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ICC
Indian Chemical Council

# Supply unchained: Building resilient and sustainable chemical networks

June 2025

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# Foreword by KPMG in India

The global chemical industry is undergoing profound transformation—marked by supply chain realignments, evolving regulatory landscapes, and a decisive pivot toward sustainability and digitalisation. In this context, resilience is no longer a choice; it is a strategic imperative.

India stands at a unique inflection point. With strong domestic demand, competitive manufacturing capabilities, progressive policy reforms, and a growing global presence, India is fast emerging as a key anchor in the reconfigured global chemical supply network. The country's focus on infrastructure modernization, backward integration, and multimodal logistics is positioning it to serve as both a manufacturing hub and a reliable trade partner in the global ecosystem.

But scale alone will not define the future. The chemical industry's next frontier will be shaped by intelligence—systems that are predictive, adaptive, and sustainable. From AI-enabled freight management to blockchain-based traceability and Scope 3 carbon tracking, digital tools are redefining how value chains operate.

At the same time, companies are embedding ESG principles into procurement, routing, and asset decisions—recasting logistics as a lever for both performance and responsibility.

This report—Supply unchained: Building resilient and sustainable chemical networks—is a joint effort between the Indian Chemical Council (ICC) and KPMG in India. It presents a forward-looking view on how India's chemical logistics ecosystem can transform itself through three strategic lenses: supply chain resilience, sustainability, and digital innovation.

At our firm, we believe the next generation of chemical supply chains will be built not just on physical assets, but on data, collaboration, and purpose-driven design. This report is a valuable contribution to that vision—grounded in industry insights, policy progress, and technological foresight.

We believe you would find it thought-provoking and actionable, and we thank ICC for their continued leadership in advancing this critical agenda.

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# Geopolitical shifts and chemical supply chain reconfiguration

## The global era of evolving chemical ecosystem

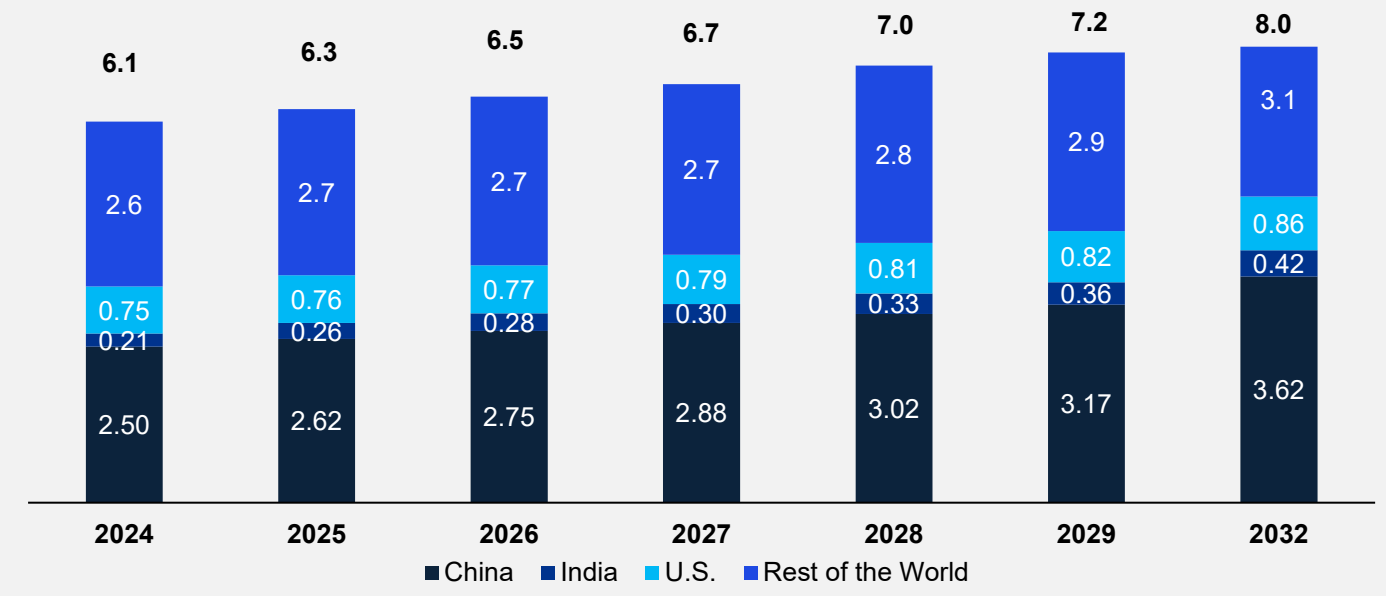
The global chemical industry stands at a pivotal juncture — shaped by fundamental shifts in demand, consumer behaviour, sustainability imperatives, and geopolitical uncertainties. It is no longer sufficient to operate with an efficiency-first mindset; companies must now rethink the fundamentals of how chemicals are produced, distributed, and consumed - one that demands proactive strategic adaptation and innovation across the supply chain.

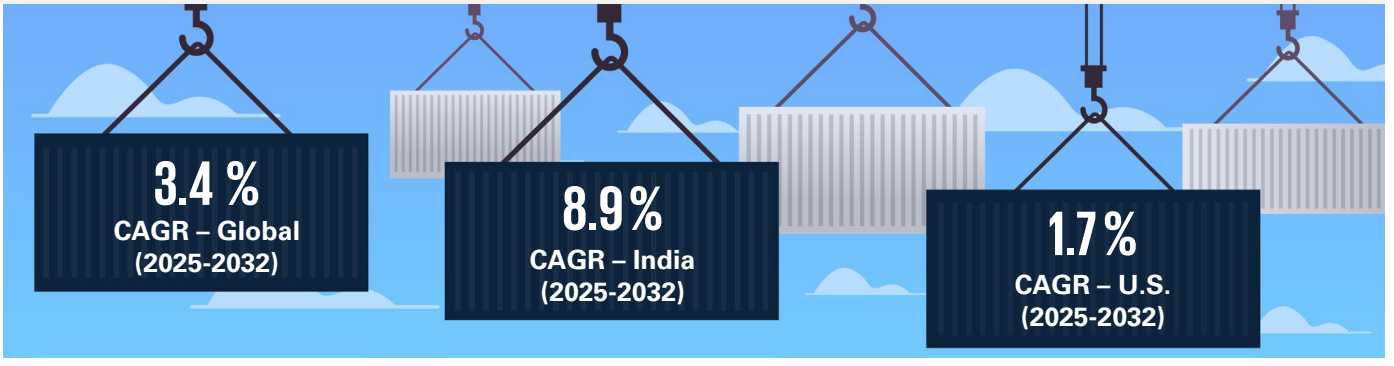
This transformation isn't isolated or temporary. It's part of a systemic and irreversible evolution of the global chemical ecosystem — a shift that will define the industry's trajectory for the next decade. For leaders and stakeholders, this presents both a challenge and a strategic opportunity to reinvent value chains, rethink business models, and embrace technology and sustainability as core pillars of resilience.

### Rising global consumption

Global chemical consumption is on an upward trajectory, fueled by economic growth, urbanization, and industrialization, particularly in emerging markets. While mature economies like the U.S., EU, and Japan remain key consumers of high-end specialty chemicals, the epicenter of volume growth has shifted eastward. The consumption continues to rise, driven by expanding middle-class populations in Asia, Africa, and Latin America. With economic development and urbanization accelerating in these regions, demand for everything from construction materials and agricultural chemicals to personal care and healthcare products is surging.

**Figure 1: Market Size of Chemicals[1]**




1. KPMG in India analysis, June 2025

### Shifts in consumer preferences

In parallel, domestic consumption within mature markets is experiencing a subtle but meaningful evolution. Globally, consumer preferences are undergoing a structural shift that is redefining the value proposition for chemical producers. While performance and price remain essential, modern consumers — both individuals and corporate buyers — increasingly prioritize sustainability, safety, and transparency.

| | |
|---|---|
| **Demand for sustainable chemical solutions** | Consumers are increasingly aware of the environmental and health impacts of the products they use, pushing brands to adopt cleaner, greener alternatives. |
| **Growing insistence on traceability and transparency** | Consumers want to know not just what is in a product, but also where it came from and how it was made— especially where chemical ingredients come into direct contact with end users. Supply chain transparency, once a compliance issue, has become a differentiator. |
| **Increased demand for bio-based chemicals** | Increased demand of chemicals derived from natural sources such as plants, algae, and microbial fermentation. Bio-based chemicals offer an alternative to fossil-derived materials and are particularly attractive in industries such as packaging, textiles, home care, and agriculture. |

Collectively, these changes reflect a paradigm shift in consumer influence over the chemical industry. Consumers are no longer passive end-users but active stakeholders driving innovation and accountability across the value chain.

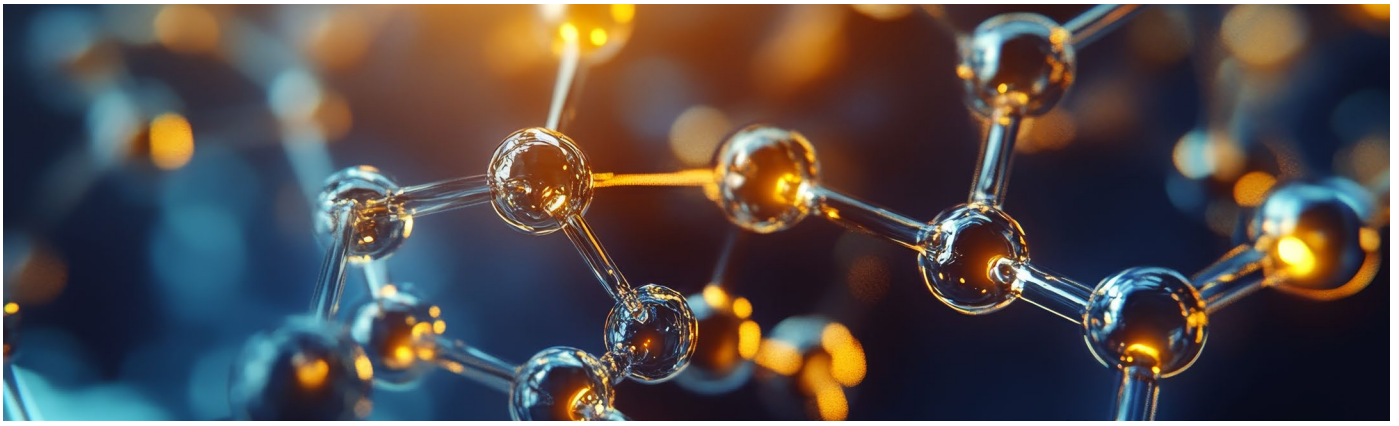
### Reconfiguration of the global supply chain

The global chemical supply chain — once optimized for efficiency — is now being restructured for resilience, flexibility, and sustainability. The disruptions brought about by the COVID-19 pandemic, geopolitical tensions and climate-induced events have highlighted vulnerabilities in the legacy model.

Moreover, there is a notable shift toward regionalization: sourcing and production are increasingly located closer to end markets. This decentralization reduces logistical risks and carbon footprints but requires significant capital investment and coordination. Digitization and advanced analytics are now vital tools for real-time monitoring and adaptive logistics.

Furthermore, reinstated tariffs and trade tensions have exacerbated supply shortages and increased material prices. These developments are prompting companies to reevaluate their supply chain strategies, emphasizing local sourcing and regional manufacturing hubs.

The chemical industry is at a crossroads, with rising consumption, shifting consumer preferences, and evolving supply chains redefining its future. By embracing sustainability, innovation, and strategic agility, companies can position themselves for success in this dynamic landscape



## Global trade realignment is redrawing supply routes

The global chemical industry—historically, anchored in highly optimized, linear, and globally integrated supply chains—is facing a profound transformation. Disrupted by rising protectionism, escalating tariffs, and a reorientation toward regionalized trade blocs, traditional supply routes are being redrawn. As global supply corridors shift, the structures and the competitive landscape of the industry will foresee a shift as well.

### The surge of protectionism and tariffs

In recent years, protectionist policies have intensified, leading to the imposition of tariffs and trade barriers. Protectionist trade policies and regional economic alliances are fragmenting the once-global nature of chemical supply chains. Trade wars between countries create uncertainty for global manufactures reliant on global supply chain and can have the following impact:

**Trade agreement realignments**
Countries are forming new trade partnerships to bypass restrictive tariffs and maintain stable supply chains.

**Shift from globalization to regionalization**
Many companies are moving away from global supply chains toward regional hubs closer to key markets with an aim to reduce dependency on foreign markets and avoid tariff penalties.

**Global inflation**
Supply chain shifts may temporarily slow down production causing price volatility. Further, Higher tariffs lead to increased costs for businesses, which are often passed on to consumers, fueling inflation.

**Stockpiling of raw materials**
Companies are stockpiling key raw materials to prevent disruptions from geopolitical tensions.

**More diversified supplier base**
Higher tariff on imports prompt companies to diversify suppliers and manufacturers across multiple countries.

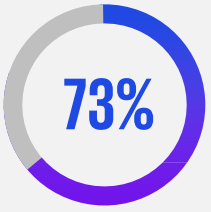
The outlined strategy reduces dependency on global supply chains, shortens delivery times, and enhances responsiveness to local market demands and thus chemical firms are moving from global to “glocal” operations—localized production, tailored to regional markets.

## Geopolitical volatility is elevating supply chain risks

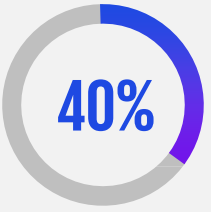
In today's changing world, understanding the impact of geopolitical risks on global supply chains is key to ensuring their efficiency and sustainability. Geopolitical events of recent years in the form of international conflicts, political changes, economic sanctions, maritime chokepoints and even natural disasters have a significant impact on global transport networks, causing various challenges and obstacles. Geopolitical tensions between major economic powers cause trade wars, which lead to the introduction of tariffs and other trade restrictions from the position of market protectionism.

Companies closely watch geopolitical issues when it comes to moving parts and products around the world. As per KPMG 2024 India CEO Outlook, 21 per cent of executives cited geopolitics and political uncertainty as the top threat to organization's growth, and 73 per cent called trade regulations as the biggest operational risk factor. These global disruptions can create uncertain operating environments that result in higher costs, increased complexity and less efficiency in supply chains.

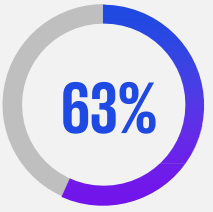
**KPMG 2024 India CEO Outlook**




Believe trade regulations as the biggest operational risk factor




Agree that evolving supply chain will impact organizational prosperity over next 3 years




Say Geopolitical conflicts will have notable impact on future of business

### The expanding impact of geopolitical conflicts on supply chains

One of the most disruptive geopolitical events in recent years has been the conflicts, which has significantly altered global trade flows. An eastern European country, a major exporter of fertilizers, industrial raw materials, and agricultural commodities, has seen its supply routes severely impacted by military blockades and infrastructure damage. Meanwhile, the other country, a key supplier of crude oil, natural gas, and critical minerals, has faced sanctions that have reshaped global energy markets. These disruptions have forced companies to seek alternative suppliers, often at higher costs, while also navigating logistical bottlenecks caused by rerouted shipments and increased freight expenses. Beyond the direct impact on raw material availability, the conflict has exacerbated inflationary pressures, as energy costs surge and transportation expenses rise.

The above-mentioned conflict is just a fleeting example on how political or military crises can affect key supply channels and leave companies searching for alternate routes. Thus, these geopolitical conflict zones encourage multinational companies to develop more flexible and sustainable strategies for managing supply systems, routes, through the diversification of suppliers and back-up logistics options.

### Maritime chokepoints: The hidden bottlenecks of global trade

While geopolitical conflicts disrupt supply chains at a macro level, maritime chokepoints present another formidable challenge. These narrow passages—such as the Suez Canal, Panama Canal, and Strait of Hormuz—are critical arteries for global trade, yet they are increasingly vulnerable to climate-induced disruptions, geopolitical tensions, and security threats. For instance, water levels in various canals have led to restrictions on vessel transit, delaying shipments and increasing freight costs. Similarly, conflicts in the Red Sea region have affected the Suez Canal, forcing ships to reroute around Africa, adding 10-15 days to transit times and increasing fuel costs by 40 per cent.

These disruptions have profound implications for the chemical industry, which relies on efficient logistics to transport raw materials and finished products across continents. Companies that depend on just-in-time inventory models are particularly vulnerable, as delays in maritime transport can lead to production halts, increased warehousing costs, and missed delivery deadlines.

## Economic sanctions and trade restrictions: The new reality

Economic sanctions, often imposed as a response to geopolitical conflicts, further complicate supply chain dynamics. The sanctions on a country, for example, have led to a reconfiguration of global energy trade, with countries like India and China emerging as primary buyers of that country's crude oil. However, these shifts come with their own risks, as secondary sanctions threaten to penalize companies engaging in trade with sanctioned entities. Beyond energy markets, sanctions also affect the availability of critical minerals and specialty chemicals, which are essential for industries ranging from electronics to pharmaceuticals.

## Strategic response: Building resilient supply chains

In response to these challenges, companies are adopting multi-pronged strategies to enhance supply chain resilience:

### Diversification and Friend Shoring

Businesses are shifting production closer to demand hubs. This reduces reliance on single-source suppliers and mitigates geopolitical risks.

### Reshoring and Regionalization

Revisit and revamp domestic capacity to ensure greater self-sufficiency.

### Digitalisation for Visibility

Advanced AI and analytics enable real-time inventory tracking, demand forecasting, and lean buffer stock management, allowing companies to pivot quickly in response to disruptions.

The transition from linear demand growth to a mature, regionally nuanced model requires proactive adaptation, ensuring that businesses remain competitive while safeguarding against future uncertainties.

As the industry moves forward, the ability to balance scale with resilience might define success. Those who invest in circular economy models, localized production strategies, and digital-driven operations are expected to not only survive but also thrive in an era where supply chain agility is the ultimate competitive advantage

## Overreliance on single-source suppliers is a strategic weakness

When a single country controls nearly half of global chemical production capacity, you don't just have a manufacturing hub – you have a potential looming strategic vulnerability.

China holds a dominant position in the global chemical supply chain, accounting for more than 40 per cent[2] of global chemical production. It also dominates production in various specialty chemicals, pharmaceuticals and APIs. Further, it also controls over 69 per cent[2] of the world's rare earth production.

This concentration poses significant risks—any disruption in China's supply due to geopolitical tensions, trade restrictions, or environmental regulations can cripple downstream industries worldwide.

## Potential risks in China's dominance:

China's dominance in the production of critical feedstocks, chemical intermediates, and APIs creates significant geopolitical exposure for companies and governments reliant on these inputs. Several potential risks arise from this concentration:

### Export restrictions and national national security controls

China has increasingly used export controls as a geopolitical tool. In 2023, Beijing imposed restrictions on exports of gallium and germanium, essential for semiconductors and solar technologies, citing national security reasons. Similarly, recently in 2025, China cut off rare-earth exports to other countries. If similar controls were applied to key APIs or chemical precursors, it could cripple pharmaceutical and industrial production in dependent countries.

### Tensions in Taiwan Strait and South China Sea

The possibility of conflict in the Taiwan Strait presents a systemic geopolitical risk. A military escalation involving Taiwan—where 90 per cent of the world's advanced semiconductors are produced—could prompt wide-reaching sanctions, supply chain collapses, and global economic shockwaves.

### Environmental policy volatility

China's rapid industrialization led to significant volatility in their policy, prompting Beijing to enforce stricter regulations in recent years. These policies, while necessary, are often implemented suddenly, leading to abrupt shutdowns of chemical plants and restrictions on energy-intensive industries.

In summary, the geopolitical and environmental risks stemming from overreliance on single country are not hypothetical—they are real and growing. Reducing the inherent vulnerabilities associated for critical chemical feedstocks etc. a multi-faceted and long-term strategy is essential.

## "China+1" strategy and its drivers

The first and most immediate step is the adoption of "China+1" sourcing strategies, whereby companies diversify their supply chains to include alternative manufacturing hubs in regions such as Southeast Asia (e.g., Vietnam, Malaysia, Thailand), Eastern Europe, or Latin America. This approach does not seek to eliminate China from the supply chain but rather to reduce exposure by ensuring operational redundancy and geographic diversification.

Secondly, governments must play a proactive role by incentivizing domestic reshoring and friend-shoring of chemical production. Countries such as the U.S., Japan, and members of the EU are already taking steps in this direction. The U.S. has allocated funding to boost local production of key materials, including high-purity chemicals and battery components. Similarly, the European Commission's strategy emphasizes reducing reliance on Chinese rare earths through domestic capacity building and alliances with trusted partners in other countries,

Thirdly, an important layer of resilience is the development of strategic reserves and stockpiles for critical inputs, such as APIs, rare earths, and specialty gases. These stockpiles can serve as buffers during sudden disruptions, akin to the strategic petroleum reserves many countries already maintain.

Finally, supply chain transparency and digitalisation must be improved. Advanced analytics, blockchain, and AI-enabled platforms can provide real-time visibility into supply chain health, risk exposure, and supplier dependencies. With better data, companies can identify weak links early and develop contingency plans proactively.

While China's scale and efficiency make it a critical part of the global chemical supply chain, the potential risks of over-concentration are increasingly untenable. A strategic, diversified, and innovation-driven approach is the most effective path forward for mitigating supply chain risks

## Multi-polar manufacturing hubs are emerging as risk mitigants

Traditionally, China has been the primary hub for manufacturing due to its cost advantages, infrastructure, and large workforce, but companies are now recognizing the limitations of overdependence on a single country. The "China+1" strategy has emerged as a solution, where firms expand their production facilities into other regions alongside China to achieve greater resilience and reduce potential risks. Among the most promising alternative locations, Southeast Asia, India, and Eastern Europe stand out due to their cost competitiveness, skilled labor pools, and strategic geographic locations. These regions are now integral to the chemical supply chain reconfiguration, offering manufacturers long-term stability and efficiency.

### Southeast Asia: A rapidly expanding manufacturing hub

Southeast Asia has rapidly positioned itself as a significant global manufacturing hub, offering businesses an alternative production base in response to shifting geopolitical and economic trends. The region has gained prominence through its ability to provide cost-effective labor, favorable trade conditions, and supportive government policies.

The region's manufacturing expansion is further evident in the growth of high-value industries, particularly electronics and chemical production. Vietnam has become an electronics manufacturing center, attracting global firms that are shifting operations to take advantage of its cost-efficient workforce and strong supply chain network. Thailand and Indonesia have developed advanced chemical processing sectors, supplying essential raw materials for pharmaceuticals, fertilizers, and petrochemicals. This diversification ensures that Southeast Asia is not just an outsourcing hub but a region capable of supporting complex and high-tech production. The driving forces behind Southeast Asia's manufacturing boom is:

#### Competitive labour market

Rising wages in China have made production more expensive, prompting businesses to explore alternative locations with more affordable workforce costs. Countries such as Vietnam, Indonesia, and Thailand offer comparatively lower labor expenses while still maintaining high productivity levels, making them attractive destinations for manufacturing operations

#### Large scale trade agreements

Trade agreements have also played a crucial role in strengthening Southeast Asia's manufacturing capabilities. Many nations in the region are active participants in large-scale trade pacts, such as the ASEAN Free Trade Agreement (AFTA) and the Regional Comprehensive Economic Partnership (RCEP), which have facilitated seamless trade by reducing tariffs and simplifying cross-border transactions.

#### Government Initiatives

Governments across Southeast Asia have taken proactive steps to encourage foreign investment by implementing business-friendly policies. Incentives such as tax breaks, subsidies, and streamlined industrial regulations have made it easier for multinational corporations to set up manufacturing operations in countries like Vietnam and Thailand. Additionally, the development of industrial parks and export processing zones has provided businesses with well-equipped infrastructure and logistical support, ensuring efficient production processes.

As geopolitical uncertainties continue to shape global trade dynamics, Southeast Asia's role in manufacturing is expected to grow even further. By offering businesses stability and strategic advantages, the region has successfully positioned itself as a key player in the evolving landscape of international production. The continued expansion of Southeast Asia's manufacturing industries demonstrates its importance in shaping the future of global supply chain resilience.

## Eastern Europe: An emerging manufacturing hub

Eastern Europe has also emerged as an important manufacturing hub, acting as a bridge between Asian production bases and Western consumer markets. Countries such as Poland, Hungary, the Czech Republic, and Romania have witnessed rapid industrial growth, offering a strategic mix of cost-efficient production, skilled labor, and proximity to the European Union. These nations are particularly attractive to companies looking for alternative locations, as they provide stable regulatory environments and seamless trade access to EU markets. The advantages are:

**Geographical proximity to western Europe:** Geographical proximity is allowing companies to manufacture products closer to their target consumers. Unlike Asian markets, which require longer shipping times and higher transportation costs, Eastern European nations offer quicker delivery and reduced logistical expenses. This is especially valuable for industries such as automotive, chemical processing, and pharmaceuticals, where supply chain predictability and regulatory compliance are essential.

**Highly skilled workforce:** Unlike low-wage outsourcing models seen in some regions, Eastern Europe focuses on technical expertise and precision-based industries. The presence of strong engineering schools and research institutions has enabled these countries to produce skilled professionals, ensuring high-quality production capabilities. This makes the region attractive for technology-intensive manufacturing, where quality and precision are utmost important.

**Stability of business environment:** Many of these nations benefit from European Union-backed investment projects, ensuring predictable trade policies and economic security. Poland, for example, has developed industrial clusters dedicated to chemical processing, making it an essential part of the global chemical supply chain. These specialized hubs allow companies to manufacture products with seamless access to raw materials, logistics networks, and efficient regulatory approvals.

## India: A bold leap into global manufacturing

India is fast becoming a powerhouse in the global chemical manufacturing scene, driven by strong government policies, strategic investments, and world-class infrastructure. With a growing demand for specialty and bulk chemicals, India is attracting global players seeking cost-effective and scalable solutions. Its talent-rich workforce, expanding domestic market, and focus on sustainability give it a competitive edge. The subcontinent is no longer just a buyer—it's becoming a bold supplier reshaping global value chains.

These upcoming regions are playing pivotal roles in reshaping global manufacturing. As businesses aim to diversify supply chains, reduce geopolitical risks, and optimize production costs, these regions present viable solutions for a stable, resilient, and interconnected global economy.

## Boardroom focus is shifting from cost to continuity and compliance

For decades, multinational corporations in the chemical sector operated under a model of relentless cost optimization. Procurement strategies were designed to minimize input costs through offshoring, bulk buying, and lean inventory models. The guiding principle was to source materials from the cheapest global suppliers and consolidate production in low-cost geographies such as China, Southeast Asia, or Latin America. This approach, often celebrated for its efficiency, enabled companies to boost margins and maintain competitive pricing across global markets. However, as the global risk landscape has become increasingly complex, this model has begun to reveal its vulnerabilities. Today, a growing number of boardrooms are recognizing that lowest cost does not necessarily mean best value—especially when supply chain fragility, compliance risks, and reputational exposure are considered.

This paradigm shift is not merely reactive; it reflects a more mature and strategic understanding of global operations. By prioritizing continuity and compliance, companies are not abandoning cost management—they are redefining it. The new question is not "Where can we source this cheapest?" but "Where can we source this most securely, responsibly, and sustainably?" In this context, continuity and compliance are not costs—they are value creators.

# 02

# India's chemical industry: Strategic pathways to a robust supply chain

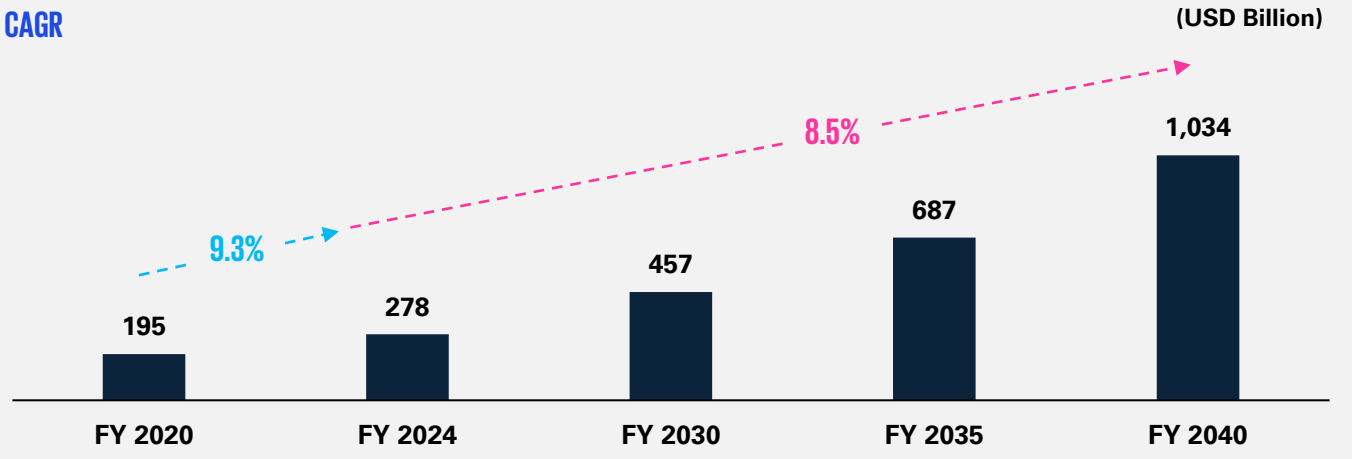
# India's chemical industry: Strategic pathways to a robust supply chain

As global supply chains reconfigure amid geopolitical shifts, India's chemical industry faces both logistics challenges and opportunities in securing a robust supply chain. Domestically, high internal freight costs and infrastructure bottlenecks have long hindered efficiency. Internationally, India has the chance to become a key node in chemical supply chains, leveraging its manufacturing scale, booming demand, and cost advantages.

## India: A bold leap into global manufacturing

India's massive market growth and competitive costs are positioning it as an emerging global hub for chemicals. The country is projected to account for over 20% of incremental global chemical consumption by 2040, as domestic demand expected to grow from USD304 billion in 2025 to as much as USD1,034 billion by 2040.

**Figure 2: Indian chemical industry - Demand[3]**




This scale – combined with relatively low labor and operating costs – provides a strong value proposition for manufacturing and exporting chemicals from India. Global companies are increasingly viewing India as a preferred supply chain destination in their "China+1" strategies.

Dutch logistics giant Vopak entered a joint venture with India's Aegis, now operating terminals across seven major Indian ports to handle LPG and chemicals, aiming to capitalize on India's dynamic economic growth. Such investments underscore India's rising stature as a critical node in global chemical logistics networks.

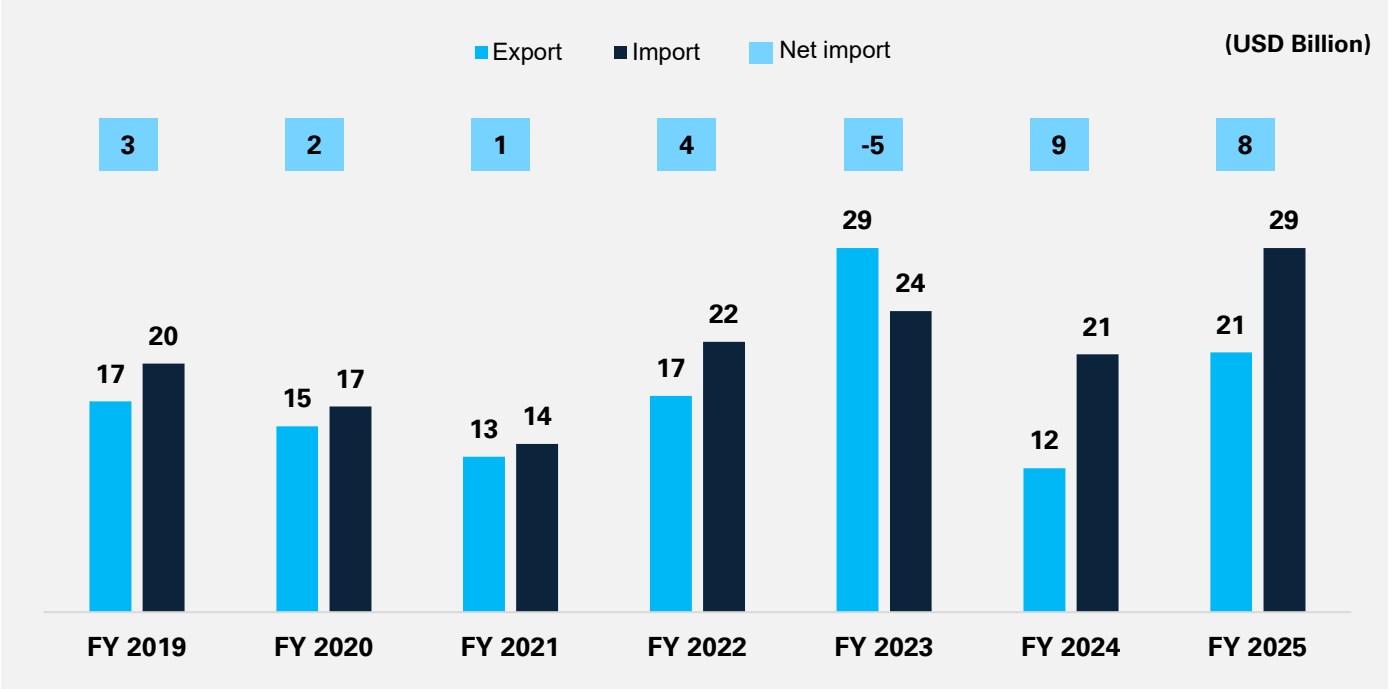
3. Chemicals, IBEF, February 2025

As global supply chains reconfigure amid geopolitical shifts, India's chemical industry faces both logistics challenges and opportunities in securing a robust supply chain. Domestically, high internal freight costs and infrastructure bottlenecks have long hindered efficiency. Internationally, India has the chance to become a key node in chemical supply chains, leveraging its manufacturing scale, booming demand, and cost advantages.

## Reducing import dependency is key to supply chain autonomy

A strategic priority for India is to lessen dependence on imported chemical inputs by building domestic capacity – a lesson reinforced by recent supply disruptions. Despite India's growing exports, its chemical* trade deficit stands around USD8 billion and could quadruple to USD40+ billion by 2040 if trade flow trends continue.

**Figure 3: Indian chemical industry - Trade[4]**




Much of this gap stems from reliance on overseas suppliers for key feedstocks, intermediates, and specialty chemicals. Annually, India imports more than 32% of its chemicals from China.

This vulnerability has prompted government and industry to pursue backward integration – investing in upstream facilities and raw material production – and to source inputs locally wherever feasible.

By developing local suppliers and integrating supply chains end-to-end within India, chemical companies can mitigate import risks, control costs, and ensure uninterrupted production.

This drive for self-reliance does not mean isolation from global trade – rather, it balances India's export growth with resilient in-country supply of key inputs, strengthening the overall supply chain against external shocks.

Indian government identified dozens of critical chemicals (e.g. for pharmaceuticals and agrochemicals) and proposed INR 25,000 crore production-linked incentive scheme to boost their domestic manufacturing. The rationale is clear: 'complete backward integration to ensure we are not dependent on imports', as officials note.

* Including alkalis, inorganic chemicals, organic chemicals, pesticides, dyes and pigments, synthetic fibre, fibre intermediate, polymers, synthetic rubber, synthetic detergent intermediates, performance plastics, olefins, and aromatics.

4. Chemical and Petrochemical Statistics at a Glance-2024, DCPC, January 2025

## Modernizing logistics infrastructure is unlocking scale and connectivity

Upgrading logistics infrastructure is the backbone of a robust supply chain. India is undertaking an ambitious modernization of transportation networks – ports, rail corridors, highways, and waterways – to streamline the movement of chemicals and raw materials across the country and beyond. Under the PM Gati Shakti national master plan, multiple agencies' infrastructure projects are being synchronized to improve connectivity and reduce logistics costs. Key initiatives include:

**Port Modernization**

- The Sagarmala program is enhancing port capacity and efficiency while improving last-mile linkages between ports and hinterland markets. It focuses on upgrading existing ports, developing new deep-water ports, and integrating them with rail, road and inland waterways.
- By expanding port infrastructure and creating coastal economic zones, Sagarmala aims to reduce transit times for exports/imports and lower overall logistics costs for domestic and EXIM (export-import) cargo. Efficient ports directly benefit the chemical industry – which relies on timely bulk shipments – by enabling faster turnaround of tankers, bulk carriers, and container vessels carrying chemicals.

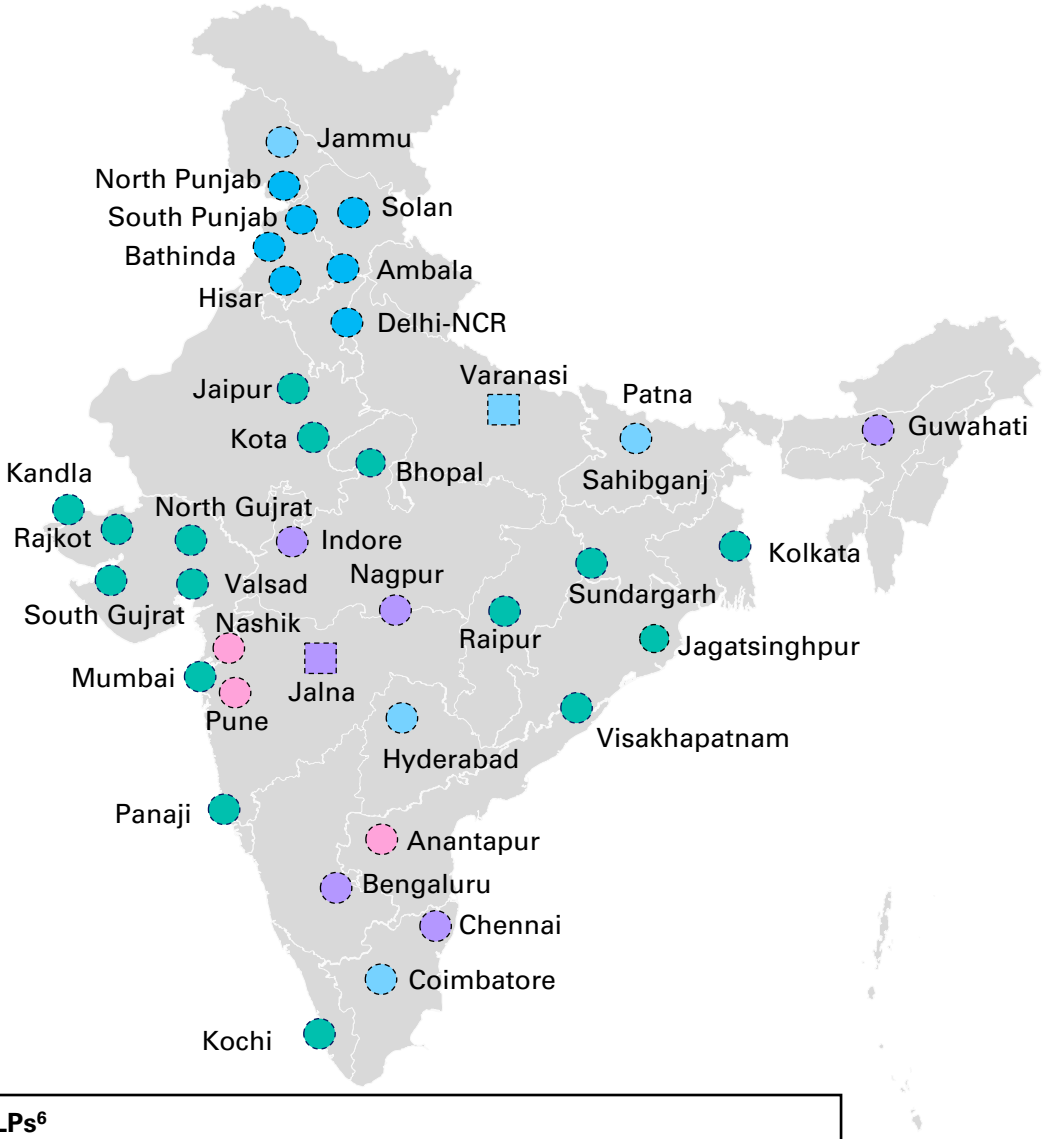
### Major achievements[5] (2015-2025)

| | | |
|---|---|---|
| **Port modernization at scale** | • 272 projects completed<br>• INR 1.4 lakh crore invested | • Faster cargo handling<br>• Improved port efficiency |
| **118% growth in coastal shipping** | • 272 projects completed<br>• INR 1.4 lakh crore invested | • Faster cargo handling<br>• Improved port efficiency |
| **700% increase in Inland waterway cargoz** | • 272 projects completed<br>• INR 1.4 lakh crore invested | • Faster cargo handling<br>• Improved port efficiency |
| **9 Indian ports in Global top 100 ports** | • 272 projects completed<br>• INR 1.4 lakh crore invested | • Faster cargo handling<br>• Improved port efficiency |

5. Sagarmala Programme, Press Information Bureau Government of India, March 2025

**Multimodal Logistics Parks**

- To enable seamless transfer of goods between road, rail, and storage, India is developing a network of multimodal logistics parks (MMLPs) at strategic locations. For instance, the new MMLP at Nagpur – part of the Bharatmala and Gati Shakti framework – integrates warehousing, rail sidings, truck terminals and customs facilities in one hub. Such parks allow chemical products to shift between trucks, trains, and possibly barges efficiently, eliminating bottlenecks at mode transfer points. The Nagpur facility alone, spread over 150 acres, is designed to lower overall freight costs and transit time through efficient inter-modal movement, while offering modern warehousing and tracking infrastructure.
- Government of India has approved 35 locations for development of MMLPs nationwide, aiming to bring similar efficiencies, especially at nodes like port cities and industrial clusters, thereby improving both speed and reliability of the chemical supply chain across India.




**Status of 35 MMLPs[6]**

- **6 awarded :** Jogighopna, Chennai, Indore, Bengaluru, Nagpur, and Jalna
- **3 bids under process :** Anantapur, Pune, Nashik
- **5 bids to be invited :** Patna, Jammu, Coimbatore, Varanasi, and Hyderabad
- Pre-feasibility Completed
- 35 CCEA Approved Locations
- 2 Additional Locations

6. Annual report 2024-2025, Government of India MoRTH, New Delhi, June 2025

**Dedicated Freight Corridors (DFC)**

- India's new freight-dedicated railway lines are a game changer for long-haul logistics. The Western and Eastern dedicated freight corridor (DFC), spanning over 3,300 km combined, create high-speed, high-capacity routes exclusively for cargo. These corridors have already halved cargo transit times in some stretches, significantly cutting delays. With double-stacked container trains and faster speeds, the DFC is reducing freight costs and decongesting the passenger rail network.
- For chemical logistics – often moving heavy bulk commodities – the DFC provides more reliable, 24-hour transport from production hubs (e.g. Gujarat, Maharashtra) to ports and key consumption centers. The western DFC (Mumbai–Delhi) in particular facilitates rapid movement of chemicals from inland plants to port terminals, enhancing both domestic distribution and export competitiveness.

### Operational efficiency

DFCs reduce operational costs by **40%**

### Enhanced speed

Average speed of DFCs is **60 kmph, compared to 20 kmph** on Indian Railways freight service

### Fewer stops

DFCs reduce operational costs by **40%**

### Growth opportunity

DFCs can enable railways to increase its freight share from **25% to 40%**

### Streamlined railways

These can decongest railway networks by moving **70%** of goods train

### Sustainable impact

DFCs can cut carbon emissions by **457 million** over the next 30 years

Collectively, these infrastructure strides are boosting the efficiency, capacity, and resilience of India's logistics. Modern ports and dedicated rail corridors strengthen international connectivity (for imports of raw materials and exports of finished chemicals), while multimodal hubs and new corridors improve domestic supply lines into many region. Better infrastructure not only cuts cost and transit time but also contributes to safer and more reliable handling of chemicals – a critical factor for an industry dealing with hazardous materials. Furthermore, these projects align with sustainability goals by promoting rail and water transport (which have a lower carbon footprint per ton-km than trucking), thereby making the supply chain both leaner and greener.

## Decarbonizing freight movement is essential for sustainable supply chain growth

India's chemical logistics ecosystem is accelerating its transition to cleaner, more efficient freight systems. Road freight carries about 68%[7] of India's freight volume, decarbonizing this segment is pivotal to achieving Scope 3 emission targets. The solution lies in a synergistic blend of clean fuel technologies, freight corridor upgrades, shipper-driven decarbonization and collaborative innovation.

### LNG for long-haul freight

Liquefied Natural Gas (LNG) is proving effective for decarbonizing long-haul chemical logistics. It emits 28% less $CO_2$, 59% less NOx, and 91% less particulate matter than diesel[7] – without compromising on payload or range. This makes LNG trucks well-suited for long-haul chemical freight that demands high power and endurance.

Logistics providers are beginning to adopt LNG at scale, for instance:

- GreenLine Mobility operates over 500 LNG trucks, aiming for 1,000 by 2025, already reducing 9,300+ tonnes of $CO_2$ emissions
- New OEM entrants like Blue Energy Motors have likewise deployed over 800 LNG heavy-duty trucks on Indian highways, logging more than 50 million km and cutting an estimated 14,000 tonnes of $CO_2$ emissions

These deployments confirm that LNG can reduce the chemical supply chain's carbon footprint while keeping operational costs in check – LNG trucks offer notably lower fuel costs per km than diesel trucks.

However, leveraging LNG at scale requires an expanded fueling network. India's LNG fueling infrastructure is nascent – currently only a few dozen stations along major corridors – which can limit long-distance deployment. Few upcoming investments include:

- THINK Gas (a city gas distributor) announced six new LNG truck fuelling hubs coming online by 2025 to support growing demand on high-traffic highways
- GreenLine is developing a network of LNG pumps along critical logistics corridors through its subsidiary Ultra Gas & Energy

With these efforts alongside public-private partnerships, LNG trucking is poised to become a mainstream option for long-range chemical freight, cutting emissions.

7. KPMG in India analysis, June 2025

## Battery-electric vehicles for urban and first-mile logistics

EVs are most viable for short-distance, high-frequency movements of packaged and specialty chemicals within industrial zones and warehousing clusters.

- Rhenus Logistics and Brenntag launched one of India's first electric truck for deliveries in Bhiwandi, a key distribution hub near Mumbai source.
- Gati (Allcargo) is deploying 1,700 alternate-fuel vehicles including EVs as part of its 2040 carbon neutrality roadmap source.[8]

EV infrastructure is expanding in industrial regions, supported by initiatives like JNPA's "Zero Emission Trucking" program which aims to replace 6,500 diesel trucks with EVs by 2029.

## Hydrogen trucks for heavy and long-haul chemical movement

Hydrogen-powered trucks offer a promising solution for regional bulk chemical logistics due to high payload capacity and quick refueling.

- Reliance Industries plans to retrofit 5,000 of its internal logistics trucks to run on green hydrogen, following successful H2-ICE truck trials between its refinery and chemical complexes.[9]
- Adani's hydrogen-powered mining truck is another indicator of growing private-sector capability for heavy-duty green freight.[6]
- The Indian government has launched pilot hydrogen corridors across Gujarat and Maharashtra under the National Green Hydrogen Mission, targeting chemical industry belts like Jamnagar–Ahmedabad and Mumbai–Pune. Across India, a total of 37 fuel-cell or H2-ICE vehicles will operate on 10 routes, supported by 9 new hydrogen refueling stations.

## Biofuels for drop-in decarbonization

Biofuels offer an immediate, engine-compatible decarbonization pathway for chemical transport fleets without needing infrastructure overhauls.

- Oil marketing companies are piloting biodiesel availability at select depots, and Maharashtra is exploring ethanol-blended freight applications, leveraging its availability of bio-ethanol.

While blending rates remain modest, biodiesel and bio-CNG can significantly reduce Scope 3 emissions for tankers and line-haul operators when scaled.

## Green freight corridors: Enabling end-to-end low-carbon movement

Achieving low-carbon logistics at scale requires more than individual cleaner vehicles – it demands Green Freight Corridors (GFCs). GFCs equips a highway or freight route with the necessary charging, fueling, and digital support systems so that low-emission trucks (electric, LNG, biofuel, even hydrogen) can operate seamlessly over long distances.

- Delhi–Mumbai Expressway is being equipped as a long-range EV corridor.
- Gati Shakti and NLP initiatives support multimodal hubs with alternative-fuel infrastructure

GFCs reduce not just emissions but also costs, downtime, and risks by standardizing infrastructure for clean freight operations.

8. KPMG in India analysis, June 2025
9. Company press releases

## Shipper-driven decarbonization & collaborative innovation

India's chemical logistics sector is decarbonizing not only through cleaner fuels and smarter corridors, but also through decisive action from anchor customers and collaborative industry platforms. The transformation is being shaped by two powerful forces: shipper mandates driving supplier accountability, and public–private innovation networks scaling practical solutions across transport, terminals, and warehousing.

- **Climate-aligned procurement by large shippers:** Chemical manufacturers and large MNCs are now using logistics procurement as a lever for decarbonization. Companies like Unilever and BASF are requiring logistics partners to adopt low-emission modes and report Scope 3 performance, aligning operational execution with global net-zero targets. Indian chemical leaders are institutionalizing similar practices by embedding KPIs such as "$gCO_2$ per tonne-km" in 3PL contracts and routing decisions. These commercial signals are accelerating EV, LNG, and rail adoption across high-volume lanes.
- **Collaborative platforms driving scalable innovation:** The launch of the CONCOR–TERI Centre of Excellence for Green Logistics in 2025 marks a step change in how India designs its logistics sustainability ecosystem. This platform brings together operational expertise and scientific research to pilot and deploy solutions across:

**Sustainable rail freight:** Improving emissions efficiency in long-haul bulk transport.

**Green terminals:** Electrifying handling equipment and optimizing yard design.

**Eco-warehousing:** Using renewable power and automation to reduce energy use.

**Smart freight management:** Leveraging AI for multimodal optimization and idle-time reduction.

These pilots are not theoretical—they are already influencing procurement strategies, infrastructure investments, and logistics SOPs across India's chemical clusters.

## Simplifying policy and regulation is enabling seamless and secure movement

A unified and digitized regulatory ecosystem is foundational to modernizing India's chemical logistics sector. By improving institutional coordination, streamlining compliance, and enabling investment through clarity and consistency, India can lower logistics costs and boost global competitiveness.

### Institutional convergence: National and state alignment

India's logistics reforms are increasingly guided by national platforms that harmonize efforts across ministries, states, and industry bodies.

- National Logistics Policy (2022) lays out a strategic roadmap to reduce logistics cost by improving multimodal connectivity, standardizing processes, and digitizing operations.
- Central to this effort is the PM Gati Shakti platform and an Empowered Group of Secretaries (EGoS), ensuring inter-ministerial coordination across Road, Railways, Shipping, and Commerce ministries.
- States are aligning via Logistics Coordination Committees and are benchmarked through the Logistics Ease Across Different States (LEADS) index. Gujarat and Uttar Pradesh, for example, have launched state-level logistics policies that complement the national agenda and expedite approvals for chemical warehouses and hazardous freight.
  - Post-GST reforms led to a 30% increase in daily truck distances—from ~225 km/day to ~325 km/day—boosting productivity and cutting freight costs by ~12%.[10]

### Digital process simplification and unified logistics interfaces

India is building a paperless logistics ecosystem that streamlines documentation, automates compliance, and enables real-time monitoring—critical for high-risk chemical transport.

- The Unified Logistics Interface Platform (ULIP) is India's UPI moment for logistics. It integrates over 36 digital systems and 1,800+ data fields across ministries, enabling real-time tracking, e-way bills, customs clearances, and multimodal freight visibility. Leading companies like Asian Paints and Tata Steel use ULIP APIs for shipment visibility and transporter verification, improving supply chain responsiveness.

➢ Over 100 crore API transactions processed on ULIP by March 2025[11]

- India has implemented digital single windows to simplify port and customs processes. The Port Community System (PCS 1x) connects shipping lines, port authorities, customs, and traders on one interface, enabling electronic document exchange for faster clearances. Similarly, the Customs ICEGATE e-platform allows filing of customs documents online and tracking cargo clearance status.
- These digital initiatives have cut down dwell times at ports and reduced the procedural burden on chemical exporters/importers. For example, RFID-enabled tracking under the NICDC Logistics Data Bank (LDB) has improved visibility for over 50 million EXIM containers so far.[12]

**Automating multi-agency coordination is particularly vital for chemical cargo, which often faces heightened scrutiny due to hazmat classification.**

10. GST is good and simple tax, Ministry of Road Transport & Highways, Government of India, July 2017
11. Unified Logistics Interface Platform, NITI Aayog
12. Ministry of Commerce & Industry, Press Information Bureau Government of India, July 2022

## Regulatory reforms for hazardous material transport

- Unified Safety Guidelines (BIS Standards): IS 18149:2023 – India's National Standard for Dangerous Goods Transport was adopted in 2023 to enhance safe chemical transport. It aligns with global best practices on classification, packaging, vehicle design, and emergency response.
  - Over 5,000 hazmat transport incidents were recorded in 2021, causing 1,000+ fatalities. A unified standard replaces a fragmented system, improving safety and simplifying compliance.[13]
- Emerging initiatives that are being considered include:
  - 24x7 emergency helplines
  - Integration of permits and licenses on ULIP
  - Joint inspections by traffic police, explosives inspectors, and pollution regulators
  - Designation of dedicated chemical freight routes

  **These advances not only reduce regulatory friction but also mitigate environmental and reputational risks associated with chemical logistics.**

## Incentivizing investment in logistics infrastructure and services

Beyond governance and compliance, policy coherence must also catalyze logistics infrastructure development—especially for hazardous and bulk goods.

Recognizing logistics as an infrastructure sector and allowing 100% FDI in warehousing has spurred capital inflows. Grade-A warehousing is projected to cross 300 million sq. ft. by 2025, with global developers building compliant chemical hubs.

Government-backed projects like Dedicated Freight Corridors, Multi-Modal Logistics Parks (MMLPs), and Sagarmala are improving multimodal connectivity, reducing turnaround times, and creating safer options for transporting hazardous cargo by rail and water.

Dahej PCPIR (Petroleum, Chemicals and Petrochemicals Investment Region) is being developed as a fully integrated chemical logistics zone, with port connectivity, last-mile road upgrades, and real-time monitoring systems—all supported by policy and fiscal incentives from the Gujarat Government.

India's chemical logistics ecosystem is undergoing a regulatory transformation—toward simplicity, safety, and speed. Coordinated governance, digital tools, and harmonized regulations are turning compliance from a barrier into a competitive advantage, accelerating India's position as a global chemical supply chain hub.

13. Ministry of Road Transport and Highways, 2022

## India's supply chain imperative: Shifting from scale to strategic advantage

For decades, India's chemical sector has been recognized for its scale, cost advantage, and expanding domestic demand. However, as the industry aspires to become a pivotal node in the global supply chain, the focus is rapidly shifting from incremental expansion to building genuine strategic advantage. Leading chemical companies are no longer content with incremental improvements—they are pursuing end-to-end supply chain modernization, sustainability integration, and digital-led agility.

This shift is not merely tactical—it signals a deeper evolution in India's approach to logistics, sourcing, and operational excellence. Modernizing infrastructure, enabling seamless multimodal connectivity, and investing in green logistics are not just cost-saving measures—they are building blocks for long-term competitiveness, resilience, and alignment with global ESG priorities.

Today, the central question for boards and executive teams is not just "How do we grow fastest?", but "How do we build a supply chain that is resilient, transparent, and future-proof?" In this context, strategic investments in domestic capability, digital innovation, and sustainability are not optional—they are the new currency of global leadership.

By prioritizing these levers, India's chemical sector can evolve from being a volume-driven player to a trusted, value-creating partner in global supply networks—shaping not just the country's growth story, but the future architecture of the world's chemical industry.

As India cements its position as a pivotal node in the global chemical supply chain - with deepened domestic integration, multimodal infrastructure, and a maturing policy landscape - resilience and sustainability have become structural capabilities. But true future-readiness will not stem from physical assets alone. In a world shaped by volatility, precision, and speed, the next frontier lies in intelligence. The chemical supply chain of tomorrow will be built not just on roads and warehouses, but on data, algorithms, and real-time insights.

# 03

# Future-proofing supply chains: Embracing digital and AI-driven transformation

# Future-proofing supply chains: Embracing digital and ai-driven transformation

The chemical industry is leveraging digital technologies and AI to create resilient, efficient, and sustainable logistics networks. This transformation significantly enhances agility, visibility, and compliance across complex supply chains. Here, we explore three critical solution themes shaping this future.

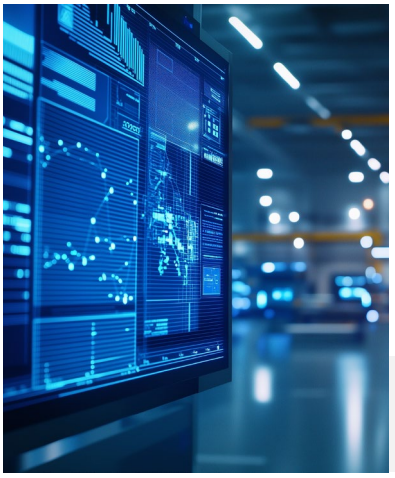
## Intelligent logistics optimization

**AI-driven routing and forecasting:** Chemical shippers are using AI/ML to optimize delivery routes, consolidate loads, and predict demand. Machine-learning models can ingest order histories, inventory levels and traffic data to forecast shipment needs more accurately and adjust routes dynamically. This reduces empty miles and stock-outs. Several firms are also integrating AI into Sales & Operations Planning to refine product demand forecasting (often via advanced SAP or custom platforms), thereby smoothing transportation schedules and avoiding last-minute rush shipments. These initiatives have allowed chemical producers to shave days off lead times and improve service without excessive cost overruns.

**Example:** Dow Chemical deployed AI-based load and route optimization in its dedicated port facilities and advanced warehousing, cutting logistics costs by about 18%.

**Digital twins for network simulation:** Virtual "digital twins" of the logistics network – software models that mirror physical flow – allow planners to simulate disruptions, weather events or new route options before implementing changes. Major chemical players like ExxonMobil and BASF have pioneered this approach. In practice, a digital twin can represent ports, terminals, rail lines and road links, enabling "what-if" analyses (e.g. Suez Canal closure or local strike) without risking real freight. When bottlenecks appear, the model suggests how to reroute or reprioritize shipments. By iteratively refining the network design in silico, companies can improve capacity utilization and robustness in a cost-effective way.

**Example:** ExxonMobil reports that deploying digital twins at its Baytown (Texas) supply network yielded a 30% reduction in unexpected outages.



**AI-based predictive maintenance:** Chemical logistics assets – from tanker trucks to railcars and cranes – increasingly carry IoT sensors to monitor equipment condition. AI/ML analytics on these sensor streams enable predictive maintenance: anticipating failures (e.g. engine wear, brake issues, trailer tank corrosion) before breakdowns occur. In logistics, a similar approach is being adopted: fleet and maintenance teams mine telematics and maintenance records to schedule service just-in-time. Early warning of a truck defect or a railcar leak allows pre-emptive repairs, avoiding costly interruptions in hazardous-product transport. Over time, these analytics shorten maintenance cycles, extend asset life, and further improve on-time delivery metrics.

**Example:** Dow partnered with Microsoft to apply predictive analytics to chemical plant equipment; this AI-driven maintenance reduced unexpected downtime by ~15% in pilot facilities.

## Integrated visibility and risk management

- **Logistics control towers for multi-modal visibility:** To manage complex, multi-modal chemical supply chains, companies are building "control towers" – centralized digital hubs that aggregate data across carriers, terminals and suppliers. In a chemical supply-chain control tower, live feeds from truck telematics, rail trackers, port systems and even weather/weather apps are combined. This end-to-end visibility lets planners see what is happening and, with embedded analytics, often why (e.g. identifying root causes). Anomalies (like a stuck shipment or a regional blockade) trigger alerts. The control tower then orchestrates responses: swapping modes, rerouting loads or reallocating inventory. In effect, it provides a "single pane" view across chemical logistics – rail, truck, barge – enabling coordination among sites and third-party providers. Such towers have become critical in crisis management (e.g. quickly finding alternative routes when pipelines back up) and in routine operations, optimizing inventory buffers while assuring timely delivery to customers.

  **Example:** Den Hartogh – a logistics provider specializing in liquid chemicals – runs a global control tower that provides real-time visibility into all freight movements. This central hub makes transport more flexible and efficient by continuously monitoring shipments and conditions.[14]

- **Blockchain for secure tracking and traceability:** Blockchain is gaining traction in chemical logistics as a way to create immutable, auditable records of hazardous shipments. By recording each transfer of custody in a tamper-proof ledger, blockchain platforms can log every step of a chemical product's journey. In practice, a blockchain entry might record a load of sulfuric acid moving from a plant to a tanker barge, then onto a depot, with all certifications and sensor readings encrypted in the record. Such records cannot be altered retrospectively, making it easier to demonstrate compliance with transport regulations and to audit safety certificates. Moreover, in the event of an incident, authorities can query the ledger to see exactly which batches and routes were affected. As one industry analysis notes, blockchain's ability to trace and isolate problematic chemical batches "genuinely save[s] lives": toxic shipments can be identified and removed from circulation immediately . Over time, we expect hazardous goods-specific blockchain consortia (similar to pharmaceutical track-and-trace networks) to emerge, providing secure end-to-end visibility across geographies.

  **Example:** Solvay launched a blockchain-based platform (built with BanQu) to ensure traceability and transparency in its guar gum supply chain.[14]

- **Real-time dashboards for compliance and alerts:** In parallel, chemical logistics operations rely on real-time dashboards that fuse data from IoT, ERP and regulatory systems. These dashboards track key safety and compliance metrics – for example, shipment adherence to Responsible Care guidelines, temperature/humidity of sensitive cargo, or time-in-transit versus permit windows. Dashboards also generate compliance reports on-the-fly. For instance, a logistics control center can display current shipment COA (certificate of analysis) statuses, hazardous-materials authorizations, and near-real-time regulatory alerts (like a new import restriction in a transit country). Any deviation (e.g. container overheat, route detour) automatically triggers alarms. In sum, these integrated portals give chemical shippers the situational awareness needed to enforce safety rules across every leg of a shipment and to respond instantly to risks.

  **Example:** BASF's smart supply-chain platform merges global transport data with live weather forecasts and news feeds, alerting teams to disruptions (e.g. extreme weather on a planned route) and thus enabling proactive intervention.

14. Company press release

## Emissions intelligence and cyber-resilience

- **Scope 3 emissions tracking by route and mode:** With carbon reporting under regulatory and stakeholder pressure, chemical companies are instrumenting logistics for detailed GHG accounting. Advanced tools now measure Scope 3 emissions at the route and shipment level. Chemical manufacturers are tying their TMS (Transport Management Systems) to carbon calculators, so that every shipping order yields an estimated $CO_2$ figure. This granular tracking not only feeds corporate sustainability KPIs but also flags high-emission "hotspots" – for instance, very long cross-border trucking legs – which can then be addressed.

  **Example:** RINNEN (a European liquid-chemical logistics provider) implemented a digital platform that ingests order data and fleet telematics to calculate $CO_2$ emissions per trip. Using GLEC (Greenhouse Gas Protocol) standards, RINNEN can attribute well-to-wheel $CO_2$ for road or rail legs of each intermodal movement. The platform automatically generates emission reports (at the shipment, vehicle, or modal level) for customers and auditors.

- **Carbon KPIs in mode and fleet decisions:** Armed with precise emissions data, chemical shippers are integrating carbon metrics into logistics decisions. Many chemical companies now include "emissions per ton-km" as a performance metric: carriers are scored (and contracted) not only on price and service but also on carbon intensity. Over time, these KPIs encourage shifts to cleaner modes: for example, favoring rail or coastal barge over road when capacity allows. In-network decisions are also influenced: route planners use emissions models to find lower-carbon alternatives even if they are slightly longer. The net effect is that Scope 3 targets begin to shape fleet composition and modal splits in logistics, paralleling efforts in production planning.

  **Example:** RINNEN's tendering process: when bidding for new business, RINNEN provided prospects with projected $CO_2$ emissions alongside cost for candidate transport options. This lets customers compare the climate impact of, say, a fast truck versus a slower rail route.

- **Cybersecurity for digital logistics (IT/OT):** As chemical supply chains become data-driven, cybersecurity is critical. Logistics IT systems (ERP, TMS, control towers) and OT systems (ICS controlling loading/unloading equipment, autonomous vehicles, IoT sensors) present attack surfaces that must be secured. Leading chemical firms have instituted robust cyber-resilience programs. The industry follows NIST and ISA/IEC 62443 guidelines for industrial control systems. Chemical logistics providers likewise train staff on cyber hygiene: for example, warehouse operators learn to spot phishing or to update firmware on smart tags. Given the convergence of IT and physical operations, any logistics digitization effort now includes IT-OT risk assessments. In practice, this means deploying intrusion detection on logistic servers, regular pentests of logistic apps, and contingency plans (e.g. alternate comms paths) to ensure the supply chain keeps moving even under a cyber incident. These cybersecurity protocols are essential to safeguard both intellectual property (product formulations, forecasts) and the safe handling of hazardous materials in an increasingly connected supply ecosystem.

  **Example:** BASF's 2023 report describes a global cybersecurity team with oversight of both IT and OT networks, operating under an ISO/IEC 27001-certified security framework. The company applies "security by design," building in safeguards (encryption, network segmentation, multi-factor authentication) from project inception.[15]

15. Corporate, Information and Cybersecurity, BASF's 2023 annual report, February 2024

## The digital frontier: From automation to autonomous value creation

The digital revolution in chemical supply chains has rapidly advanced from process automation to a new era of predictive, adaptive, and intelligent logistics. For leading players, AI/ML, digital twins, and real-time control towers are already transforming efficiency and visibility from the boardroom to the plant floor. Yet, as the industry enters the next wave of digitalisation, the imperative is not simply to keep pace—but to lead.

What's coming next is even more transformative. Agentic AI—AI that can autonomously sense, decide, and act across interconnected logistics networks—is poised to reimagine how supply chains respond to disruption, optimize routes, and collaborate across ecosystems. Coupled with advances in edge computing, IoT-enabled autonomous vehicles and drones, and secure data-sharing via blockchain, the logistics backbone of tomorrow will be increasingly self-healing, adaptive, and scalable.

This paradigm shift is not just technological—it is strategic. Success in this new landscape will belong to those who embed digital-first thinking across the organization, invest in workforce digital fluency, and partner across value chains to unlock ecosystem-wide insights. For Indian chemical companies, this means moving beyond digitization of legacy processes and towards architecting platforms that learn, adapt, and even anticipate risk in real time.

The central question for tomorrow's leaders is not simply, "How do we use digital tools to solve today's problems?" but "How do we build a supply chain that is truly autonomous, resilient, and sustainable in the face of tomorrow's unknowns?" In this context, digital transformation is not a destination but a dynamic journey—one where continuous innovation, investment, and collaboration will define who leads, who adapts, and who shapes the future of global chemical logistics.

# Key takeaways

The global chemical supply chain is undergoing a defining era of transformation—driven by shifting geopolitics, rising sustainability mandates, and accelerating digitalisation. For India, this represents a strategic inflection point to emerge as a critical node in the reconfigured global chemical landscape.

However, to fully capture this opportunity and future-proof the sector, Indian chemical industry must take decisive steps to enhance resilience, reduce environmental impact, and embrace technology-led innovation.

Firstly, companies must proactively adapt to a changing global supply chain paradigm. With the world moving away from over-reliance on any single country—especially in the context of China—dual-sourcing and regional diversification are becoming the new norm. In this evolving landscape, India has the opportunity to position itself as a preferred second-source or alternate hub for global chemical manufacturing and exports. To do so, the sector must invest in robust backward integration, enhance domestic capacity for critical intermediates, and build end-to-end visibility across its supply chains to meet global compliance and continuity expectations.

Secondly, infrastructure modernization is a foundational requirement. Investments in ports (Sagarmala), multimodal logistics hubs (MMLPs), and green freight corridors are already improving turnaround times and cost efficiency. Scaling inland waterways and rail connectivity will also align India's logistics with decarbonization goals, reducing emissions while enhancing throughput capacity.

Thirdly, sustainability must move from aspiration to execution. Practices such as LNG and hydrogen trucking, electric vehicles for intra-city chemical movement, and biofuel adoption are already being piloted. Industry players must now scale these solutions, embed Scope 3 emission tracking, and institutionalize green KPIs in freight decisions. This transition aligns with evolving customer expectations and ESG standards globally.

Fourthly, digital transformation is no longer optional—it is a competitive imperative. AI/ML-powered logistics forecasting, digital twins for supply simulation, and predictive maintenance are redefining how chemical companies operate. Emerging technologies such as IoT-enabled hazmat tracking, edge computing for real-time asset visibility, blockchain for multimodal traceability, and autonomous yard vehicles are also gaining traction. In parallel, augmented reality (AR) is being piloted in chemical warehousing for remote maintenance and operator safety. Together, these tools are not only improving visibility, compliance, and responsiveness—but are also reshaping the operating model of logistics itself into a smart, adaptive ecosystem.

Lastly, building supply chain resilience requires system-level thinking. Indian chemical firms must institutionalize risk forecasting, invest in cyber-resilient infrastructure, and embed agility into their operating models. This includes developing domestic supplier ecosystems, stockpiling critical inputs, and leveraging public–private collaboration to ensure preparedness for future shocks.

While the chemical industry transforms towards a more sustainable and digitized future, government support will play a critical enabling role. Targeted incentives, unified digital platforms, and clear regulatory pathways can accelerate this transition. With its scale, capability, and reform momentum, India is poised not just to participate in—but to shape—the future of global chemical supply chains.

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# About KPMG in India

KPMG is a global organization of independent professional services firms providing high-quality advisory support in the areas of strategy, operations improvement, policy and regulatory reform design, risk assessment, modernization and restructuring of power utilities, electricity market design and development, transaction advisory, institutional reforms, program management, capacity building among various other services, across geographies. KPMG in India is one of the fastest-growing member firms in KPMG's global network of member firms.

KPMG in India works with around 2,800 clients, including domestic and multinational, private, and public sector companies. The firm operates from 26 offices across fourteen cities. It is led by about 340 partners and has access to ~10% of the global workforce, many of whom are internationally trained. Our differentiation is derived from rapid performance-based, industry-tailored, and technology enabled advisory services delivered by some of the leading professionals in the industry.

In the energy sector, KPMG in India is providing/has provided technical assistance to governments across globe and private sector clients on investment promotion, econometric modelling for market assessment, policy interventions for achieving decarbonization pathways, and creating an enabling environment along with investment requirement assessment. Additionally, in renewable energy sector, KPMG in India is providing technical assistance on several emerging areas including RE deployment, grid integration, power generation modelling, new business models and financing mechanisms.

KPMG's global network of member firms are leading provider of advisory services to the chemicals and materials industry. KPMG's global network of member firms understand the new realities of today's chemical industry and have extensive experience working with the world's leading chemicals and performance technology companies.

# About ICC

The Indian Chemical Council (ICC) represents the USD220 billion Indian chemical and petrochemical industry. ICC is the apex national body in India that promotes and supports all branches of the chemical industry. Since its establishment in 1938, ICC is in the services of the Chemical & Petrochemical Industry in India. With membership spanning across producers, users, and transporters of chemicals—including key sectors like organic and inorganic chemicals, petrochemicals, agrochemicals, dyes, paints, and specialty chemicals—ICC serves as a vital bridge between industry, government, and civil society.

Through its extensive programming, ICC promotes responsible industry practices via:

- Thought leadership: Policy advocacy, trade facilitation, and global chemical diplomacy
- Capability building: Seminars, certifications, and ICC Annual Awards recognizing innovation and safety excellence
- Standards and certification: As a government-authorized body, ICC issues Certificates of Origin and guides compliance with national and international norms

ICC is also the official steward of Responsible Care® in India, a global voluntary initiative for safety, health, and environmental excellence. With over 91 participating companies, ICC drives the adoption of best-in-class chemical management systems and promotes sustainability across the value chain.

Further strengthening its leadership in logistics safety, ICC runs the Nicer Globe platform—India's first GPS-enabled, emergency-linked transport safety ecosystem for hazardous chemicals—serving over 10,000 monthly shipments and collaborating with emergency services nationwide.

With offices in Mumbai, Delhi, Kolkata, and Chennai, ICC continues to enable India's chemical industry to thrive responsibly, both locally and globally.

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