technologies and practices can reduce consumption. Upgrading equipment, optimizing processes, and using renewable energy sources are effective strategies.

2.7.1 Regulatory environment for Industrial Gases Market

Stringent Licensing and Safety Compliance: The Gas Cylinder Rules, 2016, under the Indian Explosives Act, 1884, mandate strict licensing for manufacturing, storage, and transportation of gas cylinders. Companies must obtain approvals from the Chief Controller of Explosives, and exceeding prescribed storage limits requires additional licenses. Compliance with PESO (Petroleum and Explosives Safety Organization) regulations for cryogenic storage and transportation adds to operational complexities.

Environmental Regulations and Pollution Control: The Environmental Protection Act, 1986 (extended in 2022), imposes strict environmental standards on industrial gas plants, requiring pollution control measures to minimize environmental impact. Compliance with these regulations demands significant investments in emissions reduction technologies, waste management, and regular monitoring, increasing operational costs.

Hazardous Waste Management and Disposal: Under the Hazardous and Other Wastes Act, 2016, companies must ensure the proper disposal and recycling of gas cylinders, storage tanks, and associated waste. Failure to meet these guidelines can lead to penalties and environmental liabilities, making waste management a critical regulatory challenge for industrial gas manufacturers.

Workplace Safety and Hazard Management: The Factories Act, 1948, and the Manufacture, Storage, and Import of Hazardous Chemicals Rules, 1989, mandate strict safety measures for handling hazardous gases like hydrogen. Industrial gas manufacturers must conduct risk assessments, implement accident prevention protocols, and provide extensive training and protective equipment to workers. Ensuring compliance with these safety regulations increases operational complexity and costs.

3 DEEP DIVE INTO 'STEAM' AND 'COMMUNITY BOILER' INDUSTRY

3.1 Usage of Steam in the Process Industries

Steam is vital across industries like textiles, pharma, food, chemicals, paper, and more due to its versatility. While traditionally generated in-house, steam is now gaining recognition as part of the industrial gas supply market, with companies like Steamhouse promoting "Steam as a Service," driving market expansion.

3.1.1 Textile Industry

Low pressure steam of 2-5 bar is commonly used in Textiles production. Approximately 4 kg of steam is required for production of 1 kg of Fabric. Following are the applications of steam in a textile unit:

Exhibit 3.1: Usage of steam in Textile Industry

Application	Usage of Steam
Fabric Pre-treatment	• Steam is used for fabric cleaning, de-sizing (removing sizing agents), scouring (removing impurities), and bleaching processes. • It helps in heating and activating chemicals for effective fabric preparation.
Fabric Dyeing	• Steam is used for heating dye liquor, activating dyes, and fixing colors onto fabrics.

	• Steam is also employed in printing machines for color fixation and steaming of printed fabrics.
Fabric Finishing	• Steam is utilized in fabric finishing processes such as calendaring, setting, and heat treatment. • It helps in improving fabric texture, setting wrinkles, and enhancing the overall appearance of the fabric.
Yarn Drying	• Steam enables precise temperature control for optimal dye absorption and fixation, ensuring uniform color distribution in yarn. It also supports efficient processing by allowing rapid heating and drying, which reduces both processing time and energy consumption.
Yarn Printing	• After the yarn has been printed and the color or pattern has been applied, steam may be used in subsequent processes to fix or set the printed design on the yarn. • The steam fixation process enhances color-fastness and durability of the printed design.
Common Effluent Treatment Plants (ETPs)	• Common Effluent Treatment Plants (CETPs) in textile clusters are established to collectively treat wastewater from multiple units, removing the need for individual ETPs at each facility. Steam plays a crucial role in these CETPs, especially in multi-effect evaporators, to achieve Zero Liquid Discharge (ZLD), enhancing treatment efficiency, reducing environmental impact, and ensuring regulatory compliance.

3.1.2 Pharmaceutical Industry

In general, 1-2 bar pressure steam is used in most of the process, however, there are units which also use 5 - 8 bar pressure steam. Approximately 3 - 3.5 TPH of steam is used in a standard Bulk Drugs, API unit. Following are the common uses of steam in the pharmaceutical industry:

Exhibit 3.2: Usage of steam in Pharmaceutical Industry

Application	Usage of Steam
Raw material heating	• Steam provides controlled, uniform heating essential for dissolving ingredients and preparing consistent pharmaceutical solutions, suspensions, and emulsions.
Equipment disinfection and Drying	• Any visible dirt, debris, or contaminants on the equipment should be removed through a pre-cleaning step before steam disinfection. • Steam is used in drying process. Equipment may be dried using hot air, compressed air, or other suitable methods.
Concentration	• Steam is used to remove solvents or water from solutions or suspensions, effectively concentrating the active pharmaceutical ingredient (API) due to its superior heat transfer and controlled, efficient heating capabilities.
Heat exchanger	• Steam is often utilized as the heating medium in steam-to-fluid heat exchangers.

	• Steam transfers its thermal energy to the process fluid, effectively heating it to the desired temperature
Humidification	• Steam is used for humidifying pharmaceutical manufacturing facilities, which helps to maintain the proper moisture levels and prevent the products from drying out.
Freeze drying	• Steam is used in the freeze-drying process, which involves removing moisture from pharmaceutical products while preserving their potency and stability.
Sterilization	• Steam is used for sterilizing pharmaceutical products, equipment, and packaging materials, to ensure that they are free from harmful bacteria and other microorganisms ensuring the safety and sterility of pharmaceutical products.
Heating	• Steam is used for heating pharmaceutical products and ingredients, as it is a precise and efficient method of avoiding damage to the products.

3.1.3 Chemical Industry

Steam pressure varies between 1- 10 bar based on types of chemicals produced in the plant. The steam consumption in the chemical industry is approximately 1.5 kg of steam per kilogram of chemical produced. However, this can vary depending on the specific process to be followed, equipment design, energy efficiency measures implemented, and the heat requirements. Following are the common uses of steam in the chemical industry:

Exhibit 3.3: Usage of steam in Chemical Industry

Application	Usage of Steam
Distillation and Fractionation	• Steam is used in distillation and fractionation processes to facilitate the separation and purification of chemical compounds by creating a vapor-liquid equilibrium within columns or towers.
Sterilization and Disinfection	• Steam is used for sterilization and disinfection of equipment, containers, and surfaces in the chemical industry to ensure aseptic conditions and prevent contamination.
Heat transfer	• Steam is employed as a heat transfer medium in various heat exchangers, condensers, and other heat transfer equipment. • It allows for efficient and controlled heat exchange between different process streams.
Evaporators	• Steam is employed in evaporation processes to remove solvents or water from chemical solutions or mixtures.

	• Steam is passed through heat exchangers or evaporators to heat the solution, causing the volatile components to vaporize, and leaving behind a concentrated product.
Reactor heating	• Steam is commonly used for heating chemical reactors to facilitate chemical reactions. • It provides efficient and controlled heat transfer, maintaining the desired temperature conditions for the reaction to occur.

3.1.4 Tyre Industry

In the Tyre industry, steam pressure varies between 18-24 bar in the vulcanization process. On average, 2 TPH of steam is used in the production of 1 kg of rubber. Following are the common uses of steam in the tyre industry:

Exhibit 3.4: Usage of steam in Tyre Industry

Application	Usage of Steam
Rubber compounding	• Steam is primarily used to heat and soften rubber compounds, making them more pliable for effective mixing and blending of natural rubber, synthetic rubber, fillers, chemicals, and additives.
Tyre building	• Steam is used during the tyre building process to aid in the shaping and bonding of tyre components. • It helps to heat and soften the rubber components, allowing them to be easily molded and adhered together to form the tyre structure.
Vulcanization	• The built tyre is transferred to a tire curing press, and steam is injected into the press to provide the required heat. • The heat from the steam causes the rubber to crosslink, resulting in a solid and durable tyre.
Post curing and finishing	• Steam autoclaves are used to apply controlled heat, pressure, and steam during tyre curing, enhancing the tyre's shape, strength, and appearance through additional curing.

3.1.5 Paper and Pulp Industry

Steam of 10 bar and above is commonly used in paper and pulp production. Approximately 1.6 – 2.2 kg of steam is required to produce 1 kg of dry paper. Following are the applications of steam in a paper and pulp unit:

Exhibit 3.5: Usage of steam in Paper and Pulp Industry

Application	Usage of Steam

Wood and Fiber Preparation	• Steam is used to soften and condition wood chips and other fibrous materials during the pulping process. • This facilitates the separation of fibers and helps to create a pulp suitable for papermaking.
Steam Digester	• Steam is used in the digester to cook wood chips or other raw materials with chemicals like sodium hydroxide or sulfite, breaking down lignin and separating cellulose fibers during the pulping process.
Pulp Washing	• After cooking, the pulp undergoes washing to remove spent chemicals and impurities. • Steam is utilized in various stages of pulp washing to aid in the efficient removal of chemicals and contaminants.
Evaporation	• Steam is used in evaporators to concentrate the black liquor, a byproduct of the pulping process, and recover chemicals for reuse in the pulping process.
Steam Heated Dryers	• After pulp washing, the wet pulp is dried using steam-heated dryers to reduce moisture content and prepare it for the papermaking process.
Paper Machine Drying	• Steam is used in the paper machine's drying section to remove water from the wet paper web. • Steam-heated dryer cylinders and rolls help achieve the desired moisture content for the paper.
Coating and Sizing	• In certain paper grades, steam is used in the coating and sizing processes to apply special coatings or treatments to enhance the paper's surface properties.
Cleaning and Sterilization	• Steam is used for cleaning and sterilizing various equipment and components in the paper and pulp mills to maintain hygienic and safe operating conditions.

3.1.6 Distilleries

Low-pressure steam of 1.5 to 3.5 bar is commonly used in distilleries. Approximately 3.4 – 6.6 kg of steam is required to produce 1 liter of Ethanol. Following are the applications of steam in a distillery unit:

Exhibit 3.6: Usage of steam in Distilleries

Application	Usage of Steam
Mash cooking	• Steam is used to heat the mash during the cooking process. • The mash typically consists of grains (e.g., barley, corn, rye) mixed with water, and steam is applied to heat the mixture and facilitate starch conversion into fermentable sugars.

Fermentation	• Steam is sometimes used indirectly for temperature control during fermentation by jacketed vessels, helping maintain consistent temperatures essential for yeast activity and proper flavor development.
Distillation	• Steam is extensively used in distillation by heating the mash in a still to vaporize alcohol based on its boiling point; the vapor is then condensed back into liquid form to produce distilled spirits.
Heat Exchangers	• Steam is used in heat exchangers to transfer heat efficiently during various stages of the distillation process, improving energy efficiency and reducing operational costs.
Cleaning and Sanitization	• Steam is utilized for cleaning and sanitizing various equipment, tanks, and pipelines to maintain hygiene and ensure the quality and safety of the distilled spirits.
Bottle sterilization	• Before bottling, steam can be used to sterilize bottles, caps, and closures, ensuring the final product is free from contaminants.
Barrel treatment	• Steam can be used to prepare wooden barrels before ageing spirits, helping to sanitize and prepare the barrels for the ageing process.

3.1.7 Wood Industry

Low-pressure steam of 6- 8 bar is commonly used for most of the processes in the Wood industry. Approximately 0.45 kg of steam is required to produce 1 kg of processed wood. Following are the applications of steam in a wood processing unit:

Exhibit 3.7: Usage of Steam in Wood Industry

Application	Usage of Steam
Wood drying	• Steam is used to dry green or wet wood to reduce its moisture content. • Kilns and steam-heated dryers are employed to control the drying process and prepare the wood for further processing or use.
Plywood manufacturing	• In plywood manufacturing, steam is used to soften wood veneers before pressing, while steam-heated platens help form strong bonds between layers during the pressing stage.
Fiberboard production	• Steam is used in the production of fiberboards (MDF, HDF) to soften and steam the wood fibers before they are formed into boards. • This process improves the bonding and strength of the boards.
Wood treatment	• In some wood treatment processes, steam is used to pre-treat wood before applying preservatives or finishes. • Steam treatment helps open the wood pores, allowing for better absorption of chemicals.

Laminating and Veneering	• Steam is used to soften wood veneers, making them more pliable for laminating or veneering onto substrates.
Wood conditioning	• Steam is used to condition wood before certain machining processes, making the wood more flexible and easier to shape.
Composite wood production	• Steam is used in the production of composite wood products, such as particleboard and OSB (oriented strand board). • Steam is applied to soften wood particles or strands before forming the panels.

3.2 Usage of Fuels for Steam Generation

Various types of fuels are used for steam generation, and they can be bucketed under two categories – fossil fuels and non-fossil fuels. The most common fossil fuel used for steam generation is coal however, other fossil fuels such as Diesel, HFO, LDO, LSHS, etc. are also used in the industries. As the City Gas Distribution (CGD) network is expanding, piped natural gas (PNG), is now available in many industrial areas across the country. Besides, other fossil fuels such as LPG, Propane, etc. are also used among the industries for heating purpose and steam generation.

Exhibit 3.8: Gross Calorific Value (GCV) of various fossil fuels

Fossil Fuel Name	Gross Calorific Value (GCV)
Coal	2,200 (G17) - >7,000 (G1) Kcal / Kg
Diesel	10,550 – 10,900 Kcal / Kg
Heavy Fuel Oil (HFO)	10,335 Kcal / Kg
Light Diesel Oil (LDO)	10,300 – 10,400 Kcal / Kg
Low Sulphur Heavy Stock (LSHS)	10,500 Kcal / Kg
Natural Gas	10,000 Kcal / SCM (8000-8500 of Gujarat Gas)
Liquid Petroleum Gas (LPG)	12,500 Kcal / Kg

Fossil fuel-based steam generation offers several advantages, including high energy density, easy availability, and reliable performance. These fuels have a high calorific value, meaning they can produce significant amounts of heat when burned. The combustion process is efficient, allowing for rapid and consistent steam production. Fossil fuels are widely accessible and have well-established supply chains, making them readily available for industrial steam generation.

3.2.1 Fossil Fuels

A. Coal

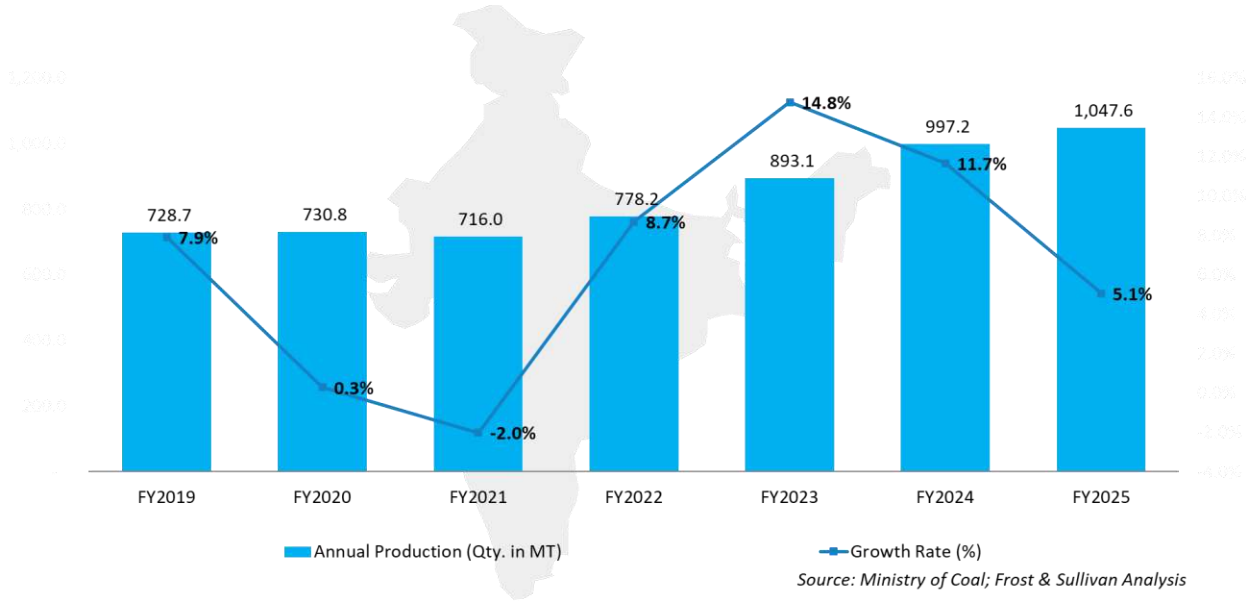
Coal is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy need. Commercial primary energy consumption in India has grown by about 700% in the last four decades

(source: Ministry of Coal, Govt. of India). The current per capita commercial primary energy consumption in India is about 350 kilogram of oil equivalent (kgoe) / year which is well below that of developed countries. Driven by the rising population, expanding economy and a quest for improved quality of life, energy usage in India is expected to rise.

Domestic coal production: India is the second largest producer and consumer of coal in the world after China. India's coal production has grown at 6.3% CAGR between FY2019 and FY2025 to reach 1047.6 million tonnes in FY2025.

Medium term projection from the Ministry estimates Indian's domestic coal production to reach 1.5 billion tonnes by FY2030.

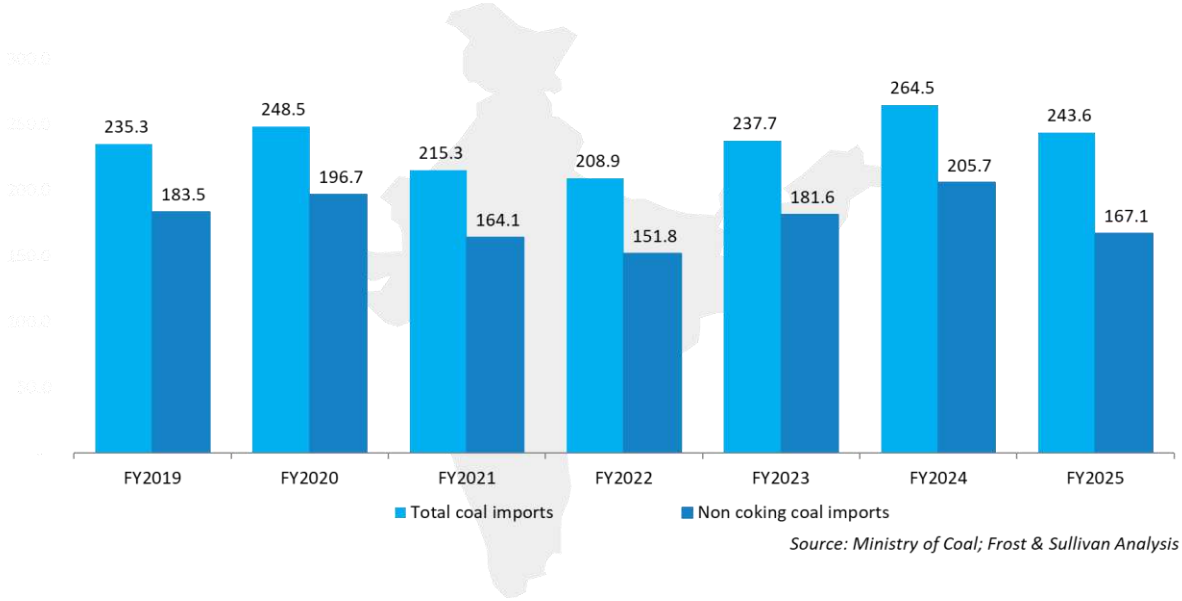
Exhibit 3.9: Domestic Coal production, India, million tonnes (FY2019 – FY2025)



Source: Ministry of Coal; Frost & Sullivan Analysis

Coal imports into India: Despite a record growth in domestic coal production, India's coal import also increased sharply by 13.7% in FY2023 to 237.7 million tonnes, after witnessing a consistent fall over the last two years. The data indicates that the coal imports are back to pre-Covid levels of 240 million tonnes.

Exhibit 3.10: Coal import, India, million tonnes (FY2019 – FY2025)



Source: Ministry of Coal; Frost & Sullivan Analysis

The increase is primarily led by non-coking coal import, which has grown by 19.7% in FY2023 to 181.6 million tonnes. The imports stood at 167.1 million tonnes in FY2025. India imports bulk of its coal from Indonesia.

The coal produced in Indonesia is known for its high energy content, low ash content, and low sulphur content. Indonesia's proximity to India makes it a convenient source for coal imports. The logistical advantages, including shipping routes and transport infrastructure, make it economically viable for India to import coal from Indonesia. The cost of coal in Indonesia is often competitive compared to domestically produced coal or coal from other countries. This cost advantage, coupled with favourable quality characteristics, makes Indonesian coal an attractive option for Indian importers.

Price of Coal: On the price front, average import price of non-coking coal almost increased more than 50 percent in FY22 to INR 7,470 per tonne and further increased to INR 13,800 in FY23 due to Russia – Ukraine war. Price started to stabilize after that.

Exhibit 3.11: Average import price of non-coking coal between FY21 and FY25

Price per tonne in INR	FY21	FY22	FY23	FY24	FY25
Average import price of non-coking coal in India	4,940	7,470	13,800	10,200	9,010

As per International Energy Agency (IEA), international coal prices have touched three all-time peaks between October 2021 and May 2022. Sanctions and bans on Russian coal following Russia's invasion of Ukraine have disrupted markets, and issues in other major exporters have contributed to supply shortages.

3.2.2 Non-Fossil Fuels

Non-Fossil Fuels or Green fuels refer to those fuels which are carbon-neutral or even carbon-free. These fuels are crucial to decarbonize the manufacturing and economic activities in future. Following are some of the green fuels used in the industry for heating and power generation applications:

A. Raw Biomass

Commonly used Biomass materials in the country are bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust etc.

B. Biomass Briquette

Biomass briquette is made from agricultural waste and a replacement for fossil fuels such as oil or coal and can be used to heat boilers in manufacturing units. Many companies in India have switched from furnace oil to biomass briquettes to save costs on boiler fuels. The use of biomass briquettes is predominant in the southern parts of India, where coal and furnace oil are being replaced by biomass briquettes. Use of biomass briquettes can earn Carbon Credits for reducing emissions in the atmosphere. Biomass briquettes also provide more calorific value compared to raw biomass and save around 30-40 percent of boiler fuel costs when compared with liquid fossil fuels.

C. Municipal Solid Waste (MSW)

Municipal Solid Waste (MSW) consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. These wastes are generated in homes, schools, hospitals, and businesses. With the fast pace of urbanization, especially in metro cities, the issue of sustainable management and disposal of Municipal Solid Waste (MSW) is gaining attention from various stakeholders in the society. Central and State Governments and Urban Local Bodies (ULBs) are contemplating various usages of MSW such as steam and electricity generation, RDF and Compost generation, Fly ash for bricks manufacturing, etc. Urbanization in India has led to increased migration from rural to urban areas, exerting pressure on cities to manage MSW. The waste-to-steam model is poised to be highly effective in India, given the abundant MSW and the country's rapid economic growth, which will likely increase per capita waste generation.

D. Industrial Waste

This waste material has a high potential energy content, making it suitable as a fuel source for boilers. Industrial waste, also known as NRSW, is non-biodegradable. It is typically either landfilled or delivered to cement factories. Company like Steamhouse are adopting strategies focusing on addressing local waste issues locally by burning NRSW in a controlled environment. This approach manages waste efficiently and minimizes transportation-related emissions.

E. Waste gas from Industrial Waste Heat

Certain industries generate waste gases such as methane, carbon monoxide and other inflammable gases during their generation processes. This includes the production of black carbon, commonly known as soot,

which is a component of fine particulate air pollution resulting from various industrial applications. If released into the atmosphere, these gases pose significant environmental and health risks. By burning these waste gases in a waste heat recovery boiler, we can generate steam. This method mitigates environmental harm and eliminates the need for fossil fuels. Industrial waste heat corresponds to heat rejected from industrial processes, in which energy (mostly in the form of heat or electricity) is used to produce high-added value products. Multiple technologies such as waste heat recovery boiler (WHRB), vapour absorption chillers, organic rankine cycle (ORC), etc. have been deployed by the industries to recover the industrial waste heat to generate steam, electricity, and produce cooling.

F. Refuse Derived Fuel (RDF)

Refuse-derived fuel (RDF) is a fuel produced from various types of waste such as municipal solid waste (MSW), industrial waste or commercial waste. RDF consists combustible components of various types of wastes. These fractions are separated by different processing steps, such as screening, air classification, ballistic separation, separation of ferrous and non-ferrous materials, glass, stones, and other foreign materials and shredded into a uniform grain size or also pelletized to produce a homogeneous material which can be used as substitute for fossil fuels for heating applications or generating electricity. It is a renewable energy source that ensures waste simply isn't thrown into a landfill and instead put to good use.

G. Textile Waste

Textile waste is fabric or clothing that is being generated by textile manufacturing units. Textile waste can contain chemical wastes and heavy metals that are potentially toxic. This waste material has a high potential energy content, making it suitable as a fuel source for boilers. Textile waste generated by the textile industry, process house, Dyeing Mills, including fabric scraps, yarn waste, or garment remnants, can also be effectively utilized for green steam generation. By processing and preparing this waste through techniques like shredding or baling, it can be used as a renewable fuel source in dedicated textile waste boilers. This not only helps in waste management but also reduces the reliance on fossil fuels for steam generation.

H. Plastic and Paper Waste

Plastic waste, which poses a significant environmental challenge, can be transformed into a valuable resource for steam generation. Plastic waste-to-energy technologies, including pyrolysis or gasification, can convert plastic waste into a fuel gas or liquid fuel, which can be utilized in boilers for steam generation. This not only helps in plastic waste management but also reduces the dependency on fossil fuels.

I. Agro-waste

A significant amount of agro-waste is generated across the country, which can include crop waste, animal waste, processing waste and some hazardous waste (such as pesticides and insecticides). This approach benefits farmers financially, reduces open-air burning of agro-waste and supports environmental sustainability

3.3 Introduction to Community Boiler service

Steam is an inevitable requirement for most of the process industries like textiles, pharmaceuticals, chemicals, food processing, fertilizer, plywood, paper, etc. to meet their heat requirements. Traditionally, industries set up boilers at their own premises to meet the steam requirements. These boilers are small

to medium in size, have low efficiency, and at times safety is compromised, which results in casualties. The chimneys in industrial areas add PM-5 and PM-10 particles to the environment, causing diseases because of improper air pollution control equipment and non-professional management.

Steam As A Service (SAAS) through community boilers refers to a model where a company operates a centralized boiler and distributes the produced steam to various industries for their production processes. The steam is distributed through a network of pipes to the industries that rely on it for various applications, such as heating, power generation, sterilization, or industrial processes. These service providers ensure the reliable generation of steam in required quantity and quality to meet the specific needs of the end user of steam. Replacing captive boilers with the use of community boilers, there can be potential savings of up to 25-30% of the fossil fuels that would have been used locally by individual boilers

By outsourcing steam production to a specialized service provider, industries can not only eliminate the need to invest in their own steam boilers but also focus on their core operations without the burden of operating and maintaining their own boiler systems. The approach to centralizing steam generation and distribution promotes efficiency, reduces environmental impact by installing pollution control mechanisms, and simplifies operations for businesses within the community. The use of community boilers often results in more efficient and optimized combustion processes as compared to individual boilers. However, there is a geographical space limitation regarding the installation and placement of new pipelines to distribute industrial gases in the established industrial clusters in India. Any new entrant would need to determine where and how to facilitate distribution to customers that are located far from the generation area without transmission losses. Moreover, those customers who have already provided a landing for the pipeline installed by an incumbent supplier may not be keen on creating another landing point for the distribution pipeline offered by such new entrant.

Steamhouse India Limited is the pioneer in community boiler service in India. It also purchases excess steam/ waste steam generated by industries during their process and acts as a distributor of such steam by laying distributed pipeline network and supplying the collected steam to its customers. Steamhouse has established their geographic dominance within industrial clusters through the creation of an exclusive pipeline network. The limited space available prevents the setup of additional distribution networks by other companies. Any new market entrants may need to overcome several entry barriers. They will likely need to source a significant amount of capital expenditures to be able to provide a centralised generation and distribution of industrial gasses, including the procurement of community boilers, gas separation and compression systems, pipelines and materials. Steam generation and distribution – the primary business model

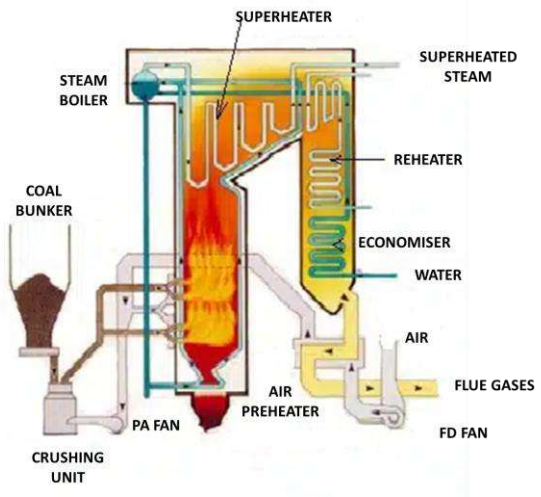
The steam is generated in a community boiler or steam generator by converting heat energy from various fossil or renewable fuel sources. The produced steam is then distributed to various industrial end users through an array of pipelines. The steam generation process using various fuel sources have been explained in the following sections.

A. Steam generation using fossil fuel (Coal)

The process of steam generation using coal involves the combustion of Crushed coal within a boiler's combustion chamber to the required sized in fluidized conditions to achieve maximum combustion. Depending on the geographical area and availability of non-fossil fuel in a particular sector, we reduce our emission by the use of scientific and automatic handling of coal and the coal ash-controlled movement

and storage of coal. Where coal is the fuel source, hydrated lime is sprinkled on coal to reduce Sox emission. The heat energy released during combustion transfers to water-filled tubes within the boiler, causing the water to reach its boiling point and generate steam.

Exhibit 3.12: Process diagram of a coal based steam generation plant

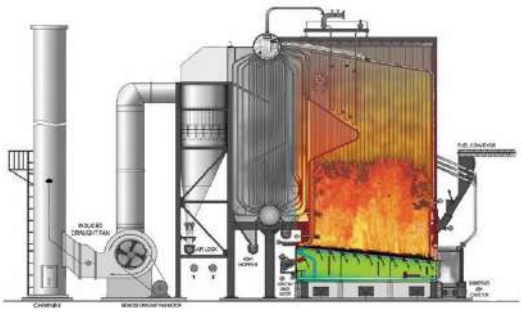


Once the steam is generated, it is distributed to various clients located nearby the common facility. The distribution system includes a network of pipes, valves, and control systems to transport and regulate the flow of steam. Steam is transferred through a network of insulated pipes which are designed to transport high-pressure steam over long distances. The insulation help minimizing heat loss during transportation.

B. Green steam generation using non-fossil fuels

Biomass: Green Steam is generated by using various types of green fuels such as biomass, briquette, industrial waste, RDF, waste heat, etc. In case of solid fuels, a biomass boiler is used for generating the steam. In case of MSW, incinerators are also used to burn the waste and generate heat which is then used in the boiler for generating the steam.

Exhibit 3.13: Process diagram of a biomass boiler based steam generation



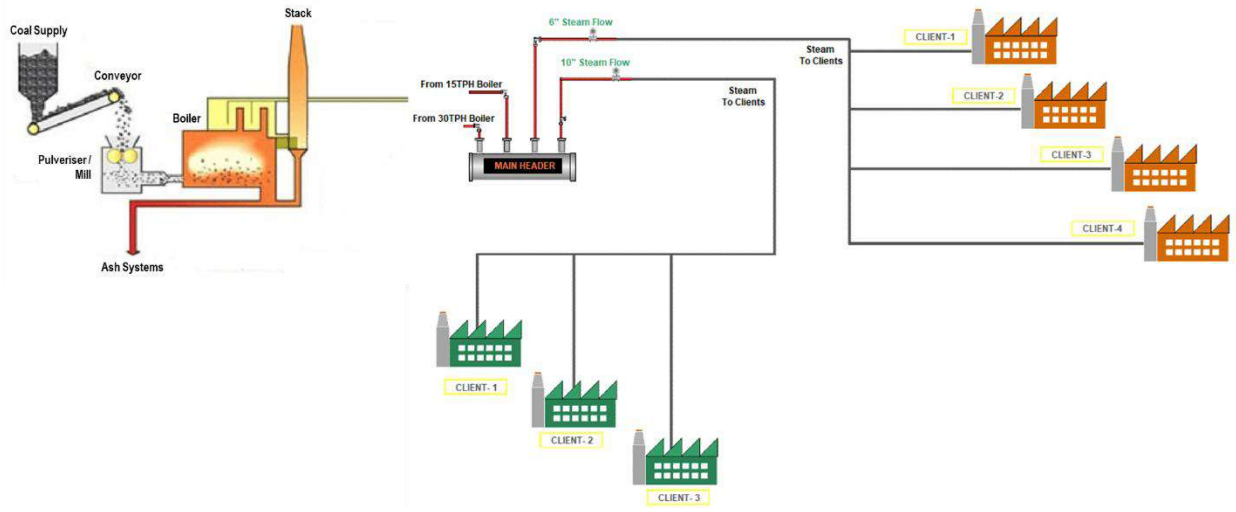
Industrial Wastes: In case of industrial wastes, most of them cannot be used directly. These industrial wastes are processed to generate liquid fuel or gas which are then used in the boiler to generate the steam. In general, Anaerobic Digestion (AD) or Bio-methanation process is used to extract gas from industrial wastewater, spent wash and aqueous waste. In the AD process, organic fraction of the waste is processed through Biogas Digester which produces methane rich biogas. This biogas can be used for cooking, heating, steam generation or for power generation.

Industrial Waste Heat: In case of waste heat recovery, the modern waste heat recovery plants are designed to extract maximum possible energy from waste. The combustion process releases the energy within the fuel or waste in the form of hot flue gas. The thermal energy within the hot flue gas is recovered with the help of a Waste Heat Recovery Boiler (WHRB) or Heat Recovery Steam Generator (HRSG) positioned after the combustion stage. As the hot flue gases flow through the boiler, the thermal energy is absorbed and eventually converted to steam.

3.3.1 Steam distribution process and structure

The steam distribution system is the essential link between the steam generator and the steam user. Immaterial of the source, an efficient steam distribution system is essential if steam of the right quality and pressure is to be supplied, in the right quantity, to the steam using industries. A typical steam distribution system is shown in the figure below.

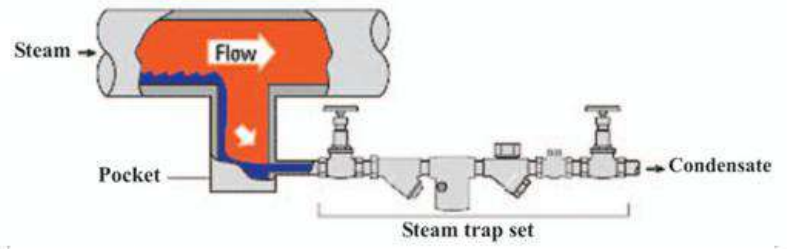
Exhibit 3.14: Layout of a steam distribution system



The steam generated in the boiler is conveyed through piping network to the point where its heat energy is required. One or more main pipes, or 'steam mains' carry steam from the boiler in the direction of the steam using plants. Smaller branch pipes then carry the steam to the individual equipment. General layout and location of steam consuming equipment is of great importance in efficient distribution of steam. Steam pipes are laid in a manner to maintain the shortest possible distance rather than to follow a building layout or road etc.

Apart from proper sizing of pipelines, provisions are made for proper draining of condensate which is bound to form as steam travels along the pipe. Large pockets are used in the piping network to enable water collection so that water is not carried along with steam. These drain pockets are provided at every 30 to 50 meters and at any low point in the pipe network. The pocket is fitted with a trap to discharge the condensate.

Exhibit 3.15: Drainage of condensate through steam traps in a steam distribution network



Expansion loops are also necessary in the network to take care of the expansion of pipes when they get heated up. Automatic air vents are fixed at the dead end of steam mains, which allows removal of accumulated air.

3.3.2 Additional Revenue sources / business model of a Community Boiler

A. Co-Generation of electricity[3]

Community boilers can function as cogeneration or Combined Heat and Power (CHP) plants, producing both electricity and useful heat from a single fuel source. This dual-generation process significantly improves overall energy efficiency compared to separate production methods.

In a cogeneration-enabled community boiler, fuels such as coal or biomass are combusted to generate steam or hot water for heating, while simultaneously driving turbines to produce electricity. The waste heat from electricity generation is recovered and utilized for various thermal applications, improving overall efficiency. Turbine types like Extraction Cum Condensing or Back Pressure are employed based on system needs.

B. Carbon credits

International Scenario:
Community boilers that adopt sustainable practices and reduce greenhouse gas emissions can earn carbon credits under international carbon trading and climate initiatives. These credits can be monetized through:

1. **Carbon Credit Sales** to companies, governments, or investors aiming to meet regulatory or voluntary emission targets.
2. **Offset Partnerships** with organizations seeking long-term emission offsets.
3. **Voluntary Carbon Markets**, targeting buyers committed to environmental responsibility.
4. **Sustainability Labels**, such as green or renewable energy certifications, which enhance credit value.

Indian Scenario:
India is developing the **Indian Carbon Market (ICM)** to price GHG emissions through tradable Carbon Credit Certificates. Spearheaded by the Bureau of Energy Efficiency and Ministry of Environment, the scheme will set sector-specific emissions intensity targets aligned with national climate goals. The ICM will include both compliance and voluntary mechanisms to encourage wider participation.

[3] IEA report on cogeneration and renewable energy

India's efforts support its **Nationally Determined Contribution (NDC)** to reduce GDP emissions intensity by 45% by 2030 (from 2005 levels). The **Emission Trading Scheme (ETS)** pilot in Surat, launched in 2019 to cap particulate matter emissions, demonstrated success with a 24% reduction. This market-based model incentivizes industries to either cut emissions or purchase additional permits, promoting cleaner technologies and low-carbon growth.

C. Revenue from fly ash

Community boilers using coal as a fuel source can generate additional revenue by utilizing coal fly ash—a byproduct rich in silica and alumina—in various industries. Fly ash can be sold for brick manufacturing, where it replaces cement to produce stronger, cost-effective, and eco-friendly bricks.

D. Revenue from flue gas sales

Community boilers can generate additional revenue by utilizing flue gases, particularly through the capture and sale of carbon dioxide (CO_2), which holds commercial value. CO_2 extracted from flue gases can be used in carbonation for beverages, food preservation and freezing, and as a feedstock in chemical and polymer manufacturing. Additionally, flue gases retain significant thermal energy, which can be harnessed using waste heat recovery systems—such as boilers or heat exchangers—to produce extra steam or hot water for industrial processes or community heating, further enhancing efficiency and profitability.

E. Revenue from sale of chill water services

Community boiler service providers can tap into an additional revenue stream by offering chilled water services, leveraging their infrastructure and expertise to meet diverse cooling needs. This can include the installation of chilled water generation systems for applications such as air conditioning, industrial processes, and data center cooling.

F. Revenue from advertising on steam pipeline network

Bridges spanning over pipeline infrastructure offer a unique opportunity for advertising, providing high visibility and a steady revenue stream. Large banners or wraps can be installed on the sides of these bridges, showcasing company logos, product promotions, or brand messages to pedestrians and motorists alike. Additionally, illuminated signs enhance visibility during nighttime or low-light conditions, maximizing the impact of the advertisements. These prominent locations serve as effective platforms for advertisers while enabling community boiler operators to monetize otherwise unused infrastructure.

G. Revenue from selling of third-party generated steam

Many industries deploy waste heat recovery boiler (WHRB) or similar technologies to generate steam from industrial waste heat or industrial waste. This steam is either used in generating electricity and for process heating or sold to other nearby end-users. Also, in certain industries, steam is generated as a byproduct in the manufacturing process. A community boiler service provider can purchase this steam and re-sell it to the nearby end-users through its own steam distribution network. Alternately, the service provider can also allow the third-party steam generator to use its network and charge rental fees for the used capacities.

3.3.3 Technology innovation in Community boilers

Steamhouse India, a leader in community boiler industry, has elevated its community boiler monitoring and assessment system through the application of state-of-the-art technologies. Innovations such as the Internet of Things (IoT), Supervisory Control and Data Acquisition (SCADA), drones, satellite images, and steam traps/auto valves have played a crucial role in revolutionizing boiler operations, monitoring, and maintenance. These technology advancements have led to improvements in efficiency, safety, and overall performance, making boilers smarter, more reliable, and aligned with the demands of modern industrial processes.

A. IoT (Internet of Things)

IoT technology is increasingly being used in boilers to enable remote monitoring, data collection, and control. IoT sensors and devices can provide real-time information about boiler performance, temperature, pressure, fuel consumption, and emissions. This data can be utilized for condition monitoring, predictive maintenance, energy optimization, and overall process efficiency improvement.

B. SCADA (Supervisory Control and Data Acquisition)

SCADA systems have found widespread applications in the Indian boiler industry, transforming how boiler operations are monitored and controlled. These centralized systems provide Indian boiler operators with a comprehensive view of critical data, consolidating information from various sensors and devices. SCADA systems offer remote access capabilities, allowing operators to manage multiple boilers and industrial processes from a central location, reducing the need for on-site personnel and enhancing operational efficiency. The real-time data acquisition and visualization provided by SCADA systems enable operators to make informed decisions promptly, responding to alarms and events efficiently. This remote accessibility and data-driven decision-making contribute to improved productivity and streamlined operations of boiler facilities.

C. Drones

In India, drones are emerging as a valuable tool for inspecting and maintaining industrial facilities, including boilers. Drone-based visual inspections of boilers and related equipment offer several advantages, particularly in India's diverse and vast industrial landscape. Equipped with high-resolution cameras, drones can access difficult-to-reach areas and provide detailed imagery of boiler components. For the boiler industry, this eliminates the need for physical access to confined spaces, reducing safety risks for inspectors. Drone inspections also support preventive maintenance efforts in boilers, as regular inspections help identify potential issues early, allowing for timely repairs and minimizing unplanned downtime.

D. Steam Trap/Auto Valves

Steam traps and automatic valves are essential components in steam distribution systems. Steam traps are used to remove condensate from the steam lines, ensuring efficient heat transfer and preventing water hammer. Automatic valves, such as control valves and safety valves, help regulate steam flow, pressure, and temperature within the boiler system. Advanced steam trap and valve technologies, including smart and self-regulating devices, improve energy efficiency, reduce steam losses, and enhance overall system performance.

3.3.4 Future Technology for Community Boiler

Emerging Technologies for Community Boilers in India

India is exploring several advanced technologies to enhance the sustainability and efficiency of community boilers. Green hydrogen, produced via electrolysis using renewable energy, holds significant potential as a clean fuel alternative. With India's vast solar and wind resources and supportive government policies, green hydrogen could soon play a key role in decarbonizing industrial steam generation.

Microwave plasma technology is a promising innovation. It uses microwave energy to generate high-temperature plasma for clean and efficient combustion. This method reduces emissions and allows flexible fuel use, including biomass and waste materials, making it a strong candidate for future boiler upgrades.

Concentrated Solar Power (CSP), which harnesses focused solar energy to generate heat, can be integrated into boiler systems to supplement or replace fossil fuel usage, lowering costs and emissions.

Exothermic reactions can be strategically utilized to generate heat in community boilers. These chemical processes reduce fuel dependency, cut emissions, and offer customized thermal output based on industrial requirements.

Small Modular Reactors (SMRs) offer a nuclear-based solution with compact design, factory fabrication, and modular deployment. Their scalability and smaller footprint make SMRs viable for industrial zones with high, consistent energy needs, while minimizing traditional nuclear plant limitations.

4 OVERVIEW OF INDUSTRIES WITH SIGNIFICANT STEAM DEMAND

4.1 Highlights of the Major Steam Consuming Industries in India

The below table represents a summary of industries who are major steam consumers

Exhibit 4.1: Highlights of the major steam consuming industries in India

Industry Name	FY'2025 Industry Size (INR Billion)	Major Production hubs	Key Growth Drivers	FY2025-FY2030 CAGR
Textile Industry	14,857	Maharashtra, AP, Haryana, Punjab, Gujarat	Policy support, global demand	6.1%
Pharmaceutical Industry	6,067	Telangana, AP, Maharashtra, Gujarat	Accessibility, acceptability, Epidemiological factors	11.4%
Food Processing Industry	490	Maharashtra, Delhi, AP, UP, Tamil Nadu	Changing demographics, consumer preference, changing lifestyle	10.3%
Chemical Industry	24,320	Gujarat, Maharashtra, Tamil Nadu, Odisha	Government initiatives, growth in specialty chemical sector	9.2%
Tyre Industry	966	Tamil Nadu, Gujarat, Maharashtra	Replacement market, improving road infrastructure, growing automobile industry	9.7%
Paper and Pulp Industry	1,472	Maharashtra, AP, MP, Karnataka, Gujarat, UP	Packaging industry, availability of raw material, increasing literacy rate	12.5%

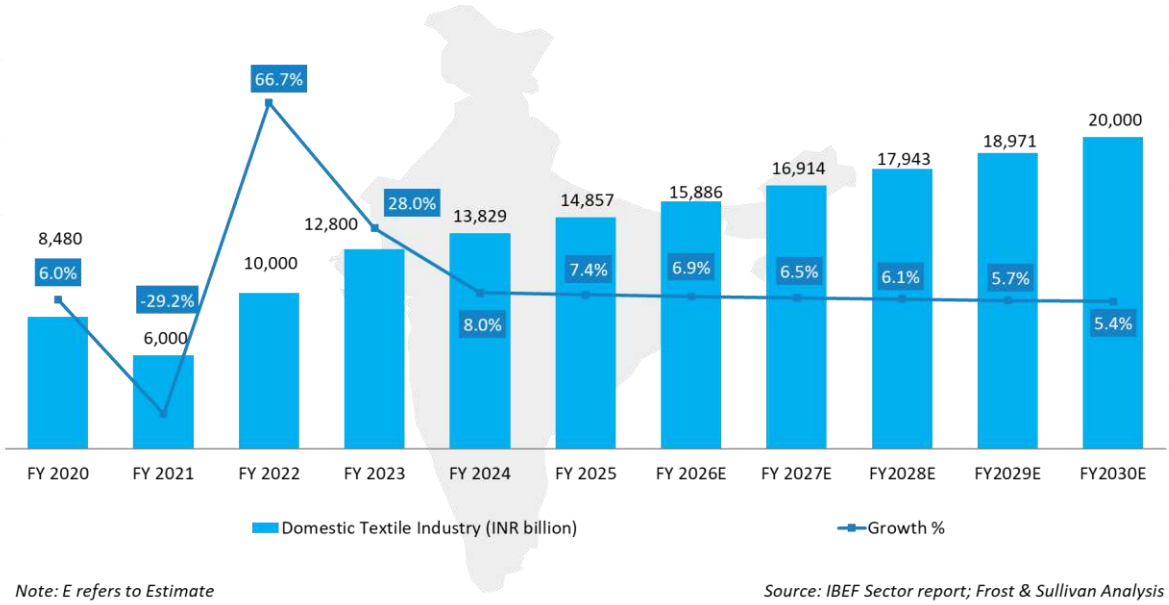
4.2 Textile Industry

4.2.1 Introduction

India's textiles sector is one of the oldest industries in the Indian economy, and is extremely varied, with hand-spun and hand-woven textiles sectors at one end of the spectrum, and capital-intensive sophisticated mills at the other end.

The decentralized power looms/ hosiery and knitting sectors form the largest component of the textiles segment.

Exhibit 4.2: Domestic textile industry in India, FY2020 – FY2030E, (Value in INR billion)



Note: E refers to Estimate

Source: IBEF Sector report; Frost & Sullivan Analysis

The textile sector is expected to play a significant role, with a target of US$ 100 billion in exports by FY2030, up from US$ 37.75 billion in FY2025. India ranks among the top five global exporters in several textile categories, with exports expected to reach US$ 65 billion by FY2026. The overall Indian textile industry in FY2019-FY2020 reached INR 8,480 Bn and is estimated to reach INR 20,000 bn by FY2029-FY2030.

4.2.2 Major Textile hubs in India

Following are the top 5 textile and clothing manufacturing hubs in India:

1. **Maharashtra**
2. **Andhra Pradesh**
3. **Haryana and Punjab**
4. **Gujarat**
5. **Tamil Nadu**

4.2.3 Textile industry in Gujarat

Leading national and international companies have invested in Gujarat textile industry owing to the availability of vast raw materials combined with investor friendly policies. There are more than 1,500 large and medium textiles units present in Gujarat.

The major textiles hubs in Gujarat are listed below:

Exhibit 4.3: Prominent Textile clusters in Gujarat

Cluster Name	Types of textiles units present in the cluster
Ahmedabad	Cotton & blended fabric, denim, made-ups, ladies' garments, machinery & parts
Surat	Art silk fabric, synthetic textiles, zari manufacturing, embroidery, textile machinery & parts
Kutch	Textile handicrafts
Surendernagar, Manavadarand Gondal	Cotton ginning
Saurashtra, Jetpur	Hand printing and processing units
Ankleshwararand Tapi	Technical textiles
Umargaon	Modern power loom, synthetic suiting & shirting

Source: Desk research and stakeholder interactions

Exhibit 4.4: Existing Textile parks in Gujarat

Name	Location	Activities
Amitara Green Hi- Tech Textile Park	Kheda	Spinning, weaving and garmenting
Fairdeal Textile Park	Surat	Weaving, Yarn Preparatory, Texturizing, Technical Textile & Composite
Gujarat Eco Textile Park	Surat	Textile Processing, Weaving, Yarn Dyeing, Composite Denim
Karnaj Textile Park	Surat	Weaving and Knitting
Kejriwal Integrated Textile Park	Surat	Texturizing, Spinning, Weaving/Looms, Embroidery Units etc.
Mundra SEZ Integrated Textile and Apparel Park	Mundra	Technical Textiles - Woven, Non-Woven (Geo Textiles, Medical Textiles, Automotive Textiles, etc.), Garmenting
Palsana Textile Park	Surat	Weaving, Technical Textiles, Garmenting, Textile Processing and Embroidery
RJD Integrated Textile Park	Surat	Weaving-Water jet Loom, Weaving–HS, Rapier Loom, Weaving-LS, Rapier Loom, Composite, Texturing Embroidery
Sayana Textile Park	Surat	Weaving, Embroidery, Texturizing, Garmenting, Technical Textile, Digital Printing
Shanti Integrated Textile Park	Surat	Spinning, weaving, and garmenting
Vraj Integrated Textile Park	Kheda	Knitting, Weaving, Technical textiles, Textile packaging, Rope dyeing
Sachin GIDC Textile & Industrial Estate	Surat	Sachin GIDC textile park is one of the largest in the region and houses numerous textile and industrial units.
Nandesari Textile Park	Vadodara	Nandesari textile park is a well-developed industrial estate with a focus on textiles and related industries.
Pandesara Textile Infrastructure Park	Surat	This textile park is dedicated to the textile industry and provides infrastructural support to textile manufacturers and exporters.
Olpad Textile Park	Surat	Olpad Textile Park is a dedicated industrial park for textile and apparel manufacturing.

4.2.4 Drivers of Textile industry in India

A. Exporters gaining from strong global demand

India is the world's second-largest textile exporter. , New Economic Cooperation and Trade Agreements with Australia and the UAE would open various opportunities for the Indian textiles and handloom. Indian textile exports to Australia and the UAE would now face zero duties, and there is possibility of Europe, Canada, the UK and GCC countries also welcoming Indian textile exports at zero duty. Recently, the Ministry of Textiles favored a limited deal for the India-UK free trade agreement that could boost the garments sector. Under the proposed trade agreement, the Textile Ministry expects more market access for the Indian textiles and clothing sector to achieve its full potential.

B. Policy support has been a key ingredient to growth

The Indian government has introduced several key initiatives to boost the textile sector's competitiveness, modernization, and export potential.

Exhibit 4.5: Highlights of Textile policy in Gujarat

Cluster	Segment
Credit-linked interest subsidy	• 5% per annum subject to a maximum of Rs. 7.5 Cr. per year for 5 years • Eligible investment-Land, Building and Plant and Machinery
Power Subsidy	• For new apparel units having minimum 150 machines and generating at least 300 domicile jobs, payroll assistance of 50% of wages will be provided up to Rs 4000/- for female and Rs. 3200/- for male worker per month for 5 years
Payroll assistance	• For new apparel units having minimum 150 machines and generating at least 300 domicile jobs, payroll assistance of 50% of wages will be provided up to Rs 4000/- for female and Rs. 3200/- for male worker per month for 5 years

Skill development / training	• Setting up of training institution
	  • Assistance up to 85% with a ceiling of Rs. 3 crore of the project
	  • Eligible investment- Building, equipment, and machinery (including installation), electrification, furniture, etc. excluding land cost

Source: IFP, Government of Gujarat; Frost & Sullivan Analysis

C. Foreign investment flowing into the sector

100% FDI is permitted in the textile sector. Cumulative FDI inflows in the textiles sector (including dyed and printed textiles) stood at INR 344 billion between April 2000-March 2024. The textiles industry in India is experiencing a significant increase in collaboration between global majors and domestic companies.

4.2.5 Upcoming major Textile projects and parks in the country

The **PM Mega Integrated Textile Region and Apparel (PM MITRA)** Park Scheme, launched by the Ministry of Textiles on October 20, 2021, aims to develop world-class textile parks across seven states—Tamil Nadu, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Uttar Pradesh, and Maharashtra—with a total outlay of **INR 44.45 billion**. These parks will include advanced infrastructure such as plug-and-play facilities, power and water supply, and common processing zones to attract cutting-edge technologies and boost both FDI and domestic investment in the textile sector.

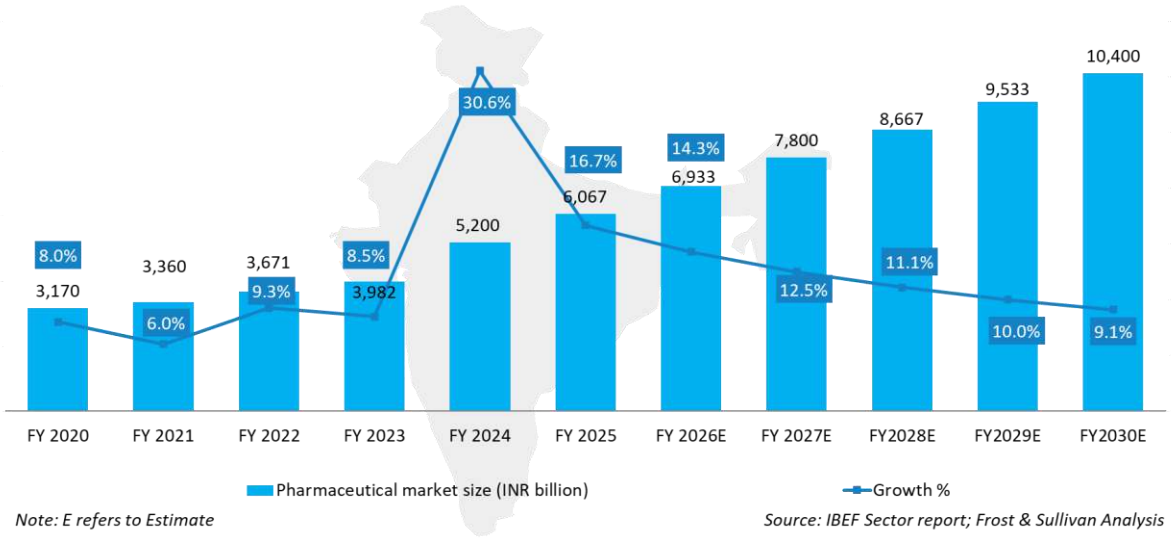
4.3 Pharmaceutical Industry

4.3.1 Introduction

India ranks 3rd worldwide for pharmaceutical production by volume and 14th by value. The country has an established domestic pharmaceutical industry, with a strong network of 3,000 drug companies and ~10,500 manufacturing units. India is home to more than 3,000 pharma companies with a strong network of over 10,500 manufacturing facilities as well as a highly skilled resource pool.

Indian pharmaceutical sector supplies over 50% of global demand for various vaccines, 40% of generic demand in the US and 25% of all medicine in the UK. The domestic pharmaceutical industry includes a network of 3,000 drug companies and ~10,500 manufacturing units.

Exhibit 4.6: Pharmaceutical industry market size, India, FY2020 – FY2030E, (Value in INR billion)



Note: E refers to Estimate

Source: IBEF Sector report; Frost & Sullivan Analysis

India's domestic pharmaceutical market stood at INR 3,982 billion (US$ 50 billion) in FY2023 and reached ~INR 6,067 billion (US$ 76 billion) by FY2025 and further expand to reach ~INR 10,400 billion (US$ 130 billion) by FY2030.

4.3.2 Major Pharmaceutical hubs in India

1. **Telangana**
2. **Andhra Pradesh**
3. **Maharashtra**
4. **Gujarat**

4.3.3 Drivers of Indian Pharmaceutical sector

A. Accessibility of medical infrastructure

More than INR 16,000 billion is expected to be spent on medical infrastructure in the next decade. New business models are expected to penetrate tier-2 and 3 cities. Over 160,000 hospital beds are expected to be added each year in the next decade.

B. Pradhan Mantri Bhartiya Janaushadhi Pariyojna (PMBJP)

The Government plans to provide free generic medicines to half the population at an estimated cost of US$ 5.4 billion. Affordable medicines under Pradhan Mantri Bhartiya Janaushdhi Pariyojna (PMBJP) achieved an impressive sale of INR 1,139 million (US$ 14.24 million) within the first two months. Medicines available under PMBJP are priced 50% - 90% less than that of branded medicines.

Epidemiological factors

Patient pool is expected to increase over 20% in the next seven years (until 2030), mainly due to rise in population. New diseases and lifestyle changes are likely to boost this demand further. Increasing prevalence of lifestyle diseases are some of the other reasons driving this industry forward.

4.3.4 Upcoming Major Pharmaceutical Projects and Parks in the country

Three bulk drug parks are being set up in Gujarat, Andhra Pradesh, and Himachal Pradesh for producing raw materials for the pharmaceutical companies. These three states have been finalized after evaluating applications from 13 states. During the COVID-19 pandemic, the need for bulk drug parks was felt and these parks would reduce the country's dependence on foreign countries for the essential chemicals used by the pharmaceutical industry. The bulk drug park projects will be executed by a State Implementation Agency and will receive the maximum assistance of INR 10 billion.

The Jambusar Bulk Drug Park, located in Bharuch district, Gujarat, is an ambitious initiative aimed at bolstering India's self-reliance in the pharmaceutical sector by reducing dependence on imported Active Pharmaceutical Ingredients (APIs). Spanning approximately 2,000 acres, the park is expected to house around 400 companies and attract investments exceeding Rs 8,000 crore.

The Gujarat Industrial Development Corporation (GIDC) is overseeing the development of the park, with infrastructure work anticipated to be completed by the end of 2025. The park will feature essential common facilities, including effluent treatment, sewage treatment, integrated treatment, storage and disposal facilities, research and development centres, and common industrial gas services.

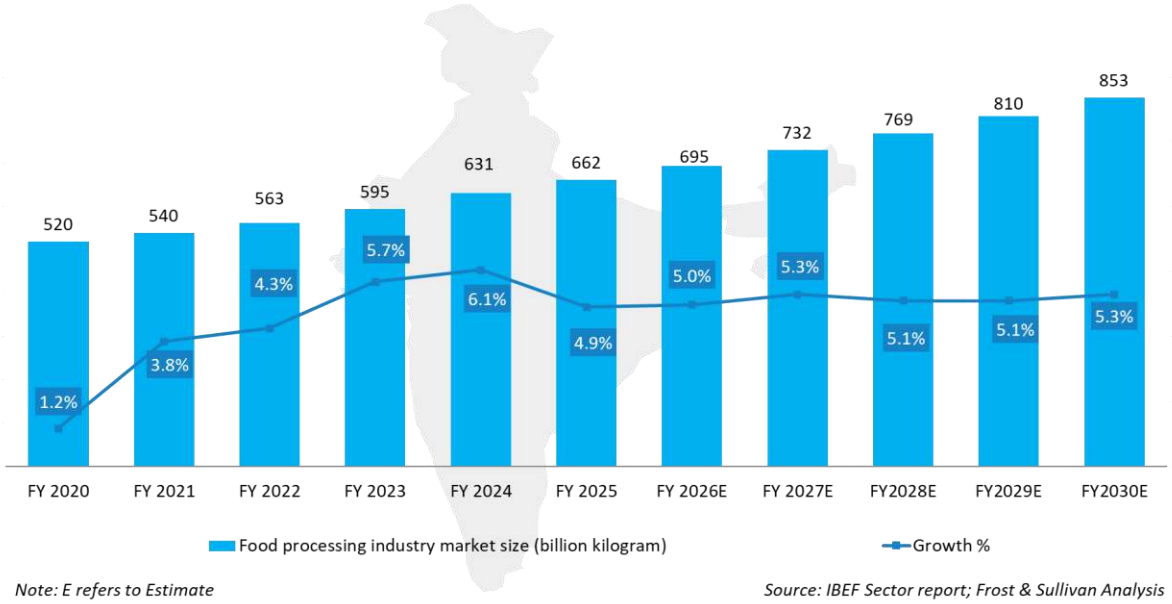
This strategic project aligns with the government's Aatmanirbhar Bharat vision, aiming to facilitate local production of critical APIs, reduce import dependency, and potentially lower costs. It is expected to attract significant investments and create numerous job opportunities, thereby contributing to the growth of the economy.

4.4 Food Processing

4.4.1 Introduction

The Food Processing sector in India has a quintessential role in linking Indian farmers to consumers in the domestic and international markets. The Ministry of Food Processing Industries (MoFPI) is making efforts to encourage investments across the value chain.

Exhibit 4.7: Size of overall Indian Food industry, India, volume in billion kilograms, FY2020 – FY2030E

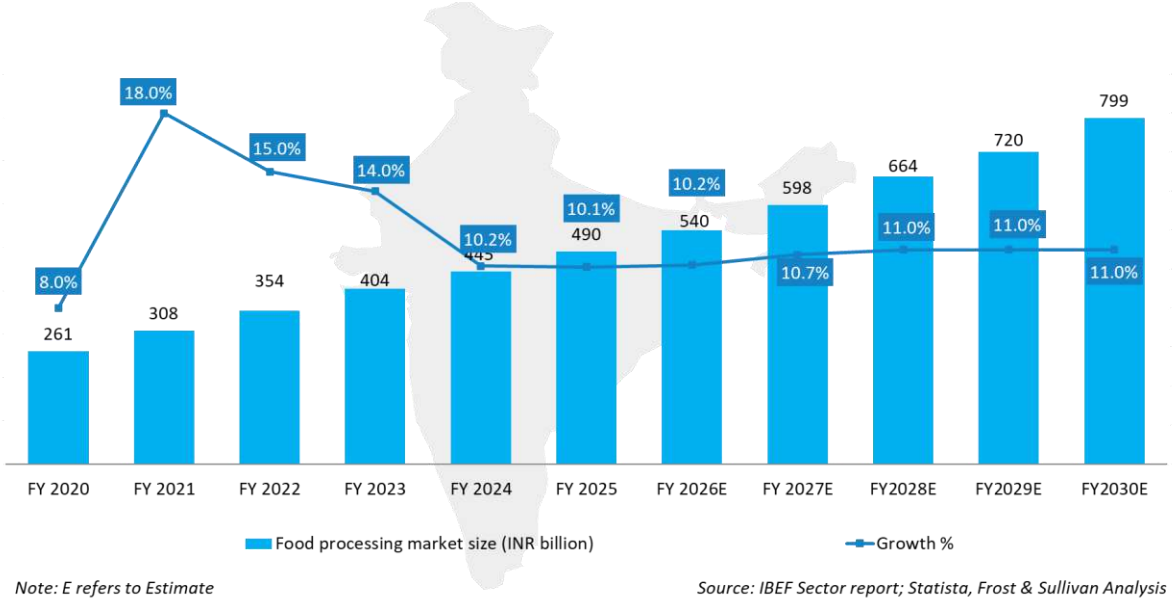


Note: E refers to Estimate

Source: IBEF Sector report; Frost & Sullivan Analysis

The size of the Indian food processing market is approx. 74% of the overall food market and stood at approximately INR 490 billion in FY25. The market is expected to grow at a CAGR of 10 - 11% between FY25 – FY30. The market's largest segment is Bread & Cereal Products in FY25.

Exhibit 4.8: Food Processing industry market size, India, FY2020 – FY2030E, (Value in INR billion)



Note: E refers to Estimate

Source: IBEF Sector report; Statista, Frost & Sullivan Analysis

4.4.2 Drivers of the Indian Food processing sector

A. Increasing population and changing demographics

India's growing population, rising middle class, and urbanization are driving strong demand for processed and packaged foods. Changing lifestyles and higher disposable incomes are expected to push food consumption to USD 1.2 trillion by FY2025-26.

B. Changes in consumer preferences

India's food industry is rapidly evolving to meet rising demand for convenient, healthy, and flavorful packaged foods, driven by urbanization, dual-income households, and a young, growing middle class. This shift is fueling innovation, competition, and expansion across distribution channels.

C. Changing lifestyle

India's food processing sector is witnessing steady growth, especially in breakfast cereals and baked snacks, driven by changing lifestyles and consumer preferences. This has led to rising imports of key ingredients and greater focus on product innovation.

D. Shifting demand from loose to branded packaging

Post-pandemic, consumers increasingly prefer packaged over loose products due to heightened focus on hygiene and safety. This shift is visible even in rural and small-town markets, where demand for branded, quality-assured items is rising.

4.4.3 Upcoming major Food processing projects and parks in the country

Under PMKSY, the government has approved 41 Mega Food Parks, 356 Cold Chain projects, and several other food processing initiatives. Of the 41 parks, 24 are operational and 17 are under implementation. Each park receives up to INR 50 crore in grants, aims to house 30–35 units, attract INR 250 crore investment, and generate jobs for 30,000 people.

The below table captures some of the upcoming notable projects in the Indian food processing sector:

Exhibit 4.9: List of upcoming mega projects in Indian Food processing sector

Project Name	Developer	Location	Cost (INR million)	Project Status
Baghpat Milk Plant Project	Gujarat Co-op. Milk Mktg. Fedn. Ltd.	Baghpat, Uttar Pradesh	6,000	Announced
Nabha Tomato Ketchup Manufacturing Plant Expansion Project	Hindustan Unilever Ltd.	Patiala, Punjab	2,000	Announced
Haveri New Fish Seed Production Plant Project	Government Of Karnataka	Haveri, Karnataka	700	Announced
Barkatpur Distillery Plant Expansion Project	Uttam Sugar Mills Ltd.	Barkatpur, Uttar Pradesh	560	Announced
Sugar Plant Expansion Project	Uttam Sugar Mills Ltd.	Jharmajri, Himachal Pradesh	400	Announced

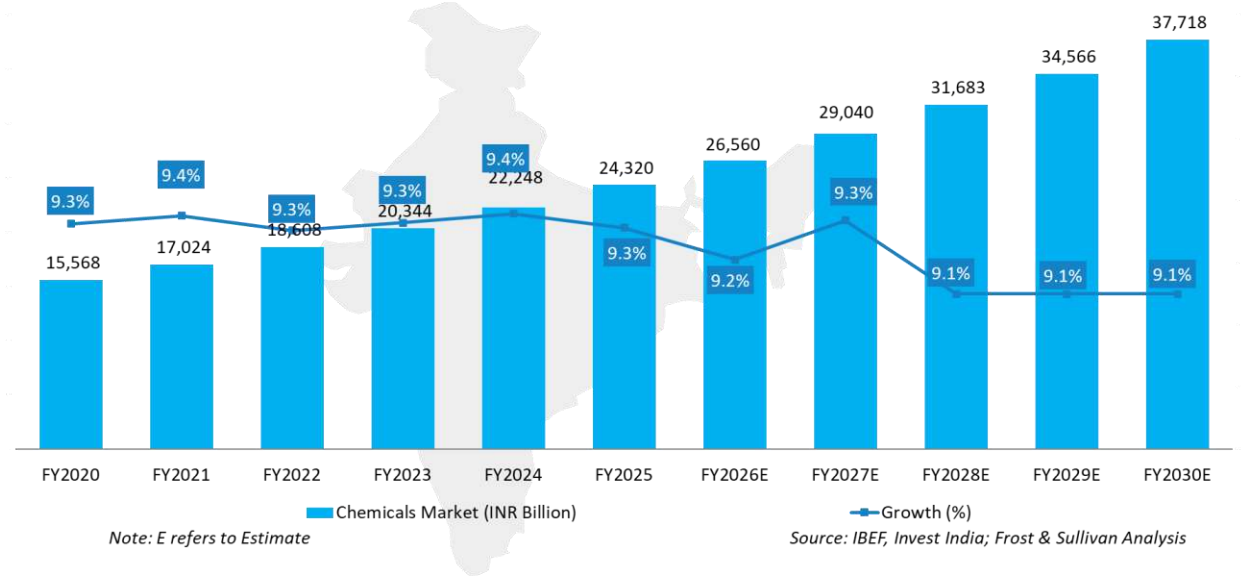
Source: CMIE; Frost & Sullivan Analysis

4.5 Chemicals

4.5.1 Introduction

Chemicals industry in India is extremely diversified, containing more than 80,000 commercial products. It is largely classified into Bulk chemicals, Agrochemicals, Specialty chemicals, Petrochemicals, Polymers & Fertilizers. India's vicinity to the Middle East, the earth's source of petrochemicals feedstock, makes for economies of scale.

Exhibit 4.10: Chemical industry market size in India, FY2020– FY2030E, (Value in INR billion)



Note: E refers to Estimate

Source: IBEF, Invest India; Frost & Sullivan Analysis

The industry is anticipated to reach INR 37,718 billion (~USD 471 billion) by FY2030 at a Compound Annual Growth Rate of 9.2%, driven by increasing demand in the end-user segments for specialty chemicals and

petrochemicals sector. Specialty chemicals make up for 22% of the total chemicals and petrochemicals market in the country.

Key sectors where steam is widely consumed such as chemicals and agrochemicals have encountered production-related challenges in India during 2024 and 2025, driven by a combination of cyclical, geopolitical, regulatory, and structural factors.

The chemicals and agrochemicals industry has been navigating a pronounced downturn since 2024, driven by a confluence of cyclical, geopolitical, regulatory, and structural forces that is likely to prolong weakness going forward as well. Cyclically, the sector has faced a sharp correction after the 2020–2022 upcycle, with global inventory destocking, excess capacity, and muted demand in key export markets leading to double-digit volume and price declines, particularly in Indian agrochemical exports in FY2024. Geopolitically, trade conflicts, renewed Chinese competition at aggressively low prices, and new tariff regimes in large end markets such as the United States have distorted trade flows, intensified price wars, and eroded realisations for Indian producers. Regulatory pressures, including tighter environmental norms, pesticide scrutiny, and compliance costs across major producing regions, have further constrained capacity utilisation and delayed new investments, even as multinational customers continue to pursue “China+1” diversification. Structurally, the reset in global supply chains, consolidation among agrochemical distributors, heightened climate and weather volatility affecting cropping patterns, and a shift toward more specialised, sustainable chemistries have created production-planning challenges, under-utilised plants, and margin compression.

4.5.2 Major Chemical hubs in India

Gujarat stands out as India’s leading state in the petrochemical and chemical industries, contributing 62% of the country's petrochemical and 53% of chemical production. With major players like Reliance Industries operating the world’s largest refinery in Jamnagar, the state has earned the title of "Petrochemical and Chemical Capital of India." Reliance’s goal of achieving net carbon zero by 2035 further reinforces Gujarat’s strategic role in the future of India’s industrial and green growth.

Maharashtra, Tamil Nadu, and Odisha also play significant roles in India’s chemical landscape. Maharashtra accounts for around 16% of chemical factories and 17% of national production, with key zones in Mumbai, Thane, and TTC. In Tamil Nadu, Chennai, Cuddalore, and Ranipet host a mix of petrochemical, dye, and pharmaceutical industries. Meanwhile, Paradip in Odisha has emerged as a growing hub, driven by the Paradip Refinery and other chemical infrastructure projects, contributing to the state's industrial development.

4.5.3 Drivers of the Indian Chemical industry

- **Manufacturing and Industrial Growth**
    - Chemicals play a crucial role in sectors like textiles, pharma, automotive, construction, agriculture, and consumer goods.
    - Applications include:
        - Textile chemicals for dyeing and finishing
        - Specialty chemicals for pharmaceuticals
        - Automotive chemicals like lubricants and coatings

- **Focus on Specialty Chemicals**
  - Shift toward high-value specialty chemicals with niche applications
  - Increasing domestic and export demand for:
    - High-performance plastics and polymers
    - Fine chemicals and intermediates for pharma and agrochemicals
    - Specialty coatings, dyes, and adhesives
- **Government Initiatives**
  - Policies promoting growth and investment in the chemical sector:
    - Make in India to attract FDI and boost local manufacturing
    - Atmanirbhar Bharat to support self-reliance
    - National Chemical Policy for sustainable, innovative growth
    - PLI Scheme to enhance competitiveness in chemicals and petrochemicals

4.5.4 Upcoming major Chemical industry projects and parks in the country

India's chemical industry is witnessing significant growth, with several major projects underway to meet the rising domestic and global demand. Here are some notable upcoming initiatives:

1. Haldia Petrochemicals' Oil-to-Chemical (O2C) Project in Tamil Nadu

Haldia Petrochemicals is investing approximately USD 10 billion in an O2C complex in Tamil Nadu.

2. Bharat Petroleum Corporation Limited (BPCL) Refinery and Petrochemical Project in Andhra Pradesh

BPCL plans to invest USD 11 billion in a new refinery and petrochemical complex in Andhra Pradesh.

3. Indian Oil Corporation (IOC) Refinery Expansions

IOC is expanding its refineries in Panipat, Gujarat, and Barauni, with completion expected by December 2025..

4. Numaligarh Refinery Expansion by Oil India Ltd.

Oil India Ltd. plans to expand its Numaligarh refinery in Assam from the current 60,000 barrels per day (bpd) to 180,000 bpd by March 2027.

Exhibit 4.11: List of upcoming mega projects in Indian Chemical sector

Project Name	Developer	Location	Cost (INR million)	Project Status
Dahej Specialty Fluoropolymers Project	SRF	Gandhinagar, Gujarat	5,950	Announced
Dahej Poly Vinyl Chloride Forward Integration Project	Meghmani Finechem	Gandhinagar, Gujarat	2,500	Announced
Agrochemical Intermediate Project	SRF	Gandhinagar, Gujarat	1,100	Announced
Nellikuppam Ethanol Manufacturing Project	E I D-parry (India)	Cuddalore, Tamilnadu	870	Announced

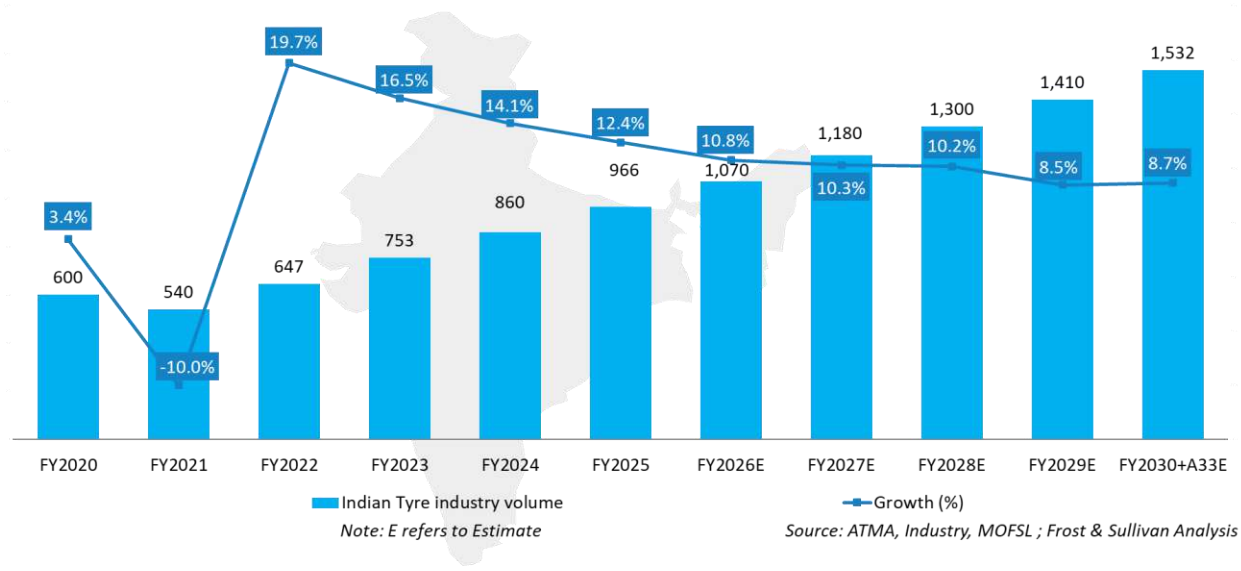
Source: CMIE; Frost & Sullivan Analysis

4.6 Tyre

4.6.1 Introduction

The Indian Tyre industry is estimated to recover from five years of weakness and be on a linear growth path of nearly 9.7% CAGR between FY2025-FY2030, backed by timely capacity expansion across companies, Improving demand and steady competitive intensity,

Exhibit 4.12: India Tyre Industry Market Size, FY2020-FY2030E, (Value in INR Bn)



Note: E refers to Estimate

Source: ATMA, Industry, MOFSL ; Frost & Sullivan Analysis

Tyre manufacturers are placing a growing emphasis on sustainability by developing tyres that are more fuel-efficient and environmentally friendly. This includes incorporating recycled materials into tyre production and creating innovative designs that lower rolling resistance, thereby reducing their overall environmental impact.

4.6.2 Drivers of the Indian Tyre industry

A. Strong headroom for growth of exports from India

India's tyre exports have strong growth potential, especially in car, bus, truck, and industrial segments where its global share is still low.

B. Growth in the automobile industry

Tyre demand in India is driven by the growth of the automotive sector, including passenger, commercial vehicles, and two-wheelers. Rising vehicle sales boost OEM tyre demand, while the growing vehicle base fuels the replacement market.

C. Replacement market

The replacement market significantly drives India's tyre industry, fueled by rising vehicle ownership, disposable incomes, and wear from poor road conditions. In commercial vehicles, replacement demand is twice that of OEMs, while it's nearly equal in passenger cars and two-wheelers.

D. Continuously improving road infrastructure and new radial capacities

Radialisation is only 36% in the truck/bus sector and 40% in light commercial vehicles. Backed by rising awareness of cost benefits, continuously improving road infrastructure and new radial capacities going on-stream, radialisation levels in commercial vehicle space are expected to reach to 65-70% over the next four years and create a new modernized and safe alternative.

4.6.3 Upcoming Major Tyre Industry Projects and Parks in the country

The Indian tyre industry is witnessing significant developments aimed at enhancing production capacity, sustainability, and the cultivation of natural rubber. Notable upcoming projects include investment of INR 100 crore in the Northeast and West Bengal under Project Indian Natural Rubber Operations (INROAD) by leading tyre manufacturers, including Apollo Tyres, CEAT, JK Tyre, and MRF.

Exhibit 4.13: List of upcoming mega projects in Indian Tyre sector

Project Name	Developer	Location	Cost (INR million)	Project Status
Waluj plant expansion project	Balakrishna tyres manufacturer	Waluj, Maharashtra	2,500	Announced
Banmore plant expansion project	JK Tires	Banmore, Gwalior	1,100	Announced
Ambernath plant expansion project	Ceat tyres	Ambernath, Maharashtra	870	Announced

Source: CMIE; Frost & Sullivan Analysis

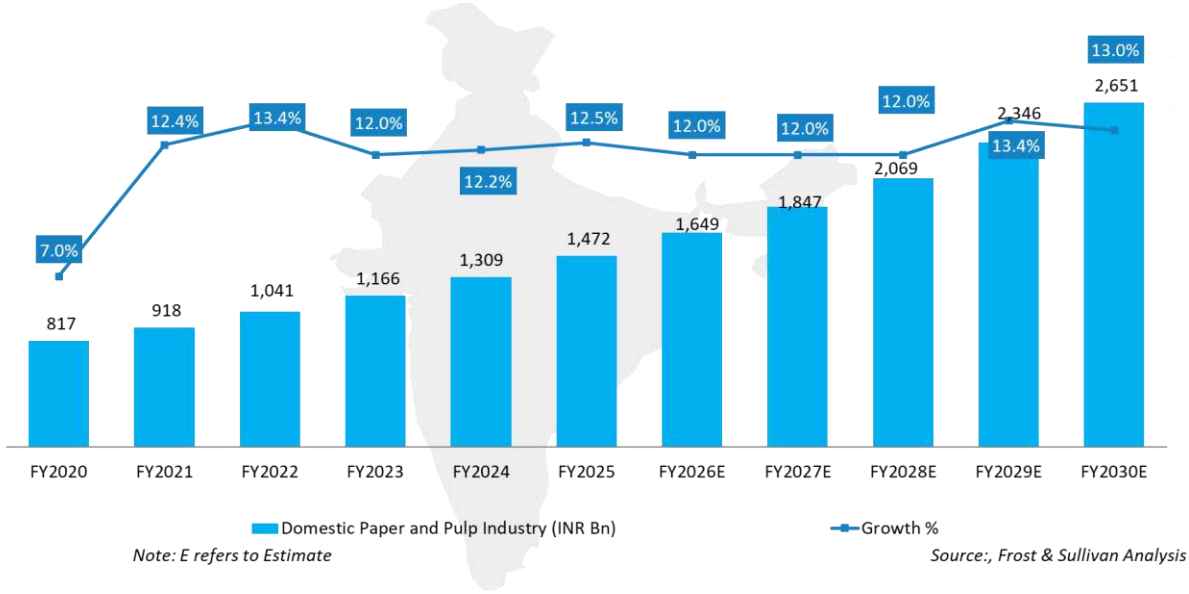
4.7 Paper and Pulp

4.7.1 Introduction

India is the 15th largest paper producer in the world and has emerged as the fastest growing market when it comes to per capita consumption of paper. The domestic market / consumption of paper is over 30 million tons per annum (MTPA).

By FY2030, the domestic paper and pulp industry is projected to rise to INR 2,651 billion growing at a CAGR of 12 – 12.5%. The paper industry in India looks positive as the demand for upstream market of paper products, like, tissue paper, tea bags, filter paper, light weight online coated paper, medical grade coated paper, etc., is growing up.

Exhibit 4.14: Domestic Paper and Pulp industry in India, FY2020 – FY2030E, (Value in INR billion)



Note: E refers to Estimate

Source:, Frost & Sullivan Analysis

4.7.2 Drivers of Indian Paper and Pulp sector

A. Rise in Demand for Paper and Paper Products in India

Rising environmental awareness and industrial growth are driving increased demand for biodegradable paper products. This has led to a surge in paper mill production across sectors.

B. Packaging industry driving growth

The packaging industry plays a significant role in driving the paper and pulp sector. With the expansion of e-commerce, FMCG (Fast-Moving Consumer Goods) sector, and retail industry, there is a high demand for packaging materials like corrugated boxes, cartons, and containers, which are made from paper and pulp.

C. Availability of raw material

India has abundant availability of raw materials required for paper and pulp production, including wood, bamboo, and agro-residues. This ensures a consistent supply of raw materials, reducing dependence on imports and supporting the growth of the sector.

D. Widening spread of education and increase in literacy rate

Rising literacy rates, enrolments, and government education initiatives are boosting demand for textbooks, notebooks, and paper products. Increased literacy also supports higher circulation of newspapers and other print media.

4.7.3 Upcoming Major Paper and Pulp Industry Projects and Parks in the Country

Exhibit 4.15: List of upcoming mega projects in Indian Paper & Pulp sector

Project Name	Developer	Location	Cost (INR million)	Project Status
Sinar Mas pulp & paper project	Sinar Mas Pulp and Paper	Raigad district, Maharashtra	200,000	Approved
Balasore bank note project	Bank Note Paper Mill India	Balasore, Odisha	25,000	Approved
Pulp and folding box boards project	Andhra Paper (APL)	Kadiyam, Rajahmundry	20,000	MoA signed
Dhenkanal paper project	Deevyashakti India	Dhenkanal, Odisha	10,000	Approved

Source: CMIE; Frost & Sullivan Analysis

4.8 Industrial Parks in India

Industrial development is the backbone of a country's economic growth. India is making it big on the world stage and making its presence felt. It is because of the massive and rapid industrial development that brand India is being recognized across the globe. One of the key factors in this development story is the development of large-scale Industrial parks across the country.

India boasts a vast network of industrial parks, serving as hubs for manufacturing, technology, and various industries. According to the India Industrial Land Bank (IILB), there are a total of ~4,000 industrial parks across the country.

The distribution of these parks varies significantly across states. Notably, more than 75% of India's approximately 3,400 industrial clusters are concentrated in just five states. This concentration highlights the significant role these states play in India's industrial landscape.

Gujarat was one of the leading states making rapid strides in the development of Industrial Parks. Bestowed with an impressive shoreline, Gujarat has become the hotbed for industrial parks. With India taking strides towards becoming a global engine of economic growth, new players are making a foray into both large-scale and small-scale industrial setups.

The Gujarat model of Industrial establishments is worth mentioning in this regard. In fact, Gujarat stands in the second position in the Ease of Doing Business (EoDB) rankings of Indian states. Gujarat is one of the only two states to implement over 300 reforms for doing business which has led to the top spot for the state.

India has several key industrial parks across various states, serving as hubs for manufacturing, IT, automotive, pharmaceuticals, and other industries. Some of the most notable industrial parks include:

Major Multi-Sector Industrial Parks

- **Delhi-Mumbai Industrial Corridor (DMIC)** – One of the largest industrial projects, spanning multiple states, including Maharashtra, Gujarat, Rajasthan, and Haryana.
- **Sriperumbudur Industrial Park (Tamil Nadu)** – Home to major electronics and automotive companies like Foxconn, Samsung, and Hyundai.
- **Sanand Industrial Estate (Gujarat)** – A major hub for automobile and manufacturing industries, hosting Tata Motors, Ford, and Honda.
- **Noida-Greater Noida Industrial Area (Uttar Pradesh)** – A key zone for IT, electronics, and manufacturing industries.
- **Peenya Industrial Area (Karnataka)** – One of Asia's largest industrial areas, housing small and medium enterprises (SMEs) in various sectors.

Exhibit 4.16: State/UT-wise number of Industrial Parks, Estates, and Clusters (In alphabetical order) (as on 1st Feb, 2021)

Name of State	No. of Industrial Parks	Name of State	No. of Industrial Parks
Andhra Pradesh	415	Madhya Pradesh	145
Arunachal Pradesh	19	Maharashtra	497
Assam	53	Manipur	7
Bihar	82	Mizoram	8
Chandigarh	7	Nagaland	6
Chhattisgarh	96	Odisha	147
Delhi	31	Punjab	64
Goa	24	Rajasthan	423
Gujarat	311	Tamil Nadu	370
Haryana	50	Telangana	169
Himachal Pradesh	64	Tripura	13
Jammu and Kashmir	69	Uttarakhand	40
Jharkhand	131	Uttar Pradesh	227
Karnataka	384	West Bengal	15
Kerala	133	**Total**	**4,000**

Source: Frost & Sullivan Analysis

5 STEAM DEMAND IN INDIAN PROCESS INDUSTRIES

5.1 Derivation of Process Steam Demand in Major Steam Consuming Industries

5.1.1 Pharmaceutical

A. Current Production in India

The pharmaceutical industry in India is expected to reach $100 Bn by 2025 and to $180 Bn by 2030. The pharmaceutical industry in India is currently valued at $50 Bn. India is a major exporter of Pharmaceuticals, with over 200+ countries served by Indian pharma exports.

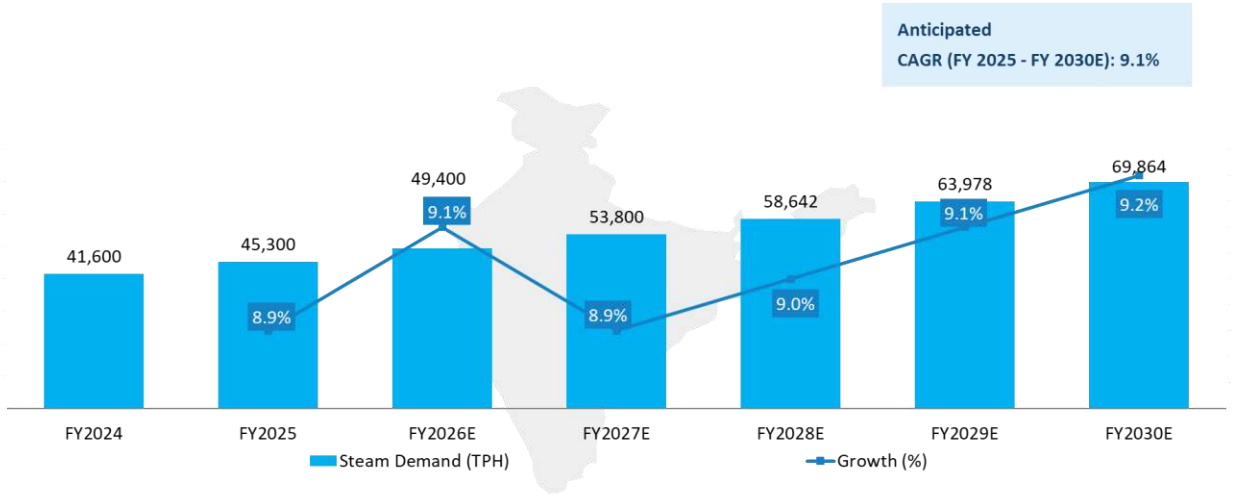
B. Process steam requirement and steam cost as % of revenue

In the pharmaceutical sector, steam is essential for sterilization, purification, and drying processes, especially for producing high-quality drugs in sterile environments. Clean steam is used in making products like eye and ear drops and supporting cell or yeast growth. Around 3–3.5 MT of steam is consumed per unit due to the heterogeneous nature of APIs and bulk drugs. Most operations require 1–2 bar pressure steam, with some needing 5–8 bar. Steam costs account for nearly 6–8% of a unit's sales revenue.

Process steam demand estimation

India's pharmaceutical market is projected to reach USD 130 billion by 2030, driven by rising demand for innovative therapies. Though COVID-19 briefly slowed the sector, recovery was strong due to government and industry collaboration. Steam demand in pharma is expected to rise from 41,000–43,000 TPH in FY24, ~45,000 TPH in FY25 to 69,000–70,000 TPH by FY30.

Exhibit 5.1: Process steam demand of Pharmaceutical industry, in TPH, India, FY25-FY30E



Source: Frost & Sullivan Analysis

5.1.2 Textile

A. Current Production in India

In FY2024, the textile production in the country stood at approximately 5.9 million metric tons.

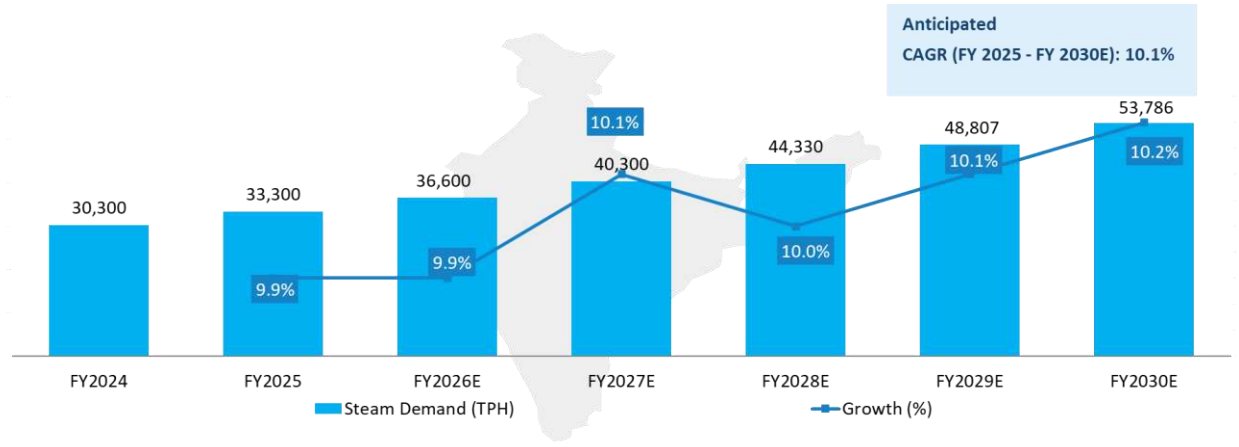
B. Process steam requirement and steam cost as % of revenue

In the textile and apparel industry, steam is essential for processes like dyeing, printing, drying, and washing. About 4 kg of 2–5 bar steam is used per kg of fabric, with steam costs making up roughly 2.5–4% of the fabric's sales revenue.

C. Process steam demand estimation

The textile industry in India is particularly robust due to the wide diversity of natural and synthetic fibers and yarns. By 2030, the textile sector in India is anticipated to attract investments totaling US$ 900 billion. The demand for steam in the textile industry has been estimated based on the industry growth trends and the demand for steam is expected to grow from , ~33,000 in FY25 to 53,000- 55,000 TPH in FY30E.

Exhibit 5.2: Process steam demand of Textile industry, in TPH, India, FY24 to FY30E



Source: Frost & Sullivan Analysis

5.1.3 Food Processing

A. Current Production in India

India's food processing sector plays a key role in connecting farmers to markets and is supported by the Ministry of Food Processing Industries (MoFPI) to boost investments. The sector accounts for 12.41% of employment in registered factories, employing around 2.03 million people. Of the ~41,000 units in India, about 40% use minimal or no steam in their processes.

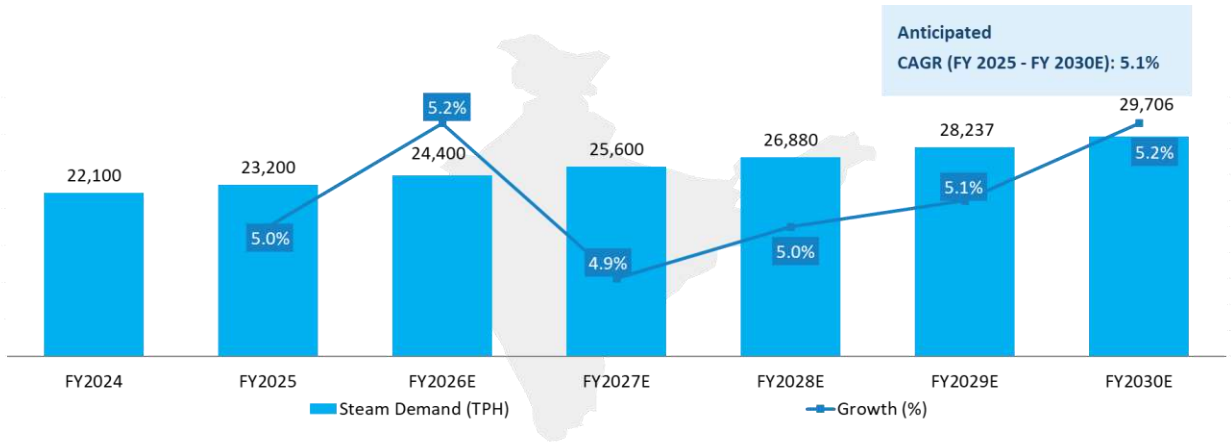
B. Process steam requirement and steam cost as % of revenue

Food processors typically use "clean" or "culinary" steam for direct product contact or sterilization of surfaces. Each unit consumes about 1.2–1.5 TPH of steam, with pressure ranging from 1–10 bar depending on the food type. Steam costs account for roughly 2–3% of sales revenue per unit.

C. Process steam demand estimation

The Indian food processing sector is anticipated to increase at a CAGR of 5% during the period from FY24 to FY30 and 5.1% during FY25-FY30. The industry is driven by the high-value processing of various agricultural products, increased urbanization, rising disposable incomes, the rise of nuclear families, and the demand for convenient food. The demand for steam in the food processing industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 23,000 to 24,000 TPH in FY25 to 29,000- 30,000 TPH in FY30E.

Exhibit 5.3: Process steam demand of Food processing industry, in TPH, India, FY24 to FY30E



Source: Frost & Sullivan Analysis

Rice

A. Current Production in India

India, the world's second-largest rice producer and top exporter, increased production from 53.6 million tons in FY18 to 125 million tons in FY25.

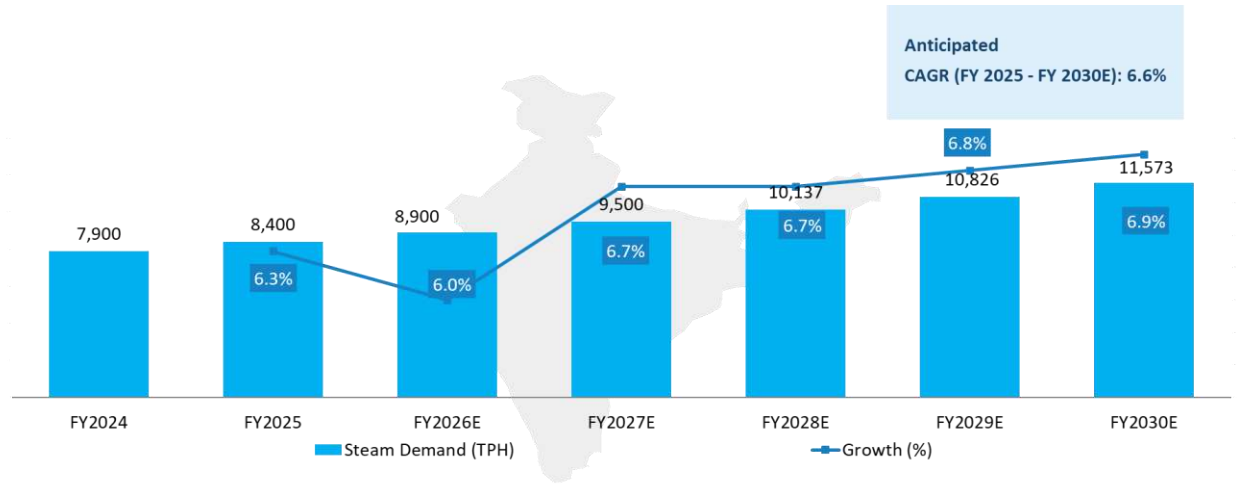
B. Process steam requirement and steam cost as % of revenue consumption norm

Rice milling processes like parboiling, steaming, and drying require significant steam generated by industrial boilers. Around 0.1–0.2 kg of 4–5 bar steam is used per kg of rice, with steam costs accounting for 2–3% of the rice's sales revenue.

C. Process steam demand estimation

The demand for steam in the rice industry has been estimated based on the industry growth trends and the demand for steam is expected to grow from 7,500 to 8,000 TPH in FY24, ~9,000 TPH in FY25 to 11,500-12,500 TPH in FY30E.

Exhibit 5.4: Process steam demand of Rice industry, in TPH, India, FY25 to FY30E



Source: Frost & Sullivan Analysis

Dairy

A. Current Production in India

India retained its position as the world's top milk producer in FY25 contributing ~25% of global output with 240 million tonnes—up ~4% from FY23 and 5.62% over the past decade.

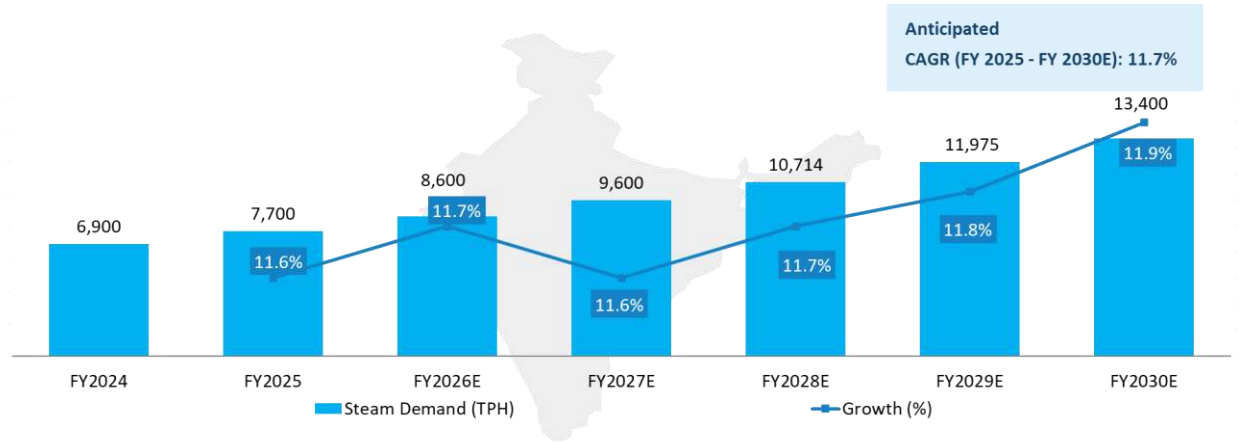
B. Process steam requirement and steam cost as % of revenue

Steam boilers are used for processing raw milk under high temperatures to ensure that it is safe for usage and other milk processing operations. Approximately 0.12 kg of steam is consumed for production of every liter of milk (based on limited industry interactions). It is estimated that cost of steam constitutes approximately 0.5 – 1% of the revenue generated from sales of every unit of dairy product.

C. Process steam demand estimation

. The demand for steam in the dairy industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 6,500 to 7,500 TPH in FY24, 7,700 in FY25 to 13,000-14,000 TPH in FY30E.

Exhibit 5.5: Process steam demand of Dairy Industry, in TPH, India, FY2025 to FY2030E



Source: Frost & Sullivan Analysis

5.1.4 Paper and Pulp

A. Current Production in India

India's paper production includes printing/writing papers (like copier, bond, map litho), packaging papers (like Kraft, boards), and specialty papers (like chromo and art paper). With around 600 mills, including 12 major global players, the paper and pulp market reached approximately 25 million metric tons in FY25.

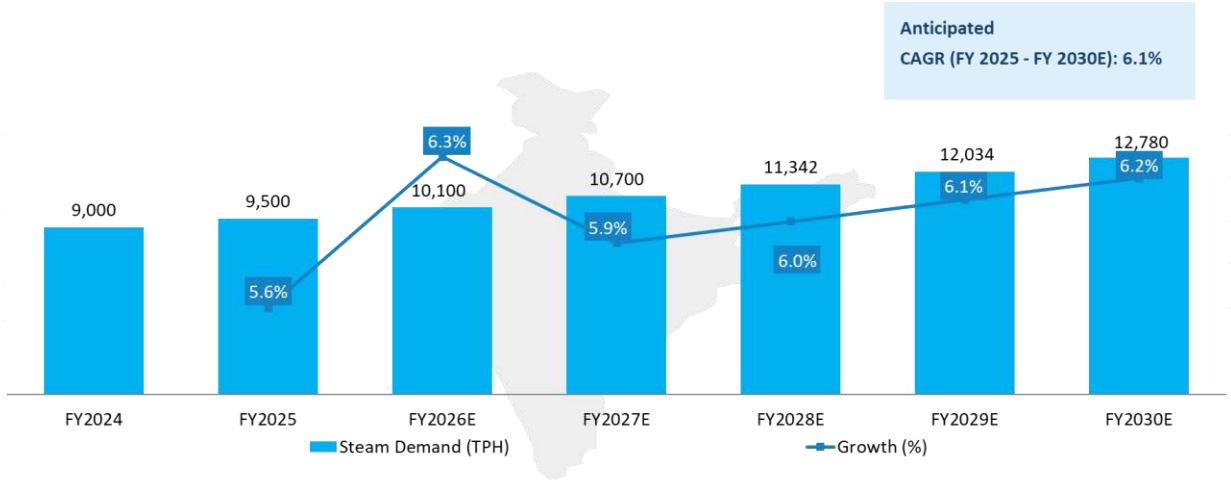
B. Process steam requirement and steam cost as % of revenue consumption norm

Paper mills and corrugated packaging plants use rolls that are internally heated with steam. Maintaining a uniform temperature across the surface of the roll is essential for making a quality product. Since steam is a gas, it fills the entire volume of the roll and evenly distributes heat as it condenses. Approximately 1.6 to 2.2 kilogram of steam is consumed for processing one kilogram of paper (based on limited industry interactions). It is estimated that the cost of steam constitutes approximately 5 – 7% of the revenue generated from sales of every kilogram of paper.

C. Process steam demand estimation

In view of the large potential for growth aided by a growing economy, the paper industry is expected to continue to grow in sync with economic growth recording 6% growth per annum. The demand for steam in the paper and pulp industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 9,000 to 9,500 TPH in FY24, FY25 to 12,000-13,500 TPH in FY30E.

Exhibit 5.6: Process steam demand of Paper and Pulp industry, in TPH, India, FY2024 to FY2030E



Source: Frost & Sullivan Analysis

5.1.5 Distillery

A. Current Production in India

India's alcoholic beverage market, valued at USD 60.48 billion, is among the fastest growing globally. Post-pandemic recovery saw strong momentum, with spirit volumes reaching ~3,500 million liters in FY23. The

market is expected to grow from USD 44 billion in 2024 to over USD 55 billion by 2027, offering significant opportunities, especially in the beer segment.

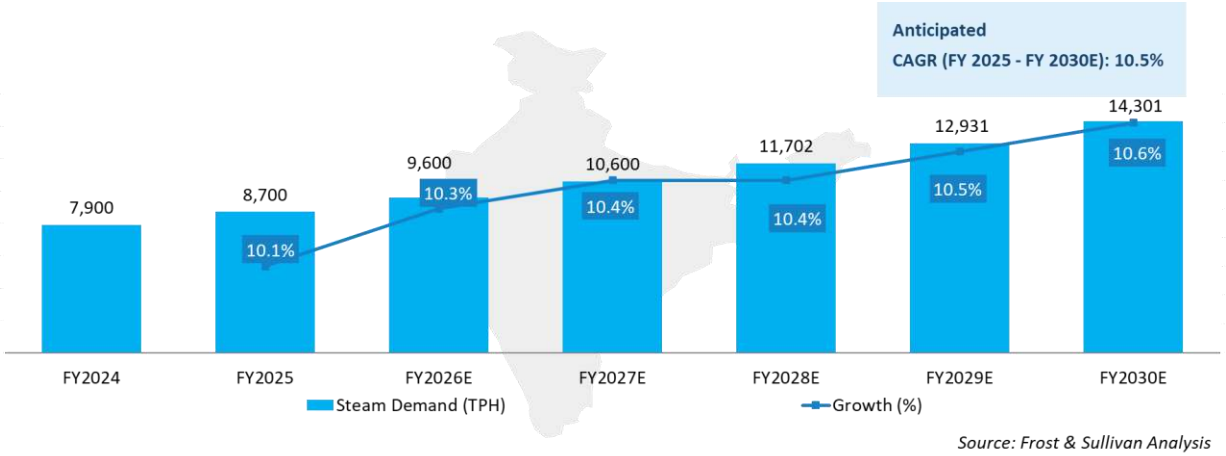
B. Process steam requirement and steam cost as % of revenue consumption norm

Steam is used as part of the sterilization step and can also be used to heat the caustic. It is also used for heating the kettle, for sanitation and sterilization, for pasteurized heating, to maintain precise temperatures and to meet production demands efficiently. Approximately 3.4 to 6.6 kilogram of 1.5 to 3.5 bar pressure steam is consumed for production of one kilogram of spirit. It is estimated that the cost of steam constitutes approximately 1 – 1.5% of the revenue generated from sales of every unit of spirit.

C. Process steam demand estimation

The domestic spirits sector grew at a CAGR of more than 6.8%, making it one of the world's fastest-growing markets. The future for India's alcoholic drinks industry remains good, owing to favorable demographics, a growing middle-class, rising disposable income levels, a penchant for luxury food and drink experiences, and increased societal acceptability of alcoholic beverages. The demand for steam in the distillery industry has been estimated based on the industry growth trends and the demand for steam is expected to grow from 7,500 to 8,500 TPH in FY24, 8,700 TPH in FY25 to 14,000-14,500 TPH in FY30E.

Exhibit 5.7: Steam demand of Distilleries, in TPH, India, FY24 to FY30E



Source: Frost & Sullivan Analysis

5.1.6 Fertilizer (Urea)

A. Current Production in India

Urea is used as a fertilizer and feed supplement, as well as a starting material for the manufacture of plastics and drugs. At present, the country's urea (conventional) production stands at 31.4 million metric tons.

B. Process steam requirement and steam cost as % of revenue

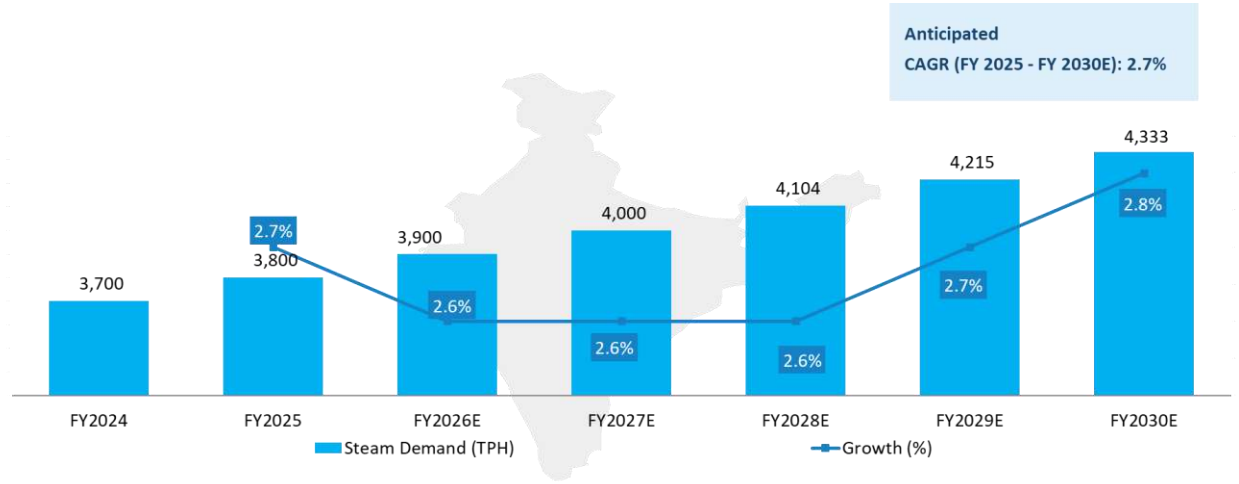
Steam is used as part of the Urea melting process and multiple other processes. Approximately one kilogram of steam is consumed for production of one kilogram of Urea. It is estimated that the cost of steam constitutes approximately 15 – 18% of the revenue generated from sales of every unit of urea.

Steam consumed per MT	Cost of steam as % of revenue	Steam demand FY2024	Anticipated steam demand FY2030E
1 MT	15 – 18%	3,700 TPH	~ 4,333 TPH

C. Process steam demand estimation

The Indian Urea market is anticipated to increase at a CAGR of 2.7% during the period from FY25 to FY30 from 37 million tons to 43 million tons, respectively. In the coming years, the demand for steam in the Urea industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 3,700 to 3,800 TPH in FY24, FY25 to 4,000-4,500 TPH in FY30E.

Exhibit 5.8: Process steam demand of Urea Industry, in TPH, India, FY24 to FY30E



Source: Frost & Sullivan Analysis

5.1.7 Wood

A. Current Production in India

India's domestic furniture sector is valued at nearly $20 billion USD. Wood accounts for nearly 65% of all furniture made in India.

B. Process steam requirement and steam cost as % of revenue

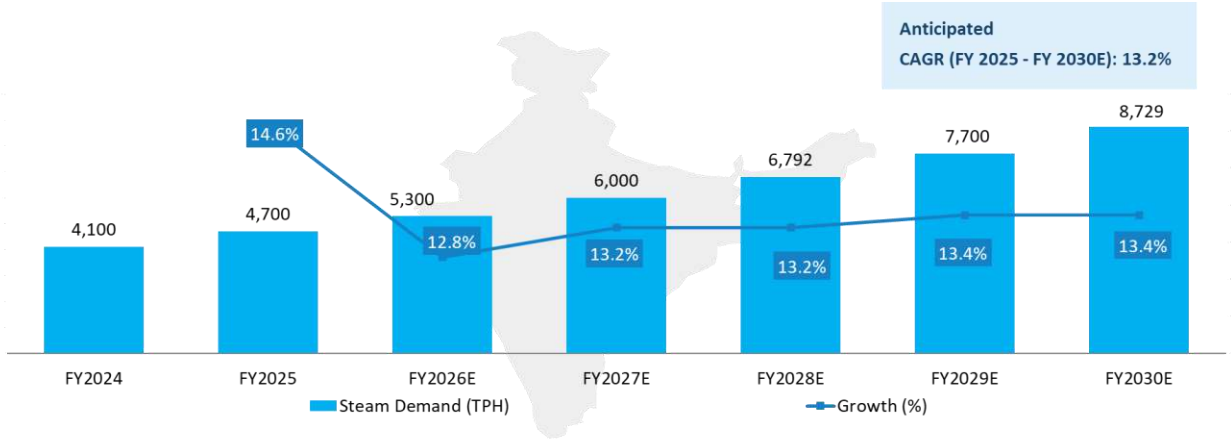
Steam in the wood industry is typically seen to be used for cleaning, drying the moisture content in the wood, chips cooking, curing, sterilizing, packaging, etc. It is estimated that the cost of steam constitutes approximately 7 – 8% of the revenue generated from sales of every unit of wood.

Steam consumed per MT	Cost of steam as % of revenue	Steam demand FY2024	Anticipated steam demand FY2030E
0.45 MT	7 – 8%	4,100 TPH	~ 8,729 TPH

C. Process steam demand estimation

The Indian wooden furniture market has enormous opportunities for manufacturers to innovate and deal with growing demand in the wood furniture The demand for steam in the Wood industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 4,000 to 4,500 TPH in FY24, 4,700 TPH in FY25 to 8,500-9,000 TPH in FY30E.

Exhibit 5.9: Process steam demand of Wood industry, in TPH, India, FY25 to FY30E



Source: Frost & Sullivan Analysis

5.1.8 Tyre

A. Current Production in India:

The Indian Tyre industry is estimated to recover from five years of weakness and be on a linear growth path of nearly 8% CAGR over the next five years, backed by timely capacity expansion across companies, improving demand, steady competitive intensity, and peak capex.

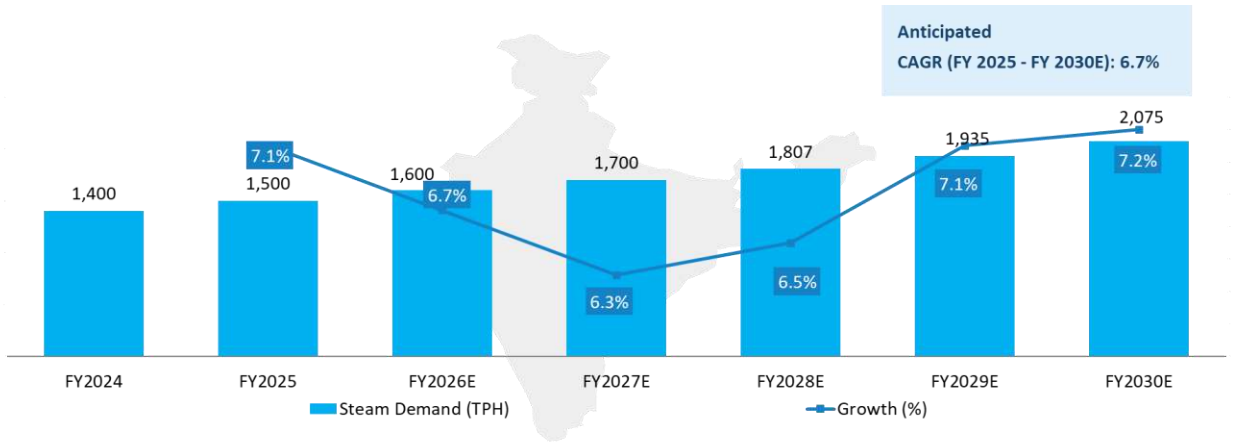
B. Process steam requirement and steam cost as % of revenue

. Around 2 kg of steam is required per kg of rubber, with steam costs comprising about 1–1.5% of tyre sales revenue. Reliable boiler performance is critical to avoid costly production downtime.

C. Process steam demand estimation

The Indian tyre industry is driven by tailwinds prevalent in the automotive industry. The Indian tyre market is anticipated to increase at a CAGR of ~7% during the period from FY2025 to FY2030. The demand for steam in the Tyre industry has been estimated based on industry growth trends and the demand for steam is expected to grow from 1,300 to 1,500 TPH in FY24, 1,500 TPH in FY25 to 2,000-2,500 TPH in FY30E.

Exhibit 5.10: Process steam demand of Tyre industry, in TPH, India, FY24 to FY30E



Source: Frost & Sullivan Analysis

5.1.9 Chemical (Soda Ash and Ethanol)

A. Current Production in India

. The country's chemical production (including ethanol and soda ash) is ~9.5 million MT, with India set to drive over 20% of global incremental chemical consumption in the next 20 years.

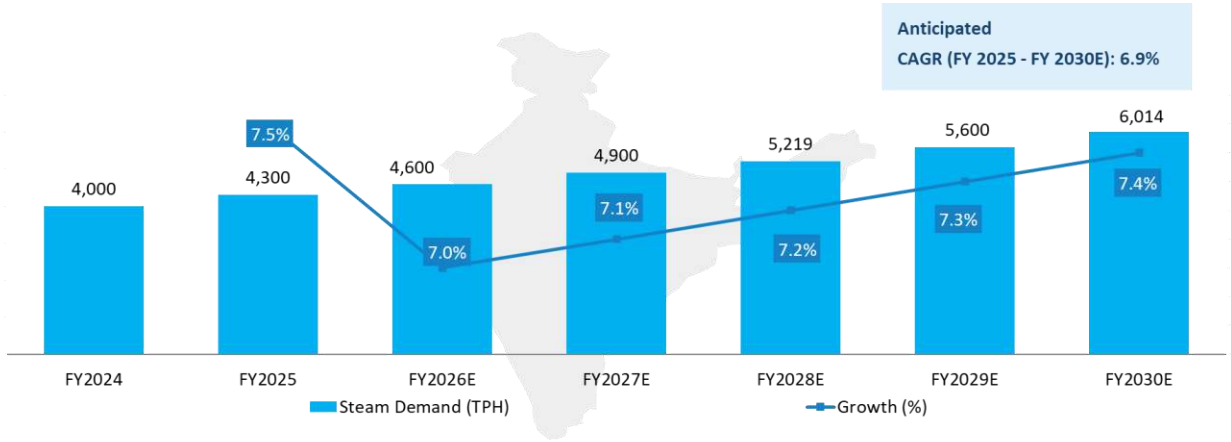
B. Process steam requirement and steam consumption as % of revenue

Steam is commonly used in the chemical process industries (CPI) for process heating, power generation, atomization, cleaning, and sterilization, moisturization and humidification, among other applications. Approximately 1.5 kg of steam is consumed for production of one kilogram of chemical (ethanol and soda ash) (based on limited industry interactions). It is estimated that the cost of steam constitutes approximately 11 -13% of the revenue generated from sales of every unit of chemical product produced.

C. Process steam demand estimation

The Chemical sector is projected to grow at a CAGR of ~7% during 2024–30 and by 7 to 10% during 2027–40—tripling its global market share by 2040. This growth is expected to be driven by a range of factors such as India is expected to account for more than 20% of incremental global consumption of chemicals over the next two decades. The demand for steam in the Chemical industry (Soda ash and Ethanol) has been estimated based on industry growth trends and the demand for steam is expected to grow from 4,000 to 4,300 TPH in FY24, FY25 to 5,500-6,500 TPH in FY30E.

Exhibit 5.11: Process steam demand of Chemical industry (Soda Ash and Ethanol), in TPH, India, FY24 – FY30E



Source: Frost & Sullivan Analysis

5.2 Overall process steam demand estimation for India

Total process steam requirement of these 11 major industries (Pharma, Textiles, Food processing, paper & pulp, Rice, Distillery, Dairy, Urea, Wood, Tyre and Chemical) stands at approx. 150,000 TPH at the end of FY25. These industries account for approximately 80% of the overall process steam requirement in the country. Hence, overall process steam requirement of India stands at approx. 186,000 TPH.

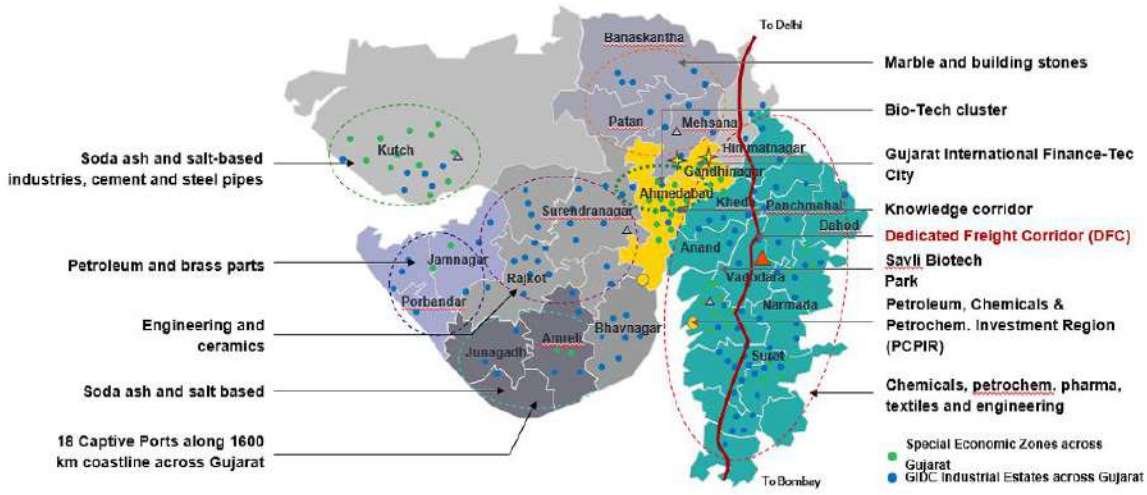
Considering individual growth in steam requirement for each industry, overall process steam requirement of the country is expected to grow from approx. 186,000 TPH in FY25 to 292,000 TPH in FY30, at a CAGR of 9.5%. This growth can also be validated from the growing demand for industrial heating equipment in various process industries. Moreover, various government initiatives such as Make in India, National Manufacturing Policy, etc. are further anticipated to spur demand for process boilers and heating equipment across the country during the forecast period. Some of the major companies operating in Indian process boiler market are Thermax Limited, Cheema Boilers Limited, Forbes Marshall, Industrial Boilers Limited, Thermodyne Engineering Systems, among others.

Exhibit 5.12: Overall process steam demand, in TPH, India, FY24 to FY30E

Sl. No.	Industry	2024	2025	2026E	2027E	2028E	2029E	2030E	% of Revenue
1	Pharmaceuticals	41,600	45,300	49,400	53,800	58,642	63,978	69,864	6-8%
2	Textiles	30,300	33,300	36,600	40,300	44,330	48,807	53,786	2.5-4%
3	Food Processing (excl. Dairy and Rice)	22,100	23,200	24,400	25,600	26,880	28,237	29,706	2-3%
4	Paper & Pulp	9,000	9,500	10,100	10,700	11,342	12,034	12,780	5-7%
5	Rice	7,900	8,400	8,900	9,500	10,137	10,826	11,573	2-3%
6	Distillery	7,900	8,700	9,600	10,600	11,702	12,931	14,301	1-1.5%
7	Dairy	6,900	7,700	8,600	9,600	10,714	11,975	13,400	0.5-1%
8	Urea	3,700	3,800	3,900	4,000	4,104	4,215	4,333	15-18%
9	Wood	4,100	4,700	5,300	6,000	6,792	7,700	8,729	7-8%
10	Tyre	1,400	1,500	1,600	1,700	1,807	1,935	2,075	1-1.5%
11	Chemical	4,000	4,300	4,600	4,900	5,219	5,600	6,014	11-13%
12	Others (18-20%)	32,785	35,297	40,472	45,440	51,029	57,642	65,112	
	TOTAL in TPH	**171,685**	**185,697**	**203,472**	**222,140**	**242,698**	**265,880**	**291,673**	

Source: Frost & Sullivan Analysis

Gujarat has emerged as a key manufacturing state in India with 239 GIDC estates. The map of GIDC estates across Gujarat is as under:



5.3 Non-Government Organizations (NGOs) promoting Community Boiler

There are various Non-Government Organizations (NGOs) in India working towards promoting energy efficiency, sustainability, and industrial development. Some of these organizations are involved in supporting or advocating for the concept of community steam boilers.

A. Centre for Science and Environment (CSE)

CSE is a research and advocacy organization working on environmental issues. They undertake projects and campaigns related to sustainable energy and industrial practices.

Recommendations of CSE

- It is recommended that industrial associations, with the support of industrial development agencies like HSIIDC and RIICO, should initiate preliminary feasibility studies of installing community boilers in industrial areas.
- States should encourage and share the technical and environmental benefits of having such systems with owners and administration of industrial units.
- Community boilers should be included in the developmental plan of an industrial area at the planning stage itself as a basic necessity, and sufficient land should be allocated for such facilities in the initial development stage of the area.
- Industrial units should prefer community boilers over small boilers, should be included in industrial policy.
- Stakeholder interactions should be conducted between owners and administration of industrial units, industrial associations, boiler manufacturers, industrial development agencies and technology providers to understand the cost economics and benefits in detail.

B. World Resources Institute (WRI)

WRI India is a research organization with experts and staff who work closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

Recommendations of WRI

- The anticipated primary solution for the ease of operations with the least air pollution and improved energy efficiency loss has a community co-generation system through which heat (in the form of steam) can be supplied to member industries.
- Introducing sustainable fuel options for heat generation would suffice to have less pollution and achieve a circular economy of heat generation for small boilers owning industrial units in industrial cluster.

C. CEE and TERI: Promoting Industrial Boiler Efficiency in India

Centre for Energy and Environment (CEE):

Boiler Best Practices Program: CEE's flagship program focuses on improving boiler operation and maintenance practices in existing industrial facilities. This includes:

- Assessments and Audits: .
- Training and Capacity Building:

  Dissemination of Knowledge: **Promotion of Energy-Efficient Boiler Technologies: Policy Advocacy:**

The Energy and Resources Institute (TERI):

Industrial Energy Efficiency Programme (IEEP): TERI's IEEP is a comprehensive program that assists industries in identifying and implementing energy-saving measures across various operations, including boiler systems. This includes:

- Energy Audits and Assessments
- Techno-Economic Feasibility Studies:
- Implementation Support: .
- Development and Demonstration of Innovative Technologies:
- Capacity Building and Awareness Programs:

5.4 Indian Companies Offering Industrial gas through distributed pipeline network

A. STEAMHOUSE INDIA LIMITED

Steamhouse India Limited is a Gujarat-based company engaged in the generation and centralized distribution of industrial gases, primarily steam and nitrogen, through a dedicated and integrated pipeline network.

B. PR ECOENERGY PVT LTD

PR Ecoenergy Limited is a Gujarat-based company that manufactures steam systems, management services, heat systems, heaters, thermostats, and heating devices.

C. Detox India Private Limited

Detox India Private Limited, is a Gujarat-based company operating in the environmental sector, in waste management and remediation services.

D. Linde India

Linde India Limited, formerly BOC India, is a subsidiary of Linde Plc. It produces, supplies, and manages industrial, medical and specialist gases.

E. Ellenbarrie

Ellenbarrie Industrial Gases Ltd. is engaged in the business of oxygen and nitrogen. The Company is a manufacturer and supplier of industrial gases in the eastern and southern India, both in bulk and packaged form.

5.5 Financial Comparison of peers in the Industrial Gas segment

Financial benchmarking of key peer companies for the Financial Year 2025

Particulars	For the period ended March 31, 2025				
	Steam house India Ltd	Linde India Ltd	PR Eco energy Limited	Ellenbarrie	Detox India Private Limited
Revenue from Operations (₹ millions)	3,951.06	24,853.76	NA	3,124.83	NA
Revenue from Operations Growth (%)	35.44%	(10.23%)	NA	15.96%	NA
EBITDA (₹ millions)	693.16	7,650.91	NA	1,097.36	NA
EBITDA Margin (%)	17.54%	30.78%	NA	35.12%	NA
Profit/ (Loss) for the Year/period (₹ Millions)	311.61	4,548.45	NA	832.89	NA
PAT Margin (%)	7.82%	17.81%	NA	23.90%	NA
Net Cash generated from operating activities (₹ Millions)	1070.98	5,835.95	NA	42.75	NA
Return on Equity (%)	23.53%	11.91%	NA	16.88%	NA
Return on Capital Employed (%)	17.20%	16.39%	NA	16.92%	NA
Net Debt to Equity (times)	1.63x	(0.04x)	NA	0.49x	NA

Source: Company Financial Statements, F&S Analytics

Financial benchmarking of key peer companies for the Financial Year 2024

Particulars	For the period ended March 31, 2024				
	Steam house India Ltd	Linde India Ltd	PR Eco energy Limited	Ellenbarrie	Detox India Private Limited
Revenue from Operations (₹ millions)	2,917.10	27,686.69	624.27	2,694.75	1,591.19
Revenue from Operations Growth (%)	(7.55%)	(11.70%)	(1.62%)	31.38%	(37.70%)
EBITDA (₹ millions)	684.06	7,023.23	133.69	615.30	(118.42)
EBITDA Margin (%)	23.46%	25.37%	21.42%	22.83%	(7.44%)
Profit/ (Loss) for the Year/period (₹ Millions)	271.86	4,340.86	72.65	452.89	(810.70)
PAT Margin (%)	9.27%	15.25%	11.26%	15.61%	(50.05%)
Net Cash generated from operating activities (₹ Millions)	210.16	4,403.97	92.42	437.47	165.53
Return on Equity (%)	26.26%	12.52%	20.55%	11.05%	223.31%
Return on Capital Employed (%)	20.24%	16.90%	18.39%	12.31%	(18.49%)
Net Debt to Equity (times)	1.77x	(0.28x)	1.06x	0.42x	(7.76x)

Source: Company Financial Statements, F&S Analytics

Financial benchmarking of key peer companies for the Financial Year 2023

Particulars	For the period ended March 31, 2023				
	Steam house India Ltd	Linde India Ltd	PR Eco energy Limited	Ellenbarrie	Detox India Private Limited
Revenue from Operations (₹ millions)	3,155.39	31,355.20	634.55	2,051.07	2,553.96
Revenue from Operations Growth (%)	NA	NA	NA	NA	NA
EBITDA (₹ millions)	579.43	7,648.37	104.63	335.88	(256.19)
EBITDA Margin (%)	18.36%	24.39%	16.49%	16.38%	(10.03%)
Profit/ (Loss) for the Year/period (₹ Millions)	333.99	5,380.59	54.18	281.42	(929.67)
PAT Margin (%)	10.55%	16.61%	8.50%	12.58%	(36.18%)

Particulars	For the period ended March 31, 2023				
	Steam house India Ltd	Linde India Ltd	PR Eco energy Limited	Ellenbarrie	Detox India Private Limited
Net Cash generated from operating activities (₹ Millions)	463.90	6,291.84	105.94	387.47	(206.82)
Return on Equity (%)	58.76%	17.14%	20.53%	7.75%	(206.29%)
Return on Capital Employed (%)	32.88%	19.89%	17.59%	8.79%	(19.61%)
Net Debt to Equity (times)	1.82x	(0.38x)	0.93x	0.24x	5.91x

Source: Company Financial Statements, F&S Analytics

Notes accompanying KPIs of Steamhouse India Limited:

1. *EBITDA is calculated as Profit/ (Loss) for the year/period less Other income add Finance costs, Depreciation and amortization and impairment expense and Total tax expenses*
2. *EBITDA Margin is calculated as EBITDA divided by revenue from operations*
3. *PAT for Steamhouse India Limited is Restated Profit after tax for the year/period*
4. *PAT Margin is calculated as profit after tax for the year/period as a percentage of total income.*
5. *Return on Equity is calculated as profit after tax for the year/period as a percentage of Total Equity for the year/period.*
6. *Return on Capital Employed is calculated as earnings before interest and tax (EBIT) divided by Capital Employed. EBIT is calculated as EBITDA add other income minus Depreciation, amortization and impairment expenses while Capital Employed is calculated as a total of Total Equity and current borrowings and non-current borrowings*
7. *Net Debt to Equity Ratio is calculated as Net Debt divided by total equity. Net Debt is calculated as non-current borrowings plus current borrowings less cash and cash equivalents less other bank balances.*

Notes accompanying KPIs of Linde India Limited, PR Eco Energy Limited, Detox India Private Limited, and Ellenbarrie:

1. *EBITDA is calculated as Profit/ (Loss) for the year/period less Other income add Finance costs, Depreciation and amortization, Total income tax expenses, Share of profit/(loss) from Joint venture and exceptional items*
2. *EBITDA Margin is calculated as EBITDA divided by revenue from operations*
3. *PAT Margin is calculated as profit after tax for the year/period as a percentage of total income.*
4. *Return on Equity is calculated as profit after tax for the year as a percentage of Total Equity for the year.*
5. *Return on Capital Employed is calculated EBIT divided by Capital Employed. EBIT is calculated as EBITDA add other income minus depreciation & amortization expenses while Capital Employed is calculated as a total of Total Equity and current borrowings and non-current borrowings*
6. *Net Debt to Equity is calculated as Net debt divided by Total Equity. Net Debt is calculated as total of Current borrowings and Non-current borrowings less cash & cash equivalents and other bank balances*

** For Linde India Ltd., Fiscal 2022 numbers represent CY21 (Jan'21-Dec'21) as the company followed calendar year accounting till 2021. FY23 numbers represent the 15 months period Jan'22-Mar'23.*

6 CONCLUSION

6.1 Benefit of Community Boiler Over Captive Boilers

Cost Efficiency

- **Community Boiler**: Shared infrastructure reduces capital and operational expenditure for individual users.
- **Captive Boiler**: High upfront and maintenance costs borne entirely by the single user.

Space Savings

- **Community Boiler**: Centralized plant frees up valuable real estate at the user's facility.
- **Captive Boiler**: Requires dedicated space, often a constraint in urban or space-tight settings.

Operational Convenience

- **Community Boiler**: Operated and maintained by a professional third party—ensures consistent performance, compliance, and 24/7 monitoring.
- **Captive Boiler**: User must handle O&M, spares, skilled manpower, and regulatory compliance internally.

Energy Optimization

- **Community Boiler**: Can integrate waste heat recovery, renewable energy (e.g., biomass, solar steam), and advanced control systems for better efficiency across users.
- **Captive Boiler**: Limited scope for such integration unless scale and investment justify it.

Regulatory Compliance

- **Community Boiler**: Managed by specialized operators familiar with pollution norms, boiler inspections, and safety standards.
- **Captive Boiler**: Risk of non-compliance if not properly staffed or updated.

Scalability & Flexibility

- **Community Boiler**: Easy to scale up capacity with aggregated demand across industries.
- **Captive Boiler**: Any scale-up requires additional investment and downtime.

Sustainability

- **Community Boiler**: Easier to incorporate cleaner fuels (biomass, green hydrogen, solar thermal), supporting ESG goals and government mandates.
- **Captive Boiler**: Switching fuels or upgrading systems is costly and complex.

Ideal For:

- Industrial parks
- SEZs
- Food processing clusters
- Pharma, textile, or chemical hubs with steam/heat demand

The below table represents a holistic view of array of benefits that a Community Boiler offers over a captive boiler user:

Exhibit 6.1: Comparison between Captive Boiler and Community Boiler

Parameters	Captive Boiler	Community Boiler
Capex including all the accessories	INR 25-30L / TPH for a low pressure steam boiler including all accessories and softwares	For Community Boiler of 60 TPH with pressure range 45 Bar ~ INR 25-30 Cr
Area requirement	Minimum 1,500 – 2,500 sq. meters for a boiler of 6 – 10 TPH capacity	Area required for 60 TPH is 3000 Sq. Meters

Manpower requirement	10 for Boiler Upto 10 TPH	40 for Boiler upto 60TPH
Boiler efficiency	50-65% (Boilers with more than 10 years age, run at 50-55% efficiency)	80-83% efficiency achieved in community boiler
Variable cost for steam generation	INR 1.8 – INR 6.0 for generating low perssure steam up to 6 – 8 Bar. Variable cost varies depending upon boiler efficiency and types of fuel used.	INR 1.50- INR 2.25 for generating super heated steam of approx. 45 Bar. Super heated steam requires approx. 1.6 to 1.7 times extra heat than low pressure steam. Hence, equivalent variable cost for generating low pressure steam in a Community boiler would be less than INR 0.9 – INR 1.3 depending upon type of fuel used.
Pollution level	Varies from 150 – 500 mg / Nm^3 for boilers upto 10 TPH capacity	Varies from 10-50 mg/Nm^3 for boilers upto 30TPH
Technology usage	Most of the companies do not use any monitoring and efficiency imporvement technology; a few of them reported usage of SCADA, Effimax 4000, etc.	Community Boiler player Steamhouse India Limited uses Monitoring and efficiency imporvement technology; a few of them reported usage of SCADA, ESP etc.

6.2 Growth Potential of Community Boilers in the country

As mentioned in the Chapter 4, process steam demand in the country currently stands at approx. 186,000 TPH and expected to reach 290,000 TPH by 2030.

Considering various advantages of Community Boiler model and favouring policies, based on discussions with the regulators and industry stakeholders, on a conservative basis, Community boiler has the potential to acquire 3% share of the process steam demand in the country over the next 5 years.

This translates to potential of approx. 10X increase in the installed capacity of Community Boilers in the country. On A CAGR basis, this indicates 55 – 60% CAGR in the installed capacity of community boilers in the country.

6.3 Factors Aiding Growth of Community Boiler in India

Recognizing the challenges posed by managing individual generation assets, process industries are increasingly turning to centralized generation and distributions services. The complexities, maintenance demands, and substantial capital investments linked to standalone boiler operation present significant hurdles. Community industrial gas generation and distribution systems provide a compelling solution, offering a centralized infrastructure that streamlines operations and enhances efficiency for industries. This shift is primarily driven by the potential for significant operational and financial advantages, enabling shared resources and collaborative management to alleviate the burdens of individual boiler maintenance.

6.3.1 Regulatory Push

The prevailing trends in the process boiler sector, marked by the adoption of advanced technologies like condensing systems and low NOx burners, reflect a growing emphasis on emissions reduction and enhanced energy efficiency.

Furthermore, the overarching trend across diverse process industries, from Pharma and Textiles to Food & Beverage, centers on digitalization, automation, and a concerted effort to diminish carbon footprint through energy-efficient measures and investments in renewable energy and this landscape presents a favorable opportunity to companies in the sector. The rising focus on connectivity and intelligence in process plants aligns seamlessly with the capabilities of community steam boilers, allowing plant managers to enhance efficiency significantly.

6.4 Community Boilers Threats and Challenges

Community boilers face several key threats that impact their operation and long-term sustainability.

1. Maintenance Challenges: Over time, boilers naturally experience wear and tear, which necessitates regular repairs to keep them functioning efficiently. As the infrastructure ages, the cost of maintaining or replacing these systems can become a significant financial burden, requiring ongoing attention and investment. The longer the system is in operation, the more frequent and costly repairs may become, further straining resources.

2. High Operational Costs: Inefficient systems are a major concern for community boilers, as they lead to increased fuel consumption and higher maintenance costs. As these systems become less efficient, the amount of fuel required to keep them operational rises, which directly impacts the overall cost of operation. Additionally, larger boiler systems may require specialized technicians for maintenance and repairs, further increasing service expenses. These rising operational costs can strain budgets, especially for communities with limited financial resources.

3. Regulatory Compliance: Stricter safety and environmental regulations are another challenge for community boilers. These regulations may require expensive upgrades to meet new standards, forcing operators to invest in technology or infrastructure improvements. Non-compliance with these regulations could have serious consequences, including hefty penalties or even the complete shutdown of the system, which could leave residents without an essential service.

4. Technological Integration: Integrating modern technologies into existing community boiler systems is a complex and costly process. Retrofitting older systems with renewable energy solutions, such as solar or wind power, or installing smart meters for improved monitoring can be prohibitively expensive. Moreover, older systems may struggle to incorporate newer, more efficient technologies, which can result in lower performance or missed opportunities for optimization.

5. Fuel Supply Vulnerabilities: Fuel supply disruptions pose a significant risk to the efficiency and cost-effectiveness of community boilers. Variations in fuel prices or interruptions in supply can disrupt the system's performance, leading to increased operational costs. Moreover, if a boiler system relies on a specific fuel type, it may be exposed to long-term sustainability risks, especially if that fuel becomes more expensive.

6.5 Process Steam Boilers Threats and Challenges

Process steam boilers face several significant threats that can jeopardize their efficiency, safety, and long-term reliability.

1. Pressure Fluctuations:
Pressure fluctuations within a process steam boiler system can lead to dangerous operating conditions and potential equipment damage. Pressure inconsistencies, if not properly managed, can cause safety valves to activate unnecessarily, disrupt the system's performance, or even result in catastrophic failures.

2. Improper Boiler Water Treatment:
The proper treatment of boiler water is essential to maintaining system efficiency and preventing issues such as scale build-up and corrosion. When water treatment is inadequate or improperly executed, impurities like minerals, dissolved gases, and contaminants can accumulate in the system. These impurities can lead to the formation of harmful deposits, accelerate corrosion, and ultimately reduce the overall efficiency of steam production.

3. Fuel Quality and Supply Issues:
Inconsistent or poor-quality fuel is another threat to the proper functioning of a process steam boiler. When the fuel quality is compromised, incomplete combustion can occur, leading to inefficient energy use, poor performance, and potentially harmful emissions. Additionally, a disruption in the fuel supply can cause interruptions in steam production, which may affect overall production processes.

4. Overheating:
Overheating is a significant risk for process steam boilers, especially when the system operates continuously at high temperatures without proper maintenance or monitoring. Excessive heat can cause wear on critical components such as pressure valves, heat exchangers, and seals, potentially leading to component failures. Boilers need to be equipped with temperature controls that can monitor and regulate heat levels.

5. Control System Failures:
The control system of a process steam boiler plays a crucial role in regulating critical parameters like water levels, pressure, and temperature. A malfunction in the control system can result in improper regulation, leading to hazardous conditions such as low water levels, excessive pressure, or overheating. In such situations, the safety of the boiler and its operators can be at risk, potentially causing system failures or accidents. Regular testing, calibration, and maintenance of control systems are necessary to prevent these failures and ensure the safe and efficient operation of the boiler.

6.6 Potential Business Opportunities for Community Boilers

6.6.1 Large Capacity Community Boilers for the Upcoming Industrial parks

India's rapid industrial development, highlighted by the growth of over 3,400 industrial clusters and large-scale parks—particularly in Gujarat, which ranks second in Ease of Doing Business—presents a strong opportunity for the expansion of community boilers as a centralized, efficient energy solution. The Gujarat model, backed by proactive governance and environmental

compliance, serves as a benchmark for other regions like Delhi-NCR, where similar implementation through state-industrial agencies such as HSIIDC and RIICO is encouraged. This shift aligns with CPCB guidelines and supports sustainable industrialization by replacing smaller, inefficient boilers. Additionally, community boiler service providers can diversify revenue through avenues such as co-generation of electricity, ash utilization in construction, flue gas and chilled water sales, nitrogen provision, steam pipeline advertising, and partnerships for steam resale or rental, creating a robust, eco-friendly ecosystem for industrial energy needs.

6.6.2 Community Steam's Growth Through Innovative Technologies in India

India's push toward a sustainable energy future presents significant opportunities for the growth of community boilers through the integration of innovative technologies. Green hydrogen, derived from solar and wind energy, offers a clean fuel alternative, while microwave plasma technology enables efficient, low-emission combustion. Incorporating Concentrated Solar Power (CSP) can supplement heat generation and reduce fossil fuel dependence, cutting operating costs. Additionally, utilizing exothermic reactions allows for cost-effective and customizable heat generation. As India invests in these transformative solutions, community boilers are set to play a key role in advancing the country's renewable energy goals.

6.7 Critical Success Factors

To succeed as a community boiler player in India, companies like Steamhouse must focus on several critical factors that ensure both strong market positioning and long-term sustainability. A key starting point is understanding market demand by assessing the specific heating or steam requirements of target communities, identifying inefficiencies in current systems, and delivering a compelling value proposition. Building robust infrastructure—including well-designed boiler plants, distribution networks, and storage facilities—is essential for reliable operations. Prioritizing fuel efficiency and environmental sustainability by integrating advanced technologies, such as efficient boilers, renewable energy, and waste heat recovery systems, not only reduces environmental impact but also offers cost benefits that can attract customers.

Cost-effectiveness, service reliability, and stakeholder engagement further contribute to a successful business model. Competitive pricing, transparent billing, and flexible payment options improve affordability and customer satisfaction. Reliability in steam or heat delivery, backed by strong maintenance protocols, emergency response systems, and responsive customer support, ensures consistent service quality. Additionally, cultivating strong partnerships with local communities, government agencies, fuel suppliers, and industry bodies enhances credibility and operational resilience. Lastly, embracing continuous innovation and remaining adaptable to market trends and technological advancements enables community boiler providers to evolve with changing customer needs, ensuring long-term relevance and growth.