Final Report for Sagarmala (Vol. I)

Ministry of Shipping, Indian Ports Association

November 2016

- Final report on origin-destination analysis and traffic projections for key cargo commodities
- Capacity enhancement/shelf of projects (including report on National Multi-Modal Transportation Grid) with high level cost estimates for major ports
- Report on identification of sites for new port development
- Annexure: Origin-destination analysis report
  - Annexure 1: Traffic at major ports
  - Annexure 2: Non-major port traffic projections
  - Annexure 3: Inland waterways
  - Annexure 4: Bunkering in India
  - Annexure 5: Domestic container movement in India
  - Annexure 6: Modal shift for container logistics in India
  - Annexure 7: User manual for multi-modal tool

Final Report for Sagarmala (Vol. I)

Prepared for

Ministry of Shipping
Government of India

Ministry of Shipping / Indian Ports Association

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Review, revisions and approvals record

Name	Date of submission	Approved by
Draft final report for Sagarmala	18th August, 2016	Suvojoy Sengupta
Final report for Sagarmala (after incorporating comments)	22th November, 2016	Suvojoy Sengupta

“In 2015 the Ministry of Shipping instructed McKinsey & Company and AECOM to provide fact-based analysis and insights from best practice around the world into [potential future trends in container shipping, options for infrastructure and potential approaches to financing ports development].

The Ministry will evaluate this advice, along with inputs and advice from a variety of internal and external experts, and determine the most appropriate strategy to give effect to the Cabinet’s decision of 25 March, 2015. McKinsey’s advice, in the form of the following confidential report, was provided in November, 2016.

McKinsey & Company, in consortium with AECOM, was selected following a competitive public tender, based on its extensive global experience advising on infrastructure, shipping and logistics, and its deep local knowledge and experience.

McKinsey & Company is a global management consulting firm, with consultants in over 110 locations in over 60 countries, across industries and functions. McKinsey has served clients in India since 1990.

The analyses and conclusions contained in this report are based on various assumptions have been developed with the Ministry of Shipping, which are subject to uncertainty. Nothing contained herein is or shall be relied upon as a promise or a representation. Neither McKinsey nor AECOM are investment advisors, and thus do~~es~~ not provide investment advice. This is not intended to serve as investment advice, and parties should conduct their own due diligence prior to making investment decisions.

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Final report on origin destination analysis and traffic projections for key cargo commodities

Ministry of Shipping, Indian Ports Association

October 2015

Contents

Introduction

India's economy has surged ahead in recent years. The pressures of a growing economy have naturally pushed its transport system to full capacity. Realizing the urgency for resolving infrastructure constraints decisively in the next two decades, the government has set development targets and plans accordingly, aiming to sustain high levels of inclusive economic growth.

The movement of bulk commodities is one of the major responsibilities of India's transportation system. Thermal coal alone accounts for around 61 percent of the freight volume on the Indian Railways and 24 percent of the seaport freight mix.

The Sagarmala program aims to change the way logistics evacuation is operated happens in India and save logistics costs nationwide for cargo handled and evacuated through seaports. Augmenting the operational efficiency of ports, optimizing logistics evacuation and increasing port-led development for India can help achieve this. The project could form around 2 percent of the country's GDP from coastal states and districts and create societal impact in the form of 10 million jobs, coastal community skill building, etc.

Five commodities contribute ~ 80 percent of the total export-import freight movement with dynamic origin and destination points across the country. They include—coal, petroleum, oil and lubricants (POL), iron ore, fertilizers, and container.

. Conducting a detailed origin-destination mapping of major cargo items therefore becomes necessary to align the port capacity and infrastructure needs.

THE SAGARMALA VISION

The broad vision of the Sagarmala program stands on four pillars

- Change how India moves logistically
  - Increase competitiveness of the core industry and the manufacturing sector by reducing supply chain cost and time
  - Increase the volume of trade via inland waterways and coastal shipping
  - Create an IT-enabled national multi-modal logistics system
  - Develop coastal roads through maritime states for inter-state port connectivity
- Boost development through ports and shipping
  - Develop three to four new mega ports
  - Develop a world-class trans-shipment port with a capacity of more than 10 million TEU
  - Create additional capacity of 1,200–1,500 MMTPA by strengthening existing ports

– Develop maritime and manufacturing clusters around the ports

– Develop 2–3 port-based smart cities and Coastal Economic Zones

- Create world-class institutions

  – Set up Sagarmala Development Company to enable project implementation

  – Set up world-class Private Partnership Programs in ports, waterways and connectivity projects

  – Develop an Indian Maritime University as a centre of excellence for maritime education

  – Set up best-in-class maritime services clusters in India

- Empower coastal communities

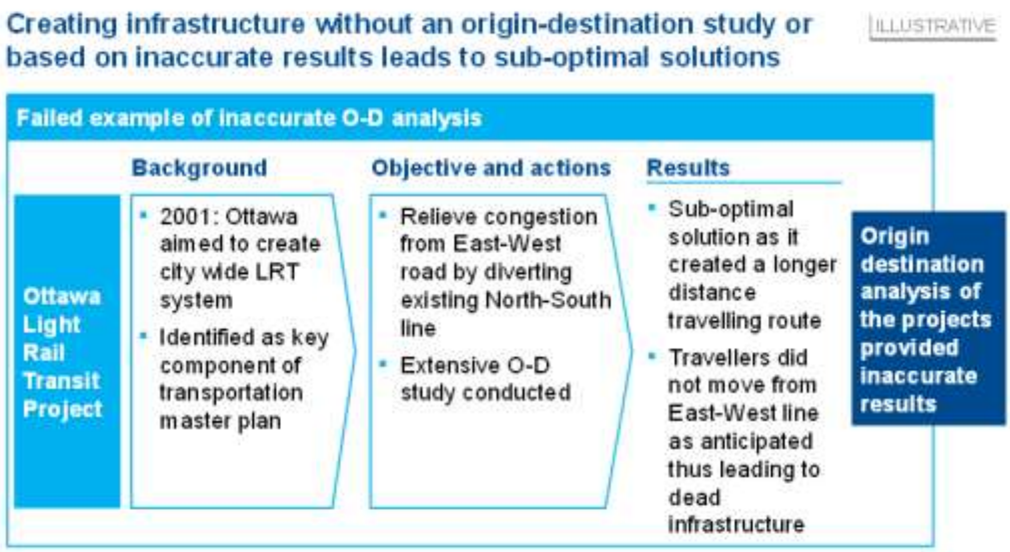
  – Create more than 1 million jobs in maritime and related sectors

  – Increase GDP contribution of maritime states and sectors through a comprehensive coastal community development plan

HOW IS THE ORIGIN–DESTINATION (OD) STUDY RELEVANT?

Globally, the creation of infrastructure without an origin-destination study or the correct estimation of traffic has not generated optimal utilization (Exhibit 1). Conducting an in-depth origin-destination analysis could enable India to create the right infrastructure at requisite demand and logistics chain centers. This pre-empts sub-optimal solutions, eventually preventing "sunk costs" and the creation of redundant infrastructure in India.

EXHIBIT 1



SOURCE: Expert interviews

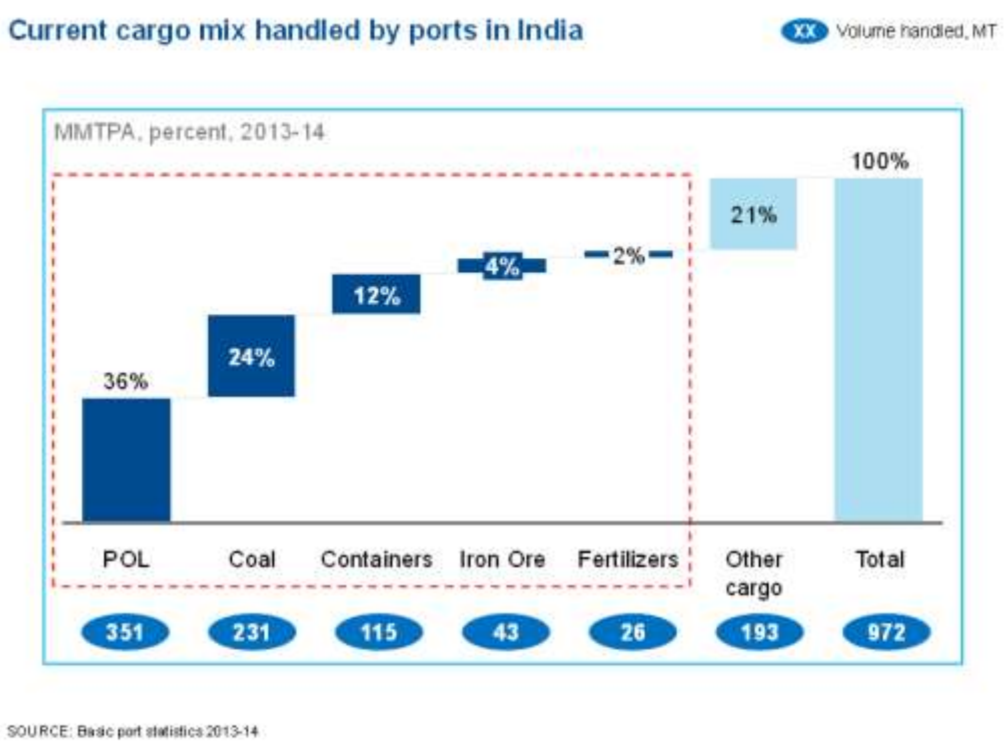
The Sagarmala OD study, therefore, aims for the creation of efficient infrastructure—such as creating greenfield ports or increasing handling capacity at ports and relieving congestion on existing high-volume routes.

Towards this, it studies the total demand and supply situation of major EXIM flow commodities—coal, petroleum, oil and lubricants (POL), iron ore, fertilizers, and containers—in the next decade and beyond as these five key commodities aggregated make 80 percent of total freight volumes (972 MMTPA in 2013–14) currently handled by ports in India (Exhibit 2).

The results of the OD analysis for each commodity bring us to an assessment of the extent of capacity increase required at ports for the efficient movement of commodities, as well as infrastructure requirements (such as rail and slurry pipelines) beyond ports.

Sagarmala program aims to create a "national perspective plan" which would include an optimized logistics mix, Costal Economic zones, port level connectivity projects etc. The origin- destination report and analysis form the basis of the national perspective plan and could aid efficient decision making for infrastructure creation to efficient decision making of infrastructure creation.

EXHIBIT 2



Executive summary

India has 7,500 km of coastline spanning 13 maritime states and union territories. Ninety-five percent of India's trade by value and 70 percent by volume takes place through maritime transport. Globally, maritime nations such as China, South Korea, Japan and the United States of America have effectively used their coastline for "port-led development". The Sagarmala programme, anchored by the Ministry of Shipping, envisions the concept of port-led development with four essential pillars: port modernization and capacity augmentation, efficient and speedy evacuation, port-led industrialisation and coastal community development.

As part of the programme, the origin-destination study had been undertaken to identify:

- Opportunities to **optimize logistics cost** for existing and future capacities
- **Capacity additions/reconfigurations needed at different ports** to prepare for future traffic flow, including identification of new ports
- **Imperatives for government and industry** to ensure time-bound implementation of opportunities

Logistics cost–saving opportunity of INR 35,000-40,000 Crores per annum

The study estimates the potential to save around INR 35,000-40,000 Crores per annum by optimizing logistics flows for key commodities by 2025. Four key initiatives could drive these savings:

1. Coastal shipping to carry about 230-280 MMTPA from current and planned capacities across coal, cement, iron and steel, food grains, fertilizers, POL (estimated INR 21,000-27,000 Crores saving by 2025)
2. New coastal capacities for bulk commodities (steel and cement) of 80-100 MMTPA (estimated INR 5,500-6,500 Crores saving by 2025)
3. Reduced time to export containers by 5 days (estimated INR 5,000-6,000 Crores saving by 2025)
4. Increase share of railways in container modal mix from current 18 percent by 2025 leading to a saving of around 2,000-3,000 INR crores.

Coastal shipping for existing/planned capacities

Water currently contributes less than 6 percent to India's modal mix. China uses its inland waterways to transport raw material and finished goods between Eastern and Western provinces; water contributes 24 percent to China's freight modal mix. Australia carries 17 percent of goods through coastal shipping. In Germany, 11 percent of goods are moved through inland waterways and coastal shipping. The study therefore finds a strong economic case for coastal movement for most of the key commodities in our study.

Coal: In 2013–14, nearly 740 MMTPA of coal moved through the country predominantly through rail. Only 23 MMTPA moved through coastal shipping even though this mode costs one-sixth that of rail cost (INR 0.2 per tonne km vs. INR 1.2 to 1.4 per tonne km). More than 90 percent of the rail routes relevant to coal are running at over 100 percent utilization. With the expected ramp-up in coal production by Coal India Limited, India may need to move 1,000 to 1,200 MMTPA coal across the country by 2025. This will put tremendous pressure on India's congested railways.

The study carried out a logistics cost comparison for all possible modal mix combinations for India's 400 thermal power plants. It estimated that using the right infrastructure and institutional support, India can coastally move 190 to 200 MMTPA of coal, and save around INR 17,000 Crores per annum, by 2025. This would help save 1 lakh rail-rake days that could be used for other commodities. Since logistics contribute 30 to 35 percent of the cost of power generation, this initiative would also directly cut power costs by 50 paisa per unit for coastal power plants fed coal coastally.

Analysis reveals potential for transportation of thermal coal for 11 power plants with capacity of 12 GW on the NW-1 system. Estimated potential of 20 to 25 million tonnes of coal traffic by year 2025. Also, potential to carry 25-35 MMTPA from Talcher/Ib Valley to Paradip port on the NW-5.

Additionally another 70 MTPA of thermal coal for non-power uses can be transported through the coastal route if port based linkages of coal are provided.

Other commodities: A similar comparison of logistics cost for plant to demand centre was conducted for five other key commodities—POL, steel, cement, fertilizers, and food grains. It identified a total potential of 70 to 80 MMTPA coastal movement, with potential savings of INR 4,500-5,600 Crores per annum. The specific project ideas for these commodities are being refined, syndicated and tested for feasibility currently.

New coastal capacities for bulk commodities: Cement and Steel

The traditional mode of setting up bulk capacity in India has been to locate hinterland plants close to raw material reserves. Eighty-five percent of India's steel capacity and almost all of its cement capacity follows this pattern. Coastal capacity, however, offers logistics cost saving, flexibility in sourcing raw material, and better linkages with global markets. The study noted international examples of setting-up large coastal clusters, e.g., Pohang in South Korea (steel), Port Said in Egypt (fertilizers).

Steel and cement, the two commodities studied for this purpose, estimates a potential of around 80–100 MMTPA (~40 MMTPA for cement & ~40 MMTPA for steel) coastal capacity by 2025. These coastal capacities could save on an average INR 800 to INR 1,000 per tonne on logistics cost. In case of steel, the savings are driven by no inland logistics costs involved for coking coal, reduction in steel transportation through coastal shipping, and use of new technology (slurry pipelines) for transporting iron ore from mine to coast. The total cost saving from these capacities is estimated at INR 5,500-6,500 Crores per annum.

We have identified potential locations for steel clusters as Odisha, Northern Andhra Pradesh, Northern Tamil Nadu, and Maharashtra. Coastal steel capacity could also be set up close to demand centres like Chennai/Ennore which receive iron-ore/pellets through coastal shipping. For cement, we have identified central Andhra Pradesh and southern Gujarat clusters based on the mapping of limestone reserves. The exact location would depend on the availability of land near specific ports.

Reduce time to export by five days

On an average, exporting a container from its hinterland in India takes 32 days, compared to 26 days taken by China, adjusted for same distance. The transit times also varies by up to five days, forcing exporters to keep a higher buffer time. The inventory cost thereby saved is estimated at INR 5,000-6,000 Crores per annum by 2025. This study identifies three initiatives for reducing container time to export by five days:

- **Last-mile connectivity of ports with National Highways and Railway network:** Sixty road projects have been identified and referred to National Highways Authority of India to be taken-up under “Bharatmala” programme; 27 railway projects have been referred to the Indian Railways. In addition eleven dedicated freight-friendly corridors have been identified connecting ports with major production and demand centres
- **Dedicated toll lane for the EXIM containers on the National Highways:** Containers spend one day just waiting at the tax/toll stoppages for an inland travel distance of 1,400 km. dedicated toll lanes for EXIM containers can cut down this waiting time
- **Simplification of customs reforms:** Simpler registration and self-sealing processes for factory stuffing; installation of container scanners at major ports and ICDs (currently only at JNPT and Mundra); linking the EXIM license to unique identification numbers to allow for deferred checking of documents; a dedicated fast lane processing area for rated exporters; increased staff strength of customs to provide 24x7 service for importers and exporters

Reduce average container export cost by INR 1,000-1,500 per container (2 percent of current cost)

The study finds that on a per tonne km basis, the cost differential between India and China is not significant. China however, has a lower overall container exporting cost due to lower lead distances. The study finds two opportunities to optimize export costs by INR 1,000-1,500 per container. At projected 25 million

TEU volume under the “business-as-usual” scenario, it would save India INR 2,000-3,000 Crores per annum by 2025.

- **Increase the share of Railways in the modal mix from 18 percent to 25 percent:** The modal mix for container transport in India is heavily skewed in favour of roads due to high railway freight, lack of reliable scheduling of freight trains, and low last-mile connectivity. Moving the modal share of rail from the current 18 percent to 25 percent will cut down crude imports by 1.2 mn KL. The study identifies 14 priority routes for road to rail movement that currently move 2.2 mn TEU from road but can move 3.1 mn TEU to rail. Three initiatives can enable this shift:
  - **Establish linkages with the Western DFC:** Four last-mile railway connectivity projects identified to link ports with the Western DFC (To Mundra, Pipavav, Kandla and Hazira). Many of these can be undertaken by the recently established “Port Rail Company”
  - **Improve ICD connectivity:** ICD connectivity with ports varies a great deal. High-traffic ICDs like Tughlakabad have a frequency of up to 14 rakes a day, whereas many ICDs like Agra and Bhopal have on average less than 1 service per day. We propose interconnecting the ICDs through a “milk-run” for higher aggregation and frequency of service. Three such milk-run routes have been identified
  - **Rationalize freight pricing:** The study calls for rationalizing freight pricing of the railways, especially for larger distances to reflect the actual cost and facilitate the shift towards railways
- **Implications for port and port capacity**

The above recommendations have implications for the bulk and container traffic at Indian ports.

Bulk

Indian ports handled around 857 MMTPA of bulk cargo in 2013–14. The study estimates that in 2025, bulk traffic will increase to 1,950 MMTPA. EXIM bulk will increase at 4 percent to reach 1,100 MMTPA. Growth in EXIM cargo will remain muted due to increase in domestic production of coal and continued weak global demand of iron ore. The coastal bulk traffic, however, will grow at 22 percent rate to reach 425 million tonnes by 2025. This would require building dedicated coastal capacities at specific ports. Three projects must be ready to prepare for this quantum jump in coastal traffic

- Coastal coal berth at Paradip/Dhamra ports with capacity of around100 million tons
- Storage, bunkering and ship repair facilities to enable coastal shipping movement of bulk cargo
- Creation of a logistics aggregator company which could provide end-to-end services

Container

Indian ports handled 10.7 mn TEU container traffic in 2013–14. Container traffic has grown at 8 percent over the last decade as the level of containerization also increased from 60 percent in 2004–05 to 67 percent in 2013–14. Going forward, we estimate that container traffic will grow at 6.5 percent rate under "business-as-usual" and reach 21.5 mn TEU by 2025. Including the impact of programs like "Make in India" and development of industrial corridors, the estimated container traffic can grow to 24–25 mn TEU. In addition, we expect two sources of additional growth:

- Around 3-5 mn TEU growth from improved competitiveness of hinterland industries due to lower cost and time to exports
- Around 4-6 mn TEU growth due to setting up port-based export-oriented manufacturing clusters for industries like electronics, apparel and footwear, automotive and auto components

The ports will need the following capacity installations to prepare for this traffic growth:

1. Transshipment port at Southern tip of India with capacity of 10-12 mn TEU
2. Increased capacity in Gujarat/ Maharashtra port cluster of 2-2.5 mn TEU
3. New feeder port in Central Andhra Pradesh and West Bengal with capacity of 1-1.5 mn TEU

- **Imperatives for the implementation of initiatives**

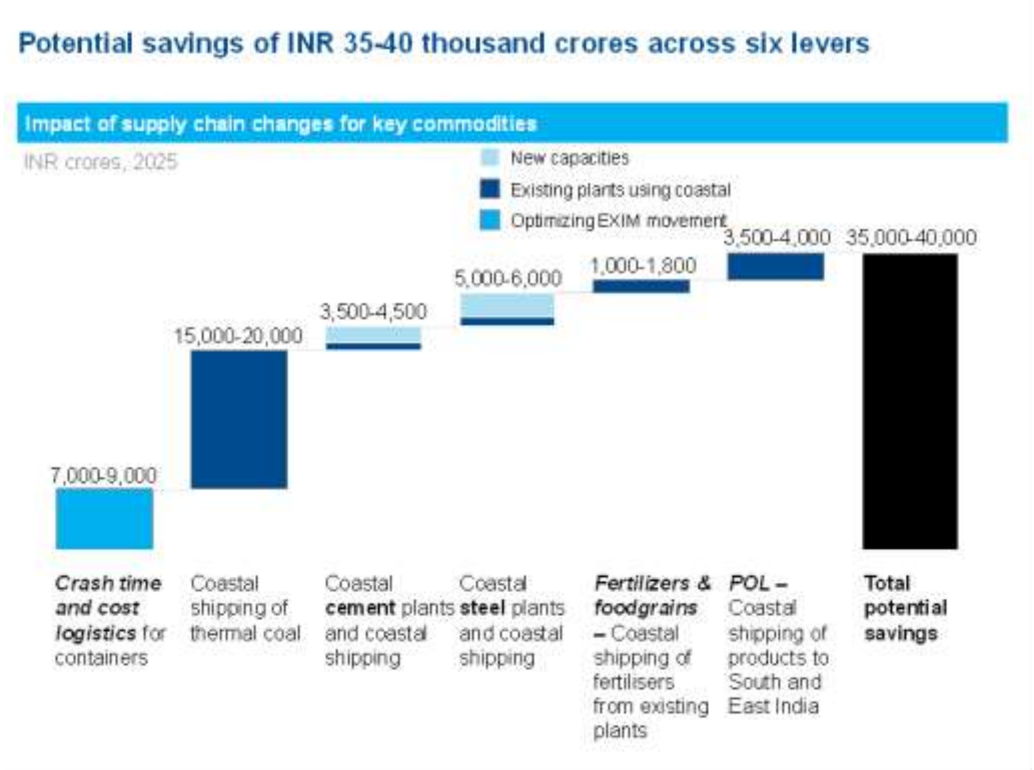
Other than specific imperatives for each commodity, there are three overarching next steps:

1. **Aggregator for facilitating coastal shipping:** Given the low liquidity of coastal shipping market in India and small parcel-size for industries other than coal, an aggregator will be necessary to consolidate the coastal shipping supply chain. The Ministry of Shipping can take the lead in either setting up or appointing such an aggregator body
2. **Capacity augmentation and efficient operations at relevant ports:** Finally, existing and new ports should align their capacity expansion plans in line with the projected increase in coastal shipping volumes. Where needed, they could provide a dedicated berth for coastal shipping. Ports could also plan for adequate storage capacities at origin-destination ports; bunkering facility and reduced taxes (baseline to Fujairah prices) to encourage ships to bunker within Indian waters; and adequate ship- repairing facilities

Modal shift opportunity in optimizing cargo movements

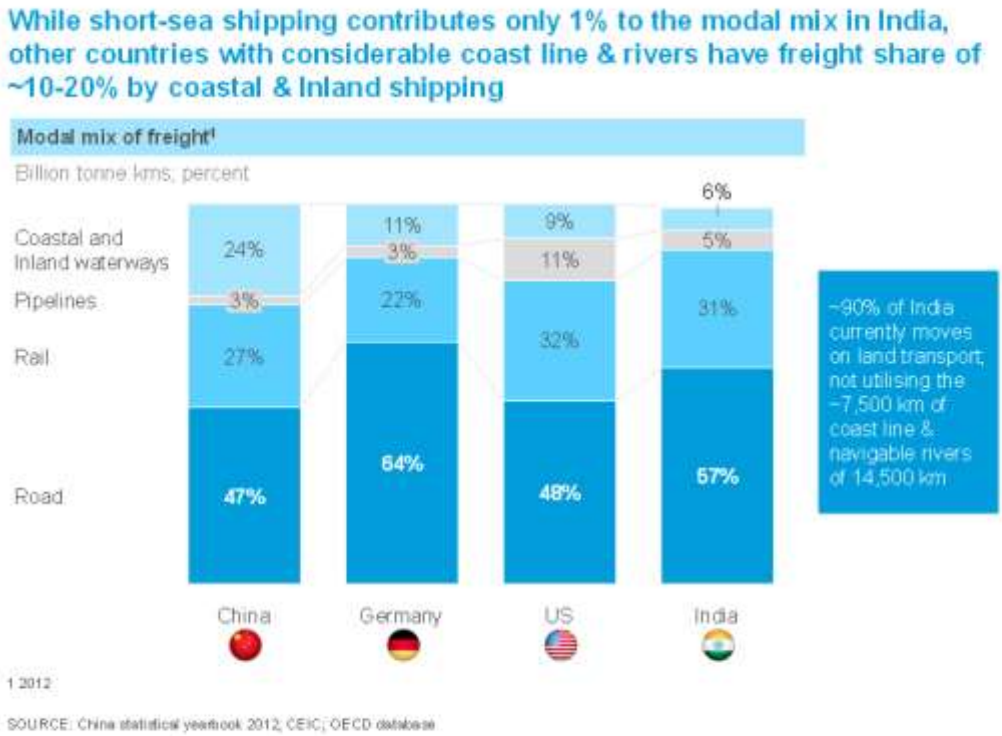
The analysis reveals a savings opportunity of around INR 45,000 Crores to 55,000 Crores per annum for key cargo commodities. This can be achieved across six levers by optimizing existing and future movements (Exhibit 3).

EXHIBIT 3



Coastal shipping and inland waterways currently form around 6 percent of the total modal mix in India, compared to around 10–20 percent for other emerging countries (Exhibit 4). Analysis reveals that around 350-450 MMTPA (current + future) has the potential to be coastally shipped by 2025 instead of being transported on rail/road.

EXHIBIT 4



Creating coastal steel and cement plants can potentially reduce logistics cost per unit from 15 percent to around 10 percent for steel and cement by optimizing the transport of raw materials by 2025.

Studies conducted under Sagarmala reveal that two optimization levers could lead to potential savings of around INR 7,000-9,000 Crores per annum in containers. Of this, around INR 5,000 Crores to 6,000 Crores per annum would be saved by cutting inventory handling cost through reduced transit time. Followed by saving around INR 2,000-3,000 Crores per annum by changing rail modal mix from current 18 percent to 25 percent.

ORIGIN-DESTINATION AND OPTIMIZATION OF PETROLEUM, OIL AND LUBRICANTS MOVEMENT

In any modern economy, efficient, reliable and competitively priced energy supplies are prerequisites for accelerating economic growth. Thus, a planned, integrated approach to energy development has to be an essential part of overall economic strategy, and especially so for developing countries.

In case of the Indian economy, with 18 refineries, India currently has surplus refining capacity and is numbered among the net exporters of petroleum products. However, domestic demand for petroleum products is projected to grow steeply over the next ten years, and is expected to push further investments into the refining sector.

Thus, creating a sustainable domestic transportation system for petroleum, oil and lubricants (POL) products through cross-country crude oil and petroleum product pipelines and establishing efficient evacuation systems at the ports will be pivotal to the POL industry over the next few years.

De-regulation of diesel prices is expected to encourage export based refineries to sell significant proportions of their petroleum products in the domestic markets. An analysis of industry trends, plans and projections suggests a potential of increased coastal shipping of around 8–10 MMTPA of products from Gujarat, which could translate into savings of around INR 1,600–1,700 crore per annum for the economy.

After coal, oil is the largest energy source for the country, with a share of about 30.5 percent in the primary energy consumption basket. An increasing demand for oil has fuelled the high rate of India's economic growth. India's fuel consumption has risen at an average of 5.52 percent in the last five years, primarily because a surge in passenger vehicles sales has driven higher petrol sales. Petrol and diesel combined create around 60 percent of all petroleum products, and so we have considered only these for the origin-destination analysis.

POL constitutes about 36 per cent of the total traffic at Indian ports. (Exhibit 5)

EXHIBIT 5

SOURCE: Basic port statistics 2013-14

Petroleum and Lubricants

Currently, domestic demand for petroleum products is around 158 MMTPA, with petrol (MS) and diesel (HSD) forming around 60 per cent of total demand (Exhibit 6) and liquefied petroleum gas (LPG) at 16 MMTPA. Over the next decade, this is expected to grow to anywhere between 275 MMTPA and 295 MMTPA, depending on the growth scenario that materializes. The 'gradual recovery' scenario envisages GDP growth at 6.1 per cent per annum, which would result in a growth of over 4.7 per cent per annum in demand for petroleum products, to reach 273 MMTPA by 2025. As against this, under the 'growth renewal' scenario with a 7.2 per cent per annum expected growth in GDP, domestic demand for petroleum products is expected to grow at 5.3 per cent per annum, to reach 288 MMTPA in 2025.

On the supply side, the 16 petroleum refineries have a total output of around 220 MMTPA of product (Exhibit 7). This is expected to increase to about 282 MMTPA by 2025 according to the base case expansion scenario, as shared by industry sources. The Indian Oil Corporation (IOC) refinery at Paradip is expected to start production by 2025, and major capacity expansions are in line at Bharat Petroleum Corporation Ltd (BPCL) Kochi, Hindustan Petroleum Corporation Ltd (HPCL) Vizag and Bharat Oman Refineries Limited (BORL) Bina.

EXHIBIT 6

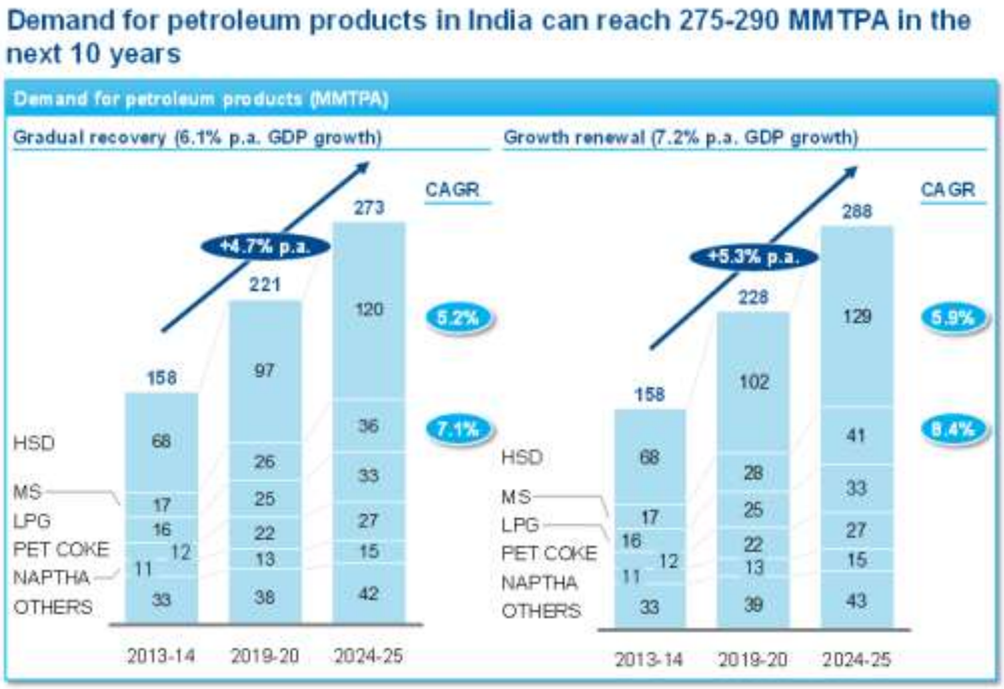
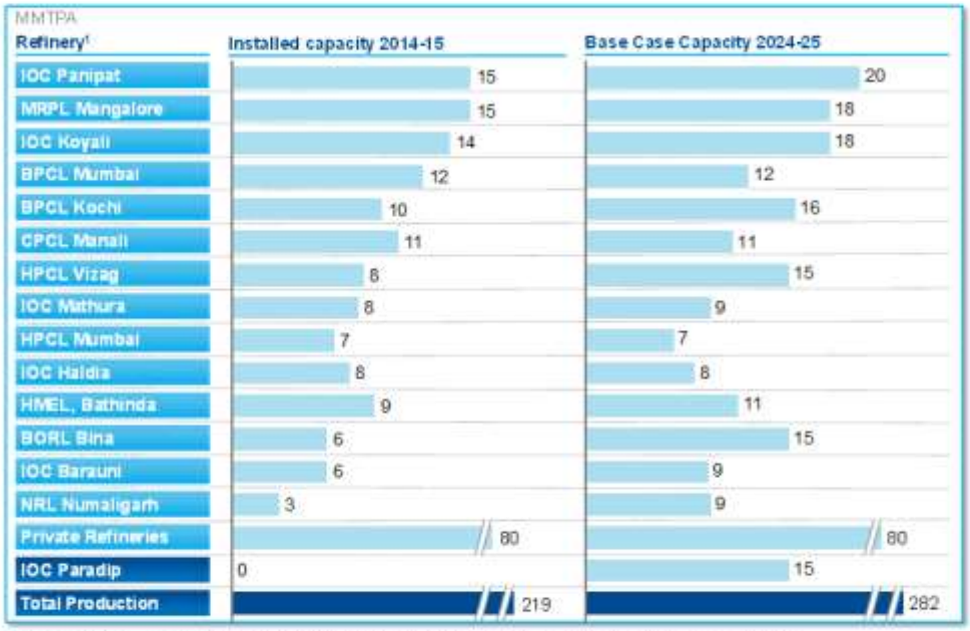


EXHIBIT 7



1 Includes refineries – IOC Bongaigaon, IOC Guwahati, IOC Digboi, CPC Narimanam, ONGC Tatipaka, besides fractionators

SOURCE: PPAC; Annual search

Current movement and optimization of petroleum products

An extensive inter- and intra-regional pipeline network transports the bulk of liquid products from refineries to terminals/depots. Around 80 percent of evacuation from the refineries to the hinterland travels through the pipeline network, with the balance moving by road/rail. Private refineries sell products at the refinery gate and coastally ship products to south India in case of a deficit.

An analysis of supply and demand scenarios by state reveals that the eastern hinterland states face a deficit of around 2.8 MMTPA while southern India faces a deficit of around 2.3 MMTPA. This could be served by either inter-state dispatches from the northeast or by coastal shipping from the west.

Pipelines dominate distribution from the refineries to the depots, with balance moving via road/rail. India has around 11,500 km of pipeline network with 77 MMTPA capacity. More than 80 percent of the MS/HSD evacuation currently happens through pipelines, with the Mumbai, Guwahati, and Digboi refineries completely relying on pipeline-based evacuation (Exhibit 8).

EXHIBIT 8: PIPELINE BASED EVACUATION OF MS/HSD BY REFINERY

Refinery	MS/HSD MMTPA evacuated	% through pipeline
IOC, Panipat	8.16	82–87%
IOC, Koyali	7.61	68–73%
BPCL, Mumbai	7.01	86–91%
MRPL, Mangalore	6.59	42–47%
BPCL, Kochi	6.36	35–40%
CPCL(MRL), Manali	5.01	65–70%
IOC, Barauni	4.44	53–58%
HPCL, Vizag	4.36	93–98%
HPCL, Mumbai	3.55	95–100%
IOC, Haldia	3.26	83–88%
IOC, Mathura	2.97	80–85%
NRL, Numaligarh	2.03	76–81%
IOCL NE Refineries	1.52	95–100%
IOC, Guwahati	0.83	95–100%
IOC, Digboi	0.44	95–100%
BORL, Bina	3.42	64–69%
HMEL, Bathinda	5.32	82–87%

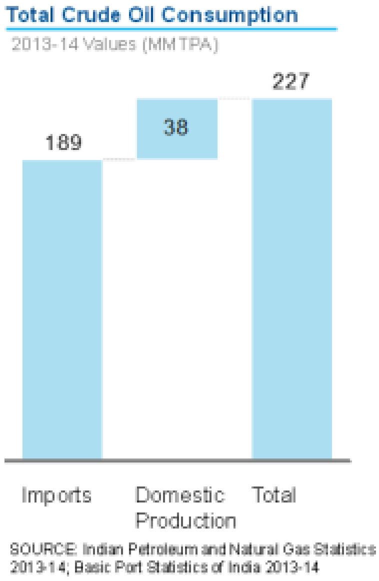
Current movement of crude oil

The Indian economy currently consumes around 227 MMTPA of crude oil, of which 189 MMTPA is sourced through imports and 38 MMTPA through domestic production. The imported product is handled by seven port clusters, namely, the Gujarat cluster, Paradip, New Mangalore, Mumbai, Chennai, Cochin and Vizag, with the Gujarat cluster handling around 65 per cent of the total crude imports. Mumbai, New Mangalore and Paradip account for seven to eight percent each, while the rest handle 4 to 5 per cent each of the total import. (Exhibit 9)

Some part of the domestically produced crude (around 13 to 16 MMT) is coastally shipped. Emergency coastal shipping of crude also takes place in cases of disruption of regular supply.

While 100 percent of the imported crude is moved inland by pipeline to the Haldia refinery from the Paradip port, around 34 percent of the crude landed at the Gujarat cluster is transported inland through pipelines to the Bathinda, Panipat, Mathura and Bina refineries. Around 90 percent of the refineries are coastal, largely optimizing the movement of crude. However, most current pipelines are operating at over 90 per cent utilization, and any plans to expand the existing refineries will also need to factor in a capacity increase for the relevant pipeline.

EXHIBIT 9



Crude oil is imported either via very large crude containers (VLCCs) or through Suez Max vessels. Direct unloading of crude from VLCCs has significant advantages, including economies of scale, lower demurrage, lower port handling charges, and relatively decongested berths. However, of the seven port clusters handling imported crude, only five have single buoy mooring (SBM) facilities, essential for direct unloading from VLCCs. Neither Mumbai nor Chennai port clusters can handle direct VLCC unloading due to absence of SBMs. (Exhibit 10)

EXHIBIT 10

Ports at only 5 of these 7 port clusters have Single Buoy Mooring (SBM) facility to efficiently unload crude from Very Large Crude Carriers (VLCCs)

Cluster	Port	Refinery(ies) served	Facility for VLCC	No. of SBMs
Gujarat	Vadinar Oil Terminal	Essar, IOC Mathura, Panipat, Koyali	✔	3
	BPCL Oil Terminal Vadinar	BPCL Bina	✔	1
	Sikka	Reliance SEZ and Jamnagar	✔	3
	GAPL (Adani port near Mundra)	IOC Panipat and HMEL Bathinda	✔	2
Paradip	PPT	IOCL Haldia, Barauni, Bongaigon, Paradip	✔	3
New Mangalore	NMPT	MRPL Mangalore	✔	1
Mumbai	MbPT	BPCL Mumbai, HPCL Mumbai	✖	0
Chennai	ChPT	CPCL Chennai	✖	0
Cochin	CoPT	BPCL Kochi	✔	1
Vizag	VPT	HPCL Vizag	✔	1

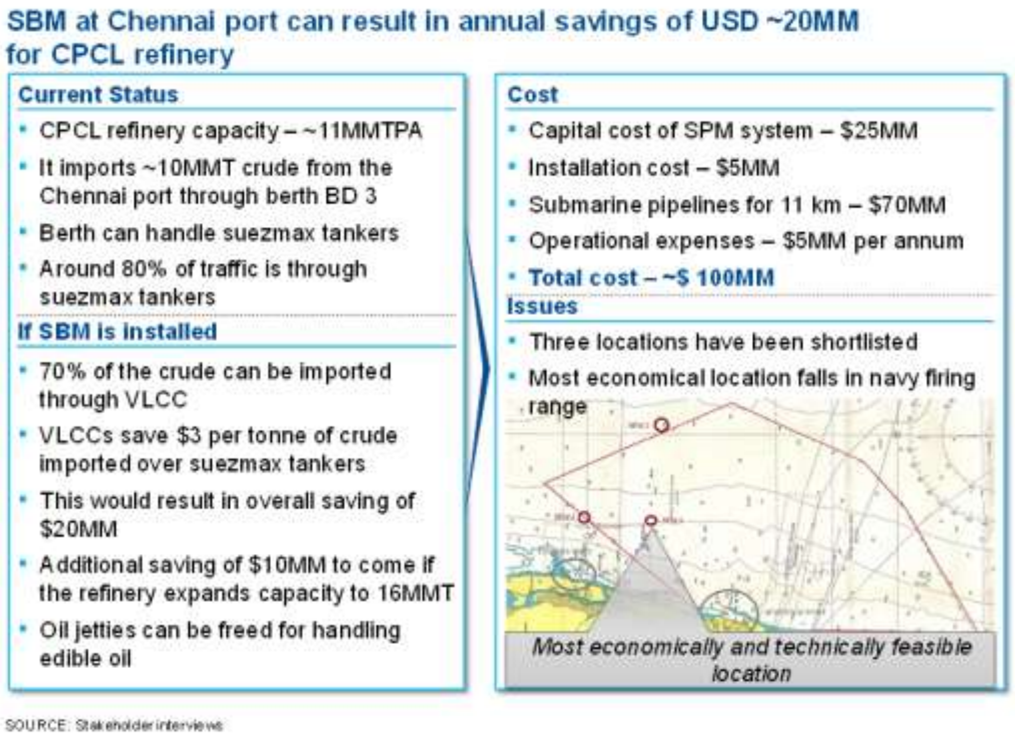
Direct unloading from VLCCs leads to freight economics due to
- Less demurrage
- Less port handing charge
- Decongested berths

Not possible to build SBM at Mumbai port. Hence 5th oil jetty is being constructed

Chennai port currently handles around 10 to 11 MMTPA crude import, 80 per cent of which is through Suez Max tankers. In the event of SBM facilities being installed, 70 per cent of this traffic can be shifted to VLCCs, thus saving $3 per tonne of crude oil imported, which translates into an annual saving of around $20 million. In case the proposed capacity expansion to 16 MMTPA is realized, an additional $10 million could be saved. Moreover, the oil jetties currently handling crude imports could be freed for edible oil, thus realizing savings over and above this.

Installing SBM at Chennai port would involve a cost of $100 million, which could be recovered within a few years from the savings from shifting to VLCC tankers.. Of the three locations identified for installation of SBM facility, the most appropriate location—technically and economically—lies in the navy firing range and thus will require permission from Ministry of Defence, Government of India. (Exhibit 11)

EXHIBIT 11



Installation of SBM at Mumbai port is currently not feasible as it requires a sea depth of at least 30 metres, which can be found only beyond 50 kilometres from the shore, and it neither feasible to provide off-shore boosters, nor lay submarine pipelines as there are too many pipelines already in the area. Building an additional (fifth) oil jetty has thus been proposed at Jawahar Deep, at which fully loaded Aframax tankers and partially loaded Suez Max and small and medium sized VLCCs can be handled, to partially realize the savings from shifting to VLCCs.

An additional SBM at the overextended Vadinar port to cater to the expansion of Panipat refinery may not be necessary, in view of the currently underutilized SBM at Mundra. The lack of an economic rationale to invest in an additional SBM in Gujarat was clear from the absence of any response to the RFQ floated for Kandla port. It is estimated that the SBM at Mundra can cater to diverted traffic from other ports in Gujarat, in addition to handling the proposed expansion of Panipat refinery.

Even with these measures, the projected additional demand for at least 55 MMTPA of crude over the next 10 years calls for significant capacity enhancement at the ports (Exhibits 12 and 13). Various enhancement projects, as ones shown below, are already underway to debottleneck the ports. These include storage enhancement at Mangalore, Mumbai, Cochin, and Vizag, as well as pipeline upgrade and/or connection at Mumbai, Chennai, Cochin, and Vizag.

EXHIBIT 12

COMMODITY FLOWS | POL

Additional crude demand of at least 55 MMT in next 10 years would require capacity enhancement at ports (1/2)

● Completed ● In progress ● Not yet announced

Port	Potential POL projects for de-bottlenecking port capacity for 2025	Rationale	Status
Vizag Port Trust	Crude storage of 1.3 MMT capacity	Strategic reserves developed by ISPRL	Completed
	Pipelines for storage facility	Connection for crude storage to ports	Completed
Paradip Port Trust	Capacity expansion of IOCL Paradip – Barauni pipeline from 11 to 15.2 MMTPA	Meet the demand of Haldia and Bongaigon refinery	In progress
	New oil jetty and additional storage facilities to import crude	Oil jetty commissioned to IOCL for handing product at Paradipport	Completed
Cochin Port Trust	Replacement of old crude pipeline	Support Kochi refinery expansion plans	In progress
	Crude storage of 2.5 MMT capacity at Padur	Strategic reserves developed by ISPRL	In progress
New Mangalore Port Trust	Crude storage of 1.5 MMT capacity	Strategic reserves developed by ISPRL	In progress
	10 km pipeline from storage to ports	Connection for crude storage to ports	In progress
Mumbai Port Trust	5th oil jetty with 7 MMTPA capacity	Over utilized oil jetties resulting in high waiting time for liquid cargo	In progress
	Crude tank farm for storage by OMCs	Alleviate pressure on land crunched refineries	Not yet announced

Assumption: Taking base case refinery expansion, domestic crude production being constant so additional crude requirement is met through imports

SOURCE: Team Analysis | 11

EXHIBIT 13

COMMODITY FLOWS | POL

Additional crude demand of at least 55 MMT in next 10 years would require capacity enhancement at ports (2/2)

Completed | In progress | Not yet announced

Port	Potential POL projects for de-bottlenecking port capacity for 2025	Rationale	Status
Chennai Port Trust	• SBM near Chennai	• Economies of scale to result in freight savings	Not yet announced
	• Up gradation of old crude pipeline from 30" to 42"	• Increase in safety and higher throughput	In progress
Oil Terminals at Vadinar (under Kandla Port Trust)	• Capacity expansion of IOCL Salaya Mathura pipeline	• Support Panipat, Mathura and Koyali refinery expansion	Not yet announced
	• Additional non-strategic crude storage capacity at Viramgam and Chaksu	• Support Mathura and Koyali refinery expansion	Not yet announced
	• Augmentation of BORL Vadinar – Bina pipeline	• Support Bina refinery expansion	Not yet announced
	• Additional BPCL crude storage tanks at Vadinar	• Projected increase in crude volume as Bina refinery expands to 15 MMTPA	In progress
GAPL (Adani-Mundra)	• Capacity expansion of HMEL Mundra Bhatinda pipeline from 9 to 11 MMTPA	• Support Bhatinda refinery expansion	Not yet announced
JNPT	• 1.33 MTPA and 0.5KM length spur lines connecting coastal jetty to other pipelines	• Oil jetty has 80%+ utilization resulting in 5-6 days of waiting times	Not yet announced

Assumption: Taking base case refinery expansion, domestic crude production being constant so additional crude requirement is met through imports

SOURCE: Team Analysis | 12

Refineries will continue to rely on the pipeline network for domestic evacuation of products, since the cost of transporting the product by pipeline comes to around INR 0.14 to 0.18 per tonne km compared to INR 1.2 to 1.5 per tonne km by railways.

However, the market scenario in the country is changing. Following the price de-regulation of diesel, private players are expected to re-enter the domestic retail market. This, along with supply–demand mismatch in the eastern and southern regions creates an opportunity for increase in coastal shipping of petroleum products. It is estimated that private refineries will retail about 26 MMTPA of MS/HSD, of which around 17 MMTPA is diverted from the bulk that is presently being exported.

Preparing to meet the future demand of MS/HSD

An alternative scenario analysis of the amount of MS/ HSD that could be made available for domestic consumption by various export choices of the private players reveals an overall shortfall of 12–13MMTPA of MS/HSD by 2025.

This analysis envisages percentage extraction of MS/HSD from crude to range between 56 and 65 per cent (the lower and higher limits of MS/ HSD production from crude) on the one hand, and private refineries exercising their choice to make available to the domestic market a higher share of MS and HSD they produce at the back of GoI relaxing SEZ rules to meet domestic demand on the other. (Exhibit 14)

In the current subsidized domestic market scenario, Essar and RIL Jamnagar are exporting 50 per cent of their product (scenario 1), but are likely to sell 100 per cent of the product in the domestic market with view to the deregulation of administered prices (scenarios 2 and 3). However, the rules of SEZ require Reliance to export 100 per cent of Reliance SEZ output (scenarios 1 and 2). In case of domestic shortages, there is possibility of GoI relaxing the rules for Reliance SEZ (scenario 3). Currently, all refineries are trying to install units that will produce more MS in place of residual fuels to meet increasing demand thus raising MS/HSD extraction to at least 60 per cent by 2025.

EXHIBIT 14

Export decision of private players and MS/HSD production capacity of refineries will determine its availability for domestic consumption

Scenario analysis of amount of MS/HSD available for domestic consumption

MMTPA

( ) Considered base case for 2025

% MS/HSD production by refineries

		56%	60%	65%
Export plans of private players	• Reliance SEZ exports 100% product • RIL Jamnagar and Essar Oil export 50% product	126	135	146
	• Reliance SEZ exports 100% product • RIL Jamnagar and Essar Oil export nothing	140	(150)	163
	• Reliance SEZ, RIL Jamnagar and Essar Oil export nothing	162	174	188

- Essar and Reliance currently export 50% of their product due to subsidized domestic market
- They plan to sell 100% of the product to domestic market if market remains unregulated
- SEZ rules enforce Reliance SEZ to export all of their product
- GoI might relax the rules for Reliance SEZ if there is a shortage of product in India
- All refineries are trying to install units that will produce more MS in place of residual fuels as the demand has gone up

SOURCE: Private sector interviews; PPAC;

The industry expects 150 MMTPA additional MS/HSD being made available to the domestic market by private refineries by 2025. However, the projected domestic demand at that point of time is between 156 and 172 MMTPA, which translates to an expected deficit of 12 to 13 MMTPA of MS/HSD. Furthermore, this deficit is likely to be unevenly distributed with Gujarat and the eastern regions expected to have surplus even as the rest of the country faces a shortage. (Exhibit 15)

A two-fold strategy is required to address this situation. The first is construction of two new greenfield refineries, one in Maharashtra on the west coast and the other in Tamil Nadu on the east coast, to meet the 12–13 MMTPA deficit. Second, there is need to redistribute supply to rectify regional supply-demand imbalances through increased coastal shipping to the south and additional pipelines to move product to the deficit areas in the north.

EXHIBIT 15

Coastal shipping to redistribute petroleum products

Out of a surplus of about 20 MMTPA in the Gujarat cluster, 15 MMTPA can be moved to the deficit areas in the north and 5 MMTPA to Maharashtra through coastal shipping. Of the 6.3 MMTPA surplus in the eastern region, 4 MMTPA could be shipped to Hyderabad and the remaining moved to the north and central regions via pipeline. With this redistribution plan, there could remain residual deficits of approx 6.3 MMTPA in the south, 3 MMTPA in Maharashtra region and 2 MMTPA in Hyderabad region.

Of the 15 MMTPA being moved north from Gujarat cluster, 10 MMTPA could be coastally shipped within Gujarat, from RIL Jamnagar to Mundra, and from there via pipeline to the north. There is also scope for 3 MMTPA coastal shipping from Kochi to Chennai and 4 MMTPA from Odisha to AP, thus amounting to a potential of about 22 MMTPA of coastal shipping of petroleum products by 2025.

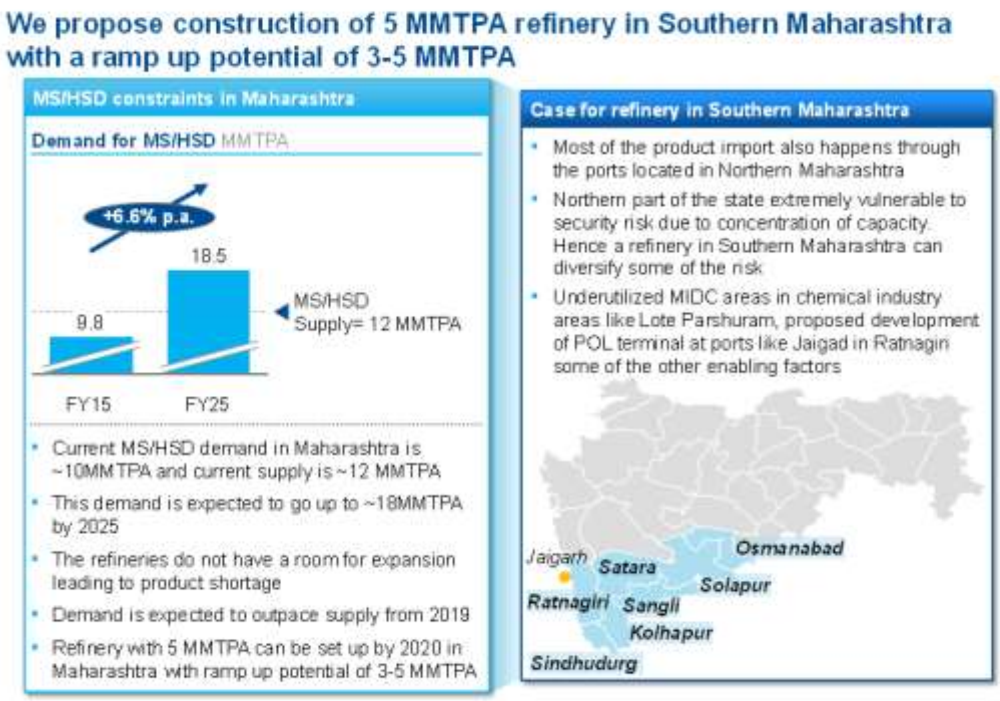
Increasing the scope for coastal shipping is also one of the objectives of the Sagarmala Project. This is because it is much more cost efficient as well as environment efficient than product movement by road or rail. The construction of a pipeline from Paradip to Hyderabad could potentially increase the efficiency of product movement. By 2025, eastern region’s demand for MS/HSD would be ~21MMTPA and production would be ~27MMTPA creating a surplus of 6MMTPA. This would primarily be due to capacity expansion of Paradip refinery to 15 MMTPA. On the other hand, AP region is expected to face deficit of ~6 MMTPA even after Vizag refinery expansion. Hence a 4 MMTPA pipeline connecting Paradip to Hyderabad would be required to meet the AP and Telangana demand.

Following the price de-regulation of diesel, it is expected that private refining players will re-enter the domestic retail market. Hence they will be able to cater to the MS/HSD demand coming from North Indian states. As Mundra and Kandla are connected to the north through product pipelines, connecting them with Jamnagar will enable efficient evacuation of the product from the private refineries in Jamanagar. It is estimated that North Indian states would face a deficit of around 10 MTPA of MS/HSD. Hence a pipeline could be constructed connecting Mundra/Kandla with Jamnagar to serve the hinterland demand in North India.

Additional refining capacity

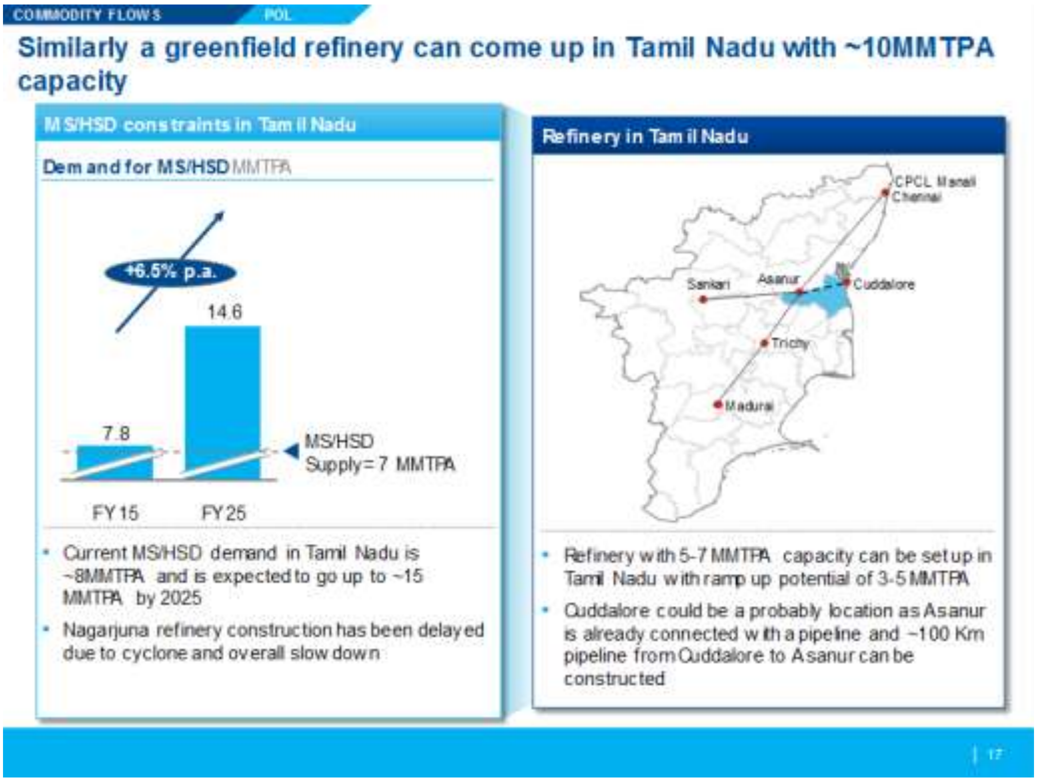
Current demand for MS/HSD in Maharashtra of around 10 MMTPA is expected to increase to about 18 MMTPA by 2025. Current supply stands at around 12 MMTPA, with no scope for expansion in the existing refineries. Demand is thus expected to outpace supply from around 2019, culminating in a deficit of about 6 MMTPA by 2025. There is thus a strong case for setting up of a 5 MMTPA refinery with a potential to ramp-up by an additional 3–5 MMTPA. However, the bulk of POL import takes place through the ports located in northern Maharashtra.. Thus, a refinery in southern Maharashtra has been recommended to diversify the risk. Other enabling factors include use of underutilized areas in the Maharashtra Industrial Development Corporation (MIDC) and development of a POL terminal at Jaigarh port in Ratnagiri. (Exhibit 16)

EXHIBIT 16



In case of Tamil Nadu, current demand for MS/HSD stands at around 8 MMTPA and is expected to rise to 15 MMTPA by 2025. With current supply at 7 MMTPA, there is already a deficit, largely on account of delay in construction of the Nagarjuna refinery due to cyclone and overall economic slowdown. The CPCL refinery in Chennai is located in the interior of the city and cannot expand due to environmental and safety concerns. A refinery with 5–7 MMTPA capacity has thus been recommended, to be set up between Cuddalore and Karaikal in Tamil Nadu by 2018, with a ramp-up potential of 3–5 MMTPA. (Exhibit 17)

EXHIBIT 17



A number of factors need to be considered while identifying suitable locations for setting up a refinery. These primarily relate to availability and ease of acquisition of land, location-related factors such as demand and feed availability, infrastructure and connectivity, as well as cooperation from the state government in question.

Conclusion and Recommendations

Over the next decade domestic demand for petroleum products is expected to increase to anywhere between 273 and 288 MMTPA, depending upon the pace of economic recovery and GDP growth. Domestic installed capacity of the existing refineries, on the other hand, can increase to a maximum of 282 MMTPA by the year 2025. Since only 56 to 65 per cent of crude input can be converted to MS/HSD, the current scenario is expected to lead to an increase in the crude import requirement by 75 MMTPA in the next 10 years.

Further, the recent deregulation of diesel prices in the economy is expected to cause a shift in the EXIM dynamics of petroleum products, inducing private refineries to divert the majority of their export volumes into the domestic market. In event of this happening, there will emerge new opportunities to coastally ship an additional 22 MMTPA petroleum products from the surplus to the deficit areas by 2025.

This expected increase in coastal shipping has implications for port infrastructure with regard to petroleum products. Storage facilities for petrol and diesel may have to increase by around 0.13 MMTPA at the destination ports. Port connectivity infrastructure—rail, road and pipelines—will also need to be strengthened to transport the coastally shipped petrol and diesel to the concerned refineries and depots, and then to the retail outlets.

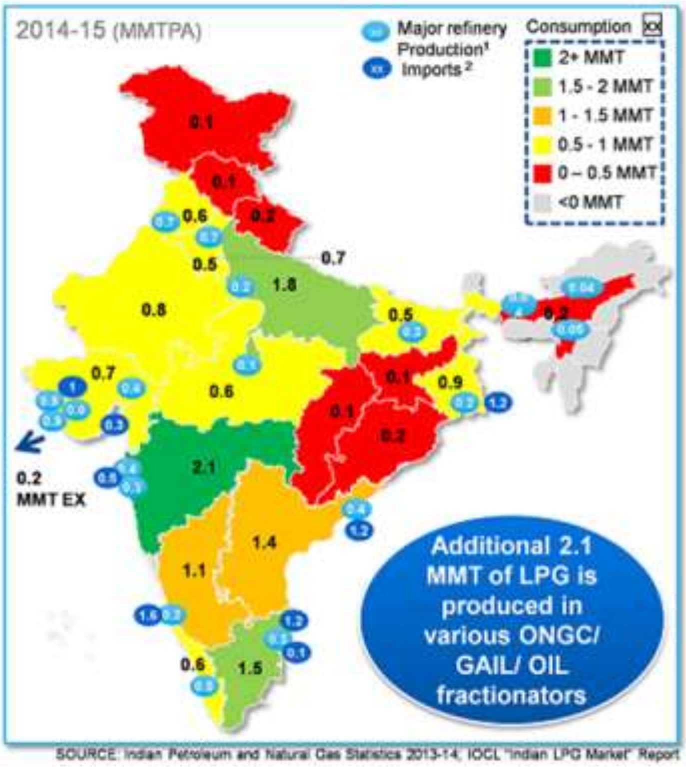
Aligning the various stakeholders and decision makers involved at various stages of the POL movement value chain will be the most important driver to increase coastal shipping of the commodity. The government will need to encourage and incentivize private-sector investment through PPP models for port infrastructure, railway infrastructure and coastal shipping. Some specific action points include:

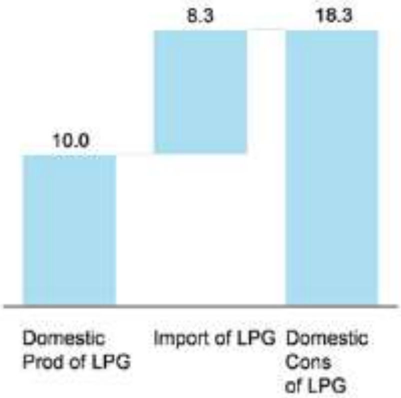
- On-boarding of private players to initiate coastal shipping.
- Creating dedicated coastal berths, bunkering and storage capacities at relevant ports.
- Establishing a coastal shipping fleet dedicated to carrying POL products under the Shipping Corporation of India.
- Developing appropriate ship-repairing/ship-building facilities at key ports; currently, most ship repairs happen outside the country.

Liquefied Petroleum Gas

As per the figures for 2014–15, current domestic consumption of liquefied petroleum gas (LPG) in the country stands at around 18 MMTPA, of which 10 MMTPA is supplied by domestic production of LPG and the rest is imported (Exhibit 18). Around 3.6 MMTPA is transported through pipelines and the rest by road in tankers. The accompanying map depicts the consumption pattern for LPG in various states, as well as the major locations of refinery production and import of LPG. Apart from these an additional 2.1 MMTPA is produced in various ONGC/GAIL/OIL fractionators. There is scope for transportation of a further 8 MMTPA of LPG through pipelines in the event of planned pipeline construction.

EXHIBIT 18

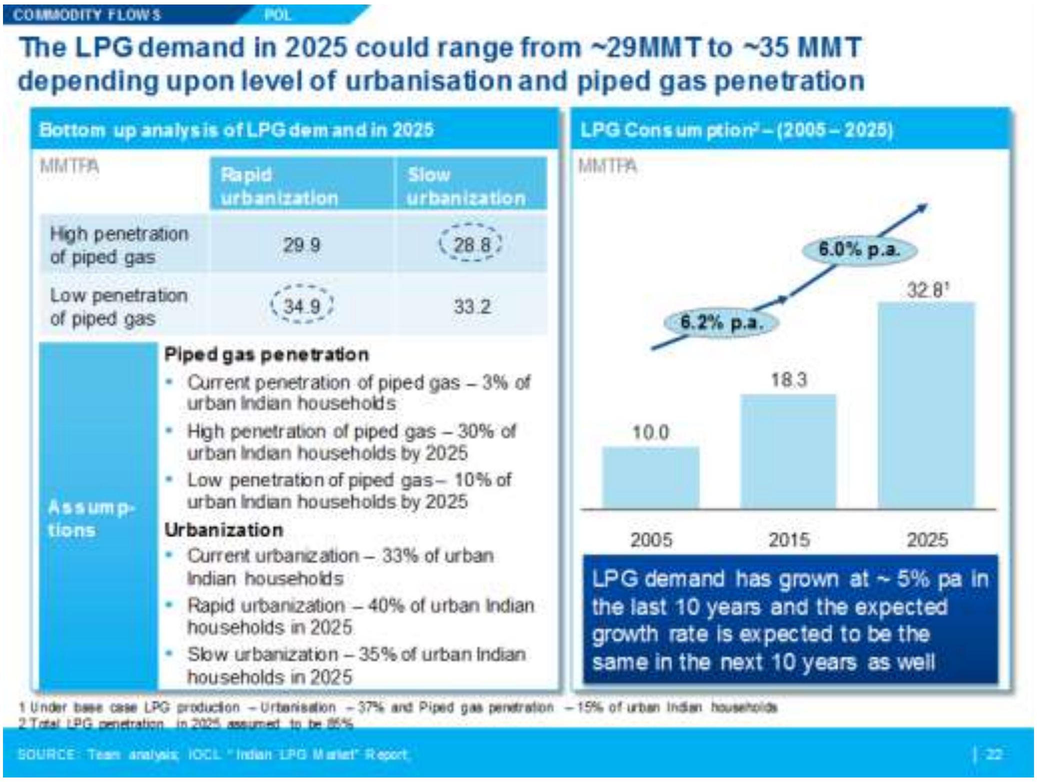




Future projections of LPG demand and supply

Given that the current penetration of piped gas is 3 per cent of urban Indian households and the current rate of urbanization in the country is 33 per cent, projections of LPG demand in 2025 have been carried out in scenarios of high (30 per cent) and low (10 per cent) penetration of piped gas, with rapid (40 per cent) as well as slow (35 per cent) urbanization (Exhibit 19). The projections throw up a demand for LPG in the range of 29 and 35 MMTPA in 2025. In view of past trends, LPG demand has been growing at around 5 per cent per annum over the last ten years and is expected to grow at a similar pace over the next 10 years as well. This gives us a projected demand for LPG of about 33 MMTPA in 2025.

EXHIBIT 19



With LPG demand poised to outpace domestic production in the next decade, increase in import capacity is required. In the present scenario, we have an import capacity of 7 MMTPA, and plans for another 3 MMTPA, taking the total projected import capacity for LPG to 10 MMTPA in 2025. However, as seen earlier, consumption demand in 2025 is expected to reach 32.8 MMTPA by 2025. Of this, 14 MMTPA is expected to be produced domestically and planned imports amount to around 10 MMTPA (Exhibit 20). This leaves a supply gap of 8.8 MMTPA, for which capacity is needed to be built.

EXHIBIT 20

COMMODITY FLOWS | POL

LPG demand to outpace domestic production in the next 10 years, requiring increased import capacity

MMTPA

Present import infrastructure[1]

Company	Port name	Achievable imports
Aegis	Mumbai	0.12
HPC, TOTAL	Mangalore	1.60
SALPG, EIPL	Vizag	1.20
GCPTCL	Dahej	0.30
BPC	Mumbai	0.40
IOC	Kandla	1.00
IPPL	Ennore	1.00
IPPL	Haldia	1.20
SHV	Tuticorin	0.12
Aegis	Pipavav	0.12
SHV	Porbundar	0.30
Total		**7.4**

Proposed import infrastructure[1]

Company	Port name	Rated capacity
IOC	Kochi	0.6
	Kandla	Augmentation from 0.6 – 1.5
	Paradip	0.6
IPPL/IOTL/ EOL	Mundra or any other port on West coast	0.6 to 1.0
Aegis	Haldia	0.1
BPCL	Haldia	0.1

LPG production and imports (2025)

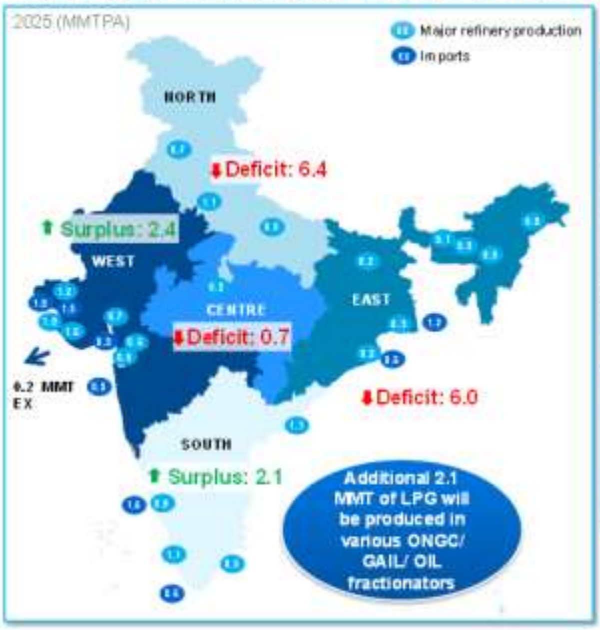
- Only 10 MMPTA of import capacity has been planned for 2025
- Import capacity of additional ~9 MMTPA will have to be developed to cater to increase in demand

SOURCE: Team Analysis; 1 IOCL "Indian LPG Market" Report; 2 Estimate 2024-25 optimistic production taking into account realization of certain speculated greenfield and brownfield projects | 23

Both the north and east of the country are deficient in LPG (Exhibit 21) and are expected to experience LPG supply deficit of the extent of 8.8 to 9 MMTPA over the next decade. To plug this deficit, LPG imports should increase in ports of Gujarat (Kandla, Pipavav/Dahej), where a Jamnagar Loni LPG pipeline to the north is available, and at Haldia, Paradip and Dhamra to feed the eastern deficit as a LPG pipeline connecting Paradip-Haldia-Durgapur is being built by IOCL.

EXHIBIT 21

LPG import capacity will have to be built at ports in Gujarat, Orissa and West Bengal that can feed the LPG deficient northern and eastern states



Region wise LPG surplus and deficit (2025)

Region	Demand	Supply	Imports	Surplus/ Deficit
North	8.3	1.9	0.0	-6.4
West	6.7	5.5	3.5	2.4
East	9.4	1.6	1.8	-6.0
South	6.4	3.7	4.7	2.1
Centre	2.0	1.3	0.0	-0.7

- LPG imports should increase in Gujarat (Kandla, Pipavav/Dahej) ports due to availability of a Jamnagar Loni LPG pipeline
- Similarly Haldia, Dhamra and Paradip ports should import more LPG to feed the eastern deficit

SOURCE: Indian Petroleum and Natural Gas Statistics 2014-15; IOCL "Indian LPG Market" Report

Conclusions and Recommendations

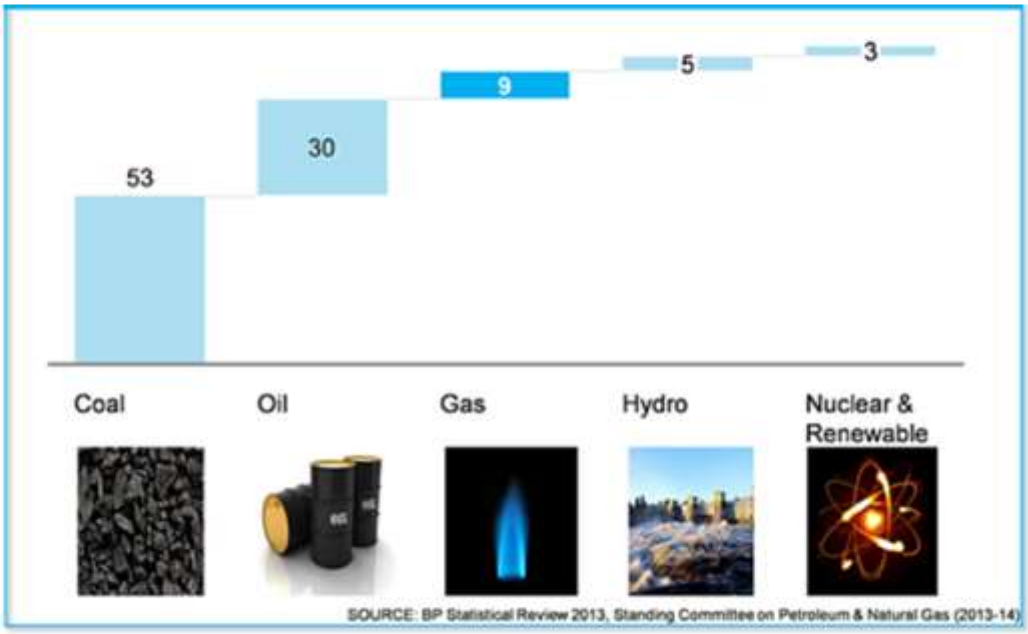
Domestic demand for LPG is expected to grow from the current level of 16 MMTPA at about 5 per cent per annum and by 2025, can increase to anywhere between 28 MMTPA to 35 MMTPA, depending upon the pace of urbanization and growth of piped gas penetration. Industry estimates fix the figure at around 33 MMTPA. As against this, domestic production of LPG is expected to increase to 14 MMTPA by 2025. Given India's present LPG import capacity of 7 MMTPA and the projected capacity increase of 3 MMTPA, this leaves a gap of nearly 9 MMTPA which needs to be provided for.

This will require enhanced import capacity at ports in Haldia, Paradip and Gujarat ports to supply gas to the LPG deficient states of northern and eastern India. Additionally, product pipeline infrastructure will have to be augmented to carry the product from ports to LPG terminals/depots.

Liquefied Natural Gas

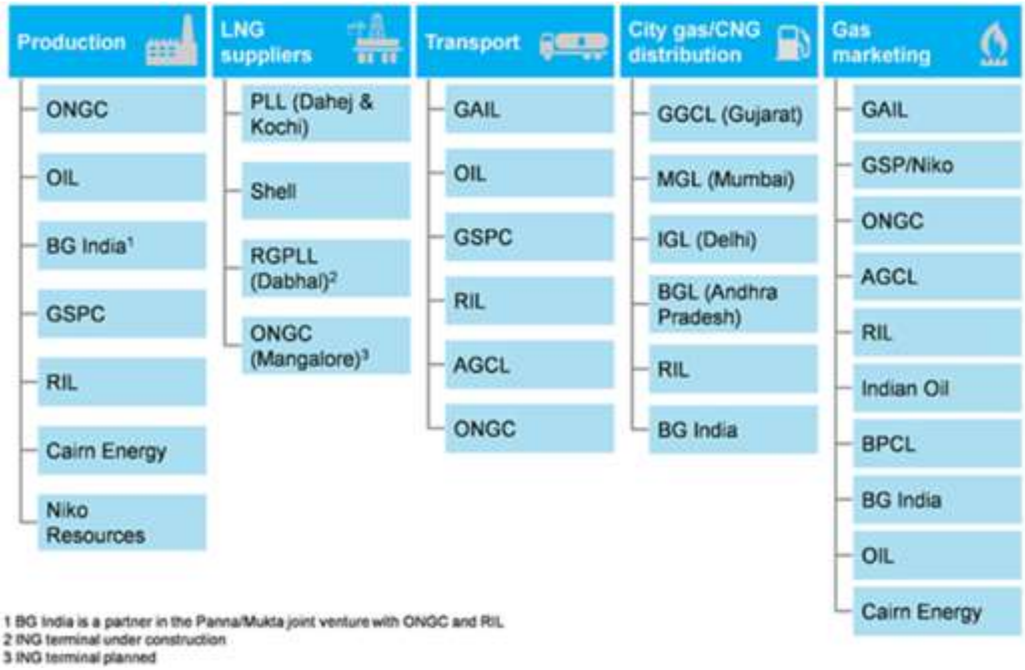
Currently about 9 per cent of India's primary energy demand is met through natural gas, making it the third largest energy source in the country after coal at 53 per cent and oil at 30 per cent (Exhibit 22). This comes to 57 million metric tons per annum (MMTPA) (~205 million metric standard cubic metres per day) of total gas consumption in the country of which 48 per cent is used for power generation and 38 per cent by industry.[1] The rest is utilized for residential, commercial, transport and other uses. The major players involved in production, supply, transport, distribution and marketing of natural gas can be seen in Exhibit 23.

EXHIBIT 22



[1] 1 mmtpa = 3.60 mmscmd

EXHIBIT 23

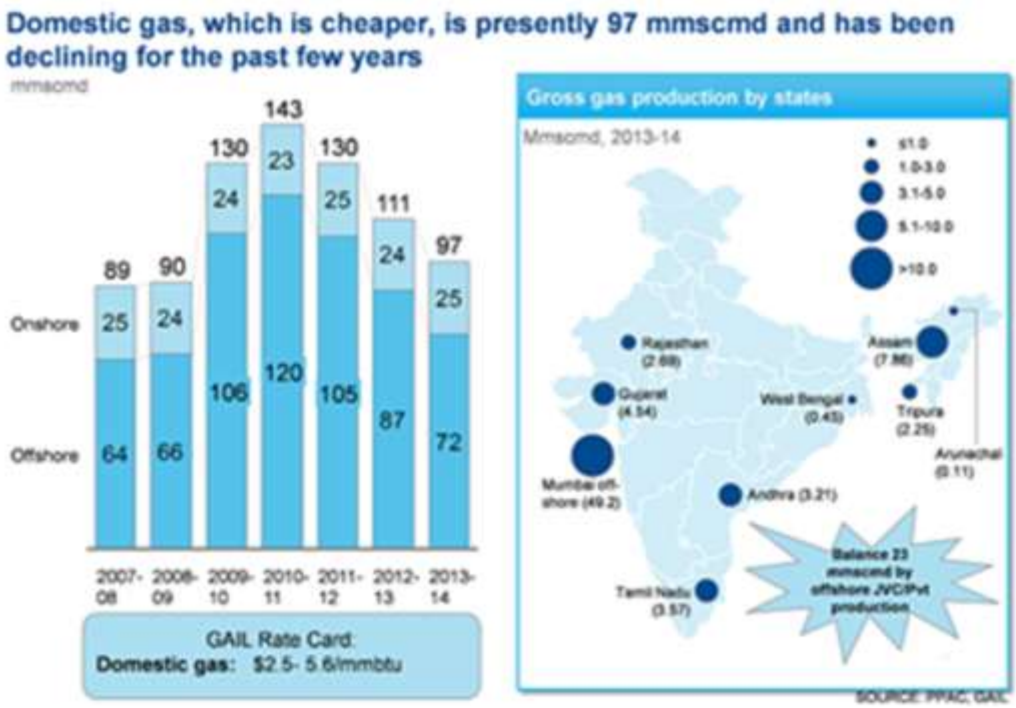


Natural Gas demand-supply scenario 2015-2025

Natural gas in India is either produced domestically (in gaseous form) or imported in liquefied form (liquefied natural gas or LNG). Gas imported in liquid form is gasified at the import terminals and then moved internally through pipelines.

The demand for imported LNG in India depends on two factors, its price and the production of domestic gas (which is significantly cheaper than imported LNG). If the production of domestic gas were to rise, a proportionate decrease in demand for LNG would be inevitable. However it is observed that domestic gas production has been declining consistently over the last few years. It has dropped from a peak of 143 mmscmd in 2010–11 to 97 mmscmd in 2013–14 and no big jump is expected in the near future (Exhibit 24). Thus, domestic gas production is not likely to be enough to meet the demand for it in the country currently (at about 205 mmscmd) or in the future and the balance needs to be met either by imported LNG or alternative fuels depending on the price of LNG.

EXHIBIT 24



Demand for LNG is also extremely price sensitive, with different end-users having varied price thresholds for substituting gas with alternate fuels. As a result, the realized demand of LNG is heavily dependent on the price at which it can be imported.

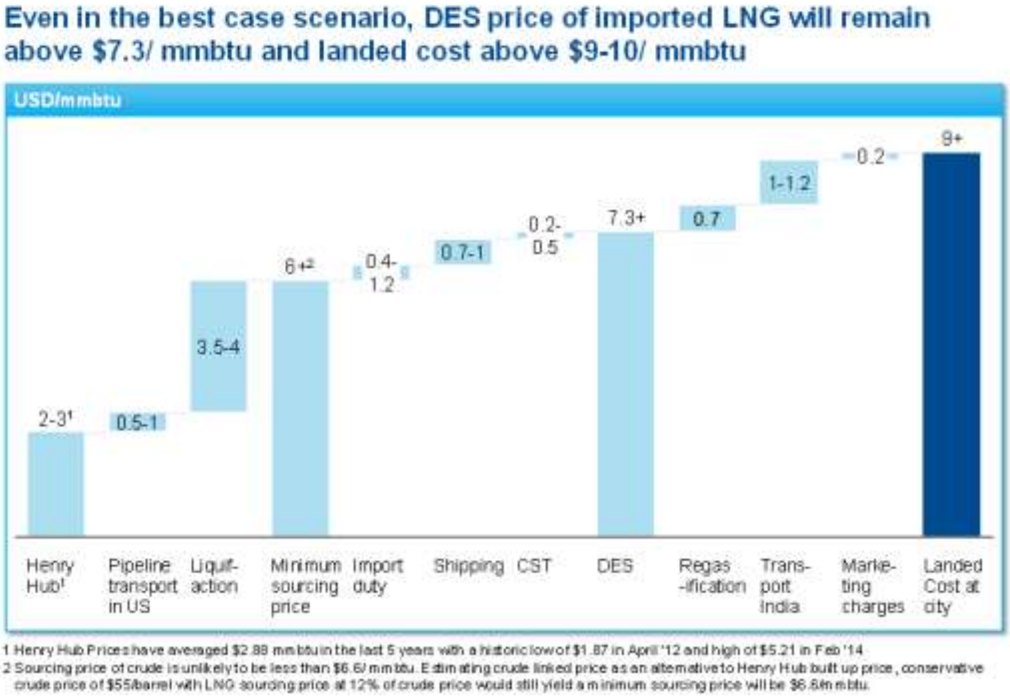
In the past few years we find that the price for LNG has averaged $12-$14 per mmbtu (Exhibit 25).[2]

[2] 1 *MMBtu* is equal to 1 million BTU (British Thermal Unit) = 25.2 standard cubic metres (to be seen in the context of current demand in India of 205 million metric standard cubic metres per day)

EXHIBIT 25

Even in the best case scenario this price is highly unlikely to drop much below $9–$10 per mmbtu. Natural gas spot prices (Henry Hub Prices) averaged $2.88 per mmbtu in the last 5 years with a historic low of $1.87 in April 2012 and high of $5.21 in Feb 2014. Sourcing price of crude is unlikely to be less than $6.6 per mmbtu. Estimating crude linked price as an alternative to Henry Hub built up price, conservative crude price of $55 per barrel with LNG sourcing price at 12 per cent of crude price would still yield a minimum LNG sourcing price will be $6.6 per mmbtu. **Consequently, the total cost of importing LNG, including procurement and end-to-end transportation, in the best case scenario is likely to vary in the range of $9–$10 per mmbtu** (Exhibit 26).

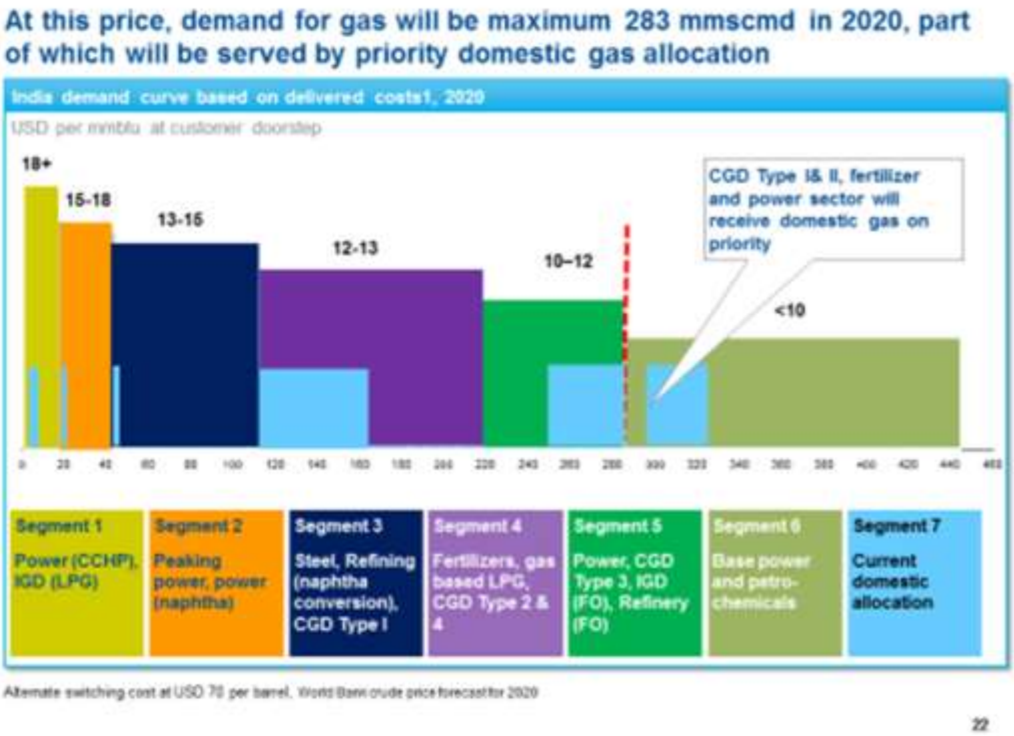
EXHIBIT 26



Therefore in this scenario assuming LNG import price to be ~$10 per mmbtu, the demand curve estimated gas demand in 2020 is at 283 mmscmd (Exhibit 27).[3]

[3] The demand curve for 2020 also depicts the switching cost of each segment (the price at which the segment will switch to an alternative fuel). For instance, if the LNG import price is at $13–$15 per mmbtu, Segments 1–3 would demand gas but Segment 4, 5 and 6 would not (Exhibit 24).

EXHIBIT 27



If we assume that domestic supply ranges between 112–119 mmscmd (say, 115 mmscmd) in 2020, the supply shortfall would be around 168 mmscmd. Given that about 15 mmscmd of domestic gas is likely to be re-injected for internal use and another 30 mmscmd would be allocated to Segment 6 as per govt. allocation, we are therefore looking at a total import requirement of 213 mmscmd in 2020 (Exhibit 28).

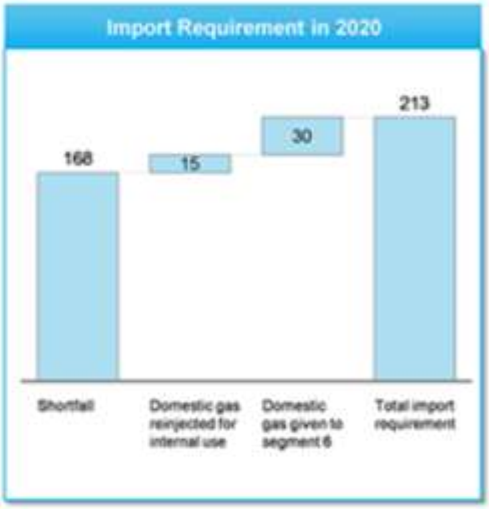
EXHIBIT 28

mmscmd

Gross Gas Demand & Supply Estimates

Gas Supply	2015	2020
Low domestic production	101	112
High Domestic Production	103	119

At 10$ per mmbtu price, LNG demand in India would be ~283 mmscmd leading to a LNG shortfall of ~168 mmscmd



1 350 mmscmd is equal to 97 MTPA

Looking at some alternative scenarios, all else being the same, if domestic supply were to increase to 150 mmscmd[4], import demand would reduce to 194 mmscmd (54 MMTPA).[5] Alternatively, ceteris paribus, if import price of LNG were to be at $11.5 per mmbtu instead of $10 per mmbtu, the total gas demand would reduce to 218 mmscmd and at a domestic production level of about 119 mmscmd, import demand would be in the range of 158 mmscmd (44 MMTPA).[6]

Moving on to projections for 2025, the demand curve for 2025 estimates national demand for natural gas at 350 mmscmd, again assuming an import price of LNG at ~$10 per mmbtu. (Exhibit 29). [7]

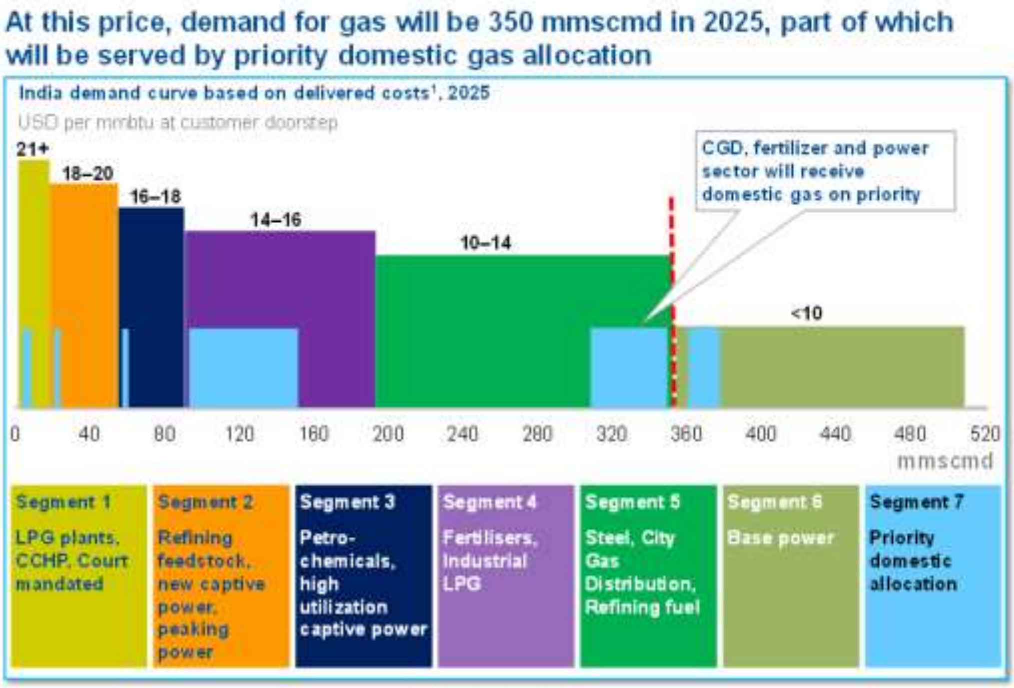
4 Ministry of Petroleum and Natural Gas projections in 12th Plan document, latest announcements in press search

5 Assuming bulk of increase (15–20 mmscmd) in domestic production will go to power sector with switching cost less than $10 per mmbtu

6 Assuming some (~15 mmscmd) domestic production is allocated to sectors that are now unviable for imported gas use

7 The demand curve for 2025 also depicts the switching cost of each segment (the price at which the segment will switch to an alternative fuel). For instance, if the LNG import price is at $13–$15 per mmbtu, Segments 1–3 would demand gas but Segment 4, 5 and 6 would not (Exhibit 29).

EXHIBIT 29



1 Alternate switching cost at USD 90 per barrel, WorldBank crude price forecast for 2025

If we were to assume that domestic supply would range between 125–138 mmscmd (say, 130 mmscmd) in 2025, the supply shortfall would be around 220 mmscmd. Given that about 20 mmscmd of domestic gas is likely to be reinjected for internal use and another 10 mmscmd would be allocated to Segment 6 as per expected govt. allocation, we are therefore looking at a total import requirement of 250 mmscmd in 2025 at an import price of $10 per mmbtu (Exhibit 30).

EXHIBIT 30

mmscmd

Gross Gas Demand & Supply Estimates

Gas Supply	2015	2020	2025
Low domestic production	101	112	125
High Domestic Production	103	119	138

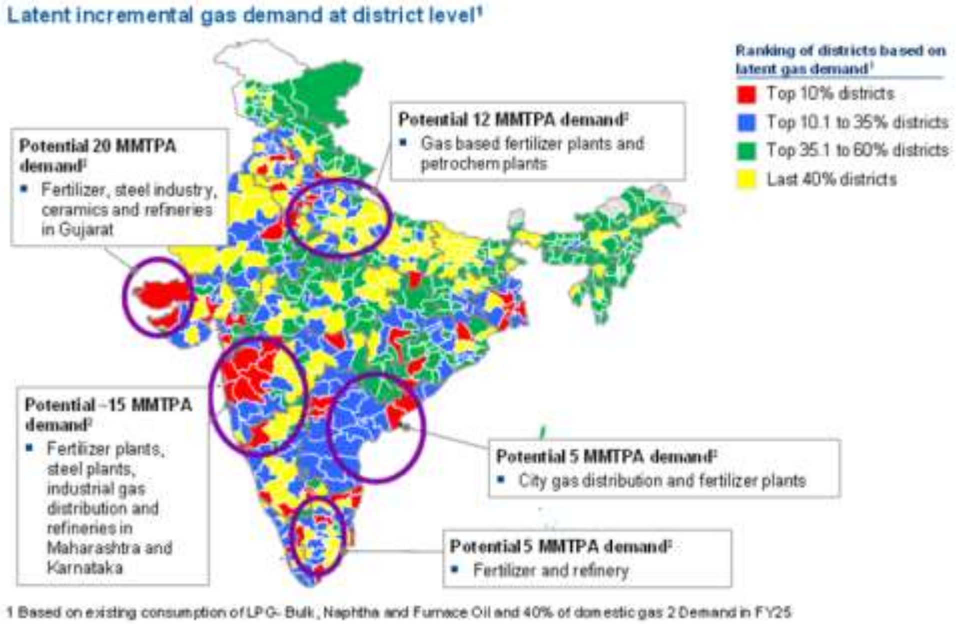
At 10$ per mmbtu price, LNG demand in India would be ~350 mmscmd by 2025 leading to a LNG shortfall of ~ 220 mmscmd

1 350 mmscmd is equal to 97 MTPA

Again, some alternative scenarios suggest that, all else being the same, if domestic supply were to increase to 204 mmscmd[8] and total gas demand were to also increase to 370 mmscmd,[9] import demand would reduce to 205 mmscmd (57 MMTPA). Alternatively, ceteris paribus, if import price of LNG were to be at $12 per mmbtu instead of $10 per mmbtu, the total gas demand would reduce to 327 mmscmd and at a domestic production level of about 138 mmscmd, import demand would be in the range of 223–241 mmscmd (62–67 MMTPA).

Demand will be strongest from Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. The power, fertilizer, industrial and city gas distribution (CGD) segments are expected to contribute to the bulk of future growth of natural gas demand in India. Natural gas demand from the power sector is expected to be driven, not only by the shortage of domestic coal supply and the rising cost of its substitute i.e. imported coal but also by increased domestic gas supply and power sector reforms. Fertilizer industry is the only industry that uses chemical and thermal heat of gas for its production and remains a major contributor to the natural gas demand in the country.[10] (Exhibit 31)

EXHIBIT 31



8 Forecast by Industry Group for Petroleum and Natural Gas Regulatory Board in "Vision 2030", based on MoPNG projections in 12th Plan document

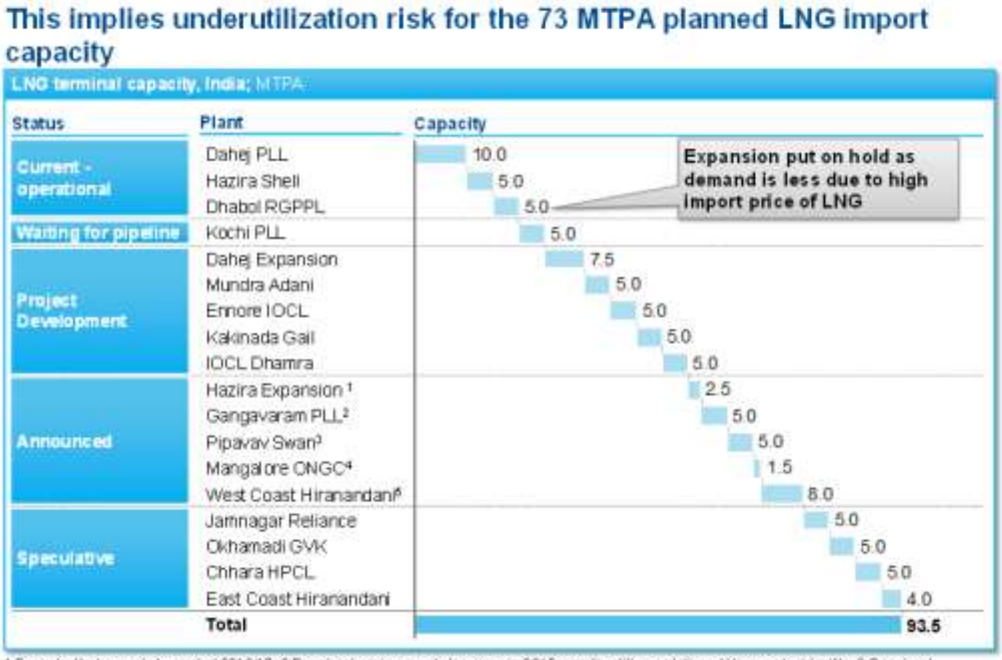
9 Because an increase in domestic gas production would also increase demand for certain sectors that were previously unviable

10 "Vision 2030" Natural Gas Infrastructure in India Report by Industry Group For Petroleum & Natural Gas Regulatory Board; http://www.pngrb.gov.in/Hindi-Website/pdf/vision-NGPV-2030-06092013.pdf

How LNG infrastructure can meet demand – now and in the future

There is currently 20 MMTPA of operational terminal infrastructure for re-gasification of LNG imports at Dahej, Hazira and Dhabol with another 5 MMTPA awaiting pipeline connection at Kochi. Moreover there is another 48 MMTPA under construction or announced in terminal infrastructure. This is in line with the best case scenario of LNG import demand growth for 2025. However if domestic supply increases or LNG prices are above $ 10 per mmbtu, there is an acute risk of underutilization. (Exhibits 32 and 33)

EXHIBIT 32



1 Expected to be ready by end of 2016/17; 2 Received environment clearance in 2015, pending till completion of Hiranandani facility; 3 Received environment clearance in 2013; 4 In talks with investors; 5 Expected to be ready by 2018

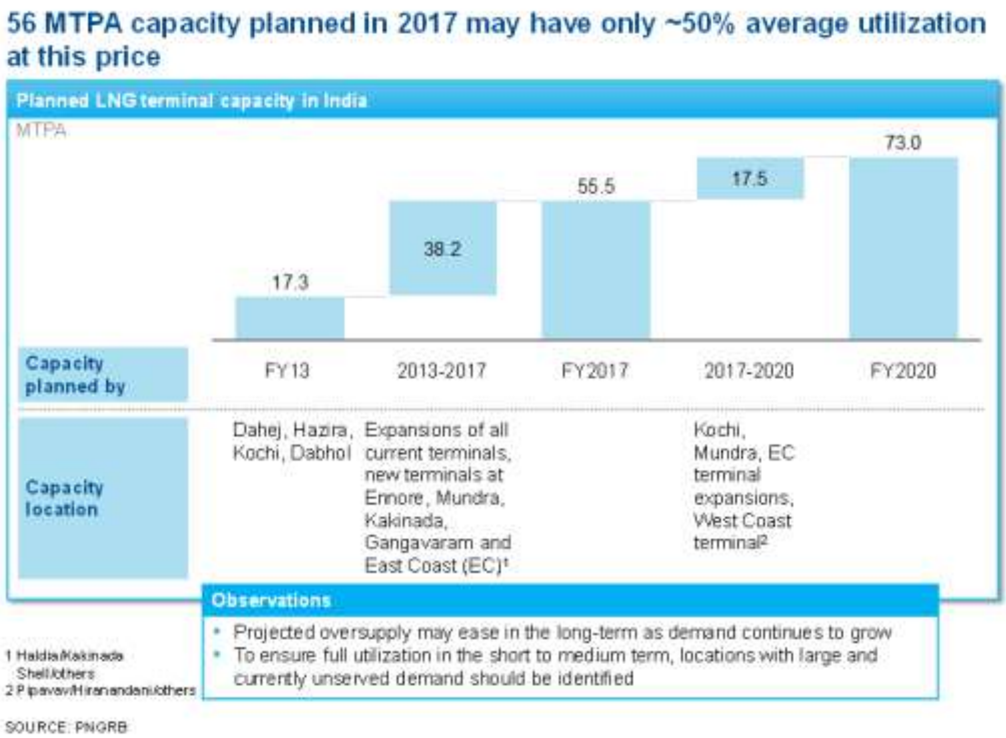
SOURCE: PPAC, Press Search

Business prospects of floating storage and regasification units

There are three main advantages of **floating storage and regasification units** (FSRUs)

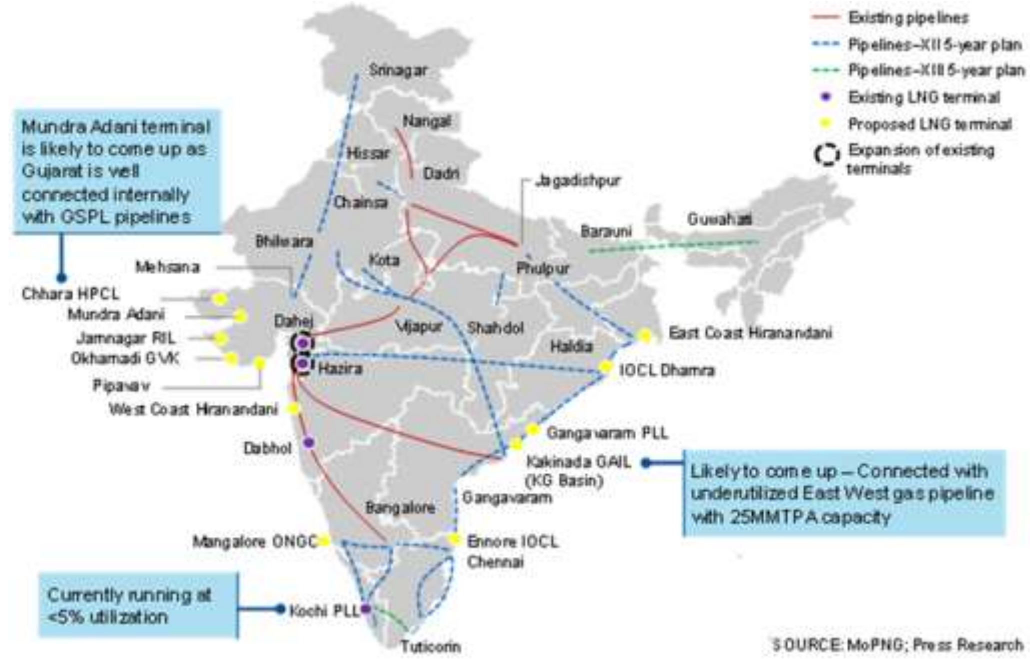
1. They are perfect for smaller demand areas are their capacity is normally ~2-3 MTPA. Therefore this leads to higher asset utilization in smaller demand hubs
2. FSRUs are very flexible and can easily be relocated. Therefore if demand for LNG increases in a certain area, the FSRU can be shifted elsewhere
3. FSRUs end up being ~$0.40 cheaper than onshore terminals. Therefore if 25% of 48 MPTA upcoming capacity was set up as FSRUs, this would **result in an overall savings of Rs 1,500 crore per annum**

EXHIBIT 33



Given that private players constantly revise business plans on the basis of changing business and market scenarios, most of the planned projects are unlikely to materialize. Only two terminals which are already well-connected by pipelines are likely to come up, namely, Adani Terminal at Mundra and GAIL Terminal at Kakinada (Exhibit 34)

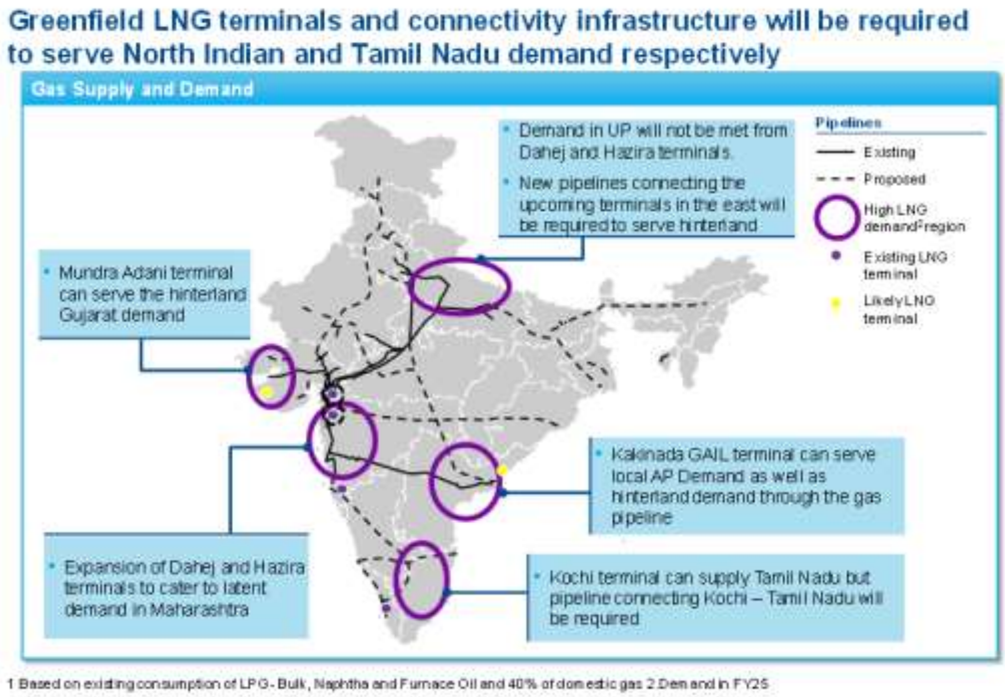
EXHIBIT 34



SOURCE: MoPNG; Press Research

With five major demand pockets for LNG and only two LNG import terminals likely to come up in addition to the three currently operational, there will be two centres of high demand which will not be served by any of the terminals—UP in the north and Tamil Nadu in the south (Exhibit 35). A pipeline from the underutilized Kochi terminal could solve the supply problem of Tamil Nadu. However, to serve the high demand pocket in UP, a new terminal or a pipeline from an existing one will be required.

EXHIBIT 35



Conclusions

Given the price sensitivity of demand for natural gas, along with the fact that the total cost of importing LNG, including procurement and end-to-end transportation, is unlikely to fall below $10 per mmbtu, taking domestic gas production at 125–138 mmscmd and making adjustments for subsidized gas supply, demand for LNG imports in the best case scenario would be 67-72 MMTPA (around 250 mmscmd) in 2025. . This demand is expected to be concentrated in selected industrial clusters in Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. However, any increase in domestic gas production or price of imported LNG will reduce the demand for imported LNG, which may fall as low as 57-62 MMTPA.

Planned LNG import terminals in the next 10 years would increase import capacity to 73 MMTPA. Taking speculated projects into consideration, this number could reach 93.5 MMTPA. This leaves a high risk of underutilization for newer terminals. Consequently, all the proposed projects are unlikely to materialize while terminals connected with pipelines are more likely to come up.

ORIGIN-DESTINATION AND OPTIMISATION STUDY FOR THERMAL COAL

In response to projected coal demand in excess of 1.2 billion tonnes (BT) by 2020, Coal India Limited (CIL) has committed itself to producing 1 BT of coal by that time. This rapid increase in production expected over the next five years will prompt all stakeholders in the coal mining and logistics industry—along with end-users such as thermal power plants, steel, cement and fertilizer plants—to re-assess two key aspects: coal linkage rationalization and coal evacuation.

As of 2013–14, approximately 740 MMTPA of coal moves through the country, including domestic production and imports. The majority of coal produced and imported in India is thermal coal, while coking coal contributes a much smaller share of 60 MMTPA. Power plants and steel plants use about 80 percent of the total domestic and imported coal. While coal production is concentrated mostly in eastern and central India, it is transported for power generation to nearly all corners of the country. Even though coastal shipping costs and one-sixth the cost of rail transportation, coastal shipping has a negligible share in the volume of coal movement. Rail costs INR 1.2 to 1.5 per ton-km for coal movement, while the cost for coastal shipping is INR 0.20 per ton-km after taking into account the cost of handlings.[11]

The cost of coal logistics contributes about 30 to 35 percent to the cost per unit of power generation. As a result, shifting coal movement from rail to coastal shipping via ports for the relevant coastal thermal and steel plants could significantly lower the cost per unit of power generation in India. Further, current movement primarily happens through railways and key rail lines which are running at a capacity utilization of 100 percent and above, causing congestion and therefore delays and higher costs. With the government investing in key manufacturing and infrastructure development programs, industry experts believe that the current network will not suffice for coal movement volumes in the next 10 to 15 years.

An in-depth study was conducted across 400 thermal power plant units for an economical logistics cost comparison of all possible combinations of the modal mix (road, rail, coastal, etc.) under different scenarios of vessel capacity. Initial analysis suggests that 12 coalfields and some key power plant clusters have the potential to move from the existing mode to coastal shipping. With the right infrastructure and institutional support, the movement of coal via coastal shipping could increase nearly six-fold, from the current 23 MMTPA to almost 125 to 130 MMTPA by 2020 and around 190 to 200 MMTPA by 2025. In addition to this, another 70 MTPA of thermal coal could be coastally shipped if initiatives like port based linkage and aggregation of volumes take places for smaller non power users

[11] Two additional handlings are caused during coastal shipping in most cases

By 2025, this will have a powerful impact

- It could save annual coal logistics costs of INR 6,000 Crores to 7,000 Crores per annum
- It could save close to 95,000 to 1,02,000 rake days every year
- It could also reduce the unit cost of power generation for coastal plants by approximately INR 0.2[12]
- It could drive INR 4,000 Crores to 4,500 Crores of additional annual revenue for the ports per annum

The shift towards coastal shipment of coal will occur in a phased manner over different time horizons. While a detailed study of all the projects required to unlock this opportunity is still under way, certain initiatives could provide a much-needed initial impetus to coastally shipping coal. Interventions would be needed at almost all levels of the coal movement value chain, such as improving port infrastructure and facilities and overall capacity, improving rake availability by building and maintaining trains, increasing the capacity of railway tracks and roads, etc.

Alignment and coordination among the numerous stakeholders will be critical for this transformation. The immediate action plan would therefore include creating a working group with representation from key stakeholders, such as the Ministry of Shipping, the Ministry of Finance, the Ministry of Coal, Indian Railways, the Shipping Corporation of India, port authorities, etc.

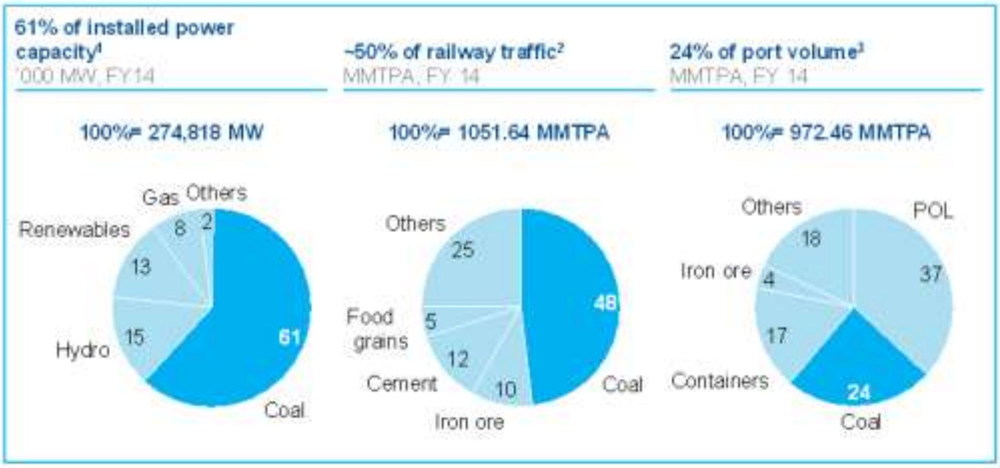
Current thermal coal movement

Thermal coal consumes a sizeable chunk of installed power capacity, forms half of all railway traffic and represents 24 percent of port volumes (Exhibit 36).

12 Plus the cost of two additional handlings

EXHIBIT 36

Coal volumes as % of total movement for power, rail and port



1 Total Installed Capacity as on 30.06.2015
2 2013-14 Loading of revenue earning traffic
3 2013-14 Traffic Handled at All Ports

SOURCE: Basic Port Statistics of India, Transport Research Wing, Government of India, 2013-14; Indian railways Annual Reports and Accounts 2013-14; Ministry of Power

Coal production in India during 2013–14 was 565.77 MMT. In addition, 168.4 MMT of coal was imported in that year, mainly from Indonesia, Australia and South Africa. After accounting for the changes in vendible stock and the small quantity of coal exported, data indicates that around 739.92 MMT of coal moved around the country.

Our findings suggest that existing power plants require about 525 MMTPA of thermal coal. Of this, nearly 80 percent (445 MMTPA) is produced domestically while another 80 MMTPA is imported (Exhibit 37).

EXHIBIT 37

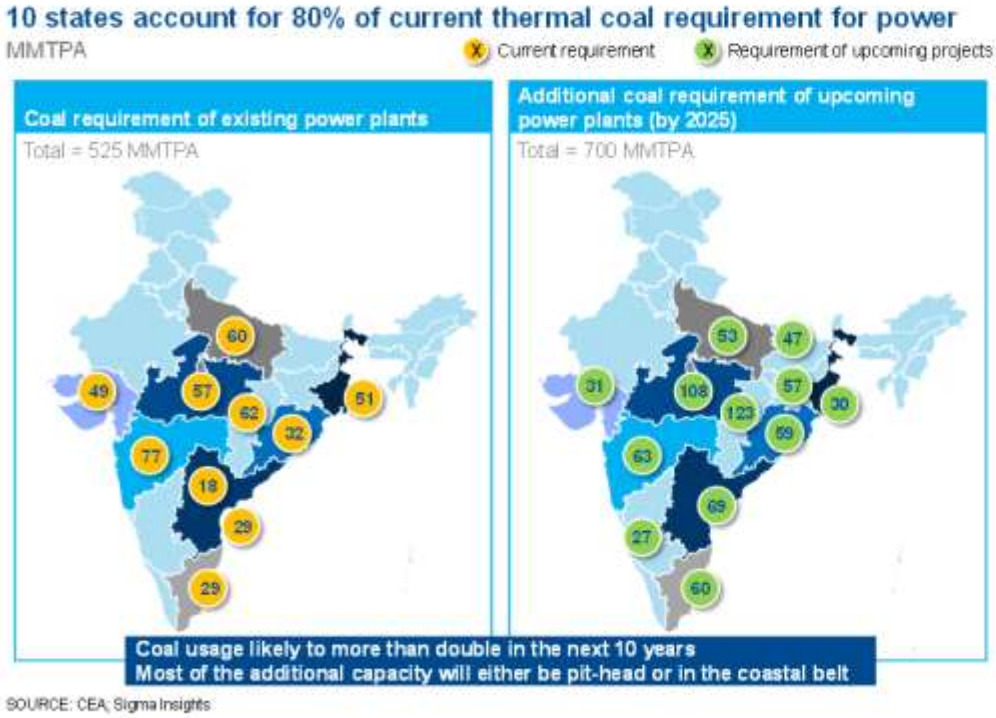
SOURCE: Sigma Insights; India coal market watch

Coal deposits are mainly confined to the eastern and southern-central parts of the country. Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra account for nearly all the coal reserves in India. Jharkhand is the largest producer of coal in the country as of March 2014, followed by Odisha and Chhattisgarh.

Since one of the key objectives of Sagarmala is to optimize the logistics efficiency for mega-commodities, its focus area is thermal coal, primarily produced by Chhattisgarh and Odisha.

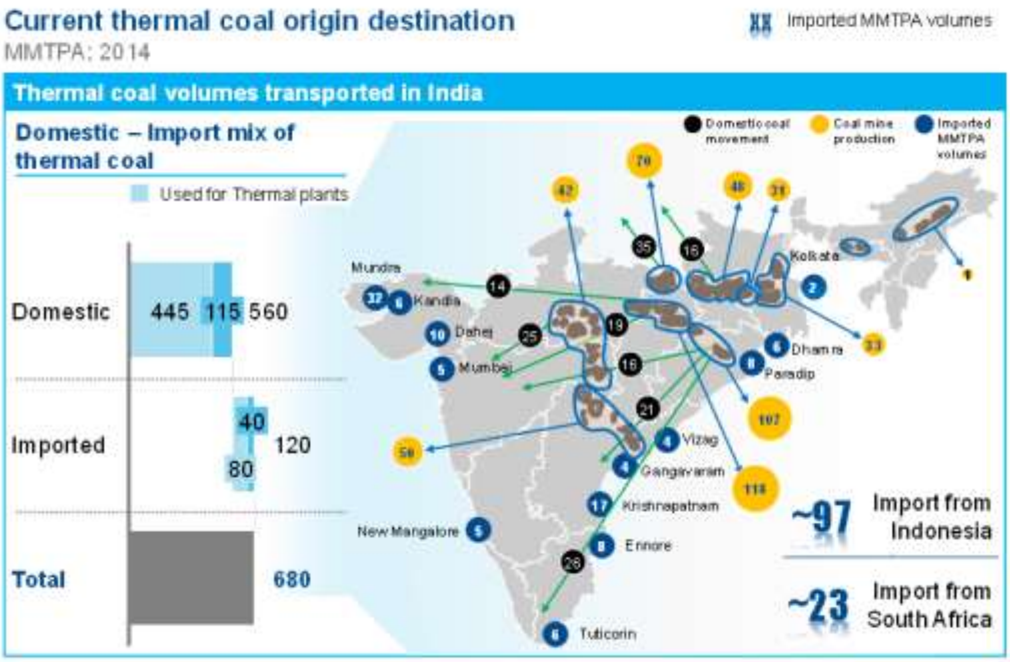
Power plants in Maharashtra consume the highest quantity of coal—about 77 MMTPA, followed by power plants in Chhattisgarh and Uttar Pradesh, at 62 MMTPA and 60 MMTPA, respectively. Overall, 10 states account for more than 80 percent of the current thermal coal requirement for power generation in India (Exhibit 38).

EXHIBIT 38



Therefore, while coal production is concentrated mostly in eastern and central parts of India, it is transported for power generation to nearly all corners of the country (Exhibit 39), for example, 26 MMTPA of coal travels from Odisha to Tamil Nadu. Similarly, volumes of coal also move from Chhattisgarh to Maharashtra (19 MMTPA) and Gujarat (14 MMTPA). Coal imported from Indonesia and South Africa arrives at various ports and then moves inland

EXHIBIT 39



SOURCE: CIL; Sigma Insights; ICMW; Reuters

Challenges of the current modal mix and future demand

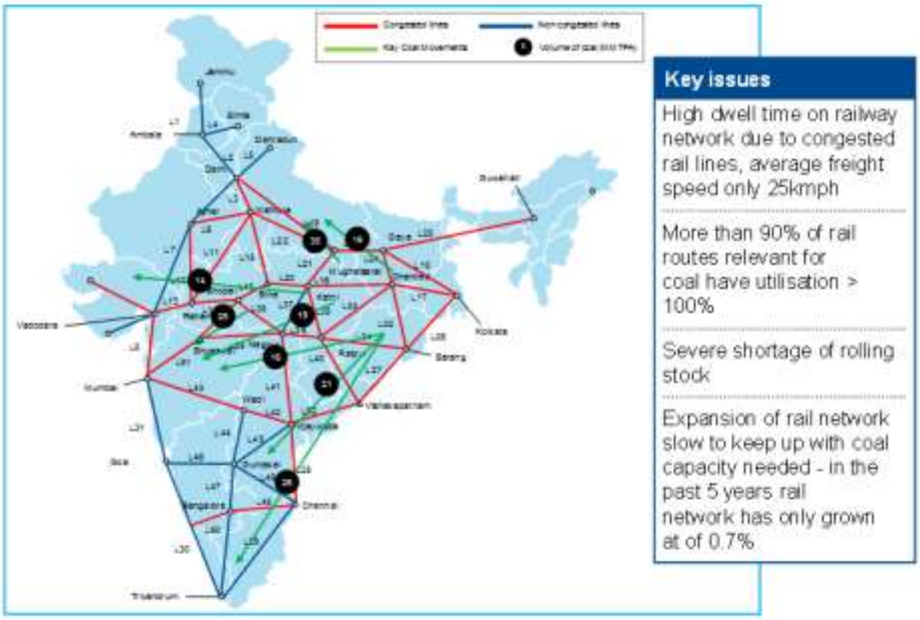
With coal production expected to double, logistics and coal evacuation would be a core focus for all stakeholders and end users of coal. While coal production is at a growth rate of 6–7 percent currently, evacuation has lagged behind at 3.5 percent. Thus, evacuation infrastructure needs to be augmented in line with production volume.

Broadly, there are three key modes for the evacuation of coal—via rail, coastal shipment and inland waterways.

Rail is by far the largest contributor to the current coal movement, carrying nearly 61 percent (356 MMTPA) of the total domestic coal volume moved in India. But rail movement presents two disadvantages: its network is already very congested (Exhibit 40) and it adds significantly to per unit power costs.

EXHIBIT 40

Current rail network is congested



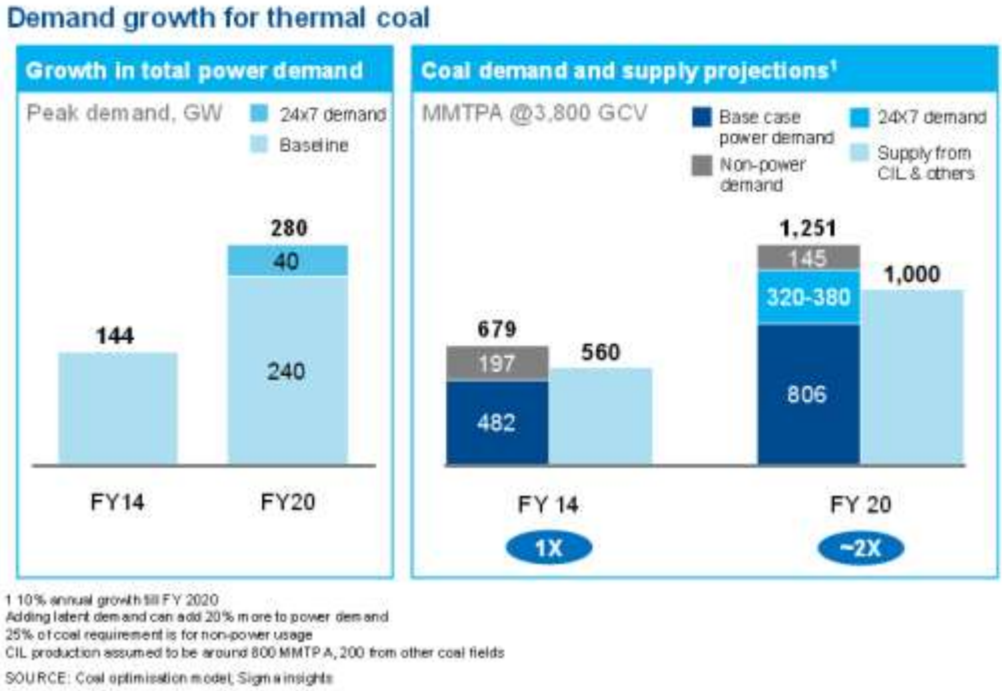
SOURCE: Indian Railways; South Asia Regional Initiative for Energy report

Congested rail lines increase dwell time, resulting in an average freight speed of only 25 kmph. More than 90 percent of rail routes relevant for coal movement have more than 100 percent utilization. As a result, ports face severe shortages of rolling stock, leading them to overstock coal and use sub-optimal methods of conventional handling and road transportation.

The rail network is not expanding at the pace necessary to keep up with the required coal capacity. It has only grown at 0.7 percent year on year. It will therefore be inadequate to manage the projected increase in freight load to support the growth of power generation facilities and industrial corridors.

Power demand in the country is expected to reach 280 GW by 2020, which automatically pushes up the demand for thermal coal, projected to rise up to 1,250 MMTPA by 2020 at a CAGR of almost 11 percent (Exhibit 41). This will further pressurize the already constrained rail network.

EXHIBIT 41



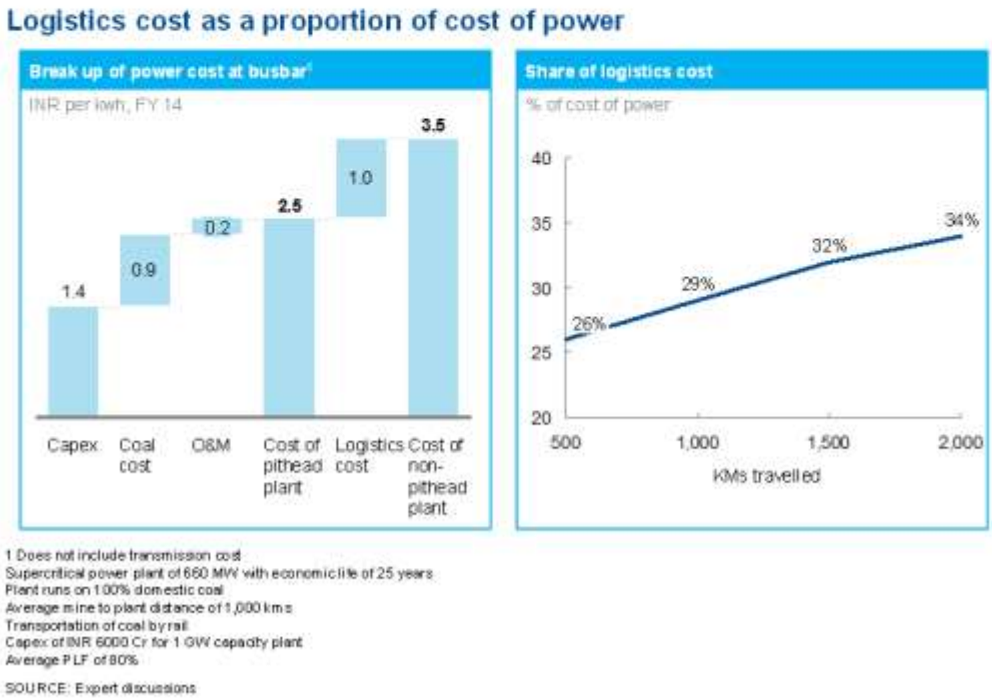
The government is taking steps to speed up evacuation, but these may not suffice. It plans to construct 60 new railway lines and purchase 200 new rakes over and above the current 200-odd rakes deployed for coal by the railways. The growth projection of railway tracks as per the Indian Railways' Vision 2020, however, shows only 25,000 tracks/route kilometers being added to the 2013–14 level of 65,808 at a CAGR of approximately 5.5 percent, which is much slower than the growth in coal demand.

The Coal India Board has also approved an INR 515 Crores plan to procure high-capacity box wagons of 80.5 tonnes each. And the Ministry of Coal has set up two JVs, in Odisha and Jharkhand, where state governments are participating with the objective of investing in coal evacuation, mainly through railway projects.

While these are laudable initiatives, issues such as land acquisition, project completion delays and cost overruns imply that rail infrastructure alone may not suffice to handle 1 BT of coal evacuation by 2020 without support from other modes.

On top of these challenges, rail transport significantly adds to the overall cost of power generation, which passes on to end-use customers. Industry experts indicate that about 30 to 35 percent of the cost of power is contributed by logistics (Exhibit 42). Thus, shifting coal movement from rail to ports wherever possible could reduce the cost of power in the country.

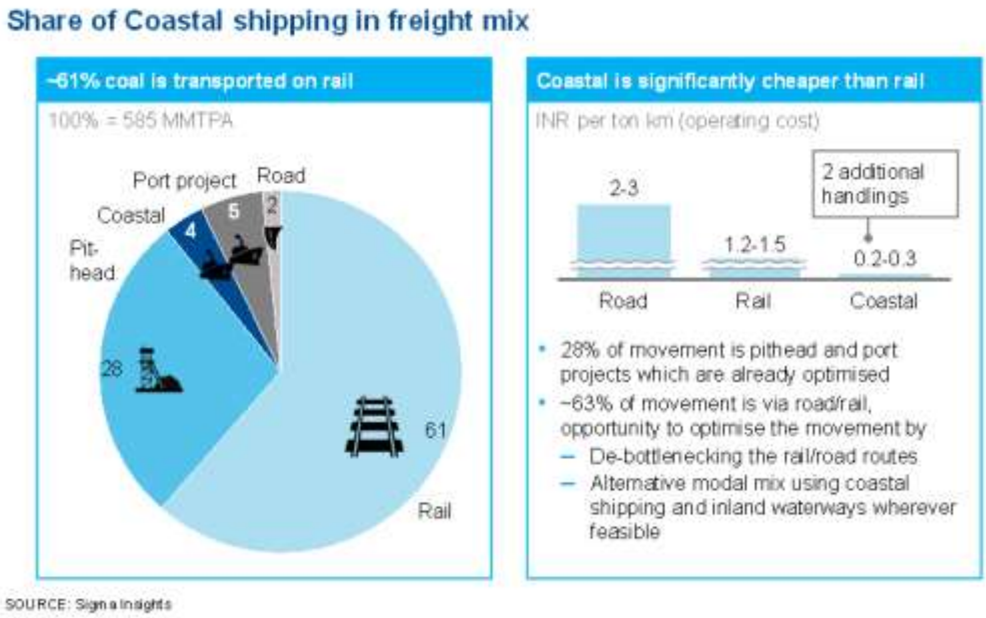
EXHIBIT 42



India needs to move away its current heavy reliance on the railways for coal movement as it is unsustainable in the long-term.

Coastal shipment only has a 4 percent share (23 MMTPA) in the total domestic coal movement (Exhibit 43), significantly low compared to countries like China, where around 600 MMTPA of coal is moved through coastal shipping.

EXHIBIT 43

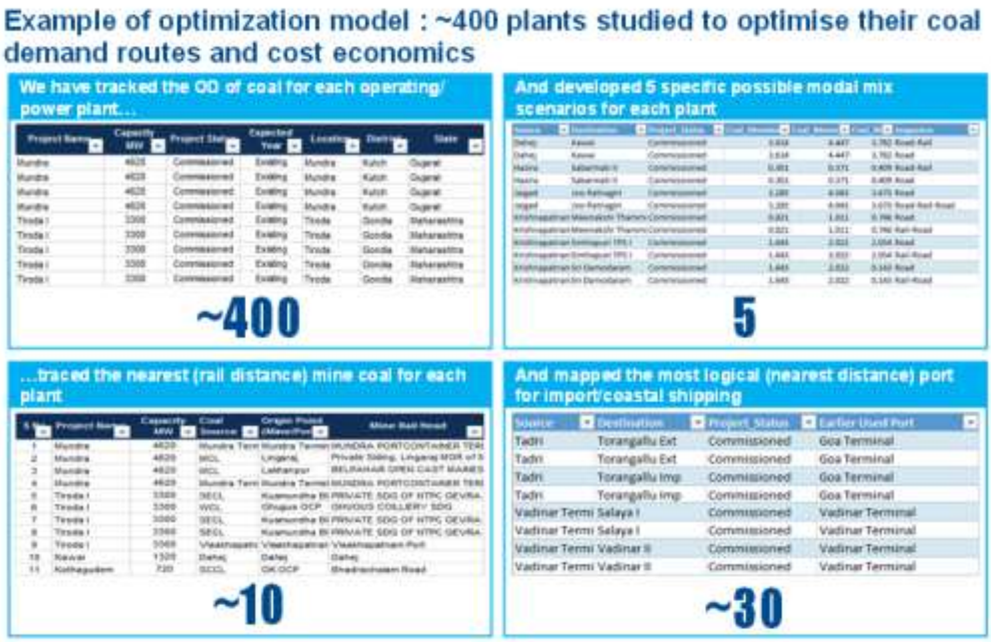


Potential to increase the coastal movement of thermal coal

While long-distance coal movement is primarily done through rail, analysis of research data and industry expert opinions indicate significant potential to cut costs through a modal-mix shift towards coastal shipping.

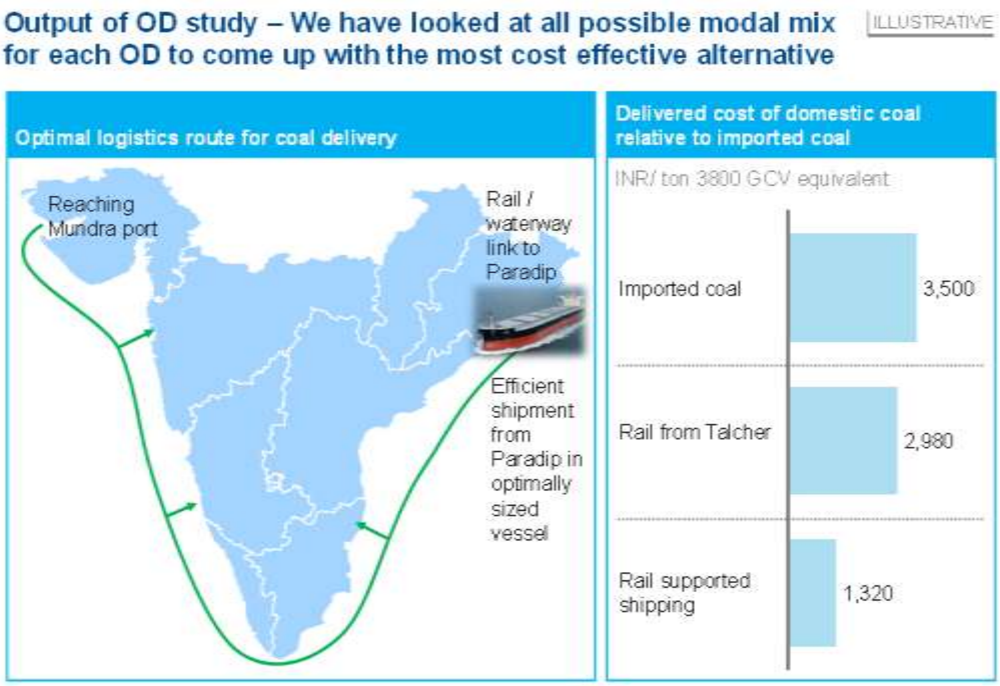
We conducted an in-depth study across 400 operational thermal power plants in the country to examine the origination, destination and mode of coal movement presently used. A cost comparison of all possible combinations of the modal mix under different scenarios of vessel capacity was also done (Exhibit 44).

EXHIBIT 44



For example, from Talcher in Odisha to a power plant at Mundra port in Gujarat, the cost for movement via rail is INR 2,980 per ton while the same via rail-supported coastal shipping could be less than half, at INR 1,320 per ton, saving to the tune of 56 percent (Exhibit 45).

EXHIBIT 45



The key assumptions used for this have been shown as a sample in Exhibit 46.

EXHIBIT 46

Estimated Coal Transportation Cost from Lingaraj mines (MCL) via Paradip port to Mundra Power Plant			
Cost Head	Distance (KM)	Rate (INR Per Ton per KM)	Total (INR per Ton)
Road Freight from Mine	-	5	0
Rail Freight (Mine to Paradip)	193	-	315
Ocean Freight (Paradip to Mundra)	3699.4	0.15	555
Road Handling	-	-	-
Rail Handling	-	-	150
Port Handling at Paradip	-	-	150
Port Handling at Mundra	-	-	150
TOTAL Transportation Cost			**1,320**

Eventually, the study identified 12 coalfields and 37 power plant linkages (including both existing and under-construction plants) as having considerable cost saving potential through increased movement via coastal shipping as shown in Exhibit 47. Although the cost economics offer only a marginal advantage in coastal shipping in some cases, overall railway congestion still makes a strong case for a shift to coastal shipment in such plants.

While each plant may need to consider a unique set of factors before shifting entirely to coastal shipping, some have already adopted coastal shipping to some extent. It is possible to combine these plants location-wise for a cluster-based view of the coal movement potential (Exhibits 47 and 48).

EXHIBIT 47

Key clusters for coastal movement of domestic thermal coal

2020 potential

1 Excluding handling cost which is considered separately

SOURCE: Sigma Insights; Coal optimisation model

EXHIBIT 48

Coastal shipping opportunity by cluster

MMTPA; FY 2020; assumed at 80% PLF

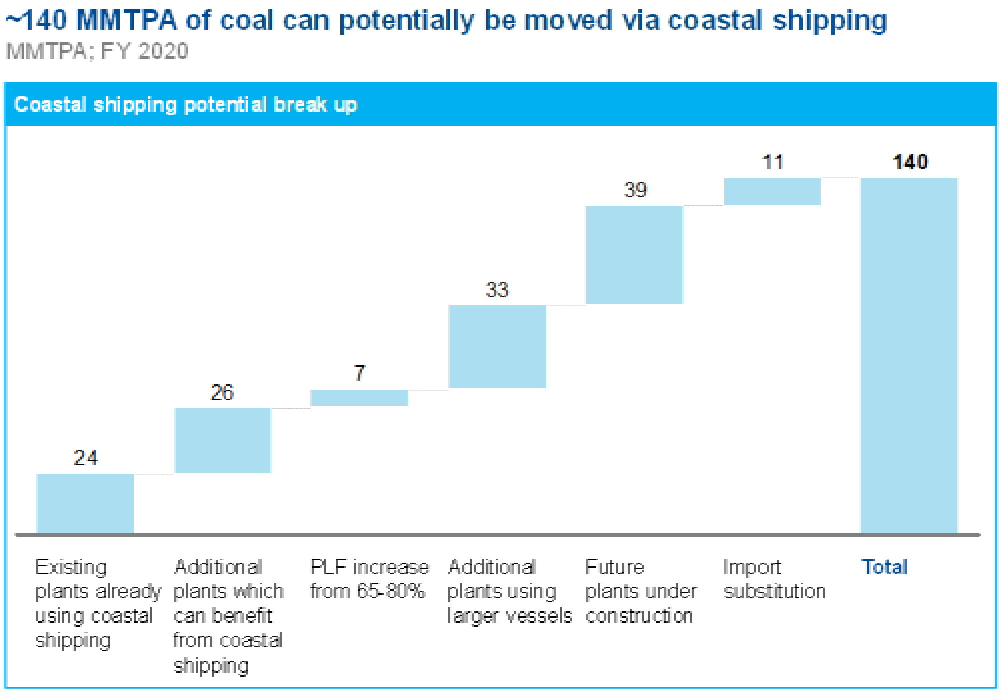
Clusters	Existing coastal shipping (MMTPA)	Additional coastal shipping opportunity for existing plants (MMPTA)	Coastal shipping opportunity for upcoming plants (MMTPA)
Tuticorin	6.4	0.8	5.4
Chennai	5.3	13.3	3.0
Salem	4.5	2.1	1.4
Raichur/Bellary	2.3	3.9	11.1
Krishnapatnam	0.1	7.5	9.3
Cuddapah	0.8	2.1	2.8
Krishna	2.4	14.9	
Vishakahapatnam			4.8
Gujarat	1.8	17.1	1.4
Kothagudem		2.3	
Total	**23.5**	**63.9**	**39.2**

SOURCE: Sigma Insights; Coal optimisation model

The cost of coastal shipping could be further slashed by deploying vessels of a larger capacity. Data suggests that with the right infrastructure and institutional support, the movement of coal via coastal shipping could increase nearly six-fold from the current 23 MMTPA to almost 140 MMTPA by 2020 (Exhibit 49)

Three coalfields are likely to service the entire opportunity of 140 MMTPA, with more than two-thirds of the opportunity arising from MCL's coal-mine fields at Talcher and Ib Valley in Odisha, around 200 to 400 km from Paradip port. Due to capacity limitations at ports, we have also considered that the Dhamra port will play an important role in the coastal movement of coal along with the Paradip port.

EXHIBIT 49



SOURCE: Sigma Insights; Coal optimisation model

Power plant clusters (e.g., districts like Thiruvallur, Krishna and Krishnapatnam) could be prioritized for execution on the basis of cumulative savings (Exhibit 50). The overall savings for the will be roughly around INR 10,000 crores with AP contributing roughly 25% of the overall number as shown in exhibit 51

EXHIBIT 50

Prioritization of potential clusters for shift to coastal shipping of thermal coal

MMTPA; FY 2020[1]

Priortised clusters

Clusters	>1,500	1,000-1,500	500-1,000	100-500	Similar	Grand total
Thiruvallur	-	17	4	-	-	22
Krishna	-	-	-	1	16	17
Nellore & Krishnapatnam	-	17	-	-		17
Tuticorin	9	3	-	-	-	12
Bijapur	-	-	-	11	-	11
Kutch	5	5	1	-	-	11
Salem	-	7	-	-	-	7
Vishakhapatnam	-	-	-	-	5	5
Gandhinagar	-	-	-	-	4	4
Raichur	-	-	4	-	-	4
Cuddapah	-	-	3	-	-	3
Kadapa	-	-	-	3	-	3
Bellary	-	-	-	-	2	2
Jamnagar	-	-	2	-	-	2
Khammam	-	-	-	-	2	2
Nagapattinam	1	-	-	-	-	1
Nasik	-	-	-	-	1	1
Total	**15**	**49**	**14**	**15**	**30**	**124**[2]

1 Assumed at 80% PLF
2 Does not include Thane & Hisar

SOURCE: Sigma Insights; Coal optimisation model

EXHIBIT 51

Economics of coastal transportation: Saving to the economy

INR 000's Cr.

Assumptions

- 140 MMTPA moves to coastal shipping
- Cost comparison between coastal cost and cost on rail as the mode of transport
- Coal volumes taken at 80% PLF
- Bottom up (plant by plant) estimation of rail cost and corresponding cost for coastal movement

System level savings

	Volume (MMTPA)	Cost via Rail (000's Cr.)	Cost via Coastal (000's Cr.)	Difference (000's Cr.)
Andhra Pradesh	45	8.99	6.59	2.39
Gujarat	17	4.74	3.14	1.60
Haryana	2	0.52	0.52	0.00
Karnataka	17	5.20	4.48	0.72
Maharashtra	4	0.84	0.82	0.02
Tamil Nadu	42	11.88	6.08	5.80
Telangana	2	0.41	0.40	0.02
Overall	**129**	**32**	**22**	**10**

INR 0.5[1] reduction in power cost for plants using coastal

1 Overall average across relevant plants

SOURCE: Sigma Insights; Coal optimisation model

Coal Beneficiation/Washing

Coal beneficiation is an important element of clean coal technologies of the Indian government. Currently, Coal India has coal washing capacity of 36.8 MTPA from 15 washeries of which 13.5 MTPA is for coking coal and 23.3 MTPA for non-coking coal. As a step towards quality improvement, CIL plans to set up additional 15 washeries with capacity of 112.6 MTPA. Washing is expected to reduce coal volumes by 10-15% depending on the ash content.

Imperatives for relevant ports

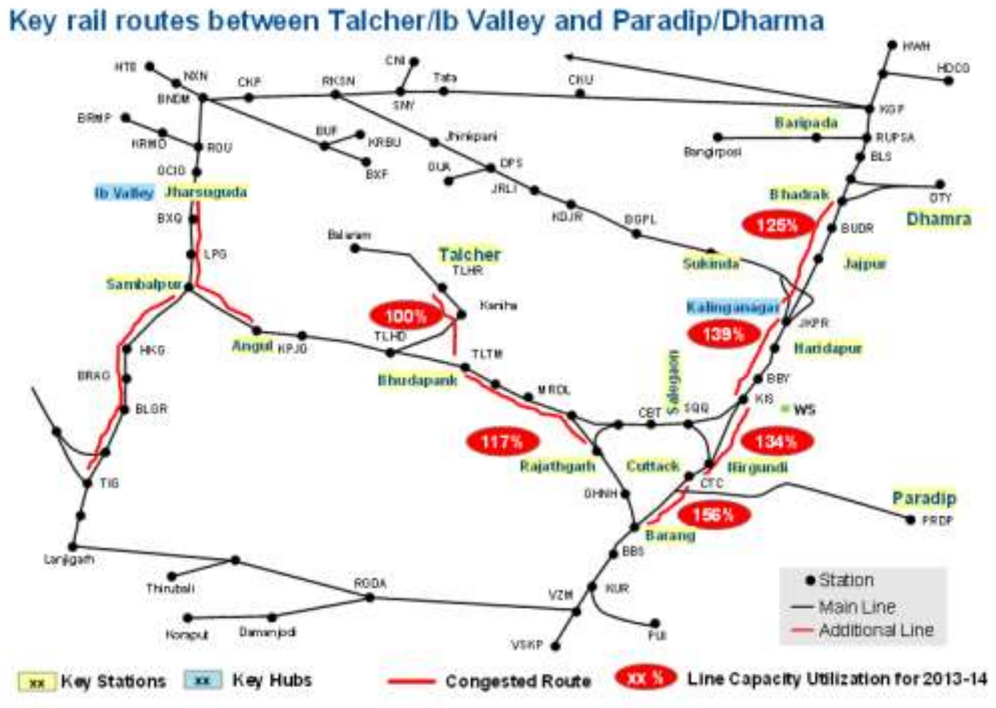
To tap the full potential savings, the Eastern port cluster (Paradip, Dhamra, Gopalpur, etc.) needs to ramp up coal export (mechanized) capacity to around100 to 120 MMTPA. This will enable best-in-class operations and reduce turnaround time.

Evacuation projects needed (rail)

The first step in the coal logistics value chain is the movement of coal from the mine to the port via rail. The coastal shipping model hinges on this to a very large extent. Even in some of the conservative scenarios depicted in the model sensitivities section (such as cases where borderline cost economics do not adopt a coastal route), about 80 to 90 MMTPA of thermal coal will need to move via coastal shipment.

This would still imply about **60 to 65 rakes per day** moving from MCL coal mines in Ib Valley/Talcher to Paradip/Dhamra by 2020 from the **current average of about 17 rakes per day**. Of this, about 40 to 45 rakes per day would be required at Paradip and another 20 to 25 at Dhamra, as the bulk of coastal coal movement is likely to take place from these two ports. We depict a snapshot (not to scale) of some of the key routes connecting Talcher/Ib Valley to Paradip/Dhamra in Exhibit 52. Other ports on the east coast, such as Haldia, Gopalpur and Vizag, may also play a relatively smaller role.

EXHIBIT 52



Most existing routes are already congested, with capacity utilization well above 100 percent. Toward Paradip, the Cuttack (CTC)-Barang (BRAG) line has **156 percent capacity utilization**; the Kapilas Road (KIS)-Cuttack (CTC) line has **134 percent capacity utilization** (despite being a double line). Similarly, for routes leading to Dhamra, the Jakahpura Junction (JKPR)-Kapilas Road (KIS) line is at **139 percent capacity utilization** and the Bhadrak (BHC)-Jakahpura Junction (JKPR) is at **125 percent capacity utilization**. From Ib Valley, the Jharsuguda-Samabalpur-Angul route faces similar congestion.

Significant **capacity augmentation** on existing lines as well as the building of **new lines** is therefore essential to increase rake movement to **nearly four to five times** the current level. Initiatives such as improving the signalling facilities on the Talcher-Paradip route and running long-haul trains (with two trains combined) are likely to add about 10 to 15 rakes per day to the existing average of 17. This still leaves a clear **shortfall of 30 to 35 rakes per day** compared to the projected demand, which has to be met through other initiatives/projects.

Some key ongoing and proposed projects that are particularly relevant for Sagarmala in this context are

New lines under construction

- Haridaspur-Paradip (around 82 kms) to benefit Paradip
- Angul-Sukinda Road (around 99 kms) to benefit both Paradip and Dhamra

Ongoing doubling of lines

- Titlagarh-Sambalpur (for Ib Valley)
- Sambalpur-Talcher (for Ib Valley)
- Rajathgarh-Barang and Barang-Cuttack (for Talcher to Paradip)
- Bhadrak-Nergundi third line (for Dhamra)
- Jakhapura-Haridaspur third line (for both Paradip and Dhamra)

Many of these projects related to new lines and the doubling of lines are **facing delays.** Intervention from the Ministry of Shipping could possibly expedite their completion.

Projects for which survey is in progress

- Budhapank-Salegaon via Rajathgarh (third and fourth lines): For Talcher to Paradip
- New line from Talcher to Kharagpur via Baripada: For Talcher to Dhamra
- New line from Talcher to Angul: To connect Ib Valley to Pardip and Dhamra, along with Angul-Sukinda and Haridaspur-Paradip, which are already under construction.

Some of these projects could be **expedited from the survey stage to the proposal stage** through the intervention of the Ministry of Shipping.

Key enablers for capturing this opportunity: Next steps

The various projects and initiatives within the initiative fall under the purview of a wide range of ministries as well as public and private enterprises. While the Ministry of Shipping is the nodal body for driving the Sagarmala initiative, the vast scope of the project requires alignment, partnership with and support from key stakeholders to realize its full potential.

It also requires encouraging and incentivizing private-sector investment through PPP models for port infrastructure, railway infrastructure and coastal shipping. These nuances call for the ownership and involvement of all communities that stand to benefit from the initiative.

A crucial step would also be to have a central body to consolidate the coal supply chain by aggregating demand from power plants and acting as a centralized supply chain optimizer. This could help further lower costs by deploying larger vessels for greater volumes.

As a long-term vision, the country should aim to optimize the landed cost of power by optimizing the location of power plants (e.g., coal by wire through pit head-based plants) as well as the logistics of transporting fuel (e.g., coastal shipping).

ORIGIN-DESTINATION AND OPTIMIZATION OF STEEL AND RAW MATERIALS

Logistics efficiency is critical for India's steel industry, which has grown from around 30 MMTPA capacity in 2004–05 to around 100 MMTPA in 2014–15. India is now the third largest producer of crude steel in 2015 and remains the largest producer of sponge iron or Direct Reduced Iron in the world. The global steel market is on a downturn; steel production and demand in China has been slowing; but steel demand in India is projected to be 115 MMTPA by 2020 and 242 MMTPA by 2035, beating the trend.

Logistics cost contributes around 15 percent to the total landed cost of steel. One reason for the high logistics cost has been the underutilization of our waters—both ocean and inland waterways. The water mode contributes only 1 percent of logistics in India (compared to 24 percent in China), even though it offers environmental benefits and savings in fuel costs.

Logistics efficiency is especially critical for India's steel industry, which has grown from 48 MMTPA capacity in 2004 to 106 MMTPA in 2014. India is now the third largest producer of crude steel in 2015 and remains the largest producer of sponge iron or DRI in the world. While the global steel market is on a downturn, the steel demand in India is projected to be 200 MTPA by 2025 under base case scenario of GDP growing at 7-8 percent per annum. One tonne of steel requires three to four tonnes of raw materials. The volume of material to be transported for the steel industry will reach 800 mn tonnes by 2025. Logistics efficiency will be critical for making existing capacity more competitive.

Studies conducted under the "Sagarmala" program have helped in identifying three opportunities for driving this logistical efficiency.

- **Coastal shipping of steel from current production centres to demand centres:**

Study estimates potential for moving 7-8 MMTPA steel through coastal route by 2020, and 12-14 MMTPA by 2025. This translates to savings of Rs. 1,000 to 1,200 crore per annum by 2025. Key routes identified for this movement are: Odisha to Andhra Pradesh; Odisha to Tamil Nadu; Jharkhand to Maharashtra; Odisha to Maharashtra; Odisha to Rajasthan; Karnataka to Gujarat; Jharkhand to Tamil Nadu; and Odisha to Gujarat.

- **Development of coastal steel clusters**:

The traditional mode of setting-up steel capacity in India has been hinterland plants located close to iron-ore reserves. 85 MMTPA of the current 103 MMTPA steel capacity follows this pattern. About 16 MMTPA capacity is coastal of which 6 MMTPA is located close to iron-ore reserves and 10 MMTPA is located close to demand centres. We note international examples of setting-up large coastal steel clusters e.g., Pohang in South Korea where coastal capacity provides benefits in terms of logistics cost saving, flexibility in sourcing raw material, and better linkage with global markets. India could aspire for 25-30% of its steel capacity to be coastal by 2025. This would entail setting-up new coastal capacity of 40-50 MMTPA.

Based on study conducted, coastal steel plants located close to iron-ore reserves connected via a slurry pipeline could on average save INR 900 per tonne. Based on demand projections till 2025, we see the potential of two 20 MMTPA capacity steel clusters, one on either coast by 2025. Potential locations for these clusters could be TN on east coast and South Maharashtra on west coast. The exact location shall depend on land availability with specific ports. This would save around **INR 3,000 to 3,500 Crores per annum** compared to setting up new capacity close to iron-ore reserves. These savings are accrued on account of:

- **No inland logistics for coking coal**: Saves Rs. 1.5 per tonne-km due to import of coking coal directly at steel plants
- **Reduction in steel transportation through coastal shipping**: Saving of Rs. 1.3 per tonne-km in steel transportation due to coastal shipping
- **Use of new technology (slurry pipelines):** Low cost way of transporting iron-ore from mine to coast using slurry pipeline – Rs. 0.70 per tonne-km compared to Rs. 1.5 per tonne-km for rail

■ **Utilisation of hinterland waterways for moving steel to Northern demand centres:**

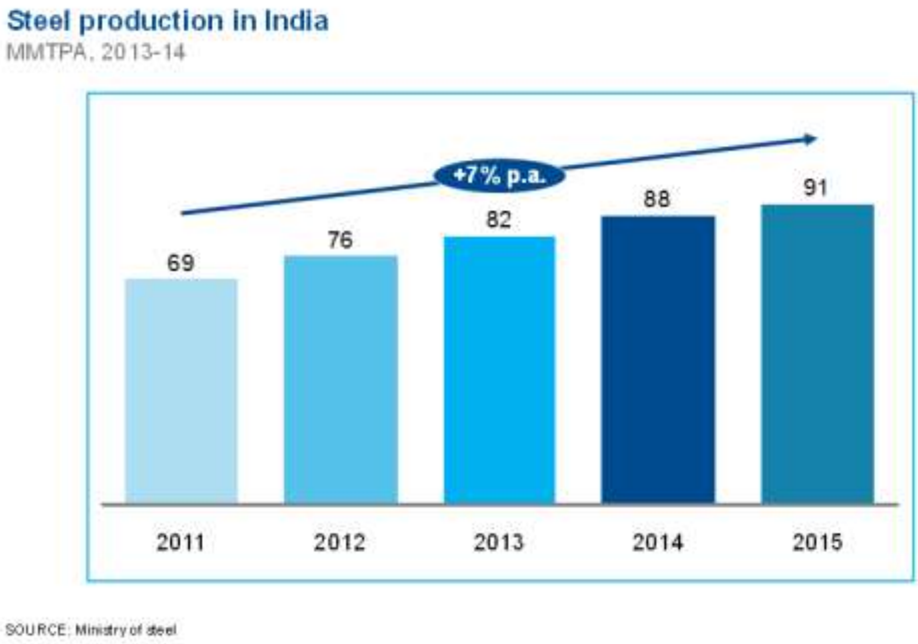
Inland waterways can prove to be an important method of transporting steel into the inland states like Bihar and Uttar Pradesh from plants situated in the West Bengal region. In addition to this, steel from the plants in West Bengal can also be shipped out through inland waterways and sent to Kolkata/Haldia. Also plants under construction plants like Tata Kalinganagar can effectively utilise NW-5(on the Brahimini river) to transport their finished products and raw materials hence solving the problem of backhaul. In order to estimate the full potential of these waterways, detailed studies will be conducted in the future.

. a workshop with representation from key stakeholders including the Ministry of Steel, PSUs, Private steel producers, Ministry of Shipping, Shipping Corporation of India, Port authorities, Indian Railways on alignment and coordination would be critical for successful execution for these initiatives.

Current EXIM movement of coking coal

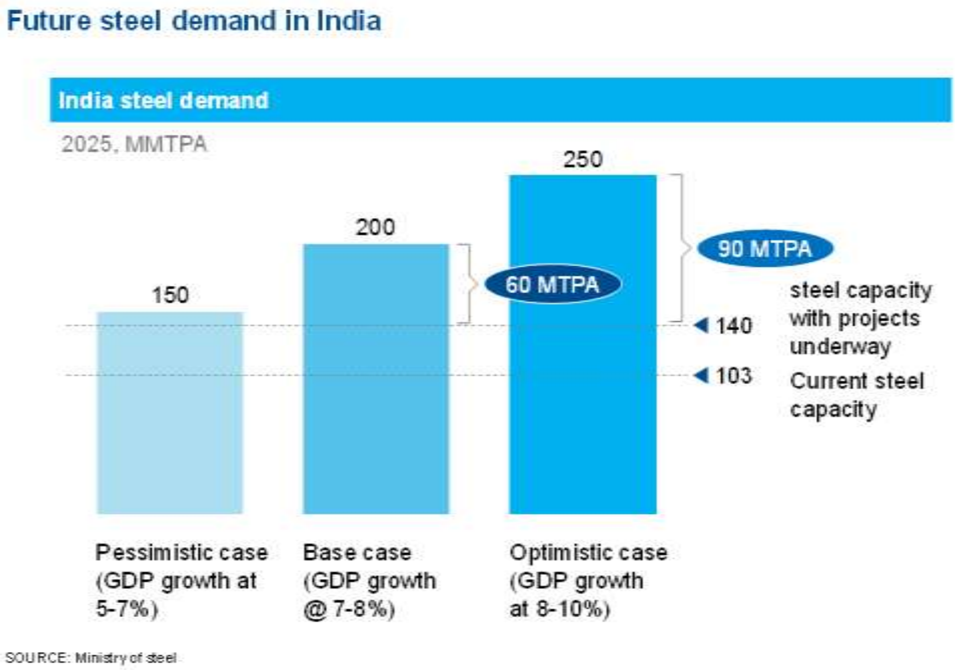
In 2014–15, the production of total finished steel for sale was 91.46 MMTPA (against an installed capacity of around 103 MMTPA) with a growth of 4.3 percent over 2013–14 (Exhibit 53).

EXHIBIT 53



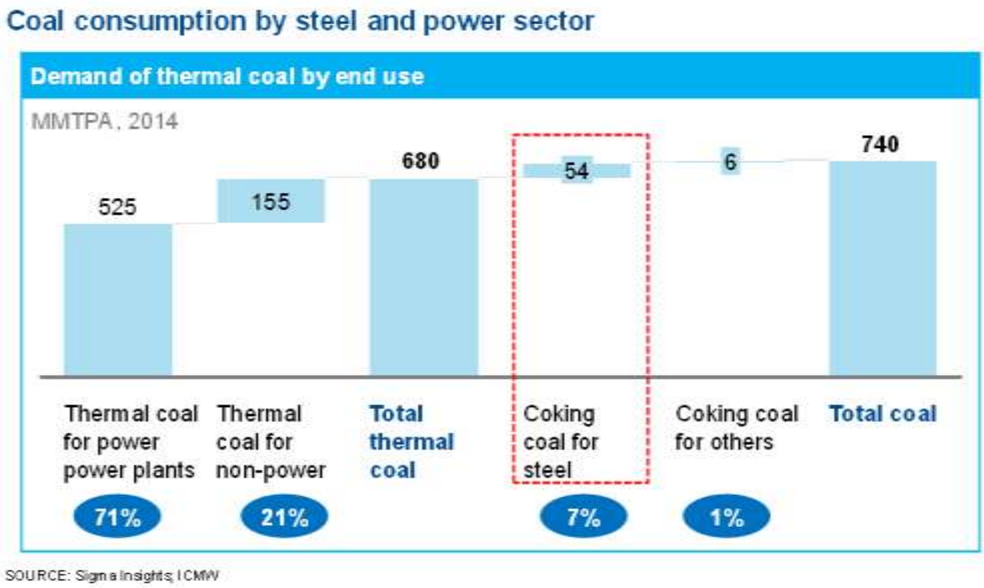
India has a low per capita consumption of steel and a high growth in GDP. This will result in a sharp rise in steel demand—projected to be 115 MMTPA by 2020 and 242 MMTPA by 2035 (Exhibit 54).

EXHIBIT 54



To service the demand of blast furnace-based steel production, around 60 to 65 MMTPA of coking coal is transported in the country, and around 54 MMTPA is consumed for the production of steel (Exhibit 55). Around 80 percent of the coking coal consumed is imported due to insufficient coking coal reserves in India.

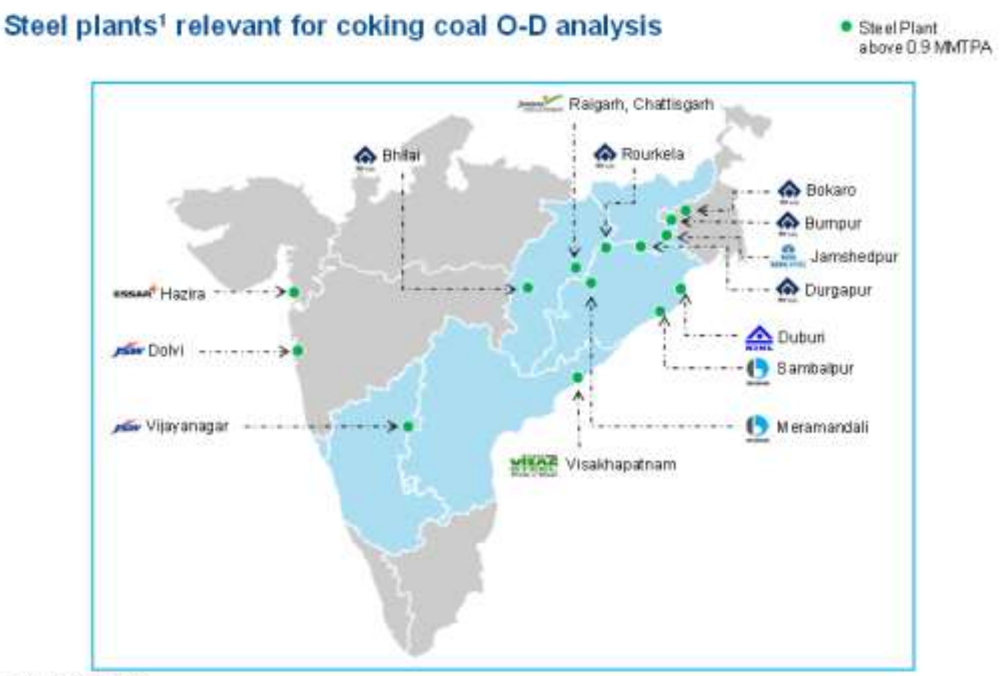
EXHIBIT 55



Eastern India (West Bengal, Jharkhand, Odisha and Chhattisgarh) is the biggest cluster of steel production in the country with 45 MMTPA (around 40 percent) of total installed steel capacity (Exhibit 56). For an OD analysis, 14 steel plants are most relevant since they are the major producers of steel (around 60 percent of the total) and consume around 80 percent of the total imported coking coal (Exhibit 56).

These 14 plants need around 45 MMTPA of coking coal; imported coking coal fulfils 37 MMTPA of this demand.

EXHIBIT 56



1 Blast furnace based

SOURCE: World steel association; Steel authority of India Limited; Expert interviews

Each steel plant is aligned with one or more ports for sourcing imported coal, with the entire evacuation done by rail. A total of 12 Indian ports handle around 37 MMTPA of the imported coking coal used at 15 steel plants (Exhibit 57).

EXHIBIT 57

Origin destination matrix for coking coal: Port to plant

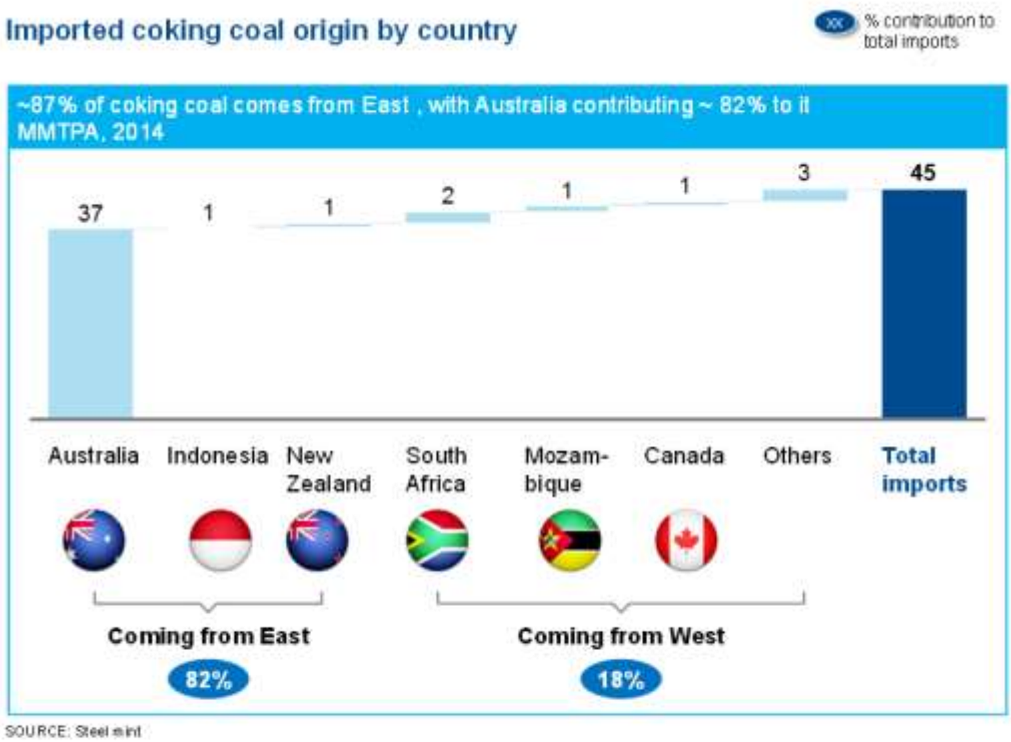
Imported coking coal and plant origin destination, MMTPA, 2014

Steel plants/ Import port	Dhamra	Dharamtar ISPAT	Ganga-varam	Haldia	Hazira	Karaikal	Krishna-patnam	Mangalore	Mor-mugao	Mumbai	Paradip	Vizag	Grand total
JSW, Vijayanagar						0.1	0.6		5.0				5.68
TISCO	4.1		0.1	1.2							0.9		6.20
SAIL, Bokaro				1.6									1.60
SAIL, Bhilai												4.0	4.00
RINL, Vizag			3.5										3.54
JSW, Dolvi		0.5						0.6	1.9	0.1			3.05
SAIL, IISCO				1.6								0.5	2.10
Essar – Hazira					0.8								0.81
SAIL, Rourkela			0.5								2.8		3.32
SAIL, Durgapur	1.6												1.60
Bhushan steel, Sambalpur	0.1										1.4		1.51
JSPL, Raipur			0.9								0.4		1.33
Bhushan steel, Meramandali			0.2									0.4	0.60
Neelachal Ispat Nigam, Odisha											0.6		0.60
JSW, Salem		0.2						0.6					0.83
Total	**5.83**	**0.66**	**5.70**	**4.35**	**0.81**	**0.11**	**0.57**	**1.24**	**6.90**	**0.08**	**6.09**	**4.92**	**36.76**

SOURCE: Steel mint; annual report and steel expert interviews

About 87 percent of coking coal (around 39 MMTPA) comes from the East, of which Australia contributes around 82 percent (37 MMTPA)(Exhibit 58). Import volumes on the eastern seaboard are, therefore, relatively much higher than on the western seaboard. Rail is by far the largest contributor to the current coking coal inland movement, since only around 10 percent of installed steel capacity is coastal. Most steel plants are around 300 km inland from the coast, positioned to leverage iron-ore reserves.

EXHIBIT 58



Challenges of the current modal mix and the future demand of coking coal

With steel production expected to double, logistics and coking coal procurement will become the core focus areas of steel manufacturers. Currently, the logistics of coking coal faces three challenges

- **Limited capacity headroom and the lack of deep draft at the Haldia port:** Haldia has natural ownership of four SAIL plants and Tata Steel (Jamshedpur), which contribute around 30 percent of all imports (Exhibit 59). But the port can only handle around 50 percent of the demand for coking coal compared to its natural ownership (nearest port). The high pre-berthing and turnaround time is causing the SAIL plants to start evacuating from multiple ports, causing sub-optimal movement (Exhibit 60)

EXHIBIT 59

Distance of specific plants from Haldia port

Short distance (shown in green: Vizag–Bhilai 550; Haldia–Durgapur 308, IISCO ~308, Bokaro 366, Rourkela 401)

Shortest distance rail route (siding to siding) kms

	Durgapur	IISCO	Bokaro	Rourkela	Bhilai
Vizag	984	656	940	665	550
Dhamra	485	453	499	531	808
Paradip	617	585	630	504	735
Haldia	308	~308	366	401	852

SOURCE: Indian railways and SAIL interviews

EXHIBIT 60

Movement of coking coal from other ports close to Haldia for relevant plants

Delay in evacuation from Haldia port

High pre-berthing and turnaround time at Haldia[1] ...

... leads to increased transport time, thus SAIL plants evacuate from multiple ports

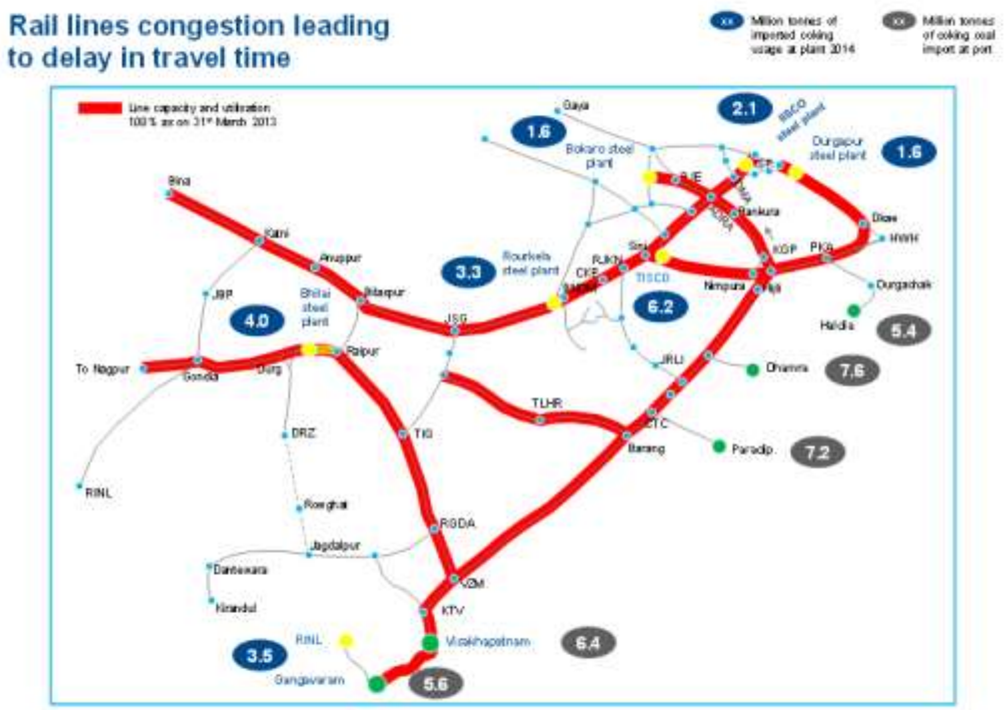
	Durgapur	IISCO	Bokaro	Rourkela	Bhilai
Vizag		✓			✓
Dhamra	✓				
Paradip				✓	
Haldia		✓	✓		
Ganga-varam				✓	

1 For 54,000 PWT Panamax Vessel; most efficient for coking coal transportation

SOURCE: Indian ports association – individual ports; expert interviews

- **Congested railway lines:** The current rail network is already congested. Industry experts believe that it also will not suffice for the projected freight load due to the growth caused by programs like “Make in India” and anticipated increase in steel production. Congested rail lines cause high dwell time, resulting in an average freight speed of only 25 kmph. More than 90 percent of rail routes relevant for the movement of coking coal have more than 100 percent utilization (Exhibit 61), such as the Howrah-Bilaspur, Vizag-Bhilai, Dhamra/Paradip-Bhilai/Rourkela and Dhamra/Paradip-Durgapur/IISCO lines. This causes delays in transporting coking coal from the ports to the plants. For example, the travel time for coking coal in the Vizag-Bhilai plant is approximately 1.5 times the average transit time by distance

EXHIBIT 61



SOURCE: Expert interviews; Indian railways

- **Shortage of rolling stock and locomotives:** Except at Haldia, all other ports—Vizag, Paradip, Gangavaram and Dhamra—face shortages of rakes and locomotives, causing delays in evacuation. Steel manufacturers are thus forced to maintain a stock of more than one month compared to the thumb rule of 15 days

While the current coking coal evacuation is facing challenges due to limited availability of rakes at unloading ports and rail line capacity at key train routes around 21 MMTPA of new steel capacity at key steel plants (1 MMTPA and above blast furnace based) is under construction and would need around 18-20 MMTPA of coking coal to be evacuated on the same rail routes which are currently running at above 100 percent utilization.(Exhibit 62)

According to estimates, the coking coal demand for steel would reach around 130-140 MMTPA in 2035 based on increased steel demand in the country for programs like Make in India and construction impetus. Also, historically the steel growth has been growing faster than GDP with the multiplier being GDP:1.14.

Thus, the evacuation capability at the relevant unloading ports and the railway routes will need to be improved for optimal evacuation of coking coal.

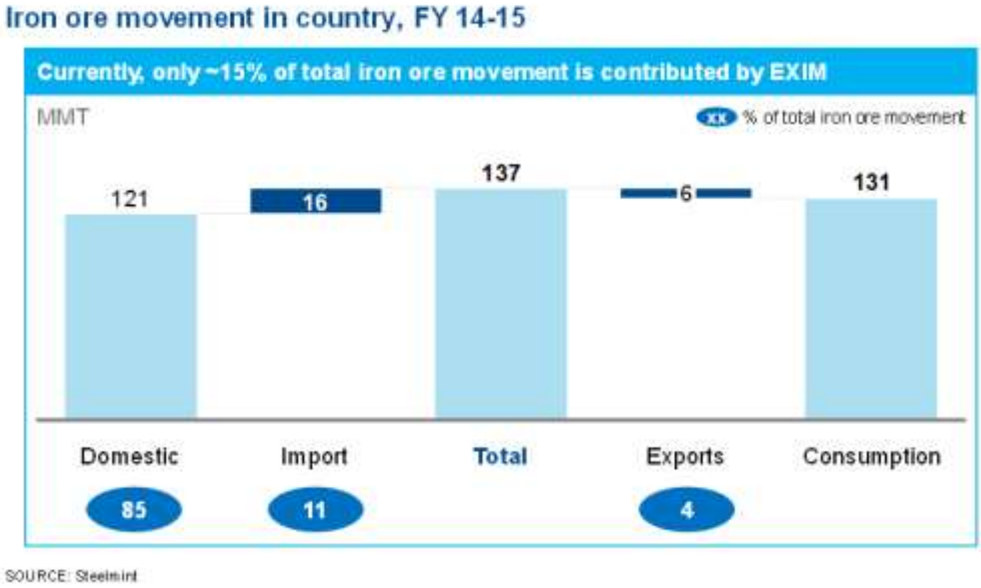
EXHIBIT 62

Current EXIM movement of iron ore

Over the last five to six years, India has turned from a net exporting country to a net importing country for iron ore. In 2008–09, before the iron-ore export ban and stoppage on illegal mining, EXIM traffic was a little over 100 MMTPA, with India producing around 220 MMTPA and exporting 102 MMTPA (or 32 percent) of all iron-ore movement, while consumption was 118 MMTPA.

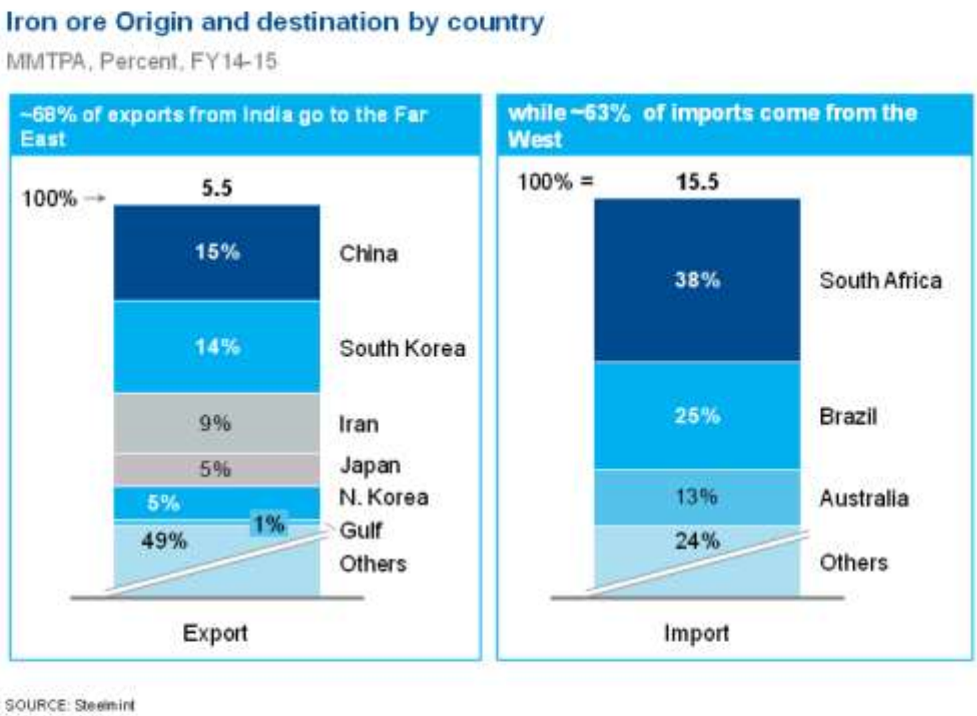
Today, India consumes around 131 MMTPA of iron ore (as of FY 2014–15). Of this, 121 MMTPA is produced domestically, 15.6 MMTPA is imported, and 5.4 MMTPA is exported. Total EXIM traffic is, therefore, around 21 MMTPA, contributing only around 15 percent of the total iron-ore movement in India (Exhibit 63).

EXHIBIT 63



The remaining is all domestic iron-ore movement. Currently, India exports around 68 percent of its outgoing iron ore to the Far East, while around 63 percent of all imports come from the West (Exhibit 64).

EXHIBIT 64



The EXIM of iron ore has declined for three reasons

- **Mining ban in key iron-ore states:** The government banned the mining of iron ore in Karnataka and Goa in 2009–10. This had a huge impact on India's iron-ore figures, taking out 45 percent of overall production and 85 percent of exports
- **Additional levies on iron-ore exports:** To discourage exports, the government introduced an export duty which has been rising continuously, from around 10 percent in 2010 to 30 percent in 2012. The new mining law (MMRDA Act) proposes profit sharing with the community, which will impact profits and make small mines unviable
- **Fall in global spot prices:** International spot prices have been falling for the past four years due to oversupply. The current spot prices are around USD 60 per ton and are estimated to remain around USD 60 to 80 per ton for the next five to seven years. This makes it an unviable scenario to export iron ore

Vizag and Paradip are currently the most extensively used ports for exports. Around 3.1 MMTPA of iron ore passes through Vizag. Across all ports, the maximum total export goes to China (around 0.84 MMTPA), with South Korea a close second (0.79 MMTPA) (Exhibit 65).

Around 80 percent of all iron-ore exports go through nine Indian ports,[13] where they arrive from eight mining districts (across Jharkhand, Odisha, Chhattisgarh, Goa and Karnataka). The mined commodity is mostly evacuated to the nearest port by rail, except from Goa, where evacuation happens via barges plying on the inland waterways.

[13] Vizag, Paradip, Panaji, Redi, Mormugao, Mangalore, Dhamra, Haldia, in that order of decreasing volumes

EXHIBIT 65

Iron ore export : Port to destination country

MMTPA, 2014-15

Exported to	Dhamra	Ganga-varam	Haldia	Kandla	Mangalore	Mormugao	Panaji	Paradip	Redi	Vizag	Grand total
China	-	0.00	0.05	0.02	0.06	0.03	0.20	0.09	0.38	0.02	0.84
South Korea	-	-	-	-	-	-	-	-	-	0.79	0.79
Iran	-	-	-	-	0.06	-	-	-	-	0.46	0.52
Japan	-	-	-	-	-	-	-	-	-	0.29	0.29
Gulf	-	-	-	-	-	-	-	-	-	0.05	0.05
Others[1]	0.10	0.02	0.23	-	-	0.19	0.19	0.85	-	1.20	2.77
Grand total	0.10	0.02	0.27	0.02	0.11	0.21	0.39	0.99	0.38	3.10	~5.47

1 Include US, Africa and European countries in very small quantities

SOURCE: Steelmint

The highest volume of imports comes in through the Krishnapatnam port, which handled around 8.5 MMTPA of iron ore in 2014–15, mostly from South Africa, followed by Brazil, Australia and Oman (Exhibit 66).

EXHIBIT 66

Iron ore import: Source country to port

MMTPA, 2014-15

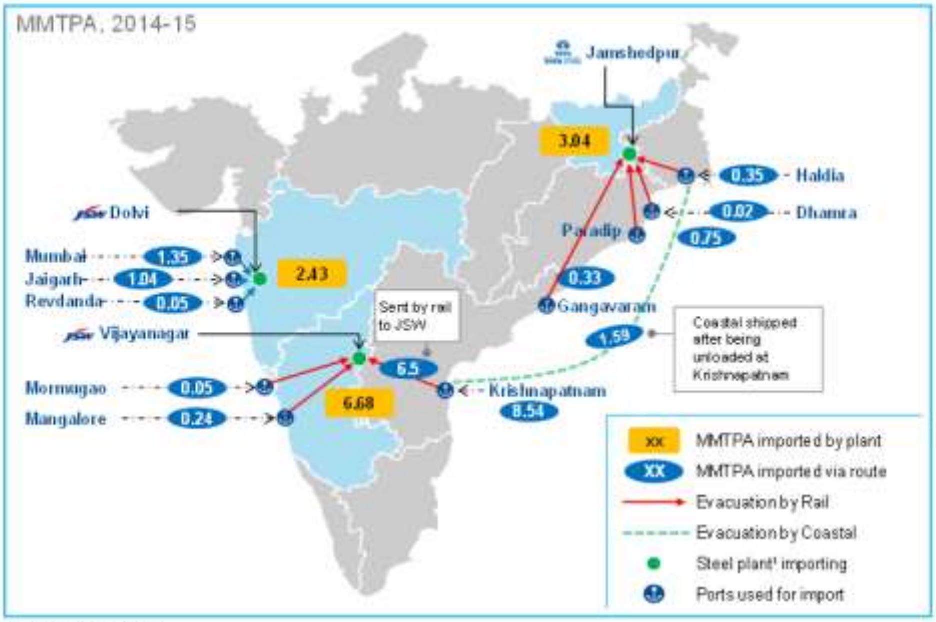
Imported from	Dhamra	Gangavaram	Haldia	Hazira	Jaigarh	Kandla	Karaikal	Krishnapatnam	Mangalore	Mormugao	Mumbai	Mundra	Paradip	Revdande	Tuticorine	Vizag	Grand total
South Africa	-	0.06	0.11	0.34	0.65	0.80	-	3.05	0.09	0.05	-	0.22	0.35	-	0.05	0.05	5.84
Brazil	-	-	-	0.29	0.24	-	-	3.35	-	-	-	-	-	-	-	-	3.89
Australia	0.02	0.36	0.25	-	-	-	0.07	0.83	-	-	0.06	-	0.36	-	-	0.02	1.96
Oman	-	-	-	-	-	-	-	-	-	-	1.29	-	-	0.10	-	-	1.39
Canada	-	-	-	-	-	-	-	0.70	-	-	-	-	-	-	-	-	0.70
Malaysia	-	-	0.02	-	-	-	-	0.30	-	-	-	-	-	-	-	-	0.33
Mauritania	-	-	-	-	-	-	-	0.30	-	-	-	-	-	-	-	-	0.30
Venezuela	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	-	-	0.14
Finland	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	0.05
Ukraine	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	0.05
Mozambique	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05
Others	-	-	0.07	-	-	0.08	-	-	0.16	-	-	0.11	0.42	-	-	-	0.84
Grand total	0.02	0.44	0.45	0.68	1.04	0.98	0.07	8.54	0.24	0.05	1.35	0.33	1.13	0.10	0.05	0.07	15.54

SOURCE: Steelmint

Three steel plants (TISCO Jamshedpur, JSW Vijaynagar and JSW Dolvi) account for around 80 percent of all imports (Exhibit 67).

EXHIBIT 67

Steel plants relevant for iron ore imports currently



1 Importing above 1 MMTPA

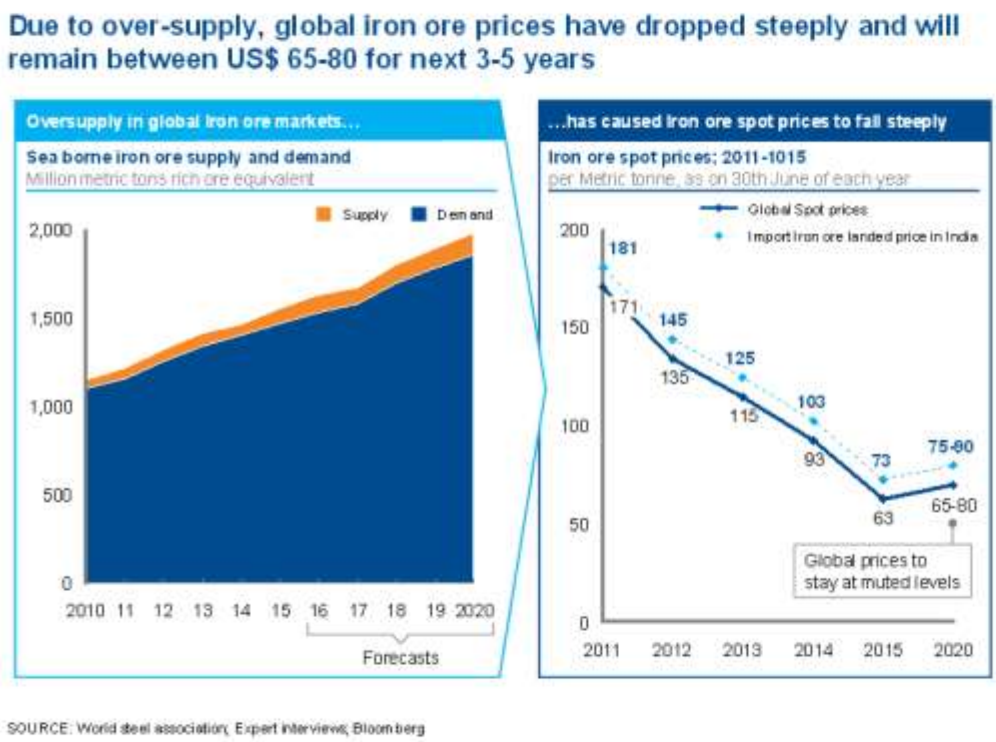
SOURCE: Steelmint

The future demand of iron ore

The future EXIM movement of iron ore depends on three factors:

- **Falling global iron-ore spot prices:** Oversupply in the global seaborne market has affected the global spot prices of iron ore (Exhibit 68). High logistics costs make Indian iron ore non-competitive at global prices, e.g., exporting from India's Baila-Dila to the China CFR through Vizag port would run up a cost of USD 115 China CFR per ton compared to global prices of USD 67–70 China CFR per ton(with the most recent numbers further declining to USD 50)

EXHIBIT 68



- **Duties imposed and high railways freight:** Current export duties are driving up export prices and limiting India's export potential. Unless the duties are removed, the export of iron ore will be unviable. Also, the per tonne per km average rail freight for iron ore is around INR 1.9 to 2.1 compared to around INR 1.3 to 1.5, which is around 40 percent of the total cost (Exhibit 69). Although the railway rates have been slashed in the past few months, the effect on the final landed price is still not big enough to make the exports competitive

EXHIBIT 69

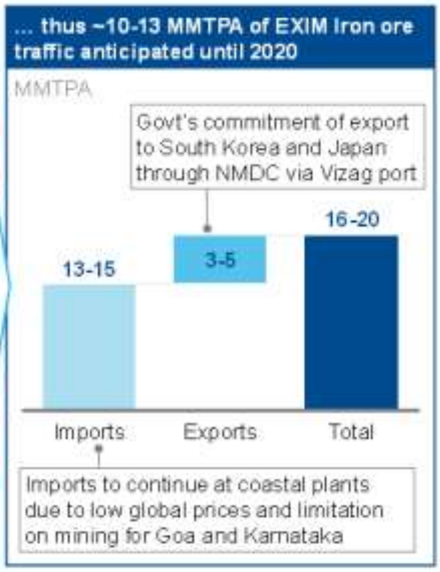
Prevalent market conditions make exports of Iron ore unviable;
Imports of 7-10 MMTPA anticipated until 2020 due to low global prices

High logistics costs, makes Indian Iron Ore non- competitive at global prices ...

Iron ore from India – China CFR price
Baila-Dila to China example through Vizag port

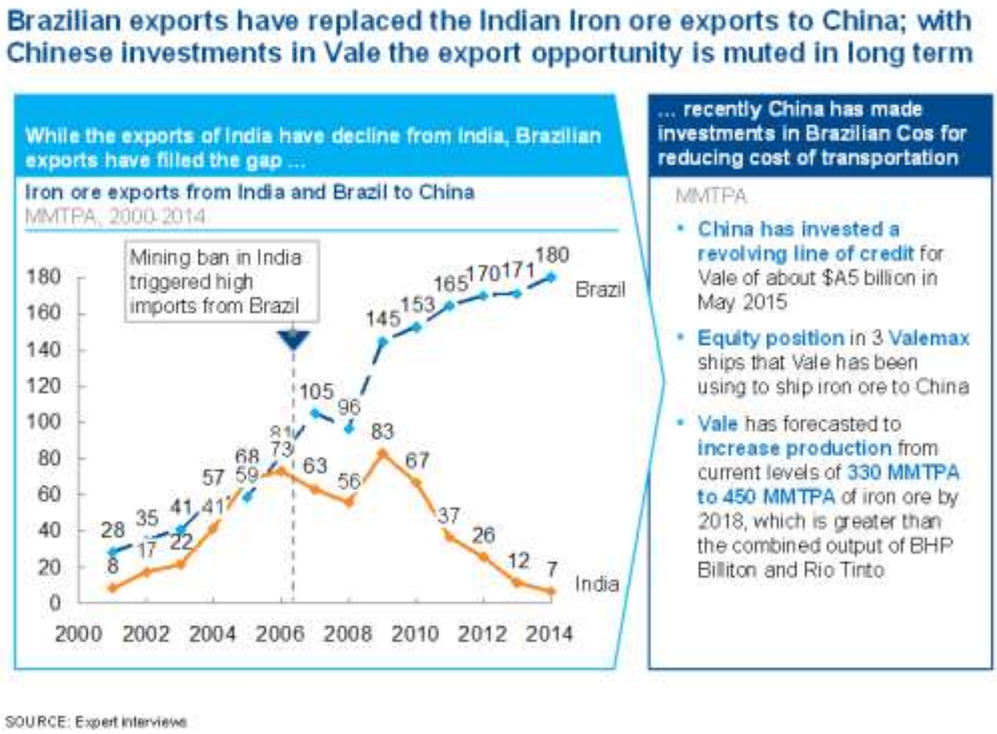
Cost heads	INR/tonne
Mining and state fund	550
Production cost	1,000
Royalty	490
Export duty	1,100
Handling cost	300
Rail freight	2,900
Sea freight	600
Total	**6,940**

Domestic Iron ore at cost ~115 China CFR; compared to global prices of ~60 US$ China CFR



- **Dipping steel demand from China:** The mining ban in India hit production volumes, and consequently, Indian exports to China. Brazil's iron-ore exports have filled the gap for China. Now, to save on logistics costs, China has invested in Vale, a Brazilian mining company, which also operates Valemax ships. China therefore pays lower transportation costs, making Brazilian iron ore far more lucrative than India's exports. Experts suggest that it is unlikely for Indian to regain this market in the near future (Exhibit 70)

EXHIBIT 70



In the near future (2020) therefore, iron-ore volumes on ports will remain muted unless there the global market recovers and iron-ore production ramps up in the country. For iron-ore volumes to recover, the following are required

- **Restoration of mining production:** Current restrictions of a mining limit of 20 MMTPA in Goa and 35 MT in Karnataka will need to be waived off. Furthermore, new captive mine allocations (no allocation after 2011) need to be kick-started
- **Removal of export duty:** A progressively increasing export duty (from around 10 percent in 2010 to 30 percent in 2012 and continuing) discourages exports and increases export prices compared to global spot prices. This limits India's potential to export
- **Exploration of new markets:** Since India has lost the China market to Brazil, it will need to identify new growth markets for the restoration of exports

A.3.5 Current movement of steel and the potential for optimizing the movement of steel: Current and future

Approximately 50 percent of the total production—around 30 MMTPA of domestic steel moves via rail; while around 15 to 20 MMTPA moves by road. Most of the material for large steel plants moves by rail while small and medium units prefer road transport for their material (Exhibit 71).

EXHIBIT 71: MIX OF RAW MATERIALS PROCUREMENT BY PLANT SIZE (KM)

	Rail		**Road**	
	Raw materials	Finished steel	Raw materials	Finished steel
Mega/Large projects	90%	70%	10%	30%
Small & medium units	30%	30%	70%	70%

Most steel plants are situated near iron-ore mines, reducing the lead distances for iron ore, but increasing the lead distances for finished steel (around 1,000 km). The transport requirements for finished steel in tonne-km are therefore much higher than for raw materials(Exhibit 72)

EXHIBIT 72: AVERAGE LEAD DISTANCES FOR STEEL AND RAW MATERIALS (KM)

Iron ore	**Coal**	**Other raw materials**	**Pig iron and finished steel**
200-325	300-405	500-763	750-988

While the production clusters are centered on iron-ore mines in Eastern India and North Karnataka–South Goa, consumption clusters are spread across the country depending on urbanization and industrialization.

Uttar Pradesh, Maharashtra and Tamil Nadu account for the highest receivers of steel mostly produced by plants in the Eastern hinterland and North Karnataka (Exhibit 73)

EXHIBIT 73: DOMESTIC INWARD MOVEMENT OF STEEL THROUGH RAIL (2013-14)

State	**Volume moved to state** (MMTPA)
Uttar Pradesh	3.99
Maharashtra -Other than coastal districts	3.94
Tamil Nadu-Other than coastal districts	3.21
Andhra-Other than coastal districts	2.88
Haryana	2.51
West Bengal-Other than coastal districts	2.06
Punjab	1.37
Goa	1.27
Jharkhand	1.27
Bihar	1.16
Orissa	1.04
Gujarat(excluding ports)	0.95
Other ports of West Bengal	0.83
Chhattisgarh	0.67
Madhya Pradesh	0.59
Delhi	0.58
Karnataka(excluding ports	0.56
Rajasthan	0.53
Chandigarh	0.38
Assam	0.34
Other ports of Tamil Nadu	0.20
Kerala(excluding ports)	0.13
Other ports of Andhra	0.10
Jammu and Kashmir	0.09
Uttaranchal	0.09
Himachal Pradesh	0.07
Other ports of Maharashtra	0.02
Grand Total	**30.82**

Studies conducted under the “Sagarmala” program have helped to identify two opportunities for driving this logistical efficiency

1. **Coastal shipping of steel from current production centres to demand centres:** This mode offers a total potential of thirteen to fourteen

MMTPA by 2025, which could translate into savings of INR 1,000 to 1,200 Crores per annum by 2025

2. **Development of coastal steel clusters:** Coastal steel plants located close to iron-ore reserves connected via a slurry pipeline can potentially save INR 900 per tonne on an average. Based on demand projections until 2025, we see the potential of two 20 MTPA capacity steel clusters, one on either coast by 2025. This could save around INR 2,000 to 2,800 Crores per annum compared to setting up new capacity close to iron-ore reserves. We also note international examples, such as Pohang that developed coastal steel clusters for serving both domestic demand and exports

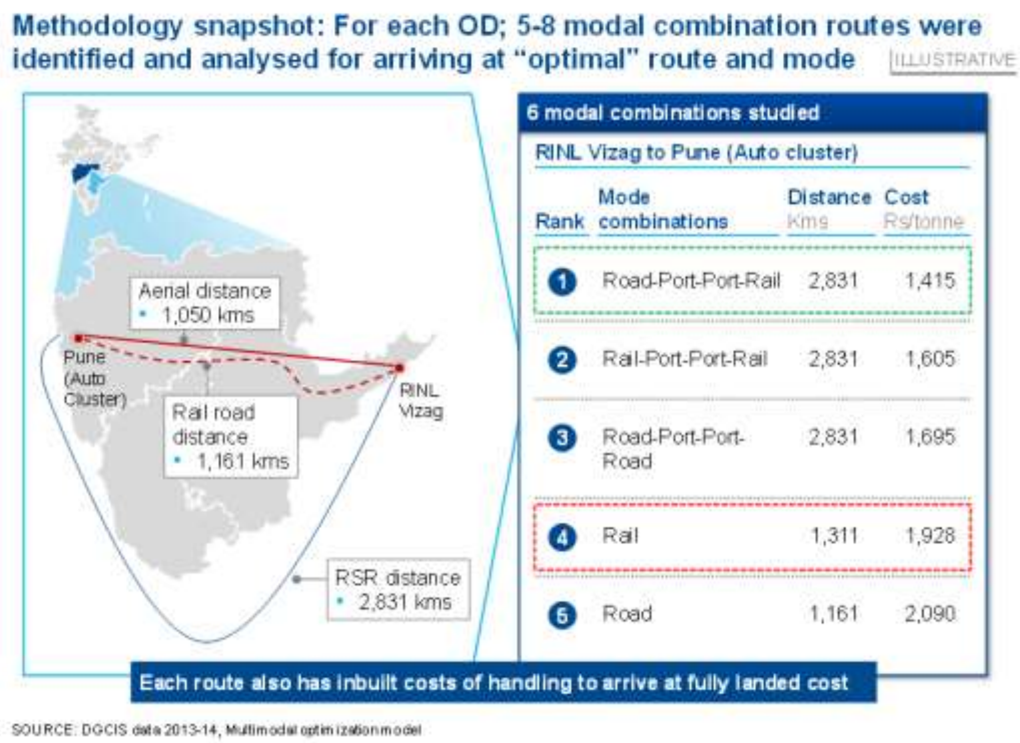
Coastal shipping of steel from existing plants

Production clusters of steel are centered on iron-ore mines in Eastern India and the North Karnataka–South Goa region, but consumption clusters are spread across the country depending on urbanization and industrialization. Uttar Pradesh, Maharashtra and Tamil Nadu account for the highest receivers of steel, mostly produced by plants in the Eastern hinterland and North Karnataka.

Approximately 50 percent of the total production—around 30 MMTPA of domestic steel—moves via rail, while around 15 to 20 MMTPA moves by road. Most of the material for large steel plants moves by rail, while small and medium units prefer road transport for their material. Analysis of research data and expert opinions indicate that a modal-mix shift towards coastal shipping can significantly reduce costs.

An analysis of key inter-state rail movements across the country was conducted to examine the origination-destination of steel movement. At the same time, a cost comparison was also done of all possible combinations of the modal mix under different scenarios of vessel capacity (Exhibit 74).

EXHIBIT 74



For example, the movement between RINL Vizag (coastal Andhra Pradesh) and the auto cluster in Pune (Maharashtra) costs INR 1,930 per tonne via rail, while the same movement via road and rail-supported coastal shipping could be as low as INR 1,420 per tonne—a potential cost saving of nearly 25 to 30 percent (Exhibit 75).

EXHIBIT 75

Estimated transportation cost from RINL Vizag to Pune via Vizag and Mumbai port

Cost head	**Distance** (km)	**Rate** (INR per ton per km)	**Total** (INR per ton)
Road freight from mine to port	11	5	55
Ocean (Vizag to Mumbai)	2,670	0.25	668
Port handling at Vizag			150
Port handling at Mumbai			150
Rail handling			150
Rail freight from Mumbai to Pune	148	1.7	243
Total cost			**1,415**

Eventually, 13 major steel plants would have the potential to shift to coastal shipping (Exhibit 76). The cost advantage is marginal in some cases, but overall railway congestion still makes the case for a shift to coastal shipping for these plants.

EXHIBIT 76

Nearly every major plants has a potential to shift nearly 30-40% of their inter-state rail movements to coastal shipping

Plant	Location	Volume Potential to shift to coastal (in MTPA)
Tata Steel	Jamshedpur	0.8-1.0
JSW Steel	Torangallu	0.5-0.6
RINL Steel	Vishakhapatnam	1.0-1.3
JSW	Dolvi	0.3-0.4
SAIL	Durgapur	0.2-0.3
SAIL	Rourkela	0.9-1.2
SAIL	Bokaro	0.5-0.6
BPSL	Sambalpur	0.4-0.5
BSL	Meramandali	0.7-0.9
JSPL	Angul	0.6-0.8
SAIL ISSCO	Burnpur	0.3-0.4
Tata Steel	Kalinganagar	0.3-0.4
NINL	Duburi	0.3-0.4

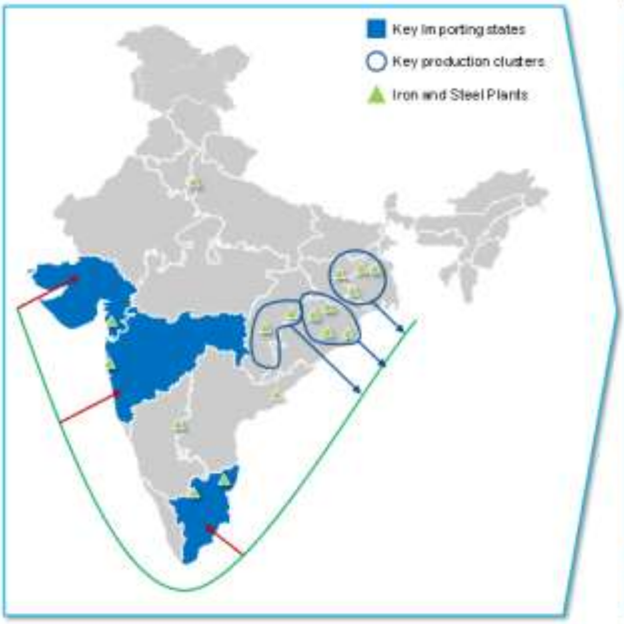
SOURCE: DGCIS data 2013-14, Multimodal optimization model

While each plant may have a unique set of factors to consider before a complete shift towards coastal shipping, some of these plants can also be combined based on location for a cluster-based view on the potential for steel movement.

Data suggests that with the right infrastructure and institutional support, seven to eight MMTPA of steel could be moved via coastal shipping—offering a savings potential of nearly INR 900 Crores to 1,000 Crores per annum. Furthermore, based on a business-as-usual growth rate of around 6 percent, the potential can rise up to eight to ten MMTPA in the future, saving around INR 1,000 Crores to 1,200 Crores per annum by 2025 (Exhibit 77).

EXHIBIT 77

13-14 MMTPA steel coastal shipping opportunity by 2025



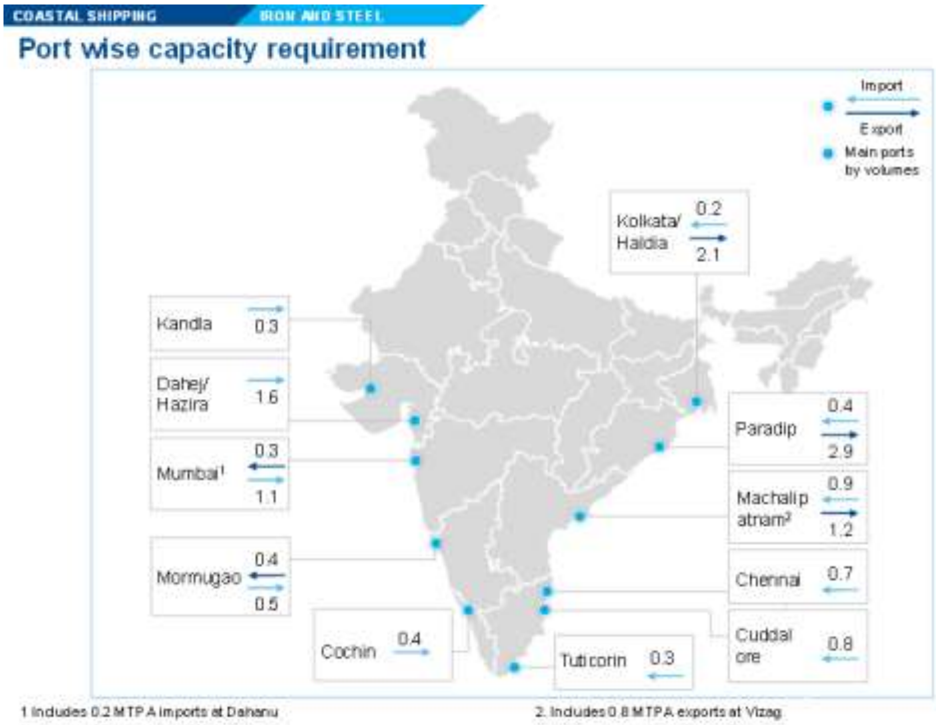
Route	Volume, '000 TPA
Odisha to Andhra Pradesh	1,500
Odisha to Tamil Nadu	1,300
Jharkhand to Maharashtra	1,100
Odisha to Maharashtra	800
Odisha to Rajasthan	800
Karnataka to Gujarat	600
Jharkhand to Tamil Nadu	520
Odisha to Gujarat	450
Total	13,500

Rs. 1,300-1,400 crore saving

SOURCE: DGCIS data 2013-14; Multimodal optimization model

This would require significant capacity to export from east coast ports like Paradip and Kolkata/Haldia and significant import capacity among west coast ports like Dahej and city ports like Chennai and Mumbai. In the future, it can warrant a need for dedicated berths at these ports to cater to these movements (Exhibit 78). Additionally there is also a potential to carry over dimensional cargo on coastal routes as it has already been proven by many players in the market that the coastal route is much cheaper and convenient than rail transport for this type of cargo.

EXHIBIT 78

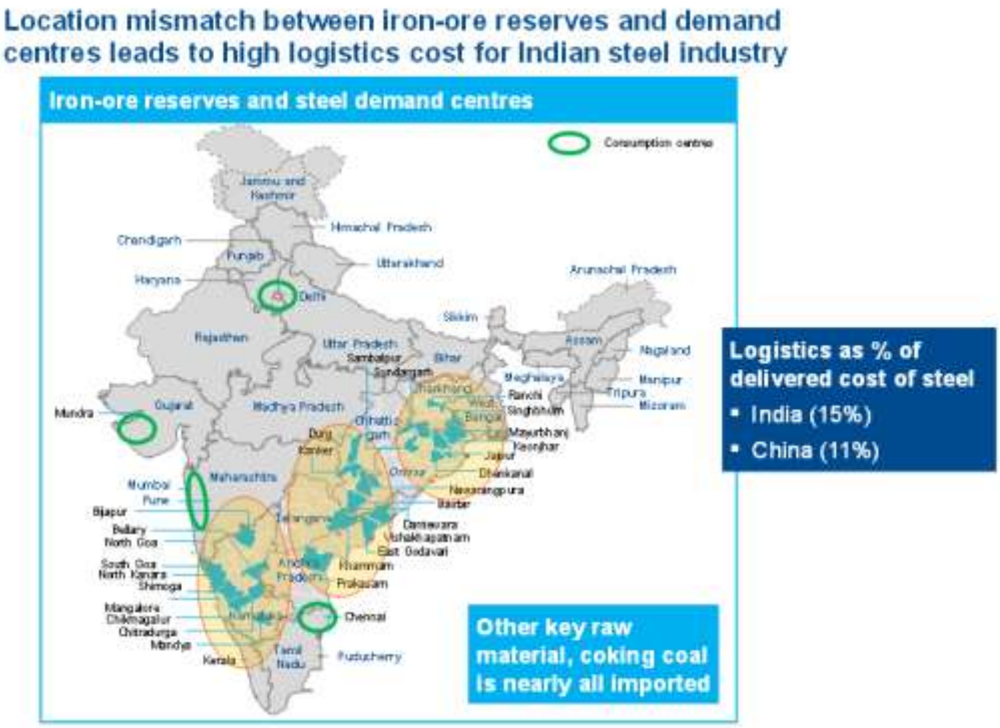


Port-led development: Greenfield coastal steel plants

India’s major steel plants have traditionally been set up close to iron-ore reserves as iron is the major ingredient in steel production. Analysis shows though that setting up new coast-based steel clusters in India could save costs of around INR 2,000 Crores to 2,800 Crores per annum.

While steel plants are centered on iron-ore mines in Eastern India and the North Karnataka–South Goa region, consumption clusters are spread across the country depending on urbanization and industrialization. Uttar Pradesh, Maharashtra and Tamil Nadu are the highest receivers of steel, mostly produced by plants in the Eastern hinterland and North Karnataka. This creates a demand-supply location mismatch (Exhibit 79) and pushes up logistics costs.

EXHIBIT 79



Although locating steel plants near iron-ore reserves reduces the lead distance for iron ore, it increases the lead distance for finished steel (around 1,000 km). The transport requirements for finished steel in tonne-km are, therefore, much higher than for raw materials (Exhibit 80).

EXHIBIT 80: AVERAGE LEAD DISTANCE FOR STEEL AND RAW MATERIALS (KMS)

Iron ore	Coal	Other raw materials	Pig iron and finished steel
200–325	300–405	500–763	750–988

The analysis tried to estimate upcoming demand from various districts in India and conducted a cost comparison to meet this demand through three different locations of steel plants (Greenfield facilities):

- **Inland plants close to iron ore:** Brownfield expansion of existing hinterland plants, e.g., SAIL plants in West Bengal, Chhattisgarh
- **Coastal plants close to raw materials:** Greenfield plants set up on the coast with:
  - Iron-ore slurry pipeline to feed raw materials
  - Coking coal imported at the nearest port
  - Steel end-product to be coastally shipped to the demand cluster, e.g., RINL, Vizag

- **Coastal plants close to production centres:** Greenfield plants set up near the demand centre with:
  - Pelletization hub at the source coastal port
  - Coking coal imported at the nearest port
  - Steel to be moved by road for the last leg, e.g., JSW, Dolvi, Essar Hazira

By logistics cost, option two—setting up coastal steel capacity close to iron-ore reserves on the coasts—could work out cheaper by around 1,000 INR per tonne of steel (Exhibits 81 and 82). Contrary to the finding, only around 10 percent of India's steel capacity is currently coastal (2013–14) compared to other maritime nations (China, 25 percent; South Korea, 20 percent).

EXHIBIT 81

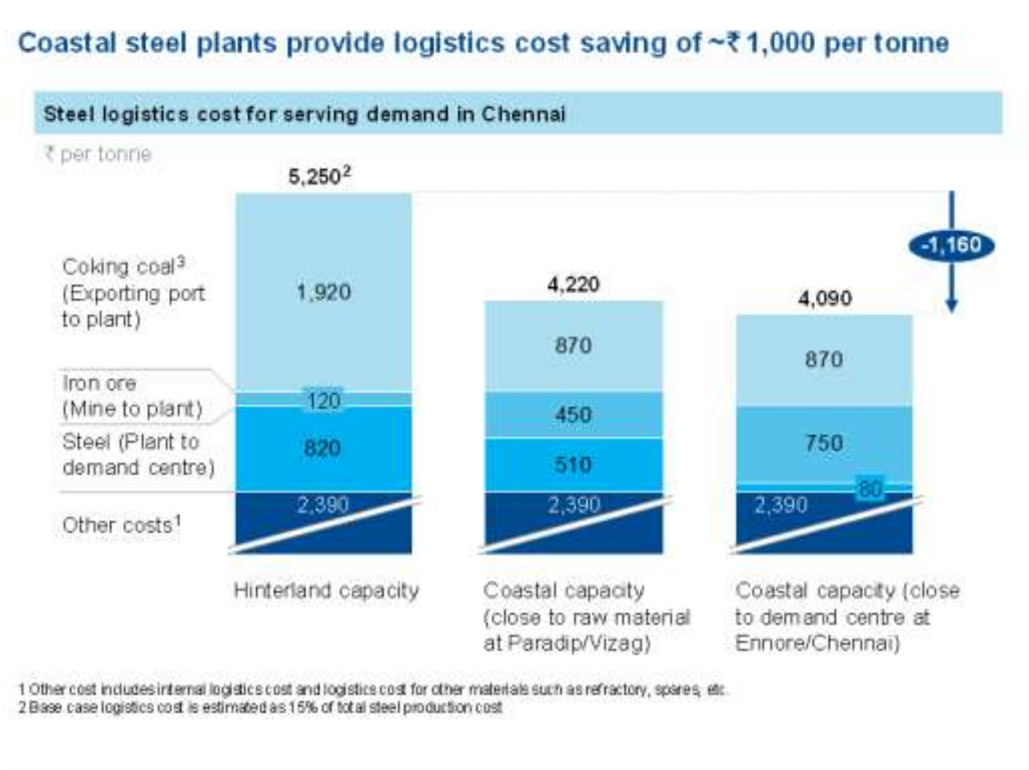
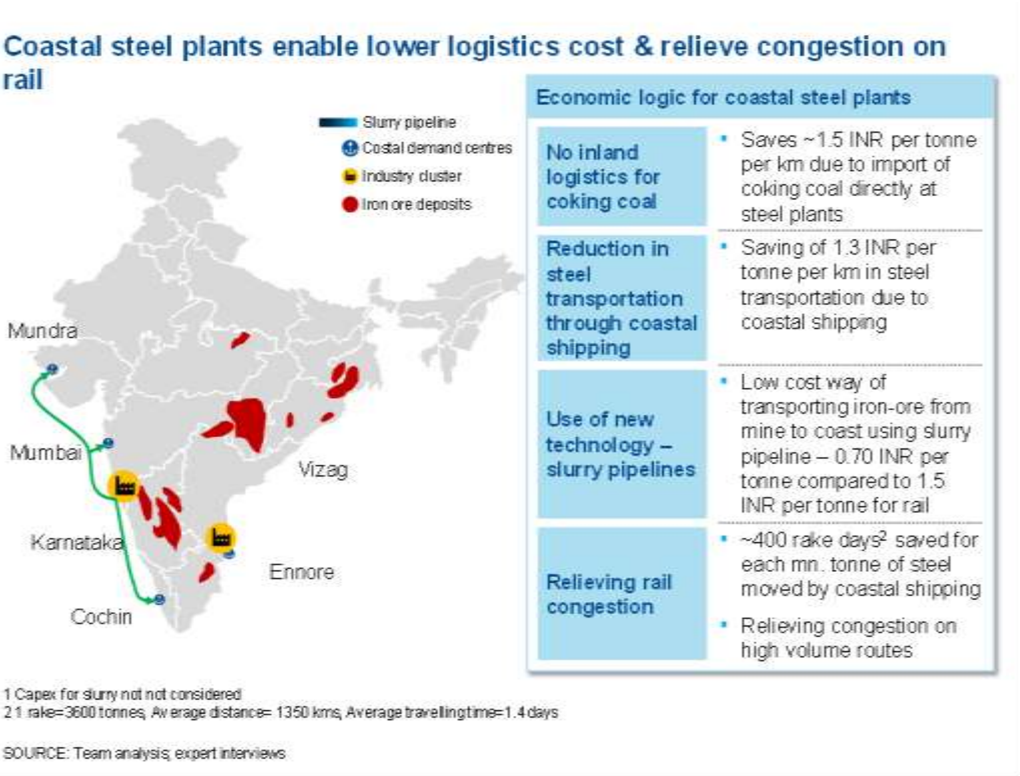


EXHIBIT 82: LOGISTICS COST OF TRANSPORTING STEEL AND RAW MATERIALS (INR PER TONNE)

INR per tonne	Expand existing plants	Coastal plants close to iron-ore mines	Coastal plants close to demand centres
Coking coal	1,920	870	870
Iron ore	120	450	1,200
Steel	820	510	80
Other costs	2,390	2,390	2,390

Steel production requires an additional 2 million tonnes of raw material such as coking coal and ferro alloys, which are mainly imported to India. A coastal steel plant can receive imported raw material directly at the port, saving the cost of transporting the material to hinterland production units. The use of slurry pipelines offers low-cost transportation to take iron ore from the mines to the coastal steel plant (Exhibit 83).

EXHIBIT 83



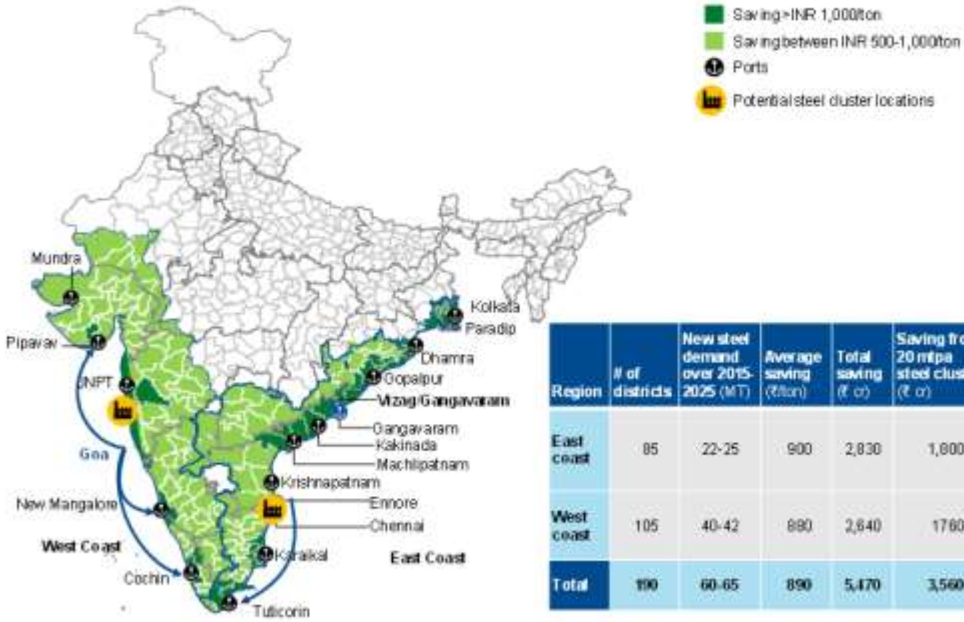
Coastal steel plants close to iron-ore reserves could enable savings in four ways

- **No inland logistics for coking coal:** Saves around INR 1.5 per tonne per km due to the import of coking coal directly at steel plants
- **Reduction in steel transportation through coastal shipping:** Saves around INR 1.3 per tonne per km in steel transportation due to coastal shipping
- **Use of new technology—slurry pipelines:** A way to transport iron ore from mine to coast at half the price: costs INR 0.7 per tonne compared to INR 1.5 per tonne for rail
- **Relieving rail congestion:** Saves around 400 rake days for each million tonne of steel moved by coastal shipping; also, relieves congestion on high-volume routes

Land availability is a major bottleneck for creation of coastal steel cluster, hence in the near and medium term, many brownfield expansions could take place to cater to the expanding steel demand of the country, but in the long run a coast-based steel cluster would be a more economical option to serve the 65 MMTPA of upcoming steel demand in Indian There is potential to set up two such steel clusters with a combined capacity of around 40 million tonnes at North Tamil Nadu and South Maharashtra close to the demand centers to meet demand for the east and west coast (Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal). They could serve around 190 districts (69 coastal plus others). **The combined savings from these clusters would be around ~INR 3,500 Crores** (Exhibit 84).

EXHIBIT 84

Two new proposed steel clusters (40 MMTPA capacity), that would save the economy annual savings of ~3,500 crore



Region	# of districts	New steel demand over 2015-2025 (MT)	Average saving (₹/ton)	Total saving (₹ cr)	Saving from 20 mtpa steel cluster (₹ cr)
East coast	85	22-25	900	2,830	1,800
West coast	105	40-42	880	2,640	1760
Total	**190**	**60-65**	**890**	**5,470**	**3,560**

The key success factor of the Pohang steel cluster in South Korea was its strategic coastal location, which reduced the cost of importing raw materials and developing a world-class port. Pohang currently houses 384 industrial complexes.

Imperatives for relevant ports

As proposed above, four port clusters: Eastern cluster (Paradip), North Andhra cluster (Vizag/ Gangavaram), North TN and South Maharashtra are ideal locations for setting up steel clusters.

Also, critical steel demand centres in the country, i.e., Chennai/Ennore, Mumbai, Gujarat will need to develop adequate handing capacity to receive the steel that is coastally shipped.

Evacuation projects needed (rail)

- Electrification of railway lines
  - Vizainagram to Raipur line
- Doubling of lines
  - Howrah to Tatanagar to Rourkela to Bilaspur
  - Vizag to Bhilai to Bondia

- Dhamra/Paradip to Talcher-Bhilai/Rourkela
- Dhamra/Paradip to Bhadrak to Bankura to Durgapur to Burnpur
- Howrah to Dhanbad

- Construction of slurry pipelines from iron-ore mines to proposed greenfield locations
  - Baila- dila to Vizag
  - Keonjhar to Paradip
  - Bellary mines to North Karnataka

Key enablers for capturing this opportunity: Next steps

The various projects and initiatives within steel optimization fall under the purview of a wide range of ministries as well as public and private enterprises. While the Ministry of Shipping is the nodal body for driving the Sagarmala initiative, the vast scope of the project requires alignment, partnership with and support from key stakeholders to realize its full potential.

It also requires encouraging and incentivizing private-sector investment through PPP models for port infrastructure, railway infrastructure and coastal shipping. The ownership and involvement of all communities that stand to benefit from the initiative is necessary to manage the nuances of project identification, feasibility studies, funding, structuring (in terms of PPP, etc.).

A crucial step would also be to have a central body to consolidate the steel supply chain by aggregating demand from plants and acting as a centralized supply chain optimizer. This could help further lower costs by deploying larger vessels for greater volumes.

As a long-term vision, India should aim to optimize the landed cost of steel by optimizing the location of steel plants (e.g., coastal steel plants) as well as the logistics of transporting other raw materials (e.g., iron ore, coking coal).

OPPORTUNITY FOR COASTAL SHIPPING OF CEMENT

The Indian cement industry is the second largest in the world and is expected to grow in direct correlation with GDP in the future. Cement is a high-volume, low-value product, which becomes unprofitable when transported over long distances using road or rail transport. Low-cost sea transport routes are therefore very important for cement.

The cement demand in India is projected to grow to 700-800 million tonnes by 2025 under base case scenario of GDP growing at 7-8 percent per annum. One tonne of cement requires 2 tonnes of raw materials. The volume of material to be transported for the cement industry will reach 1.6 billion tonnes by 2025. From a cost perspective, logistics contribute about 25 per cent of the cost for cement. Logistics efficiency will be critical for making existing capacity more competitive.

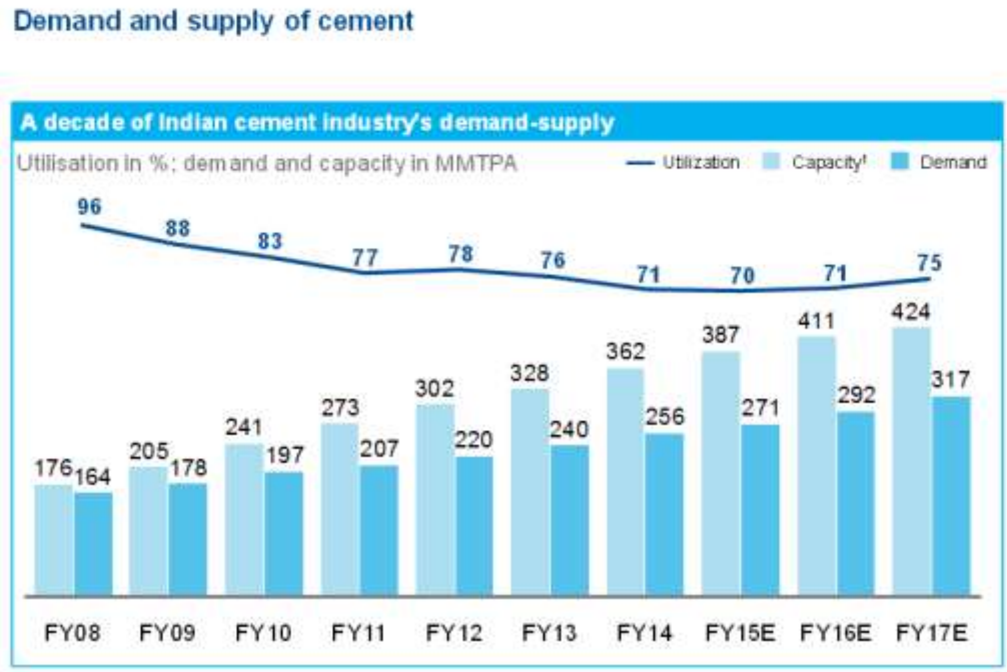
Currently, ~200 MMTPA of cement travels on rail/road within the country. Studies conducted under the "Sagarmala" program have helped to identify two opportunities for driving logistical efficiency

1. **Coastal shipping of cement from current production centres to demand centres:** Study estimates potential for moving 5-6 MMTPA cement through coastal route currently, 7-8 MMTPA by 2020, and 9-10 MMTPA by 2025. This translates to savings of Rs. 900 to 1,000 crore per annum by 2025. Key routes identified for this movement are: Andhra Pradesh to Tamil Nadu; Andhra Pradesh to West Bengal; Andhra Pradesh to Odisha; Andhra Pradesh to Kerala; Madhya Pradesh to West Bengal; Karnataka to Kerala; Andhra Pradesh to Bihar; Andhra Pradesh to Coastal Maharashtra; Andhra Pradesh to Jharkhand; and Karnataka to Tamil Nadu.
2. **Development of coastal cement clusters:** The traditional mode of setting-up cement capacity in India has been hinterland plants located close to limestone reserves. Five coastal states (West Bengal, Kerala, Odisha, Tamil Nadu, Maharashtra) have very limited limestone reserves that will deplete in near future. On the other hand, 3 coastal states (Andhra Pradesh, Karnataka, Gujarat) have excess limestone reserves. Cement demand in the "limestone deficient" coastal states is expected to reach 190 mn ton in 2025 from current 86 mn tons. Based on studies conducted, most economical mode of serving this demand will be through setting-up coastal clinkerisation clusters in Northern Gujarat and Central Andhra Pradesh and grinding units at ports close to demand centres (Mumbai, Cochin, Chennai/Ennore, Kolkata and others). This configuration could save on average Rs. 600/tonne (10-15% of total delivered cost of cement) compared to serving this demand through hinterland plants located close to limestone reserves. The savings are driven by lower cost of fly-ash movement (due to better availability at ports), and lower cost of cement transport to demand centres. A total potential of 40 MMTPA new capacity is estimated through this route. This 40 MMTPA coastal cement capacity would save around Rs. 2,500 crore per annum in logistics cost by 2025.

Current domestic movement of cement

In the past five years, the capacity of the cement industry has increased by around 75 percent. Demand has been growing at a rate of 6 to 8 percent year on year, mostly moving with GDP. Utilization is expected to bottom out in FY 2015 as the economy picks up under the new government—expecting more investments in infrastructure and housing schemes (Exhibit 85).

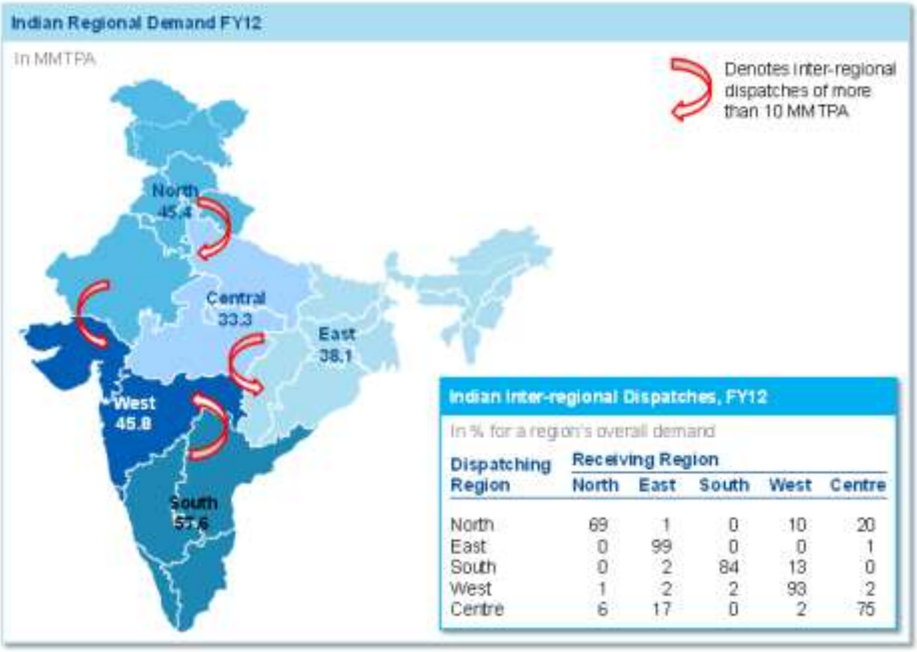
EXHIBIT 85



Inter-regional cement dispatches in India occur mostly through road or rail transport. The major dispatch routes are from Southern to Western India and from Central to Eastern India (Exhibit 86).

EXHIBIT 86

There is a moderate amount of inter-regional cement dispatches in India

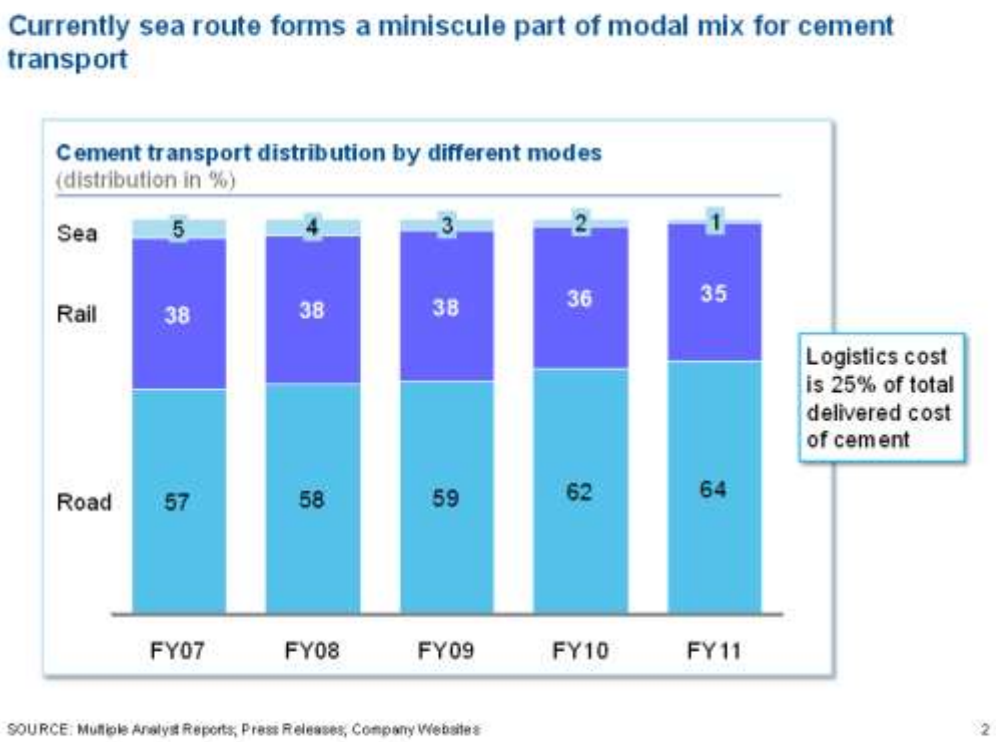


Dispatching Region	Receiving Region: North	East	South	West	Centre
North	69	1	0	10	20
East	0	99	0	0	1
South	0	2	84	13	0
West	1	2	2	93	2
Centre	6	17	0	2	75

SOURCE: Analyst Reports (IDBI and TATA Securities); Press Releases; Company Websites

Logistics costs form around 25 percent of the retail price per tonne of cement (around INR 6,000). The sea route forms only a minuscule part of the modal mix for cement transport (Exhibit 87). This is primarily due to inefficiencies in coastal shipping, unavailability of port infrastructure and greater expansion in the hinterland plants as compared to coastal plants. Road is still the most preferred mode. It is also the most expensive, costing INR 3 per tonne km—approximately twice as expensive as rail (INR 1.5 per tonne km) and 20 times as expensive as sea transport (INR 0.15 per tonne km).

EXHIBIT 87



The potential for optimizing the movement of cement: Current and future

- Analysis reveals that rail is the preferred mode of movement for the long-distance transit of cement in the country, whereas the shorter intra-state movements are primarily through road. Coastal movement is currently dominated by large players that have dedicated jetties or coastal berths at ports

Due to the availability of fly ash and anticipated growth in the cement industry, coastal cement plants next to limestone reserves prove to be more economical than inland cement plants

Studies conducted under the "Sagarmala" program have helped to identify two opportunities for driving logistical efficiency:

- **Coastal shipping of cement from current production centres to demand centres:** This mode offers a total potential of five to six MMTPA currently, which translates into savings of INR 500 to 1,000 Crores per annum
- **Development of coastal cement clusters:** Northern Gujarat and Central Andhra Pradesh as potential locations for coastal cement clinkerization clusters, with grinding units near demand centres. Gujarat and Andhra Pradesh boast of coastal limestone deposits, which can last for many years to come, and can supply to other limestone-deficient coastal

states. Freight cost savings of around **INR 2,500 Crores** are expected by setting up two coastal cement clinkerization clusters, serving ~100 districts in the west coast and ~75 districts on the east coast. Ports alongside these clinkerization clusters and demand clusters can be used to facilitate the movement of clinker.

Coastal shipping of cement from existing plants

Large players dominate the coastal shipping mode for moving cement across India. They typically have dedicated jetties or coastal berths at ports. The key coastal berths/jetties of cement players are as follows

- Multipurpose cement berth at New Mangalore port
- Ultratech cement berth at Pipavav port
- Shree Digvijay cement berth at Sikka port
- Ambuja cement berth at Muldwarka port

In addition to the coastal traffic for large cement players, coastal shipping could also accommodate a sizeable chunk of the volumes currently moving by rail, concentrated in the southern peninsular region of the country. Large city ports like Mumbai are the key importers of cement due to the infrastructure-related requirements in the hinterlands of these ports. Existing movements of cement testify to the economics of coastal shipping. Even the relatively short Gujarat-to-Maharashtra movement proves economical for players.

An analysis of the key inter-state rail movements was conducted across the country to examine the origination-destination of cement movement. At the same time, a cost comparison of all possible combinations of the modal mix under different scenarios of vessel capacity was also done.

Moving cement between Andhra Pradesh and West Bengal via rail costs INR 2,200 per tonne, but could cost as little as INR 1,250 per tonne via road and rail-supported coastal shipping—a potential cost saving of nearly 40 percent for this particular route (Exhibit 88). Savings across the routes where we found coastal shipping to be more efficient could range from INR 800 per tonne to INR 1,200 per tonne.

EXHIBIT 88

Estimated transportation cost from Mellacheruvu to Birbhum			
Cost head	**Distance** (km)	**Rate** (INR per ton per km)	**Total** (INR per ton)
Rail freight from mine to port	191	1.7	325
Ocean (Machilipatanam to Kolkata)	968	0.2	194
Port handling at Machilipatnam			150
Port handling at Kolkata			150
Rail freight from Kolkata to Birbhum	267	1.6	425
Total cost			**1,250**

Nine plants in the Andhra Pradesh/Telangana area have the potential to shift to coastal shipping while shipping to states like Tamil Nadu, Maharashtra, West Bengal, etc. Smaller players do not have sufficiently large volumes to sustain the year-round movement of large and economical ships along the coast. Putting an efficient, large-scale aggregation system into place will enable players to consolidate their parcel size across geographies. In addition to making economic sense, coastal shipping is also much more environmentally friendly and eases the load on India's already congested railway network.

If the key long-distance rail routes along coastal states are considered to extend from major cement plants to the top-200 construction- and infrastructure-related districts in India (these represent 70 percent of cement consumption in India), around nine plants have the potential to shift to coastal shipping (Exhibit 89). Located close to each other, these plants offer the possibility to consolidate their movements and use larger ships for economies of scale.

EXHIBIT 89

Plant wise potential to shift to coastal

CURRENT POTENTIAL

Plant	Location	Volume Potential to shift to coastal (in MMTPA)
Maha Cement	Mellachevuru	1.2-1.4
India Cements/Raasi	Wadapally	1.0-1.2
Ultratech	Tadipatri	0.9-1.1
Zuari Cements	Jaggayypet	0.7-0.9
Zuari Cements	Kadapa	0.7-0.9
Ultratech-Vikram	Jawad Road/Neemuch	0.3-0.4
Birla/Vasvdatta	Sedam	0.1-0.2
J.K. Cement	Mudhol	0.1-0.2
Ultratech	Malkhed	0.1-0.2

SOURCE: DGCIS data 2013-14; Multimodal optimization model

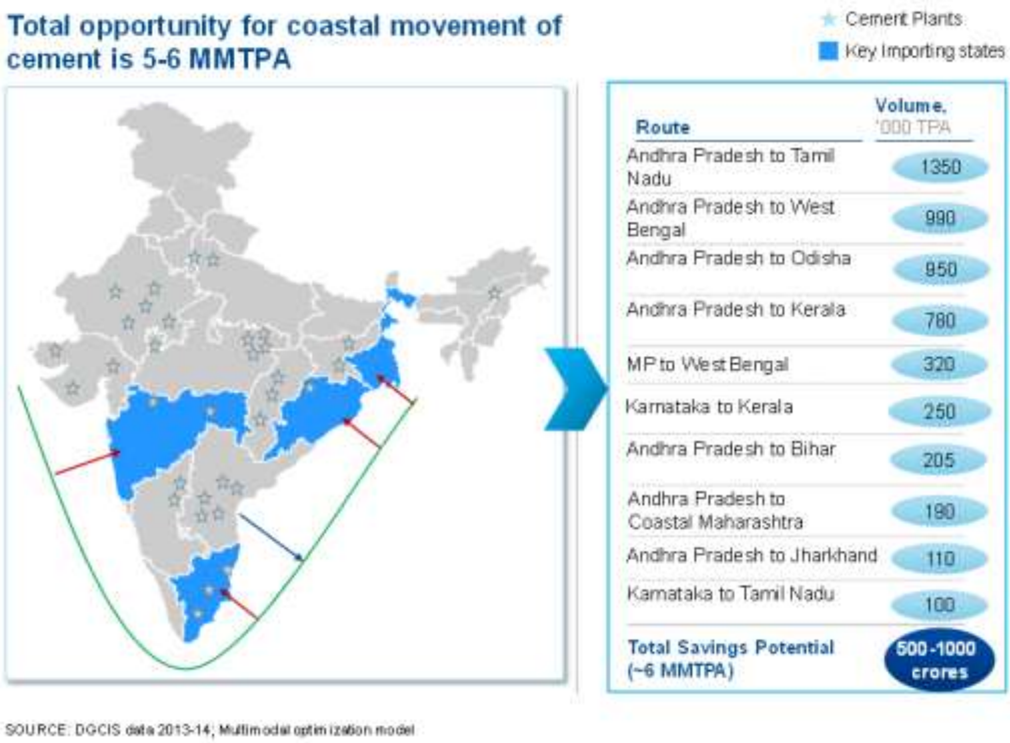
5

Large cement players with multiple plant locations across the country seem to have the highest potential to gain from coastal shipping. Commodities like steel and iron, too, have potential on similar routes, offering immense scope for consolidation and using large vessels for economies of scale. Coastal plants in Andhra Pradesh are unique—offering a coastal location, having large plants and being far away from the primary consumption hinterlands of cement. Some of these plants can also be combined based on location for a cluster-based view of the potential for cement movement.

Data suggests that with the right infrastructure and institutional support, it could be possible to move around five to six MMTPA of cement via coastal shipping at present, saving nearly **INR 500 Crores to 1000 Crores** (Exhibit 90).

It was also found out that another five to six MMTPA of cement can be shipped via coastal route from Kutch region (Sewagram) in Gujarat if dredging is done for the 5 km channel approaching the Sanghi Jetty. Plants owned by ABG, Sanghi Cements and Ultratech will be the key players who could make use of the coastal route for transportation to Maharashtra and Tamil Nadu from this region.

EXHIBIT 90



Port led development: Coastal cement plants

Limestone forms an important raw material with the requirement of 1.2 tons per unit tonne of cement. The cement industry also relies heavily on imported coal and pet-coke, allowing greater savings for plants located next to ports.

The five key maritime states (West Bengal, Kerala, Odisha, Tamil Nadu and Maharashtra)—when assessed for current limestone reserves vs. cement production capacity—could run out of limestone in the next two decades, prompting higher inter-regional transport, as well as imports. On the other hand, Gujarat, Andhra Pradesh and Karnataka are the coastal regions where limestone reserves can last for more than a century. However, Karnataka's reserves are mostly hinterland and cannot contribute to coastal savings (Exhibit 91).

Cement demand in the states projected to run out of limestone reserves could rise to around 213 MMTPA (Exhibit 92), demanding significant inter-regional dispatches by 2025.

EXHIBIT 91

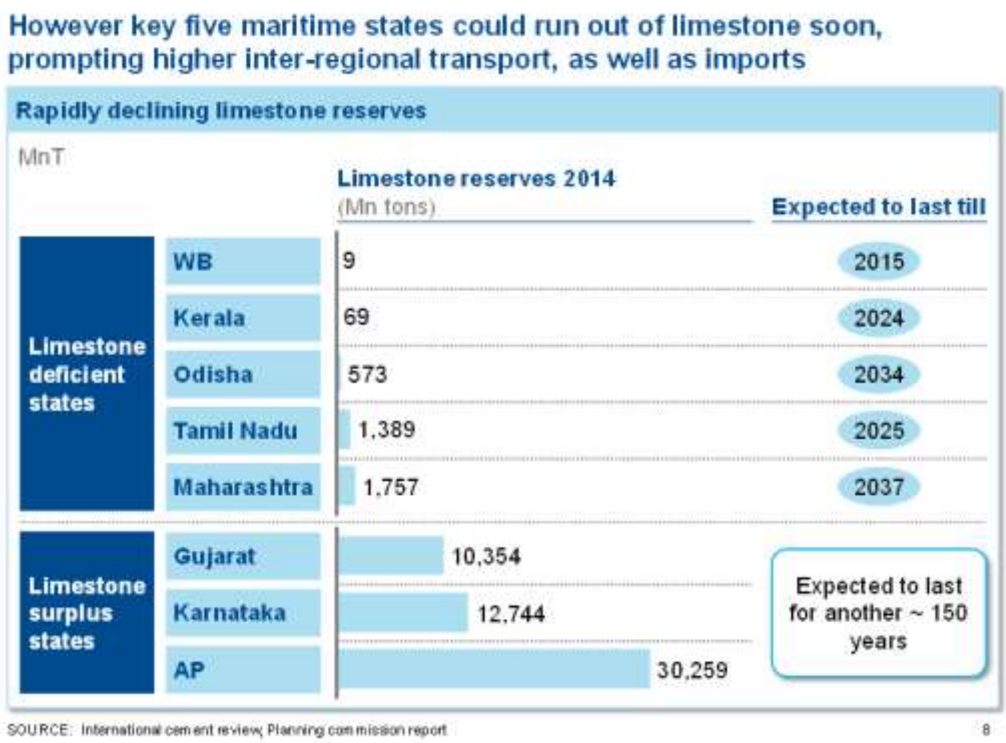
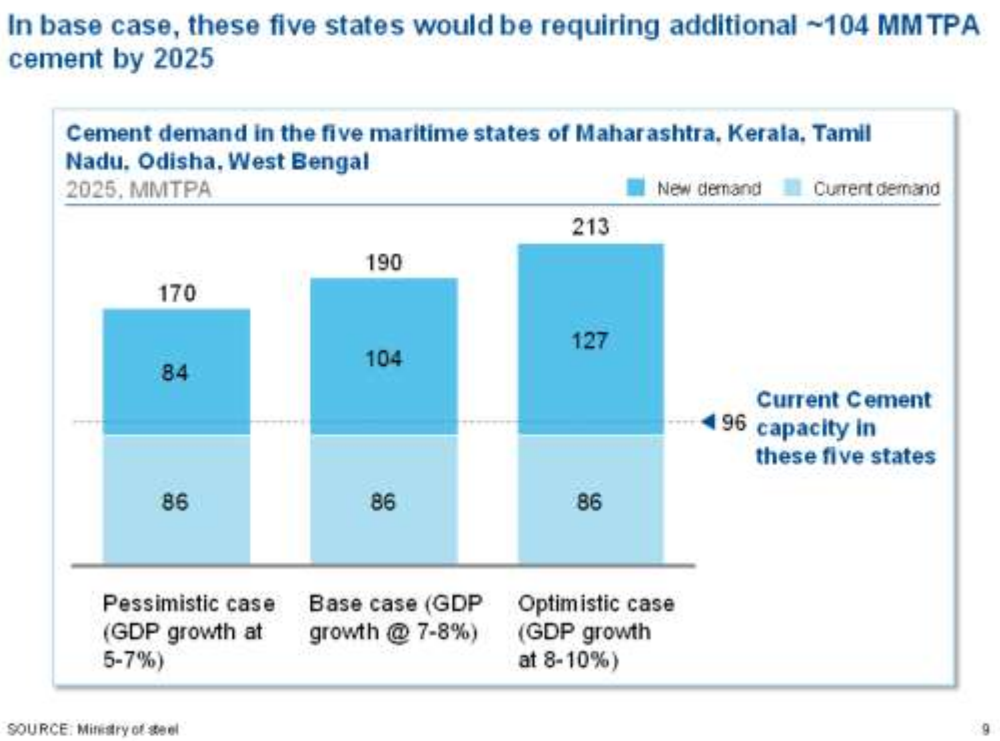


EXHIBIT 92

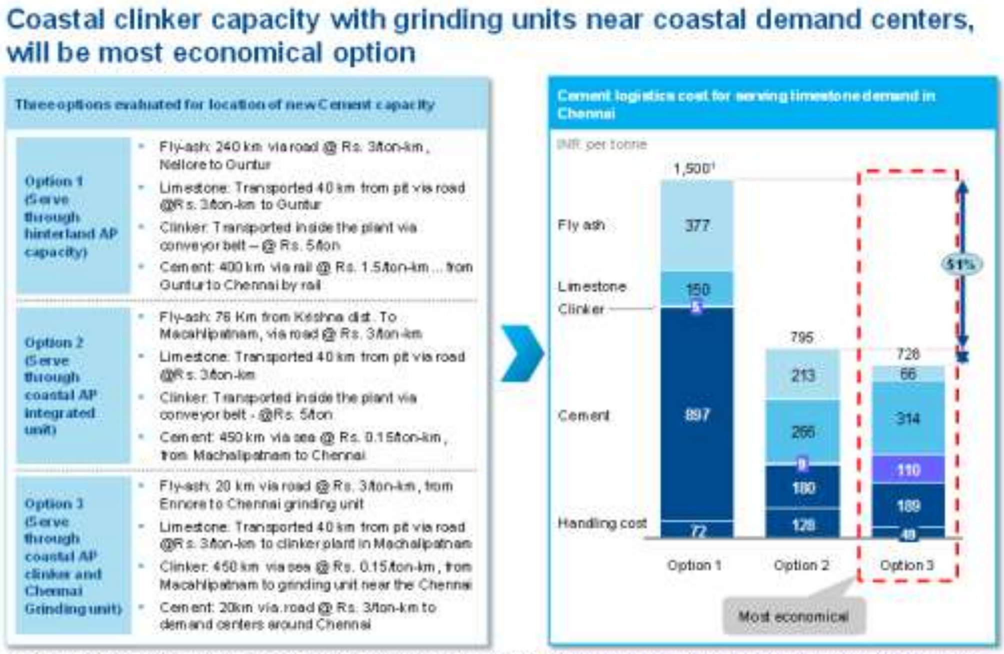


There are three options for serving the cement demand of these five states

- **Serve through the existing hinterland plant:** A mix of greenfield and brownfield expansion of existing hinterland plants; this could result in significant rail/road transportation from supply to demand states
- **Coastal integrated clinker and grinding plant:** A mix of greenfield and brownfield plants set up on the coast
  - Close to the limestone reserves, which can be fed by conveyor belts
  - Coal and pet-coke imported at the nearest port
  - Fly ash and slag taken from the nearby power plant and slag furnace respectively
  - Finished cement shipped to the coastal demand centres
- **Coastal clinker plant and grinding unit close to demand centre**: Greenfield grinding plants set up near the demand centre, and a mix of greenfield and brownfield clinker capacity near coastal limestone reserves
  - Fly ash and slag secured from the power plant and slag furnace respectively, near the demand centre
  - Clinker ground and mixed with fly ash near the demand centre
  - Finished cement sent to the nearest demand centres by road/rail

Assessed by logistics cost, option three—setting up coastal steel capacity close to limestone reserves on the coast and grinding facility close to demand centres—emerges cheaper by about 51 percent compared to hinterland plants (Exhibit 93).

EXHIBIT 93

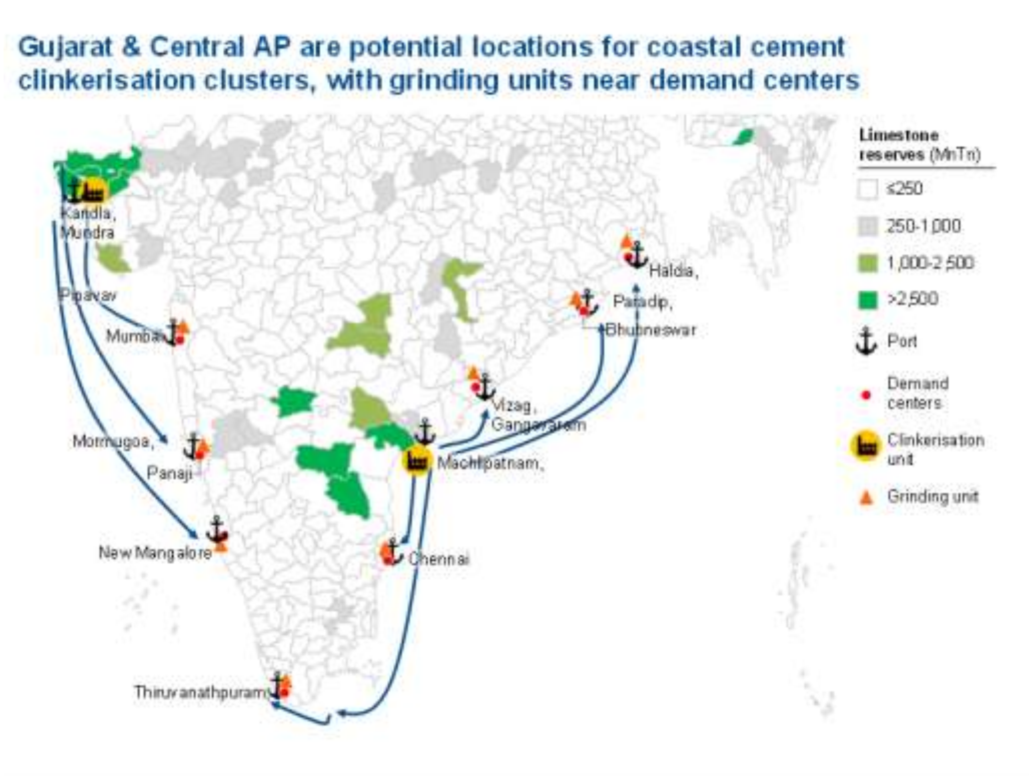


1 Base logistics cost estimated (assuming 25% of total cement cost of INR 6,000/ton) to be INR 1500/ton for hinterland plant, and relatively scaled up for other capacity examples too

Close to coastal limestone deposits, Southern Gujarat and Central Andhra Pradesh are potential locations for setting up clinkerization units, which can leverage Kandla, Jakhau and the upcoming Machilipatnam/Vodarevu port. However, the capacity of cement cluster in central AP needs to be looked in light of the upcoming capacity from new plants in Chhattisgarh.

The clinker from these locations could be shipped to the coastal grinding units close to the high demand centres of Mumbai (JNPT port), Goa (Mormugoa port), Mangalore (New Mangalore port), Thiruvananthapuram (Thiruvananthapuram port), Chennai (Chennai port), Vizag (Gangavaram port), Bhubaneswar (Paradip port) and Haldia (Haldia port) (Exhibit 94).

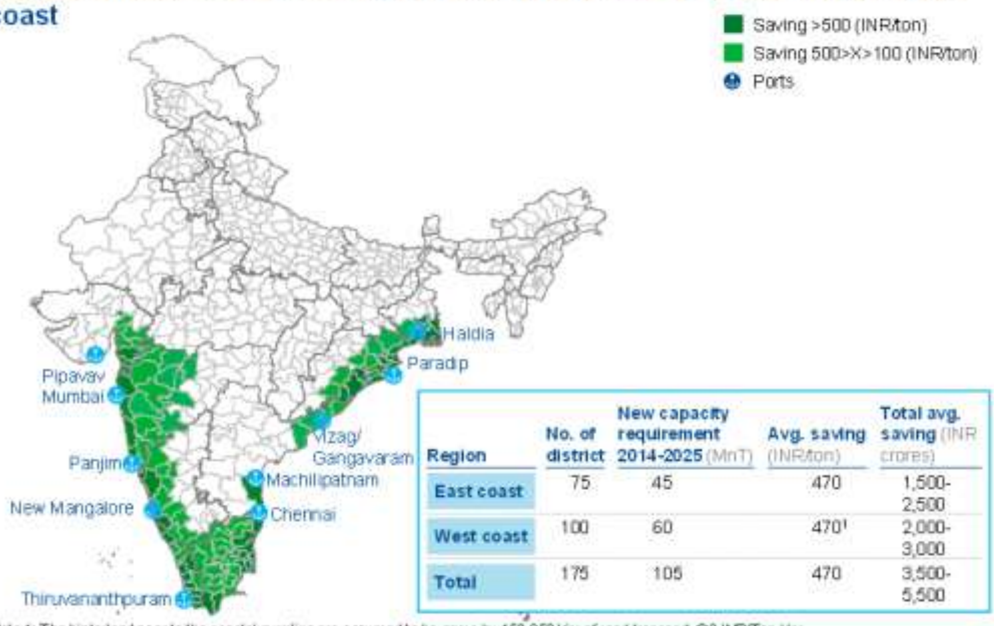
EXHIBIT 94



Savings of around **INR 2,500** Crores are expected by setting up two coastal cement clinkerization clusters of around 80 MMTPA, serving ~100 districts in the West coast and ~75 districts on the East coast as shown in Exhibit 95.

EXHIBIT 95

Savings of nearly INR 2,500 Cr expected by setting up 2 coastal cement clinkerisation clusters, serving 100 districts in West & 75 districts on East coast



Region	No. of district	New capacity requirement 2014-2025 (MnT)	Avg. saving (INR/ton)	Total avg. saving (INR crores)
East coast	75	45	470	1,500-2,500
West coast	100	60	470[1]	2,000-3,000
Total	175	105	470	3,500-5,500

Note 1: The hinterland near to the coastal supplies are assumed to be serve by 150-250 Km of road transport @3 INR/Ton-Km

Imperatives for relevant ports

As proposed above, two port clusters: Northern Gujarat (Kandla, Jakhau, etc.) and Central Andhra Pradesh (Machilipatnam, Vodarevu, etc.) are ideal for setting up cement clusters due to the proximity of existing thermal plants for easy availability of fly ash and optimal logistics due to the proximity of demand centres.

Thus, post the sign-off from relevant stakeholders on setting up port based plants or coastal shipping of cement, by 2025, adequate handling capacity (~20 MMTPA each at Northern Gujarat and Central Andhra Pradesh cluster) would be required to evacuate the manufactured cement.

Critical ports proximate to cement demand centres in the country, i.e., Chennai/Ennore, Mumbai, Haldia, Paradip will need to develop adequate handing capacity to receive the coastal shipped cement. Central Andhra port (Machilipatnam/Vodarevu) is an important location from an economics and logistics perspective, making it imperative for the government to expedite the development of the location.

To facilitate coastal shipping of cement from the operational plants, there would be requirement of adequate handling facilities within the port premises. Option of a dry port in Andhra Pradesh and Karnataka connected to the respective ports via rail is worth considering.

Key enablers for capturing this opportunity: Next steps

Aligning various stakeholders and decision makers across various stages of the cement movement value chain will be the most important driver to increase the coastal shipping of cement. Private-sector investment will also need to be encouraged and incentivized through PPP models for port infrastructure, railway infrastructure and coastal shipping.

While the Ministry of Shipping is the nodal body for driving the Sagarmala initiative, the vast scope of the project implies that partnership with and support from key stakeholders would be pivotal in realizing its full potential.

The aforementioned projects and initiatives within cement optimization would potentially fall under the purview of private enterprises. Nuances of project identification, feasibility studies, funding, structuring (in terms of PPP, etc.) and implementation cannot be managed without the thorough involvement of and ownership from all communities that stand to benefit from the "cement optimization" initiative within the Sagarmala vision.

Significant action points and discussions would be required for realizing the Sagarmala vision for cement optimization:

- On-boarding of private players to initiate coastal shipping
- Dedicated coastal berths, bunkering and storage capacities at relevant ports
- Aggregation services: Identifying or setting up an aggregation agency to handle small parcel sizes and operate logistics
- Dedicated coastal shipping fleet under the Shipping Corporation of India
- Appropriate ship-repairing/ship-building facilities at key ports; most ship repairs currently happen outside the country

ORIGIN-DESTINATION ANALYSIS AND OPTIMIZATION FERTILIZER MOVEMENT

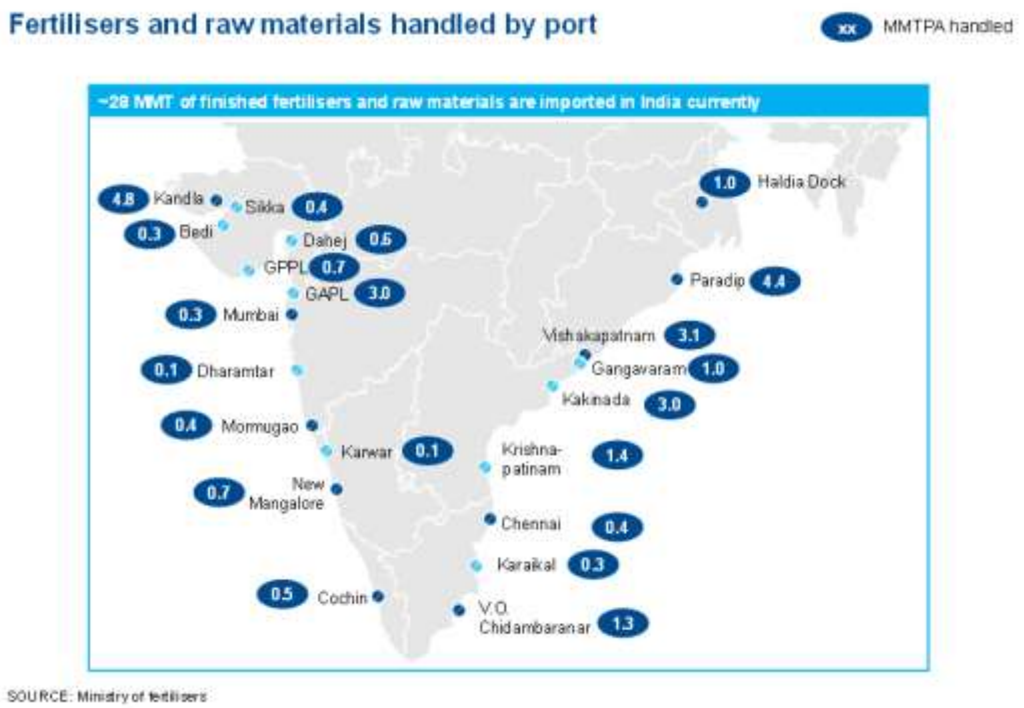
Fertilizer is the backbone of agricultural productivity. The demand for fertilizer has grown along with the demand for food. This commodity contributes 2 percent of the total cargo handled at ports in India.

Fertilizer production is very energy-intensive—with the cost of feedstock and fuel alone accounting for 55 to 80 percent of production cost. From the logistics perspective, therefore, production cost is of particular interest. Analysis reveals a potential savings opportunity of around INR 900 Crores to 1,000 Crores per annum by executing coastal shipping of around nine to 10 MMTPA of fertilizers by 2025.

The current EXIM movement of fertilizers

India imports 28 MMT of finished fertilizers and raw materials (Exhibit 96), with Andhra Pradesh, Gujarat and Odisha being the biggest clusters. Kandla, Krishnapatnam, Paradip, Vishakhapatnam and Kakinadaa are the ports with the highest import figures

EXHIBIT 96

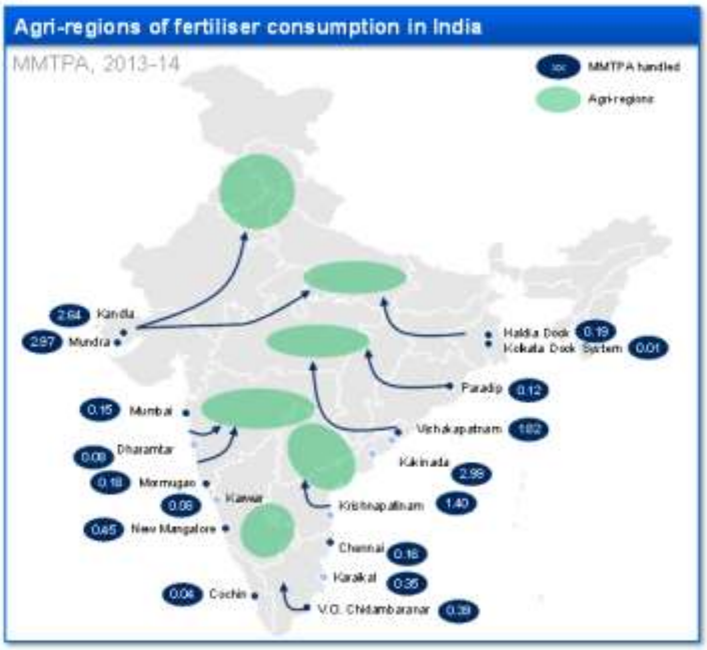


Finished products constitute half of the 28 MMTPA of imports, and raw materials for fertilizers make up the other half. Imported finished fertilizers travel to six significant agri-clusters, with the largest consumption centres in Andhra Pradesh (Exhibit 97) The Ministry of Chemicals and Fertilizers optimizes the majority of port and agri-region combinations, spreading imports across multiple ports.

The long-haul traffic from Haldia and Paradip to northern India, and from the Gujarat cluster to Madhya Pradesh and northern India, etc. is transported by rail.

EXHIBIT 97

Imported finished fertilisers travels to agricultural region for the final consumption

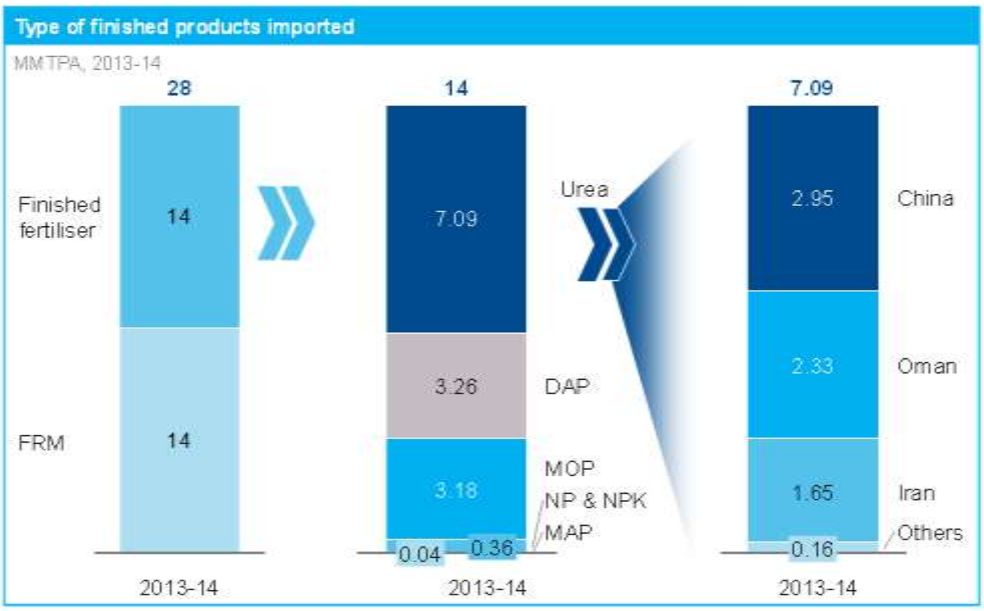


SOURCE: Ministry of fertilisers

Urea, which is largely imported from China and Oman, is the biggest imported finished fertilizer, followed by DAP and MOP. (Exhibit 98)

EXHIBIT 98

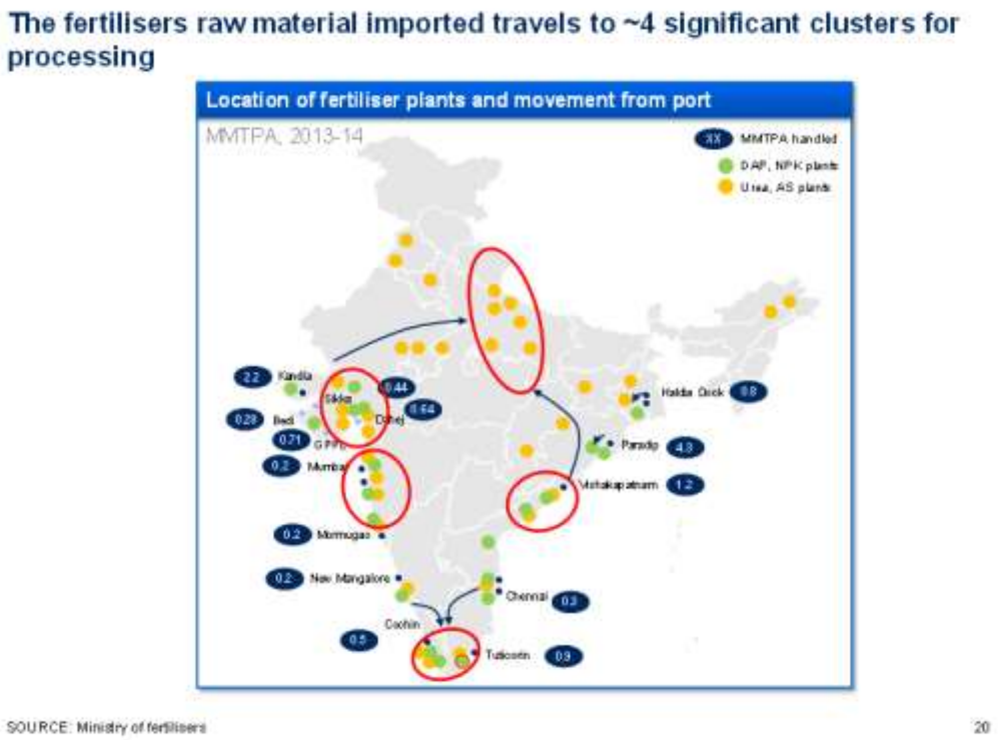
Finished fertilizers import split and origin country



The imported fertilizer raw material travels to five significant clusters for processing. The plant locations of fertilizers are mostly situated on the coast, because they use naphtha as a raw material and are situated next to oil refineries.

Due to different plant locations, imported fertilizer raw materials are handled in small parcel sizes at various ports, with Kandla and Paradip being the largest clusters (Exhibit 99). The western seaboard across Gujarat and Maharashtra has aggregated fertilizer-production clusters.

EXHIBIT 99



Future movement and usage

In the last five years, the consumption of fertilizers has increased by around 2.5 percent and is expected to rise at approximately 4 percent in the future. Growing agri-produce and an increase in the overall sown area will prompt greater demand for fertilizer end products—around 70 MMTPA by 2020 and around 120 MMTPA by 2035.

Urea consumption in India is around 29 MMTPA, of which around 22.5 MMTPA is produced domestically and around 7 MMTPA is imported. While domestic plants are increasing capacity by around 5 MMTPA in 2020, the rising demand for urea (expected to be 35 MMTPA in 2020) will ensure that India continues to import around 7 MMTPA of urea.

The volume of imports of fertilizer raw materials and finished products will grow at around 4 percent, keeping the volumes handled at Indian ports fairly stable by 2020.

Kakinada, Mundra and Kandla will continue to be the largest finished fertilizer-importing ports, while Paradip, Kandla and Vishakhapatnam will be the largest fertilizer raw material–importing ports.

Current domestic movement and the optimization of fertilizers

While rail is currently the primary mode of transport for long-distance fertilizer movement, analysis of research data and expert opinions indicate that a modal-mix shift towards coastal shipping can significantly reduce costs.

An analysis of the key inter-state rail movements was conducted across the country to examine the origination-destination of fertilizer movement. At the same time, a cost comparison of all possible combinations of the modal mix was also done under different scenarios of vessel capacity (Exhibit 100). For example, the movement between Andhra Pradesh and Maharashtra costs INR 1928 per tonne via rail, while the same movement via road and rail-supported coastal shipping could cost as little as INR 1,415 per tonne – a potential cost saving of nearly 25 to 30 percent (Exhibit 101).

EXHIBIT 100

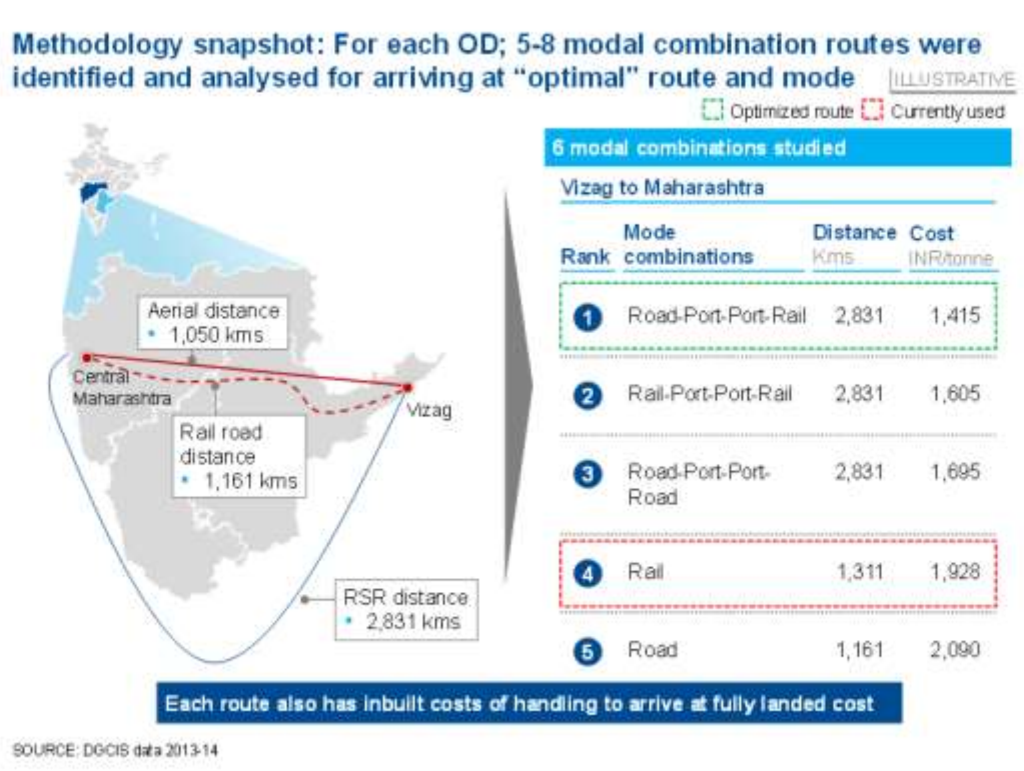


EXHIBIT 101

Estimated transportation cost from Vizag to Central Maharashtra via Vizag and Mumbai Port			
Cost head	**Distance** (km)	**Rate** (INR per ton per km)	**Total** (INR per ton)
Road freight from plant to port	11	5	55
Ocean (Vizag to Mumbai)	2,670	0.25	668
Port handling at Vizag			150
Port handling at Mumbai			150
Rail handling			150
Rail freight from Mumbai to Pune	148	1.7	243
Total cost			**1,415**

Coastal plants in Andhra Pradesh and Gujarat have the potential to coastally ship their products to the peninsular states. If an efficient aggregation system is put in place, the parcel size of individual plants which is currently not enough to sustain the year around movement of large ships along the coast could be collaborated based on homogeneity, and movement could be made feasible.

If key rail movements are considered to be from the major fertilizer plants to the top-200 fertilizer-consuming districts in the country, around 10 plants have the potential to shift to coastal shipping (Exhibit 102).

EXHIBIT 102

Plant wise potential to shift to coastal

Plant	Location	Volume Potential to shift to coastal (in MTPA)
Coromandel	Vizag	1.0-1.2
RCFL	Vizag	1.0-1.2
GSFCL	Sikka	0.4-0.5
IFFCO	Kandla	0.4-0.5
IFFCO	Kalol	0.2-0.3
IFFCO	Paradeep	0.3-0.4
GSFCL	Rourkela	0.2-0.3
SPIC	Tuticorin	0.4-0.5
RCFL	Mumbai	0.2-0.3

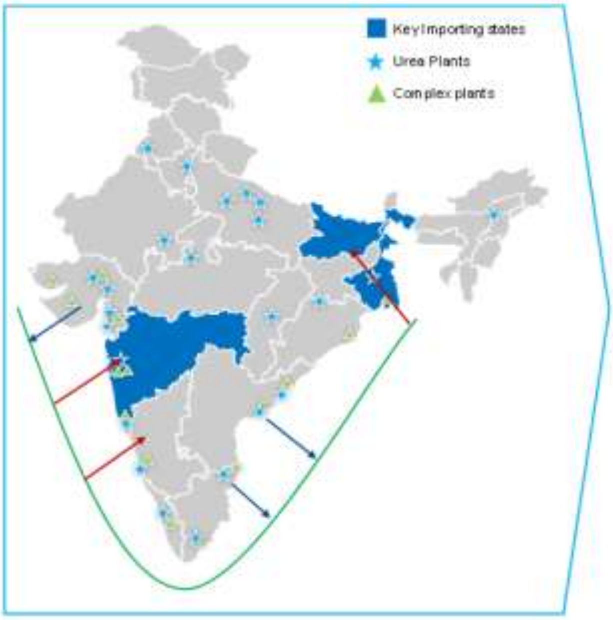
Fertilizer corporations with multiple plant locations across the country seem to have the highest potential to leverage coastal shipping (e.g., IFFCO and RINL). Urea and complex fertilizers are homogenous goods and cumulative capacity provides a unique combination of movements, which enable backhaul thus, further reduces coastal shipping costs.

Coastal plants in Gujarat and Andhra Pradesh provide a unique set of circumstances—they are located along the coast, have large plants and are far from the primary consumption hinterlands of fertilizers. Some of these plants could also be combined based on location for a cluster-based view on the potential for fertilizer movement. It is possible to consolidate the movements for a cluster and use larger ships for economies of scale on these routes.

Even if the price differential between individual ODs is minimal, a shift to coastal shipping could potentially ease the pressure on an already congested rail network. Data suggests that with the right infrastructure and institutional support, it could be possible to move around six to seven MMTPA of fertilizers via coastal shipping—saving nearly INR 800 Crores to 900 Crores per annum (Exhibit 103).

EXHIBIT 103

Total opportunity for coastal movement of fertilisers is 6-7 MMTPA



Route	Volume, '000 TPA
Coastal Gujarat to Coastal Maharashtra	720
Coastal Andhra Pradesh to Bihar	430
Coastal Andhra Pradesh to Maharashtra	410
Coastal Andhra to West Bengal	620
Odisha to Andhra Pradesh	326
Coastal TN to Coastal Karnataka	298
Coastal Andhra Pradesh to Tamil Nadu	271
Coastal Andhra Pradesh to Odisha	265
Gujarat to Andhra Pradesh	234
Coastal TN to Coastal Karnataka	187
Total Savings Potential (~6MTPA)	**500-1000 crores**

Imperatives for relevant ports

Maximum export capacity will be required at the Andhra Pradesh ports. The western and southern Gujarat cluster will also require significant export capacity.

From an imports perspective, ports in Maharashtra will require significant capacity augmentation to cater to the requirements of Vidarbha, etc. The West Bengal region will also require greater capacity to cater to Bihar and the Eastern hinterland. These needs can warrant dedicated berths at these ports in the future.

In addition to the potential for coastal shipping, there exists a scope to mechanize the existing berths in order to reduce the overall import cost and time for the country, this will also lead to a cleaning up of the ports and ease in transporting the fertilizers out of the port. Mechanization of berth #6 at Kandla which can be directly connected to a full rake length warehouse via a conveyor system is one of the proposals being considered under this initiative.

Not only is the mechanization of berths the only requirement, ports most also equip themselves with the provision to handle clean cargo. Paradip and Haldia are best places to cater to the traffic of Up and Bihar, if better handling facilities are made in these ports the logistics cost of importing fertilizers can be brought down further. Containerization of cargo can also be looked into to ensure that the movement of the cargo is safer and the quality of the final delivered product is in the best condition for the farmers of the country. Additionally being a time sensitive cargo it would be important for the operators to ensure that the lead time is reduced as much as possible hence further warranting the need of dedicated coastal import/export berths at high volume handling ports throughout the country

Key enablers to capture the opportunity: Next steps

Aligning various stakeholders and decision makers involved at various stages of the fertilizers movement value chain would be one of the most important drivers to increase the coastal shipping of fertilizers. Private-sector investment would also need to be encouraged and incentivized through PPP models for port infrastructure, railway infrastructure and coastal shipping.

Significant action points and discussions would be needed to make the coastal shipping of fertilizers a reality

- On-boarding of private players to initiate coastal shipping
- Creating dedicated coastal berths, bunkering and storage capacities at relevant ports
- Establishing a coastal shipping fleet dedicated to carrying POL products under the Shipping Corporation of India
- Developing appropriate ship-repairing/ship-building facilities at key ports; currently, most ship repairs happen outside the country

OPTIMIZATION OF EXIM CONTAINERS: CRASH LOGISTICS TIME AND COST

Container traffic at Indian ports has grown at an average CAGR[14] of 8 percent in the past decade. The non-major ports (private or state-owned) continued to fare better than the major government-owned ports, with a growth of over 24 percent in 2014–15. These non-major ports have registered higher growth rates in the past five years or so due to their adequate container-handling capacity, improved road and rail connectivity, better draft levels, and modern equipment and technology for faster cargo evacuation.

Sagarmala studies reveal that two optimization levers can lead to potential savings of ~INR 7,000-9,000 Crores per annum

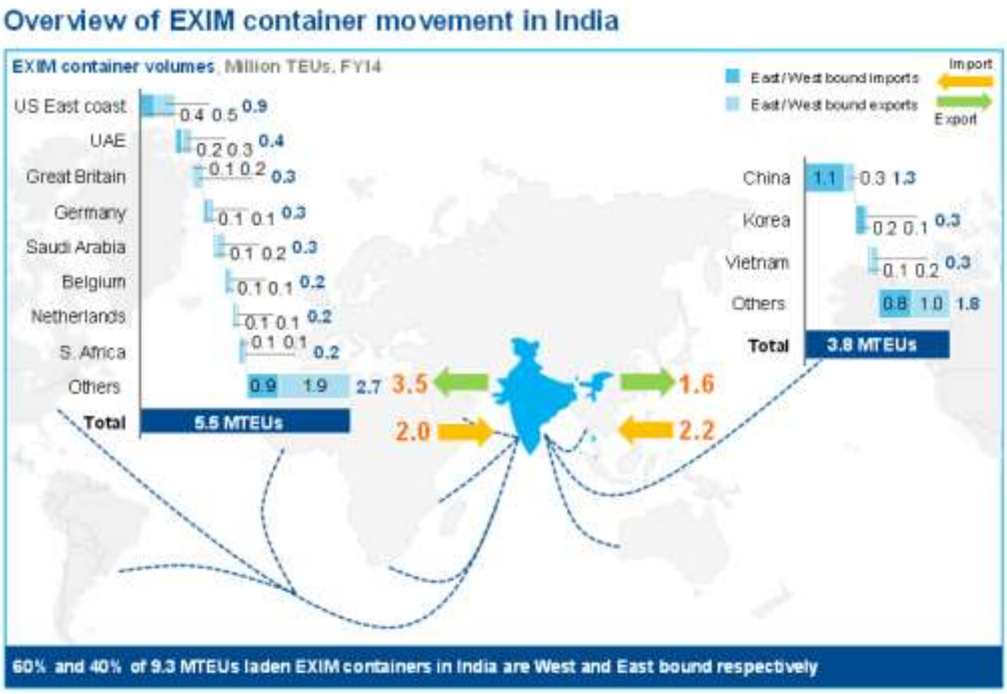
- Reduced transit time can save inventory handling cost of ~INR 5,000 Crores to 6,000 Crores per annum
- Modal shift from road to rail can save ~INR 2,000 to 3,000 Crores per annum in terms of fuel import bill

[14] Compounded Annual Growth Rate

Current EXIM container movement to/from and within India

EXIM container movement in the country, including empties, was 10.7 MTEUs during FY 2014. Of the 9.3 MTEUs laden container volume, 60 percent was west-bound, and the remaining 40 percent was east-bound. China and the US accounted for approximately 14 percent and 10 percent respectively of the EXIM container volumes to/from India, while the remaining was split between several countries including the UAE, United Kingdom, Germany, Saudi Arabia, Korea, Vietnam and others. With respect to the overall balance of trade in containers, India exported 5.1 MTEUs while it imported 4.2 MTEUs during FY 2014 (Exhibit 104).

EXHIBIT 104

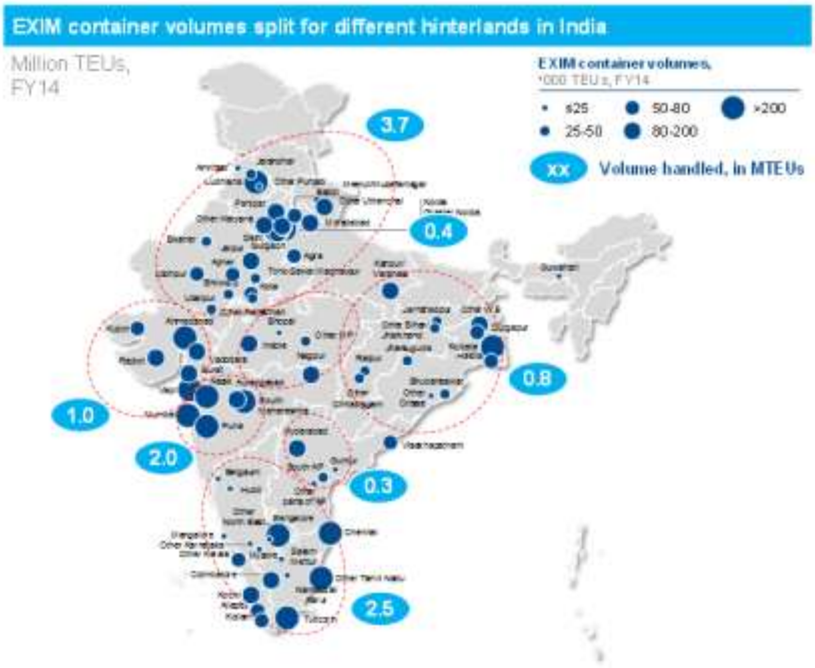


SOURCE: Khambadkones; APMT; IPA statistics; Stakeholder interviews

Out of the 10.7 MTEUs of total container volume, 0.6 MTEUs is coastally shipped traffic, 7.4 MTEUs is gateway traffic and 2.7 MTEUs is transshipped. Colombo, Singapore and Klang account for approximately 75 percent of transshipped cargo from India.

Three major hinterlands in India—the northwest, west and southern clusters—account for roughly 90 percent of container volumes. The northwest cluster is farthest from the coastline and is the largest cluster, generating 3.7 MTEUs of container volumes in FY 2014. It therefore has the greatest impact on the overall logistics cost of container movement. It lies at a weighted average distance of 1,087 km from the Gujarat/JNPT port cluster. The container-handling hinterlands in the country are mapped in Exhibit 105 along with the individual volumes handled.

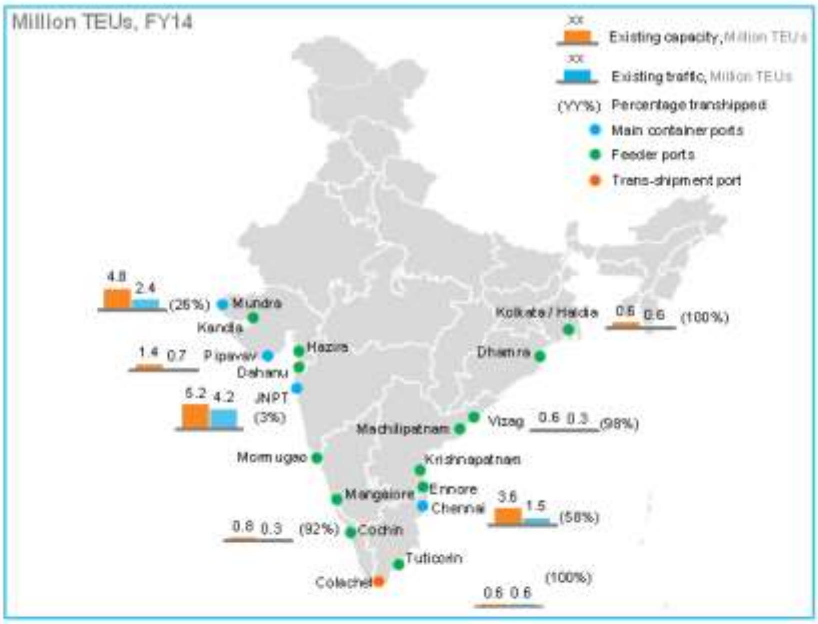
EXHIBIT 105



SOURCE: APMT; IPA statistics; Stakeholder interviews

The Gujarat-Maharashtra port cluster comprising the Mundra, Kandla, Pipavav and JNPT ports handles 70 percent of India's EXIM traffic, while Chennai handles another 14 percent. Other ports on the east coast—Haldia, Vizag and Tuticorin—account for the remaining traffic. Around 78 percent of the traffic from the east coast ports is transshipped in the absence of sufficient traffic to attract a gateway movement. Exhibit 106 shows the current traffic, handling capacity and the percentage of cargo transshipped at ports.

EXHIBIT 106



SOURCE: APMT; Expert interviews

Exhibit 107 below details the current split of container traffic at ports originating from the different hinterland clusters for FY 2014. Mundra and Pipavav are the only ports whose primary hinterland lies outside the port state. Also, a significant portion of the total traffic from the hinterlands of NCR and Punjab is handled at JNPT even though they are closer to the Gujarat port cluster.

EXHIBIT 107

Hinterland to port mapping of EXIM container movement

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Vallarpadam	Visakhapatnam	Mangalore	Hinterland total
NCR+Punjab	936	1,284	0	329	0	0	0	0	0	2,543
Maharashtra	2,121	54	0	0	0	0	0	0	0	2,177
Tamil Nadu	0	0	1,240	0	484	0	0	0	0	1,724
Gujarat	552	262	0	169	0	0	0	0	0	984
Uttar Pradesh	228	274	0	107	0	0	0	0	0	612
West Bengal	0	0	0	0	0	458	0	0	0	458
Rajasthan	43	448	0	60	0	0	0	0	0	560
Karnataka	94	0	163	0	66	0	0	0	50	408
Kerala	0	0	0	0	0	0	351	3	0	351
Andhra Pradesh	75	0	66	0	0	0	0	110	0	253
Madhya Pradesh	43	70	0	14	0	0	0	29	0	156
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0	93
Uttaranchal	96	0	0	0	0	0	0	0	0	96
Odisha	0	0	0	0	0	12	0	69	0	81
Chhattisgarh	16	18	0	14	0	0	0	16	0	64
North East	0	0	0	0	0	7	0	0	0	7
Port total	4,202	2,390	1,468	683	651	562	351	263	50	10,711

SOURCE: APMT; Expert interviews

With respect to the modal mix for container movement from the hinterland to the ports, road has an 82 percent share overall while rail accounts for just 18 percent. The rail coefficient for five out of the eight major container-handling ports is less than 10 percent. The next section describes the reasons for the existing modal mix and the time and cost challenges in inland logistics.

Challenges in the current movement: Cost and time

The major challenges for each mode in the inland transportation of containers are mentioned below.

Rail

- Congestion and priority to passenger trains adds to delays in freight transportation
- Cross-subsidization between passenger and freight yields have made the railways unviable for most transportation routes. This results in a greater preference for road, which is not the ideal mode of transportation for the long haul
- Overcrowded ICDs (Inland Container Depots) in the northern cluster cannot get enough traffic to ensure even two rakes per day, adding to the waiting time for cargo at ICDs

Road: High congestion, specifically in the stretch from container freight stations to the port gate, leads to huge delays. This issue is more prominent in public ports like JNPT and Chennai.

Others: Due to issues pertaining to the unreliability of schedules, the time for customs clearance at ICD/CFS and the congestion on roads and rail, shippers build a lot of buffer into the transportation schedule, leading to idle waiting time for export cargo at ports.

A benchmarking of cost and time required for the end-to-end transportation of a container in India vis-à-vis in China reveals specific actionable insights (Exhibit 108).

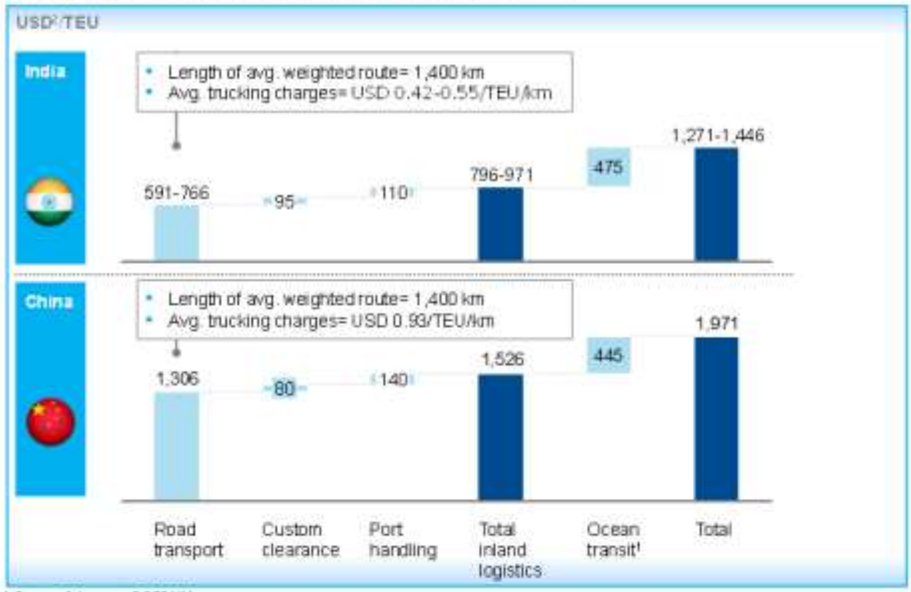
Cost

- **Road:** The weighted average of distance between the manufacturing hinterlands and the port for India is 700 to 800 km compared to 150 to 300 km in China. Even though India fares better than China in the transportation cost for a comparable distance, longer hinterland to port distance leads to higher costs for exporting/importing a container in India as compared to China (Exhibit 108 and 109).

EXHIBIT 108

Comparison of end-to-end cost of transporting a container in India and China by road on similar routes

BOTTOM UP ANALYSIS FOR ROAD COST



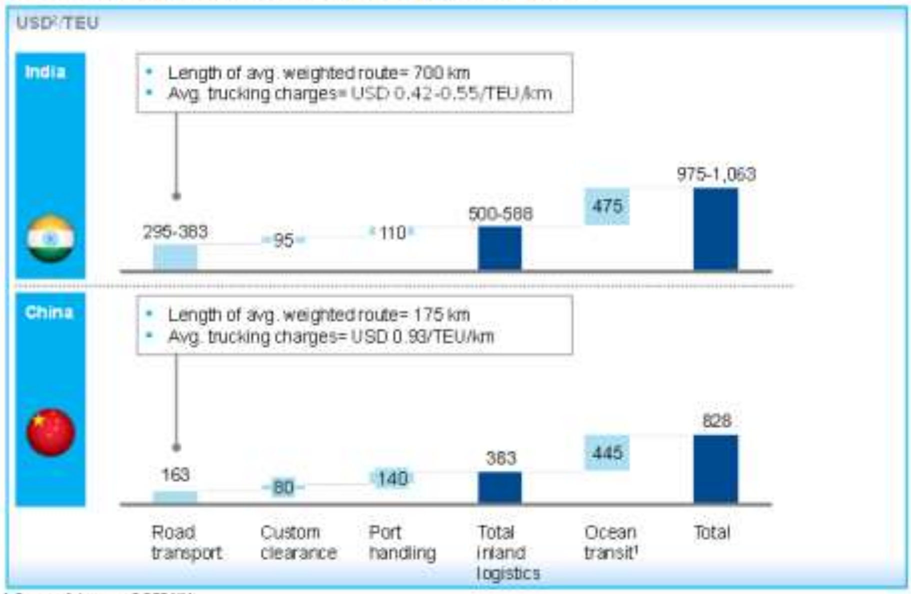
1 Ocean distance = 6,658 NM
2 USD to INR exchange rate= 64; USD to RMB exchange rate= 6.4

SOURCE: Interviews with Truck companies, CTOs, Freight forwarders, Importers, Exporters, Port management; World Bank

EXHIBIT 109

Comparison of end-to-end cost of transporting a container in India and China by road on a typical route

BOTTOM UP ANALYSIS FOR ROAD COST

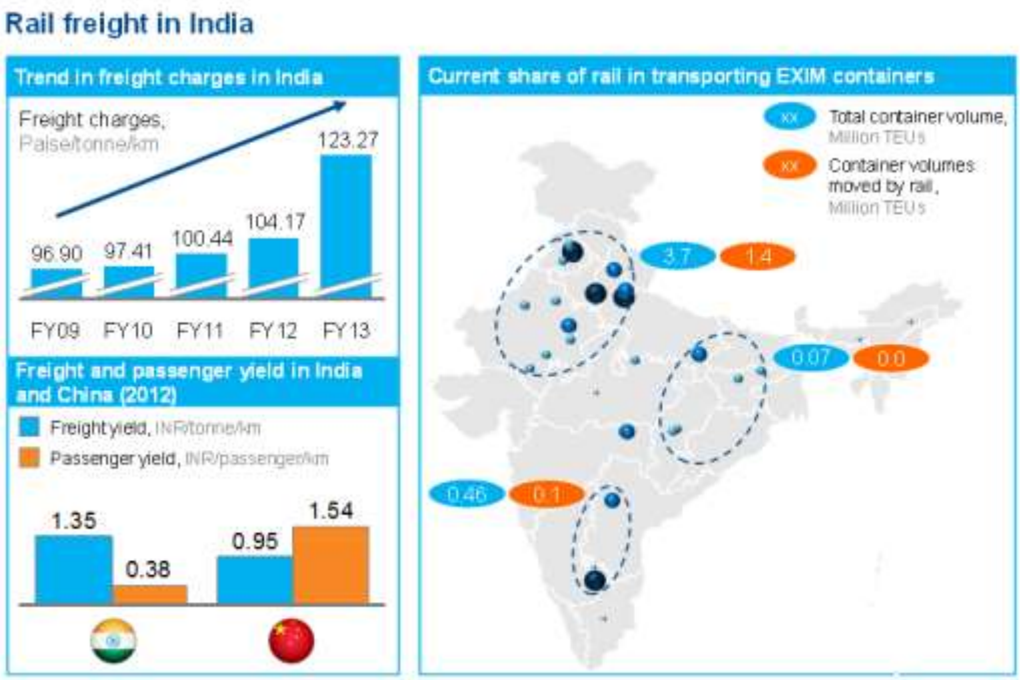


1 Ocean distance = 6,658 NM
2 USD to INR exchange rate= 64; USD to RMB exchange rate= 6.4

SOURCE: Interviews with Truck companies, CTOs, Freight forwarders, Importers, Exporters, Port management; World Bank

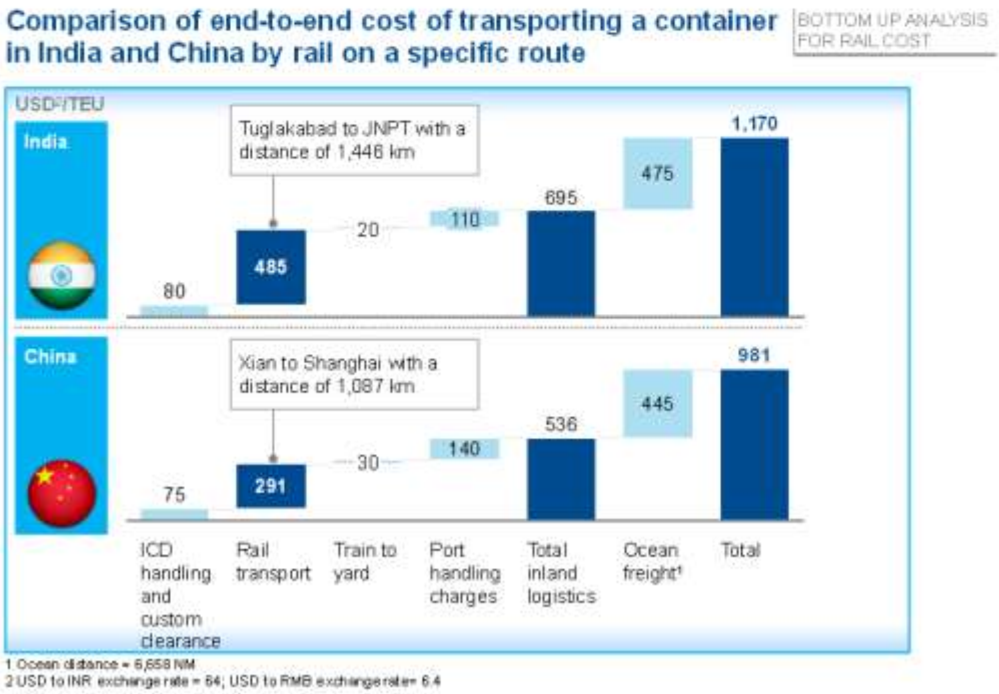
Rail: Higher haulage charges due to cross-subsidization (unlike in China) make exports/imports expensive in India. The recent increase in freight charges has further aggravated the issue. Exhibit 110 compares India and China with respect to yields and shows increases in cargo freights. Exhibit 111 compares the countries on the current end-to-end cost of transporting a container via rail on a typical route.

EXHIBIT 110



SOURCE: APMT; Khambadkones; IPA statistics; Stakeholder interviews, White paper- Indian Railways

EXHIBIT 111

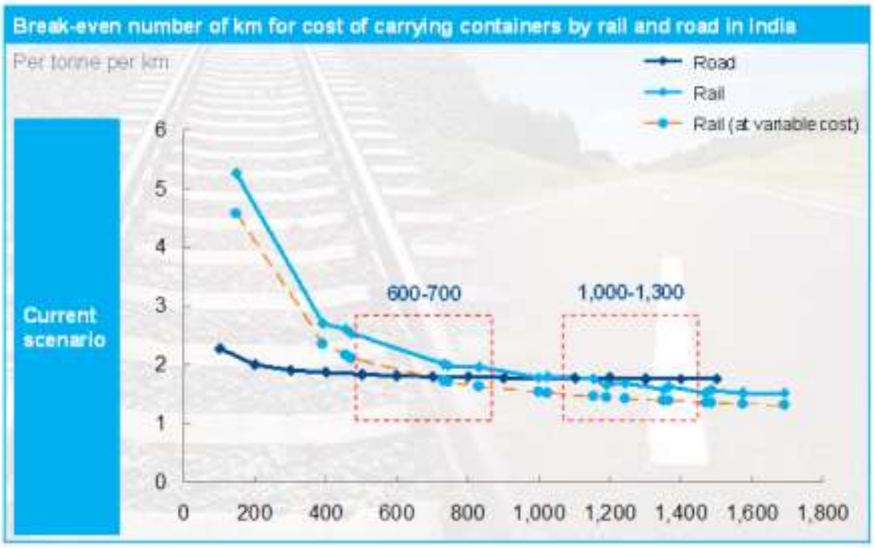


Implications for modal mix: Due to the freight charges on road and rail and handling cost involved, rail in India is currently viable for shippers only for a transportation distance beyond 1,000 to 1,300 km. This makes the northwest cluster the primary hinterland where rail becomes viable for inland container transportation. It is also noteworthy that the differential cost between road and rail remains minimal even beyond a distance of 1,000 to 1,300 km. Due to this only 38% of the total volume from this cluster moves by rail.

Assuming a scenario where the rail charges only the cost incurred to transport containers without any markup, the viable distance for shippers to use rail reduces to 600 or 700 km. This implies that many routes from the hinterland to the ports will not shift from road to rail because of the economics involved. Exhibit 112 shows the break-even distance by road and rail under the two scenarios mentioned above. Exhibit 113 shows the key routes handling more than 50,000 TEUs, which should ideally be on rail but are currently using road for the majority of the volume.

EXHIBIT 112

Break-even distance by road and rail



SOURCE: CONCOR; Transporter interviews

EXHIBIT 113

Key rail routes currently using roads

ONLY ROUTES WITH HANDLING >50K TEUS

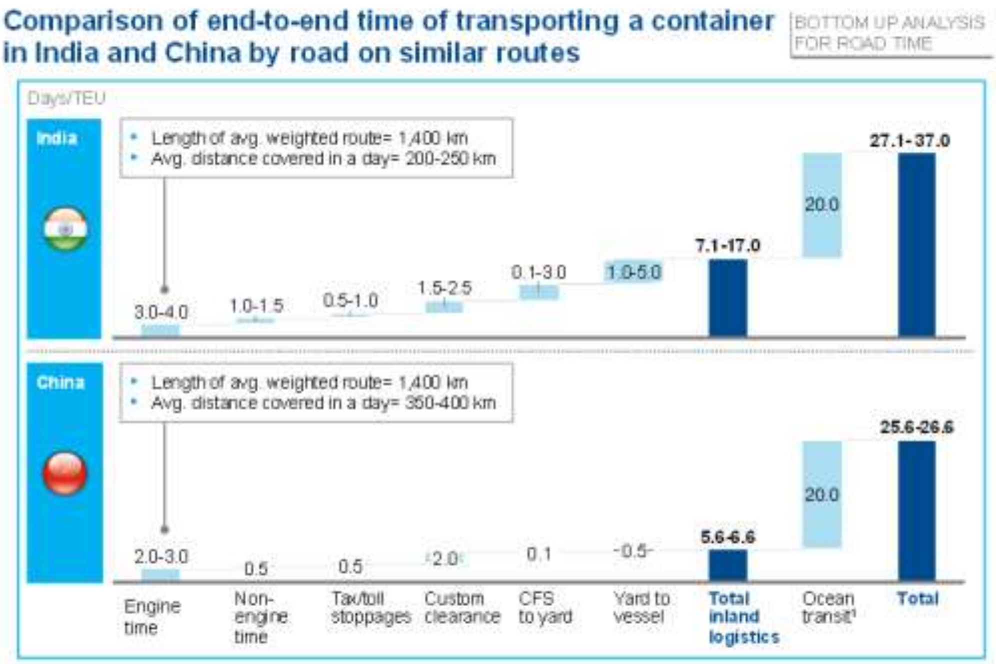
S. No.	Route	Current mode	EXIM volumes '000 TEUs, FY 14
1	NCR – Gujarat/ JNPT	38% rail, 62% road	2,141
2	Ludhiana – Gujarat/ JNPT	63% rail, 37% road	301
3	Other parts of UP – Gujarat/JNPT	15% rail, 85% road	235
4	Moradabad – Gujarat/JNPT	27% rail, 73% road	130
5	Kanpur/Lucknow/Varanasi – Gujarat/JNPT	47% rail, 53% road	106
6	Jaipur – Gujarat/JNPT	44% rail, 56% road	105
7	Ajmer/Kishengarh – Gujarat/JNPT	100% road	90
8	Other parts of Uttaranchal – Gujarat/JNPT	15% rail, 85% road	88
9	Agra/Aligarh/Mathura – Gujarat/JNPT	10% rail, 90% road	71
10	Meerut/Muzafarnagar – Gujarat/JNPT	100% road	71
11	Jodhpur – Gujarat/JNPT	66% rail, 34% road	68
12	Kota – Gujarat/JNPT	16% rail, 84% road	64
13	Bikaner – Gujarat/JNPT	16% rail, 84% road	58
14	Tonk Sawai – Gujarat/JNPT	16% rail, 84% road	58
	Total		3,586

SOURCE: APMT

Time: Indian containers can take around 50 percent longer than Chinese containers for a similar inland distance. The duration is highly variable due to the lack of automation in customs processes, lower speed of trucks and trains, and congestion and inefficiency at ports (especially major ports). This unreliability of transport schedules forces shippers to incorporate buffers into timelines, increasing variability of idle time at the yard.

Exhibit 114 and 115 compare the time taken by an Indian export container vis-à-vis a Chinese export container for both road and rail as a mode of inland transportation for a specific route. As can be seen, the major difference is the variability of time taken for inland transportation, primarily due to the yard-to-vessel stage.

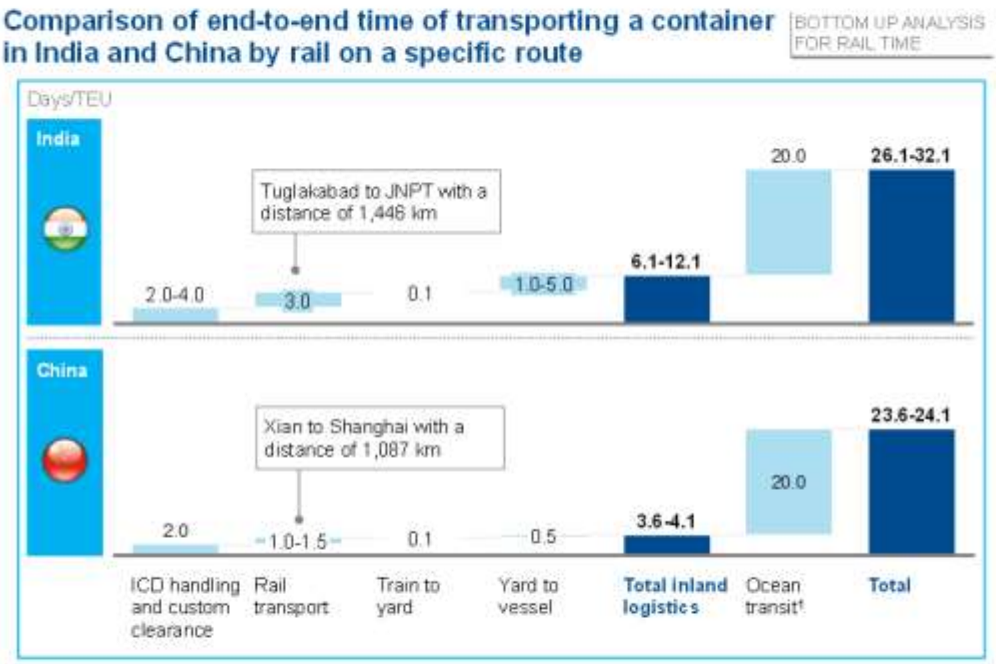
EXHIBIT 114



1 Ocean distance = 6,658 NM

SOURCE: Interviews with Truck companies; CTOs; Freight forwarders; Importers; Exporters; Port management; World Bank

EXHIBIT 115



1 Ocean distance = 6,658 NM

SOURCE: Interviews with Truck companies; CTOs; Freight forwarders; Importers; Exporters; Port management; World Bank

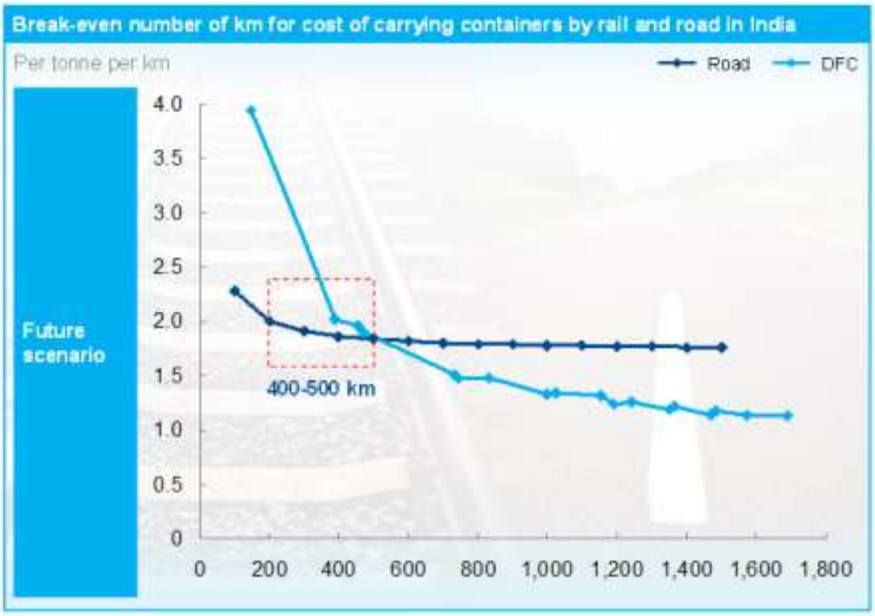
Potential to reduce time and cost through different levers

The study identifies three broad levers and a total of twenty-one projects to enable reduction of inland transit time for containers by four to seven days. Estimated four to seven days will be saved on the northwest cluster to Gujarat/JNPT port cluster and three to four for other routes. The three themes include customs efficiency, last-mile connectivity and process improvement at ports and road infrastructure for efficient hinterland evacuation. The inventory cost saved on account of this is estimated at INR 5,000-6,000 Cr by 2025. Savings will also come from instances of lost contracts, cost of obsolescence, etc., which currently happens due to variability in transit times and shippers missing out on the scheduled timelines for shipment.

The study also identifies two broad levers and a total of nine projects to increase rail's share in the container modal mix from 18% to 25% resulting in savings of ~INR 2,000-3,000 Cr through reduction in fuel import bill. Rationalizing rail rates for containers could reduce the cut-off distance for the viability of rail from 1,000-1,300 km as shown for current rail to 400-500 km (Exhibit 116). This could enable changing the modal mix from road to rail, especially for the northern India hinterland, saving on fuel imports for India (Exhibit 117). Hence, by 2025 this could result in an overall saving of ~INR 7,000-9,000 Cr enabled by the proposed projects.

EXHIBIT 116

Break-even distance by road and rail



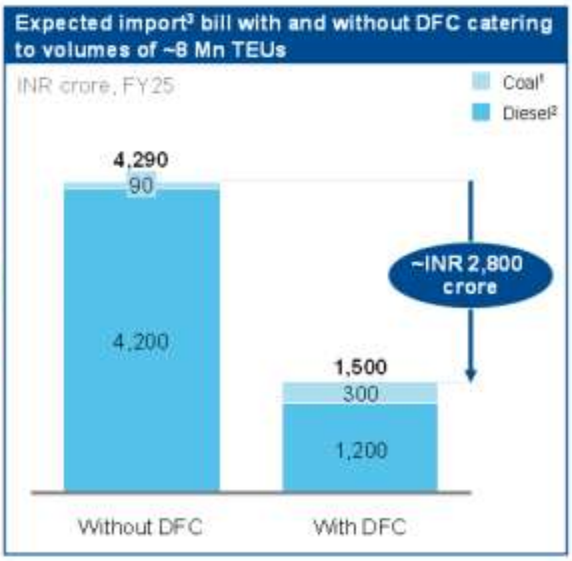
SOURCE: CONCOR; Transporter interviews

EXHIBIT 117

Savings due to reduction in crude import bill due to higher rail share

Assumptions

- Main rail route: North-west region to Gujarat/ JNPT port cluster
- Avg. weighted distance: 1,087 km
- Year of operation of Western DFC: FY20
- Rail coefficient without DFC: 38%
- Rail coefficient with DFC: 80%
- Level of electrification of present trains by FY20: 47%
- Level of electrification of DFC: 100%



1 Present rail and DFC electric locomotive consuming 0.011 KWh*0.48kg and 0.008 KWh*0.48kg of coal per NTKM
2 Present rail diesel locomotive and truck consuming 0.0045 litres and 0.0143 litres of diesel per NTKM
3 Import cost for coal and diesel assumed to be INR 5.64/kg and INR 25.37/ litre respectively

SOURCE: IOCL; IIMA

The list of projects identified under the different levers is as mentioned below

1. Reduction of inland transit time by four to seven days

Lever #1.1: Customs efficiency

- **Project 1:** Simplification of registration process for factory stuffing and self-sealing of containers to enable higher proportion of green channel volumes
- **Project 2:** Installation of container scanners at all major container ports, ICDs and CFSs to facilitate green channel custom clearance
- **Project 3:** Dedicated fast lane processing area for clearance at the ports for "credible" rated institutional players
- **Project 4:** Linkage of EXIM licenses to unique identification numbers to allow for deferred checking of documents
- **Project 5:** Increased staff strength of customs to provide 24*7 service for importers and exporters
- **Project 6:** Complete automation of filing IGM / EGM with all formalities for submission of hard copies to different organization dispensed with
- **Project 7:** Uniform specific/ detailed guidelines across all parties and in all geographies involved
- **Project 8:** Vessels should be allowed to carry domestic as well as international containers. Coastal ships to be allowed to pick up EXIM cargo for ports en route

Lever #1.2: Last mile-connectivity

- **Project 9:** Increased port and port gate capacity to facilitate faster movement of container from gate to yard and yard to vessel
- **Project 10:** Reduced lead time at the gate through OCR (Optical Character Recognition) based automation
- **Project 11:** Evacuation and penalty mechanism for trucks lacking necessary approvals or documents
- **Project 12:** Setting up of truck holding areas for the drivers with basic facilities, to avoid truck parking in shoulder areas

Lever #1.3: Road infrastructure

- **Project 9:** Dedicated toll lanes for the EXIM container trucks on National highways
- **Project 10:** Construction of freight friendly road corridors from Ahmedabad/Vadodara/ Surat/Vapi to JNPT
- **Project 11:** Construction of freight friendly road corridors from Hyderabad/Amravati to Central Andhra Pradesh port

- **Project 12:** Construction of freight friendly road corridors from Hyderabad to JNPT
- **Project 13:** Construction of freight friendly road corridors from Bangalore to Mangalore
- **Project 14:** Construction of freight friendly road corridors from Bangalore/Trichy to Colachel
- **Project 15:** Construction of freight friendly road corridors from Coimbatore to Colachel
- **Project 16:** Construction of freight friendly road corridors from Durgapur to Haldia
- **Project 17:** Construction of freight friendly road corridors from Pune to JNPT
- **Project 18:** Construction of freight friendly road corridors from Bangalore to Chennai
- **Project 19:** Construction of freight friendly road corridors from Ahmedabad to Mundra
- **Project 20:** Construction of freight friendly road corridors from Ahmedabad to Pipavav
- **Project 21:** RFID enabled toll and inter-state checks

2. Reduced import bill due to modal shift: Rail share improvement from 18% to 25%

Lever #2.1: DFC and connectivity to ports

- **Project 1:** Connection of western DFC to Mundra port
- **Project 2:** Connection of western DFC to Pipavav port
- **Project 3:** Connection of western DFC to Hazira port
- **Project 4:** Connection of western DFC to Kandla port

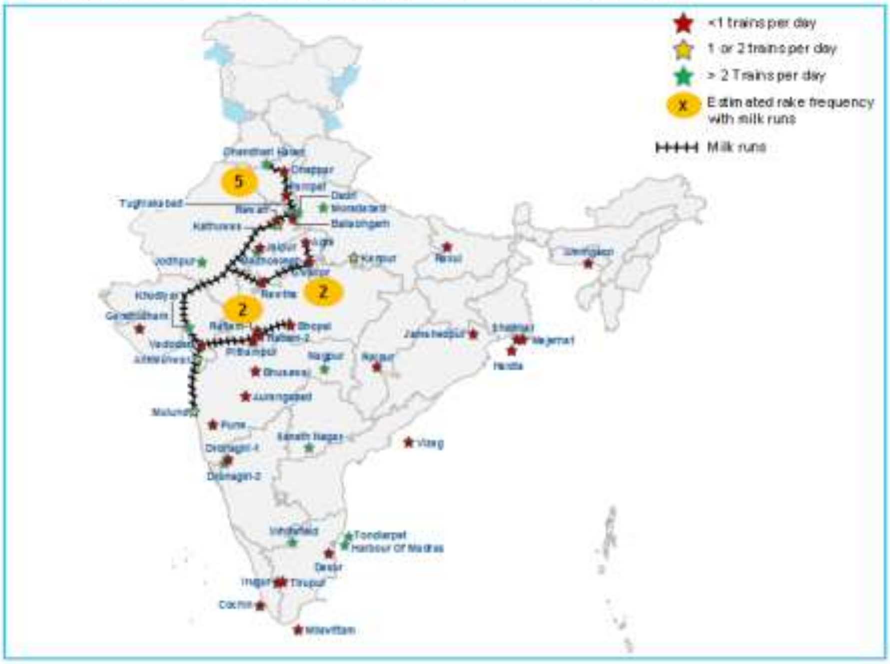
Lever #2.2: Multimodal grid connectivity and efficiency projects

- **Project 5**: Inter-connection of ICDs, Dhandhari Kalan→Dhappar→Panipat →Tughlakabad through a milk run with DFC (Exhibit 119)
- **Project 6:** Inter-connection of ICDs, Agra→Gwalior→Rawtha through a milk run with DFC (Exhibit 119)
- **Project 7:** Inter-connection of ICDs, Bhopal→Ratlam→Pithampur→Vadodara through a milk run with DFC (Exhibit 118)

- **Project 8:** Fixed rail schedule for each ICD to reduce variability in transit time
- **Project 9:** Revamp of ICD approval process to avoid overcrowding of ICDs; Ensure mega ICDs along the upcoming DFC exploit full potential
- **Project 10:** ICDs to be used as common rail terminals to ensure maximum utilisation of the already done capital expenditure projects
- **Projects 11:** New Multimodal hubs namely
  - Hubli (Karnataka)
  - Managalore(Karantaka)
  - Darjeeling(West Bengal)
  - Bhubaneswar(Odisha)
  - Singarauli (Madhya Pradesh)
  - Nagaur (Rajasthan)

EXHIBIT 118

Need for upgradation and aggregation of existing ICDs



SOURCE: IPA

Lever #2.3: Rail freight charges rationalization

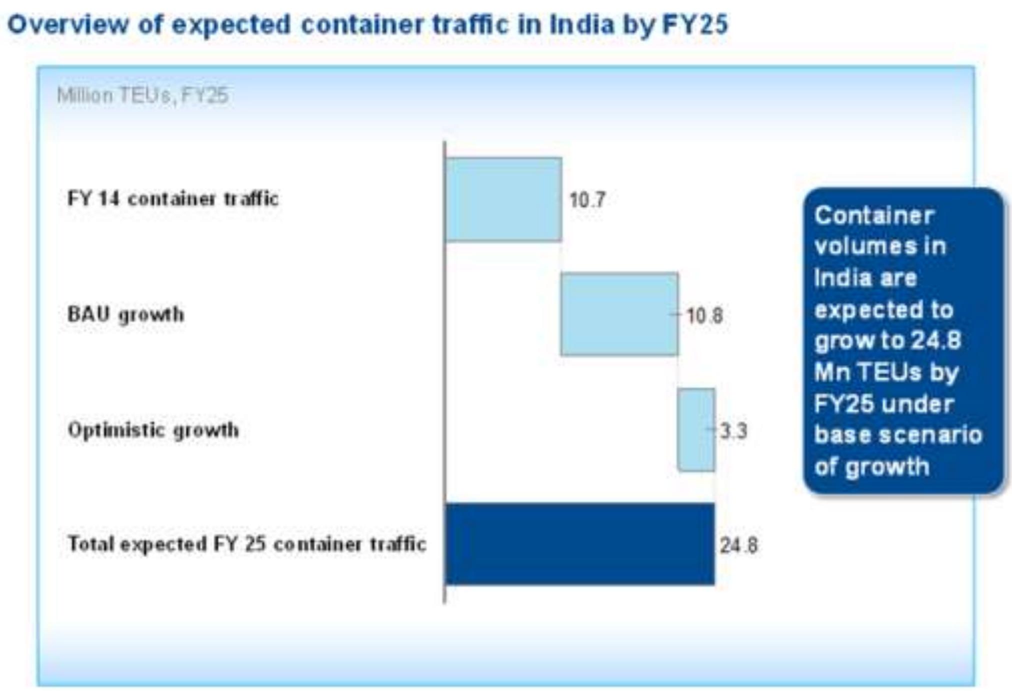
- **Project 9:** Immediate requirement of rationalization of rail freight charges especially for the proposed Dedicated Freight Corridor (DFC) to increase trade competitiveness, de-congest road & port gates and from an environment point of view

Projected future traffic of EXIM containers: Business as usual and additional through port-led development

We have analyzed two scenarios for growth projections of containers (Exhibit 119). The scenarios are:

- Business-as-usual: With the sustenance of past growth rate, FY 2014 traffic of 10.7 MTEUs is expected to be 21.5 MTEUs in FY 2025
- Optimistic scenario: With boost from "Make in India" and upcoming industrial corridors (DMIC, VCIC, CBIC, etc.), the container traffic could grow to 24.8 MTEUs in FY 2025 registering a CAGR of ~8%

EXHIBIT 119



Recommended 2025 network: Port and hinterland connectivity network

Considering the projected OD mapping for containers by FY 2025, the recommended port and hinterland network could include

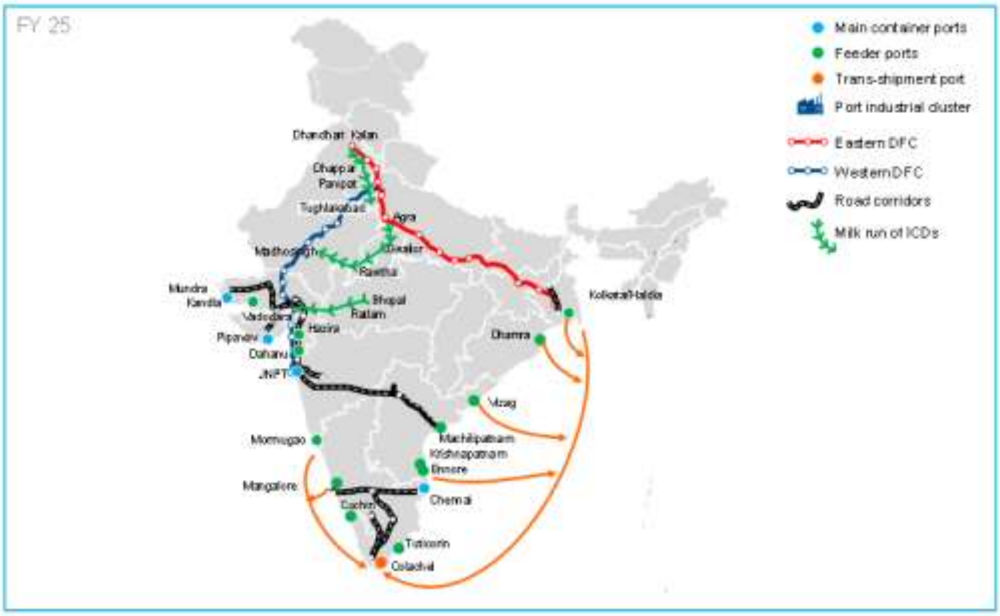
- Colachal as a transshipment port on the southern tip

- Machilipatnam to serve the growing hinterland of Andhra Pradesh
- Mundra, Pipavav, JNPT and Chennai to serve as main container ports with all other ports feeding into these ports or Colachel for transshipment
- Eleven high-density road routes connecting specific hinterlands to ports
- Western DFC and appropriate connectivity of the ICD network to DFC through three milk runs
- Industrial port clusters in Gujarat, Maharashtra, the southern tip, central Andhra Pradesh, northern Tamil Nadu and West Bengal

Exhibit 120 shows the recommended 2025 network with port and hinterland connectivity

EXHIBIT 120

Optimised container network in India



A.6.6 Key enablers: Steps required to capture the opportunity

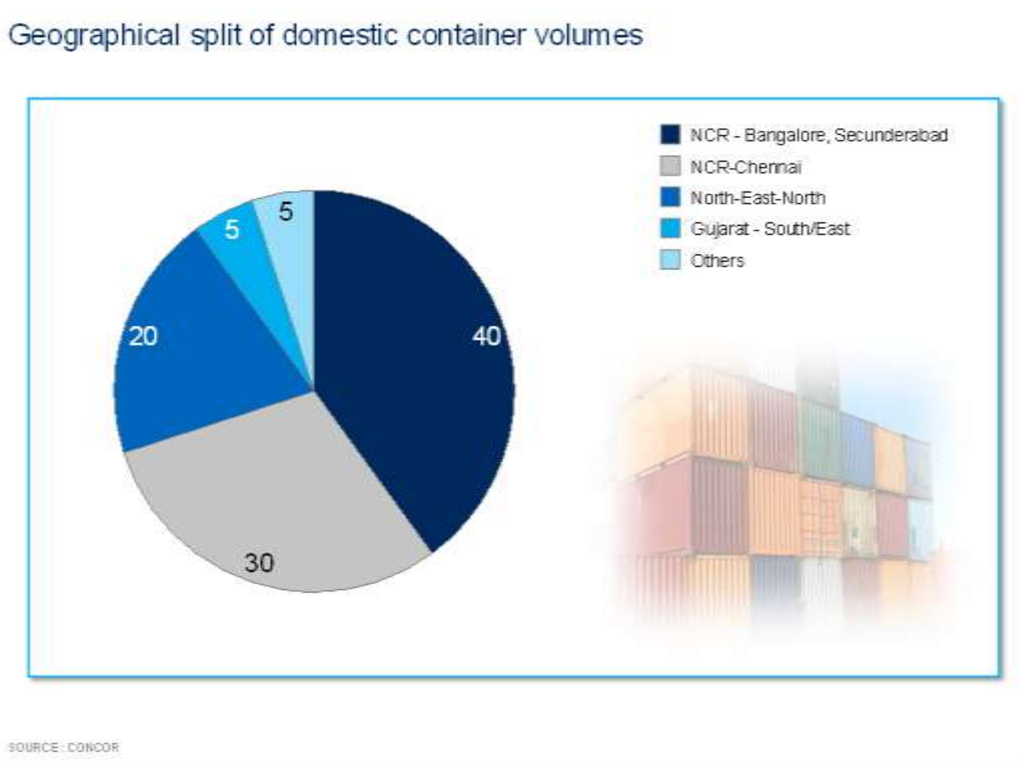
Different stakeholders need to come together to capture the opportunity of achieving potential savings of **INR 7,000-9,000 Crores** per annum by FY 2025. The Ministry of Shipping could act as the nodal agency to develop a concrete plan for an efficient container port network, including a gateway, feeder and transshipment port. It could work with different organizations like Department of Industrial Policy and Promotion to develop a strategy on port-led development, Central Board of Excise and Customs to streamline customs procedures, the Indian Railways and CTOs to ensure rationalization of rail-freight charges and optimization and aggregation of the ICD network.

Coastal shipping of Domestic Containers

The Sagarmala project's vision is to reduce logistics cost for both domestic and EXIM cargo with minimal infrastructural investment. As part of the programme, coastal shipping potential has been identified for various commodities like thermal coal, steel, cement, POL and fertilizers. Coastal shipping is significantly cheaper as compared to road and rail transport. This note identifies the potential for coastal shipping of domestic containers.

Domestic container market is estimated to be around 450,000 – 500,000 TEUs, out of which around 350,000 – 375,000 are transported by rail. Container Corporation of India (CONCOR) has 67% market share in domestic containers transported by rail. Based on the geographical split of domestic container volumes handled by CONCOR (Exhibit 121), coastal shipping potential has been estimated. Containers moved by road are limited to a distance of about 200-300 kms and hence are not considered for coastal shipping analysis

EXHIBIT 121



Containers moving via rail from NCR to South and vice versa are destined for three locations in South India – Secunderabad, Chennai and Bangalore. Some of the commodities being transported are rice, garments and auto components. Secundarabad and Bangalore being far away from the coast are not feasible for coastal shipping. For Chennai, cost of transportation via rail and rail-sea-rail route has been calculated. As can be seen in Exhibit 122, coastal shipping is cheaper than railways. Approximately 100,000 TEUs of containers moving to and from NCR to Chennai could be switched to coastal shipping.

EXHIBIT 122

In addition to this, 18,000–20,000 TEUs containers moving from Gujarat to Southern and Eastern States could be switched to coastal shipping. Movement from Ahmedabad to Haldia by rail over a distance of 2,043 km has cost of Rs 2,958 versus coastal shipping cost of around Rs 1550. Similarly coastal shipping from Ahmedabad to Mangalore costs Rs 1,300 versus rail cost of Rs 2400.

Therefore, there is an overall potential of around 120,000 TEUs of containers that could be switched to coastal shipping.

High potential enablers to capture the opportunity

Analysis indicates that cargo traffic at ports is projected to increase to around 2.2 to 2.5 bn MMTPA by 2025 from the current 972 MMTPA (2013-14). The transport requirements for bulk commodities are therefore going to increase over the next two decades.

An integrated, well-defined set of next steps and recommendations is necessary to draft an execution plan to rapidly improve the bulk transport system. India needs to execute the plan to ensure a steady supply of essential commodities that will help unlock its economic potential without straining its transport system.

Analysis of data and conversations with industry experts helped to outline four key steps to enable optimized and efficient evacuation to and from ports:

- **Stakeholder alignment and sign-off**
- **Establishment of new ports:** Transshipment port at Southern tip and bulk port at central Andhra Pradesh
- **Logistics aggregator for facilitating coastal shipping**
- **Capacity augmentation and efficient operations at relevant ports**

Stakeholder alignment and sign-off

Aligning the various stakeholders and decision makers involved across the value chain for all commodities will be the most important driver in optimizing logistics through the Sagarmala project. While the Ministry of Shipping is the nodal body for driving the Sagarmala initiative, the vast scope of Sagarmala implies that partnership with and support from key stakeholders is essential for success. Private-sector investment would also need to be encouraged and incentivized through PPP models for port infrastructure, railway infrastructure and coastal shipping.

As a long-term vision India should aim to optimize the landed cost of commodities by either optimizing the location of steel and cement plants (e.g., new coastal capacities for steel and cement identified) as well as the logistics of transporting fuel (e.g., coastal shipping).

Over the next couple of months, the Ministry of Shipping could reach out to relevant stakeholders for workshops and meetings with the project development consultants for alignment on proposed ideas of coastal shipping of thermal coal, steel, cement and fertilizers.

Establishment of new ports: Transshipment port at Southern tip and port at Central Andhra Pradesh

An analysis of the expected port traffic from key commodities (thermal coal, cement, steel and containers) reveals the need for a transshipment port on the Southern tip since around 25 percent of India's current container traffic is transshipped through Colombo. This cargo entails additional costs of feedering from origin point to Colombo and also carries the burden of double handling costs.

Creating a transshipment port at the Southern tip (Colachel or Vizinjham) could enable top shipping liners (Maersk, MSC, CMA-CGM, etc.) to call directly at the port, reduce the feedering cost to Colombo, and ensure faster evacuation of the cargo to the destination directly from India.

The origin-destination analysis pinpoints a central Andhra port (Machilipatnam or Vodarevu) as a strategic location to establish a cement cluster of around 20 MMTPA. Anticipated cement demand from the five maritime states (Maharashtra, Kerala, Tamil Nadu, Odisha, West Bengal) and their own limited limestone reserves makes a strong case for inter-state dispatch of cement from either Andhra Pradesh or Gujarat in the coming decade. This dispatch of cement could be economically transported through coastal shipping since the per tonne per km cost of rail is around INR 1.2 to 1.5 compared to INR 0.20 to 0.25 via coastal shipping.

Building a transshipment port will take time since selecting sites for mega ports is a phased process, and takes approximately three to five years. The physical studies necessary for the port construction should commence at the earliest.

Logistics aggregator for facilitating coastal shipping

In order to achieve a reasonable percentage of the outline coastal shipping opportunity of India will require a central body to consolidate the coastal shipping supply chain by aggregating demand from relevant plants and demand centres across industries, and acting as a centralized supply chain optimizer. This could help leverage larger volumes to deploy bigger vessels and further lower cost. In this way, India can achieve a reasonable percentage of the outline coastal shipping opportunity of around INR 20,000 Crores to 25,000 Crores per annum.

The aggregator agency could help to combine multi-commodity parcels since single commodity loads do not make many routes feasible. The aggregating agency would need to act as a nodal point for all the industrial plants willing to use coastal shipping.

Capacity augmentation and efficient operations at relevant ports

The relevant ports will need to upgrade their existing infrastructure and construct additional capacity based on the projected increase in cargo. To ease the move to coastal shipping, the following next steps are critical:

- Creating dedicated coastal berths at relevant ports for coastal shipping
- Setting up storage capacities at origin-destination ports to shorten turnaround time
- Establishing a bunkering facility and reducing taxes (baseline to Fujairah prices) to encourage ships to bunker within Indian waters
- Developing adequate ship-repair facilities in the maritime states (most repairs currently happen in Singapore/East Asia)

Capacity enhancement/ shelf of projects (including report on National Multi-Modal Transportation Grid) with high level cost estimates for major ports

Contents

Executive Summary

Projects identified under Sagarmala

The concept of "port-led development" is central to the Sagarmala vision. Port-led development focuses on logistics-intensive industries (where transportation either represents a high proportion of costs, or timely logistics is a critical success factor). These industries can be structurally competitive if developed proximate to coast/waterways. They would be supported by efficient and modern port infrastructure and seamless multi-modal connectivity. The synergistic and coordinated development of the above four components—logistics intensive industries, efficient ports, seamless connectivity and requisite skill base—leads to unlocking economic value.

The Sagarmala National Perspective Plan (NPP) has identified a range of projects and enablers under these four pillars, which can unlock the opportunities for port-led development. This report focuses on port modernisation and port connectivity pillars of Sagarmala. Projects related to the efficiency improvement and capacity enhancement of ports are covered under port modernisation. Port connectivity covers challenges relating to evacuation for EXIM and domestic cargo and proposes projects and initiatives to ensure connectivity across pipelines, waterways, rail and roads. There are three main sources of identifying projects and interventions for Sagarmala

- OD study – Demand and supply situation of major EXIM flow commodities were studied in order to ensure an optimized end to end logistics chain for the commodities
- Master plans for major ports – Based on the OD study, a detailed master plan was prepared for every port identifying port modernisation and connectivity projects
- State visits & consultation with major and non-major ports -
  - State Sagarmala meetings were held in all coastal states
  - Projects identified by states validated and included in list of projects with details captured in a concept plan
  - Post release of draft NPP, further meetings conducted in several states

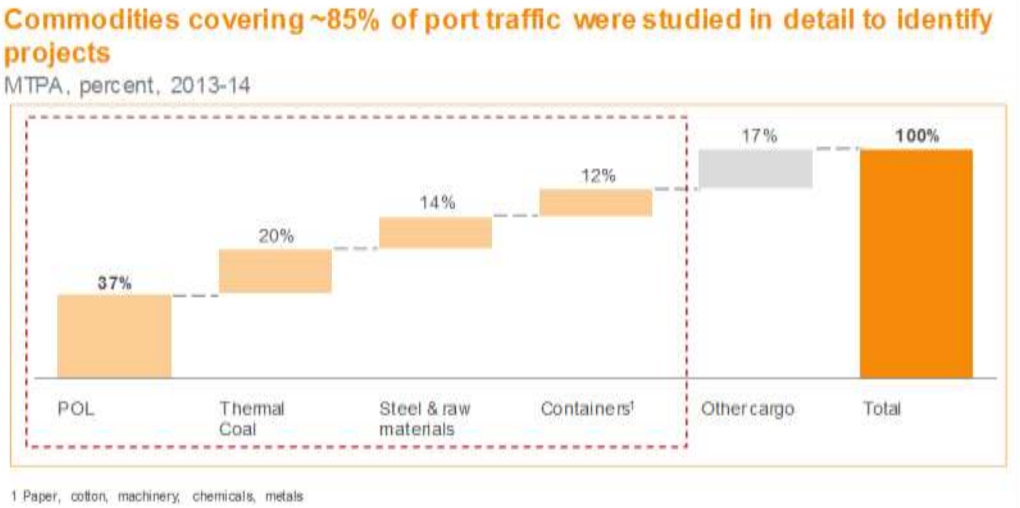
In addition to this, a multi-modal model was developed on the basis of OD study to revalidate the key constraints in logistics movement which in turn were analysed to evolve projects to address bottlenecks.

Sagarmala OD study

Conducting a detailed origin-destination mapping of major cargo items is necessary to align the port capacity and infrastructure needs at requisite demand & logistics chain centres. The Sagarmala OD study, therefore, lays the basis for the creation of efficient infrastructure—such as creating greenfield ports or increasing handling capacity at ports and relieving congestion on existing high-volume routes.

Towards this, it studies the total demand and supply situation of major EXIM flow commodities—coal, petroleum, oil and lubricants (POL), steel[1], foodgrains, fertilisers, and containers—upto 2035 with a sharper focus on 5-10 year timeframe as these five key commodities aggregated make 85 per cent of total freight volumes (972 MMTPA in 2013–14) currently handled by ports in India (Exhibit 1).

EXHIBIT 1



POL

Over the next decade domestic demand for petroleum products is expected to increase to anywhere between 273 and 288 MMTPA, depending upon the pace of economic recovery and GDP growth. Domestic installed capacity of the existing refineries, on the other hand, can increase to a maximum of 282 MMTPA by the year 2025. Since only 56 to 65 per cent of crude input can be converted to MS/HSD, the current scenario is expected to lead to an increase in the crude import requirement by 75 MMTPA in the next 10 years.

Further, the recent deregulation of diesel prices in the economy is expected to cause a shift in the EXIM dynamics of petroleum products, inducing private refineries to divert the majority of their export volumes into the domestic market. In event of this happening, there will emerge new opportunities to coastally ship an additional 22 MMTPA petroleum products from the surplus to the deficit areas by 2025.

[1] Includes coking coal, iron ore and steel

This expected increase in coastal shipping has implications for port infrastructure with regard to petroleum products. Storage facilities for petrol and diesel may have to increase by around 0.13 MMTPA at the destination ports. Port connectivity infrastructure—rail, road and pipelines—will also need to be strengthened to transport the coastally shipped petrol and diesel to the concerned refineries and depots, and then to the retail outlets.

Liquefied Petroleum Gas

Domestic demand for LPG is expected to grow from the current level of 16 MMTPA at about 5 per cent per annum and by 2025, can increase to anywhere between 28 MMTPA to 35 MMTPA, depending upon the pace of urbanization and growth of piped gas penetration. Industry estimates fix the figure at around 33 MMTPA. As against this, domestic production of LPG is expected to increase to 14 MMTPA by 2025. Given India's present LPG import capacity of 7 MMTPA and the projected capacity increase of 3 MMTPA, this leaves a gap of nearly 9 MMTPA which needs to be provided for.

This will require enhanced import capacity at ports in Haldia, Paradip and Gujarat ports to supply gas to the LPG deficient states of northern and eastern India. Additionally, product pipeline infrastructure will have to be augmented to carry the product from ports to LPG terminals/depots.

Liquefied Natural Gas

Given the price sensitivity of demand for natural gas, along with the fact that the total cost of importing LNG, including procurement and end-to-end transportation, is unlikely to fall below $10 per mmbtu, taking domestic gas production at 125–138 mmscmd and making adjustments for subsidized gas supply, demand for LNG imports in the best case scenario would be 67-72 MMTPA (around 250 mmscmd) in 2025. . This demand is expected to be concentrated in selected industrial clusters in Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. However, any increase in domestic gas production or price of imported LNG will reduce the demand for imported LNG, which may fall as low as 57-62 MMTPA.

Planned LNG import terminals in the next 10 years would increase import capacity to 73 MMTPA. Taking speculated projects into consideration, this number could reach 93.5 MMTPA. This leaves a high risk of underutilization for newer terminals. Consequently, all the proposed projects are unlikely to materialize while terminals connected with pipelines are more likely to come up.

Coal

In 2013–14, nearly 740 MMTPA of coal moved through the country predominantly through rail. Only 23 MMTPA moved through coastal shipping even though this mode costs one-sixth that of rail cost (INR 0.2 per tonne km vs. INR 1.2 to 1.4 per tonne km). More than 90 percent of the rail routes relevant to coal are running at over 100 percent utilization. With the expected ramp-up in coal production by Coal India Limited, India may need to move 1,000 to 1,200

MMTPA coal across the country by 2025, creating tremendous pressure on the already congested railways.

The study carried out a logistics cost comparison for all possible modal mix combinations for India's 400 thermal power plants. It estimated that using the right infrastructure and institutional support, India can coastally move 190 to 200 MMTPA of coal, and save around INR 17,000 Crores per annum, by 2025. This will help to save 1 lakh rail-rake days that can be used for other commodities. Since logistics contribute 30 to 35 percent of the cost of power generation, this initiative will also directly cut power costs by 50 paisa per unit for coastal power plants fed coal coastally.

Analysis reveals potential for transportation of thermal coal for 11 power plants with capacity of 12 GW on the NW-1 system. Estimated potential of 20 to 25 million tonnes of coal traffic by year 2025. Also, potential to carry 25-35 MMTPA from Talcher/Ib Valley to Paradip port on the NW-5.

Additionally another 70 MTPA of thermal coal for non-power uses can be transported through the coastal route if port based linkages of coal are provided.

Containers

Container traffic at Indian ports has grown at an average CAGR of 8 percent in the past decade. The non-major ports (private or state-owned) continued to fare better than the major government-owned ports, with a growth of over 24 percent in 2014–15. These non-major ports have registered higher growth rates in the past five years or so due to their adequate container-handling capacity, improved road and rail connectivity, better draft levels, and modern equipment and technology for faster cargo evacuation.

Sagarmala studies reveal that two optimization levers can lead to potential savings of ~INR 7,000-9,000 Crores per annum

- Reduced transit time can save inventory handling cost of ~INR 5,000 Crores to 6,000 Crores per annum
- Modal shift from road to rail can save ~INR 2,000 to 3,000 Crores per annum in terms of fuel import bill

National multi-modal transportation model

An important element of the OD study is the multi-modal cost optimisation model. The model optimises the cost of transportation for various commodities and suggests potential savings and capacity load on ports, rail routes, road routes and ICDs if the optimum plan is followed.

The objective of the model is to optimise the transportation of EXIM volumes of cargo comprising 85% of the total port volumes in the country. This mainly includes the containers, coal, fertilisers and steel sectors. POL traffic has been left out as it has very different supply chains consisting mainly of pipelines. Key inputs for the model are

- Details of origin points and quantities of containers and commodities
- Port location and capacities
- Transportation cost via rail and road.

The model first computes an unconstrained optimum route for origin-destination pair. In the next step, constraints in port and connectivity infrastructure hampering these movements are identified. Based on this projects to address these constraints are identified. A detailed user manual of the model is appended as Annexure-I.

Exhibit 2 is an example of the model output wherein major constrained rail routes are highlighted.

EXHIBIT 2

Exhibit 3 & 4 highlight congestion on key container routes

- Exhibit 3 shows the constraint in the route between northern hinterland (accounting for 3.7 mn TEUs of traffic) and ports in the west coast
- Exhibit 4 highlights the congestion in the Bangalore-Chennai route, another key corridor

EXHIBIT 3

EXHIBIT 4

Exhibit 5 gives an example of logistical constraint for coal movement. In this example, the model highlights congestion on Talcher-Paradip rail route.

EXHIBIT 5

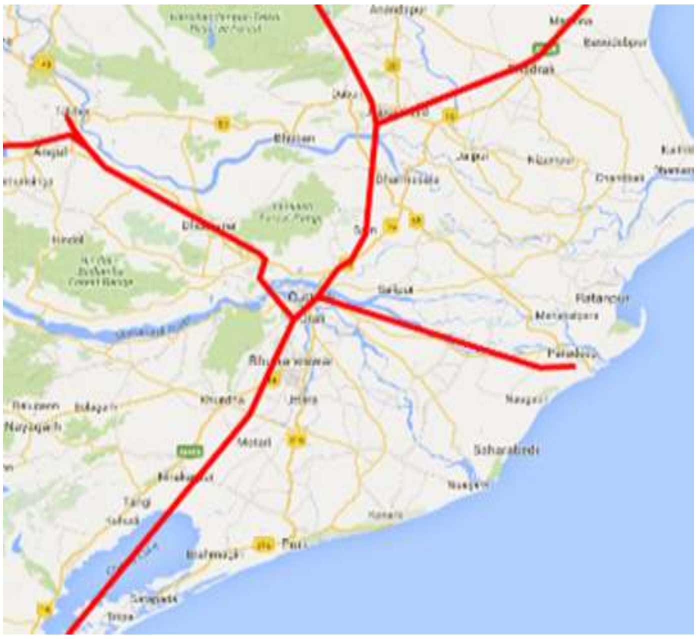
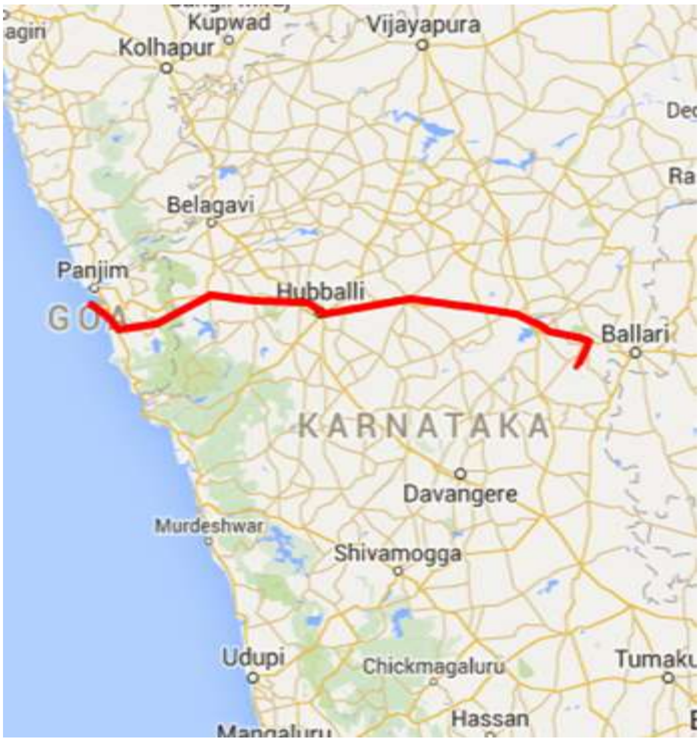


Exhibit 6 shows congestion in the evacuation of iron ore to Mormugao.

EXHIBIT 6



Shelf of projects

173 projects were identified for inclusion under Sagarmala. Broad details of these projects are presented in Exhibit 7. Exhibit 8 gives an overview of the financing plan for the projects. Annexure-II gives more details on projects identified.

EXHIBIT 7

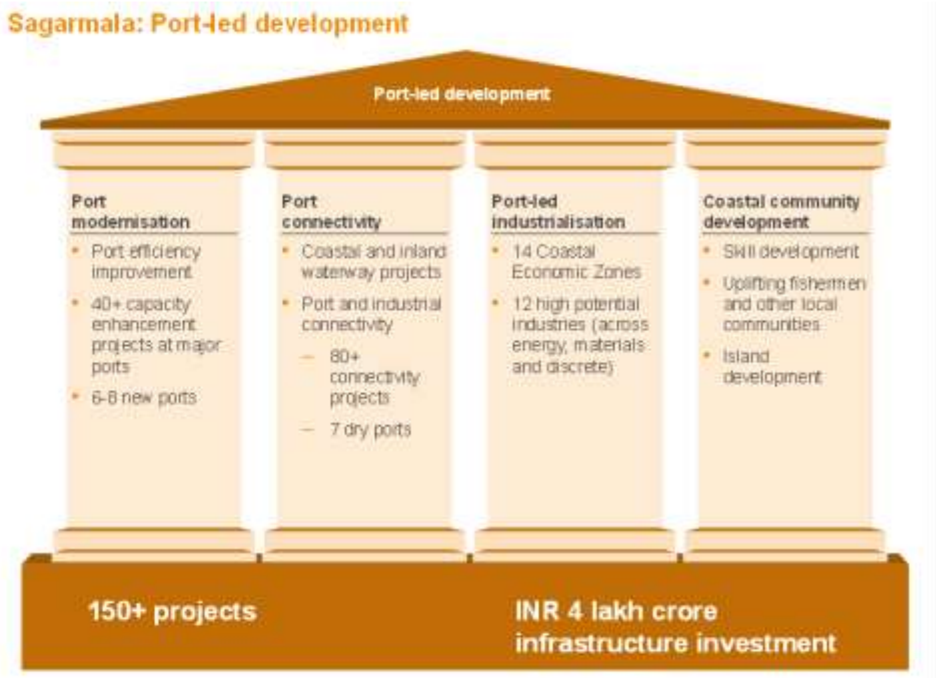


EXHIBIT 8

Theme	Project category	Project development agency	Funding required (INR Crore)
PM	New Major Ports	MoS	50,000
	Port Modernization - Major Ports	States	
	Non Major Port Projects	MoS	
PC	Expressways Projects	NHAI	200,000
	Port Road Connectivity Projects	IWAI	
	Internal Port Road Projects	MoS	
	Last Mile Road projects	States	
	Strategic Rail Projects	MoPNG	
	Port Rail Connectivity Projects	Railways	
	Multi Modal Hubs	NHAI	
	Inland Waterways Projects	Railways	
	Pipeline projects	CONCOR	
PLI	Bulk Cluster Projects	States, Ministries	100,000
	Discrete Cluster Projects	MoC, MoS, States	
	Tourism Projects	Ministry of Tourism, Ports	
CCD	Fishing Harbor Projects	MoS, States	5,000
	CCD Skill Initiatives	MoS	
	CCD Other Projects	Agriculture	
	Total		**355,000**

National multi-modal transportation grid

Logistics account for a major portion of India's industrial GDP, among the highest for any country. Inefficiency in logistics, thus, increases the cost of end products, requires higher amount of working capital and reduces competitiveness of exports. As part of the Sagarmala Programme, several opportunities have been identified to reduce logistics costs of bulk commodities and containers, totalling around INR 35,000 to 40,000 cr per annum (Exhibit 9). Main enablers for unlocking this opportunity include greater use of coastal shipping and inland waterways, addressing existing gaps and bottlenecks in road and rail connectivity, creation of multimodal logistics hubs and streamlining procedures. The following Exhibit summarises these opportunities by commodity.

Savings opportunity has been estimated based on a comprehensive origin–destination study of logistics movement of key commodities. Detailed findings for each commodity are presented in origin destination analysis for key commodities report, however the main findings for each commodity are summarised in subsequent sections.

Exhibit 10 shows the proposed evacuation network with high potential projects marked.

EXHIBIT 9

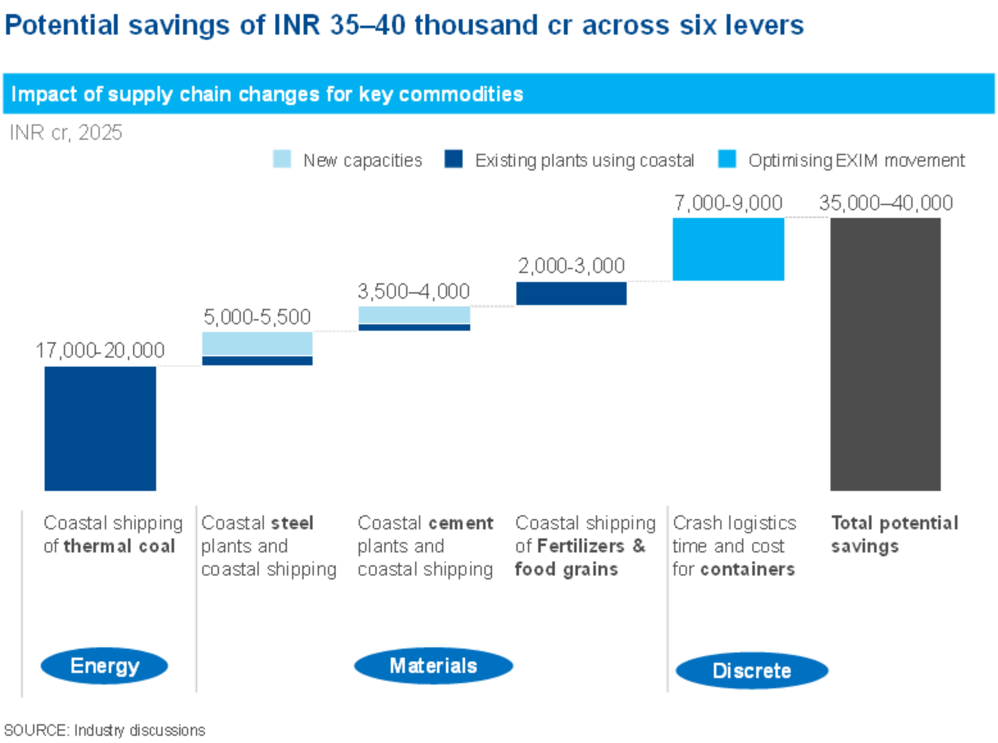
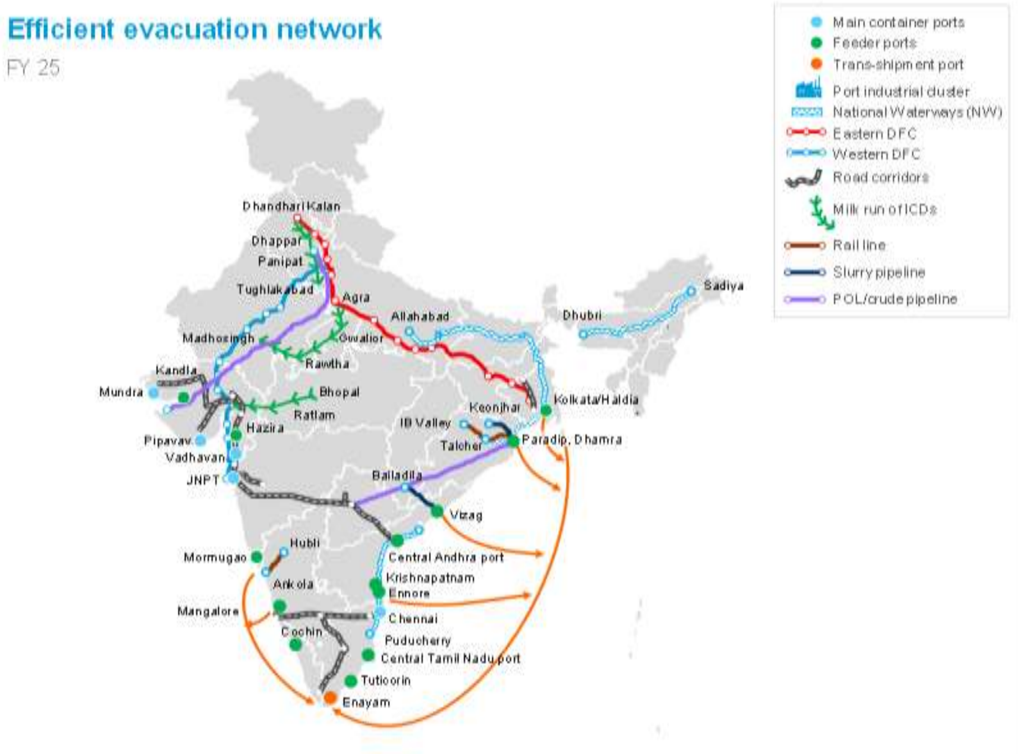


EXHIBIT 10



Efficient evacuation network
FY 25
Main container ports
Feeder ports
Trans-shipment port
Port industrial cluster
National Waterways (NW)
Eastern DFC
Western DFC
Road corridors
Milk run of ICDs
Rail line
Slurry pipeline
POL/crude pipeline
Dhandhari Kalan
Dhappar
Panipat
Tughlakabad
Agra
Allahabad
Dhubri
Sadiya
Madhosingh
Gwalior
Rawtha
Kandla
Mundra
Bhopal
Ratlam
Hazira
Pipavav
Vadhavan
JNPT
Keonjhar
Kolkata/Haldia
IB Valley
Talcher
Paradip, Dhamra
Bailadila
Vizag
Hubli
Mormugao
Central Andhra port
Krishnapatnam
Ennore
Ankola
Mangalore
Chennai
Cochin
Puducherry
Central Tamil Nadu port
Tuticorin
Enayam

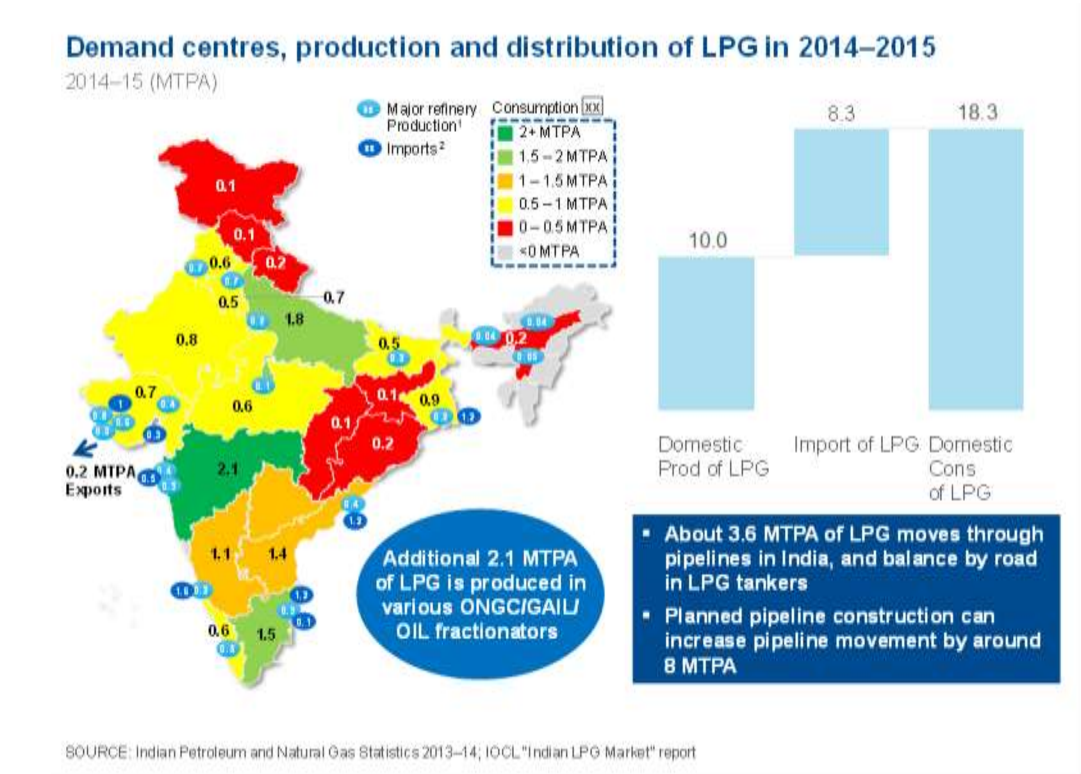
PETROLEUM, OIL AND LUBRICANTS

Petroleum and lubricants

For liquefied petroleum gas (LPG), the current domestic consumption is around 18 MTPA, of which 10 MTPA is supplied by domestic production while the rest is imported.

Around 3.6 MTPA is transported through pipelines and the rest by road in tankers. The accompanying map depicts the consumption pattern for LPG in various states as well as the major locations of refinery production and import of LPG. Apart from these an additional 2.1 MTPA is produced in various fractionators belonging to Oil and Natural Gas Corporation Limited (ONGC) or Gas Authority of India Limited (GAIL) or Oil India Limited (OIL) (Exhibit 11).

EXHIBIT 11



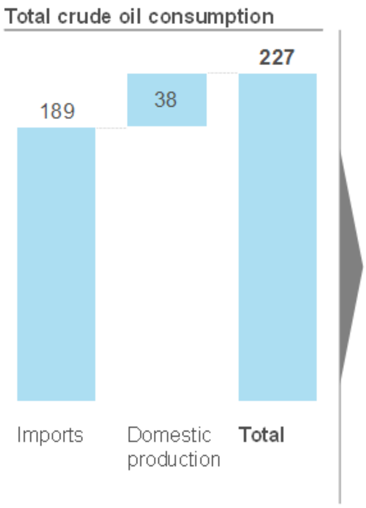
The Indian economy currently consumes around 227 MTPA of crude oil, of which 189 MTPA is sourced through imports and 38 MTPA through domestic production (Exhibit 12). Imported crude is received at seven port clusters—the Gujarat cluster (Vadinar, Mundra, Sikka), Paradip, New Mangalore, Mumbai, Chennai, Kochi and Visakhapatnam. The Gujarat cluster handles around 65 per cent of the total crude imports. Mumbai, New Mangalore and Paradip account for 7 to 8 per cent each, while the rest handle 4 to 5 per cent each of the total import.

Imported crude is either processed at coastal refineries or moved to inland refineries by pipelines. An extensive inter-regional and intra-regional pipeline network transports the bulk of liquid products from refineries to terminals/depots. Around 80 per cent of evacuation from the refineries to the hinterland travels through the pipeline network, with the balance moving by road/rail. Private refineries sell products at the refinery gate and coastally ship products to demand centres along the coast.

EXHIBIT 12

Nearly 227 MTPA of crude is consumed in the country today, >80% of which is accounted by crude imports to 7 port clusters in the country

2013–14 Values (MTPA)



Crude imports by port

Port cluster (% of total crude imported)	Total crude imported at port MTPA	Consumed by refinery near port %	Moved inland by pipeline %
Gujarat cluster (65%)	121.6	66%	34%
Paradip (8%)	15.4	0%	100%
New Mangalore (7%)	13.5	100%	0%
Mumbai (7%)	13.4	100%	0%
Chennai (5%)	8.8	100%	0%
Cochin (4%)	7.8	100%	0%
Visakhapatnam (4%)	7.4	100%	0%

Coastal shipping of crude (13–16 MTPA) happens for

- Transport of domestic crude production (e.g., Bombay High crude sent to Mangalore, Cochin, Chennai and Visakhapatnam)
- Emergency transfer of crude from one port to another in case of disruption in regular supply of crude

SOURCE: Indian Petroleum and Natural Gas Statistics 2013–14; Basic Port Statistics of India 2013–14

Refineries will continue to rely on the pipeline network for domestic evacuation of products, since the cost of transporting comes to around INR 0.14 to 0.18 per tonne km compared to INR 1.2 to 1.5 per tonne km by rail.

The market scenario in the country is changing following the price de-regulation of diesel. Private refiners are expected to re-enter the domestic retail market. Since private sector refineries are based in Gujarat and these companies do not have a well-developed network of pipelines for moving products to other regions, it is expected that they will use coastal shipping for this purpose.

It is estimated that total scope for coastal shipping of MS/HSD would be around 15–20 MTPA by 2025[1]. In the case of Reliance SEZ being allowed to sell in the domestic market, the volume of coastal shipping could go up by another 20 MTPA.

1 Discussions with OMCs, PPAC

Liquefied natural gas

Natural gas in India is either produced domestically (in gaseous form) or imported in liquefied form (liquefied natural gas or LNG). Gas imported in liquid form is gassified at the import terminals and then moved internally through pipelines. Currently 57 mn metric tonnes per annum (MTPA) (around 205 mn metric standard cubic metre per day [mmscmd]) of gas is consumed in the country annually.

Assuming that domestic supply would range between 125–138 mmscmd (say, 130 mmscmd) in 2025, the supply shortfall would be around 220 mmscmd. Given that about 20 mmscmd of domestic gas is likely to be reinjected for internal use and another 10 mmscmd may be allocated to Segment 6 as per expected government allocation, therefore a total import requirement of 25 mmscmd in 2025 at an import price of USD10 per mmbtu could be considered.

EXHIBIT 13

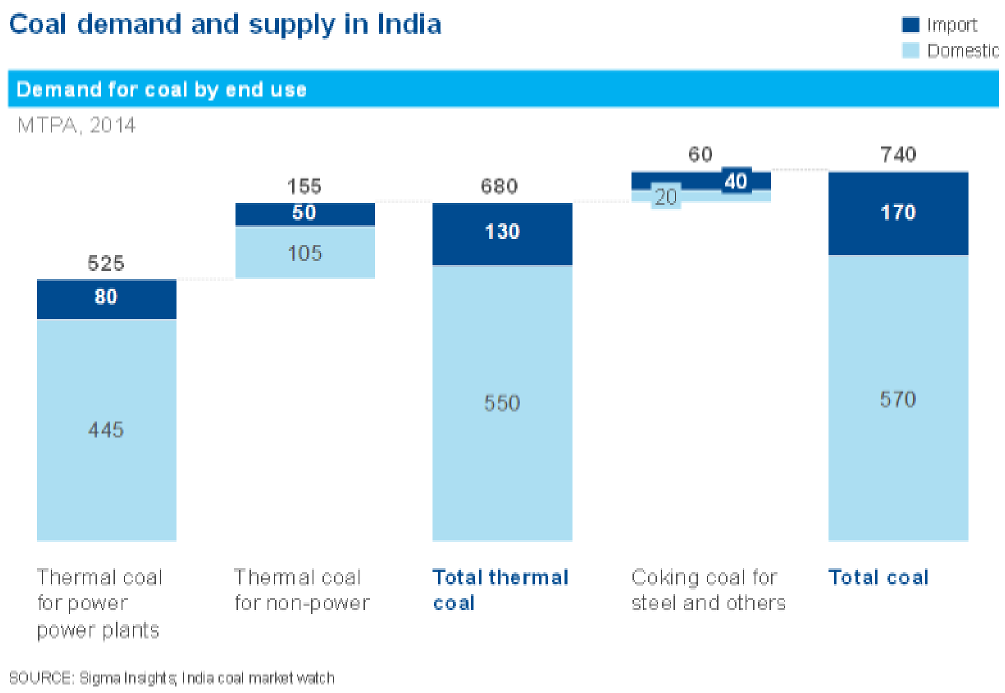
Exhibit 13 shows that out of a surplus of about 20 MTPA in the Gujarat cluster, 15 MTPA could be moved to the deficit areas in the North and 5 MTPA to Maharashtra through coastal shipping. Of the 6.3 MTPA surplus in the eastern region, 4 MTPA could be shipped to Hyderabad and the remaining moved to the North and central regions via pipeline. This would leave residual deficits of 6.3 MTPA in the South, 3 MTPA in the Maharashtra region and 2 MTPA in the Hyderabad region.

Of the 15 MTPA being moved north from the Gujarat cluster, 10 MTPA could be coastally shipped within Gujarat, from RIL Jamnagar to Mundra, and thereafter through pipeline to the North in the short run. There is also scope for coastal shipping of 4 MTPA from Odisha to Andhra Pradesh (AP), thus amounting to a nearly 15 MTPA of coastal shipping of petroleum products by 2025. To facilitate coastal shipping, supporting infrastructure shall be required at ports in Vizag, Paradip, Kandla, Jamnagar and JNPT/Mumbai.

THERMAL COAL

As of 2013–14, approximately 740 MTPA (Exhibit 14) of coal moved through the country, including domestic production and imports. The majority of coal produced and imported in India is thermal coal, while coking coal contributes a much smaller share of 60 MTPA. Power and steel plants use about 80 per cent of the total domestic and imported coal. While coal production is concentrated mostly in eastern and central India, it is transported primarily by rail to other parts of the country. Coastal shipping, at INR 0.20 per tonne-km after taking into account the cost of double handling[2], has a negligible share in the volume of coal movement even though cost per tonne by coastal shipping is 80 per cent lower than by rail, which is INR 1.2 to 1.5 per tonne-km for coal movement[3].

EXHIBIT 14

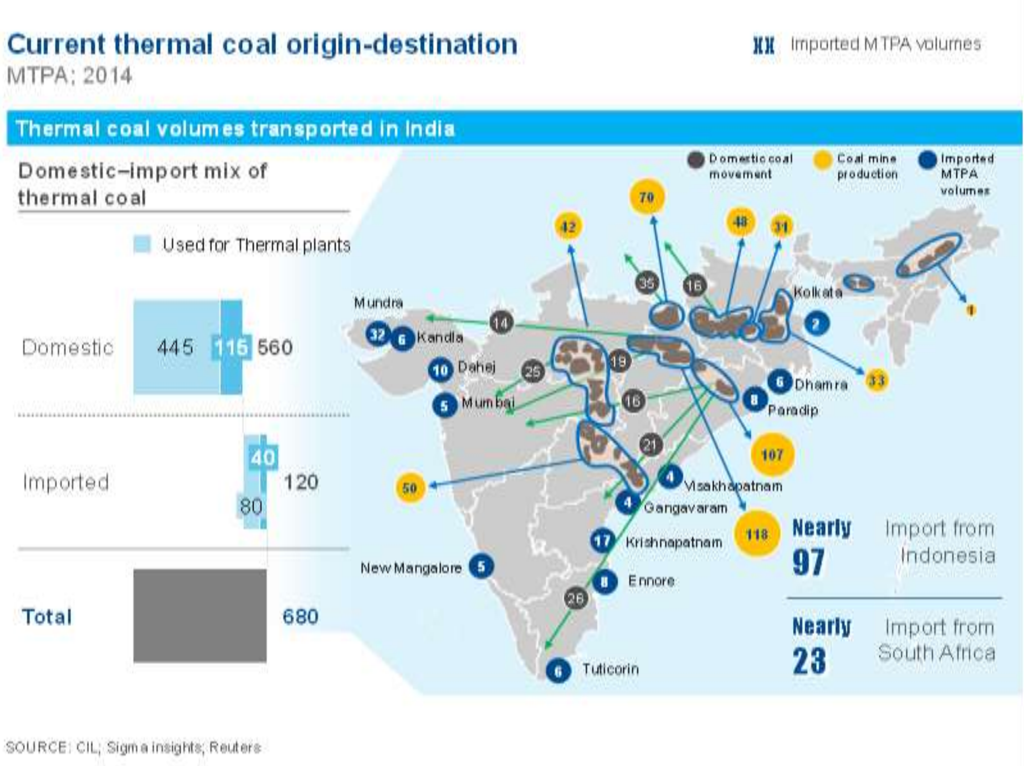


While coal production is concentrated in the eastern and central zones of India, it is transported for power generation to nearly all parts of the country, e.g., 26 MTPA of coal travels from Odisha to Tamil Nadu. Similarly, 19 MTPA of coal also moves from Chhattisgarh to Maharashtra and 14 MTPA to Gujarat (Exhibit 15). Coal imported from Indonesia and South Africa arrives at various ports and then moves inland.

[2] Two additional handlings are caused during coastal shipping in most cases

[3] Source: Actual prices and clean sheet analysis

EXHIBIT 15

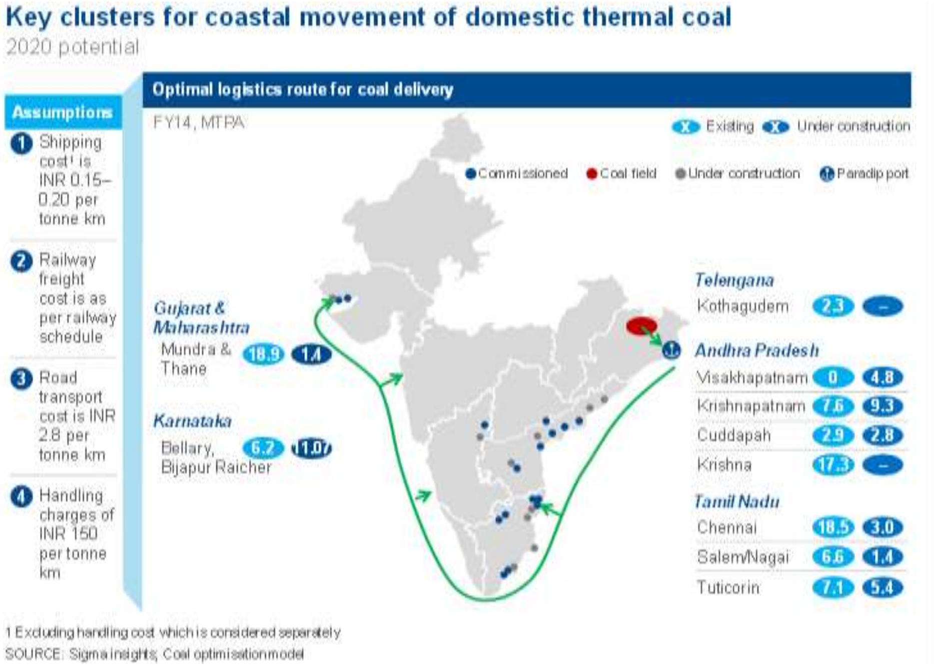


Rail network is not expanding at the pace necessary to keep up with the required coal capacity, having grown at only 0.7 per cent year-on-year historically. Coastal shipment only has a 4 per cent share (23 MTPA) in the total domestic coal movement (Exhibit 16).

EXHIBIT 16

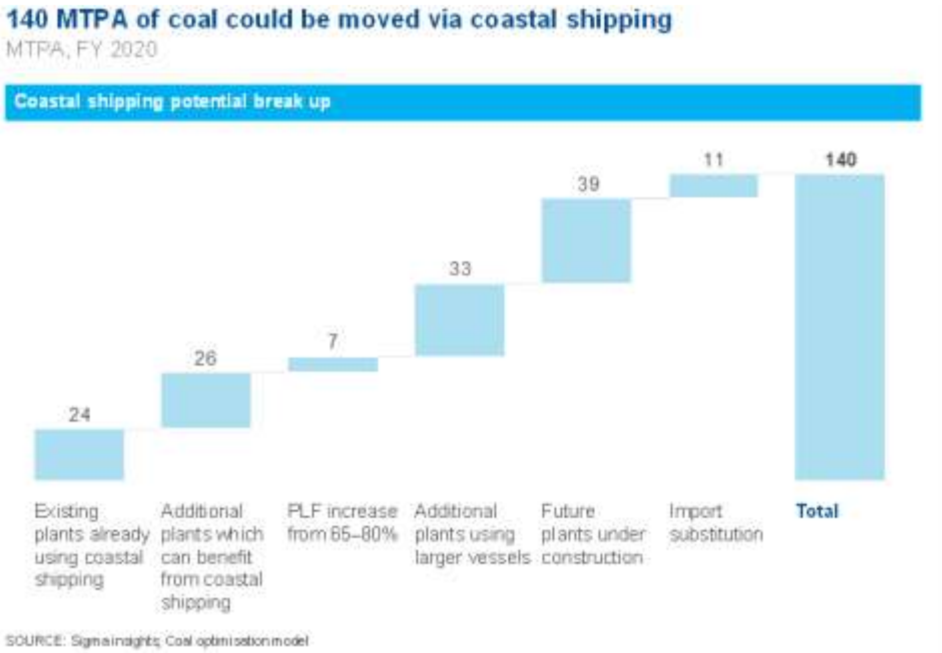
An analysis of current and projected coal movement indicates significant potential to cut costs through a modal-mix shift towards coastal shipping (Exhibit 17).

EXHIBIT 17



The cost of coastal shipping could be further reduced by deploying vessels of a larger capacity. Data suggests that with the right infrastructure and institutional support, movement of coal via coastal shipping could increase nearly six-fold from the current 23 MTPA to almost 140 MTPA by 2020 (Exhibit 18).

EXHIBIT 18



Coking coal

Current and future supply chain

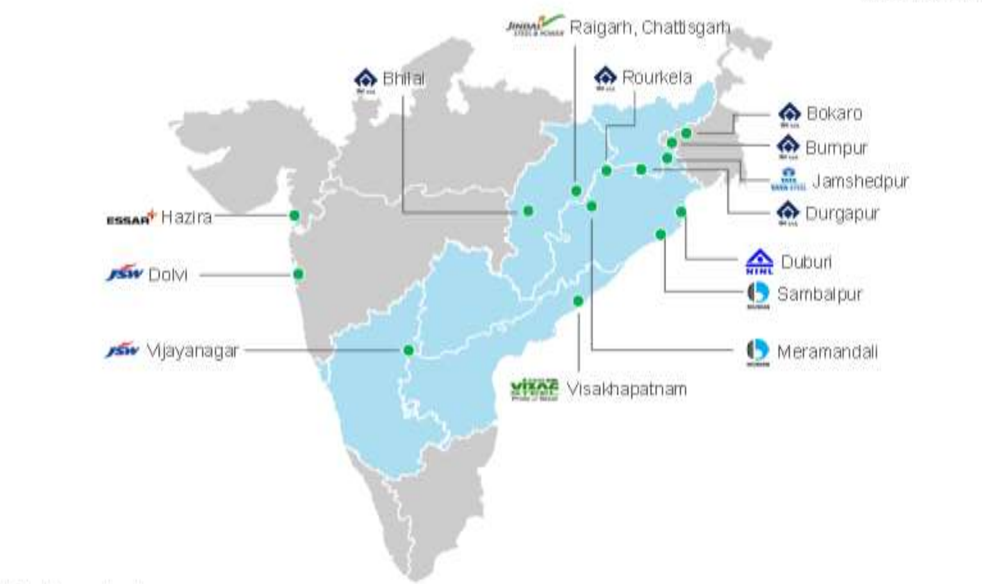
Around 60 MTPA of coking coal is transported in the country of which around 54 MTPA is consumed for the production of steel (Exhibit 19). About 80 per cent of the coking coal consumed is imported due to insufficient coking coal reserves in India.

EXHIBIT 19

Each steel plant is aligned with one or more ports for sourcing imported coal with the entire evacuation done by rail. A total of 12 Indian ports handle around 37 MTPA of the imported coking coal used at 15 steel plants ((Exhibit 20 and 21).

EXHIBIT 20

Steel plants[1] relevant for coking coal OD analysis



1 Blast furnace based

SOURCE: World Steel Association; Steel Authority of India Limited; expert interviews

EXHIBIT 21

Origin-destination matrix for coking coal: Port to plant (Current)

Imported coking coal and plant origin destination, MTPA, 2014

Steel plants/ Import port	Dhamra	Dharamtar ISPAT	Ganga-varam	Haldia	Hazira	Karaikal	Krishna-patnam	Mangalore	Mor-mugao	Mumbai	Paradip	Vizag	Grand total
JSW, Vijayanagar						0.1	0.6		5.0				5.68
TISCO	4.1		0.1	1.2							0.9		6.20
SAIL, Bokaro				1.6									1.60
SAIL, Bhilai												4.0	4.00
RINL, Vizag			3.5										3.54
JSW, Dolvi		0.5						0.6	1.9	0.1			3.05
SAIL, IISCO				1.6								0.5	2.10
Essar – Hazira					0.8								0.81
SAIL, Rourkela			0.5								2.8		3.32
SAIL, Durgapur	1.6												1.60
Bhushan steel, Sambalpur	0.1										1.4		1.51
JSPL, Raipur			0.9								0.4		1.33
Bhushan steel, Meramandali			0.2									0.4	0.60
Neelachal Ispat Nigam, Odisha											0.6		0.60
JSW, Salem		0.2						0.6					0.83
Total	**5.83**	**0.66**	**5.20**	**4.35**	**0.81**	**0.11**	**0.57**	**1.24**	**6.90**	**0.08**	**6.09**	**4.92**	**36.76**

SOURCE: SteelMint; annual report and steel expert interview

Australia accounts for over 82 per cent (37 MTPA) of coking coal imports. Import volumes on the eastern seaboard are much higher than on the western seaboard. Rail, by far, is the largest contributor to the current coking coal inland movement since only around 10 per cent of India's steel capacity is coastal. Most steel plants are around 300 km inland from the coast, positioned to leverage iron ore reserves.

Current coking coal evacuation is facing challenges due to limited availability of rakes at unloading ports and rail line capacity at key railway routes. Around 21 MTPA of new steel capacity at key steel plants (1 MTPA and above blast furnace based) is under construction and would further need 18 to 20 MTPA of coking coal evacuation on the same routes, which are currently running at above 100 per cent utilisation.

Thus, evacuation capability at the relevant unloading ports and railway routes may need to be improved for optimal evacuation of coking coal.

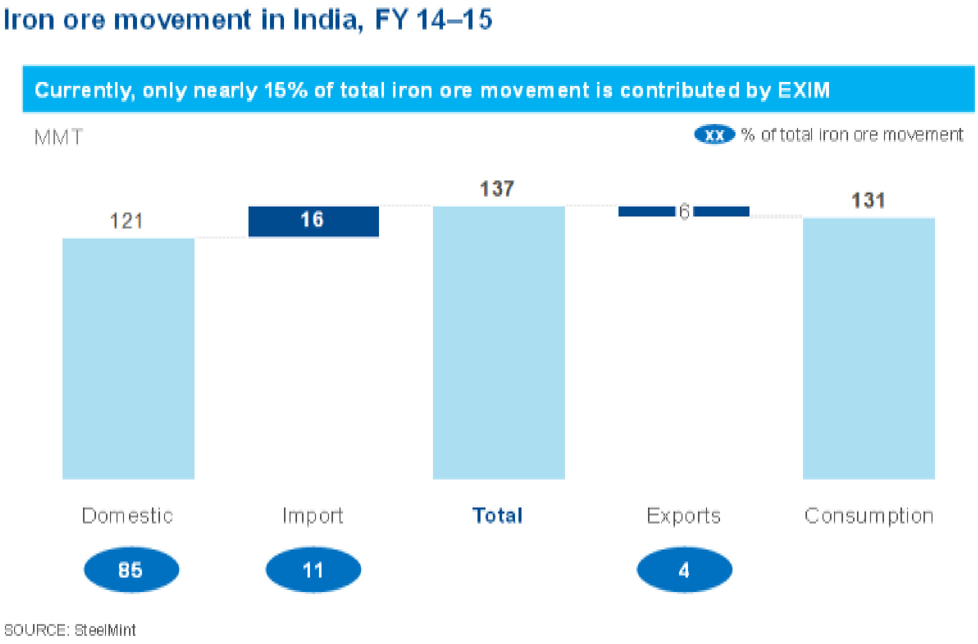
Iron ore

Current and future supply chain

Over the last five to six years, India has turned from a net exporting country to a net importing country for iron ore. In 2008–09, before the iron ore mining ban, India produced around 220 MTPA and exported 102 MTPA (around 32 per cent) of iron ore.

Today, India consumes around 131 MTPA of iron ore (as of FY 2014–15). Of this, 121 MTPA is produced domestically, 15.6 MTPA is imported, 5.4 MTPA is still exported. Total EXIM traffic at around 21 MTPA, contributes only about 15 per cent of the total iron ore movement in India (Exhibit 22).

EXHIBIT 22



Visakhapatnam and Paradip are currently the most extensively used ports for exports. Around 3.1 MTPA of iron ore passes through Visakhapatnam. Across all ports, the maximum total export of around 0.84 MTPA goes to China while South Korea is a close second with 0.79 MTPA.

Around 80 per cent of all iron ore exports pass nine Indian ports [4], where they arrive from eight mining districts across Jharkhand, Odisha, Chhattisgarh, Goa and Karnataka (Exhibit 23). The mined commodity is mostly evacuated to the nearest port by rail, except from Goa, where evacuation happens through barges plying on inland waterways.

The highest volume of imports comes in through the Krishnapatnam port, which handled around 8.5 MTPA of iron ore in 2014–15, mainly from South Africa, followed by Brazil, Australia and Oman (Exhibit 24.

Three steel plants—Tata Steel Jamshedpur, JSW Vijaynagar and JSW Dolvi—accounted for around 80 per cent of all imports (Exhibit 24).

4 Visakhapatnam, Paradip, Panaji, Redi, Mormugao, Mangalore, Dhamra, Haldia, in that order of decreasing volumes

EXHIBIT 23

Iron ore export: Port to destination country

MTPA, 2014–15

Exported to	Dhamra	Ganga-varam	Haldia	Kandla	Manga-lore	Mormu-gao	Panaji	Paradip	Redi	Visakha-patnam	Grand total
China	-	0.00	0.05	0.02	0.06	0.03	0.20	0.09	0.38	0.02	0.84
South Korea	-	-	-	-	-	-	-	-	-	0.79	0.79
Iran	-	-	-	-	0.06	-	-	-	-	0.46	0.52
Japan	-	-	-	-	-	-	-	-	-	0.29	0.29
Gulf	-	-	-	-	-	-	-	-	-	0.05	0.05
Others[1]	0.10	0.02	0.23	-	-	0.19	0.19	0.85	-	1.20	2.77
Grand total	0.10	0.02	0.27	0.02	0.11	0.21	0.39	0.99	0.38	3.10	Nearly 5.47

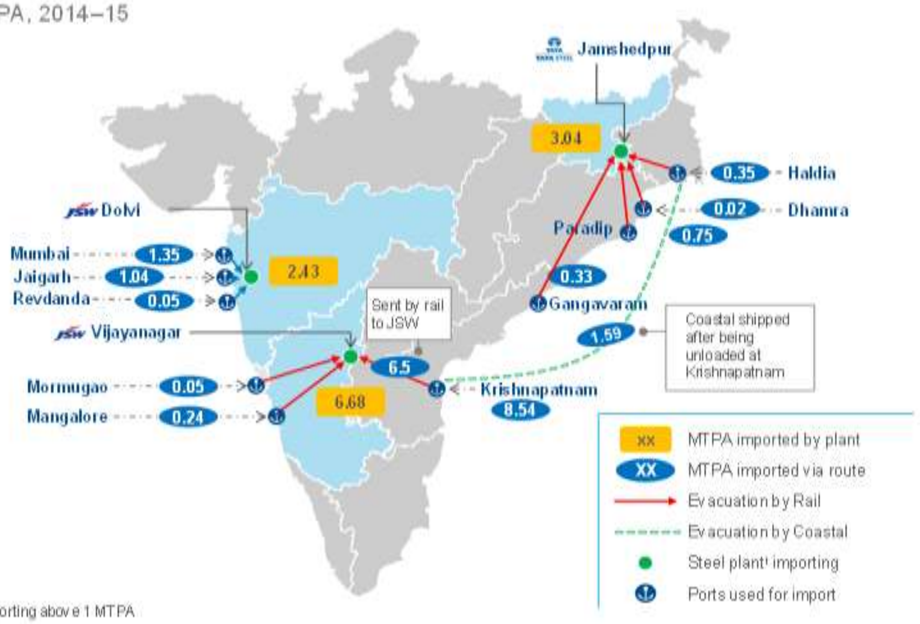
1 Includes the US as well as African and European countries in very small quantities

SOURCE: SteelMint

EXHIBIT 24

Steel plants relevant for iron ore imports currently

MTPA, 2014–15



1 Importing above 1 MTPA

SOURCE: SteelMint

Given that the volumes have dropped significantly in the past few years and the trend is expected to continue, the current infrastructure will be more than enough on the key routes if expansions for all the other commodities are done in order. Key infrastructure projects concerning ports of NMPT and Mormugao that need to be undertaken have been discussed in detail in Chapter 2.

Steel

Current and future supply chain

Approximately 50 per cent of the total production, i.e., around 30 MTPA of domestic steel moves via rail while around 15 to 20 MTPA moves by road. In fact, most of the material for large steel plants moves by rail while small and medium units prefer road transport
for their material (Exhibit 25).

EXHIBIT 25

	Rail		Road	
	Raw materials	**Finished steel**	**Raw materials**	**Finished steel**
Mega/large projects	90 %	70 %	10 %	30 %
Small & medium units	30 %	30 %	70 %	70 %

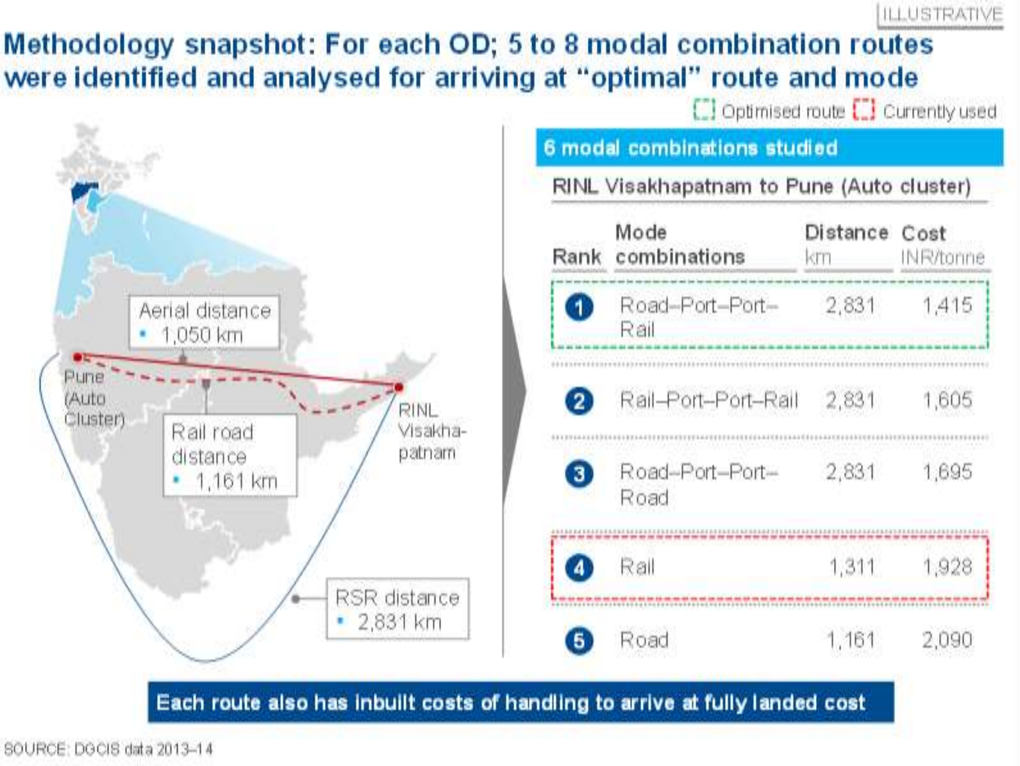
Source: Expert interviews

Production clusters of steel are centred on iron ore mines in eastern India and the North Karnataka–South Goa region, but consumption clusters are spread across the country depending on urbanisation and industrialisation. Uttar Pradesh, Maharashtra and Tamil Nadu account for the highest receivers of steel, mostly produced by plants in the eastern hinterland and North Karnataka.

Approximately 50 per cent of the total production—around 30 MTPA of domestic steel—moves via rail, while around 15 to 20 MTPA moves by road. Most of the material for large steel plants moves by rail, while small and medium units prefer road transport for their material. Analysis of research data and expert opinions indicate that a modal-mix shift towards coastal shipping could significantly reduce costs.

An analysis of key inter-state rail movements across the country was conducted to examine the origination–destination movement of steel. At the same time, a cost comparison was also done of all possible combinations of the modal mix under different scenarios of vessel capacity (Exhibit 26).

EXHIBIT 26



For instance, the movement between RINL Vizag (coastal Andhra Pradesh) and the auto cluster in Pune (Maharashtra) costs INR 1,930 per tonne via rail, while the same movement via road and rail-supported coastal shipping could be as low as INR 1,415 per tonne, which would be a cost saving of nearly 25 to 30 per cent

Possible outcomes and recommendations

Eventually, 13 major steel plants have the potential to shift to coastal shipping. The cost advantage is marginal in some cases, but overall railway congestion still makes the case for a shift to coastal shipping for these plants (Exhibit 27).

EXHIBIT 27

Almost every major plant has the potential to shift nearly 30–40% of their inter-state rail movements to coastal shipping

Plant	Location	Volume Potential to shift to coastal MTPA
Tata Steel	Jamshedpur	0.8–1.0
JSW Steel	Torangallu	0.5–0.6
RINL Steel	Visakhapatnam	1.0–1.3
JSW	Dolvi	0.3–0.4
SAIL	Durgapur	0.2–0.3
SAIL	Rourkela	0.9–1.2
SAIL	Bokaro	0.5–0.6
BPSL	Sambalpur	0.4–0.5
BSL	Meramandali	0.7–0.9
JSPL	Angul	0.6–0.8
SAIL ISSCO	Burnpur	0.3–0.4
Tata Steel	Kalinganagar	0.3–0.4
NINL	Duburi	0.3–0.4

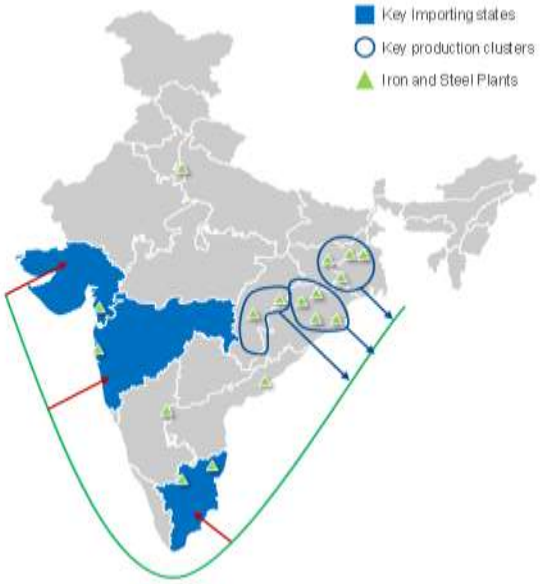
SOURCE: DGCIS data 2013–14

While each plant may have a unique set of factors to consider before shifting completely to coastal shipping, some of these plants can also be combined based on location for a cluster-based view on the potential for steel movement.

With the right infrastructure and institutional support, 7 to 8 MTPA of steel could be moved via coastal shipping, offering a savings potential of nearly INR 900 cr to 1,000 cr per annum. Furthermore, based on a business-as-usual (BAU) growth rate of around 6 per cent, the potential may rise up to 13 to 14 MTPA in the future, saving around INR 1,300 cr to 1,400 cr per annum by 2025 (Exhibit 28 and 29).

EXHIBIT 28

13–14 MTPA steel coastal shipping opportunity by 2025



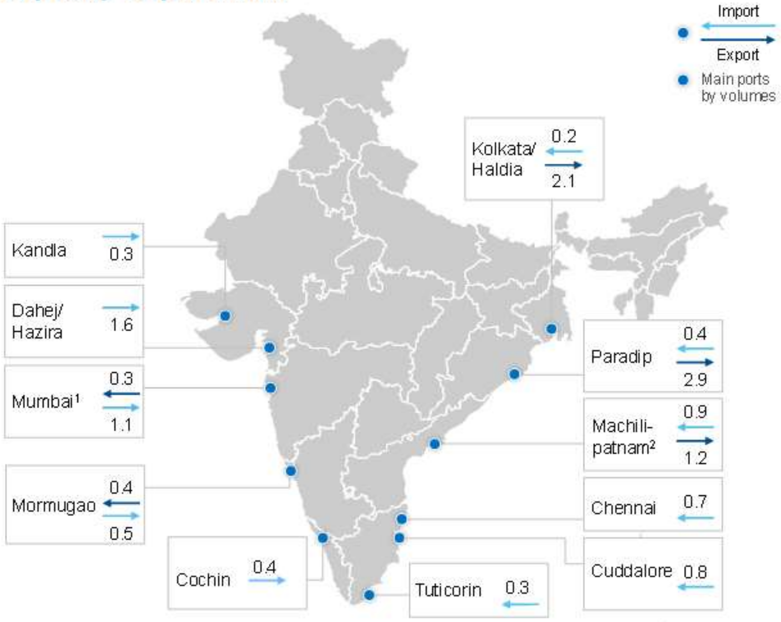
Route	Volume '000 TPA
Odisha to Andhra Pradesh	1,500
Odisha to Tamil Nadu	1,300
Jharkhand to Maharashtra	1,100
Odisha to Maharashtra	800
Odisha to Rajasthan	800
Karnataka to Gujarat	600
Jharkhand to Tamil Nadu	520
Odisha to Gujarat	450
Total	13,500

INR 1,300–1,400 cr saving

SOURCE: DGCIS data 2013–14

EXHIBIT 29

Port-wise capacity requirement



1 Includes 0.2 MTPA imports at Dahanu
2 Includes 0.8 MTPA exports at Visakhapatnam
SOURCE: Multimodal optimisation model

CEMENT

The Indian cement industry is the second largest in the world and is expected to grow in line with GDP growth in the future. Cement is a high-volume, low-value product, which becomes unprofitable when transported over long distances using road or rail transport. Low-cost sea transport routes could therefore be very important for cement.

Cement demand in India is projected to grow to 700 to 800 mn tonnes by 2025 under base case scenario of GDP growing at 7 to 8 per cent per annum. One tonne of cement requires 2 tonnes of raw materials. The volume of material to be transported for the cement industry will reach 1.6 bn tonnes by 2025. Logistics contribute about 25 per cent of the cost of cement. Logistics efficiency will be critical for making existing capacity more competitive.

Current and future supply chains

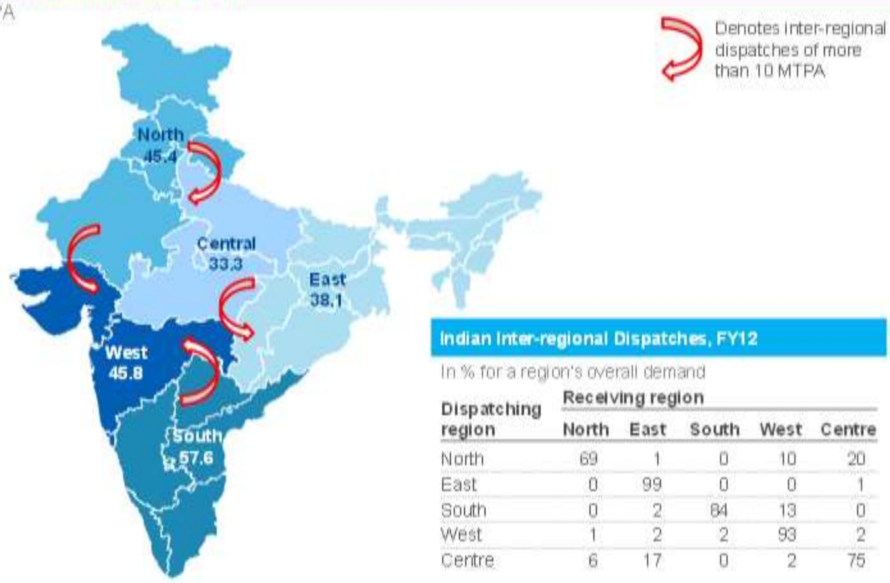
Inter-regional cement dispatches in India occur mostly through road or rail transport. Major dispatch routes are from southern to western India and from central to eastern India (Exhibit 30).

EXHIBIT 30

There is a moderate amount of inter-regional cement dispatches in India

Indian regional demand FY12

MTPA



Indian inter-regional Dispatches, FY12

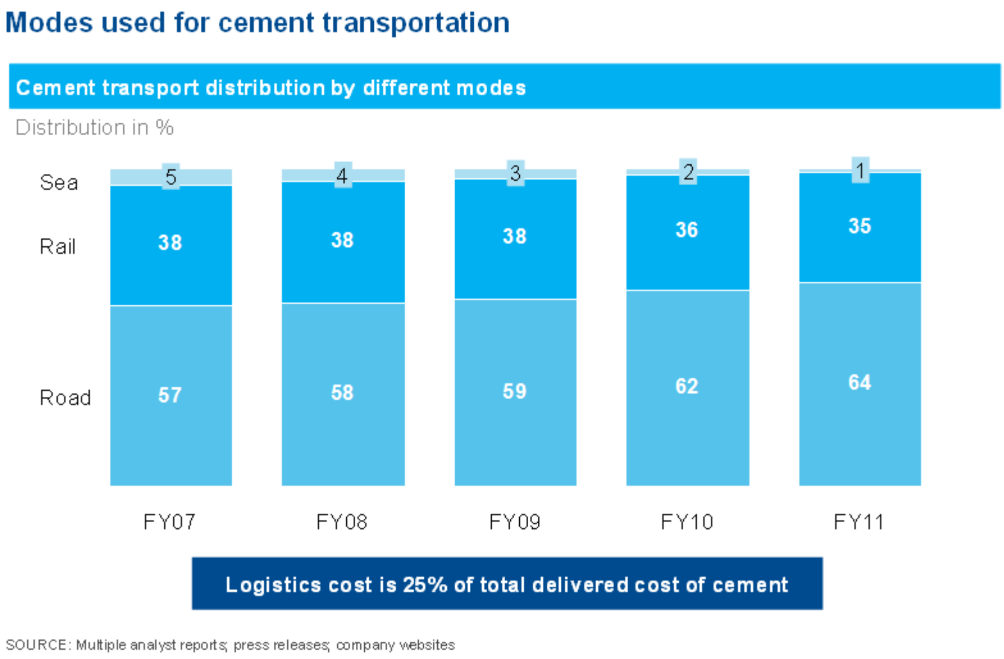
In % for a region's overall demand

Dispatching region	Receiving region				
	North	East	South	West	Centre
North	69	1	0	10	20
East	0	99	0	0	1
South	0	2	84	13	0
West	1	2	2	93	2
Centre	6	17	0	2	75

SOURCE: Analyst reports (IDBI and TATA Securities); press releases; company websites

Logistics costs are around INR 1,500 per tonne of cement in the retail price (around INR 6,000). The sea route forms only a minuscule part of the modal mix for cement transport (Exhibit 31). This is primarily due to inefficiencies in coastal shipping, unavailability of port infrastructure and greater expansion in hinterland plants as compared to coastal plants. Rail is the preferred mode of movement for the long-distance transit of cement in the country, whereas shorter intra-state movements are primarily through road. Coastal movement is currently dominated by large players that have dedicated jetties or coastal berths at ports.

EXHIBIT 31



An analysis of the key inter-state rail movements was conducted across the country to examine the origination–destination movement of cement. At the same time, a cost comparison was also done of all possible combinations of the modal mix under different scenarios of vessel capacity.

With the right infrastructure and institutional support, it could be possible to move around 9 to 10 MTPA of cement via coastal shipping by 2025, saving nearly INR 900 to 1,000 cr (Exhibit 32and Exhibit 33).

It was estimated that another 5 to 6 MTPA of cement could be shipped via coastal route from the Kutch region (Sewagram) in Gujarat if dredging was done for the 5 km channel approaching the Sanghi Jetty. Plants owned by ABG, Sanghi Cements and Ultratech could use the coastal route for transportation to Maharashtra and Tamil Nadu from this region.

EXHIBIT 32

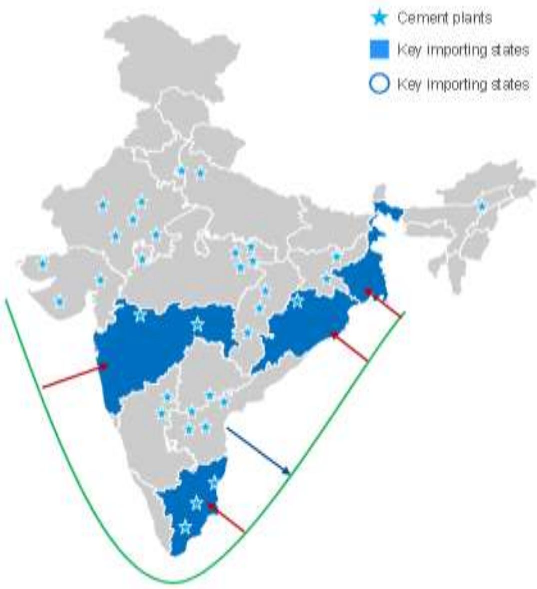
Plant-wise potential to shift to coastal

Plant	Location	Volume potential to shift to coastal MTPA
Maha Cement	Mellachevuru	1.2–1.4
India Cements/Raasi	Wadapally	1.0–1.2
Ultratech	Tadipatri	0.9–1.1
Zuari Cements	Jaggayyapeta	0.7–0.9
Zuari Cements	Kadapa	0.7–0.9
Ultratech-Vikram	Jawad Road/Neemuch	0.3–0.4
Birla/Vasvdatta	Sedam	0.1–0.2
J.K. Cement	Mudhol	0.1–0.2
Ultratech	Malkhed	0.1–0.2

SOURCE: DGCIS data 2013–14

EXHIBIT 33

9–10 MTPA cement coastal opportunity by 2025



Route	Volume '000 TPA
Andhra Pradesh to Tamil Nadu	2,420
Andhra Pradesh to West Bengal	1,780
Andhra Pradesh to Odisha	1,700
Andhra Pradesh to Kerala	1,400
MP to West Bengal	600
Karnataka to Kerala	450
Andhra Pradesh to Bihar	350
Andhra Pradesh to Coastal Maharashtra	340
Andhra Pradesh to Jharkhand	200
Karnataka to Tamil Nadu	150
Total	**9,900**

INR 900–1,000 cr saving potential

SOURCE: DGCIS data 2013–14

CONTAINERS

Out of the 10.7 MTEUs of total container volume, 0.6 MTEUs is coastally shipped traffic, 7.4 MTEUs is gateway traffic and 2.7 MTEUs is transshipped. Colombo, Singapore and Klang account for approximately 75 per cent of transshipped cargo from India.

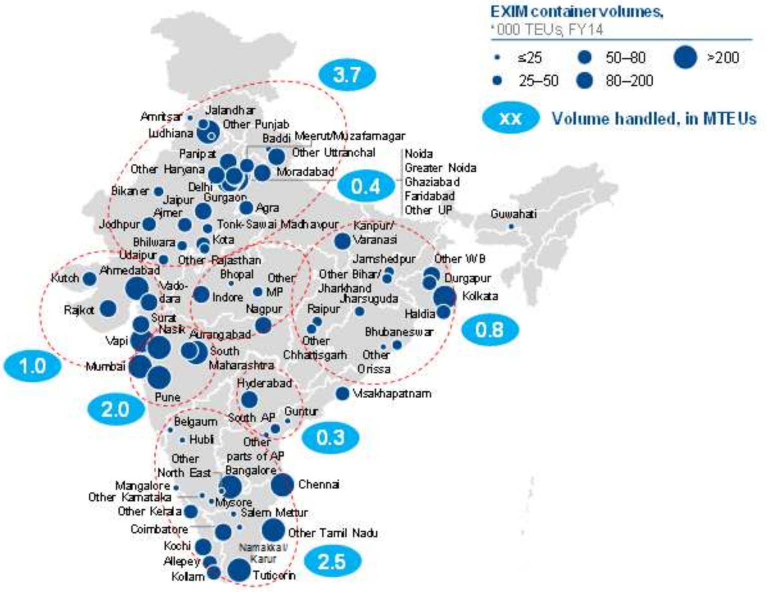
Three major hinterlands in India, i.e., the northwest, west and southern clusters, account for roughly 90 per cent of container volumes. The northwest cluster is farthest from the coastline and is the largest cluster, generating 3.7 MTEUs of container volumes in FY 2014. It, therefore, has the greatest impact on the overall logistics cost of container movement. It lies at a weighted average distance of 1,087 km from the Gujarat/JNPT port cluster. The container-handling hinterlands in the country are mapped in the Exhibit 34 along with the individual volumes handled.

The Gujarat–Maharashtra port cluster comprising the Mundra, Kandla, Pipavav and JNPT ports handles 70 per cent of India's EXIM traffic, while Chennai handles another 14 per cent. Other ports on the east coast, Haldia, Vizag and Tuticorin, account for the remaining traffic (Exhibit 35). Around 78 per cent of the traffic from east coast ports is transshipped in the absence of sufficient traffic to attract a gateway movement.

EXHIBIT 34

EXIM container volumes split for different hinterlands in India

mn TEUs, FY 14



SOURCE: APMT; IPA statistics; stakeholder interviews

EXHIBIT 35

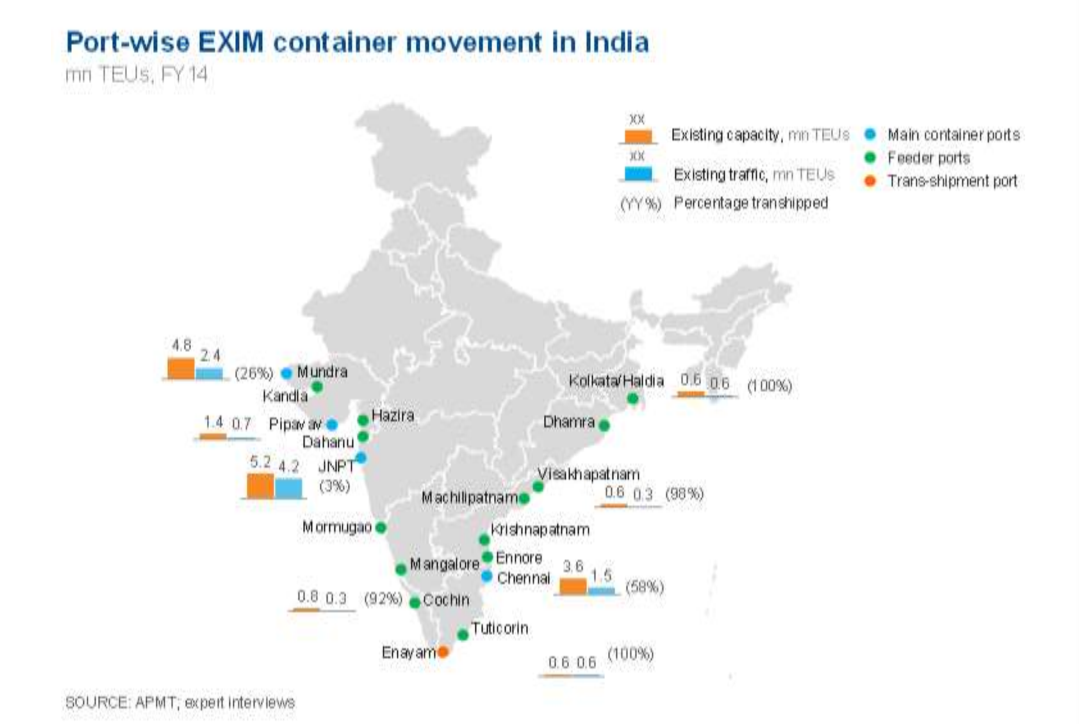


Exhibit 36 details the current split of container traffic at ports originating from the different hinterland clusters for FY 2014. Mundra and Pipavav are the only ports whose primary hinterland lies outside the port state. Also, a significant portion of the total traffic from the hinterlands of NCR and Punjab is handled at JNPT even though they are closer to the Gujarat port cluster.

EXHIBIT 36

Hinterland to port mapping of EXIM container movement

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Vallarpadam	Visakhapatnam	Mangalore	Hinterland total
NCR+Punjab	936	1,284	0	329	0	0	0	0	0	2,540
Maharashtra	2,121	54	0	0	0	0	0	0	0	2,177
Tamil Nadu	0	0	1,240	0	484	0	0	0	0	1,724
Gujarat	552	262	0	169	0	0	0	0	0	984
Uttar Pradesh	228	274	0	107	0	0	0	0	0	613
West Bengal	0	0	0	0	0	458	0	0	0	458
Rajasthan	43	448	0	60	0	0	0	0	0	560
Karnataka	94	0	163	0	66	0	0	0	50	406
Kerala	0	0	0	0	0	0	351	0	0	351
Andhra Pradesh	75	0	65	0	0	0	0	110	0	250
Madhya Pradesh	43	70	0	14	0	0	0	29	0	156
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0	93
Uttarakhand	95	0	0	0	0	0	0	0	0	95
Odisha	0	0	0	0	0	12	0	69	0	81
Chhattisgarh	15	18	0	14	0	0	0	15	0	64
Northeast	0	0	0	0	0	7	0	0	0	7
Port total	4,202	2,390	1,468	693	551	562	351	263	50	10,711

SOURCE: APMT; expert interviews

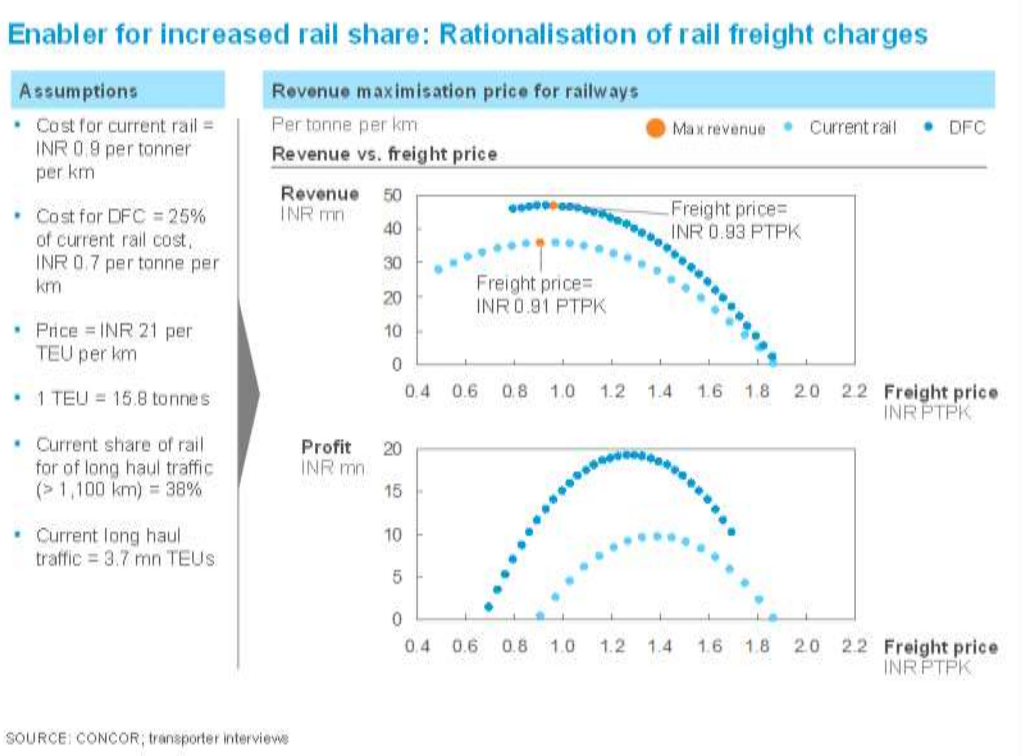
With respect to the modal mix for container movement from the hinterland to ports, road has an 82 per cent share overall while rail accounts for just 18 per cent. The rail coefficient for five out of the eight major container-handling ports is less than 10 per cent[5].

Price rationalisation for containers on railways

The analysis of current and optimal revenue for railways shows that current rail can maximise its revenue at charges of INR 14 to 15 per TEU per km for an average distance of 1,100 km as opposed to the prevailing charges of around INR 21 per TEU per km (reduction of roughly 33 per cent). The same analysis for DFC shows that revenue would be maximised at around INR 15 per TEU per km (Exhibit 37). The higher price in DFC as compared to current rail is because DFC is dedicated to cargo handling with the ability to carry four times the cargo (DFC will be double the length with double-stacked containers as compared to current rail).

5 Khambadkones

EXHIBIT 37

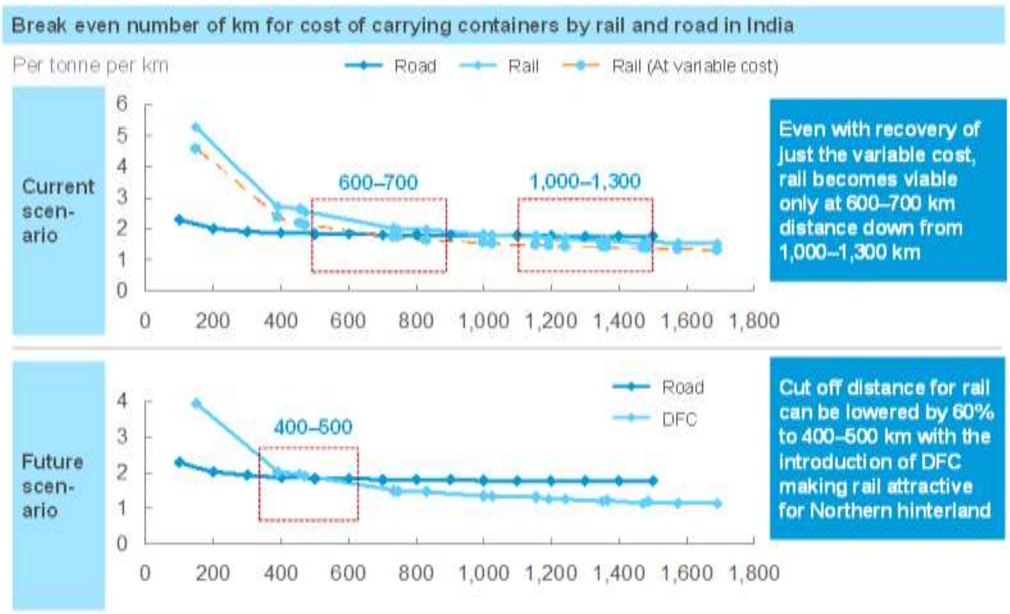


Even a 25 per cent reduction in freight charges for DFC (from INR 21 per TEU per km to INR 16 per TEU per km) can still yield an IRR of 16 per cent assuming DFC investment of INR 48,000 cr and amortisation period of 30 years. This reduction in price can reduce the cut-off distance where rail becomes more economical than road for current rail current rail from 1,000 or 1,300 km to 400 or 500 km (Exhibit 38).

The shift from road to rail will be driven primarily by the northern hinterland, including NCR, Punjab, Haryana, Rajasthan and western UP, which would contribute around 30 per cent of container volumes by FY 2025. With 25 per cent reduction in freight charges allowing DFC to handle 80 per cent of the above volumes, rail share could go up from 18 to 25 per cent (Exhibit 39). Assuming a growth rate of around 8 per cent in container volumes until FY 2025, the higher rail share could lead to potential savings of INR 2,000 to 3,000 cr.

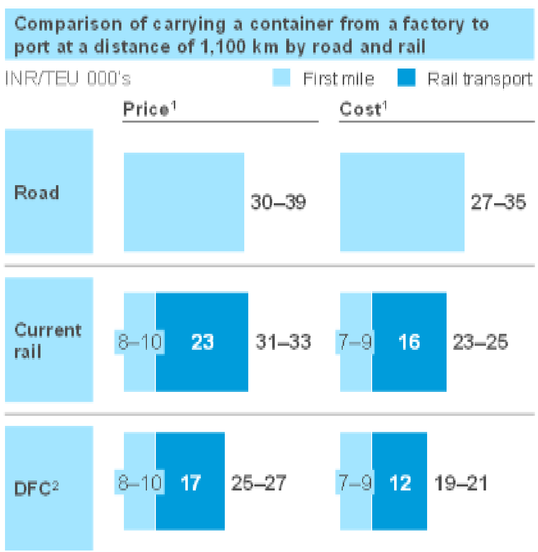
EXHIBIT 38

Enabler for increased rail share: Rationalisation of rail freight charges



SOURCE: CONCOR; transporter interviews

EXHIBIT 39



Potential savings with increased rail share	
Potential volumes of North hinterland, FY25	7.7 mn TEUs
Cost of transporting with Rail@38% share	INR 20–24k cr
Cost of transporting with Rail@80% share	INR 17–18k cr
Price of transporting with Rail@38% share	INR 24–28k cr
Price of transporting with Rail@80% share	INR 21–23k cr

1 Does not include ICD/CFS and port handling charges
2 To achieve IRR of 16%, prices can be reduced to 25% assuming cost of building western DFC is INR 48,000 cr at current cost of construction, 25% lesser operating cost due to double stacking, no cross subsidisation and capex amortisation over 30 years

SOURCE: Interviews with DFCCIL; transporters

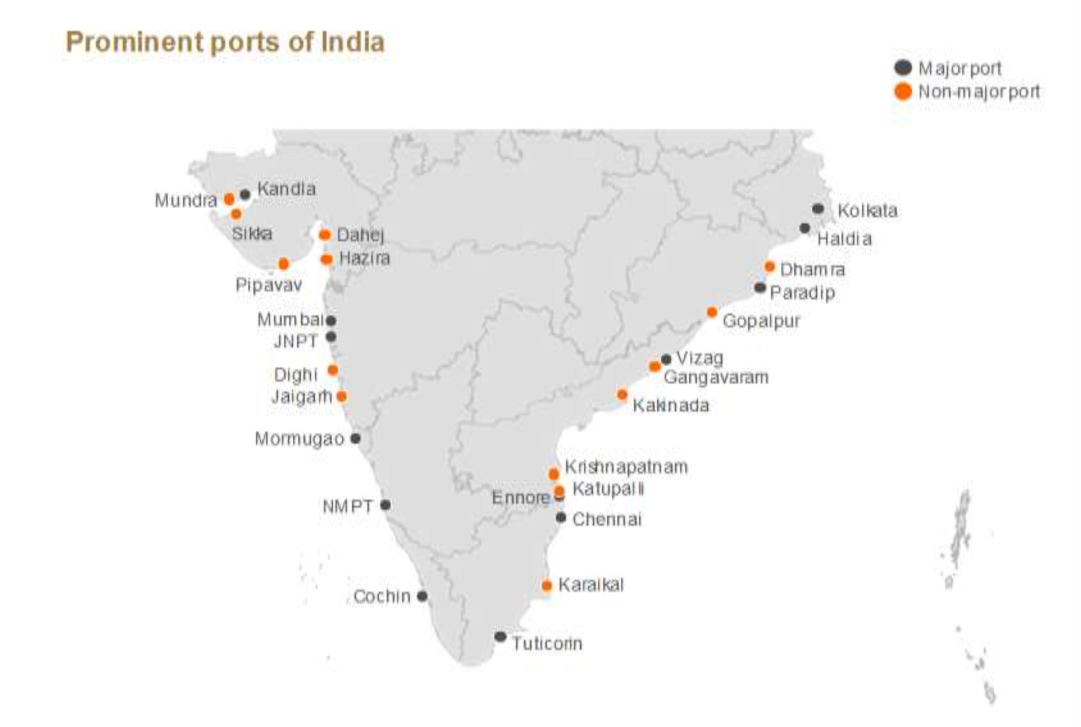
Port Modernisation

CHALLENGES IN PORT CAPACITY PLANNING

Overall supply and demand scenario today and port-wise cargo

India has a coastline of around 7,500 km with 12 major ports (Exhibit 40) and around 200 notified non-major ports along the coastline and sea-islands. The ports are important economic and service provision units since they are intermodal, acting as the interchange point for two transport modes, maritime and land.

EXHIBIT 40

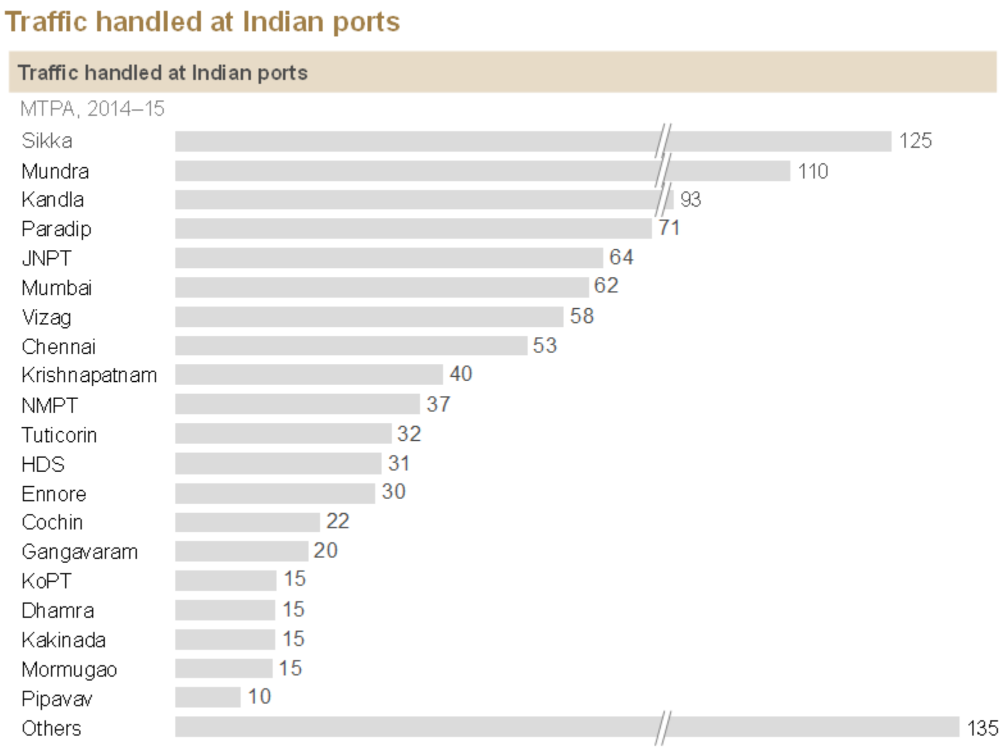


The total traffic handled at Indian ports rose from 934 MTPA in 2012–13 to 1050 MTPA in 2014–15 (Exhibit 41). Major ports handled 55 per cent of the total cargo at Indian ports. The capacity of major ports stands at 871 MTPA, while they handled cargo of 581 MTPA. The capacity of non-major ports stands at 660 MTPA while they handled 471 MTPA of cargo[6]. The capacity utilisation of major ports has been decreasing and stands at 70 per cent; in non-major ports it is at

[6] IPA

more than 80 per cent. Nineteen ports account for around 80 per cent of the cargo handled.

EXHIBIT 41



Indian ports performance against international ports

Benchmarking Indian ports against Chinese and US ports shows that India has a significantly opportunity to improve its port infrastructure (Exhibit 42). Considering the strategic location of India's major ports and their importance to trade, there is an opportunity to improve their performance to meet global benchmarks.

Seven of the top 10 ports in the world today (by throughput) are Chinese, while no Indian ports figure in the top 30. Most Indian ports don't have the draft to handle cape sized vessels. The average size of a container vessel calling at Indian ports is around 5,000 TEUs while for China it is around 12,000. At JNPT—India's biggest container port—draft by volume is 14 m while a cape size vessel requires upwards of 18 m (Exhibit 43). Around 25 per cent of India's container cargo is transshipped through international transshipment ports due to the lack of infrastructure to handle larger vessels at Indian ports. Average turnaround time (Exhibit 44) at Indian ports is much higher—4.5 days as compared to just one day in China.

EXHIBIT 42

Comparison of port-related KPIs – India, China and US

	India	China	US
Port capacity stock (% of GDP)	1	3	10
Number of shipyards[2]	7	70	45
Number of ports in global top 20	0	9	2
Container traffic (mn TEU)	11	185	44
Average annual growth in container traffic[1] (mn TEU)	0.5	10	0.4
Contribution of waterways in domestic transportation[3]	<1%	24%	6%
Average turn-around time (Days)	4.5	1	1.2

1 Over 2008–2012
2 That can make more than 120 mts long ships
3 Includes both Coastal Shipping and Inland Waterways

SOURCE: Expert discussion; World Bank; Lloyd's list; OECD; Port technology; Clarksons

The low productivity and high vessel turnaround time at Indian ports are due to:

- Low level of mechanisation and insufficient draft
- Skewed handling capacity for different types of cargo
- Infrastructure constraints in hinterland connectivity

Lagging behind other countries on performance parameters pushes up the cost of trade and renders Indian ports less competitive. Most of the major ports have high turnaround times even while the utilisation level is low and only a few have the ability to handle bigger cape-size vessels. The shipping industry is moving towards cape-size vessels, so it is important that India develops cape handling capability at its key ports to ensure economies of scale for the trade.

EXHIBIT 43

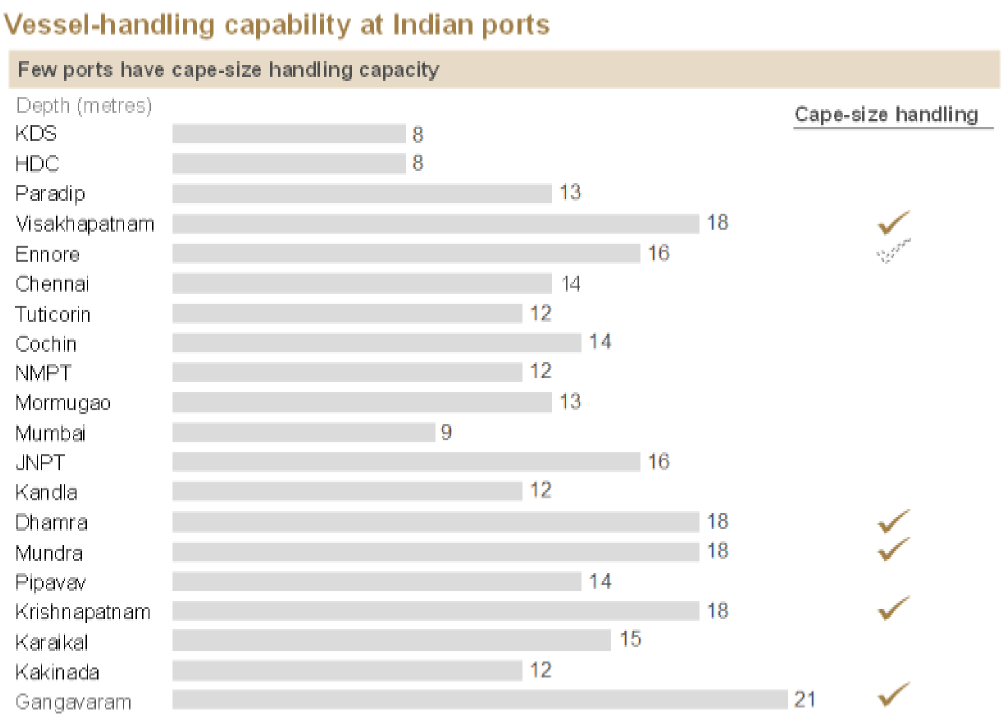
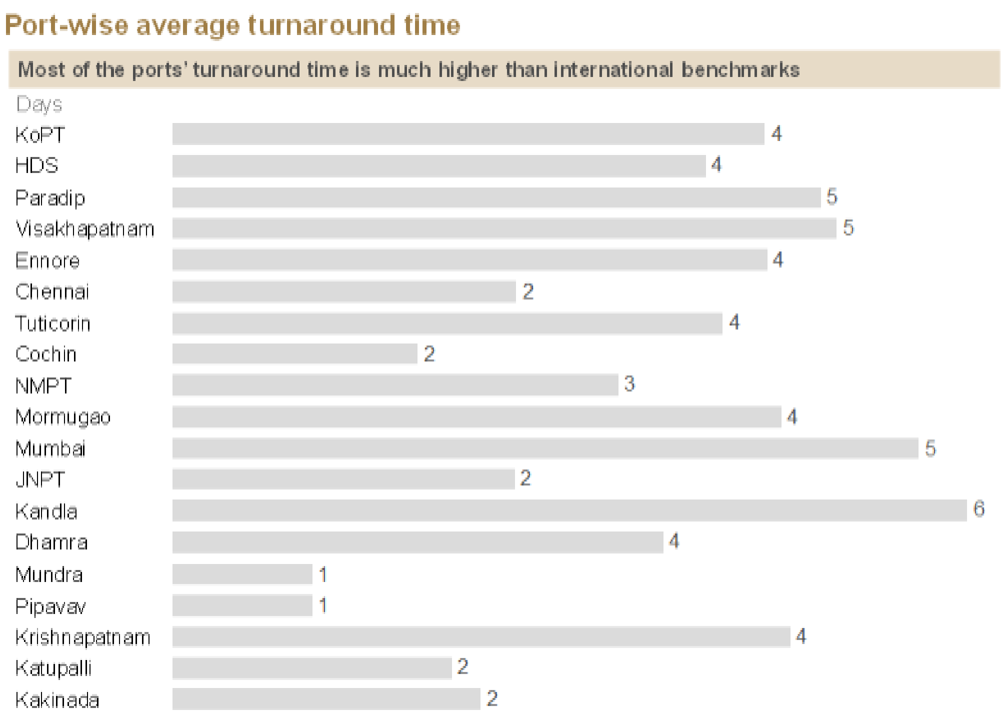


EXHIBIT 44

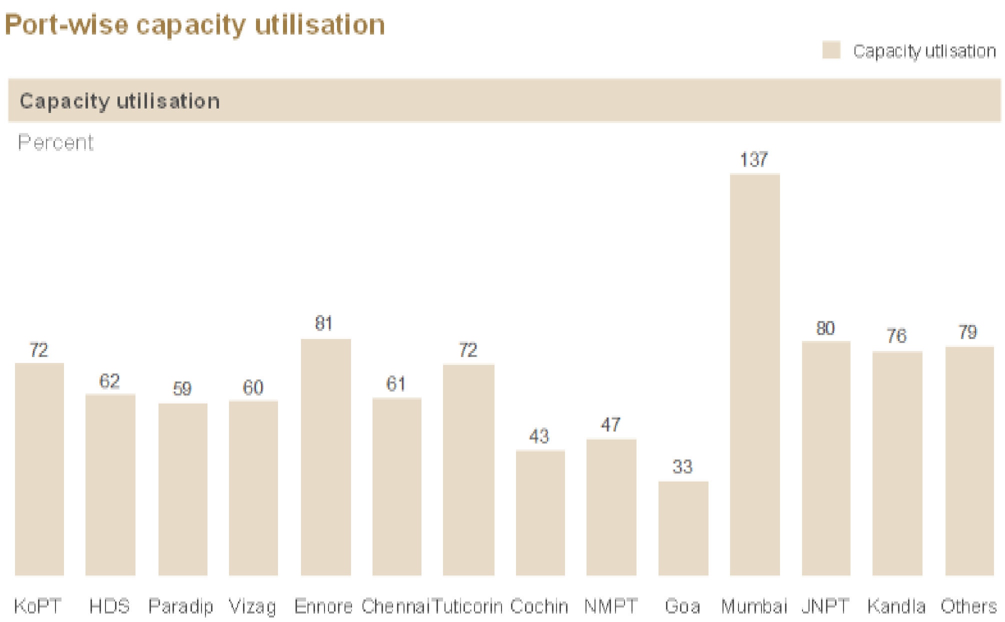


Coordinated approach to capacity addition needed

The Indian port sector has a dual structure, with the central government controlling major ports and respective maritime states controlling the non-major ports. The lack of a coordinated strategy for capacity building along the coastline has led to a geographical skew of capacity and skewed commodity-handling capacity inside the ports – some regions have significant overcapacity while others have low capacity (Exhibit 45). Northern Tamil Nadu and southern Andhra Pradesh (AP) have built up significant extra container-handling capacity – Chennai and Ennore are the major ports while Krishnapatnam and Kattupalli are the non-major ports catering to the same hinterland. On the other hand, Maharashtra lacks container-handling capacity – JNPT is running full, resulting in traffic spilling over to Mundra and Pipavav.

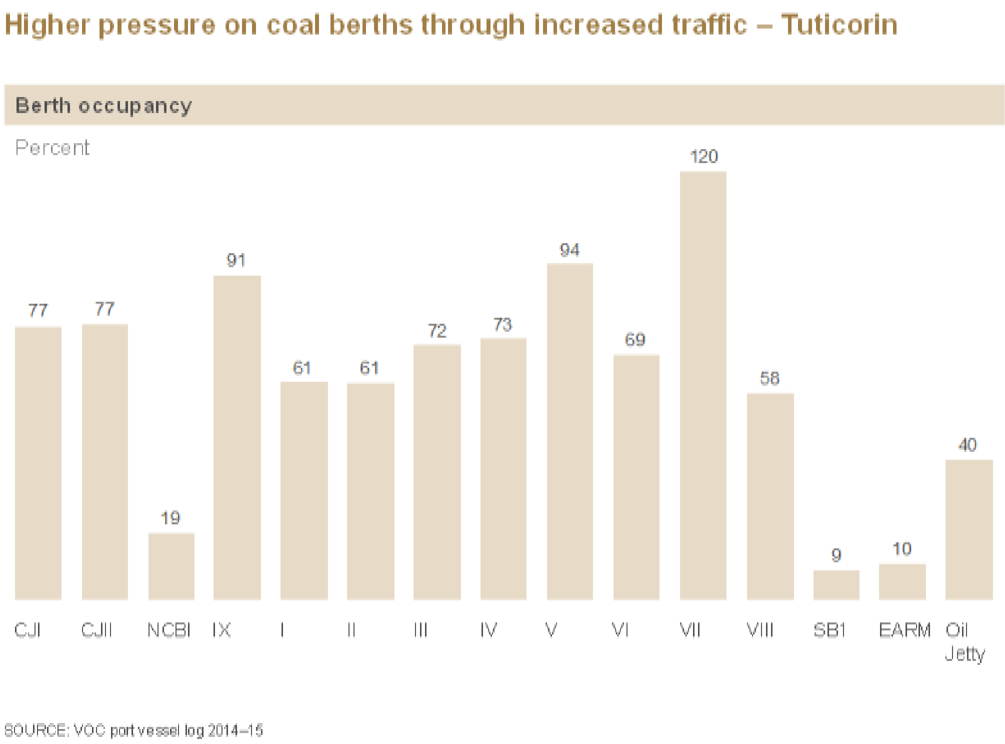
Limited commodity-wise capacity creates high variance in berth occupancy rates within ports. At Tuticorin port, berth occupancy of terminals ranges from 9–120 per cent (Exhibit 46).

EXHIBIT 45



SOURCE: Basic port Statistics, IPA

EXHIBIT 46



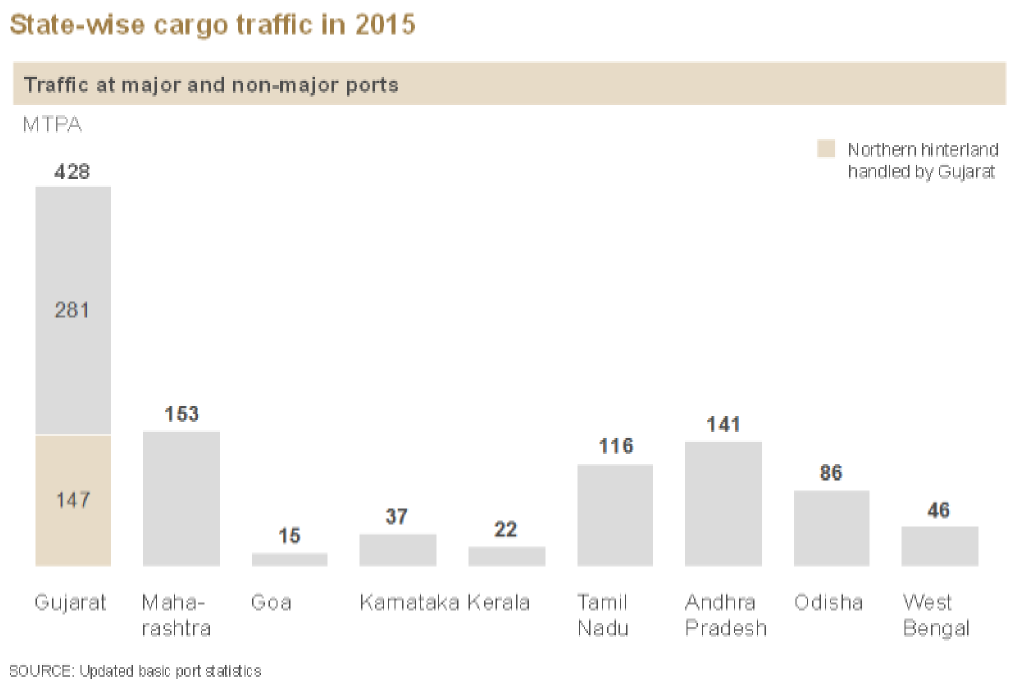
Higher pressure on coal berths through increased traffic – Tuticorin
Berth occupancy
Percent
77
77
19
91
61
61
72
73
94
69
120
58
9
10
40
CJI
CJII
NCBI
IX
I
II
III
IV
V
VI
VII
VIII
SB1
EARM
Oil Jetty
SOURCE: VOC port vessel log 2014–15

IMPLICATIONS AND OPPORTUNITIES FOR PORT CAPACITY

Port capacity needs

In 2014–15, Indian ports handled ~1050 MTPA of cargo, growing at a rate of 4.5 per cent per annum. Western coast ports handle more than 60 per cent of the total cargo owing to the large North West hinterland that the west coast caters to (Exhibit 47).

EXHIBIT 47



Over the next decade, the following commodity wise factors could drive traffic at the ports:

- Petroleum, oil and lubricant
  - Continual increase in the import of petroleum, oil and lubricant (POL) products
  - Coastal shipping of POL products from surplus to deficit centres
  - Setting up of new refining capacity near increasing demand centres
  - Rising demand of LPG due to increased penetration
  - Increased demand of LNG

- Coal
  - High growth rate of the power sector and continued reliance on demand centre coal-based power plants
  - High growth in CIL's production, enabling coastal shipping of thermal coal to serve power plants in the coastal states
- Materials
  - Coastal shipping of bulk commodities like steel from production to consumption centres
  - Setting up of new coastal capacities for bulk commodities, such as steel and cement
  - Capacity expansion of steel plants boosting demand for imported coking coal
- Discrete manufacturing
  - Increase in container volumes due to growth in the manufacturing sector
  - Boost in EXIM trade from improved logistics due to infrastructure upgradation
- Development of Coastal Economic zones

With all the above factors cargo volumes at the ports can potentially increase to 2500 MTPA by 2025 (Exhibit 48). While POL, coal and containers will continue to account for majority of the volume, share of coal can grow from 24 per cent to ~40 per cent. Development of Coastal Economic Zones can contribute ~341 MTPA of cargo to ports – both bulk and discrete.

EXHIBIT 48

Cargo volume growth at Indian ports by commodities
MTPA

Commodity	2014	2025 Base	2025 Optimistic	2025 Total
POL	351	460	80	540
Coal	231	850	128	978
Containers	115	323	53	375
Others	275	527	80	607
Total[1]	972	2,160	341	2,500

1 Numbers may not add up due to rounding error

Much of the growth will likely come from coastal shipping of bulk commodities. While the EXIM cargo will double over the next decade to ~1,670 MTPA, share of coastal shipping can increase 5 times taking its share in port traffic from current 15 per cent to over 33 per cent (Exhibit 49).

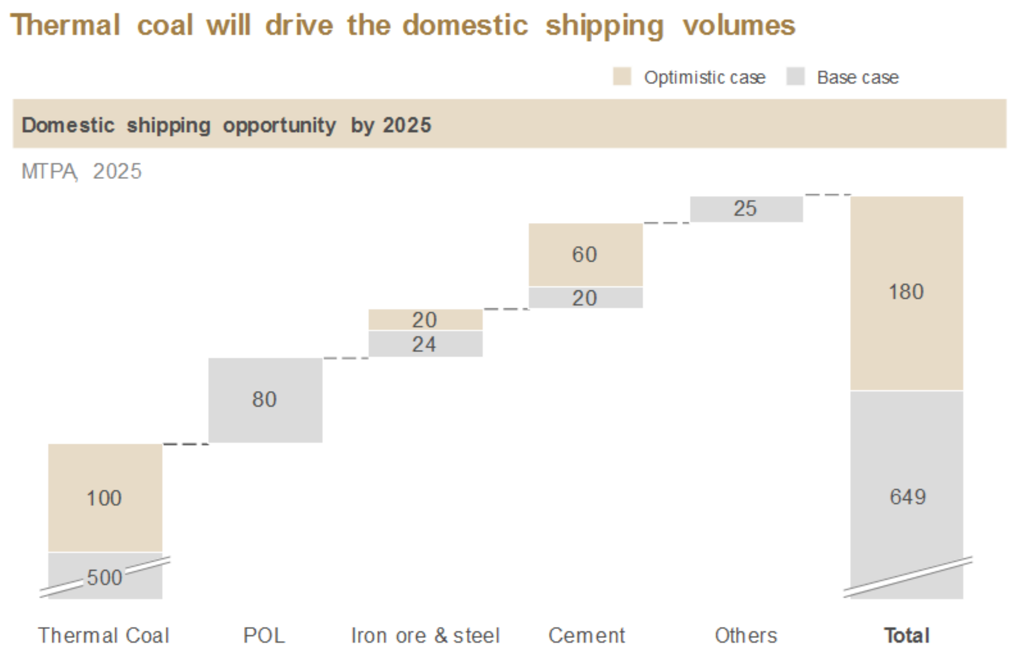
EXHIBIT 49

EXIM and domestic shipping cargo growth
MTPA

Commodity	2014	2025 Base	2025 Optimistic	2025 Total
EXIM	820	1,511	161	1,671
Domestic shipping	150	649	180	829
Total	970	2,160	341	2,500

Thermal coal would grow from 50 MTPA to 600 MTPA by 2025 driving volumes of coastal shipping (optimistic case). Most of this thermal coal will be evacuated from MCL mines through Paradip port to serve the requirement of the thermal power plants in the coastal states. Other bulk commodities like cement, steel can also leverage coastal shipping to reduce the overall logistics cost. Setting up of bulk clusters in Coastal Economic Zones will also add to the overall potential (Exhibit 50).

EXHIBIT 50



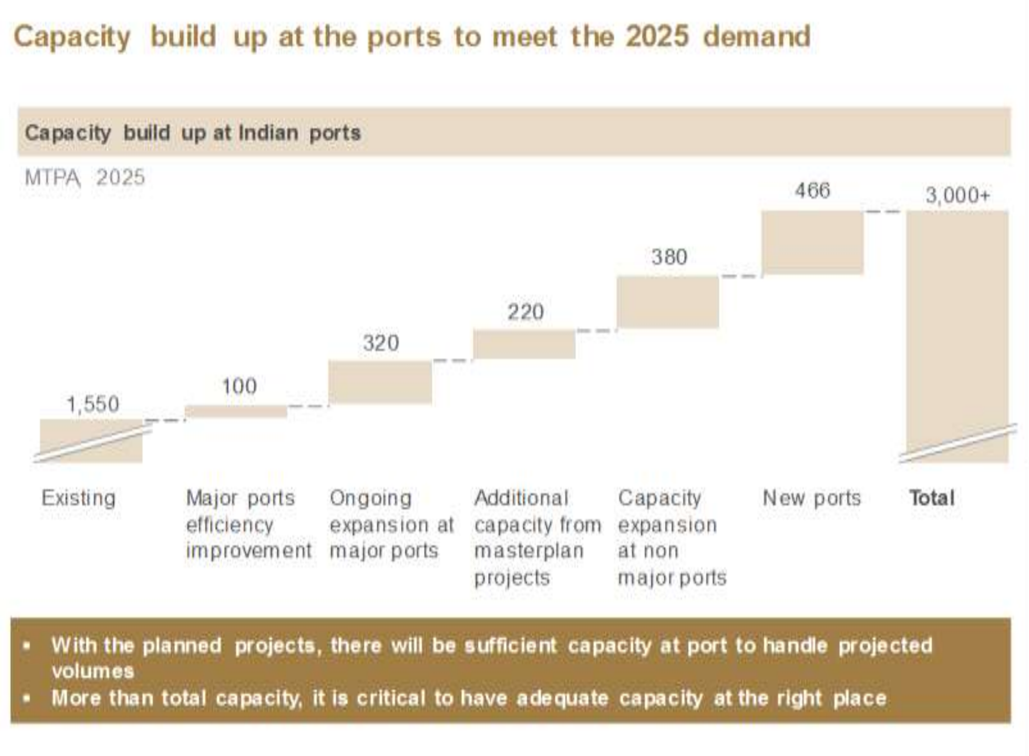
Potential opportunities for port modernisation

Catering to the increasing traffic over the next 10 years will require augmenting capacity. Cargo traffic at the ports is expected to be 1,650 MTPA in 2020 and reach 2,500 MTPA by 2025.

To cater to this demand, the ports will need to create additional capacity (Exhibit 51) by:

- Unlocking 100 MTPA capacity at existing terminals through improved efficiency
- Increasing capacity at existing ports through mechanisation and building new terminals
- Building new greenfield ports

EXHIBIT 51



Efficiency improvement for major ports is undertaken by PDC working on "Benchmarking and Operational Improvement Roadmap for Major Ports in India".

As part of Sagarmala, detailed master plans have been developed for the 12 major ports. For non-major ports, existing capacities and expansion announcements have been accounted for in arriving at traffic potential. Competitive dynamics between ports located within the same cluster have been taken into account.

Development of new ports could add additional capacity of 450 - 500 MTPA. Six locations have been identified as potential new port locations (based on

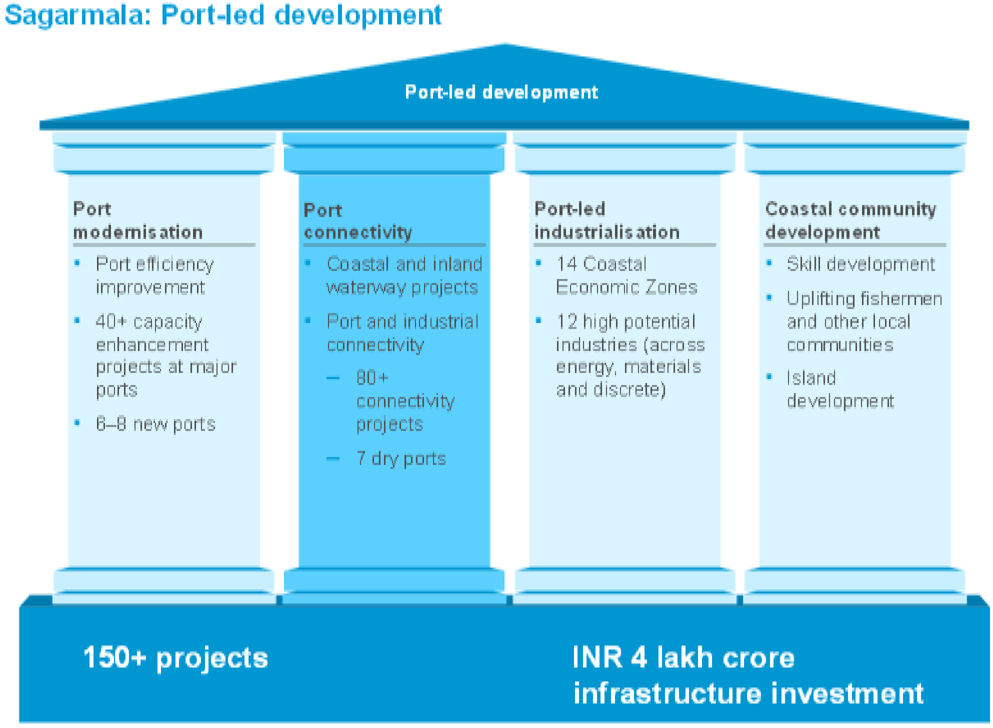
- Existing port saturation
- Non-availability of a port on the coastline stretch
- Strategic location

Further details on six locations of new ports have been included in a separate deliverable – Report on identification of sites for new port development

Port Connectivity

Port connectivity is the second pillar of the port-led development model under Sagarmala (Exhibit 52). It aspires to provide the most optimal mode of evacuation to and from ports for both EXIM and domestic cargo. The study compared possible modes of connectivity from domestic production/demand centers to ports. Pipelines, coastal and inland waterways, railways and road networks were studied to provide recommendations on efficient evacuation.

EXHIBIT 52



Connectivity is one of the critical enablers for ports as it is the end to end effectiveness of the logistics system that drives competitiveness for industry. For example, intermodal transportation network of rail, inland shipping, road, short sea and pipelines gives the port of Rotterdam the best possible connections to the rest of Europe – transit times to most destinations is less than 24 hours. Superior connectivity has helped Port of Rotterdam to become the largest sea port in Europe handling more than 450 MTPA of cargo.

Connectivity challenges exist in India and even new ports that have world class equipment can see their turnaround times hamstrung because of poor connectivity. This chapter discusses the main challenges to port connectivity that constrain India's trade competitiveness and increase industrial production costs. The key challenges are underleveraging of domestic waterways, severely constrained rail infrastructure along key routes, sub optimal modal mix for container freight, connectivity to west coast ports through the Western Ghats, lack of coordinated end to end planning for bulk logistics and last mile connectivity to ports and key industrial hinterlands.

India's hinterland connectivity is mainly based on road and rail networks. Domestic waterways, both coastal shipping and inland routes, so far have played a limited role. This chapter suggests ways of reinventing the modal mix through pipelines, waterways, roads and railways.

Pipelines are an effective means of transporting liquid cargo to and from ports. Cost of transporting the product by pipeline could be about 10–15 per cent of that by rail. Currently, many of the pipelines are operating at utilisation level of more than 90 per cent, therefore any increase in refineries capacity has to be matched by pipeline expansion. With this in mind, potential pipelines projects have been outlined for capacity enhancement and expansion. Development of pipeline from Paradip to Hyderabad and expansion of Salaya Mathura pipeline are some of the high potential projects. Slurry pipelines could also be considered for transporting iron ore from the mines in Chattisgarh and Odisha to the nearest port. NMDC is already building a pipeline from Bailadila to Vizag.

Freight transportation by waterways is highly underutilised in India as compared to US, China and EU. For example the Yangtze River system is one of the most developed inland waterways navigation system with 13 waterways and 92 ports. Port of Shanghai is located in the vicinity of Shanghai, at the confluence of Yangtze, Huangpu and Qiantang rivers and handled 35 mn TEUs in 2014, most of which originates in the industrial clusters located in the Yangtze valley. Similarly in India, National Waterways 1, 2, 4 and 5 can be developed to play an important role in cargo movement.

Railways is the mainstay for carrying long lead distance and bulk cargo. But the expansion of rail network has not been able to keep up with the growing demand – in the past 5 years, rail network has only grown at 0.7 per cent. Most of the routes carrying bulk cargo (like thermal coal) are constrained and running at high utilisation. Evacuation capacity in Odisha and Chhattisgarh is much lower than projected requirement. There is also an issue of constrained infrastructure between receiving ports and demand centres especially around the Western Ghats. Development of Heavy Haul Rail corridor, decongesting RV line, Hospet-Vasco da gama line are some of the high potential rail projects. High freight rates due to cross subsidisation and low priority for goods trains have made railways uneconomical for container movement. Because of this, shippers prefer moving even long distance containers on road. Western DFC with linkages to ports of Hazira, Kandla and Mundra through spur lines can result in modal shift from road to rail for containers generated in the northern hinterland.

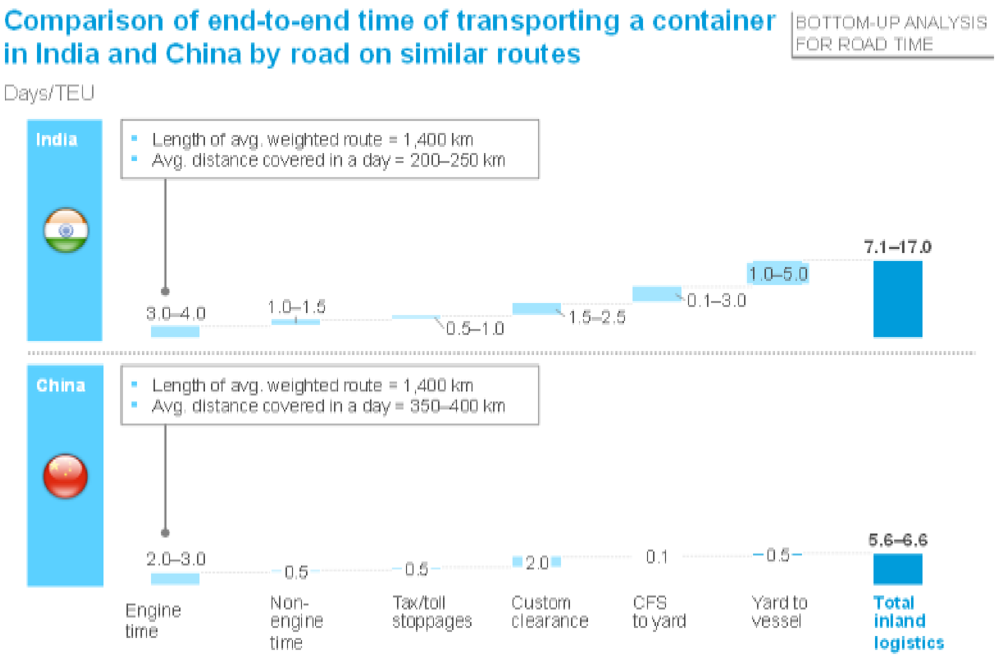
Road is economical compared to rail for covering distances up to 500 to 1,000 km from the port, however the current condition of highway stretches is inconsistent. Moreover, the Indian coastline does not have a coastal road network. To make roads more effective as a mode of cargo movement, ten potential highway stretches have been analysed as freight friendly expressways. In addition to this the Government of India has undertaken the Bharatmala programme which would also help in joining coastal regions through road links. Policy related interventions can help reduce the overall cost and time for freight movement.

OVERARCHING CONNECTIVITY CHALLENGES

Connectivity is one of the critical enablers for ports as it is the end-to-end effectiveness of the logistics system that drives competitiveness for industry. With infusion of new technology and capacity building, the cumulative or total capacity available at ports could meet the requirements. However, when evacuation of cargo is slow, then despite adequate capacity and modern handling facilities, ports will not able to ensure a quicker turnaround of ships. This could undermine the competitiveness of Indian trade. It is important that connectivity of ports with the hinterland is augmented not only to ensure smooth flow of traffic at present levels but also to meet the requirements of a projected increase in traffic.

A comparison between India and China for time taken to transport a container by road on similar routes suggests that there is a significant variability in time for inland transportation in India (Exhibit 53). Compounding this problem is the long logistics lead distance of India versus comparable countries. While this is good for balanced regional development, it also means logistics costs are structurally higher.

EXHIBIT 53



1 Ocean distance = 6,658 NM

SOURCE: Interviews with truck companies; CTOs; freight forwarders; importers; exporters; port management; World Bank

This section covers key port connectivity stretches in India for coal, container traffic, petroleum, oil and lubricants (POL), iron ore, steel, fertilisers, cement and food grains, identified through origin–destination (OD) studies.

Energy-focused commodities

- Around 80 per cent of the crude requirement in India is imported and moves through pipelines to refineries. Domestically produced crude from Bombay High is transported via coastal shipping.
- Approximately 75 per cent of the product (MS/HSD) movement from PSU refineries takes place via pipelines while the remaining 25 per cent is transported via road or rail. Product from private refineries is largely exported due to price regulation in the past or is coastally shipped to south in case of a deficit.
- Thermal coal movement is predominantly by rail. While domestic coal is mostly transported directly by rail from mines to power plants, there is some movement to ports as well, e.g., from Mahanadi Coal fields in Odisha to Paradip port. Imported coal-based generation is mostly located in the immediate vicinity of ports with a few exceptions in Rajasthan and Maharashtra. The proposed impetus to coastal shipping could significantly alter connectivity needs for coal movement.

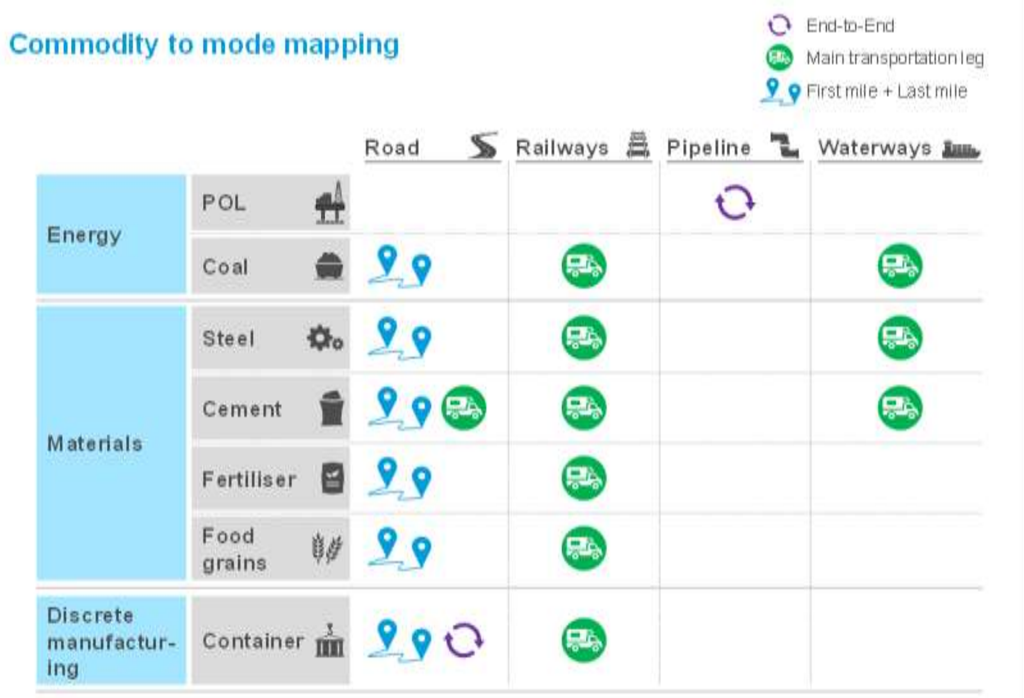
Materials-focused commodities

- Coking coal is mostly imported by steel plants by rail from receiving ports of Visakhapatnam, Gangavaram, Dhamra, Paradip and Haldia to steel clusters in Odisha, Jharkhand, Chhattisgarh and West Bengal.
- There is also significant opportunity for movement of coastal cargo especially in steel, cement, fertilisers and food grains apart from coal. Key movement of food grains is mainly by rail from Andhra Pradesh to Tamil Nadu and Kerala. Similarly, steel and cement moves from the east coast of India to south and west. Apart from re-routing existing cargo from rail to coastal movement, there is also potential to set up mega cement cluster in AP and steel clusters in Tamil Nadu, Maharashtra and Gujarat.

Discrete manufacturing

- Container traffic is the heaviest from the northern states, i.e., Delhi, Punjab, Haryana and Uttar Pradesh, to ports in Gujarat, e.g., Mundra and Pipavav and Maharashtra (JNPT). The cargo movement on these stretches is skewed in favour of road at 62 per cent as compared to rail at 38 per cent. Other high density stretches, mainly from the southern cities of Bangalore, Coimbatore and Hyderabad, are considerably shorter and better suited for road than rail. The upcoming dedicated freight corridors will have a significant influence on the rail–road mix, especially for the northern hinterland. Exhibit 54 shows the current mapping of commodities to different modes.

EXHIBIT 54



Projections of cargo traffic create the need to further strengthen connectivity projects so that future demand is met through easing of bottlenecks in the choked rail and road systems and effective shifts in the modal mix toward inland waterways and coastal shipping, which are both cost-effective and environment friendly.

Later sections discuss some of the key connectivity challenges for movement of EXIM cargo. The implications for key cargo and a corresponding list of initiatives for meeting the projected cargo traffic and connectivity challenges have been identified.

The following section detail out the main challenges to port connectivity, constraining both country's export competitiveness as well as increasing industrial production costs.

Waterways

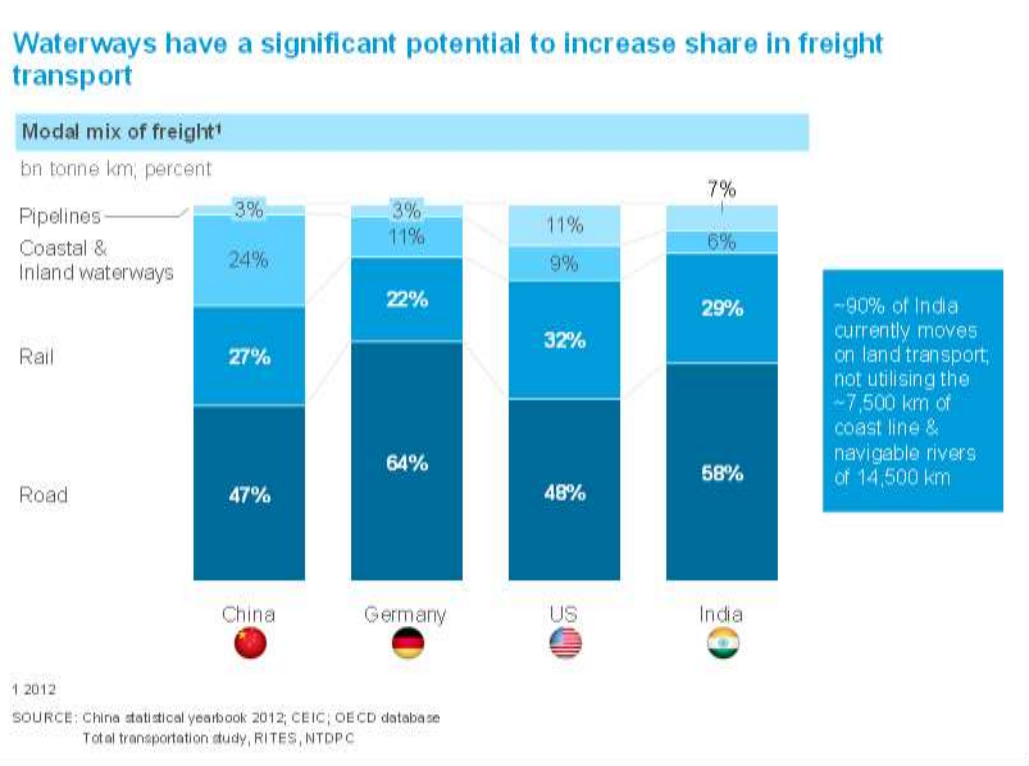
India has around 7,500 kilometers (km) of coastline and 14,500 km of navigable rivers. In spite of this, cargo movement in India through domestic waterways is negligible.

Globally, domestic waterways are seen as cost-effective as well as environmentally friendly means of transporting freight. For instance, the cost of moving coal via coastal shipping is significantly cheaper than cost of moving it by the currently preferred means of railways (for coastal plants).

Exhibit 55 below shows a comparison of the modal mix of cargo movement in China, the US, Germany and India. It can be seen that while China ships as much as 24 per cent of its freight via waterways, India's utilisation of waterways for freight movement is less than 6 per cent.

By contrast, in the US, waterways are utilised in a much more effective manner. The Mississippi waterway became operational in the 1930s and has a minimum navigable depth of 9 feet, carrying roughly 126 MTPA of traffic every year. The overall inland waterways system in the US has nearly 12,000 miles of navigable rivers with more than 9 feet depth with 192 locks moving more than 600 MTPA of cargo. Underused waterways constitute a major challenge in optimising connectivity to ports in India. This is all the more significant, given that the railway network is heavily constrained, as discussed subsequently.

EXHIBIT 55



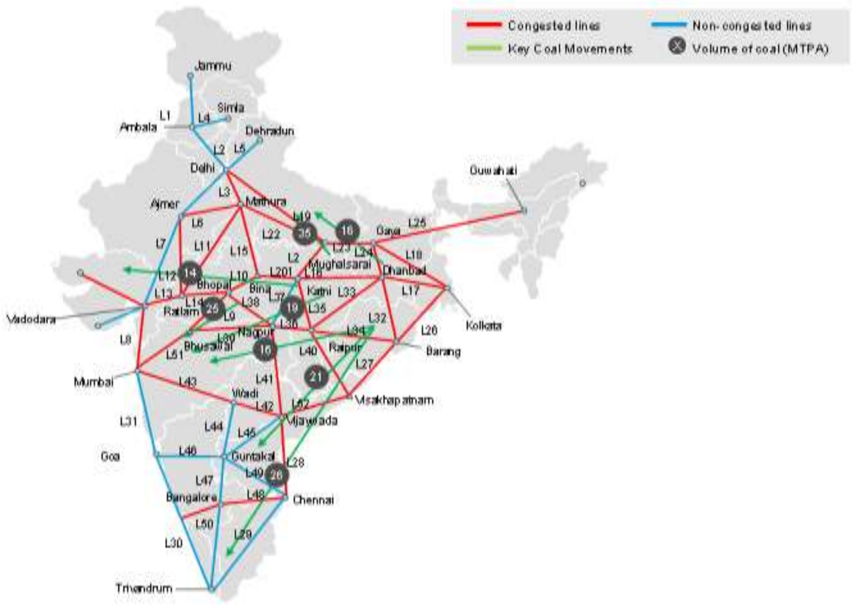
Railways infrastructure bottleneck on key routes

Rail is the primary mode for transporting bulk freight bound to and from ports. Railways carry nearly 60 per cent, i.e., 356 MTPA of the total domestic coal volume moved in India. Chronic underinvestment in infrastructure, however, has resulted in rail capacity failing to keep pace with demand, especially on trunk routes. For example, the stretch from Talcher coalfield to Paradip port is highly constrained and unable to handle the demand from coal traffic. In 2013–14, coal movement in the country was ~740 MT, including domestic production and imports. Though coal production is concentrated mostly in the eastern and central parts of India, it is transported for power generation to nearly all corners of the country. Coal production is currently growing at a rate of 6 to 7 per cent per annum, but infrastructure for its evacuation has lagged behind with an annual growth rate of 3.5 per cent, which needs to be augmented to keep pace with production.

This has resulted in congestion, high dwell time and an average freight speed of only 25 kmph. More than 90 per cent of rail routes handling coal movement are operating at over 100 per cent utilisation as shown in the Exhibit 56. Severe shortage of rolling stock causes overstocking of coal at the ports hampering port productivity and increasing the inventory cost.

EXHIBIT 56

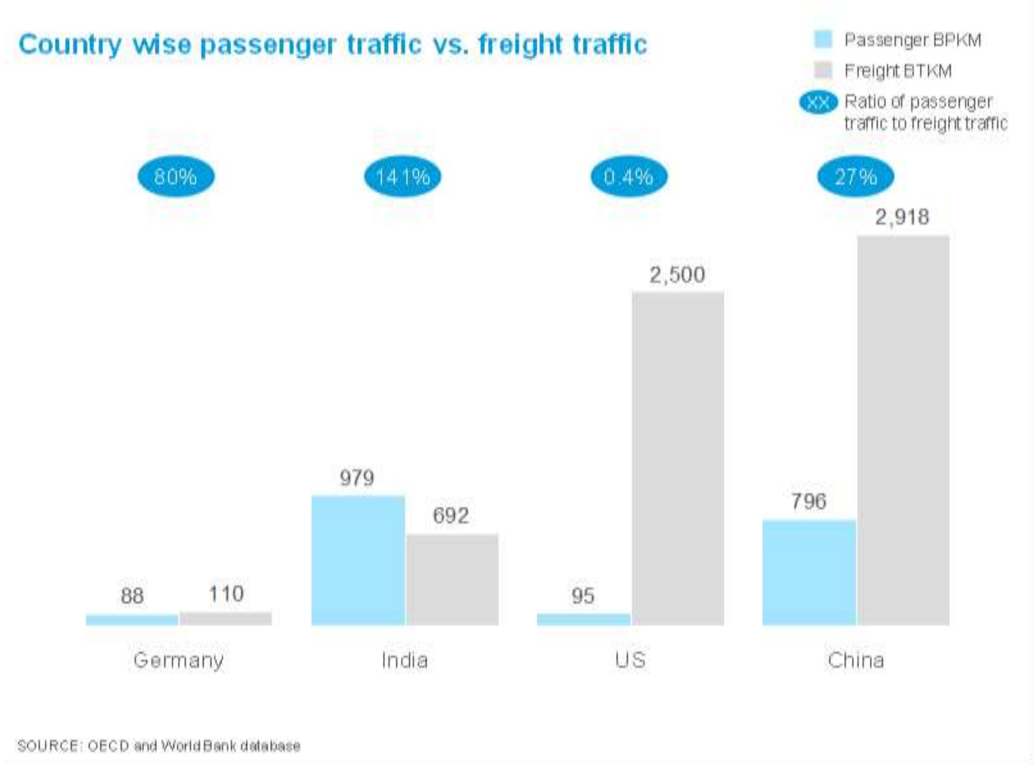
Current rail network is congested and will likely not be able to support future volumes



SOURCE: Indian Railways

The Delhi–Mumbai rail route is the most important corridor for container freight in the country. The route, also known as the “Western Corridor”, services the movement of container cargo from prime manufacturing hubs in the northern region, namely Delhi NCR, Punjab and Haryana, to Mumbai and Mundra ports. It is the one of the busiest and most congested passenger route in the country, with capacity utilisation between 115 and 150 per cent. Indian Railway policies have traditionally been passenger-centric with cargo being a second priority. Freight trains are given the seventh preference in terms of track availability in the railways which further slows down the already congested movement on key trunk routes. This is also reflected in terms of the proportion of the passenger traffic to the freight traffic in which India leads the major industrial countries by a large distance in terms of passenger dependence (Exhibit 57).

EXHIBIT 57



Connectivity to west coast ports through the Western Ghats

India's west coast runs parallel to the Western Ghats. The Western Ghats are steep, creating technical challenges in construction and adding to project costs. The rich yet fragile ecology of the area poses significant environmental challenges. These challenges particularly impact two ports, Mormugao and New Mangalore, as well as potential port locations in north Karnataka, such as Belekeri, Pavinkurve and Tadadi. These ports are severely constrained by the lack of adequate road and rail connectivity to their natural hinterlands, especially power plants and steel clusters located across the Western Ghats to the east.

While several projects have been proposed in the past, none have been successfully completed. The Castle Rock–Kulem stretch is one of the most challenging rail stretches in the country with a gradient of 1 in 30, 16 narrow tunnels and around 15 bridges. Additionally the Tinaighat–Castle Rock stretch and the Hubli to Ankola line to connect potential new ports in north Karnataka have been delayed due to environmental issues. The Kulem–Vasco railway doubling is a part of the Tinaighat–Vasco doubling sanctioned by Indian Railways in 2010–11, for which land acquisition is required at isolated locations like major bridge approaches, deep cuttings, high bank locations and station yards.

Currently, if a passenger train travels from Castle Rock to Kulem (which is downhill), no other goods train is allowed to move in this section, even though the goods trains are well equipped with supplementary braking power in the event of a brake failure (Exhibit 58 and 59)

EXHIBIT 58

Railway line in western ghats

The rocky ghats run close to the railway tracks and laying an additional line next to the existing line poses the challenge of having to blast through hard rock at many places. The estimated time for completion of this 26 km stretch could be between five and 10 years from now.

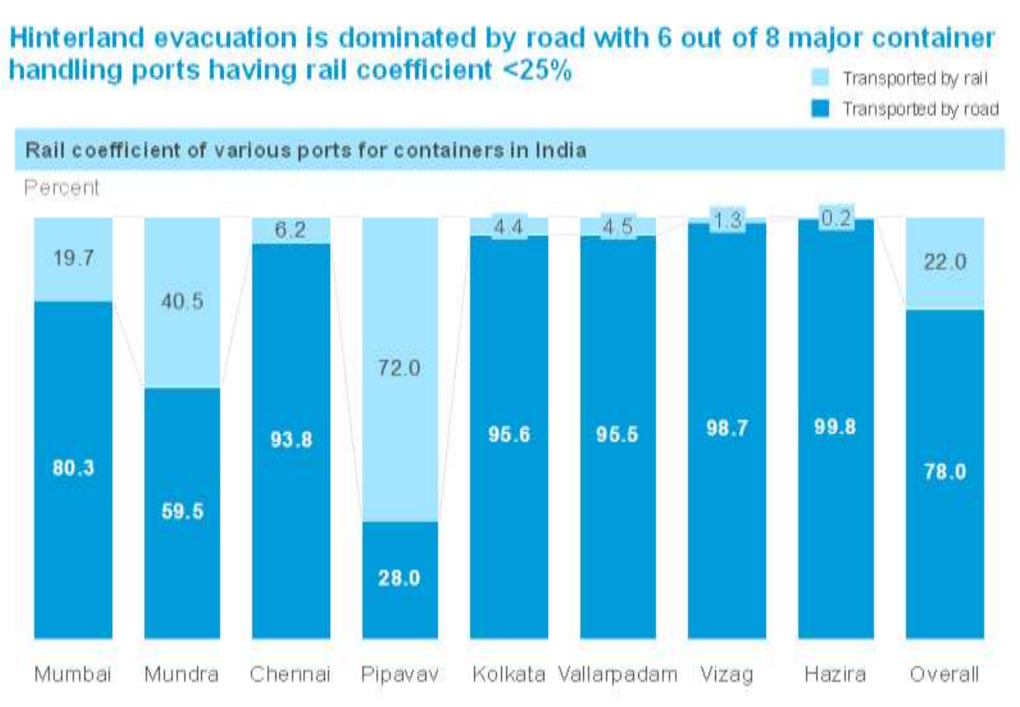
EXHIBIT 59

Bellary – Madgaon railway line

Sub-optimal modal mix for container freight

Roads are the predominant mode for transporting containers in India despite the superior cost economics of railways. As seen in the Exhibit 60, less than 22 per cent of India's total container evacuation to ports is handled by rail and of the eight major ports handling containers, only two ports, i.e., Mundra and Pipavav, have appreciable rail coefficients (40 and 72 per cent respectively), while Visakhapatnam and Hazira depend heavily on roads.

EXHIBIT 60

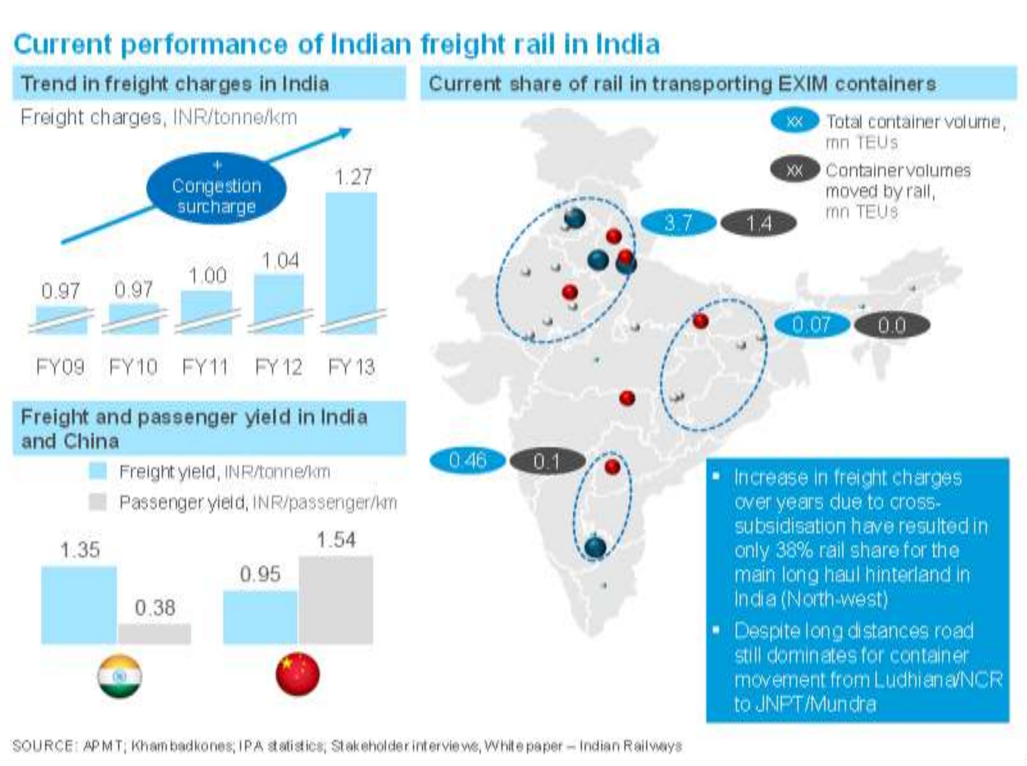


The highest container volume in the country is generated in the northern region, namely, Punjab, Rajasthan, Uttar Pradesh and Delhi NCR. Of the 3.7 mn tonnes of container freight currently generated, only 1.4 mn tonnes of container freight is moved by rail and the rest by road.

This is despite the fact that not only is rail faster, but also has economies of scale as a result of its consolidated end-to-end logistics, while container traffic by road is run by private transporters at the current de-regulated diesel prices.

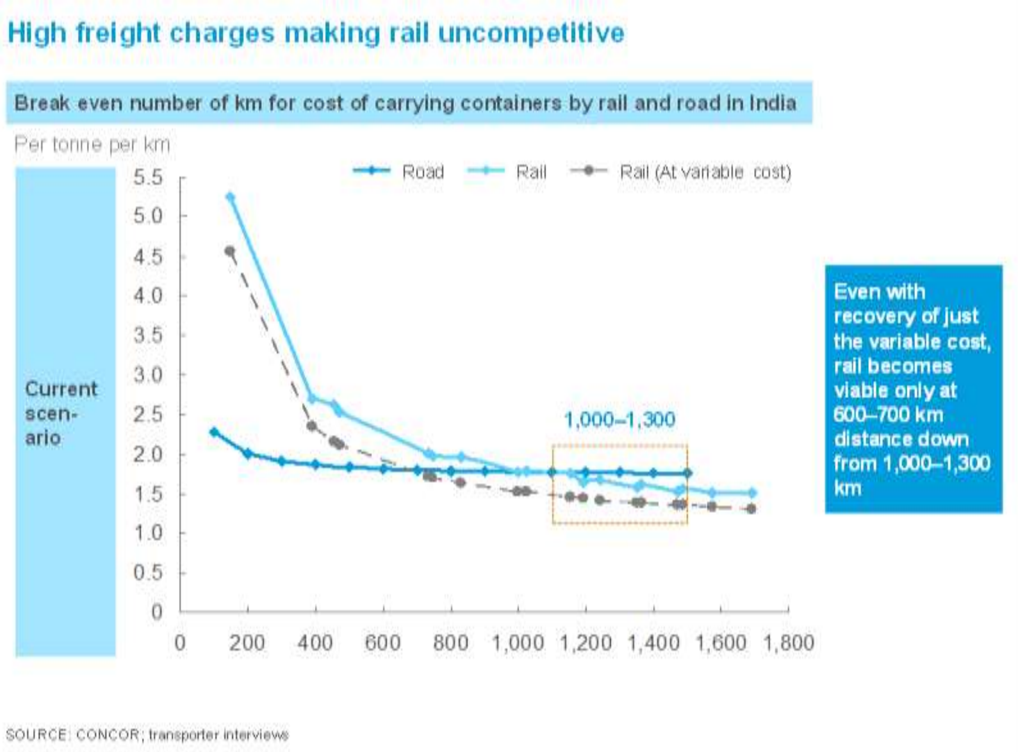
One of the reasons behind roads having a larger share in India is the cross-subsidisation of passenger traffic by container freight. This has led to reduction in the economic viability of transporting containers by rail. The top panel in the Exhibit 61 below shows the steep increase in freight charges that is driving container traffic away from rail. The bottom panel highlights the significant differential between freight and passenger yield for railways, as well as a comparison with China, where the railways keeps freight yield much below passenger yield.

EXHIBIT 61



Due to the cross-subsidy to passenger charges with the high cost of container freight, the distance at which the cost of rail transportation of containers breaks even with road is currently between 1,000 and 1,300 km (Exhibit 62).

EXHIBIT 62



Lack of coordinated end-to-end planning for multimodal bulk logistics

Bulk cargo in India is naturally amenable for centrally planned logistics networks because of certain characteristics:

- Typically bulk movements are concentrated among a few players in India. For example, in coal there are only a few generating companies and Coal India is the largest coal miner. This means the corresponding logistics network also involves fewer players
- Bulk logistics can be projected with relative accuracy as compared to variable container flows. Projections of power and steel capacity under development and construction, for example, can accurately inform logistics infrastructure capacity
- However, the current logistics system is unbalanced due to multiple other challenges. Compared to the complex rail-sea-rail route movement, the railways provide a door-to-door single-window service through a transparent and smooth process. The railways can also charge a higher price for the convenience over coastal shipping (Exhibit 63)

EXHIBIT 63

What needs to happen to capture the coastal shipping opportunity

Stakeholder involvement & enabling port infrastructure is required	
1	On-boarding of PSU players (Power utilities, SAIL, DCI) and private players (Steel producers, cement producers) to initiate coastal shipping
2	Creation of supporting transport infrastructure (e.g., Talcher-Paradip railway line), slurry pipelines
3	Dedicated berths, bunkering & storage capacities at relevant ports
4	Aggregation services: Identifying or setting-up aggregation agency to handle small parcel sizes & operate logistics
5	Dedicated capacity fleet under Shipping Corporation of India
6	Appropriate ship-repairing/ship-building facilities on key ports; currently most of the ship repairs happen outside the country

Challenges faced in road transport

Despite the push to expand the highway network, multilane roads (4+ lanes) in India is low. In addition, incomplete stretches in NHDP and lack of city bypasses on key corridors add to congestion in the road network. Lack of standardisation in documentation requirements across different states hinders inter-state freight transportation. In addition, lack of digitisation, with requirement of manual documentation at a few states results in higher waiting time for clearance at inter-state borders. Also, the differences in entry taxes across states increases the complexity in documentation requirement, resulting in higher freight transit times. In addition, differences in entry restrictions across different cities increases complexity in route planning

Last-mile connectivity to ports and key industrial hinterlands

A large number of ports still lack basic connectivity through rail and road. Even if ports are connected via these modes, there are multiple issues pertaining to congestion which cause exporters and importers to pay the price for using these ports. It is of utmost importance under the programme that all last-mile/gate-related issues are addressed so that the overall supply chain functions in the manner it is intended to.

MODE WISE PROJECTS

To address the above challenges, a detailed study of all modes of evacuation was undertaken to come up with detailed list of mode wise projects and initiatives to ensure efficient port evacuation.

Pipelines

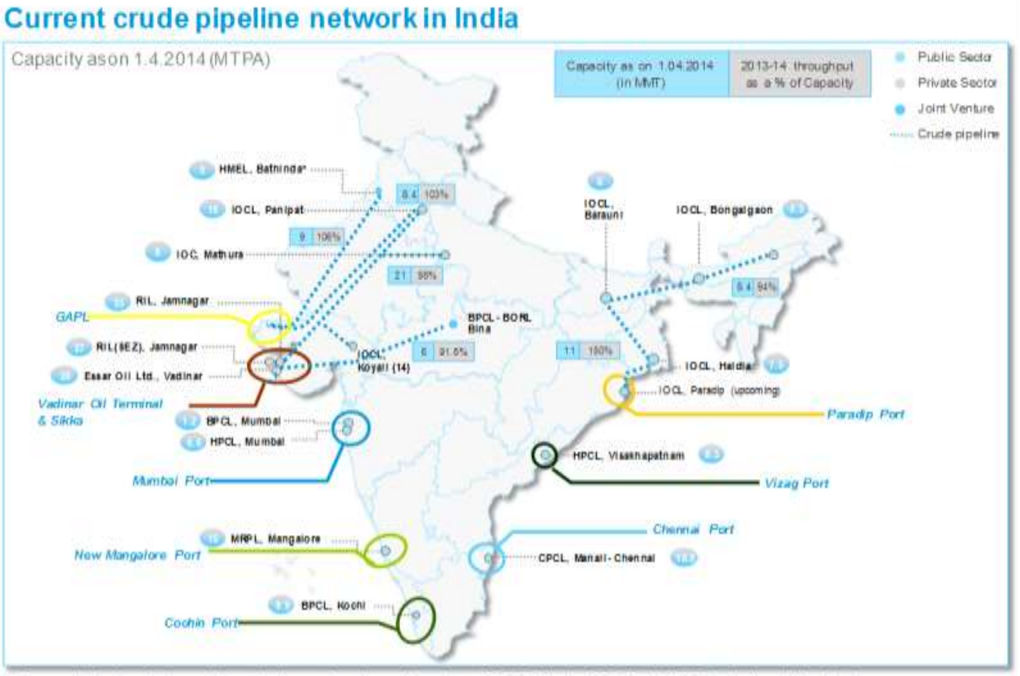
Pipelines are the primary means of transport for liquid cargo to and from ports. Broadly, this can be split into crude, which is imported by refineries, and products which moves from refineries to the hinterland.

Crude oil

India currently consumes around 227 MTPA of crude oil, of which 189 MTPA is sourced through imports and 38 MTPA through domestic production. The imported product is handled by seven port clusters—the Gujarat cluster, Paradip, New Mangalore, Mumbai, Chennai, Cochin and Visakhapatnam, with the Gujarat cluster handling around 65 per cent of the total crude imports. Mumbai, New Mangalore and Paradip account for 7 to 8 per cent each, while the rest handle 4 to 5 per cent each of the total import.

Significant percentage of refinery capacity is coastal, largely optimising the movement of crude. Around 34 per cent of the crude landed at the Gujarat cluster is transported inland through pipelines to the Bhatinda, Panipat, Mathura and Bina refineries. Similarly crude landed at Paradip port is moved inland to serve Paradip, Haldia, Barauni and Bongaigon refineries (Exhibit 64). Some part of the domestically produced crude (around 13 to 16 mn tonnes) is also shipped coastally. Emergency coastal shipping of crude also takes place in cases of disruption of the regular supply.

EXHIBIT 64



1. Does not include refineries relying primarily on domestic crude such as ONGC Tatipaka, IOC Digboi, IOC Guwahati and Numaligarh

Note: Map is indicative only, not to scale

Most current crude pipelines operate at over 90 per cent utilisation and any plans to expand the existing refineries will also need to factor in a capacity increase for the relevant pipeline. For example the IOCL refineries in Panipat and Mathura get their crude from Mundra and Vadinar ports in Gujarat via pipelines (Exhibit 65). These pipelines currently operate at near-capacity utilisation levels. As the refineries expand, corresponding augmentation will be required in the crude pipelines as well. The current capacity of the Salaya to Mathura pipeline, which feeds crude to the refineries in Koyali, Mathura and Panipat (partially), is around 21 MTPA, and IOCL has plans to augment its capacity to 25 MTPA. There is a proposal for further augmentation of the pipeline to around 40MTPA to align with future expansion of the Panipat, Mathura and Koyali refineries[8]

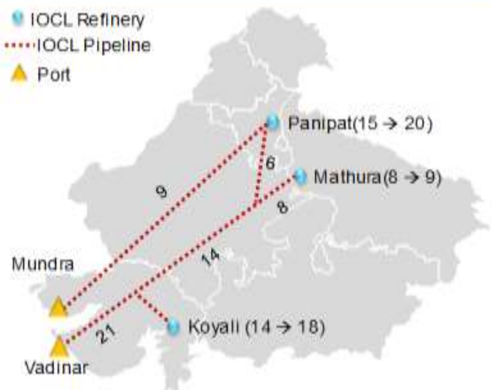
Some of the other projects could include upgradation/replacement of old crude pipelines serving CPCL Manali from Chennai port.

[8] Discussion with IOCL and Kandla port

EXHIBIT 65

Salaya – Mathura pipeline could be expanded to cater to future expansion of Matura, Koyali and Panipat refineries

Current IOCL Pipeline Network



- Panipat refinery plans to expand to 20 MTPA
- Mundra – Panipat pipeline operating at 100%+ utilisation supplies 9 MTPA crude currently
- Remaining 6 MMPTA comes from Salaya – Mathura pipeline operating at full capacity

Mundra-Panipat versus Salaya Mathura Pipeline

SBM Utilisation

- IOCL's captive SBM at Mundra port is currently underutilised
- IOCL's 2 SBMs at Vadinar port will operate at near 100% utilisation post expansion

Cost

- Mundra to Panipat distance is 100 km less than Salaya Panipat pipeline distance
- Salaya to Mathura pipeline CAPEX and OPEX could be higher
- Port charges are higher at Mundra as compared to Vadinar

Strategic sense

- Mundra to Panipat pipeline will be augmented for only one refinery
- Augmentation of Salaya Mathura pipeline can serve future expansion of three refineries

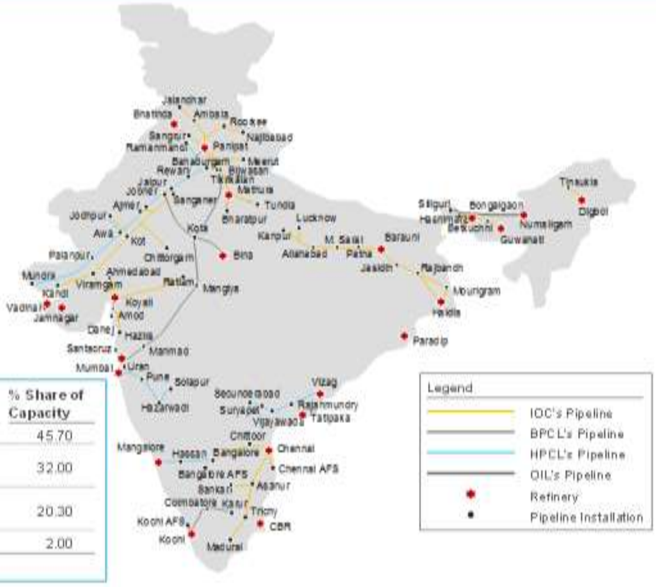
Product

Refineries rely on the pipeline network for domestic evacuation of products, since the cost of transporting the product by pipeline comes to around INR 0.14 to 0.18 per tonne km compared to INR ~1.2 per tonne km by rail. India has ~12,000 km of product pipeline with a total capacity of ~86 MTPA (Exhibit 66). Approximate 75 per cent of the MS/HSD evacuation currently happens through pipelines. Pipelines dominate distribution from the refineries to the depots, with the balance moving via road or rail.

EXHIBIT 66

Current product pipeline network in India

Existing Petroleum Product Pipelines Network



PSU	Length km	Capacity MMTPA	% Share of Length	% Share of Capacity
IOC	6,359	39.39	52.50	45.70
HPC+ PMHB	2,898	27.55	23.90	32.00
BPC+ PCCK	2,201	17.44	18.20	20.30
OIL	654	1.72	5.40	2.00
Total	**12,112**	**86.1**		

Note: Map is Indicative only, not to scale

SOURCE: IOC: Indian Oil Corporation Ltd., | HPC: Hindustan Petroleum Corporation Ltd., | BPC: Bharat Petroleum Corporation Ltd., | OIL: Oil India Ltd., PCCK: Cochin-Coimbatore-Karur Petronet Ltd., | PMHB: Mangalore-Hassan-Bangalore Petronet Ltd.,

IOCL has proposed the construction of a new product pipeline:

Product pipeline from Paradip to Hyderabad: By 2025, the eastern region's demand for MS/HSD will be around 21 MTPA and production will be around 27 MTPA, creating a surplus of 6 MTPA. This will primarily be due to capacity expansion of the Paradip refinery to 15 MTPA. On the other hand, the AP region is expected to face a deficit of around 6 MTPA, even after the Visakhapatnam refinery expansion. Hence, a 4 MTPA pipeline connecting Paradip to Hyderabad will be needed to meet the AP and Telangana demand (Exhibit 67). The pipeline is already part of IOCL's plans and the construction should not be delayed.

EXHIBIT 67

Product pipeline proposed by IOCL with ~5MTPA capacity from Paradip to Hyderabad will cater to the AP deficit

Proposed product pipeline

Rationale

- Product pipeline from Paradip to Hyderabad
  - By 2025, demand for MS/HSD in East would be ~21MTPA and production would be ~27MTPA
  - On the other hand, AP region is expected to face deficit of ~6MTPA
  - Pipeline from Paradip to Hyderabad with ~5MTPA capacity will help meet this deficit

SOURCE: IOCL, Press Research

List of pipeline projects

Project name	Agency	Concerned state	Investment required (INR cr)	Timeframe
Enhanced pipeline capacity to CPCL Manali, increasing diameter from 30" to 42"	MoPNG	Tamil Nadu	500	24 months
Expansion of Salaya Mathura Pipeline	MoPNG	Gujarat, UP	1,000	60 months
Pipeline from Paradip to Hyderabad	MoPNG	Odisha and AP	3,000	120 months

Waterways

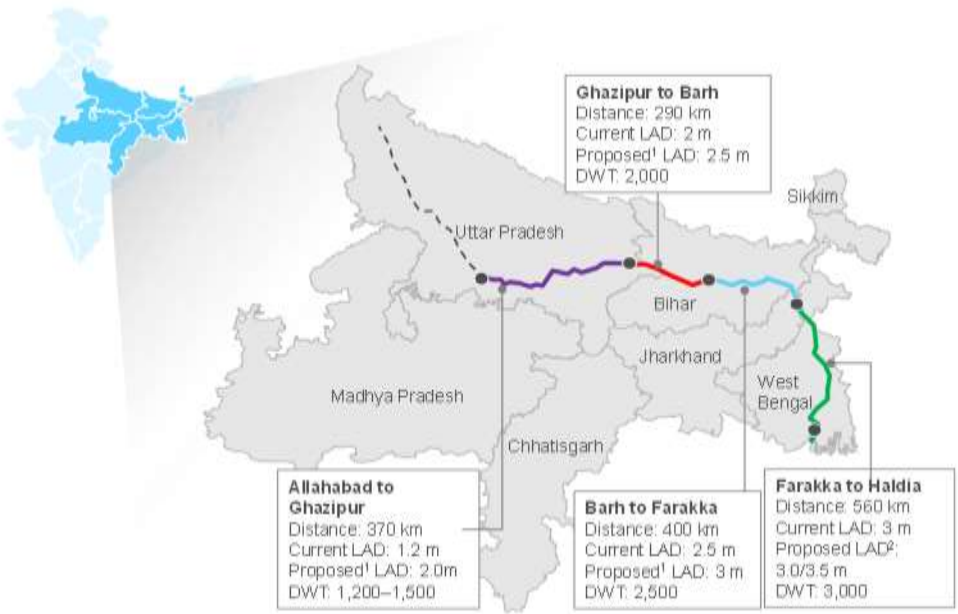
India has an extensive network of inland waterways in the form of rivers, canals, backwaters and creeks. Of the total navigable length of 14,500 km, 5,200 km of the river and 4,000 km of canals can be used by mechanised craft. Freight transportation by waterways is highly underutilised in the country as compared to the US, China and the European Union (EU). India has five recognised national waterways and 106 other waterways. Indian parliament has recently passed a bill to convert these 106 waterways to national waterways. Economic viability of a waterway to carry traffic as an alternative to rail and road depends on its length. Apart from this, it should have a large hinterland coverage area and potential in order to generate enough traffic on routes. Considering this, National Waterways could be developed to play an important role in transportation.

National Waterway 1

With a length of 1,620 km, the National Waterway 1 (NW1) is the longest waterway in India passing through four states, i.e., UP, Bihar, Jharkhand and West Bengal (Exhibit 68). It was declared a national waterway in October 1986. NW1 is a stretch of the Ganga Bhagirathi–Hooghly river system starting from Allahabad in UP, extending up to Haldia in West Bengal, and is navigable by mechanical boats up to Patna. Key opportunities in the region lie in 11 major power plants located on the banks of NW1 with a cumulative capacity of 12,000 MW as well as multiple chemicals and food exporters in UP and West Bengal.

EXHIBIT 68

NW1 is 1,620 km navigable stretch of the river Ganga from Allahabad to Haldia with a minimum channel width of 45 m



1 Proposed LAD by 2010
2 Farakka - Tribeni: 3.0m; Tribeni – Haldia: 3.5m

Commodities like thermal coal and food grains from the hinterland of UP to various South and East Indian states, automobiles in containers as well as containers to be exported from UP to the port of Haldia/Kolkata and imported steel from the Kolkata/Haldia port into UP and Bihar along with by-products like fly ash can be catered to by the waterway provided issues related to high sedimentation of the river, maintenance of constant draft of 3 m throughout the system and possibility of high-capacity barges plying on the river can be addressed successfully. Other challenges include the high rate of waste dumping from industrial cities along the Ganga as well as the difficulties faced in creating barrages along a religious river like the Ganga. Additionally, light manufacturing clusters could be developed around NW1.

National Waterway 5

National Waterway 5 (NW5) (Exhibit 69) runs through the states of Odisha and West Bengal along the Mahanadi River. The main rationale for NW5 is its proximity to the Talcher–Paradip region, which is abundant in resources and provides opportunities for evacuation of coal as well as other commodities like coking coal and iron ore.

NW5 has potential of 65-75 MTPA of coal movement and about 14-15 MTPA of coking coal in back haul in addition to some potential for iron ore transport. While the capacity of the waterway is limited to around 20 MTPA using a conventional system, it can be enhanced if barge trains are used. The viability of using tugged barges, however, would need to be established through a detailed technical study.

Based on high-level estimates, the investment to operationalise NW5 could be INR 5,000 cr for dredging purposes, INR 900 cr for terminal development at Talcher and Paradip and INR 200 cr for annual maintenance. For tugged barges, the overall capital expenditure will be higher.

The revenues to the developer—assumed to be the Inland Waterways Authority of India (IWAI)—would consist of a usage fee of INR 1 per tonne km, vessel berthing fee of INR 750 per terminal and cargo-handling fees of INR 1 per tonne at each terminal.

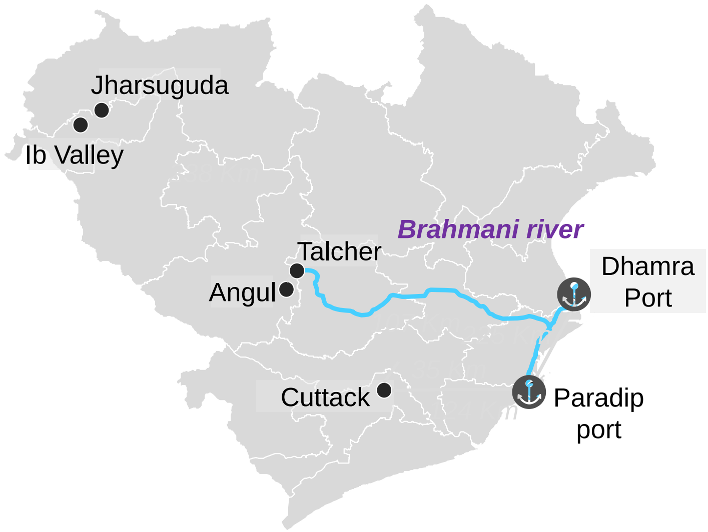
For barge operators, this revenue would be an operating cost. In addition, they would incur INR 2.4 cr per barge towards fuel, manning and repair and maintenance. On the capex front, operators will need to invest about INR 700 cr. The revenue for barge operators is assumed to be INR 1.2 per tonne km, based on benchmarking with alternative modes of transport.

Based on a single barge configuration of 20 MTPA with a draught of 2.5 metres over 55–60 km with five navigational locks and three barge terminals. This yields an estimated return of 13 per cent to the IWAI as the developer, whereas barge operators would earn 18 per cent.

These initial estimates would need to be revalidated based on a detailed feasibility report.

EXHIBIT 69

National waterway – 5



National Waterway 4

National Waterway 4 (NW4) is a 1,095 km-long waterway connecting several South-Indian states through parts of the Krishna and Godavari rivers. It also connects Tamil Nadu via the Buckingham Canal (Exhibit 70).

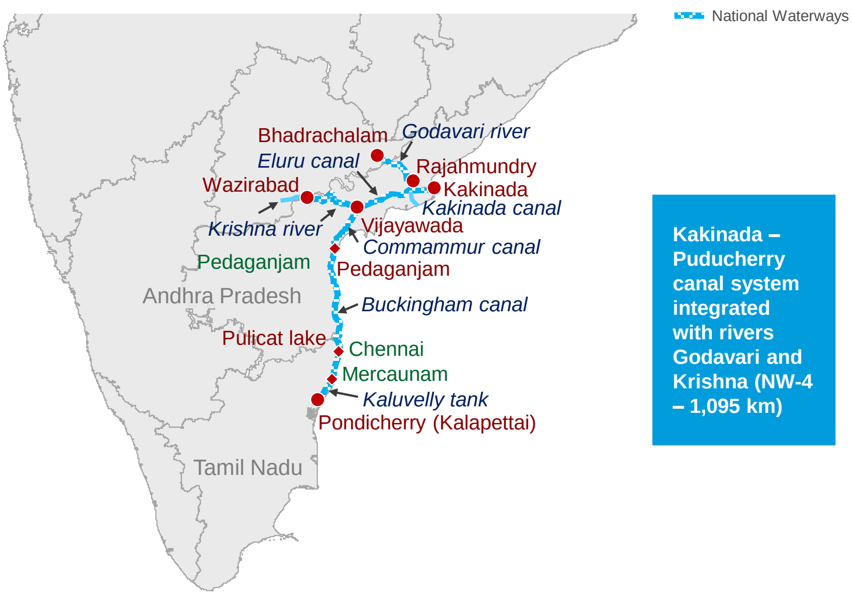
A two-phased development of the project has been proposed at a total cost of INR 1,515 cr. Phase I of the project envisages the development of a stretch comprising the Godavari and Krishna rivers and Kakinada and Eluru canals, which has maximum cargo potential, at an estimated cost of INR 390 cr and land acquisition for remaining stretch at an estimated cost of INR 219 cr. Phase II of the project involves development of the North and South Buckingham Canals, Commamur canal, and Kaluvelly tank at an estimated cost of INR 906 cr.

However, the stretch with the highest potential would be between Amaravati, the new capital of Andhra Pradesh, and the new proposed ports along the coast, such as Machilipatnam and Vodarevu. The stretch may have potential to transport 3 to 5 MTPA of bulk commodities by 2020. It may also be possible to transport containers using a multimodal hub along the riverfront near Amaravati.

While it has preliminary potential, the viability of the NW4 project needs to be assessed through a more detailed project report to estimate project cost and validate the estimated traffic potential.

EXHIBIT 70

National Waterway 4



National Waterway 2

National Waterway 2 (NW2) is an 891-km long waterway connecting Dhubri on the Bangladesh border with Sadiya in Assam. It currently has nine fixed terminals and one floating terminal (Exhibit 71).

The Brahmaputra, along with its continuous water routes leading up to the ports of Kolkata and Haldia, is a very important traditional IWT route. Under an agreement with the Government of Bangladesh, the Central Inland Water Corporation Limited and other Indian vessel operators are plying their cargo vessels between the Assam and Kolkata regions using IWT transit facilities through Bangladesh.

The waterway has a potential to cater to the traffic in the northeastern region of the country and relieve pressure on the already congested Siliguri corridor Instead of travelling by road or rail, goods from the Northeast can instead travel by waterway down the Brahmaputra (Jamuna) river into Bangladesh and Chittagong port from where they can be either exported or coastally shipped to other states of India. Several basic commodities, including food grains and fertilisers, could be transported more efficiently through this route. Exports from this region, such as handicrafts, spices and rubber, could also be exported using this waterway.

EXHIBIT 71

National Waterway 2

A more detailed project report needs to be prepared to validate the traffic potential, assess the capital and operating costs and determine feasibility.

National Waterway 3

National waterway 3 runs from Kottapuram to Kollam (168 km) along with Udyogmandal Canal (23 km) and Champakara canal (14 km) (Exhibit 122). Commodities moving along this stretch include phosphoric acid, sulphur, rockphosphate and liquid ammonia. A majority of the traffic moves on canals, for an average distance of 12 km. However, cargo movement on NW3 has been on the decline over the past few years, from 13.4 lakh tonnes in 2011–12 to 10.7 lakh tonnes in 2013–14. Given the short distances focus of NW 3 could be more on river cruise tourism.

Railways

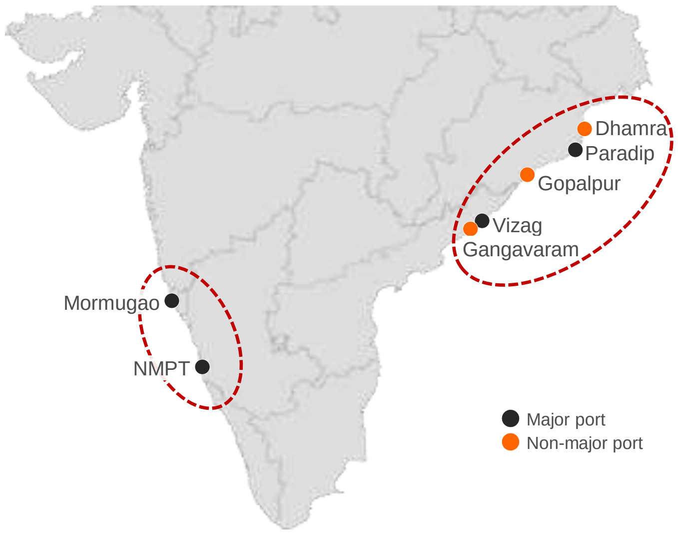
Basic infrastructure creation

Indian railways is the mainstay for the freight transportation in the country. Major commodities moving on rail include thermal coal, coking coal, iron ore, steel as well as EXIM containers from the Northern hinterland. The growth in the network of railways has not been able to keep pace with the economic and cargo growth, putting pressure on the existing network creating multiple bottlenecks.

Two pockets have been identified where the rail infrastructure would need to significantly ramp up - resource rich region of Odisha and Chhattisgarh for movement of bulk cargo, and Northern Karnataka and Southern Maharashtra lying to the east of Western Ghats (Exhibit 72).

EXHIBIT 72

Railway infrastructure bottlenecks



As mentioned in Chapter 2, 150 to 180 MTPA of coal can be shifted from the conventional rail mode of transport to coastal shipping by 2020. However, for such a shift to take place, large capacity augmentation at the ports will have to be accompanied by expansion of port connectivity to the hinterland which produces and consumes coal. Given that mine to port movement of coal in India is entirely by rail, increasing the capacity of the relevant railway lines is an essential prerequisite.

The most important stretch for coastal shipping of coal is the Ib/Talcher to Paradip route. A total potential of approximately 150 to 180 MTPA of thermal coal movement from Ib/Talcher to Paradip by 2020 as well as about 20 MTPA of coking coal/imported coal in backhaul is identified across commodities. Added to this is the increased opportunity for iron ore/coking coal traffic as a result of the installation of new steel plant/steel pelletisation clusters.

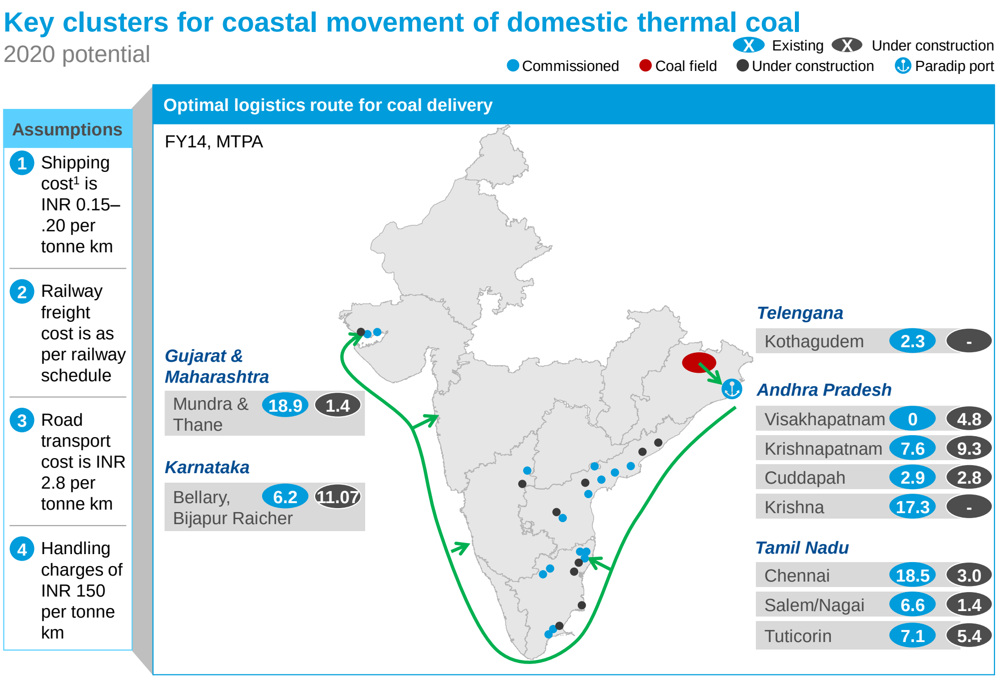
COAL VOLUMES EXPECTED ON ORISSA-CHHATTISGARH RAIL LINE

Commodity	Location	Volume (MTPA)
Thermal coal	MCL mines (Talcher/Ib valley)–Paradip	150–180

Imported coal	Paradip–Odisha/Chhattisgarh power plants	5
Coking coal	Paradip–SAIL Rourkela, Bhushan Steel Sambalpur, TISCO Kalinganagar	15

As most receiving plants for thermal coal are situated in the coastal regions of Andhra Pradesh, Tamil Nadu and Gujarat and are close to the ports, greater focus will be on strengthening supply-side connects from mine to port and onwards in connectivity projects (Exhibit 73).

EXHIBIT 73



1 Excluding handling cost which is considered separately

SOURCE: Sigma Insights; coal optimisation model

Currently, only about 17 rakes on an average move daily from Talcher to Paradip. There are many sectors within these routes between Talcher/Ib Valley and Paradip/Dhamra where the line capacity utilisation is quite high (Table below). At present, although the entire Talcher-Paradip line is doubled and electrified, the heavy freight traffic on that line makes it imperative to expedite 2 critical initiatives between Talcher – Paradip – Automatic Signalling and Intermediate Block Signalling projects on the entire Talcher-Paradip route, and 3rd and 4th line from Budhapank to Salagaon. Similarly, in case of the rail corridor towards Dhamra port, there is heavy congestion on the stretch between Kapilas Road and

Bhadrak on the main Howrah to Chennai line, with utilisation as high as 130-140 per cent on the ~85 Km long Kapilas Road—Bhadrak stretch. On the Ib Valley side, there is heavy congestion on the railway lines from Jharsuguda up to Angul and Titlagarh.

IB VALLEY/TALCHER TO PARADIP/DHAMRA RAIL LINK

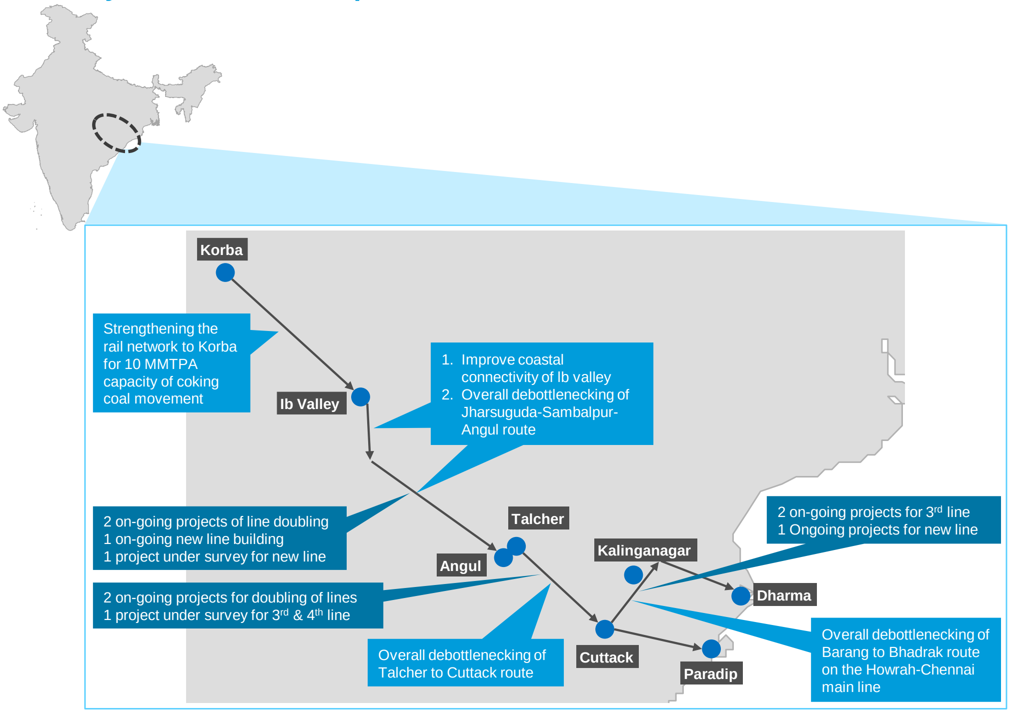
S No.	**Section**	**Div./Rly**	**Distance** (km)	**Line capacity**	**Capacity utilisation** (%)
1	Talcher–Budhapank	Khurda Road–ECOR	11	61	100
2	Budhapank–Rajatgarh	Khurda Road–ECOR	62	52	117
3	Rajathgarh–Salagaon	Khurda Road–ECOR	23	56	92
4	Salagaon–Nirgundi	Khurda Road–ECOR	3	61	47
5	Nirgundi–Cuttack	Khurda Road–ECOR	9	60	134
6	Cuttack–Paradip	Khurda Road–ECOR	83	43	89

As per the projected volumes of coastal shipment of thermal coal, the required daily movement could potentially increase almost five to seven times demanding up to 120 rakes per day. Therefore, alongside the heavy haul rail system, certain line strengthening/expansion interventions would be required in many sectors for realising the full opportunity.

Exhibit 74 present the ongoing and upcoming projects of the Indian Railways, which in the near and medium term (by 2020) would lead to a capacity increase of roughly 60 to 70 MTPA. Expeditious and smooth execution would enable quick ramp up of coastal cargo from the state.

EXHIBIT 74

IB Valley/Taclher to Paradip/Dhamra rail link



To service the demand of blast furnace-based steel production, around 60 to 65 MTPA of coking coal is transported in the country and around 54 MTPA is consumed for the production of steel. Around 80 per cent of the coking coal consumed is imported. Key challenges faced by the industry are related to congested railway lines and shortage of rolling stock and locomotives. The current rail network is already congested and may not be sufficient for the projected freight load due to the growth caused by programmes like “Make in India” and anticipated increase in steel production. Over 90 per cent of rail routes relevant for the movement of coking coal have more than 100 per cent utilisation, such as the Howrah–Bilaspur, Visakhapatnam–Bhilai, Dhamra/Paradip–Bhilai/Rourkela and Dhamra/Paradip–Durgapur/IISCO lines. This causes delays in transporting coking coal from the ports to the plants. For example, the travel time for coking coal from Visakhapatnam port to Bhilai plant is approximately 1.5 times the average.

Keeping these factors in mind, capacity augmentation on multiple routes would be required to solve port evacuation issues on the eastern side of the country.

While the Ib/Talcher to Paradip/Dhara capacity augmentation and Eastern DFC will solve many of the mentioned capacity issues, the other major route is between Chhattisgarh steel belt and Visakhapatnam port which is quite important for steel-related connectivity.

Projects for the Eastern coast

Project name	Agency	Port	**Investment required** (INR cr)
Rail connectivity between proposed Port at Sagar Island and Kashinagar Rail station.	IPRCL/Port Trust	Sagar	270
Northern Rail Link connecting north of Minjur to KPL	IPRCL	Ennore	244
Doubling of rail line from Bhadrak to Dhamra Port	Private port	Dhamra	1,500
IB signalling for RV line	Indian Railways	Vizag	50
Decongesting RV line (Vizag & Gangavaram port) - 2nd line	Indian Railways	Vizag	4,200
Heavy Haul railways corridor from Salegaon to Paradip port	Indian Railways	Paradip	3,000
Third line from Jakhapura to Haridaspur	Indian Railways	Paradip	150
3rd line from Bhadrak to Nergundi	Indian Railways	Paradip	837
3rd and 4th line from Budhapank-Salegaon via Rajatgarh	Indian Railways	Paradip	1,200
Doubling of line from Rajatgarh to Barang	Indian Railways	Paradip	276
Doubling of line from Sambhalpur to Talcher	Indian Railways	Paradip	679
Doubling of line from Titlagarh to Sambhalpur	Indian Railways	Paradip	1,351
New Line from Angul to Sukhinda Road	Indian Railways	Paradip	679
New Line from Haridaspur to Paradip	Indian Railways	Paradip	1,118
Third line from Sukhinda Road to Jakhapura	Indian Railways	Paradip	56

Project name	**Agency**	**Port**	**Investment required** (INR cr)
New line from Jharsuguda to Barpalli	Indian Railways	Paradip	1,000
Double rail track from Gopalpur Port to Chatarpur	IPRCL/Port Trust	Gopalpur	140

Even if all the rail projects proposed in the area were to be developed in the next five years, the lines would still be running at 100 per cent utilisation, assuming the base case of 80 to 90 MTPA of coal being coastally shipped. In the event that all power plants, for whom coastal shipping works out to be cheaper than rail, were to opt for the coastal route, the volume of coastally shipped coal would reach around 130 MTPA by 2020. Additionally, in case port-based linkage enabled smaller non-power players to take coastally shipped coal, an additional capacity of 50 MTPA will be required on this line.

Hence, in the longer term, larger solutions are required to cater to the demand on this route. In this regard, a heavy haul rail system between Talcher-Ib Valley and Paradip could be considered. A heavy haul system has a number of advantages:

- Higher capacity wagons and more wagons per rake resulting in lesser number of rakes required
- Decrease in the number of loading and unloading streams required due to fewer rakes

The current connectivity between the Goa and Bellary clusters is running at critical utilisation, with very limited scope for increasing capacity, hindering the development of new ports in North Karnataka, e.g., Belekeri, Tadadi and Pavinkurve.

Hospet–Vasco is a key line which connects the Mormugao port with the steel clusters located in Bellary and Tornagallu and with the power plant clusters situated in Kudgi, Belgaum. The average daily rake frequency of 10 to 11 transports mainly thermal coal and imported coking coal at a current effective capacity utilisation of around 95 per cent[9]. Efforts to improve connectivity would need be taken keeping in mind the expected increase in demand of coking coal and thermal coal to amount to 30 MTPA from the existing 13.5 MTPA (Exhibit 75).

[9] South Western Railway Headquarters, Hubli

EXHIBIT 75

Hospet – Mormugao connectivity improvement

Line doubling is essential for the volume requirements of port in future

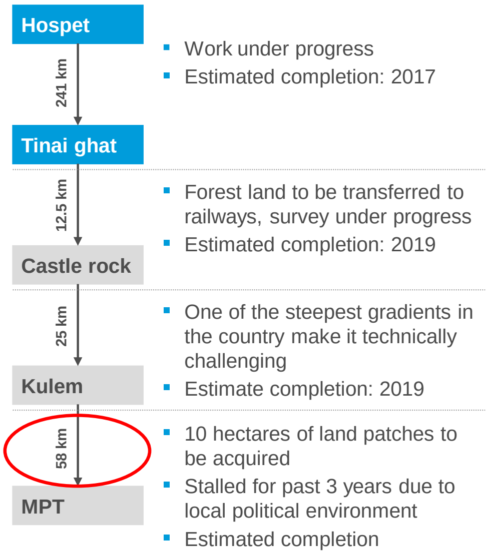
Current scenario – single line

Line capacity	14 rakes
Avg. rakes from port	11 rakes
Maximum cargo capacity	13.5 MTPA
Expected demand by 2020	30 MTPA

Capacity enhancement by doubling line

Avg. rakes from port	45–50 rakes
Maximum cargo capacity	>60 MTPA

Last mile connectivity is a challenge



The commissioning of double line on the entire Hospet–Vasco route would need to be considered with a long-term view of boosting rail line capacity post 2025. Expediting construction of the section passing through the Western Ghats on the Castle Rock–Kulem stretch would require significant technical expertise.

In the short to medium term, two strategies could be considered to boost the capacity on this line:

- Exploring the feasibility of using heavy haul rail system by strengthening the existing line and making it 25T axle load compliant. This would lead to an increase of 25 to 30 per cent in capacity.
- Allowing goods trains to run simultaneously with passenger trains from Castle Rock to Kulem. Currently, as per the order of the Railway Commissioner (Safety), if a passenger train travels downhill on that route, no other goods train is allowed to move in this section even though the goods trains are well equipped with supplementary braking power in the event of a brake failure. If allowed to run simultaneously, there could be a potential to increase the rakes per day by 15 to 20 per cent.

As a result of brisk doubling of the Hospet–Tinaighat section, there is also a “risk” of passenger trains getting augmented on the Mumbai–Bengaluru route (via Londa junction). The long-term impact of this on the freight route between Hospet–Vasco needs to be assessed.

Key projects

Project name	Agency	Port	Investment required (INR cr)
Hospete-Hubballi-Londa-Tinaighate-vasco da gama at Mormugao	Railways	Mormugao	1,458
Bellikeri port to Ankola railways line	Railways	Mormugao	1,420
Rail evacuation from port to Hospet and Bellary (Hubli–Ankola link)	Railways	Mangalore	2,200

Last mile connectivity

In addition to the sending ports, it is important to improve the connectivity of the receiving ports to the final consuming power plants in the country. Krishnapatnam is a port that need to be connected to power plants to ensure that the end-to-end landed cost of this mode is cheaper than a mine-to-plant rail connect.

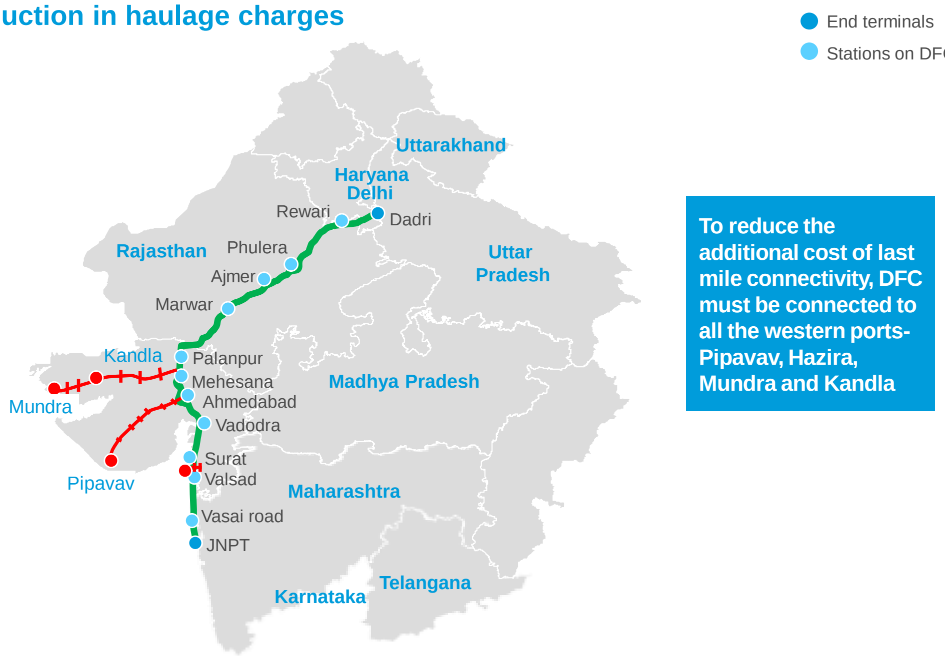
Last mile connectivity projects

Project name	Agency	Port	Investment required (INR cr)
New rail line between Obulavaripalle and Krishnapatnam	Railways	Krishnapatnam	1185
Doubling of Krishnapatnam–Venkatachalam	Railways	Krishnapatnam	87

Last-mile connectivity of the western Dedicated Freight Corridor (DFC) to Gujarat/Maharashtra port is critical for EXIM container evacuation. To avoid at least last mile connectivity charges, DFC stations need to be connected to the nearest ports. Three spur line projects, which connect the ports to the western DFC, have been proposed (Exhibit 76).

EXHIBIT 76

DFC can make rail economically more viable due to reduction in haulage charges



SOURCE: DFCCIL

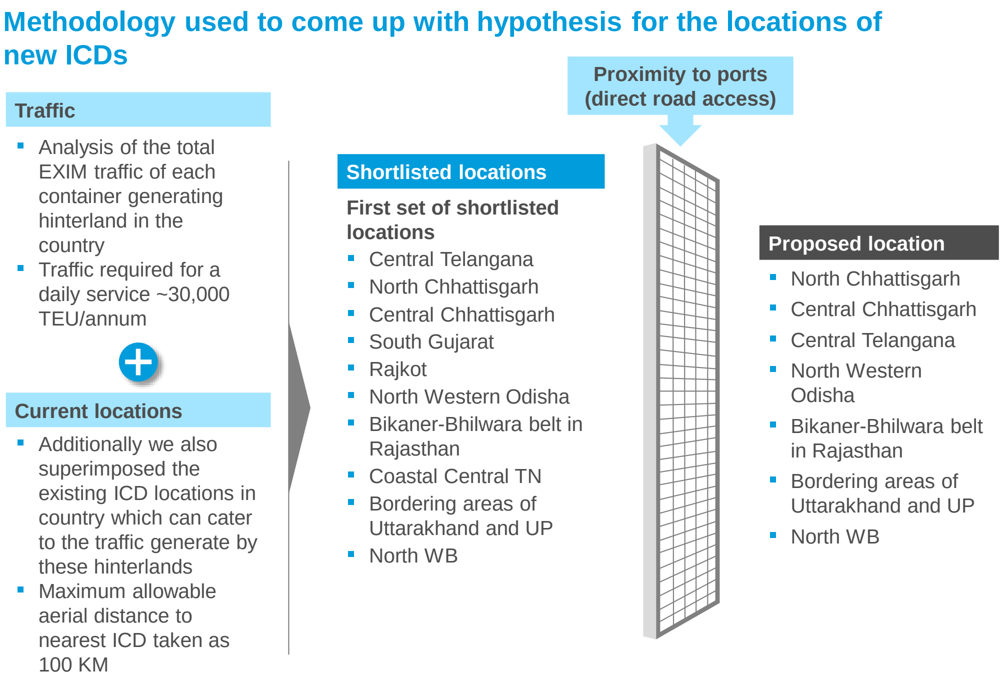
Proposed spur lines for railways

Project name	Agency	Port	Investment required (INR cr)
Connection of western DFC to Hazira	Railways	Hazira	3,500
Connection of western DFC to Pipavav	Railways	Pipavav	2,500
Connection of western DFC to Mundra	Railways	Mundra	300

New multi modal hubs

Setting up multimodal hubs at the right locations enables the overall transportation grid of the country to function efficiently and also reduce the cost and time taken to export, making the exporters competitive in the global market. In order to address this challenge, seven locations have been identified, as potential sites for multimodal hubs, through the multi-model optimisation model where the total EXIM traffic at each container generating point in the country and the traffic required for daily service were analysed. These container generating points were superimposed on the existing multimodal hub network in the country to locate regions where containers have to travel long distances to reach an aggregation point. Some of the shortlisted locations were later removed due to their proximity to ports. An illustration of the process can be seen in Exhibit 77. Isolated pockets and locations for proposed multimodal hubs are shown in Exhibit 78. In this section, ICDs refer to land based multimodal hubs and have been used interchangeably.

EXHIBIT 77



The five proposed multimodal hubs lie in the states of Madhya Pradesh, Chhattisgarh, Rajasthan, Odisha, Uttarakhand and West Bengal. All the multimodal hubs are situated in regions of high potential for traffic with important industrial clusters, which makes their presence advantageous for the transport of containerised commodities. The presence of these multimodal hubs reduces the distance that the commodities have to travel in order to be aggregated for formal transport. For instance, the proposed ICD in West Bengal reduces the distance for perishable commodities, such as pineapples, mangoes, litchis and tea, to reach an

ICD. ICDs in Chhattisgarh, Odisha and Telangana would ideally be linked to container terminal at Visakhapatnam port for optimising the movement. Specific details about the seven ICDs are given in the following Exhibit 78-85

EXHIBIT 78

Based on the above analysis we have shortlisted 7 new ICD locations where significant traffic can be foreseen

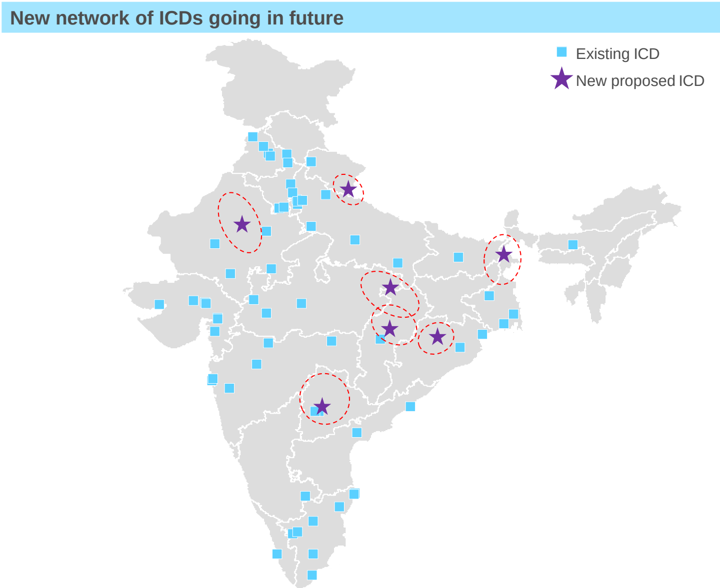


EXHIBIT 79

There are 6-7 isolated pockets with limited ICD connectivity in the country

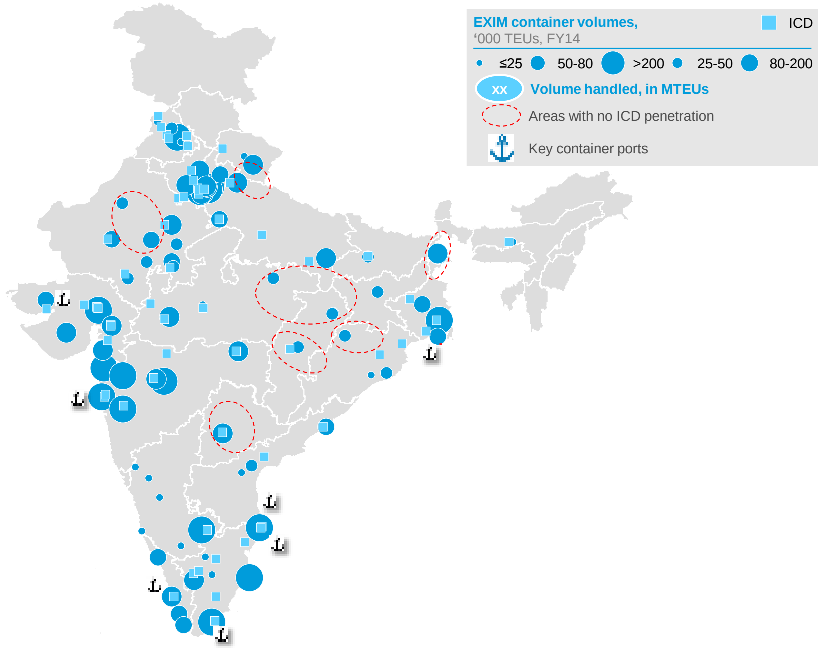


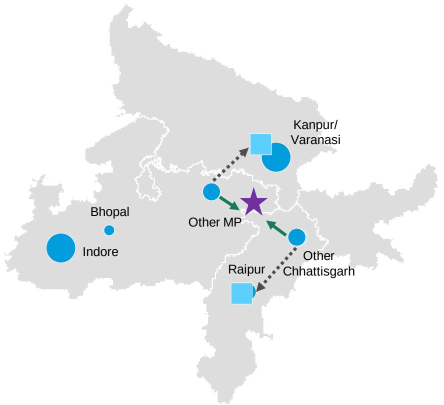
EXHIBIT 80

Location justification for East MP/North Chhattisgarh

EXIM container volumes, '000 TEUs, FY14

≤25 | 25-50 | 50-80 | 80-200 | >200 | ICD | Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Korba/Bilaspur belt in Chhattisgarh
  - Katni, Jabalpur, Satna region (Cement production)
  - South East UP
- Nearest alternate: Madhosingh and Raipur

Impact

- Distance reduction: 150 km
- Capacity required in 2020: 104,000

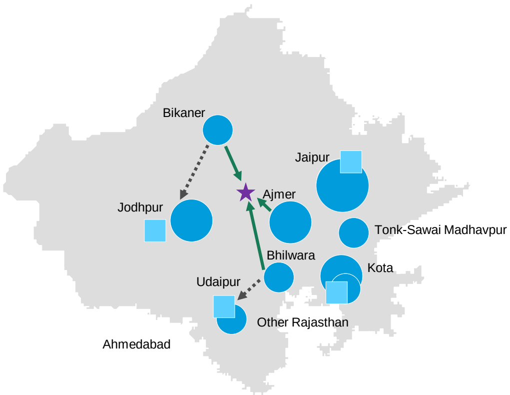
EXHIBIT 81

Location justification for Central Rajasthan ICD

EXIM container volumes, '000 TEUs, FY14

≤25 | 25-50 | 50-80 | 80-200 | >200 | ICD | Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Bikaner
  - Ajmer
  - Bhilwara
- Nearest alternate: Bhagat ko Kothi and Kankpura

Impact

- Distance reduction: 130 km
- Capacity required in 2020: 200,000

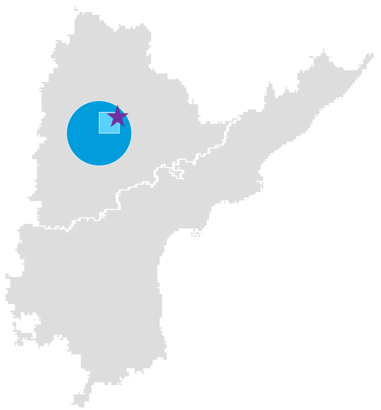
EXHIBIT 82

Location justification for Telangana ICD

EXIM container volumes, '000 TEUs, FY14

- ≤25
- 25-50
- 50-80
- 80-200
- >200
- ICD
- Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Hyderabad
- Nearest alternate: Sanatnagar (which is already congested and does not have linkages to VPT)

Impact

- Capacity required in 2020: 100,000

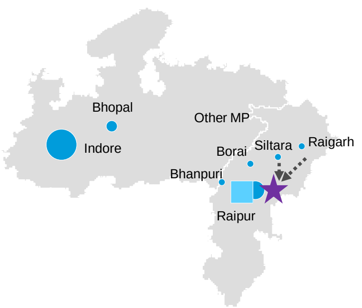
EXHIBIT 83

Location justification for Central Chhattisgarh ICD

EXIM container volumes, '000 TEUs, FY14

- ≤25
- 25-50
- 50-80
- 80-200
- >200
- ICD
- Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Raipur
  - Raigarh
  - Siltara
  - Borai
  - Bhanpuri
- Nearest alternate: Raipur ICD

Impact

- Capacity required in 2020: 40,000

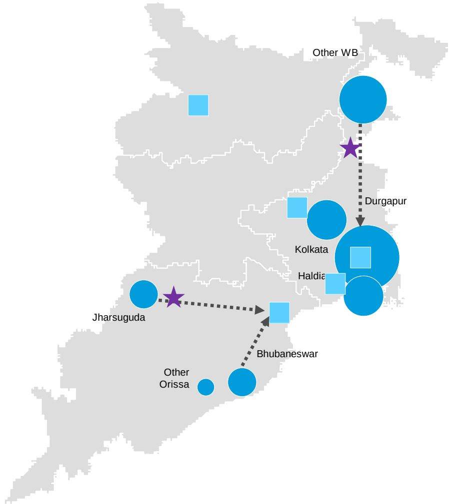
EXHIBIT 84

Location justification for Bengal and Odisha ICDs

EXIM container volumes, '000 TEUs, FY14

≤25 · 25-50 · 50-80 · 80-200 · >200 · ICD · Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Darjeeling
  - Bhubaneshwar
  - Jharsuguda
  - Farraka
- Nearest alternate: Balasore or Kolkata

Impact

- Distance reduction: 300 km (Jharsuguda) and 300 km (North Bengal)
- Capacity required in 2020: 45,000 Bhubaneswar and 120,000 Northern Bengal

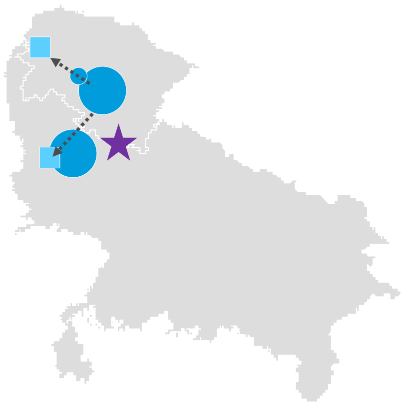
EXHIBIT 85

Location justification for Uttarakhand/UP ICD

EXIM container volumes, '000 TEUs, FY14

≤25 · 25-50 · 50-80 · 80-200 · >200 · ICD · Proposed location

Hinterland for ICD



Rationale and impact

Rationale

- Key Hinterland
  - Western UP
  - Eastern Uttarakhand
- Nearest alternate: Baddi or Moradabad

Impact

- Distance reduction: ~100 km for UP and Uttarakhand hinterlands (except Baddi and Moradabad)
- Capacity required in 2020: 200,000

Key projects

Project name	Agency	Concerned state	Investment required (INR cr)
New ICD Development in Raipur	CONCOR	Chhatisgarh	207
New ICD Development in North Bengal(Darjeeling)	CONCOR	West Bengal	85
New ICD Development in Hyderabad	CONCOR	Telangana	120
New ICD Development in Central Rajasthan(Nagaur)	CONCOR	Rajasthan	85
New ICD Development in North MP/CG border(Singrauli)	CONCOR	Madhya Pradesh	85
New ICD Development in South Uttarakhand	CONCOR	Uttarakhand	120
New ICD Development in Jharsuguda	CONCOR	Odisha	100

Initiatives

Aggregation of ICDs through milk runs

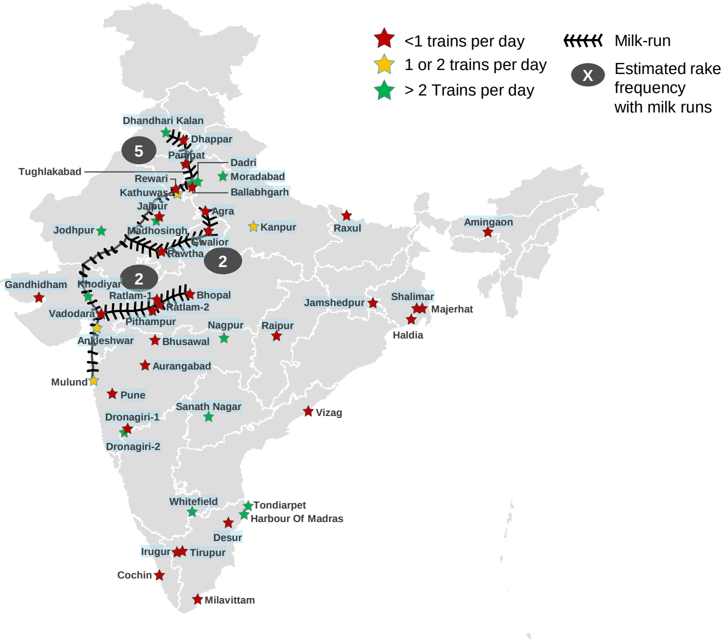
Many ICDs in India currently suffer from infrequent and unpredictable train schedules. Aggregation of ICDs in the form of a “milk-run” would mean the same train going through different ICDs to aggregate containers to improve frequency of trains at different ICDs. Some ICDs which can be inter-connected to finally connect to a DFC station include (Exhibit 86):

- Dhandhari Kalan → Dhappar → Panipat → Tughlakabad
- Agra → Gwalior → Rawtha
- Bhopal → Ratlam → Pithampur → Vadodara

EXHIBIT 86

A “milk-run” service connecting ICDs will improve rail rake frequency

FY14



Increasing priority for freight trains on railways network

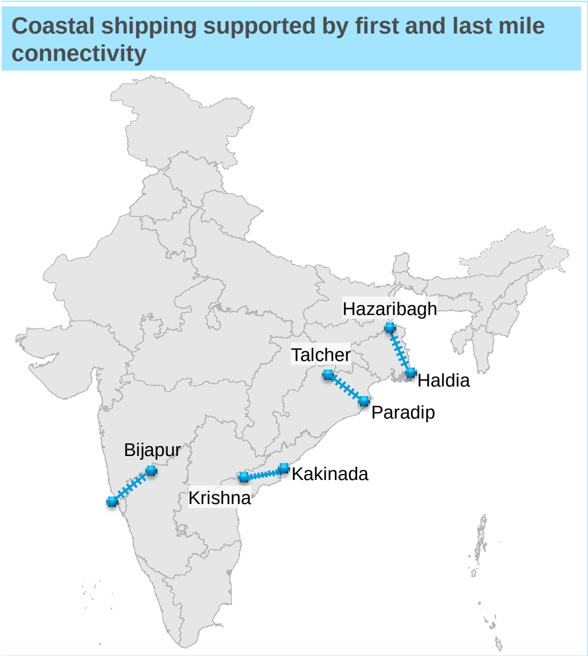
One of the major reasons for the slow movement of the freight trains on the rail network is the fact that freight traffic is given the lowest priority in terms of right of way on the tracks. Given that freight is one of the biggest revenue generators for the railways, due weightage should be given to freight while deciding the right of way on the tracks.

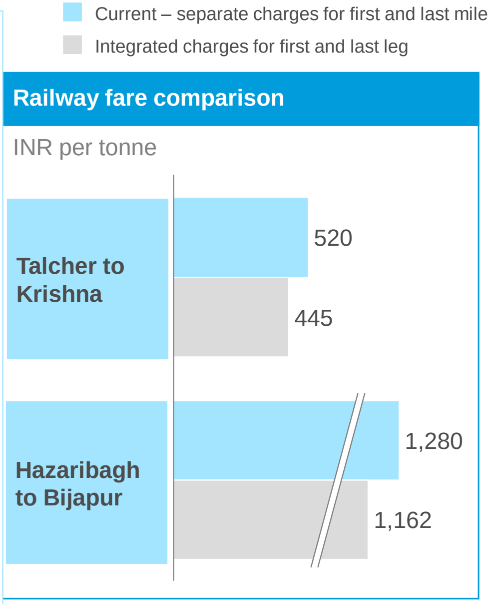
Integrated pricing for first and last mile stretch

For an efficient multi modal model, it is important to have an integrated system for all the legs of transport. Currently, railways charges separately for the first and last mile of connectivity, based on their slab rates. Having an integrated pricing for the total distance including the first and last mile will have a huge impact on reducing the cost as well as integrating the multi modal model. Exhibit 87 shows an illustrative example of integrated rail freight charges. For instance rail freight charge for Talcher to Krishna with first mile (Talcher to Paradip) and last mile (Kakinada to Krishna) taken separately would be significantly higher than the freight charge in case of integrated pricing for first and last mile.

EXHIBIT 87

Build a true multimodal system by having integrated rail freight charges for first and last mile connectivity





Roads

Road is economical compared to rail for covering distances up to 500 to 1,000 km from the port and is convenient for final exporters or importers as it provides delivery at the doorstep without additional handlings. But the current condition of highway stretches is inconsistent. In addition, the Indian coastline does not have a coastal road network.

The following interventions have been proposed for highways.

10 highway stretches to be developed as freight friendly expressways

Freight friendly lanes would be needed to improve road transit time from factory to port. Exhibit 88 outlines potential road corridors based on traffic intensity. These corridors could to handle approximately 6 mn TEUs by FY 2025.

EXHIBIT 88

Current and potential critical road routes for containers

	EXIM volumes '000 TEUs	
Road	**FY14**	**FY25**
1 Ahmedabad/Surat/Vadodara/Vapi-JNPT	552	1,597
2 Pune-JNPT	576	1,551
3 Coimbatore-Colachel	0	167
4 Ahmedabad-Mundra	234	678
5 Bangalore/Trichy-Enayam	0	483
6 Durgapur-Haldia	227	439
7 Ahmedabad- Pipavav	145	432
8 Hyderabad-JNPT	60	147
9 Hyderabad-Amravati-Central Andhra port	60	139
10 Bangalore-Chennai	141	136
Total	**1,997**	**5,768**

- Probable case for construction of 10 freight friendly road corridors expected to handle ~6 mn TEUs by FY25

SOURCE: APMT

The following are some of the key enablers for making freight friendly expressways even more effective

1. **Electronic tolls** - already being implemented by NHAI; Freight lanes can be pre paid on specific routes/All India basis so that no stoppage is needed
2. **GST** - When implemented GST will significantly reduce stoppage time between states at border checkpoints
3. **Support infrastructure for drivers** - Several companies (e.g., Rivigo) are using "relay concept" for driver interchanges every 500 kms or so. The government can provide social infrastructure for drivers strategically at such locations through PPP model to further facilitate this
4. **60 axle truck load** - Road designs should support larger truck loads which can enable scale efficiency in movement of goods; Additional incentives to owners for larger vehicles can also be considered
5. **Combine land acquisition for road and rail**: Land acquisition is a time consuming process. If agencies responsible for developing radial infrastructure such as railways and highways (as well as pipelines and transmission) can come together and optimize alignment and land acquisition processes, the pace of development can be significantly strengthened
6. **ICD-like facility for truck**s - Rail bound containers benefit from customs clearance at the ICD; the concept of dedicated lanes can be combined with customs clearance at hinterland points. Once done, the goods shall be free from inspections until it reaches the port

Project name	NH	Description	Status	Cost (INR cr)
Ahmedabad to JNPT (Concerned State: Gujarat)	NE1 from Ahmedabad to Vadodara NH8 from Vadodara to Ghodbunder State highway 42 from Ghodbunder to Thane NH4 from Thane to JNPT	6-laning from Ahmedabad to Vadodara completed recently 6-laning of Vadodara–Surat section under construction 6-laning of Surat–Dahisar section completed 4-laning of NH4B connecting JNPT to Mumbai–Pune Expressway under way Mumbai–Vadodara Expressway project: 2 phases under construction; 1 phase scrapped due to land acquisition	6-laned from Ahmedabad to Ghodbunder except Vadodara–Surat section 4-laning underway rom Mumbai–Pune Expressway to JNPT	18,000
Pune to JNPT (Concerned State: Maharashtra)	SH50 from Dighi ICD to Mumbai–Pune Expressway NH4 from Talegaon to Panvel NH4B from Panvel to JNPT	Mumbai–Pune Expressway is an access controlled 6-lane Expressway 4-laning of NH4B connecting JNPT to Mumbai–Pune Expressway underway	6-laned up to Panvel 4-laning underway from Mumbai-Pune Expressway to JNPT	4,500
Coimbatore to Enayam (Concerned State: Tamil Nadu)	SH172 to Kangayam NH67 to Vallaikoil SH84c to Aravaakurichi NH7 to Kavalkinary NH47 to Enayam	4-laned from Aravakurichi to Kavalkinaru 2-laned road from Kavalkinaru to Enayam	4-laned from Aravakurichi to Kavalkinaru 2-laned road from Kavalkinaru to Enayam	13,000

Project name	NH	Description	Status	Cost (INR cr)
Ahmedabad to Mundra (Concerned State: Gujarat)	NH947 from Sarkhej to Maliya NH8A from Maliya to Mundra	6-laning in projects from Samakhiyali to Mundra in 2 packages	4-laned; 6-laning partly in progress	10,000
Bangalore to Enayam (Concerned State: Karnataka, Tamil Nadu)	SH45 from Whitefield to Attibele NH45 from Attibele to Krishnagiri NH7 from Krishnagiri to Kavalkinaru NH47 from Kavalkinaru to Enayam	6-laned up to Krishnagiri 4-laned from Krishnagiri to Kavalkinaru 2-laned road from Kavalkinaru to Enayam	6-laned up to Krishnagiri 4-laned from Krishnagiri to Kavalkinaru 2-laned road from Kavalkinaru to Enayam	20,000
Panagarh (Durgapur) to Haldia (Concerned State: West Bengal)	NH2 From Panagarh to Dankuni NH6 from Dankuni to Kolaghat NH41 from Kolaghat to Haldia	Entire stretch has been 4 lanes NHAI has identified Kolkata–Dhanbad as one of 7 Expressway projects but feasibility to be revisited Panagarh–Dankuni also identified as a 6-laning project under NHDP 6	4-laned	9,000
Ahmedabad to Pipavav (Concerned State: Gujarat)	NH 8A from Sarkhej to Bagodara SH 40, 6 and 36 from Bagodara to Budhel NH 8E from Budhel to Pipavav	4 laning from Budhel to Pipavav balance for award for 4 laning under NHDP IV	4 lane road from Sarkhej to Budhel 2 lane road from Budhel to Pipavav	9,000

Project name	NH	Description	Status	Cost (INR cr)
Hyderabad to JNPT (Concerned State: Andhra Pradesh, Maharashtra)	NH8 from Sanathnagar to Solapur Mumbai–Pune Expressway to Panvel NH4B from Panvel to JNPT	Mumbai–Pune expressway is an access controlled 6-lane Expressway 4-laning of NH4B connecting JNPT to Mumbai–Pune Expressway underway	City roads from Sanathnagar to Sangareddy 4-laning underway from Sangareddy to Maharashtra–Karnataka border 4-laning underway from Maharashtra–Karnataka border to Solapur 4-laning underway from Solapur to Pune 6-laned from Pune up to Panvel, Mumbai–Pune Expressway 4-laning underway from Mumbai Pune Expressway to JNPT	22,000
Hyderabad to Vodarevu[1] (Concerned State: Andhra Pradesh)	City roads from Saanthnagar to LB Nagar NH9 from LB Nagar to Vijayawada NH5 from Vijayawada to Chilakuripeta Local road from Chilakuripeta to Vodarevu	6-laning underway from Vijayawada to Chilakuripet on NH5	4-laned up to Vijayawada 4-laned from Vijayawada to Chilakuripeta	10,000

Project name	NH	Description	Status	Cost (INR cr)
Bangalore to Chennai (Concerned State: Karnataka, Tamil Nadu)	SH45 from Whitefield to Attibele NH45 from Attibele to Maduravoyal Poonamallee High Road to Chennai Port	6-laning from Attibele to Walajahpet Completed 6-laning underway from Walajahpet to Poonamalle The stretch is identified as one of the 7 proposed expressways	6-laned up to Walajahpet 4-laned up to Maduravoyal	10,000

1 Central Andhra port – Location subject to change

Last-mile connectivity and Bharatmala

Apart from containers, all other types of cargo utilise road primarily for their first and last mile movement. As part of the Sagarmala study last-mile road connectivity projects have been identified.

Port connectivity projects

Project name	**Agency**	**Port**	**Investment** (INR cr)
Upgrading of the existing four lane road connecting to NH16 at Gajuwaka to Gangavaram Port in to six lane road in the State of Andhra Pradesh	NHAI	Gangavaram	50
Flyover for GTI Entry/Exit Over the Rail Tracks at JNPT	Port Trust	JNPT	70
Improvement of road Connectivity to facilitate the trade and Port users at KOPT	Non-NHAI/Port trust	KoPT	24
Road circulation plan for ease of movement of break bulk cargo at Mormugao	Non-NHAI/Port trust	Mormugao	50
Road Connectivity to Hare island (Tuticorin Port)	Non-NHAI/State Highways/Port Trust	Tuticorin	12
Development of roads connectivity to Cuddalore Port	Non-NHAI/State Highways/Port Trust	Sirkazhi	100
Development of 7.2Km green field road connecting NH 65 to Machilipatnam Port in the State of Andhra Pradesh.	AP Ports Dept/MoS	Machilipatnam	175

Project name	**Agency**	**Port**	**Investment** (INR cr)
Construction of RoB cum Flyover at Ranichak level crossing at Kolkata Port	NHAI - SPV	KoPT	128
Azhikkal Port - Proposed NH – Bypass and widening of 2 km.	Non-NHAI/Road and Bridges Development Corporation of Kerala	Azhikkal	61
Evacuation road for proposed standalone Container Terminal (330m extension to DPW terminal) at JNPT	Port Trust	JNPT	54
Flyover at Y Junction for Decongestion of Traffic Flow at JNPT	NHAI	JNPT	200
Upgrading existing B.T Road in to C.C. pavement from Burmah Shell area to security gate near Sakthi Gas Plant at Kakinada Anchorage port, AP	NHAI	Kakinada	15
Development of greenfield bypass road for better connectivity of Gangavaram port in Visakhapatnam District (Lanes to be specified)	NHAI	Gangavaram	80
Formation of a New by pass parallel road west of NFCL and CFL in Kakinada Port (Kakinada), AP	NHAI	Kakinada	70
RoB at Dummalapeta and Old Port Area (Kakinada)	NHAI	Kakinada	80
Development of 5 km Greenfield road connecting north and south industrial cluster of Khandaleru Creek near Krishnapatnam port	NHAI	Krishnapatnam	90
Upgrading of Manginapudi Beach Road to a 4 lane road to connect to cater to Machilipatnam	Non-NHAI/Port trust	Machilipatnam	60

Project name	**Agency**	**Port**	**Investment** (INR cr)
Development of Four Lane green field road from Machilipatnam North Port to NH-SH-46 in the State of Andhra Pradesh	Non-NHAI/Port trust	Machilipatnam	232
Connectivity of Vizag port to NH-16 (Phase II)	NHAI - SPV	Vizag	99
Road Connectivity From Outer Harbour To Port Connectivity Junction (B) at Vizag port	Port Trust	Vizag	13.5
Construction of grade separator from H-7 area to Port connectivity Road by passing Convent Junction - Vizag Port	NHAI - SPV	VIzag	90
RoB on Kandla-Kutch Road	Port Trust	Kandla	125
	Port Trust	Chennai	63

Initiatives

Reduction of cost and time by policy initiatives

Currently, India ranks 35th on the logistics performance index (LPI) issued by the World Bank. There are potential options for policy-related actions that could help reduce the overall cost and time for export. The details of these interventions are given in Exhibits 89 and 90. The numbers in these examples have been taken for a sample Delhi-to-Mumbai route, which is currently one of the major trunk routes of the country.

EXHIBIT 89

Possible levers identified for transit time reduction

Element	Levers for time reduction	Time impact (hrs saved per 100 tonne transported)	Rationale
A Reduction stoppage time during transit	1 Integrating dynamic weighbridges, toll nakas and RTO check points 2 RFID enabled seals on vehicles to enable 'zero' stoppage at RTO check posts	2–3	30 min per RTO x 5 RTO points (MAH o/b, AHM- i/b and o/b, Rajasthan i/b and o/b)
	3 Integrated online sales tax platform fed through RFID seal detection on vehicles	3–5	1 sales tax per State x 2.5 hrs per sales tax point
	4 Moving 100% tolling counters to electronic tolling	3–4	15 min per naka x 15 naka per way
	5 Implement chain linking/ double driver models to ensure continuous travel	40	Double driver expected to do away with nearly 90% of resting time currently
B Loading/ unloading centers	6 DP norms for warehousing/ loading centres to mandate for necessary parking lots and sufficient approach roads to avoid truck lines	8–10	Ideally considered 1–2 hrs per truck
C Overall travel speed	7 SLA defined on timely delivery; performance based incentives on % SLA achievement 8 Control tower operations to debottleneck issues enroute	20–25	Potential speed of 45–50 km/hr can be achieved from current 25–30 km/hr
	Total time impact	**60–80**	**Hrs per 100 tonne**

SOURCE: Expert interviews

EXHIBIT 90

Four levers identified for cost reduction

Element	Levers for time reduction	Cost impact INR PTPK	Rationale
A RTO expense	9 100% containerisation of vehicles leading to minimal overloading/ tampering possibilities 10 Cashless transactions enabled through fuel cards/online sales tax systems/ electronic tolling, etc. 11 Rationalizing of state wise entry taxes for goods with state GST	Up to 0.1	TBD
B Fuel cost	12 Reduction in time stops (as described in next section) Infrastructure initiatives to improve % of paved surface roads	0.1–0.15	13% increase in vehicle mileage (from ~3.5 to 4 km/L of diesel)
	Total cost impact	**0.15–0.2**	**INR per tonne per km**

SOURCE: Expert interviews

Logistics efficiency programme

Following key initiatives could be explored to help improve India's Logistics Performance Index (LPI) ranking

- Logistics Park Development

  A master plan for logistics parks would need to be developed to facilitate freight aggregation and disaggregation at key locations, based on assessment of freight flows in the country. In addition, there is a need to focus on enabling improvements in multimodal freight movement in the country. Quick win opportunities to improve efficiencies and capacity utilisation of existing logistics infrastructure (railway freight terminal, transport nagars, etc.) through asset light interventions would need to be identified and evaluated.

- Freight Corridor Upgradation

  Corridors would need to be identified and prioritised for development/ upgrade based on assessment of freight flows and existing road infrastructure. In addition, there is a need to identify bottlenecks around existing road infrastructure (lack of city bypasses, road over bridges, etc.) on key corridors resulting in congestion and a roadmap needs to be developed to remove these bottlenecks.

- Procedural Complexity Reduction

  There is a need to look at opportunities for consolidating documentation requirements and to standardise documents across states. Reduction, standardisation and digitisation of documentation required can be explored to enable easier inter-state freight movement. In addition, there is a need to standardise processes for enabling EXIM cargo, in line with global best practices

- Development of Information and Communication Technology backbone

  There is a need to design a comprehensive Information and Communication Technology (ICT) backbone to facilitate efficient freight movement. Opportunities to connect various government departments to enable process standardisation through an ICT backbone would need to be explored. Investments in ICT infrastructure to improve freight tracking and traceability would need to be considered.

- 3PL service provider ecosystem development

  Existing landscape of 3PL service providers would need to be mapped to assess the nature of organisations, reach, and services provided, etc. In addition, a compelling business case could be explored for 3PL service providers/ other partners to partner and operate the logistics parks

Simplification of Customs processes

Simplifying customs procedures could help in reducing the time taken in custom clearances. Initiatives like rollout of EDI, implementation of en-block movement in selected ports, introduction of Risk Management System (RMS) etc. have greatly improved India's perception as a facilitator of international trade. There is further scope for improvement in terms of requirement for documents and signatures indicating immediate need for automated and integrated systems.

Based on multiple interactions with Port authorities, Importers, Exporters, Shipping lines, Transporters, Freight forwarders, Customs Handling Agents, Container Freight Station officials and Ex-Customs officials, following five issues have been identified.

- Manual filing of IGM/ EGM/SMTP even after electronic filing/generation in ICE GATE and separate submission of documents to different authorities

Current process

The IGM form asks for 84 inputs to be filled including ~30 mandatory fields and need manual filing, e.g., 8 hard copies need to be submitted at various customs section at JNPT

Sub-Manifest Transshipment Procedure (SMTP) generated automatically in ICE GATE and transmitted automatically to all concerned parties still needs to be printed and signed by customs officials and couriered to ICD operators by shipping lines (Each vessel has >20 hard copies of SMTP)

The current Electronic Data Interchange (EDI) system has limited provisions of attaching supporting documents because of which physical copies of Bill of Entry along with supporting documents are submitted to multiple parties including customs house, port authority, regulators like FSSAI, etc. leading to delays in the clearance process

Proposed solution

Submission of hard copy to be dispensed with through development of a robust Electronic Signature (ES) module in the ICE GATE

Activate all modules of ICE GATE especially Generation of rotation number and Port clearance modules

Provision for submission of all documents online with access to all concerned authorities including different ministries, regulators, ICD operators etc.; Eventually move towards a Port community system with integrated access to Shipping lines, Port authorities, Marine Department, Customs and Traders, e.g., HAROPA system developed by SOGET in France.

Ensure qualified and committed manpower and infrastructure with the DG systems in the CBEC (Central Board for Excise and Customs) to ensure robust automation of Customs clearance procedures

- Long and manual procedure for rectification of errors in filing EGM/IGM

Current process

Physical application along with fee to be submitted to Customs for any modification to IGM/EGM for all kinds of fields. Customs further needs verification from Port of Landing after which BoE has to be re-submitted

Proposed solution

Classification of fields into sensitive and non-sensitive with provision for modification of non-sensitive fields online without any permission from Customs or need for re-submission

- Submission of Form 13 at port gate

Current process

In ports where en-block movement has been identified (eg. JNPT), Form 13 has to be submitted in the presence of CFS agent and customs officer for gate movement of goods. This leads to congestion of up to 6-8 hours at the gates

Proposed solution

Use of OCR technology to avoid paper form submission while still allowing for tracking of vehicles and containers in and out of port

- Lack of specialised clearance system for accredited importers/exporters and requirement of large number of documents to become an accredited importer/exporter

Current process

Accredited importers have to go through the normal method of movement of cargo till it reaches the CFS after which they are able to clear the cargo immediately through customs green channel procedure

Requirement of ~200 documents to become an accredited player

Proposed solution

Earmarking a separate area in the Port premises to enable faster delivery of cargo of accredited importers/exporters

Simplification of process, e.g., history of trade, number of containers imported and exported to be taken into account to become an accredited player to register for factory stuffing and self-sealing of containers

- Limited resources for scanning and provision for factory stuffing for accredited importers/ exporters

Current process

Number of scanners inadequate for the increased quantity of containers needed to be scanned

Proposed solution

Ports should supplement CBEC in providing necessary scanning equipment according to guidelines issued by CBEC

- Same rules for checking coastal cargo as EXIM cargo

Current process

Customs treat coastal cargo the same way as EXIM cargo which is time consuming and coastal cargo is given the last preference as customs consider it as non-important cargo

India is part of the World Customs Organisation, under which coastal cargo is not subject to the same clearances as EXIM cargo; The Indian customs act also doesn't force coastal cargo to undergo the same scrutiny as EXIM cargo

International examples of ports exists where coastal and EXIM cargo have segregate much like the airports system (e.g., Port of Antwerp)

Proposed solution

Treatment of coastal cargo to be done as per World Customs Organisation (of which India is a part) and Indian Customs Act both of which dictate different scrutiny for coastal and EXIM cargo

Benchmarking based on international examples like Port of Antwerp where coastal and EXIM cargo are segregated as is done on Airports.

This is an indicative list of some directional areas that require intervention and actions by various stakeholders of handling customs procedures.

Alignment and coordination between the stakeholders involved is critical for the transformation, and therefore the immediate action plan involves creating working groups with representation from key stakeholders such as Central Board for Excise and Customs, Port Authorities, Ministry of Shipping, Indian Railways, CONCOR and other CTOs, Port Rail Company, etc.

Report on identification of sites for new port development

Contents

Port capacity needs

In 2014–15, Indian ports handled ~1050 MTPA of cargo, growing at a rate of 4.5 per cent per annum. Western coast ports handle more than 60 per cent of the total cargo owing to the large North West hinterland that the west coast caters to.

Over the next decade, the following commodity wise factors could drive traffic at the ports:

- **Petroleum, oil and lubricant:** Continual increase in the import of petroleum, oil and lubricant (POL) products, coastal shipping of POL products, setting up of new refining capacity and rising demand of LPG and LNG
- **Coal:** High growth rate of the power sector and continued reliance on demand centre coal-based power plants, high growth in CIL's production and thrust on coastal shipping of thermal coal
- **Materials:** Coastal shipping of bulk commodities from production to consumption centres and setting up of new coastal capacities for bulk commodities, such as steel and cement
- **Discrete manufacturing:** Increase in container volumes due to growth in the manufacturing sector and boost in EXIM trade from improved logistics

With all the above factors, cargo volumes at the ports could potentially increase to 2500 MTPA by 2025. While POL, coal and containers may continue to account for majority of the volume, share of coal could grow from 24 per cent to ~40 per cent (Exhibit 1).

EXHIBIT 1

Cargo volume growth at Indian ports by commodities

MTPA

Commodity	2014	2025 Base	2025 Optimistic	2025 Total
POL	351	460	80	540
Coal	231	850	128	978
Containers	115	323	53	375
Others	275	527	80	607
Total[1]	972	2,160	341	2,500

1 Numbers may not add up due to rounding error

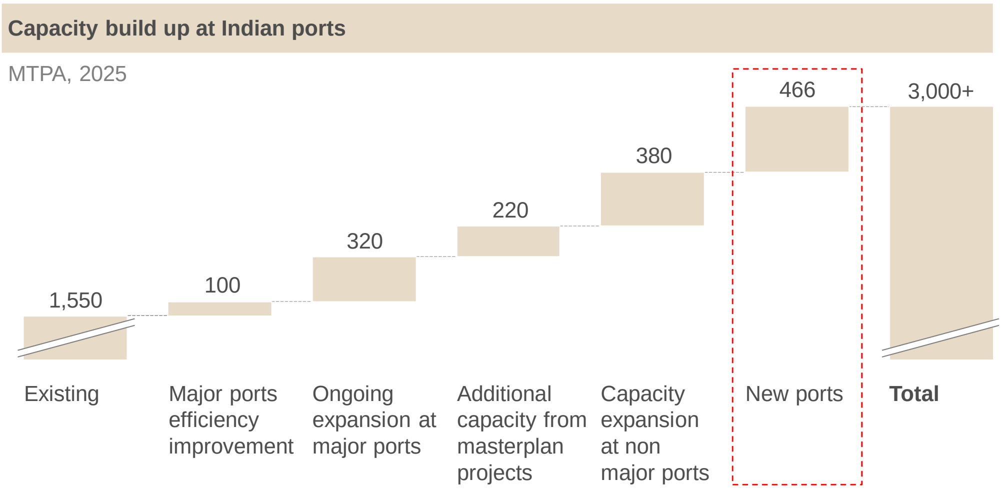
Catering to the increasing traffic over the next 10 years may require augmenting capacity. Cargo traffic at the ports is expected to be 1,650 MTPA by 2020 and 2,500 MTPA by 2025.

To cater to this demand, the ports could create additional capacity (Exhibit 2) by:

- Unlocking 100 MTPA capacity at existing terminals through improved efficiency
- Increasing capacity at existing ports through mechanisation and building new terminals
- Building new greenfield ports

EXHIBIT 2

Capacity build up at the ports to meet the 2025 demand



New port development

Development of new ports could potentially add additional capacity of 450 - 500 MTPA. Six-eight potential new ports have been considered based on the following factors (Exhibit 3 and 4):

- Existing port saturation
- Non-availability of a port on the coastline stretch
- Strategic location

Vadhavan, Paradip south satellite port and Sagar have been considered in places where existing ports have saturated. Similarly, ports in central AP, central Tamil Nadu and Karnataka have been considered on coastal stretches where ports are not available. Enayam port is strategically located as it falls on the East–West trade route.

Mega ports are defined as “100 million tonnes or 10 million TEUs capacity, over the next 10-15 years.

EXHIBIT 3

6-8 potential new ports based on three themes have been identified that could add upto 400 MTPA

Three themes for identifying new port locations

Port saturation	**Vadhavan** - JNPT is saturated and requires a satellite port **Paradip outer harbour** - To handle 150-200 MTPA of coastal shipping of coal for power plants in Southern and Western India **Sagar** – Handle overflow traffic of Kolkata and bulk traffic from Hadia
Unavailability of ports	**Central AP** – Potential for facilitation of cargo including thermal coal, cement and containers **Belekeri** – Potential for handling cargo including thermal coal, iron ore, coking coal, steel, etc. **Cuddalore/Sirkazhi** – Facilitate cargo movement of thermal coal
Strategic ports to capture international opportunity	~25% of Indian EXIM container traffic is transshipped via Colombo and Singapore **Enayam** – Potential for a mega transshipment port to capture the opportunity

New port locations

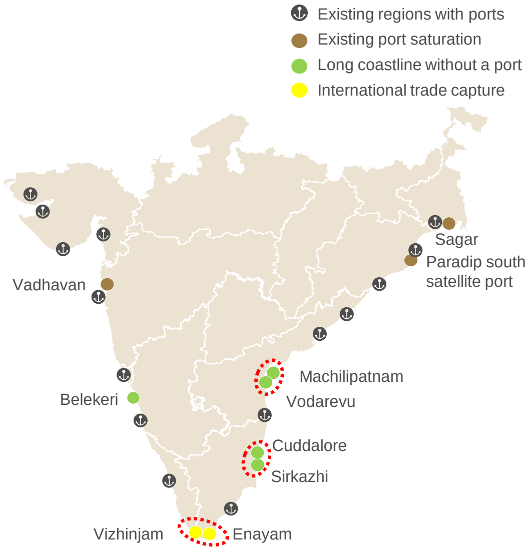


EXHIBIT 4

New port identification framework

		Existing location	Green field location
Anchor commodity	Bulk	1 **Sagar:** Debottleneck Haldia and Kolkata 2 **Paradip south satellite port:** For coastal movement of thermal coal 3 **Belekeri:** For efficiently serving hinterland demand for coal and iron-ore	4 **Machilipatnam/ Vodarevu:** New AP capital linkage; proximity to key reserves 5 **Cuddalore/Sirkazhi:** Central Tamil Nadu linkage, proximity to power cluster
	Discrete	6 **Vadhavan:** Debottleneck JNPT and Mumbai ports	7 **Enayam:** Transshipment hub to arrest the flow of Indian cargo to Singapore, Colombo, etc.

Post considering the probable sites for development of new ports, traffic potential has been quantified for each of the locations along with a high level business case for the ports. Observations show that significant traffic potential exists for all the identified sites:

- **Sagar:** The port is required to handle the spill-over traffic from Kolkata and Haldia. It has been estimated that the cargo generated in the eastern hinterland is projected to increase to around 440 MTPA by 2025. While Paradip and Dhamra have potential for expansion, Kolkata Dock System and Haldia Dock Complex have limited headroom for expansion. The new port will share the hinterland cargo currently being serviced by Haldia and Kolkata ports catering to traffic of POL, coal, containers and break bulk.
- **Paradip South Satellite port:** The new port is required to handle thermal coal for coastal shipping with facilities to handle 200,000 DWT cape size vessels. It has been estimated that there is a potential to coastally ship 150-180 MTPA of coal from MCL by 2020. However, even with the planned capacity expansion, Paradip could ship around 50 MTPA of thermal coal building a case for development of new infrastructure.
- **Belekeri:** The need for a new infrastructure is based on the potential to more efficiently serve the hinterland of northern and central Karnataka. Currently, the thermal power and steel plants more the cargo through rail or through alternate ports of Krishnapatnam and Mormugao involving longer distances.
- **Central Andhra Pradesh:** The proposed port has a significant traffic potential because of its locational advantage. It could efficiently serve the thermal power plants located in central AP and the upcoming capital city of Amaravati. In addition to this, presence of limestone reserves in the immediate hinterland could be leveraged to develop a cement cluster which could t efficiently move its cargo through the central AP port.
- **Central Tamil Nadu:** The proposed port is ideally placed to serve the coal requirements of multiple thermal power plants- Neyveli, IL&FS and Mettur and JSW steel plant.
- **Vadhavan:** JNPT is expected to get saturated by 2025 even with the expanded capacity of ~10 Mn TEUs due to high demand. This may need development of a satellite port to cater to the spillover traffic. Along with the container traffic, the port is also expected to handle break bulk for the hinterland and could possibly serve the proposed coastal power complex through coastally shipped coal.
- **Enayam:** The port, with natural deep draft of ~20 m and proximity to international trade route, could help capture the international opportunity in transshipment of container cargo. Access to an important hinterland along with locational advantage makes this location as most suitable for transhipment in India.

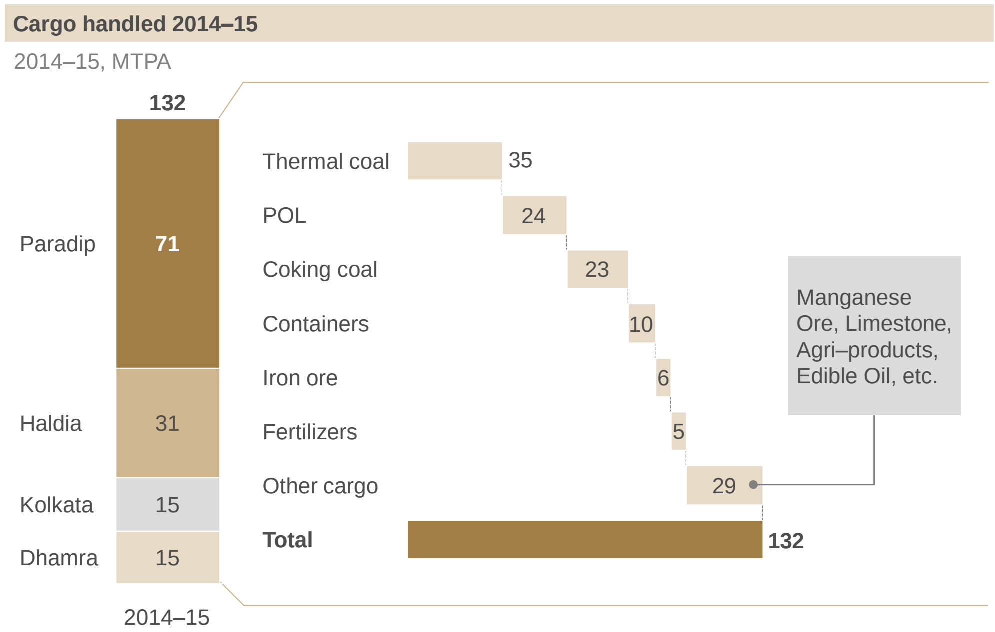
Traffic assessment for each of the identified location has been mentioned in the subsequent section. However, for locations like central Andhra Pradesh, there are operational challenges like unavailability of land which need to be resolved.

1. Sagar

Port at Sagar will share the hinterland of Haldia and Kolkata ports, covering eastern parts of India, i.e., western UP, Odisha, Jharkhand, Chhattisgarh, and the neighbouring landlocked countries, i.e., Nepal and Bhutan. On the upper eastern coast, there are currently 4 ports – Kolkata, Haldia, Dhamra and Paradip (Exhibit 5).

EXHIBIT 5

Current cargo traffic at relevant eastern ports



SOURCE: Basic port statistics

Primary hinterland for containers for Haldia and Kolkata ports comprise manufacturing units and agri-based cargo in the vicinity. Secondary hinterland includes Bihar, Jharkhand and the northeast, parts of Odisha, Chhattisgarh, Uttar Pradesh and Madhya Pradesh (Exhibit 6).

Based on the origin–destination analysis of key commodities and industrial growth in the eastern hinterland, the cargo is projected to increase to around 440 MTPA by 2025 (Exhibit 7).

EXHIBIT 6

Ports in Eastern India with their primary and secondary hinterland

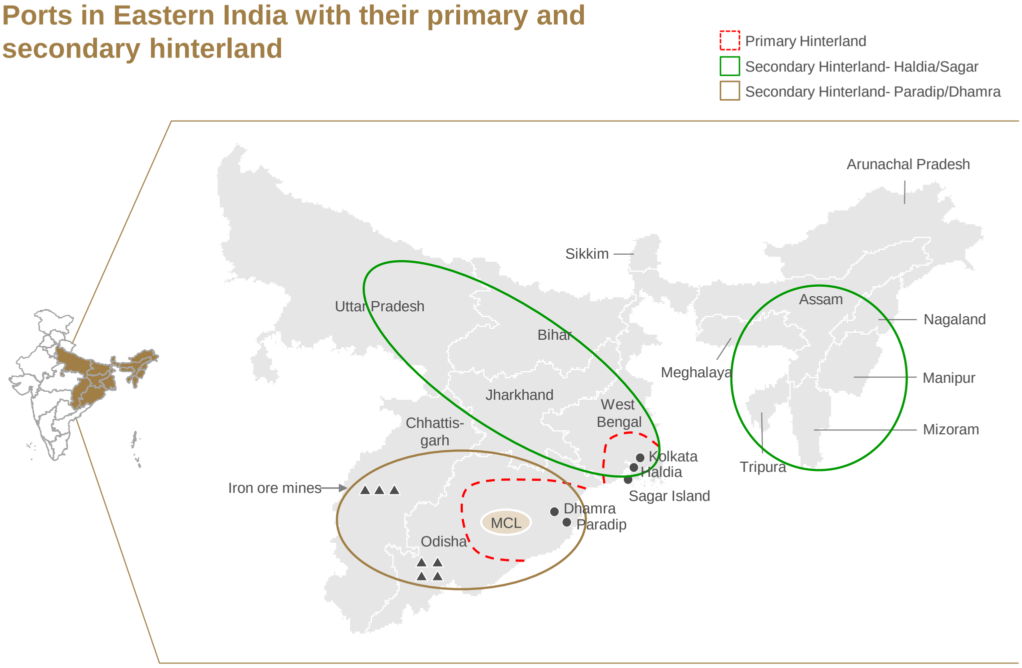


EXHIBIT 7

Eastern Hinterland: Kolkata Dock System, Haldia Dock Complex, Paradip and Dhamra port

Key commodities for the cluster	Current–2014–15 MTPA	2020 MTPA	2025 MTPA	2035 MTPA	Growth drivers for the next 5–10 years
Thermal Coal	35.3	129.0	196.7	291.2	Ujjamala: Paradip and Dharma port to be used as loading ports for coastal shipping
Coking Coal	23.0	37.8	47.5	78.8	Increased coking coal imports due to capacity expansion of steel plants (Meramandali & Patratu) and greenfield plant at TATA, Kalinganagar
Iron Ore	5.7	3.9	5.3	9.4	Linear growth in exports/imports due domestic mining regulation and low global export spot prices
Fertiliser	5.4	10.0	12.6	18.9	Business as usual growth for finished and fertiliser raw material. No major upswing identified
POL	24.1	40.1	53.4	88.5	Operations start of IOCL Paradip. increasing the volume of crude imports at Paradip
Containers (nm. TEU)	10.1	17.2 (1.1)	26.6 (1.7)	34.5 (2.3)	Increased containerisation, port led development and increased export competitiveness
Cement	0.4	8.0	30.7	50.9	Coastal shipping of Steel, Creation of New Steel clusters as part of port led development
Steel	0.0	8.4	20.9	34.6	Coastal shipping of Cement, Creation of New Cement clusters as part of port led development
Others	28.3	57.0	72.4	112.9	
Total	**115.6**	**294.2**	**439.5**	**719.0**	

2. Paradip South satellite port

As part of its vision, Coal India Limited (CIL) is planning to produce 1000 MTPA of coal by 2020[1], of which 250 MTPA will be produced from MCL. The current railway system does not have adequate capacity to evacuate an additional 110 MTPA to power Gencos in Andhra Pradesh, Tamil Nadu and Gujarat.

As per an assessment of the movement of coal through various combinations of rail, road and coastal shipping, observations show that the coastal route is the cheapest mode of transfer. Since most of the power plants in the coastal states have linkage agreements with MCL, coal could be brought to Paradip port by rail and be coastally shipped to a destination port nearest to the power plant. Already, 23 MTPA is being coastally shipped to meet the demand of coastal power plants. Considering the commissioned and under-construction power plants as well as the demand of thermal coal for non-power usage, the potential of coastally-shipped coal to meet the requirement of coastal states could be 150 to 180 MTPA by 2020 and 250-300 MTPA by 2025. Paradip port has a locational advantage of being close to MCL and therefore is a port of choice for the coastal movement of coal to the power plants located in the southern and western states of India. The port does not have adequate capacity to handle projected volumes, through existing or planned capacity and therefore it requires additional capacity. Even after the current development plans of the inner harbour, the port may only be able to ship around 50 MTPA of thermal coal. Also, the port has multiple steel plants in the primary hinterland, which import coking coal mainly from Australia, Indonesia and South Africa. In view of the long shipping routes, savings in voyage cost are substantial if this commodity is handled in large parcel sizes. Neighbouring ports, e.g., Dhamra, Visakhapatnam and Gangavaram, have the facilities for handling 200,000 DWT cape size ships. For Paradip to be competitive, therefore, an outer harbour could be considered to ensure enough draft to handle 200,000 DWT cape size ships (Exhibit 8).

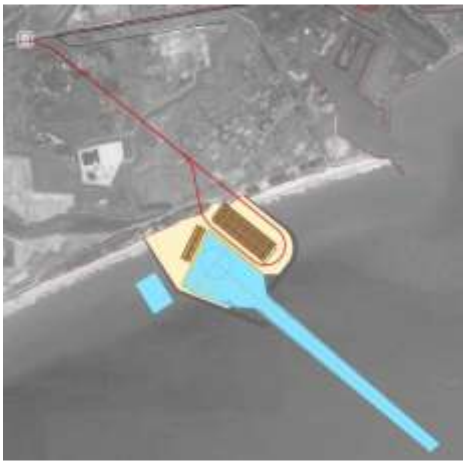
To handle projected coal traffic at Paradip, a site for the proposed development of a deep-water port has been considered, which is adjacent to the south of the existing harbour. Since this site will have separate road and rail connectivity, it will not impact the movement of cargo from the existing port.

Please give exact source

EXHIBIT 8

Location of the satellite port

- This harbour is
  - located approximately 3km south of the existing port.
  - arrangement proposed is similar to Option 1 but could be optimised further
- This harbour would require a new rail line from the nearest rail head ≈ 8km
- The port will have an independent access free from constraints posed currently at port.
- Best procedures and practices could be adopted independent of the current operations
- The proposed layout could have the provision of LNG berth as tankfarms could be provided nearshore.



- Independent infrastructure – rail, road, water and power requiring additional capital investment.
- There would be some R&R issues for rail connectivity
- Littoral drift management with sand trap arrangement would be necessary

The satellite port will mainly be a bulk handling port, loading thermal coal to power plants in the coastal states and unloading coking coal for steel plants in the hinterland. By 2025, the total volume at the port is expected to reach 70 MTPA (Exhibit 9).

EXHIBIT 9

Traffic projection for Paradip satellite port

MTPA

Cargo handled	Projected traffic 2021	2026	2031	2036
1 Coal export	30	60	90	120
2 Coal import	10	10	10	20
3 Break bulk	0	0	2	4

3. Belekeri port

JSW Steel plant (located at a distance of ~380 km from Mormugao port and ~450 km from Krishnapatnam port) currently imports iron-ore via

Krishnapatnam port and coking coal via Mormugao and Krishnapatnam port. Belekeri port, which is closer to JSW Steel as compared to alternate options of Mormugao and Krishnapatnam has significant potential to attract traffic for serving this demand (Exhibit 10).

Along with the above, the port has potential to attract traffic of thermal coal for power plants in the northern and central Karnataka, primarily NTPC Kudgi, JSW Power, KPCL Raichur and KPCL Bellary which are currently using either rail or alternate ports of Mormugao and Krishnapatnam for receiving coal. NTPC Kudgi currently consumes ~9 MTPA of coal which is presently moving by rail. JSW Power imports coal from Mormugao while KPCL Raichur and KPCL Bellary current receive coal partly by rail and partly through coastal shipping from east-coast ports. Belekeri port, which is closer to these thermal power plants as compared to other alternate ports, has significant potential to cater to the imported and coastally shipped domestic thermal coal.

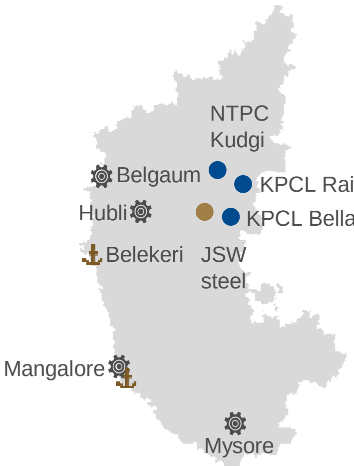
Hubli, which currently generates ~18,000 TEUs, could also be a key source of cargo for the port. Along with the major commodities of coal and iron-ore, the port could facilitate a part of the coastal shipping traffic of fertilizers and food-grains destined for serving the demand of Karnataka and outbound coastal traffic of steel and cement from Karnataka to other states.

EXHIBIT 10

Non-availability of port in Northern Karnataka

Karnataka

- Commissioned power plants
- Discrete manufacturing
- Steel Plant
- Port



Challenges

- Thermal power plants in Northern and Central Karnataka uses rail or alternate ports like Krishnapatnam for getting coal which are much farther off
- JSW Steel gets coking coal and iron-ore from ports of Krishnapatnam and Mormugao involving longer distances
- Belekeri is much better located to serve the demands of steel and thermal power plants
- The port can also facilitate movement of coastally shipped outbound cargo of cement and steel and inbound cargo of food-grains and fertilizers

The traffic projections for the port are shown in Exhibit 11.

EXHIBIT 11

Traffic projection for Belekeri port

Cargo handled (MTPA)	Projected traffic 2021	2026	2031	2036
1 Thermal Coal	2.6	2.9	3.7	4.8
2 Coking coal	6.8	8	10.7	14.3
3 Iron-ore	8.1	9.5	12.6	16.8
4 Containers (mn TEUs)	0.03	0.04	0.06	0.09
5 Others	3.3	4.2	5.3	6.9

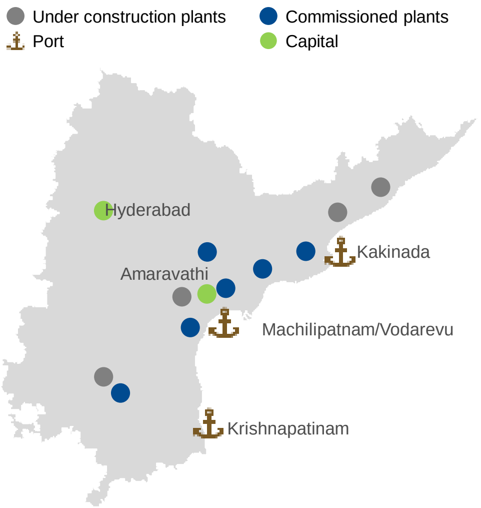
4. Port in central Andhra Pradesh

Thermal power plants located in central Andhra Pradesh are currently using Krishnapatnam and Kakinada port to receive coal from MCL (Exhibit 12). Kakinada is located at a substantial distance from these power plants; thus, Krishnapatnam is significantly sought after for the central power plant cluster. Power plants in central AP include Dr Narla Tata Rao plant in Krishna and Kothagudem II. Total coal handling potential with these two power plants is around 10 MTPA. Machilipatnam and Vodarevu could be potential locations in central Andhra Pradesh for development of port that could serve the cargo requirement of the hinterland much more efficiently. Port in central Andhra Pradesh will also be closest to Hyderabad as well as Amaravati, the upcoming capital of AP. With increasing industrial activity in the capital region, the port could significantly boost developmental activity. In addition, presence of limestone reserves in the hinterland could be leveraged to build a 20 MTPA cement cluster in central Andhra Pradesh. The cement could be coastally shipped to other states from the proposed port.

EXHIBIT 12

Coal: Non-availability of port in Central Andhra Pradesh

Andhra Pradesh and Telangana



Challenges

- Power plants in central AP are currently using Krishnapatnam or Kakinanda involving higher railway distance
- A port in Central AP (Vodarevu/ Machillipatnam) would significantly cut down coal logistics cost for these plants
- Central AP port would be the closest port for both Hyderabad and Amaravathi and can serve other industries also
- The port can also serve as a cement cluster benefiting from limestone reserves in the region

Traffic projections for the port are shown in Exhibit 13.

EXHIBIT 13

Traffic projection for Central Andhra Pradesh port

Cargo handled MTPA	Projected traffic 2021	2026	2031	2036
1 Coal	11.0	21.0	25.0	30.0
2 Containers (mn TEUs)	0.1	0.3	0.7	1.0
3 Others	9	35	41	47

However, it is important to note that there are operational challenges with the probable port locations in central Andhra Pradesh. For example, Machilipatnam has already been awarded but the progress on the same has been limited due to issues with land availability. State Government is working to resolve the same. Vodarevu also has issues with land availability due to legal problems in concession agreement of VANPIC (Vodarevu and Nizamapatnam Industrial Corridor).

5. Port in Central Tamil Nadu

Port in Central Tamil Nadu is ideally placed to supply coal to multiple thermal power plants situated in the hinterland, namely:

- Neyveli Lignite Corporation
- IL&FS
- Mettur (TANGENCO)

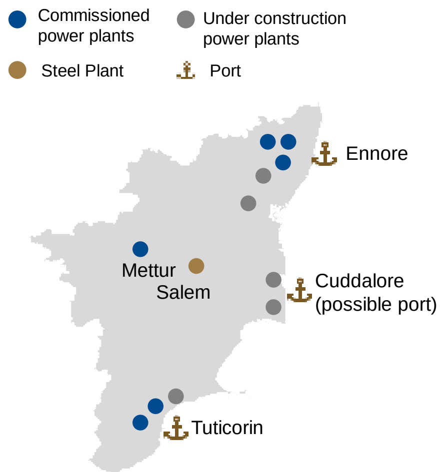
Total coal requirement of these power plants could be around 12 MTPA. Currently, these plants are getting coal through Ennore and Tuticorin ports (Exhibit 14).

Additionally, the port could also handle the coking coal cargo for the JSW Salem plant. Traffic projections for the port are shown in Exhibit 15.

EXHIBIT 14

Coal: Non-availability of port in Central Tamil Nadu

Tamil Nadu



Challenges

- Central Tamil Nadu coastline is suitable for serving a number of power and steel plants with large coal requirements
- This includes coking coal for SAIL plant at Salem as well as power plants in Mettur and Cuddalore

EXHIBIT 15

Traffic projection for Central Tamil Nadu port

Cargo handled MTPA	Projected traffic 2021	2026	2031	2036
1 Coal	10.1	29.3	32.4	35.4
2 Containers (mn TEUs)	0.1	0.1	0.2	0.3
3 Others	2.7	7.6	9.2	10.8

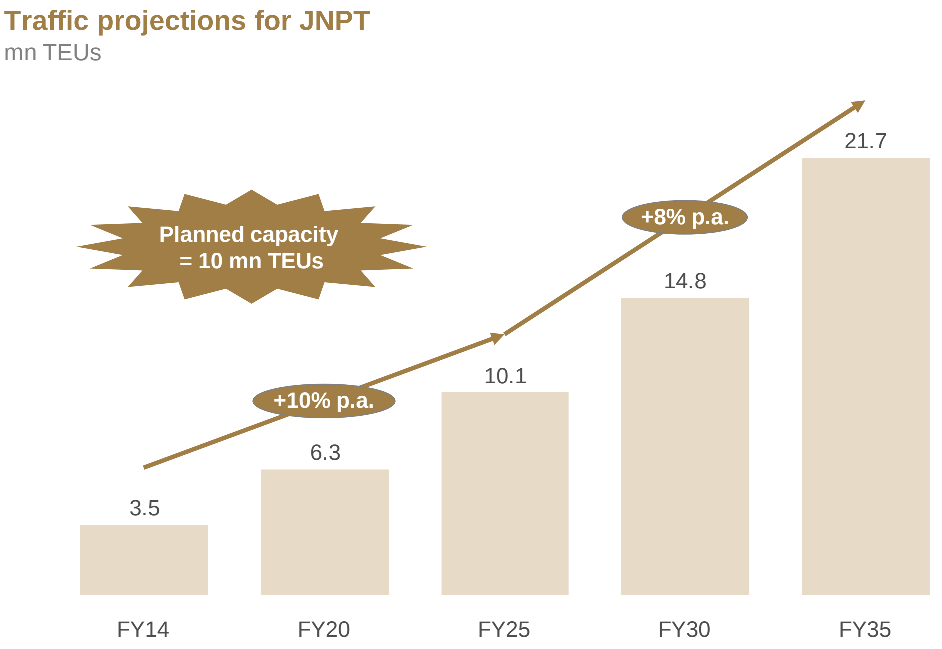
6. Vadhavan

The port at Vadhavan could act as a satellite port for JNPT, which currently has Maharashtra as its primary hinterland. It shares the other hinterlands—NCR, Punjab, Rajasthan and UP—with the Gujarat ports, Mundra and Pipavav. While Vadhavan is mainly expected to cater to container traffic, it may also have the potential to handle coal for the power plants in the region.

Vadhavan is on the west coast of India near Dahanu in Maharashtra's Thane district. Bathymetric studies of the region show that the 20 m depth line is about 6,000 m from the shoreline in this location. Vadhavan provides the least R&R issues with ease of construction and expansion. Additionally, issues of impact on the environment and maintenance overhead are the least in this region.

Vadhavan is expected to be a container port primarily. It is assumed to cater to spill-over traffic from JNPT port once its expanded capacity of 10 mn TEUs is fully utilised (Exhibit 16).

Exhibit 16



SOURCE: Interviews with stakeholders, APMT

However, since it is closer to south Gujarat and parts of Madhya Pradesh, e.g., Vapi, Surat, Ahmedabad, Indore, as compared to JNPT, it is assumed that Vadhavan could attract a part of the total traffic from these hinterlands even before JNPT reaches full capacity utilisation. Traffic from areas that are closer to Vadhavan and JNPT is around 30 per cent of the total hinterland considered for JNPT. However, considering the stickiness of container traffic, only 15 - 20 per cent is actually allocated to Vadhavan. 2023 will be the first year of operation for Vadhavan with potential traffic of 0.83 mn TEUs. Traffic is expected to grow over the years and reach 2.7 mn TEUs in 2028, 8.6 mn TEUs in 2033 and 15.1 mn TEUs in 2038. In addition to containers, this port is also expected to handle 2.3 MTPA of coal from 2026 till 2030 and 11.5 MTPA of coal thereafter. Traffic estimates are mentioned in Exhibit 17.

Exhibit 17

Traffic projection for Vadhavan

Cargo handled MTPA	Projected traffic 2025	2030	2035
1 Containers (Mn TEUs)	1.0	4.8	8.6
2 Break bulk	2.5	5	15

A 1,390 m long container and multipurpose berth could be developed in Phase I in 2023. This could add handling capacity of 0.8 mn TEUs of containers and 4 mn tonne of break-bulk. In Phase II, from 2024 to 2028, a 2,350 m container berth and 300 m bulk berth could be developed. This could take total capacity of the port to 4.4 mn TEUs of containers and 13 MTPA of bulk and break-bulk cargo. Between 2029 and 2033, a 350 m berth could be constructed. Cumulative capacity of the port after these three phases will be 6.8 mn TEUs of containers and 16 MTPA of bulk and break-bulk. Between 2034 and 2038, 1,400 m berth could be constructed taking the overall port capacity to 9.9 mn TEUs and 16 MTPA of bulk and break-bulk. Provision to handle liquid bulk cargo is also provided in the overall port master plan.

The cost for construction of Phase 1 of the port is estimated to be INR 9,297 cr, which includes breakwater cost of INR 2,826 cr, dredging and reclamation cost of INR 2,920 cr, equipment cost of INR 796 cr and project management and contingency cost of INR 1,212 cr.

The port could be developed on reclaimed land, with no land acquisition for port development. Land will only be required for road and rail connectivity.

Apart from containers, this port could also serve the proposed coastal power complex around the region by handling the coastally shipped thermal coal from Odisha. A power complex of 5 GW has been proposed in Vadhavan to meet the power demand of the state by 2025.

7. Enayam: Transshipment hub in the southern cluster

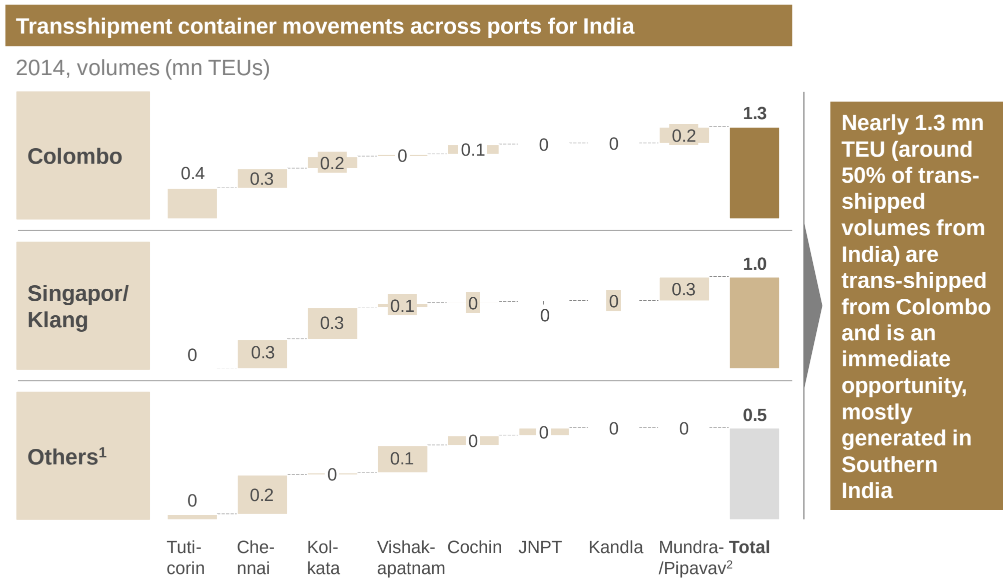
Container traffic in India has seen strong growth in the last decade. The traffic has grown by more than 10 per cent CAGR and is expected to continue growing at this rate as India's GDP growth rate accelerates to 7 to 8 per cent Y-o-Y. The demand for container traffic could further accelerate if the plans for debottlenecking the logistics infrastructure are implemented in due course under the Sagarmala initiative and the “Make in India” campaign drives greater exports and outsources manufacturing to India.

Currently, there are only a few ports in India which have sufficient draft and can match global cargo handling efficiencies. Given the progressive increase in mainline vessel sizes, liners typically prefer calling at ports that have at least 18 m draft. Approximately, 2.7 mn TEUs of conatiners destined for India in 2013–14 were transshipped at international ports like Colombo, Singapore, Klang, which fall on the East West trade route (Exhibit 18), adding to the cost and resulting in the Indian port industry losing out up to INR 1,500 cr of revenue each year on transshipment handling of cargo originating and destined for India. Transshipment also increases the logistics cost by INR 5,000–6,000 per TEU for the trade making it less competitive.

Apart from the lack of a large efficient port with sufficient deep draft, strategic location on main shipping routes is another important reason for transshipment at international ports as mainliners generally prefer minimum deviation from their route, e.g., Colombo is only an hour's deviation from the busy Suez route. An efficient operating condition in the port with stable labour situation, high-productivity levels, simplified customs processes and linkage with cost-efficient feeder networks are also critical factors for attracting container cargo (Exhibit 19).

EXHIBIT 18

Transshipment container movements across Indian ports

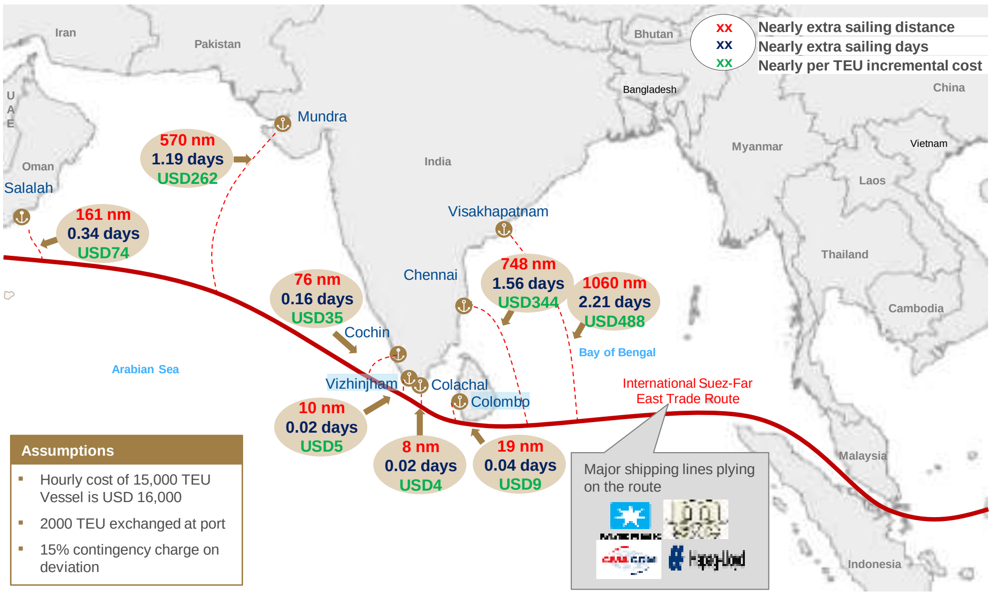


1 Jebel Ali, Salalah, etc.
2 Sourced from expert interviews

SOURCE: Ministry of Shipping

EXHIBIT 19

Deviation from main sailing route is the key determinant for Transshipment hub location



SOURCE: AECOM

Enayam is the most suitable transshipment location in India based on the above mentioned factors. It is located on the south-west coast of India at about 14 nautical mile (NM) deviation (around one or two hours) from the International East–West Trade route. This route accounts for 80 per cent share of India's current container transshipment cargo and most of East Asia's trade with Europe.

Enayam has a natural deep draft of around 20 m which makes it feasible for the largest of vessels to call at the port. Minimal need for maintenance dredging gives it a cost edge over other neighbouring ports, including Colombo. In Colombo, only one terminal (CICT) has a draft of 18 m with dredging.

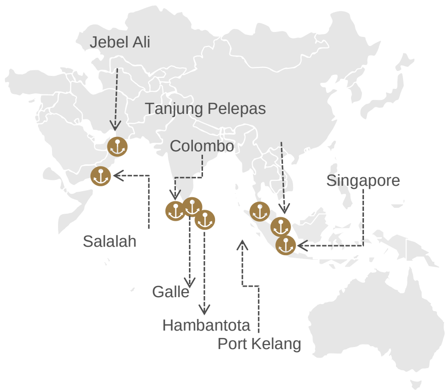
Scale of operations ensures better optimisation of parcel sizes and reduces cost significantly for the port as well as for the customer. All successful transshipment ports in Asia have planned capacities of more than 10 mn TEUs, e.g., Singapore (50 mn), Klang in Malaysia (30 mn), Colombo (13 mn), Hambantota in Sri Lanka (20 mn), Jebel Ali in the UAE (19 mn) and Port Abdullah in Saudi Arabia (25 mn) (Exhibit 20). Enayam's low population density and potential expansion capacity up to 10 mn TEUs, due to the availability of a 4-km-long shoreline, and relatively lower environmental and social impact, provides sufficient scale for the port. This capacity could be further expanded to 18 mn TEUs by converting the breakwater into a container-handling berth.

EXHIBIT 20

Most transshipment ports in the region have capacity between 5–10 mn TEUs annually

Major transshipment ports in the region

mn TEUs



… with most ports with capacity of around 10 mn TEUs or expanding towards that

		Current capacity	Planned expansion
1	Port Kelang	11	13[1]
2	Singapore	40	–
3	Tanjung Pelepas	11	–
4	Salalah	06	9[2]
5	Jebel Ali	19	–
6	Galle	–	6[4]
7	Colombo	5	nearly 13[3]
8	Hambantota	5	nearly 20

1 By 2017; 2 By 2020; 3 2016; 4 Subject to change

SOURCE: Expert interviews and ADB

The proposed site is at a distance of 11.7 km from NH47, which also connects to NH7. Developing a road link with NH47 could be considered as the fastest and most cost-efficient way of connecting the port with the hinterland. The stretch of NH47 and NH47 B, from Villukuri to Nagercoil to Kavalkinaru, is expected to be the principal evacuation route for the Enayam port. This is the main arterial route along which most of the hinterland industries are located. The NHAI is already undertaking a project to expand NH47 under NHDP Phase III, which includes 4-laning of NH47, from Villukuri to Kanyakumari, and 4-laning of NH47 B, from Nagercoil to Kavalkinaru. Land acquisition for the project is ongoing. This project could further cover the extension of the road to the Enayam port which could ensure that connectivity is established before operations begin.

In the southern cluster, Enayam was identified as optimal locations for transshipment port. Vizhinjam with a natural draft of 18.2 m is located at 18 to 20 NM from the major international shipping route. Total project cost in the first phase involves an investment of INR 4,098 cr, of which INR 1,635 cr has been sanctioned as viability gap funding shared equally by the state and central governments at around INR 817 cr each). Enayam has several advantages as a potential location for transhipment hub:

- Possibility of capacity expansion up to 18 mn TEUs due to the availability of a 4 km long waterfront as compared to Vizhinjam's 2.5 km waterfront that restricts the capacity to around 4.3 mn TEUs

- Availability of vast tracts of vacant lands in Radhapuram Taluk, located at a distance of 60 km and Nanganeri SEZ, at a distance of 71 km
- Substantial transshipment cargo originating in the hinterland and the possibility of converting present transshipment cargo to gateway cargo, thus reducing transaction cost to the trade
- Possibility to attract coal traffic in view of the proximity to proposed thermal power stations
- Natural draft of 20 m with minimal maintenance dredging

Transshipment hubs in the world tend to be located in clusters. Singapore, Klang and Tanjung Pelepas in Malaysia are located in the Southeast Asian cluster while Jebel Ali, Salalah and King Abdullah ports are located in the Middle East cluster. Multiple ports at the southern tip of India could create similar cluster of transshipment hubs. Given the shorter shoreline in Vizhinjam (2.5 km vs. 4 km in Enayam), the port is currently planned for a maximum capacity of 4.3 mn TEU. This may not be sufficient to cater to the demand post 2025 as per traffic estimates (Exhibit 21); thus, additional capacity or a new port could be planned to meet the demand. Additionally, Sri Lanka is also aggressively creating new port capacities in Colombo of around 14 mn TEU and Hambantota of around 20 mn TEU. It is essential to create adequate transshipment port capacity in India itself.

EXHIBIT 21

Traffic projection for Enayam

Cargo handled	Projected traffic			
	2020	2025	2030	2035
1 Containers (mn TEUs)	1.7	4.9	6.7	9.2

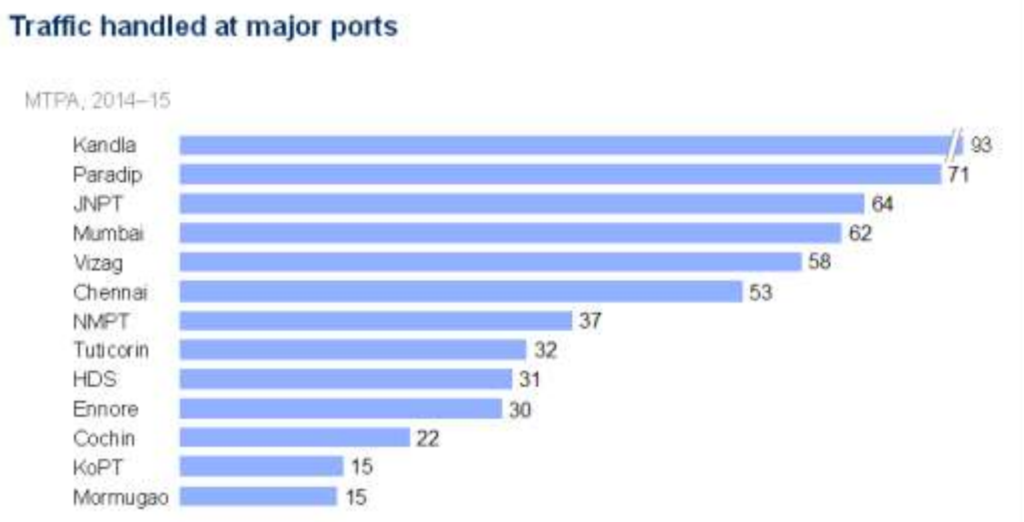
Annexure: Origin-destination analysis report

Contents

Annexure 1: Traffic at major ports

In 2014–15, Indian ports handled around 1,050 MTPA of cargo, growing at the rate of 4.5 per cent per annum. While major ports handled around 580 MTPA, non-major ports handled around 471 MTPA[1] of cargo (Exhibit 1).

EXHIBIT 1



Over the next decade, the following commodity-wise factors could drive the traffic at non-major ports:

- **Petroleum, oil and lubricant:** Continual increase in import of POL products, coastal shipping of POL products to deficit centres, increase in demand of liquefied natural gas (LNG) and liquefied petroleum gas (LPG) and setting up of new refineries
- **Coal:** Growth in CIL's production and coastal shipping of thermal coal to serve power plants in coastal states
- **Bulk materials:** Coastal shipping of bulk commodities, like cement, steel, etc., from production to consumption centres, capacity expansion of existing coastal steel plants driving demand for coking coal and setting up of new coastal capacities for cement and steel
- **Discrete manufacturing:** Increase in container traffic due to growth in the manufacturing sector and boost in EXIM trade

For arriving at the traffic projections for the ports, an origin–destination analysis has been done for the key commodities, including coal, POL, steel, cement, fertilisers, food grains and containers, which contribute around 85 per cent to the total port traffic.

[1] Basic Port Statistics 2014-15

This section focuses on the estimated traffic potential at the 12 major ports. Subsequent sections detail the cargo traffic estimation for each port.

TRAFFIC PROJECTIONS FOR KANDLA PORT

In terms of volume, Kandla is the largest major port in the country, handling more than 90 MTPA of cargo (including the Kandla creek and Vadinar). Currently the port handles large volumes of POL, including roughly 54 MTPA at Vadinar. Other major commodities include thermal coal, fertilisers, food grains, and salt and timber logs.

Major commodities and their projections

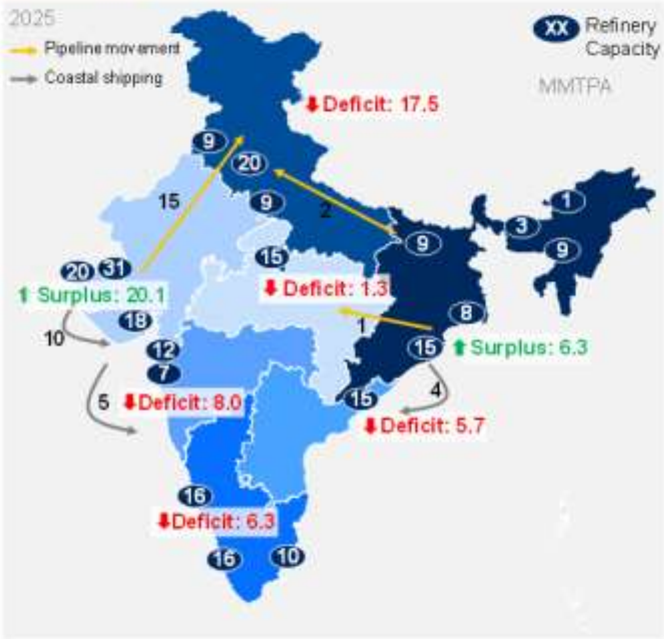
Petroleum, oil and lubricant

POL crude and product constitute the biggest portion of traffic handled Kandla (including Vadinar and Kandla creek).The port handles roughly 2 MTPA of POL while majority of the traffic is at Vadinar. At Vadinar, around 40 MTPA of crude is imported for the close by refineries and then after processing roughly 15 MTPA of products are exported including coastal and EXIM. IOCL Mathura, Koyali, Panipat, Essar Vadinar and BPCL Bina are the key refineries served by the crude from Vadinar.

Going forward, the expansion of these refineries will lead to a traffic of roughly 60 MTPA by 2020, 74 to 76 MTPA by 2025 and 84 to 92 MTPA by 2035. Crude oil imports are expected to rise to around 51 MTPA considering refinery expansions. LPG imports are expected to increase with government's focus on distribution of LPG connections to rural households. By 2025, there is a potential to coastally ship nearly 5 MTPA of POL product from Kandla to Maharashtra (Exhibit 2).

EXHIBIT 2

There is a potential for coastal shipping of ~5 MMTPA of MS/HSD from Kandla to Maharashtra by 2025

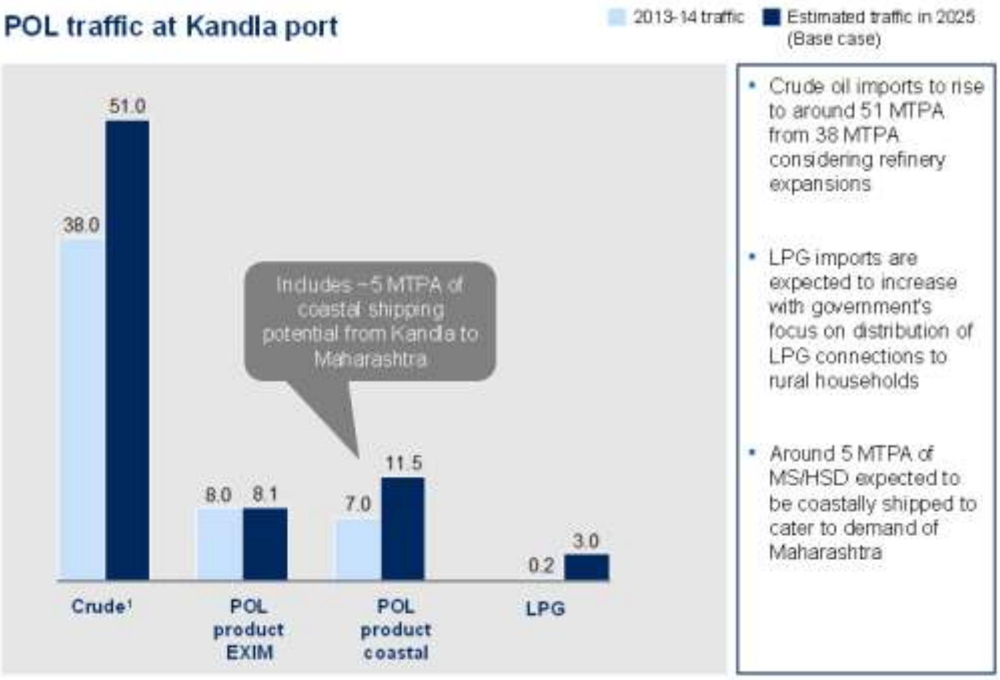


1. Assumes RIL Jamnagar and Essar Oil export nothing while Reliance SEZ exports 100% product

Exhibit 3 shows the split of the current POL traffic and the estimated traffic in 2025.

EXHIBIT 3

POL traffic at Kandla port



1. Includes Panipat, Koyali, Mathura and Bina refinery numbers

SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

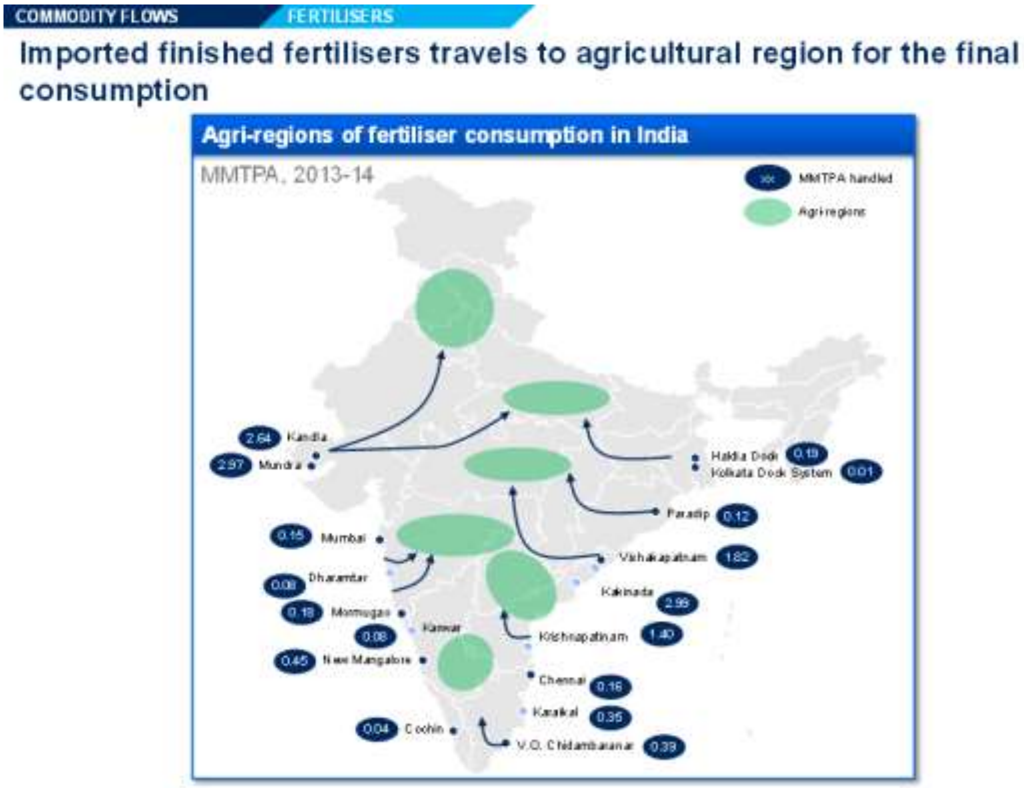
Thermal coal

Currently, the port imports 9.7 MTPA of thermal coal primarily for the consumption of non-power plants (that is, more than 50 per cent of the overall imports). This number is expected to grow at a healthy rate of 10 to 15 per cent since the port has already developed a mega coal terminal at Tuna Tekra, with further plans of expansion through a mega bulk terminal outside the creek. By 2020, the volumes handled by Kandla will be roughly around 18 MTPA, 23 to 25 MTPA by 2025 and 38 to 46 MTPA by 2035.

Fertilisers

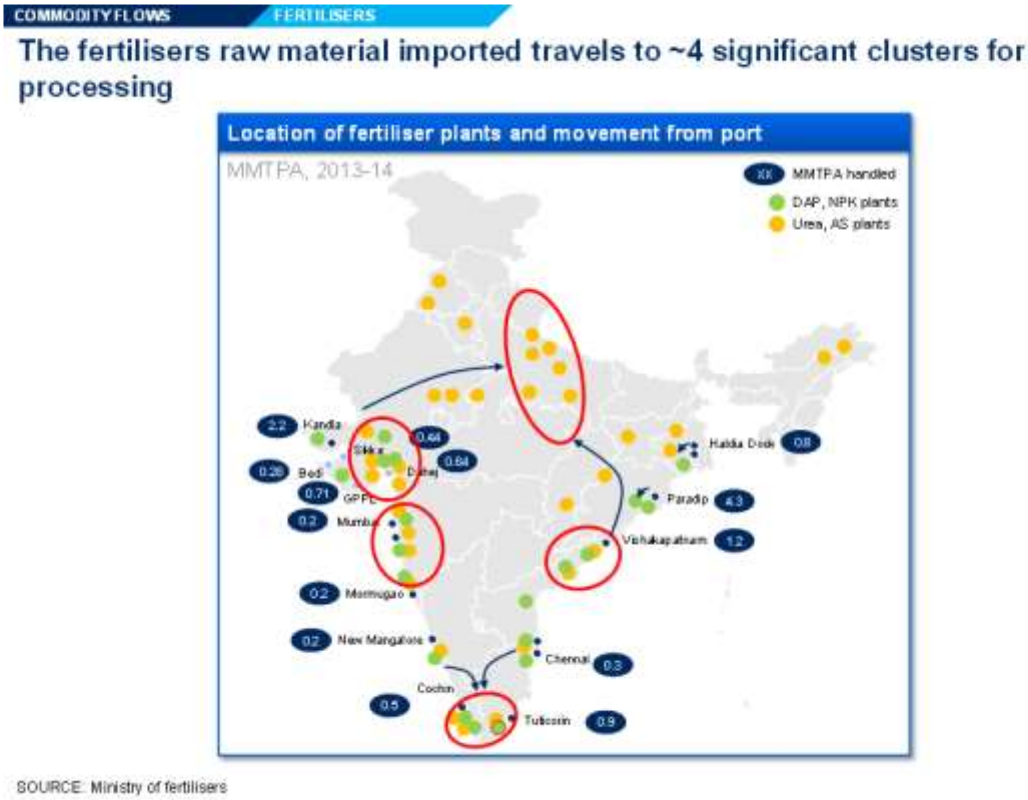
The port primarily imports fertilisers to serve the hinterlands of Punjab, Haryana and UP (Exhibit 4). It port imported 4.5 MTPA of fertilisers in FY2015, of which 0.66 MTPA was rock phosphate (used as a raw material for fertiliser plants), 2.71 MTPA was urea (finished fertiliser which is primarily government controlled) and 1.14 MTPA is DAP (finished fertilisers). Going forward, with the proposal of mechanisation of one or two berths for the import of urea and availability of neem-coating facilities with the port, it is expected that the port could handle roughly 6.1 MTPA of fertilisers by 2020, 8 MTPA by 2025 and 11 to 13 MTPA by 2035.

EXHIBIT 4



SOURCE: Ministry of fertilisers

EXHIBIT 5



Food grains

Kandla is ideally placed to serve the northern hinterlands to export key food grains. Primarily, wheat and rice are exported from the port; these grains are mainly grown in the north and central areas of the country (Punjab, Haryana and MP). In the past few years, exports have steadily declined from roughly 4 MTPA in FY2013 to 2.2 MTPA in FY2015. These volumes are expected to remain stagnant due to the shifting of pulses and rice towards containerisation.

Containers

Of the 2.5 mn TEU produced in the north-western region (NCR+ Punjab), around 50 per cent (1.3 mn TEU) is handled by Mundra port at the moment due to an advantage of turnaround time, call of mother line ships and strong connectivity. Kandla port has an approximate 60 km advantage over Mundra for container cargo coming from NCR + Punjab. In case Kandla port is able to establish a container terminal with world-class efficiency benchmarks (e.g., turnaround time, container clearance etc.), it could attract a sizeable market share from the Mundra port. Traffic projections of container handling are based on the premise of Kandla port of being more efficient and with a strong port-to-hinterland connectivity.

Other localised commodities

Commodities like salt and sugar are produced in the nearby hinterlands of the port and are still one of major drivers of port volumes in the country. Roughly 3 MTPA of salt is exported from Kandla which will grow to roughly 5 MTPA by 2025 and to 8 to 9 MTPA by 2035. Also, 1.5 MTPA of sugar traffic is expected to grow to roughly 2.5 to 3 MTPA by 2025. Exhibit 6 shows the overall commodity-wise projections for the port.

EXHIBIT 6

Kandla Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo							
POL	55.6	59.0	73.7	76.3	84.0	91.6	• Mainly Crude imports driven by IOCL expansion (Koyali, Panipat & Mathura)
Vegetable Oil	3.6	4.8	6.5	6.8	10.7	12.2	
Mixed chemical	1.2	1.6	2.2	2.3	3.6	4.1	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	9.7	18.2	23.0	25.5	38.2	45.6	
Coking Coal	0.2	0.3	0.5	0.5	0.8	1.0	
Iron Ore	1.2	1.3	1.8	1.9	3.1	3.6	• Mostly imports
Steel	1.1	1.6	2.1	2.3	3.8	4.4	
Food grains	2.3	2.3	2.5	2.5	3	3	
Fertilizers	4.5	6.1	7.7	8.1	11.6	12.9	
Salt	2.8	3.7	4.9	5.1	8.1	9.2	
Sugar	1.5	2.0	2.6	2.7	4.3	4.9	
Timber log	2.8	3.8	5.0	5.3	8.4	9.5	
Gypsum	0.4	0.5	0.7	0.7	1.1	1.3	
Containers and other Cargo							
Containers (Mn TEU)	0.00	0.1-0.6	0.2-0.6	1.2	0.6	3.0	• Base case relates to operation of existing container terminal, Optimistic case-operation of Tuna Tekra terminal
Others	5.5	6.3	8.4	8.9	14.1	15.9	• Highly fragmented
Total (MMTPA)	**92.4**	**120.5**	**150.6**	**167**	**204**	**264**	

Conversion Factor Used for Containers Projections: 1 TEU = 15 Tons

For the preparation of the port master plan base case scenarios has been considered.

Coastal shipping potential

Kandla is strategically positioned to serve large areas in the hinterland, with coal, food grains and fertilisers as the major commodities, to/from the port through coastal shipping.

- **Thermal coal:** There is a potential to coastally ship thermal coal from MCL to the plants of GSECL (Gandhinagar), Reliance Power (Thane) and HPGCL (Hisar). Paradip and Dharma will be the origin ports for this cargo and Kandla could act as a receiving port. The overall potential for coastal traffic has been identified to be around 6.3 MTPA by 2020 and 12 MTPA by 2025 (Exhibit 7). However, Kandla would have to compete with the terminals at Alewadi, Navlakhi and Ahmedabad for this traffic

EXHIBIT 7

COMMODITY TRAFFIC COAL

~6.3 MTPA Coal can be coastally moved to Kandla Port via coastal shipping by 2020; GSECL and Reliance Power will be the key customers

Key plants with coastal shipping potential

Plant	Location	Volume Potential to shift to coastal (in MTPA)
GSECL	Gandhinagar	~4.0
Reliance Power	Thane	~2.3

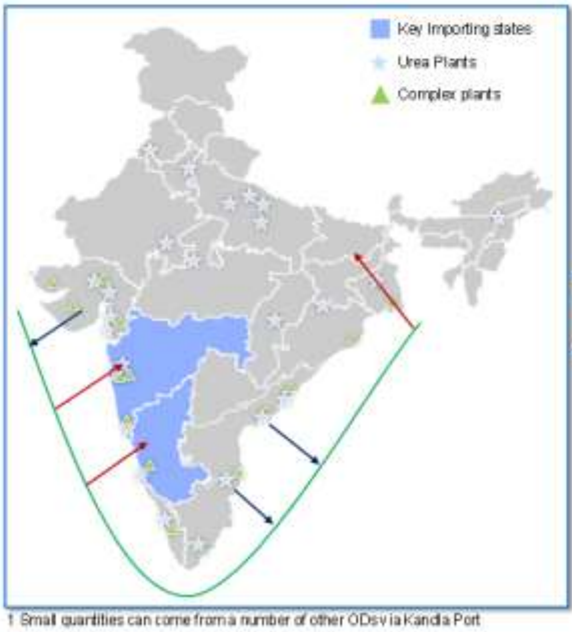
1 Considering linkage rationalization from Pakri Barwadih to Talcher does not happen

- **Fertilisers:** Around 1.3 MTPA of fertilisers can be coastally shipped to the demand states of Maharashtra and Karnataka through Kandla port by 2025.

EXHIBIT 8

COASTAL SHIPPING | FERTILISERS

~1.3 MTPA fertilizer can be shipped via Kandla Port by 2025; Maharashtra and Karnataka will be the key demand states



1 Small quantities can come from a number of other ODs via Kandla Port

Key ODs with coastal shipping potential from Kandla Port

Route[1]	Volume, '000 TPA
Gujarat to Maharashtra	1,071
Gujarat to Karnataka	180

Exhibit 9 summarises the potential of coastal movement for key commodities at Kandla port.

EXHIBIT 9

Kandla Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Unloading)	6.36	11.93	11.93
Steel (Loading)	-	-	-
Steel (Unloading)	0.44	0.59	1.05
Cement (Loading)	0.08	0.11	0.20
Cement (Unloading)	0.00	0.00	0.00
Fertilizer (Loading)	1.07	1.30	1.93
Fertilizer (Unloading)	0.01	0.02	0.02

- Additional Coastal shipping Potential if GSECL Gandhinagar, Reliance Power Thane adopt coastal shipping: Kandla would have to compete with Alewadi, Navlakhi and Ahmedabad Terminal

Meetings held with the Kandla port team:

Date	Discussions with
24th–28th Aug, 2015	Chairman, Traffic Manager
15th–16th Sept, 2015	Chm, Dy. Chm, TM, CE, CME
7th–9th Oct, 2015	Traffic Manager, Deputy Traffic Manager, Chief Engineer
13th–17th Oct, 2015	Vice Chairman, Traffic Manager, Deputy Traffic Manager, Chief Engineer, CME
22nd–23rd Oct, 2015	Dy. Chairman, TM
28th–30th Oct, 2015	Vice Chairman, Traffic Manager, Deputy Traffic Manager, Chief Engineer, Estate Manager, CME
17th–18th Feb, 2016	Dy. Chairman, TM, CE, Estate Manager, CME
15th Mar, 2016	Chairman, Deputy Chairman, Traffic Manager, Deputy Traffic Manager
21st –23rd March, 2016	Chairman, TM, CE, Estate Manager
26th May, 2016	Chairman, Dy. Chairman, Traffic Manager (Video Conferencing)
14th –15th June, 2016	Chairman, Dy. Chairman, Traffic Manager

TRAFFIC PROJECTIONS FOR MUMBAI PORT

In terms of volumes, Mumbai is the fourth largest major port in the country handling more than 60 MTPA of cargo. Currently, the port handles around 61.7 MTPA of cargo with POL as the largest component. Other key commodities include thermal coal (imports), construction intensive commodities like steel and cement and iron ore.

Major commodities and their projections

Coal

Mumbai port imported around 7.4 MTPA of thermal coal in 2014–15, of which around 2 MTPA was for the 140 MW capacity of the Tata power plant at Trombay, around 2.3 MTPA was at Haji Bunder and around 3 MTPA was at Dharamtar. Haji Bunder has stopped handing coal since the port decided not to handle any coal that enters city limits. Also, the Tata power plant cannot expand beyond the current capacity owing to paucity of land. Due to these reasons, it is estimated that the volume of coal handled at the port might remain constant or even decrease in the future.

Consequently, in 2020, the total coal traffic is expected to be around 5.2 MTPA, of which 4.6 MTPA would be thermal coal and 0.6 MTPA would be coking coal. Around 3 MTPA of the 4.6 MTPA of thermal coal will be for the Tata power plant, while the remaining would be handled at Dharamtar for small coal traders. The traffic is expected to remain the same in 2025. In 2035, the total coal traffic is expected to be around 6 MTPA, of which around 5 MTPA would be thermal coal and 1 MTPA would be coking coal.

Steel

In 2014–15, the port handled 4.1 MTPA of steel in imports for the steel multiplier industries present in the Mumbai hinterland and exports of roughly 0.6 MTPA of steel from the JSW Dolvi plant. Going forward, the volume of steel handled at the port is expected to grow with the steel multiplier relative to the GDP.

The overall volume of steel handled at the port is expected to grow to roughly 7 to 8 MTPA by 2025 and to 13 to 15 MTPA by 2035. This traffic would primarily be led by the huge steel demand coming from the hinterlands of Mumbai region as a result of automobile and industrial growth, and increased construction activity.

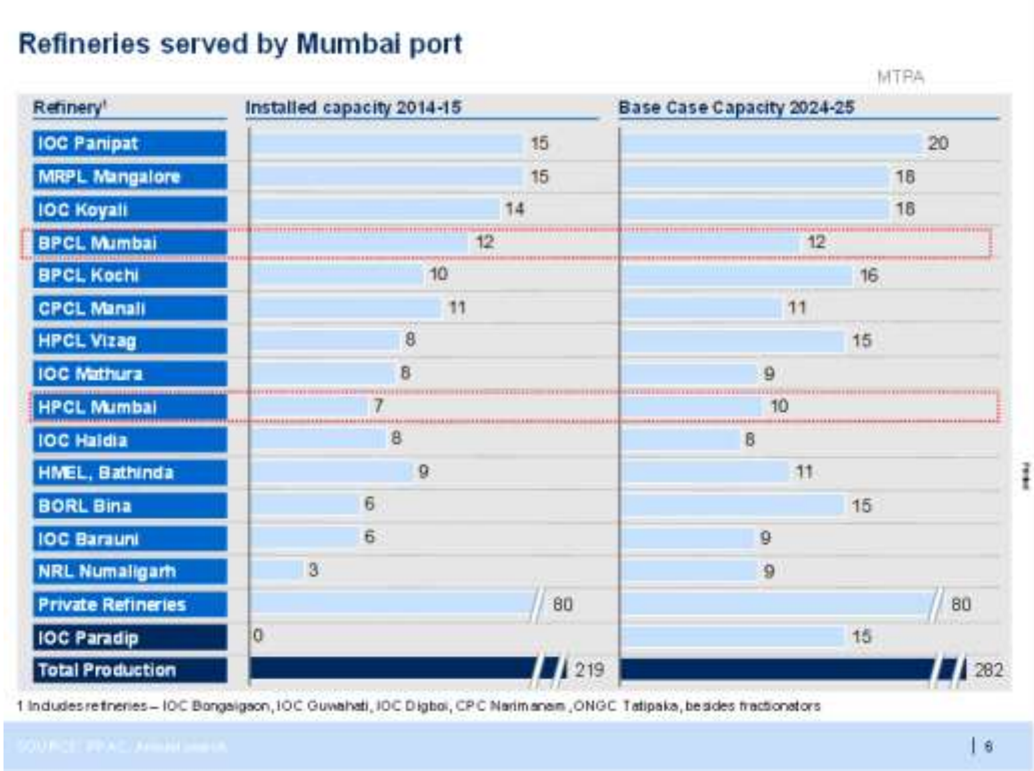
Cement

The port caters to the demands of the real estate hub of Mumbai. The total cement at the port is 1.3 MTPA, most of which is handled at the railway yard currently. This is expected to change in the future with traffic from railways becoming negligible. This traffic would be replaced by 1.0 MTPA of coastally-shipped cement from surplus areas like Gujarat. These volumes are expected to grow to 1.25 MTPA by 2025 and 2.0 MTPA by 2035.

POL

The port imported 25.7 MTPA of crude, a large part of which is used for two refineries in Mumbai—BPCL and HPCL (Exhibit 10). The HPCL refinery is expected to increase its capacity by 3 MTPA by 2025. Therefore, the volume of crude handled in the port is expected to go up by a similar quantum. It should be noted that some of this crude from the Bombay High oilfields is not actually handled at the port but just passes through the pipelines. Beyond 2025, the Mumbai port could also feed some of the crude requirements of a Greenfield refinery expected to come up in Maharashtra. For the traffic projections, it has been assumed that less than 10 per cent of this new refinery's capacity will be served by the Mumbai port. However, this is contingent to the increase in crude production capacity at Bombay High by 5 MTPA.

EXHIBIT 10

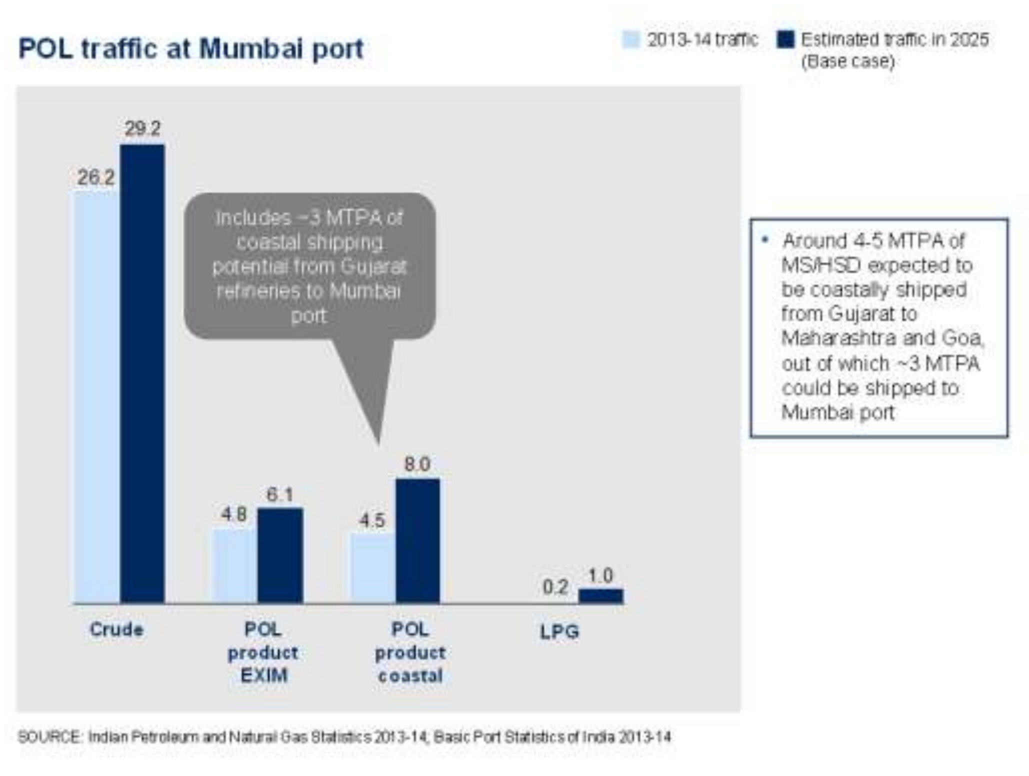


The port also handled POL product traffic of around 10.6 MTPA due to EXIM and coastal movement of POL products. This traffic is expected to go up in the next 10 years as the regional demand of the product will be fulfilled by the excess product produced by refineries in Gujarat. By 2025, it is expected that around 3MTPA of POL product could be coastally shipped to Mumbai port from refineries in Gujarat to cater to the growing demands of the clusters around the Mumbai metropolitan region. Due to limited expansion plans of refineries in Mumbai, the region currently served by these refineries is expected to face a deficit of around 5 MTPA in the next decade. Some part of this deficit could be met by imports at

Mormugao port and ports in southern Gujarat as they will be closer. But a bulk of the traffic would continue to be at the Mumbai port as the major demand centres in Maharashtra are closer to the port.

LPG could also see an organic growth. In 2013–14, LPG imports were around 0.2 MTPA which increased to 0.5 MTPA this year and are expected to increase to 1 MTPA by 2025. Besides LPG, traffic of POL product (both coastal and imported) would grow with incremental traffic of around 2 MTPA by 2025 (Exhibit 11).

EXHIBIT 11



The overall traffic of POL (crude and product) at the port is expected to reach around 39 MTPA by 2020, 44 to 50 MTPA by 2025 and 53 to 61 MTPA by 2035 owing to the refinery expansion, coastal shipping of product and the upcoming Greenfield refinery in the region.

Iron ore

The port caters to the iron-ore demand of the JSW Dolvi plant, which imported 5.2 MTPA in 2014–15. This traffic is handled at the midstream and JSW is expected to import this iron ore at its own port. Going forward, the import of iron ore from the Mumbai port is expected to decrease to around 1 to 2 MTPA.

Automobiles

Mumbai port serves as a hub for exporting automobiles manufactured in the Pune cluster. The port handled around 1.3 lakh vehicles in 2014–15. Most of these exports were from the manufacturing plants of Volkswagen (Chakan), Tata Motors (Pune), Ashok Leyland (Bhandara), Mahindra and Mahindra (Chakan, Kandivali, Nashik) and General Motors (Pune). Since the port is closest to these plants, the logistics costs of export from these via Mumbai is the lowest.

Society of Indian automobile manufacturers SIAM is targeting around 10 mn units of exports by 2025 from India, of which 2 to 2.5 mn is expected to be passenger vehicles and 0.3 to 0.5 mn would be commercial vehicles. Based on the growth over the last few years, it has been assumed that India would meet these export targets in the optimistic case in 2025 and base case in 2035.

Using the targets set by SIAM and the available data on growth plans of the manufacturing plants in its vicinity, Mumbai port can expect traffic of 2.4 lakh units in 2020, 2.9 lakh units in 2025 and 3.9 lakh units in 2035 in the base case. Of the 2.4 lakh units in 2020, passenger cars could be around 1.7 lakh, while remaining would be commercial vehicles. Similarly in 2025, 2.2 lakh vehicles would be passenger cars and 0.7 lakh would be commercial. In 2035, there could be roughly 2.7 lakh passenger vehicles and 1.2 lakh commercial vehicles. Most of this export traffic is contingent on the expansion plans of the Volkswagen plant (Chakan)—to 2 lakh units per annum from their current capacity of 1.3 lakh.

This analysis, however, does not take into account the export of two and three wheelers manufactured in the hinterland region. Bajaj manufactures two and three wheels at its plants in Aurangabad and Chakan. Similarly, Piaggio vehicles manufactures two wheelers in the Baramati plant. These vehicles are mainly moved as part of containerised cargo with JNPT as the preferred port.

Other cargo

Commodities included under other cargo are rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and miscellaneous cargo. Some of this traffic is handled midstream as well. While the total other cargo handled at Mumbai port was 4.1 MTPA, around 1.5 MTPA was handled midstream. In 2025, the total other cargo handled at the port could be around 4.4 MTPA, while 2.2 MTPA would be handled midstream.

Exhibit 12 shows the overall commodity-wise projections for Mumbai port.

EXHIBIT 12

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Total)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	36.3	39.3	44.2	49.5	53.1	61.5	• Coastal shipping of ~3 MTPA from Gujarat
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	• As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	• Doesn't include coastal shipping potential
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.09	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[1]	3.8	4.6	6.2	6.5	10.2	11.6	• 1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**61.7**	**62.7**	**71.0**	**79.3**	**94.7**	**110.3**	

1. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

A part of the traffic projections includes cargo that is not actually handled at Mumbai port (ONGC Bombay High Crude to refineries and JNP, POL product at OPL Wadala). Exhibit 13 shows the amount of cargo actually handled at port, including the cargo handled midstream (iron ore, some part of coal and other commodities). Of this, traffic handled midstream is estimated to be around 4.2 MTPA in 2020, 4.7 MTPA in 2025 and 7 MTPA in 2035. This would include some part of coal traffic, all of iron ore traffic and most of other commodities cargo.

EXHIBIT 13

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Handled[1])

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	23.8	27.3	32.2	37.5	41.1	49.5	
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	• As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	• 2014-15 cement is handled at the railway yard
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.08	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[2]	3.8	4.6	6.2	6.5	10.2	11.6	• 1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**49.3**	**50.7**	**59.1**	**67.3**	**82.7**	**98.3**	

1. Includes midstream cargo but excludes ONGC BH Crude to refineries, ONGC BH Crude to JNP, OPL Wadala

2. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

Coastal shipping potential

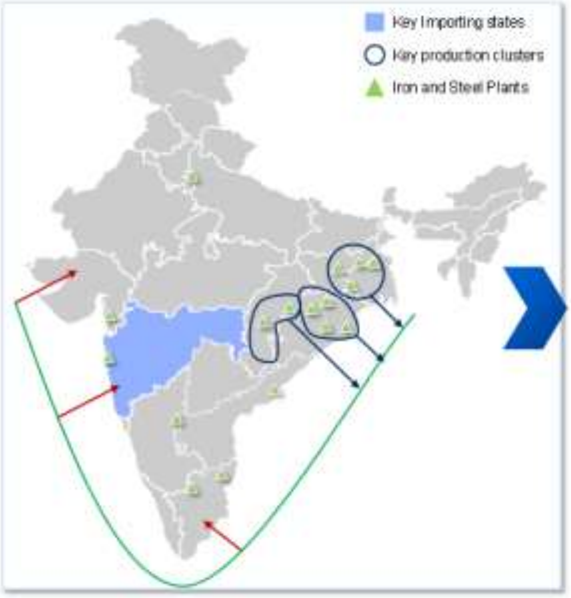
The port is strategically positioned to serve the large demands of the Mumbai hinterland and adjoining areas through coastal shipping. Steel and fertilisers can be major commodities for the Mumbai port as and when the coastal shipping revolution takes place in the country.

- **Steel:** Around 2 MTPA of steel can be coastally shipped to Mumbai port primarily from Odisha and Jharkhand. Small quantities can come from West Bengal and Andhra Pradesh (Exhibit 14).

EXHIBIT 14

COASTAL SHIPPING | IRON AND STEEL

~1.8 MTPA steel can be coastally shipped to Mumbai port by 2025 primarily from Odisha and Jharkhand



Key ODs with coastal shipping potential to Mumbai Port

Route[1]	Volume, '000 TPA
Jharkhand to Maharashtra	614
Odisha to Maharashtra	392
West Bengal to Maharahtra	165
AP to Maharashtra	156

1 Small quantities can come from a number of other ODs via Mumbai Port

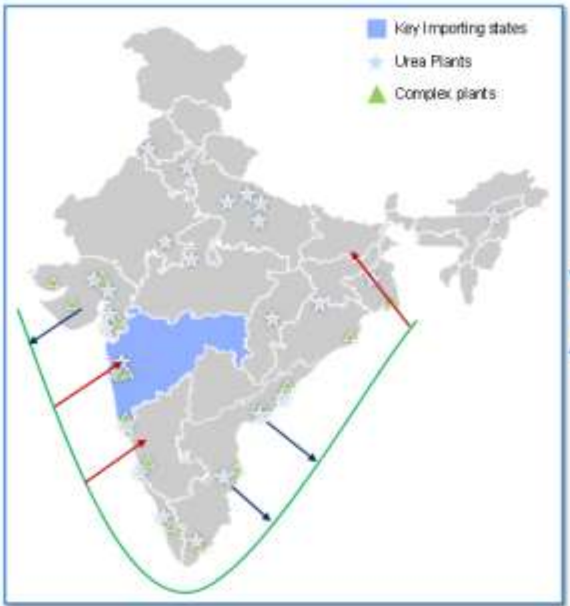
SOURCE: DGCIS data 2013-14

- **Fertilisers:** Around 2 MTPA of fertilisers can be coastally shipped to Mumbai port primarily from Andhra Pradesh and Gujarat (Exhibit 15).

EXHIBIT 15

COASTAL SHIPPING | FERTILISERS

~2 MTPA fertilizer can be shipped to Mumbai Port by 2025; AP and Gujarat will be the key source states



Key ODs with coastal shipping potential to Mumbai Port

Route[1]	Volume, '000 TPA
Gujarat to Maharashtra	1,284
AP to Maharashtra	606

1 Small quantities can come from a number of other ODs via Mumbai Port

SOURCE: DGCIS data 2013-14

Exhibit 16 summarises the potential of coastal movement for key commodities at Mumbai port

EXHIBIT 16

Mumbai Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.45	0.60	1.07
Steel (Unloading)	1.03	1.37	2.47
Cement (Loading)	-	-	-
Cement (Unloading)	-	-	-
Fertilizer (Loading)	0.28	0.34	0.50
Fertilizer (Unloading)	1.73	2.11	3.12
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	0.01	0.01	0.01

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small.

Meetings with the Mumbai port team:

Date	Discussions held with
30th June, 2015	Chairman
17th–19th Nov, 2015	Chairman, CE, DCE, TM
8th Dec, 2015	Chairman
18th–19th Jan, 2016	Dy. Chairman, DCE, CME
1st–2nd May, 2016	Ports Team
26th May, 2016	Chairman, Dy. Chairman, Traffic Manager (Video Conferencing)
13th June, 2016	Chairman, Dy. Chairman, Traffic Manager (Video Conferencing)
22nd June 2016	Chairman, Dy. Chairman, Traffic Manager (Video Conferencing)
30th June, 2016	Chairman, Dy. Chairman, Traffic Manager, Dy. Traffic Manager

TRAFFIC PROJECTIONS FOR JNPT

JNPT handles containers, liquid cargo including POL, vegetable oil and chemicals and cement in dry and break bulk cargo. Out of these, containers constitute around 90 per cent of the cargo. JNPT currently has Maharashtra as its primary hinterland for containers with other hinterlands including Gujarat, NCR, Punjab, Rajasthan and UP, which it shares with Mundra and Pipavav ports in Gujarat.

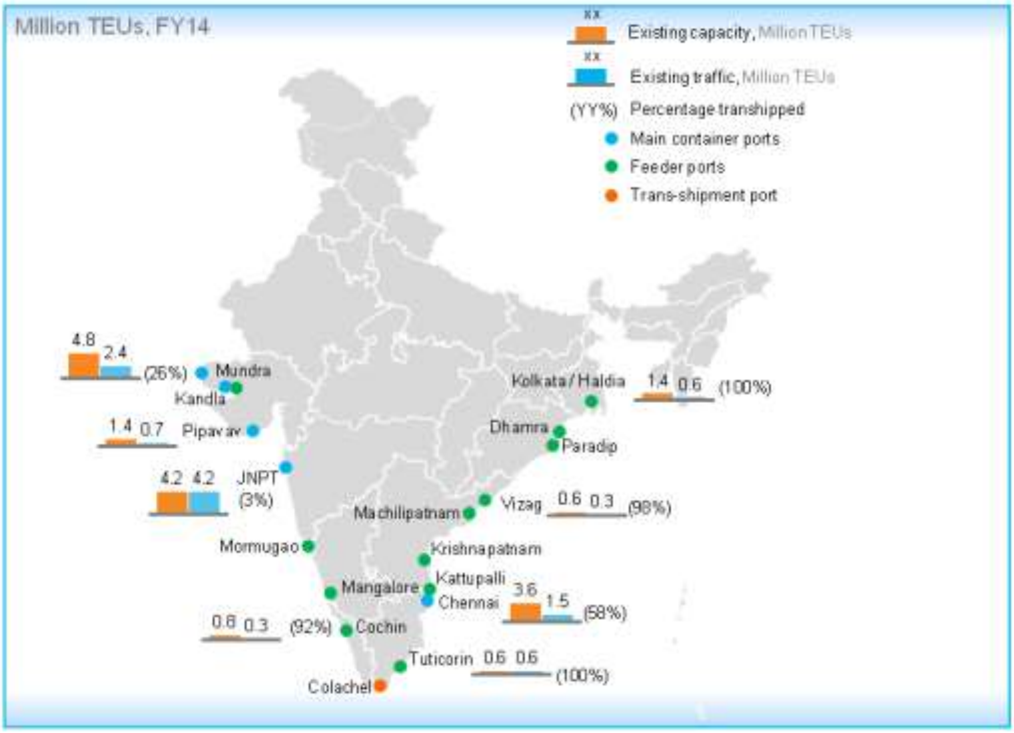
Major commodities and their projections

Containers

Assessment of traffic was based on the analysis of past traffic at JNPT, interviews with port authorities, Maharashtra Maritime Board and Maharashtra Industrial Development Corporation (MIDC) as well as several stakeholders in the shipping and user industries.

Of the 10.7 mn TEUs handled in India in FY2014, west coast container ports handled around 7.6 mn TEUs (Exhibit 17). In the same year, JNPT operated at around 100 per cent capacity utilisation handling 4.2 mn TEUs.

EXHIBIT 17



Maharashtra (Mumbai, Pune, Nashik, Aurangabad and Nagpur) is the primary hinterland for JNPT generating around 45 per cent of the total traffic (Exhibit 18 &19).

EXHIBIT 18

COMMODITY TRAFFIC CONTAINER

Maharashtra is the primary hinterland of JNPT followed by NCR, Punjab and Gujarat

■ Primary hinterland of port

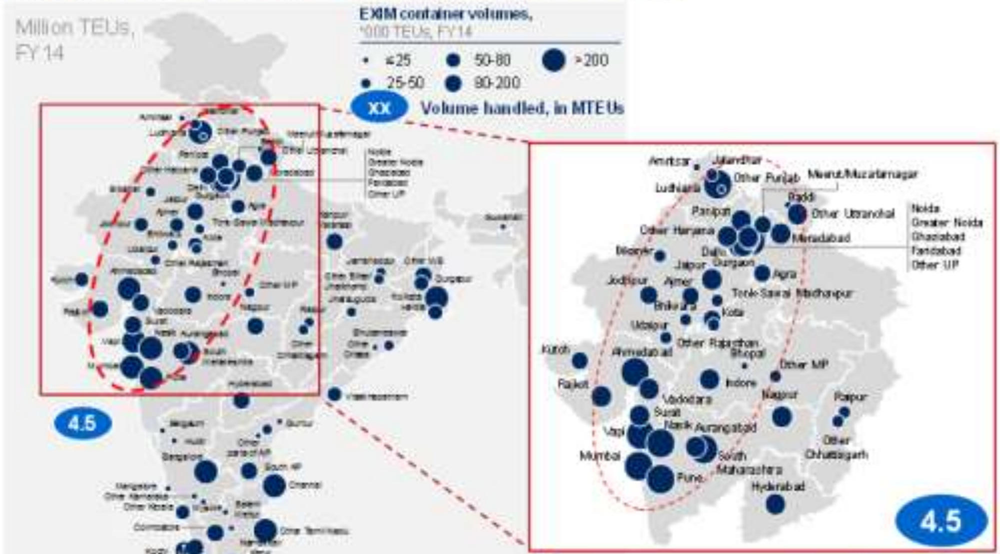
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakhapatnam	Mangalore
NCR+Punjab	938	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhattisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

EXHIBIT 19

COMMODITY TRAFFIC CONTAINER

EXIM container generating hinterlands for JNPT port



- JNPT currently handles ~40% of total EXIM container traffic
- Only ~3% of JNPT traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

Container traffic from the North and north-western parts of India (including NCR, Uttar Pradesh, Haryana, Punjab and Rajasthan) has shifted to Mundra and Pipavav in recent years. This trend is expected to continue mainly because of the shorter distances by road and rail from this hinterland to Gujarat ports as compared to JNPT, e.g., average rail distance of NCR from/to Mundra and Pipavav is around 350 and 250 km lesser, respectively, than JNPT.

A part of the reason for the shift is due to increasing congestion at JNPT. While the completion of the fourth container terminal and other expansions will ease this situation, the rail distance advantage of Gujarat ports will still make them more competitive for the North and north-western parts of India.

JNPT handled 4.2 mn TEUs in FY2014. Traffic projections for JNPT have been done considering (Exhbit 20):

- Historical growth in container traffic at JNPT and other ports
- Historical trends in containerisation levels in India
- Forecast for manufacturing GDP of different districts including increase in demand and manufacturing from initiatives like the Delhi–Mumbai Industrial Corridor (DMIC), the Vizag–Chennai Industrial Corridor (VCIC), the Chennai–Bangalore Industrial Corridor (CBIC), the Mumbai–Bangalore Economic Corridor (MBEC), “Make in India” campaign, etc.
- Proposed Dedicated Freight Corridor from Dadri to JNPT

Based on these, container traffic at JNPT is expected to be around 9 to 10 mn TEUs by FY2025—the same as the planned capacity at the port.

EXHIBIT 20

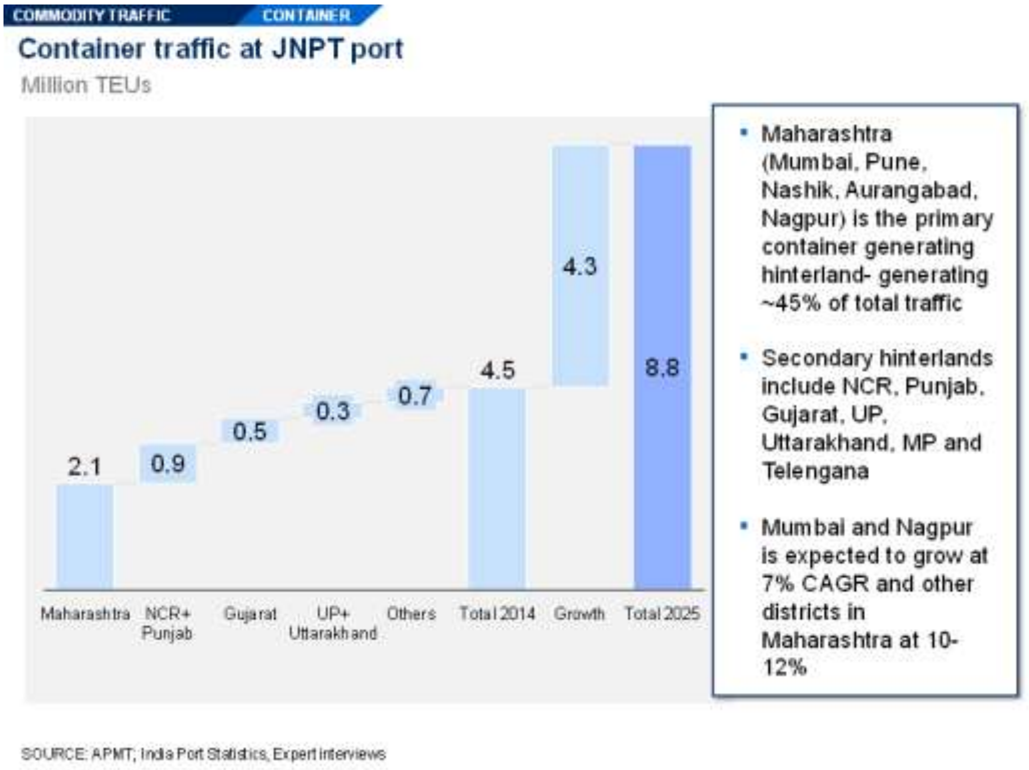


Exhibit 21 summarises traffic projections for all commodities at JNPT.

EXHIBIT 21

JNPT - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario; xx Optimistic Scenario

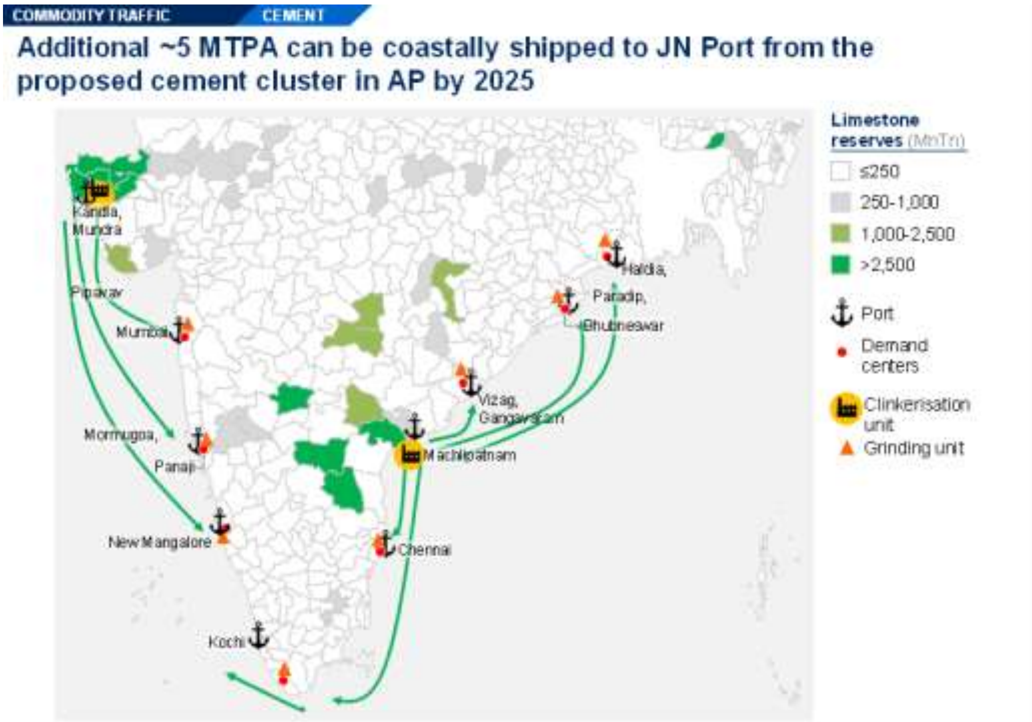
Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	4.1	5.5	7.0	8.1	9.1	10.3	
Vegetable Oil	1.0	1.3	1.7	1.8	2.9	3.3	
Chemicals	0.8	1.1	1.4	1.5	2.4	2.7	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	0.0	0.0	0.0	0.0	0.0	0.0	
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.0	0.0	0.0	0.0	0.0	0.0	
Cement	0.7	0.9	1.2	1.3	2.0	2.3	
Fertilizers	0.0	0.0	0.0	0.0	0.0	0.0	
Containers and other Cargo							
Containers (Mn TEU)	4.5	6.8	8.8	10.2	14.6	18.3	
Others	0.2	0.3	0.4	0.4	0.6	0.7	
Total (MMTPA)	**64.4**	**96.1**	**124.5**	**143.9**	**203.9**	**253.5**	

Conversion Factor Used for Containers Projections: 1 TEU = 12.8 Tons

Coastal shipping potential

Apart from the above mentioned traffic, the potential of coastally shipping cement could also be tapped. Around 5 MTPA of cement could be coastally shipped from Andhra Pradesh to Maharashtra via JN Port by 2025 (Exhibit 22). This is contingent on the development of the central AP port which will serve as the origin port for this movement.

EXHIBIT 22



Meetings with the JNPT Port team:

Date	Discussions held with
15th–16th July, 2015	Vice Chairman, Traffic Manager
26th–27th Aug, 2015	Vice Chairman, Traffic Manager,
1th Oct, 2015	Manager-Projects
6th Oct, 2015	Manager-Projects
15th Oct, 2015	Manager-Projects
17th Nov, 2015	Traffic Manager
18th Nov, 2015	Traffic Manager, Chief Manager
26th–27th Nov, 2015	Traffic Manager
30th Nov, 2015	Manager-Projects, Vice Chairman
6th–7th Jan, 2016	Chairman
16th–20th Feb, 2016	Traffic Manager, Chief Manager
10th March 2016	Manager-Projects, Vice Chairman
	Chairman, Chief Manager
26th May, 2016	Chairman, Dy Chairman, Traffic Manager (Video Conference)
10th June, 2016	Chairman, Chief Manager
15th July, 2016	Chairman, Chief Manager

TRAFFIC PROJECTIONS FOR MORMUGAO PORT

The port of Mormugao currently handles roughly 14.7 MTPA of cargo catering primarily to the hinterlands of south Maharashtra, northern Karnataka and Goa. One of the major bottlenecks hindering the growth of the port is the lack of good connectivity due to the Western Ghats. The port used to be the largest gateway of iron ore from the country as the largest export from the port but with the mining ban and Brazil taking over the China market for the supply of ore, the volumes at the port have decreased drastically.

Major commodities and their projections

Coking coal

The port currently imports 6.6 MTPA of coking coal from Australia and South Africa. This coking coal is primarily used by steel plants in its vicinity—JSW Vijayanagar consumes nearly 5 MTPA and JSW Dolvi consumes the remaining 1.6 MTPA.

Going forward, the volume of steel handled at the port is expected to grow with the steel multiplier relative to the GDP. The overall traffic of coking coal is expected to grow to 14 MTPA by 2020, 19 to 21 MTPA by 2025 and 34 to 40 MTPA by 2035.

Thermal coal

The port currently imports 1.9 MTPA of coal primarily for non-thermal power plant purposes. The demand is expected to grow to roughly 2.6 MTPA by 2020, 3.5 MTPA by 2025 and 5 to 6 MTPA by 2035.

Steel

Being close to key JSW steel plants, the port is an ideal location to export finished steel products from these plants to coastal places within India and to locations abroad. The port exports around 1 MTPA HR steel coils from the nearby plants. With natural steel multiplier growth, it is expected that the volume of exports would increase to 2.4 MTPA by 2020, 3 to 4 MTPA by 2025 and 6 to 7 MTPA by 2035.

Iron ore

In 2010–11, during the peak of iron ore exports from the country before the mining ban in Goa, Mormugao port was used to export around 41 MTPA of iron ore. In the last few years, export volumes decreased significantly to reach around 0.6 MTPA.

Even after the ban was lifted, the high-landed price of iron ore from India has led to sluggish growth. Meanwhile, Brazil has taken up a major chunk of the markets and global prices have fallen to as low as USD 45/T owing to oversupply of ore in the market (Exhibit 23).

EXHIBIT 23

Unless the market rates pick up, it is expected that the volumes of the ore exported from the port will be muted at less than 18 MTPA till 2035. Only when prices pick up would there be an increase in traffic to reach around 50 MTPA by 2035.

There is an additional potential of handling around 11 MTPA by 2025 once the Betul port begins operations. Traffic projections for 2025 include commodities like woodchips, gypsum, bauxite, granite, steel coil, LPG, edible oil, cement and sand.

Exhibit 24 shows the overall commodity-wise projections for the port (including those expected to be handled at Betul port).

EXHIBIT 24

Units: MMTPA (except Containers)

Mormugao Port - Traffic Projections

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL product	0.6	1.0	1.5	1.8	2.2	2.7	Some part of crude might be imported if a green-field mega refinery comes up in southern Maharashtra- the impact of the same has not been taken in traffic projections
Chemicals	0.5	0.7	0.8	1.0	1.3	1.9	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	1.9	2.6	3.4	3.6	5.7	6.4	• Overseas imports likely to decline; may attract ~14 MT from Belekeri
Coking Coal	6.6	14	19	21	34	40	
Coke	0.7	1.0	1.3	1.4	2.4	2.8	
Iron Ore	0.8	8	11	35	18	50	• Exports; includes pellets; Optimistic case is related to volumes handled before ban
Steel	1.7	2.4	3.3	3.5	5.8	6.7	
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	
Containers and other Cargo							
Containers (MnTEU)	0.02	0.04	0.10	0.13	0.15	0.18	
Others	1.4	2.4	3.1	3.3	5.2	5.9	• Highly fragmented
Others (once Betul port takes off)	NA	9.0	10.0	12.0	16.6	21.5	• Major commodities: woodchips, gypsum, bauxite, granite, steel coil, LPG, Edible oil, cement and sand
Total (MMTPA)	**14.7**	**42.1**	**55.35**	**84.9**	**94.1**	**141.3**	

Conversion Factor Used for Containers Projections: 1 TEU = 12.5 Tons

Coastal shipping potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping that can be potentially tapped. Thermal coal can form the significant share in coastal shipping while small volumes of other commodities like steel can be moved coastally.

- **Thermal coal:** Coal can prove to be a major commodity which can be coastally shipped to Mormugao port. NTPC Kudgi and KPCL Bellary plants can shift to coastal shipping and receive their coal from the Mormugao port, if Belekeri port does not come up in the near future (Exhibit 25).

EXHIBIT 25

COMMODITY TRAFFIC — COAL

~11 MTPA Coal can be moved from Pakri Barwadih to Kudgi[1] and ~2.4 MTPA from Bharatpur to Bellary via coastal shipping through Mormugao port

Pakri Barwadih to Kudgi (Optimimum route: 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Road-Rail-Port-Road-Rail	3,833	2,883
2	Road-Rail	2,035	3,300

Bharatpur to Bellary (Optimimum route: 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Rail-Port-Rail	3,308	2,250
2	Rail	1,435	2,298

1 Considering linkage rationalization from Pakri Barwadih to Talcher does not happen

Exhibit 26 shows the overall outlook of coastal shipping from Mormugao port.

EXHIBIT 26

Mormugao Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Unloading)	13.37	13.37	13.37
Steel (Loading)	0.49	0.65	1.17
Steel (Unloading)	0.67	0.89	1.59
Cement (Loading)	0.39	0.52	0.93
Cement (Unloading)	0.01	0.02	0.03
Fertilizer (Loading)	0.03	0.04	0.06
Fertilizer (Unloading)	0.06	0.07	0.10
Food Grains (Loading)	0.00	0.00	0.00
Food Grains (Unloading)	0.14	0.18	0.26

- Additional Coastal shipping Potential if Belekeri is not built and NTPC Kudgi I in Bijapur and KPCL Bellary adopt coastal shipping

Meetings with the Mormugao port team:

Date	**Discussions held with**
24th Nov, 2015	Chairman
1st-2nd Dec, 2015	Chairman
12th Dec, 2015	Chairman and Port team
9th–11th Feb, 2016	Chairman and Port team
11th–13th Feb 2016	CE, TM
6th–7th April 201626th May, 2016	Chairman and Port team
	Ports team (Video conference)

TRAFFIC PROJECTIONS FOR NMPT

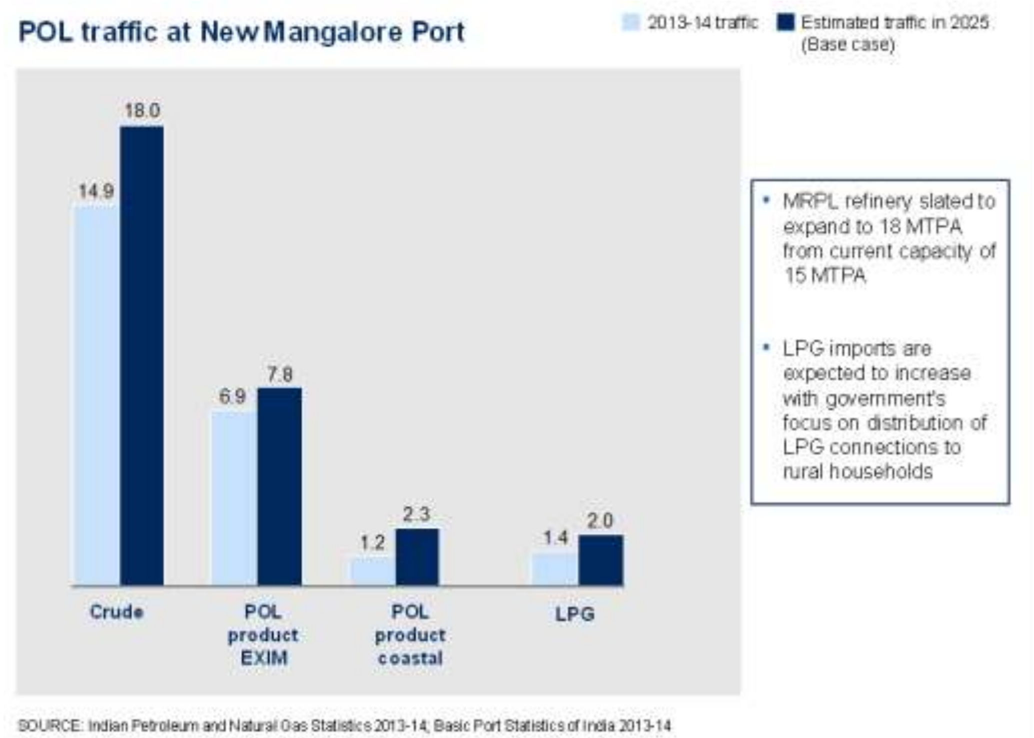
New Mangalore port trust is the only major port in Karnataka located in southern part of Karnataka. The port has 15 berths—nine for general cargo, five for POL and one each for coal and iron ore. Total traffic handled by the port in 2014–15 was around 37 MTPA, with POL accounting for the majority at around 65 per cent. Cargo traffic is expected to increase to around 44 MTPA by 2020 and 53 to 63 MTPA by 2025.

Major commodities and their projections

POL

NMPT currently handles around 23 MTPA of POL. ONGC is the captive customer for POL, handling 15 MTPA of crude imports and 8 MTPA of refined products exports. NMPT has the highest productivity in POL amongst Indian ports. Over the last years, POL volumes have reduced by 1 MTPA due to reduction in MRPL's refined product exports. Going forward, MRPL refinery is slated to expand to 18 MTPA from the current capacity of 15 MTPA. LPG imports are expected to increase with the government's focus on distribution of LPG connections to rural households. Cumulatively, the POL volume is expected to reach 25 MTPA by 2020 and 30 to 33 MTPA by 2025. Exhibit 27 shows the split of 2013–14 POL traffic and the projected volumes in 2025.

EXHIBIT 27



Coal

NMPT handles 8.2 MTPA of coal, with the Udupi power plant as the primary customer based on imported thermal coal. Shutting down of coal handling in Chennai port has also provided some spill-over traffic to NMPT. There is limited opportunity for additional coal volumes at NMPT, mainly because of connectivity issues to Bellary and Hospet (Sheradi Ghat). Due to this, it is more economical to transport coal through Krishnapatnam and Mormugao. Coal volume is expected to reach around 12 MTPA by 2020 on the back of Udupi power and import substitution, and 13 to 14 MTPA by 2025.

Containers

NMPT currently handles 50,000-60,000 TEUs with most of the cargo getting transhipped from other ports (Exhibit 28 & 29). Karnataka is the only hinterland for the port. The cargo handled at the port largely are coffee exports from the hinterland and cashew imports. There is potential to increase container volumes from Mysore, Bangalore, Hassan and Bellary, provided the connectivity is improved and mechanised facility is installed. Due to poor connectivity, most of the container traffic moves to Chennai port. Going forward, the container traffic is expected to marginally increase to 0.1 to 0.12 mn TEUs by 2025 driven by growth in the hinterland.

EXHIBIT 28

COMMODITY TRAFFIC CONTAINER

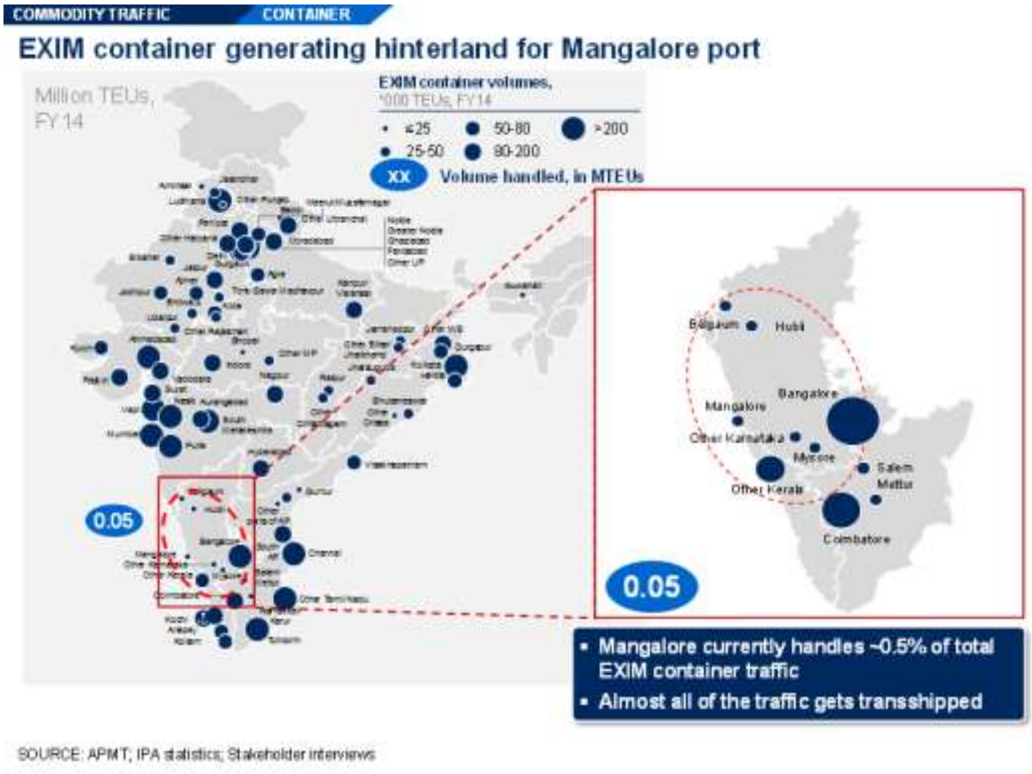
Mangalore is the only hinterland for Mangalore port

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	468	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

EXHIBIT 29



Other cargo

NMPT has 1.5 MTPA of KIOCL's captive cargo which includes 0.8 MTPA of iron-ore fines imports and 0.75 MTPA of iron-ore pellets exports. There is limited scope to expand here due to the mining ban and the decrease in iron ore prices globally.

NMPT also handled around 0.7 MTPA of fertilisers in 2015. The volumes have fallen by around 30 per cent since 2008, as it has moved to other ports like Krishnapatnam. There is potential to increase the volume by reducing handling costs through mechanisation.

Exhibit 30 summaries the traffic potential for key commodities for NMPT.

EXHIBIT 30

Units: MMTPA (except Containers)

Mangalore Port - Traffic Projections

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo							
POL	22.9	25.1	30.3	33.3	37.2	41.1	• MRPL refinery expansion and possibility of LNG terminal in optimistic case
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	6.4	11.2	12.9	14.3	21.4	25.5	• Udupi Power and import substitution
Coking Coal	1.8	1	1	1.2	1.2	1.4	• Diversion of traffic by JSW Dolvi is expected to reduce traffic at the port
Iron Ore	1.5	1.5	1.5	6.0	4.9	6.0	• Import of fines and export of pellets (KIOCL)
Fertilizers	0.7	0.9	1.1	1.1	1.7	1.8	
Containers and other Cargo							
Containers (MnTEU)	0.06	0.08	0.10	0.12	0.17	0.21	
Others	2.3	2.5	3.4	3.5	5.6	6.3	• Highly fragmented
Total (MMTPA)	**36.5**	**43.4**	**51.7**	**61.2**	**74.5**	**85.2**	

Conversion Factor Used for Containers Projections: 1 TEU = 14.6 Tons

Coastal shipping potential

Apart from the above mentioned traffic, NMPT could explore the potential of coastal shipping:

- **Fertilisers:** There is a potential to coastally ship around 1.5 MTPA of fertilisers to Mangalore port by 2025 (Exhibit 31). This movement would primarily be from the source states of Tamil Nadu, Andhra Pradesh, Gujarat and Odisha.

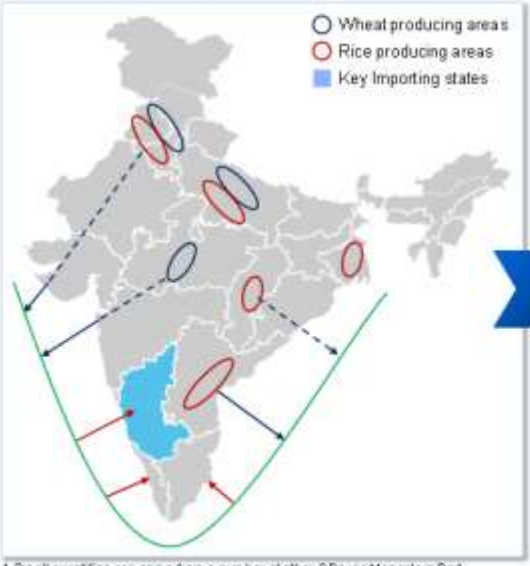
EXHIBIT 31

- **Food grains:** There is a potential to coastally ship around 6 MTPA of food grains to Mangalore port by 2025 from Punjab and Haryana via ports in Gujarat (Exhibit 32). Small movements can also happen from Uttar Pradesh and Chhattisgarh.

EXHIBIT 32

COASTAL SHIPPING | FOODGRAINS

~6 MTPA of food grains can be coastally shipped to Mangalore Port by 2025: Punjab and Haryana being key source states



1 Small quantities can come from a number of other ODs via Mangalore Port

Key ODs with coastal shipping potential to Mangalore Port

Route[1]	Volume, '000 TPA
Punjab to Karnataka	2,888
Haryana to Karnataka	1,294
UP to Karnataka	401
Chattisgarh to Karnataka	225

- **Cement:** Around 2.5 MTPA of cement can be coastally shipped to Mangalore port from the proposed cement cluster in Andhra Pradesh by 2025 contingent on the development of the central AP port (Exhibit 33).

EXHIBIT 33

COMMODITY TRAFFIC | CEMENT

Additional ~2.5 MTPA can be coastally shipped to Mangalore Port from the proposed cement cluster in AP by 2025

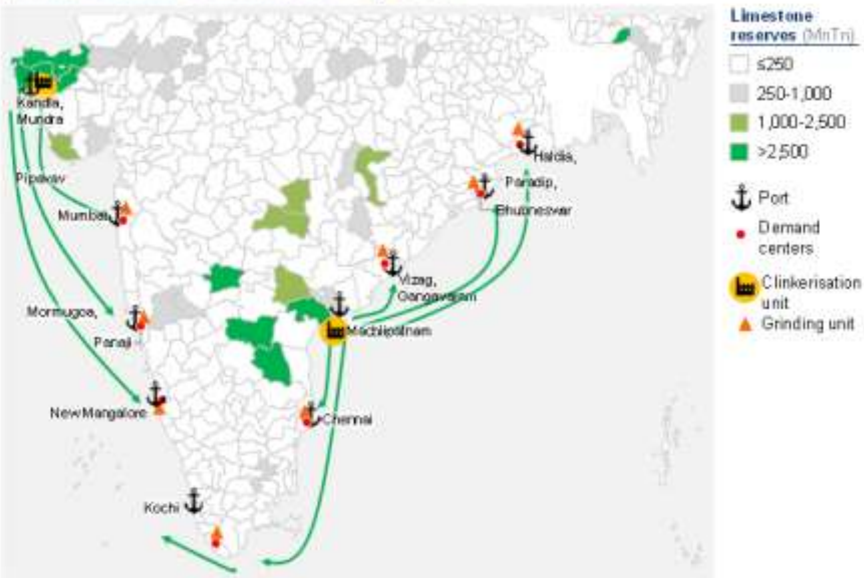


Exhibit 34 summarises the potential of coastal movement for key commodities at NMPT

EXHIBIT 34

Mangalore Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.11	0.15	0.27
Steel (Unloading)	0.07	0.10	0.17
Cement (Loading)	0.03	0.04	0.06
Cement (Unloading)	0.00	2.50	2.50
Fertilizer (Loading)	0.02	0.03	0.04
Fertilizer (Unloading)	1.32	1.60	2.37
Food Grains (Loading)	-	-	-
Food Grains (Unloading)	4.85	5.90	8.73

- 2.5 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

Meetings with the NMPT port team:

Date	Discussions held with
26th Nov, 2015	Chairman
14th–16th Dec, 2015	Ports Team
11th–13th Feb, 2016	Chairman, Ports Team
21st–22nd March, 2016	Dy Chairman, CE,DCE
20th–22nd April, 2016	Dy Chairman, CE
19th–21st May, 2016	Port Team
26th May, 2016	Ports team (Video conferencing)

TRAFFIC PROJECTIONS FOR COCHIN PORT

Cochin currently handles around 21.4 MTPA of cargo out of which liquid cargo, e.g., POL, LNG and LPG, forms the major chunk at 14 MTPA. Other commodities including containers, fertilisers, coking coal, etc., constitute a smaller share of the total traffic.

Going forward, it is expected that the total traffic handled at this port will go up to 41 to 43 MTPA by 2025 and 52 to 60 MTPA by 2035, driven primarily by the expansion of the BPCL refinery, LNG and LPG imports and growth in container volumes.

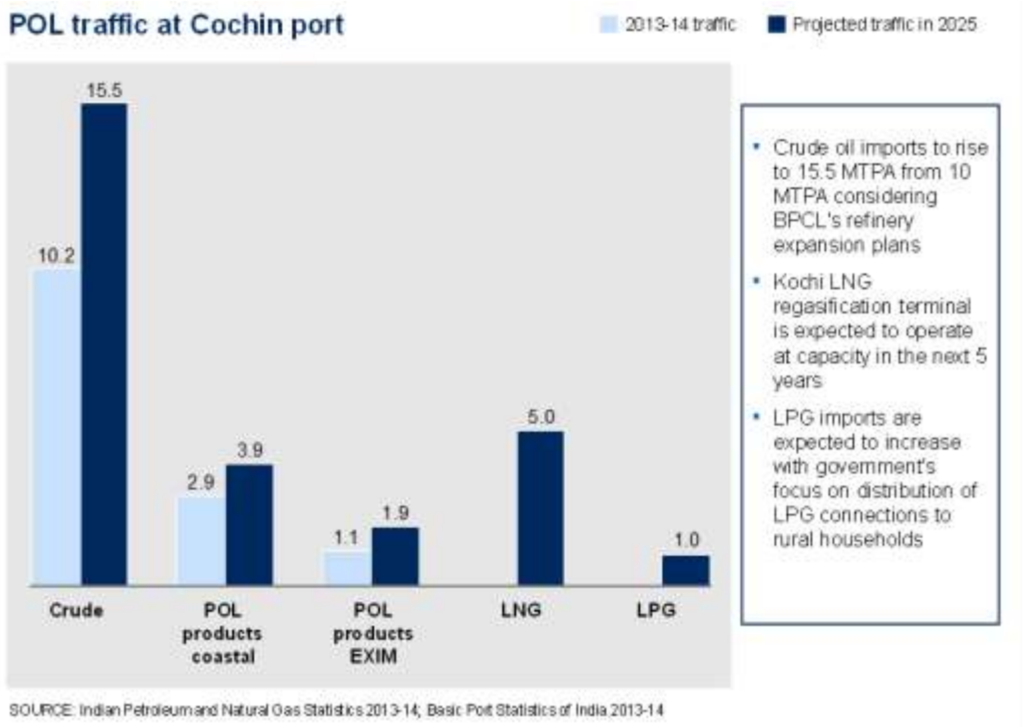
Major commodities and their projections

POL

POL crude and product constitute the biggest portion of traffic handled at the port. Cochin handles approximately 10 MTPA of crude for the BPCL refinery out of which approximately 8 MTPA is imported. The remaining domestic crude production is coastally shipped, e.g., Bombay High to Kochi. POL products coastal and EXIM traffic form the remaining share.

Going forward, crude oil import is expected to increase from around 10 MTPA to around 15.5 MTPA, considering the expansion plans for BPCL refinery. Currently, BPCL has an installed capacity of 10 MTPA and is expected to expand to 16 MTPA by 2025. Kochi LNG regasification terminal is expected to operate at capacity in the next five years adding around 5 MTPA to the total traffic. LPG imports are expected to rise to around 1 MTPA by 2025 with the government’s focus on distribution of LPG connections to rural households. Exhibit 35 shows the split of the current POL traffic and the projected traffic for 2025.

EXHIBIT 35



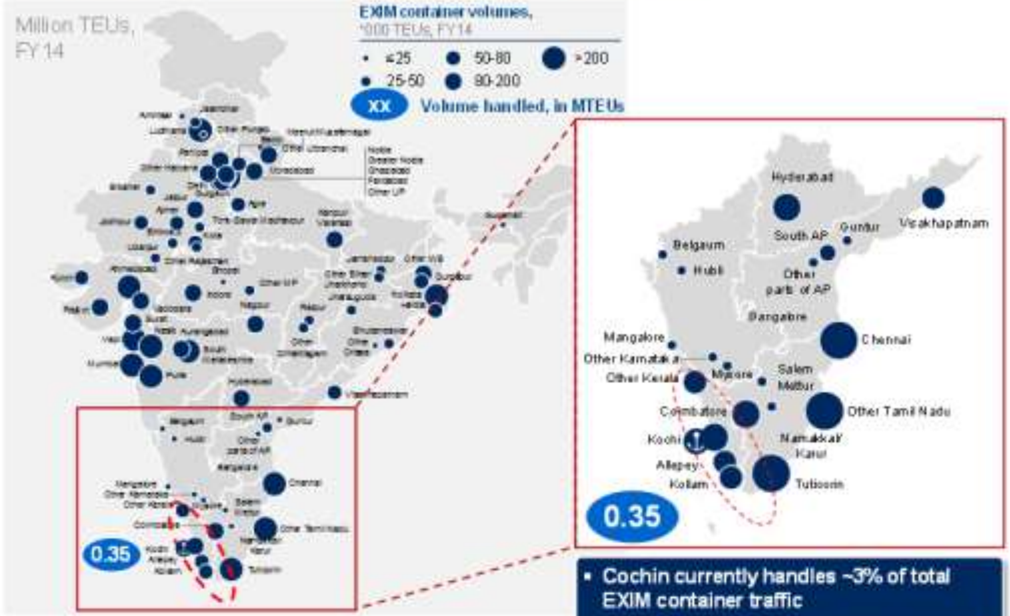
Containers

The port currently handles 0.35 mn TEUs of containers serving the primary hinterland of Kerala (Exhibit 36& 37). Kochi, Alleppey and Kollam contribute around 85 per cent to this traffic.

EXHIBIT 36

COMMODITY TRAFFIC | CONTAINER

EXIM container generating hinterlands for Cochin port



- Cochin currently handles ~3% of total EXIM container traffic
- ~92% of Cochin's traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

EXHIBIT 37

COMMODITY TRAFFIC | CONTAINER

Kerala is the only hinterland for container traffic at Cochin port

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakhapatnam	Mangalore
NCR+Punjab	696	1,284	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	282	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	468	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhattisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	683	551	562	351	263	50

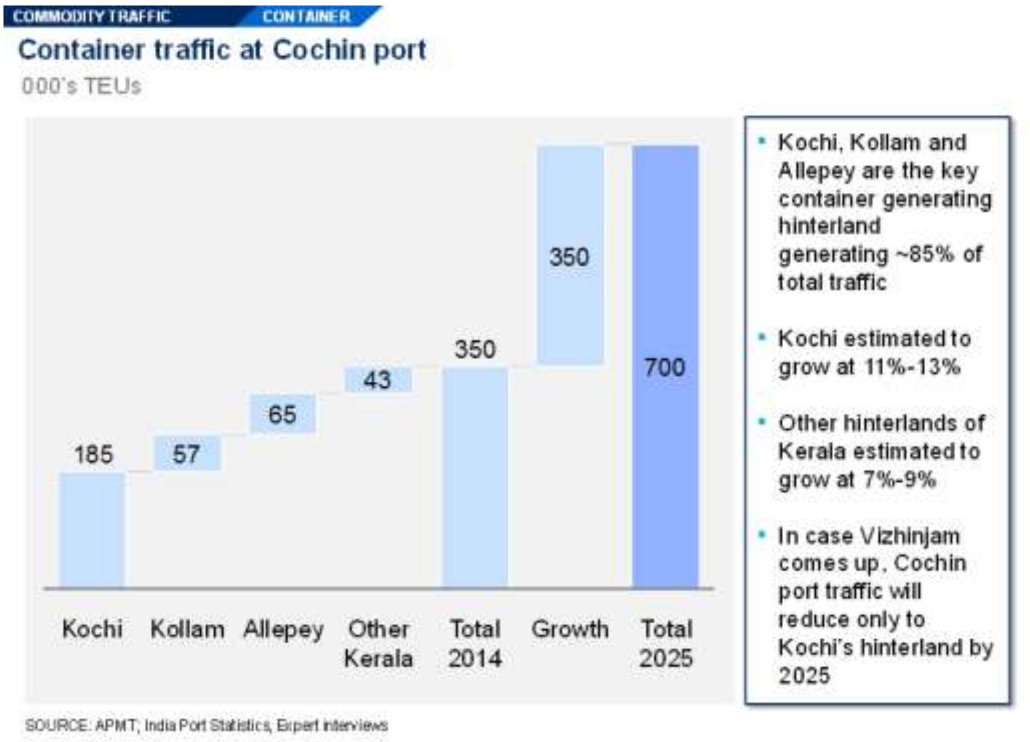
SOURCE: APMT; Expert interviews

Kochi's GDP is expected to grow at a CAGR of 11 to 13 per cent while other hinterlands are expected to grow at 7 to 9 per cent. Combined with the manufacturing coefficient of the state and the estimated increase in containerisation, total container traffic at the port is expected to increase to 0.7 TEUs by 2025 and 1.2 mn TEUs by 2035 in the base case scenario.

The actual traffic attracted by the port would depend on a number of factors like last-mile connectivity, operational efficiency, pricing, customer preference, etc. The port has been giving significant thrust on building a positive image and changing customer preference. In the optimistic scenario, considering an increased share of traffic from Tamil Nadu hinterlands including Coimbatore, Salem, Namakkal, etc., it is projected that the container traffic can reach around 1.1 mn TEUs by 2025 and around 2.3 mn TEUs by 2035.

However, this traffic might reduce only to traffic from Kochi's hinterland by 2025 if Enayam and/or Vizhinjam come up since most of the other cargo would preferably go to the gateway port. Exhibit 38 shows the base case projected traffic at Cochin port for 202z.

EXHIBIT 38



Fertilisers

Current traffic of around 0.45 MTPA of fertilisers at Cochin port is dominated by imports of fertiliser raw material including rock phosphate, MOP, etc. The finished fertiliser forms a very small share in the traffic, of roughly 0.04 MTPA in the traffic. The volume of imports of fertiliser raw materials and finished products is estimated to grow to around 0.7 MTPA by 2020, 0.8 to 0.9 MTPA by

2025 and 1.3 to 1.4 MTPA by 2035. Kochi is the biggest consumer of the fertiliser raw material imports at Cochin port. Exhibit 39 shows the location of fertiliser plants and movement from ports.

EXHIBIT 39

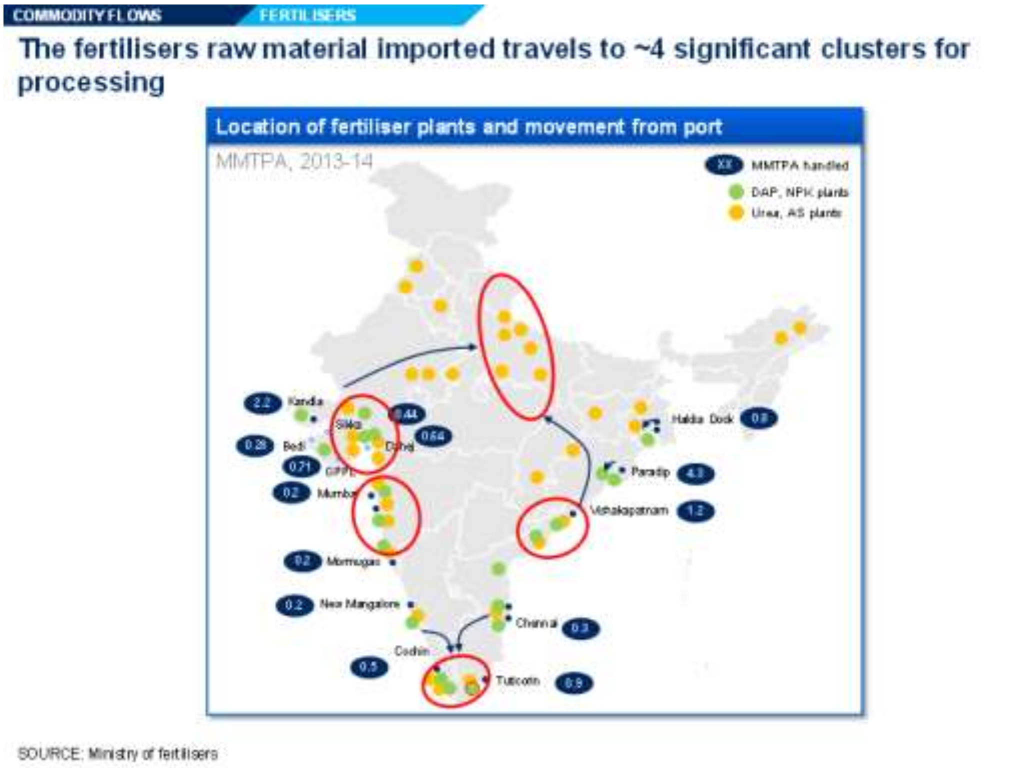


Exhibit 40 shows the overall commodity-wise projections for the port.

EXHIBIT 40

Cochin Port – Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario   xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	14.0	24.1[1]	27.3	27.7	30.1	34.1	• Increase in crude imports driven by BPCL Kochi refinery expansion and LNG imports
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	0.0	0.0	0.0	0.0	0.0	0.0	
Coking Coal	0.10	0.13	0.2	0.2	0.3	0.4	
Iron Ore	0.0	0.0	0.0	0.0	0.00	0.0	
Fertilizers	0.45	0.66	0.8	0.9	1.3	1.4	
Containers and other Cargo							
Containers (MnTEU)	0.35	0.55	0.70	1.05	1.16	2.3	• Optimistic scenarios refer to increased share of container traffic from Coimbatore, Salem, Namakkal, etc. Development of Vizhinjam/ Enayam would reduce the traffic significantly
Others	1.8	2.5	2.8	3.2	3.8	4.2	• Highly fragmented
Total (MMTPA)	**21.4**	**35.3**	**41.1**	**47**	**52.1**	**73**	

1 Assuming LNG re-gasification terminal is operational at 60% capacity

Conversion Factor Used for Containers Projections: 1 TEU = 14.3 Tons

Coastal shipping potential

For the hinterland of Kerala and western Tamil Nadu, Kochi can facilitate the movement of coastal shipped cargo from other states. Cement and food grains can be major commodities unloaded at Cochin port as and when the coastal shipping revolution takes place in the country.

- **Cement:** Cochin port can be the destination port for coastally-shipped cement from Andhra Pradesh. Around 3 to 4 MTPA cement can be coastally shipped to Cochin port by 2025 (Exhibit 41). Roughly 50 per cent of this will serve the demand of western Tamil Nadu while the remaining quantity will be claimed by the Kerala hinterland. Around 2.5 MTPA of additional cement can be coastally shipped to Cochin by 2025, contingent on the development of the coastal cement cluster in AP and its movement facilitated by the proposed central AP port (Exhibit 42).

EXHIBIT 41

COASTAL SHIPPING CEMENT

~3-4 MTPA of cement can be coastally shipped to Cochin Port by 2025; AP will be the key source state[1]

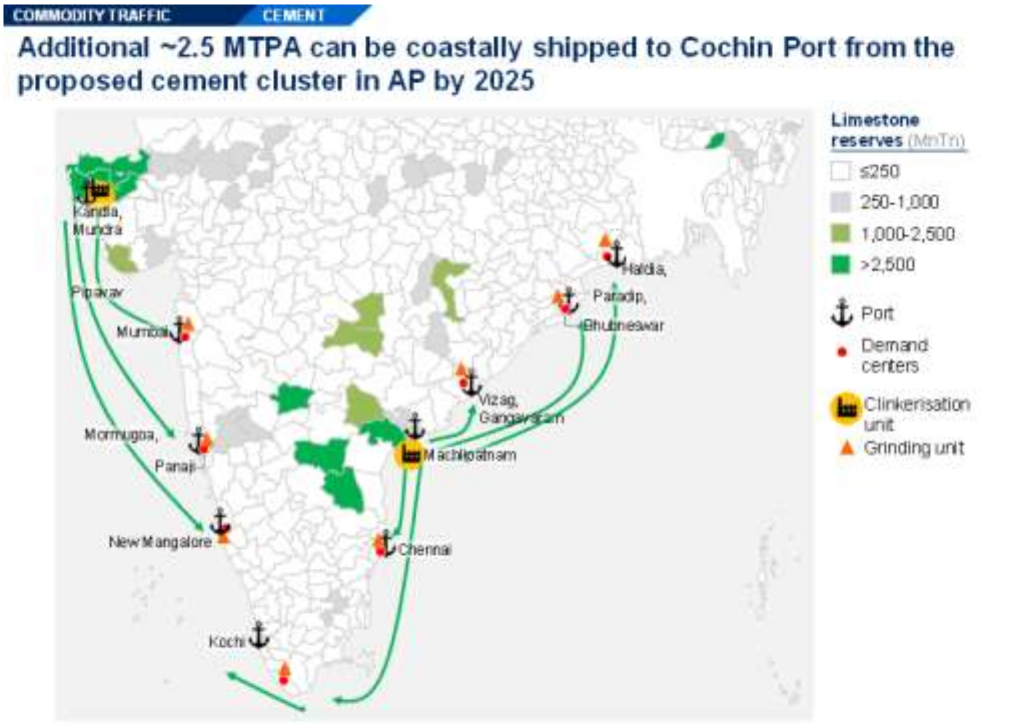
Key ODs with coastal shipping potential to Cochin Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to Tamil Nadu	1,860
Andhra Pradesh to Kerala	1,392
Karnataka to Kerala	435
Karnataka to Tamil Nadu	112

1 Small quantities can come from a number of other ODs via Cochin Port

SOURCE: DGCIS data 2013-14

EXHIBIT 42

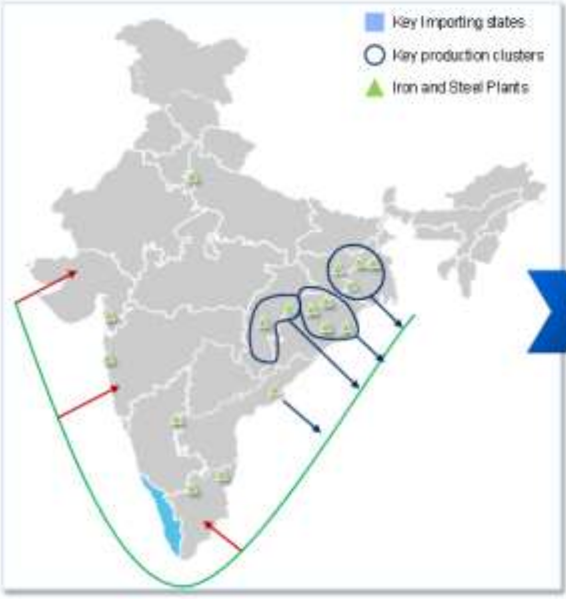


- **Steel:** Cochin can also facilitate around 0.6 MTPA of coastal movement of steel by 2025—most of which will serve the demand of western Tamil Nadu. This traffic is expected to increase to around 1.15 MTPA by 2035. Andhra Pradesh and Odisha will be the primary source states for this movement (Exhibit 43). Multiple steel plants on the eastern coast—such as, Vizag (through Vizag port), Rourkela (through Paradip port), Jamshedpur (through Kolkata port), Meramandali (through Paradip port)—have the potential to move traffic to coastal route.

EXHIBIT 43

COASTAL SHIPPING | IRON AND STEEL

~0.6 MTPA of steel can be coastally shipped to Cochin Port by 2025; Andhra Pradesh and Odisha being the primary source state



Key ODs with coastal shipping potential to Cochin Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to Tamil Nadu	233
Andhra Pradesh to Kerala	66
Odisha to Tamil Nadu	198
Jharkhand to Kerala	55
Jharkhand to Tamil Nadu	76

1 Small quantities will move on a number of other routes via Cochin port

SOURCE: DGCIS data 2013-14

- **Fertilisers:** There is a potential for coastal movement of fertilisers from Cochin of around 0.24 MTPA by 2020. Coastal districts of Andhra Pradesh and West Bengal will be the primary consumers of the same. This traffic can increase to around 0.30 MTPA by 2025 and around 0.44 MTPA by 2035.

Exhibit 44 summarises the potential of coastal movement for key commodities at Cochin port.

EXHIBIT 44

Cochin Port – New Opportunities Possible via Coastal Shipping

Units: MTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.06	0.08	0.15
Steel (Unloading)	0.48	0.64	1.15
Cement (Loading)	0.01	0.01	0.02
Cement (Unloading)	2.85	6.32	9.34
Fertilizer (Loading)	0.24	0.30	0.44
Fertilizer (Unloading)	0.04	0.05	0.08
Food Grains (Loading)	-	-	-
Food Grains (Unloading)	0.2	0.24	0.36

- 2.5 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

Meetings with the Cochin port team:

Date	Discussions held with
26th–27th Nov. 2015	Dy. Chairman, TM, Dy TM, Port officials, CEO-ICTT (DP World),
18th–20th Jan, 2016	Dy. Chairman, TM, Dy TM, Port officials
28th–30th Jan 2016	Dy. Chairman, Traffic Manager, Dy Traffic Manager, Port officials, CEO-ICTT (DP World), Visit to ICTT
31st March–1st April, 2016	Chairman, Dy. Chairman, Ports Team
2nd May, 2016	Chairman, Traffic Manager, Sr. Deputy Traffic Manager, CEO, India Gateway Terminal Pvt. Ltd.
26th May, 2016	Ports team (Video Conference)

TRAFFIC PROJECTIONS FOR TUTICORIN PORT

Tuticorin port mainly handles containers, catering to the industrial regions in central and southern Tamil Nadu, and thermal coal for the power plants in the hinterland.

The port currently handles 32.5 MTPA of cargo traffic. Key commodities include thermal coal and containers. Thermal coal contributes around 42 per cent to the total traffic while containers contribute another around 34 per cent. The total cargo is expected to increase to around 54 MTPA by 2020 and 75 to 83 MTPA by 2025.

The materialisation of projected traffic will however depend upon many factors like growth of economy as assumed and certain specific events like installation of some of the proposed power plants. Thermal coal and industrial coal imports would constitute the bulk cargo. Exhibit 45 shows the trend in historical traffic at Tuticorin, while Exhibit 46 gives the traffic forecast.

EXHIBIT 45

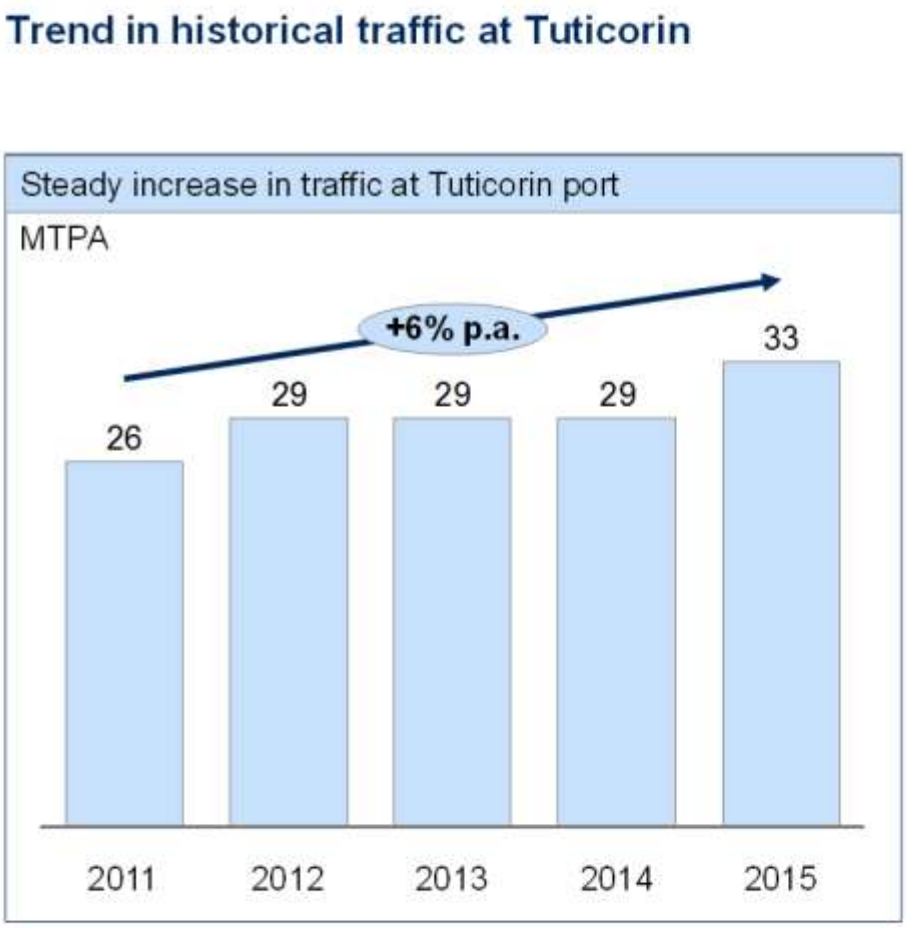


EXHIBIT 46

Major commodities and their projections

Although a number of bulk cargoes are handled through the port, thermal coal, industrial coal, copper concentrate, pet coke and limestone form the majority and were identified for handling through mechanised methods. They are also the most enduring part of the cargoes of port. These are all import cargoes and have the potential to generate dust during handling, thereby causing pollution when handled through semi-mechanised methods.

Coal of all types is classified as one cargo and copper concentrate is included in other ores.

Bulk cargoes: Handled by fully mechanised systems

Thermal coal

Thermal coal imports through VOC Port can be classified as (a) thermal coal meant for captive users and (b) thermal coal meant for others.

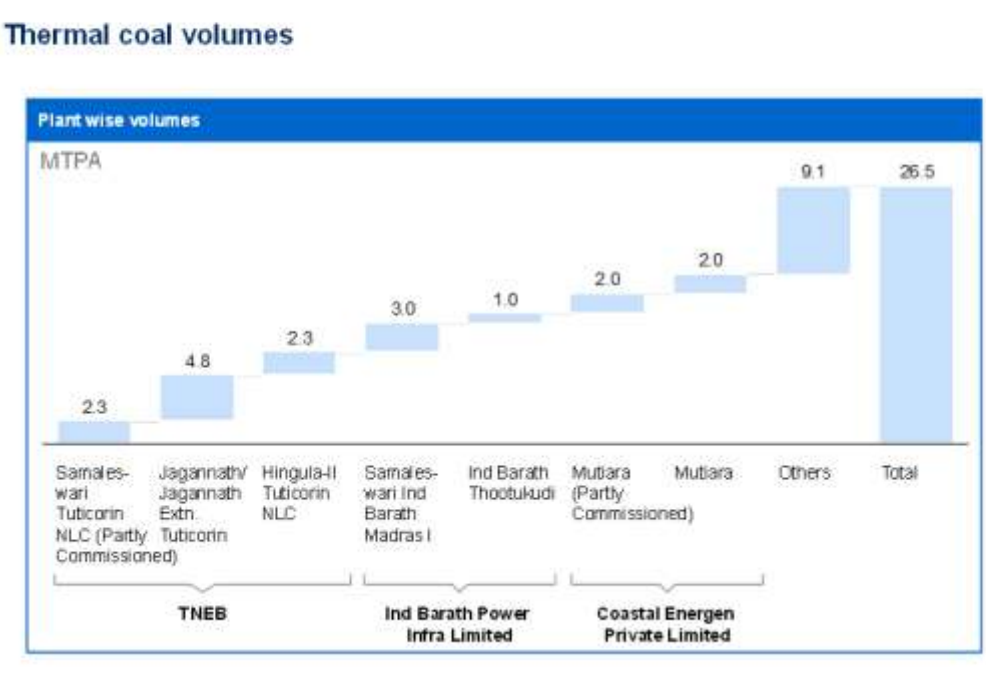
Thermal coal meant for captive users form the major quantity which consists of coal meant for the TNEB and NTPL power plants. Both are handled through captive jetties and through conveyors. Captive thermal coal for the port includes the thermal coal meant for M/s Coastal Energen (plant is located at about 30 km from port) whose first of the two units of 600 MW each was commissioned in 2014–15, along with the coal meant for the 160 MW power plant of M/s Sterlite Industries, which are handled by semi-mechanised methods through multipurpose berths

Further, M/s SEPC is putting up a 525 MW power plant close to the port in the Harbour estate itself and is expected to go to operation in the near future. Thermal coal import on account of this will also be captive coal for the port.

Currently, the port imports 13.8 MTPA of thermal coal primarily for the consumption of power plants. Out of this, 4.4 MTPA is coastally shipped coal for Tuticorin thermal power plant. 9.3 MTPA is imported coal catering to Tuticorin thermal power plant, Coastal Energen, Ind Bharath power plant, DCW, Sterlite, NTPL and other non-power customers. With the power sector growing resulting in higher PLFs, and the new capacity expected to come up around Tuticorin, along with import substitution on the back of rising domestic coal production, thermal coal imports can reach around 27 MTPA by 2020 and 38 to 42 MTPA by 2025. Exhibit 47 shows the plant-wise projected thermal coal traffic through Tuticorin. Thermal coal volumes for industrial uses have also been included in the "others" category.

The base case and optimistic scenario for traffic projections of coal are based on the estimated growth rate of GDP (5.88 per cent in base scenario and 7 per cent in optimistic scenario), which is expected to vary non-power based coal consumption.

EXHIBIT 47



Copper concentrate

It is a captive cargo of the port because it is imported as raw material for use by Sterlite copper. The annual throughput requirement of copper concentrate is 1.2 MTPA and is nearly a fixed quantity for now .

Industrial coal

VOC Port has emerged as preferred port in the region for import of industrial coal meant for cement plants, paper industry, foundries etc. with increasing throughputs over the years.

Pet coke

Petroleum coke—mainly used by aluminium and anode-making industries—is imported through the port. Though its quantity is not very large, it still has reasonable volume.

Limestone

Limestone has of late emerged as a sizeable bulk cargo basically imported by cement industry.

Projections for commodities like iron ore, limestone and other ores in the base case scenario were calculated by taking a GDP multiplier of 1.14 and an estimated growth rate of 5.88 per cent. In the optimistic scenario, the same GDP multiplier with an estimated GDP growth rate of 7 per cent was assumed.

The following table shows the traffic pattern of coal of different types coal and pet coke for the last three years.

Traffic pattern of coal traffic for the last three years

Sl No	Cargo	2012-13	2013-14	2014-15
1	Thermal coal	66,60,692	66,43,688	86,12,589
2	Industrial coal	39,57,099	55,03,190	51,91,288
3	Pet coke	68,299	2,02,387	2,12,482
	Total	**1,06,86,090**	**1,23,49,265**	**1,40,16,359**

In addition, limestone is emerging as a major bulk over the years. Traffic projections for coal for the master plan period are consistently increasing as shown in the following table. Traffic for 2015–16 is based on the port's estimates, while the projections for 2020, 2025 and 2035 are as per the OD study for ocean-bound traffic of all the major ports as part of this master plan.

Traffic projection of major bulk cargoes over the master plan period (in MT)

Sl No	Cargo	2015-16	2020-21	2025-26		2035-36	
				Base Scenario	Optimistic Scenario	Base Scenario	Optimistic Scenario
1	Coal of all types	17.1	26.6	38.3	42.3	63.4	75.8
2	Limestone	1.1	1.1	1.5	1.6	2.7	3.1
3	Copper concentrate	1.2	1.2	1.2	1.2	1.2	1.2
	Total	**18.4**	**28.9**	**41.0**	**45.1**	**67.3**	**80.1**

Containers

The port primarily caters to industrial districts of southern and central Tamil Nadu—Salem, Mettur, Namakkal, Karur, Coimbatore, Tuticorin, and also some parts of Karnataka. Currently, the port handles 0.56 mn TEUs of containers. Tuticorin generates around 55 per cent of the container cargo for the port. Tuticorin, other regions of Tamil Nadu and the secondary hinterland of Bangalore are expected to grow at a rate of 9 to 11 per cent GDP CAGR. Industrial activity is expected to increase at a healthy rate in Tamil Nadu, with container volumes reaching 0.9 mn TEUs and 1.18 to 1.37 mn TEUs by 2020 and 2025 respectively. For projections till 2025, it is estimated that the GDP of above mentioned hinterland is expected to grow at 9 per cent CAGR in the base case and 11 per cent CAGR in the optimistic case. From 2025 to 2035, a growth rate of 5 per cent in projected volume has been assumed in the base case and 6 per cent in the optimistic case.

Tuticorin port is a feeder port and the containers are transhipped at international locations like Colombo and Singapore. If a transshipment port comes up at the southern tip of India, it can severely impact container volumes at Tuticorin as part of the cargo would directly go to the transshipment port via road. The evolution of container traffic through the port for the last five years is seen in the following table.

Container traffic in VOCPT during the last five years

Description	2010–11	2011–12	2012–13	2013–14	2014–15
No. of vessels handled	NA	365	351	399	491
Import TEUs	2,26,230	2,31,457	2,34,098	2,51,038	2,88,503
Export TEUs	2,41,522	2,45,639	2,41,501	2,56,697	2,71,224
Total TEUs	4,67,752	4,77,096	4,75,599	5,07,735	5,59,727

It is seen that the increasing trend in container traffic through the port has been consistent and robust. Exhibits 48 to 50 show the split of cargo from the different hinterlands and the projected traffic growth.

EXHIBIT 48

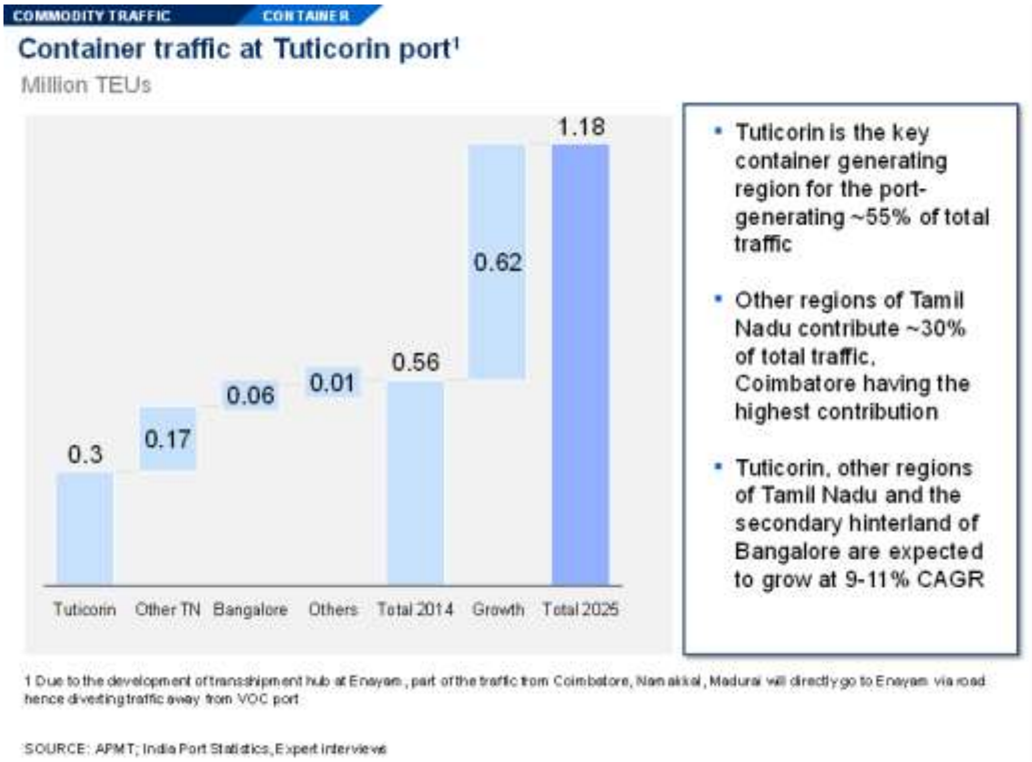


EXHIBIT 49

COMMODITY TRAFFIC CONTAINER

Tamil Nadu is the primary hinterland of Tuticorin port with small traffic from Bangalore

Primary hinterland of port

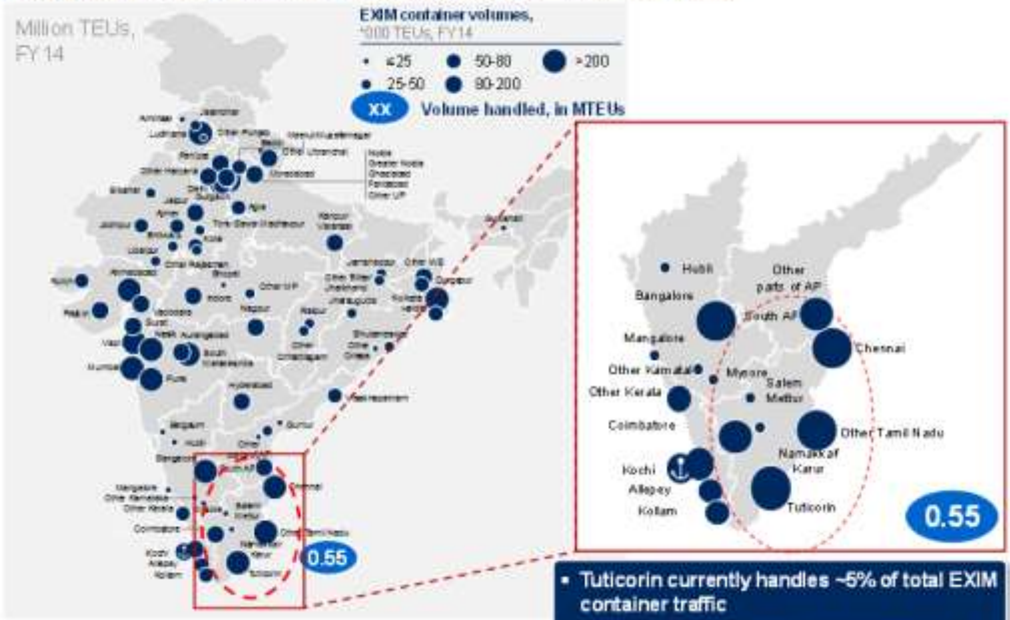
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	183	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	96	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,488	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

EXHIBIT 50

COMMODITY TRAFFIC CONTAINER

EXIM container generating hinterlands for Tuticorin port



- Tuticorin currently handles ~5% of total EXIM container traffic
- Almost all of the traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

Break bulk cargo

The following tables show the traffic data pertaining to general or break bulk cargo for the last five years.

Imports and exports of general cargo over the last five years

S. No	Commodity	2010–11	2011–12	2012–13	2013–14	2014–15
Import (MTPA)						
1	Fertiliser	1.16	1.11	0.49	0.39	0.42
2	F.R. materials	0.73	0.89	0.56	0.79	1.05
3	General cargo	2.49	2.56	2.88	2.06	2.76
4	Other general cargo	1.36	1.22	0.55	0.56	0.25
	Total imports	5.74	5.78	4.48	3.8	4.48

Export (MTPA)						
1	Dry cargo	0.72	0.43	0.46	0.48	0.3
2	Liquid cargo	0.54	0.47	0.7	0.55	0.4
3	Food grains	0.04	0.3	0.13	0.05	0.06
4	General cargo	1.05	1.06	0.95	0.34	0.96
5	Other general cargo	0.06	0.15	0.27	0.01	0.06
Total export		**2.41**	**2.41**	**2.51**	**1.43**	**1.78**
General cargo—total import & export		**8.15**	**8.19**	**6.99**	**5.23**	**6.26**

Imports

The import of fertiliser is mainly import of urea, MOP and DAP. The fertiliser raw materials imports mainly are sulphur and rock phosphate. The general cargo under imports includes copper concentrate whose volume is about 1.2 MTPA during 2014-15. Imports under the head general cargo and other general cargo include limestone, gypsum, cashew nuts, timber, iron and steel materials, palm oil, caustic soda lye and vinyl chloride monomer (VCM).

Limestone imports alone constitute about 0.8 MT during 2014–15. Palm oil imports during the same period was about 0.3 MT. Timber in log form constitutes about 0.5 MT. VCM, caustic soda lye and peas (yellow) have a quantity of about 0.1 mn each. The rest are highly fragmented. VCM is handled through Shallow berth I as the pipe line for this cargo is located in that berth.

Exports

General cargo and other general cargo under exports include construction materials for the Maldives, cement mainly for the Maldives, granite, stone dust and oil cake and copra.

Export of construction materials and cement to the Maldives have a quantity of about 0.4 MT which are handled through shallow berths. The rest are highly fragmented.

Traffic projections for general cargo

Traffic projection for general cargo is presented in the following table, including some dry cargo in bulk like fertilisers and copper concentrate for 2014–15.

Dry and break bulk cargo (to be handled in multipurpose berths)

Commodity	Current 2014–15	2020–21	2025–26		2035–36	
			Base	Optimistic	Base	Optimistic
Iron ore	0.05	0.06	0.08	0.09	0.14	0.17
Other ore	1.2	1.7	2.2	2.3	3.7	4.2
Fertilisers	1.5	1.6	2	2.1	3.1	3.4
Others	3.5	4.4	5.9	6.2	9.7	11.1
Total (MTPA)	**5.05**	**7.76**	**10.18**	**10.69**	**16.64**	**18.87**

Exhibit 51 summarises the traffic potential for key commodities at Tuticorin port.

EXHIBIT 51

Tuticorin Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
Liquid Cargo							
POL	0.6	0.8	1.3	1.8	2.0	2.5	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	13.8	26.5	38.3	42.3	63.4	75.8	• Increase in coastal shipping
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.05	0.06	0.08	0.09	0.14	0.17	• Mostly imports
Limestone	0.8	1.1	1.5	1.6	2.7	3.1	
Other Ore	1.2	1.7	2.2	2.3	3.7	4.2	
Fertilizers	1.5	1.6	2.0	2.1	3.1	3.4	
Containers and other Cargo							
Containers (MnTEU)*	0.56	0.90	1.18	1.37	1.95	2.44	• Traffic projections for the port may reduce post development of transshipment hub in Enayam
Others	3.5	4.4	5.9	6.2	9.7	11.1	• Highly fragmented, no particular commodity with significant volume
Total (MMTPA)	**32.5**	**54.0**	**74.5**	**83.4**	**123.2**	**148.6**	

* Due to the development of transshipment hub at Enayam, part of the traffic from Coimbatore, Namakkal, Madurai will directly go to Enayam via road hence diverting traffic away from VOC port

Conversion Factor Used for Containers Projections: 1 TEU = 19.7 Tons

Coastal shipping potential

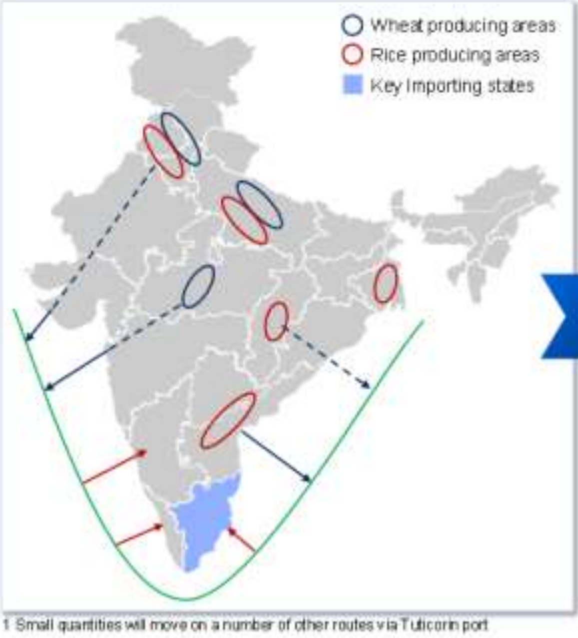
Apart from the above mentioned traffic, Tuticorin could explore the potential of coastal shipping. Food grains provide a significant opportunity with small volumes possible for other commodities as well.

- **Food grains:** Around 1 to 2 MTPA of food grains can be coastally shipped to Tuticorin port by 2025 from Andhra Pradesh, Madhya Pradesh, Punjab and Haryana (Exhibit 52).

EXHIBIT 52

COASTAL SHIPPING — FOODGRAINS

~1-2 MTPA of food grains can be coastally shipped to Tuticorin Port by 2025



Key ODs with coastal shipping potential to Tuticorin Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to Tamil Nadu	536
Madhya Pradesh to Tamil Nadu	343
Punjab to Tamil Nadu	190
Haryana to Tamil Nadu	171

1 Small quantities will move on a number of other routes via Tuticorin port

Exhibit 53 the potential of coastal movement for key commodities at Tuticorin port.

EXHIBIT 53

Tuticorin Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	-	-	-
Steel (Unloading)	0.40	0.54	0.96
Cement (Loading)	-	-	-
Cement (Unloading)	0.44	0.59	1.06
Fertilizer (Loading)	0.57	0.70	1.03
Fertilizer (Unloading)	0.02	0.03	0.04
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	1.27	1.54	2.28

Meetings with the Tuticorin port team:

Date	Discussions held with
29th–30th Oct, 2015	Chairman, TM, CE/CME, DCE
17th–19th Nov. 2015	TM, CE/CME, DCE
7th–8th Jan, 2016	TM, CE/CME, DCE, CEE
28th–30th March, 2016	Chairman, TM, CE/CME, DCE
26th May, 2016	Ports team

TRAFFIC PROJECTIONS FOR CHENNAI PORT

Chennai port currently handles more than 50 MTPA of traffic. It is one of the major container ports in the country handling more than 1.5 mn TEUs across three terminals. Along with containers, the port also handles large volumes of POL, limestone, steel and dolomite.

Major commodities and their projections

Containers

The port handles roughly 1.55 mn TEUs with an export–import balance slightly tilted towards import (around 55 per cent). The key hinterlands that the port serves for containers are Chennai and SEZs located nearby, Bangalore, southern AP and parts of southern Tamil Nadu. A large portion of the traffic (around 50 to 60 per cent) is transhipped from the port to other ports in Southeast Asia like Colombo and Singapore.

The growth of new ports in the vicinity, like Krishnapatnam, Katupalli, as well as the development of the container terminal at Ennore, could take away a significant share of volumes from Chennai. The port is expected to cater to a traffic of roughly 0.9 mn TEUs by 2020, 1.2 to 1.4 mn TEUs by 2025 and 2.0 to 2.4 mn TEUs by 2035.

In the case of a new transshipment hub coming up on the southern tip of the country, the potential traffic is expected to decline further as most of the southern Tamil Nadu containers will go directly to the transshipment hub.

Exhibits 54 to 56 show the split of the container traffic from the different hinterlands as well as the projected growth.

EXHIBIT 54

COMMODITY TRAFFIC · CONTAINER

Tamil Nadu is the primary hinterland of Chennai port with small traffic from Bangalore and Hyderabad

■ Primary hinterland of port

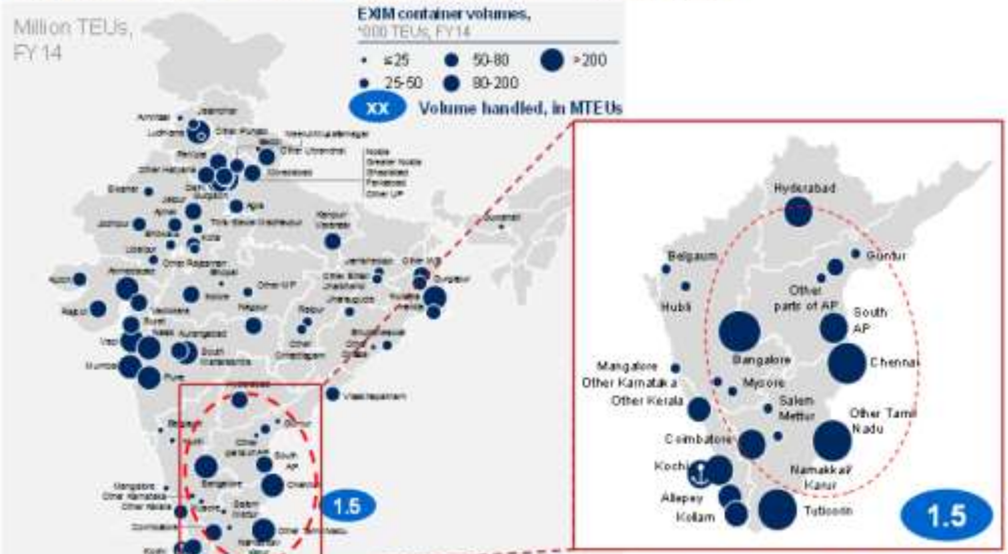
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	582	351	263	50

SOURCE: APMT; Expert interviews

EXHIBIT 55

COMMODITY TRAFFIC · CONTAINER

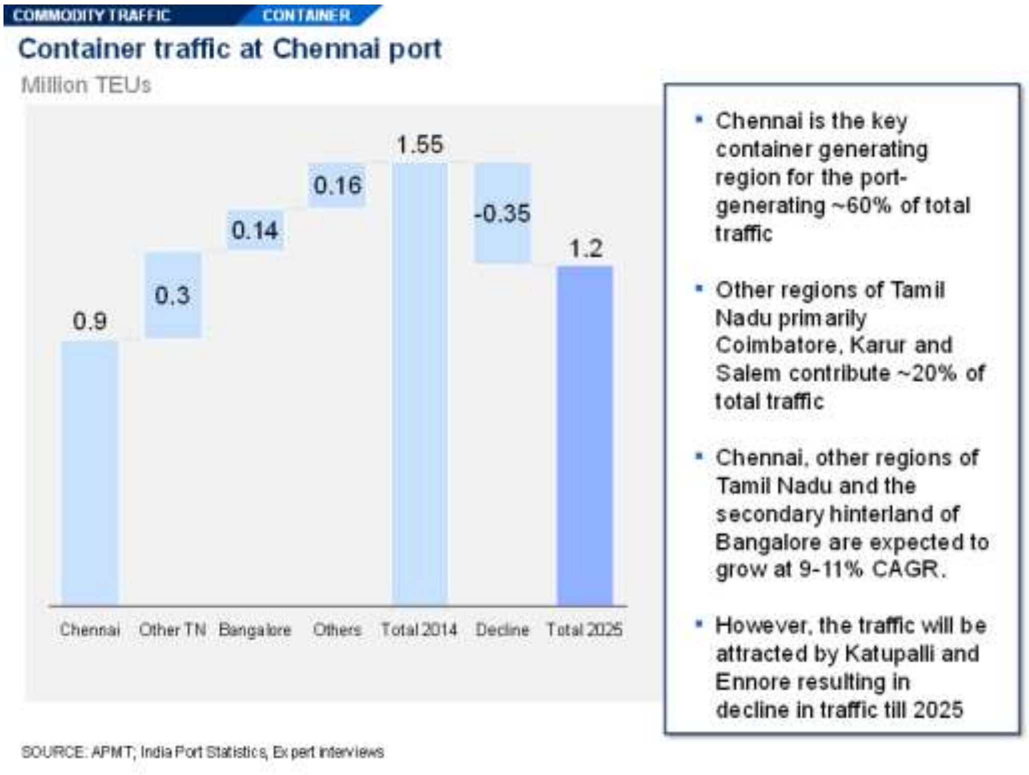
EXIM container generating hinterlands for Chennai port



- Chennai currently handles ~15% of total EXIM container traffic
- ~50-60% of Chennai traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

EXHIBIT 56



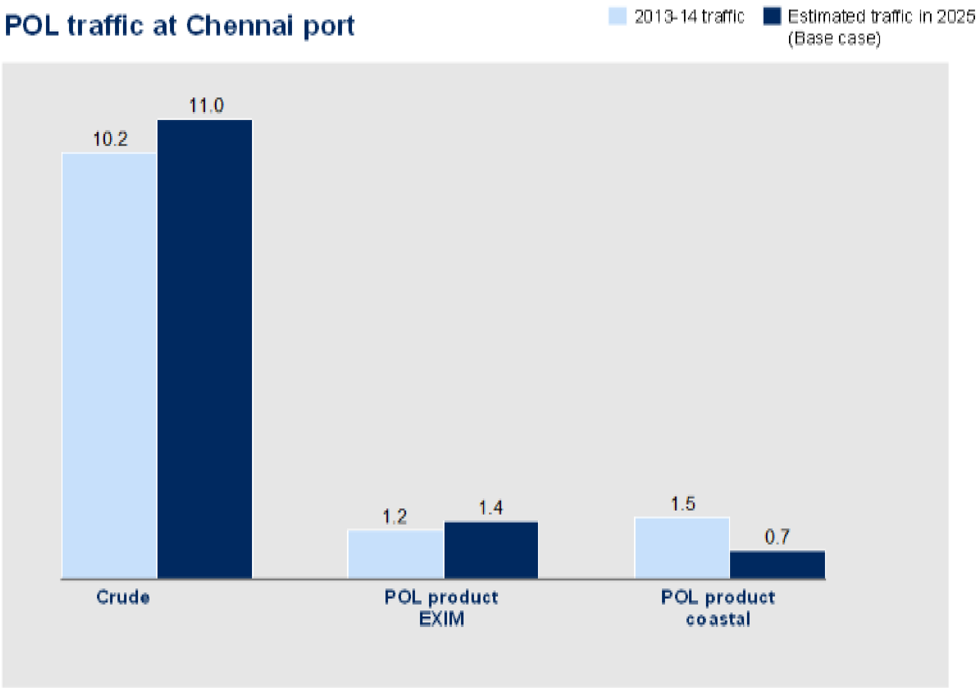
POL

The port currently handles 12.7 MTPA of POL—around 10.2 MTPA of this is crude imports for the nearby CPCL Manali refinery. The port also exports roughly 1 MTPA of products from the same refinery and receives roughly 1.5 MTPA of products to cater to the specific demands of the Chennai cluster.

Going into 2025, there could be a marginal increase in crude import to around 11 MTPA as the refinery operates to near capacity because of increased demand from the hinterland. In addition, most of the coastal product traffic is expected to decrease in the next few years. This is because the product traffic could move to Ennore port as OMCs have been shifting their terminals there. Indian Oil Corporation is planning to shift incoming POL products, for marketing purposes, to Ennore because they have been given a captive berth. Product export is expected to remain the same in the coming years. However, this shift of traffic will have no project implications for Chennai port.

Exhibit 57 shows the split of the current POL traffic and the projected future traffic.

EXHIBIT 57



SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

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Steel

The port currently handles around 1.4 MTPA of steel roughly divided 50–50 in terms export and imports. Imports cater to the vibrant auto industry in the vicinity of the port.

The overall volume of steel handled at the port is expected to grow to around 2 MTPA by 2020, around 2 to 3 MTPA by 2025 and around 3 to 5 MTPA by 2035.

Limestone

The port also imports large amounts of limestone to cater to the cement industry in the Chennai area. The current volume of limestone handled by the port is roughly 2.6 MTPA. However, the volume has declined to 2.25 MMT during 2015–16. JSW—major importers of limestone and dolomite—are contemplating on alternate indigenous resources to replace limestone and dolomite. As a result, the projected traffic at the port is expected to decline in the future.

Exhibit 58 shows the overall commodity-wise projections for Chennai port.

EXHIBIT 58

Chennai Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	12.7	13.3	13.1	18.8	14.3	19.2	• CPCL expansion considered in optimistic case
Vegetable Oil	1.1	1.7	1.8	2.1	3.0	3.4	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)*	0.0	6.1	0.0	7.0	0.0	12.5	• Traffic projections are contingent on permission to the port by Hon'ble SC to handle coal
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.1	0.2	0.3	0.3	0.4	0.4	
Steel	1.4	1.9	2.5	2.9	3.0	5.5	
Limestone	2.6	1.5	1.4	1.4	1.2	1.2	
Dolomite	1.0	0.6	0.5	0.5	0.3	0.3	
Fertilizers	0.5	0.7	0.8	0.9	1.0	1.4	
Containers and other Cargo							
Containers (MnTEU)	1.55	0.9	1.2	1.4	2.0	2.4	• Traffic may further reduce by 2025 if Enayam comes up
Others	3.2	4.3	5.7	6.0	9.2	10.8	• Highly fragmented
Total (MMTPA)	**52.5**	**47.7**	**49.3**	**66.9**	**71**	**101.0**	

*Traffic potential include non-power thermal coal consumption in the hinterland and part of the thermal coal requirement projected for Mettur plant

Conversion Factor Used for Containers Projections: 1 TEU = 19.3 Tons

Coastal shipping potential

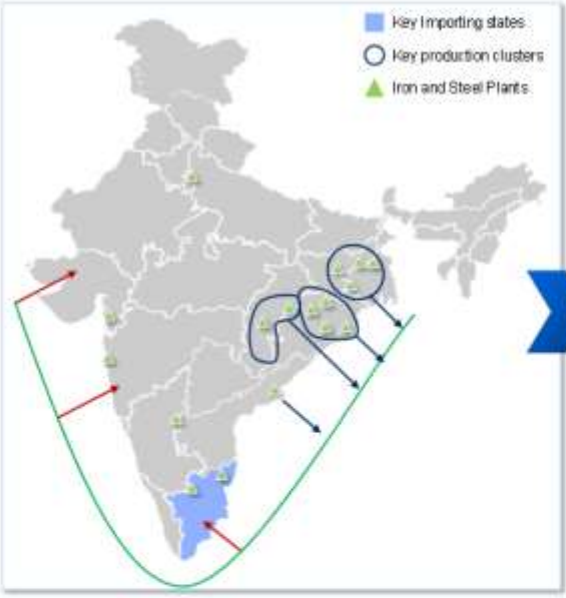
Chennai is strategically positioned to serve the large demand of the Chennai hinterland and the adjoining areas through coastal shipping. Steel and cement can be major commodities to Chennai as and when the coastal shipping revolution takes place in the country. In case a central AP port comes up in the near future, roughly 5 MTPA can be imported in the area to support constructions, in view of the diminishing reserves of limestone in the state.

- **Steel:** Around 1 MTPA of steel can be coastally shipped to Chennai port by 2025 to cater to the demand of the immediate Chennai hinterland and southern Andhra Pradesh (Exhibit 59). Odisha will be the key source state for this movement.

EXHIBIT 59

COASTAL SHIPPING IRON AND STEEL

~1 MTPA of steel can be coastally shipped to Chennai Port by 2025; Odisha being the primary source state



Key ODs with coastal shipping potential to Chennai Port

Route[1]	Volume, '000 TPA
Odisha to Andhra Pradesh	799
Odisha to Tamil Nadu	198

1 Small quantities will move on a number of other routes via Chennai port

SOURCE: DGCIS data 2013-14

- **Cement:** Roughly 2 to 3 MTPA can be coastally shipped to Chennai port by 2025 contingent on the development of the coastal cement cluster, facilitated by the proposed central AP port (Exhibit 60).

EXHIBIT 60

COMMODITY TRAFFIC | CEMENT

~2-3 MTPA can be coastally shipped to Chennai Port from the proposed cement cluster in AP by 2025

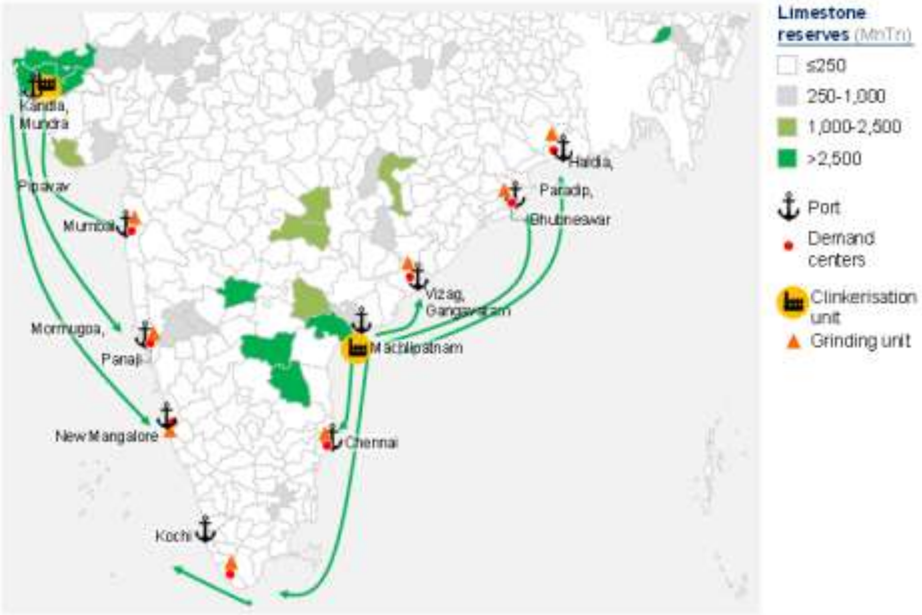


Exhibit 61 summarises the potential of coastal movement for key commodities at Chennai port.

EXHIBIT 61

Chennai Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.05	0.07	0.13
Steel (Unloading)	0.86	1.15	2.06
Cement (Loading)	0.0	0.0	0.0
Cement (Unloading)	0.11	2.65	2.77
Fertilizer (Loading)	0.04	0.04	0.06
Fertilizer (Unloading)	0.34	0.41	0.61
Food Grains (Loading)	0.02	0.02	0.04
Food Grains (Unloading)	0.35	0.42	0.62

- 2-3 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

Meetings with the Chennai port team:

Date	Discussions held with
17^{th}–18^{th} Aug, 2015	Vice Chairman, Traffic Manager
17^{th}–19^{th} Oct. 2015	Dy. Chairman, DCE, CE,
2^{nd} Nov. 2015	Dy. Chairman, DCE, CE,
16^{th} Dec. 2015	Dy. Chairman, DCE, CE,
19^{th} March 2016	Dy. Chairman, DCE, CE, CPCL
28^{th} April 2016	Dy. Chairman
3^{rd}–4^{th} May 2016	Dy. Chairman, DCE, CE
26^{th} May, 2016	Ports team (Video conference)
6^{th}–7^{th} June 2016	Dy Chairman, CE, DCE
18^{th} June 2016	CE
30^{th} June 2016	CE, DCE

TRAFFIC PROJECTIONS FOR ENNORE PORT

Ennore handles roughly 30 MTPA of cargo. Thermal coal forms the major share in the port traffic contributing around 80 per cent to the total traffic. POL, coking coal and automobiles form the majority of the remaining share. Going forward, the total traffic at the port is expected to increase to around 70 MTPA by 2020 and 85 to 95 MTPA by 2025.

Major commodities and their projections

Thermal coal

Ennore facilitates the movement of thermal coal to TNEB–Ennore, north Chennai and Mettur power stations. Total coal requirement for all these power plants, with an installed capacity of around 5,200 MW, is around 26 to 67 MTPA.

The capacities of these power stations are:

- Ennore TPS 450 MW
- Mettur TPS 1,440 MW
- North Chennai TPS 1,830 MW
- Vallur TPS 1,500 MW

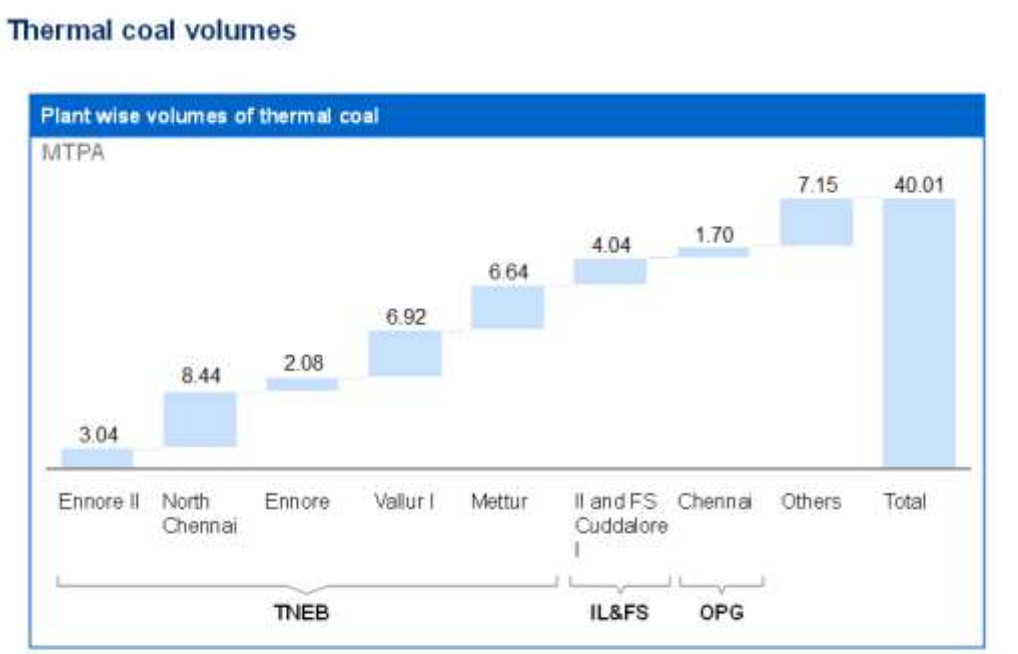
In addition, TNEB is taking action for the following power plants:

- ETPS expansion 660 MW
- NCTPS Stage III 800 MW
- Kattupalli TPS 1,600 MW

These plants are expected to be commissioned before 2020. Total coal requirements for these power plants is about 13 MTPA. Accordingly, total thermal coal imports are likely to be 40 MTPA by 2020.

Exhibit 62 shows the split of the thermal coal traffic among the different power plants.

EXHIBIT 62



Earlier, the Karnataka Power Corporation Ltd. (KPCL) for their Raichur Power Plant (1.0 MTP) and the Andhra Pradesh Power Generation Corporation Limited (APGENCO) for its power plant at Muddanur (1.0 MTPA) were importing thermal coal through Chennai Port. Subsequently, they shifted to Krishnapatnam. It is possible to get these back to Ennore.

POL

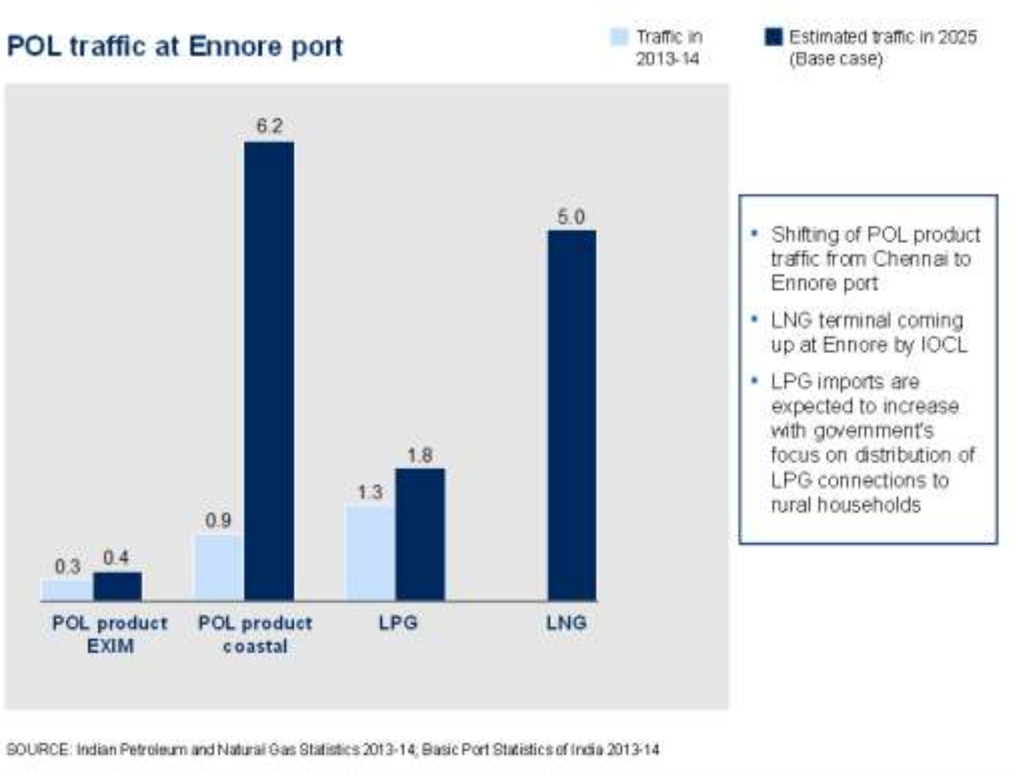
Currently, around 3 MTPA of POL is handled at the Ennore port—comprising 1.80 MTPA of POL products (coastal and EXIM) and 1.30 MTPA of LPG. IOC is planning to shift incoming POL products, for marketing purposes, to Ennore because they have been given a captive berth. This volume will be about 2.0 MT. In addition, they propose to handle about 0.7 MT of lubricants. They also have a proposal to bring in excess POL (more than 1 MT) from Paradip for marketing purposes which will be moved through existing pipelines to Bangalore and Trichy/Madurai/Sankari. They have provisionally informed the port that their volume could be 3.5 MTPA.

BPC has acquired land near Ennore Port for shifting their existing marketing terminals from Chennai. They have already started getting POL products at Ennore in small quantities through MLT 1. Once their new terminal is fully commissioned, the volume could reach nearly 1.0 MT.

Besides product, LPG traffic grew from 0.6 MT in 2012–13 to 1.0 MT in 2023–14 and to 1.3 MT in 2014–15. It is expected to reach roughly 1.5 MTPA by 2020. Consequently, by 2020, the total POL traffic could reach 7.8 MTPA. Additionally, IOC has also initiated action for the construction and commissioning of an LNG terminal at Ennore, with a capacity of 5 MTPA. This terminal is likely to be commissioned by 2018.

Exhibit 63 shows the split of the current POL traffic and the projected volumes for 2025.

EXHIBIT 63



Containers

Adani Ennore Container Terminal Private Ltd. (AECTPL), in the first phase, will construct a 400-m-long berth with a capacity to handle 0.8 mn TEUs. In the second phase, another 330-m-long extension of the berth will be carried out with a capacity to handle additional 0.6 mn TEU. Even though the first phase is scheduled for commissioning by early 2017, they are planning to commission it by mid-2016 because they are assured of getting the required traffic. Developing the container-handling facility at Ennore would divert part of the traffic going to Chennai.

It is estimated that Ennore would be able to attract 0.8 mn TEUs by 2020, 1.1 to 1.3 mn TEUs by 2025 and 1.8 to 2.2 mn TEUs by 2035. However, the exact potential to attract container traffic depends on a number of factors including tariff, operational efficiency and last-mile connectivity, etc.

Other localised commodities (automobiles)

Currently 2.15 lakh car units have been handled. (≈ 0.22 MT). According to a report prepared by JICA, likely exports from Chennai and Ennore by 2020 will be around 1.5 mn car units. Accordingly, they have recommended additional berths at Ennore port. Based on the present situation, Chennai port may not be able to add any more Ro-Ro berths for want of parking space and due to restrictions in the timing of cars arriving into the port. Taking a conservative look at the growth of the industry, it may be assumed that KPL will be required to handle at least 900,000 car units by 2025.

Exhibit 64 summaries the traffic potential for key commodities at Ennore port.

EXHIBIT 64

Ennore Port - Traffic Projections

Units : MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo*							
POL product (EXIM and coastal)		6.3	6.6	7.0	8.1	8.8	• Shifting of POL product traffic from Chennai
LPG		1.5	1.8	2.0	2.5	2.8	
LNG		3.0	5.0	5.0	5.0	5.0	• 5 MTPA LNG terminal by IOCL
Total POL (including LPG and LNG)	3.2	10.8	13.4	14.0	15.6	16.6	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	24.0	40.2	48.5	51.4	77.0	92.0	• Coastal increase; could also capture traffic from Cuddalore and Katupalli
Coking Coal	0.3	0.5	0.6	0.7	1.1	1.3	
Iron Ore	0.0	0.0	0.0	0.0	0.0	0.0	
Fertilizers	0.0	0.0	0.0	0.0	0.0	0.0	
Containers and other Cargo							
Containers (MnTEU)	0.0	0.8	1.1	1.3	1.8	2.1	
Others	2.7	4.2	5.6	5.9	9.2	10.5	• Vehicle Exports and Other commodities
Total (MMTPA)	30.2	71.1	87.3	97.1	137.6	160.1	

Conversion Factor Used for Containers Projections: 1 TEU = 19.3 Tons

* For 2013-14, POL, LPG and LNG traffic split: POL (EXIM and coastal)- 1.3 MTPA, LPG- 1.3 MTPA

Additional traffic potential from proposed coastal clusters

Apart from the above mentioned traffic, there is additional opportunity of handling around 14 to 15 MTPA of coking coal by 2025—if the proposed 20 MTPA coastal steel cluster comes up at Ennore.

Meetings with the Ennore Port team:

Date	Discussions held with
1st–2nd Sept, 2015	CMD, Dir(O), GM (M) , GM (Proj)
21st Sept. 2015	CMD, Dir(O), GM (M) , GM (Proj)
23rd Oct. 2015	CMD, Dir(O), GM (M) , GM (Proj)
14th Dec.2015	CMD, Dir(O), GM (M) , GM (Proj)
24th Feb, 2016	CMD, Dir(O), GM (M) , GM (Proj)
28th March, 2016	CMD, Dir(O), GM (M) , GM (Proj)
17th April, 2016	CMD, Dir(O), GM (M) , GM (Proj)
26th May, 2016	Ports team (video conference)

TRAFFIC PROJECTIONS FOR VIZAG PORT

In terms of volumes, Visakhapatnam is the fifth largest major port in the country handling approximately 58 MTPA of cargo. Currently the port handles around 12 MTPA of thermal coal and around 14.6 MTPA of POL. Other major commodities include coking coal, containers, fertilisers and iron ore. The total traffic at the port is expected to grow to around 80 MTPA by 2020 and 100 to 110 MTPA by 2025.

Major commodities and their projections

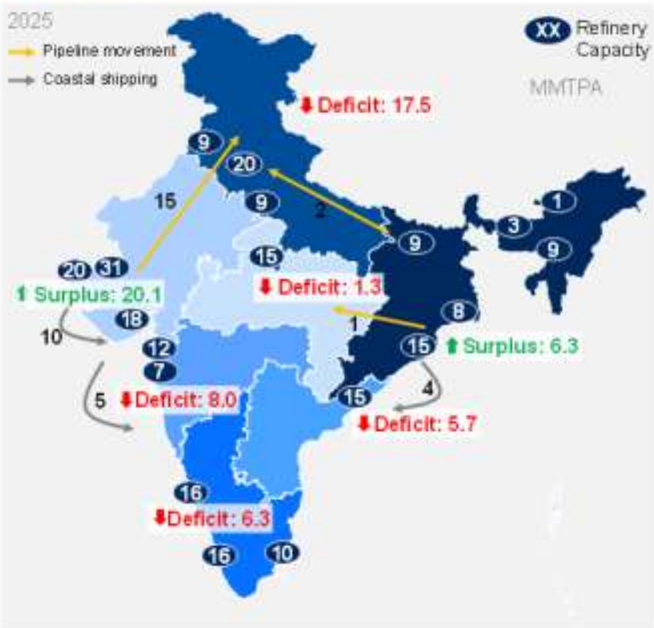
POL

POL crude and product constitute the biggest portion of traffic handled at the port. Visakhapatnam handles roughly 15 MTPA of POL which comprises approximately 8 MTPA of crude import, 4.6 MTPA of product movement and 1.1 MTPA of LPG imports.

Expansion of HPCL in the future will lead to a traffic of roughly 15 MTPA of crude import by 2025. POL coastal traffic is expected to reach 7.5 MTPA by 2025, which includes roughly 4 to 5 MTPA of coastal shipping potential from Paradip to Vizag port to cater to the demand of Andhra Pradesh and Telangana (Exhibit 65). LPG imports are expected to increase to 1.5 MTPA by 2025 driven by the government's focus on distribution of LPG connections to rural households.

EXHIBIT 65

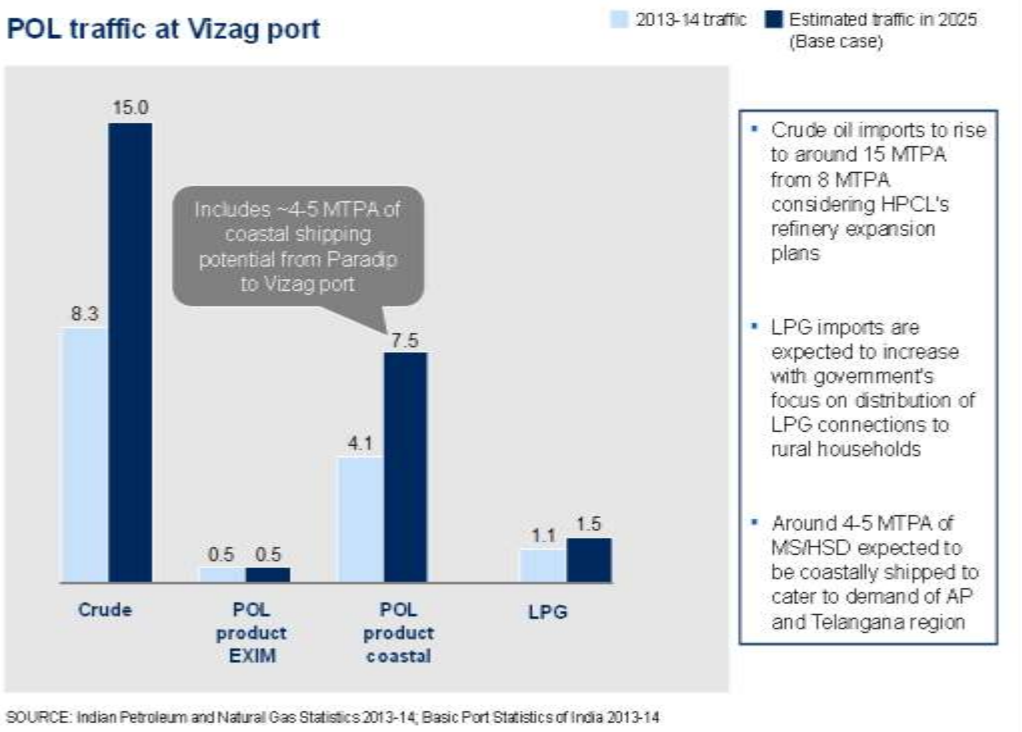
There is a potential for coastal shipping of ~5 MMTPA of MS/HSD from Paradip to Vizag port by 2025



1. Assumes RIL Jamnagar and Essar Oil export nothing while Reliance SEZ exports 100% product

Exhibit 66 shows the split of the current POL traffic and the estimated traffic in 2025.

EXHIBIT 66



Thermal coal

Currently, the port unloads 9.3 MTPA of thermal coal, of which approximately 4 MTPA is for power generation in Adani Power Maharashtra Ltd. in Gondia district. The remaining volume is primarily for the consumption of non-power plants (that is, 50 per cent of the overall imports). Unloading of thermal coal will be driven by Tiroda plant, demands of captive power plants and import substitution.

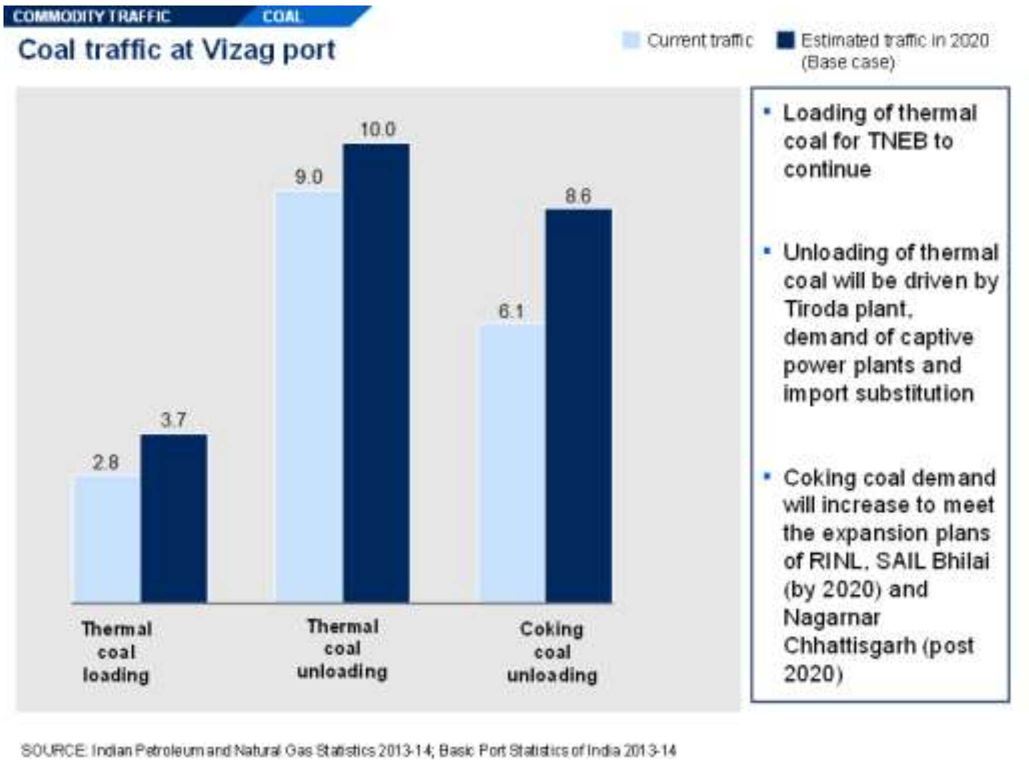
The port also handles 2.8 MTPA of outbound coal, which is coastally shipped to Tamil Nadu. This figure is projected to grow to around 3.7 MTPA by 2020, 5 MTPA by 2025 and 5 to 6 MTPA by 2035.

Coking coal

The port currently handles 6 MTPA of coking coal, which is used for steel production in the steel plants of Rashtriya Ispat Nigam Limited (RINL), SAIL Bhilai, Tata Steel Limited and Jindal Steel and Power Limited. Other consumers of coking coal include Uttam Galva Metallics, Jayswal Neco and Bhushan Power and Steel Limited. The volume of coking coal handled by the port is expected to increase to 8.6 MTPA by 2020, 11 to 12 MTPA by 2025 and 18 to 20 MTPA by 2035. This increase will be driven primarily by expansion in SAIL, Bhilai and Nagarnar plants. Increase in coking coal traffic, due to expansion of steel plants in the hinterland, would also be shared by the competing non-major port of Gangavaram.

Exhibit 67 shows the current traffic of thermal coal and coking coal and the estimated traffic in 2020.

EXHIBIT 67



Containers

The port, through the Visakha Container Terminal, currently handles around 0.25 mn TEUs. Andhra Pradesh and Telangana are the key hinterlands for the port (Exhibit 68 & 69). Other hinterlands include Odisha (primarily Bhubaneswar and Jharsuguda), Madhya Pradesh, Bihar and Chhattisgarh. Visakhapatnam region itself contributes around 20 per cent to the total container traffic at port.

EXHIBIT 68

COMMODITY TRAFFIC | CONTAINER

Andhra Pradesh is the primary hinterland of Visakhapatnam port with small traffic from Odisha and MP

■ Primary hinterland of port

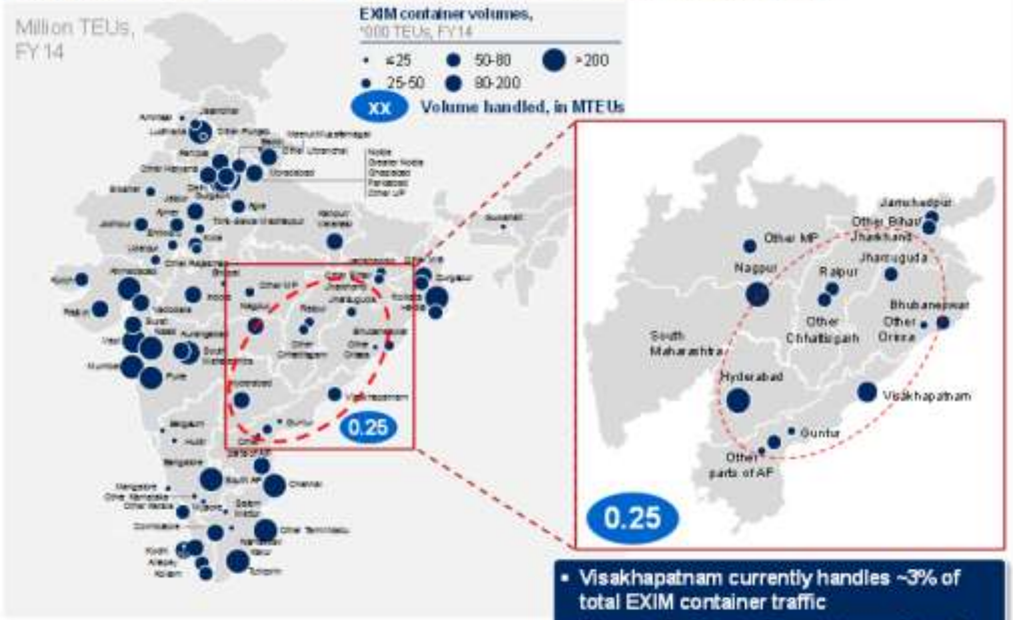
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakhapatnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	468	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhattisgarh	15	18	0	14	0	0	0	16	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	582	351	263	50

SOURCE: APMT; Expert interviews

EXHIBIT 69

COMMODITY TRAFFIC | CONTAINER

EXIM container generating hinterlands for Visakhapatnam port

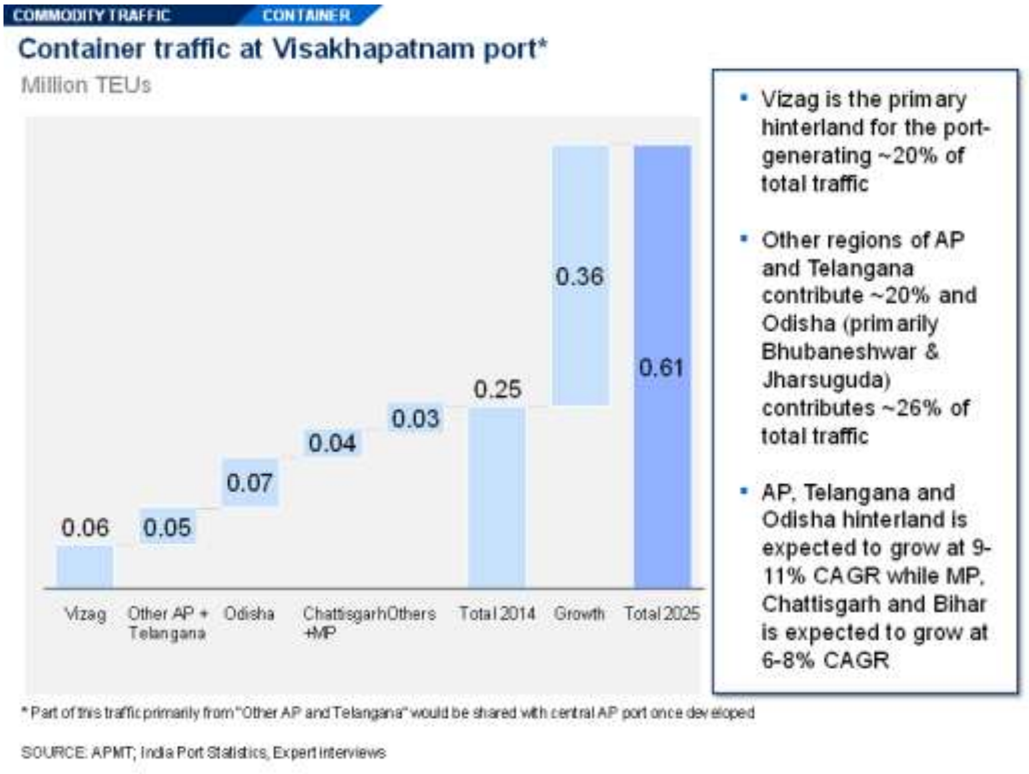


- Visakhapatnam currently handles ~3% of total EXIM container traffic
- Almost all of the traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

GDP of Andhra Pradesh, Telangana and Odisha is expected to grow at a rate of 9 to 11 per cent CAGR while Madhya Pradesh, Chhattisgarh and Bihar is expected to grow at around 6 to 8 per cent CAGR. Going forward, container volume at the port is expected to grow to around 0.5 mn TEUs by 2020 and to around 0.6 to 0.7 mn TEUs by 2025 (Exhibit 70). However, the development of a port in central AP could attract a significant share of this traffic.

EXHIBIT 70



Iron ore

The port currently handles around 8 MTPA of iron ore and pellet exports, which is expected to increase to around 12 MTPA by 2020. Depending on how the export volumes pick up in future, the volume handled by the port will increase to around 14 to 16 MTPA by 2025.

Fertilisers

The port imported 2.6 MTPA of fertilisers and raw materials for fertilisers in FY2015. This comprises approximately 1.5 to 1.8 MTPA of finished fertiliser and 1 to 1.2 MTPA of raw material of fertilisers. Finished fertiliser serves the demand in the hinterlands of Andhra Pradesh, Telangana, Madhya Pradesh and Chattisgarh. Part of the raw material for fertilisers is utilised in the DAP, NPK, Urea and AS fertiliser plants in Andhra Pradesh and a part of it is sent to plants in Uttar Pradesh.

The overall volume of fertiliser and fertiliser raw material is expected to increase to around 4 MTPA by 2020, 5 MTPA by 2025 and 7 to 8 MTPA by 2035.

Alumina powder and other ores

Visakhapatnam port, currently, also handles alumina power and other ores of approximately 2.6 MTPA. This is utilised by customers including NALCO, Sesa Sterlite Ltd. and other metallurgy units. This figure is expected to increase to around 2.6 MTPA by 2020 and 3 to 4 MTPA by 2025.

Other localised commodities

Other highly fragmented cargo also contributes a sizeable chunk to the total cargo volume handled at Visakhapatnam port. This volume is currently around 4.6 MTPA and is expected to increase to around 8 MTPA by 2020 and 10 to 12 MTPA by 2025.

Exhibit 71 shows the overall commodity-wise projections for the port.

EXHIBIT 71

Units: MMTPA (except Containers)

Vizag Port - Traffic Projections

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
Liquid Cargo							
POL	14.6	18.7	24.5	27.1	30.0	35.5	• Mainly Crude imports driven by HPCL Vizag expansion and coastal shipping of product from Paradip refinery
Chemicals	1.0	1.3	1.7	1.8	2.9	3.3	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	2.8	3.7	4.7	5.2	5.0	5.5	
Thermal Coal (Unloading)	9.3	10.0	11.0	11.5	13.3	15.2	
Coking Coal*	6.1	8.6	11.8	12.6	18.1	20.4	• Driven by expansion in SAIL Bhilai by 2020 and Nagarnar Chattisgarh post 2020
Iron Ore	8.3	12	14	16	16	16.5	• Mostly exports; likely to remain low.
Steel	1.08	1.5	2.1	2.2	3.7	4.2	
Alumina Powder	1.2	1.6	2.1	2.2	3.5	4.0	
Other Ore	1.4	1.0	1.3	1.4	2.2	2.5	
Food Grains	0.8	0.5	0.7	0.7	1.1	1.3	
Fertilizers	2.6	3.4	4.9	5.1	7.3	8.1	
Containers and other Cargo							
Containers (MnTEU)	0.25	0.49	0.61	0.72	1.02	1.29	• Some traffic may shift to central AP port once developed
Others	4.6	7.7	9.96	12.33	12.8	13.33	• Highly fragmented,
Total (MMTPA)	**58.2**	**78.6**	**99.5**	**110.8**	**133.9**	**152.5**	

Conversion Factor Used for Containers Projections: 1 TEU= 17.6 Tons

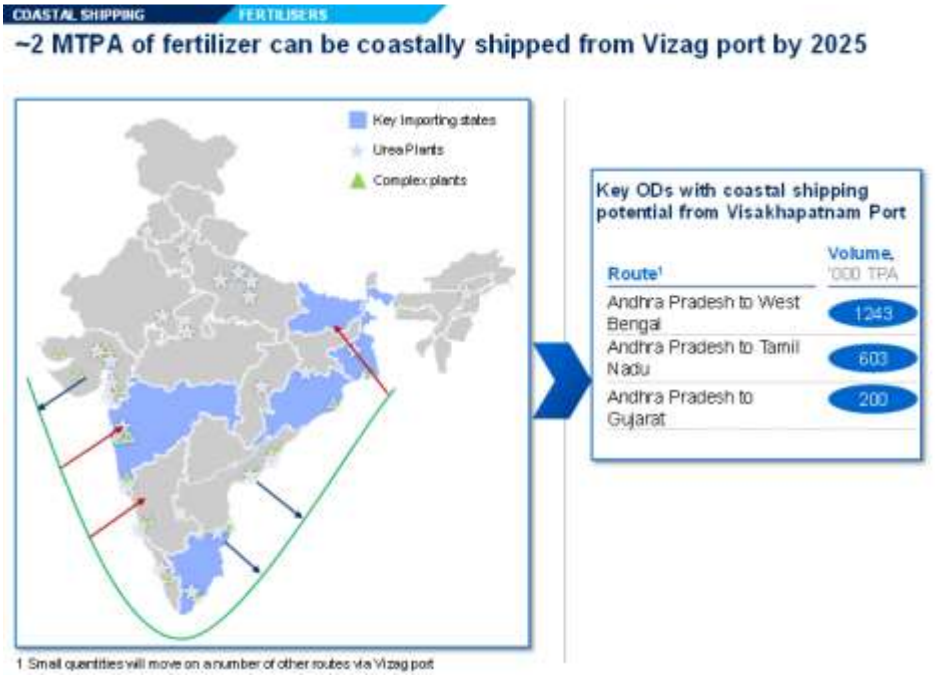
* Conversion factor for coking coal consumption per tonner of steel produced is taken as 0.85. Any incremental traffic due to expansion of existing and new plants has been split between Vizag and Gangavaram in 50:50 ratio

Coastal shipping potential

Visakhapatnam is strategically positioned to serve large areas in the hinterland of the country through coastal shipping. Coal, steel and fertiliser can be major commodities to/from Visakhapatnam as and when the coastal shipping revolution takes place in the country.

- **Fertilisers:** There is a potential for coastal shipping of around 2 MTPA of fertiliser from Andhra Pradesh to West Bengal, Tamil Nadu and Gujarat via Visakhapatnam port by 2025 (Exhibit 72).

EXHIBIT 72



- **Steel:** Around 1.5 MTPA of steel can be coastally shipped from RINL, Visakhapatnam to demand states of Maharashtra, Gujarat and Tamil Nadu by 2025 (Exhibit 73).

EXHIBIT 73

Exhibit 74 summarises the potential of coastal movement for key commodities at Visakhapatnam port.

EXHIBIT 74

Vizag Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Unloading)	0	0	0
Steel (Loading)	1.15	1.54	2.75
Steel (Unloading)	0.08	0.11	0.20
Cement (Loading)	0.03	0.04	0.07
Cement (Unloading)	0.01	0.02	0.03
Fertilizer (Loading)	1.68	2.05	3.03
Fertilizer (Unloading)	0.17	0.21	0.31
Food Grains (Loading)	0.57	0.69	1.02
Food Grains (Unloading)	-	-	-

- Additional Coastal shipping Potential if Machilipatnam is not built and Dr. N Tata Rao and Kothegudem plants in AP and Telangana adopt coastal shipping. Vizag would also have to compete with Kakinada

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small. The handling charges and sea freights assumed for the analysis is INR 150 per tonne per handling and INR 0.2 per tonner per km respectively

Meetings with the Vizag port team:

Date	Discussions held with
28th–29th July, 2015	Ports Team
28th Sept, 2015	DCE, Ports Team
16th Oct, 2015	DCE, Ports Team
29th Oct, 2015	Chief Engineer, Deputy Chief Engineer
15th–18th Feb 2016	Ports Team
23rd–26th Feb 2016	Dy. Chairman, Sr Dy. Chairman, Dy. Chief Engineer, SE's & EE's
15th March, 2016	Chairman and Port Team, terminal operators and key customers
22nd–23rd March 2016	Chairman, Ports Team
26th May, 2016	Ports team (Video conference)
13th June, 2016	Ports team (Video conference)
5th July 2016	Chairman, Ports Team

TRAFFIC PROJECTIONS FOR PARADIP PORT

In terms of volumes, Paradip is one of the largest major ports in the country handling more than 70 MTPA of cargo. Currently, major commodities handled in the port are coal and POL. Roughly 23 MTPA of coal is exported from the port and is coastally shipped to the southern and western hinterlands of the country. Additionally, the port imports around 16 MTPA of POL primarily to serve the IOCL refineries at Paradip and Haldia.

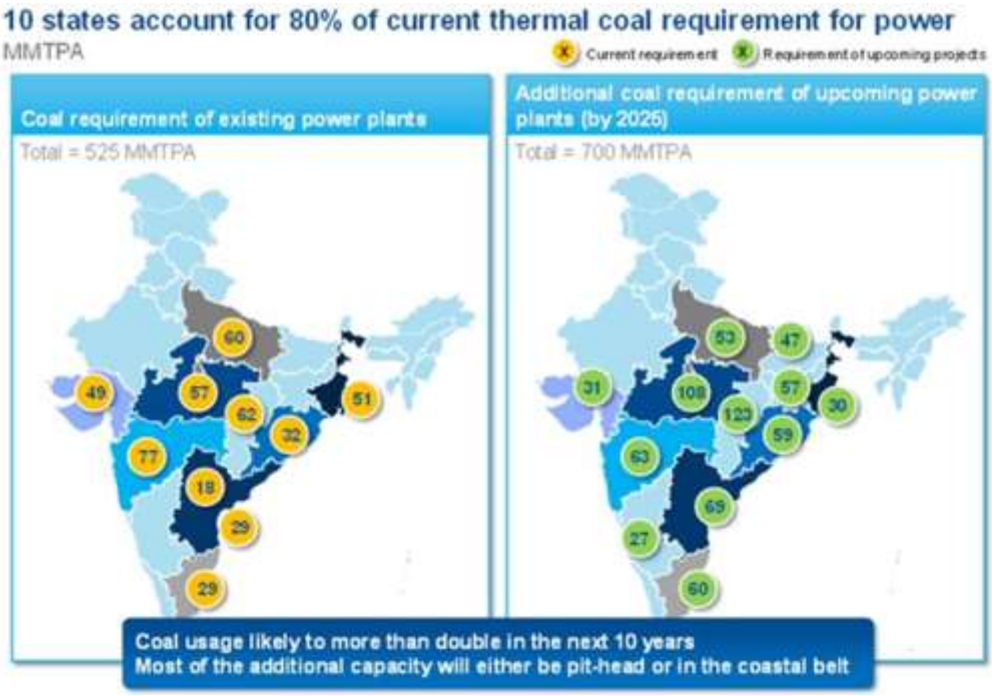
Major commodities and their projections

Coal

Coal deposits are mainly confined to the eastern and south-central parts of the country. The states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra account for nearly all of the total coal reserves in the country. As of March 2014, Jharkhand is the largest producer of coal in the country followed by Odisha and Chhattisgarh. Since one of the key objectives of Sagarmala is optimising logistics efficiency for mega-commodities, the focus area is thermal coal.

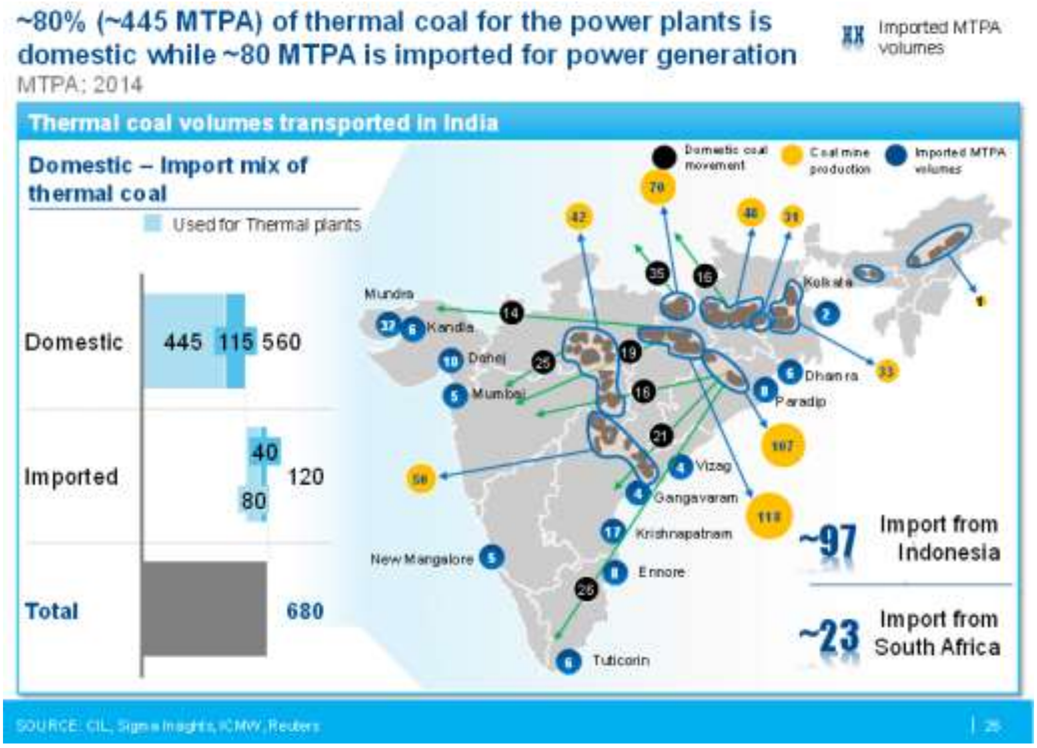
Presently, power plants located in Maharashtra consume the highest quantity of coal of roughly 77 MTPA, followed by power plants in Chhattisgarh and Uttar Pradesh at 62 MTPA and 60 MTPA respectively. Overall, 10 states account for more than 80 per cent of the current thermal coal requirement for power generation in the county (Exhibit 75).

EXHIBIT 75



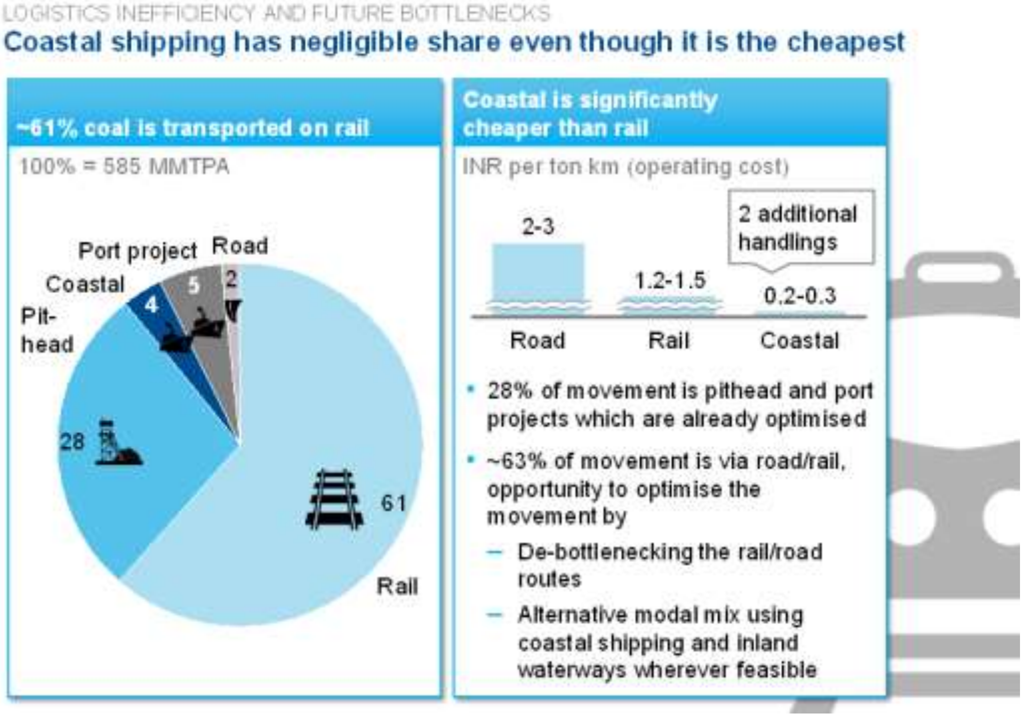
Therefore, while coal production is concentrated mostly in the eastern and central parts of India, it is transported for power generation across the country. For example, 26 MTPA is sent from Odisha to Tamil Nadu. Similarly, volumes of coal also move from Chhattisgarh to Maharashtra (19 MTPA) and Gujarat (14 MTPA). Coal imported from Indonesia and South Africa arrives at various ports and then moves inland (Exhibit 76).

EXHIBIT 76



Rail is currently the preferred mode with 61 per cent share in overall domestic volume movement, while coastal shipping has a negligible share. Rail freight is INR 1.2 to 1.5 per tonne-km for coal movement while the freight for coastal shipping is nearly one-sixth of rail transport (Exhibit 77).

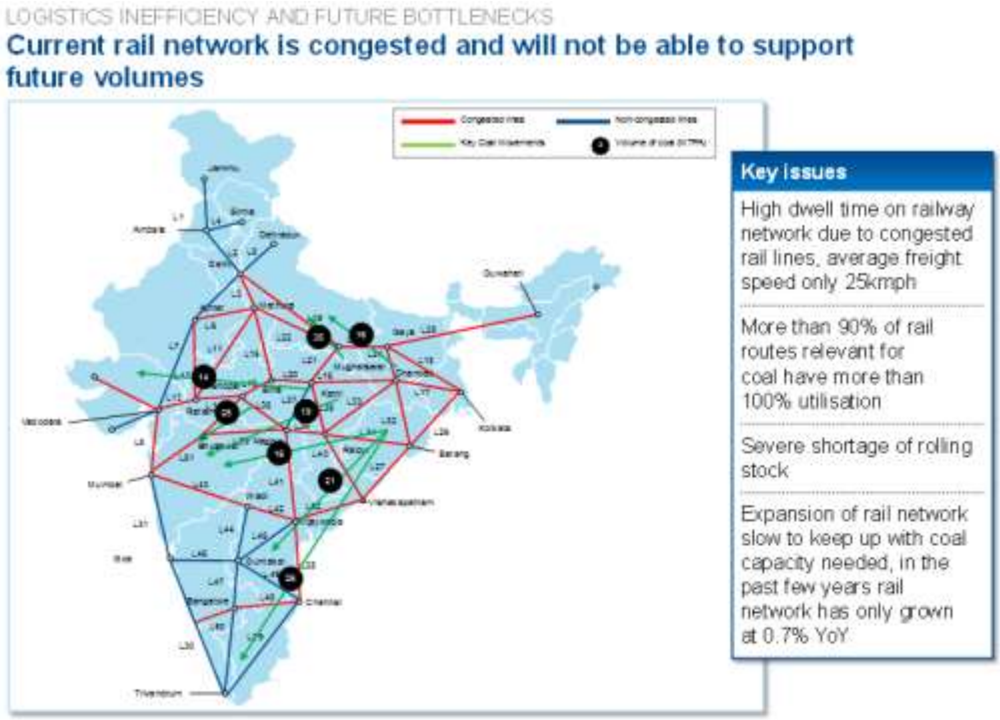
EXHIBIT 77



Furthermore, the current rail network is already congested and industry experts believe that it will not be able support the freight load projected due to growth in power-generation facilities and industrial corridors. Congested rail lines cause high dwell time, resulting in an average freight speed of only 25 kmph. More than 90 per cent of rail routes relevant for coal movement have more over 100 per cent utilisation (Exhibit 78).

Ports are facing severe shortage of rolling stock, which causes overstocking of coal at ports and using of sub-optimal methods of conventional handling and road transportation. The expansion of rail network is also falling behind the coal capacity needed. In the past few years, rail network has only grown at 0.7 per cent year-on-year.

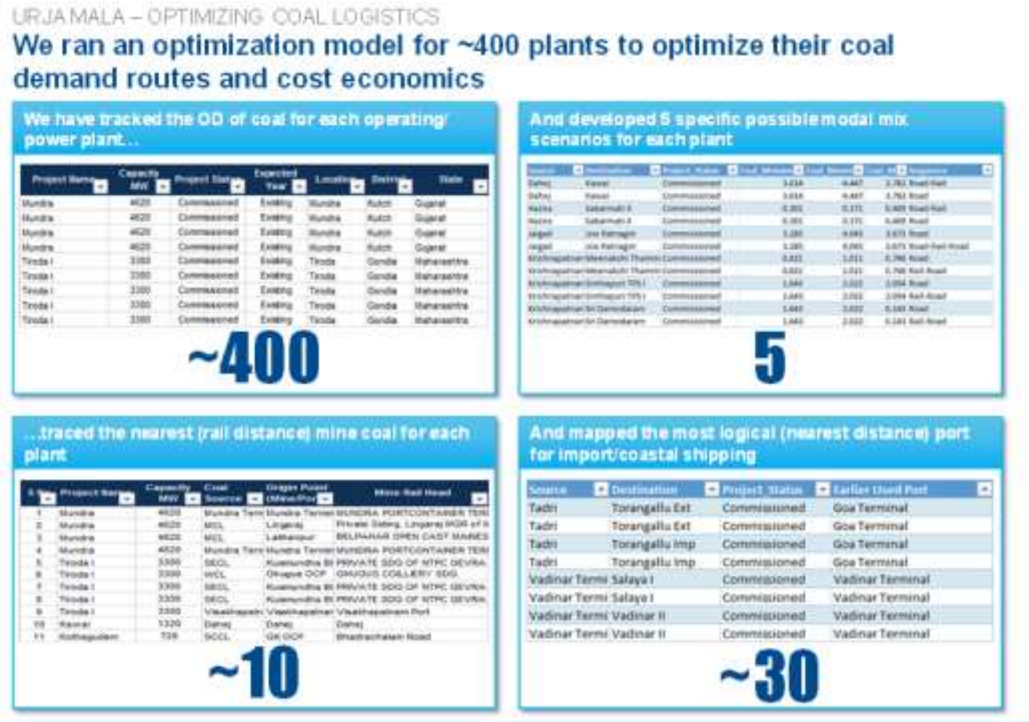
EXHIBIT 78



While rail is the primary mode of transport used for long-distance coal movement currently, analysis based on research data and industry expert opinions indicate that there is a potential of significant cost reduction in causing a modal-mix shift towards coastal shipping. Therefore, focus on the coastal shipment of thermal coal has been identified as a key component of the overall Sagarmala vision.

An in-depth study was conducted across 400 operational thermal power plants in the country to examine the origination, destination and mode of coal movement used at present (Exhibit 79). At the same time, a cost comparison of all possible combinations of modal mix under different scenarios of vessel capacity was also done. For example, for movement between Talcher in Odisha to a power plant at Mundra port in Gujarat, the cost for movement via rail is INR 2,980 per ton while the same via rail-supported coastal shipping could be much lower at INR 1,320 per ton (that is, a potential cost saving of as high as 56 per cent).

EXHIBIT 79



Eventually, coastal shipping potential has been identified for around 130 MTPA of thermal coal. In some cases, the cost economics give a marginal advantage to coastal shipment but the overall railway congestion implies that there still may be a case for coastal shipment in such plants. Even in a conservative scenario, around 80 MTPA of thermal coal can be coastally shipped. Exhibit 80 gives the list of identified power plants with the potential to move to coastal shipping.

EXHIBIT 80

List of Power Plants with Potential for Coastal Shipping: ~130 MTPA

Source	Power Plant	State	Coal Movement at 80% PLF (MTPA)	Capacity (MW)	Status
MCL - Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Dr. N. Tata Rao - Krishna	Andhra Pradesh	8.1	1760	Existing
MCL - Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Rayalseema - Cuddapah	Andhra Pradesh	2.9	1050	Existing
MCL - Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Sri Damodaram - Nellore	Andhra Pradesh	4.6	1600	Existing
MCL - Lakhanpur	Gayatri Projects Limited/Sembcorp Utilities, Thermal Powertech I - Krishnapatnam	Andhra Pradesh	3.0	660	Existing
MCL - Lakhanpur	Gayatri Projects Limited/Sembcorp Utilities, Thermal Powertech I (Partly Commissioned) - Krishnapatnam	Andhra Pradesh	3.0	660	Under construction
MCL - Lingaraj	Meenakshi Energy Private Limited, Meenakshi Thamminapatnam II - Nellore	Andhra Pradesh	3.2	700	Under construction
MCL - Lingaraj	Nagarjuna Construction Company/Gayatri Projects Limited, Muthukur Mandal I - Nellore	Andhra Pradesh	3.0	1320	Under construction
MCL - Lakhanpur	Adani Power Limited, Mundra - Kutch	Gujarat	4.6	990	Existing
MCL - Lingaraj	Adani Power Limited, Mundra - Kutch	Gujarat	4.6	330	Existing
MCL - Samaleswari	Ind Barath Power Infra Limited, Ind Barath Madras I - Tuticorin	Tamil Nadu	3.0	660	Under construction
MCL - Lingaraj	KVK Energy and Infrastructure Private Limited, Nagai - Nagapattinam	Tamil Nadu	1.4	300	Under construction
MCL - Hingula-II	National Thermal Power Corporation Limited/Tamilnadu Electricity Board, Vallur I - Thiruvallur	Tamil Nadu	6.9	1500	Existing
MCL - Hingula-II	Neyveli Lignite Corporation Limited/Tamilnadu Electricity Board, Tuticorin NLC - Tuticorin	Tamil Nadu	2.2	500	Existing
MCL - Samaleswari	Neyveli Lignite Corporation Limited/Tamilnadu Electricity Board, Tuticorin NLC (Partly Commissioned) - Tuticorin	Tamil Nadu	2.2	500	Under construction
MCL - Lakhanpur	OPG Power Gen Limited, Chennai I - Thiruvallur	Tamil Nadu	0.4	77	Existing
MCL - Lakhanpur	OPG Power Gen Limited, Chennai II - Thiruvallur	Tamil Nadu	0.4	77	Existing
MCL - Lakhanpur	OPG Power Gen Limited, Chennai III - Thiruvallur	Tamil Nadu	0.4	80	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Ennore - Thiruvallur	Tamil Nadu	2.1	450	Existing
Mandakini B - Mandakini B	Tamilnadu Electricity Board, Ennore II - Thiruvallur	Tamil Nadu	3.0	660	Under construction
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Mettur - Salem	Tamil Nadu	6.6	1440	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, North Chennai - Thiruvallur	Tamil Nadu	6.4	1830	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Tuticorin - Tuticorin	Tamil Nadu	4.8	1050	Existing
	Total		75.8		
MCL - Lakhanpur	Andhra Pradesh Power Generation Corporation Limited, Rayalseema IV - Kadapa	Andhra Pradesh	2.6	600	Under construction
MCL - Samaleswari	Hinduja National Power Corporation Limited, Vishakhapatnam - Vishakhapatnam	Andhra Pradesh	4.8	1040	Under construction
MCL - Hingula-II	National Thermal Power Corporation Limited, Simhadri - Krishna	Andhra Pradesh	7.8	1700	Existing
ECL - Khottadih OC	National Thermal Power Corporation Limited, Simhadri - Krishna	Andhra Pradesh	1.4	300	Existing
SECL - Dipka	Gujarat State Electricity Corporation Limited, Gandhi Nagar - Gandhinagar	Gujarat	4.0	870	Existing
SECL - MANIKPUR OC	Gujarat State Electricity Corporation Limited, Sikka Rep. - Jamnagar	Gujarat	2.2	490	Existing
SECL - MANIKPUR OC	OPG Power Gen Limited, Mundra OPG - Kutch	Gujarat	1.4	300	Under construction
MCL - Bharatpur	Karnataka Power Corporation Limited, Bellary TPS - Bellary	Karnataka	3.3	1000	Existing
MCL - Ananta	Karnataka Power Corporation Limited, Raichur - Raichur	Karnataka	2.8	840	Existing
MCL - Bharatpur	Karnataka Power Corporation Limited, Raichur - Raichur	Karnataka	1.2	330	Existing
Parsa East/Kanta Basan - Parsa East/Kanta Basan	National Thermal Power Corporation Limited, Kudgi I - Bijapur	Karnataka	11.1	2400	Under construction
MCL - Lakhanpur	Indiabulls Power Limited, Nasik I - Nasik	Maharashtra	1.2	270	Existing
SECL - Dipka	Reliance Power, Dahanu - Thane	Maharashtra	2.3	500	Existing
MCL - Lingaraj	Telangana State Power Generation Corporation Limited, Kothagudem V - Khammam	Telangana	2.3	1000	Existing
	Total		47.7		

Note: Cases where cost advantage from coastal shipping may be marginal are marked in RED

Based on these projections it was concluded that since Paradip was the nearest port to the cluster of coal mines which are suitable for coastal shipping of coal, it will have a step jump in terms of coastally-shipped coal. The current traffic of 23 MTPA is expected to increase to nearly 95 MTPA by 2020, 135 to 140 MTPA by 2025 and 200 MTPA by 2035. To realise this potential, many connectivity projects need to be undertaken in order to feed the requisite amount of coal to the port.

Coking coal

Another major commodity imported in Paradip is coking coal. To service the demand of blast furnace-based steel production, around 60 to 65 MTPA of coking coal is transported in the country, and around 54 MTPA is consumed for the production of steel. Around 80 percent of the coking coal consumed is imported due to insufficient coking coal reserves in India.

Eastern India (including West Bengal, Jharkhand, Odisha and Chhattisgarh) is the biggest cluster of steel production in the country with 45 MTPA (around 40 percent) of total installed steel capacity.

Current coking coal evacuation is facing challenges due to limited availability of rakes at unloading ports and rail-line capacity at key train routes. Around 21 MTPA of new steel capacity at key steel plants (1 MTPA and above blast-furnace based) is under construction and would need around 18 to 20 MTPA of coking coal to be evacuated on the same rail routes, which are currently running at above 100 percent utilisation.

According to estimates, the coking coal demand for steel would reach around 130 to 140 MTPA in 2035 based on increased steel demand in the country for initiatives like "Make in India" and the construction impetus. Also, historically the steel growth has been faster than the GDP, with the multiplier being GDP: 1.14.

The evacuation capability at the relevant unloading ports and the railway routes will need to be improved for optimal evacuation of coking coal.

Based on these projections, it is expected that the traffic at Paradip will increase to around 16 MTPA in the next five years, 20 MTPA by 2025 and 30 MTPA by 2035. Growth until 2020 will primarily be driven by the new Tata Kalinganagar plant and the expansion of the Bhushan Steel plant in Meramandali (Exhibit 81).

EXHIBIT 81

Coking coal volumes projected at Paradip port for key steel plants

Steel plants	Coking coal volume 2020 (MMTPA)
TISCO	0.9
SAIL, Rourkela	2.8
Bhushan steel, Sambalpur	1.4
JSPL, Raigad	0.4
Neelachal Ispat Nigam, Odisha	0.6
Tata, Kalinganagar	3.5
JSPL, Patratu	2.5
Bhushan steel, Meramandali	1.7

SOURCE: Origin destination analysis

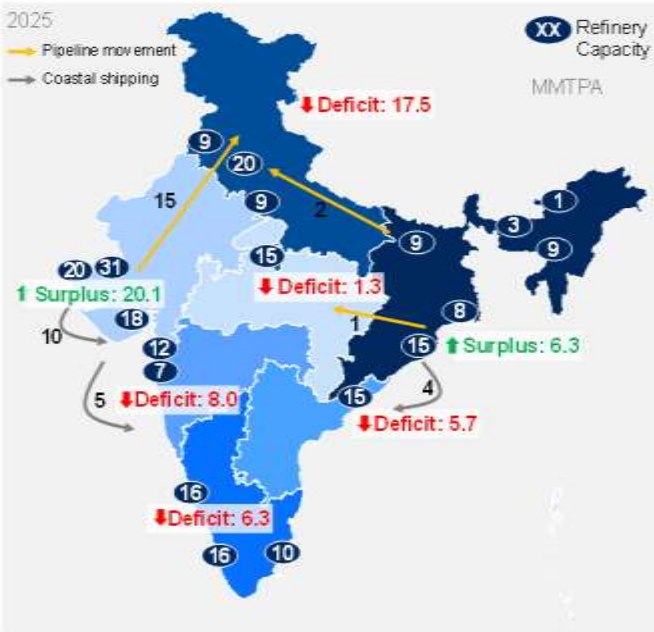
POL

In addition to coal and coking coal, POL is another key commodity for Paradip port. The port currently handles around 18 MTPA of POL which includes roughly 16 MTPA of crude import at IOCL refineries and around 2 MTPA of coastal movement of POL products from Paradip. By 2025, crude oil import is expected to rise to around 34 MTPA considering the Paradip refinery is going to be operational. LPG imports are expected to rise as a result of the government's focus on the distribution of LPG connections to rural households. Additional 4 to

5 MTPA of MS/HSD is also expected to be coastally shipped from Paradip to cater to the demand of Andhra Pradesh and Telangana (Exhibit 82).

EXHIBIT 82

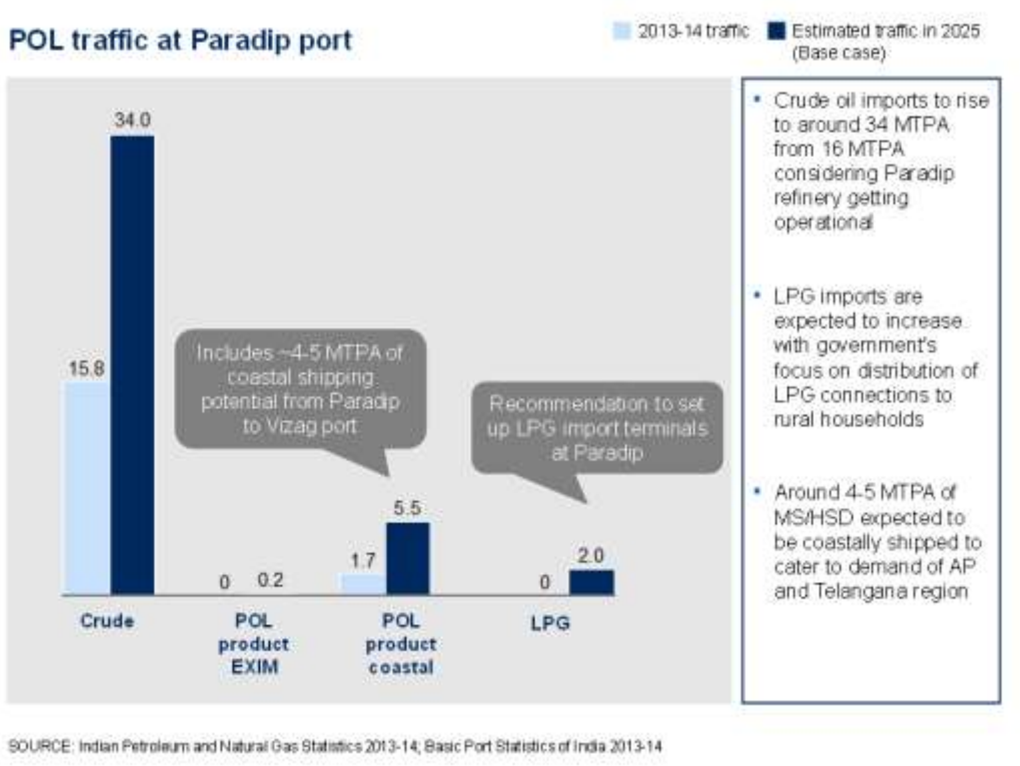
There is a potential for coastal shipping of ~5 MMTPA of MS/HSD from Paradip to Vizag port by 2025



1. Assumes RIL Jamnagar and Essar Oil export nothing while Reliance SEZ exports 100% product

Exhibit 83 shows the split of the current traffic of POL and the projected traffic for 2025.

EXHIBIT 83



Other commodities

Other key commodities handled at Paradip port include iron ore, limestone, fertilisers and gypsum. In the base case scenario, it is expected that exports of iron ore from the port will be depressed due to the crashing of the global prices and the non-competitiveness of the Indian ore in the export markets.

Fertiliser traffic is also projected to grow to roughly 7 MTPA by 2025, owing to IFFCO's presence next to the port and good connectivity to agricultural areas in Bihar and UP. Exhibit 84 summaries the traffic potential for key commodities at Paradip port.

EXHIBIT 84

Paradip Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	17.9	35.2	41.8	45.4	47.5	51.2	• Mainly Crude oil imports by IOCL Paradip, IOCL Haldia and coastal shipping
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	23	95	135	142	200	201	• Driven by coastal shipping from MCL mines
Thermal Coal (Unloading)	7.0	6.0	7.5	8.5	9.0	11.0	• Imported Coal for power likely to be reduced as CIL production increases
Coking Coal	7.9	16.3	19.0	21.0	28.0	32.0	• TATA Kalinganagar and Bhushan Steel Meramandli expansion
Iron Ore	2.2	6.5	7.5	15.9	10.0	30.1	• Mostly exports; likely to remain low. JSW captive berth cargo considered. Optimistic case is related to the volumes handled before ban. Pellets are part of others
Limestone	2.2	3.1	4.3	4.5	7.6	8.8	
Dolomite	0.7	1.0	1.35	1.44	2.4	2.8	
Gypsum	0.8	1.1	1.5	1.6	2.7	3.1	
Fertilizers	4.4	5.6	7.0	7.3	10.5	11.7	
Containers and other Cargo							
Containers (MnTEU)	0.004	0.02	0.10	0.13	0.15	0.18	
Others	4.6	6.1	8.2	8.6	13.6	15.4	• Highly fragmented
Total (MMTPA)	**71.0**	**176.2**	**234.8**	**258.4**	**333.8**	**370.1**	

Conversion Factor Used for Containers Projections: 1 TEU = 16.75 Tons

Coastal shipping potential

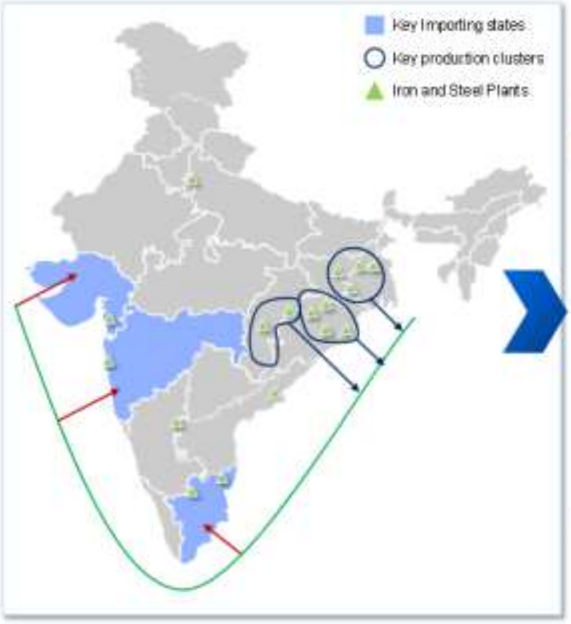
Paradip is strategically positioned to serve large areas in the hinterland of the country through coastal shipping. Steel can be a major commodity from Paradip as and when the coastal shipping revolution takes place in the country.

- **Steel:** Around 5 to 6 MTPA of steel can be coastally shipped to the demand states of Maharashtra, Tamil Nadu, Andhra Pradesh and Gujarat by 2025 (Exhibit 85). Key plants which will lead to the advent of coastal shipping of steel from Paradip include SAIL Rourkela, BPSL Sambhalpur, BSL Meramandli and JSPL Angul.

EXHIBIT 85

COASTAL SHIPPING | IRON AND STEEL

~5-6 MTPA of steel can be coastally shipped from Odisha to demand states of Maharashtra, Gujarat, AP and TN by 2025



Key plants with coastal shipping potential from Paradip Port

Plant	Location	Volume Potential to shift to coastal (in MTPA)
SAIL	Rourkela	1.3-1.4
BPSL	Sambalpur	0.4-0.5
BSL	Meramandali	0.9-1.0
JSPL	Angul	0.8-0.9
Tata Steel	Kalinganagar	0.4-0.5
NINL	Duburi	0.4-0.5

SOURCE: DGCIS data 2013-14; Team analysis

- **Cement:** Around 1 to 2 MTPA of cement can be coastally shipped to Paradip port from Andhra Pradesh by 2025 (Exhibit xx). Roughly 2.5 MTPA can also be coastally shipped from the proposed cement cluster in AP by 2025 if the central AP port is developed (Exhibit 86 & 87).

EXHIBIT 86

COASTAL SHIPPING CEMENT

~ 1-2 MTPA of cement can be coastally shipped to Paradip Port by 2025; Andhra Pradesh will be the key source

Key ODs with coastal shipping potential to Paradip Port

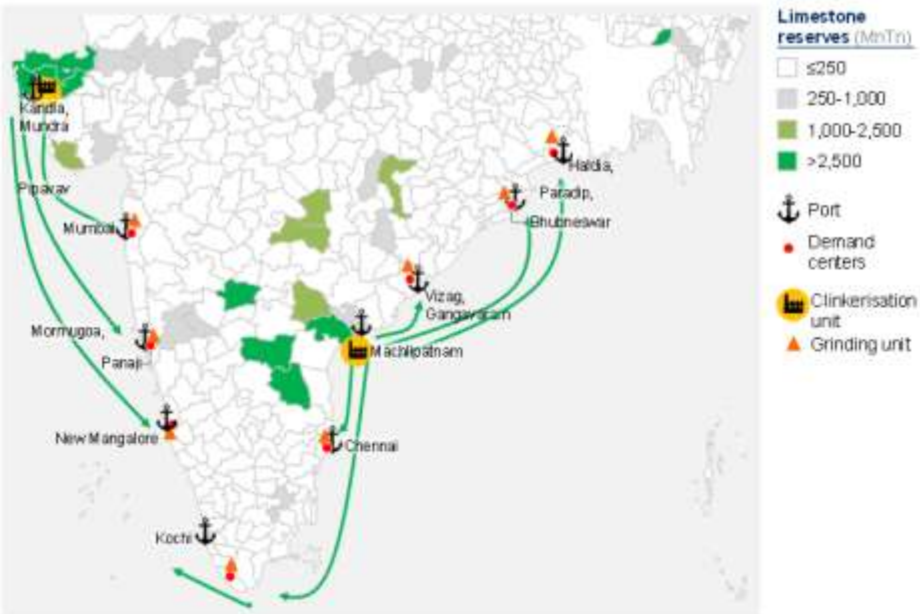
Route	Volume, '000 TPA
Andhra Pradesh to Odisha	1,690

SOURCE: DGCIS data 2013-14

EXHIBIT 87

COMMODITY TRAFFIC CEMENT

Additional ~2.5 MTPA can be coastally shipped to Paradip Port from the proposed cement cluster in AP by 2025



- **Fertilisers:** Around 1 MTPA of fertilisers can be coastally shipped from Paradip port by 2025 to Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra (Exhibit 88).

EXHIBIT 88

Exhibit 89 summarises the potential of coastal movement for key commodities at Paradip port.

EXHIBIT 89

Paradip Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	3.91	5.23	9.37
Steel (Unloading)	0.50	0.67	1.19
Cement (Loading)	0.01	0.01	0.02
Cement (Unloading)	1.27	4.2	5.5
Fertilizer (Loading)	0.87	1.06	1.57
Fertilizer (Unloading)	0.39	0.47	0.70
Food Grains (Loading)	0.40	0.49	0.72
Food Grains (Unloading)	-	-	-

- 2.5 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

Meetings with the Paradip port team:

Date	Discussions held with
7th July, 2015	Chairman and DMSSE
22nd–23rd July, 2015	Vice Chairman, Chief Traffic Manager, Deputy Traffic Manager, Projects Head
25th Aug, 2015	Dy. Chairman, TM and Ports Team
26th Aug, 2015	Vice Chairman, Chief Traffic Manager, Deputy Traffic Manager, Projects Head
30th Sept, 2015	Chairman & Ports Team
1st Oct, 2015	Chairman, Traffic Manager
8th Oct, 2015	Traffic Manager
19th–20th Nov, 2015	CE, Traffic Manager, EE-Civil, EE-Mechanical
15th–16th Dec, 2015	Chairman, Ports Team
20th–22nd Jan 2016	Dy. Chairman and Ports Team
5th–7th Feb, 2016	
14th March, 2016	

9th–11th March, 2016	Chairman, Ports Team
29th–31st March 2016	Chairman, Deputy Chairman
13th–14th May 2016	Chairman, Chief Engineer
	Chairman, Ports Team
	Ports Team
26th May, 2016	Ports team (Video conference)

TRAFFIC PROJECTIONS FOR HALDIA PORT

Haldia Dock Complex (HDC) is a major port in West Bengal handling around 31 MTPA of cargo. It handles containers, coking coal, iron ore, fertilisers and POL. Out of these commodities, liquid bulk and coking coal constitute around 50 per cent of the cargo. West Bengal is Haldia's primary hinterland. Other hinterlands include Bihar, Jharkhand, the Northeast and Odisha. Haldia's current traffic is expected to grow to 54 to 65 MTPA by 2025.

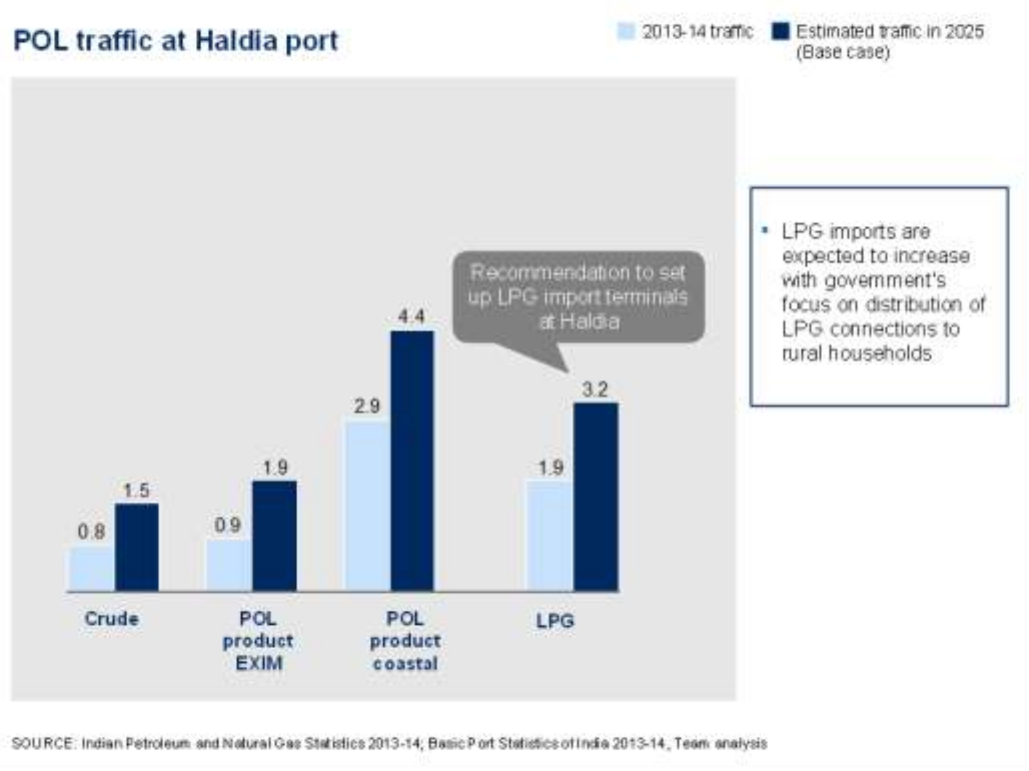
Major commodities and their projections

POL

POL crude and product constitute 18 per cent of the traffic handled. The current traffic of 5.5 MTPA is split between crude, POL product (EXIM and coastal movement) and LPG. IOCL Haldia is the key player for crude oil imports. Exhibit 90 shows the current and the estimated traffic of POL in 2025.

There is minimal increase in POL crude traffic, with no significant capacity expansion expected at Haldia and no new facility planned. However, LPG imports are expected to increase with the government's initiative of distributing LPG connections to rural households. There is also a proposal to set up an LPG import terminal at Haldia.

EXHIBIT 90



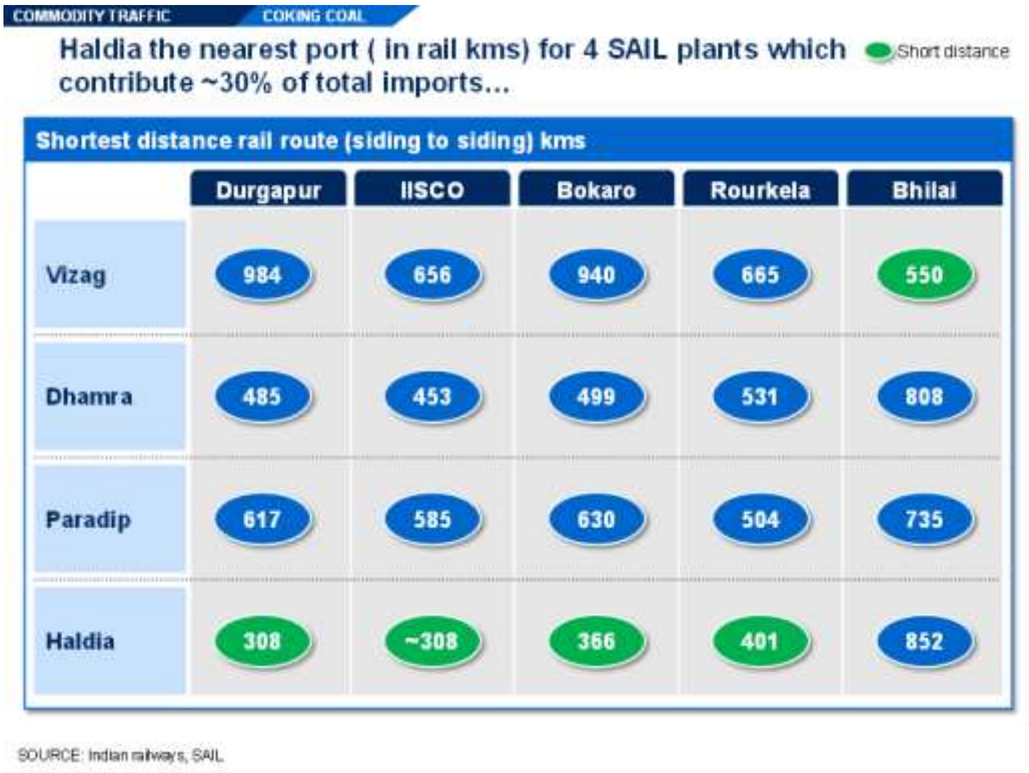
Thermal coal

Currently, Haldia imports 3.5 MTPA of thermal coal to meet the blending requirement of the power plants in the hinterland (NTPC Farakka). In addition, it also exports 1.2 MTPA of thermal coal, which is coastally shipped to TNEB power plants. Going forward, with the output of ECL increasing, overseas coal imports is unlikely to increase. By 2025, thermal coal imports is likely to be in the range of 3 to 4 MTPA, the coastal coal exports will be around 2 MTPA.

Coking coal

Currently, Haldia imports 6 MTPA of coking coal primarily to meet the energy requirement of the steel plants in the hinterland. Haldia is the nearest port for four major steel plants—Durgapur, IISCO, Bokaro and Rourkela (Exhibit 91). But due to low draft, Haldia can meet only a part of their requirements. Dhamra and Paradip cater to the rest of their demands, as these ports have a much higher draft, allowing bigger vessels to call at the port (Exhibit 92). Going forward, coking coal import is expected to increase and reach 8 MTPA by 2020 and around 11 to 12 MTPA by 2025.

EXHIBIT 91


COMMODITY TRAFFIC COKING COAL

Haldia the nearest port (in rail kms) for 4 SAIL plants which contribute ~30% of total imports...

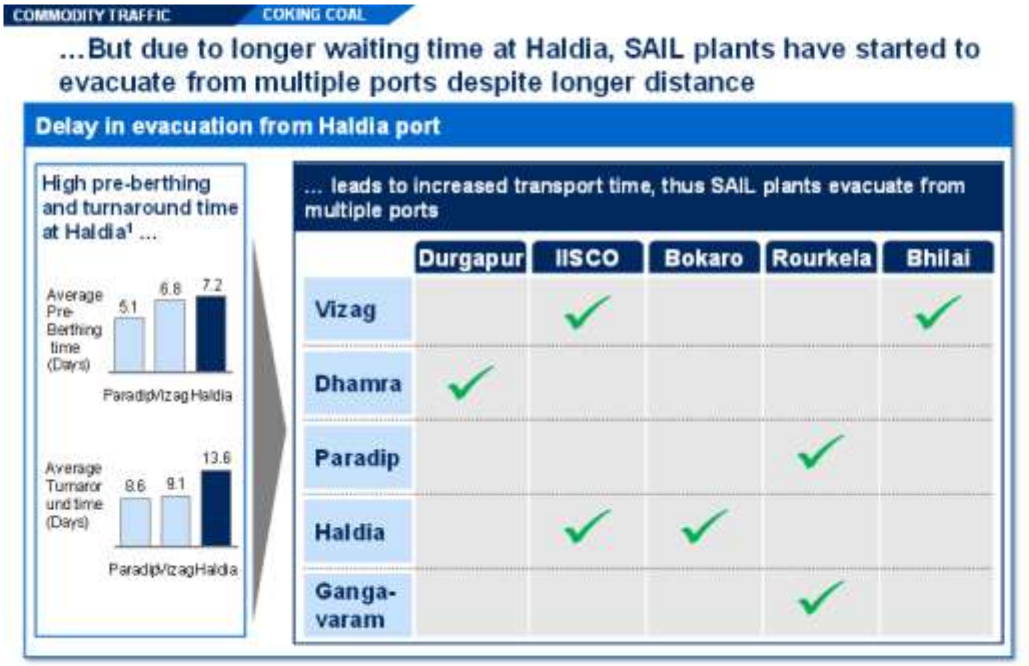
Short distance

Shortest distance rail route (siding to siding) kms

	Durgapur	IISCO	Bokaro	Rourkela	Bhilai
Vizag	984	656	940	665	550
Dhamra	485	453	499	531	808
Paradip	617	585	630	504	735
Haldia	308	~308	366	401	852

SOURCE: Indian railways, SAIL

EXHIBIT 92



	Durgapur	IISCO	Bokaro	Rourkela	Bhilai
Vizag		✓			✓
Dhamra	✓				
Paradip				✓	
Haldia		✓	✓		
Ganga-varam				✓	

1 For 54,000 PWT Panamax Vessel; most efficient for coking coal transportation

SOURCE: Indian ports association – individual ports

Containers

Haldia port currently handles 0.1 mn TEUs of containers, catering primarily to the West Bengal hinterland. Kolkata, Durgapur and Haldia are the key container generating hinterlands for HDC and KDS, generating around 60 per cent of the overall traffic and small volume move to/from Bihar, Jharkhand and other parts of West Bengal. Kolkata's GDP is expected to grow at around 9 to 11 per cent while other hinterlands are expected to grow at around 8 to 10 per cent CAGR.

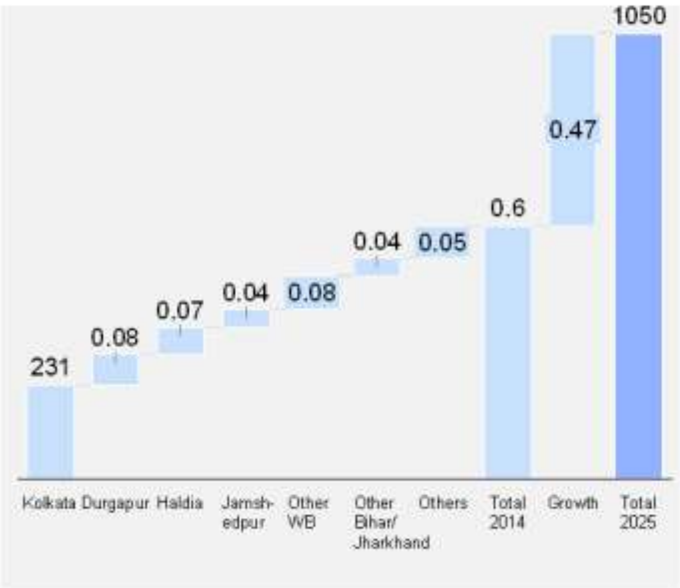
With the capacity at KDS being saturated, spill-over traffic is expected to come to Haldia port. Going forward, container volumes are expected to touch nearly 0.15 mn TEUs by 2020 and around 0.2 to 0.3 mn TEUs by 2025. Exhibits 93 to 95 show the current and projected container traffic shared between Kolkata and Haldia. In case of capacity constraints, a part of this traffic will move to Dhamra and Sagar.

EXHIBIT 93

COMMODITY TRAFFIC | CONTAINER

Container traffic at Haldia and Kolkata port

Million TEUs



- Kolkata, Durgapur and Haldia is the primary hinterland for Haldia/Kolkata ports generating ~60% of total traffic
- Kolkata is expected to grow at 9-11% while most other hinterlands are expected to grow at 8-10% CAGR

SOURCE: APMT; India Port Statistics, Expert interviews

EXHIBIT 94

COMMODITY TRAFFIC | CONTAINER

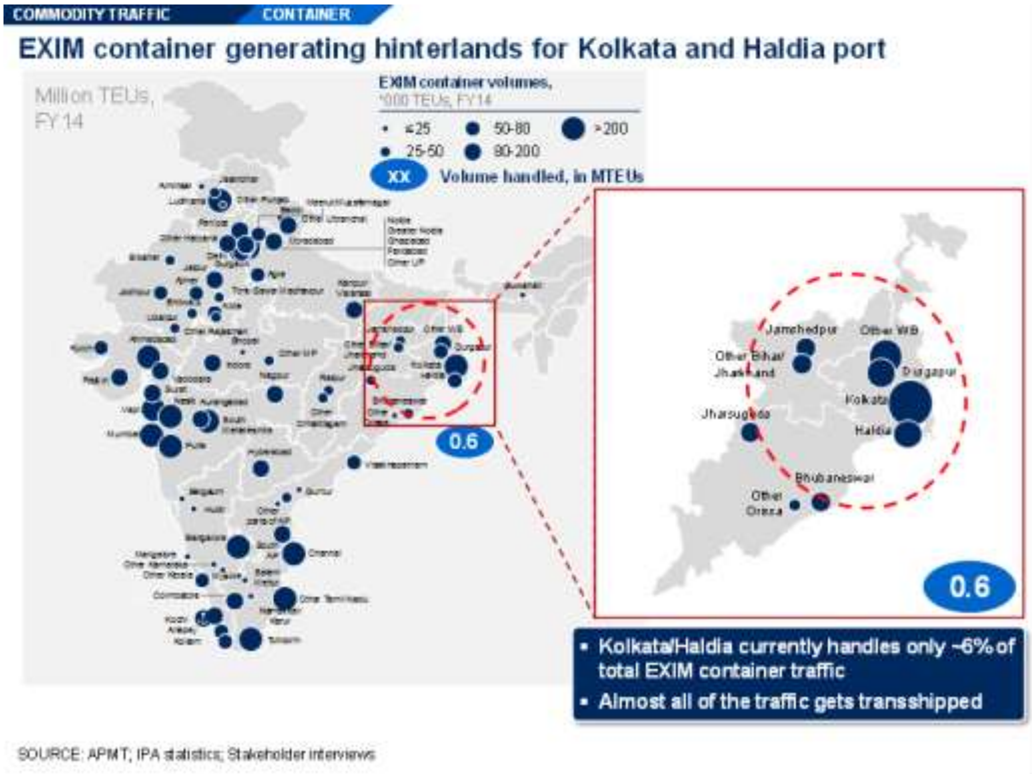
West Bengal is the primary hinterland of Kolkata and Haldia port with small traffic from Bihar and Jharkhand

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Kolkata/ Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT

EXHIBIT 95



Other localised commodities

Other commodities include iron ore, manganese, vegetable oil, chemicals and limestone. With the mining ban on iron ore, exports are expected to remain low, while chemicals and vegetable oil will grow at a healthy rate.

Exhibit 96 summaries the traffic potential for key commodities at Haldia port.

EXHIBIT 96

Haldia Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	Current	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	5.5	9.9	11.0	12.1	13.6	15.3	• Growth coming from LPG import terminals proposed to set up in east coast ports
Vegetable Oil	1.6	3.5	4.5	5.5	5.5	6.5	
Chemicals	2.9	3.0	4.5	5.5	6.5	7.5	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	1.2	1.6	2.1	2.3	3.4	4.1	
Thermal Coal (Unloading)	3.5	3.3	3.3	4.0	4.0	5.0	• Overseas coal imports likely to decline as CIL production rises
Coking Coal	6.0	8.0	11.2	11.9	19.9	23.1	
Iron Ore	2.3	1.0	1.3	4.6	2.3	8.7	• Mostly exports; likely to remain low. Optimistic case is related to the volumes handled before ban
Limestone	1.4	2.0	2.8	3.2	4.8	5.5	
M.Ore	1.4	2.0	2.5	2.6	4.1	4.7	
Other Ore	0.9	1.5	1.8	2.2	2.8	3.2	
Fertilizers	0.8	1.0	1.5	1.6	1.8	2.2	
Containers and other Cargo							
Containers (MnTEU)	0.10	0.15	0.2	0.3	0.4	0.6	
Others	1.4	2.5	3.4	3.6	4.6	6.7	• Highly fragmented
Total (MMTPA)	**30.8**	**42.2**	**53.7**	**64.9**	**81.0**	**104.0**	

Conversion Factor Used for Containers Projections: 1 TEU = 19.2 Tons

Coastal shipping potential

Apart from the above mentioned traffic, Haldia port could explore the potential of coastal shipping:

- **Thermal coal:** Around 12.4 MTPA of thermal coal can be coastal shipped to NTPC Kudgi (Karnataka) and NTPC Simhadri from Pakri Barwadih and Khottadih OC mines respectively (Exhibit 97).

EXHIBIT 97

COMMODITY TRAFFIC COAL

~11 MTPA Coal can be moved from Pakri Barwadih to Kudgi1 and ~1.4 MTPA from Khottadih to Simhadri via coastal shipping through Haldia port

Pakri Barwadih to Kudgi (Optimimumroute: row 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Road-Rail-Port-Road-Rail	3,833	2,883
2	Road-Rail	2,035	3,300

Khottadih to Simhadri (Optimimumroute: row 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Rail-Port-Rail	1,074	1,318
2	Rail	1,024	1,783

1 Considering linkage rationalization from Pakri Barwadih to Talcher does not happen

- **Cement:** Around 2.5 MTPA of cement can be coastally shipped to Haldia port from Andhra Pradesh by 2025 (Exhibit 98). This would primarily be consumed in West Bengal, Bihar and Jharkhand. Additionally, roughly 5 MTPA of cement can be coastally shipped to West Bengal via Haldia port from central Andhra Pradesh by 2025, contingent on the development of the central AP port (Exhibit 99).

EXHIBIT 98

COASTAL SHIPPING | CEMENT

~ 2.5 MTPA of cement can be coastally shipped to Haldia Port by 2025; Andhra Pradesh will be the key source1

Key ODs with coastal shipping potential to Haldia Port

Route	Volume, TPA
Andhra Pradesh to West Bengal	1,804
Andhra Pradesh to Bihar	369
Andhra Pradesh to Jharkhand	194

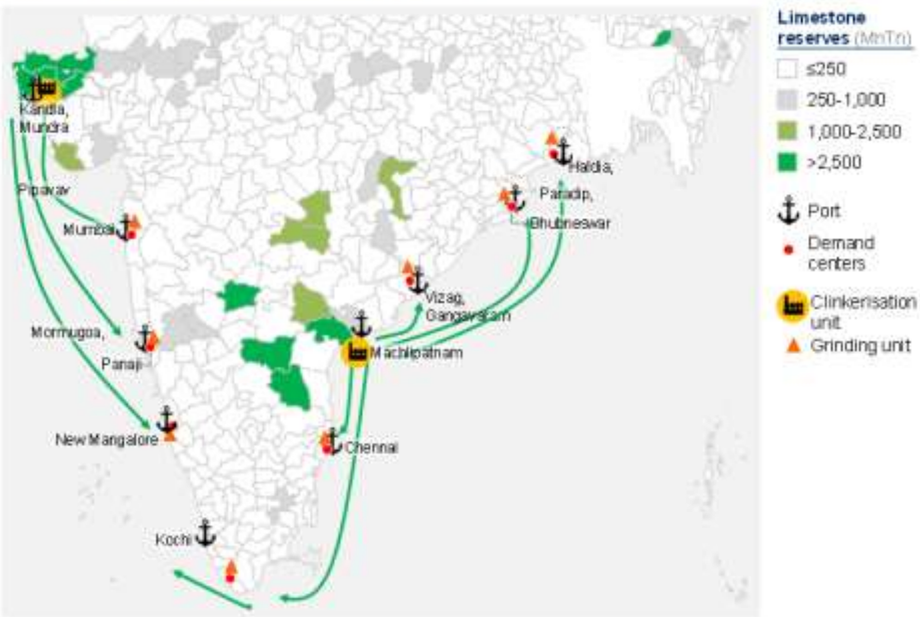
1 Small quantities can come from a number of other ODs via Haldia Port

SOURCE: DGCIS data 2013-14

EXHIBIT 99

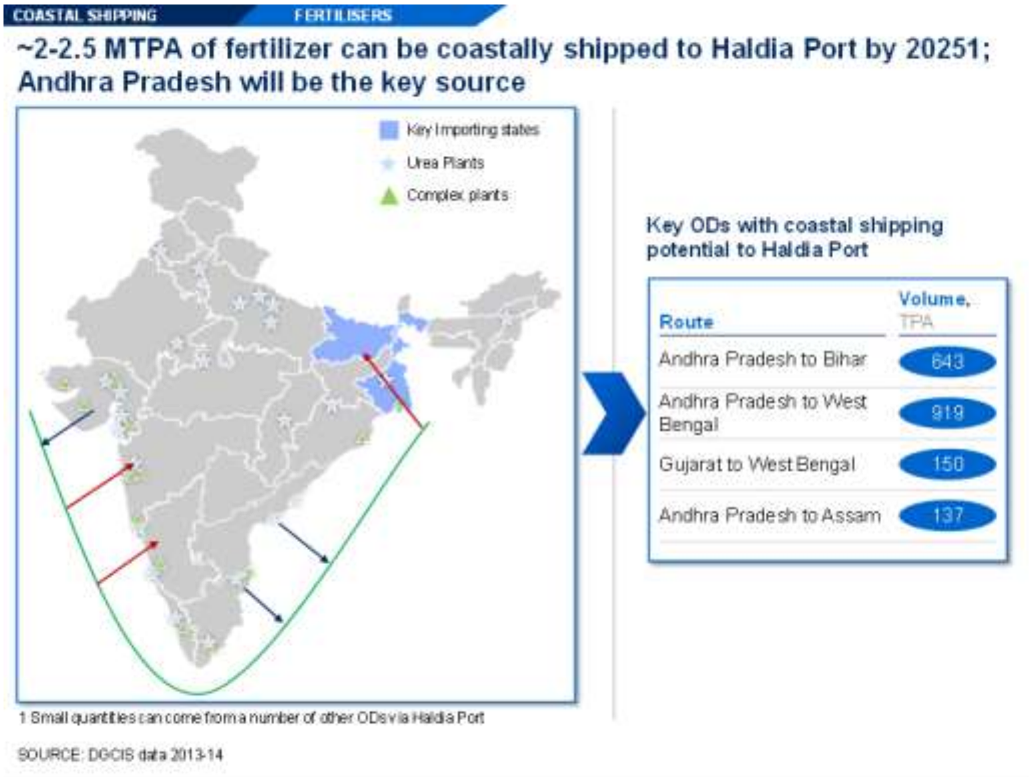
COMMODITY TRAFFIC | CEMENT

Additional ~5 MTPA can be coastally shipped to Haldia Port from the proposed cement cluster in AP by 2025



- **Fertilisers:** Around 2 to 2.5 MTPA of fertilisers can be coastally shipped to Bihar and West Bengal via Haldia port by 2025. Andhra Pradesh would account for most of this supply (Exhibit 100).

EXHIBIT 100

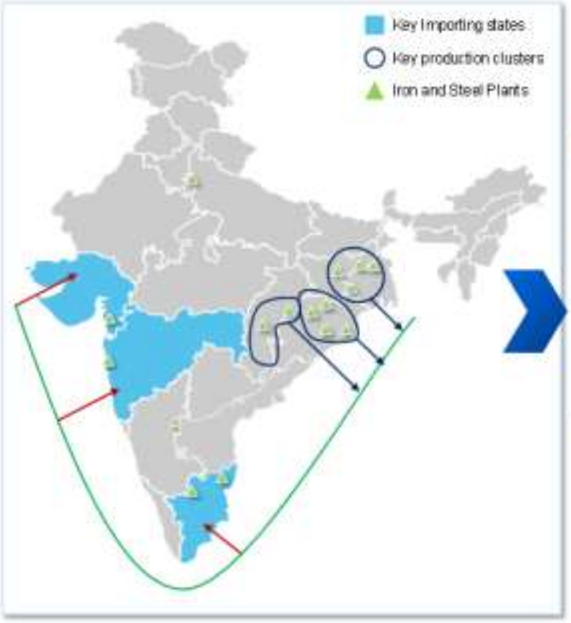


- **Steel:** Roughly 3 to 4 MTPA of steel can be coastally shipped by 2025 from Haldia port to the demand states of Maharashtra, Andhra Pradesh, Tamil Nadu and Gujarat (Exhibit 101). The Tata steel plant in Jamshedpur and SAIL plants in Durgapur, Bokaro and Burnpur have the maximum potential for coastal movement.

EXHIBIT 101

COASTAL SHIPPING | IRON AND STEEL

~3-4 MTPA of steel can be coastally shipped from Haldia Port to demand states of Maharashtra, AP, TN and Gujarat by 2025



Key plants with coastal shipping potential from Haldia Port

Plant	Location	Volume Potential to shift to coastal (in MTPA)
Tata Steel	Jamshedpur	1.5-1.6
SAIL	Durgapur	0.2-0.3
SAIL	Bokaro	0.7-0.8
SAIL ISSCO	Burnpur	0.3-0.4

SOURCE: DGCIS data 2013-14

Exhibit 102 summarises the potential of coastal movement for key commodities at Haldia port.

EXHIBIT 102

Haldia Port – New Opportunities Possible via Coastal Shipping*

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Loading)	12.4	12.4	12.4
Steel (Loading)	2.74	3.66	6.56
Steel (Unloading)	0.39	0.52	0.94
Cement (Loading)	0.00	0.00	0.00
Cement (Unloading)	1.88	7.5	9.49
Fertilizer (Loading)	0.00	0.00	0.01
Fertilizer (Unloading)	1.92	2.34	3.46
Food Grains (Loading)	0.11	0.13	0.20
Food Grains (Unloading)	0.00	0.01	0.01

- Additional Coastal shipping from Pakri Barwadih in Jharkhand to Kudgi I in Bijapur, and Khottadih OC to NTPC Simhadri
- 5MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small. The handling charges and sea freights assumed for the analysis is INR 150 per tonne per handling and INR 0.2 per tonner per km respectively

TRAFFIC PROJECTIONS FOR KOLKATA PORT

Kolkata port handles containers, coking coal, iron ore and fertilisers in dry and break bulk cargo and POL in liquid bulk. Of these, containers alone constitute around 53 per cent of the cargo. Kolkata currently has West Bengal as its primary hinterland for containers. Other hinterlands include Bihar, Jharkhand, the Northeast and Odisha.

Major commodities and their projections

Assessment of traffic was based on the analysis of past traffic at Kolkata, interviews with Port authorities, the West Bengal Industrial Development Corporation (WBIDC) as well as several stakeholders in the shipping and user industries.

Going forward, hinterland for container traffic at Kolkata is expected to remain the same. Tidal draft, limited plans for capacity expansion and no mainline vessel call for containers in India limit hinterland growth for Kolkata.

Kolkata port currently handles around 0.5 mn TEUs of containers, catering primarily to the West Bengal hinterland. Kolkata, Durgapur and Haldia are the key container-generating hinterlands for HDC and KDS generating around 60 per cent of the overall traffic and small volume move to/from Bihar, Jharkhand and other parts of West Bengal. Kolkata’s GDP is expected to grow at a rate of 9 to 11 per cent while other hinterlands are expected to grow at roughly 8 to 10 per cent CAGR.

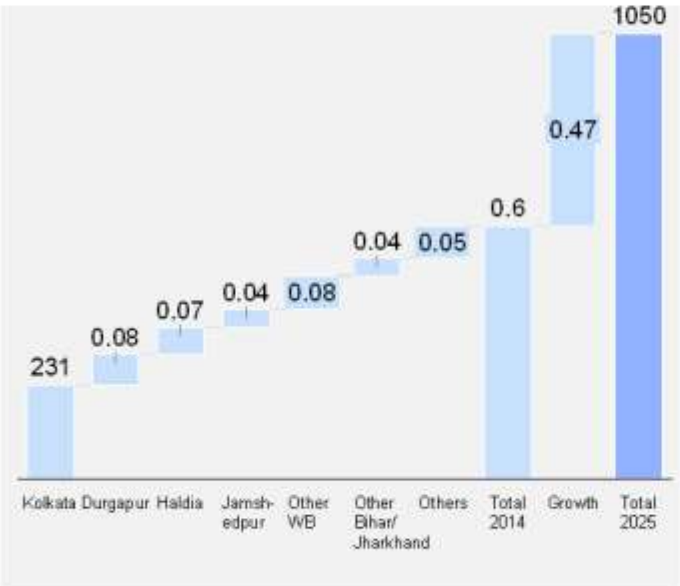
Kolkata is expected to handle around 0.7 to 0.8 mn TEUs by 2025. Further increase in traffic is limited by the port’s planned capacity of around 0.8 mn TEUs. Exhibits 103 to 105 show the current and projected container traffic shared between Kolkata and Haldia.

EXHIBIT 103

COMMODITY TRAFFIC | CONTAINER

Container traffic at Haldia and Kolkata port

Million TEUs



- Kolkata, Durgapur and Haldia is the primary hinterland for Haldia/Kolkata ports generating ~60% of total traffic
- Kolkata is expected to grow at 9-11% while most other hinterlands are expected to grow at 8-10% CAGR

SOURCE: APMT; India Port Statistics, Expert interviews

EXHIBIT 104

COMMODITY TRAFFIC | CONTAINER

West Bengal is the primary hinterland of Kolkata and Haldia port with small traffic from Bihar and Jharkhand

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Kolkata/ Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT

EXHIBIT 105

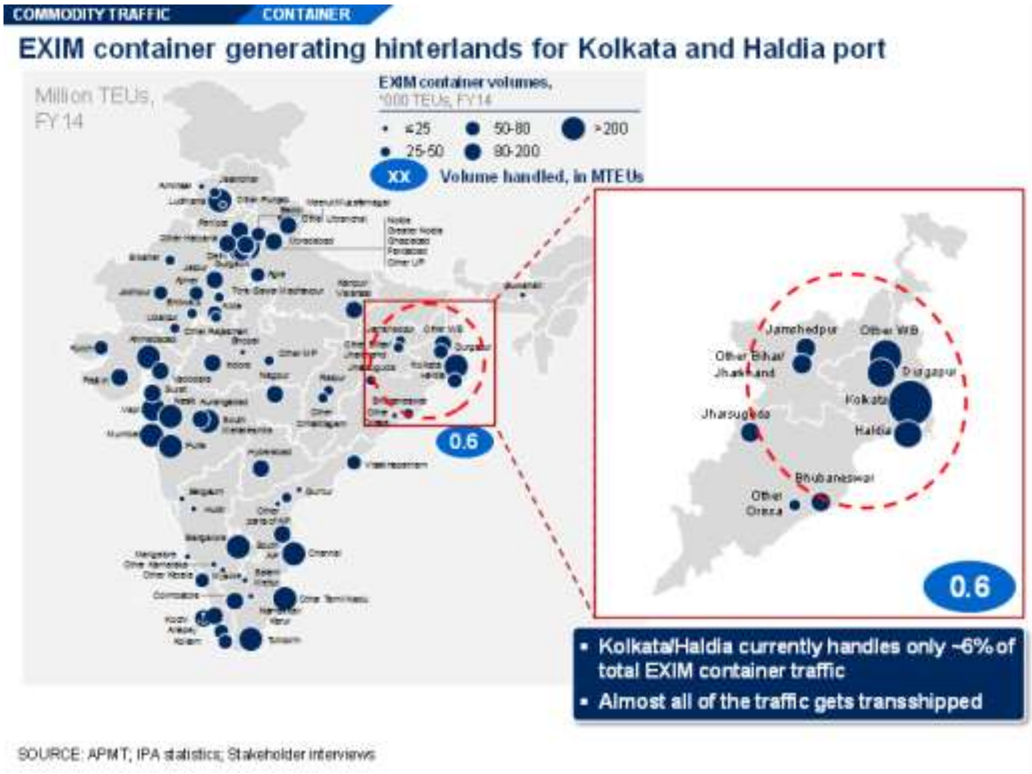


Exhibit 106 summarises traffic projections for all commodities at Kolkata port.

EXHIBIT 106

Kolkata Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	0.6	0.9	1.1	1.5	1.8	2.2	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	0.0	0.5	0.5	0.5	0.5	0.5	
Coking Coal	0.12	0.17	0.2	0.3	0.4	0.5	
Iron Ore	0.13	0.0	0.0	0.0	0.0	0.0	
Fertilizers	0.20	1.0	1.0	1.0	1.3	1.3	
Containers and other Cargo							
Containers (MnTEU)	0.53	0.65	0.7	0.8	0.8	0.8	• If any capacity constraints, some traffic may move to Dharma/ Haldia
Others	6.1	7.7	10.3	10.8	13.2	19.4	• Highly fragmented
Total (MMTPA)*	**15.3**	**20.3**	**23.9**	**26.4**	**29.5**	**36.2**	

Conversion Factor Used for Containers Projections 1 TEU = 15.4 Tons

* Currently, the port is limited by its capacity of ~20 MTPA. It has limited scope of expansion and will not be able to capture all of its traffic potential post 2025.

Meetings with the Kolkata port team:

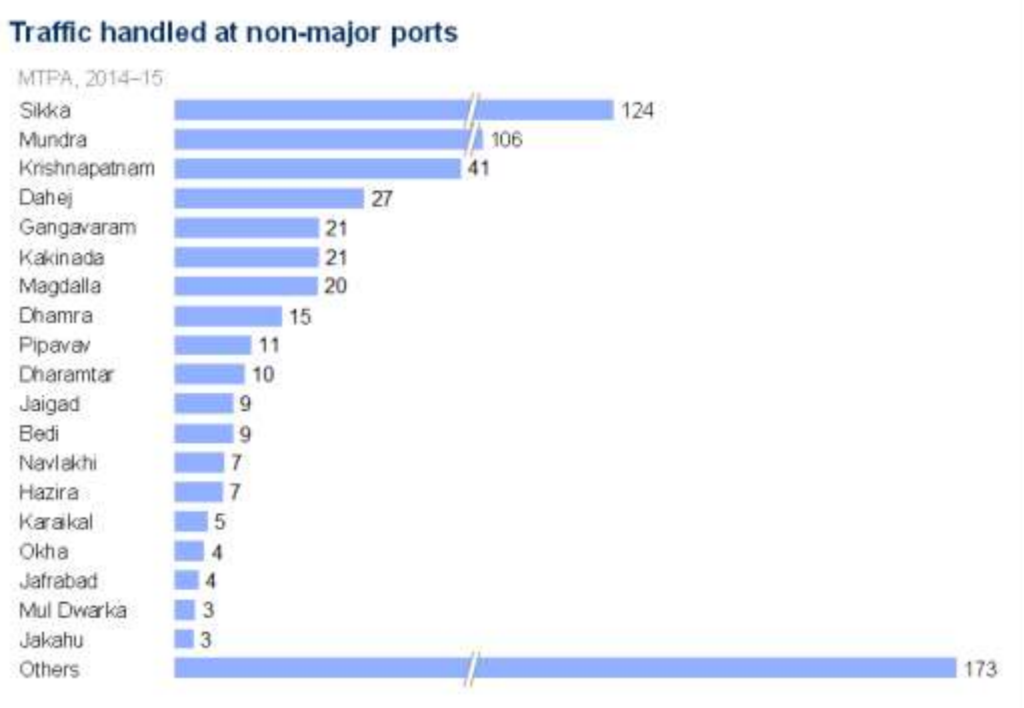
Date	Discussions held with
10th May, 2015	Vice Chairman
31st May–2nd June 2015	Dy Conservator
7th Aug, 2015	Deputy Chairman
1st–3rd Sept. 2015	Deputy Chairman, Traffic Manager
4th Sept, 2015	Chairman
13th Oct, 2015	Deputy Chairman, Traffic Manager
14th Oct, 2015	Traffic Manager
17th–18th Nov. 2015	Chairman, Deputy Chairman, Ports Team
1st–4th Dec. 2015	Ports Team
17th Dec. 2015	Deputy Chairman, Ports Team
5th Jan. 2016	Deputy Chairman, Ports Team
15th–16th Feb 2016	Dy Chairman, Ports Team
26th May, 2016	Ports team (Video conference)
13th May, 2016	Ports team (Video conference)
23th–24th June 2016	SG

Annexure 2: Non-major port traffic projections

TRAFFIC AT NON-MAJOR PORTS

In 2014–15, Indian ports handled around 1,050 MTPA of cargo, growing at the rate of 4.5 per cent per annum. Non-major ports handled around 471 MTPA[2] of cargo (around 45 per cent of the total cargo), while they cumulatively add up to a capacity of around 660 MTPA. Among non-major ports, 19 ports account for 70 per cent of the cargo handled (Exhibit 107).

EXHIBIT 107



Over the next decade, the following commodity-wise factors could drive the traffic at non-major ports:

- **POL:** Continual increase in import of POL products, coastal shipping of POL products to deficit centres, increase in demand of LNG and LPG and setting up of new refineries
- **Coal:** Growth in CIL's production, coastal shipping of thermal coal to serve power plants in coastal states
- **Bulk materials:** Coastal shipping of bulk commodities like cement and steel from production to consumption centres, capacity expansion of existing

2 Basic Port Statistics 2014–15

coastal steel plants driving demand for coking coal and setting up of new coastal capacities for cement and steel

- **Discrete manufacturing:** Increase in container traffic due to growth in the manufacturing sector and boost in EXIM trade

For arriving at the traffic projections for the ports, an OD analysis was done for the key commodities—including coal, POL, steel, cement, fertilisers, food grains and containers—which contribute around 85 per cent to the total port traffic. A cluster-wise view was taken into consideration to project commodity traffic for each port clusters, e.g., Dhamra, Gopalpur and Paradip which are proximate to each other have been treated as a single cluster. The following table shows the clusters and their corresponding major and non-major ports.

Table 1: Clusters and corresponding ports

S. No.	Cluster	Corresponding ports
1	West Bengal	Kolkata, Haldia
2	Odisha	Paradip, Dhamra, Gopalpur
3	Northern AP	Visakhapatnam, Gangavaram, Kakinada
4	Northern Tamil Nadu and southern AP	Krishnapatnam, Katupalli, Chennai, Ennore, Puducherry, Karaikal
5	Southern Tamil Nadu	Tuticorin
6	Kerala	Cochin
7	Karnataka	Mangalore, Belekeri
8	Southern Maharashtra and Goa	Mormugao, Vijaydurg, Jaigad
9	Northern Maharashtra	Mumbai, JNPT, Dighi
10	Southern Gujarat	Dahej, Magdalla, Hazira
11	Saurashtra	Navlakhi, Vadinar, Sikka, Pipavav
12	Kutch	Kandla, Mundra

The traffic assessed for the cluster has been further divided between the major and non-major ports present depending on factors like current traffic handled, optimal logistical flows, availability of infrastructure for handling the different types of cargo, vessel-handling capacity (draft), etc. Existing capacities, expansion announcements and competitive dynamics between the ports located within the same cluster have been accounted for arriving at the traffic potential.

In some cases, competing ports within a cluster have a clear advantage for certain hinterlands, e.g., coking coal imports for RINL steel plant can only be handled in Gangavaram because it is located right next to the plant. But in a majority of cases, such a precise allocation is not possible. In reality, competing ports' share will depend on a number of factors such as tariff, marketing and customer preferences, which cannot precisely be quantified. Given this, the focus is on allocation to a cluster with a high-level assessment of competitive position of ports within a cluster for each traffic item. Master-planning for major ports has been done considering the current capacity and expansion plans of non-major ports in order to avoid redundancy.

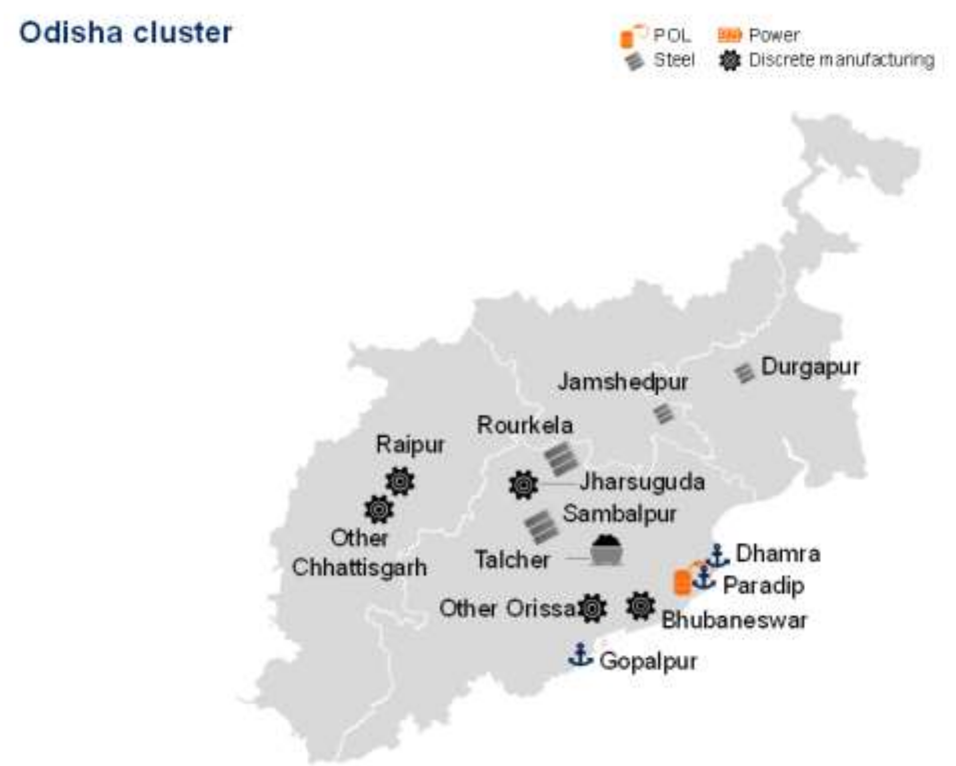
This sections describes the estimated traffic potential for ports currently handling cargo traffic greater than 10 MTPA (except Magdalla). These include the ports of Pipavav, Sikka, Mundra, Krishnapatnam, Dahej, Gangavaram, Kakinada, Dhamra and Gopalpur.

The subsequent section details the cargo traffic estimation for each cluster and the approximate split of the traffic shared by the non-major ports.

ODISHA CLUSTER: DHAMRA AND GOPALPUR PORTS

The cluster currently handles around 85 MTPA of cargo, with Paradip as the major port and Dhamra and Gopalpur as the non-major ports (Exhibit 108). Odisha, Chhattisgarh, Jharkhand and West Bengal are the key hinterlands for this cluster (Exhibit 108). Paradip is one of the largest major ports in the country by volume, handling more than 70 MTPA of cargo alone. Dhamra handled 15 MTPA of cargo in 2014–15 while Gopalpur resumed operations by the end of 2015 after a gap of two years. It has been shut down due to cyclone damage.

EXHIBIT 108



Main drivers of traffic for the ports in this cluster include:

- **Thermal coal:** The cluster is close to the coal reserves in the hinterland, primarily MCL. Currently, the cluster handles around 23 MTPA of outbound thermal coal for coastal shipping to the southern and western states of India (TANGENCO, APGENCO and NTPC). As MCL production picks up and the power sector grows with new power plants being commissioned, coastal shipping of thermal coal to power plants could reach around 100 to 130 MTPA by 2020. Total traffic potential for the cluster has been estimated to be around 160 to 180 MTPA by 2025. Thermal coal for non-power uses can also be linked to MCL and be coastally shipped, giving an additional upside of around 50 MTPA.
- **Coking coal:** The cluster currently imports more than 20 MTPA of coking coal for serving the demand of steel plants in the hinterland, including

Odisha, Chhattisgarh and West Bengal. With the planned capacity addition and new plants coming up in the hinterland, the total demand can reach around 35 to 40 MTPA by 2025. The cluster will need additional capacity for coking coal imports, and the ability to handle cape-size vessels.

The following table shows the distances from key cargo-generating/consuming hinterlands to the ports and vessel-handling capacity (drafts), which are some of the important factors for determining traffic potential of the ports.

Table 2: Draft and hinterland to port distances for key ports in the cluster

Parameters		**Ports**		
		Paradip	**Dhamra**	**Gopalpur (all road distances)**
Draft (m)		14	18.5	18.5
Distance from port to hinterland (km)	Raipur (rail)	706.8	779.65	586
	Bhubaneswar (road)	113	207	155
	Jharsuguda (road)	408	452	402
	Durgapur (rail)	626.75	488.89	621
	Jamshedpur (rail)	506.94	369.08	503
	Rourkela (rail)	496.12	532.5	458
	Sambalpur (rail)	355.87	428.72	350
	Talcher (rail)	191.62	264.47	249

The total traffic for thermal coal and coking coal for the cluster has been projected to be around 160 to 180 MTPA and around 35 to 40 MTPA respectively by 2025. Of this, around 135 to 142 MTPA of thermal coal (loading), 5 MTPA of thermal coal (unloading) and 4.8 to 5 MTPA of coking coal has been allocated to Paradip, considering the relative distances from hinterland to competing ports, vessel-handling capacity and competitive dynamics between the ports. Dhamra and Gopalpur have been allocated the balance traffic.

Dhamra and Gopalpur would share the coastal outbound traffic of thermal coal from MCL to coastal states. Dhamra currently handles around 5.8 MTPA of thermal coal imports, which is expected to reduce in future as CIL production increases. However, the current traffic of around 5.8 MTPA of coking coal import at Dhamra is expected to rise to roughly 9 to 10 MTPA by 2020 and 13 to 14

MTPA by 2025, driven by the expansion of TATA Kalinganagar and Bhushan Steel Meramandli. No traffic of coking coal is expected at Gopalpur unless nearest ports have congestion on delivering coking coal through rail.

The following table shows the traffic projections for key commodities at Dhamra and Gopalpur ports.

Units: MMTPA (except Containers)

Dhamra Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Bulk cargo					
Thermal Coal (Loading)	0	5-10	8-12	12-20	• Driven by coastal shipping from MCL to coastal states
Thermal Coal (Unloading)	5.8	3-4	3-4	6-8	• Imported Coal for power likely to be reduced as CIL production increases
Coking Coal	5.83	9-10	13-14	23-27	• Driven by expansion of TATA Kalinganagar and Bhushan Steel Meramandli

Units: MMTPA (except Containers)

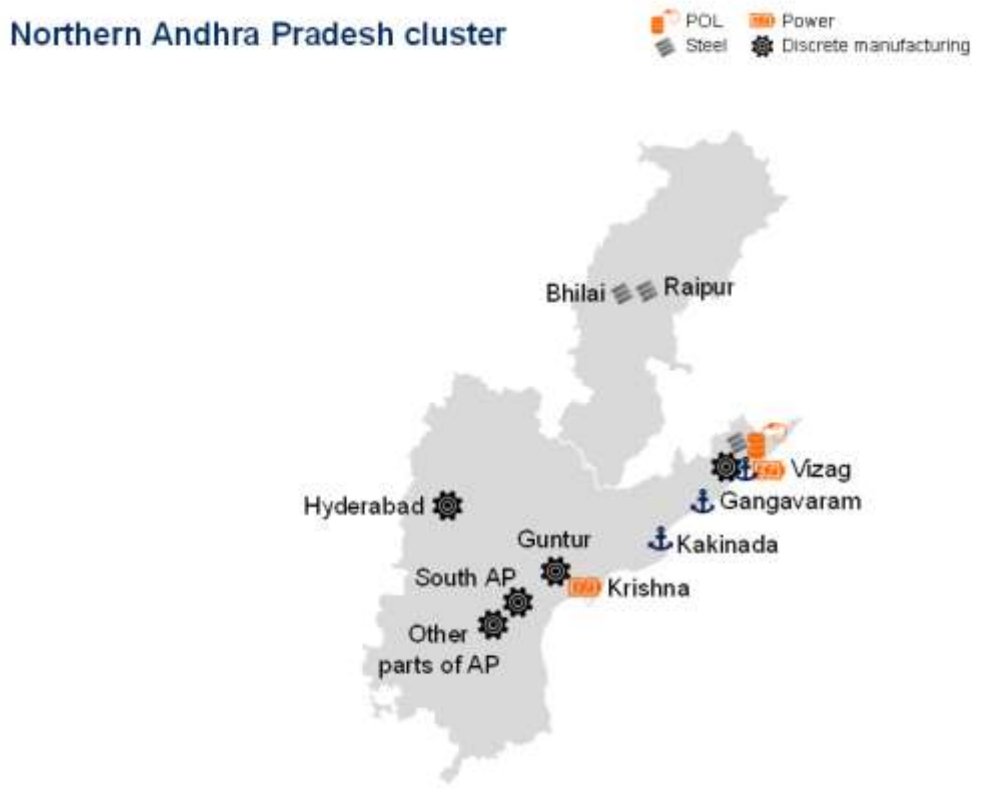
Gopalpur Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Bulk cargo					
Thermal Coal (Loading)	0	15-18	23-25	34-36	• Driven by coastal shipping from MCL to coastal states
Thermal Coal (Unloading)	0	0	0	0	
Coking Coal	0	0	0	0	• No traffic unless nearest ports have congestion on delivering coking coal through rail

NORTHERN AP CLUSTER: GANGAVARAM AND KAKINADA PORTS

This cluster has the Visakhapatnam as the major port and Gangavaram and Kakinada (for anchorage and deep water) as the non-major ports. Primary hinterland for these ports include Andhra Pradesh, Telangana, Chhattisgarh, Madhya Pradesh and southern Odisha (Exhibit 109). Visakhapatnam is the fifth largest major port in the country handling approximately 58 MTPA of cargo. In 2014–15, Gangavaram and Kakinada together handled around 21 MTPA of cargo —Kakinada deep water handled 18 MTPA and Kakinada anchorage handled 3 MTPA.

EXHIBIT 109



Main drivers of traffic for the ports in this cluster include:

- **POL:** Visakhapatnam port is the anchor customer for POL and handles roughly 15 MTPA of POL, which comprises approximately 8 MTPA of crude import and balance exports of products from the HPCL refinery. Expansion of HPCL in the future will lead to a traffic of roughly 21 MTPA by 2020 and 28 to 29 MTPA by 2025. An LNG terminal with a capacity of 5 MTPA is expected to come up in Kakinada by 2025.
- **Thermal coal:** Ports of this bulk-oriented cluster serve multiple power plants in the hinterland that require thermal coal. In 2014–15, the three ports handled a total of around 24 MTPA of coal, including around 3 MTPA of coastal coal export from Visakhapatnam for TANGENCO plants in Tamil Nadu. Thermal coal customers include NTPC Simhadri, APGENCO and

other captive power units of steel and power plants. The total coal traffic is expected to touch around 35 to 40 MTPA by 2025, based on the expansion plans of power plants in the hinterland.

- **Coking coal:** Coking coal customers include RINL, SAIL Bhilai, Tata Steel and JSPL. Other consumers of coking coal include Uttam Galva Metallics, Jayswal Neco and Bhushan Power and Steel Limited. This port cluster handled around 11 MTPA of coking coal in 2014–15. Driven by the expansion of the steel plants in the hinterland, this traffic is expected to reach roughly 25 MTPA by 2025.
- **Fertilisers:** The port cluster imports fertilisers and raw materials for fertilisers to serve the demand in the hinterlands of Andhra Pradesh, Telangana, Madhya Pradesh and Chhattisgarh. Part of the raw material for fertilisers is used in the DAP, NPK, urea and AS fertiliser plants in Andhra Pradesh, while the rest is sent to plants in Uttar Pradesh. The overall volume of fertiliser and fertiliser raw material in this port cluster is expected to increase to around 8 MTPA by 2020 and 11 MTPA by 2025.

The following table shows the distances from key cargo-generating/consuming hinterlands to the ports and the vessel-handling capacity (drafts), which are some of the important factors for determining the traffic potential of the ports.

Table 3: Draft and hinterland to port distances for key ports in the cluster

Parameters		**Ports**		
		Visakhapatnam	**Gangavaram**	**Kakinada**
Draft (m)		18.1	21	10
Distance from port to hinterland (km)	Raipur (rail)	527.89	534.44	685.83
	Bhilai (rail)	551.43	557.98	709.37
	Visakhapatnam (road)	17.2	10.8	160
	Guntur (road)	400	393	256
	Hyderabad (road)	634	596	489
	Hyderabad (rail)	706.26	701.94	576.9
	Krishna (rail) (Vijayawada)	358.87	354.55	229.51

The total traffic of thermal coal (unloading), coking coal and fertilisers for this port cluster is estimated to be around 35 to 40 MTPA, 33 to 35 MTPA and 11

MTPA respectively for 2025. Of this, roughly 16 to 17 MTPA of thermal coal (unloading), 20 to 22 MTPA of coking coal imports and 5 MTPA of fertilisers has been allocated to Visakhapatnam considering the relative distances from hinterland to competing ports, vessel-handling capacity and competitive dynamics between the ports. Gangavaram and Kakinada have been allocated the balance traffic.

Gangavaram is expected to handle around 16 to 18 MTPA of thermal coal (unloading) traffic by 2025 driven by coastal shipping from MCL to serve the demand of power plants in the hinterland. Existing traffic of around 2.7 MTPA of thermal coal (unloading) at Kakinada is expected to move to the central AP port by 2025. Coking coal import traffic at Gangavaram is expected to grow to around 13 to 14 MTPA by 2025, driven by the expansion of SAIL Bhilai, RINL and Nagarnar Chhattisgarh, while no traffic has been projected for Kakinada. When the LNG terminal at Kakinada is operational, LNG traffic could increase to around 3 to 5 MTPA by 2025.

The following table shows the traffic projections for key commodities at Gangavaram and Kakinada ports.

Units: MMTPA (except Containers)

Gangavaram Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Bulk cargo					
Thermal Coal (Loading)	0	0	0	0	
Thermal Coal (Unloading)	9.5	13-15	16-18	27-32	• Driven by coastal shipping from MCL
Coking Coal	5.2	9-10	13-14	22-26	• Driven by expansion of SAIL Bhilai, RINL and Nagarnar Chhattishgarh
Fertilizers	0.6	0.7	0.9-1.1	1.3-1.9	

Units: MMTPA (except Containers)

Kakinada Port - Traffic Projections

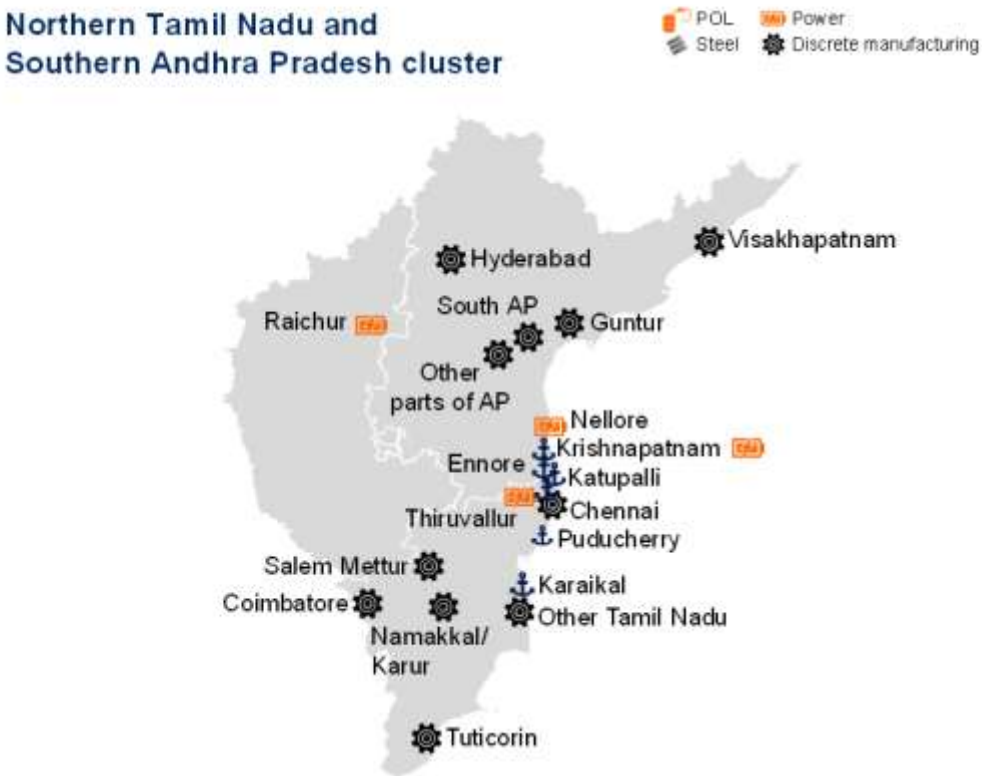
Commodity	2014-15	2020	2025	2035	Remarks
Liquid Cargo					
POL	0	0	3-5	4-5	• 5 MTPA from LNG import terminal at Kakinada at full capacity
Bulk cargo					
Thermal Coal (Loading)	0	0	0	0	
Thermal Coal (Unloading)	2.7	3.5-4.5	0	0	• Unloading traffic expected to move to proposed central AP port 2025 onwards
Coking Coal	0	0	0	0	
Break bulk	21	24-28	31-38	46-67	

NORTHERN TAMIL NADU AND SOUTHERN AP CLUSTER: KRISHNAPATNAM PORT

Chennai and Ennore are the major ports in this cluster with Krishnapatnam, Katupalli and Karaikal as the non-major ports and Cuddalore as the proposed port (among others). Chennai is one of the largest major ports in the southern part of the country currently handling more than 50 MTPA of traffic.

Tamil Nadu, Karnataka, southern Andhra Pradesh and parts of Telangana form the primary hinterland for this cluster (Exhibit 110). Chennai, as a city port, handles containers, while Ennore and Krishnapatnam ports predominantly handle bulk cargo. In 2014–15, Krishnapatnam and Karaikal handled 41 MTPA and 5 MTPA of cargo respectively.

EXHIBIT 110



Main drivers of traffic for the ports in this cluster include:

- **POL:** The 3.2 MPTA of POL handled at Ennore port comprise POL (1.90 MTPA) and LPG (1.30 MTPA). By 2020, the total POL traffic could reach 7.8 MT, without taking into account the incremental imports by Shell, Reliance or Essar for marketing purposes, as also normal growth. Chennai port currently handles 12.7 MTPA of POL, the majority of which is crude import for the CPCL Manali refinery. The port also exports roughly 1 MTPA of products from the same refinery and receives roughly 1.5 MTPA of products to cater to the specific demands of the Chennai cluster. The overall traffic at the port is pegged to increase to 14 MTPA by 2020. By 2025, the natural growth of this traffic will take the volumes to around 18 to 19 MTPA and 30 to 35 MTPA by 2035. However, the non-major port of Krishnapatnam is not expected to handle any traffic of POL.

- **Thermal coal:** Bulk ports in the cluster currently handle 50 MTPA of coal, including imported coal and domestic coastal coal. Ennore, Krishnpatnam and Karaikal handled around 24 MTPA, 25.4 MTPA and 1.2 MTPA respectively. Most of this is for thermal power plants in the cluster. The total traffic of thermal coal in the cluster is expected to reach around 70 to 80 MTPA by 2020.
- **Containers:** Chennai port handles more than 95 per cent of the total container volume of around 1.7 mn TEUs, while Krishnapatnam handles around 80,000 TEUs. The main hinterlands that the port serves for containers are Chennai and nearby SEZs (around 1 mn TEUs), Banagalore (around 150,000 TEUs), southern AP and Hyderabad (around 100,000 TEUs) and a part of southern Tamil Nadu (around 200,000 TEUs). A large portion of the traffic (around 60 per cent) is transshipped from the port to other ports in Southeast Asia, like Colombo and Singapore.

  By 2020, container volume is expected to reach nearly 2.32 mn TEUs and 3 mn TEUs by 2025. The cluster has sufficient capacity for container handling, with Krishnapatnam and Ennore also adding capacity. In the first phase, Adani Ennore Container Terminal Private Ltd. (AECTPL) will construct a 400-m-long berth with the capacity to handle 0.8 mn TEU. In the second phase, another 330-m-long extension of the berth will be carried out with a capacity to handle additional 0.6 mn TEU.

  In case a new transshipment hub comes up on the southern tip of the country, most of the south Tamil Nadu containers will go there directly, causing a 0.7 mn TEUs drop in potential traffic by 2025.

The following table shows the distances from key cargo-generating/consuming hinterlands to the ports and vessel-handling capacity (drafts), which are some of the important factors for determining traffic potential of the ports.

Table 4: Draft and hinterland to port distances for key ports in the cluster

Parameters		Ports					
		Chennai	Ennore	Krishna-patnam	Katupalli	Karaikal	Cuddalore /Sirkazhi
Draft (m)		16.50	13.50	18	14	n/a	n/a
Distance from port	Hyderabad (road)	572	622	478	628	906	791

to hinter-land (km)	Raichur (rail)	575.13	592.13	563.13	587.5	917.73	770.23
	Guntur (road)	417	411	267	417	713	598
	Nellore (rail)	177.71	161.67	49.55	153.48	532.29	384.79
	Chennai (road)	5.2	27.1	176	33.1	312	197
	Thiruvallur (road)	49.4	48.8	162	54.8	323	208
	Salem (road)	350	372	469	378	264	205
	Coimbatore (road)	513	534	630	540	359	367
	Namakkal (road)	396	417	521	423	227	243

The traffic of thermal coal in the cluster is expected to reach around 70 to 80 MTPA by 2020. Container traffic is expected to reach 2.4 mn TEUs by 2020 and 3.2 to 3.7 mn TEUs by 2025. Of the thermal coal traffic, Ennore port is expected to handle around 40 MTPA of thermal coal (unloading) by 2020, while Krishnapatnam, Karaikal and Katupalli ports will handle the balance traffic, considering the relative distances from hinterland to competing ports, vessel-handling capacity and competitive dynamics between the ports. Of the container traffic projections of 2025, it is expected that Chennai and Ennore ports together will handle around 3 to 3.5 mn TEUs of containers, while Krishnapatnam will handle the balance.

The following table shows the traffic projections for key commodities at Krishnapatnam port.

Units: MMTPA (except Containers)

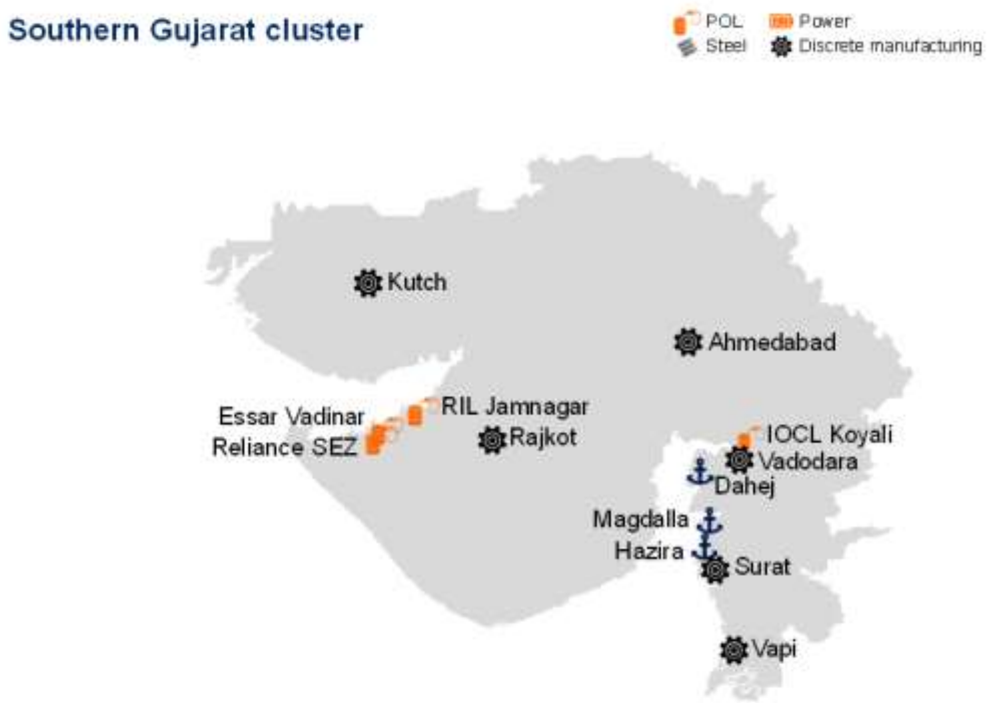
Krishnapatnam Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Bulk cargo					
Thermal Coal (Loading)	0	0	0	0	
Thermal Coal (Unloading)	25.4	40-45	51-56	84-102	• Driven by coastal shipping from MCL and growth of non-power based coal consumption
Container cargo					
Containers (Mn TEUs)	0.08	0.1-0.12	0.15-0.19	0.25-0.34	• If southern transshipment hub comes up, part of the container cargo will move there resulting in reduction in the estimated traffic

SOUTHERN GUJARAT CLUSTER: DAHEJ PORT

This cluster consists of three main ports—Dahej, Hazira and Magdalla (Exhibit 111). In 2014–15, Dahej, Magdalla and Hazira handled 27 MTPA, 20 MTPA and 7 MTPA of cargo respectively.

EXHIBIT 111



Main drivers of traffic for the non-major ports in this cluster include:

- **POL:** The demand for gas is expected to go up in Gujarat—supported by the expansion of the LNG terminal in Dahej from the current capacity of 10 MTPA to 17.5 MTPA. At Hazira, it could expand by 2.5 MTPA. Hence, an additional 10 MTPA of LNG importing facilities will be required at these two ports.
- **Coal:** The cluster handled around 21 MTPA of thermal coal in 2014–15 catering to non-power customers in the hinterland.

The following table shows the distances from key cargo-generating/consuming hinterlands to the ports and vessel-handling capacity (drafts), which are some of the important factors for determining the traffic potential of the ports.

Table 5: Draft and hinterland to port distances for key ports in the cluster

Parameters		Ports		
		Dahej	Magdalla	Hazira
Draft (m)		14	10 (at present, plans to make it 14)	14
Distance from port to hinterland (km)	Ahmedabad (road)	208	261	290
	Vadodara (road)	109	148	177
	Koyali (road)	119	159	187
	Surat (road)	123	3.9	31.5
	Vapi (road)	214	120	142
	Rajkot (road)	354	444	473

Considering the relative distances from hinterland to competing ports, vessel-handling capacity and competitive dynamics between the ports, the traffic for thermal coal has been split between the ports of Dahej, Magdalla and Hazira.

Dahej is expected to handle around 20 to 24 MTPA of thermal coal (unloading) driven primarily by the growth in non-power based consumption of coal and imported coal for power plants. The port is also expected to handle around 16.5 to 18 MTPA of LNG based on the expected expansion of the LNG terminal.

The following table shows the traffic projections for key commodities at Dahej port.

Dahej Port - Traffic Projections

Units: MMTPA (except Containers)

Commodity	2014-15	2020	2025	2035	Remarks
Liquid Cargo					
POL	10.5	12-15	16.5-18	18-20	• Projections based only on expected expansion of LNG terminal at Dahej
Bulk cargo					
Thermal Coal (Loading)	0	0	0	0	
Thermal Coal (Unloading)	13.2	15-17	20-24	33-46	• Driven by growth primarily in non-power based consumption of coal and imported coal for power plants

SAURASHTRA CLUSTER: SIKKA AND PIPAVAV PORTS

This cluster has ports of Sikka, Vadinar, Navlakhi and Pipavav (Exhibit 112). Sikka and Vadinar handle POL primarily while Pipavav handles containers. In 2014–15, Sikka handled around 124 MTPA of cargo followed by Pipavav and Navlakhi handling around 11 MTPA and 7 MTPA respectively. Vadinar comes under the purview of Kandla port.

EXHIBIT 112

The main drivers of traffic for the ports in this cluster include:

- **POL:** Vadinar and Sikka together handle nearly 180 MTPA of POL. Sikka is a captive port feeding the refineries at Reliance SEZ and Jamnagar. It currently handles around 125 MTPA of POL, importing around 75 MTPA of crude and exporting around 50 MTPA of POL products. Vadinar caters to the Essar refinery as also the Panipat, Koyali, Mathura and Bina refineries. With planned expansion of these refineries, additional crude handling capacity of around 15 MTPA will be required primarily at Vadinar port. LPG imports could go up to roughly 2 MTPA from the current 0.3 MTPA, requiring new LPG import facilities.
- **Container:** Pipavav port, currently handles around 0.7 mn TEUs of container traffic. It is operated by APM Terminals, is the container-handling port in the Saurashtra region. Its hinterland includes southern Gujarat and northern India. NCR, Punjab and UP contribute around 0.44 mn TEUs of this traffic while Gujarat contributes around 0.17 mn TEUs. Rajasthan and

parts of Madhya Pradesh contribute to the remaining traffic. The container traffic at the port is expected to increase to nearly 1.4 to 1.6 mn TEUs by 2025.

The following table shows the traffic projections for key commodities at Sikka and Pipavav ports.

Units: MMTPA (except Containers)

Sikka Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Liquid cargo					
POL	124	125-130	130-135	140-145	▪ Overseas loading would translate into coastal loading as private refineries ship product for domestic usage as against selling in foreign markets

Units: MMTPA (except Containers)

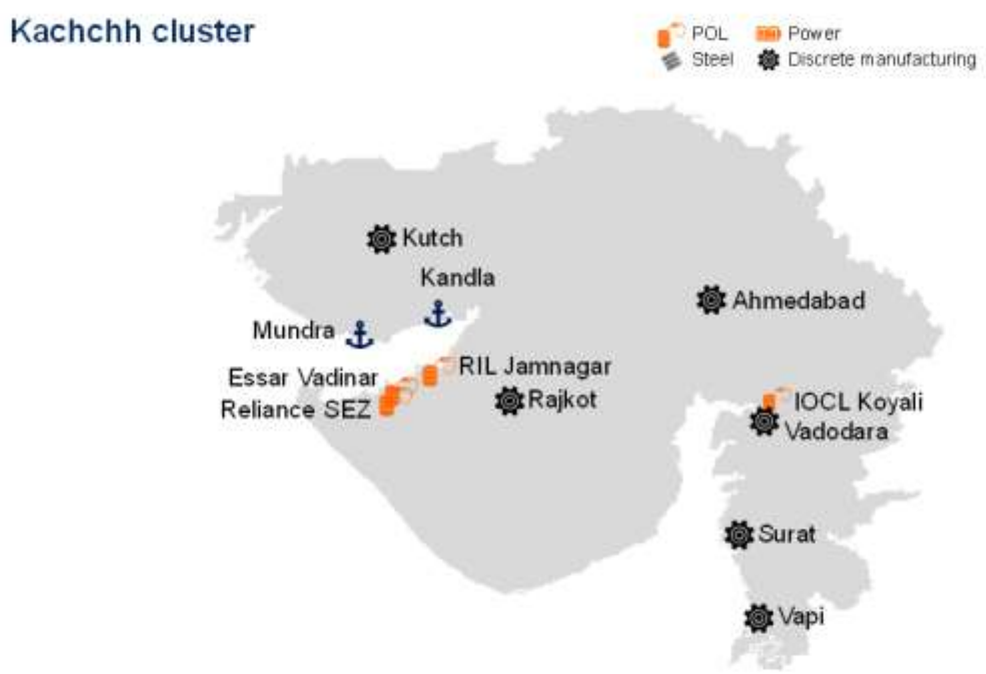
Pipavav Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Container cargo					
Containers (Mn TEUs)	0.74	1-1.1	1.4-1.6	2.3-2.9	▪ Driven by growth of northern hinterland and Gujarat

KUTCH CLUSTER: MUNDRA PORT

Kandla and Mundra are the two prominent ports in this cluster. The geospatial location of the cluster positions it ideally to handle traffic from the northern and north-western parts of India (Exhibit 113). This cluster is closest to the northern states, which is a large hinterland for both containers and POL. Kandla is a major port handling POL, dry bulk and other break bulk commodities. Most of the POL is handled at Vadinar which is in the Saurashtra cluster but comes under the purview of Kandla port. Mundra port handles containers, dry bulk and liquid cargo, catering to Gujarat and the northern hinterland. In 2014–15, Mundra handled around 106 MTPA of cargo.

EXHIBIT 113



Main drivers of traffic for the ports in this cluster include:

- **POL:** POL crude and product constitute the biggest portion of traffic handled in this cluster. Kandla handles roughly 2 MTPA of POL while Vadinar handles the majority of the traffic. Mundra port has been taking away the POL traffic from Kandla, handling around 20 MTPA of crude for HPCL and IOCL, through long-term agreements. This crude traffic is expected to go up as the Bathinda refinery expands, thereby requiring additional storage capacities at Mundra port. Similarly, additional product berthing and handling capacity of around 10 MTPA will be required at Mundra port because deregulation of MS/HSD prices will make private refineries move their product to the domestic market to serve the North-Indian deficit. LPG imports at Mundra and Kandla are also expected to increase by roughly 4 to 5 MTPA in the next 10 years.

- **Coal:** Currently, Kandla port imports 9.7 MTPA of thermal coal primarily for the consumption of non-power plants. This is expected to grow at a healthy rate of 10 to 15 per cent given the port already has developed a mega coal terminal at Tuna Tekra, with further plans of expansion through a mega bulk terminal outside the creek. Mundra port currently handles around 40 MTPA of coal, with the thermal coal as the majority at 38 MTPA. Imported thermal coal is used to feed thermal power plants in the hinterland, e.g., Adani Power and Tata Power. The thermal coal traffic at Mundra port is expected to reach nearly 51 to 57 MTPA by 2025 driven by coastal shipping from MCL, growth of imported coal and non-power based coal consumption. Total volumes handled by the cluster are expected to be approximately 55 MTPA by 2020, 65 MTPA by 2025 and 80 to 90 MTPA by 2035.
- Container: The cluster serves as a gateway for container cargo of Gujarat and northern India. Mundra currently handles around 2.7 mn TEUs, which is expected to grow to roughly 4.5 to 5.2 mn TEUs by 2025, driven by growth of Gujarat and northern India hinterlands. Kandla currently does not handle container traffic. However, container volumes can reach nearly 0.2 mn TEUs by 2025 in the base case as a result of the resolution of issues with the earlier concessionaire. In the optimistic case, when the Tuna Tekra terminal gets fully operational, container volumes at Kandla can reach roughly 1.7 mn TEUs.

The following table shows the traffic projections for key commodities at Mundra port.

Units: MMTPA (except Containers)

Mundra Port - Traffic Projections

Commodity	2014-15	2020	2025	2035	Remarks
Liquid Cargo					
POL	22.6	23-27	25-27	30-32	• Driven by expansion of Bathinda refinery
Bulk cargo					
Thermal Coal (Loading)	0	0	0	0	
Thermal Coal (Unloading)	38.9	40-41	51-57	85-103	• Driven by coastal shipping from MCL, growth of imported coal and non-power based coal consumption
Container cargo					
Containers (Mn TEUs)	2.71	3.5-3.7	4.5-5.2	7.5-9.3	• Driven by growth of Gujarat and northern hinterland

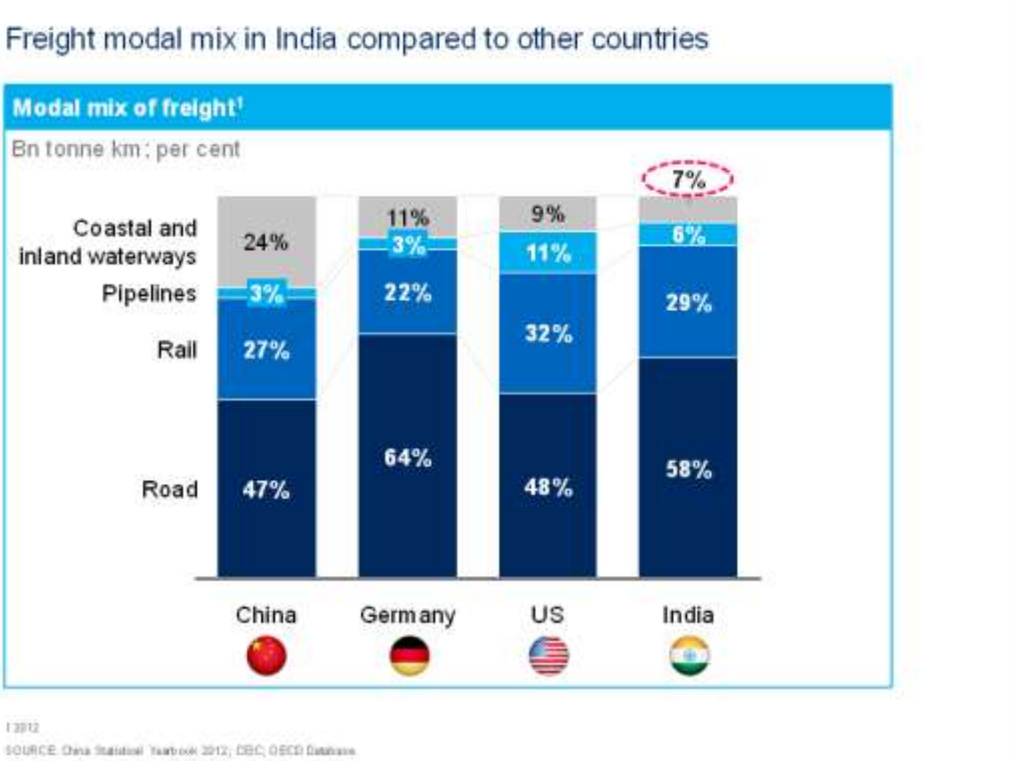
Meetings with non-major ports

Port	Contact	Month
Jaigad	Mr. Sarma	Oct, 2015
Mundra	Mr. Sinha	Feb, 2016
Dhamra	Mr. Mohapatra	May, 2015
Krishnapatnam	Mr. Anil	Sept, 2015
Gangavaram	Mr. Naik	Sept, 2015
Kattupali	Mr. Venkatesh	May, 2015
Karaikal	Mr. Pranoy	Sept, 2015
Dighi	Mr. Kalantri	June, 2015
Pipavav	Mr. Dedenis	Aug, 2015

Annexure 3: Inland waterways

India has an extensive but under-utilised network of inland waterways in the form of rivers, canals, backwaters and creeks. Of the total navigable length of 14,500 km, 5,200 km of rivers and 4,000 km of canals can be used by mechanised craft. While domestic waterways are globally seen as a cost-effective and environment-friendly means of transporting freight, the freight modal mix in India is heavily skewed towards land transport—around 90 per cent of freight moves via land. This does not make sufficient use of the 7,500-km-long Indian coastline and waterways. In contrast, China moves 24 per cent of freight cargo through its waterways (Exhibit 114).

EXHIBIT 114



India has five national waterways (NW) (Exhibit 115). Of these, NW1, 2 and 3 see a fair amount of cargo traffic (Exhibit 116). In 2013–14, NW1 alone transported around 33 lakh tonnes of the total waterway traffic of 69 lakh tonnes.

Tapping the national waterways will help to ease the passage of freight in India, especially in congested regions. Traffic potential of NW 1, 2, 3, 4 and 5 along with the eight waterways identified for development have been estimated and is discussed subsequently. The Indian Parliament passed a bill in 2016 to convert 106 inland waterways to national waterways. Furthermore, the India–Bangladesh agreement on coastal shipping and waterways has been studied to leverage the potential of the north-eastern waterways.

EXHIBIT 115

National Waterways of India

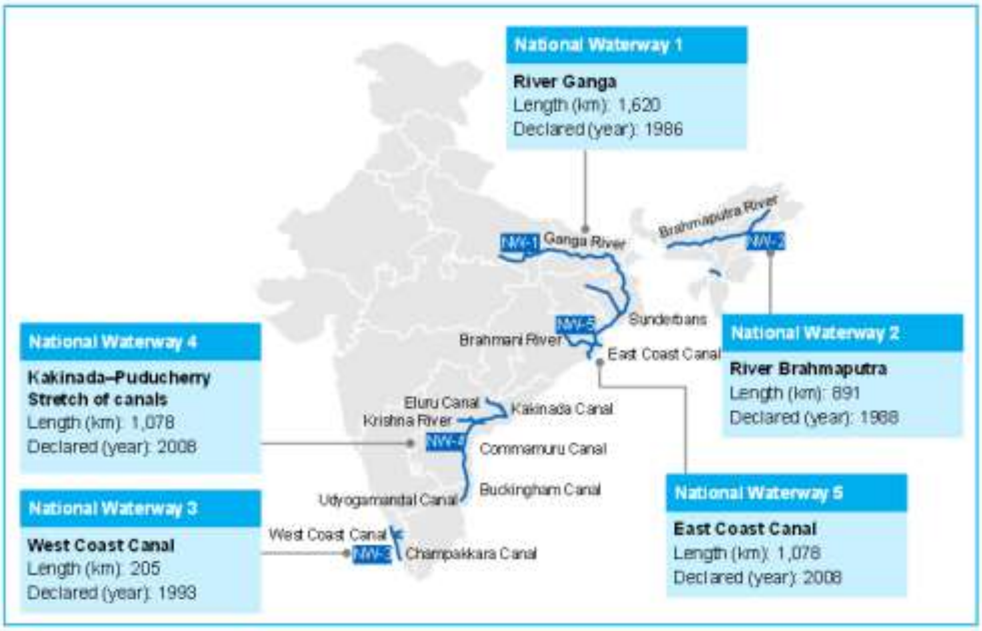
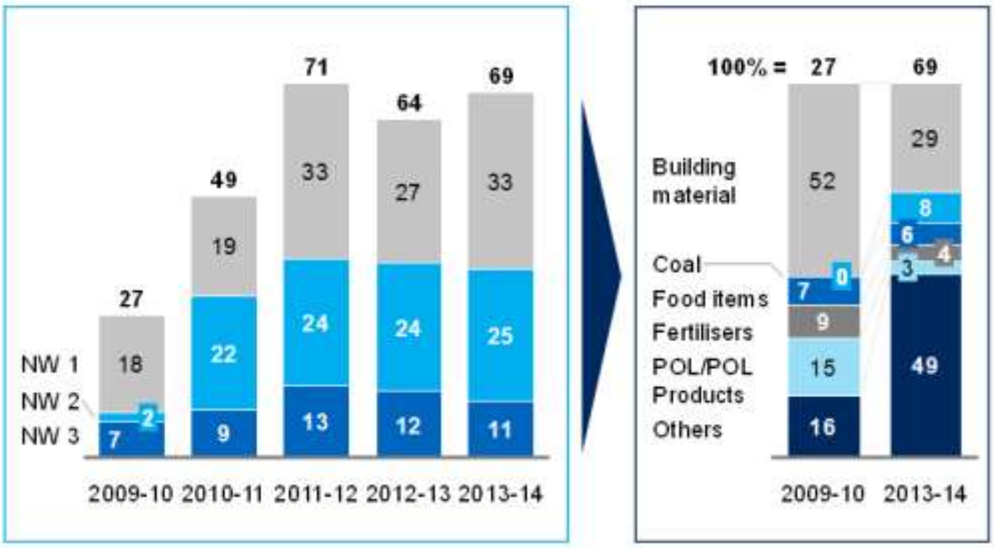


EXHIBIT 116

Cargo movement on National Waterways 1, 2 and 3

Lakh tonnes



NATIONAL WATERWAY 1

This 1,620-km long stretch of water connects Allahabad in Uttar Pradesh and Haldia in West Bengal (Exhibit 117). It can cater to the movement of coal from the Rajmahal Mines. It can also help to transport containers between Nepal, Kanpur, Varanasi and parts of Bihar to Kolkata or Haldia; cement from Varanasi to Patna and Patna to Kalughat; fertilisers from Patna and Varanasi to Haldia. Exhibit 118 shows the potential traffic identified for NW1.

EXHIBIT 117

National Waterway 1

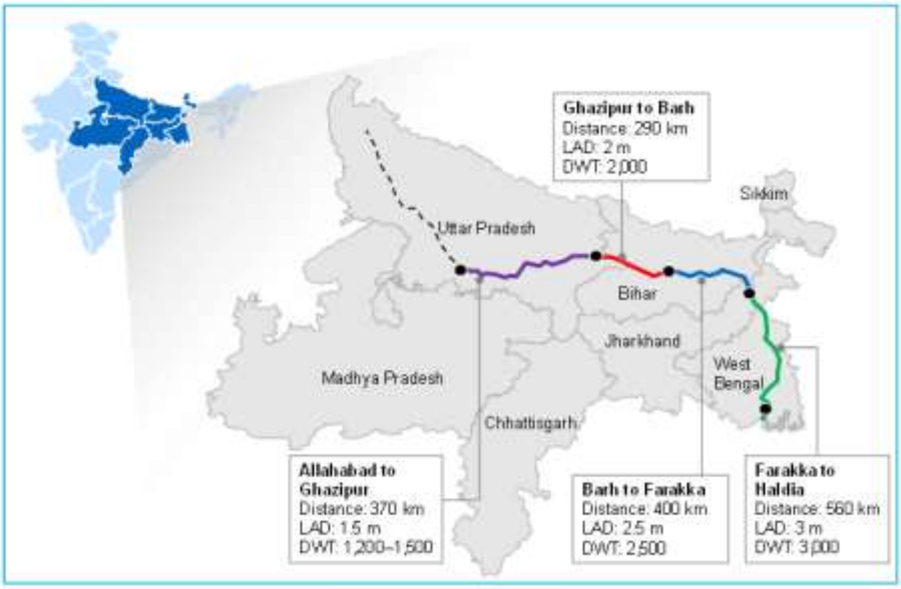
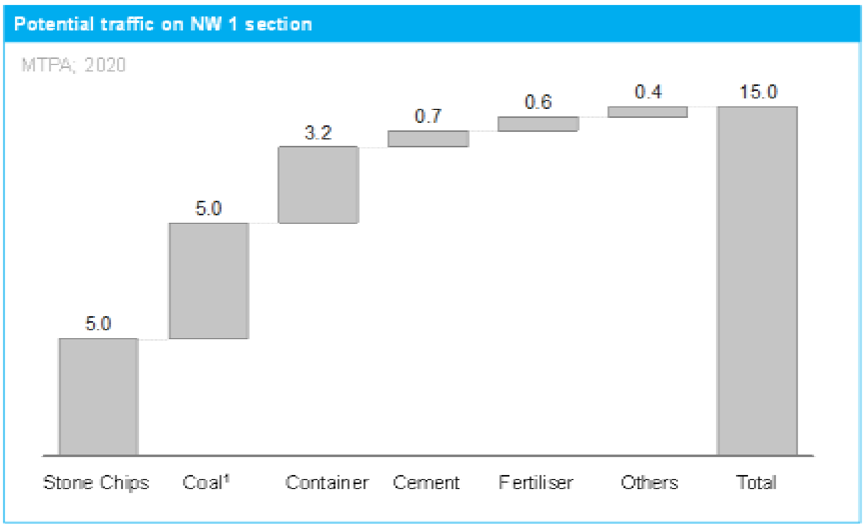


EXHIBIT 118

National Waterway 1 traffic potential



1 Container Potential: 210,000 – 220,000 TEUs; Conversion Factor: 1 TEU = 15 tonnes

SOURCE: IWAI

NATIONAL WATERWAY 2

Located between the India–Bangladesh border (Dhubri to Sadiya), this stretch of waterway on the Brahmaputra river is around 891 km long (Exhibit 119). NW2 along with the India-Bangladesh protocol routes can cater to traffic movement between the north-eastern states and the rest of India. This could be facilitated by the Indo-Bangladesh agreement on coastal shipping and waterways.

EXHIBIT 119

India–Bangladesh agreement on coastal shipping and waterways

India and Bangladesh have signed an agreement on coastal shipping and extended protocol on inland water transit and trade. This agreement is applicable for the operation of inland vessels on the river protocol routes between the river ports of Haldia, Kolkata, Pandu, Karimganj and Silghat in India and Narayanganj, Khulna, Mongla, Sirajganj and Ashuganj in Bangladesh.

Smooth coastal shipping between India and Bangladesh will enable the movement of cargo to the Northeast through coastal shipping up to Chittagong and thereafter by road or inland waterways. The deep draft ports on the eastern coast of India can be “hub ports” for the onward transportation of cargo to Bangladesh, via the coastal mode through river sea vessel (RSV) category of vessels. Setting up this system would help to decongest the Siliguri corridor, Land Customs Stations and integrated check-posts at the India–Bangladesh border.

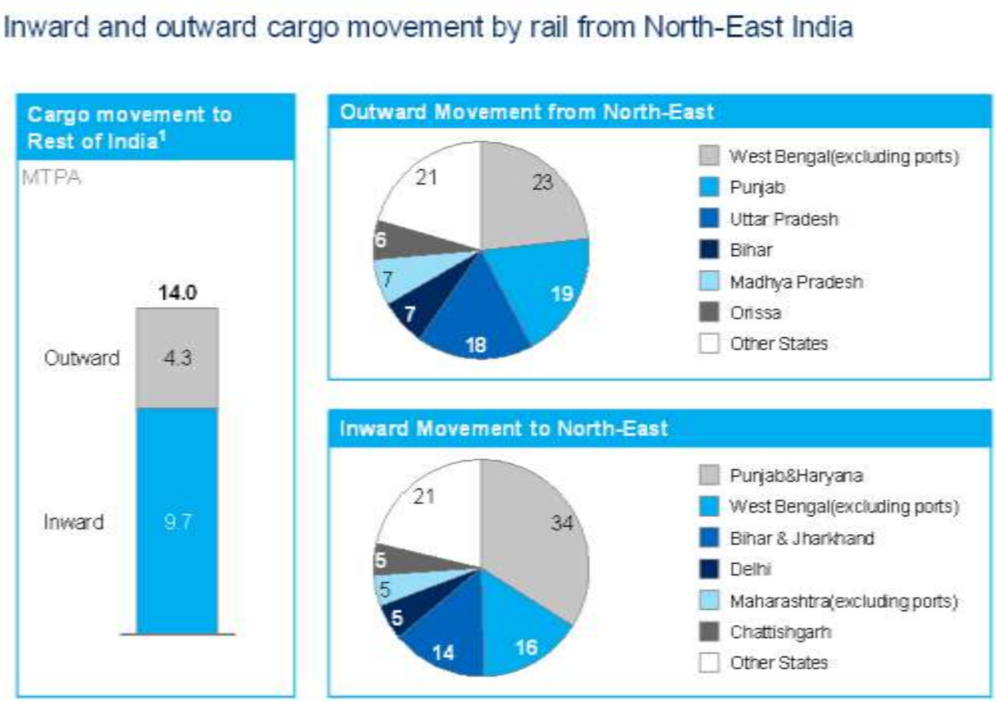
In 2013–14, of the total of 1.8 mn tonnes of cargo moved on the India–Bangladesh protocol route, about 98 per cent was fly ash transported from Kolkata to various river ports in Bangladesh. Remaining traffic included the occasional movement of over-dimensional cargo (ODC).

Traffic estimation

Cargo movement by rail between the north-eastern states and the rest of India causes congestion in the Siliguri Corridor. Rail moved around 9.7 MTPA of inward cargo and 4.3 MTPA of outward cargo between the north-eastern states and the rest of India (Exhibits 120 and 121). Major incoming commodities include rice, marble and stones, wheat, cement, sugar, while major outgoing commodities are coal and coke, mineral oils, bamboo, cement, limestone, paper.

Of the overall 14 MTPA movement, around 5 MTPA traffic moved to and from coastal regions by rail. There is high potential for shifting the movement of this traffic to a combination of coastal shipping and inland waterways. Assuming that 50 to 60 per cent traffic could be diverted, it is estimated that around 3 MTPA of this traffic can be switched to waterways.

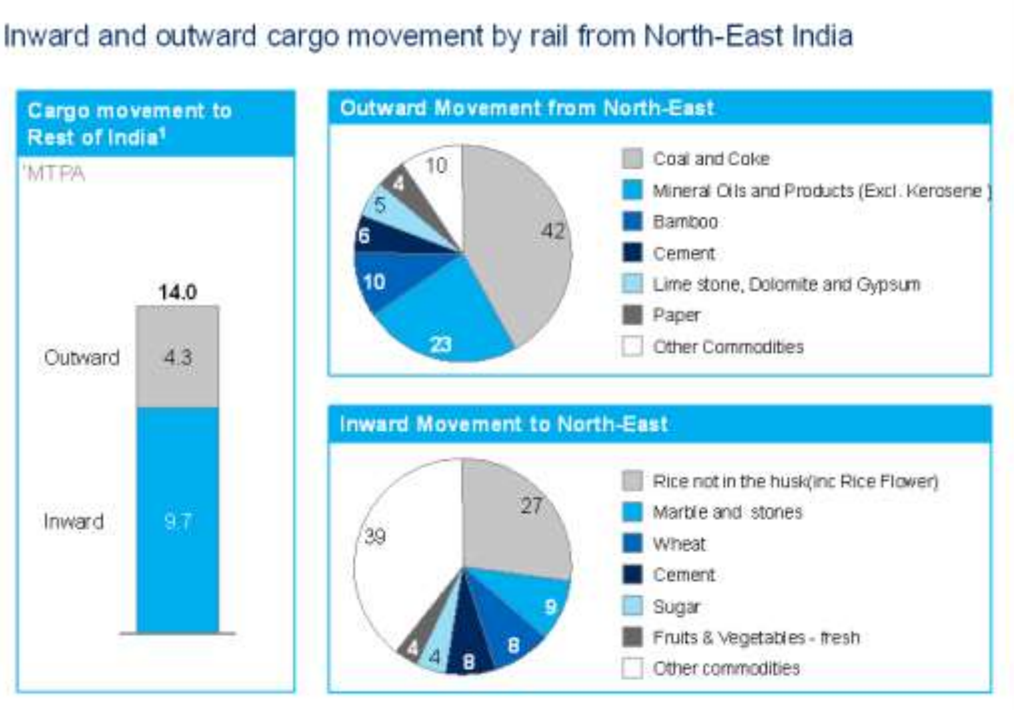
EXHIBIT 120



1 Excluding North-east States

SOURCE: DGCIS 2013-14

EXHIBIT 121



1 Excluding North-east States

SOURCE: DGCIS 2013-14

Road transport moves around 5 MTPA of inward and outward cargo[3] (Raiganj–Dalkhola road). Assuming that 50 per cent of the goods from West Bengal are from riverine areas and around 50 per cent of those going towards the Northeast is also on a riverine area or can be distributed by road from a river terminal, around 2.5 MTPA of traffic can be diverted to waterways.

On the whole, around 5.5 MTPA of the cargo currently moving by road or rail can be diverted to waterways and coastal shipping. These volumes are likely to grow to around 7 to 8 MTPA by 2020.

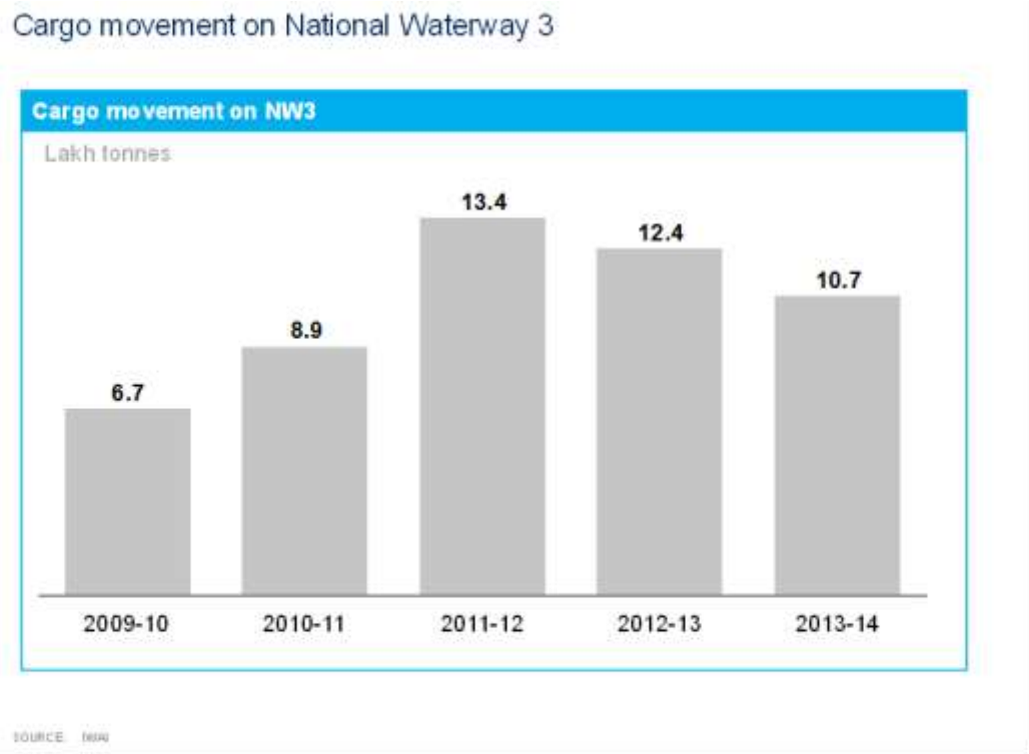
[3] Based on traffic movement on Raiganj–Dalkhola

NATIONAL WATERWAY 3

NW3 runs from Kottapuram to Kollam (168 km) along with Udyogmandal Canal (23 km) and Champakara canal (14 km) (Exhibit 122). Commodities moving along this stretch include phosphoric acid, sulphur, rock phosphate and liquid ammonia. A majority of the traffic moves on canals for an average distance of 12 km. However, cargo movement on NW3 has been on the decline over the past few years, from 13.4 lakh tonnes in 2011–12 to 10.7 lakh tonnes in 2013–14 (Exhibit 123). Given the short distances, NW3's focus could be more on river cruise tourism.

EXHIBIT 122

EXHIBIT 123


Cargo movement on National Waterway 3
Cargo movement on NW3
Lakh tonnes
6.7
8.9
13.4
12.4
10.7
2009-10
2010-11
2011-12
2012-13
2013-14

NATIONAL WATERWAY 4

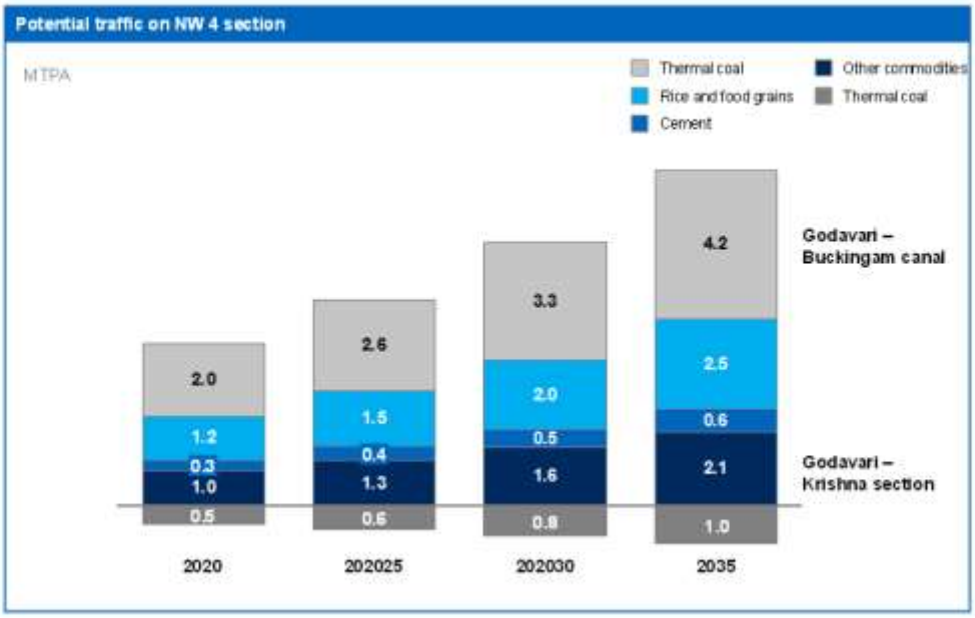
This waterway comprises the Kakinada–Puducherry canal system integrated with the Godavari and Krishna rivers, and extends for around 1,095 km (Exhibit 124). Major traffic on this route will include coal from Bhadrachalam to Vijayawada, Wazirabad and Krishnapatnam; rice and food grains along the canal from Vijayawada, Eluru and Kakinada to Chennai/Ennore; and cement and other commodities (e.g., fertilisers) from the Vijayawada region to Chennai. Some coal also travels around the Godavari–Krishna section from Bhadrachalam to Wazirabad. Most traffic moves one way—across the Godavari section and down the canal.

EXHIBIT 124

While this route has limited scope for backhaul, it does need dredging to create an LAD of around 1.75 m in the channel. An assessment of traffic potential indicates cargo movement of around 5 MTPA by 2020 (Exhibit 125).

EXHIBIT 125

National Waterway 4 traffic potential

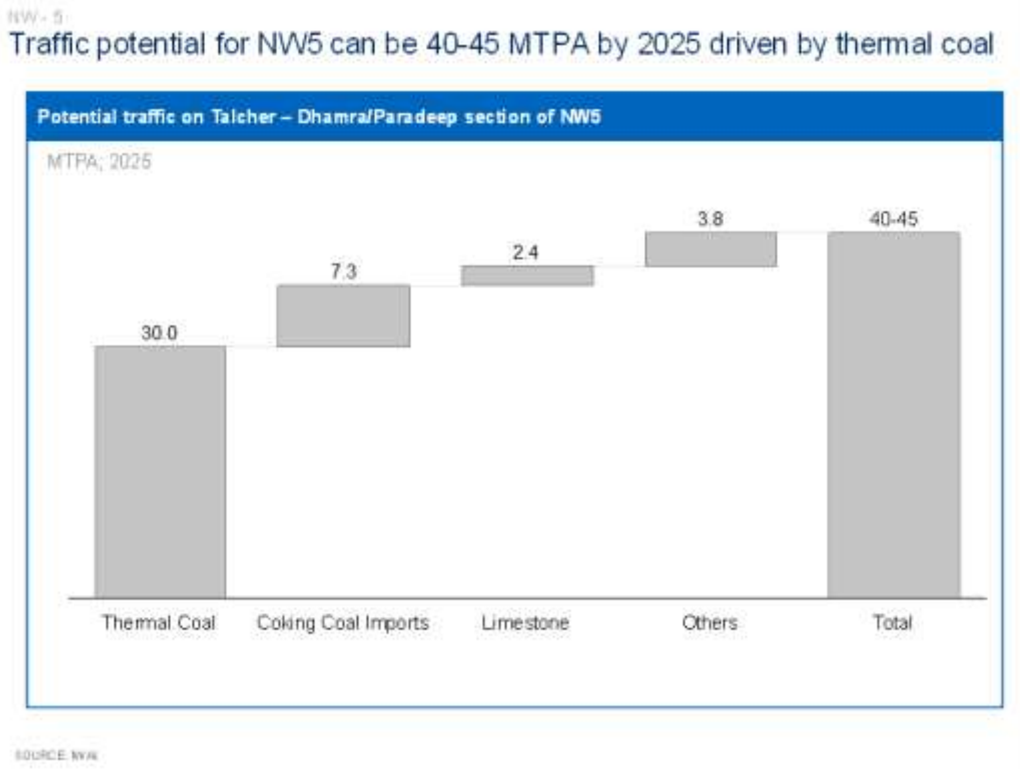


NATIONAL WATERWAY 5

NW5 stretches for 623 km across Odisha and West Bengal, with Talcher to Dhamra (265 km), Mangalgadi to Paradip (101 km) and the East Coast Canal (217 km) as the major areas (Exhibit 126). The stretch between Talcher and Dhamra/Paradip, in particular, offers significant scope for traffic movement. The waterway can handle outbound thermal coal from the MCL mines in Talcher and coking coal to steel plants like TISCO, Bhushan and Neelachal Ispat. The Talcher to Dhamra stretch, to be developed, will require a minimum draft of 2.5 to 3 m, creating scope for barges to operate with up to 2,000 MT capacity (Exhibit 127).

EXHIBIT 126

EXHIBIT 127


NW - 5
Traffic potential for NW5 can be 40-45 MTPA by 2025 driven by thermal coal
Potential traffic on Talcher – Dhamra/Paradeep section of NW5
MTPA; 2025
30.0
7.3
2.4
3.8
40-45
Thermal Coal
Coking Coal Imports
Limestone
Others
Total

OTHER WATERWAYS

Besides the national waterways, eight other waterways represent potential modes of transport for freight cargo in India. Traffic potential is very low for two of these waterways: Cumberjua and Sunderbans. Exhibit 128 outlines the potential for the other six waterways.

EXHIBIT 128

Additional waterways that can transport freight cargo

S. no.	River	Stretch description	Cargo potential (MT)	Main cargo
1	Barak Waterways (NW – 16)	121 km between Lakhipur & Bhanga in state of Assam	**1.86**	• Cement, paper products, fly ash, bamboo products, tea, edible oil & food grains
2	Mandovi Waterways (NW – 68)	41 km on Mandovi River in state of Goa	**6.5**	Iron ore, coal, wood chips, timber & bauxite
3	Zuari Waterways (NW – 111)	55.3 km on Zuari river in state of Goa		
4	Ghaghra Waterways (NW – 40)	345 km between Faizabad & Manjhighat in state of UP	**4.91**	Food grains, sugar, paper, coal
5	Gandak Waterways (NW – 37)	277 km between Gandak Barrage at Balmikinagar and Ganga confluence at Patna	**5.22**	Construction material, cereals/cash crops, chemicals/ minerals
6	Kosi Waterways (NW – 58)	237 km between Kosi Barrage and Kursela	**1.37**	Cereals, edible oil, livestock iron & steel products

Traffic potential is very low for the two other waterways: Cumberjua[1] and Sunderbans[2]

1 Cumberjua is a canal connecting Zuari and Mandovi rivers
2 Minimal traffic potential due to environmental restrictions

Barak waterways

Phase 1 will include the development of the Bhanga–Silchar stretch of 70 km, upgrading existing terminals at Karimganj and Badarpur and making provisions for a floating terminal at Silchar (Exhibit 129). This development will improve connectivity with the protocol route through the Karimganj terminal. At the same time, as a redistribution centre, Silchar will handle traffic for Silchar district and other states in the Northeast, connecting with other major regions through NH 53 and 54.

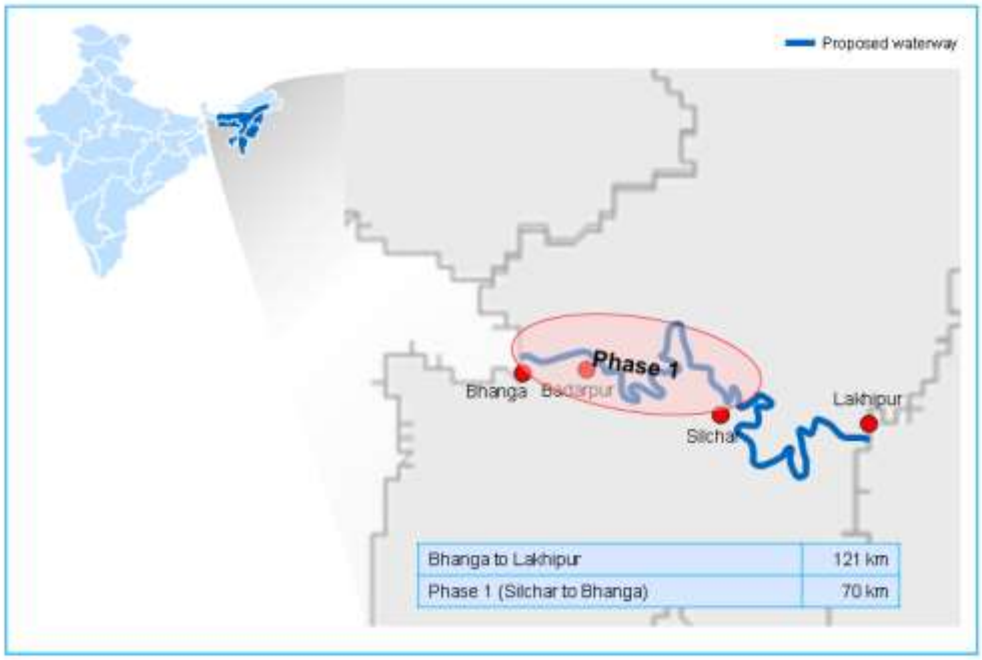
The proposed channel's properties include a bed width of channel 40 m under normal conditions and 60 m at bends with a side slope of 1:5 and LAD of 2.0 m, which can facilitate the movement of 500 to 600 tonne vessels.

The total development cost for Phase 1 is estimated to be around INR 82.44 cr. This breaks up as INR 57 cr for fairway development (including navigation aids and maintenance dredging for 2 years) and INR 25.44 cr for terminal development (including cargo handling equipment).

Phase 2 will include the development of the Silchar–Lakhipur stretch of 51 km, setting up new permanent terminals at Silchar and Lakhipur after making a realistic assessment of the cargo potential in the upstream stretch.

EXHIBIT 129

Barak river system in Assam



Badarpur terminal lies on this route, and will attract traffic from cement, paper industries and coal transported from Meghalaya. Fly ash from Haldia/Bangladesh will be the incoming cargo for cement industries.

Bamboo and its finished products will be the return cargo for the Badarpur Paper Mills. Other key commodities for potential transportation along the Barak Waterways include food grains, edible oil, cement, iron and steel. The total cargo potential is around 1.8 to 1.9 MT.

Mandovi and Zuari river systems

The Goa waterways system consists of the Mandovi (NW68) and Zuari (NW111) river systems. The IWT in Goa is expected to handle around 22 to 24 MTPA of potential traffic by 2020[4], whereas the current traffic (FY2015–16) is around 4 MTPA (Exhibit 130). The anchor commodity is iron ore (approximately 3 MTPA) and other commodities include limestone, slack and wood chips.[5]

[4] Revalidation study, PwC

[5] Goa Barge Association and Captain of Ports

EXHIBIT 130

Baseline map showing Mandovi & Zuari river system in Goa

SOURCE: IWAI

The proposed development includes fairway development of Mandovi river (41 km), Zuari river (55.3 km) along with providing navigation aids, bank protection work, etc. Thalweg surveys have revealed that the least available depths in the Mandovi river in the upstream reach, near Usgaon bridge, are around 1.2 to 1.5 m below the chart datum (CD), and in the remaining reach, the depths are around 2 to 2.5 m below CD with intermittent deep pools of around 10 to 15 m. In the Zuari river, too, the least available depths in the upstream reach near Sanvordem bridge are barely around 1.2 to 1.5 m below CD and in the remaining reach the depths are around 2.5 m with intermittent deep pools of around 8 to 12 m.

The channel needs a bed width of 67.5 m under normal conditions and 83.5 m at bends with a side slope of 1:5 and LAD of 3.2 m. This will facilitate an all-year navigable channel for the existing fleet of barges with more than 2,000 T capacity.

The total fairway development cost (including navigation aids, cost of dredging, supervision costs, and miscellaneous expenditure) is INR 112.7 cr. No terminal development is planned at the moment.

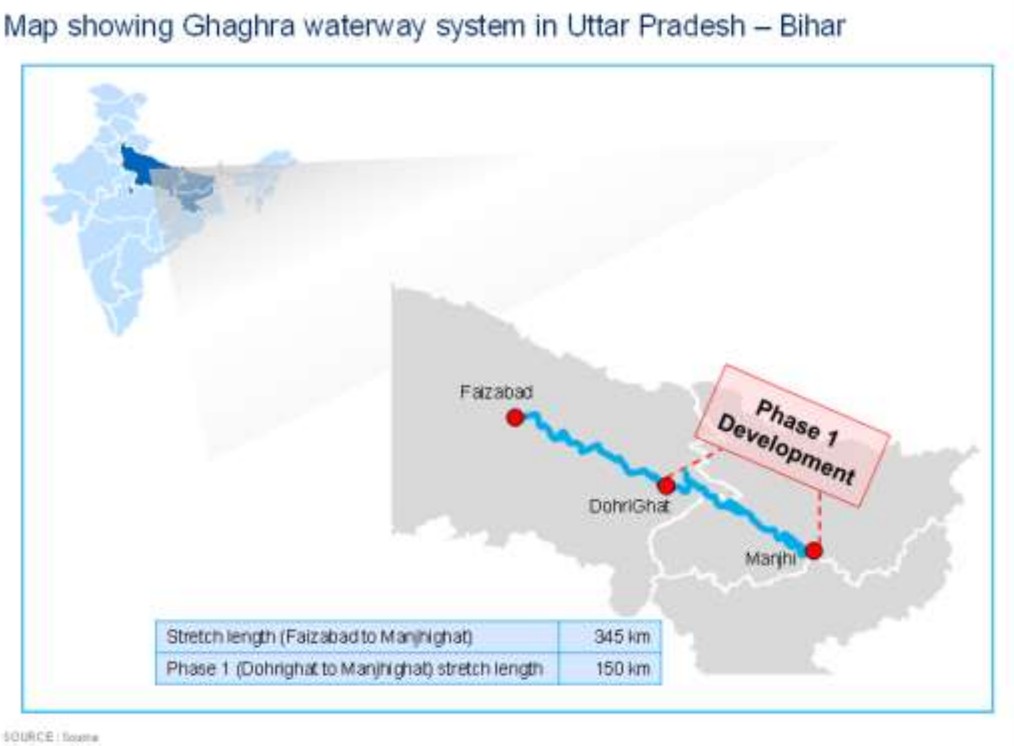
The proposed waterway has good rail and road connectivity. Origin points (Sanvordem) on the Zuari river stretch under consideration are well connected through rail terminals at the Curchorem–Sanvordem junction, 40 km from Vasco that are extensively used for the movement of ore coming from outside Goa (via rail).

All the jetties on the Mandovi and Zuari rivers have good road connectivity, helping to transport ores by truck from the mines of Surla, Bicholim and Sanvordem to existing private jetties along the Mandovi and Zuari rivers. The road network is well connected with key hubs and distribution centres (Tinnneighat in Karnataka), which are extensively used for transportation of non-Goan ore into the state through the existing road network (roads coming from Anmod–Mollem).

Ghaghra waterways

This water route stretches between Ayodhya in Uttar Pradesh and Chhapra in Bihar (Exhibit 131). In terms of traffic, the proposed NW40 stretch of 345 km between Faizabad and Manjhighat is expected to handle around 1.7 MTPA of cargo. Developing the IWT mode on this stretch will also serve the transportation needs of UP and Bihar.

EXHIBIT 131



Phase 1 will include the development of the 150-km stretch between Dohrighat and Manjhighat, with a bed width of channel 45 m and side slope of 1:3 and LAD of 2 m. It will also have floating terminals at both locations. The proposed stretch is designed for the movement of 600 T vessels. In terms of traffic, this route is expected to handle 1 MTPA of cargo. The anchor cargo will be paper and paper products, food grains and sugar. The return cargo will be coal.

The overall tentative cost estimate for Phase 1 of this development is INR 120.75 cr. This breaks up into INR 87.4 cr for fairway development (including dredging, navigation aids and bank protection works) and INR 33.35 cr for terminal development (including civil works, land cost and allied infrastructure cost).

The proposed stretch has good road and rail connectivity with major areas in UP and Bihar. The terminals at Manjhighat and Dohrighat are well connected with NH 85, 19 and 28, providing better accessibility through the districts of Chhapra, Siwan and Gopalganj, Balia, Azamgarh and Gorakhpur. Indara and Mau are the nearest railheads used extensively for handling coal (at Indara) and cement, fertilisers and food grains (at Mau). The secondary catchment area of the river extends to Maharajaganj district, which is the entry point for all coal traffic going to Nepal through Bhairahwa.

Gandak waterways

This 277-km stretch of waterway extends from Bagha near Nepal all the way to Ghaighat in Patna (Exhibit 132). The anchor cargo and return cargo for Gandak Waterways will consist of construction material, cereals or cash crops, conventional fuels, livestock, chemicals and mineral ore. The route (with the IWT at Gandak) is expected to handle around 4.65 MTPA of cargo along the stretch between Gandak Barrage at Balmikinagar and Ganga confluence at Patna.

EXHIBIT 132

Phase 1 will include developing the 160-km stretch between Dhumariaghat and Gaighat, with a bed width of channel 25 m under normal conditions with side slope of 1:5 and LAD of 1.2 m. Dhumariaghat will also have a floating terminal. The proposed stretch is designed for the movement of 100 T vessels.

The overall tentative cost estimate for Phase 1 of this development is INR 50 cr. This breaks up into INR 29.3 cr for fairway development (including navigation aids) and INR 20.7 cr for terminal development.

Vaishali along the proposed route is at a distance of only 48 km from Patna, with terminals located close to NH 102 (Chhapra–Muzaffarpur) and NH 28 (Gopalganj–Muzaffarpur), and to the Hajipur–Muzaffarpur railway line. This road and rail connectivity links the waterway through major cities like Hajipur, Lalganj, Mahuwa, Areraj, Kesariya and Chakiya.

Kosi waterways

The Kosi Waterways system extends from Kosi Barrage to Kursela, a length of around 237 km (Exhibit 133). The anchor cargo ranges from construction material and cereals/cash crops to consumer goods, conventional fuels, edible oil, refined oil, chemicals, paper products and mineral ore. The IWT at Kosi is expected to handle around 1.37 MTPA of cargo along the proposed stretch, and also address the transportation needs of Bihar and Jharkhand.

EXHIBIT 133

Kosi Waterway system in Bihar

The proposed development includes forming a stretch between Kosi Barrage and Kursela (232 km) along with floating pontoons at Kalyanpur, Basbitti, Dambharghat and Kursela.

Phase 1 will include developing the 95-km stretch between Dambharghat and Kursela, with a floating terminal at Dambharghat. Kursela, the other end of the stretch, is very close to Sahebganj where a multimodal terminal has already been proposed by the IWAI. This stretch will have a bed width of channel 25 m with side slope of 1:5 and LAD of 1.2 m. It is designed for the movement of 100 T vessels. Floating terminals have been proposed at Dambharghat and Manjhighat.

The overall tentative total cost for Phase 1 of this development is INR 36.25 cr, which breaks up into INR 19 cr for fairway development (including navigation aids) and INR 17.25 cr for terminal development (including land and allied infrastructure costs).

This proposed stretch has good rail and road connectivity. Dambharghat is in the vicinity of the Khagaria–Supaul railway line and close to the Khagaria–Sukhpur road. It is well connected to Koparia, Dhanchaur, Goar, Kursela and Khagaria. Kursela is 1.87 km from the Kursela Road Bridge that connects Begusarai and Purnea, making Patna more accessible.

FRAMEWORK FOR COST ANALYSIS

The economics of waterways transportation has been evaluated with following considerations:

- Distance by waterways can be around 20 to 30 per cent higher than rail distance since waterways tend to meander
- Viability of transportation by waterways changes for different rail and road distance
- For the given railway and road freight, the competitiveness of waterways is dependent on first mile and last mile distance

Comparison with rail and road freight

A comparison of waterways vs rail or road freight (transporting coking coal) evaluated the viability of waterway transport based on differing values for distance of origin and destination from the river and the distance covered on the main leg. It assumed the same number of handlings, but that cost of transportation by waterways was INR 1 PTPK, and that distances by waterways were 25 per cent longer since waterways meandered. It also assumed the first- and last-mile road connectivity to be INR 5 PTPK.

The cheaper mode of transport varies based on the main leg distance and first- and last-mile distance (Exhibits 134 and 135). Waterways is the cheaper mode compared to rail if the first mile and last mile distance is less than 10 km. For higher first and last mile distances, waterways is the cheaper option for large distances. For the comparison with road, two extra handlings have been considered for waterways cost wherever first mile and last mile connectivity is required. Waterways was found to be the cheaper mode of transport for distances greater than 200 km for first and last mile distance of even up to 50 km.

EXHIBIT 134

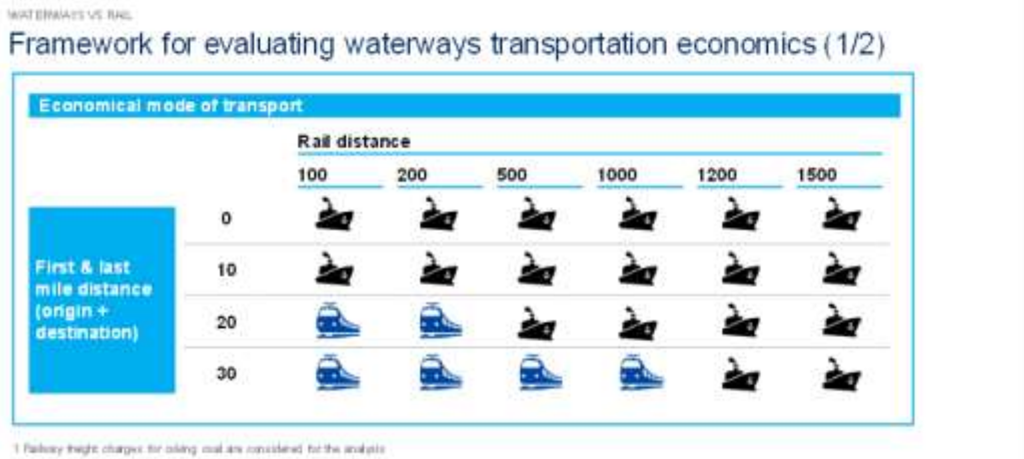
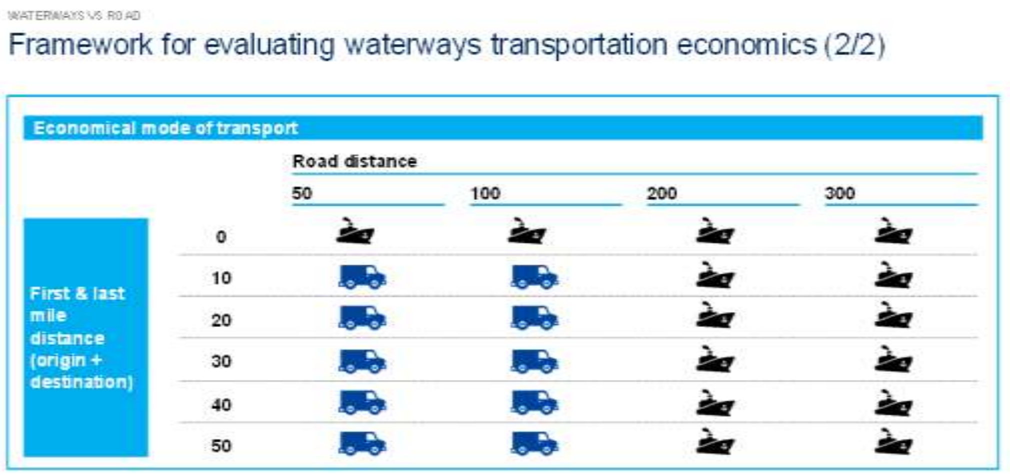


EXHIBIT 135



ENABLERS

Using inland waterways is an important shift to leverage this natural asset and cut down freight costs. To do so, it requires three enablers—navigational infrastructure, modal integration and private-sector investment.

Navigational infrastructure

Various elements, which need to be developed, include:

- Adequate depth of river beds (LAD) of at least 2.5 to 3 m—this can enable vessels to navigate smoothly all year round
- Adequate vertical clearance or air draft by raising bridges to at least 5 m above high-flood levels to help commercial cargo carriers navigate canal systems
- Augmentation of cargo terminals and IWT vessels, ideally on concessional terms. This can be done through forming a special purpose vehicle to procure and lease out vessels
- Development of night navigation can improve travel times and safety. This requires differential global positioning systems (DGPS), light buoys, river information services (RIS), and other advanced technology for night navigation on some stretches of waterways and can subsequently be extended to all national waterways
- Development of MRO facilities in the north-eastern states and other national waterway corridors by exploring private-sector participation

Modal integration

Terminals should have adequate connectivity with roads, and ideally with rail for last-mile connectivity. As a first step, it is important to identify potential multimodal corridors based on a detailed mapping of waterways and industrial clusters and an OD analysis of cargo. Developing IWT feeder routes and also connecting national waterways to their tributaries can connect important cargo hubs and improve connectivity at optimal costs.

Encouragement for private participation

Given the limited public investment available for the transport sector, it is strategic to explore and promote the participation of the private sector to support the development, maintenance and regulation of some river stretches. To attract private investment, a long-term cargo commitment is required from both sides, especially to mitigate uncertainty at the outset while business volumes are lower. Freight subsidies should also be given on par with road and rail modes of transport.

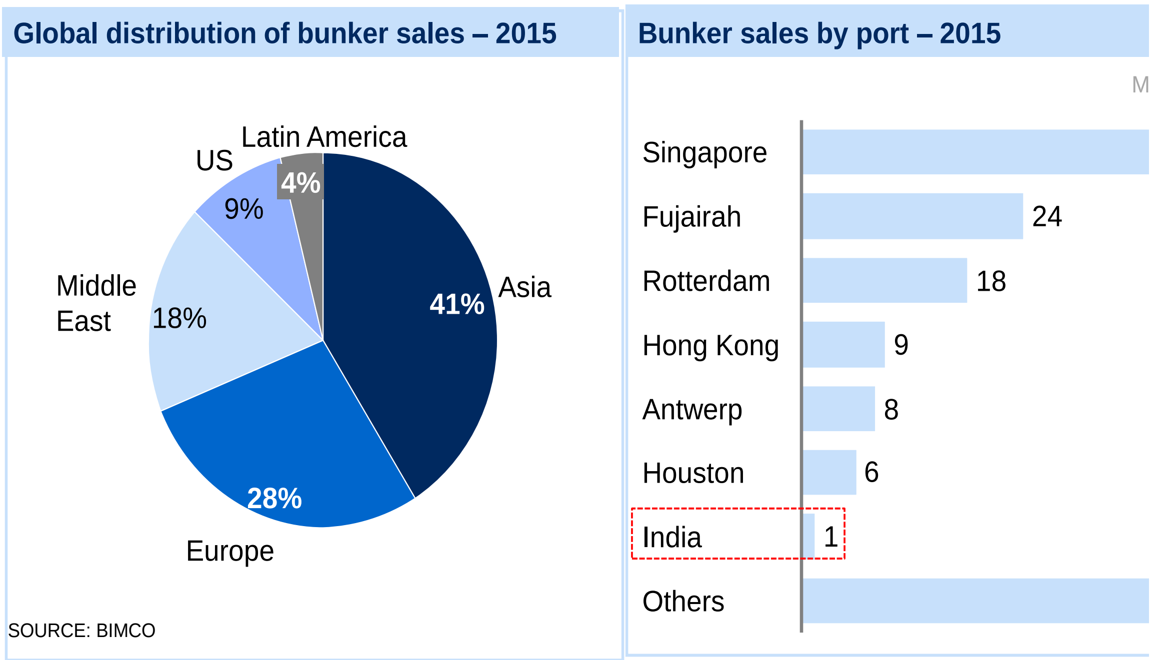
The skewed modal mix in favour of expensive land transport will gradually shift to more economical modes of transport. Strategically evaluating India's national waterways and river systems can help to transport cargo at optimal costs. This requires taking into account the potential, estimated traffic and the economics of various modes of transport, and also setting in place the necessary enablers.

Annexure 4: Bunkering in India

1.1 IMPORTANCE OF BUNKERING IN COASTAL SHIPPING

Bunkering facilities are an essential prerequisite to as well as a facilitator of growth in coastal shipping in India. As bunker fuel prices are related to global crude oil prices, they have reduced by 30%–50% in the last 5 years. However, in spite of the reduction in cost of $120 million per day worldwide, it continues to be the most significant operating cost item (30%–40%) for ships. Even though Asia accounts for 41% of global bunker sales for 2015, the share of Indian ports is almost negligible. In the absence of bunkering facilities at Indian ports, ships coming to India get their bunker fuel from neighboring international ports of Singapore and Fujairah. Many ships moving along the Indian coastal ports also obtain their bunker fuel from outside the country (Exhibit 136).

EXHIBIT 136: GLOBAL DISTRIBUTION OF BUNKER SALES AND BUNKER SALES BY PORT – 2015



1.2 BUNKERING AT SINGAPORE AND FUJAIRAH: DRIVERS OF SUCCESS

The large volumes of bunker trade from ports like Singapore and Fujairah are owed to a combination of factors involving cost benefits, convenience for customers as well as high quality of services. Moreover, given the economies of scale, these ports run fairly profitable bunkering facilities despite comparatively narrow margins.

Cost: The fuel cheaper due to favourable taxation and bunkering facilities available outside the port limits which saves port calling charges for the ships.

The charges for bunkering while in inner anchorage are minimal. Unlike Indian ports, long term contracts between vessel operators and bunker suppliers in Fujairah foster a sustainable ecosystem.

Convenience: These facilities are convenient for customers since they provide round the clock service, supported by good quality infrastructure and qualified technicians. Other offerings include duty-free merchandise, spare parts, repair and waste disposal facilities. The entire bunkering process and transaction at Singapore is online with no time wasted in paperwork.

Quality: Since ports like Fujairah import fuel from a number of sources across the globe, it is easier for them to blend these and obtain the required fuel which complies with restrictions regarding type of fuel and its sulphur content. The presence of regulatory checks and vigilance at the floating barges protects against pilferage.[6] Finally, quality control mechanisms assure vessel operators of bunker fuel that is free of sludge, water or sand (not assured at Indian ports).

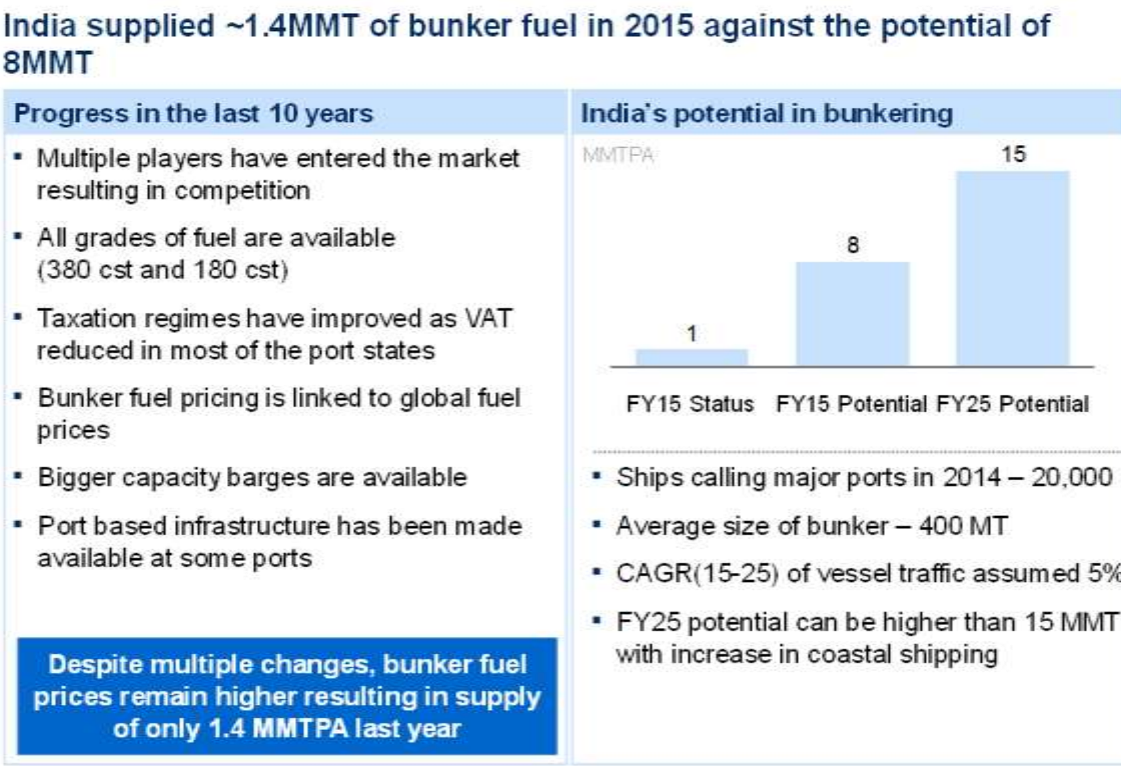
1.3 BUNKERING POTENTIAL IN INDIA

Due to policy interventions to permit the entry of multiple players, decontrolling of bunker fuel pricing and its linking to global oil pricing, provision of different grades of fuel and bigger capacity barges, and reduction of VAT in most port states, Indian ports filled up only ~2mmt (million metric tonnes) of bunker oil in 2015 domestically as opposed to its annual supply potential of 8mmt. India has a potential to supply ~15MTPA of bunker fuel by 2025 with the rise of traffic lining the Indian shores. It is to be noted that if the coastal shipping revolution picks up in the country, the potential for bunkering in India would be significantly higher than 15 MTPA. In 2035, the potential for bunkering could range from 18-22 MTPA[7] depending on the growth of coastal traffic. (Exhibit 137)

[6] Bunker fuel is supplied to ships via floating barges or pipelines. These facilities are not available at all the ports of India.

[7] Low case assumes 3% yoy growth for 10 years from 2025 to 2035 and high case assumes growth of 5% yoy for 10 years from 2025 to 2035

EXHIBIT 137



There are a plethora of issues hampering the growth of bunkering industry in India. Some of the more prominent ones are related to taxation, quality concerns, regulatory challenges and infrastructure.

1.3.1 Tax structure

The prevailing tax structure in India is one of the most important reasons for high prices of fuel in the country. Added to the excise tax levied by the central government is the VAT levied by the state governments on coastal shippers. Coastal shippers in India pay $409 per metric tonne of fuel and foreign run vessels pay $337 which is considerably higher than the cost paid by foreign run vessels in Singapore and Fujairah (Exhibit 138). Being a low margin business, this cost acts as a deterrent for the shippers to get their bunker supplies from Indian ports.

Additional tax related issues raised by OMCs/INSA

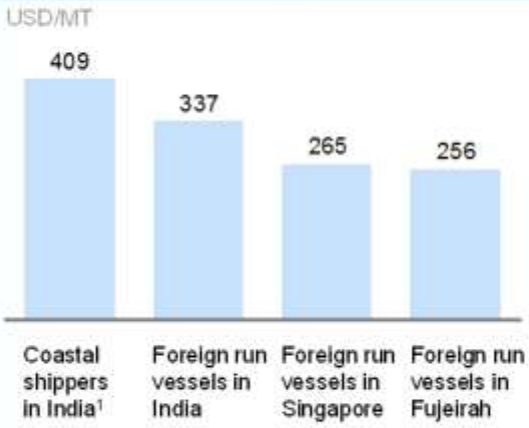
- VAT payable is different depending on the address of the person on whom the invoice is raised. Instead of this, it would be preferable that the “Place of Supply” should be the determining factor for the VAT rate.
- Bunkering to foreign flag vessels is considered "export" under the Customs act. However, VAT does not recognize it as export. Similarly DGFT does not recognize this as deemed export. Further if bonded bunkers were to be

supplied to foreign going Indian flag vessels then the supplier is required by law to receive payment in local Indian currency. But doing so will mean that such a supply will not be considered as export and hence this needs to be resolved.

- If a product is imported for the purpose of re-export to foreign flag vessels then VAT applied is zero. However, if domestically produced fuel is sold to foreign flag vessels then the same is not considered export and has to pay VAT. This is an anomaly and has to be taken up by customs.

EXHIBIT 138: COMPARATIVE BUNKER RATES AND VAT STRUCTURE

Comparative bunker rates



- Coastal shippers get 20- 30 % costlier fuel as compared to foreign run vessels
- Foreign run vessels get fuel at ~1.25 times the price as compared to Fujeirah

VAT Structure

Percentage	IFO 180 / 380 cst	
Port	Bonded	Duty Paid
Mundra, Kandla, Sikka, Vadinar, Okha, Dahej, Hazira	Nil (SEZ) 5 (Non-SEZ)	5.0
Mumbai	Nil	12.5
Goa	1	12.5
Chennai, Ennore, Tuticorin	4	5.0
Vishakhapatnam (Vizag), Kakinada	14.5	14.5
Cochin (Kochi)	0.5	5.0
New Mangalore	1	14.5
Kolkata, Haldia	1.5	5.0
Paradip	5	13.5

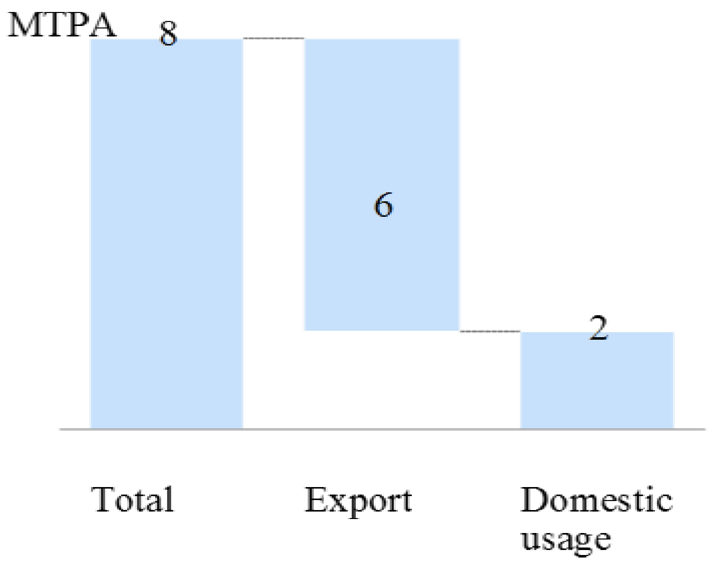
1. Duty paid including VAT; 1 USD = 65 INR; Fuel costs as per September 1, 2015

SOURCE: INSA; Press research

1.3.2 Availability of Good Quality Fuel

Beleaguered as they are with fuel quality and regulatory issues, Indian Oil Marketing Companies (OMCs) end up exporting about three-fourth of the indigenously produced bunker fuel, supplying a meagre 2mtpa (million metric tonnes per annum) to Indian ports (Exhibit 139)

EXHIBIT 139: BUNKERING SUPPLIES IN INDIA -2014



One of the key issues is related to the sulphur content in bunker fuel. As a signatory to the IMO MARPOL Guidelines designed to prevent pollution of the marine environment, India is mandated to ensure that the sulphur content of bunker grade fuel is limited at 3.5%. Unfortunately, crude oil imported by India is high in sulphur content (10%) and the low sulphur crude oil from Bombay High (with only 1% sulphur) is allocated solely to the Mumbai refinery of Bharat Petroleum Corporation Ltd (BPCL). To complicate matters further, the mandated sulphur content for bunker oil for inland usage is 4% which entails additional investment in separate storage facilities for fuel of this category. Since reducing the sulphur content is a complicated process, and bunker fuel demand is not too high in India, OMCs find it simpler to export it to destinations such as Fujairah (despite transportation costs) rather than trying to clean it up and supplying to Indian ports.

1.3.3 Regulatory Challenges

There are regulatory challenges on multiple fronts that constricts the growth of bunkering facilities in the country. From additional paperwork to absence of quality checks, various issues have been raised by OMCs that require resolution.

1. Concession in respect of bunker fuel is not available for traders. It seems that currently this is applicable only for supplies made by oil manufacturing companies (OMCs).
2. It is not clear as to the extent of coverage of the area over which the Customs exercises jurisdiction i.e. is it 12 nautical miles, or outer anchorage or EEZ. Similarly geographical limit of a state is unclear and leads to question as to whether sales tax applies on High Sea Sales.

3. OPL supplies are not permitted to foreign flag ships. However, recently this is being permitted in Cochin. It would be beneficial to have an all India order permitting such supplies.
4. Bunkering is not permitted during the monsoon season. Though Cochin Customs has permitted this but there is no all India instruction.
5. Night bunkering, bunkering on holidays and floating storages are currently not permitted. If India has to develop a bunkering hub, then companies must be able to supply bunkers 24x7.
6. Floating storage if permitted for domestic supplies would need approval of the Excise department. However, floating storages are in the jurisdiction of the Customs and procedures which will make it easy to conduct such activities will need to be put in place.
7. Port charges for vessels coming solely for bunkering is extremely high. Infact there is no case for charging port dues to a vessel which anchored outside the port in order to receive bunkers. Similar to Singapore, India must not charge port dues for vessels coming to bunker at least for a period of 10 years in order to encourage bunkering.
8. Common and mixed tankage is allowed at Mumbai, Kandla and Goa. An all India process should be declared for mixed tankage based on the process of self-certification by OMCs.
9. Similarly dual bonding of Customs and excise should be permitted so that there is no need for double infrastructure.

1.3.4 BUNKERING INFRASTRUCTURE

There are wide ranging infrastructure challenges to boot—bunkering facilities are not available after sunset, ports are found wanting in bunkering set up and allied services as also shore reception facilities. Since bunkering supplies are not permitted after nightfall, the slightest variance between the expected time of arrival of a vessel and actual arrival, leads to massive delays in bunkering and consequent scheduling nightmares.

1.4 BUNKERING: THE WAY FORWARD FOR INDIA

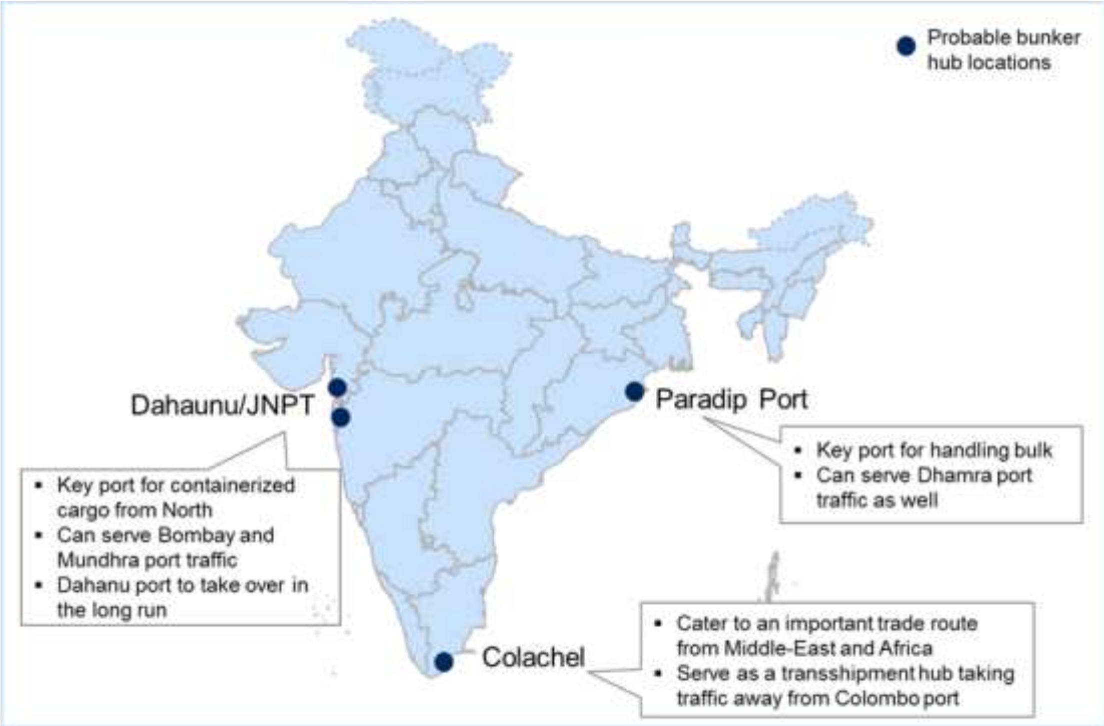
Given the high demand potential for bunkering facilities in India, there is much to be gained from investing time and resources in improving them. In 2014, 20,000 ships called at major Indian ports with an average bunker size of 400MT. It goes without saying that given adequate facilities, such vessels would prefer to refuel in India instead of wasting time bunkering at ports like Singapore and Fujairah. Assuming a compounded annual growth rate (CAGR) of 5% of vessel traffic during 2015–2025, the potential bunker fuel demand in 2025 in India can be estimated at 15mmt.

A number of steps may be taken to address these challenges the first of which should focus on taxation measures. State governments may consider reducing the sales tax to a minimum or even to zero in case of sales of bunker supplies to foreign going vessels. If OMCs extend credit facilities to container vessels on coastal run, it may lead to increases in demand.

Emphasis should also be given to infrastructure development and modernization with improving the capacity and pumping rate of ocean going barges and introducing fuel blending facilities. Permissions for facilities like floating barges and off-port limits (OPL) supply without calling charges should be granted at all ports. Quality issues should be addressed by certification of suppliers and enforcing standard operating procedures (SOP) for bunker transfer. Finally, the transaction should be made less cumbersome by streamlining customs processes across states and online custom clearances.

Apart from providing bunkering facilities and basic infrastructure development at all major ports, some bunkering hubs with 100% facilities are also required to cater to traffic bound for other ports. A hub each on the east, west and south coast of the country is envisioned which will provide facilities like pipelines for bunker fuel as well as allied services of maintenance and repair. On the east coast, Paradip port seems to be the most suitable option as it is expected to become a major port handling coal cargo in the next few years. Similarly JNPT is a major container port on the west coast of India. Additionally one of the two ports of Vizhinjam and Enayam are potential locations for bunker hubs on the southern tip. (Exhibit 140)

EXHIBIT 140: PROBABLE BUNKER HUB LOCATIONS



Bunkering hub on the east coast

The current (2015) bunkering supplies of 0.2mtpa at Paradip can potentially increase to 0.8mtpa, including a 0.2mtpa vessel calling potential of the nearby Dhamra port. This will be due to the increase in coastal shipment of coal from the port in the next few years. This potential may increase to 1.3mtpa in 2025. Currently, the major bunker fuel suppliers namely, Indian Oil Corporation Ltd (IOCL), Hindustan Petroleum Corporation Ltd (HPCL), and BPCL use barges or tank flurries in the absence of pipeline bunker transfer facility. As the requirement increases, it can get bunker fuel supplies from Paradip, Haldia and Barauni refinery. Having world class bunker facilities at the port would go a long way in becoming an enabler for making the coastal shipping revolution a success in the country.

Port-specific interventions in the sphere of relaxing state taxation on bonded and duty paid bunker, measures to ensure availability of all grades of oil (e.g., 380 cSt), permitting OPL bunkering without calling charges to cater to Dhamra traffic as well as bunkering permission while loading/unloading to save time should be made in order to upgrade the port to a bunkering hub.

Additional options for a bunkering hub on the east coast of India include Vizag port as HPCL has already built bunkering infrastructure on the port.

Bunkering hub on the west coast

JNPT has one of the highest container traffic in the country and a high vessel turnaround rate which make it a strong contender as a bunkering hub. Increase in bunker demand in the region can be assisted by the recent exemption on containerized cargo. The potential of JNPT for 2015 is estimated to be around 3.8mmt which can increase up to 6mmt by 2025. Here, the vessel calling potential of the closely situated minor port of Mundra is also included. To cater to this demand, JNPT can get the bunker fuel from refineries in Bombay. This bunkering hub could also come up in a nearby port in the region that carries large enough traffic to justify investment.

Specific interventions suggested in case of JNPT include tax relaxations on duty paid bunkers, allowing bunker supply at night, permitting OPL bunkering without calling charges to cater to Mundra traffic, permission for bunkering while loading/unloading (to save time) and allowing barges to supply bunker fuel at oil terminals. At present, this is not allowed so vessels which dock at the oil terminal have to go to Mumbai port for bunkering and pay extra charges.

Additional options for bunkering hub on the west coast of India include Mumbai and Mundra. The former handles high POL volumes and Mundra is the second highest container carrying port in the country after JNPT.

Enayam bunkering hub

As a result of their strategic location on the transhipment route, having bunkering facilities at Enayam port will help in catering to the traffic from the Middle East to East Asia and from East Asia to Africa. The port can get its bunker fuel supply from Kochi refinery. There is a need to focus on good infrastructure for prompt bunker delivery, introduction of pipeline facility to supply bunker along the port jetties, and deployment of barges for supplying at OPL.

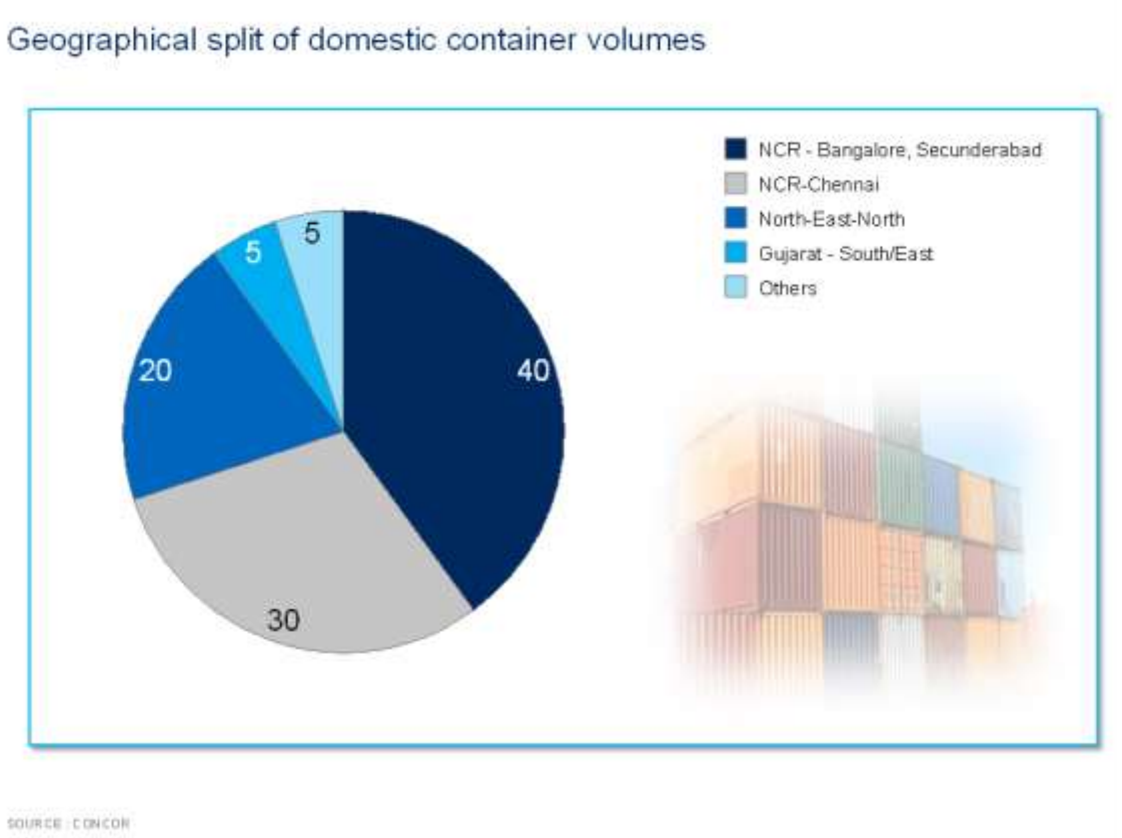
EXHIBIT 141: MAJOR SEA PATHS ON INDIAN WEST COAST

Annexure -5 : Domestic container movement

Vision of Sagarmala is to reduce logistics cost for both domestic and EXIM cargo with minimal infrastructural investment. As part of the programme, coastal shipping potential has been identified for various commodities like thermal coal, steel, cement, POL and fertilizers. Coastal shipping is significantly cheaper as compared to road and rail transport. This note identifies the potential for coastal shipping of domestic containers.

Domestic container market is estimated to be around 450,000–500,000 TEUs, out of which around 350,000–375,000 are transported by rail. Container Corporation of India (CONCOR) has 67% market share in domestic containers transported by rail. Based on the geographical split of domestic container volumes handled by CONCOR (Exhibit 142), coastal shipping potential has been estimated. Containers moved by road are limited to a distance of about 200–300 kms and hence are not considered for coastal shipping analysis

EXHIBIT 142



Containers moving via rail from NCR to South and vice versa are destined for three locations in South India—Secunderabad, Chennai and Bangalore. Some of the commodities being transported are rice, garments and auto components. Secunderabad and Bangalore being far away from the coast are not feasible for coastal shipping. For Chennai, cost of transportation via rail and rail-sea-rail route has been calculated. As can be seen in Exhibit 143, coastal shipping is cheaper than railways. Approximately 100,000 TEUs of containers moving to and from NCR to Chennai can be switched to coastal shipping.

EXHIBIT 143

In addition to this, 18,000–20,000 TEUs containers moving from Gujarat to Southern and Eastern States can be switched to coastal shipping. Movement from Ahmedabad to Haldia by rail over a distance of 2043 km has cost of Rs 2958 versus coastal shipping cost of around Rs 1550. Similarly coastal shipping from Ahmedabad to Mangalore costs Rs 1300 versus rail cost of Rs 2400.

Therefore, there is an overall potential of around 120,000 TEUs of containers to be switched to coastal shipping.

Annexure 6: CONTAINER MODAL SHIFT NOTE

OPTIMIZATION OF EXIM CONTAINERS: CRASH LOGISTICS TIME AND COST

Container traffic at Indian ports has grown at an average CAGR[8] of 8 percent in the past decade. The non-major ports (private or state-owned) continued to fare better than the major government-owned ports, with a growth of over 24 percent in 2014–15. These non-major ports have registered higher growth rates in the past five years or so due to their adequate container-handling capacity, improved road and rail connectivity, better draft levels, and modern equipment and technology for faster cargo evacuation.

Sagarmala studies reveal that two optimization levers can lead to potential savings of ~INR 7,000-9,000 Crores per annum

Reduced transit time can save inventory handling cost of ~INR 5,000 Crores to 6,000 Crores per annum

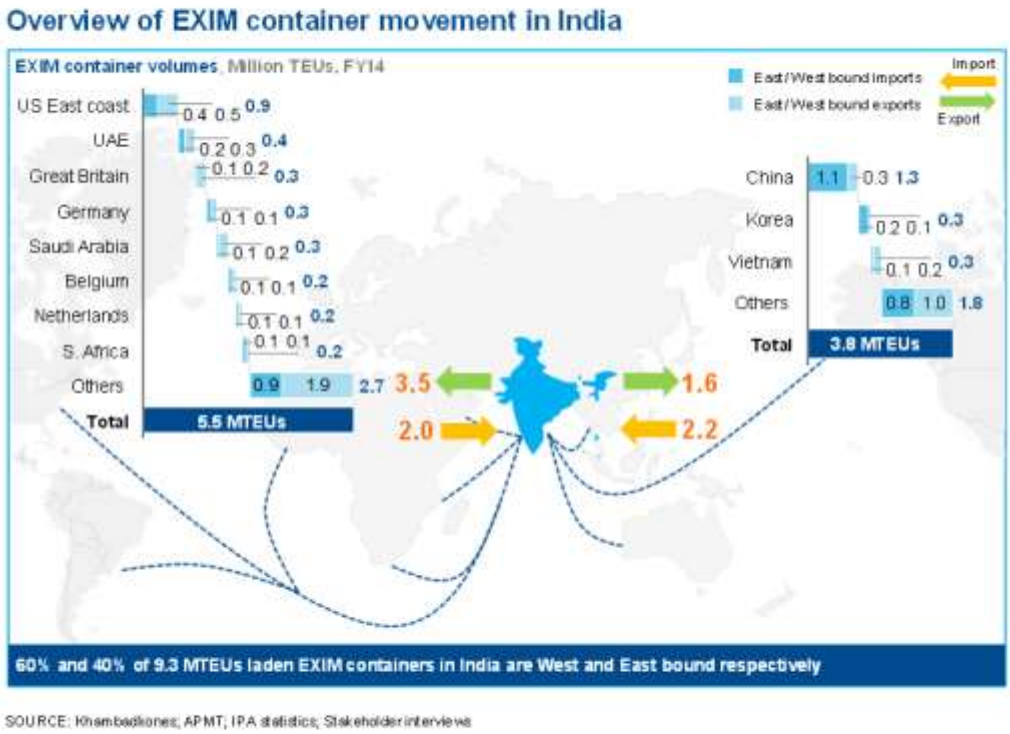
Modal shift from road to rail can save ~INR 2,000 to 3,000 Crores per annum in terms of fuel import bill

A.1 Current EXIM container movement to/from and within India

EXIM container movement in the country, including empties, was 10.7 MTEUs during FY 2014. Of the 9.3 MTEUs laden container volume, 60 percent was west-bound, and the remaining 40 percent was east-bound. China and the US accounted for approximately 14 percent and 10 percent respectively of the EXIM container volumes to/from India, while the remaining was split between several countries including the UAE, United Kingdom, Germany, Saudi Arabia, Korea, Vietnam and others. With respect to the overall balance of trade in containers, India exported 5.1 MTEUs while it imported 4.2 MTEUs during FY 2014 (Exhibit 144).

[8] Compounded Annual Growth Rate

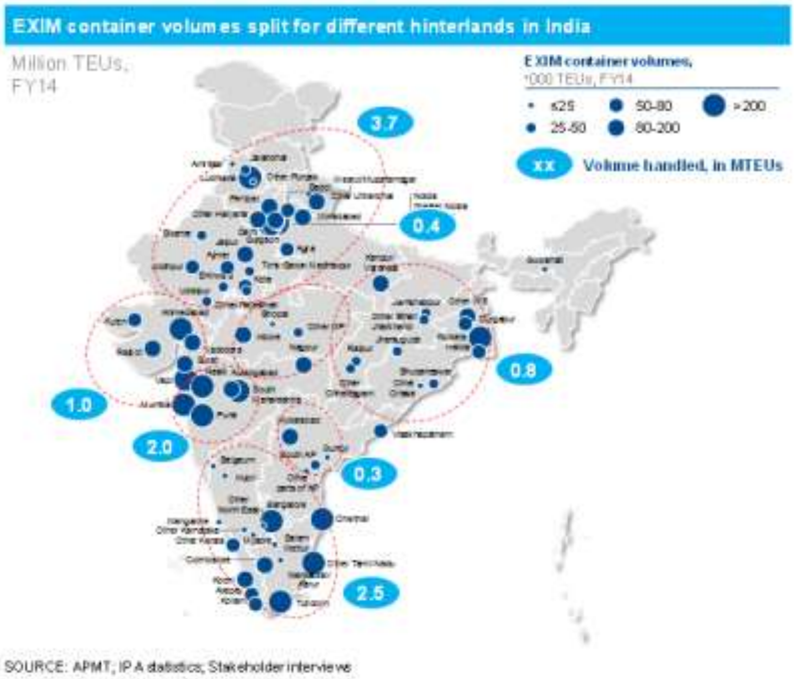
EXHIBIT 144



Out of the 10.7 MTEUs of total container volume, 0.6 MTEUs is coastally shipped traffic, 7.4 MTEUs is gateway traffic and 2.7 MTEUs is transshipped. Colombo, Singapore and Klang account for approximately 75 percent of transshipped cargo from India.

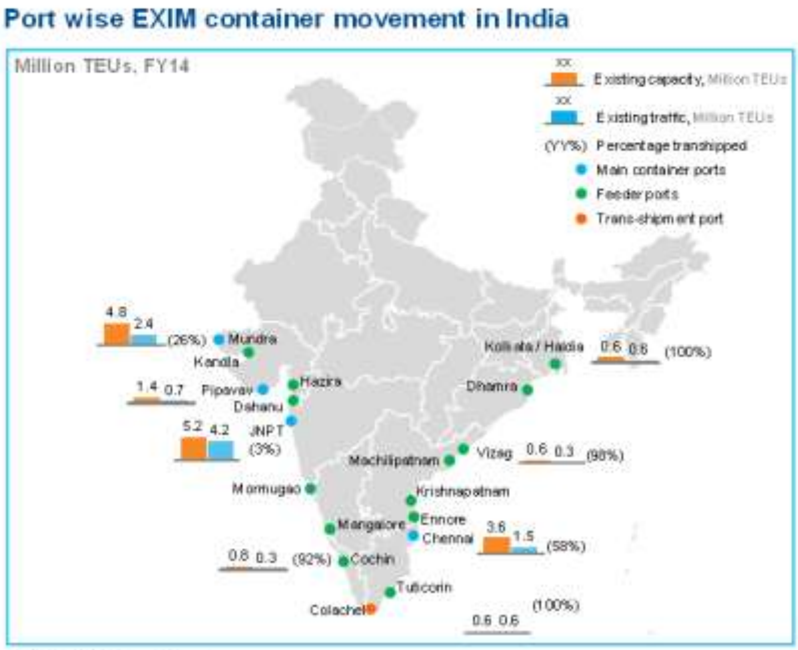
Three major hinterlands in India—the northwest, west and southern clusters—account for roughly 90 percent of container volumes. The northwest cluster is farthest from the coastline and is the largest cluster, generating 3.7 MTEUs of container volumes in FY 2014. It therefore has the greatest impact on the overall logistics cost of container movement. It lies at a weighted average distance of 1,087 km from the Gujarat/JNPT port cluster. The container-handling hinterlands in the country are mapped in Exhibit 145 along with the individual volumes handled.

EXHIBIT 145



The Gujarat-Maharashtra port cluster comprising the Mundra, Kandla, Pipavav and JNPT ports handles 70 percent of India's EXIM traffic, while Chennai handles another 14 percent. Other ports on the east coast—Haldia, Vizag and Tuticorin—account for the remaining traffic. Around 78 percent of the traffic from the east coast ports is transshipped in the absence of sufficient traffic to attract a gateway movement. Exhibit 146 shows the current traffic, handling capacity and the percentage of cargo transshipped at ports.

EXHIBIT 146



SOURCE: APMT; Expert interviews

Exhibit 147 below details the current split of container traffic at ports originating from the different hinterland clusters for FY 2014. Mundra and Pipavav are the only ports whose primary hinterland lies outside the port state. Also, a significant portion of the total traffic from the hinterlands of NCR and Punjab is handled at JNPT even though they are closer to the Gujarat port cluster.

EXHIBIT 147

Hinterland to port mapping of EXIM container movement

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY[illegible]	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Vallarpadam	Visakhapatnam	Mangalore	Hinterland total
NCR+Punjab	936	1,254	0	329	0	0	0	0	0	2,540
Maharashtra	2,121	54	0	0	0	0	0	0	0	2,177
Tamil Nadu	0	0	1,240	0	494	0	0	0	0	1,724
Gujarat	562	262	0	169	0	0	0	0	0	994
Uttar Pradesh	228	274	0	107	0	0	0	0	0	610
West Bengal	0	0	0	0	0	458	0	0	0	458
Rajasthan	43	448	0	60	0	0	0	0	0	560
Karnataka	94	0	163	0	66	0	0	0	60	406
Kerala	0	0	0	0	0	0	351	0	0	351
Andhra Pradesh	75	0	65	0	0	0	0	110	0	250
Madhya Pradesh	43	70	0	14	0	0	0	29	0	156
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0	93
Uttaranchal	95	0	0	0	0	0	0	0	0	95
Odisha	0	0	0	0	0	12	0	69	0	81
Chhattisgarh	15	18	0	14	0	0	0	15	0	64
North East	0	0	0	0	0	7	0	0	0	7
Port total	4,202	2,390	1,468	683	651	562	351	263	60	10,711

SOURCE: APMT; Expert interviews

With respect to the modal mix for container movement from the hinterland to the ports, road has an 82 percent share overall while rail accounts for just 18 percent. The rail coefficient for five out of the eight major container-handling ports is less than 10 percent. The next section describes the reasons for the existing modal mix and the time and cost challenges in inland logistics.

A.2 Challenges in the current movement: Cost and time

The major challenges for each mode in the inland transportation of containers are mentioned below.

Rail

Congestion and priority to passenger trains adds to delays in freight transportation

Cross-subsidization between passenger and freight yields have made the railways unviable for most transportation routes. This results in a greater preference for road, which is not the ideal mode of transportation for the long haul

Overcrowded ICDs (Inland Container Depots) in the northern cluster cannot get enough traffic to ensure even two rakes per day, adding to the waiting time for cargo at ICDs

Road: High congestion, specifically in the stretch from container freight stations to the port gate, leads to huge delays. This issue is more prominent in public ports like JNPT and Chennai.

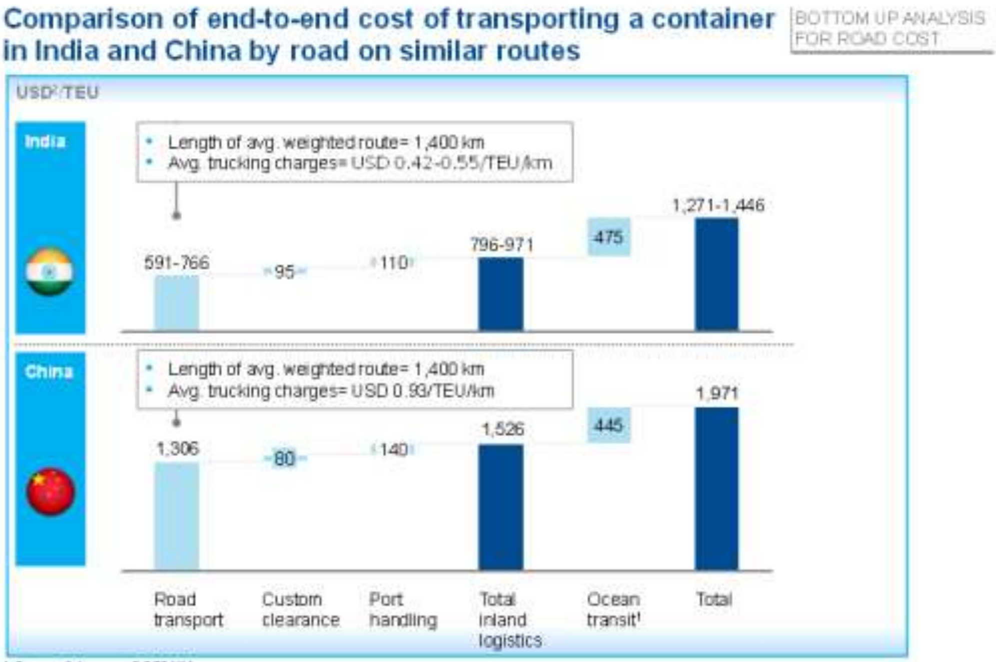
Others: Due to issues pertaining to the unreliability of schedules, the time for customs clearance at ICD/CFS and the congestion on roads and rail, shippers build a lot of buffer into the transportation schedule, leading to idle waiting time for export cargo at ports.

A benchmarking of cost and time required for the end-to-end transportation of a container in India vis-à-vis in China reveals specific actionable insights (Exhibit 5).

Cost

Road: The weighted average of distance between the manufacturing hinterlands and the port for India is 700 to 800 km compared to 150 to 300 km in China. Even though India fares better than China in the transportation cost for a comparable distance, longer hinterland to port distance leads to higher costs for exporting/importing a container in India as compared to China (Exhibit 148 and 149).

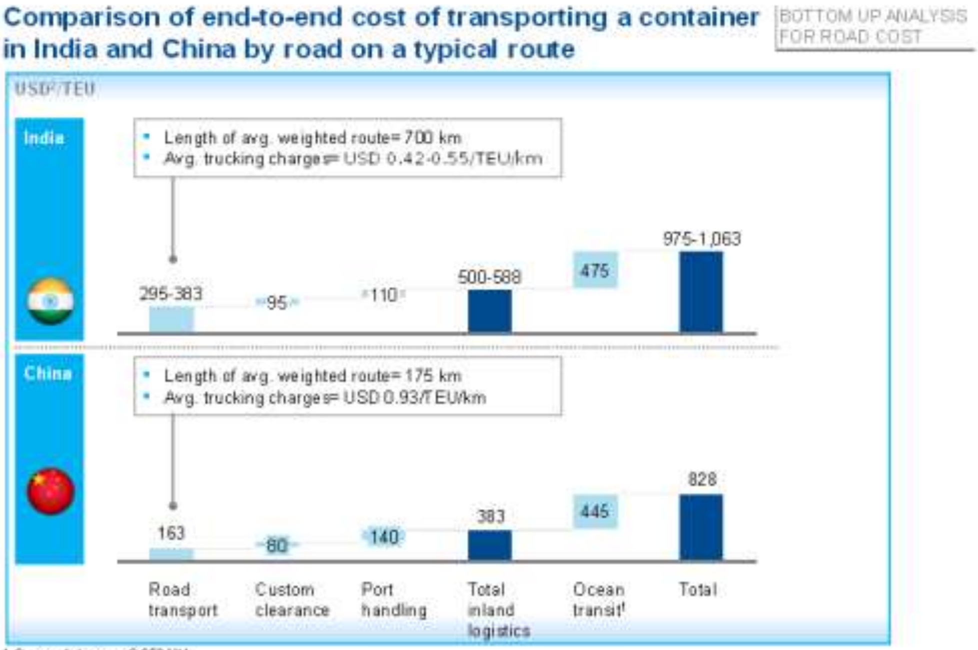
EXHIBIT 148



1 Ocean distance = 6,658 NM
2 USD to INR exchange rate= 64; USD to RMB exchange rate= 6.4

SOURCE: Interviews with Truck companies, CTOs, Freight forwarders, Importers, Exporters, Port management; World Bank

EXHIBIT 149

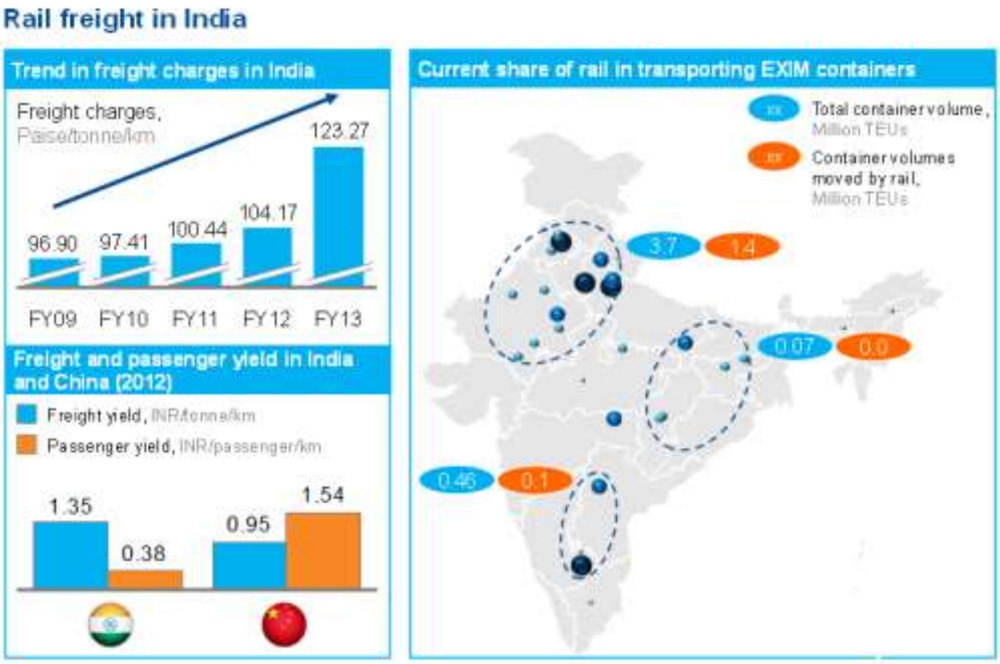


1 Ocean distance = 6,658 NM
2 USD to INR exchange rate= 64; USD to RMB exchange rate= 6.4

SOURCE: Interviews with Truck companies, CTOs, Freight forwarders, Importers, Exporters, Port management, World Bank

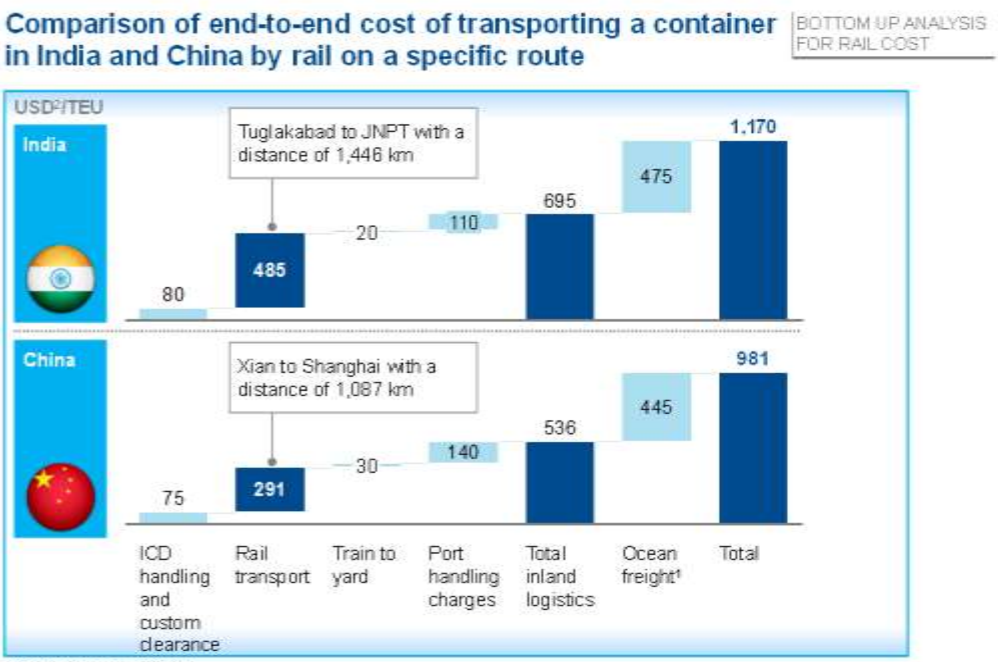
Rail: Higher haulage charges due to cross-subsidization (unlike in China) make exports/imports expensive in India. The recent increase in freight charges has further aggravated the issue. Exhibit 150 compares India and China with respect to yields and shows increases in cargo freights. Exhibit 151 compares the countries on the current end-to-end cost of transporting a container via rail on a typical route.

EXHIBIT 150



SOURCE: APMT; Khambadkones; IPA statistics; Stakeholder interviews, White paper- Indian Railways

EXHIBIT 151

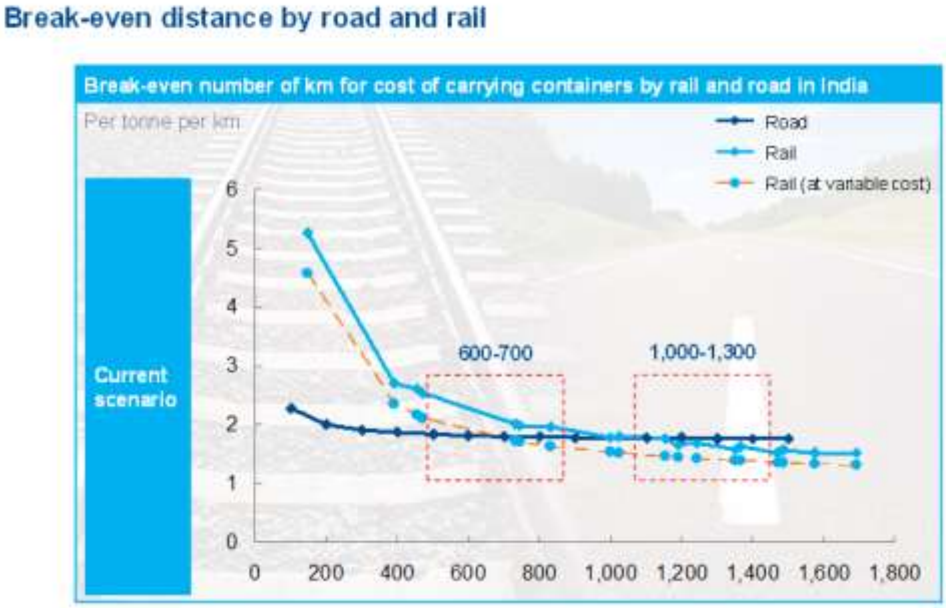


1 Ocean distance = 6,658 NM
2 USD to INR exchange rate = 64; USD to RMB exchange rate= 6.4

Implications for modal mix: Due to the freight charges on road and rail and handling cost involved, rail in India is currently viable for shippers only for a transportation distance beyond 1,000 to 1,300 km. This makes the northwest cluster the primary hinterland where rail becomes viable for inland container transportation. It is also noteworthy that the differential cost between road and rail remains minimal even beyond a distance of 1,000 to 1,300 km. Due to this only 38% of the total volume from this cluster moves by rail.

Assuming a scenario where the rail charges only the cost incurred to transport containers without any markup, the viable distance for shippers to use rail reduces to 600 or 700 km. This implies that many routes from the hinterland to the ports will not shift from road to rail because of the economics involved. Exhibit 152 shows the break-even distance by road and rail under the two scenarios mentioned above. **Exhibit 153 shows the key routes handling more than 50,000 TEUs, which should ideally be on rail but are currently using road for the majority of the volume.**

EXHIBIT 152



SOURCE: CONCOR; Transporter interviews

EXHIBIT 153

Key rail routes currently using roads

ONLY ROUTES WITH HANDLING >50K TEUS

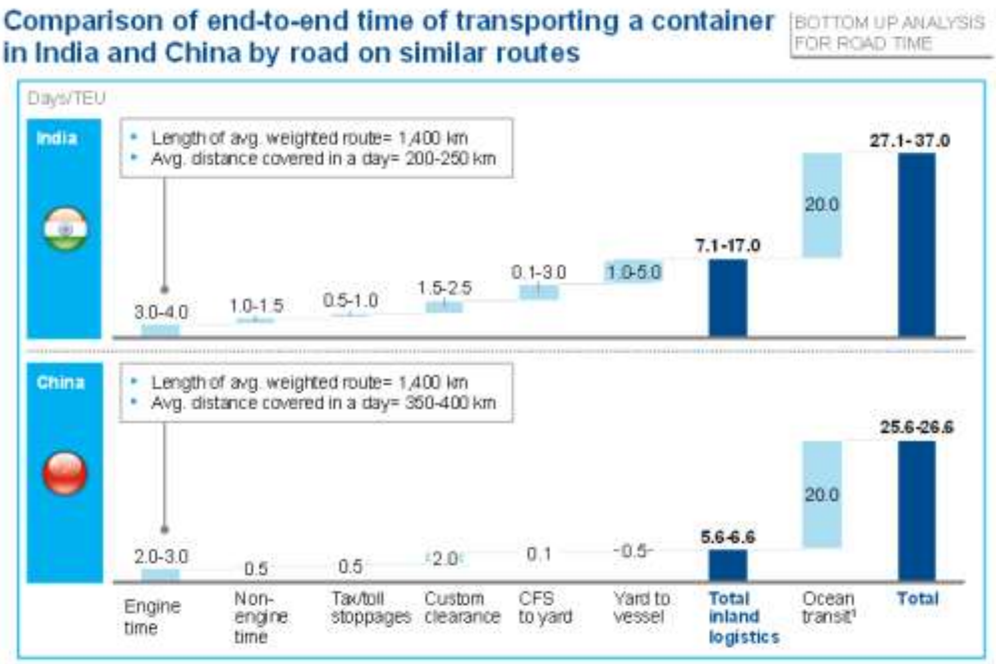
S. No.	Route	Current mode	EXIM volumes '000 TEUs, FY 14
1	NCR – Gujarat/ JNPT	38% rail, 62% road	2,141
2	Ludhiana – Gujarat/ JNPT	63% rail, 37% road	301
3	Other parts of UP – Gujarat/JNPT	15% rail, 85% road	235
4	Moradabad – Gujarat/JNPT	27% rail, 73% road	130
5	Kanpur/Lucknow/Varanasi – Gujarat/JNPT	47% rail, 53% road	106
6	Jaipur – Gujarat/JNPT	44% rail, 56% road	105
7	Ajmer/Kishengarh – Gujarat/JNPT	100% road	90
8	Other parts of Uttaranchal – Gujarat/JNPT	15% rail, 85% road	88
9	Agra/Aligarh/Mathura – Gujarat/JNPT	10% rail, 90% road	71
10	Meerut/Muzafarnagar – Gujarat/JNPT	100% road	71
11	Jodhpur – Gujarat/JNPT	66% rail, 34% road	68
12	Kota – Gujarat/JNPT	16% rail, 84% road	64
13	Bikaner – Gujarat/JNPT	16% rail, 84% road	58
14	Tonk Sawai – Gujarat/JNPT	16% rail, 84% road	58
	Total		**3,586**

SOURCE: APMT

Time: Indian containers can take around 50 percent longer than Chinese containers for a similar inland distance. The duration is highly variable due to the lack of automation in customs processes, lower speed of trucks and trains, and congestion and inefficiency at ports (especially major ports). This unreliability of transport schedules forces shippers to incorporate buffers into timelines, increasing variability of idle time at the yard.

Exhibit 154 and 155 compare the time taken by an Indian export container vis-à-vis a Chinese export container for both road and rail as a mode of inland transportation for a specific route. As can be seen, the major difference is the variability of time taken for inland transportation, primarily due to the yard-to-vessel stage.

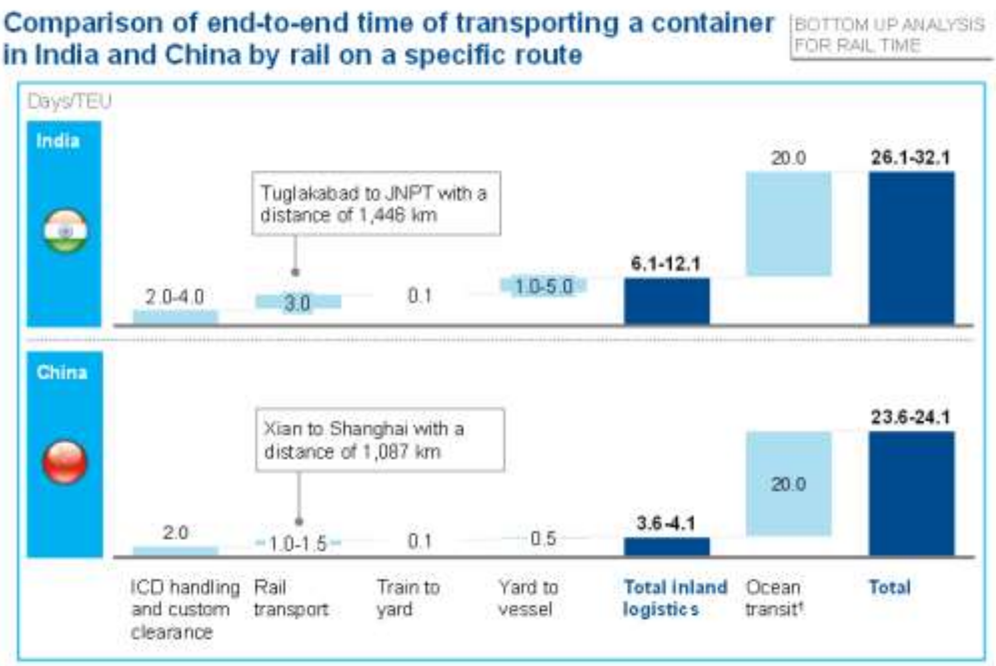
EXHIBIT 154



1 Ocean distance = 6,658 NM

SOURCE: Interviews with Truck companies; CTOs; Freight forwarders; Importers; Exporters; Port management; World Bank

EXHIBIT 155



1 Ocean distance = 6,658 NM

SOURCE: Interviews with Truck companies; CTOs; Freight forwarders; Importers; Exporters; Port management; World Bank

A.3 Potential to reduce time and cost through different levers

The study identifies three broad levers and a total of twenty-one projects to enable reduction of inland transit time for containers by four to seven days. Estimated four to seven days will be saved on the northwest cluster to Gujarat/JNPT port cluster and three to four for other routes. The three themes include customs efficiency, last-mile connectivity and process improvement at ports and road infrastructure for efficient hinterland evacuation. The inventory cost saved on account of this is estimated at INR 5,000-6,000 Cr by 2025. Savings will also come from instances of lost contracts, cost of obsolescence, etc., which currently happens due to variability in transit times and shippers missing out on the scheduled timelines for shipment.

The study also identifies two broad levers and a total of nine projects to increase rail's share in the container modal mix from 18% to 25% resulting in savings of ~INR 2,000-3,000 Cr through reduction in fuel import bill. Rationalizing rail rates for containers can reduce the cut-off distance for the viability of rail from 1,000-1,300 km as shown for current rail to 400-500 km (Exhibit 156). This will enable changing the modal mix from road to rail, especially for the northern India hinterland, saving on fuel imports for India (Exhibit 157). Hence, by 2025 this can result in an overall saving of ~INR 7,000-9,000 Cr enabled by the proposed projects.

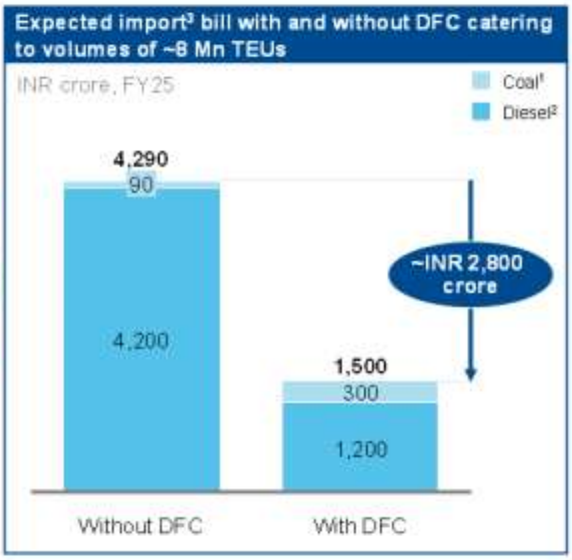
EXHIBIT 156

EXHIBIT 157

Savings due to reduction in crude import bill due to higher rail share

Assumptions

- Main rail route: North-west region to Gujarat/ JNPT port cluster
- Avg. weighted distance: 1,087 km
- Year of operation of Western DFC: FY20
- Rail coefficient without DFC: 38%
- Rail coefficient with DFC: 80%
- Level of electrification of present trains by FY20: 47%
- Level of electrification of DFC: 100%



1 Present rail and DFC electric locomotive consuming 0.011 KWh*0.48kg and 0.008 KWh*0.48kg of coal per NTKM
2 Present rail diesel locomotive and truck consuming 0.0045 litres and 0.0143 litres of diesel per NTKM
3 Import cost for coal and diesel assumed to be INR 5.64/kg and INR 25.37/ litre respectively

SOURCE: IOCL; IIMA

The list of projects identified under the different levers is as mentioned below

1. Reduction of inland transit time by four to seven days

Lever #1.1: Customs efficiency

- **Project 1:** Simplification of registration process for factory stuffing and self-sealing of containers to enable higher proportion of green channel volumes
- **Project 2:** Installation of container scanners at all major container ports, ICDs and CFSs to facilitate green channel custom clearance
- **Project 3:** Dedicated fast lane processing area for clearance at the ports for "credible" rated institutional players
- **Project 4:** Linkage of EXIM licenses to unique identification numbers to allow for deferred checking of documents
- **Project 5:** Increased staff strength of customs to provide 24*7 service for importers and exporters
- **Project 6: C**omplete automation of filing IGM / EGM with all formalities for submission of hard copies to different organization dispensed with
- **Project 7:** Uniform guidelines across all parties and in all geographies involved and should not be left open to interpretation
- **Project 8:** Vessels should be allowed to carry domestic as well as international containers. Coastal ships to be allowed to pick up EXIM cargo for ports en route

Lever #1.2: Last mile-connectivity

- **Project 9:** Increased port and port gate capacity to facilitate faster movement of container from gate to yard and yard to vessel
- **Project 10:** Reduced lead time at the gate through OCR (Optical Character Recognition) based automation
- **Project 11:** Evacuation and penalty mechanism for trucks not having necessary approvals or documents
- **Project 12:** Setting up of truck holding areas for the drivers with basic facilities, to avoid truck parking in the shoulder areas

Lever #1.3: Road infrastructure

- **Project 9:** Dedicated toll lanes for the EXIM container trucks on National highways
- **Project 10:** Construction of freight friendly road corridors from Ahmedabad/Vadodara/ Surat/Vapi to JNPT

- **Project 11:** Construction of freight friendly road corridors from Hyderabad/Amravati to Central Andhra Pradesh port
- **Project 12:** Construction of freight friendly road corridors from Hyderabad to JNPT
- **Project 13:** Construction of freight friendly road corridors from Bangalore to Mangalore
- **Project 14:** Construction of freight friendly road corridors from Bangalore/Trichy to Colachel
- **Project 15:** Construction of freight friendly road corridors from Coimbatore to Colachel
- **Project 16:** Construction of freight friendly road corridors from Durgapur to Haldia
- **Project 17:** Construction of freight friendly road corridors from Pune to JNPT
- **Project 18:** Construction of freight friendly road corridors from Bangalore to Chennai
- **Project 19:** Construction of freight friendly road corridors from Ahmedabad to Mundra
- **Project 20:** Construction of freight friendly road corridors from Ahmedabad to Pipavav
- **Project 21:** RFID enabled toll and inter-state checks

2. Reduced import bill due to modal shift: Rail share improvement from 18% to 25%

Lever #2.1: DFC and connectivity to ports

- **Project 1:** Connection of western DFC to Mundra port
- **Project 2:** Connection of western DFC to Pipavav port
- **Project 3:** Connection of western DFC to Hazira port
- **Project 4:** Connection of western DFC to Kandla port

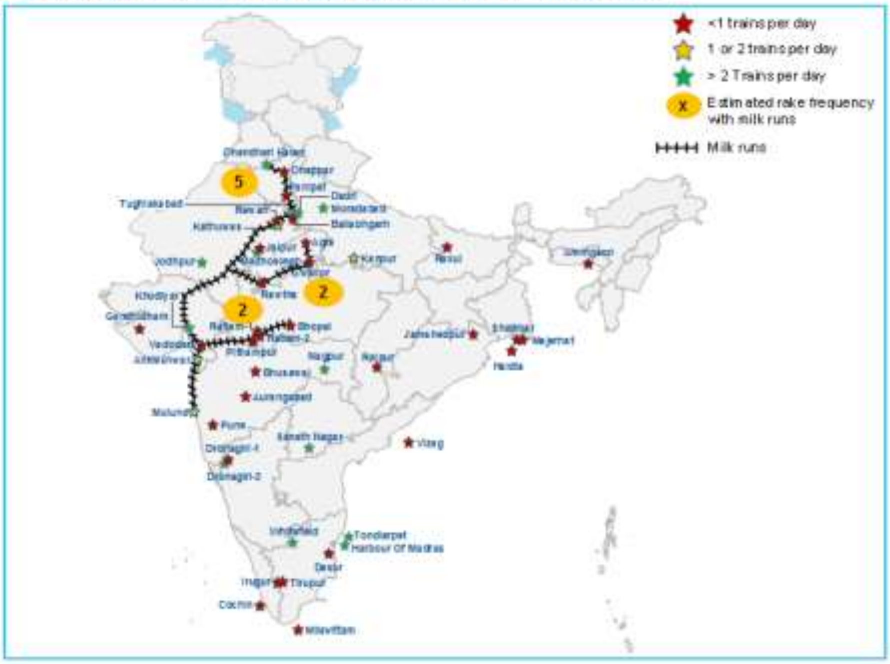
Lever #2.2: Multimodal grid connectivity and efficiency projects

- **Project 5**: Inter-connection of ICDs, Dhandhari Kalan→Dhappar→Panipat →Tughlakabad through a milk run with DFC (Exhibit 119)
- **Project 6:** Inter-connection of ICDs, Agra→Gwalior→Rawtha through a milk run with DFC (Exhibit 119)
- **Project 7:** Inter-connection of ICDs, Bhopal→Ratlam→Pithampur→Vadodara through a milk run with DFC (Exhibit 15)

- **Project 8:** Fixed rail schedule for each ICD to reduce variability in transit time
- **Project 9:** Revamp of ICD approval process to avoid overcrowding of ICDs; Ensure mega ICDs along the upcoming DFC exploit full potential
- **Project 10:** ICDs to be used as common rail terminals to ensure maximum utilisation of the already done capital expenditure projects
- **Projects 11:** New Multimodal hubs namely
  - Hubli (Karnataka)
  - Managalore(Karantaka)
  - Darjeeling(West Bengal)
  - Bhubaneswar(Odisha)
  - Singarauli (Madhya Pradesh)
  - Nagaur (Rajasthan)

EXHIBIT 158

Need for upgradation and aggregation of existing ICDs



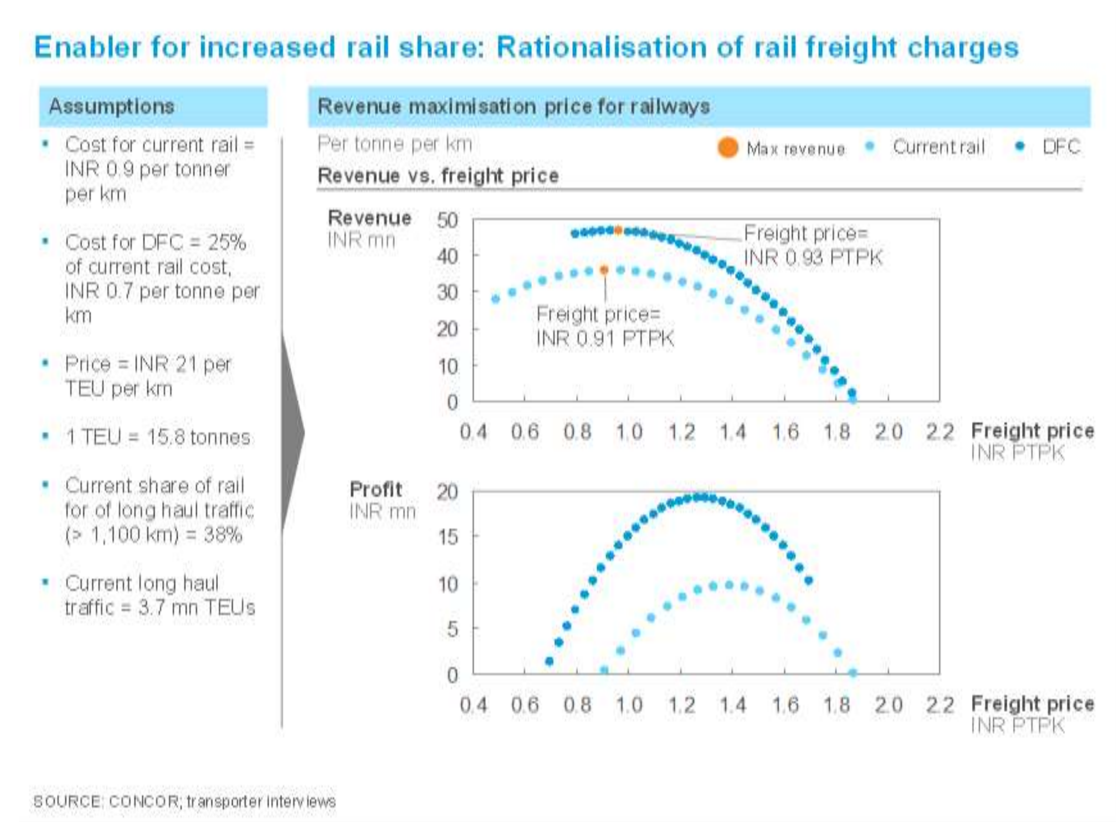
SOURCE: IPA

Lever #2.3: Rail freight charges rationalization

Project 9: Immediate requirement of rationalization of rail freight charges especially for the proposed Dedicated Freight Corridor (DFC) to increase trade competitiveness, de-congest road & port gates and from an environment point of view

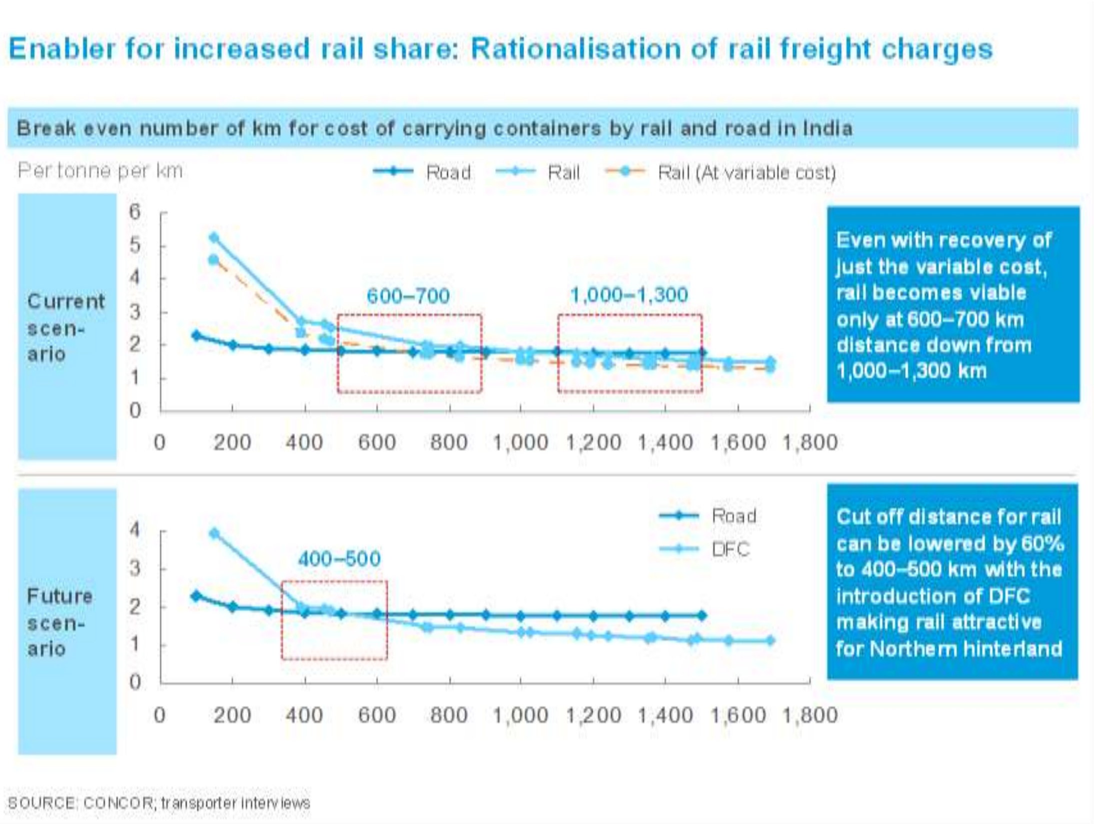
The analysis of current and optimal revenue for railways shows that current rail can maximise its revenue at charges of INR 14 to 15 per TEU per km for an average distance of 1,100 km as opposed to the prevailing charges of around INR 21 per TEU per km (reduction of roughly 33 per cent). The same analysis for DFC shows that revenue would be maximised at around INR 15 per TEU per km (Exhibit 159). The higher price in DFC as compared to current rail is because DFC is dedicated to cargo handling with the ability to carry four times the cargo (DFC will be double the length with double-stacked containers as compared to current rail).

EXHIBIT 159



Even a 25 per cent reduction in freight charges for DFC (from INR 21 per TEU per km to INR 16 per TEU per km) can still yield an IRR of 16 per cent assuming DFC investment of INR 48,000 cr and amortization period of 30 years. This reduction in price can reduce the cut-off distance where rail becomes more economical than road for current rail current rail from 1,000 or 1,300 km to 400 or 500 km (Exhibit 160).

EXHIBIT 160



The shift from road to rail will be driven primarily by the northern hinterland, including NCR, Punjab, Haryana, Rajasthan and western UP, which would contribute around 30 per cent of container volumes by FY 2025. With 25 per cent reduction in freight charges allowing DFC to handle 80 per cent of the above volumes, rail share could go up from 18 to 25 per cent (Exhibit 161). Assuming a growth rate of around 8 per cent in container volumes until FY 2025, the higher rail share could lead to potential savings of INR 2,000 to 3,000 cr.

EXHIBIT 161

Comparison of carrying a container from a factory to port at a distance of 1,100 km by road and rail

Potential savings with increased rail share	
Potential volumes of North hinterland, FY25	7.7 mn TEUs
Cost of transporting with Rail@38% share	INR 20–24k cr
Cost of transporting with Rail@80% share	INR 17–18k cr
Price of transporting with Rail@38% share	INR 24–28k cr
Price of transporting with Rail@80% share	INR 21–23k cr

1 Does not include ICD/CFS and port handling charges
2 To achieve IRR of 16%, prices can be reduced to 25% assuming cost of building western DFC is INR 48,000 cr at current cost of construction, 25% lesser operating cost due to double stacking, no cross subsidisation and capex amortisation over 30 years

SOURCE: Interviews with DFCCIL; transporters

Integrated pricing for first and last mile stretch

For an efficient multi modal transportation, it is important to have an integrated system for various legs of transport. Currently, railways charges separately for the first and last mile of connectivity, according to their slab rates. This initiative can further boost coastal shipping through rail-sea-rail route by improving economics for coastal shipping compared to rail transportation.

Recently, railways have announced adjustment in prices for short lead distances. Even though it has improved economics for routes with short distances, there is still scope for improvement by integrating leg distances. Exhibit 1 shows an illustrative example of benefit of integrated rail freight charges. As can be seen in the exhibit 162, there can be savings of upto INR 100/ton by combining first and last mile distances.

EXHIBIT 162

Cost advantage by integrating first and last mile distances

Rail freight[1,2] difference between individual and combined distances (INR)

Distance (km)	10	20	50	80	100	200	500	800	1000	1250
10	119	119	85	119	77	87	51	53	-14	119
20		119	85	111	77	87	51	53	-14	119
50			68	21	30	53	51	53	-14	119
80				33	7	28	25	29	28	29
100					15	36	34	38	37	38
200						59	54	61	58	61
500							57	62	62	165
800								74	103	316
1000									206	427
1250										655

1 Class 150 railway freights
2 Adjustment in freight rates for short lead distances considered

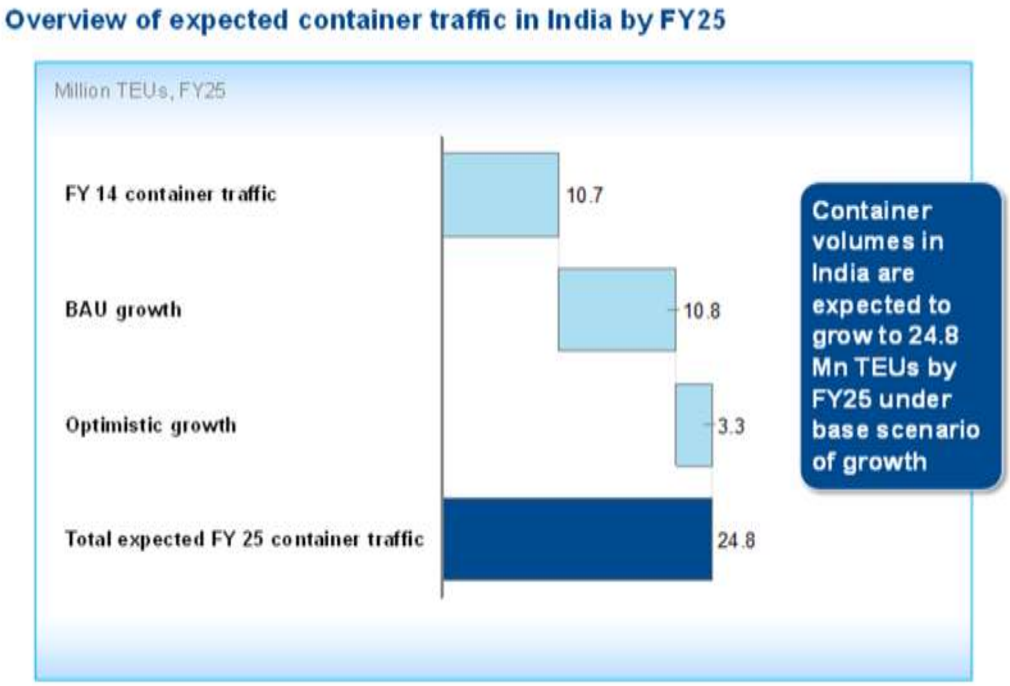
A.4 Projected future traffic of EXIM containers: Business as usual and additional through port-led development

We have analyzed two scenarios for growth projections of containers (Exhibit 163). The scenarios are:

- Business-as-usual: With the sustenance of past growth rate, FY 2014 traffic of 10.7 MTEUs is expected to be 21.5 MTEUs in FY 2025

- Optimistic scenario: With boost from “Make in India” and upcoming industrial corridors (DMIC, VCIC, CBIC, etc.), the container traffic is expected to grow to 24.8 MTEUs in FY 2025 registering a CAGR of ~8%.

EXHIBIT 163



A.5 Recommended 2025 network: Port and hinterland connectivity network

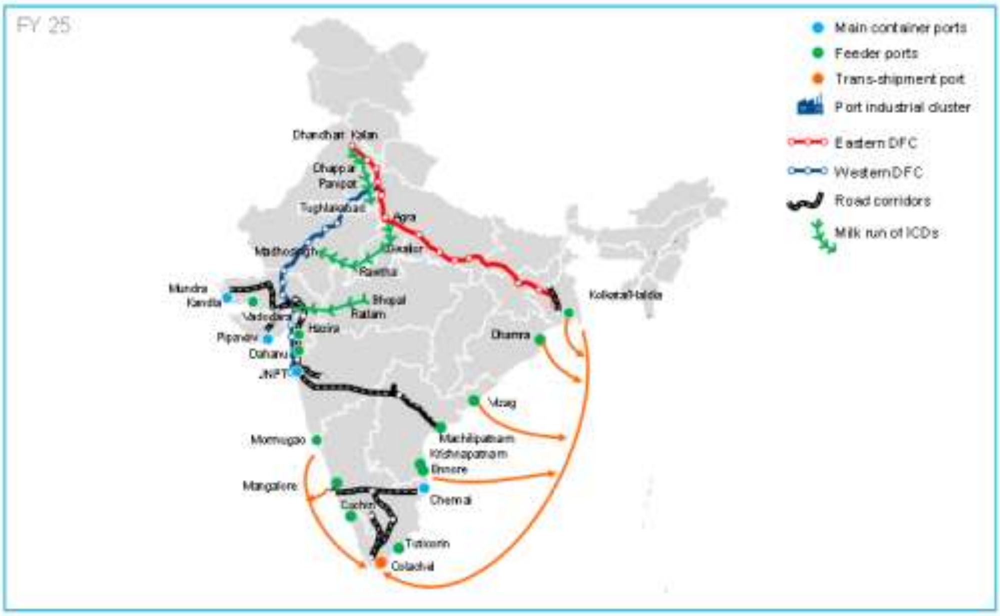
Considering the projected OD mapping for containers by FY 2025, the recommended port and hinterland network should include

- Colachal as a transshipment port on the southern tip
- Machilipatnam to serve the growing hinterland of Andhra Pradesh
- Mundra, Pipavav, JNPT and Chennai to serve as main container ports with all other ports feeding into these ports or Colachel for transshipment
- Eleven high-density road routes connecting specific hinterlands to ports
- Western DFC and appropriate connectivity of the ICD network to DFC through three milk runs
- Industrial port clusters in Gujarat, Maharashtra, the southern tip, central Andhra Pradesh, northern Tamil Nadu and West Bengal

Exhibit 164 shows the recommended 2025 network with port and hinterland connectivity

EXHIBIT 164

Optimised container network in India



A.6 Key enablers: Steps required to capture the opportunity

Different stakeholders need to come together to capture the opportunity of achieving potential savings of **INR 7,000-9,000 Crores** per annum by FY 2025.

The Ministry of Shipping should act as the nodal agency to develop a concrete plan for an efficient container port network, including a gateway, feeder and transshipment port. It should work with different organizations like Department of Industrial Policy and Promotion to develop a strategy on port-led development, Central Board of Excise and Customs to streamline customs procedures, the Indian Railways and CTOs to ensure rationalization of rail-freight charges and optimization and aggregation of the ICD network.

Annexure 7 – Multi-modal transportation model user manual

INTRODUCTION

The multi-modal transportation model analyses the current transportation model of containers and bulk cargo from given sources to all major ports in India and then compares it with the optimum model to calculate savings. It also shows which rail/road routes, ICDs or ports will be congested if we follow the optimum model. To access the model, click http://maptool.saverisk.com/dashboard.aspx.

The main objective of the model is to identify the road and rail routes, ICDs and ports which need to be developed to handle existing and future capacity. Various parameters inside the model can be changed to see how these affect the optimum output.

Parameters that can be added or changed are:

Cost assumptions for container and bulk cargo movement via road or rail

- New ports in the existing infrastructure
- New ICDs in the existing infrastructure (new ICD location is limited to the location of existing railway stations in India)
- New sources for cargo movement to check how future capacity additions will affect the existing model

Static data required to run the model includes:

- A list of sources for container/bulk cargo movement
- A list of existing ICDs and their container handling capacity
- Transportation cost for container and bulk cargo movement via road and rail
- A list of existing ports and their container/bulk cargo handling capacity
- Capacity of road and rail routes

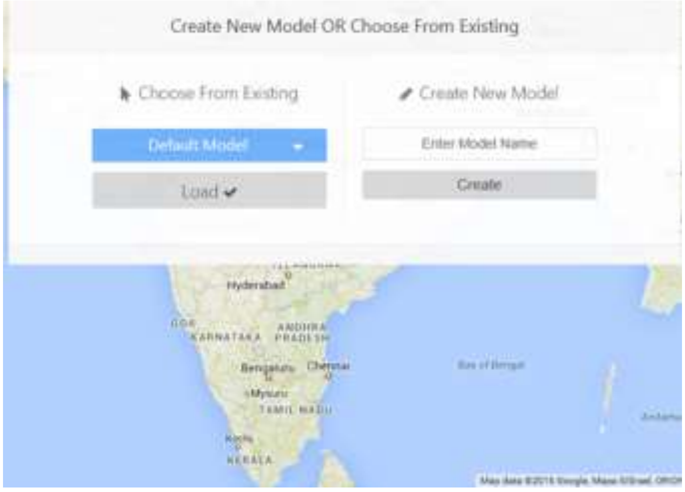
Along with the static data points mentioned above, there are also a few dynamic data points such as road/rail route and distance between source points, ICDs and ports. These are required when parameters inside the model are manually changed.

Road data is taken from Google Maps and rail route data is take from Indian Railway website on a real-time basis. In some cases, when these sources do not provide the requested data, calculations are based on aerial distance instead.

Stage 1: Create new model/load existing or default model

Open the link mentioned in introduction and log in with the credentials provided. Click at the top left corner of the webpage. A dialogue box will open, offering two options (Exhibit 165). To select existing/default model click **Load** to open that model or enter a name to create a new model. Click **Save** and **Next** to continue.

EXHIBIT 165



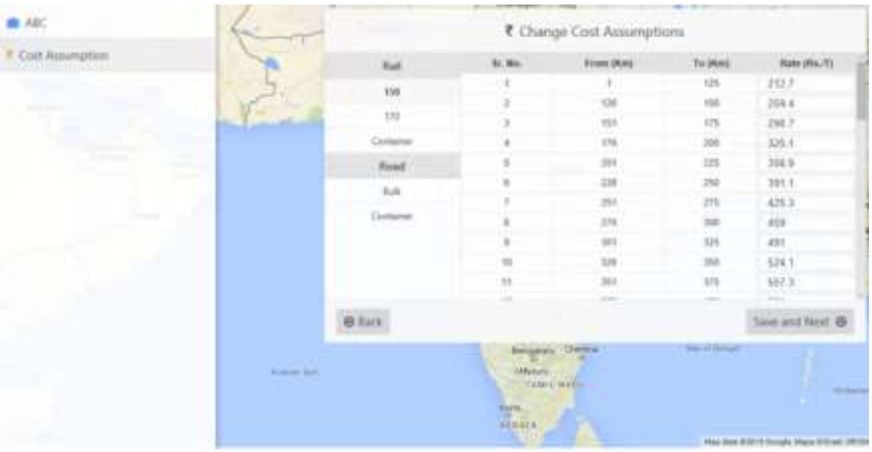
Stage 2: Change cost assumptions

The next screen contains the cost assumption for road and rail as modes of transport (Exhibit 166). Based on the type of goods, the cost of rail transport is divided into three categories:

- Coal and fertiliser (150)[9]
- Iron ore (170)
- Containers
- Similarly, road transport is divided into 2 categories
- Break-bulk cargo
- Containers

[9] 150 and 170 are the numbers given by Indian Railways to respective categories

EXHIBIT 166



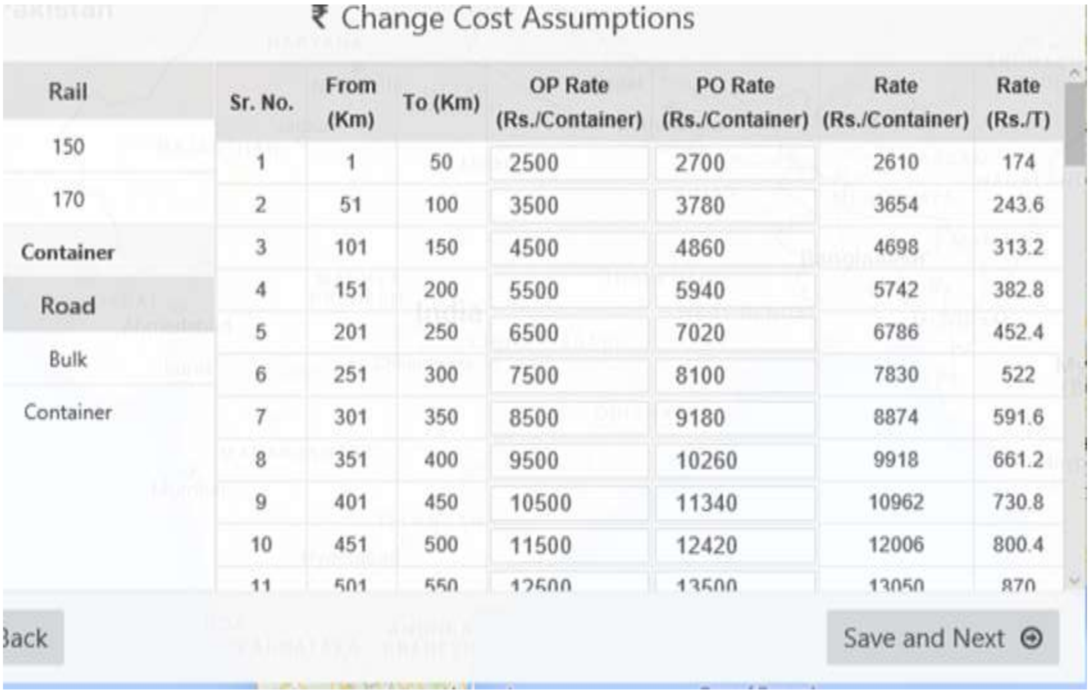
Click on the tabs in the first column (**150, 170, Container**, etc.) to view/change cost assumptions for the categories mentioned above (Exhibit 1). To change the cost assumptions for a particular km range for coal, fertilisers or bulk cargo, edit the value of column **Rate (Rs/T)** shown in Exhibit 167.

To change the cost assumption for containers, enter values in two columns:

OP Rate, i.e., cost of movement from Origin to Port

PO Rate, i.e., cost of movement from Port to Origin

EXHIBIT 167



₹ Change Cost Assumptions

Rail
150
170
Container
Road
Bulk
Container

Sr. No.	From (Km)	To (Km)	OP Rate (Rs./Container)	PO Rate (Rs./Container)	Rate (Rs./Container)	Rate (Rs./T)
1	1	50	2500	2700	2610	174
2	51	100	3500	3780	3654	243.6
3	101	150	4500	4860	4698	313.2
4	151	200	5500	5940	5742	382.8
5	201	250	6500	7020	6786	452.4
6	251	300	7500	8100	7830	522
7	301	350	8500	9180	8874	591.6
8	351	400	9500	10260	9918	661.2
9	401	450	10500	11340	10962	730.8
10	451	500	11500	12420	12006	800.4
11	501	550	12500	13500	13050	870

Back   Save and Next

The final value is calculated by assuming 40 per cent export traffic and 60 per cent import traffic for containers, assumed for both road and rail traffic for containers. Click **Save** and **Next** to continue.

Stage 3: Choose/add ports

Existing ports: This tab contains the list of all ports in the database considered for calculation of the optimum route. The handling capacity for different commodities are given in corresponding columns (Exhibit 168).

EXHIBIT 168

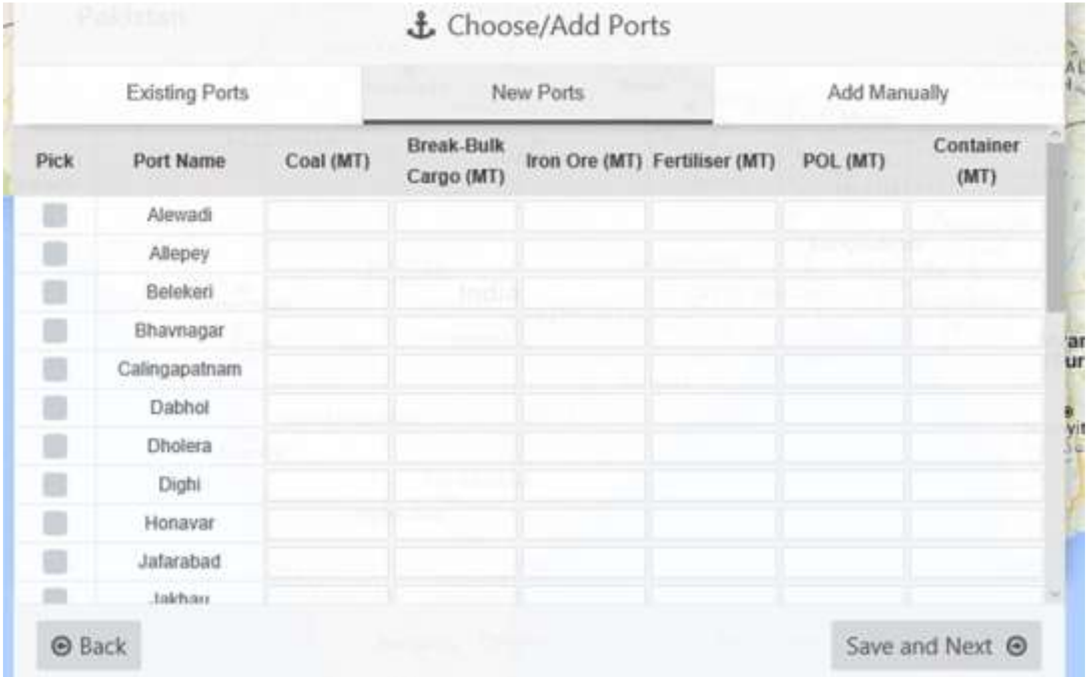
Choose/Add Ports

Existing Ports | New Ports | Add Manually

	Port Name	Coal (MT)	Break-Bulk Cargo (MT)	Iron Ore (MT)	Fertiliser (MT)	POL (MT)	Container (MT)
☑	Kolkata Dock System		6.74			4.5	5.9
☑	HALDIA	7	15.75	6		17	4
☑	PARADIP	20	33.8	4.5	7.5	43	
☑	VIZAG		47.09	12.5	1	25.65	2.68
☑	GANGAVARAM		47.09	12.5	1	25.65	2.68
☑	Ennore	21	1	6		3	
☑	Chennai		17.92	8		17.67	42.45
☑	Tuticorin	12.55	22.21			2.3	5
☑	Cochin		12.35		0.8	24.01	12.5
☑	Mangalore	5.4	15.7	7.5		49.17	
☑	MORMUGAO		7.65	27.5		1.5	
☑	MUMBAI		11.53			32	1
☑	Kandla		26.52		2	66.6	7.2
☑	JNPT		0.9			5.5	59.48

New ports: Exhibit 169 lists the new ports identified and mapped in the database but not used for calculation. These can be added if required by clicking the corresponding check box in the **Pick** column.

EXHIBIT 169



Enter the handling capacity of mentioned commodities for the ports added. This can be left blank if the port does not handle that commodity.

Add manually: It is possible to **Add manually** those ports that are not mentioned in the database (Exhibit 170). Port location can be selected directly from the map. To add a new port click the checkbox in the **Pick** column, and a map will open up (Exhibit 171).

EXHIBIT 170

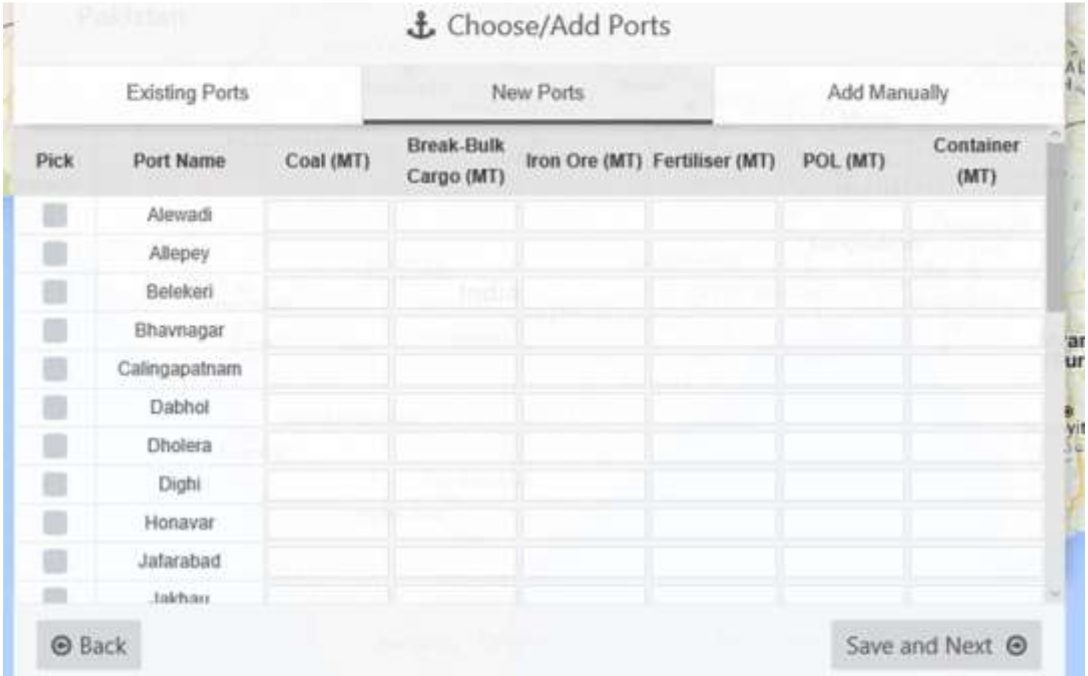
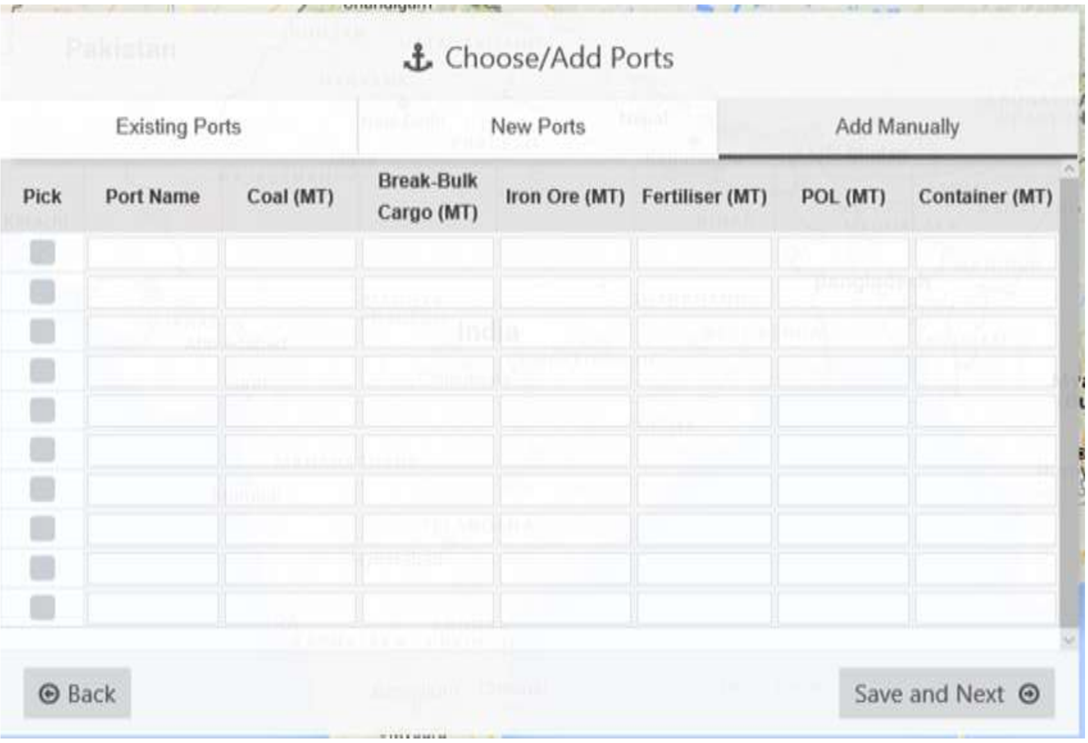
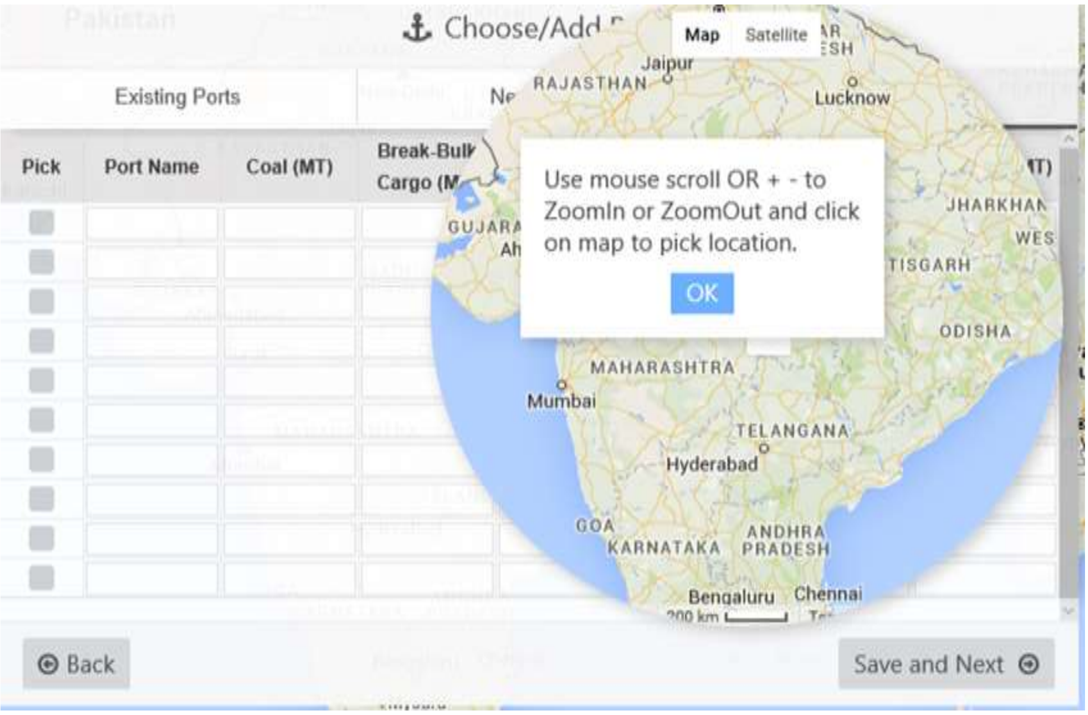


EXHIBIT 171


Choose/Add Ports
Existing Ports
New Ports
Add Manually
Pick
Port Name
Coal (MT)
Break-Bulk Cargo (MT)
Iron Ore (MT)
Fertiliser (MT)
POL (MT)
Container (MT)
Back
Save and Next


Existing Ports
Pick
Port Name
Coal (MT)
Map
Satellite
Jaipur
RAJASTHAN
Lucknow
Use mouse scroll OR + - to ZoomIn or ZoomOut and click on map to pick location.
OK
JHARKHAND
ODISHA
MAHARASHTRA
Mumbai
TELANGANA
Hyderabad
GOA
KARNATAKA
ANDHRA PRADESH
Bengaluru
Chennai
Back
Save and Next

Click **OK** and use **+/-** sign to **Zoom in** and **Zoom out** of the map. Select the location of the new port on the map and click **OK**. Add the port name and capacity for mentioned commodities. Add more ports if required and click **Save** and **Next**.

STAGE 4: ADD NEW ICD

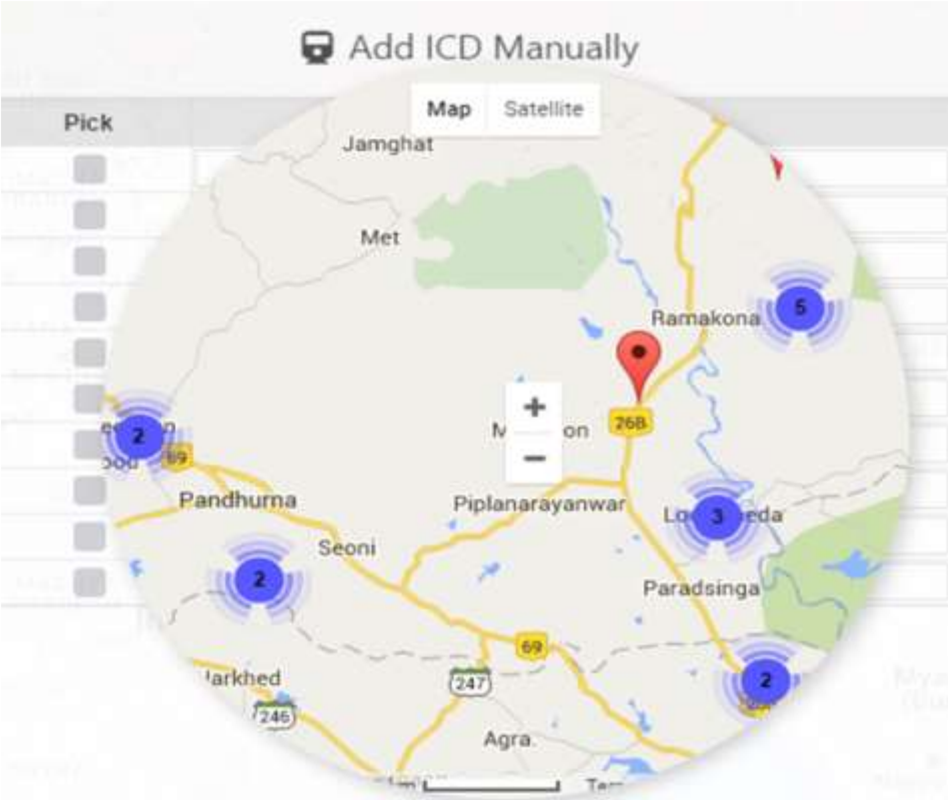
It is possible to **Add ICD manually** using the tab shown in Exhibit 172.

EXHIBIT 172

Similar to adding new ports, click the checkbox in the **Pick** column to open up a map (Exhibit 173). It is assumed that a new ICD can only be added near existing railway stations.

More than 10,000 railway stations are marked on the map in groups, represented by a number that indicates the count of stations in each group. Click on the numbers to view the stations within that group. Zoom in/out to check the stations marked on the map. Select the desired station and click **OK** to choose it as an ICD.

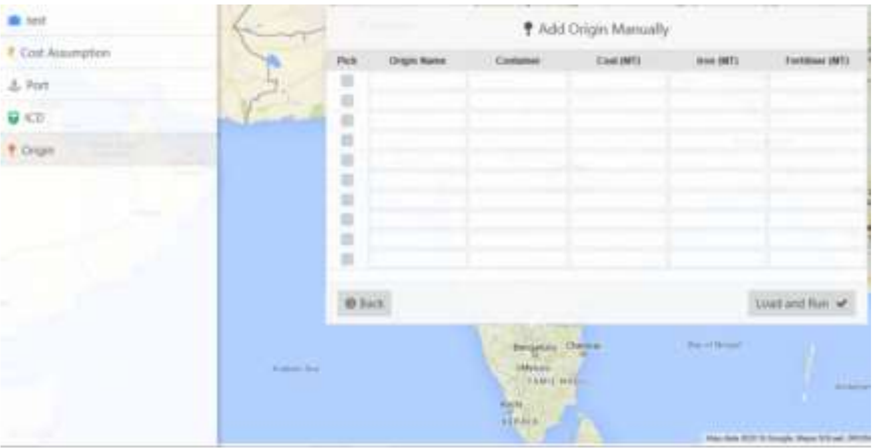
EXHIBIT 173


Add ICD Manually
Pick
Map
Satellite
Jamghat
Met
Ramakona
5
268
2
69
Pandhurna
Piplanarayanwar
3
Seoni
2
Paradsinga
69
247
246
2
Agra

Stage 5: Add Origin Manually

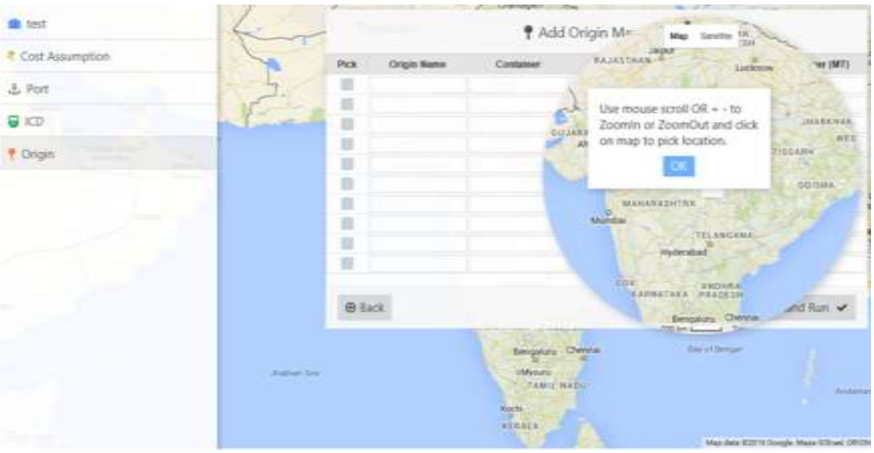
The tab shown in Exhibit 174 is used to add any new origin in the database.

EXHIBIT 174



Similar to Ports and ICDs, click the checkbox in the **Pick** column to open up a map. Click **OK** and use the **+/-** signs to **Zoom in** and **Zoom out** of the map (Exhibit 2).

EXHIBIT 175



Select the desired point to set it as a new origin point. Add the **Origin Name** and fill its capacity in the corresponding columns.

Previous stages can be accessed with the help of the back button to make any changes. Click **Load and Run** to run the scenario. It may take 20 to 30 minutes for the process to complete.

Output

Output contains two major sections: **Savings** and **Congestion**.

Savings: Exhibit 176 contains the list of all origin points matched to the destination ports for which the cost of transportation is optimum. Savings for each route are calculated by comparing the optimum transportation cost to the existing cost.

EXHIBIT 176

DEFAULT MODEL

Savings

Sr. No.	Origin	Current Destination	Total Saving (Cr)
1	Delhi	Kandla	1676
2	Other parts of UP	Kolkata Dock System	915
3	Mumbai region (MMR)	MUMBAI	735
4	Faridabad	Kandla	506
5	Bangalore	Chennai	473
6	Noida	Kandla	451
7	Gurgaon	Kandla	441
8	Vapi	Dahanu	417
9	Karnataka	MANGALORE	396
10	Greater Noida	Kandla	383
11	Tisco Jamsh-edpur	HALDIA	366
12	Other Tamil Nadu	Tuticorin	365
13	Kanpur/Lucknow/Varanasi	Kolkata Dock System	315
14	Surat	HAZIRA	308
15	Other parts of Uttaranchal	Kandla	304
16	Other parts of Haryana (Karnal, Kurushetra, Kaithal, Hisar)	Kandla	283
[illegible]	[illegible]	DHARAMTAR	[illegible]

Click on the savings for each route to get a breakup along with detailed information on the earlier destination, volume and cost. Exhibit 177 shows how cargo was moving to three different locations from Delhi. The model changed the destination to Kandla as that route incurs the minimum cost of transportation from Delhi.

EXHIBIT 177

Kandla - Delhi | Savings : ₹ 1676 (Cr.)

Sr. No.	Origin	Earlier Destination	Current Destination	Earlier Volume (MT)	Earlier Cost (Cr)	Final Cost (Cr)	Savings (Cr)
1	Delhi	JNPT	Kandla	6.2	2192	1317	875
2	Delhi	Mundra	Kandla	6.98	2052	1482	570
3	Delhi	Pipavav	Kandla	2.33	725	494	231

Congestion: Exhibit 178 shows the capacity load on all ports, rail routes, road routes and ICDs if the optimum plan is followed.

EXHIBIT 178

Congestion

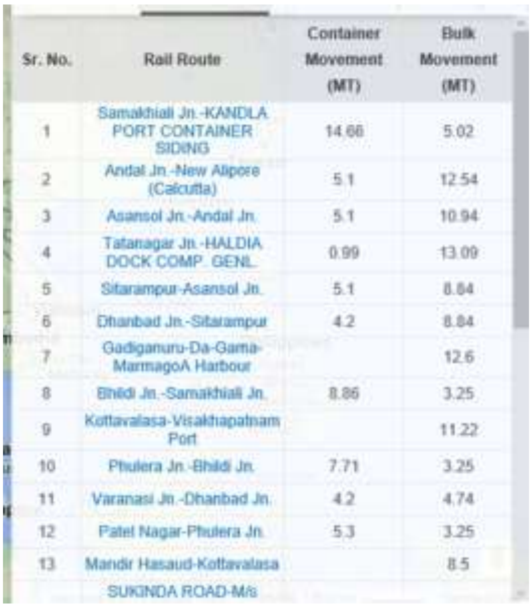
Port | Rail | Road | ICD

Sr. No.	Port Name	Container Handling (MT)	Bulk Handling (MT)
1	Kandla	66.37	8.11
2	Kolkata Dock System	15.11	16.09
3	MUMBAI	27.54	1.85
4	Chennai	26.75	
5	VIZAG	4.52	11.22
6	Tuticorin	13.96	1.73
7	HALDIA	2.54	13.09
8	MORMUGAO	0.6	12.6
9	JNPT	11.32	
10	PARADIP	2.79	5.58
11	DHAMRA	0.06	8.11
12	GANGAVARAM		7.4
13	Cochin	6.14	
14	Kakinada	2.41	3.27
15	DHARAMTAR ISPAT		5.54
16	Dahej	5.41	

The **Port** tab will show the list of ports with their container handling and bulk handling. Click on any port on the table to view it on the map along with all the sources from where that port will receive goods.

The **Rail** tab will show the top rail routes sorted in descending order based on the amount of **Container movement** and **Bulk movement**. Click on any rail route to view the source and ports connected via that route (Exhibit 179).

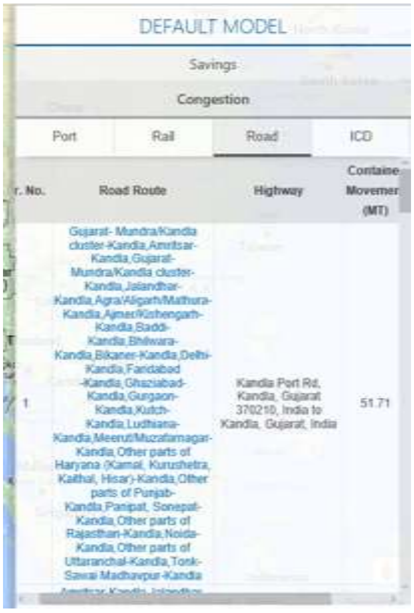
EXHIBIT 179



Sr. No.	Rail Route	Container Movement (MT)	Bulk Movement (MT)
1	Samakhiali Jn.-KANDLA PORT CONTAINER SIDING	14.66	5.02
2	Andal Jn.-New Alipore (Calcutta)	5.1	12.54
3	Asansol Jn.-Andal Jn.	5.1	10.94
4	Tatanagar Jn.-HALDIA DOCK COMP. GENL.	0.99	13.09
5	Sitarampur-Asansol Jn.	5.1	8.84
6	Dhanbad Jn.-Sitarampur	4.2	8.84
7	Gadiganuru-Da-Gama-MarmagoA Harbour		12.6
8	Bhildi Jn.-Samakhiali Jn.	8.86	3.25
9	Kottavalasa-Visakhapatnam Port		11.22
10	Phulera Jn.-Bhildi Jn.	7.71	3.25
11	Varanasi Jn.-Dhanbad Jn.	4.2	4.74
12	Patel Nagar-Phulera Jn.	5.3	3.25
13	Mandir Hasaud-Kottavalasa		8.5
	SUKINDA ROAD-M/s		

The **Road** tab will show the top busy routes in India along with the highways on that route. Click on any road route to view the source and ports connected via that route (Exhibit 180).

EXHIBIT 180



DEFAULT MODEL

Savings

Congestion

Port | Rail | Road | ICD

r. No.	Road Route	Highway	Containe Movemer (MT)
1	Gujarat- Mundra/Kandla cluster-Kandla,Amritsar-Kandla,Gujarat-Mundra/Kandla cluster-Kandla,Jalandhar-Kandla,Agra/Aligarh/Mathura-Kandla,Ajmer/Kishengarh-Kandla,Baddi-Kandla,Bhilwara-Kandla,Bikaner-Kandla,Delhi-Kandla,Faridabad -Kandla,Ghaziabad-Kandla,Gurgaon-Kandla,Kutch-Kandla,Ludhiana-Kandla,Meerut/Muzaffarnagar-Kandla,Other parts of Haryana (Karnal, Kurushetra, Kaithal, Hisar)-Kandla,Other parts of Punjab-Kandla,Panipat, Sonepat-Kandla,Other parts of Rajasthan-Kandla,Noida-Kandla,Other parts of Uttaranchal-Kandla,Tonk-Sawai Madhavpur-Kandla	Kandla Port Rd, Kandla, Gujarat 370210, India to Kandla, Gujarat, India	51.71

The **ICD** tab contains the list of all ICDs sorted in descending order on the basis of the number of containers passing through each depot (Exhibit 181).

EXHIBIT 181

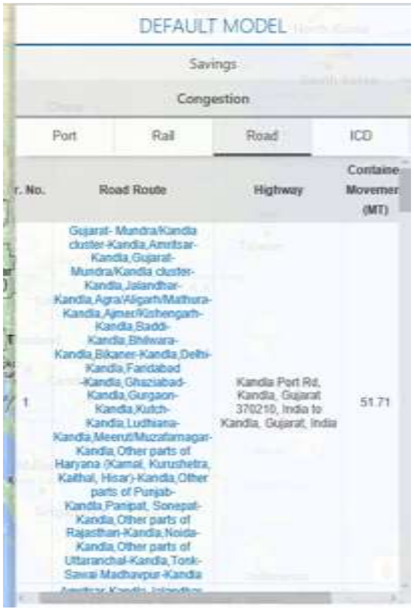


EXHIBIT 182

Click on any ICD to view its location on the map along with the location of the port to which the containers are transported from that ICD.