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NITI Aayog

Chemical Industry:
Powering India's participation in Global Value Chains

July 2025

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While due care has also been exercised to ensure the accuracy of analysis and arguments supported by existing literature, the possibility of alternate interpretations cannot be ruled out. NITI Aayog shall not be held responsible for the findings or opinions expressed in the document.

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Azadi Ka Amrit Mahotsav

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MESSAGE

Global Value Chains(GVCs) are among the most potent drivers of productivity enhancement, employment generation, and rising living standards. By enabling countries to rapidly expand their manufacturing capacities, GVC participation offers a pathway to accelerated development. It also facilitates critical knowledge transfers between firms, which can lead to industrial upgrading, manifested in improved product quality, enhanced operational efficiency, and greater involvement in higher-value activities. In this sense, GVCs are not merely conduits for trade, but catalysts for broader economic transformation, innovation, and large-scale job creation.

India is fast emerging as a globally competitive and high-quality manufacturing hub. Over the past decade, the manufacturing sector has witnessed transformative reforms and targeted policy support, including flagship initiatives such as *Make in India*, strategic efforts to enhance GVC integration, and capital and operational expenditure incentives for industries. With its vast potential, the sector is poised to make a substantial contribution to India's GDP in the years ahead.

The chemicals sector stands out as a compelling illustration of India's industrial progress. Driven by forward-looking policies such as the Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR), the Sagarmala Programme, and the National Logistics Policy, the sector has experienced robust growth. India is now recognised as a key global hub for chemical manufacturing, reflecting both the resilience of our economy and the dynamism of this industry. The government is acutely aware of the strategic role that GVCs can play in further expanding India's footprint in this critical domain.

In this context, NITI Aayog has undertaken a focused initiative—*Driving Accelerated Growth for India's Share in Global Value Chains for Chemicals*—developed through extensive consultation with industry stakeholders and state governments. This comprehensive exercise aims to identify the key strategic interventions required to enhance India's competitiveness in chemical manufacturing and deepen its integration into global production networks.

This report underscores the imperative of strengthening domestic capacities to enable the sector to ascend the value chain. It outlines a range of policy measures and institutional reforms that will help build an enabling environment for sustainable growth. As we move forward on this path, the commitment and coordinated efforts of the relevant Ministries and State Governments will be vital to realising the vision of positioning India as a global manufacturing leader in chemicals.

In conclusion, I believe this report—*Chemicals Sector: Powering India's Participation in Global Value Chains*—marks a crucial step towards that ambition. It lays a robust foundation for the future of the chemicals industry in India, and for the broader vision of an Atmanirbhar Bharat integrated confidently into the global economy.

Suman Bery

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MESSAGE

India's manufacturing landscape is diverse, dynamic, and integral to the nation's economic growth. Encompassing a wide range of industries such as automotive, textiles, electronics, and chemicals, it serves as a key driver of employment, innovation, and global competitiveness. With a strong policy push toward self-reliance and industrial development, the manufacturing sector is projected to contribute significantly to India's GDP. Supported by initiatives like "Make in India" and advancements in infrastructure and technology, India's manufacturing ecosystem is poised for robust growth, attracting global investments and enhancing its position as a global manufacturing hub.

Among the diverse industrial sectors, the chemical industry is a key pillar, significantly contributing to India's global competitiveness and manufacturing excellence. Within the chemical sector, speciality chemicals have long been a source of strength and comparative advantage. With the right intervention like designing ecosystem for chemicals hubs, incentivising innovation and other necessary steps, it has the potential to increase India's participation in the Chemicals global value chain significantly by 2030.

The chemical industry accounts for 7% of India's GDP, making it a cornerstone of the economy and one of the largest globally. Ranking fifth in revenue worldwide in 2023, this highly diversified sector produces over 80,000 products and provides raw materials to multiple end-use industries, from agriculture to textiles and pharmaceuticals, among others. Employing huge workforce, the industry is a mix of knowledge- and capital-intensive sub-sector, serving as a foundation for India's industrial and agricultural development.

The chemical industry encompasses a broad spectrum of segments, including basic chemicals, petrochemicals, fertilizers, paints, and fragrances. It plays a vital role in enhancing the quality of life by supporting downstream sectors and producing essential products like textiles, soaps, detergents, and pharmaceuticals. Sustained economic growth and robust macroeconomic fundamentals have created a strong foundation for the sector's expansion.

I commend Shri Ishtiyaque Ahmed, Programme Director (Industry), and his team at NITI Aayog for their sincere efforts in creating this insightful report. Their extensive stakeholder consultations and site visits have enriched its content. My gratitude also extends to Industry Associations, Knowledge Partners, Central Ministries, Departments, Industry representatives, and States for their valuable inputs and contributions.

The findings in this report provide a roadmap for the chemical sector to achieve its ambitious vision by 2030. These insights will help shape segment-specific policies including institutional reforms, infrastructure development, fiscal incentives and regulatory reforms enabling India to strengthen its position as a global leader in chemicals manufacturing while fostering innovation, sustainability, and economic growth.

New Delhi

April, 2025

Arvind Virmani

(Arvind Virmani)

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MESSAGE

Over the past decade, the Government of India has initiated a series of transformative measures aimed at accelerating economic growth, enhancing competitiveness, and attracting investment across diverse sectors. While these have delivered excellent results, India's integration into Global Value Chains (GVCs) remains relatively modest compared to economies like China, Europe, and USA. With manufacturing contributing around 17% to GDP, there is a pressing need to intensify efforts to enhance India's role in Global Value Chain.

The Chemicals sector in India has seen a remarkable growth with its share in Global Value Chains being around 3.5% in 2023. India has now established itself as a global hub for chemical production, underscoring the resilience and dynamism of its economy and highlighting the vast potential of the chemicals industry. It is one of the few sectors where India could establish itself as a major player capturing 10-12% of market share by 2040.

Recognizing this, NITI Aayog, in collaboration with various stakeholders, has launched a comprehensive initiative titled **"Growing India's share in the Global Chemicals Value Chain"**. The primary objective of this initiative is to identify key strategies and interventions to boost India's competitiveness in the chemicals sector and facilitate its integration into Global Chemical Value Chains.

This initiative has involved rigorous research, consultations with stakeholders, and detailed analysis of industry trends and market dynamics. Through engagements with industry bodies, think tanks, academia, state governments, and key industry players, valuable insights have been gained into the challenges and opportunities facing the chemicals sector. A significant finding of this research underscores the critical need to enhance India's capabilities in chemical manufacturing.

To address these challenges, the recommendations encompass a comprehensive range of fiscal and non-fiscal interventions designed to create an enabling environment for sustainable growth. These include fiscal incentives to streamline manufacturing processes, as well as non-fiscal support for infrastructural development and institutional support in PCPIR regions.

This report is presenting the findings and recommendations, thereby providing a strategic roadmap for enhancing India's participation in the Global Chemicals Value Chain. I would like to extend my gratitude to Secretary, Department of Chemicals and Petrochemicals and her team for constant support in the preparation of this report.

I complement Shri Ishtiyaque Ahmed, Programme Director (Industry) and his team in NITI Aayog for developing such an insightful report on a crucial sector of the economy.

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Dated: 30th June, 2025

[B.V.R. Subrahmanyam]

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Message

India has emerged as the fastest-growing major economy in the world and is expected to be one of the top three economic powers in the world over the next 10-15 years, backed by its robust democracy and strong partnerships. India's economic growth trajectory has been exemplary in the last decade. While the service sector has been the most important sector propelling India's growth, manufacturing sector has laid the foundation for the country's economic progress. India's strategic location advantage, manpower, good governance, high-quality infrastructure, robust investment policies, strong regulatory framework, promising labour reforms, trade agreements, and lucrative tax incentives have further propelled it into the league of preferred manufacturing destinations. The increasing significance of manufacturing is driven by the strong performance of important sectors such as automotive, electronics, chemicals, pharmaceuticals, and consumer durables.

The chemical manufacturing with roots spread across a wide range of end-use industries is a crucial segment. Enabling Government initiatives, availability of large workforce, increasing export demand and low per capita consumption are the key growth drivers for the Indian chemical industry. Attractive business opportunities are present in different segments, including petrochemical intermediates, downstream petrochemicals and speciality chemicals. India's chemical industry has a long way to go in forging intercompany and academic partnerships to drive innovation.

The Government is also addressing challenges related to the availability of feedstock, access to industrial infrastructure and common user facilities, complex approval procedures, skill development and research & development. Moreover, the Government has implemented enterprising initiatives and schemes such as Make in India, Aatmanirbhar Bharat Abhiyan and the Production-Linked Incentive (PLI) Scheme with the objective of improving the competitiveness of domestic manufacturing, attracting investments and enabling exports. These initiatives are expected to boost domestic production and also increase the demand for chemicals and petrochemicals. Such significant measures are expected to transform India into a global manufacturing hub for chemicals and petrochemicals.

This report is the culmination of findings from numerous stakeholder consultations with industry, academia, industry associations, Ministries and Departments of Union Government and States. Field visits to chemical manufacturing units were separately undertaken to understand the nuances of the manufacturing process. I also acknowledge the association of our knowledge partner in this study. This report could not have been possible without continuous support of Hon'ble Vice Chairman, Shri Suman Bery, Hon'ble Member, Dr Arvind Virmani and CEO NITI Aayog, Shri B V R Subrahmanyam, whose insightful suggestions and guidance were instrumental during the entire project.

I sincerely hope that the recommendations presented in this report will benefit the industry in adopting suitable business strategies; and also help concerned Ministries/ Departments and state governments in developing favourable policies for the advancement of this sector.

(Ishtiyaque Ahmed)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

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Preface

Over the past decade, the Government of India has introduced a series of transformative policies aimed at accelerating economic growth, enhancing competitiveness, and integrating key sectors into Global Value Chains (GVCs). Reforms such as the implementation of the Goods and Services Tax (GST), liberalization of Foreign Direct Investment (FDI), and initiatives like "Make in India" and "Aatmanirbhar Bharat" have significantly contributed to improving the business environment, bolstering manufacturing, and fostering industrial growth. The Production-Linked Incentive (PLI) schemes and strategic policy interventions across multiple sectors have further strengthened India's position as a global manufacturing hub.

Among these critical sectors, the chemicals industry stands as a pillar of India's industrial and economic landscape. With a market size of approximately $220 billion in 2023, the sector is poised to grow exponentially, reaching around $400 to 450 billion by 2030 and $850 to 1,000 billion by 2040.[1] India is currently the world's sixth-largest and Asia's third largest producer of chemicals, supplying essential raw materials to industries such as pharmaceuticals, textiles, automotive, and agriculture. The sector's dynamic growth trajectory underscores its potential to play a key role in India's aspiration of achieving a $5-trillion economy.

Despite its strengths, India's participation in the global chemicals market remains relatively modest, accounting for only 3 to 3.5 percent of global consumption in 2023. For instance, India's petrochemical industry has traditionally emphasized the production of bulk, commodity-grade polymers and chemicals, a trend reflected in the current utilization patterns of key feedstocks. An overwhelming share of India's propylene and ethylene is directed toward polypropylene and polyethylene production respectively—significantly higher than global averages. Similar disparities exist across other critical feedstocks such as benzene and butadiene, which are predominantly channelled into basic derivatives rather than more advanced, value-added chemicals.

This focus on upstream, large-volume outputs has led to limited diversification into specialty and high-value downstream products, thereby constraining the sector's global competitiveness. To realign the industry with international trends and unlock its full potential, there is a growing need for strategic interventions. With high reliance on imports, limited feedstock availability, infrastructural bottlenecks, and regulatory complexities, there are several challenges that must be addressed to enhance India's competitiveness and strengthen its foothold in the global chemicals value chain.

This report explores the current landscape, identifies critical imbalances, and outlines actionable pathways to foster a more diversified and globally aligned petrochemical value chain in India.

[1] https://economictimes.indiatimes.com/industry/indl-goods/svs/chem-/-fertilisers/indian-chemical-industry-to-bevalued-at-1-trillion-by-2040/articleshow/98334280.cms

Executive summary

India's chemicals industry is a cornerstone of the country's manufacturing ecosystem, contributing approximately 7 percent to the national gross domestic product (GDP) and supplying essential raw materials to critical industries such as agriculture, pharmaceuticals, textiles, automotive, and construction. Ranked as the sixth-largest chemicals producer globally and third in Asia, India holds immense potential for expansion—provided it receives the right strategic support from the Government. The domestic chemicals market was valued at $220 billion in 2023 and is expected to grow to around $400 to 450 billion by 2030, with aspirations to reach about $850 to 1,000 billion by 2040 complemented by the Government support. However, despite its robust growth trajectory, India's participation in global chemicals value chains (GVCs) remains limited, with its share in global chemicals consumption standing at 3 to 3.5 percent in 2023.

India's chemicals industry faces several structural constraints that hinder its ability to scale and integrate into GVCs. Therefore, Government intervention is necessary for enabling the sector to achieve its full potential. A high reliance on imports, particularly in petrochemicals intermediates and specialty chemicals, has resulted in a trade deficit of approximately $31 billion. Infrastructure limitations, including insufficient feedstock availability, inadequate common user facilities, and logistics inefficiencies, further impact cost competitiveness. Additionally, complex regulatory frameworks, environmental compliance hurdles, and skill shortages present significant barriers to domestic production and investment.

For example, the feedstock availability for petrochemical intermediates is driven by focus of Indian players towards production of bulk (typically commodity) polymers/ chemicals. For instance, approximately 95% of propylene in India is converted into polypropylene (PP), compared to just 70% globally. Similarly, 75% of ethylene in India is used for polyethylene (PE) production versus 63% globally. A comparable trend exists for other key feedstocks: around 87% of benzene (BZ) in India goes into alkylbenzene, chlorobenzene, and cumene, while globally only about 25% is allocated to these chemicals, with a significantly larger share diverted to more complex derivatives like ethylbenzene, cumene, cyclohexane, and nitrobenzene. In the case of butadiene (BDE), roughly 84% in India is converted to polybutadiene rubber (PBR) and styrene-butadiene rubber (SBR), whereas the global average is closer to 54% (Exhibit A). To address this imbalance and foster a more globally competitive sector, there is a strong case for targeted government support—such as Viability Gap Funding (VGF)—to catalyze investments in downstream, higher-value chemical manufacturing.

Exhibit A:

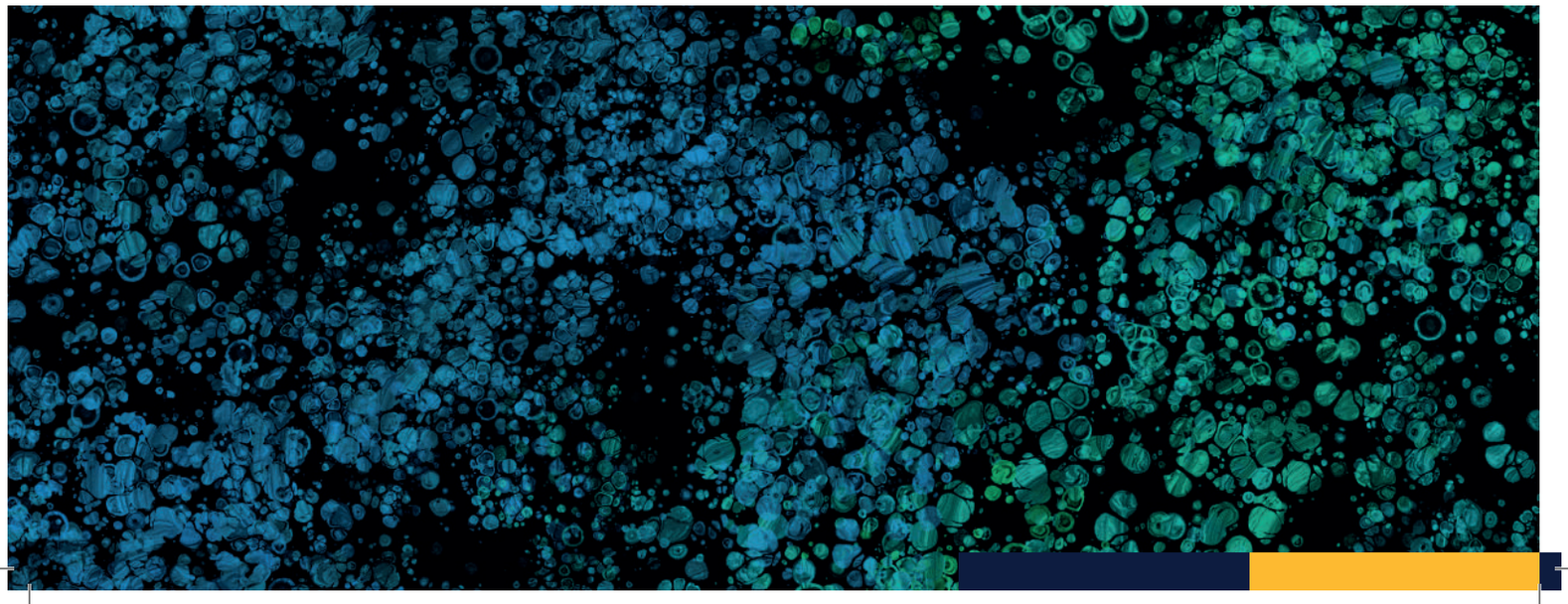
Feedstock Conversion Comparison: India vs Global

Feedstock	Converted To	India (%)	Global (%)
Propylene	Polypropylene (PP)	95%	70%
Ethylene	Polyethylene (PE)	75%	63%
Benzene (BZ)	Alkylbenzene, Chlorobenzene, Cumene	87%	25%
Butadiene (BDE)	Polybutadiene Rubber (PBR), Styrene-Butadiene Rubber (SBR)	84%	54%

Source: CMA Database

To address these challenges and position India as a global chemicals manufacturing hub, targeted Government interventions are required across key strategic areas. Expanding domestic production capacity by developing world-class chemicals hubs with advanced infrastructure and seamless port connectivity is essential. Policy reforms focused on streamlining regulatory approvals, providing fiscal and non-fiscal incentives, and strengthening trade agreements can further enhance India's competitiveness. Increasing investments in research and development (R&D), particularly for high-value specialty chemicals and green chemistry, could foster innovation and self-sufficiency. Furthermore, skill development initiatives tailored to industry needs will be crucial in building a future-ready workforce.

The Government of India has already undertaken significant initiatives, such as "Make in India", "Aatmanirbhar Bharat", and the Production-Linked Incentive (PLI) Scheme, to boost domestic manufacturing and attract investments. By leveraging these policies and implementing a structured roadmap, India aims to increase its share in the global chemicals value chain to approximately 5 to 6 percent by 2030. Achieving this vision would not only help India become a net-zero importer of chemicals but also generate 700,000 to 1 million new employment opportunities. With the right mix of policy interventions, industry collaboration, and infrastructure investments, India is well-positioned to emerge as a leading player in the global chemicals market. This report outlines a comprehensive strategy to unlock the full potential of the chemicals industry, enabling India to drive sustainable growth, enhance global trade participation, and establish itself as a high-value chemicals manufacturing powerhouse.



The initiatives aim to transform aspirations into actionable progress. They are as follows:

Intervention 1: Establish world-class chemicals hubs in India

1.1 Establishment of empowered committee at the Central level along with creation of a Chemical Fund under the empowered committee with a budgetary outlay for shared infrastructure development, VGF, etc

1.2 Administrative body at the chemical hub level, which will handle the overall management of the hub

Intervention 2: Develop existing port infrastructure

2.1 Composition of a Chemical Committee for ports to advise on and address infrastructural gaps in chemical trading at ports

2.2 Development of 8 high-potential clusters

Intervention 3: Introduce a Opex subsidy scheme for chemicals

3.1 Incentivize incremental production of chemical based on import bill, export potential, single source country dependence, end-market criticality etc. The scheme proposes for incentives on incremental sales to selected participants for a fixed number of years

Intervention 4: Develop and access technologies to enhance self-sufficiency and foster innovation

4.1 Disbursement of R&D funds to drive innovation with enhanced collaboration between industry and academia through creation of an interface agency in collaboration with DCPC and DST

4.2 Acquiring access to specific technologies available outside India through fostering MNC partnerships

Intervention 5: Fast-track environmental clearance with transparency and accountability

5.1 Fast-track environmental clearance with transparency and accountability —Simplify and fast-track EC clearance process through setting up an audit committee under DPIIT to monitor timelines and compliance and publish periodic reports and give more autonomy to EAC

Intervention 6: Securing FTAs to support Industry growth

6.1 Targeted FTA negotiations: Moving forward, India could negotiate FTAs that incorporate specific provisions for the chemicals industry. This can include incorporating industry focused protections such as tariff quotas or selective duty exemptions on critical raw materials and petrochemical feedstocks

6.2 Awareness and effective utilization of FTAs: Raising FTA awareness, simplifying procedures, and easing origin proofs can help more exporters access benefits and boost competitiveness

Intervention 7: Talent and skill upgradation in the chemical industry

7.1 Expansion of ITIs and specialized training institutes: The expansion is essential to meet the growing demand for skilled labour

7.2 Upgrading faculty and teacher training: The effectiveness of vocational training programme is directly linked to the quality of instruction

7.3 Industry-academia partnership: These collaborations can introduce industry-relevant courses in core areas like petrochemicals, polymer science, and industrial safety

Proposed policy interventions and potential impact by 2030

INTERVENTION 1
Establish world-class chemicals hubs in India

INTERVENTION 2
Develop existing port infrastructure for storage and handling of chemicals

INTERVENTION 3
Introduce an opex subsidy for chemicals with high import dependence, export potential, and end-market criticality

INTERVENTION 4
Develop and access technologies to enhance self- sufficiency and foster innovation

INTERVENTION 5
Fast-track environmental clearance with transparency and accountability

INTERVENTION 6
Securing FTAs to support Industry growth

INTERVENTION 7
Talent and skill upgradation in the chemical industry

700K
Additional employment generation by 2030

5-6%
Production share in the Global Value Chain by 2030 (from 3-3.5% in 2023)

35-40 $ bn
Additional exports in 2030 vs 2023

220-280 $ bn
India production of chemicals by 2030

Net zero
India trade balance in chemicals by 2030

Introduction: Unlocking the potential of India's chemicals industry

India's chemicals industry is a core driver of economic growth, contributing 7 percent to the country's GDP. Today, India is the world's sixth- and Asia's third-largest producer of chemicals.[2] With over 80,000 commercial products, the industry fuels multiple sectors such as agriculture, pharmaceuticals, textiles and automotives. As of 2023, the Indian chemicals market consumption stood at around $220 billion, expected to expand to $400–450 billion by 2030 and $850–1,000 billion by 2040.[3]

While the industry has shown a consistent growth trajectory, addressing a few challenges could help bolster momentum and further unlock its potential. Limited feedstock availability, lack of adequate infrastructure, regulatory concerns and shortage of skilled talent are some areas that could benefit from closer attention.

Strategic initiatives, including sustainability efforts and backward integration, are essential for enhancing market attractiveness and cost-competitiveness to position India' chemicals industry as a global challenger.

The Indian government could to play a significant role in achieving the industry's goals. This report outlines the journey of the Indian chemicals industry so far, proposes a roadmap to achieve its aspirations, and focuses on seven specific areas where policy interventions could transform the industry. By addressing these critical areas, India's chemicals industry can not only achieve its growth targets but also emerge as a global leader in the chemicals sector, contributing significantly to the nation's vision of becoming a $5 trillion economy.

2 https://www.ibef.org/industry/chemical-industry-india
3 IHS Markit, UN Comtrade, ITC Trademap

India's chemicals landscape: Outlook and aspiration

01

India's participation in the global chemicals market is on the rise. The country accounted for 3 to 3.5 percent of global chemicals consumption in 2023, a figure expected to rise to 10 to 12 percent by 2040 (Exhibit 1). With strong tailwinds driving growth, this sector presents significant opportunities for expansion.

However, as a net importer of chemicals with a trade deficit of around $31 billion[4], India faces a complex challenge. The high import requirements for the country point to a shortfall in domestic production and the urgent need to improve domestic manufacturing capabilities. By strategically addressing gaps in domestic capacity, India has the potential to transform its chemicals industry and move towards becoming a net zero importer by 2030, positioning itself as a key player in the global market.

Current consumption and trade balance

Petrochemicals, specialty and inorganic chemicals are the three key categories in India's chemicals industry by market consumption size (Exhibit 1).

Petrochemicals: These chemicals are derived from petroleum and natural gas through a refinement process and are also known as petroleum distillates. The segment includes polymers, synthetic fibers, performance plastics and others. The category is further divided into building blocks (ethylene, propylene, benzene, butadiene, etc.), intermediates—terephthalic acid (PTA), styrene, vinyl chloride monomer (VCM), phenol, etc.—and end-products i.e. high density polyethylene (HDPE), linear low density polyethylene (LLDPE), polyvinyl chloride (PVC), among others. Petrochemicals forms the biggest chemicals segment, with consumption of $65 to 75 billion (Exhibit 1). The production - consumption gap in these has remained negative over the years.

Specialty chemicals: Chemicals with high value but low production volume are considered specialty chemicals, such as paints and coating, dyes, agrochemicals, surfactants, textile chemicals, to name a few. They facilitate function-specific products tailored for industries like pharmaceuticals, agriculture, and personal care, driving innovation and customization. Specialty chemicals are a highly research and development-intensive category, accounting for over 50 percent of the total chemical exports from India. This category constitutes around $40 to 45 billion of market consumption.

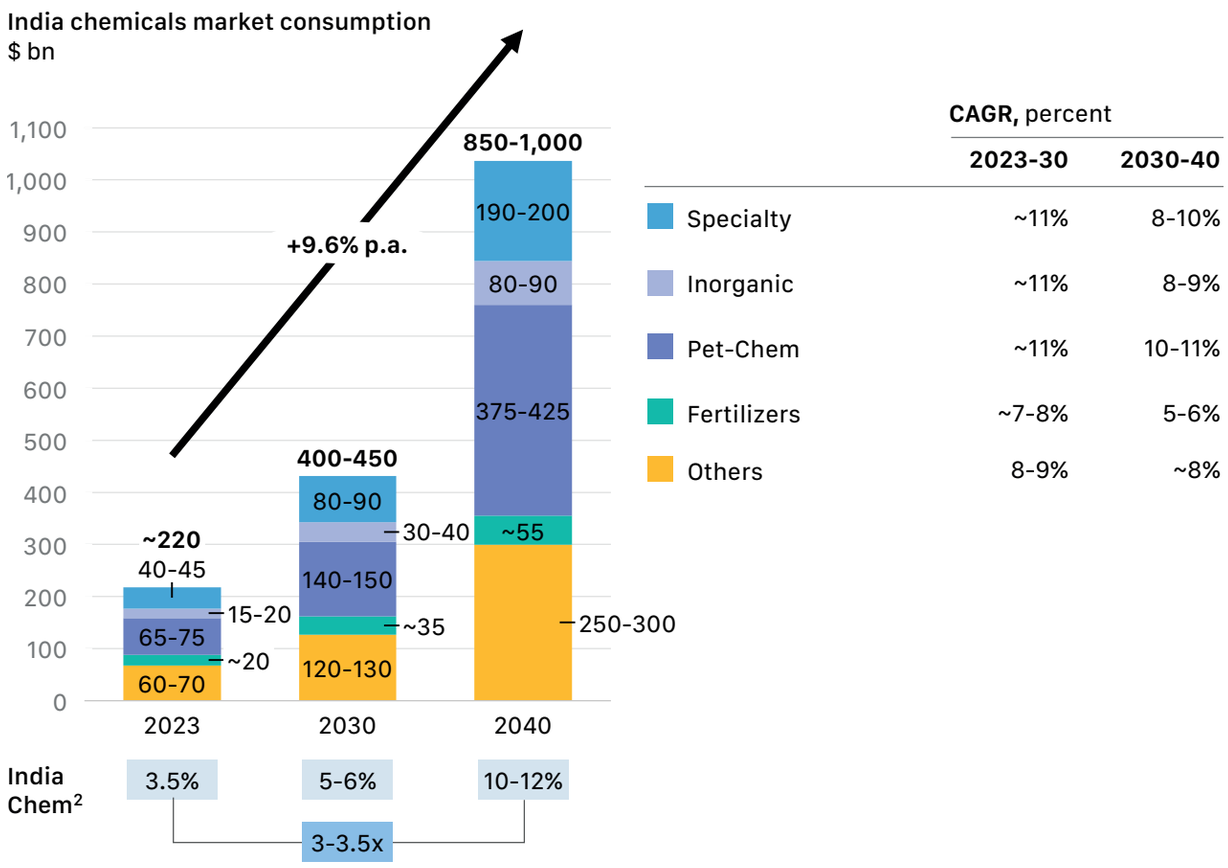
Inorganic chemicals: Fundamental to India's industrial base, these chemicals provide essential materials for applications in construction, water treatment and electronics, among other sectors. Inorganic chemicals are a broad category of compounds that do not contain carbon-hydrogen bonds but encompass a variety of substances such as metals, salts and minerals. These chemicals find application in numerous industries, including agriculture (ammonia in fertilizers), manufacturing (hydrogen peroxide for surface treatment of metals), food processing (sodium hydroxide) and many more. The market for these chemicals is driven by their diverse applications and the availability of raw materials. Inorganics make up $15 to 20 billion of the total market consumption.

Other "non-core" chemicals categories include fertilizers, pharmaceutical products (vaccines, injectables, OSDs, etc., such as Meloxicam capsules, poliomyelitis vaccine and Atazanavir tablets) and medical devices (e.g., medical impregnated wadding, gauze, bandages, dressings and surgical gut string) per the industry division 21 of National Industrial Classification (NIC) and personal-care consumer products (e.g., shampoo, hair oil, toothpastes, soaps and detergent) per the industry division 20 of NIC. Together, they contribute around $90 billion in market consumption.

[4] ITC Trade Map, Chapters 28. 29, 32, 38, 39, and 40

Exhibit 1

A snapshot of India's chemicals market



[1] Includes fertilizers, pharma products (vaccines, injectables, OSDs etc. e.g. Meloxicam capsules, Poliomyelistis vaccine, Atazanvir tablets etc.) and medical devices (e.g. medical impregnated wadding, gauze, bandages, dressings, surgical gut string etc.) as per the industry division 21 of NIC. Also includes personal care consumer products (e.g. Shampoo, hair oil, toothpastes, soaps & detergent etc.) as per the Industry division 20 of NIC

[2] Excluding others as % of Global Chem

Source: IHS Markit, UN Comtrade, ITC Trade Map

Tailwinds for consumption growth

India's share in the chemicals global value chain (GVC) is expected to reach $400 to 450 billion by 2030, with an estimated compound annual growth rate (CAGR) of 10 to 11 percent. Some macro factors expected to contribute to the growth and global competitiveness of India's chemicals industry include rising disposable incomes, growing urbanization, shifting consumer preferences, and a reshaping of the global supply chain, among others.

A crucial trend is the rise in disposable incomes in India, expected to contribute $1.5 trillion in household consumption growth by 2030[5]. Expected to become the world's third largest economy by that year, India is expected to see around 140 million new households enter the consuming class, with each household earning over $10,000 a year

[5] GDP projections

(Exhibit 2). This transition is set to create substantial demand for chemical products. Additionally, urbanization and evolving consumer preferences for sustainable and health-conscious options could drive demand for specialty chemicals and innovative solutions. Another tailwind is the supply-chain disruptions seen in recent years that highlighted the vulnerabilities within these networks.

From a once-in-a-generation pandemic to geopolitical crises and natural disasters, various disruptions are prompting global companies to diversify their supply chains. This presents an opportunity for India to emerge as an ideal trade partner, leveraging its manufacturing base and boosting its export capabilities.

India's position as a net importer of chemicals

In 2023, India imported chemicals worth $75 billion compared to exports worth $44 billion, accounting for a trade deficit of around $31 billion (Exhibit 3). Back in the year 2000, India had a net zero trade balance. Rising imports of plastics, inorganics and chemicals have since caused a growing deficit over time. Heavy domestic reliance on petrochemicals, too, contributes substantially to the trade imbalance.

India imports its highest volume of chemicals from China (30 to 35 percent).

The United States, Southeast Asia, South Korea, Japan, Saudi Arabia, Germany, UAE, Kuwait and Italy are other significant import partners for chemicals in India (Exhibit 4).

China is also an export partner for chemicals, accounting for 5 percent of India's total export value. The other significant export partners include the United States, Southeast Asia, Brazil, UAE, Germany, Netherlands, Saudi Arabia, Belgium and Japan.

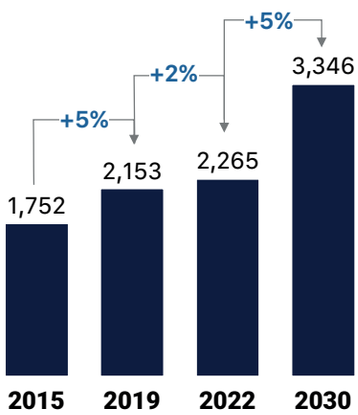
Growing chemicals production for India and the world

Exhibit 2

The growth in incomes fueling a rise in consumption in India

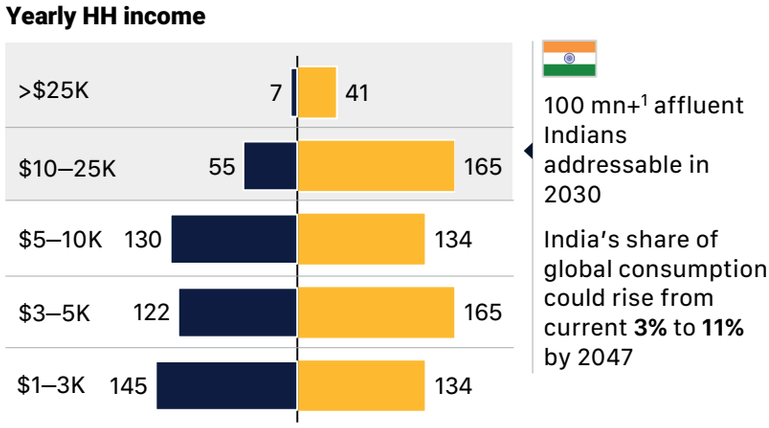
Per capita incomes are expected to increase

Nominal per capita income, $



Rising household incomes expected to lead a ~1.5 trillion growth in HH consumption by 2030

# of households by annual income bracket[1], mn



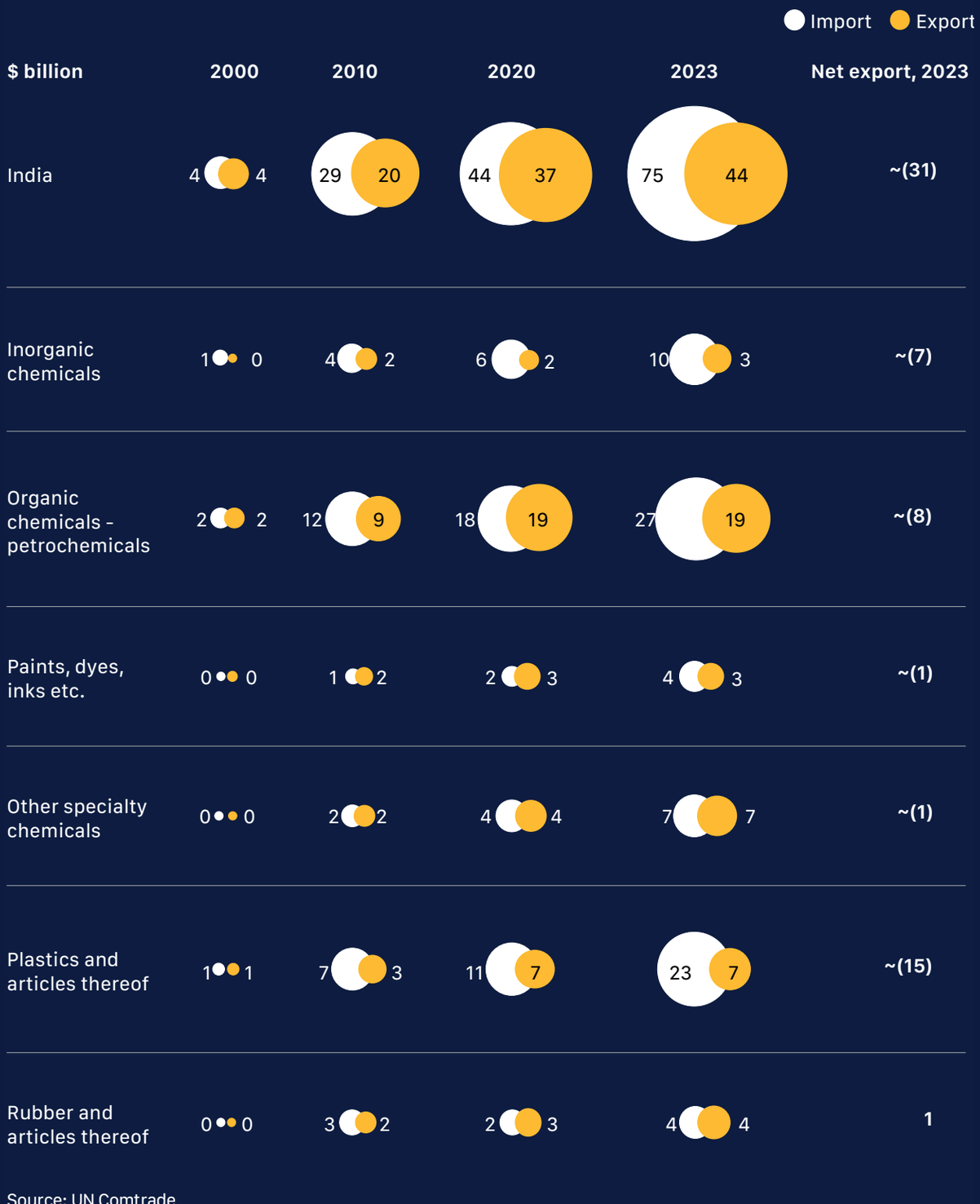
[1] Assuming 2 addressable people in household in >$25K segment and 20% of households addressable in the >$10K segment (2 addressable people in household)

Source: GDP (projections, data and per capita) — EIU 2010 $constant prices, EIU

Exhibit 3

India's growing trade deficit since 2000s

Includes HS chapters inorganic chemicals, specialty chemicals, plastics and rubber



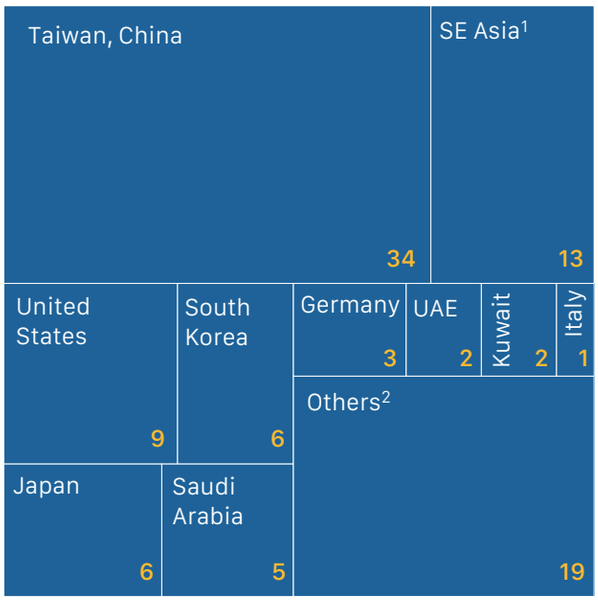
Source: UN Comtrade

Exhibit 4

India's top EXIM partners

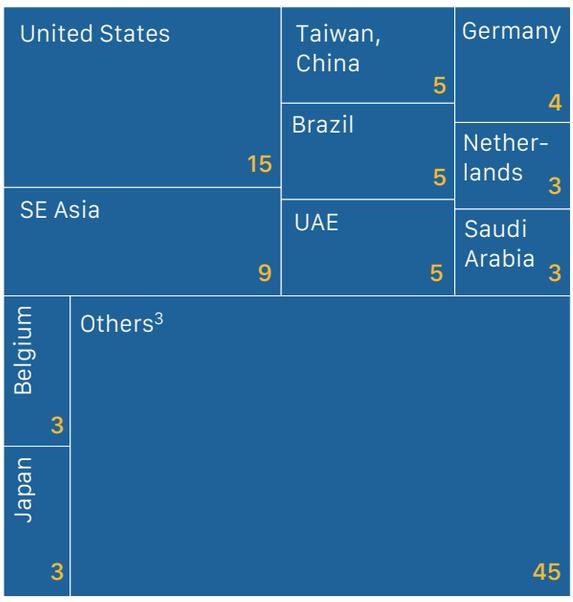
Top import partners

Import value (2023), % **$~75 bn**



Top export partners

Export value (2023), % **$~44 bn**



[1] Includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, and Vietnam
[2] Includes Oman, Qatar, France, Jordan, UK, Belgium, etc.
[3] Includes Bangladesh, Turkey, Italy, UK, Korea, Russia, etc.
Source: ITC Trade Map

Attaining **5-6%** production share of the chemicals GVC

To meet growing demand and consumption of chemicals in India, it will be vital to ramp up domestic chemicals production capabilities. This could help India more than double its share in the chemicals GVC and become a net zero importer. In the process the industry could create 700,000 to 1 million new jobs by the end of this decade.

India aims to substantially expand its participation in the global chemicals market, targeting a 5 to 6 percent share of the chemicals GVC by 2030 (Exhibit 5). In 2023, India produced chemicals valued at approximately $110 billion[6]. By 2030, India's chemicals market consumption is expected to reach around $250 to 300 billion, or around 5 to 6 percent of global consumption. Meeting this demand would require India to double its chemicals production to a range of $220 and 280 billion by 2030.

Becoming a net zero importer

Exports powered by specialty chemicals worth $20 to 25 billion (in net exports), balanced by imports of petrochemicals and inorganics, could help India become a net zero importer by 2030 (Exhibit 6). Consumption CAGR would need to increase by 10 to 11 percent, while production CAGR would need to increase by about 14 percent to achieve this aspiration.

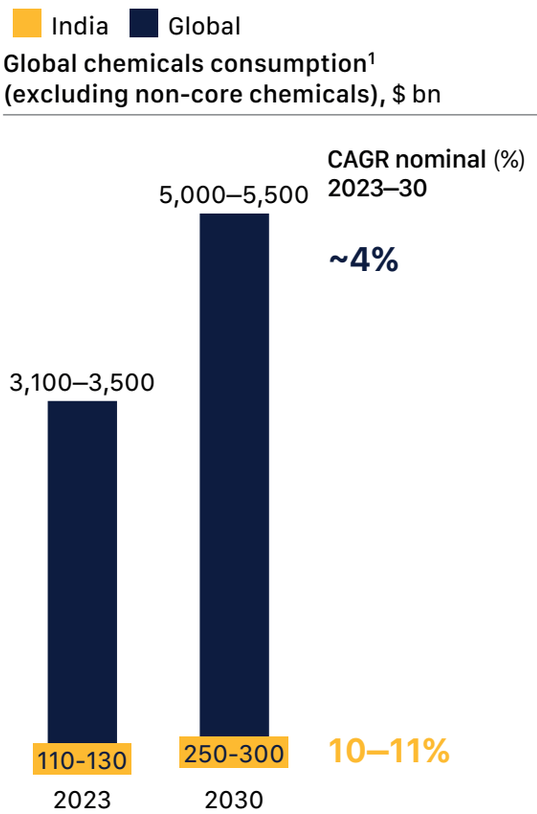
[6] Excluding non-core chemicals

By increasing specialty chemical exports to around $45 billion, driven by dyes and pigments, paints and coatings, agrochemicals, and flavors and fragrances, focused initiatives could significantly improve domestic production capabilities.

The inorganic chemicals segment could contribute a further $5 to $10 billion in exports, while the petrochemicals segment could expand exports from $21 billion to $26 billion. These strategic aspirations are essential to growing India's share of the global chemicals market and decreasing its reliance on imports.

Exhibit 5

India's potential to grow its share in the chemicals global value chain



India chemicals landscape

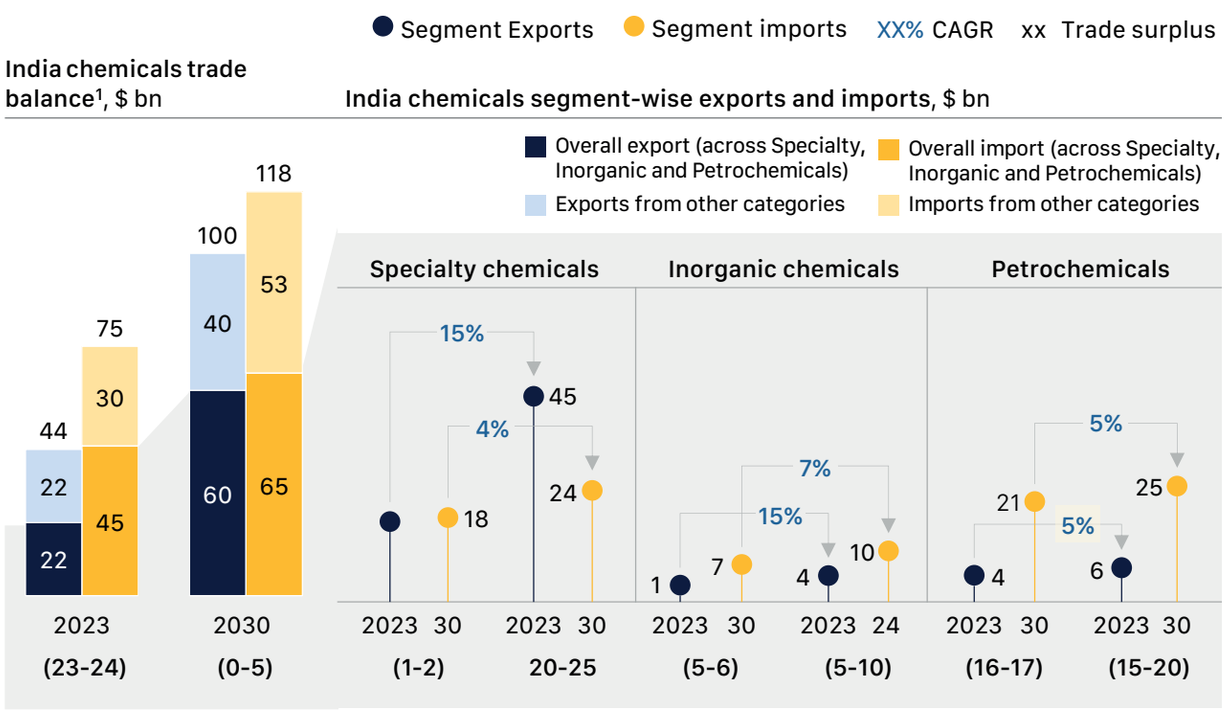
	2023	2030	CAGR nominal (%) 2023–30
India's production share in GVC, %	3-3.5%	5-6%	
India production, $ bn	100-110	220-280	~14%
% consumption	80-90%	~100%	
India trade balance, $ bn	(20-30) Net importer	~0 Net zero	
Total sectoral employment, mn	0.9-1	~1.6 +0.7 Mn	8-9%

[1] Including Petro Chemicals, Specialty Chemicals and Inorganic Chemicals

Source: DCPC Statistics 2022; Table 44 - Employment in Chemicals and Chemical products (Industry Division 20, NIC-2008) from the FY 2014-15 to FY 2019-20

Exhibit 6

The potential growth of Indian exports toward net zero importer status



[1] Excludes fertilizers, pharma end-products and consumer products; includes pharma intermediate chemicals
Source: IHS Markit, ITC Trade Map, McKinsey Global Institute

Reaching these milestones calls for a blueprint that prioritizes the right strategic interventions and investments. Not only could this set India on track for its 2030 aspiration, but it could also unlock the momentum for India to become a $850 billion to $1 trillion chemicals industry by 2040.

The Indian chemicals industry benefits from competitive advantages such as rising domestic consumption, supportive policies and strong manufacturing capabilities. However, challenges like infrastructure gaps, regulatory hurdles and the need for technological advancements need to be addressed to fully realize its aspirations.

Achieving these ambitions will require a structured and strategic approach. The next step is to outline a comprehensive roadmap that identifies measures to overcome barriers and capitalize on opportunities. This includes fostering targeted investments, enabling policy interventions, and building an innovation-driven ecosystem to position India as a leader in the global chemicals value chain.

Case study: The growth story of China's chemicals industry

China has grown its share in global chemicals production five-fold since the year 2000, from 6 percent to 33 to 35 percent (Exhibit 7). A robust petrochemicals and plastics production trajectory growth stems from strategic investments in vital infrastructure, research and development (R&D), and harnessing its unique competitive advantage over the rest of the world[7].

Today, the country's chemicals industry constitutes approximately 23 percent of global exports and 12 percent of global imports (Exhibit 8). China maintains this export dominance while balancing a high domestic demand of 75 to 80 percent. It has evolved from being a net importer in 2010 to becoming a net exporter across categories.

This transformation over two decades began with a phase of massive overinvestment and oversupply, led by state-owned enterprises (SOEs) and a thrust on establishing small to medium-scale production. For example, one of the largest oil and petrochemicals companies in the world was established during this period by integrating operations from refinery to cracker. The industry relied heavily on advanced foreign technologies to improve domestic capabilities. China began localized development of an important chemical feedstock, ethylene, around the year 2000.

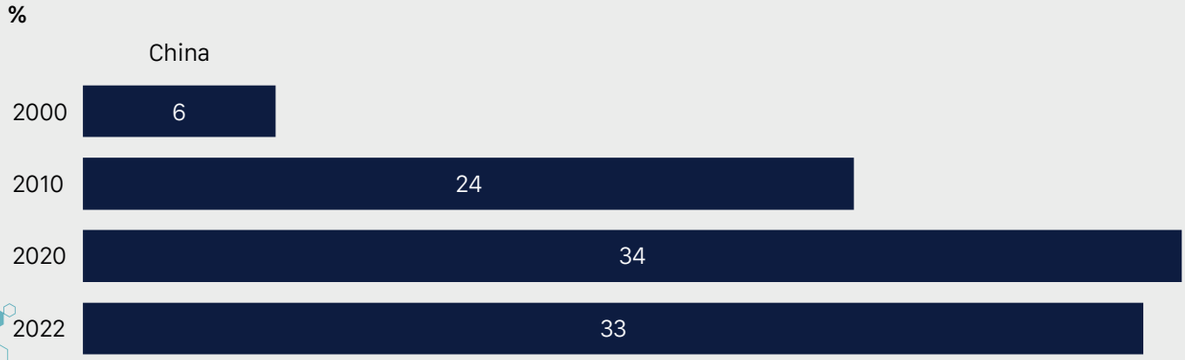
This was followed by a phase of consolidation, with the eventual entry of multinational corporations. Joint ventures (JVs) emerged to leverage the advantages of local feedstocks with advanced foreign technologies. China became the lastest consumer of ethylene. Prominent companies brought in international technology and licenses to enable local production of complex product profiles.

After 2015, the opening of the domestic market led to the rise of private enterprises and the development of domestic technologies. The scale of operations shifted as companies deeply benefitted from the Chinese government's petrochemical policy reforms aimed at driving secondary upgrading[8]. The government focused on updating the chemicals industry with international technology by leveraging matured local upstream capabilities. This led to a rise in privately-owned companies in the country. Most of these were either non-integrated but supported by stable and strong feedstock, or fully integrated from refinery to cracker for large to giant scale production.

[7] UN Comtrade
[8] Secondary upgrading refers to the refining of crude oil to break down heavy, less valuable oil fractions into lighter, more valuable products like gasoline and diesel

Exhibit 7

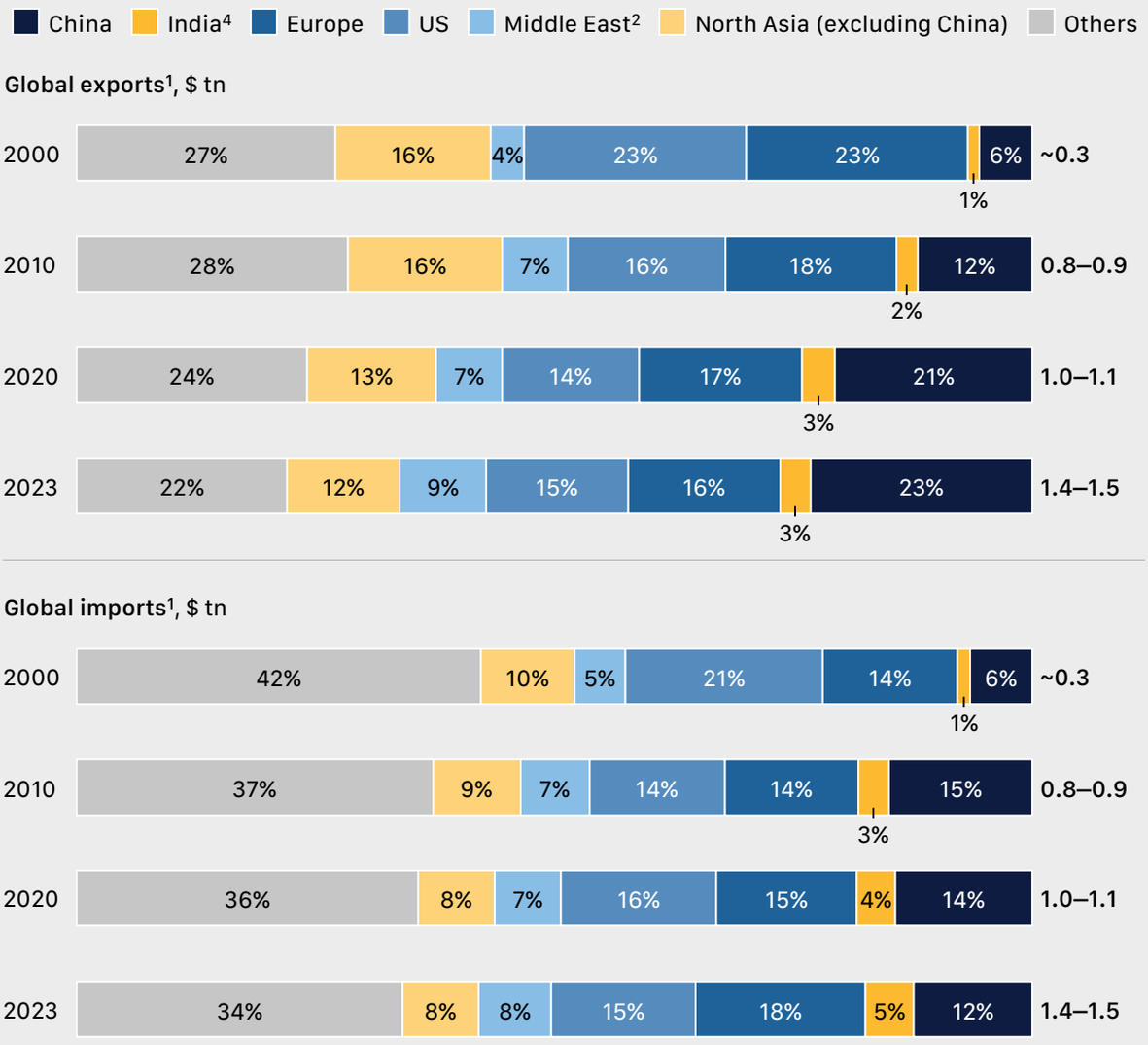
Production of chemicals in China between 2000 and 2022



Source: IHS Global insight; CRISIL report; World Bank; China Chemical Company Database

Exhibit 8

Split of global chemicals exports and imports across geographies



[1] Excludes trade among European countries
[2] Includes all 50 countries in Europe (27 in EU, United Kingdom, Russia, and others)
[3] Includes United Arab Emirates, Bahrain, Iran, Iraq, Cyprus, Egypt, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, Yemen
[4] Includes Japan, Mongolia, Korea (Rep.), Korea (DPR)
Source: UN Comtrade

Since 2020, MNCs have increasingly entered China's chemicals market to establish their base on a sole proprietorship basis. The opening of the Chinese market to MNCs was a significant move that inspired confidence in the location and encouraged major companies (such as the European multinational to make large-scale investments in China. The MNCs brought in self-owned technologies or developed advanced technologies.

The competitive advantages of the Chinese supply chain

The supply chain in China is uniquely competitive, mainly due to its advantageous capital expenditure (Capex) structure, which is around 70 percent of the Capex in western countries.

For MNCs on the lookout for the most cost-efficient location to build their factories, China has emerged as a prime location for investments in recent decades. A few fundamental drivers contribute to the China advantage:

- In China, labor (which comprises 44 percent of overall cost) costs 20 to 40 percent of the cost of labor in the US.
- China boasts 2 to 3 times higher labor productivity compared to other regions, resulting in a more cost-efficient supply chain, with higher output in less time.
- The supplier network in China is one of the most competitive in the world. Constant price battles to gain contracts for key components and materials drive down material costs, ultimately benefiting firms based in China.
- China is one of the few regions in the world to offer an end-to-end domestic supply chain option to investors to set up their operations. Chinese firms can access required materials and services locally, reducing import costs and supply chain bottlenecks for operational efficiency.

While the chemicals industry in China has been steadily growing, it has also experienced some uncertainties due to the economic uncertainity of the past few years, including China's economic slowdown. Geopolitical tensions remain, and many countries have imposed some restrictions on trade with China, such as the US's decision to escalate import tariffs by up to 25 percent in 2018, Germany's declaration of "de-risking" from China by diversifying supply chains away from the country, the European Union's Green Deal Industrial Plan placing tariffs on the imports of titanium dioxide, and more.

The role of the government

China's 14th Five Year Plan[9], drafted in 2020 during the COVID-19 pandemic, emphasized self-sufficiency and set ambitious targets for the chemicals and petroleum industries, including the development of new materials. The planned targets aim for:

- 70 percent self-sufficiency in engineering plastics
- 90 percent self-sufficiency in specialty rubbers and elastomers
- 85 percent self-sufficiency in high-performance fibers
- 75 percent self-sufficiency in all new chemical materials

To achieve these targets, the government has encouraged the development of advanced technologies such as highly selective catalysts, highly efficient purification processes, and carbon capture, utilization and storage solutions (CCUS).

In addition, China's government has set decisive environmental policies and goals for 2025 with the Industrial Green Development Plan, to increase the share of renewables to 33 percent of generated energy, reduce carbon emissions by 2.6 gigatons, control domestic crude oil processing and reduce energy consumption of key products such as ethylene. It aims to hit peak carbon emissions by 2030 with an accelerated path to net zero emissions and a transition roadmap for process decarbonization in key industries. The country has signed the net zero emissions pledge to eliminate greenhouse gas (GHG) emissions by 2060. It will focus on carbon-neutral production and carbon capture along the value chain, using more of renewable electricity and green feedstock among other such initiatives.

To attain self-sufficiency and net zero goals, the Chinese government has helped with supportive policymaking and the easing of

[9] National Development and Reform Commission, China

trade restrictions, which have in turn brought greater foreign investment to the industry.

Supportive policymaking

Proactive policies, such as establishing industrial parks and clusters, have significantly contributed to the country's competitiveness by reducing manufacturing and logistical costs for Chinese firms. The infrastructure in these clusters adheres to modern standards of wastewater treatment, energy efficiency and other regulatory requirements. This eases the compliance burden on individual companies. Additionally, these clusters minimize transportation costs between firms operating in the same sector, further enhancing efficiency.

Easing of trade restrictions

Over the past few years, China has steadily eased restrictions on market access. The number of restrictions in free trade zones dropped from 190 in 2013 to just 27 in 2021. The rising number of new free trade zones, from 1 in 2013 to 21 in 2022, has also helped build China's image as a global player. These zones are designed to attract foreign direct investment by reducing barriers and improving market access.

Growth of investments in China

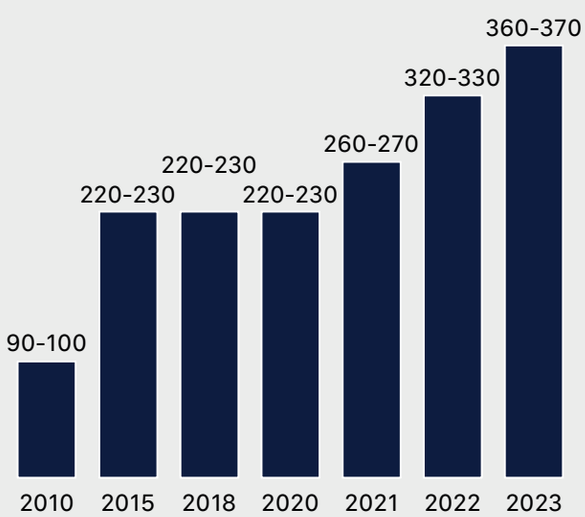
The country has seen a significant rise of capex within the chemicals industry, from ~$100 bn in 2010 to ~$370 bn in 2023 (Exhibit 9). Many major MNCs have made substantial investments in the Chinese chemicals market, highlighting the strategic importance of China in their global footprint.

All these efforts have been part of a concerted approach to leverage the best of China's competitive advantages and resources, along with a strategy to invite foreign investment into the country. This approach has led China's chemicals industry to a leadership position globally—an exemplary transformation from its small share back in the year 2000.

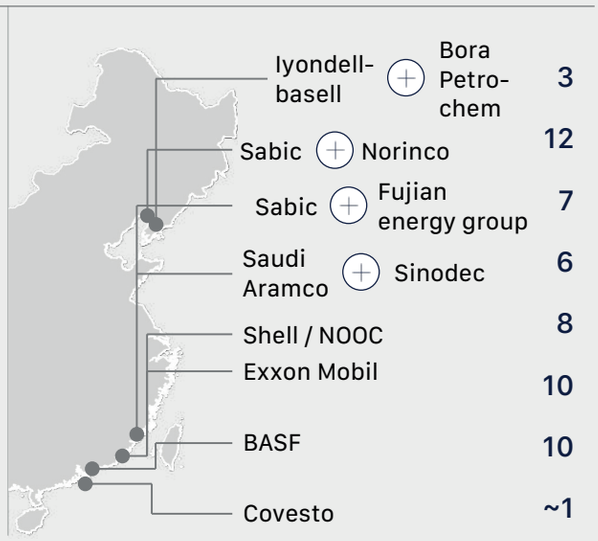
Exhibit 9

The growth of foreign investments in China

Significant increase in chemicals industry CAPEX
$ bn[1]



Recent MNC investment in China (examples)
$ bn



[1] Assuming Yuan to USD conversion ratio of 0.14

Source: Bureau of Statistics

Framework to define roadmap for India's chemical industry

02

Building on the industry's outlook and potential, this section outlines the methodology used to identify key chemical segments for prioritization and categorizes them into strategic focus areas.

By leveraging India's existing strengths and addressing critical challenges, this roadmap aims to position the country as a competitive global leader in the chemicals industry.

Methodology for developing the roadmap for chemical industry

Identification of chemicals to be prioritized for government interventions

An extensive list of chemicals (across petrochemicals, specialty chemicals, and inorganic chemicals) was examined to serve as the foundation of this analysis. These categories were selected based on their potential for growth and development, as well as their significance in contributing to the industry as a whole. The parameters encompass various aspects such as net exports by India, India's share in global trade, potential for value addition by India, availability of technology and processes, extent of imports from a single source, significance of end-markets, accessibility of required feedstock within India, and so on.

Categorization of identified chemicals across four pillars

To develop a roadmap towards achieving the aspiration of a 5 to 6 percent production share in the chemicals GVC by 2030, it is imperative to focus on four distinct pillars (Exhibit 10). The first two focus on supernormal growth for segments that can raise India's standing in the export market and on sunrise segments where India can establish a presence. The other two focus on bridging gaps through an emphasis on easing production bottlenecks and unlocking technology access for accelerated production.

Tapping into the export market

The first pillar highlights the need to capitalize on India's existing comparative advantage and production capabilities in certain segments. Focusing on these strengths can enable India to effectively tap into export markets, boosting its international competitiveness and solidifying its position as a major player in the global chemicals industry. This approach leverages India's potential for growth and profitability by catering to the rising global demand for chemicals such as paints and coatings, polyester fiber, carbon black, and more.

Growing sunrise sectors

The second pillar highlights the importance of developing emerging or sunrise segments within the chemicals industry. Focusing on these segments can enable India to capitalize on new market opportunities, drive innovation and diversify its product portfolio. The objective is to identify and support the growth of segments that are now nascent but could become core contributors to the chemicals industry with the right policy interventions for growth. Segments identified for this pillar are battery chemicals and electronic chemicals.

Solving for production competitiveness

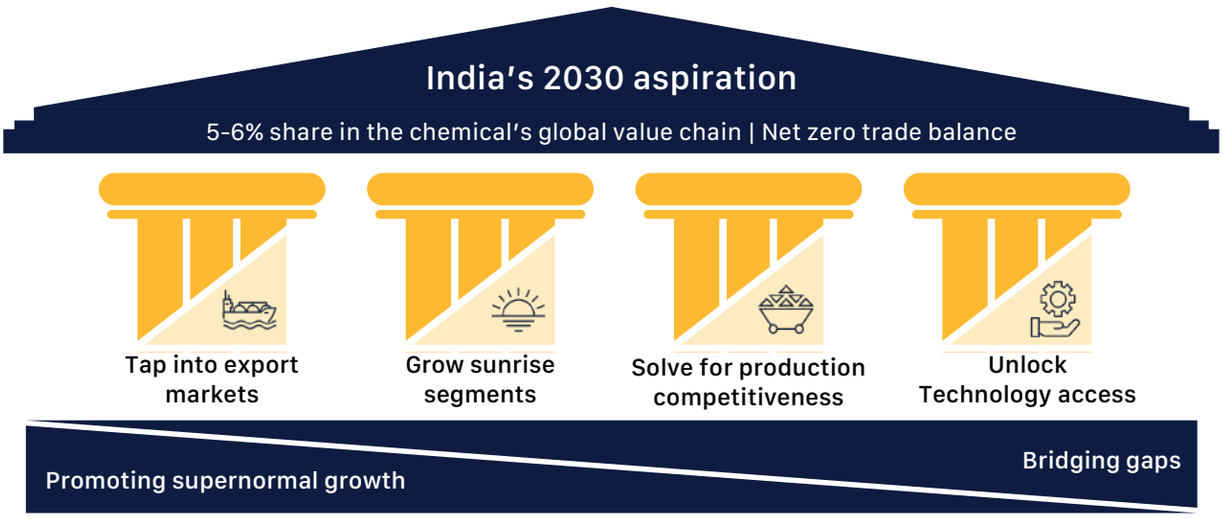
The third pillar involves identifying and resolving issues that hinder the industry's ability to compete effectively in the global market. By improving feedstock access, large-scale production processes and cost efficiency, India could emerge as a cost-competitive manufacturer of chemicals segments such as ethylene-vinyl acetate (EVA), styrene, phenol and nylon 6.

Unlocking technology access

The focus of the final pillar is on acquiring and adopting new technologies required to stay at the forefront of the industry. This includes gaining access to advanced manufacturing processes, investment in R&D capabilities and upskilling the workforce to adopt cutting-edge technologies. Segments identified for this pillar are toluene diisocyanate (TDI)/ methylene diphenyl diisocyanate (MDI), acetic acid and titanium dioxide.

Exhibit 10

The 4 pillars for the chemicals industry's 2030 aspiration



Policy support required across seven dimensions for identified chemicals

A thorough evaluation was conducted to determine the necessary policy support that can enable these prioritized chemicals to facilitate the growth of India's chemicals industry. Each intervention was assessed on potential impact, feasibility of implementation, and extent of industry backing. Encompassing seven key parameters, these interventions represent effective and strategic steps that have the potential to significantly impact the production of the identified chemicals.

These seven dimensions are: Development of infrastructure (e.g., development of port infrastructure for the chemicals industry), financial interventions (e.g., introduction of production-linked incentives (Opex subsidy) for the chemicals industry), R&D interventions (e.g., setting up of an R&D fund for targeted development), talent and skill upgradation (e.g., upskilling labor specifically for the chemicals industry), international cooperations (e.g., revision of free trade agreements to support the chemicals industry), ease of doing business (e.g., simplification of environmental clearance regulations along with maintenance of accountability and transparency) and institutional interventions (e.g., simplification of process across regulatory and governmental bodies).

Development of infrastructure

Optimal infrastructure is a critical starting point to set up any industry for success. Government support could be Policy support required enabler for infrastructure development through two kinds of initiatives:

- Establishing world-class chemical hubs in India through cluster-based development under Petroleum, Chemicals, and Petrochemical Investment Regions (Chemical hubs).
- Improving infrastructure at strategically important ports (e.g., Dahej and Paradip) for the storage and handling of hazardous chemicals and gases.

Financial support

Lack of funding can significantly impede large-scale growth and development. Supportive financial policies could thus prove to be a crucial unlock for chemicals manufacturing in India. These supportive policies could include:

— Introducing production-linked incentive (Opex subsidy) schemes to support incremental production of chemicals (based on the import bill) such as styrene, acetic acid, EVA, agrochemicals, dyes and pigments, and titanium dioxide. This could promote domestic manufacturing, reduce imports and improve global competitiveness. This intervention has proved impactful in other industries such as fruits and vegetables, and electronics manufacturing.

R&D and technology investments

Continuous research and development is essential for any industry to innovate, upgrade, and make new discoveries. For the chemicals industry, R&D is a critical lever to explore additional possibilities, optimize production techniques, adapt environment-friendly processes and develop sustainable products. This requires strategic investment to promote and embed R&D where it matters most.

Supportive policy initiatives could include:

— **Developing indigenous technologies and unlocking prioritized technologies to foster innovation and self-sufficiency:** The creation of an R&D fund under private and public sector collaboration can help focus attention on R&D required to manufacture "new" products, develop technologies in sustainable and green chemistries (that could help India proactively match carbon border adjustment mechanism (CBAM) requirements), develop technologies for applications tailored for India, and to develop domestic technologies for high-value products for which Indian manufacturers don't have ready access to international technologies. MNCs could also get involved in important areas to work in a targeted manner toward select, prioritized technologies.

Talent and skill upgradation

A skilled workforce capable of meeting evolving needs is crucial for the long-term success of any industry. For the chemicals industry, this could be possible through policy support aimed at:

— Establishing Industrial Training Institutes (ITIs) close to chemical belts via a public-private partnership (PPP) model.

— Launching industry-specific courses with clear mapping of critical roles (e.g., operator, technician, etc.) and shop-floor apprenticeship programs with the support of chemical zone industrial associations. Ensuring that the updated curricula of universities and the ITIs remain in sync with the latest industry developments and needs. This will empower the graduating students with the relevant knowledge and skill base.

— Attracting and retaining talent through supportive mechanisms such as 10-year income tax breaks for Indians working abroad, and other welcome advantages. While India will make up around 20 percent of the world's working-age population by 2047 owing to its demographic dividend, it will be important to keep the talent in India[10].

[10] https://indbiz.gov.in/india-can-become-us40-trillion-economy-by-2047-if-the-working-population-is-employed-cii/

International cooperation

Government policies could also promote international cooperation that paves the way for meaningful knowledge and technology exchange partnerships with leading chemicals producers in the world, through some of the following initiatives:

- Encouraging partnerships with MNCs on specific technology development for the country.
- Revising existing free-trade agreements (FTAs) to ease partnerships for robust and dynamic trade relations with more countries and companies.

Ease of doing business

Over the past decade, India has considerably eased the regulatory burden for business operations by streamlining regulations, digitizing processes, and improving infrastructure. Its efforts in this domain have been widely recognized, and the country is now being seen as a more attractive business destination. India's ranking in the World Bank's Doing Business report, which, until 2020[11], ranked countries on their regulatory environment's supportiveness for business operations, steadily improved over the years. From ranking 142nd of 190 economies in 2014, India reached the 63rd position in 2020 through a focused effort to be a more conducive business destination.

In tandem with encouraging foreign investment and presence in India, government policies could further attend to ease of doing business for the chemicals industry in India through a few impactful interventions, such as:

- Simplifying and fast-tracking environmental clearance (EC) processes. It would help to club the Expert Appraisal Committee (EAC) and Environmental Impact assessment authority (EIAA) into a single committee for faster approvals. Companies could be allowed to initiate civil construction activities on site at the developer's risk, if a public hearing is not required. There could be a provision for a "deemed EC" if clearance is delayed beyond 270 days. Companies could also work faster if ECs were eased for capacity enhancements or product mix changes.
- Accelerate approvals for priority segments, such as chemicals that are part of a potential Opex subsidy scheme, aiming for clearance within a 30- or 60-day period.

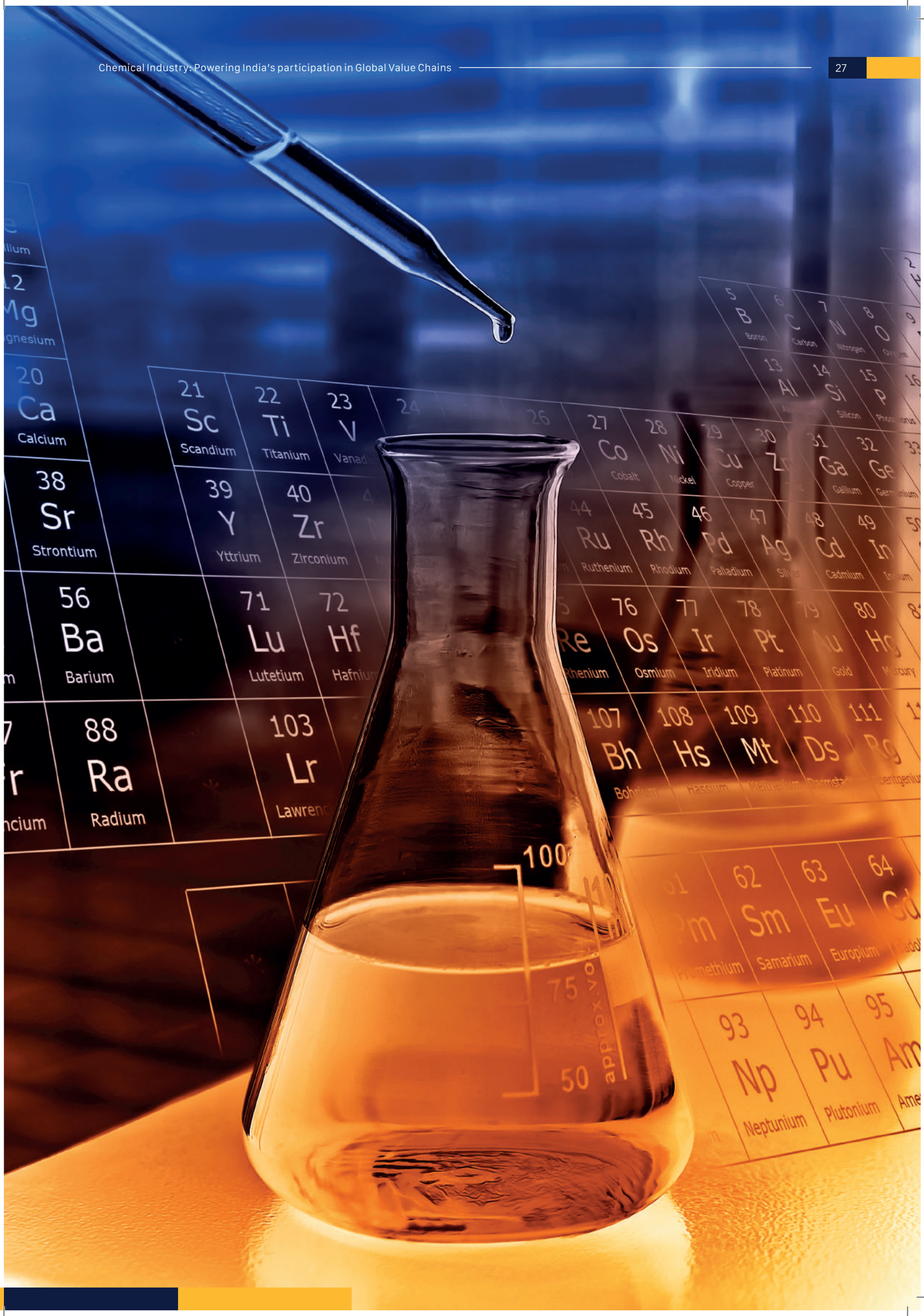
Institutional interventions

At the institutional level, policies could embed processes and standards that accelerate production to global quality, through interventions such as aligning Indian chemicals export standards with global export standards and expediting Bureau of Indian Standards certification for more chemicals. Towards this, the government could support the setting up of 50 to 60 world-class laboratories across the country for standardized quality and testing of chemicals.

In addition, the government could encourage the drafting of a national 02C blueprint that captures the country's overall strategy on fuel, bulk and specialty products. It could also streamline processes across regulatory bodies and governing ministries to help fast-track environmental clearances that may be held up due to multiple check-points across these entities.

Seven focused initiatives or structural shifts to address these focus areas form the crux of this report. They are explained in greater detail in Section 3.

[11] https://www.worldbank.org/en/news/statement/2021/09/16/world-bank-group-to-discontinue-doing-business-report


Calcium
Strontium
Barium
Radium
Scandium
Titanium
Yttrium
Zirconium
Lutetium
Hafnium
Lawrencium
Cobalt
Nickel
Copper
Ruthenium
Rhodium
Palladium
Cadmium
Rhenium
Osmium
Iridium
Platinum
Gold
Bh
Hs
Mt
Ds
Samarium
Europium
Neptunium
Plutonium
Boron
Carbon
Nitrogen
Silicon
Gallium
Indium
100
75
50
approx vo

Structural shifts to help expand India's presence in the chemicals global value chain

03

Introduction

Having explored a suitable framework to develop a strategy for advancing India's chemicals industry, this chapter focuses to the measures required to translate those ambitions into reality. The data collected to support these measures results from multiple stakeholder conversations with representation from industry players, industry bodies, academia, relevant government departments and field visits. While the roadmap outlined strategic goals and opportunities, achieving them require targeted support that address both immediate challenges andlong-term enablers.

By aligning efforts across stakeholders and tackling systemic inefficiencies, India can not only scale its global presence but also create a resilient and competitive chemicals ecosystem. Together, these initiatives aim to transform aspirations into actionable progress.

List of recommended Interventions

Intervention 1: **Establish world-class chemicals hubs in India**	**1.1** Establishment of empowered committee at the Central level along with creation of a Chemical Fund under the empowered committee with a budgetary outlay for shared infrastructure development, VGF, etc.
	1.2 Administrative body at the chemical hub level, which will handle the overall management of the hub
Intervention 2: **Develop existing port infrastructure**	**2.1** Composition of a Chemical Committee for ports to advise on and address infrastructural gaps in chemical trading at ports
	2.2 Development of 8 high-potential clusters
Intervention 3: **Introduce a Opex subsidy scheme for chemicals**	**3.1** Incentivize incremental production of chemical based on import bill, export potential, single source country dependence, end-market criticality etc. The scheme proposes for incentives on incremental sales to selected participants for a fixed number of years
Intervention 4: **Develop and access technologies to enhance self-sufficiency and foster innovation**	**4.1** Disbursement of R&D funds to drive innovation with enhanced collaboration between industry and academia through creation of an interface agency in collaboration with DCPC and DST
	4.2 Acquiring access to specific technologies available outside India through fostering MNC partnerships
Intervention 5: **Fast-track environmental clearance with transparency and accountability**	**5.1** Fast-track environmental clearance with transparency and accountability – Simplify and fast-track EC clearance process through setting up an audit committee under DPIIT to monitor timelines and compliance and publish periodic reports and give more autonomy to EAC

Intervention 6:

Securing FTAs to support Industry growth

6.1 Targeted FTA negotiations: Moving forward, India could negotiate FTAs that incorporate specific provisions for the chemicals industry. This can include incorporating industry focused protections such as tariff quotas or selective duty exemptions on critical raw materials and petrochemical feedstocks

6.2 Awareness and effective utilization of FTAs: Raising FTA awareness, simplifying procedures, and easing origin proofs can help more exporters access benefits and boost competitiveness

Intervention 7:

Talent and skill upgradation in the chemical industry

7.1 Expansion of ITIs and specialized training institutes: The expansion is essential to meet the growing demand for skilled labour

7.2 Upgrading faculty and teacher training: The effectiveness of vocational training programme is directly linked to the quality of instruction

7.3 Industry-academia partnership: These collaborations can introduce industry-relevant courses in core areas like petrochemicals, polymer science, and industrial safety

Initiative 1: Establish world-class chemicals hubs in India

To enhance the effectiveness and global competitiveness of India's chemical industry, a revised governance and operational framework for Chemical Parks has been proposed by the Indian government through DCPC. This new structure emphasizes centralized coordination, state-level autonomy, and seamless integration of stakeholders, with clearly defined accountability and responsibilities. India can adopt practices from successful global chemical parks such as Jurong in Singapore, which contributes to around 3% of Singapore's GDP[12], and employs thousands of people. The Ludwigshafen Chemical Park in Germany, one of the largest in the world, generates approximately €20 billion in annual revenue (as of 2020)[13]. In Saudi Arabia, the Jubail Industrial City is a prime example, housing over 100 companies and producing about 7 per cent of the world's petrochemicals[14], generating thousands of jobs. By adopting best practices from these global examples, India can replicate their success and significantly improve the performance and competitiveness of its own chemical industry.

The current scenario

Introduced through a policy resolution in 2007, India's[15] Mega-Chemical Industrial Estates, now known as Petroleum, Chemicals, and Petrochemicals Investment Regions (chemical hubs), are special economic zones in India aimed at facilitating the production of petrochemicals and petroleum through strategic investments and infrastructure development. India has four approved chemical hubs, in Visakhapatnam (Andhra Pradesh), Dahej (Gujarat), Paradip (Odisha), and Cuddalore and Nagapattinam [16](Tamil Nadu).

Institutional framework for Indian chemical hub[17]

Policy Framework

In the policy for the Petroleum, Chemicals and Petrochemicals Investment Region (chemical hub), initially designed in 2007 and after several amendments over the years, a High-Powered Committee was proposed as the central coordinating authority and Management body at the chemical hub level.

Led by the Department of Chemicals and Petrochemicals (DCPC), chaired by the Cabinet Secretary and including senior officials from central ministries, the High-powered committee aimed to oversee chemical hub proposals, monitor project implementation, and ensure regulatory compliance. At the chemical hub level, Management Boards, potentially in the form of Special Purpose Vehicles (SPVs), were to handle master planning, infrastructure development, and investment facilitation.

The composition, leadership and responsibilities of High-Powered Committee and Management Boards were designed to be as follows:

The High-Powered Committee

Composition and Leadership:

- Chaired by the Cabinet Secretary, the committee includes senior officials from central ministries and departments
- The Secretary of DCPC will serve as the Convenor, ensuring alignment with national chemical industry objectives

[12] https://www.sg101.gov.sg/resources/connexionsg/til-jurong-island/
[13] https://www.basf.com/in/en/who-we-are/organization/locations/europe/german-sites/ludwigshafen
[14] https://middleastfreezone.com/En/Jubail-Industrial-City
[15] https://chemicals.gov.in/sites/default/files/Policies/PCPIRPolicy.pdf
[16] The Cuddalore and Nagapattinam cluster is on hold at present.
[17] https://chemicals.gov.in/sites/default/files/Policies/PCPIRPolicy.pdf

— Additional members can be co-opted as needed, and Chief Secretaries of state governments may be invited for region-specific deliberations

Responsibilities:

— Strategic Oversight: Evaluate and approve chemical hub proposals to ensure alignment with industrial and environmental standards

— Implementation Monitoring: Oversee project progress, address bottlenecks, and coordinate with state-level bodies for streamlined development

— Regulatory Integration: Facilitate environmental clearances and ensure regulatory compliance by working across ministries and stakeholders

Management Boards for each chemical hubs

Composition and Leadership:

— The Management Board may take the form of an SPV headed by a CEO, ensuring streamlined decision-making

— It will include representatives from developers, co-developers, and anchor tenants, fostering collaboration among public and private stakeholders

Responsibilities:

— Master Planning: Develop and enforce a detailed Master Plan to guide infrastructure development, land use, and resource allocation

— Infrastructure Development: Oversee the establishment of shared utilities, transportation networks, and residential facilities to support industrial growth

— Investment Facilitation: Identify and promote investment opportunities, streamline approvals, and foster partnerships between anchor tenants and downstream industries

— Operational Coordination: Ensure compliance with environmental standards, resolve disputes, and provide operational support to investors

However, this structure was not effectively implemented on the ground. The chemical hub policy has faced gaps between policy formulation and on-ground implementation. Among chemical hubs, only Gujarat witnessed a dedicated chemical hub level management board being formed.

Overview of India's Petroleum, Chemicals, and Petrochemicals Investment Regions (chemical hubs)

The development of India's chemical hubs has faced several challenges, including operating difficulties, contractual issues, and reluctance from international chemical companies to enter ventures without majority shareholding. Addressing these challenges is crucial for realizing the full potential of the chemical hubs and developing a world-class chemical industry in India.

Gujarat chemical hub (Dahej)[18]: The Gujarat chemical hub in Dahej covers 465 square kilometers and is India's most active and successful chemical hub. It hosts the largest petrochemical plant in India, operated by OPaL, and has attracted over ₹1.2 lakh crore in investments, creating employment opportunity to thousands of people. With respect to the current institutional structure at Gujarat chemical hub, the Gujarat Petroleum, Chemicals and Petrochemicals Special Investment RDA (GPCPSIRDA) is responsible for the overall planning, execution, and regulatory functions. However, while the region has made significant strides, there is still a need to further enhance coordination and optimize infrastructure development to maintain and accelerate growth.

Odisha chemical hub (Paradip):[19] The Odisha chemical hub in Paradip spans 275 square kilometers and has attracted over ₹50,000 crore in investments. With respect to the current institutional structure

[18] DoCPC Annual Report and website https://chemicals.gov.in/pcpir, JTC website, press search, Team Analysis

[19] https://investodisha.gov.in/Application/uploadDocuments/Content/Petroleum_Chemicals_Petrochemicals_Investment_Region.pdf

at Odisha chemical hub, the Odisha Industrial Infrastructure Development Corporation (IDCO) oversees infrastructure development, land allocation, and investment facilitation. However, IDCO operates across multiple industries, not exclusively within chemicals, which can impact the focused growth of the chemical hub. Additionally, the Industrial Promotion and Investment Corporation of Odisha (IPICOL) acts as the single point of contact for all industrial investments in the state. To further drive success, there is a need for a more dedicated focus on the chemicals sector within the chemical hub framework.

Andhra Pradesh chemical hub[20] (Visakhapatnam to Kakinada)[21]: The chemical hub spanning 640 square kilometers between Visakhapatnam and Kakinada has attracted ₹20,000 crore in investments. Despite its strategic coastal location, the region lacks a finalized anchor tenant and faces significant challenges in land acquisition, regulatory clearances, and logistical support. The Andhra Pradesh Industrial Infrastructure Corporation (APIIC) is the nodal agency for managing the implementation of the chemical hub, but it also oversees a range of industries, not specifically focusing on the development of the chemical hub. Strengthening infrastructure and regulatory processes, as well as securing anchor tenants, will be essential for realizing the region's full potential.

Tamil Nadu chemical hub (Cuddalore and Nagapattinam)[22]: The Tamil Nadu chemical hub, covering Cuddalore and Nagapattinam, is strategically located near major ports and has the advantage of European company presence to fuel industrial growth. However, the region faces challenges in environmental sustainability, local community engagement, and infrastructure development. Despite its significant potential, addressing these concerns, enhancing connectivity, and fostering stronger local industry support are key areas that require improvement to attract further investments and maximize the region's industrial capabilities.

In conclusion, while the chemical hubs in Gujarat, Odisha, Andhra Pradesh, and Tamil Nadu have made some progress in attracting investments and creating jobs, there are still critical areas that need further attention to fully realize their potential. To maintain global competitiveness, these regions would need to improve infrastructure, streamline regulatory processes, prioritise sectoral growth, and address environmental and community issues.

20 INDIA Port Infrastructure: Chemicals report by J.M. Baxi , Maritime India Vision 2030 report, team analysis
21 Envoronment Clearance report for Development of VK-PCPIR at Visakhapatnam & East Godavari Districts, Andhra Pradesh
22 DoCPC Annual Report and website https://chemicals.gov.in/pcpir, JTC website, press search, Team Analysis

Case study: Jurong Chemical Park

Jurong Island in Singapore has emerged as a global leader in the chemical industry, ranking among the top 10 hubs worldwide in terms of chemical exports. With an impressive $40 billion investment to enhance its production capacity, Jurong Island has attracted more than 100 chemical companies. This case study explores the factors contributing to the success of Jurong Chemical Park (Exhibit 11).

1. **High production capacity and strong feedstock integration:** Jurong Island boasts a substantial cracker capacity of 4 MMTPA for ethylene and 2.5 MMTPA for propylene, ensuring efficient petrochemical production and a steady supply of raw materials for downstream industries. The robust integration with anchor tenants guarantees a reliable and consistent feedstock supply, minimizing disruptions and ensuring smooth operations
2. **Well-developed shared infrastructure:** The island features well-developed shared infrastructure, including utilities and logistics that lower operational costs and enhance overall efficiency. Companies benefit from common facilities for power, water, and waste management, reducing redundancy and fostering a collaborative environment
3. **Excellent strategic connectivity and logistics support:** Jurong Island's strategic connectivity through ports, railways, and road networks ensures the seamless transportation of raw materials and finished products. The island's proximity to major shipping routes and its state-of-the-art port facilities enable efficient import and export operations, making it a vital hub for global chemical trade. Additionally, Jurong Island has two logistics parks that offer comprehensive logistics and supply chain support, further streamlining operations for chemical companies
4. **Effective governance and proactive role of the government:** Effective governance and streamlined regulatory processes create a conducive business environment, with clear guidelines and efficient approval processes that minimize bureaucratic delays. The Singaporean government, which owns Jurong Island and supports third-party service providers for utilities, storage, and maintenance, ensures continuous improvement and maintenance of infrastructure and services to meet the needs of the chemical companies
5. **Sustainability initiatives and future potential:** Jurong Island has been identified as a potential site for Carbon Capture and Storage (CCS). This aligns with global sustainability goals and positions Jurong Island as a forward-thinking hub in the chemical industry. The potential for CCS, along with other sustainability initiatives, underscores Jurong Island's commitment to environmental stewardship and sustainable industrial practices

These strategic advantages collectively create a conducive environment for chemical companies to thrive, making Jurong Island a benchmark of success in the global chemical industry.

Lessons for India from Jurong's success story

A comparison of chemical hubs in India with Jurong Island, across investments, infrastructure, and operations (Exhibit 12), highlights the potential for Indian chemical hubs to boost competitiveness and offers useful lessons for the way forward.

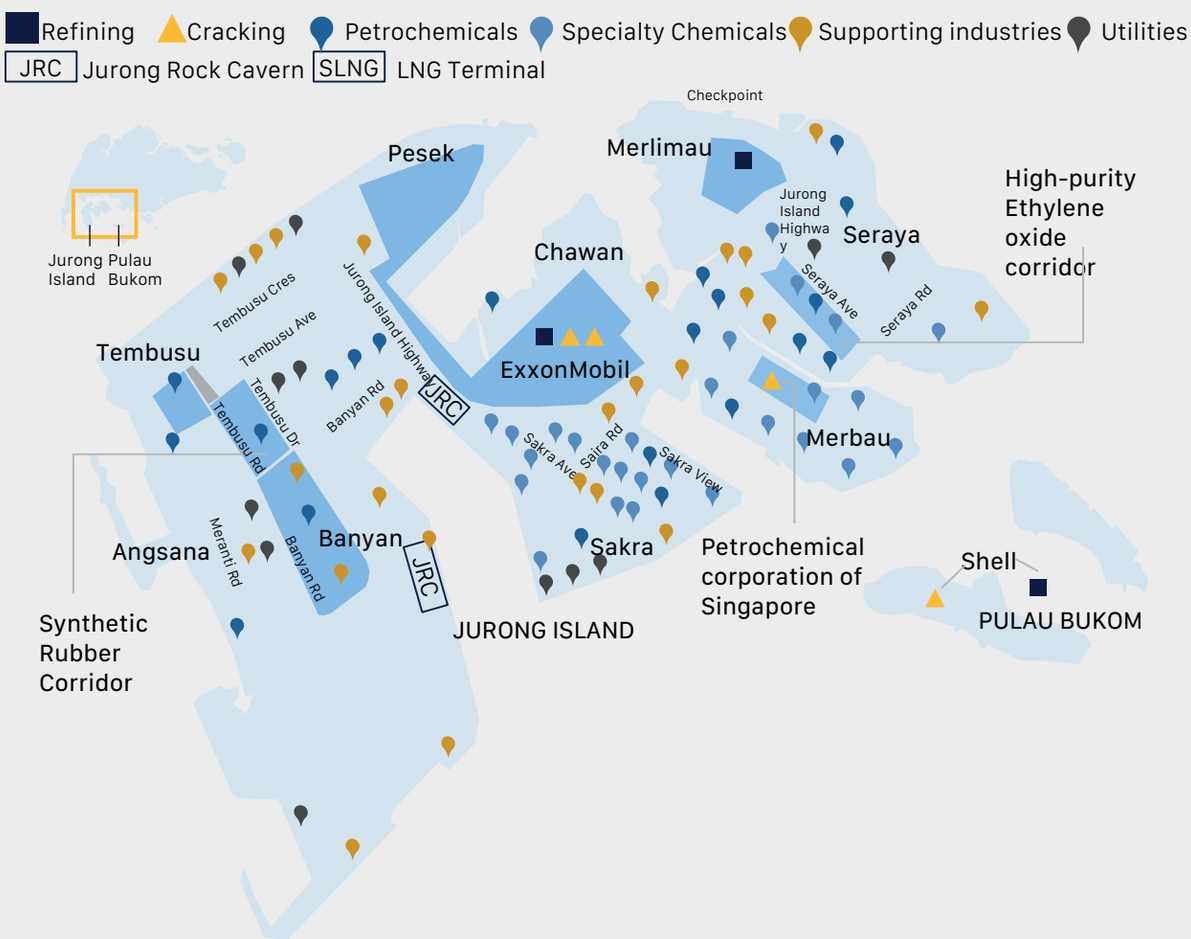
Jurong Island serves as a prime example of successful, world-class and cluster-based infrastructure development. With substantial investment in high cracker capacity, it efficiently produces essential petrochemicals like ethylene and propylene, ensuring a reliable feedstock supply through strong integration with anchor tenants.

The chemical park's well-developed shared infrastructure—encompassing utilities, logistics, and waste management—lowers operational costs and fosters collaboration among stakeholders. Jurong's proactive governance structure streamlines decision-making and compliance, while its strategic location and connectivity through comprehensive transport networks enhances the movement of raw materials and finished products.

Indian chemical hubs, when considered against the backdrop of Jurong's success story, have potential for higher production and performance. Prioritising high cracker capacity, integrated feedstock supply, and shared infrastructure can lead to successful chemicals clusters like Jurong Island, while also increasing India's chemical production quantities.

Exhibit 11

A snapshot of the chemical park at Jurong Island, Singapore



Key Statistics

~$40bn	24K+	100+	32km^2
Investments made	Employment generated	Energy and chemical companies	Area of Jurong Island

Source: IHS Markit, JTA website, BT Infographics, https://www.businesstimes.com.sg/companies-markets/energy-commodities/jurong-island-singapores-chemicals-hub

Exhibit 12

Overview of Jurong Island Chemical Park, Singapore and India's PCPIRs

High progress | Medium progress | Limited progress | Challenges with PCPIRs | On-hold

		Jurong	Dahej	Paradip	Vizag	Cuddalore - Nagapattinam	Remarks
Investment	Investments made	~INR 3L Cr.	~INR 1.2L Cr.	~INR 50K Cr.	~INR 20K Cr.	~INR 10K Cr.	Cracker capacity per unit investment and area is low in India as compared to chemical parks globally
	Area (sq. km)	32	465	275	640	256	
	Cracker capacity	Cracker: 6.5 MMTPA	Cracker: 1.7 MMTPA	Refinery: 15 MMTPA, cracker being set-up	Not finalized	Not finalized	
	Anchor tenant and major investors	Exxon Mobil, Shell, SPC, Chevron etc.	OPaL (anchor), Reliance, BASF, ABG	IOCL (anchor), IFFCO, Paradeep Phosphates	HPCL, GAIL, Petronet, Haldia etc.	NA	Few global players have made investments in Indian PCPIRs
Infra-structure	Master Plan status	Completed	Develop-ment & master plan sanctioned	Preparation of plan under process	Studies completed, master plan to be finalized	Not started	
	Environmental clearance	Clearance provided after relocating endangered species	EC/CRZ clearance for full PCPIR	Draft report submitted, awaiting hearing at the Districts	Studies completed, hearing to be conducted	No progress	Nagapattinam PCPIR project has been put on hold due to environmental concerns
	Connectivity (E.g. Ports)	Excellent	Excellent (DMIC, Freight Corridor)	Adequate (Ports, Railways, Roads)	Adequate (Ports, Railways, Roads)	Adequate (Ports, Railways, Roads)	
	Utilities & shared infrastructure	High	Medium	Low	Low	Low	Low access to shared infra-structure increases capex substantially impacting project IRR
Operations	Feedstock availability via anchor	High	Low	Low	NA	NA	Anchor tenants in India do not provide adequate feedstock to producers downstream

Source: DoCPC Annual Report and website https://chemicals.gov.in/pcpir, JTC website

Bridging the gaps to build world-class chemical hubs

Future chemical hubs: stakeholder roles and entities

Key changes to the institutional framework are essential to drive sustainable growth, improve infrastructure, and attract both domestic and international investments. Following are the proposed entities with clearly defined roles and responsibilities along with enablers for them to perform their functions effectively (Exhibit 13):

1.1 Empowered committee at central level:

— **Proposed objectives:**

- A central empowered committee, chaired by secretary of Department of Chemicals and Petrochemicals and representation from Ministry of Finance, Ministry of Petroleum, NITI Aayog, etc., can oversee the strategic direction and policymaking for all chemical hubs across India. This committee can ensure that the development of chemical hubs aligns with national priorities, fostering a coordinated approach between central and state governments as well as promote private petrochemical complexes. The committee's mandate could include setting clear objectives, defining growth strategies, and ensuring that each chemical hub meets the necessary standards for global competitiveness. The committee can also play a role in streamlining the regulatory environment, thereby reducing delays in approvals and facilitating faster time-to-market for investors.

— **Proposed responsibilities:**

- **Awarding Incentives – Identify and award financial or non-financial incentives:** This could focus on identifying the right mix of incentives, both financial (such as tax breaks, subsidies) and non-financial (like infrastructure support or skill development programs), to attract and retain investors by lowering operational costs or enhancing the value proposition
- **Tracking KPIs – Identify KPIs to track development of each chemical hub:** Key performance indicators (KPIs) can be used to monitor the progress of each Petroleum, Chemicals, and Petrochemicals Investment Region (chemical hub), focusing on metrics like investment inflow, project completion rates, job creation, and environmental sustainability, to ensure the successful implementation and growth of the initiative

— **Key enablers:**

- **GVC Chemical fund for infrastructure development:** A GVC Chemical fund could be established to provide financial support for infrastructure development and other key initiatives within the chemical hub. This fund can ensure that necessary investments are made to address critical infrastructure needs and can offer financial backing for projects that support the long-term sustainability of the parks. State governments will assist in land procurement and handle dispute resolution at the local level. This collaborative approach between the central government, state governments, and private sector investors is essential for ensuring that chemical hubs receive the necessary support to meet their operational challenges and contribute to India's standing in the global chemicals market
- **Streamlined approval processes:** Special authority within the committee to handle fast-tracked approvals (including environmental clearances etc.) with focus on sustainability

1.2 Administrative body at the chemical hub level:

— **Proposed objectives:** Each chemical hub can be governed by a local administrative body, which will handle the day-to-day operations and management of the park. This body would be responsible for crucial tasks such as investment screening, land management, and coordination with service providers. It can also be tasked with liaising with central empowered committee and state government to achieve its mandate

— **Proposed responsibilities:**

- **Marketing – Attract investors to set up plants:** This involves promoting the region as a prime investment destination, highlighting its competitive advantages like infrastructure, skilled labor, and incentives, while engaging investors through targeted campaigns, digital channels, and industry events to generate interest in setting up manufacturing plants
- **Investment screening:** Evaluate investment opportunities based on key factors such as size, type, lease duration, land productivity, and proposal credibility to ensure they align with business objectives
- **Land sales:** Ensure that land is sold with preapproved building plans and suitable for specific industrial uses or concepts (e.g., biomedical research), in compliance with planning regulations
- **Lease management:** Provide comprehensive assistance with regulatory issues related to leasing, including subletting, transfers, name changes, and environmental matters
- **Management of shared facilities:** Develop an operating model for shared infrastructure, including the creation of a special purpose vehicle (SPV) with private co-investment and onboarding of service providers
  - » **SPV and co-investments:** Establish an SPV structure that involves co-investment from private entities and the chemical hub entity to fund and manage shared facilities
  - » **Contractual service providers:** Engage and onboard third-party service providers through contractual agreements to support the operation and maintenance of shared infrastructure
  - » **Environmental Clearance:** Providing pre-approved environmental clearances for factories being set up to ease and speed up the set up process

— **Key enablers:**

- **Access to financing of development of chemical hubs through GVC Chemical fund in SPV or other financing model (including equity/debt financing):** A GVC Chemical fund within the SPV model, offering equity/debt financing or combination of both, serves as a crucial enabler for securing the necessary capital to drive development projects forward
- **Support from state government for land procurement and dispute management:** State government assistance in land procurement and dispute resolution acts as a key enabler, ensuring smooth access to land and addressing any legal challenges that may hinder project progress
- **Regular check-ins with empowered committee to address issues and concerns:** Regular engagement with the empowered committee ensures ongoing oversight and timely resolution of issues, enabling the entity to stay aligned with its objectives and maintain project momentum

Anchor tenants:

— Key stakeholders will also include anchor tenants—typically large refineries and petrochemical companies—which will

form the backbone of each chemical hub, providing essential feedstock for downstream industries. These anchor tenants will work in close collaboration with downstream producers of specialty chemicals, petrochemical intermediates, and end products. The involvement of private players is critical for ensuring that the parks are economically viable and attract the right investments.

Infrastructure and Services at the chemical hubs

— **Utilities and Services:** The chemical hub would need to have reliable utilities and essential services to support industrial operations

- **Waste Management Systems:** Provide sustainable solutions for effluent treatment and waste disposal to meet environmental compliance. Waste disposal to be handled inside the chemical parks. Deep sea discharge standards to be at par with global standards
- **Safety Mechanisms:** Ensure robust safety protocols, including emergency response systems, industrial fire safety, and health monitoring facilities
- **Laboratories and Testing Facilities:** Enable product testing, quality control, and R&D activities

— **Specialized infrastructure for small enterprises (Access to common facilities like warehouses, testing centers, and co-working spaces, canteens etc.):** Affordable utilities and infrastructure tailored to their specific needs are critical to foster innovation and promote the inclusion of smaller players in the ecosystem

— **Residential infrastructure:** To support the workforce, well-planned residential infrastructure can be developed

- Housing facilities for employees across all levels, from senior management to operational staff
- Amenities such as schools, healthcare facilities, recreational centers, and shopping areas to improve the quality of life

— **Ports and logistics:** Efficient transport and logistics are vital for ensuring seamless supply chain operations.

- **Collaborative Efforts:** Partnerships with the Ministry of Ports, Shipping & Waterways, state governments, and private players would be key to:
  - » Develop port facilities with adequate storage, loading, and unloading capacity
  - » Improve connectivity between chemical hub and key trade routes through roads, railways, and waterways

Exhibit 13

Current and proposed institutional framework of Indian PCPIRs

Existing Institutional framework of Indian PCPIRs

High-powered committee (Chaired by the Cabinet Secretary)

Pain points faced:
- Infrequent meetings leading to limited decision making on infrastructure and development issues

Management board (constituted by the state government for each PCPIR)

Pain points faced:
- Only Gujarat constituted a management board (GPCPSIRDA) dedicated to PCPIRs, however, not located in Dahej
- Other PCPIRs (including Odisha, Andhra Pradesh failed to implement dedicated management board leading to several bottlenecks and development issues)

- Anchor tenant (refineries and cracker companies)
- Chemical manufacturing companies
- Shared infra development companies

Proposed Institutional framework

Creation of Central trust fund under the Steering committee along with implementation of current PCPIR policy across all existing PCPIRs

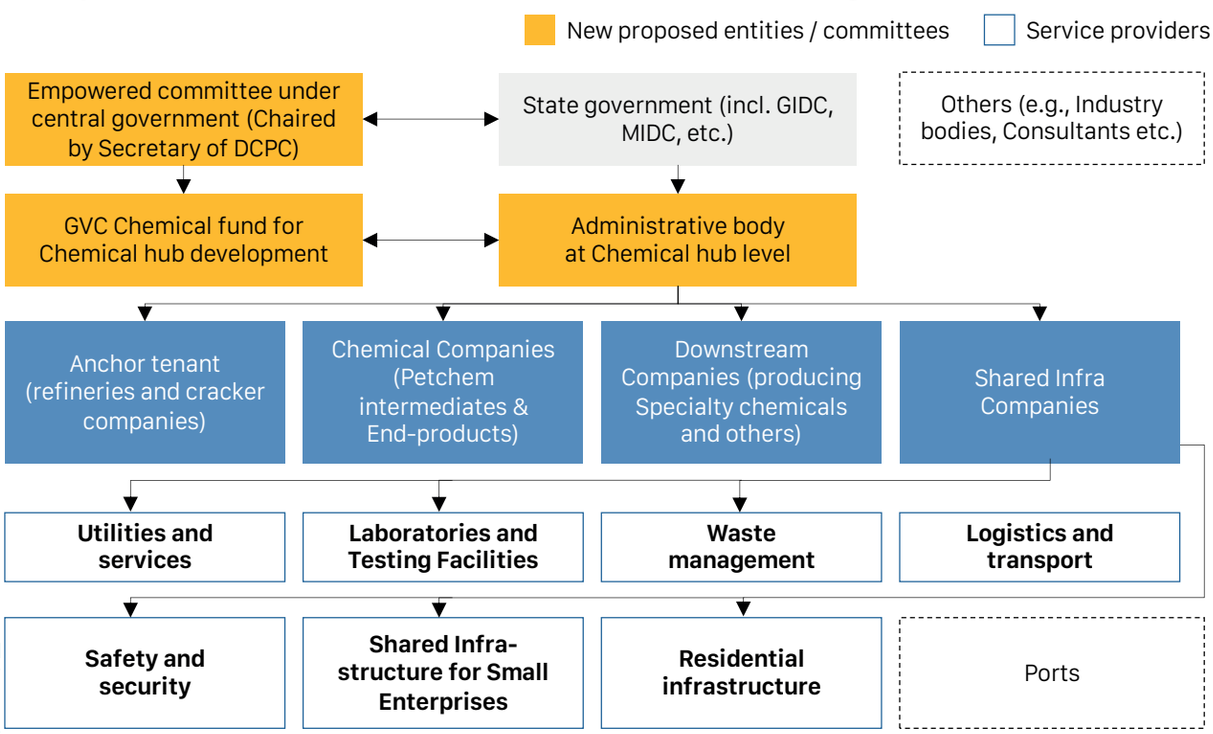
Steering committee (with Dept. of Chem. & Petrochem. as nodal agency) — Central body for strategic decision making across all PCPIRs with sole focus on chemicals

Central trust fund for PCPIR development (under Steering committee) — Trust fund for infrastructural development of PCPIRs

Administrative body at PCPIR level (e.g., SPV with state and central investment) — PCPIR-level body responsible for managerial roles within the PCPIR (incl. anchor tenant, chemical cos. etc.)

- Anchor tenant (refineries and cracker companies)
- Chemical manufacturing companies
- Shared infra development companies

Clearly defined stakeholder roles for effective chemical hub governance



Looking forward: Implementing the cluster-based approach for infrastructure development

By concentrating resources and expertise within defined geographic areas, the cluster-based model facilitates the sharing of infrastructure, reduces costs, and accelerates innovation.

Revamping existing PCPIRs

The first pathway focuses on revitalizing India's existing chemical hubs, such as those in Gujarat, Odisha, and Andhra Pradesh (Exhibit 14). These regions have already made significant progress in establishing infrastructure, attracting anchor tenants, and laying the groundwork for chemical industry development. However, they face challenges related to infrastructure quality, financial incentives, and regulatory complexities. By addressing these issues, particularly the development of shared utilities, streamlining investment processes, and offering more competitive financial incentives, these parks can be optimized for higher productivity and growth. The key advantage of this pathway is that it leverages existing infrastructure, allowing for faster time-to-market and cost-effective expansion. This makes it easier to attract new investments and scale up operations without the delays and high costs associated with setting up entirely new regions. For instance, Gujarat's well-established chemical hub has already attracted substantial investments but could further benefit from improvements in infrastructure connectivity and regulatory efficiency. Similarly, following immediate investments could be considered to be made in the existing chemical hubs:

- Increase cracker capacity and improve shared infrastructure at Dahej and Paradip: Enhancing cracker capacity at Dahej and Paradip is crucial to meet the growing demand for petrochemical products and improving operational efficiency. Dahej, which already hosts the largest petrochemical plant in India, can further solidify its position by expanding its cracker capacity, thus ensuring a steady supply of ethylene and propylene for downstream industries. Improving shared infrastructure such as utilities, logistics, and waste management systems at both sites can reduce operational costs, enhance efficiency, and attract more investments
- Finalize an anchor tenant, address feedstock availability, and fix connectivity at Vizag: The Vishakhapatnam-Kakinada chemical hub needs a finalized anchor tenant to drive investment and development. Identifying and securing a major industry player can provide a stable foundation and attract ancillary industries to the region. Ensuring a reliable supply of feedstock is another critical factor; this can be addressed by establishing secure and efficient supply chains and partnerships with feedstock providers. Additionally, improving connectivity through better transportation networks, such as roads, railways, and ports, will facilitate easier movement of raw materials and finished products, making the region more attractive to investors
- Restart projects at Cuddalore-Nagapattinam with improved environmental clearances and better infrastructure planning: The Cuddalore-Nagapattinam chemical hub has significant potential but requires a restart of stalled projects with a focus on obtaining improved environmental clearances. Ensuring compliance with environmental regulations will not only facilitate project approvals but also enhance the region's sustainability credentials. Better infrastructure planning, including upgrading transportation networks, utilities, and industrial facilities, is essential to support new and existing projects. A holistic approach that considers environmental impact, community engagement, and industrial requirements can rejuvenate the region and attract new investments

Developing new clusters

The second pathway proposes the creation of new chemical clusters, which would be developed from the ground up, tailored to the needs of the industry, and selected based on regional advantages such as proximity to raw material sources, transportation networks, and potential market access. This approach allows for greater control over the development process, enabling a tailored infrastructure plan that could meet the specific needs of anchor tenants, downstream industries, and related sectors. While this approach requires a more intensive setup—including land acquisition, infrastructure development, and long-term investment—the potential for establishing cutting-edge facilities with state-of-the-art technology and sustainable practices could make these new clusters highly competitive in the global market. The creation of such clusters would also enable India to diversify its chemical manufacturing capacity and cater to a broader range of products, from petrochemicals to specialty chemicals.

Potential locations for these new clusters include Maharashtra, Karnataka, West Bengal, Kerala, Haryana, Uttar Pradesh, Madhya Pradesh, and Rajasthan (Exhibit 15). These areas would need to be evaluated based on various factors, including area size, refining capacity, proximity to the nearest port, and the port's size. The evaluation must also consider potential challenges, such as high population density and limited end-industries.

When considering potential locations for new clusters, several districts across India emerge as potential candidates (Exhibit 15). However, each location presents unique challenges that must be addressed. The final decision can be made after thorough discussions with stakeholders. Some of the potential locations are as follows:

Western India:

- **Sagar:** Boasting a refining capacity of 7,800 KMT, Sagar also faces issues related to restricted land and dense population.

Southern India:

- **Dakshina Kannada:** With a refining capacity of 15,000 KMT, this district has significant potential. The primary challenge here is the limited number of end-users, which could affect market viability.
- **Ernakulam:** While Ernakulam's refining capacity stands at 15,500 KMT, like Dakshina Kannada it suffers from a scarcity of end-users.

Northern India:

- **Panipat:** These districts have considerable refining capacities but face high logistics costs and a lack of end-use industries. Additionally, waste management presents a significant challenge.

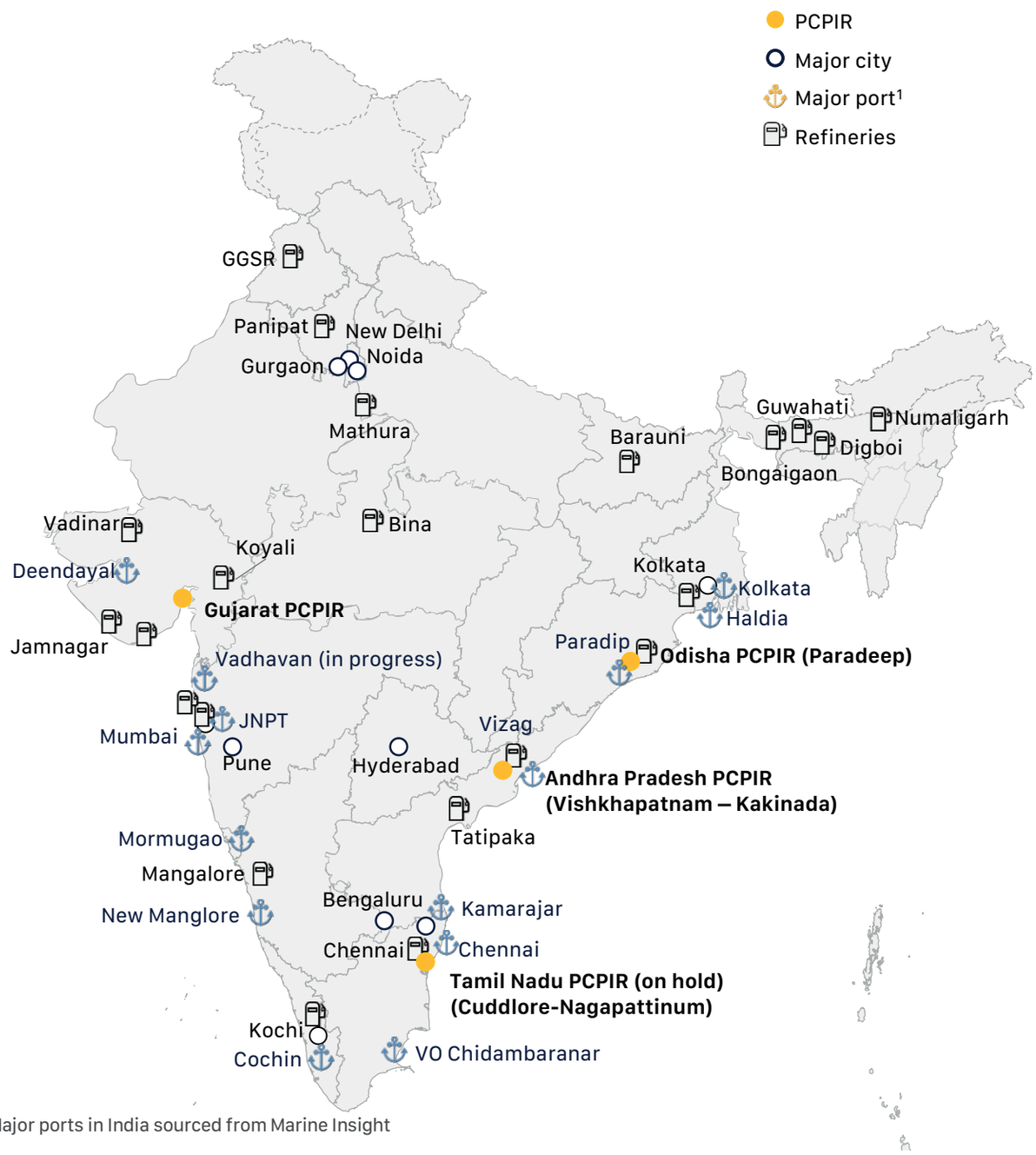
Eastern India:

- Haldia is a potential site with substantial refining capacity. However, it is hindered by high population density and a shortage of end-use industries.
- By focusing on integrated planning, ensuring adequate cracker capacity, feedstock availability, and shared infrastructure from the outset, India could develop efficient and world-class chemicals clusters for greater production volumes.

The newly defined governance model, with empowered committee at the central level and administrative body at the state level, could eliminate any ambiguity and overlaps by clearly defining the role of all stakeholders, from anchor tenants and chemical companies to service providers within the chemical hub ecosystem.

Exhibit 14

Location of PCPIRs and major refineries in India



[1] Major ports in India sourced from Marine Insight

Exhibit 15

Evaluating potential locations for creation of new chemical clusters

	District	Area (sq. KM)	Refinery	State	Refining capacity (KMT)	Distance from closest major port (KM)	Size of the port (MMT)
West	Sagar	10,252	Bina (Bharat Petroleum)	Madhya Pradesh	7,800	~1200 (Jawaharlal Nehru Port Trust)	~20
South	Dakshina Kannada	4,866	Mangalore (ONGC)	Karnataka	15,000	<50 (New Mangalore Port)	~80
	Ernakulam	3,068	Kochi (Bharat Petroleum)	Kerala	15,500	<50 (Cochin Port)	~80
North	Panipat	1,268	Panipat (Indian Oil)	Haryana	15,000	~1150 (Kandla Port)	~270
	Balotra, Barmer	10,551	Barmer (Hindustan Petroleum)	Rajasthan	9,000 (upcoming)	~450 (Kandla Port)	~270
East	Purba Medinipur	4,736	Haldia (Indian Oil)	West Bengal	8,000	<50 (Haldia Dock Complex)	~50

Source: Expert interviews

Initiative 2: Develop existing port infrastructure

Chemicals storage and handling plays a crucial role in increasing the sector's overall efficiency. Building world-class port infrastructure at high-potential chemicals clusters in India could transform logistics for the industry. This initiative could help overcome the insufficiencies of storage capacity, handling capacity, mechanization and last-mile connectivity that the industry grapples with at present.

Developing existing port infrastructure in a targeted manner, with state-of-the-art storage and material handling facilities for critical substances (such as ammonia, ethylene, propylene and natural gas) could enhance the industry's supply-chain efficiency.

Infrastructure requirements across the chemicals port logistics value chain

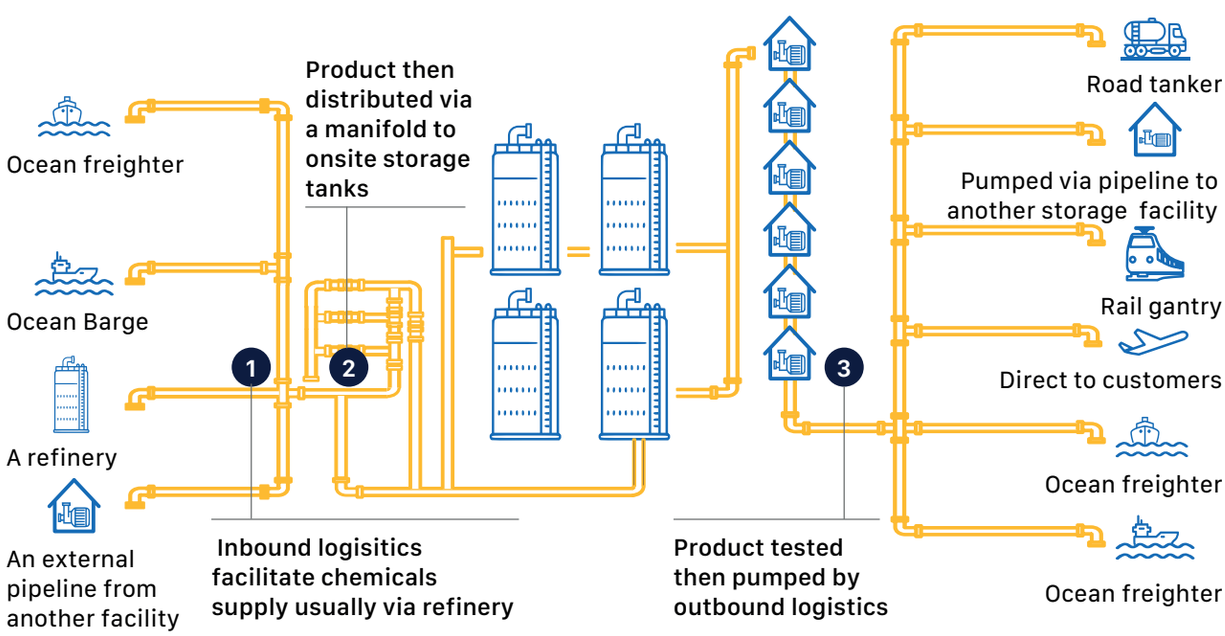
India's existing port infrastructure shows promise alongside other leading maritime nations like the US and China. A significant maritime sector situated along India's 7500-km[23] long coastline, it offers a vast network of navigable waterways for chemicals supply chain management. In fact, two of India's ports rank among the top 402 ports globally. With state-of-the-art storage and material handling facilities for critical substances (such as ammonia, ethylene, propylene and natural gas), port infrastructure development could help Indian chemicals businesses scale new heights in bolstering self-reliant growth. The value chain for trading liquid and gaseous chemicals through ports is as follows (Exhibit 16):

Inbound logistics for chemicals include directing the cargo to onsite storage containers from a variety of sources,

[23] https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/Maritime%20India%20vision%202030.pdf

Exhibit 16

Value chain for transport of liquid and gaseous chemicals at ports[1]



[1] Source: Chemicals weekly, industry interactions

including refineries, ocean freighters, ocean barges and external pipelines. Infrastructure includes cranes, compressors and vacuum systems to guarantee the safe and efficient unloading of goods. Safety measures like spill-containment pallets (for hazardous materials) and gas detectors (in case of leaks) are critical at this stage to guard against environmental risks.

The storage and testing phase utilizes chemicals storage containers with secondary containment provisions and specialized warehouses that are temperature and humidity controlled to appropriately and safely house hazardous materials. Infrastructure at this stage includes ventilated storage units, safety equipment and storage cabinets for flammable liquids.

The primary goal of **outbound logistics** is to ensure the safe transportation of substances to their final destinations. The port infrastructure includes loading equipment, transport tankers, gas-cylinder handling equipment and emergency response kits that facilitate the safe transfer of chemicals to a variety of destinations via road tankers, pipelines, rail gantries and ocean vessels.

A look at India's port/terminal operations

India comprises 12 major and over[24] 200 non-major ports across its vast coastline. The private sector participates in the operations of these ports alongside the government through concession agreements for specific projects, berths or terminals. Top private sector players manage 70 to 75 percent of overall traffic across Indian ports, moving commodities ranging from containers, dry bulk, and liquid and gas cargo, to coal and iron ore.

In recent years, India's Union Ministry of Ports, Shipping and Waterways has prioritized the upgradation of ports through multiple initiatives for port-led industrialization in the country. The Sagarmala Programme[25], launched in 2015, aims to reduce logistics costs for export-import and domestic trade through developing coastal economic zones (CEZs) for efficient transportation. The National Sagarmala Apex Committee (NSAC)[26] sets the strategic direction and policies for port development, integrating inputs from various stakeholders, including representatives from the Ministry of Shipping. The framework distinguishes between major port trusts, which are government-managed, and private terminals, emphasizing the importance of collaboration between public and private sectors in port operations.

The Maritime India Vision 2030[27], launched in 2021, sets out over 150 initiatives to enhance the Indian maritime sector through coordinated development across all aspects of the maritime sector. Chemicals is one of 12 industries identified as a focus area for major ports. The initiative includes developing dedicated terminals for chemicals handling and enhancing connectivity between ports and chemicals manufacturing hubs for lower shipping costs.

While these initiatives are expected to make a big difference to port infrastructure in the country, at present the chemicals industry struggles with some pain points that impact chemicals trade and logistics efficiency. These constraints are significant, particularly when compared to major global ports, such as Antwerp in Belgium (Exhibit 18). Some of the pain-points faced by chemical industry players are as follows:

[24] https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/Maritime%20India%20vision%202030.pdf#:~:text=India%20comprises%20a%20significant%20size%20maritime%20sector,and%20a%20vast%20network%20of%20navigable%20waterways.&text=The%2012%20Major%20Indian%20Ports%20handled%20nearly,overall%20cargo%20traffic%20over%20last%205%20years.
[25] CRISIL—Study of ports sector in India
[26] https://sagarmala.gov.in/sites/default/files/NPP%20executive%20summary.pdf
[27] CRISIL—Study of ports sector in India

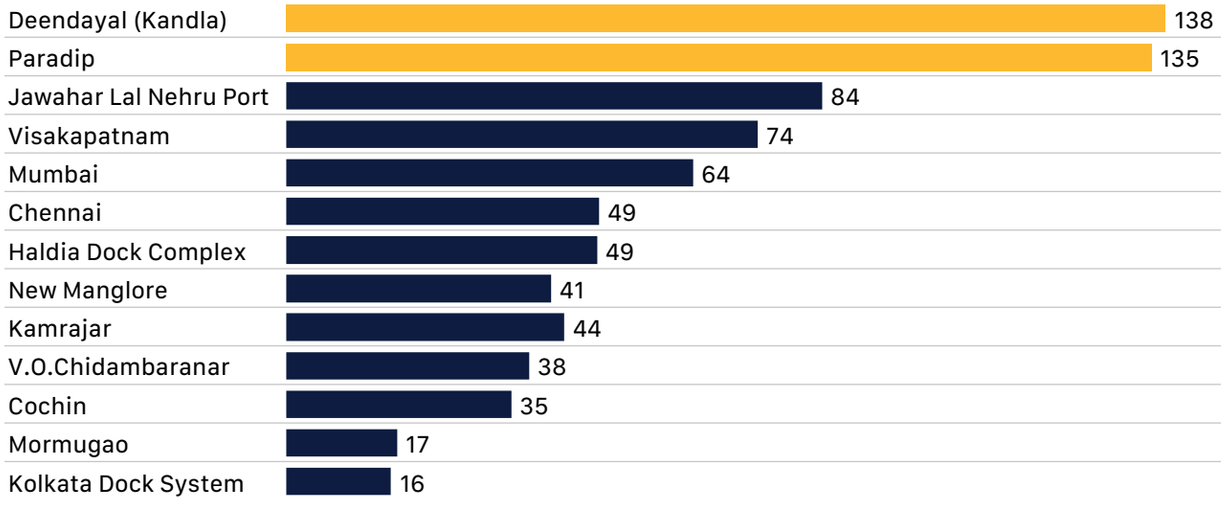
- **Insufficient handling capacity:** Indian ports do not have enough dedicated berths and handling capacity, compared to global standards. To draw a parallel between one of Europe's biggest ports and India's top two major ports (Exhibit 17), for example, from 2022 to 2023[28], Antwerp handled total traffic of 286 MMT, whereas Kandla handled 138 MMT, and Paradip handled 135 MMT. As the industry grows steadily, demand increases organically. In order to sustain and encourage this rising level of demand, India's port infrastructure requires significant support in upgrading their handling capabilities in the global arena
- **Lack of required storage capacity:** Limited tankage for specialized chemicals creates bottlenecks and delays. Antwerp has a total liquid bulk storage capacity of 9.6 MMT and 6.15 million[29] square meters of covered storage. In contrast, Kandla has a storage capacity of 3 to 4 MMT, and Paradip has a storage capacity of 4 to 5 MMT, with warehouses and open storage of 4 million square meters and 3 million square meters respectively
- **Limited mechanization:** Limited logistics budgets restrict the development of mechanization and handling capabilities at Indian ports, particularly for chemical trade. The lack of access to advanced, state-of-the-art equipment significantly delays operations and hampers the ability to achieve high output within a given timeframe. As a result, chemical handling often relies on manual processes, which are not only less efficient but also pose potential safety risks
- **Inadequate last-mile connectivity:** India lacks sufficient road, rail, and pipeline connectivity between its port areas and key industrial hubs and consumption centers. In contrast, the Port of Antwerp is strategically located[30] within a 500-kilometer radius of approximately 60 percent of the European consumer market

[28] Ministry of Ports, Shipping and water ways, Annual reports of Paradip and Kandal ports, press search, team analysis
[29] ibid
[30] https://www.portofantwerpbruges.com/en/business/transport

Exhibit 17

Benchmarking Indian ports against Antwerp, a leading global port

Port-wise cargo traffic handled, MMTPA (2022-23)



Source: Ministry of ports, shipping and water ways, annual reports of Paradip and Kandal ports

Case study of a leading global port: Port of Antwerp, Belgium

Antwerp port, a major global port for chemicals, offers extensive infrastructure and connectivity within Europe and beyond (Exhibit 18). With over 1,000 kilometers of 48 different product pipelines and a maritime throughput of 90.6 MMT of liquid bulk, the port is designed to attract and manage heavy traffic.

Its success rests on three core factors:

— **Extensive and growing infrastructure:** Antwerp has a network of major tank storage and handling providers, and an extensive pipeline network for different products. By 2026, the port's interconnected, open-access hydrogen backbone will be operational. The port authority is also working on expanding its existing ammonia and methanol capacity, supplementing this with other hydrogen carriers.

Exhibit 18

Snapshot of Antwerp port, Belgium

Key Statistics

90.6	13.5	0.8M m^3	48	~1K km
MMT Maritime throughput of liquid bulk	Million TEU	Storage capacity of polymers	Different product pipelines	Pipelines in Antwerp port area

Source: Port of Antwerp (Facts and Figures 2023) report

- **Multimodal gateway to the European hinterland:** Antwerp boasts of great connectivity via rail, inland navigation, road, shortsea and pipeline routes, along with proximity to the European consumer market (60 percent of which is within a 500-kilometer radius).
- **Digital and circular innovation hub:** The port uses Internet of Things, data analytics and automation to feed into a digital platform for real-time data sharing. This helps optimize logistics. Antwerp port also collaborates with industry stakeholders to develop closed-loop systems that reduce waste and incorporate eco-friendly practices.

Developing the existing port infrastructure for chemicals

The strategic development of port infrastructure in India could focus on enhancing operational capacity at high-potential port clusters for the chemicals sector.

Based on existing infrastructure and proximity to chemicals markets, the efforts could look at eight such clusters: Gujarat, North Maharashtra, South Maharashtra & Goa, Karnataka, West Bengal & Odisha, North Andhra Pradesh, South Andhra Pradesh & North Tamil Nadu, and South Tamil Nadu and Kerala (Exhibit 19). The government's support could drive high-impact infrastructure development that optimizes the potential of these clusters and bridges existing gaps.

For this, setting up a committee on port infrastructure for chemicals for creation and upgradation of infrastructure for movement and handling of chemicals could be considered.

2.1 Composition of the committee

Such a committee would have representatives from the Union Ministry of Ports, Shipping and Waterways and the Department of Chemicals and Petrochemicals. The committee would also seek advice from public and private terminal operators, industry members, and safety and copliance experts.

Key objectives of the committee

The committee can focus on several strategic objectives to enhance the port infrastructure for the chemicals sector:

- **Enhance operational capacity and efficiency:** The primary goal is to improve the operational capacity of high-potential port clusters, ensuring they can handle increased volumes of chemical products efficiently. This includes streamlining logistical processes to improve efficiency and reduce costs associated with the transportation and storage of chemicals, thereby enhancing the overall supply chain
- **Optimize infrastructural needs for chemical industry:** Develop and optimize the necessary infrastructure to support the chemical industry, including the creation of dedicated storage zones, enhanced pipeline connectivity, and modernized handling facilities
- **Ensure safety, compliance, and promote environmental sustainability:** Establish and maintain high safety standards and ensure compliance with all relevant regulations to protect workers, communities, and the environment. Additionally, implement measures to minimize the environmental impact of chemical handling and transportation, such as reducing emissions, managing waste effectively, and adopting green technologies

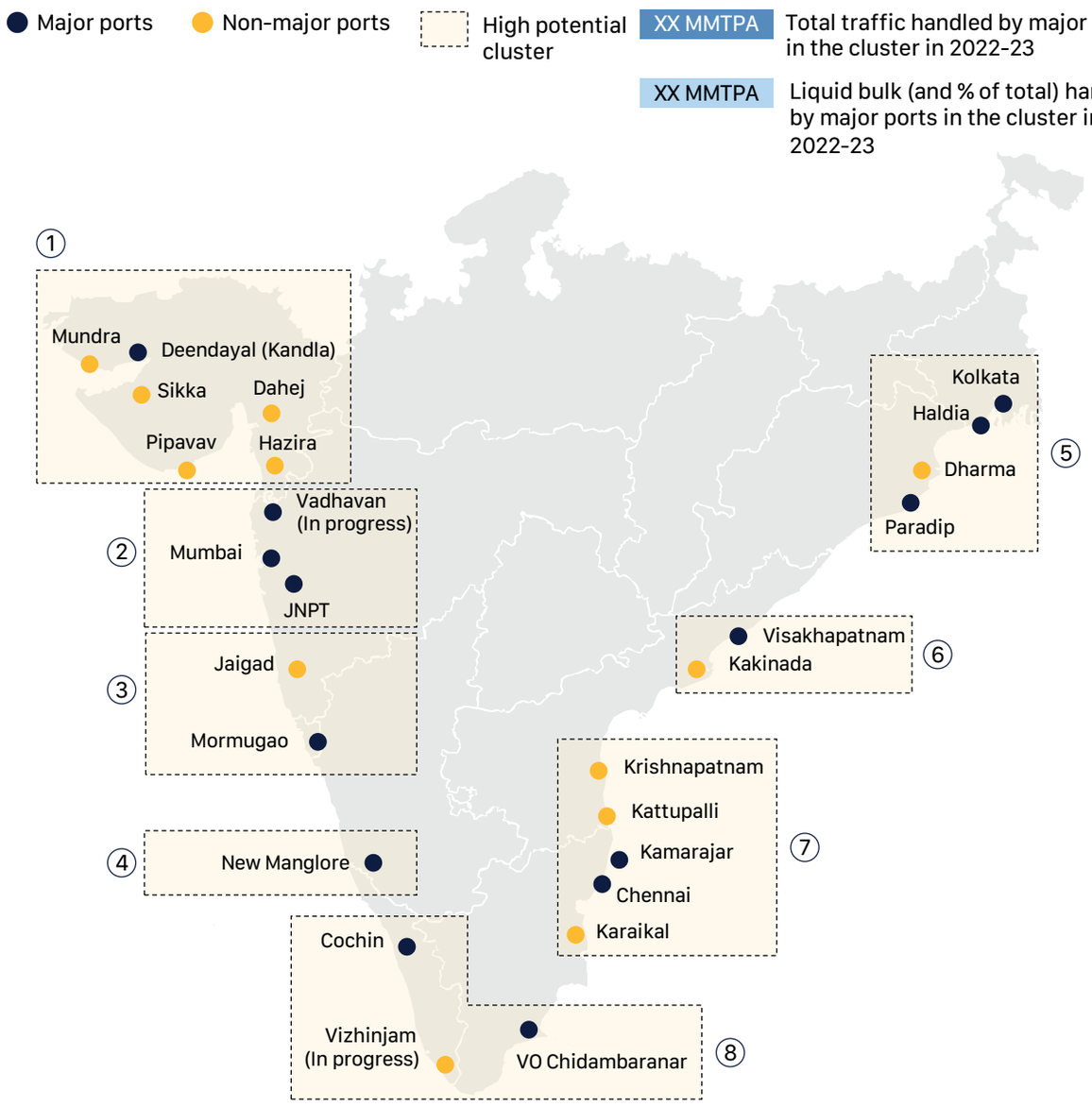
Success KPIs of the committee

The success of the committee's initiatives can be measured through a set of Key Performance Indicators (KPIs) that reflect improvements in operational efficiency, service quality, and environmental sustainability:

- **Logistical efficiency and cost reduction:** Metrics such as turnaround time at ports, storage costs per ton of chemicals, and transport lead time can be used to assess improvements in logistical efficiency and cost-effectiveness
- **Service quality:** Indicators like the on-time delivery rate and customer satisfaction scores can help measure the quality of services provided to the chemical industry
- **Environmental impact:** Measures including emission reduction levels, waste management efficiency, and the adoption of sustainable practices can be tracked to ensure that environmental sustainability goals are being met

Exhibit 19

2.2 Targeted development of port infrastructure at eight high-potential clusters



Gujarat cluster 1	North MH cluster 2	South MH & Goa cluster 3	Karnataka cluster 4
450-460	140-150	70-80	30-40
220-230 (~50%)	45-50 (~30%)	~1 (<5%)	25-30 (>80%)

West Bengal & Odisha cluster 5	North AP cluster 6	South AP & North TN cluster 7	South TN & Kerala cluster 8
180-190	80-90	170-180	70-80
40-45 (~20%)	15-20 (~20%)	20-25 (~15%)	20-25 (~30%)

Source: INDIA Port Infrastructure: Chemicals report by J.M. Baxi , Maritime India Vision 2030 report

Initiative 3: Introduce a Opex subsidy scheme for chemicals

Designed to boost domestic manufacturing and global competitiveness, (Opex subsidy) scheme for the chemicals industry could be a crucial unlock. Opex subsidy's incentivize local production, contribute to reducing supply chain vulnerabilities, and boost competitiveness.

By raising chemicals manufacturing volumes in the country, Opex subsidy's could foster import substitution for chemicals with high import bills, such as petrochemicals, and reduce India's chemicals dependence on a single import partner, especially for specialty chemicals along with unlocking export potential. This initiative aims to develop global leaders from India who can use advanced technologies, accelerate growth, and establish India as a global hub for chemical manufacture.

3.1 Implementing the Opex subsidy scheme to bridge gaps in the chemicals industry

The chemicals industry requires a significant production boost to facilitate import substitution and reduce single-source dependency. India's imports of $75 billion[31] cover the bulk of domestic demand for essential chemicals, with many of these imports coming from just a few supplier countries. Additionally, India would need to tap into the global export market in areas where its share in global trade is low. By increasing production capacity and enhancing product quality,

[31] ITC Trade map

Exhibit 20

Proposed structure of Opex subsidy for chemicals industry

Objective of the Opex subsidy	Details of the incentive	Beneficiaries
The aim of this initiative is to **bolster India's manufacturing capabilities** within the chemical industry by stimulating investment and boosting production facilitating: • Diversification of products towards high-value chemical goods • **Developing global leaders from India** who can expand in size and scale by leveraging advanced technologies, thereby integrating into and enhancing global value chains	**Incremental sales over base year:** The scheme proposes for incentives on incremental sales to selected participants for a period of 5 years at the rate of 10% for Year 1, 9% for Year 2, 8% for Year 3, 7% Year 4, 6% for Year 5	**Grouped based on end-usage: Chemicals within these groups to be identified for Capex/Opex support or combination of both** • **Group 1:** Agrochemical intermediates • **Group 2:** Pharmaceutical intermediates • **Group 3:** Battery and electronic chemicals • **Group 4:** Dyes and Pigments • **Group 5:** Petrochemicals • **Group 6:** Multiple uses

INR 65,000 Cr
Additional investment over 5 years stimulated by scheme incentives

INR 3L Cr
Additional turnover over 5 years stimulated by scheme incentives

India can become a competitive player in the international market, particularly in segments like specialty chemicals, where it currently has a minimal presence. To implement the Opex subsidy scheme, two objectives would need to be addressed: import substitution to reduce single-source dependency and targeting the global export market.

The objectives of the Opex subsidy scheme are as follows (Exhibit 21):

Substituting imports by reducing single-source dependency
The heavy reliance on specific countries, for critical chemical imports like petrochemicals, intermediates and specialty chemicals exposes the Indian market to potential risks. These risks include possible supply chain disruptions, price volatility and geopolitical tensions, which could significantly impact industries reliant on chemical inputs, such as pharmaceuticals, textiles, and agriculture.

Targeting global export market
India would need to expand its footprint in the global export market, particularly in areas where its current share is low. This involves increasing production capacity, improving product quality, and adhering to international standards. By focusing on high-demand segments like specialty chemicals, agrochemicals, and advanced intermediates, India can position itself as a key supplier in the global market. This approach will increase India's export revenues while reducing its trade deficit and strengthening its global economic positioning.

The approach for identification of chemicals for Opex subsidy is as follows:

Identification of Chemicals for Import Substitution

The process to identify chemicals for import substitution focuses on reducing dependency on imports and enhancing domestic production capabilities. Here is a detailed breakdown:

1. **Initial Screening at 8-digit HS Code Level:** Criteria used for screening are as follows:

— Imports greater than INR 1,000 crore in FY24
— Growth rate of imports greater than 0% over the last three years (FY22-24)
— Single-source dependency greater than 30%

2. **At transaction level data (to identify chemicals included in "others" category)**

— Imports greater than INR 1,000 crore in FY24
— Production in India as % of total consumption < 30% (in FY24)

3. **Final List Compilation:**

— **Output:** A list of 16 chemicals after consideration of the criticality of the end-market

Identification of Chemicals for Export Growth
The process to identify chemicals for export growth involves several steps, focusing on analyzing export data and global trade dynamics. Here is a detailed breakdown:

1. **Initial Screening at 6-digit HS Code Level: Criteria used for screening are as follows:**

— Global trade value for the chemical exceeds INR 41,500 crore in FY24
— Exports greater than INR 1,000 crore in FY24
— India's share in global trade is less than 10% over the last three years (FY21-24)

2. **Detailed Analysis at 8-digit HS Code Level:**

— **Objective:** Identify specific chemicals included in broader "others" categories at the 6-digit level
— **Outcome:** A refined list of chemicals that meet the export growth criteria.

3. **Filtering Based on Domestic Manufacturing:**

— **Output:** A list of 3 chemicals after consideration of the primary end-use and the growth rate of the end-use market.

The identification process for both export growth and import substitution involves a multi-step approach, starting with broad data analysis at the 6-digit or 8-digit HS code level and refining the list based on specific criteria such as export/import values, growth rates, market share, and dependency factors. This structured approach ensures that the chemicals selected for incentives are strategically important for enhancing export performance and reducing import dependency.

Exhibit 21

Process followed to identify chemicals to be included as part of the incentive scheme

① Identification of chemicals through filtering funnel	Identification of chemicals for import substitution	# of HS codes	Identification of chemicals for export growth	# of HS codes
EXIM data Chapters 28, 29, 32, 38, 39, 40	**Step 1:** At 8-digit HS code	~2160	**Step 1:** At 6-digit HS code	~1060
Step 1	Imports > INR 1,000 Cr (in FY23)	~120	Global trade > INR 41,500 Cr (in FY23)	~100
	Growth rate of imports > 0% (in last 3 years – FY22-24)[1]	~75	Exports > INR 1,000 Cr (in FY23)	~40
	Single-source dependency > 30%	~50	India's share in global trade <10% (in last 3 years – FY21-24)[1]	~20
Step 2	**Step 2:** At transaction level data (to identify chemicals included in "others" category)		**Step 2:** At 8-digit HS code (to identify chemicals included in "others" category)	
	Imports > INR 1,000 Cr (in FY24)	37	Exports > INR 1,000 Cr (in FY24)	11
Step 3	Production in India as % of total consumption < 30% (in FY24)	28		
	Step 3: List of chemicals		**Step 3:** List of chemicals	
List of chemicals for Opex subsidy	End-market criticality	16	Primary end-use, Growth rate of end-use market	3
② Identification of other strategically important chemicals	Identification of strategically important chemicals and chemical groups not included through the filtering process		**At 6-digit level**	**18**
			At 8-digit level	**105***

[1] HS codes with non-chemical categories also excluded
Source: : ITC trade map, press search, team analysis

***Chemicals included (at 8-digit HS code) within the chemical groups (at 6-digit HS code) identified for Opex are attached in the Appendix. The list represents all 8-digit HS codes within the chemical group. It does not necessarily include the chemicals eligible for the Opex subsidy**

Initiative 4: Develop and access technologies to enhance self-sufficiency and foster innovation

To transform India's chemical industry into a global leader, boosting self-sufficiency and innovation is essential. In 2023, the annual spend of Indian chemicals companies on R&D was around 0.7 percent of revenues [32], whereas that of global chemicals companies was around 2.3 percent of revenues. By establishing robust R&D funding mechanisms, India can significantly enhance domestic innovation and indigenous technology development. Additionally, forming strategic partnerships with multinational corporations can unlock access to advanced global technologies. These initiatives will not only elevate R&D standards but also reduce reliance on imports, driving sustainable growth and improving competitiveness on the global stage.

Furthermore, technological advancements are crucial to address pressing industry challenges, such as increasing PET recycling capacity in response to growing plastic waste concerns and stricter government regulations aligned with the nation's 2050 sustainability goals. As consumer demand for advanced products such as electronics, hygiene items, and apparel rises, fueled by high-growth economies and changing consumption patterns, opportunities for innovation in specialty chemicals will expand. With accelerated urbanization and an aging population in industrial countries, new markets are emerging for artificial implants, biomimetic materials, flexible wearable devices, sensors, nutraceuticals, and food additives. To capitalize on these growth opportunities, India's chemical industry must prioritize innovation and R&D investments to meet evolving market demands and drive global competitiveness.

Challenges that block innovation

India's R&D spending trails that of its global peers, limiting the potential scope of innovation and research to continuously improve and enhance the chemical sector. The innovation gap between India and the rest of the globe may eventually lower the grade of chemicals manufactured in India. This could take India further away from, instead of towards, its goal of a net zero importer status.

- **Funding constraints:** Small and mid-sized companies in the chemicals sector often struggle to secure adequate funding for long-term R&D initiatives. These companies, unlike larger corporations, typically have limited access to capital, which results in a preference for short-term financial gains over investment in innovation. As a result, they may struggle to fund even the initial stages of R&D projects, thus stalling progress in developing new technologies. This creates an uneven landscape, where only larger players can afford to sustain meaningful R&D efforts.
- **Limited collaboration between industry and academia:** Insufficient collaboration between the chemical industry and academic institutions remains a major challenge. The disconnection between research and practical application results in missed opportunities for turning academic breakthroughs into market-ready innovations. Without closer ties, the translation of research into commercialization becomes difficult, limiting the overall effectiveness of R&D funding.
- **Lack of forums for diverse stakeholder engagement:** There is a lack of structured forums that bring together diverse stakeholders (industry leaders,

[32] CapitalIQ; Stakeholder consultations

academic researchers, and regulators, etc.) which further exacerbates the disconnect between technological advances and real-world market needs. For example, the Annual GPCA[33] Forum is the flagship event of the Gulf Petrochemicals and Chemicals Association (GPCA). It serves as a platform where industry professionals from around the world convene to share knowledge, exchange ideas, and build valuable networks. By fostering an environment of collaboration and dialogue, the Annual GPCA Forum has established itself as the central hub for leadership and strategic discussions in the chemical and petrochemical industry, both regionally and globally. Similarly, the Helsinki Chemicals Forum (HCF)[34] is an independent, non-profit forum founded by the Finnish Fair Foundation and the City of Helsinki, dedicated to promoting chemicals safety and chemicals management globally. This event unites international authorities, industry leaders, politicians, academics, NGOs, journalists, and experts in chemical safety management, fostering groundbreaking ideas and collaborations.

— **Shortage of skilled R&D talent:** The chemical industry in India faces a shortage of skilled researchers and technicians, particularly in specialized fields like nanotechnology, biotechnology, and sustainable chemistry. With a 30 percent shortfall in skilled R&D talent, the industry is limited in its capacity to innovate and scale new technologies[35]. This shortage is further compounded by the growing demand for expertise in emerging areas, creating intense competition for a limited pool of qualified professionals. The lack of skilled talent can delay project timelines and reduce the potential impact of R&D funding, as highly specialized expertise is crucial to the success of many advanced technological developments.

Unlocking innovation in Indian chemicals industry

India's chemicals industry has a two-fold objective:

— Objective 1: Develop indigenous technologies for manufacturing high-value products where Indian companies do not have access to global technologies

  • Approach: Disbursement of R&D funds to drive innovation with enhanced collaboration between industry and academia

— Objective 2: Acquire access to specific technologies available with select players outside India

  • Approach: Foster MNC partnerships on areas of importance and targeted towards select technologies

4.1 Disbursement of R&D funds to drive innovation with enhanced collaboration between industry and academia

The R&D fund constitutes budgetary support for boosting indigenous technology development and innovation. With the help of this fund, Indian chemicals manufacturers can refine output quality and supply chain management practices, by training personnel and upgrading local equipment and infrastructure. The annual budget of $150 million[36] to $200 million[37] is said to be set aside from the R&D fund, for dedicated chemicals research. With funding availability no longer a constraint, the focus can now shift to ensuring efficient allocation and utilization of these funds to plug gaps in the technical know-how of Indian chemicals

[33] https://www.gpca.org.ae/events/18th-annual-gpca-forum/
[34] https://helsinkichemicalsforum.messukeskus.com/
[35] https://www.indianchemicalcouncil.com/
[36] For latest available year or annualized over a budgeted period
[37] 20% (~2000 Cr) announced in 2023-24; initial announcement of ~28% over 5 years of overall budget of ~50,000 Cr

companies aiming to manufacture high-value products.

The disbursement strategy for the R&D fund can be focused on in three innovation principles, emphasizing the development of:

- **Sustainability-led Innovations:** Supporting projects that drive sustainable development in the chemicals industry include funding for green chemistries, carbon capture, utilization, and storage (CCUS) technologies, as well as circular economy initiatives. Such projects are crucial for reducing the environmental footprint of India's industrial sector while ensuring long-term sustainability. For example, advancing CCUS technologies can help Indian industries meet global emissions standards, while circular economy solutions can promote the recycling and reusing of materials, reducing dependence on finite resources.
- **Process improvement-led innovations:** Enhancing existing chemical processes through advanced technologies such as new reactors and separation techniques are critical for increasing the efficiency and cost-effectiveness of chemical production, particularly in energy-intensive sectors. For instance, innovations in separation technologies can reduce the use of harmful chemicals or energy in critical industrial processes. It would enable Indian industries to achieve better resource utilization and lower operating costs. This principle aligns with the global push towards more efficient and cleaner industrial practices.
- **New molecule development:** The development of new molecules is essential for expanding India's capabilities in advanced chemicals and materials. These projects are aimed at creating novel compounds with specific industrial applications, such as high-performance polymers, specialty chemicals, and bioplastics. Further, India's pharmaceuticals exports are strong and steadily growing thanks to new chemical entities (NCEs) targeting healthcare and medical research. As per export trends, Indian pharmaceutical, biotech and bulk drug exports expanded to double-digits from 2023 to 2024 alone. The NCEs bolster the development of therapeutic drugs for treating cancer, HIV, tuberculosis and diabetes.[38] Supporting the development of new molecules can help India reduce its dependency on imported chemicals and establish a more self-reliant chemical sector. The creation of such products will not only serve domestic industries but also provide new market opportunities globally.

Efficient governance and fund disbursement mechanisms could be pivotal in boosting self-sufficiency and R&D upgrades. For this purpose, carefully designed mechanisms can ensure transparency, accountability and alignment with national innovation goals. These key design choices could include:(Exhibit 22)

Identifying governing mechanisms:
A critical first step is identifying the governing entity. A neutral agency staffed with technical experts can facilitate objective decision-making and prevent delays in fund allocation. While existing institutions like the Department of Science and Technology (DST) or the Anusandhan National Research Foundation (ANRF) bring substantial experience in managing R&D initiatives, sector-specific insights from the Department of Chemicals and Petrochemicals (DCPC) are also valuable. A hybrid model—establishing an interface agency that combines DST's technical oversight with DCPC's industry expertise—emerges as a potential practical solution. This approach would facilitate streamlined fund management and ensure alignment with sectoral and national innovation goals.

[38] https://www.business-standard.com/industry/news/india-s-pharma-exports-expected-to-remain-strong-amid-global-slowdown-124100900585_1.html

Categorization of projects to be funded: Project evaluation and selection can be based on criteria including innovation, commercial feasibility, impact and specific R&D and technology requirements. Identifying and organizing categories of projects funded by the R&D initiative could play a big role in defining its impact. Comprehensive funding covering the full technology readiness spectrum (4/5 to 9) would support transformative projects from ideation to market readiness, ideal for groundbreaking areas such as new molecule development. Further, targeted funding for the middle to later stages of development (TRL-4/5 to TRL-9) would focus on accelerating the commercialization of validated concepts, bridging the gap between research and practical application. Prioritization would include sustainability-led projects, such as green chemistries, Carbon Capture, Utilization, and Storage (CCUS), and circular economy innovations, alongside initiatives leveraging IoT, AI and machine learning for process optimization.

Investments in advanced reactors, separation technologies and similar improvements could further bolster industrial competitiveness. The Department[39] of Biotechnology (DBT) in India, for instance, uses similar criteria to select projects for funding in biotechnology, focusing on innovation, market potential, and technological feasibility. Internationally[40], South Korea's Ministry of Science and ICT uses a rigorous selection process for funding technological innovations, particularly in high-tech industries like chemicals and advanced materials. Their focus on commercializing research outcomes has helped South Korea become a global leader in specialty chemicals and materials technology.

By explicitly catering to the modernization needs of Micro, Small, and Medium Enterprises (MSMEs), which form the backbone of India's industrial sector, the fund could enable them to adopt and scale innovative technologies. This would ensure their participation in the national innovation drive. This inclusivity fosters a broad-based industrial transformation, with benefits extending to smaller players often constrained by limited resources.

MSMEs in India involved in the production of agrochemicals or specialty chemicals can be supported to adopt more efficient, sustainable technologies, such as those for waste reduction or energy optimization. The National Innovation Foundation (NIF)[41] in India already supports grassroots innovations by MSMEs, enabling them to scale through better access to technology. Similarly, countries like Germany[42] provide support for small chemical producers through their German Federation of Industrial Research Associations (AiF), which offer funding for innovative projects within small and medium-sized enterprises.

Targeted beneficiaries: Joining forces between academia and industry: Many countries have adopted balanced approaches to support both industries and academic research. For instance, in the United States, the Advanced Manufacturing National Program Office (AMNPO)[43] under the Department of Energy funds both industry-led initiatives and academic research projects to ensure a robust pipeline from basic research to practical implementation. Additionally, Germany's[44] Fraunhofer Society integrates industry partners with academic research centers, ensuring a continuous flow of innovation from the lab to the marketplace.

To facilitate these partnerships in the Indian chemicals industry, a targeted approach is

39 https://www.indiascienceandtechnology.gov.in/covid-19-the-pandemic/department-biotechnology-dbt-govt-india
40 https://www.oecd.org/en/publications/korean-focus-areas_f91f3b75-en/a-global-powerhouse-in-science-and-technology_61cbd1ad-en.html
41 https://nif.org.in/aboutnif#:~:text=NIF%20has%20proved%20that%20Indian,ideas/innovations%20on%20the%20same.
42 https://www.daad-argentina.org/files/2022/10/RIG-Industrie_barrierefrei.pdf
43 https://www.nist.gov/oam
44 https://nap.nationalacademies.org/read/18448/chapter/13

Exhibit 22

Key design choices in the disbursement of R&D fund

A Identifying the governing entity for R&D fund disbursement

1 Creation of an interface agency / council in collaboration with DST and DCPC ✓
- Disbursement and allocation of the fund to be done by DST

Rationale for selection
- Neutral agency staffed with experts for technical decision-making
- Allows for a streamlined process without delays

B Categories of project to be funded

1 Early-stage validation and commercialization (TRL-4/5 to TRL-9) ✓
- Targeted funding to support the transition from validated concepts to market-ready products

2 Funding for MSMEs ✓
- Provide financial support for innovative technology application program promoting modernization and innovation at MSMEs

Types of projects
- Sustainability-led including green chemistries, CCUSs (Carbon Capture, Utilization and Storage), Circular economy etc.
- Process improvement-led through advanced reactors, separation technology etc.
- New molecule development

C Beneficiaries

1 Industry players ✓

2 Universities and research institutions ✓

necessary. First, the creation of a dedicated interface agency, led jointly by the DCPC and the DST, can play a crucial role in streamlining the collaboration process. This agency would act as a liaison, ensuring the efficient allocation of funds and the monitoring of project outcomes. In addition, a co-development model for R&D projects could be encouraged, where a percentage of the R&D funds are specifically allocated to joint projects. These projects would require clear deliverables and milestones to be agreed upon by both academic institutions and industry players. To further incentivize collaboration, the provision of tax benefits and performance-based grants could motivate both sectors to actively engage in joint initiatives. Lastly, capacity building is essential for successful collaborations, and academia could be supported with industry-relevant training programs and access to state-of-the-art infrastructure to ensure readiness for these joint projects.

This comprehensive approach will foster innovation, accelerate technology commercialization, and strengthen the link between research and industry in India's chemicals industry.

Responsibilities of the funding entity

For maximum impact and smooth functioning, this R&D funding body would have three core responsibilities: strategic planning and design, the effective disbursement of funds, and finally the ongoing tracking of progress to ensure transparency and success parameters are met.

Strategic planning and design

— **Strategic planning:** The strategic planning process can focus on defining long-term research agendas and priorities that align with both national goals and global technological trends. This ensures that R&D efforts are not only forward-

thinking but also relevant to the evolving needs of the industry and the global market.

— **Building partnerships:** To enhance the impact and reach of R&D initiatives, the plan could emphasize on building strong collaborations with research institutions, private sector players, and international organizations. These partnerships would provide access to additional resources, expertise, and cutting-edge technologies, enabling more effective and innovative solutions.

Fund allocation and disbursement

— **Fund allocation by DST in consultation with the interfacing agency:** Fund allocation by the Department of Science and Technology (DST), in consultation with the interfacing agency, could be carried out based on pre-defined criteria, such as complete grants, cost-sharing models, loans, or milestone-based disbursements.

— **Project evaluation and selection:** In terms of project evaluation and selection, projects would be chosen based on a set of criteria, including innovation, commercial feasibility, potential impact, and the specific R&D and technological requirements.

Reporting and monitoring

— **Monitoring and evaluation:** A robust monitoring and evaluation system can be established to continuously assess the progress and outcomes of funded projects. This would ensure that projects are on track, meeting milestones, and delivering value in terms of technological advancements, economic impact, and alignment with broader goals.

— **Reporting:** Regular updates and detailed reports would be provided to stakeholders, keeping them informed about the status, progress, and impact of funded projects. Transparent reporting, in turn, fosters accountability, facilitates timely interventions when necessary, and ensures that all parties involved are aligned with the project's objectives and outcomes.

Specific KPIs could help to gauge the fund's overall success on its responsibilities:

— Funds raised
— Funds disbursed
— Number of projects commercialized
— Revenue generated through commercialized projects
— Number of patents issued

4.2 Acquiring access to specific technologies available outside India

While the previous approach would focus on developing self-sufficiency for global technologies not easily accessible, some technologies may be accessible beyond India through select players. To be able to use and adopt these technologies, Indian companies may need partnerships with multinational corporations (MNCs) that are well versed in these.

Unlocking the specific technologies for at least 11 products could be a strong starting point in this direction (Exhibit 23). India's limited access to methanol carbonylation technology, for example, and the commercial inviability of the acetaldehyde oxidation route due to ethanol prices make partnerships with global leaders fruitful for acetic acid production.

The government could support attracting MNC investments to India for these prioritized product segments. A targeted approach could entail the following:

— **Incentivizing collaborations and joint ventures** by providing tax breaks, grants, or subsidies for efforts to bring in specific technologies of national importance. MNCs could benefit from the access to India's attractive domestic market, while Indian chemicals companies could gain access to these technologies, with both parties receiving financial incentives. Doing this may take some time, as identifying the right, willing entities to participate in such a collaboration, and ensuring their goals

are aligned, could be a time-consuming process.

— **Providing financial and regulatory incentives for MNC investments** could raise India's attractiveness as an investment destination. These incentives could include low-interest loans or support on capital cost, as well as simplified regulatory requirements. MNCs could benefit from the ability to retain full autonomy and control over operations. This might be the fastest route to unlock new technologies

— **Subsidizing licenses for prioritized technologies** would be unlikely to impact licensors while being a boon for domestic companies. They could now afford new technologies where the licensors are available.

The KPIs to gauge the success of this could focus on two outcomes: the number of chemicals unlocked through technology access and the number of MNCs that invest in India for the prioritized technologies.

With efficient implementation, this two-pronged approach could help the Indian chemicals industry break new ground. The lack of continuous upgradation and improvement could give way to a culture of constant, dynamic innovation in much needed areas. This could generate a greater self-sufficiency in India's chemicals industry, and establish a global reputation as an innovator of products and technologies.

Exhibit 23

Select products for technology partnerships

Non-exhasutive

Prioritized segment	Key challenge
1 Acetic acid	Limited access to the 'methanol carbonylation' tech while the 'acetaldehyde oxidation' route is not commercially viable owing to ethanol prices
2 SAP	Requires integrated play into acrylic acid; technology limited to the Western consolidated market and Chinese players
3 PC resin	Concentrated technology with limited players
4 MDI and TDI	Limited players with tech know-how; requires phosgenation license
5 Nylon 6,6	Limited to players having access to adiponitrile technology
6 Specialty polymers	Limited investment and innovation capabilities in building application-oriented high-tech compounds like PEEK, HPPA, etc.
7 Plastic additives (incl. flame retardants)	Limited access to low-cost raw materials (like P, Br, Sb, etc.) for integrated play coupled with little to no investment in manufacturing high performance additives
8 Food & nutraceutical ingredients	Limited technology in fermentation, bio-processing and application development
9 Titanium dioxide	Domestic restrictions for private players on mining restricts competitive play against global integrated players
10 Battery chemicals	Non-existent domestic market coupled with high R&D investments
11 Electronic chemicals	Extremely small domestic market coupled with high R&D investments

Initiative 5: Fast-track environmental clearance with transparency and accountability

The environmental clearance (EC) process is a critical step at the pre-construction stage for chemical manufacturing projects. Despite its goal to balance industrial growth with environmental safeguards, India's EC process has become a major challenge. The prescribed timeline for obtaining EC is 255 days, yet 90%[45] of projects face delays, with an average delay of 196 days. Consequently, the total average time to receive EC extends to nearly two years, substantially higher than in other countries. For example, in the United States, the National Environmental Policy Act (NEPA) process for major projects typically takes about 1 year[46] although some complex projects can take longer. In the European Union, the Environmental Impact Assessment (EIA)[47] process generally takes around 12 to 18 months, depending on the complexity and scope of the project.

These delays in India are primarily due to prolonged public consultations, documentation inconsistencies, and insufficient resources among regulatory bodies. The extended timeline significantly inflates project costs and disrupts industrial development, creating financial uncertainties for industries, especially those handling hazardous materials like chemicals. This situation deters foreign investment and hinders the growth of the manufacturing sector.

Accelerating the EC process could be one of the factors that improves India's ease of doing business ranking, facilitating the swift establishment and operation of new chemical production facilities, and ultimately boosting the country's industrial output and economic growth.

Decoding the EC process

The rigor of an EC check is essential to guard against possible environmental damage from a manufacturing plant and ensure that proposed projects adhere to environmental safeguards. To receive an EC certification, chemicals companies need to meet certain requirements such as an environmental impact assessment, consulting with local communities and stakeholders, risk assessment and hazard waste management practices, complying with national standards and regulations, and sustainability measures like green initiatives that support a larger environmental management plan (Exhibit 24).

The EC certification process is a step-by-step journey that every large-scale industrial project, especially in chemicals manufacturing, must navigate in order to move from concept to construction. It ensures that industrial projects not only meet regulatory standards but also contribute positively to India's industrial ecosystem while safeguarding environmental integrity.

Application submission

The process begins with the project proponent submitting a formal application for EC to the regulatory authorities, along with a pre-feasibility report that outlines the project's potential environmental impact. This application also includes documents such as project location maps, site plans, and details on resource requirements like land, water, and energy.

[45] https://cag.gov.in/en/audit-report/details/27540
[46] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/opinion-improve-epa-s-new-chemicals-program-or-risk-more-innovation-offshoring
[47] https://environment.ec.europa.eu/law-and-governance/environmental-assessments/environmental-impact-assessment_en

Screening for category classification[48]
The submitted application undergoes a screening process, where projects are classified based on potential environmental impact.

Category A projects, with larger potential impacts, are reviewed by the central-level Expert Appraisal Committee (EAC).

Category B projects are reviewed at the state level by the State Expert Appraisal Committee (SEAC). Category B is further divided into B1 (requires Environmental Impact Assessment (EIA)) and B2 (does not require EIA). If categorized as A or B1, the project must prepare an Environmental Impact Assessment report based on scoping Terms of Reference (ToR) provided by the committee.

Public consultation by the pollution control board
The public consultation process consists of a public hearing carried out by the Pollution Control Board (PCB) and a written response period. During this phase, the project details and EIA findings are presented to the local community. The public is invited to voice concerns, offer suggestions and provide feedback, which is then documented and incorporated into the final EIA report.

Scrutiny of the final EIA report
The project proponent submits the final EIA report, which includes data from the public consultation process and outlines any revisions to environmental safeguards. The report is scrutinized by the EAC, which examines the accuracy, feasibility and comprehensiveness of the mitigation measures outlined in the Environmental Management Plan (EMP).

Appraisal by EAC based on the EIA Report and public consultation

The EAC performs a detailed appraisal of the final EIA report, taking into account both the environmental assessment and the public consultation feedback. This appraisal involves a rigorous examination of environmental risks, proposed controls and the project's alignment with environmental regulations.

Placing of EAC's recommendation to EIAA
Following the appraisal, the EAC compiles its recommendation for or against granting clearance. This recommendation, along with supporting documents, is submitted to the Environmental Impact Assessment Authority (EIAA) for a final decision.

Decision by the EIAA

The EIAA reviews the EAC's recommendation and makes the final decision to either grant or reject EC for the project. If clearance is granted, it is usually issued with specific conditions for ongoing environmental management and monitoring. The project must comply with these conditions and report regularly to maintain its certification status. In case of a rejection, the EAC may recommend that EIAA reconsider, and that decision would be final.

Challenges faced by chemicals industrial projects in the EC process

In India, obtaining EC approvals for a new manufacturing plant is complicated by disproportionately long processing times, complex clearance requirements, and overlapping regulatory scrutiny at both the state and central levels. These delays inflate project costs and hurt India's global perception as a manufacturing destination.

Presently, about 89 percent of projects in the chemicals industry are delayed at different stages of the EC grant procedure. On average, proponents wait for around 255 days for an EC decision after submitting their application. Of these, 194 days account for average delay periods. Some delays have even recorded 1005 days (Exhibit 24).

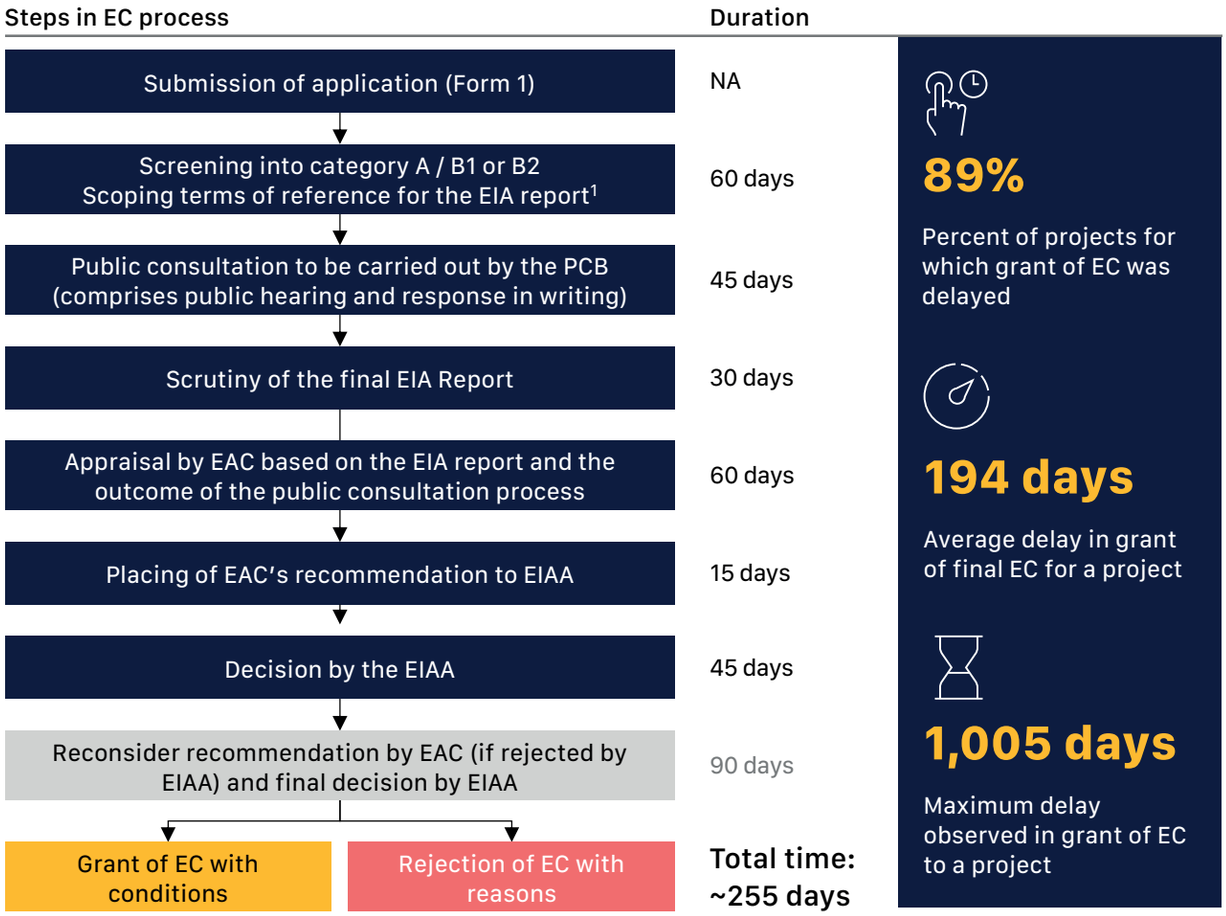
[48] https://www.cseindia.org/environmental-clearance---the-process-403

A closer look at the various stages in the EC application process highlights that the screening and classification stages, as well as EAC appraisal, are the most time-consuming stages with delays, requiring about 60 days each. The public consultation engagement along with response collation takes about 45 days to process. The EIAA's decision requires another 60-day wait. In the event of a reconsideration recommendation, the wait time increases by another 90 days.

Long approval timelines drive up project prices because companies must retain resources and secure land while waiting for the EC. These delays may discourage foreign and domestic investment, since potential backers view regulatory delays as an obstacle to timely returns. Additionally, in a rapidly evolving global market, such delays hinder a company's ability to capitalize on immediate demand, especially for specialty and high-value chemicals.

Exhibit 24

The time taken at various stages of the EC certification process



[1] Category B2 projects are exempted from further process

Source: Client Inputs, Expert Insights, CAG Report, 2016 https://cag.gov.in/en/audit-report/details/27540

5.1 Accelerating the EC certification

A thrust on faster, more efficient decision making at various stages could simplify and fast-track the EC process in India. Following ideas could be considered (Exhibit 25):

— Set up a dedicated committee under the Ministry of Commerce and Industries to oversee and monitor EC timelines. This could add valuable oversight and expedite the process at the public consultation stage. The committee could work alongside the Ministry of Environment, Forest and Climate Change (MoEFCC) to ensure adherence to specific timeframes, identify bottlenecks and coordinate with relevant authorities for faster resolution. It could also publish quarterly reports to track performance and delays.

— Give autonomy to the EAC to make the final decision or allow companies to proceed with a deemed EC. At the final decision-making stage, which is primarily the responsibility of the Environmental Impact Assessment Authority (EIAA), the EAC could make the final decision, instead, without needing additional EIAA validation, eliminating a duplicative step and facilitating accelerated decisions and saving about 45 days. Another alternative could be to move forward with a provisional EC, which is a deemed clearance pending final approval.

— Permit companies to commence certain construction activities onsite at their own risk while awaiting final EC approval. This permission could apply to companies planning civil construction, in cases of capital expansion or where the product mix is changing and a public hearing is not required. This could help streamline project timelines and prevent capital stagnation. This phased approach, introduced at the EAC appraisal stage, would allow for preparatory work, such as building basic infrastructure, pending full clearance. Companies could start preliminary work around 120 days earlier than in the normal waiting period, and hit the ground running once the EC certificate is granted.

— There would be clear guidelines and limitations on approved pre-clearance activities to protect the environment. While companies could go ahead with preparations at their own risk, this measure could promote flexibility and significantly accelerate project completion timelines, allowing companies to respond swiftly to market demands.

— Pre-environment clearance to be taken by chemical parks for industries; chemical parks to have capacity to collect environment data

— In case of no increase in pollution load due to product mix changes, fresh EC may not be required

Implementing a quicker EC certification process

These suggestions aim to achieve a six-month EC process by 2026, ensuring that fewer than 10% of projects experience delays in EC certification. Exhibit 25 shows a possible roadmap for implementing these alternate suggestions.

Easing the EC process could enhance the supportive regulatory environment without compromising the environment. This initiative contributes significantly to the policy steps for improving competitiveness, investment, and sustainable growth in India's chemicals industry.

Exhibit 25

Implementing the fast-tracked process for EC

Dec'24	Jun'25	Dec'25
Suggestion under review by MoEF	Policy design	Implementation (including release of amendment note)

Suggestion 1: Set up audit committee to monitor timelines and publish quarterly reports on performance and delays.	• **Draft committee design** (no. of members, qualifications, etc.) • **Draft roles & responsibilities** (key tasks like audit reports, ensuring compliance, etc.)
Suggestion 2: • **Option 1:** Clubbing the two committees to cut down on time required.	• **Draft committee design** (no. of EACs at state and center, no. of members, representation from regulatory authority) • **Draft roles & responsibilities** (meeting frequency, prescribed timelines, etc.)
• **Option 2:** Provision of a deemed EC in case of delayed EIAA decision.	• **Draft approval criteria and exclusions** (category of projects like capacity expansion, change in product mix, etc.) • **Draft allowed activities with deemed EC** (e.g., civil construction, etc.)
Suggestion 3: • Allow companies to initiate civil construction) in cases of capital expansion / change of product mix and where public hearing is not	• **Draft approval criteria and exclusions** (category A/B1/B2 projects) e.g., where public hearing is not required and in cases of capacity expansion, etc. • **Draft allowed activities**

Initiative 6: Securing FTAs to support industry growth

India's reliance on chemical imports continues to expand, with the gap between imports and domestic production forecasted to widen significantly. The existing Free Trade Agreements (FTAs) and discussions about new ones, particularly with Middle Eastern countries, have brought both opportunities and challenges for the Indian chemicals industry. FTAs are designed to boost trade, reduce barriers and expand markets, but their impact on India's cost competitiveness in chemicals has rendered mixed results. Currently, India has signed FTAs with 14 countries, including the UAE and Australia, and has more under negotiation, potentially broadening its preferential trade network to over 120 countries once concluded[49].

The chemicals and petrochemicals sectors, which contribute to more than two million[50] jobs and are crucial to India's economic output, have not benefited uniformly from these agreements. For instance, zero-duty imports under some FTAs have led to an increase in cheaper chemical imports, further stressing the domestic production landscape. This impact is evident in the high demand for petrochemical intermediates and specialty chemicals, sectors where India has yet to achieve cost parity with major exporters due to limited domestic feedstock availability and production capabilities.

Gaps and challenges

FTAs have created a mixed landscape for the chemicals industry, with roadblocks that complicate growth and competitiveness. As India seeks to integrate more deeply into global trade networks, FTAs have often exposed domestic players to significant hurdles.

Cost competitiveness and import surge
India's chemical imports reached nearly[51] $75 billion in FY 2023, with China, Saudi Arabia, and the United States as major suppliers. Import dependency has worsened under FTAs, with zero-duty concessions allowing low-cost chemical imports, particularly from Asia-Pacific FTA partners, to flood the Indian market. This influx impacts local companies by putting pressure on production costs, as they struggle to compete with cheaper imports from countries with stronger infrastructure and access to affordable feedstock. Consequently, Indian producers face difficulties in maintaining profitability and expanding production, as cheaper imports often claim a larger share of the domestic market.

Limited protection for sensitive sectors
FTAs often include sensitive product lists, which allow some sectors protection through tariffs. However, India's sensitive lists do not adequately shield critical segments within the chemicals industry (i.e. petrochemical intermediates and specialty chemicals) from zero-duty imports. This exposure undermines local industries and prevents the growth of domestic manufacturing capacity. The lack of tariff protections also dissuades potential investors in high-growth sectors, like specialty chemicals, which have seen rising demand globally but remain underdeveloped domestically.

[49] https://www.newindianexpress.com/nation/2024/Mar/10/explained-indias-recent-push-in-free-trade-agreements-ftas-signings-types-and-benefits
[50] https://prsindia.org/policy/report-summaries/demand-and-availability-of-petrochemicals
[51] UN Comtrade, team analysis

Impact on value-added manufacturing
FTAs inadvertently promote raw material imports over local value-added manufacturing expansion, which, in turn, curtails job creation and economic development. Although India exported around $44 billion[52] worth of chemicals in FY 2024, much of this was in lower-value segments, limiting opportunities for more advanced and specialized manufacturing. India's chemicals industry has significant potential for downstream processing and creating specialized products. However, the ease of importing finished products at low tariffs under FTAs discourages domestic companies from investing in advanced manufacturing technologies and infrastructure. This challenge has prevented India from fully capitalizing on global supply chain opportunities.

Inadequate feedstock and infrastructure support
FTAs have intensified India's dependence on imported feedstock, as most domestic producers lack access to competitively-priced raw materials. Many partner countries within FTAs, particularly in the Middle East, have a natural advantage in petrochemical production due to abundant and cost-effective resources. This creates a cost imbalance that hinders the development of India's own chemicals supply chain. While FTAs can drive trade, India's lack of basic feedstock infrastructure means that the industry remains exposed to global supply chain risks, further constraining growth.

Overlooked industry-specific needs in FTA negotiations
FTAs typically focus on broader economic interests without adequately addressing the specific needs of the chemicals sector, which demands a nuanced approach. For example, despite India's need for support in specialty chemicals and intermediates, many agreements lack provisions that would incentivize domestic production or ensure access to necessary technologies and investments. Policymakers have yet to fully integrate sector-specific clauses that would protect and promote chemicals, petrochemicals and specialty manufacturing, limiting the long-term strategic benefits of FTAs for the industry.

Fostering balanced growth from future FTAs

The trade imbalances that FTAs have created in the Indian chemicals industry highlight the need for targeted support to protect and develop the sector. The following initiatives could help India build a more resilient and competitive chemicals industry within the global market.

6.1 Targeted FTA negotiations Moving forward, India could negotiate FTAs that incorporate specific provisions for the chemicals industry. This can include incorporating industry-focused protections such as tariff quotas or selective duty exemptions on critical raw materials and petrochemical feedstocks. At the same time, it would also be retaining tariffs on imported finished products to protect domestic manufacturers. Tailored FTA provisions would allow India to safeguard its chemical industry from cost disadvantages.

[52] https://indianexpress.com/article/cities/ahmedabad/ftas-that-unduly-favour-imports-in-petrochemical-and-chemical-sectors-to-be-reviewed-says-mos-9524449/

6.2 Awareness and effective utilization of FTAs

Many exporters, particularly smaller companies, are unaware of the benefits and procedures associated with utilizing FTAs effectively. Improving the awareness and accessibility of FTA provisions could enhance their utility and ensure that exporters are able to take full advantage of tariff reductions. Simplifying the administrative process, especially around proving the origin of exports (an essential requirement for preferential tariff treatment), could lower costs and improve compliance, enabling more companies to benefit from FTA provisions. A government-led initiative focusing on awareness and streamlined procedures could further empower exporters to access foreign markets more easily, boosting their capacity to compete in the global arena.

The current challenges faced by the Indian chemicals industry also present an opportunity for India to recalibrate its FTA strategy. Projections for the chemicals sector show that India's chemical exports could grow by 10 to 12[53] percent annually if the right measures are implemented, particularly in areas like specialty chemicals and petrochemical intermediates. India's chemicals industry is expected to reach a market value of $450 billion[54] by 2030, growing from approximately $200 billion in 2020. These projections highlight the significant opportunity for India to leverage FTAs more effectively and foster a competitive and self-reliant chemicals industry.

[53] IHS Markit, UN Comtrade, ITC Trade Map, Press search, Team analysis
[54] ibid

Case study: The Indo-Japanese Free Trade Agreement

The Comprehensive Economic Partnership Agreement (CEPA) between Japan and India, signed in FY11, has played a prominent role in shaping trade relations, particularly affecting India's trade balance in the chemicals sector. Since the agreement, Japan's exports to India have nearly doubled, reaching $16.49 billion in FY23 from $8.62 billion in FY11. However, India's exports to Japan have seen limited growth, increasing only slightly from $5.09 billion in FY11 to $5.46 billion in FY23, leading to a more pronounced trade imbalance. This imbalance is notably reflected in the chemicals sector, where India's import-to-export ratio with Japan has worsened—from 3.0 at the agreement's inception to 3.7 by FY23. These trends suggest that the FTA has largely benefited Japan's industries while posing challenges for Indian exporters, particularly those in the chemicals sector (Exhibit 26).

One of the primary factors contributing to these trends is the FTA's rules of origin (ROOs) and product-specific norms, which define the eligibility for preferential tariffs. Many of these stipulations favor Japanese industries, creating barriers for Indian chemical exports. India's Ministry of Commerce and Industry has advocated for a revision of these rules, aiming to make them more favorable for Indian industries, including MSMEs, which often struggle to meet Japan's strict technical standards. A proposed review of the CEPA's terms may focus on easing these standards and rebalancing the trade dynamics to ensure that the chemicals industry, among others, can better capitalize on export opportunities to Japan.

The Japan-India FTA illustrates how FTAs can impact the chemicals industry by creating asymmetrical trade benefits. Recognizing these patterns, India's approach to upcoming FTAs should be informed by a strategic framework that mitigates risks to vulnerable sectors while fostering equitable trade relationships.

Exhibit 26

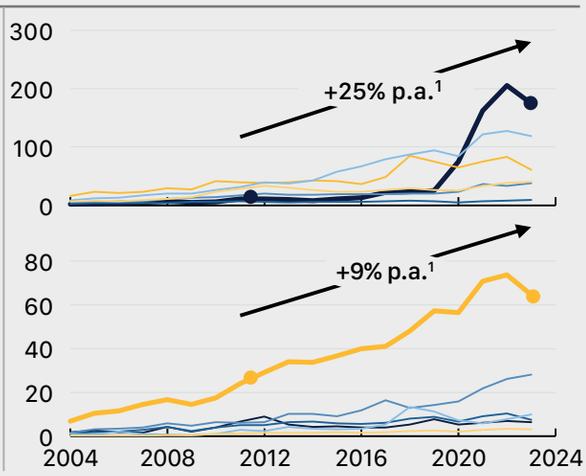
Increased imports accompany export growth after signing of FTA

— Inorganic chemicals — Paints, dyes, inks etc. — Plastics and articles
— Organic chemicals - Petrochemicals — Other specialty chemicals — Rubber and articles

India's trade balance with Japan
(Overall & chemicals), $ bn

		FY11	FY23
A	Imports from Japan	11.2	18.8
B	Exports to Japan	5.6	5.1
C	Ratio (A/B)	2.0	3.7
D	Chemical imports from Japan	1.4	4.4
E	Chemical exports to Japan	0.5	1.2
F	Ratio (D/E)	3.0	3.7

Chemicals trade between Japan and India
US$ mn



[1] For top traded category - Imports from Japan CAGR of 25 percent for Inorganic chemicals and Exports from India CAGR of 9% for organic chemicals

Source: UN Comtrade; ITC Trade map

Initiative 7: Talent and skill upgradation in the chemicals industry

India's immense potential to drive economic growth and enhance India's share in the global value chain faces some significant challenges in workforce readiness. A major talent and skills gap exists within the sector, creating a pressing barrier to scaling up operations, meeting production targets and fostering innovation. As the demand for skilled workers continues to surge—with projections indicating a substantial annual need—the current vocational training infrastructure remains insufficient to fill this gap.

Current scenario

Industrial Training Institutes (ITIs), a primary source of vocational education, fall short in offering the industry-specific courses required to support the Indian chemicals industry. Only about 8[55] to 10 percent of ITI programs cater to this industry's unique needs, with companies struggling to find adequately trained talent. Furthermore, with a gross enrolment rate of just 55 percent, the capacity of ITIs to produce skilled graduates is limited, making workforce expansion and upskilling a priority.

The revenue growth in India's chemicals industry has been supported by a favorable Compound Annual Growth Rate (CAGR) of around 7.7 percent[56] for chemicals exports between 2018 and 2023 . However, while revenues have increased, challenges remain in profitability and operational efficiency due to high production costs and skill shortages, particularly in technical and process-specific roles. These gaps contribute to attrition and misalignment, affecting the sector's ability to sustain long-term growth and competitiveness.

Gaps and challenges in leveling up workforce capabilities

The Indian chemicals industry, although expanding rapidly, faces critical challenges related to talent development and skill upgradation that impact its ability to compete globally. These challenges are multi-faceted and encompass education, training infrastructure, industry-specific skill requirements, and alignment between **educational institutions and industry demands**.

- **Mismatch between industry needs and training programs:** Since a relatively smaller number of ITI programs align with the chemical industry's specific needs, it has left a gap in critical skill areas such as process engineering, quality control and safety standards. This mismatch results in a shortage of skilled workers ready to take on specialized roles in chemicals manufacturing, R&D and operations, which are essential for efficiency and innovation in the sector.
- **Insufficient enrolment in vocational training:** The gross enrolment rate in ITIs is about 55 percent[57], which significantly limits the number of graduates entering the chemicals industry with relevant skills. Additionally, current curricula often focus on general manufacturing skills rather than sector-specific competencies, creating a large pool of workers who lack specialized training.
- **Lack of advanced training facilities:** India's training infrastructure for advanced chemicals skills, such as those required for specialty chemicals and petrochemicals, is underdeveloped. While the sector aims to reach about $450 billion[58] by 2030, the current

[55] https://www.niti.gov.in/sites/default/files/2023-02/ITI_Report_02022023_0.pdf
[56] https://chemicals.gov.in/sites/default/files/Reports/Statistics_at_a_Glance-2023.pdf
[57] https://www.niti.gov.in/sites/default/files/2023-02/ITI_Report_02022023_0.pdf
[58] IHS Markit, UN Comtrade, ITC Trade Map, Press search, Team analysis

training setup is insufficient to meet the projected workforce demand, which will continue to grow as the industry expands[59]. Furthermore, limitations in training facilities for emerging areas like green chemistry and sustainable processes prevent the industry from fully adapting to global trends.

— **Attrition and skill retention challenges:** Due to limited career development opportunities and upskilling programs, the chemicals industry faces high attrition rates, especially for advanced technical skill sets. The gap in career growth initiatives and professional development programs not only leads to workforce churn but also weakens the sector's ability to retain experienced personnel who can drive operational efficiency.

— **Regional and socioeconomic barriers:** The chemicals industry's concentrated foothold in states like Gujarat and Maharashtra often leads to a local talent shortage, while workers from other regions encounter difficulties with relocation. The socioeconomic factors, including limited access to quality vocational training in rural and semi-urban areas, further exacerbate the skill gap, creating barriers to entry for a large segment of the population.

The path to a skilled workforce

India can draw several lessons from the UK's approach to overcoming their workforce-related hurdles in the logistics sector. To effectively address the skill gap in India's chemicals industry, a multifaceted approach is required, integrating policy reforms, infrastructure expansion and strategic collaborations.

7.1 Expansion of ITIs and specialized training institutes

The expansion of Industrial Training Institutes (ITIs) and specialized chemicals training institutes is essential to meet the growing demand for skilled labor. Currently, the number of ITIs offering courses relevant to the chemicals sector is limited, (amounting to only 8 to 10 percent of ITIs providing industry-specific courses). Skill India[60] Mission aims to increase the number of these institutes, particularly in chemicals manufacturing hubs such as Gujarat, Maharashtra and Tamil Nadu. With over 14,000[61] ITIs in the country, scaling up their reach and aligning their courses to the chemicals industry's requirements is key to improving both accessibility and enrolment rates.

The government has also launched the Pradhan Mantri Kaushal Vikas Yojana (PMKVY)[62] to promote vocational training, which can boost much-needed industry-specific training as well as address the shortage of skilled personnel in quality control, R&D and operations.

Furthermore, expanding the Public-Private Partnership model is key in upgrading the existing training infrastructure and ensuring it meets industry standards. The PPP model enables private industry players to take an active role in modernizing ITIs, set up centers of excellence, and develop specialized courses.

[59] https://chemicals.gov.in/latest-news/indias-booming-chemical-and-petrochemical-industry-understanding-industry-landscape
[60] https://www.niti.gov.in/sites/default/files/2023-02/ITI_Report_02022023_0.pdf
[61] ibid
[62] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2100845#:~:text=Pradhan%20Mantri%20Kaushal%20Vikas%20Yojana%204.0%3A,15%2D59%20years%20of%20age.

The National Policy on Skill Development and Entrepreneurship highlights the importance of the PPP model to improve vocational training infrastructure. The Ministry of Chemicals and Fertilizers, through collaboration with the private sector, has been working to develop centers of excellence in key sectors of the chemicals industry, which will offer specialized training in emerging areas including sustainable manufacturing processes, automation and safety management[63].

7.2 Upgrading faculty and teacher training

The effectiveness of vocational training programs is directly linked to the quality of instruction. A critical intervention is the upskilling of faculty at ITIs and polytechnic institutes. The Ministry of Skill Development and Entrepreneurship (MSDE)[64] has recognized this need and launched programs to improve the competencies of instructors, especially in rural and semi-urban areas. This initiative includes regular training for instructors on the latest technologies in the chemicals sector and industry practices. Such upskilling ensures that students receive practical, industry-relevant training.

In 2021[65], the NSDC focused on improving faculty quality by providing up-to-date training on both technical and soft skills required by industry. The long-term impact of upskilling faculty will be a more robust, well-equipped workforce that meets industry standards.

7.3 Industry-academia partnerships

Strengthening partnerships between the chemical industry and educational institutions is another critical initiative. These collaborations can introduce industry-relevant courses in core areas like petrochemicals, polymer science and industrial safety. For example, the National Apprenticeship Promotion Scheme (NAPS)[66] has provided opportunities for about 32.38 lakh apprentices across industries. Apprenticeships and on-the-job training opportunities for students will help them gain practical experience while pursuing their education, making them more employable upon graduation.

Programs like the Atal Innovation Mission (AIM)[67], a government initiative to foster innovation and entrepreneurship in sectors like this one, encourage collaborations between educational institutions and the chemicals industry. The Department of Chemicals and Petrochemicals has advocated for closer alignment between academia and industry to ensure that the curricula in colleges and ITIs are regularly updated to meet the changing demands of the chemicals sector.

Despite strong sector growth, shortages in skilled labor—particularly in critical areas like R&D, operations and quality control—remain a major obstacle. Expanding ITIs, upskilling faculty and fostering a collaborative approach by the industry and academia are vital to bridging these gaps. Policy support that focus on targeted training programs and stronger partnerships between industry and education systems can play a key role in equipping India's workforce with the necessary skills as well. This approach can drive greater efficiency, innovation and competitiveness, positioning the chemicals industry to lead in both the domestic and global markets.

63 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2053796
64 https://www.msde.gov.in/#:~:text=Welcome%20to%20Ministry%20of%20Skill,of%20a%20'Skilled%20India'.
65 https://www.msde.gov.in/en/organizations/nsdf#:~:text=NSDC%20acts%20as%20a%20catalyst%20in%20skill,31st%20March%202021%2C%20NSDF%20has%20released%20Rs.
66 https://pib.gov.in/PressNoteDetails.aspx?NoteId=152129&ModuleId=3&reg=3&lang=1
67 https://www.pib.gov.in/PressReleasePage.aspx?PRID=1804813#:~:text=India%20has%2015L+%20schools%20

Conclusion

India, today, stands at a critical juncture in its industrial progression, with the chemicals sector offering a transformative opportunity to catalyse the nation's journey toward a $5-trillion economy and beyond. This report has articulated a clear, actionable roadmap to elevate India's share in the global chemicals value chain from a modest 3-3.5 percent in 2023 to an ambitious 5-6 percent by 2030 and 10-12 percent by 2040. Achieving this vision will require a concerted national effort across policy formulation, infrastructure development, technology acquisition, and international cooperation.

Anchored in four strategic growth themes and seven policy interventions, the roadmap provides a comprehensive pathway to overcome current constraints and unlock the industry's latent potential. The four key unlock themes outlined are: First, Export Market Expansion which focuses on strengthening high-potential segments such as agrochemicals, dyes, pigments, to tap into growing international demand. Second, investment in Sunrise Sectors including battery and electronic chemicals that seeks to position India at the forefront of emerging technologies. Third, efforts to Improve Production Competitiveness emphasize enhancing domestic capabilities in key segments like PVC, VAM, EVA, and Nylon-6. Finally, the strategy aims to Aid Technology Access by targeting import-dependent products such as acetic acid, MDI/TDI, PC resins, and plastic additives, thereby reducing reliance on external sources and fostering self-reliance.

Building on these growth themes, the strategy is further supported by seven targeted policy pillars: PCPIR, Ports, Opex support, R&D, ease of doing business, talent, and international cooperation. These were identified through extensive stakeholder consultations, including a roundtable with over 30 CXOs and representatives from key ministries. The resulting policy roadmap proposes a targeted mix of fiscal and non-fiscal measures to strengthen India's chemical sector. By focusing on building world-class chemical hubs, streamlining regulatory processes, supporting R&D and innovation, and nurturing a future-ready workforce, India can reposition itself from being a net importer to a globally competitive exporter of high-value chemicals.

The blueprint also draws insights from China's transformation, emphasizing localized production, scale, vertical integration, and regulatory reform. The timing of these interventions is particularly critical. Global supply chains are undergoing seismic shifts due to geopolitical tensions, trade realignments, and the push for sustainability. As multinational corporations seek alternative manufacturing hubs beyond China, India has a unique opportunity to emerge as a preferred destination provided it acts swiftly and decisively. The realignment of global trade presents India with a once-in-a-generation chance to establish itself as a key node in the global chemicals network.

Ultimately, success will depend on a cohesive approach that brings together government, industry, academia, and civil society. These policy interventions must be backed by sustained financial investments, collaborative research, and robust institutional mechanisms. The role of the central and state governments will be pivotal in providing the necessary fiscal support, land, infrastructure, and regulatory clarity. Industry must respond with investments in capacity, innovation, and training, while academic institutions must realign their programs to industry needs and co-create knowledge for the future.

In its essence, this report is both a call to action and a blueprint for progress. It outlines not just what must be done, but how it must be done. It invites all stakeholders to align their efforts toward a shared national goal: to build a globally competitive, resilient, and future-ready Indian chemicals industry.

In conclusion, the Indian chemicals industry has the capacity to be a transformative force in the country's journey towards economic self-reliance, job creation, and global leadership in manufacturing. The interventions laid out in the report are comprehensive and actionable, targeting the foundational elements of competitiveness, innovation, infrastructure, and governance. By embracing these recommendations with urgency and commitment, India can achieve its 2030 aspiration of a larger GVC share, transition to a net-zero chemical trade position, and set the stage for becoming a USD 1 trillion chemicals industry by 2040. The future of India's chemical sector is not just a vision—it is a well-charted roadmap awaiting timely execution.

Proposed policy interventions and potential impact by 2030

07 Policy interventions

01 Establish world-class chemicals hubs in India

02 Develop existing port infrastructure for storage and handling of chemicals

03 Introduce an opex subsidy for chemicals with high import dependence, export potential, and end-market criticality

04 Develop and access technologies to enhance self- sufficiency and foster innovation

05 Fast-track environmental clearance with transparency and accountability

06 Securing FTAs to support Industry growth

07 Talent and skill upgradation in the chemical industry

Net zero
India trade balance in chemicals by 2030

5-6%
Production share in the Global Value Chain by 2030 (from 3-3.5% in 2023)

700K
Additional employment generation by 2030

220-280 $ bn
India production of chemicals by 2030

35-40 $ bn
Additional exports in 2030 vs 2023

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