Comprehensive Integrated Master Plan for Chennai Bengaluru Industrial Corridor Final Report

Regional Comprehensive Plan

October 2015

Japan International Cooperation Agency

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1 Introduction

1.1 Background and Objective

1.1.1 Background

Both Bengaluru and Chennai are developing rapidly and accept increasing number of private companies including Japanese. On the other hand, the private sector claims that bad access to ports, bad road condition, frequent blackouts, tax system, not transparent visa procedure, incomplete policy etc, are bottlenecks of their investments in India.

Joint Statement between Government of Japan (GOJ) and Government of India (GOI) at December 2011 emphasized the importance of infrastructure at Chennai-Bengaluru area, and Japan informed to provide with financial and technical support for the preparation of the comprehensive master plan for this area.

Based on the request from GOI to formulate "Infrastructure Development Program for Chennai-Bengaluru Industrial Corridor" (the Program), GOI and JICA agreed to develop "Comprehensive Regional Perspective Plan for Chennai-Bengaluru Industrial Corridor Region," (the Perspective Plan) in May 2013. In addition to the development of the Perspective Plan, the Program consists of: (ii) feasibility studies for prioritized infrastructure projects; (iii) development of infrastructure; (iv) technical assistance for performance improvement support.

JICA hired a consortium for the preparation of the Perspective Plan and a consortiumprepared this report with consultation of related stakeholders and JICA.

1.1.2 Objective

The basic understanding of the study framework is the following.

Aim and Objectives of the Consulting Assignment:

- To prepare a Comprehensive Regional Perspective Plan for the Chennai-Bengaluru Industrial Corridor Region, along with developing Strategy for transforming the region into a globally competitive investment destination
- Identify suitable nodes to be taken up for industrial development within the project influence area (states of Karnataka, Andhra Pradesh and Tamil Nadu) and prepare Master Plan and Development Plan for at least two selected Industrial nodes (amongst the various nodes identified under the study)

Target Year:

- The Master Plan will cover 20 years, during 2013-2033.

Target Area:

- Target of the study would be an Influence Area spread across the States of Karnataka, Andhra Pradesh and Tamil Nadu, along the corridor between Chennai-Bengaluru (around 560 km).

1.2 Counterparts Involved

Main counterparts include Department of Industrial Policy and Promotion (DIPP) of Ministry of Commerce and Industry and three State Governments, Government of Tamil Nadu, Karnataka, and Andhra Pradesh. The study team consults with related Ministries, including Ministry of External Affairs, Finance, Shipping, Railways, Civil Aviation, Road Transport and Highways, Power, Environment and Forests, and related agencies, such as NHAI.

It was agreed between GOI and GOJ that the Monitoring Committee is established to monitor the study progress. The Monitoring Committee is chaired by Prime Minister's Office of at India and Embassy of Japan with the structure described in the chart below.

In addition, a monthly meeting is held between DIPP and JICA to update and share the progress of the study.

Monitoring Committee	India	Japan
Chair	Prime Minister's office	Embassy of Japan in India
Related stakeholders and supporting agencies	• Ministry of External Affairs • Department of Economic Affairs, Ministry of Finance • Ministry of Shipping • Ministry of Railways • Ministry of Civil Aviation • Ministry of Road Transport and Highways • Government of Tamil Nadu • Government of Karnataka • Government of Andhra Pradesh • DMICDC • Ministry of Urban Development • Ministry of Environment & Forests • Ministry of Power	• Ministry of Foreign Affairs • Ministry of Economy, Trade and Industries • Ministry of Land, Infrastructure, Transport and Tourism • Japan External Trade Organization • Japan Chamber of Commerce and Industry India
Implementing agency	Department of Industrial Policy & Promotion (DIPP)	Japan International Cooperation Agency (JICA)

Table 1.2.1: Related stakeholders and supporting agencies

1.3 Scope of Work

1.3.1 Overall scope of work

GOJ and GOI agreed with the detail scope of the work and structure is summarized below. The scope of work is divided to two parts which correlates to the study objectives. Part A aims to prepare comprehensive regional perspective plan for CBIC region, which is assumed to be conducted in about 6-8 months, during October 2013-March 2014. The main steps include (i) defining the delineation of the Corridor; (ii) reviewing industry and infrastructure; (iii) short listing of nodes; and (iv) developing a comprehensive regional plan.

Part A: Preparation of Comprehensive Regional Perspective Plan for CBIC Region (6-8 months)	Part B: Preparation of Concept Master Plan and Development Plan for two Industrial Nodes (10-12 months)
1. Define delineation of the Corridor and its influence area 2. Identify the macro level development vision and target for the corridor 3. Evolve the industrial development plan in the CBIC region 4. Identify potential nodes for future development 5. Recommend development of the regional infrastructure 6. Develop phasing plan and comprehensive regional perspective plan	1. Conduct market potential and critical gap assessment study of industries and infrastructure 2. Evolve concept master plan by sector with block cost estimates 3. Prepare development plan for the industrial node

Table 1.3.1: Scope of work of the study

After the completion of Part A, GOJ and GOI will agree on the selection of two nodes for the further study under Part B. Part B aims to prepare a concept master plan and development plan for two nodes in about 10-12 months. The detail work plan will be developed by the study team at the beginning of Part B, April 2014.

1.3.2 *Coverage of the Interim Report*

This Interim Report 2 (ITR2) covers the conclusion of Part A of the study. Possible industry development scenario and shortlist of nodes were developed after a series of the analyses and consultation meeting with State Governments and a comprehensive regional plan was developed.

The main contents of the reports and indicative timeline are summarized in the table below.

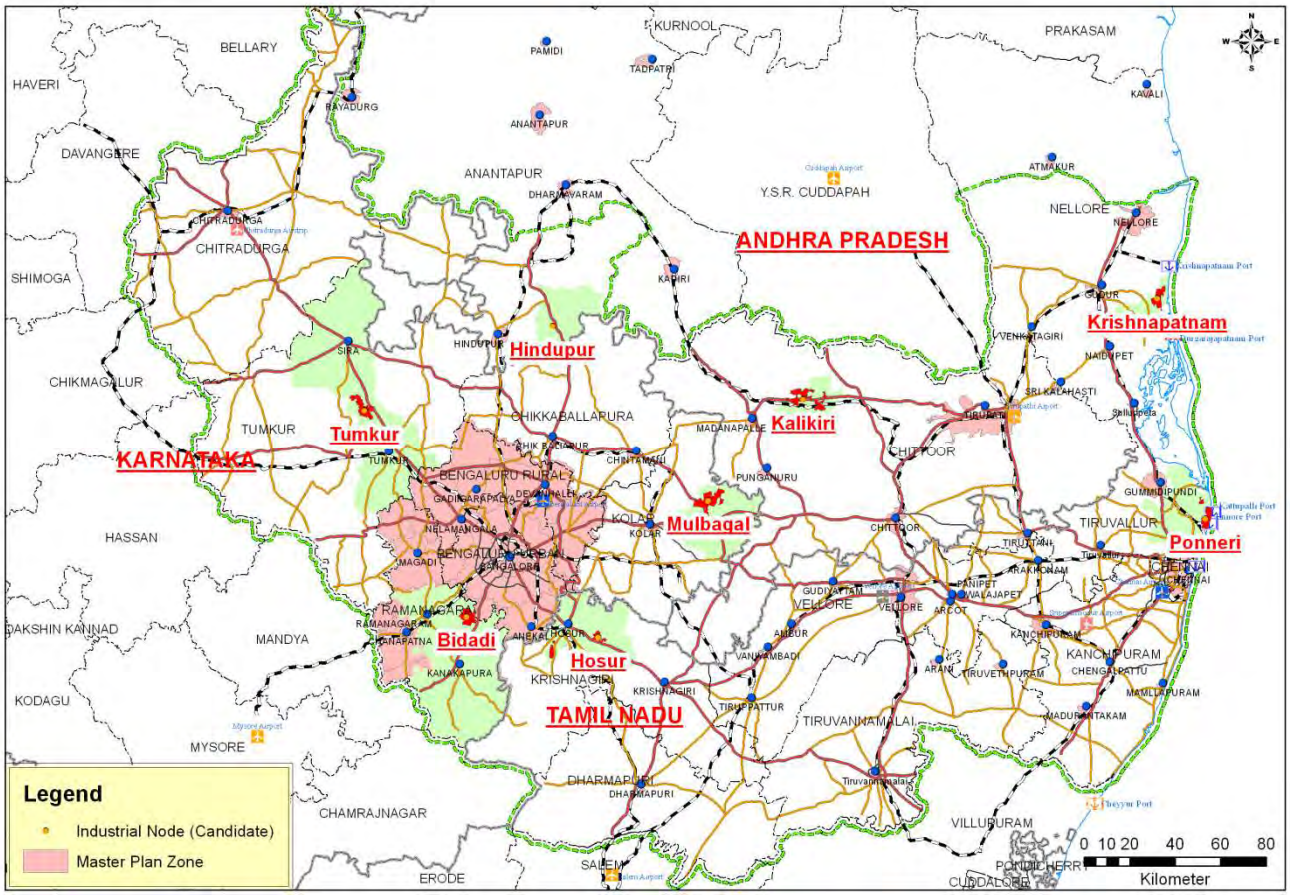
Main Reports	Main Contents	Indicative Timeline	Review by Monitoring Committee
Part A			
Inception Report	• Plan and Deliverables	October 2013	✓
Interim Report 1	• Regional profiling • Industry potential analysis • Infrastructure study • View on broad locations for industrial nodes	December 2013	✓
Sub-interim note	• Shortlists of nodes	January 2014	✓
Interim Report 2	• Phasing Plan • Comprehensive Regional Plan	March 2014	✓
Part B			
Inception Report	• Plan and Deliverables	April 2014	
Interim Report 3	• Concept Master Plan of nodes with block cost estimates	July 2014	✓
Draft Final Report	• Development plan of Nodes	December 2014	✓

Table 1.3.2: Contents and timelines of the report

2 Regional Profiling of the Corridor

2.1 Socio Economic profiling of the corridor

The CBIC region is composed of parts of 3 states, Tamil Nadu, Karnataka and Andhra Pradesh. Delineation of the region is basically along district administrative boundary; however, in Anantapur and Nellore districts in Andhra Pradesh state, they are under discussion how large the parts of these districts will be components of the region. At the stage of 1st Interim report issued on December 6 2013, the south part of Nellore and south west of Anantapur would be regarded as potential CBIC region so that at this section, we reviewed socio-economic parameters of 7 districts of Tami Nadu state, 7 district of Karnataka state, 1 district and also 2 parts of district of Andhra Pradesh state.



Source: PwC Analysis

Figure 2.1.1: Overview of Corridor influence zone

Table 2.1.1: Districts under the corridor influence

Districts covered		
Tamil Nadu	***Karnataka***	***Andhra Pradesh***
1. Chennai	8. Bengaluru (urban and rural)	14. Chittoor Potential area
2. Tiruvallur	9. Ramnagara	15. South part of Nellore
3. Kancheepuram	10. Kolar	16. South west part of Anantapur
4. Tiruvannamalai	11. Chikkaballapura	
5. Vellore	12. Tumkur	
6. Dharmapuri	13. Chitradurga	
7. Krishnagiri		

Table 2.1.2: Area of the CBIC region

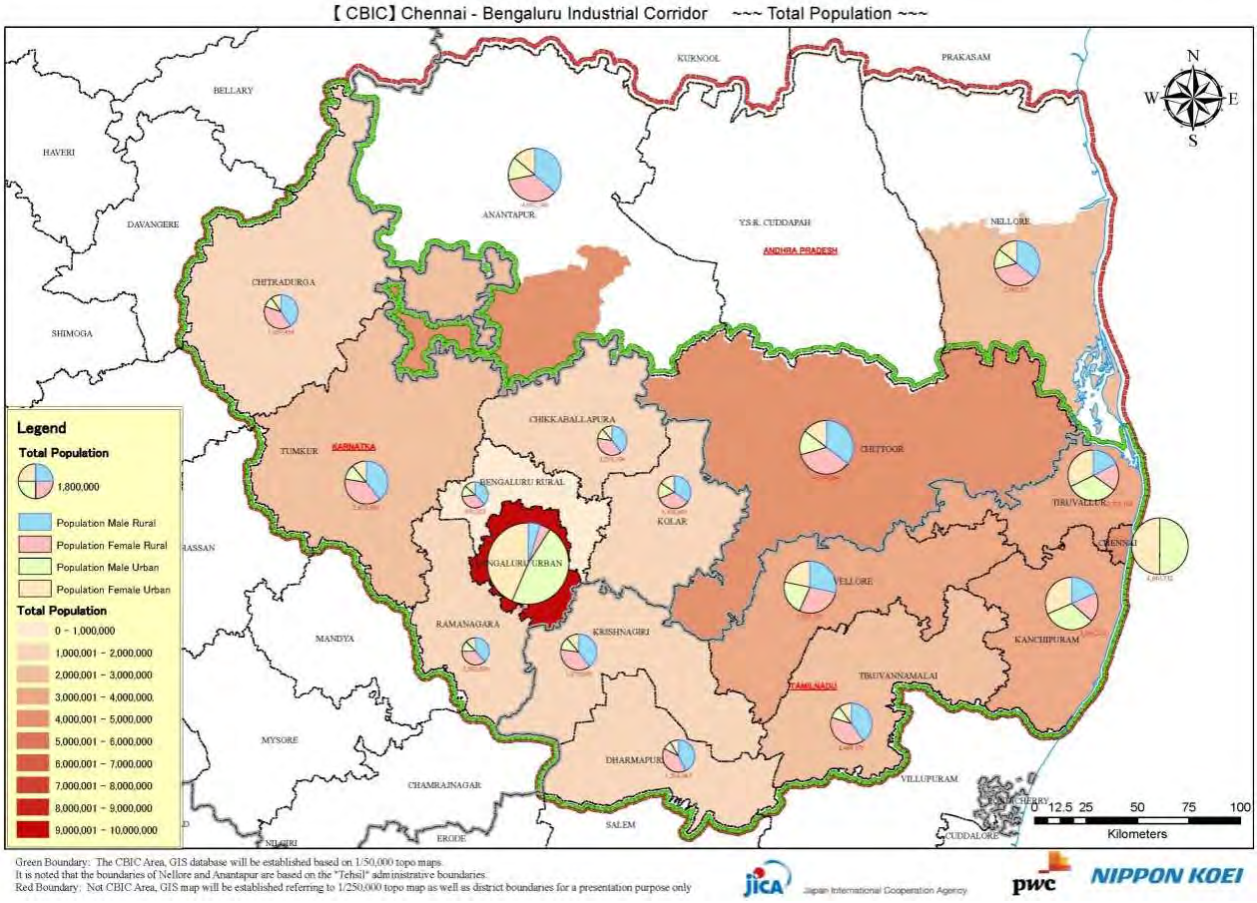
State	CBIC districts	Area covered (Sq. Km)
Tamil Nadu	Chennai	175
	Thiruvallur	3,394
	Kancheepuram	4,483
	Tiruvannamalai	6,188
	Vellore	6,075
	Dharmapuri	4,497
	Krishnagiri	5,129
Karnataka	Bengaluru	2,196
	Bengaluru rural	2,298
	Ramanagara	3,516
	Kolar	3,979
	Chikkaballapura	4,244
	Tumkur	10,597
	Chitradurga	8,436
Andhra Pradesh	Chittoor	15,152
	Nellore	6,400
	Anantapur	4,300
Total CBIC		**91,059**
All India		**3,166,414**
CBIC as a % of India		**2.9%**

Source: Census 2011

2.1.1 *Population and related parameters*

2.1.1.1Total population

According to Census 2011, the total population of India is 1,210.57million, while that of the CBIC region is 47.53million. Compared with 2001, the total population of India has increased by 17.69% from 1,028.61 to 1,210.57million while that of the CBIC region was 26.60% from 37.54 to 47.53million. It clearly indicates the population growth speed of CBIC region for the last decade has been greater than that of all India.



Source: PwC, NK Analysis, data from respective state governments

Figure 2.1.2: Breakup of population along corridor region

The most populated district is Bengaluru which has 9.62 million (20.24% of the CBIC region) in 2011. Chittoor n Andhra Pradesh state and Chennai in Tamil Nadu state, the 2nd populated districts in the region, have respectively over 4 million. Also the 3 eastern districts in Tamil Nadu, Tiruvallur, Kancheepuram, and Vellore, have a population of over 3.5 million respectively despite their relatively smaller areas. It could be suggested that east coast districts closer to the Bay of Bengal are populous area rather than inland area except Bengaluru district.

2.1.1.2 Density, gender balance and urbanization ratio

Average density of the CBIC region is 464 persons per Sq. km as per census 2011. The density map above typically suggests that the density of Chennai in Tamil Nadu state and Bengaluru in Karnataka state are enormously higher dense than the other district.

Also it can be suggested that in the eastern side of the CBIC region, Tiruvallur, Vellore and Kanchipuram districts in Tamil Nadu states nearer the Bay of Bengal are populous and dense which is higher than the average of the CBIC region.

Between Chennai and Bengaluru districts, the ones along NH-4 (one of the alignments in CBIC) tend to be denser than the other districts. Especially the inland or north districts of CBIC region are less dense than NH-4 between Chennai and Bengaluru.

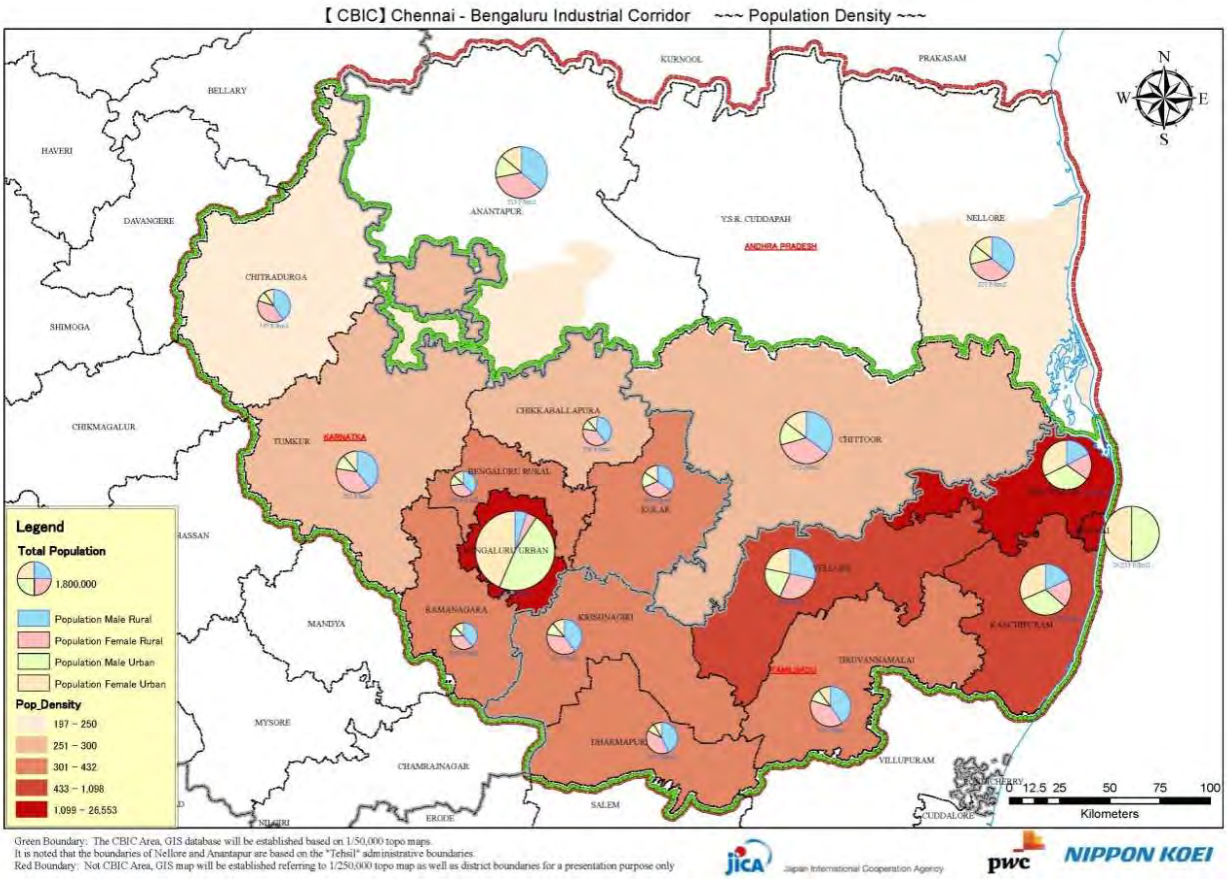
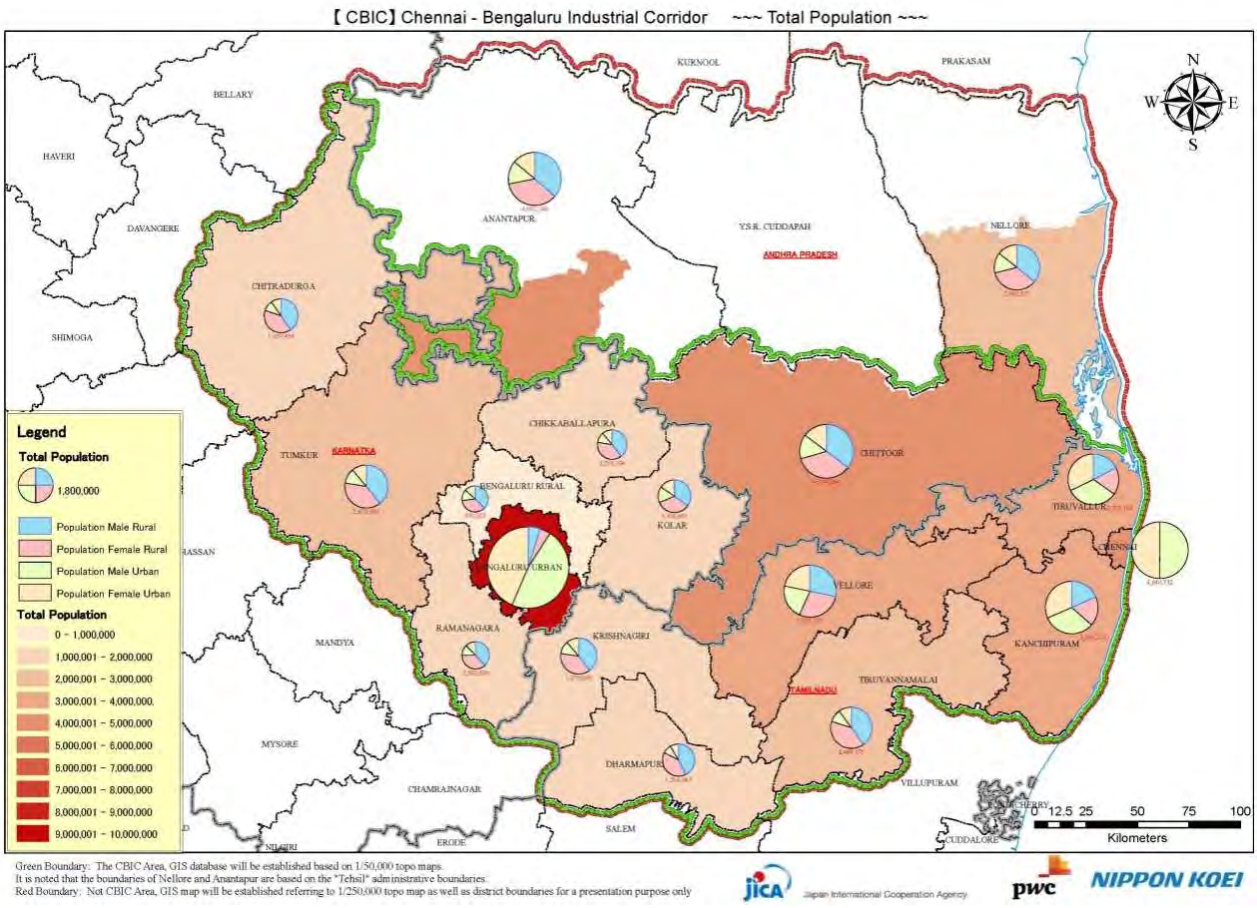


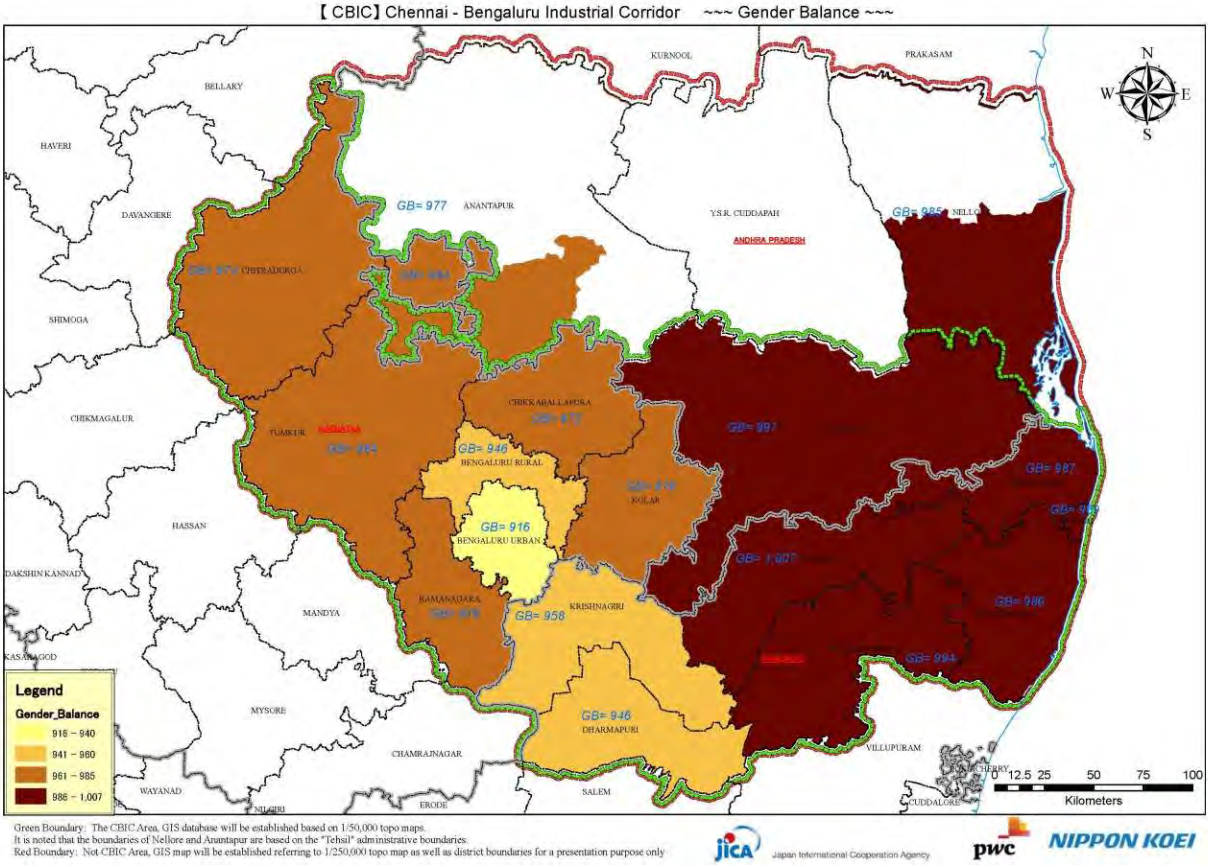
Figure 2.1.3: Density in the CBIC region



Source: PwC, NK Analysis, data from respective state governments

Figure 2.1.4: Breakup of population along corridor region

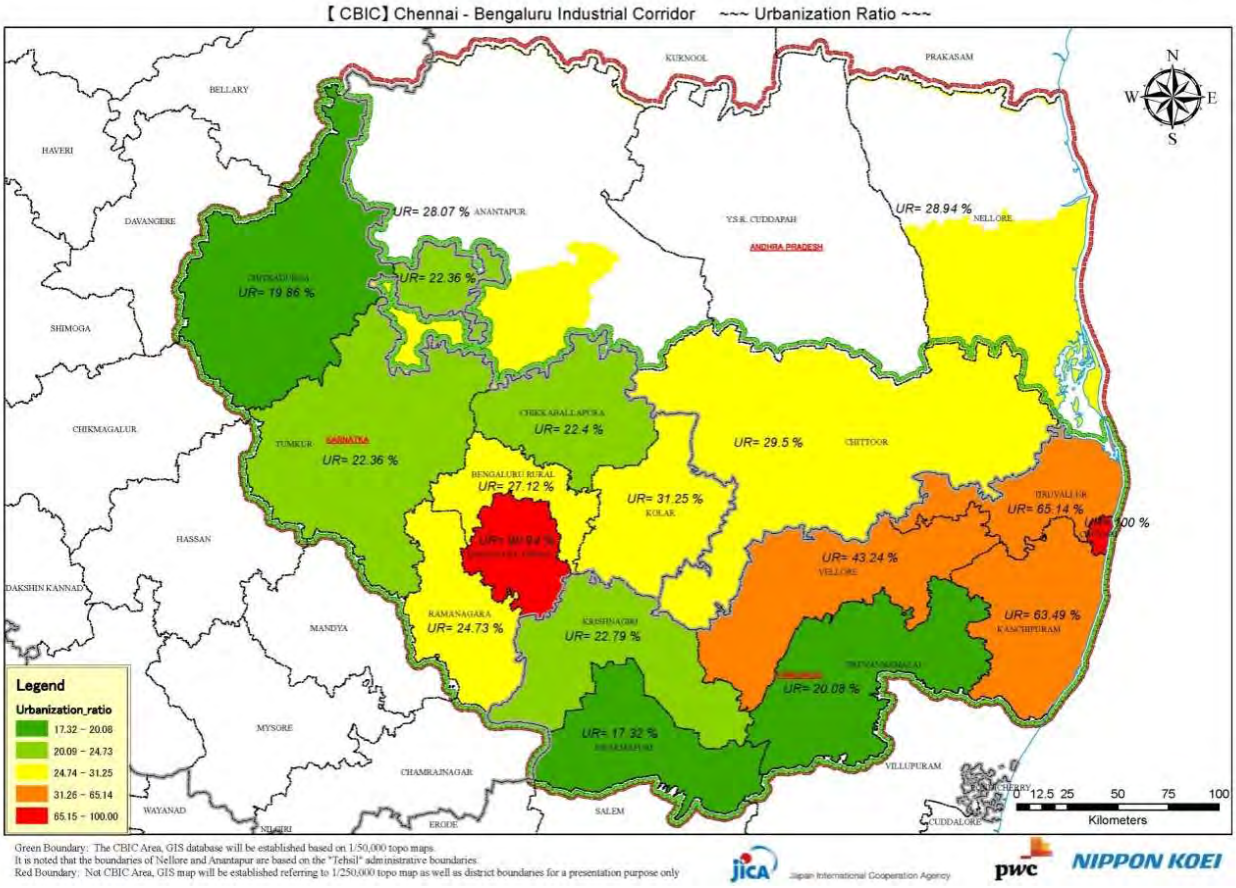
The gender balance indicates as district-wise number of females per thousand males. Average gender balance in the CBIC region is 971. This figure shows better balance than all India which is 943 as per Census 2011. Bengaluru is the only district which has a lower gender balance of 916 which is below the national threshold. Bengaluru Rural and Dharmapuri districts have relatively lower gender balance in the CBIC region, both of them indicate 946. The other districts account for a gender balance of over 970.



Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.5: Gender balance in the CBIC region

Urbanization ratio is percentage of urban population to total population. The terms urban or rural is defined with respect to minimum administrative unit of village or town. The all India urbanization ratio is 31.15%, while that of the CBIC region is 51.17%. Chennai and Bengaluru, which are two most populous districts in Karnataka state and Tamil Nadu state respectively, are the most urbanized districts in the CBIC region. Additionally, in eastern area, the districts of Tiruvallur and Kanchipuram have an urbanization ratio over 60%. The other inland districts such as Dharmapuri in Tamil Nadu and Chitradurga in Karnataka are under the average urbanization ratio of the CBIC region.



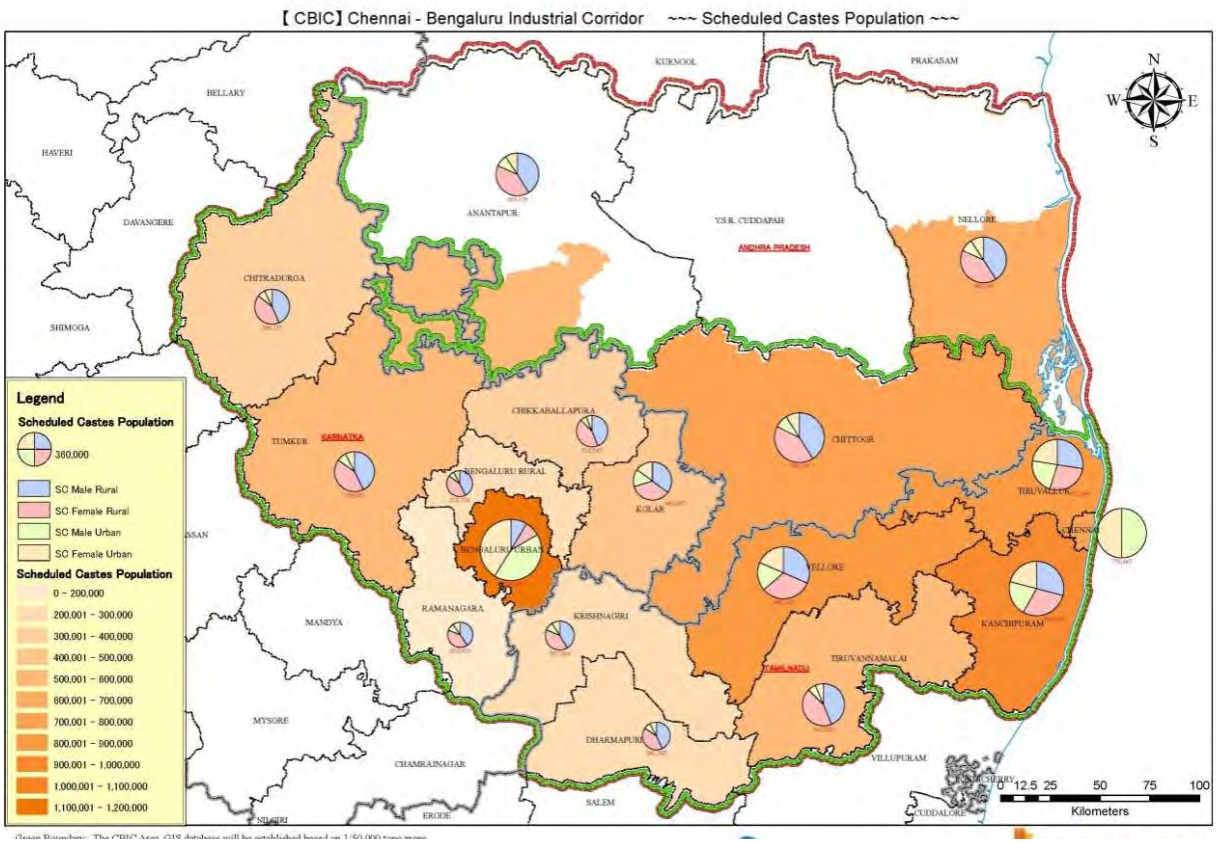
Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.6: Urbanization ratio in the CBIC region

2.1.1.3 Scheduled Caste & Scheduled Tribe

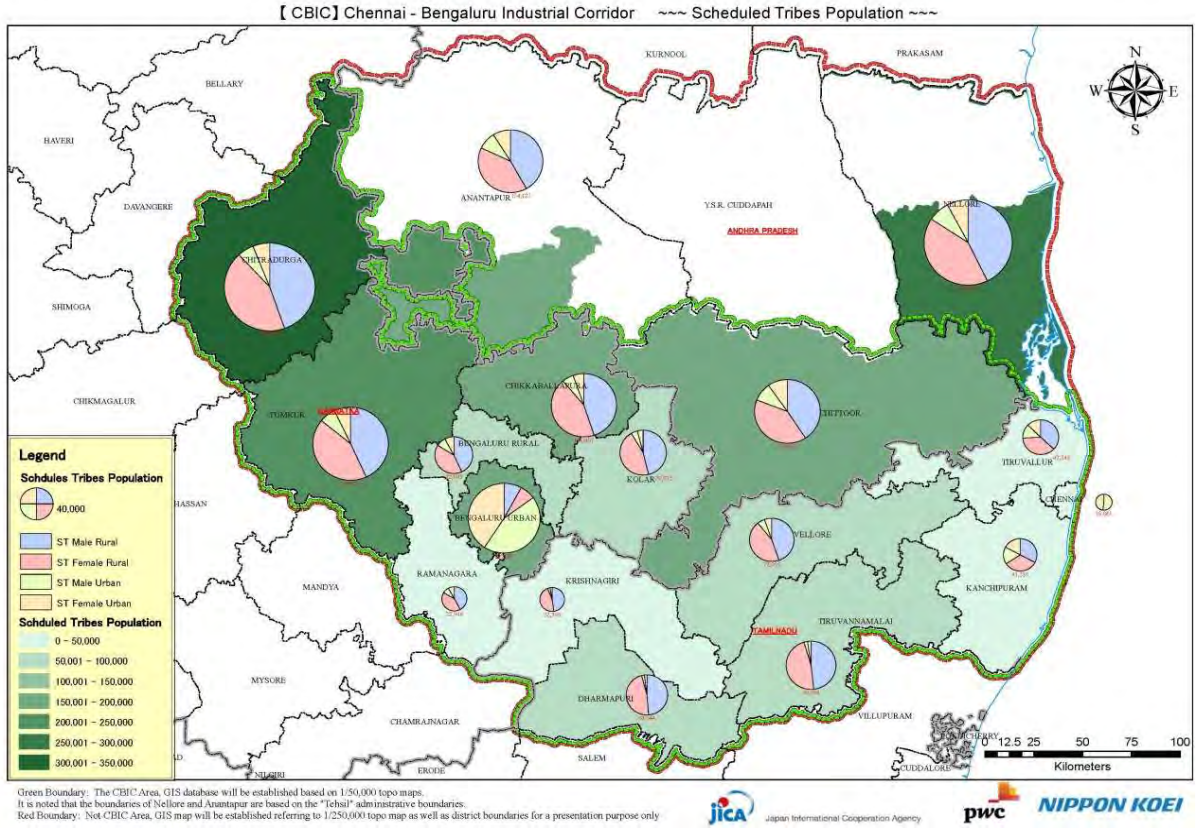
It is important to study demographic distribution of Scheduled Caste (SC) and Scheduled Tribe (ST) in this region from the perspective of achieving inclusive growth in the CBIC region.

The SC and ST ratio of all India are 16.63% and 8.61% respectively, while average SC and ST ratio of the CBIC region is 18.80% and 3.76%. The SC ratio in Kolar district is the highest at 30.32%, while Bengaluru accounts for the lowest of 12.46%. The ST ratio of Chitradurga district, 18.23% is the highest in this region, and that of Chennai, 0.22%, is the lowest. Districts with high or low SC ratio are randomly spread in the region, and there is no suggestion for the trend of SC ratio from the map. On the other hand, ST ratio in south eastern areas of the CBIC region is relatively low compared with other areas such as the north western areas where the ratio is relatively high.



Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.7: Scheduled Caste in the CBIC Region

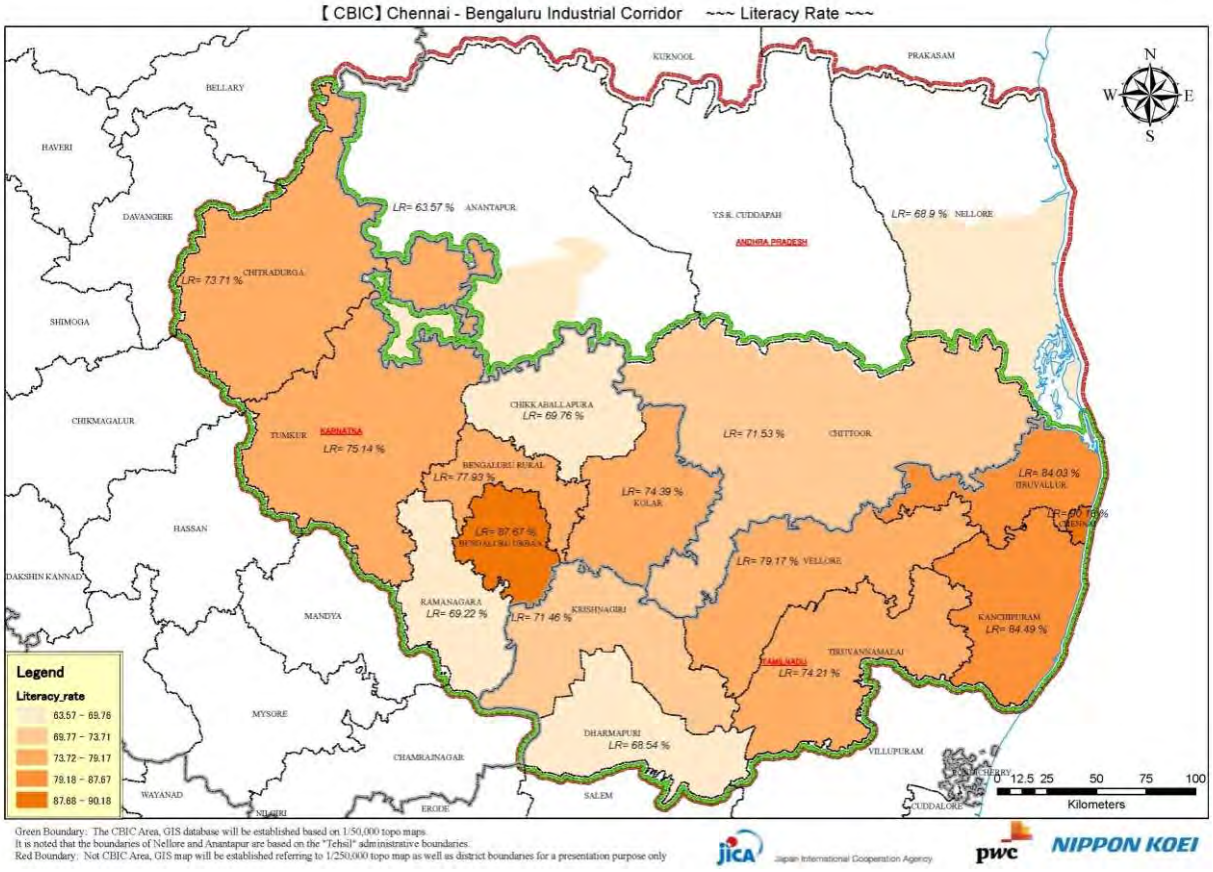


Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.8: Scheduled Tribes in the CBIC region

2.1.1.4 Literacy rate

The following map shows literacy rate which is the ratio of literate persons to total population except the age group of 0-6 years. It could be suggested that industries generally would tend to be aggregated in and around areas with relatively high literacy rates. The average literacy rate of all India is 72.99%, and that of the CBIC region is 78.27%. The places where many foreign enterprises have been invested, especially Chennai and Bengaluru, have high literacy rates of over 85%. The high average of literacy rate of the CBIC region, compared to that of all India, suggests that the region has high potential to incubate industries from foreign countries. Also these districts have a large number of educational and skill development institutions. The Corridor is home to about 2,500 graduate and higher education institutions, which constitute about 47% of such institutions in Tamil Nadu and Karnataka states in total. Particularly, Bengaluru district is an educational institution hub in India with presence of leading educational institutions such as the Indian Institute of Science (IISc.), Indian Institute of Management and many other leading educational institutions.



Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.9: Literacy rate in corridor region

2.1.1.5 Workers ratio

The workers[1] ratio is caluculated as percentage of workers to total population except age 0-6 group[2].

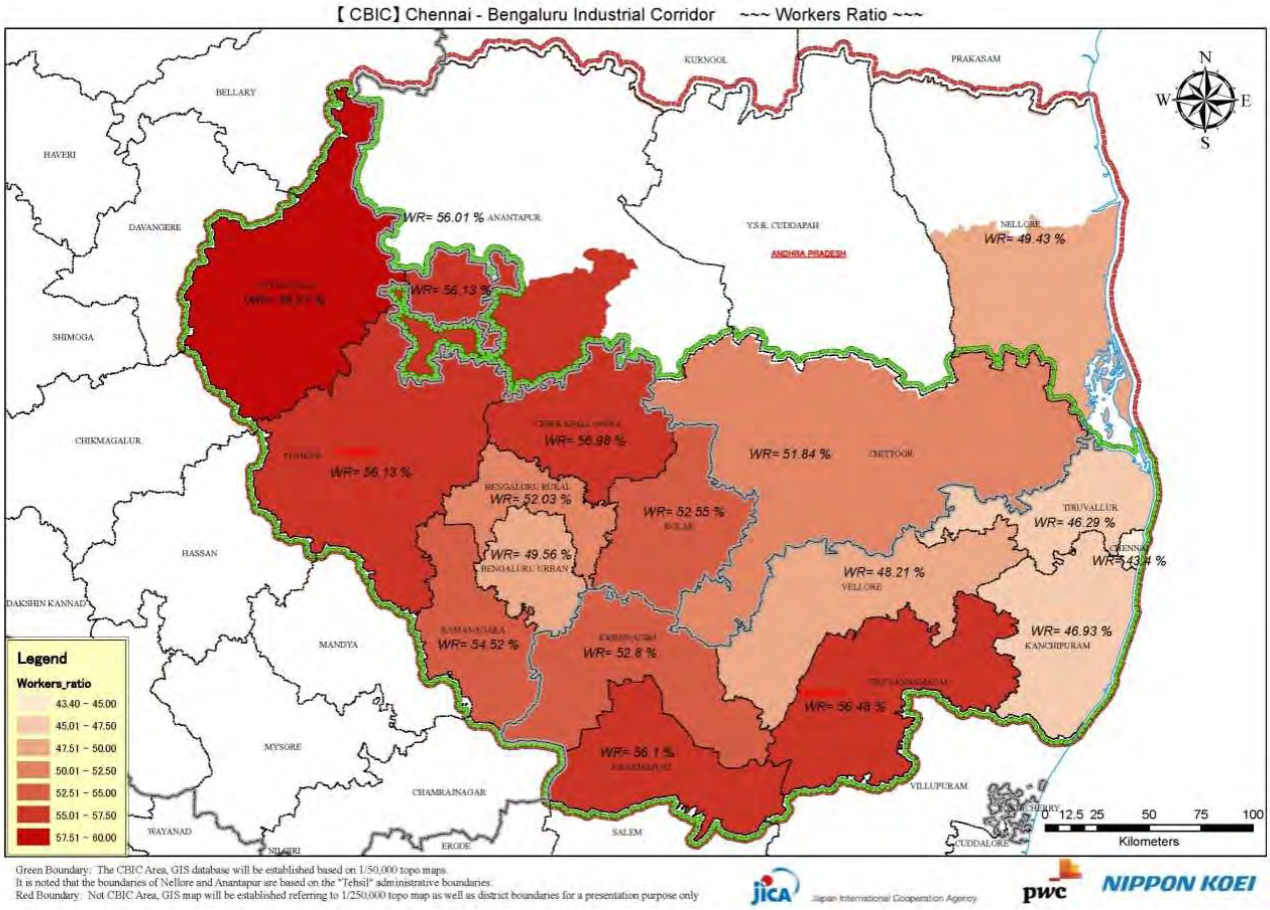
The average workers ratio in India is 46.05% as per census 2011, and that of the CBIC region is 50.81%. The workers ratio in the districts of Tiruvallur and Kanchipuram (46.29% and 46.93% respectively) is slightly over

[1]As per the Census of India, "Main workers" are defined as "those workers who had worked for the major part of the reference period (i.e. 6 months or more)", and "Marginal workers" are defined as "those workers who had not worked for the major part of the reference period (i.e. less than 6 months)". Only difference of these workers are the working period in the referencing dates for census, so that Main and Marginal workers are both regarded as workforce.

[2] Further classification of population by age is not available through Census 2011

the average of the CBIC region. The inland districts of the CBIC region appear to have high workers ratio compared to the eastern area of the CBIC region.

Map xx: Workers Ratio in CBIC region



Source: PwC, NK Analysis; data from respective state governments

Figure 2.1.10: Worker ratio in corridor region

2.2 GDP growth

2.2.1 Future population Growth

The objective of this chapter is to explore future population of each district within CBIC area until 2033. This projected future population is utilized to estimate required capacity of infrastructure, such as road, railway, port, airport, logistics, water, solid waste management and so on.

In 2006, the population growth of India by State from 2001 to 2026 was forecasted by The Office of The Register General & Census Commissioner India based on fertility, mortality and migration rates of India along with universally accepted way[3]. The working group made assumptions on fertility rate, mortality rate, and various factors and then projected future population.

The above mentioned projection is used as the basis of the future population projection up to 2033 under this study with the adjustment based on actual demographic data of the latest census, which was conducted in 2011. In addition,

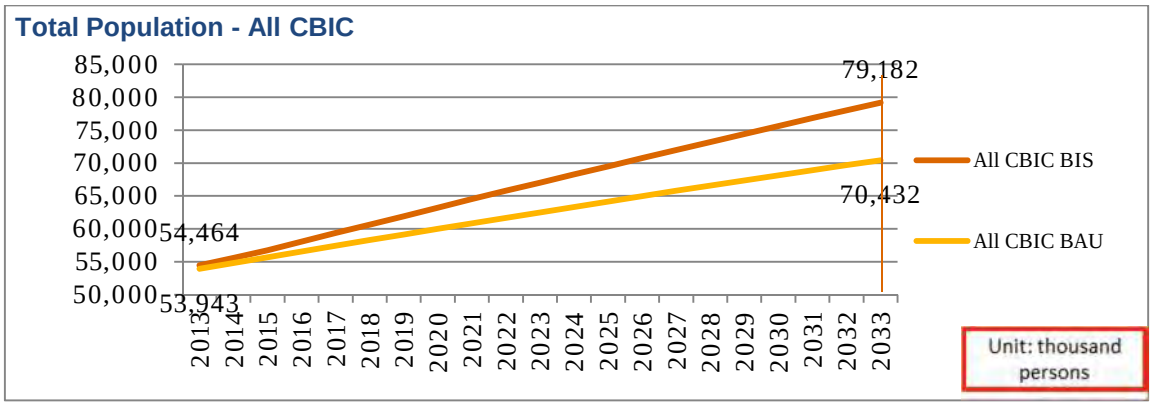
[3] http://gujhealth.gov.in/pdf/projection_report.pdf

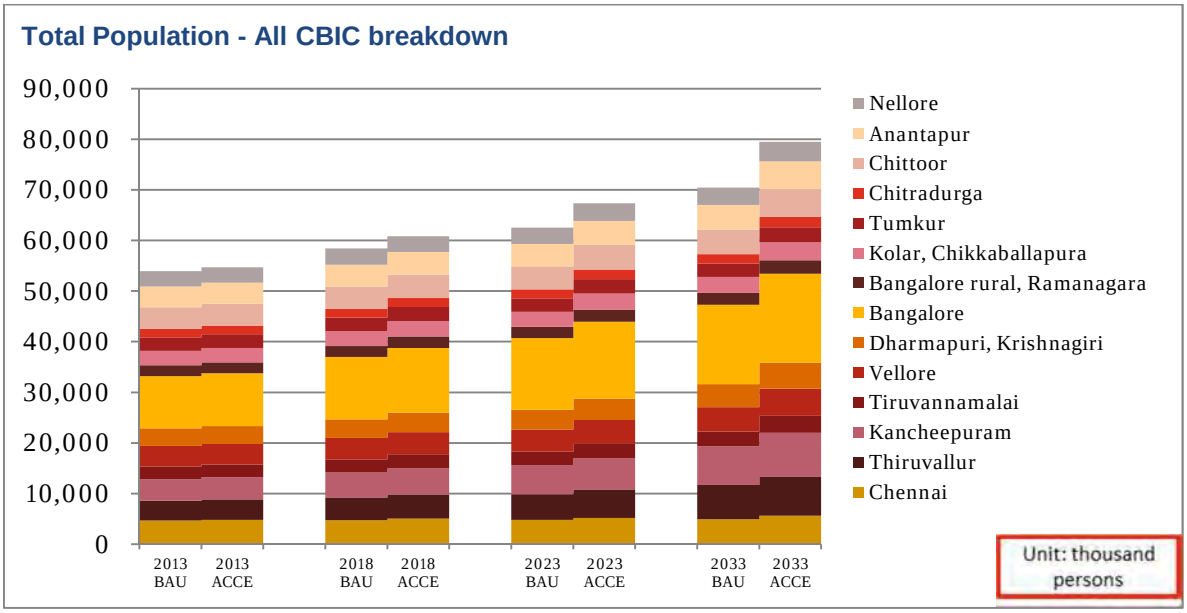
Future population was calculated by sub-district from 2013 to 2033 for 20 years under Business As Usual scenario (BAU) and Business in Induced Scenario (BIS) according to the GDP growth scenario defined under Section *2.2.1*.

Followings are the result of future population projection in CBIC area.

- All CBIC

Table 2.2.1: Total Population-All CBIC





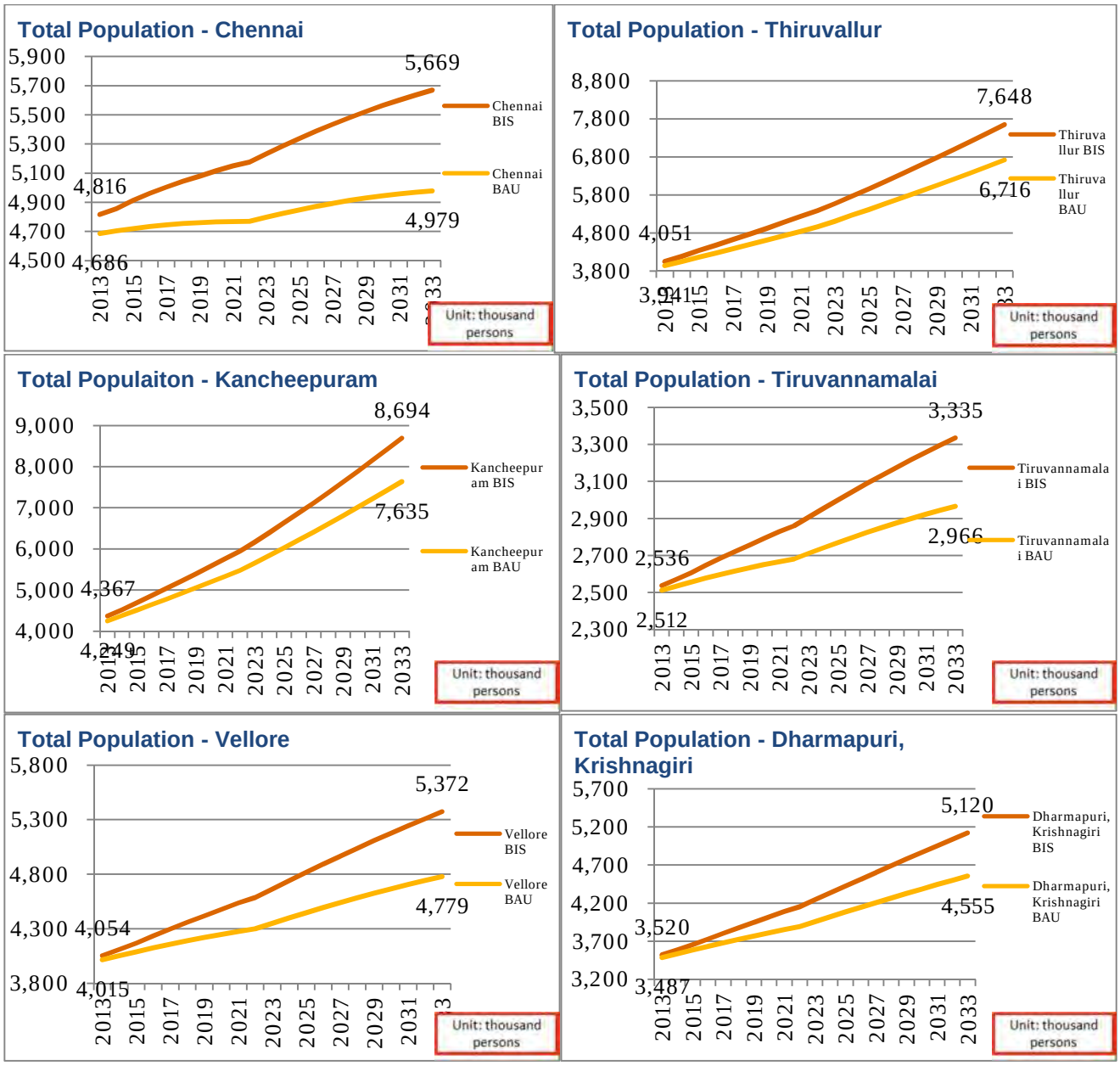
– Regarding to future population of all CBIC area until 2033 under BIS, the population will increase by 47% from 54,464 thousand in 2013 to 79,182 thousand in 2033. The compound average population growth rate from 2013 to 2033 is estimated as 1.89%, which is slightly higher than actual growth rate from 2001 to 2011 of 1.82%.

– On the other hand, the average growth rate from 2013 to 2033 under BAU scenario is estimated as 1.37%. In 2033, population will reach at 70,432 thousand, the level which will be achieved in 2026 under BIS.

The followings are population projection for each district;

- Tamil Nadu State

Table 2.2.2 : Population of each district in Tamil Nadu state



- Total population of these 7 districts are estimated to increase from 23,345 thousand in 2013 to 30,718 thousand in 2033by 32%. According to the actual data on Census 2011, the population of these 7 districts account for 42% of CBIC area. In 2033, the share of the population in CBIC area is assumed to increase to 45%.The average population growth rate from 2013 to 2033 is estimated at 2.17%, which is higher than actual State average growth rate from 2001 to 2011 of 1.82%.
- Kancheepuram district and Tiruvallur district are estimated to show the highest population growth rate until 2033 based on the actual data during 2001-2011. In Kancheepuram District, population is estimated to increase in almost double from 4,367 thousand in 2013 to 8,694 thousand in 2033 and in Tiruvallur district, population is estimated to increase by 89% from 4,051 thousand in 2013 to 7,648 thousand in 2033.

– Chennai District, where is the most populated area among these 7 districts in Census 2011, is estimated to have less population increase than the above two districts due to the high density. As per census 2011, the density of Chennai District in 2011 was 26,553 people per square km, which was prominently high in the CBIC region. The density of the district of second highest density, Bangalore in Karnataka state, was 4,381 people per square km.

- Karnataka State

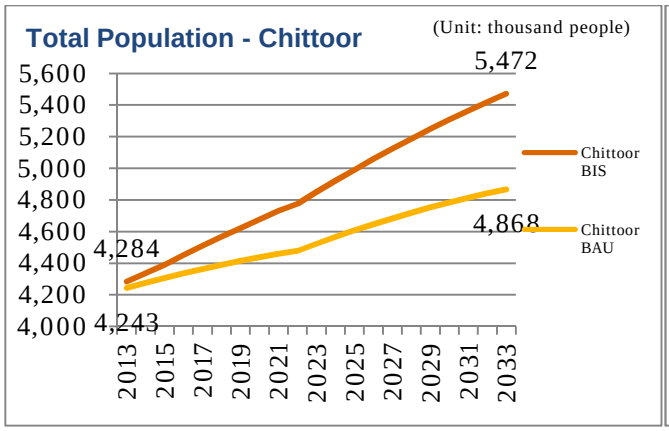
Table 2.2.3 : Population of each district in Karnataka state

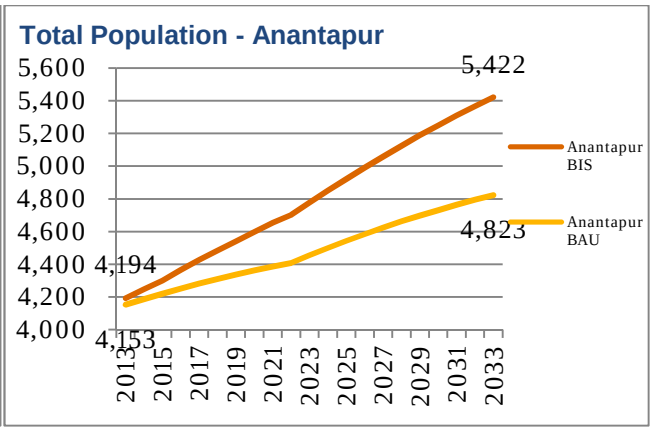
– In 2023, Bangalore urban area is estimated to reach urbanization of 100%. Population inflow into Bangalore urban would be forecasted to slow down and the population would tend to spread out to districts around Bangalore urban.
– Total population of these 7 districts will increase by 46% and is estimated to reach at 28,873 thousand in 2033, of which 60% will be in Bangalore.
– According to the Census 2011, the population of these 7 districts account for 36% of that of CBIC area. In 2033, the share of population in CBIC region will be about 36% as well. The average

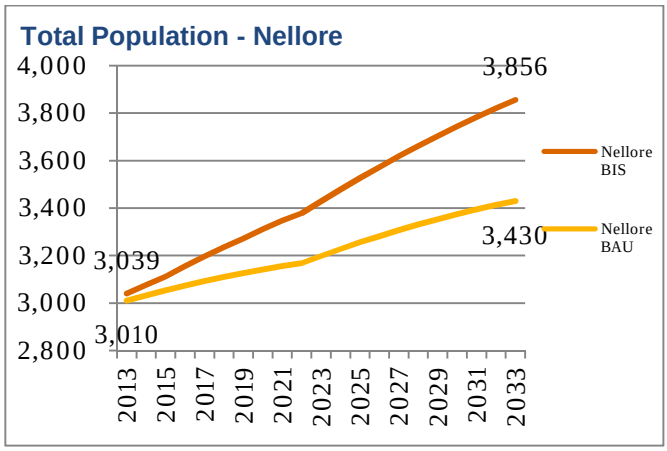
population growth rate from 2013 to 2033 is estimated as 1.89%, which is lower than actual State average growth rate from 2001 to 2011 of 2.26%.

- Andhra Pradesh state

Table 2.2.4 : Population of each district in Andhra Pradesh state







- Total population of these 3 districts is estimated to increase by 23% from 11,517 thousand in 2013 to 14,751 thousand in 2033. According to the Census 2011, the population of these 3 districts account for 20% of that of CBIC area and expected to slightly decrease to 19% in 2033. The average population growth rate from 2013 to 2033 is estimated at 1.25%, which is higher than actual State growth rate from 2001 to 2011 of 1.10%.
- As for the districts of Chittoor and Anantapur, the population is estimated to increase over 1,000 thousand people during 20 years by 2033. Population in Chittoor and Anantapur Districts are expected to increase by 28% from 4,284 thousand in 2013 to 5,472 thousand in 2033, and by 29% from 4,194 thousand to 5,422 thousand, respectively. The relatively low density of population at the area expected to allow some room for future population increase.

The table below shows the summary of population projection of each district in 2013, 2018, 2023 and 2033. The population of 2011 was actual data from Census 2011.

Table 2.2.5 : District wise population projection

(in 000)			Actual	Projected	Projected	Projected	Projected
State	**District**	**Level**	**2011**	**2013**	**2018**	**2023**	**2033**
TN	Chennai	District	4,647	4,816	4,946	5,144	5,597
	Thiruvallur	District	3,728	4,051	4,680	5,477	7,550
	Kancheepuram	District	3,998	4,367	5,113	6,063	8,583
	Tiruvannamalai	District	2,465	2,536	2,722	2,907	3,335
	Vellore	District	3,936	4,054	4,359	4,664	5,372
	Dharmapuri, Krishnagiri	District	3,387	3,520	3,874	4,243	5,120
KA	Bangalore	District	9,622	10,445	12,808	15,185	17,593
	Bangalore Rural, Ramanagara	District	2,074	2,124	2,253	2,373	2,650
	Kolar, Chikkaballapura	District	2,792	2,859	3,031	3,190	3,558
	Tumkur	District	2,679	2,711	2,788	2,847	2,989
	Chitradurga	District	1,659	1,697	1,793	1,881	2,083
AP	Chittoor	District	4,174	4,284	4,567	4,849	5,472
	Nellore	District	2,964	3,039	3,235	3,429	3,856
	Anantapur	District	4,081	4,194	4,485	4,776	5,422

3 Investment Environment of CBIC

The purpose of this chapter is to describe strength and weakness of CBIC as a global investment destination through statistical comparison with rival countries/regions, as well as investors' view on the ground. As to the former, quantitative analysis of 12 countries will be conducted at each level of country, state and city. As for the latter, the comparative advantages/disadvantages as well as bottlenecks will be clarified based on qualitative analysis through the result of interview surveys to Japanese companies those already operating in CBIC on the ground.

3.1 Quantitative Assessment–Comparative Analysis with Other Countries/Regions

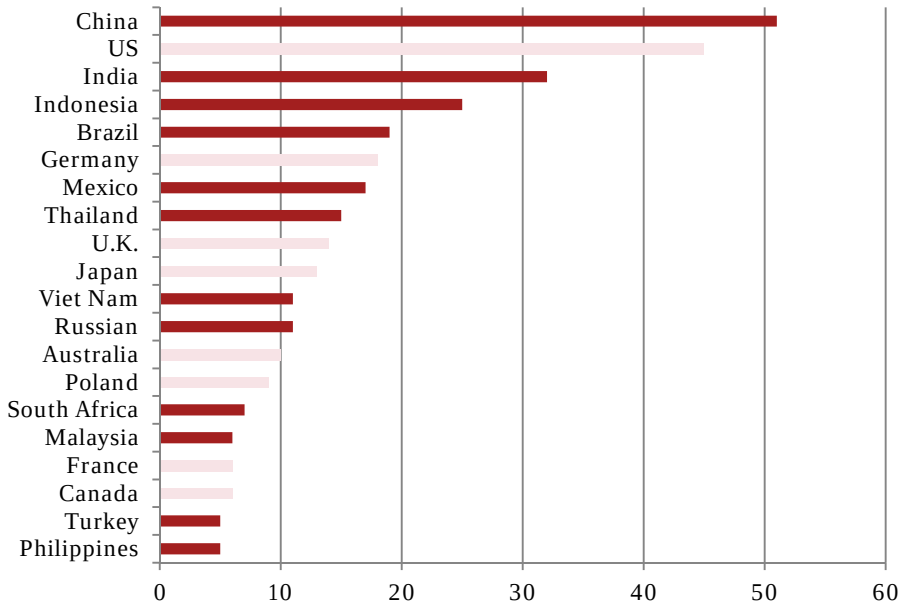
3.1.1 Country Level Comparison

(1) Selection of Competitors

According to the latest World Investment Report published by UNCTAD, the following countries are nominated as the most promising investment destinations founded on the interview survey to globally influential investors.

- OECD: US, Germany, UK, Japan, Australia, France, Canada
- BRICS: Brazil, Russia, India, China, South Africa
- Growing Asia: Indonesia, Thailand, Malaysia and Philippines
- Emerging G20: Turkey, Mexico

Above all, USA and China outstandingly attract investor's attention. Then India is following ranked at the 3rd position. For the comparative analysis, the 12 countries, i.e., the countries listed above except OECD, are defined as the competitors of India.

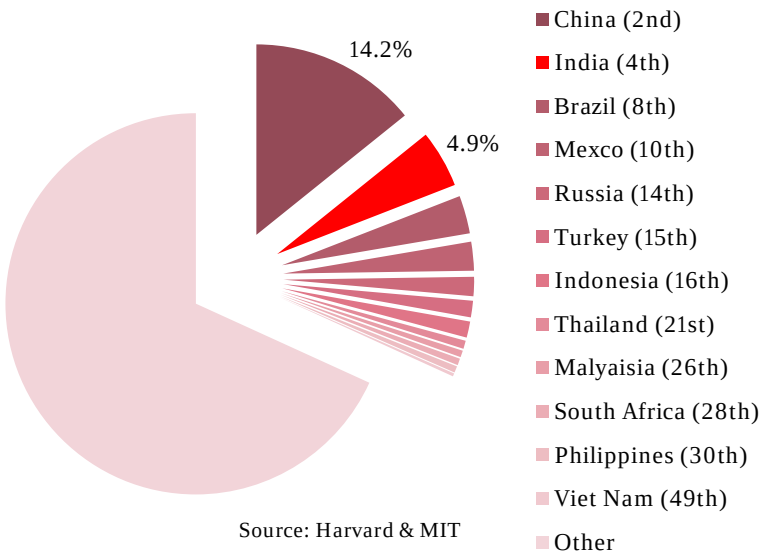


Unit: Number of Companies

Source: World Investment Report 2013 by UNCTAD

Figure 3.1.1: Top Prospective Host Economies (2013-2015)

The 12 countries have similarities in their large population and GDP scale, as well as high growth rate. According to Harvard University & MIT estimation, those countries occupy one third of world's GDP in 2020. China is the largest country among them and occupies 14% of world total. India is placed at the 2nd position (4th in world total) and occupies 4.9%.

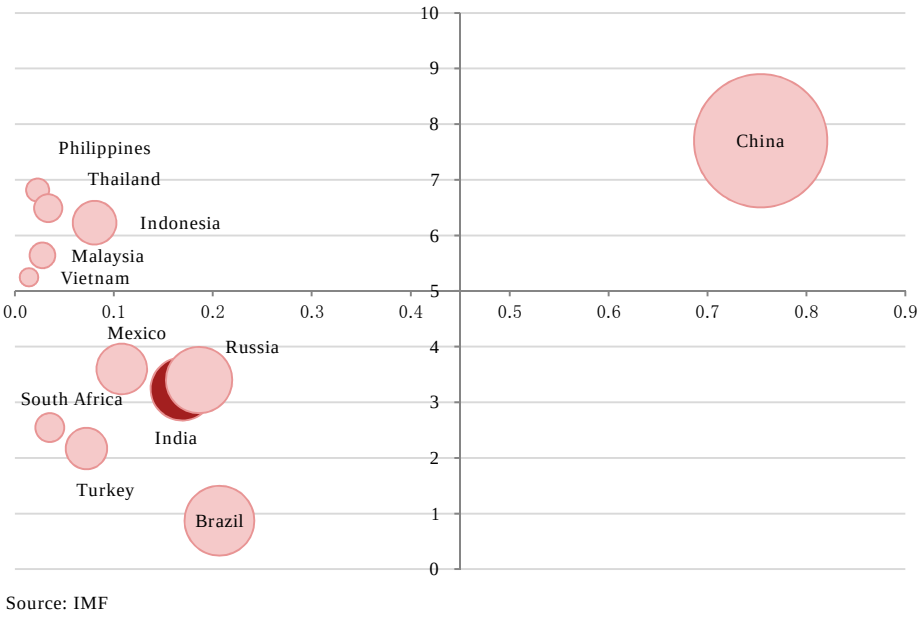


Source: Harvard & MIT

Figure3.1.2: Expected contribution to World GDP growth (2020 estimated)

(2) Comparison of Economic Scale and Growth Potential

In order to overview their economic condition, 1) GDP scale, 2) GDP growth rate and 3) global share of GDP are to be reviewed. China shows outstanding performance in all parameters. The other countries can be divided into the following two groups; 1) small scale and high growth mostly from Asia, 2) large scale and low growth mostly from BRICS. This explains more or less a historical theory of Economics that marginal growth rate decreases over the time. However, China has been succeeded in increasing the economic scale and marginal growth rate simultaneously by the continuous innovation and renovation of economic structure. Indonesia also shows similar performance to China.



Source: IMF

Figure3.1.3: India's Position: GDP Scale, Growth and Share in the world (2012)

Comparison of long term growth rate clearly illustrates the China's outstanding position. The economic scale of China is currently almost 4 times as big as the rest of 11 countries, although they were still at a same level of growth in 1990. China has "taken off" to a country which could produce and trade high value added goods and services, through structural change of the economy, industry and trade thanks to the strong leadership of the Government as well as innovations by the private sector. China has gained premier status of the best global investment destination through realising virtuous cycle between the expansion of global share and the increase of global investment incubation. While India has been stacking into a vicious cycle often cited as the "middle income trap," same as the other countries except China. She still follows traditional track of economic development.

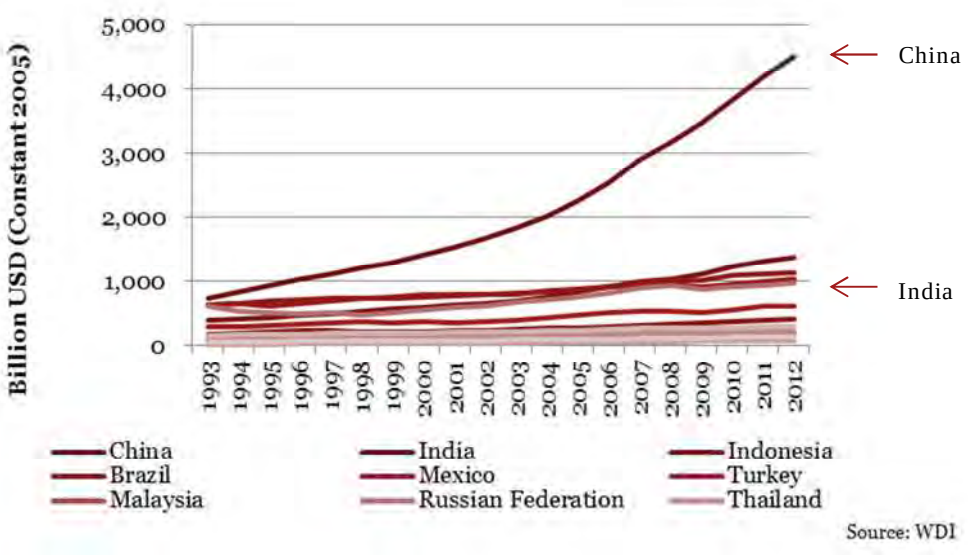
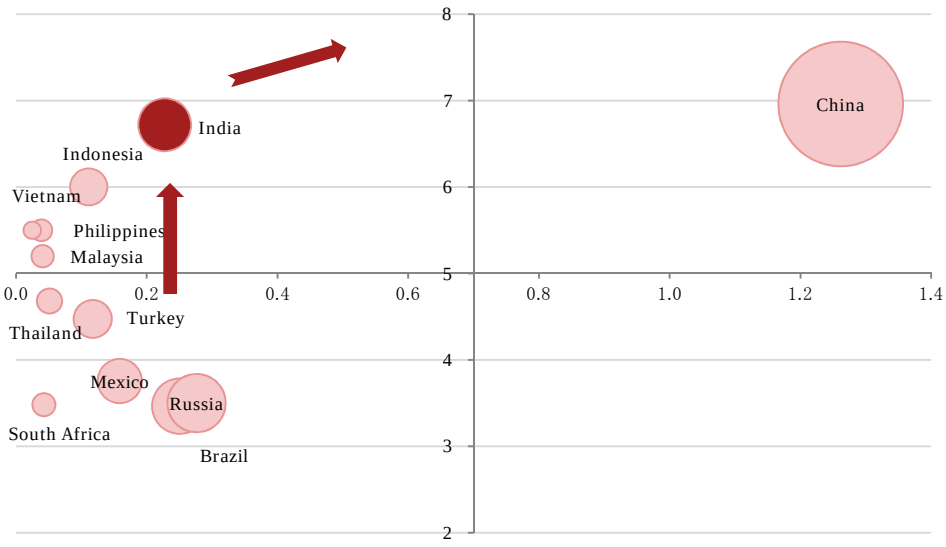


Figure3.1.4: Long-term GDP Growth (Past 20 Years)

Prospect for the future growth of India seems to be bright. According to IMF estimation, India will rapidly increase the GDP growth rate and share in the world in 2018, despite the fact that the composition of other countries does not change significantly. This also implies economic transformation is underway in India. In addition, the positive outlook of reliable international institutions, such as IMF, encourages higher expectation of investors and thus enhances the attractiveness of CBIC/India as a global investment destination.



Source: IMF

Figure3.1.5: GDP Scale, Growth and Share in the world (2018)

Another key factor that global investors expect future growth of India is the originality of the industrial growth model. India's historical process of industrial development after 1990s is quite different from that China or developed countries has experienced in the past. The industries of those countries has tended to grow in the following 5 orders; 1) agriculture, 2) light industry, 3) heavy industry, 4) service and logistics industry, 5) IT industry. However, in India, the 5thstage industry, i.e., IT and software, developed at first and the same time with others. Then it has been encouraging the development of other industries through playing a role of catalyst for upgrading the industry and economy. This shows a new growth model that cannot be explained by the5 stage theory of economic development by WW Rostow, which has been told to traditional dogma. In the theory, development occurs from traditional society consisting of agricultural production. After following the steps and reaching take-off stage, a country finally reached at an advanced mass consumption society. The India type growth model has been received as innovation in the history of the world economic growth by global investors, and led to their great expectations for the future.

However, it cannot be said that the investment climate in the field of India is as good as the expectation. Enhancement of investment climate is required for CBIC in order to fulfil the gap between the reality and the expectations. Through the development of the industrial cluster and generation of innovations, intensive development areas, especially CBIC, is expected to be a detonator of the innovative changes of economic structure of India through fostering industrial clusters.

(3) India's Global Competitiveness

India's major global competitiveness comes from its tremendous market size. At present, India holds over 1.2 billion population and is one of the top 2 largest populated counties. In addition, in 2033, the target year of the Master Plan, the population will increase up to 1.4 billion and become the world's largest exceeding China. Furthermore, according to OECD estimation, in 2050, Indian will occupy two thirds of middle income

population in the world. The share is top in the world, and exceeds that of Chinese taking one fifth and being at the 2nd position. Given the future estimates, most of global investors consider their presence in Indian market will critically affect the core part of their global strategy. That is the key driver for them to invest in CBIC at the moment.

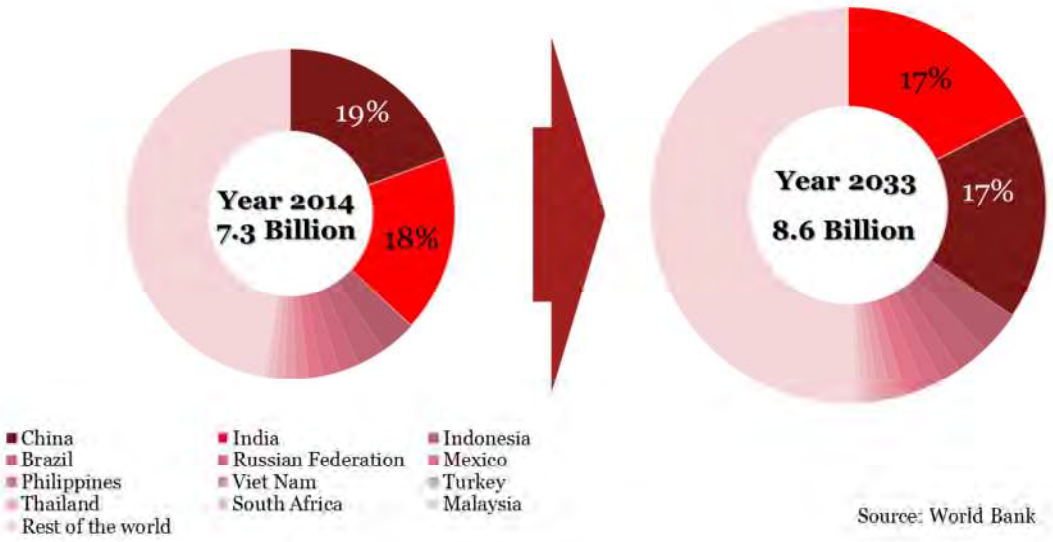
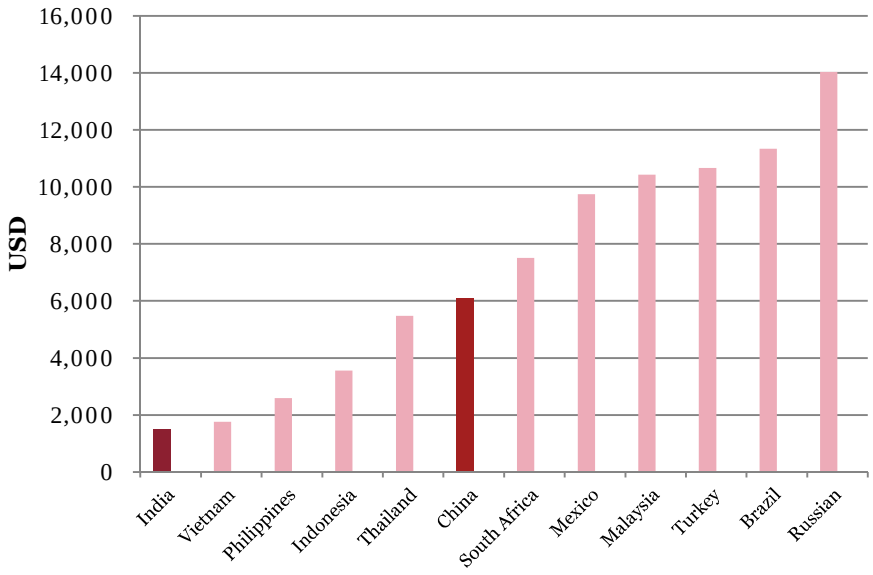


Figure3.1.6: World Population and Share of India

In terms of per capita GDP, India is ranked at the lowest level in the world. This means less than one third of China. China is also categorized as a country in lower group, but continues the steady growth exceeding rival countries in Asia, such as Thailand, Indonesia, Philippines and Vietnam.

The per capita GDP indicates purchasing power of the market as well as wealth of the people in the country. A market consisting of people with low purchasing power tends to be occupied by low quality and cost transactions. Global companies which consider investment in India are forced to take a strategy to lower the quality and technology level of product in order to secure certain competitiveness in the price. In such case, efficiency in industry and commerce is enhanced, but transactions of high value added goods and services are not increased. As a result, high growth as China has experienced is rarely occur.



Source: WDI

Figure3.1.7: Current GDP per capita (2012)

According to Global Competitiveness Index (GCI) of World Economic Forum, the targeted 12 countries are evaluated as high level in terms of the overall global competitiveness. However, India is placed at the bottom level. Looking into details, India shows comparative advantage in the aspect of market size and degree of financial market development. On the other hand, it is ranked at low level in the degree of infrastructure readiness, macroeconomic environment development, availability of health, primary and higher education and training, and technological readiness. In addition, the report evaluates India as the lowest stage economy in the 5 category of 1) factor driven, 2) efficiency transition, 3) efficiency driven, 4) innovation transition, and 5) innovation driven.

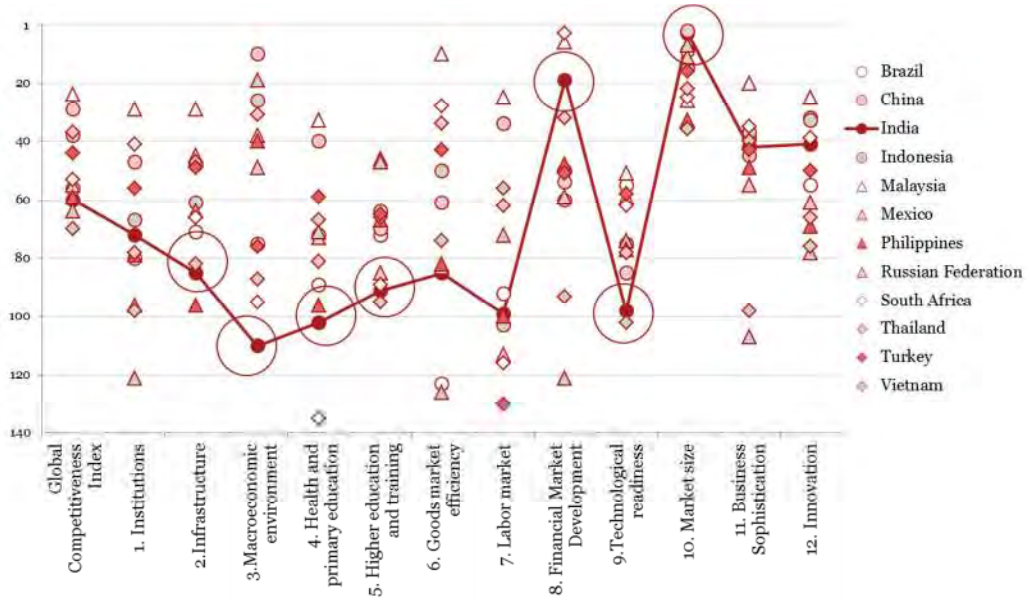


Figure3.1.8: Global Competitiveness Index Ranking (2013-2014)

GCI has the details in each of 12 main indicators shown in the above figure. The contents which received the high/low evaluation (higher and lower 30th in all 148 countries) are shown below.

Table 3.1.1: Global Competitiveness Index Ranking in Detail (Rank out of 148 countries)

Parameter	Pros	Cons
1. Institution	-	-
2. Infrastructure	Available airline seat 13 Quality of railroad infrastructure 19	Mobile telephone subscriptions 123 Fixed telephone lines 148
3. Macroeconomic Environment	Gross National Savings 28	Government budget balance 141 Inflation 130
4 Health and Primary Education	-	Infant mortality 120
5 Higher Education and Training	Quality of management schools 30	-
6 Goods Market Efficiency	Intensity of local competition 24 Extent of market dominance 26 Effectiveness of anti-monopoly policy 29	Total tax rate 128 No. of procedures to start business 129 Trade tariffs 128
7 Labour Market Efficiency	-	Women in labour force 137
8 Financial Market Efficiency	Financing through local equity market 18 Venture capital availability 27 Regulation of securities exchanges 27 Legal rights 28	-
9 Technological Readiness	-	Individuals using internet 120
10 Market Size	Domestic Market size and GDP 3 Foreign Market size 4	Exports as a percentage of GDP 125
11 Business Sophistication	Local supplier quantity 2 State of cluster development 16	-
12 Innovation	Availability of scientists and engineers 15	-

(4) Business Environment of India

World Bank is publishing “Doing Business” report for the comparative evaluation of investment climate at country level in all over the world. According to the report, India is ranked at the lowest position in the 12 target countries as well as at 134th in the all 183 countries in the category of “Ease of Doing Business” which shows accumulation of all evaluation indicators. Especially, India is inferior in the ease of starting business, dealing with construction permits, paying taxes, trading across borders, and enforcing contract. On the other hand, it is prior in the ease of getting credit and protecting investors.

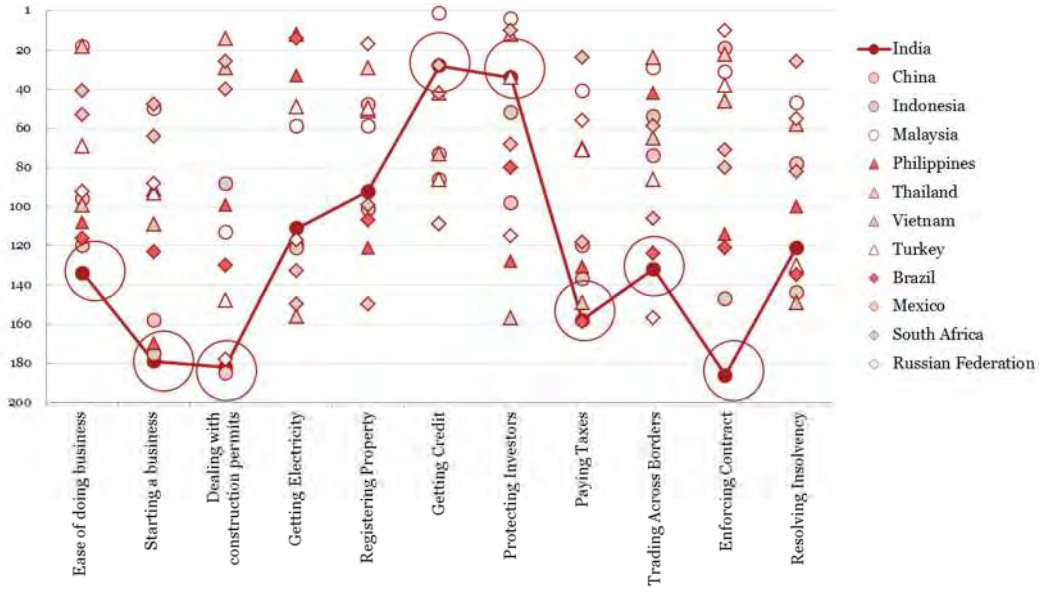
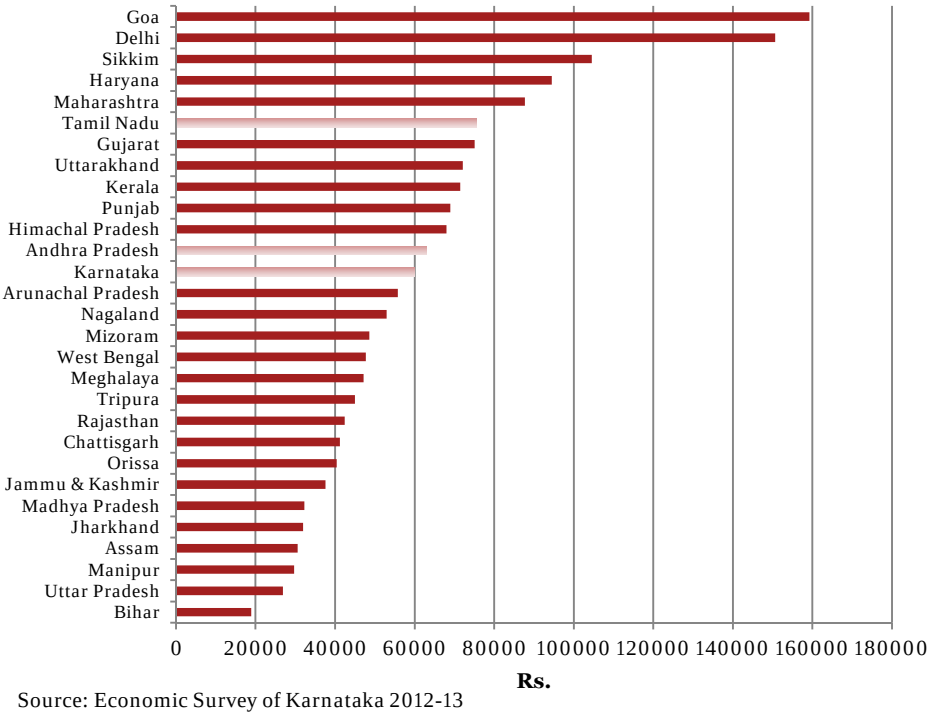


Figure3.1.9: Doing Business Global Ranking (2012)

3.1.2 *State and City Level Comparison*

(1) Scale of Market and FDI Inflow

This chapter deals with "state" and "city" level comparative analysis for CBIC's investment climate. It defines CBIC as the accumulation of Tamil Nadu, Karnataka and Andhra Pradesh States at the state level, and Chennai and Bangalore at the city level. First of all, it goes through the data of per capita GDP in order to sense a degree of purchasing power of people in the market. In all states in India, Goa and Delhi States show good performance. It tends to be high in the states with major cities, and low in the states with large rural area. The 3 states in CBIC are included in the high score group. CBIC can be said as one of the promising markets in India, which consists of people who holds certain purchasing power.



Source: Economic Survey of Karnataka 2012-13

Figure3.1.10: Per Capita Income at Current Prices (2010-11)

As to FDI inflow, Mumbai and Delhi show outstanding performance on the city level comparison. Chennai and Bangalore are following the top 2 cities, but Mumbai is collecting 4 times as much FDI as the 2 cities in CBIC. The total of 2 states in DMIC is 3 times as much as that of 2 states in CBIC. As a result, it can be said that CBIC can be evaluated as one of the promising global investment destinations, but currently lagging far behind the domestic rival, DMIC.

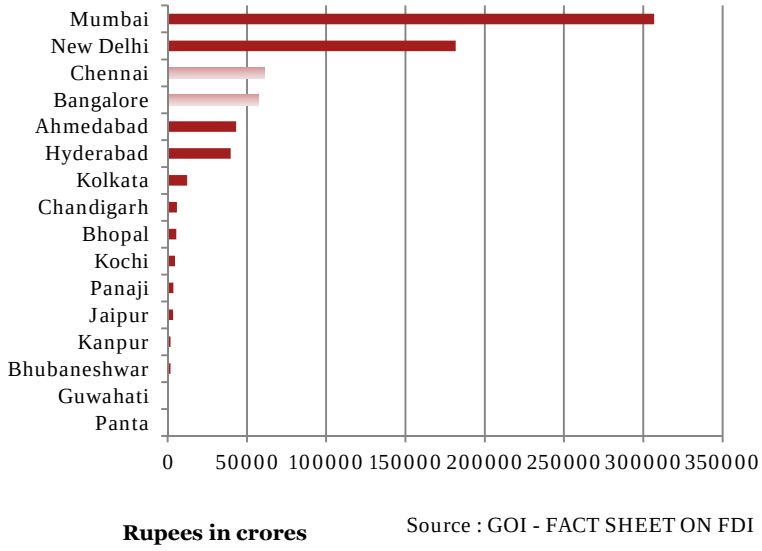


Figure3.1.11: Received FDI Equity (April 2000 - November 2013)

(2) Business Environment of CBIC

According to the investment climate survey of World Bank for 17 major cities in India, the 2 cities in CBIC are ranked at the lowest level in terms of ease of doing business, which means aggregate evaluation of investment climate. Chennai is placed in the 15th position. It is inferior to the other cities in the criteria of registering property and paying taxes. Bangalore is ranked at the 13th position. It has weakness in starting business, paying taxes, and enforcing contracts. While both cities receive high evaluation in terms of dealing with construction permits and trading across borders mainly thanks to the volume of construction works and import/export due to the rapid growth in infrastructure development and industrial clusters.

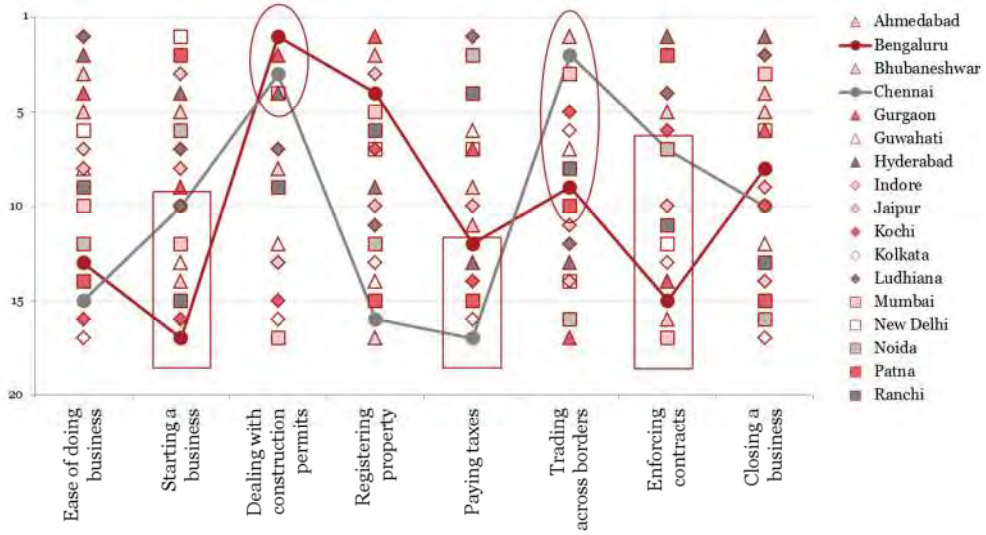


Figure3.1.12: Doing Business Ranking in India (Latest-2009)

The dealing with construction permits is pointed out as a comparative advantage of CBIC in domestic comparison, but is not actually competitive if includes other countries. India, including the 2 cities in CBIC, is

categorised as the expensive group. ASEAN countries, i.e., Indonesia, Malaysia, Thailand, Vietnam and Philippines, are very competitive due to the historical competition for attracting foreign trade in the region.

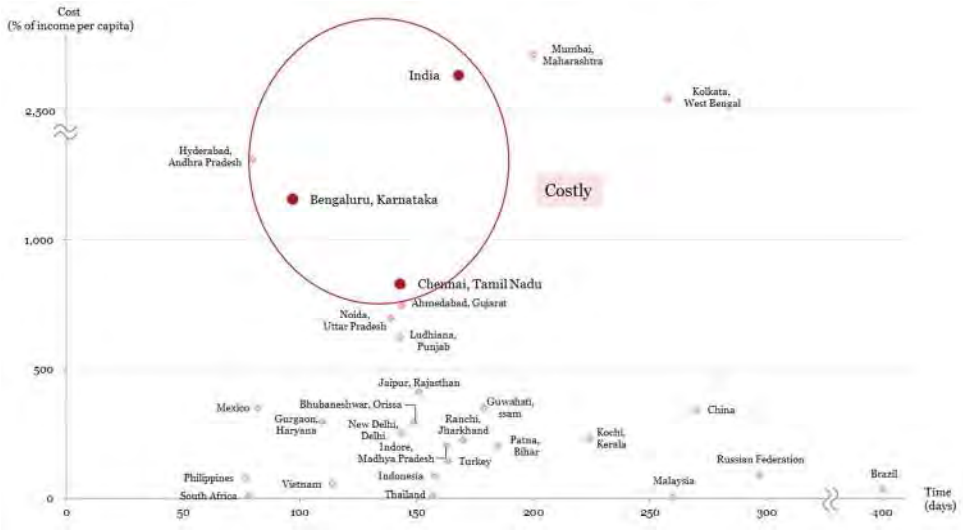


Figure3.1.13: Dealing with Construction Permits

As for the cost and time for import, the 2 cities in CBIC are in top class in domestic comparison, and competitive in global comparison as well. India is not comparable to the top group of Thailand, Philippines and Malaysia, but almost equal to China, Vietnam and Indonesia. Asian countries are generally advanced in ease of trade due to the competition in the region.

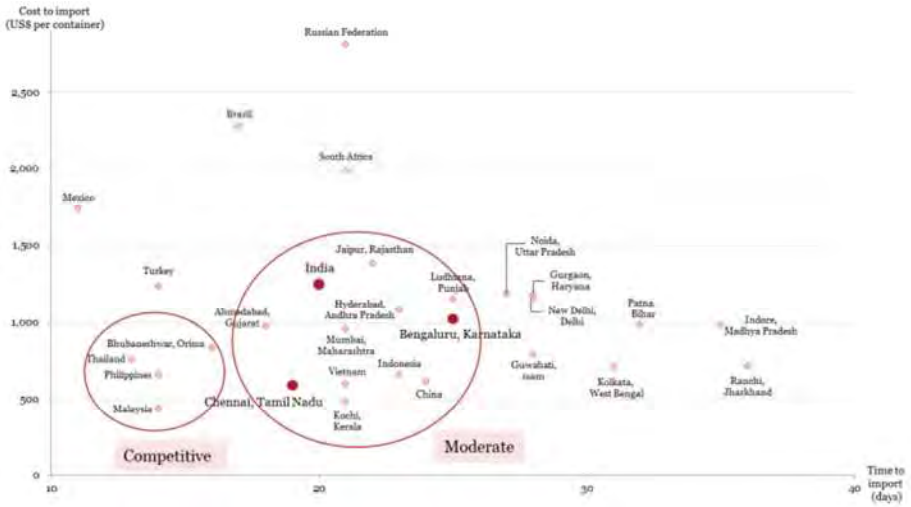


Figure3.1.14:Trading Across Borders - Import

However, regarding the export, investment climate of CBIC/India saves the cost for investors but requires more time for the procedures. CBIC is significantly inferior to the ASEAN countries in terms of ease of export.

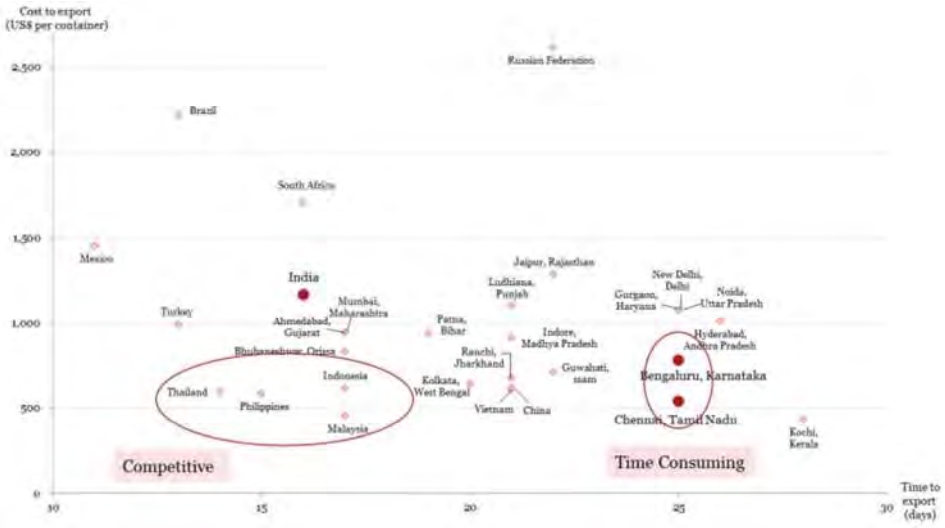


Figure3.1.15:Trading Across Borders – Export

Also, the ease of getting electricity for users could be said as the strength of CBIC. However, it is only true for large scale companies in reality.

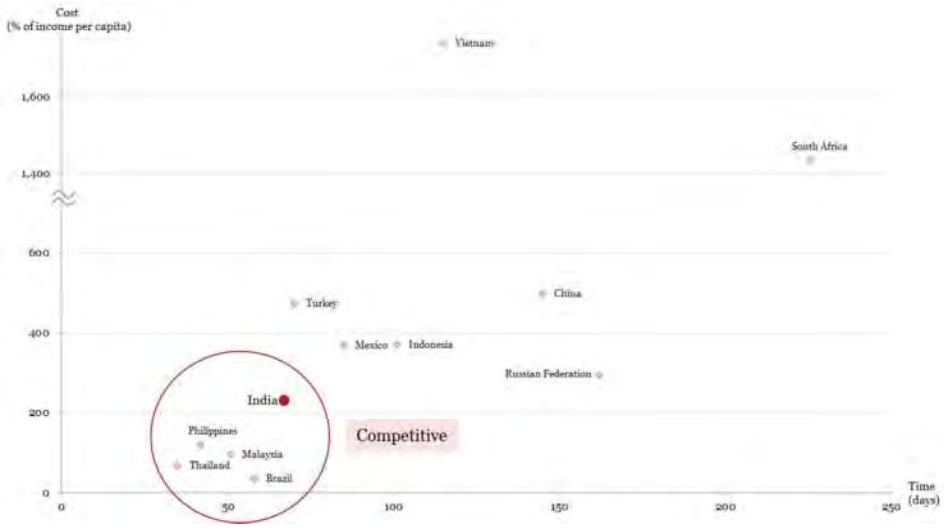


Figure3.1.16: Getting Electricity

For the next, the analysis takes up the contents evaluated as weaknesses of CBIC, i.e., starting business, paying taxes and enforcing contract.

India requires high cost for investors when they start a business. The environment in Bangalore is outstandingly expensive following to the most expensive city of Mumbai. On the other hand, the other countries, e.g., China, South Africa, Thailand, Vietnam and Russia, require much lower cost than India.

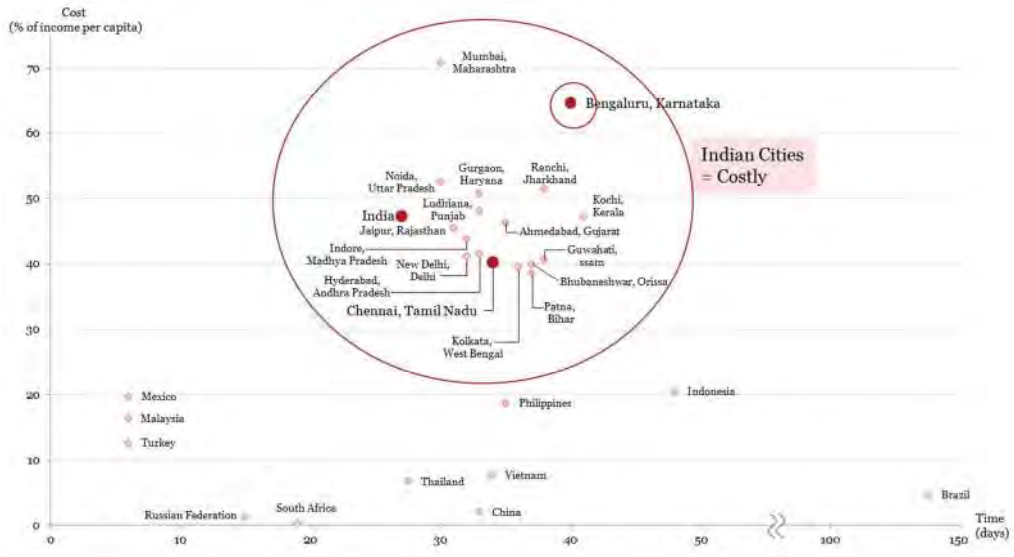


Figure3.1.17: Starting a Business

The environment of paying tax in CBIC is at the worst level in all over the world. The corporate tax, which is particularly important for foreign investors, is at very high level, i.e., 30% for domestic and 40% for foreign companies. In addition, V.A.T., dividend remittance tax and other taxes are also expensive.

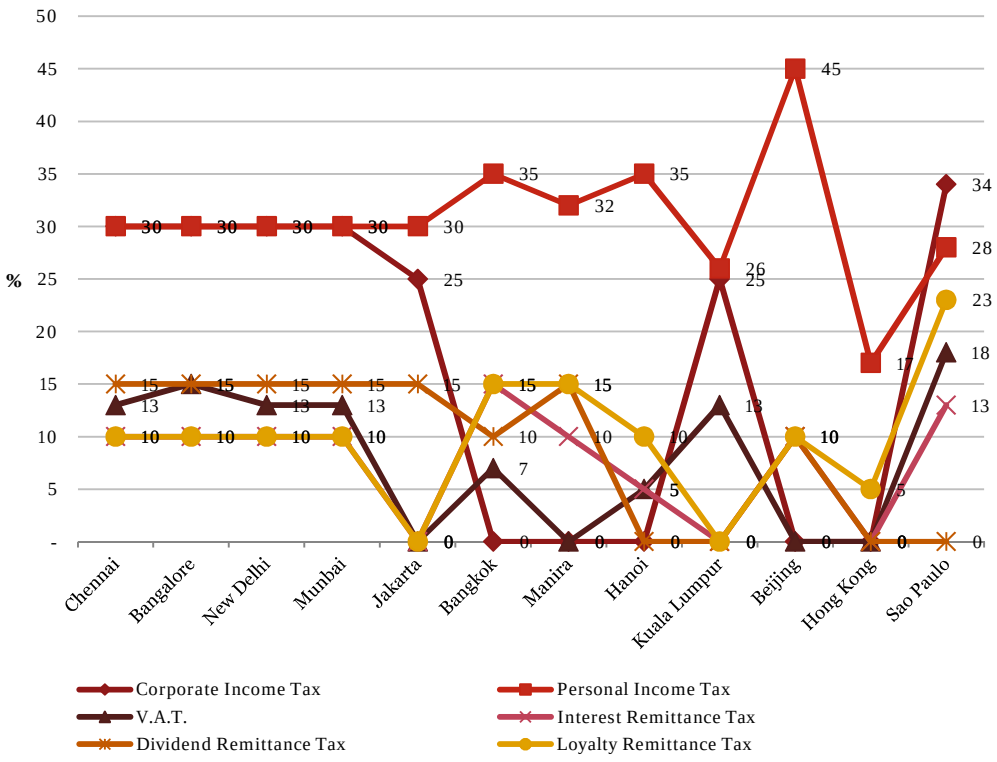


Figure3.1.18: Tax Rates (2013)

Here are other taxes the investors are levied in CBIC.

Table 3.1.2: Direct Taxes

Name	Rate	Description
Corporate tax	40%	Plus applicable surcharge and cess. For Domestic company - 30%.
Dividend distribution tax (DDT)	15%	Plus 10% surcharge, 2% education cess, and 1% secondary and higher education cess. A holding company does not have to pay.
Tax on buyback of shares	20%	Plus 10% surcharge, 2% education cess and 1% secondary and higher secondary education cess
Minimum alternate tax (MAT)	18.5%,	Plus applicable surcharge and education cess. Companies whose tax payable under normal income tax provisions is less than 18.5% of adjusted book profits.
Taxation of the know-how fee in the hands of foreign companies	25%	Royalties or technical fees payable to non-residents with a permanent establishment in India are taxed on a net basis. In contrast, they are taxed on a gross basis in the case of non-residents without a permanent establishment in the country.
Taxing dividends received from overseas group companies	15%	Dividends received by Indian companies from specified foreign companies will be taxed
Wealth tax	1%	Both on individuals as well as companies of the amount by which the 'net wealth' exceeds 3 million INR.

Table 3.1.3: Indirect Taxes

Name	Rate	Description
Basic Customs Duty (BCD)	0-10%	The rate of customs duty applicable to a product to be imported or exported depends on its classification under the Customs Tariff Act, 1975. Education cess at 2% and secondary and higher education cess at 1% are also levied on the aggregate customs duties. Additional duty of customs at 4% is charged in addition to the above duties on imports, subject to certain exceptions. ADC is calculated on the aggregate of the assessable value of imported goods, the total customs duties (i.e. BCD and CVD) and the applicable EC and SHEC Basic customs duty (BCD) is the basic component of customs duty levied at the effective rate notified under the First Schedule to the CTA and applied to the landed value of the goods (i.e. the CIF value of the goods plus landing charges at 1%) The peak rate of BCD is currently set at 10% for all goods other than agricultural and other specified products. However, the government has the power to exempt specific goods, wholly or in part, from the levy of custom duties. In addition, preferential or concessional rates of duty are available under various bilateral and multilateral trade agreements that India has entered into with other countries.
Countervailing Duty (CVD)	12%	It is charged in lieu of, the excise duty applicable on like goods manufactured in India. CVD is calculated on the landed value of goods and the applicable BCD. However, the CVD on specific consumer goods intended for retail sale is calculated on the basis of the maximum retail price (MRP) printed on their packs after allowing specified abatements.
Central Value Added Tax (CENVAT or Excise Duty)	Approx. 12%	CENVAT is a tax levied by the central government on the manufacture or production of movable and marketable goods in India. The rate of excise duty levied on the goods depends on the classification of the goods under the excise tariff, which is primarily based on the HSN classification adopted so as to achieve conformity with the customs tariff. Education Cess (EC) at 2% and Secondary and higher education at 1% are applicable on aggregate excise duties. There are different product, industry and geographical area specific exemptions available under CENVAT, which present excellent business opportunities to manufacturers in India.
Service Tax	12%	All services are taxable but for the services mentioned in the negative list.EC of 2% and SHEC of 1% of the service tax are levied on taxable services.

Name	Rate	Description
Central Sales Tax (CST)	2%	The sale of movable goods in India is chargeable to tax at the federal or state level. The Indian regulatory framework has granted power to state legislatures to levy tax on goods sold within that state. On the other hand, all goods sold in the course of interstate trade are subject to the federal sales tax i.e. central sales tax (CST).
Value Added Tax (VAT)	1-20%	At present, most of state-level sales tax has been replaced by VAT.VAT paid on goods purchased within the state is eligible for VAT credit. The input VAT credit can be utilized against the VAT or CST payable on the sale of goods. This ensures that the cascading effect of taxes is avoided and that only the value addition is taxed. Currently, there is no VAT on goods imported into India. Exports are zero rated.
Entry Tax (Octroi Duty)	n.a.	Entry tax is on entry of specified goods into the state from outside the state for use, consumption or sale therein. Entry tax continues to exist under the VAT regime, though in certain states it has been made Viable and can be set off against the output VAT liability in the state. Entry tax is levied on purchase value, which is defined as the amount of the valuable consideration paid or payable by a person for the purchase of any goods. The value of the specified goods can be ascertained from the original invoice for purchase of such goods. Octroi is a municipal tax levied at the time of the entry of specified goods into the limits of the municipal corporation. Thus, octroi can be levied if there is movement of goods from one city to another in the same state, in the event the cities fall under the jurisdiction of two different municipal corporations.
Stamp Duty	n.a.	Stamp duty is levied at various rates on documents such as bills of exchange, promissory notes, insurance policies, contracts effecting transfer of shares, debentures and conveyances for transfer of immovable property.
Research and Development Cess	5%	Research and redevelopment cess of 5% is levied on all payments made for the import of technology. The term 'technology' includes import of designs, drawings, publications and services of technical personnel.

In addition to the tax rate, procedure of paying tax is troublesome and requires time for investors. For example, the time of paying tax per year in China is 9 times, but it is 68 times in Chennai. This means India has still been trapped in the short term and micro view on taxation that higher tax rate brings more budgets to the Government. This kind of superstition prevents CBIC from growing to truly world top investment destination.

On the other hand, long term and macro view on taxation is taken root in China, ASEAN countries as well as globally competitive countries for attracting foreign investors. They aim at encouraging economic growth through setting competitive tax rate in order to attract high valued globally companies.

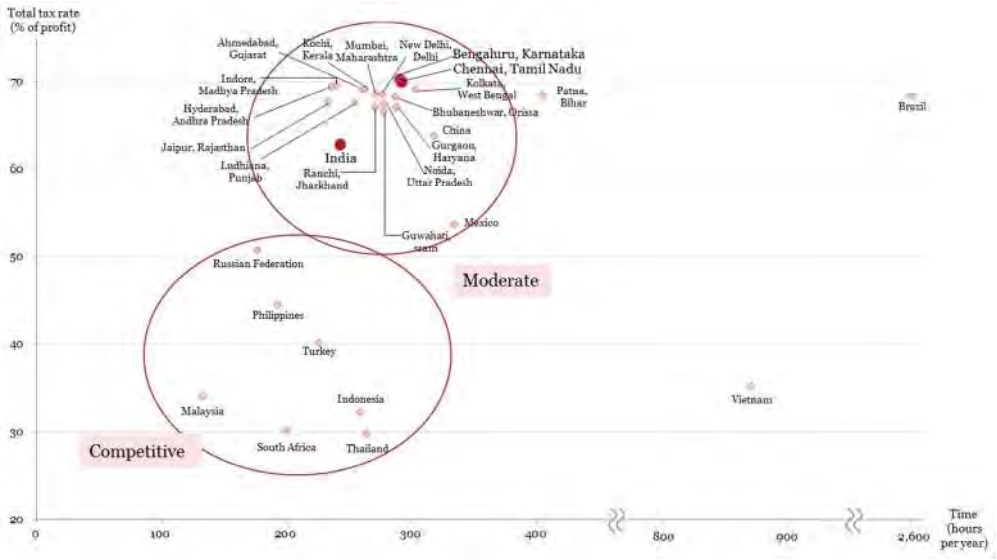


Figure3.1.19: Paying Taxes

In the aspect of enforcing contract, CBIC is inferior to the other countries regarding the time for procedures. Enforcing contract means the readiness of legal framework when investors get into trouble, as well as time and cost for solving it.

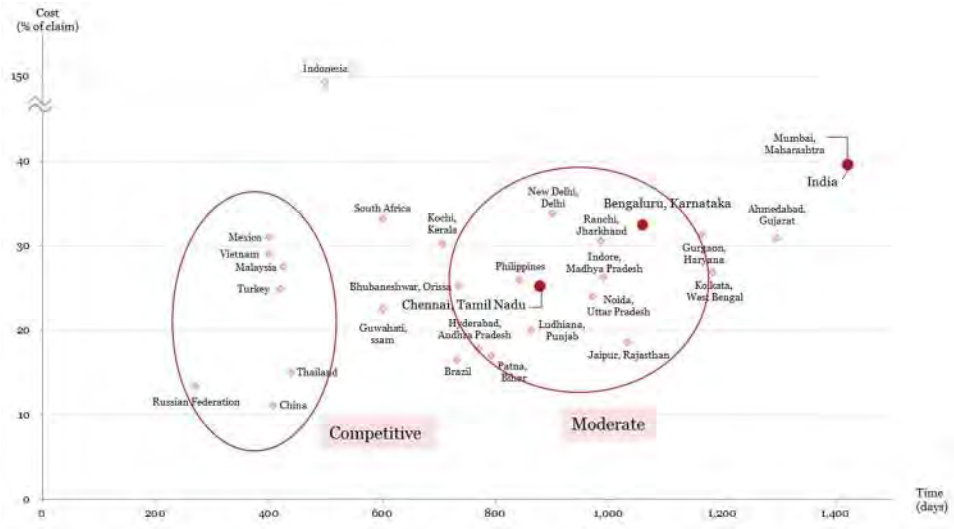
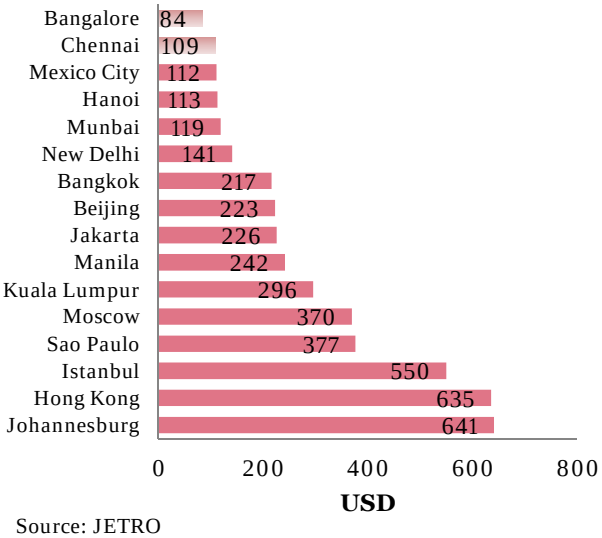


Figure3.1.20: Enforcing Contract

(3) Labour Cost Comparison

At last, here is the comparison of labour costs among major cities of CBIC and DMIC, i.e., Chennai, Bangalore, Mumbai and Delhi, and major cities in target 12 countries, i.e., Beijing and Hong Kong (China), Jakarta (Indonesia), Bangkok (Thailand), Kuala Lumpur (Malaysia), Hanoi (Vietnam), Manila (Philippines), Sao Paulo (Brazil), Moscow (Russia), Johannesburg (South Africa), Mexico City (Mexico), Istanbul (Turkey).

As to the minimum wages, the 2 cities in CBIC are the cheapest and most competitive. Following India, the 2 cities in DMIC, Mexico City and Hanoi are at the same level. The others could be categorized as the expensive group. The minimum wages of Bangkok, Beijing, Jakarta and Manila are 2-3 times, and Johannesburg, Hong Kong, Istanbul are 5-6 times, as much as that of CBIC.



Source: JETRO

Figure3.1.21: Minimum Wages (Latest-2011)

As for the average wages, the office workers' wages in 2 cities in CBIC are placed in the low level group. Given the level of education in those cities available for white collared persons, it can be said that high quality human resources are available at reasonable price in CBIC. In addition, in India, most of white collared persons are English speakers. In terms of the wages for office workers, Hanoi, Manila, Jakarta and New Delhi are comparable to CBIC.

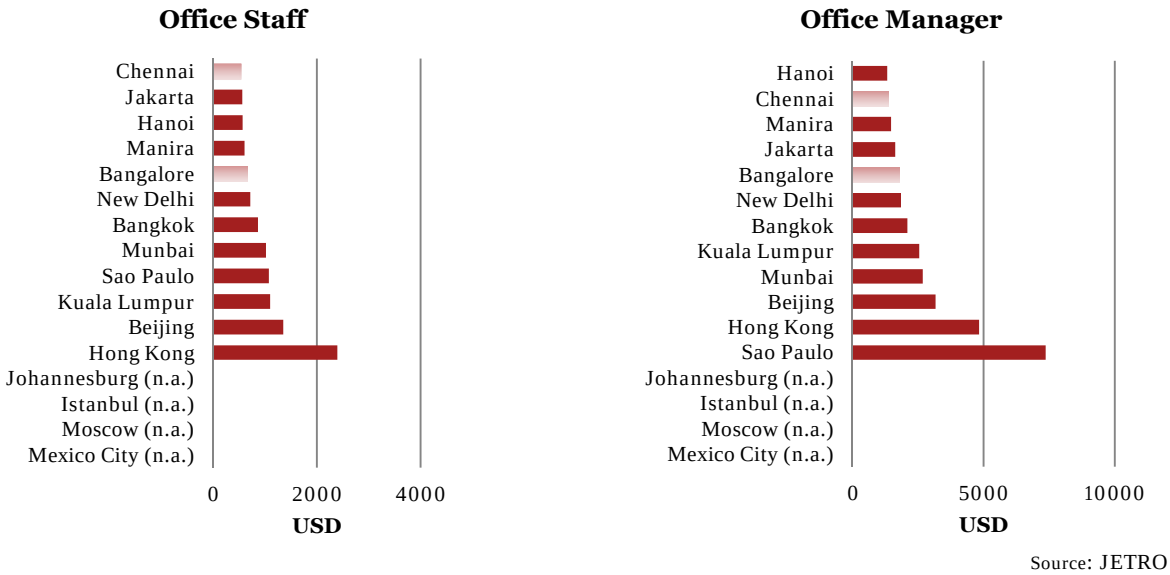


Figure3.1.22: Average Monthly Wages – Service Sector (2012)

In terms of factory workers, CBIC is included in the lower wage group. It is almost equal to Mumbai and Delhi in India, and Hanoi, Manila, Jakarta, Bangkok, Beijing and Kuala Lumpur.

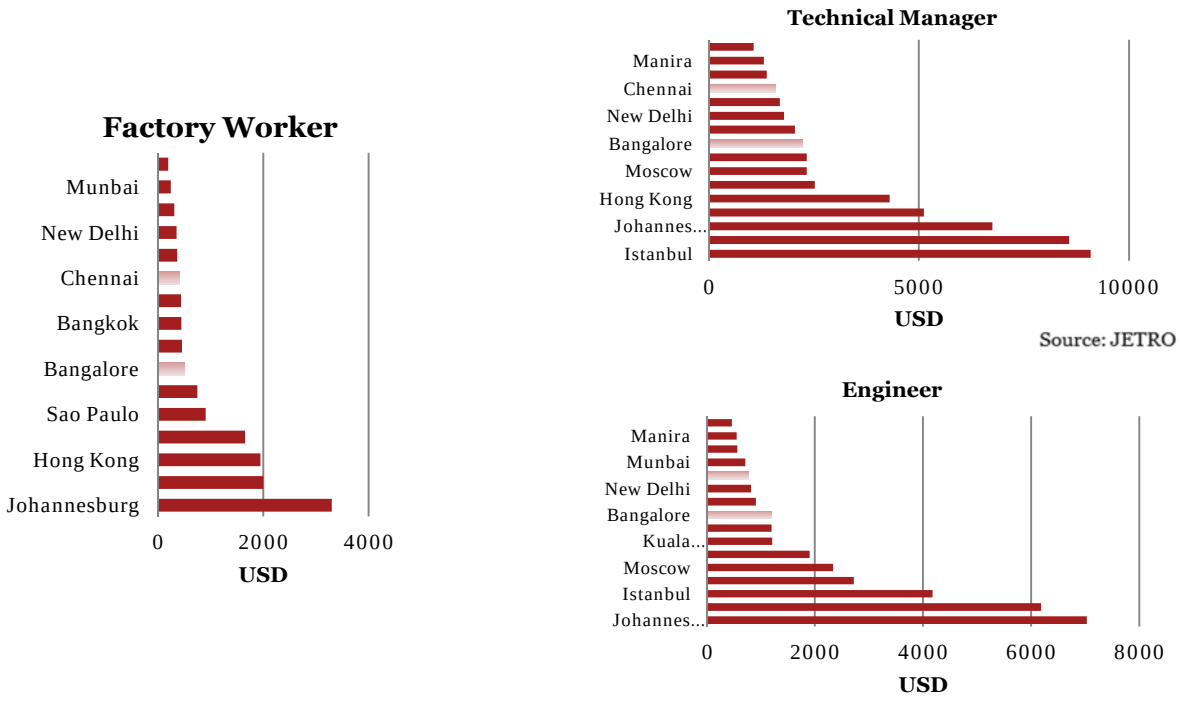


Figure3.1.23: Average Monthly Wages – Industry Sector (2012)

Although the standard of average wages in CBIC is low, the increase rate is very high. CBIC is encountering more than 15 % of wage increase recently, which is almost equal to the rate of Jakarta, Beijing and Istanbul. Wage increase rate is also high in entire India and DMIC.

Recently global companies are shifting their production base from those countries with high wage increase to more cost competitive countries, such as Myanmar, Bangladesh and Lao PDR. In order to make high value added and innovative business taken root in CBIC, the Indian/CBIC Government should strategically construct high quality goods and services market consisting of highly educated Indian workers who deserves the high level of wages.

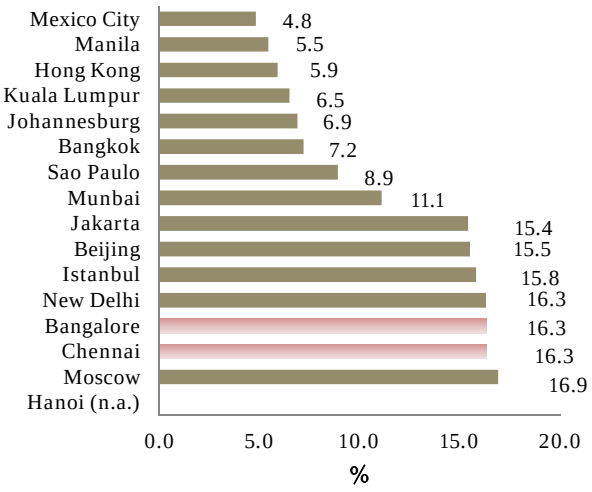


Figure3.1.24: Wage Increase Ratio in (Latest-2011)

(4) Foreign Direct Investment Policy

Unlike China and other countries, India has permitted FDI up to 100% to the sectors directly related to CBIC development, i.e., Construction Development Projects and Industrial Activities. In both sectors, FDI is permitted up to 100%.

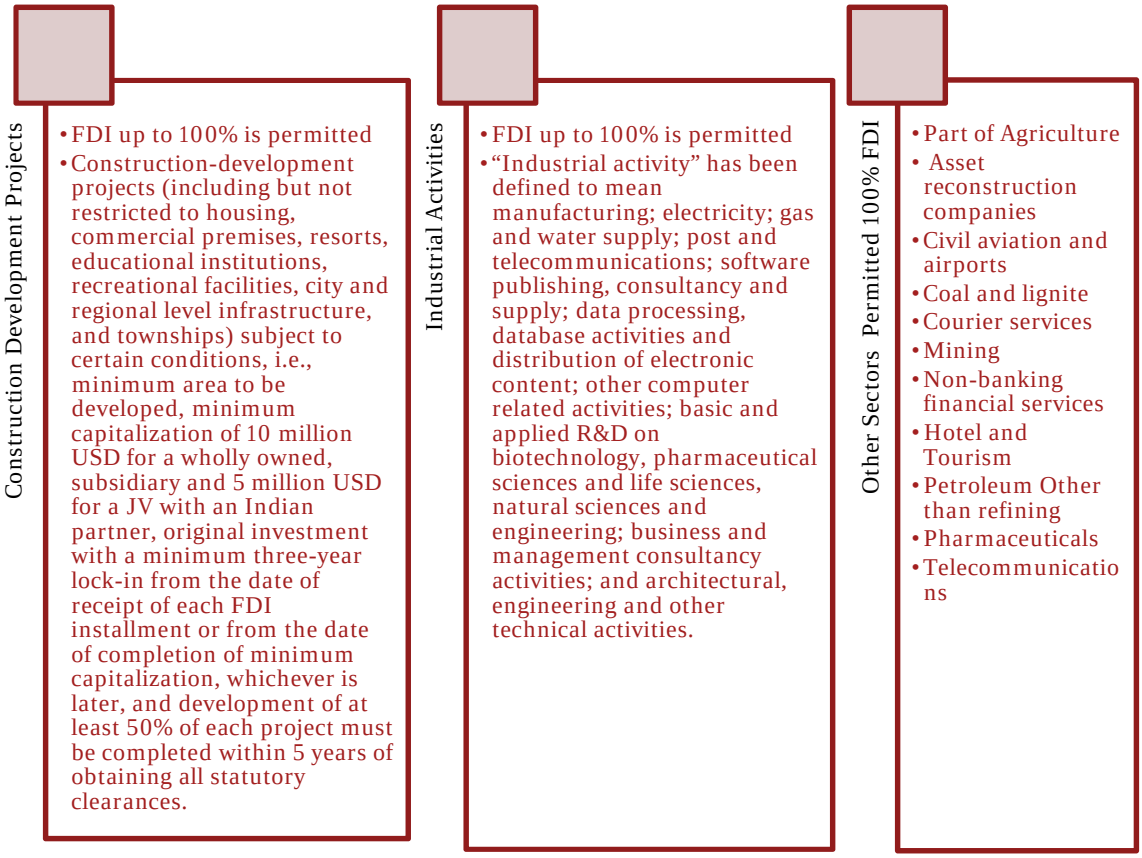


Figure3.1.25: Regulations on FDI

3.2 Qualitative Assessment - Investor's View

During the inception and interim research period, the study team have conducted interview surveys to several Japanese companies which have already penetrated in the CBIC region. The study team has consolidated their views on the region through the interview surveys as well as consultations with Japan External Trade Organization (JETRO), the member companies of Japan Chamber of Commerce and Industry (JCCI) in Chennai and Bengaluru, and the Indo-Japanese Chamber of Commerce & Industry (IJCCI) in Karnataka. The purpose of the analysis is to get a sense of the CBIC's reality and a possible future development scenario through the views of its foreign partners.

3.2.1 *CBIC's Comparative Advantages Attracting Foreign Companies and Investors*

According to the interim survey result, major factors currently attracting foreign companies/investors to the CBIC region are as follows.

1. Formulation of Large Scale Industrial Clusters and High Technical Potential

The best advantage of the CBIC development for foreign companies/investors is future possibility of enhancing the global competitiveness through effective industrial clusters. Due to the presence of Indian national manufacturing as well as inflow of foreign investments, industrial clusters in the CBIC region are rapidly

growing in these years. In addition, suppliers of parts and materials as well as skilled labours necessary for the industries' production activities have already been available to some extent, thanks to a unique history of India's manufacturing industry, especially, the automobile sector. In addition, in the future, the diverse industrial clusters will show synergy effects each other. For example, skilled suppliers and workers in automobile sector could potentially supply parts and materials for heavy industry or a part of electronics industry. Furthermore, CBIC has Bengaluru and Chennai which locates close to key industrial parks, and provides relatively finer living condition to foreign workers than the other regions in India.

2. Access to Entire Indian Domestic Market

The size of the CBIC's population, over 50 million, surpasses that of major Asian countries, such as Korea and Malaysia. The total population of 3 States in CBIC, i.e., Tamil Nadu, Karnataka and Andhra Pradesh State, is comparative to that of Indonesia, the most populated country in South East Asia. This tremendous market size and volume of workers are attracting foreign investors. In addition, CBIC locates along with the Golden Quad lateral Highways which enable manufacturers to deliver their products not only within CBIC, but also to all over India. The accessibility to entire Indian market makes CBIC a promising production base for foreign manufacturing companies.

3. Promising Future Economic Growth

Despite the recent economic downturn, India has shown high economic growth trend over the decades as a leading player of world's emerging economies. Besides, the 3 states of CBIC are showing higher growth trend than the average of India. The growth rate is often proportionate to production or sales of industries. According to an empirical analysis of automobile industry, the growth of per capita GDP tends to proportionate to the growth of automobile sales. Given the experience in China where the sales of vehicles surpassed 20 million recently, it is said that the auto sales of India may surpass 10 million within next 10 years. It is crucial for foreign investors whether they have a production base in such a region when the market has grown the size.

4. Location Merit as A Potential Global/Regional Hub - Access to Asian and African Regional Markets

The East end of CBIC faces a coastline stretching over Andhra Pradesh and Tamil Nadu States, where 4 ports are in operation. CBIC's comparative advantages for foreign investors considerably owes to the location merit which offers easy access to both Asian and African best growing economies. Furthermore, CBIC holds 1 domestic and 2 international airport in the region. The large evacuation capacity enables foreign companies to consider CBIC as a hub of their global and/or regional value chains in their long term strategy. Indeed foreign manufacturers in the CBIC region have already started exporting their products to all over the world, including Asia, Africa, US and European countries.

5. Low Labour Cost

Middle income countries which used to attract global investments are currently facing severe increase of average wages. For example, the minimum wage in the Jakarta city in Indonesia has increased in 44% from last year. The average wages are rapidly increasing also in Viet Nam, Malaysia and Thailand in these years. The increase of wages leads to increase of whole production costs and suffers foreign manufacturers operating in the region. Relatively small wage increase rate in India is unintentionally strengthening CBIC's global competitiveness.

6. Proactive Investment Promotion by the Government

In 2002, the Indian Government allowed foreign companies/investors to operate their business in India with a ratio of 100% Foreign Direct Investment (FDI). The difference between India and China, where the ratio is 50%, is considerably enhancing global competitiveness of CBIC. Moreover, the Indian and the CBIC's 3 State Governments are quite positive to further invite foreign investors and continue dialogues with many foreign partners.

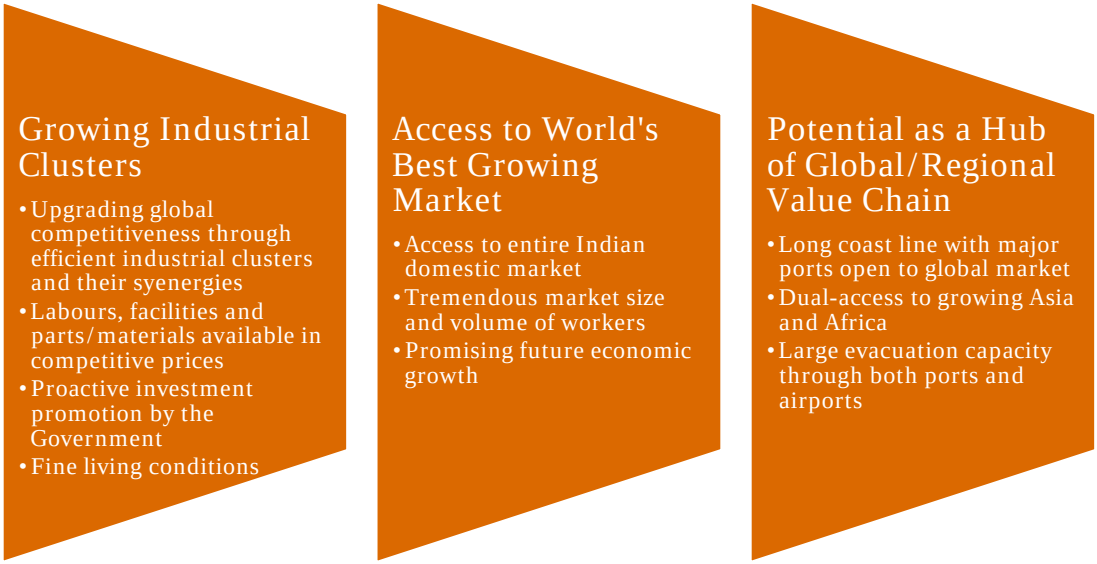


Figure3.2.1: Summary of CBIC's Key Appeals to Foreign Investors

3.2.2 *CBIC's Major Difficulties Alienating Potential Foreign Companies & Investors*

When foreign companies/investors make a decision on an investment destination, they need to pick up one or some of regions from numbers of other options. Although they carefully check the risks and chances through various methodical ways, the result of decision is often affected by reputations formed by companies which have already been operating in the region. As described in the previous chapter, the CBIC region, currently known as a part of Southern India including Chennai and Bengaluru, is regarded as the promising investment destination. However, there is another negative reputation as the "risky" and/or "unprofitable" region, due to gaps between the global fame and reality on the ground.

For example, while companies in the manufacturing and service industries are expanding their Indian base in the CBIC region, companies relevant to these industries are not necessarily gathered in the area. Therefore, the manufacturing companies need to import parts and materials, which are essential for their product, from overseas remote areas. Thus, penetration into CBIC is not always leading to enhanced competitiveness for these companies. One of the key reasons for this is that domestic Indian companies and foreign companies (in particular, mid-to-small-sized companies) are forced to engage in tasks and bear costs that would naturally not have been required, and are thus unable to make a decision on penetrating into the CBIC.

1. Lack of Readiness of Industrial Parks

The quality of the industrial park in the CBIC region is far from an average industrial park in the international standard. Due to the low quality, the foreign manufacturers newly invested in CBIC are facing serious problems, e.g., shortage of water, lack of stable power supply, delay of planned road construction, and deferral of the Government permission. In some cases, they even encounter the situation that land allocation and acquisition is not completed even after starting construction of the facilities on the allotted land. Moreover, in order to solve the problem, they have to negotiate with each line ministry though highly ambiguous and time consuming process. This happens partly because many of the industrial parks in CBIC are still under public operation. While successful industrial parks in the world were operated by private developers.

2. Challenges of Infrastructure Bottlenecks

In addition to the challenges inside the industrial parks, there are challenges of infrastructure bottlenecks outside. As to the transportation sector, essential improvements needs to be addressed, e.g., mid-long term road planning, construction of access roads to main roads and major port, establishment of management

system for freight railway and loading points, and enhancement of overall operation of major ports. Similarly in the power sector, chronic shortage of electricity should be solved through development of comprehensive electricity supply and demand plan. (Further details are described in the following chapter.)

3. High Risk and Cost in Policy Environment

Although the Indian and State Governments attempt to develop investor friendly environment in the CBIC region, current policy environment in CBIC forces the foreign investors to take too much additional risks and costs. For example, problems on logistics and import taxation regularly occur at the ports and airports. Rules on documentation and licensing for international trade are highly inconsistent. Permitting process of the Government is pretty time consuming. Logistics are often delayed due to the roads jam-packed by vehicles which do not follow the traffic regulation. (Further details are described in the following chapter.)

4. Low Comparative Profitability

Most of the Japanese foreign companies describe the character of the Indian market as "exhaustively cost competitive." Many of them feel the values of their products, such as the higher quality, life cycle cost and safety for users, are underestimated by the Indian consumers. On the other hand, there are a lot of growing economies and high profitable regions in Asia, such as Malaysia, Thai, Indonesia, and China. They also have advanced characters as investment destinations, e.g., industrial cluster, higher skilled labours and facilities, and business environment and living condition preferred by foreign investors. The foreign companies which try to invest in CBIC are mostly aspiring investors which dare to take a risk and invest in new region instead of expanding on-going investments to their familiar regions.

5. Instable Indian Economy and Market

Indian economy is currently losing the growth momentum. The GDP growth rate of India decreased to 3.24% in 2012. Given the economic downturn, foreign companies tend to postpone their investment plan as well as downgrade the growth estimation to India. Observed the China's high growth period facing earlier slowdown, global investors currently start considering the future growth of emerging economy has been overestimated. Under the situation, small and medium scale foreign companies, mostly essential parts suppliers for manufacturing, are confronting a serious challenge in order to determine investments to CBIC.

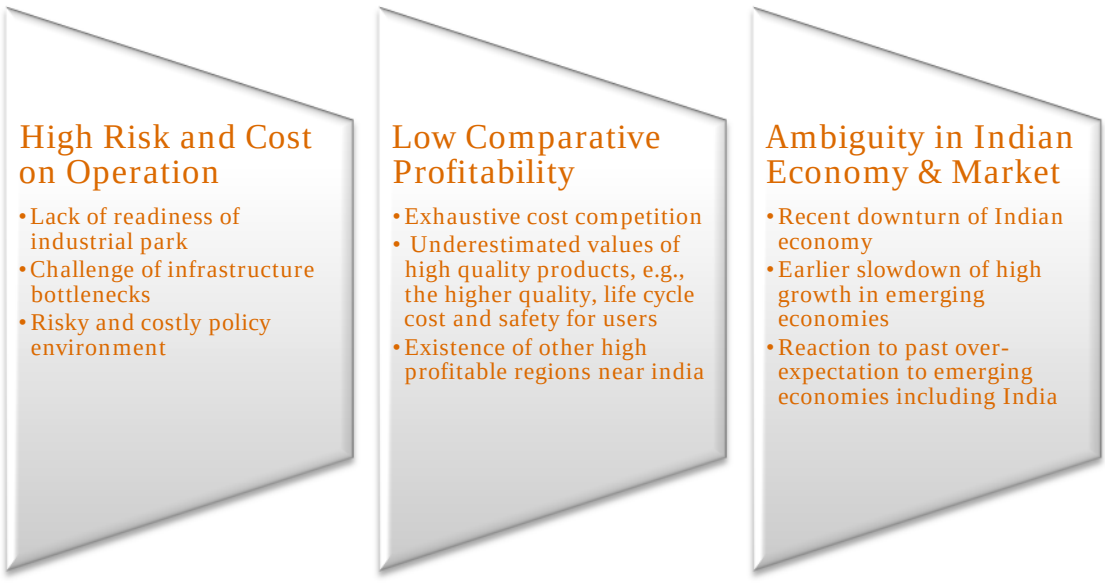


Figure3.2.2: Summary of CBIC's Major Weakness Alienating Potential Foreign Investors

3.2.3 *Details of Difficulty in Policy Environment*

Here are further details of difficulty in policy environment which the foreign companies are frequently encountering on their daily business in the CBIC region.

1. Logistics in International Trade at Ports and Airports

- Logistics problems frequently occur at ports and airports, especially at Chennai Port. Due to lack of organized and integrated regulation or guidelines, rules of mandatory submitting documents and licences for clearance are often changed suddenly by orders of clearance officers at the port or airport. Also, there are numbers of local rules and regulations in each port/airport which are not officially enforced by the Government. Some foreign companies are feeling the human cost and time for port clearance in CBIC region takes 10 times as much as that of Singapore.

2. Taxation System/Process

- Despite the fact that the tax system are under control of the Indian Government, the same issue in logistics occurs in taxation at the port and airport. Rules of taxation process changes frequently and suddenly by the orders of tax officers at the port or airport. For example, a rule for determining import tax base, either Maximum Retail Price (MRP) or Invoice Value, often changes depending on the sporadic order by the officers.
- Tax system should be considered from viewpoints of not only collecting more tax from private sector but also encouraging production activities of industries which will produce much higher tax revenue to the Government in the long run. In the context, current rate of import tax, i.e., 25 % is felt too high when comparing to other Asian countries', 10-15 %. Also, necessity of Special Value Brunch (SVB) is under question.
- As to VAT refund process, one invoice needs to be provided to the Taxation Bureau per part when receiving a refund on VAT. As the invoice is requested in hard copy, more than 10,000 invoices must be filed for 1 car, and the administrative cost is enormous. Furthermore, the documents must be stored for 8 years, leading to a large storage cost only for keeping the copies.

3. Permitting Process

- A company must submit various applications to the State Government when penetrating the market, but the process is enormously time consuming. For example, when constructing a plant or an office, a declaration will be made on the environmental impact of the business and construction works which will require assessment by specialist as needed. In many cases, this process takes 3-4 months on average. Companies considering entry will develop a detailed schedule for the start of new production and sales. However, if the permitting process takes a long period of time, the production and sales schedule will be delayed, and in some worst cases, a company had to abandon market penetration.

4. Regulations

- According to the current Indian environmental standard, metal plating and coating industry are categorized as "Red" industries. The category creates a hurdle for them to construct a factory near Chennai and Bengaluru. It makes automobile industry difficult to form complete cluster in the CBIC region.
- One of the important issues causing traffic jam is the current situation where vehicles are travelling without complying with the road traffic rules. The main cause is the moral degeneration regarding compliance with road traffic rules. Appropriate operation of the examination system for obtaining a driver's license may contribute to solve the problem. In order to receive a license, both a written and a skill test are required, but cases can be seen where a license is given without going through a skill test.

3.2.4 *Details of Infrastructure Bottlenecks*

Here are further details of infrastructure bottlenecks which depreciate the foreign companies' manufacturing activities in the CBIC region.

1. Industrial Parks

(1) Operation of Industrial Parks

- At many of industrial parks in CBIC, the tenant must build and maintain by themselves basic infrastructures such as water, electricity, draining facilities and surrounding roads. An agreement on the construction of infrastructure between the tenant and the Governmental corporations managing the industrial park was not realized in many cases in the past.
- This happens partly because many of the industrial parks in CBIC are still under public operation. While successful industrial parks in the world were operated by private developers.
- In order to solve those serious problems, the tenant has to report the problems and negotiate with each line ministry by their own risk and through time consuming process.

(2) Access Roads from Industrial Parks to Main Roads

- Main roads and industrial parks are not effectively connected in the CBIC region. Since many of the access roads are unpaved and damaged, the worsened traffic jam does not allow vehicles to travel in an ordinary manner. Even if a national highway (NH) is constructed or expanded, the lead time between industrial parks and ports will result longer without the effective access roads which connect the NH and industrial park.

(3) Roads inside Industrial park

- Construction of roads within industrial parks is insufficient. In particular, difficulty is found in carrying heavy loads. The construction of roads within industrial parks is initially responsibility of the state's public development corporation. However, in many cases, the progress is slow.

2. Roads

(1) Mid-Long Term Road Planning

- A road plan needs to be developed with an eye to the future of CBIC's industrial development. There are frequent project announcements regarding new investment or expansion by automobile or two-wheeler manufacturers in CBIC. Currently not only Japanese but also European and Korean companies are seeking to expand the production. Therefore the volume of logistics in CBIC will escalate along with the increase of domestic as well as international transport of the parts and materials for their production. Thus, sporadic constructions of new roads or increase of lanes will not fundamentally solve the issue of traffic jams.

(2) Access Roads to Main Roads and Major Ports

a. Realization of the peripheral road concept in the Chennai region

- This concept was announced in March 2012 by the Chief Minister of Tamil Nadu, and includes the construction of an outer ring road connecting Mamallapuram, Singaperumaikoil, Sriperumbudur, Tiruvallur, Thamaraipakkam, Periyapalayam, Puruvayal, and Kattupalli around Chennai. The announcement states that this will involve the extension of existing roads.
- Currently, vehicles must pass through Chennai City to access Ennore and Chennai Ports, but due to the traffic jam, it is difficult to set the lead time with accuracy. For example, it takes 8 hours for transport only between the industrial park in Southern Chennai to the port.
- The construction of roads connecting industrial parks are yet to be built and the smooth distribution of parts and materials from the assembler to the supplier is an issue. In particular, the road environment

surrounding the Oragadam Industrial Park is severe. Logistics activities between affiliated companies are facing serious inefficiency.

- The construction of the peripheral road will enable the manufacturers to set a more accurate lead time, as vehicles will be able to avoid driving through the city centre for reaching the Ennore Port, and as roads between major industrial parks will be in place.

b. Access road from NH4 to NH7 in the Bengaluru region

- Earlier commencement of STRR project is essential issue. Currently, the expansion of NH207 from Dabaspet to Hoskote into a 4-lane road is being planned, but an expansion up to Hosur is more important. The road from Hoskote to Hosur via Malur can deepen industrial cluster around Bengaluru region as well as be used as an access route from the industrial park near Bengaluru to the main road, NH7.

c. Access roads near Ennore and Chennai Ports

- The delay in the construction of an access road in the area surrounding Ennore and Chennai Ports, the gateway to CBIC, is impeding business operations in the entire CBIC region. Large traffic jams caused by the delay makes cargos arriving late. An accurate lead time cannot be estimated.

Area near Ennore Port:

NCTPS Road	- Early construction of the Attipattu ROB and Pullicat Backwater Bridge. In particular, the completion of Attipattu ROB is an impending issue for the safe shipment of products to the Ennore Port. - Expansion of existing roads into 4-lane roads at an early stage
TPP Road	- Early construction of the Napallayam Bridge - Early paving of existing roads - Expansion of existing roads into 4-lane roads at an early stage
Ennore Port Road	- Early construction of the Bridge for Buckingham Bridge - Expansion of existing roads into 4-lane roads at an early stagy
Northern Port Access Road	- Early start of construction

Area near Chennai Port:

Elevated Corridor to Chennai port	- Early completion
EMRIP (Ennore-Manali Road Improvement Project	- Early completion

d. Chennai Outer Ring Road

- The completion of the Outer Ring Road will enable companies located south of Chennai and in Bengaluru to access Ennore Port without passing through the Chennai city. The road will play an essential role in alleviating the current traffic jam. Also, connection with the Northern Port Access Road for securing access to Ennore Port will contribute to the smooth logistics in the CBIC region.

e. Bengaluru's Peripheral Ring Road

- The traffic jam in Bengaluru City is impacting manufacturing companies' operations and logistics. Peripheral ring road will be an essential solution in order to alleviate the traffic jam.

(3) Main Roads between Chennai and Bengaluru

- Improvement of the current main roads between Chennai and Bengaluru, i.e., NH4, NH7 and NH46, are necessary. The construction of roads to access the industrial clusters centered on industrial parks from these main roads is a priority issue. The traffic jam on NH4 and NH7 is particularly severe in Bengaluru. It could be alleviated through the construction of flyovers near crossroads.
- Highways exclusively for vehicles are needed to be constructed on the mid-to-long-term as one of the main roads connecting industrial clusters within CBIC. It is important to simultaneously build access roads that connect with the highway and industrial parks.

(4) Road Maintenance

- The damaged roads in CBIC are damaging the load during the transportation. Together with the construction of new roads and expansion of existing roads, the development and implementation of an organized road maintenance plan is required. Especially, the TPP Road and SP Koil Road in Chennai, and the Mysore Road (between BHEL Signal and Muslim Burial Ground), White Field Road and Tumkur Road in Bengaluru are in need of prompt improvements to road conditions.

3. Ports

(1) Ennore Port

- The cost for usage of Ennore Port is more than twice that for other ports in India, and over 5 times the international level. Further revision of port charge is necessary.
- A facility (crane) for shipping large-sized heavy loads would be required when expanding domestic shipment or overseas export of large-sized plants in future.
- Improvement of the port's safety measures is required. There were cases where cargo could not be handled due to the waves, and where ships were damaged.

(2) Chennai Port

- The clearance system goes down frequently, and operation cannot be handled smoothly.
- There is only one gate through which the trucks can enter the Chennai Port for receipt and delivery. A security check is conducted at the gate on the trucks one by one, and the line of trucks waiting to enter reaches several tens of kilometres. A vicious circle where trucks cannot enter the Port, cannot receive the load, and ships are waiting in line to discharge their load.
- Clearance hours are only between 9am to 5pm.
- Freight vehicles e.g., trailers can only enter the Chennai city between 10 pm to 6 am and are stopping and waiting in the suburbs of the city until night time, causing a serious traffic jams.
- Intensive study to fund solutions to improve port operation system, e.g., 24 hour operation of the port, effective way of gate access, and simplification of security check.
- Expansion of car parking yard is required in order to solve the traffic congestion in the area.

(3) Ports in Southern Chennai

- As industrial clusters consisting mainly of autos and two-wheelers are located in Southern Chennai and Bengaluru, there would be no need to consider traffic in the Chennai city and lead time can easily be estimated, if a port were to be constructed on the southern coast of Chennai. This would also have the impact avoiding environmental contamination in the city caused by trucks. A comprehensive development of a port such as the Marg Port currently being planned, and surrounding roads in Southern Chennai will encourage smooth logistics in the region.

(4) Ports in Northern CBIC

- There is high possibility to further expand CBIC's import/export capacity through construction of new ports as well as upgrading of existing ports, such as Krishnapatnam Port, in northern part of the CBIC region. However, as far as the above mentioned low operation capacity remains, the construction or expansion of physical facilities does not necessary lead to the result. Improvement of operation capacity, e.g., allocation of skilled staffs, well organized work team building, establishment of clear clearance/logistics rules, should be addressed in addition to the infrastructure development.

4. Power and Energy

(1) Chronic Shortage of Electricity

- The chronic shortage of electricity is causing difficulty in production, e.g., restrictions on the use of electricity, planned as well as frequent unexpected outages. For example, in Tamil Nadu, despite the increasing electricity demand every year due to the accelerated growth in the number of manufacturers in the state, supply capacity remains at around 10000 MW for the past several years.
- The shortage of electricity supply forces companies to make downward adjustments to their production plan. The frequent unexpected outages will abruptly stop production lines and produce a large number of defective products. The companies will have no choice but to introduce privately-owned electrical power facilities for avoiding this situation, but the burden would be large considering that this would require large investments and the electricity cost would be around twice the ordinary charge. Stable and high quality electricity supply, i.e., stable power voltage and frequency, as well as no outage, is essential for development of industrial sector in CBIC.

(2) Comprehensive Electricity Supply and Demand Plan

- Since global companies complete their products in the optimum location with receiving parts and materials from various bases all around the world, lack in the supply of parts in the global value chain due to India's shortage of electricity would impede their worldwide production activities. The lack of an effective electricity supply and demand plan would indicate the review of their global strategy for India as a global base.

(3) Use of Private Sector

- It would be required to consider the effective use of IPP (Independent Power Provider) that have their own power generation and transmission facilities for securing a stable, high-quality power supply.

5. Railways

(1) Exclusive Freight Railway and Management System

- Freight railway can be one of the effective transportation means for industrial clusters along CBIC due to its advantages of safety and mass transport. As demand for cargo vehicles including truck trailers is increasing, there could be growing needs for freight railway in the future. Nevertheless, accurate operation cannot be expected of the current railway, and mass transport is impossible. For example, freight railway waits for passenger trains to depart, and is not operated according to the timetable, taking 48 hours from Chennai to Bengaluru. Thus, the lead time is inaccurate and difficult to apply for business. Furthermore, the goods must currently be unloaded from the freight train and loaded on to a truck. It is better to use land transport from the location where the goods are loaded. The rail can be used if a structure is possible in which an exclusive line can be built at the plant for direct shipment to the port.

(2) Loading Points

- Management of loading points is unreliable. There are cases where loads are damaged (stained or failure due to dust or water) as a result of bad management and operation at the place where goods are unloaded.

3.3 Summary of Key Findings

Given the above analysis, the investment competitiveness of CBIC as a global investment destination, i.e., strength, weakness, opportunity and thread, is summarized as below table.

In summary, as to the strength, the best comparative advantage of CBIC is the scale and growth potential of the accessible domestic and foreign markets, e.g., entire regions in India, Asia, Africa and other regions of the world, thanks to the geological location and surrounding infrastructures. For example, the population only within CBIC is equivalent to medium sized countries in the world, and the estimated GDP growth rate in future is higher than the most of them. In order to make the most of the advantage, further infrastructure development, such as ports, airports, highways and railroads, for reinforcing the linkage between CBIC and those markets will be the most important for improving the competitiveness. The location merit and advanced infrastructures will enable CBIC to be a hub of global network for many manufacturing companies in the future.

Thanks to the large FDI inflow due to the high expectation of investors, industrial clusters are developing in CBIC. Current proactive manufacturing development and FDI promotion policies along with actual enhancement of NIMs, SEZs and Industrial Parks are contributing to accelerating the process. Also, advanced financial market and availability of qualified and low-cost local suppliers and industrial workers provide foundation of the development. Furthermore, unique pass of previous development of CBIC/India encourages higher expectation for investors on the possibility of innovative growth in the future.

Meanwhile, as to the weakness, CBIC is surrounded by very competitive investment destinations, e.g., China and growing ASEAN countries internationally, and DMIC domestically. Among them, CBIC is inferior in many aspects of investment environment due to the following disadvantages; 1) infrastructure bottlenecks, especially capacity and quality of port/airport, road, railway and industrial park, 2) ambiguity in procedures for permits and licences especially regarding import and export, , 3) high tax rates , 4) increase of business cost, especially worker's wage and land value, 5) technological level of suppliers and workers, and 6) lack of market for high quality goods and services.

Table 3.3.1: SWOT Analysis

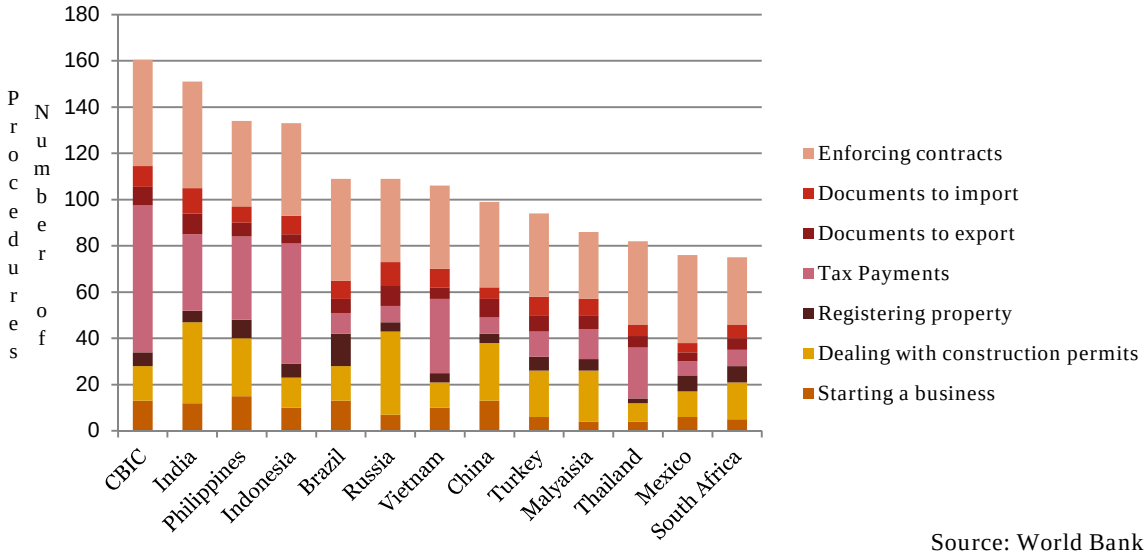
	Plus Factor	Minus Factor
Internal	<Strength> 1. Scale and the growth potential of accessible domestic and foreign markets, e.g., all states in India, Asia, Africa and other regions of the world, thanks to the geological location and surrounding infrastructure, e.g., ports in long coast line, airports, road and railroad 2. Quantity of available, qualified and low-cost local suppliers and industrial workers, such as engineers, technicians, scientists, researchers, and any industrial workers, who are mostly English speakers 3. Proactive manufacturing development and FDI promotion policies, e.g., target of manufacturing GDP share 25%, and permission of 100% FDI for construction and industrial activities 4. Glowing industrial clusters due to NIMs, SEZs and Industrial Parks and possibility of innovative growth in the future due to the unique pass of development 5. Development of financial market especially in the aspects of protection of investors, acquisition of cash, financing through local equity market, venture capital availability, and regulation of securities exchanges 6. Others: Competitiveness in imports, Availability of power for industry, High level of Gross National Saving, Quality of railroad infrastructure and Quality of management schools.	<Weakness> 1. Infrastructure bottlenecks, especially capacity and quality of port/airport, road, railway and industrial park 2. Ambiguity in procedures for permits and licences especially regarding import and export, e.g., fluctuating rules and procedures and existence of corruption 3. High tax rates, e.g., corporate tax, V.A.T., dividend remittance tax and import tax 4. Rising business cost, i.e., growing worker's wage and land value 5. Technical gap between the needs of foreign manufactures and local suppliers/workers 6. Lack of market for high quality goods and services and too much cost competition 7. Others: High inflation rate, Difficulty in starting business, Low readiness of Macro-economic environment, Low quality of health care, high infant mortality, Low quality of primary education and higher education, Low perseverance of subscriptions in mobile telephone, fixed telephone lines and internet, Unbalanced Government budget, and Small share of women in labour force
External	<Opportunity> 1. Higher rising wages and other production costs in China and South East Asia than India 2. Shortage of skilled labours and industrial parks in Asia 3. Political instability and lessened economic growth of China 4. Expansion of global share of India in GDP and population scale	<Threat> 1. Surrounding competitive and glowing countries/regions in terms of foreign trade, investment and production of high quality materials in such countries as China, Indonesia, Thailand, Malaysia, Vietnam and Philippines 2. DMIC's presence as the prime Indian investment destination 3. Recent economic downturn of India 4. High political, economic and cultural ambiguity and risk 5. Middle income trap: Shift of foreign investors from India to emerging production cost competitive countries.

3.4 Key Issues on Overview of Investment Environment

1. Administrative Issues – Procedures on Approval and Authorization

In order to develop CBIC to a truly world best investment destination, the Government of India and the related State Governments, i.e., Tamil Nadu, Karnataka and Andhra Pradesh, are recommended **to decrease, shorten, simplify and clarify the procedures** for approval and authorization. The Government's efforts for clarification of procedure rules through written documents, setting target periods for the procedures, improving one stop service and utilizing online system will contribute to the improvement.

The comparison analysis in the previous chapter shows that doing business in CBIC is time and cost consuming. The situation is summarised in the following figure and table.



Source: World Bank

Figure3.4.1: Number of Procedures

The comparison of necessary period of major administrative procedures in CBIC and the rival countries/regions are shown in the below table.

Table 3.4.1: Period of Proceduresin CBIC

Name of Procedures	Period of Procedures in CBIC	Comparison with Rival Countries/Regions		Authority in Charge	
		Best Practice	Average	Gov. of India	State Gov.
Starting a business	37 days	6 days (Mexico)	31 days	√	√
Dealing with construction permits	120 days	77 days (Philippines)	181 days	√	√
Registering property	38 days	2 days (Thailand)	33 days	√	√
Trading across borders Export	25 days	11 days (Mexico)	17 days	√	
Trading across borders Import	22 days	11 days (Mexico)	18 days	√	
Enforcing contracts	968 days	270 days (Russia)	533 days	√	
Paying taxes	292 hours	133 hours (Malaysia)	292 days	√	√

The competitive period shows the best practice which is applied in the 12 compared countries. The moderate period shows the averages. It is recommended for CBIC to set the target period at least at the level of the average, in order to enhance the global competitiveness.

In addition, the following issues are the critical weaknesses of CBIC which need to be addressed.

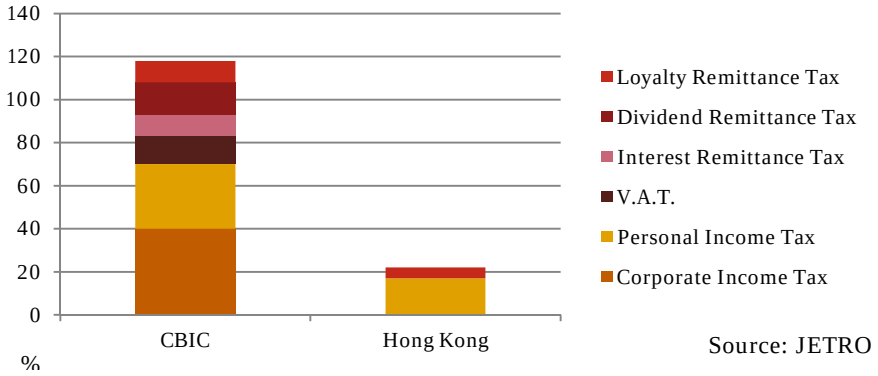
Table 3.4.2: Key Bottlenecks in Administrative Issue in CBIC

Key Issues	Challenges	Solutions
1. Land Acquisition on Industrial Parks	■ When serious problems occur on land acquisition in industrial park, private company has to solve by taking all responsibilities. ■ Information on industrial park is closed and difficult to know for potential investors unless they have connection with the Government officials.	■ All responsibility on land acquisition for industrial parks should be taken by the Government. Negotiation with local residents should not be responsible for private companies. ■ Land allocation and other essential information on industrial parks should be open to public. ■ All procedures should be transparent and preferably done by single window.
2. Import/Export at Ports and Airports	■ Due to lack of integrated guidelines, rules of mandatory submitting documents and licenses for clearance are frequently changed by orders of officers at the port or	■ Clear, integrated and transparent rule for the following procedures should be set. • Licences and application documents

Key Issues	Challenges	Solutions
	airport. ■Number of local rules and regulations which are not officially enforced by the Government exist in each port and airport. ■ One invoice needs to be provided to Taxation Bureau per part when receiving a refund on VAT. As the invoice is requested in hard copy, more than 10,000 invoices are required.	for custom clearance • Payment rules and tax rates on custom duty ■ Port and airport operation should be improved. • 24 hours operation of major ports • Improvement of gate utilization • Simplification of security check and gate check • Increase of custom officers ■ V.A.T. Refund process should be simplified.
3. Environmental Assessment and Approval of New Projects	■ Environmental assessment takes too much time, i.e., 3-4 months on average. ■Approvals for new projects, such as approvals of State's high level committee and issues of official approval letters are taking too much time.	■Environmental assessment procedures should be simplified. ■Industrial waste management facilities should be pre-installed to industrial parks rather than strictly imposing ZERO emission and EIA policy ■ Procedures for project approvals should be simplified.

2. Financial Issue - Taxation

As analyzed in the previous chapters, the tax burden for foreign investors in CBIC is more than the other rival countries and regions. The higher tax rate critically deteriorates the attractiveness of CBIC as an investment destination.



Source: JETRO

Figure3.4.2: Comparison of Tax Rates between CBIC and Hong Kong

Comparison of major tax rates in CBIC and other rival countries are shown below.

Table 3.4.3: Current and Recommended Tax Rates for CBIC

Name of Tax	Current Rate	Comparison with Rival Countries/Regions		Authority in Charge	
		Best Rate	Average Rate	Gov. of India	State Gov.
Corporate Income Tax	40%	0%	17%	√	
Personal Income Tax	30%	17%	31%	√	
V.A.T.	13-15%	0%	8%		√
Interest Remittance Tax	10%	0%	8%	√	
Dividend Remittance Tax	15%	0%	9%	√	
Loyalty Remittance Tax	10%	0%	10%	√	
State Entry Tax	Varies	0%	0%		√
Import Tax	25%	10%	15%	√	

The competitive rates show the best rates which are applied in the 12 compared countries. The moderate rates show the averages. It is recommended for CBIC to set the tax rates considering the level of the average, in order to be a globally competitive investment destination which is chosen and preferred by major global investors. In addition to the tax rate, cess should also be reconsidered.

4 Industry Scenario

4.1 India as an industrial hub for the world

4.1.1 India's current manufacturing position

Post liberalisation, Indian manufacturing sector has been able to shift to a steeper trajectory from 5.37% CAGR to 6.73% CAGR[4]. In the past 10 years, Indian manufacturing has grown at a robust rate of 8.4%, putting itself on the map of some of the best performing manufacturing economies. Yet, the subject of criticism has been lower contribution of manufacturing sector to overall GDP when compared to fast developing economies in the region like Thailand, China, Indonesia and Malaysia and the ease with which business is done in India.

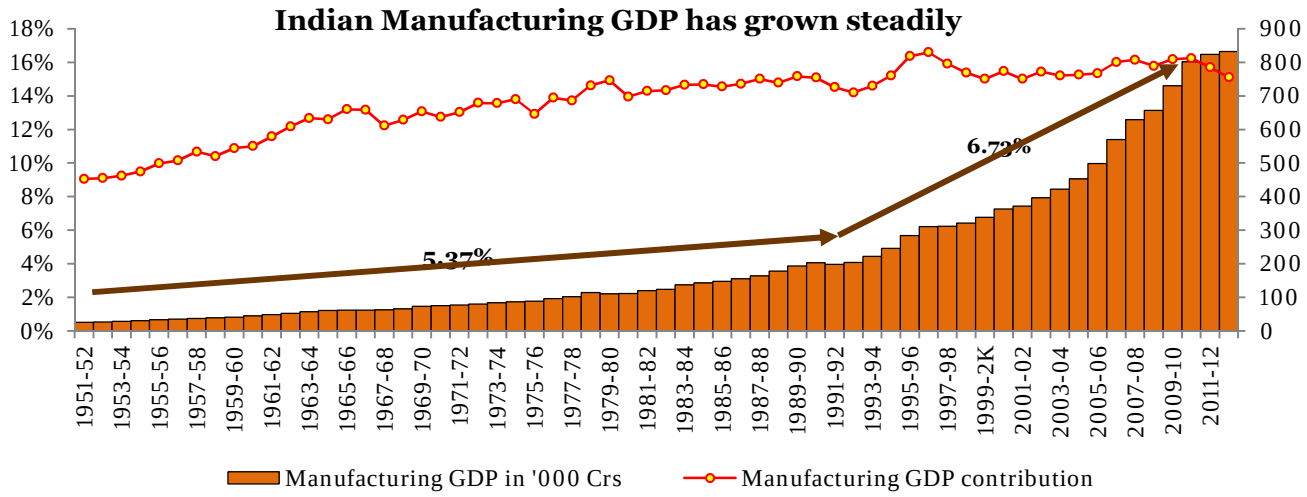


Figure4.1.1: Indian Manufacturing GDP and contribution

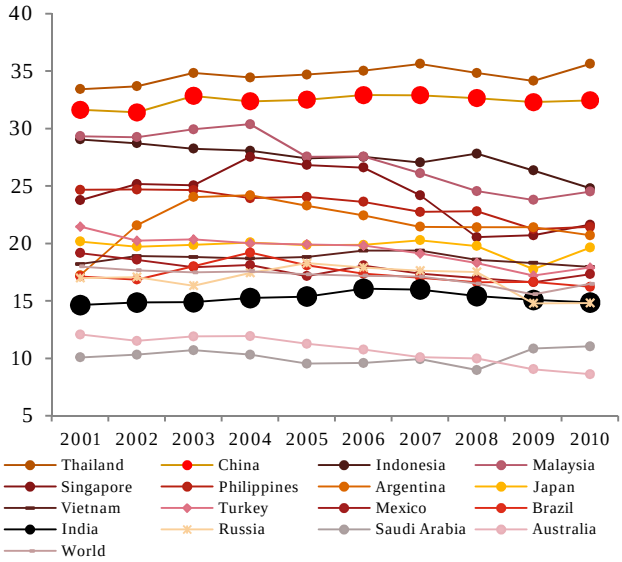
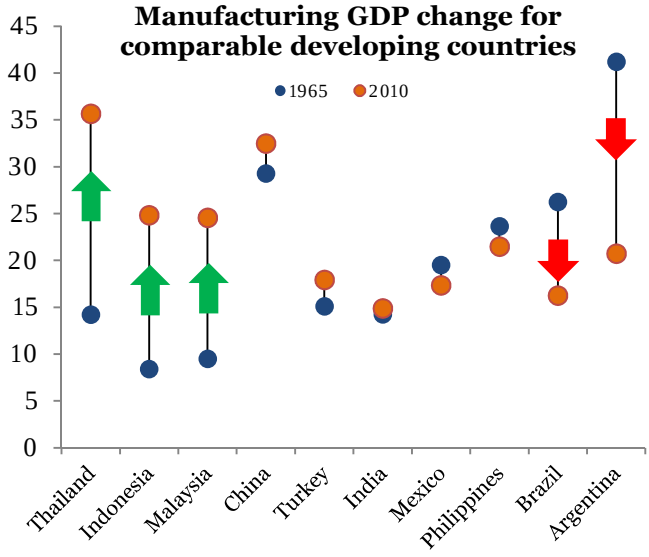


Figure 4.1.3: Trend in manufacturing contribution in past 10 years



GDFigure 4.1.2: Change in Manufacturing GDP contribution in past 45 years

Looking back at the trend of these fast growing economies in the past 10 years (refer figure 3[5]), it seems that these countries inherently had strong manufacturing presence. There hasn't been any significant improvement

[4]Planning Commission Data Tables
[5]World Bank Statistics

in manufacturing contribution in any of the economies. However, tracing back performances to the past 45 years, the change is apparent (refer figure 2[6]). Economies like Thailand, Indonesia and Malaysia have increased their manufacturing GDP contribution by 15-21% in the past 45 years. It may be one thing to say that India can also shift towards higher manufacturing contribution; but the challenge is achieving that in much shorter time frame as compared to 45 years. The challenge is much more, when the services sector itself is growing at a very fast pace. Achieving this would require a completely different strategy moving out of the business as usual.

4.1.2 *Manufacturing Sector contribution to Employment, GDP and Exports*

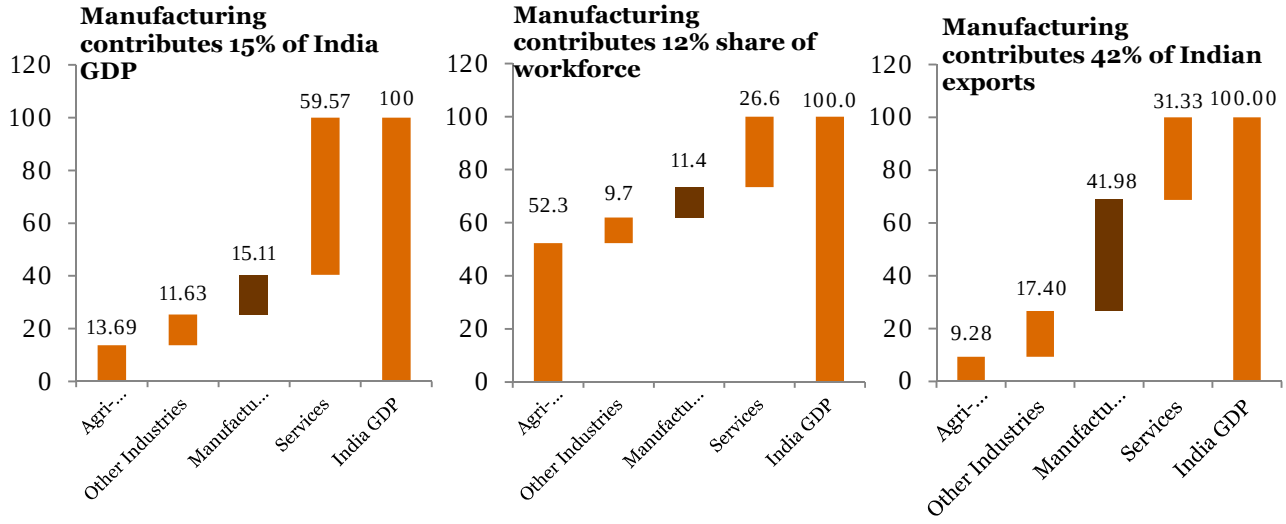


Figure4.1.4: Manufacturing sector's contribution to the economy

Manufacturing sector plays a key role in the Indian economy. With a current contribution of only around 15% of India's GDP, the sector commands 42% share of Indian exports. Additionally, manufacturing contributes to 12% share of Indian workforce[7]. Increase in Manufacturing GDP contribution is certainly going to drive up creation of fresh jobs.

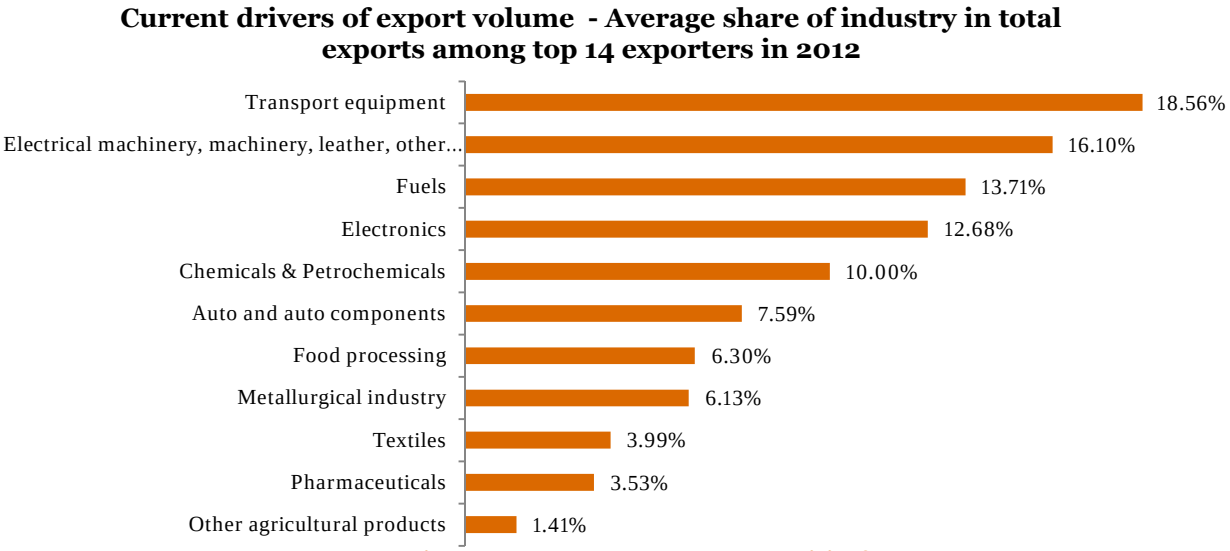


Figure4.1.5: Key export commodities[8]

[6]*World Bank Statistics*
[7]*Planning commission data tables, Crisil research, CARE ratings*
[8]*UNCTAD, World Trade Organization*

However, when looked at the international map, manufacturing segments still show a lot of potential in tapping exports. Currently, though India features among top exporters, its export share in the top traded manufacturing commodities is least. Going forward strategic focus in manufacturing product trade can provide further boost to Indian economy.

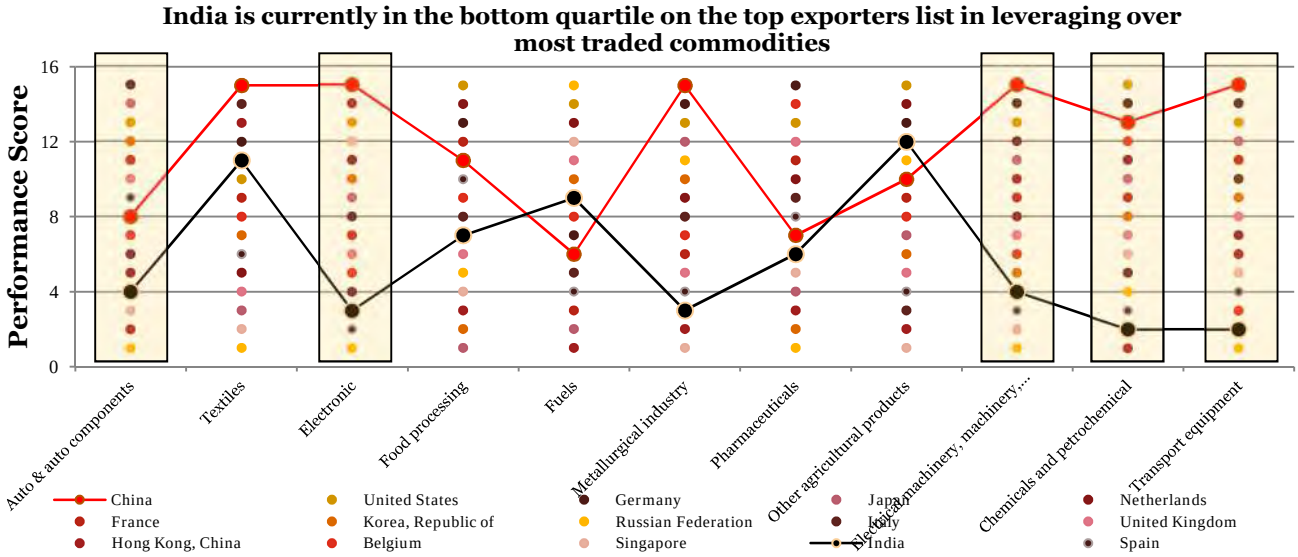


Figure4.1.6: Country wise trade performance scores for key sectors

4.1.3 *Challenges to Manufacturing in India*

The ease of doing business index ranks economies (on 10 parameters) from 1 to 189. India was ranked 134th in 2013. India has dropped from the 131st spot from 2012. Infrastructure development is critical to the achievement of national manufacturing vision. Driving the manufacturing sector and creating opportunities for further investments can be challenging. A recent report says that a majority of the India's largest manufacturers don't return their cost of capital, a factor that dampens investment in the sector.

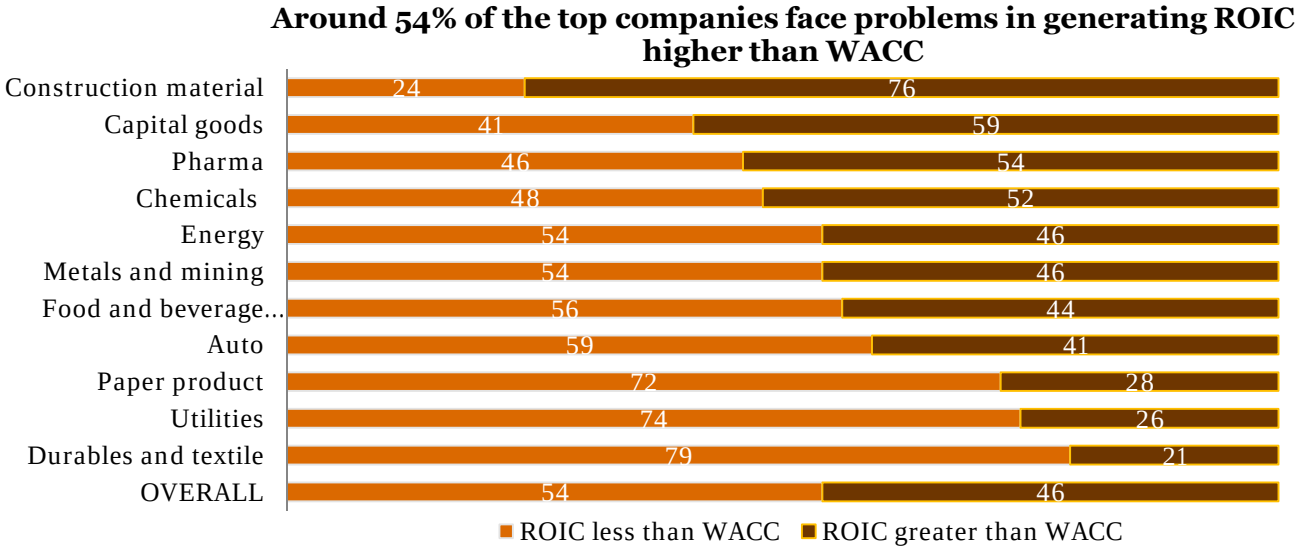


Figure4.1.7: Relationship between Return on Invested Capital (ROIC) and Weighted Average Cost of Capital (WACC) across major sectors in India

Improving productivity through greater focus on technology, plugging infrastructure and logistics gaps and more so in a sustainable manner, creating suitable policies to help companies optimise conversion costs would be some of the key areas where significant efforts will be required.

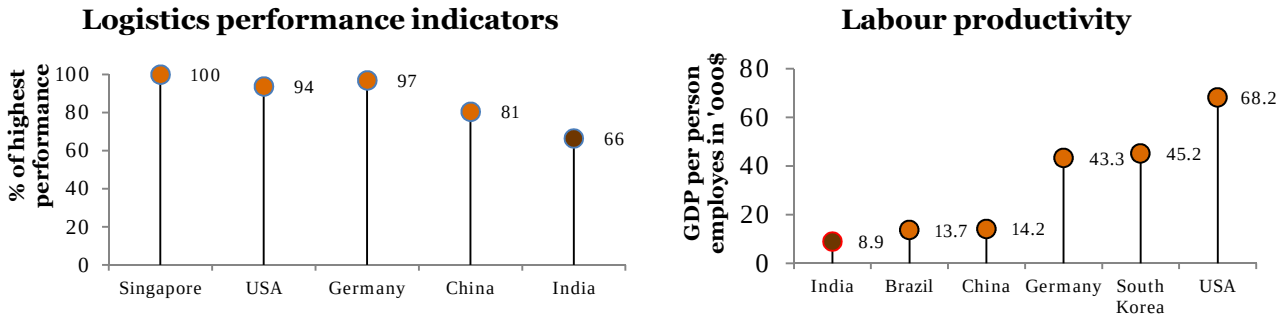


Figure4.1.8: Logistics performance and labour productivity benchmarks – India vs. Other competing nations

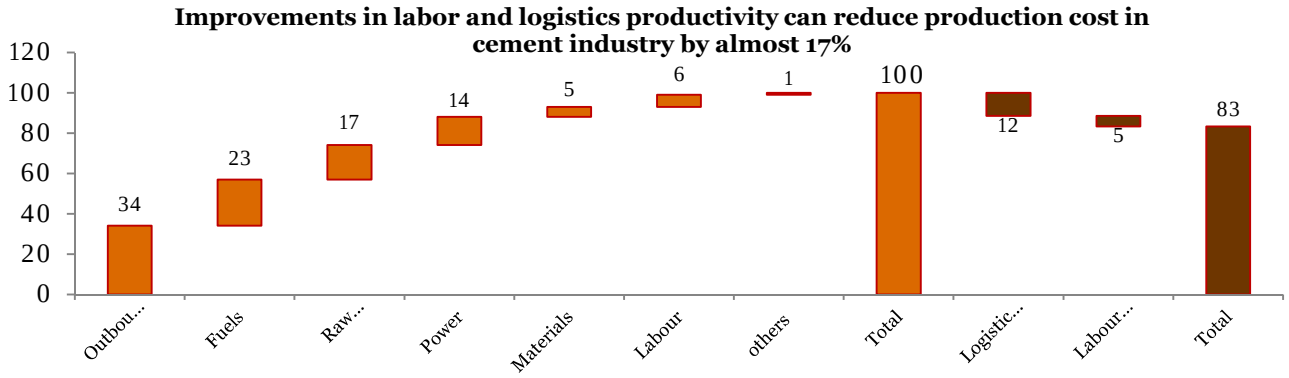
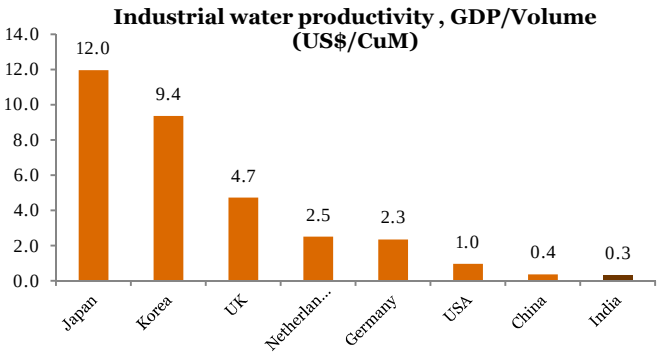


Figure4.1.9: Relationship of labour and logistics productivity to production costs



Further, technology and incentives for elements like water, which is key for most of the manufacturing industry is necessary. Currently, water scarcity may be a key issue in CBIC region along many districts. It is currently estimated that for every 1 litre of waste-water discharged in India, 5-6 litres of usable water gets polluted[9]. But if, we can improve our productivity to that of US, we can support 35 times the output with the available water. Incentives to recycle and reuse industrial waste water are essential.

Figure4.1.10: Industrial water productivity – India vs. Other competing nations

[9] *http://www.idfc.com/pdf/report/2011/Chp-18-Industrial-Water-Demand-in-India-Challenges.pdf*

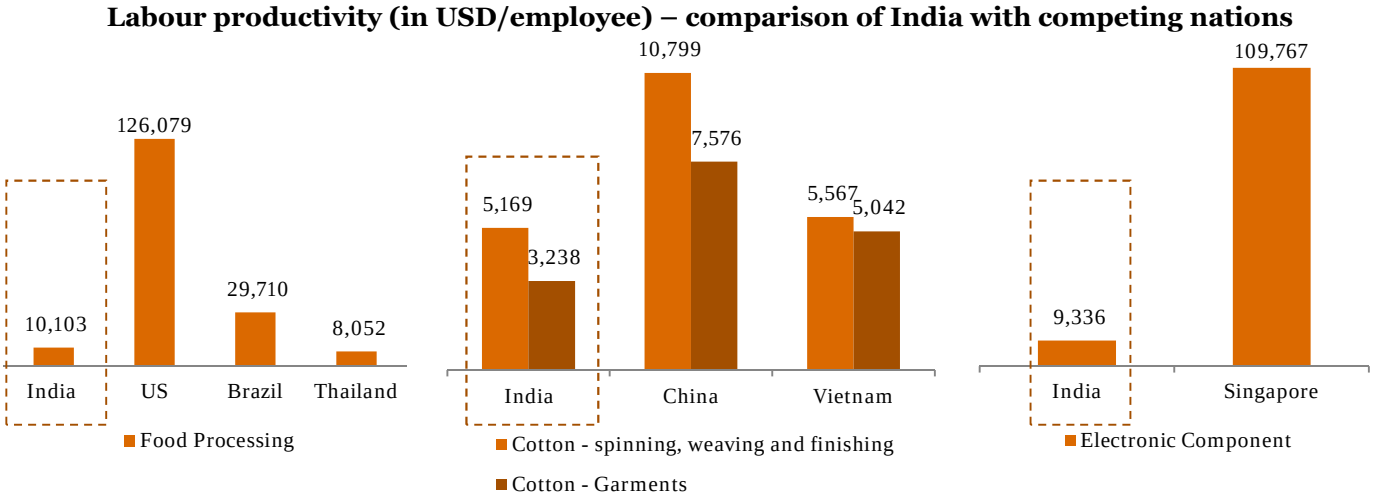


Figure4.1.11: Labour productivity benchmarks – India vs. Other competing nations

Source: Department of Scientific and Industrial Research

Raw material & inputs expenses need to be tightened to make India's cost structure competitive as compared to competing countries. This can be done by rationalising the policies for procurement of technology, raw materials, utilities and distribution costs. Further, arrangements need to be made for assured supply of raw materials and necessary resources over a long term.

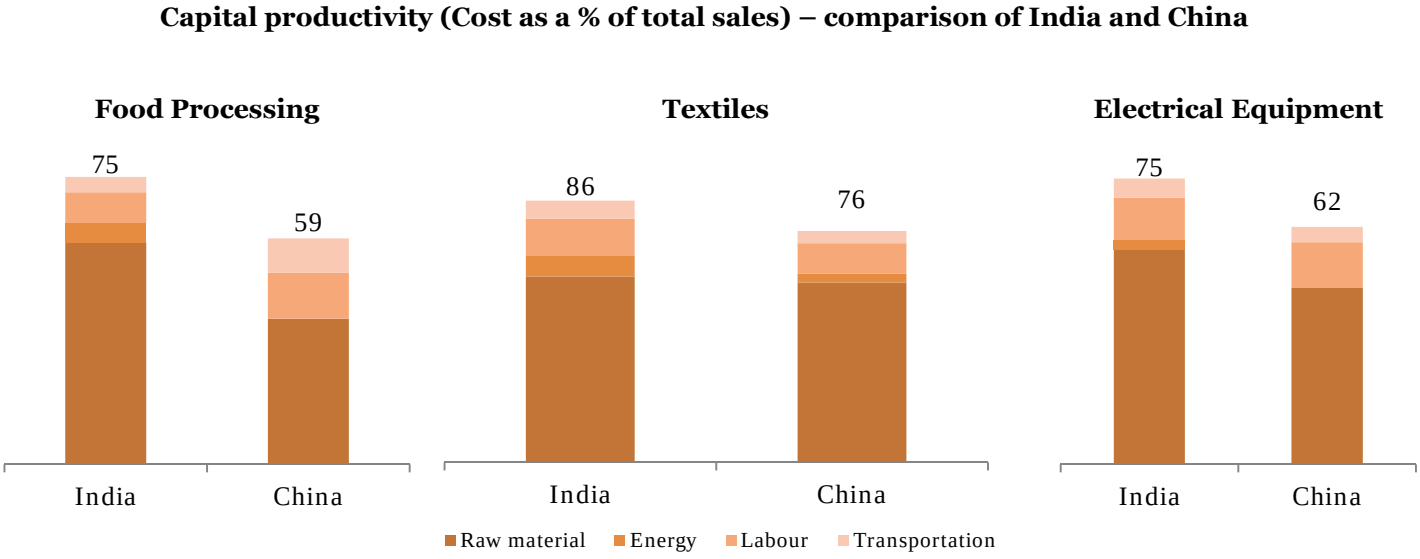


Figure4.1.12: Capital productivity (cost as a % of total sales) – India vs. China

Source: Department of Scientific and Industrial Research

In comparison to competing nations, India scores low on labour productivity across various sectors. For a few sectors, labour productivity in India is lesser by ten times when compared to other countries. In order to bridge the gap it would be essential to take steps to improve productivity by taking steps like promoting skill development programmes, form better institutional arrangements of labour unions, rationalise employment laws etc. Thrust on infrastructure development, creating the right investment enabling environment and focussing on global competitiveness will hold the key for India to become a major manufacturing hub.

4.2 India's manufacturing sector – the accelerated growth plan

4.2.1 Vision, strategy and framework

The Government of India's vision is to ensure India emerges as a preferred manufacturing destination for investors, and create employment opportunities for a large set of people within India and thereby proper the economy of the country. To achieve this, Government of India came up with the National Manufacturing Policy in 2011 with the following vision:

Figure4.2.1: India's vision for the manufacturing sector – National Manufacturing Policy

The IMF's global competitiveness report gives 25% weightage to quality of infrastructure. In order to promote the growth of manufacturing sector in India and meet the objectives of the National Manufacturing Policy several initiatives have been taken by Government of India. Infrastructure development is one of the top agenda items. Government has put impetus on developing large investments and manufacturing zones, sector specific investment regions and industrial corridors across India. Delhi Mumbai Industrial Corridor and Chennai Mumbai Industrial Corridor are amongst the most ambitious projects announced by India under these initiatives.

4.2.2 CBIC development– integral to growth aspiration

Chennai Bengaluru Industrial Corridor will be one of the key drivers for economic growth in India and will be a strong contributor to the economic growth of South India as well. Presently the area under the corridor assumes one of the prime positions on development landscape and as one of the key contributors to the economies of South India in specific and India in general.

Geographically, it is strategically planned between **two major South Indian cities, Bengaluru and Chennai**. Chennai is a key financial centre in South India, with strong presence of major Indian financial institutions and foreign banks. It is also a renowned auto production hub and is named **"The Detroit of India".** Bengaluru is the **4th largest technological cluster** in the world after Silicon Valley, Boston and London. About 50% of MNC R&D centres in India are based in Bengaluru. With **two international airports** (Chennai and Bengaluru) and **two major sea ports** (Chennai and Ennore), CBIC can further capitalize on the strength of Chennai and Bengaluru.

- ***Chennai accounts for ~60% of India's automotive export***
- About **50%** of the world's SEI CMM Level 5 certified companies are located in Bengaluru
- **Chitradurga** is the **4th largest producer of wind energy** and has one of the high wind sites in the country with over 20,000 windturbines.

Figure4.2.2: Map of CBIC region

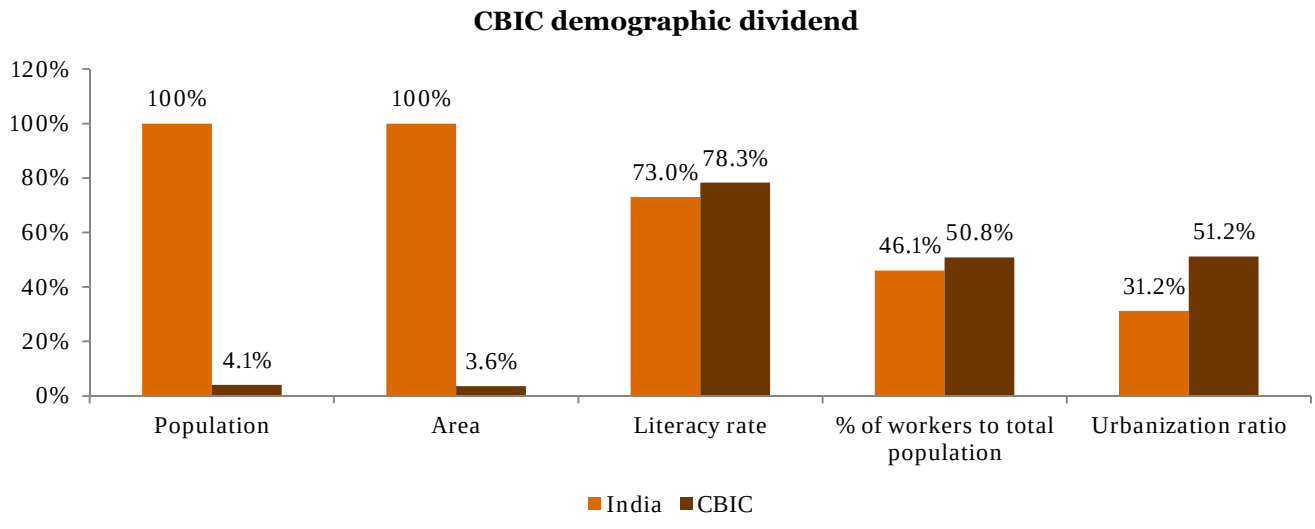


Figure4.2.3: Demographic dividend of the corridor

The area under CBIC covers 3.6% of India's total territory and is home to 4.1% of country's total population[10]. It is a highly urbanized area with urbanization levels 1.5 times higher than the national average. The districts

[10]*Source: Census 2011*

selected for the corridor are above the national average in terms of literacy rates as well as percentage of workers to total population.

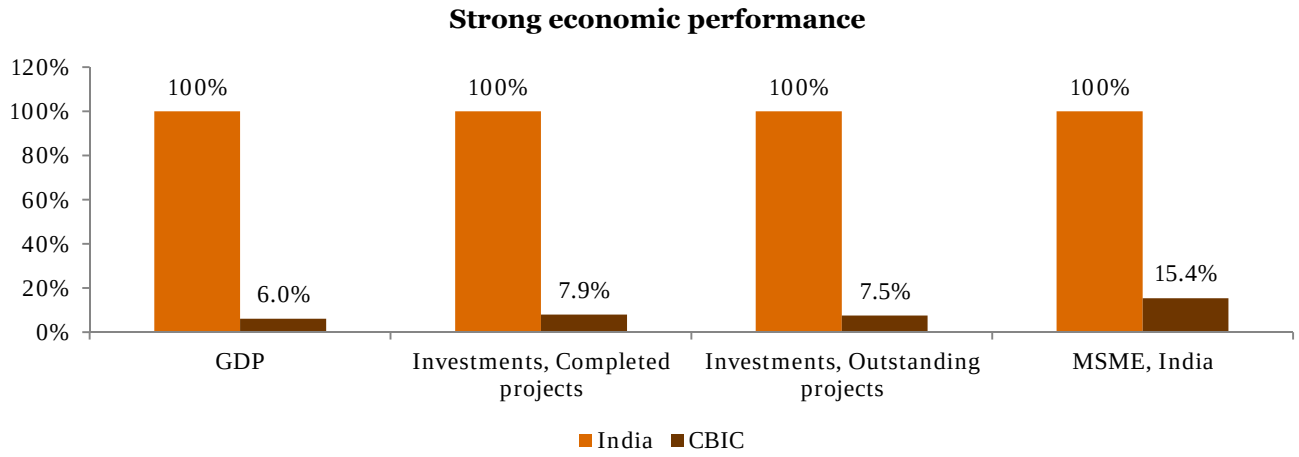


Figure4.2.4: Economic performance of the corridor

- Kancheepuram is the traditional centre of **silk weaving and handloom industries** of India
- Vellore District has a dominant presence in the **leather and leather based industries** and accounts ~ 37% of the country's export of Leather products.
- Around 400 of the Fortune Global 500 companies outsource their IT services to firms in Bengaluru

Districts under CBIC are strong economic performers; their overall contribution to GDP is 6%[11]. 7.9% of total investments (completed projects) in the country for the past decade are landed in these districts and another 7.5% of upcoming projects are planned and being implemented in the CBIC region.

CBIC region has the largest MSME base in India and is a host to 15.4% of country's total MSME units[12].

Automobiles, Information technology, Chemical and Petrochemical, Machinery and Electronics are the top 5 sectors that contribute to around three-fourth of total investment in the corridor.

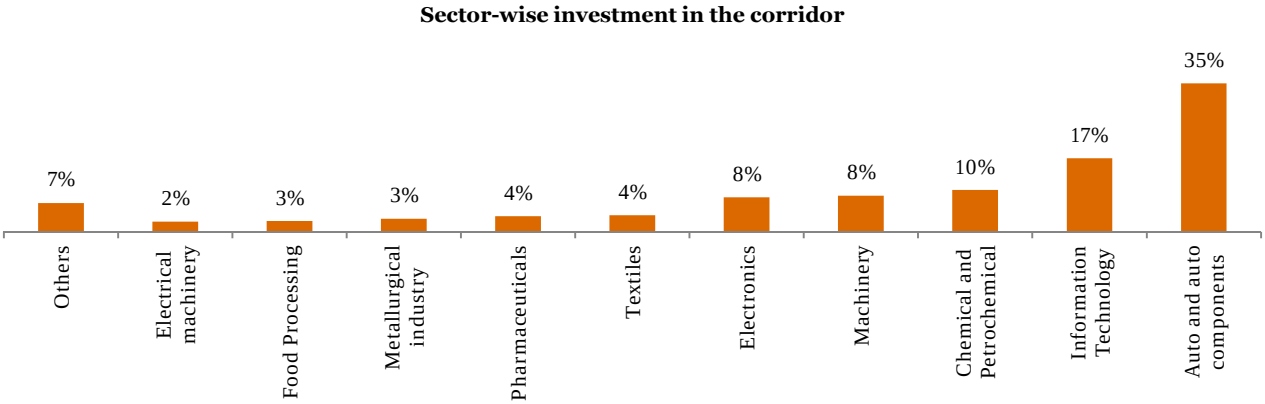


Figure4.2.5: Sector-wise investments in the corridor

Source: CMIE CapEx database

[11]*Source: Socio-Economic Review, GOI*
[12]*Source:Entrepreneurs Manual (Part - II), DCMSME*

*With **4.1%** population and **3.6%** of land mass, CBIC region contributes to **6%** to the national GDP and hosts **15.4%** of country's MSMEs.*

4.2.3 *Drivers of industrial growth in CBIC*

An in depth analysis for identifying potential industries for the corridor was undertaken as a part of Interim Report I. The parameters used for the analysis is as indicated in the figure below.

Global industrial analysis	Policy level analysis	National and state industrial analysis	Corridor level industrial analysis	Upcoming industry sub-segments analysis
• Global trade analysis (analysis of commodities) • Cross border transactions • Foreign Direct Investment	• National level manufacturing policy • FDI Policy • Foreign trade policy • State level industrial policies	• Investment– completed and upcoming • Performance of the sector (Contribution to GDP and project growth) • FDI analysis • IEM analysis • Trade performance (Export and Import) • State's contribution to national output	• Analysis of industries in the corridor • MSME's in the corridor • Key companies in the region	• Projected growth rate globally till 2020 • Projected growth rate in India till 2020 • Size of the sector globally and in India

Figure4.2.6: parameters used for short-listing of potential sector in the corridor

As per the analysis undertaken, the following sectors are the key drivers of industrial growth in the CBIC region:

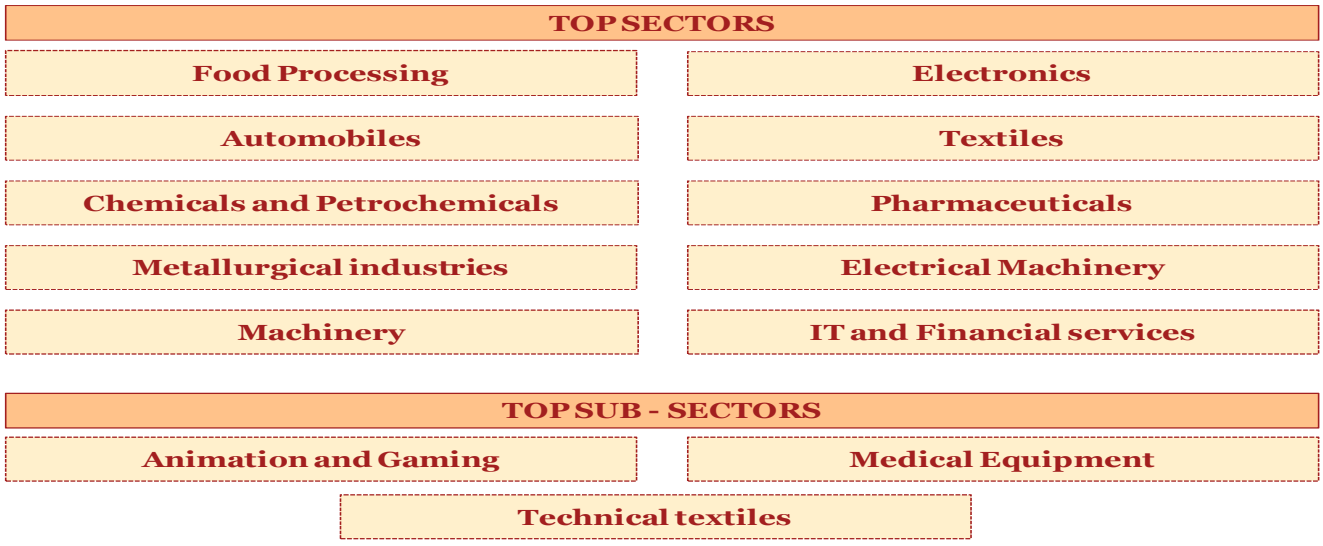
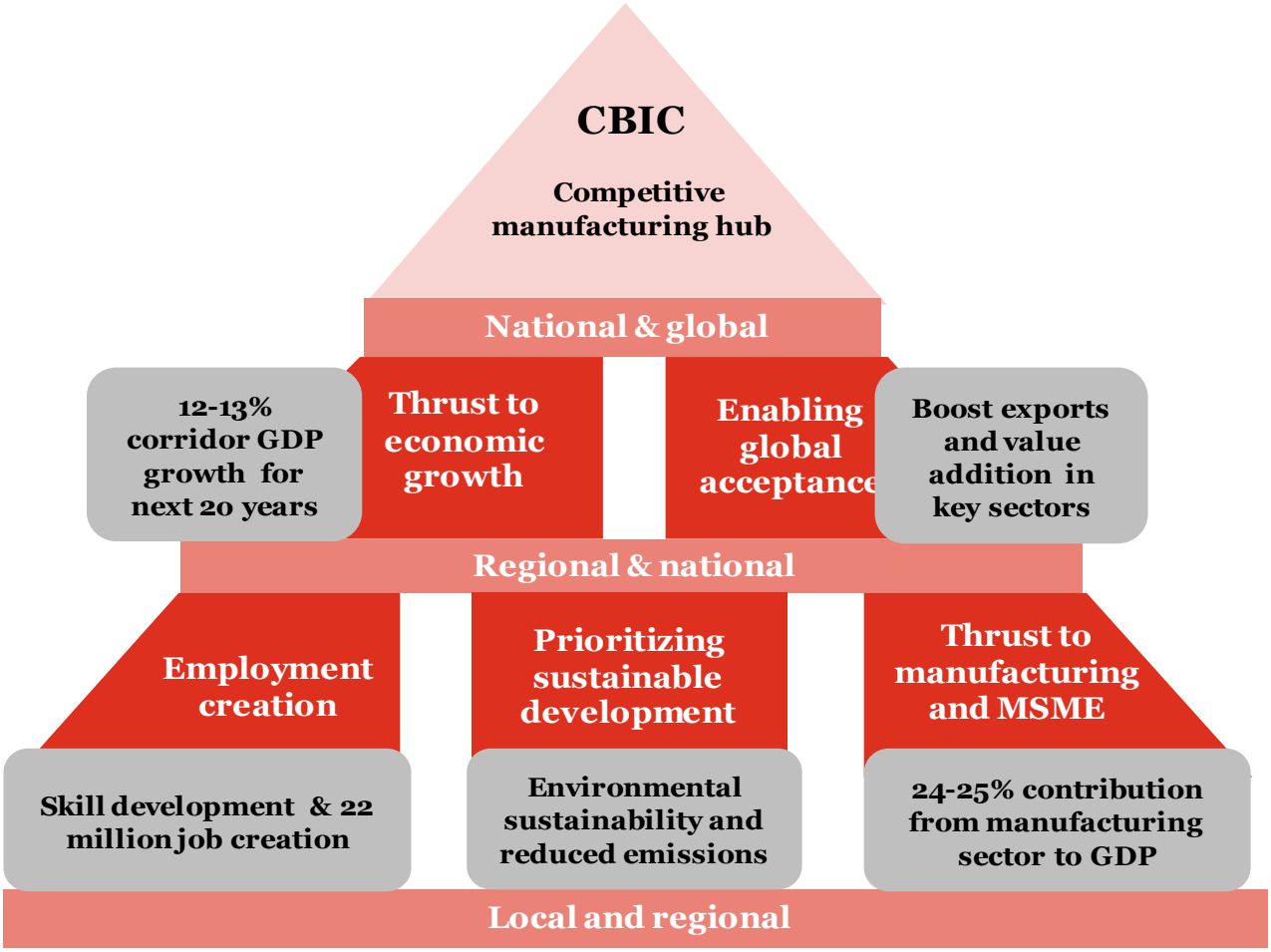


Figure4.2.7: Sectors shortlisted as potential sectors for the corridor

4.3 Corridor's vision, strategy and framework

The long term vision of the corridor is to develop itself as ***"a globally competitive manufacturing hub that can make sustainable economic and environmental impact locally".*** The vision is articulated across five principle strategies:

Figure4.3.1: Strategic framework for CBIC



- ✓ *Repositioning manufacturing in the region*: While, tertiary sector has given substantial thrust to corridor economy in the past; going forward manufacturing will further add to this thrust. The manufacturing contribution in the corridor will contribute 24-25% of corridor GDP by 2033-34.

- ✓ *Enabling global acceptance:* The manufacturing industries in the corridor will be driven by high standards that gain preference in international markets. In addition to reducing imports and catering to domestic demand, the industries will also drive up export from the region.

- ✓ *Activating higher value:* The manufacturing industries will integrate further into hi-tech and down-stream products that will create higher value add per unit produced and shall drive up GDP. The corridor GDP growth will move up from 8-9% as seen during past 9 years to an average of 12-13% during the next 20 years.

- ✓ *Suiting, creating and engaging local skills:* The economic progression will create a sustainable impact on local communities creating and engaging an employable workforce with high skill levels. The corridor will progressively create 22 million additional jobs in next 20 years.

- ✓ *Prioritising environment:* The corridor will take into account environmental responsibility with focus on green processes and products aimed at reducing carbon emissions in the region.

However, for the corridor to give effect to the above strategy, a comprehensive development framework for the corridor is required. The following development framework comprising three elements – Economic enhancers, administrative enhancers and value enhancer attempts at creating the roadmap for affecting the strategies.

- *Economic enhancers* refer to the interventions required in terms of support infrastructure to industries to operate efficiently.

- *Administrative enhancers* refer to the soft policy interventions that can enhance competitiveness and ease of operation of industries

- *Value enhancers* refer to interventions that can directly or indirectly impact the operation of the industries to higher efficiency and improved value delivery.

4.3.1 *Objectives of the corridor*

The corridor's vision is supported by six key objectives. In order to achieve the vision, it would be essential to focus on achieving these objectives. Across each of the objectives, we have shortlisted the top sectors that should be the key focus areas to meet the objectives and achieve the corridor's vision in the next 20 years.

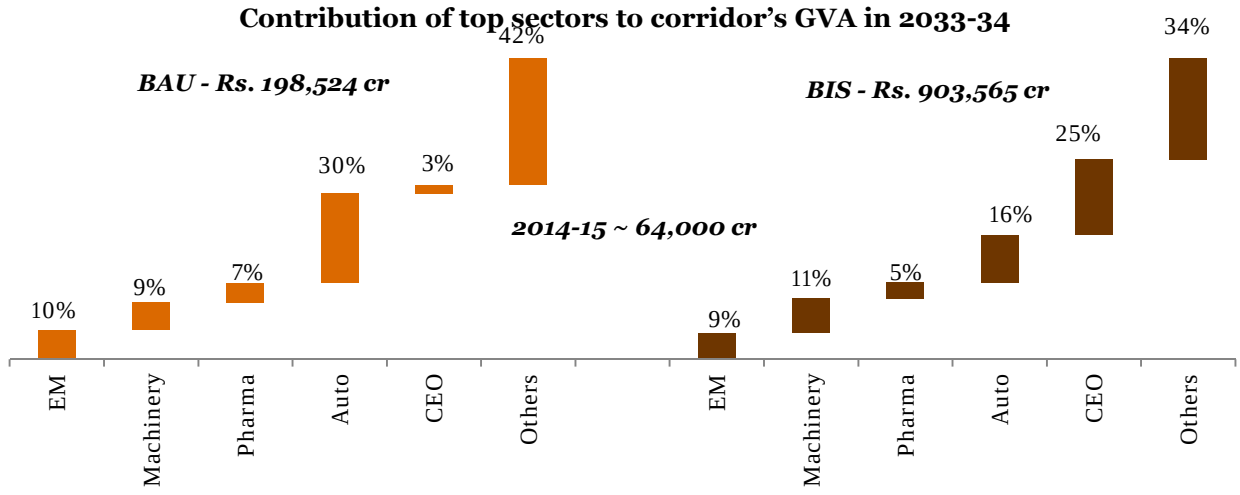
The focus sector across each of the objectives is as shown in the table below.

Table 4.3.1: Focus sectors across corridor's objectives

Sectors	*Thrust to manufacturing in the region*	*Employment creation*	Thrust to MSME	*Activating higher value addition in key industries*	*Prioritising environment*	*Enabling global acceptance*
Food Processing		√	√		√	√
Textiles & Apparels		√	√	√		√
Machinery & Electrical Machinery	√	√	√	√		
Pharmaceuticals	√		√	√	√	√
Automobiles	√	√	√	√		√
Computer, electronics & optical (CEO)	√	√				√

4.3.2 *Thrust to manufacturing GDP*

To ensure improved contribution of the manufacturing GDP it would be essential to focus on sectors that are large in size. Machinery, Electrical Machinery, Pharmaceuticals, Automobiles and Computer, Electronics and Optical products would be key to driving GDP. These sectors together contribute to over 50% of the corridor's GVA. In addition to these sectors, amongst the services sector Information Technology and Financial Services sector would also play a key role in driving the industrial output from the corridor.

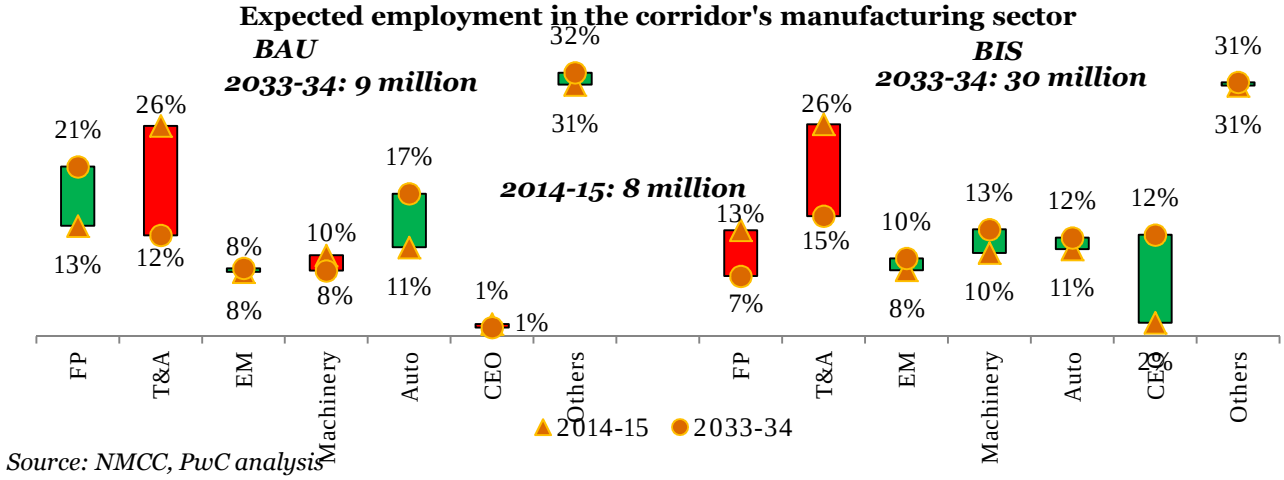


Source: ASI, PwC analysis

Figure4.3.2: Contribution of top Sector's to corridor's Gross Value Added

4.3.3 *Employment Creation*

In terms of employment, Food processing, Textiles and Apparels, Electrical Machinery, Machinery, Automobiles and CEO sector are expected to generate around 70% of the employment. Proposed interventions in these sectors will help in increasing job creation from 4 million under business as usual to 22 million under BIS. In addition to this, IT sector is expected to generate an additional employment of around 10 million by 2033-34 in the corridor districts.



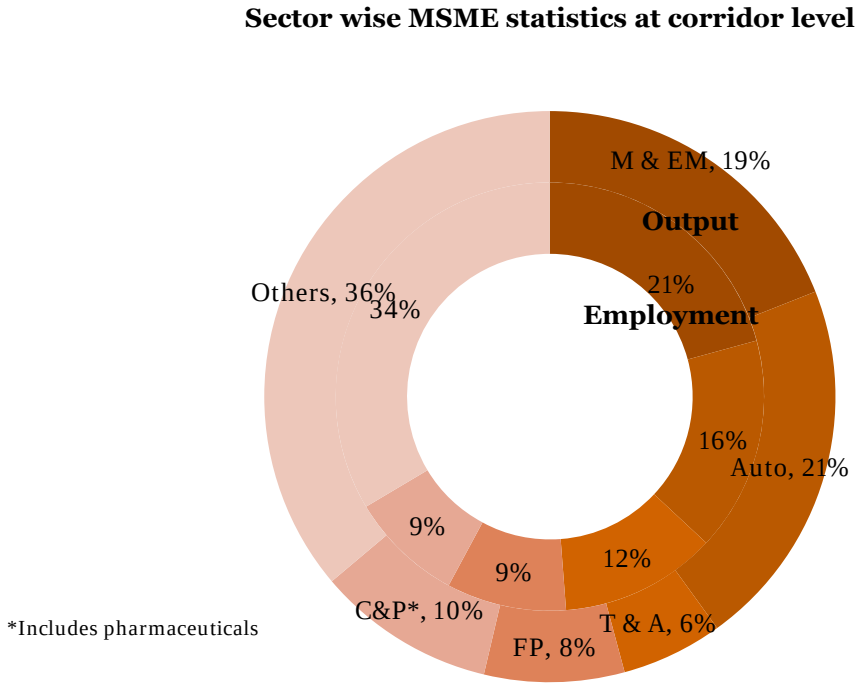
Source: NMCC, PwC analysis

Bars in green represent increase in % contribution to corridor's employment - 2013-14 vs. 2033-34

Figure4.3.3: Expected employment in corridor's manufacturing sector in 2033-34

4.3.4 *Thrust to MSME*

Machinery, Electrical Machinery, Automobiles, Textiles and Apparels, Food Processing, Chemical & Petrochemical and Pharmaceuticals are likely to play a key role in developing the MSME output. These sectors together contribute to around 65% of the employment in the corridor in the MSME sector. For MSMEs to flourish in the corridor it would be essential to focus on these sectors and take steps to overcome the challenges faced by enterprises across all sectors.



Source: Final Report, Fourth All Inida Census of Micro, Small and Medium Enterprises, Ministry of MSMEs, GoI, PwC analysis

Figure4.3.4: Contribution of major sectors to employment in the MSME sector

4.3.5 *Achieving higher value addition in key industries*

Automobiles, Pharmaceuticals, Machinery, Electrical Machinery, Textiles and Apparels and Medical Equipment are among the highest value addition sectors. Amongst these, Pharmaceuticals and Electrical Machinery are expected to be the key drivers of value addition. Technical textiles and apparels are the segments that are expected to drive value addition in Textiles and Apparels sector. In addition to these sectors, Medical Equipment which is a sunrise sector in India is expected to be high on value addition and will be majorly driven by product innovation in India.

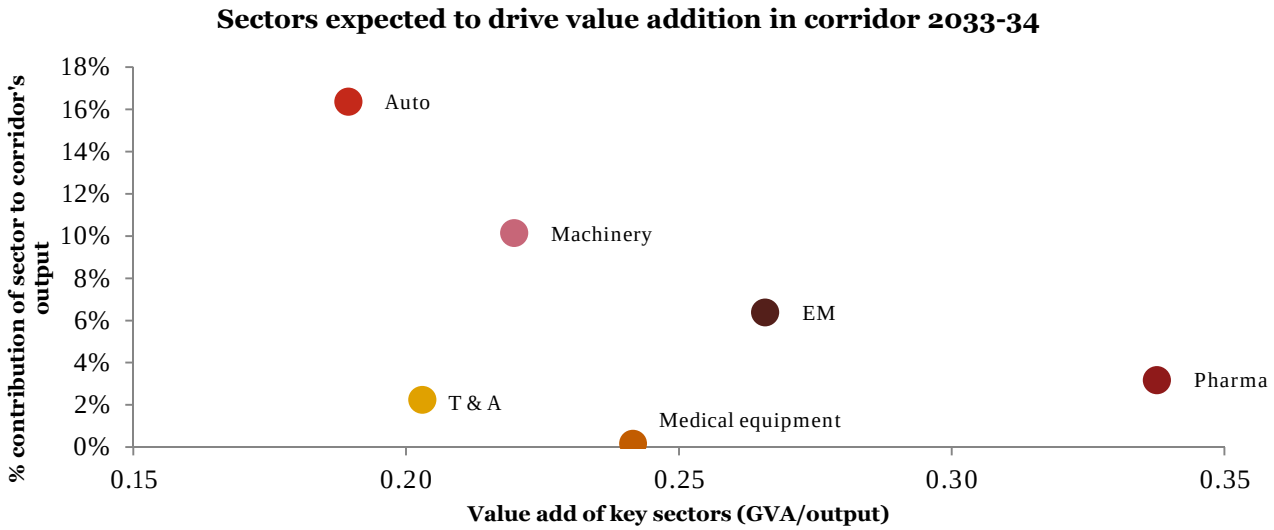
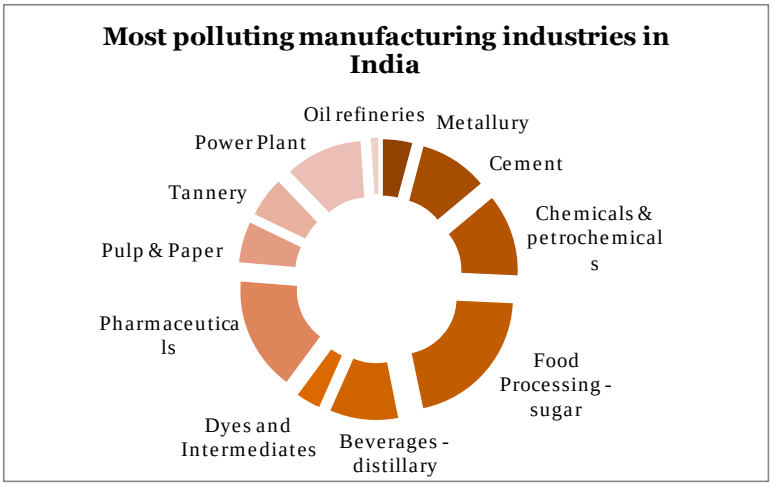


Figure4.3.5: Focus sectors to increase corridor's value addition in the manufacturing sector

4.3.6 *Prioritising sustainable development*

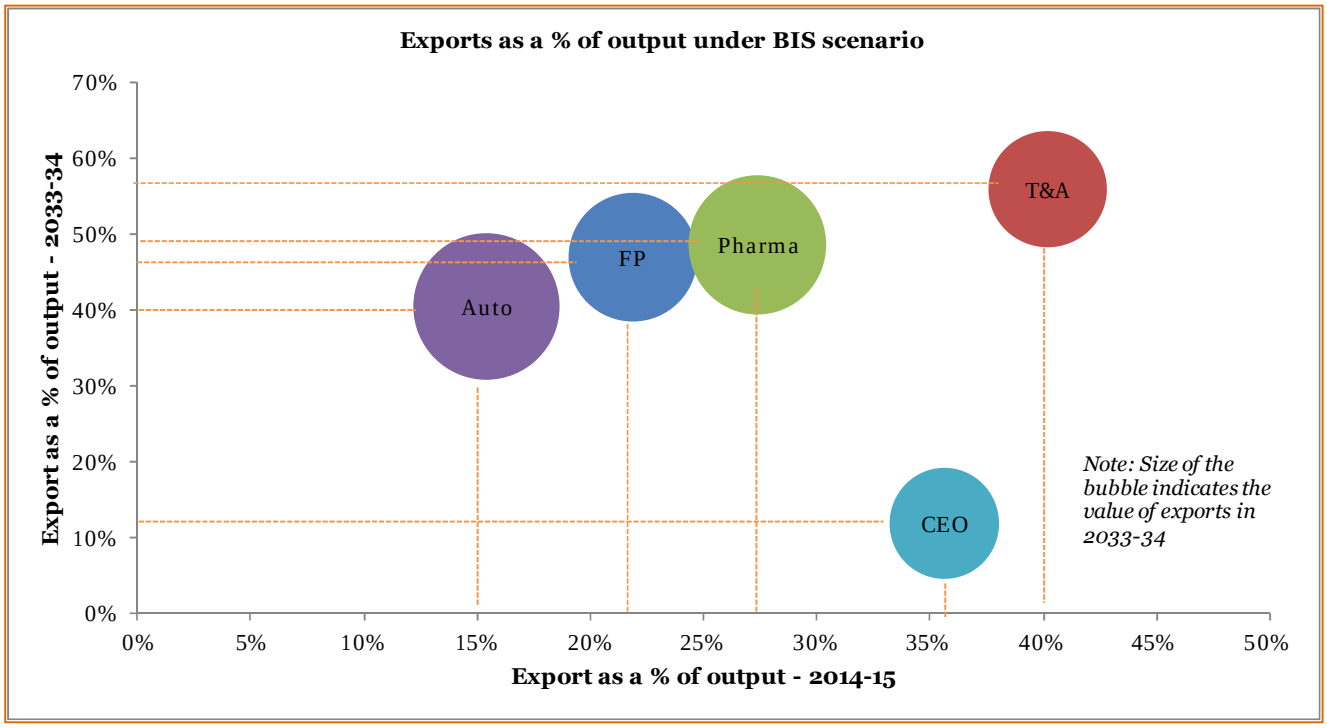
The corridor will focus on promoting sustainable industrial development by focussing on efficient use of resources like Power, Water, and Land. Also, the corridor will promote green mobility through auto sector investments in electric vehicles and green energy through renewable energy sector investments. The process of industrial growth plays a vital role in economic development, but any industrial growth appears to correspond with environmental deterioration. The cost of environmental damage has been estimated to be to the tune of 5% of GDP in India, approximately USD 32 billion. The Central Pollution Control Board has identified 17 highly polluting industries, the majority of which are manufacturing industries. The food processing, pharmaceuticals, chemical & petrochemical, metallurgy are identified as highly polluting sectors. These sectors are also going to drive investmens within the corridor. Secondly, while MSMEs contribute to over 40% to industrial production, they account for substantial pollution i.e. 70% of the total industrial pollution load of India. Regulatory mechanisms to ensure compliance are ill-suited towards MSMEs, as they are tailored more towards larger industries, creating a scenario where MSMEs are unable to comply with regulations. Such approach will have to be avoided. The key strategies identified to ensure sustainability are:



- Incentivising scrap consolidation and recycling to reduce natural resource exploitation
- Incentivise products that are energy efficient and low on emissions
- Incentivise use of energy efficient machinery through subsidies
- Identify ways to prevent pollution at source through setting up of treatment plants. etc
- Improve efficient utilization of resources through productivity optimization projects, etc

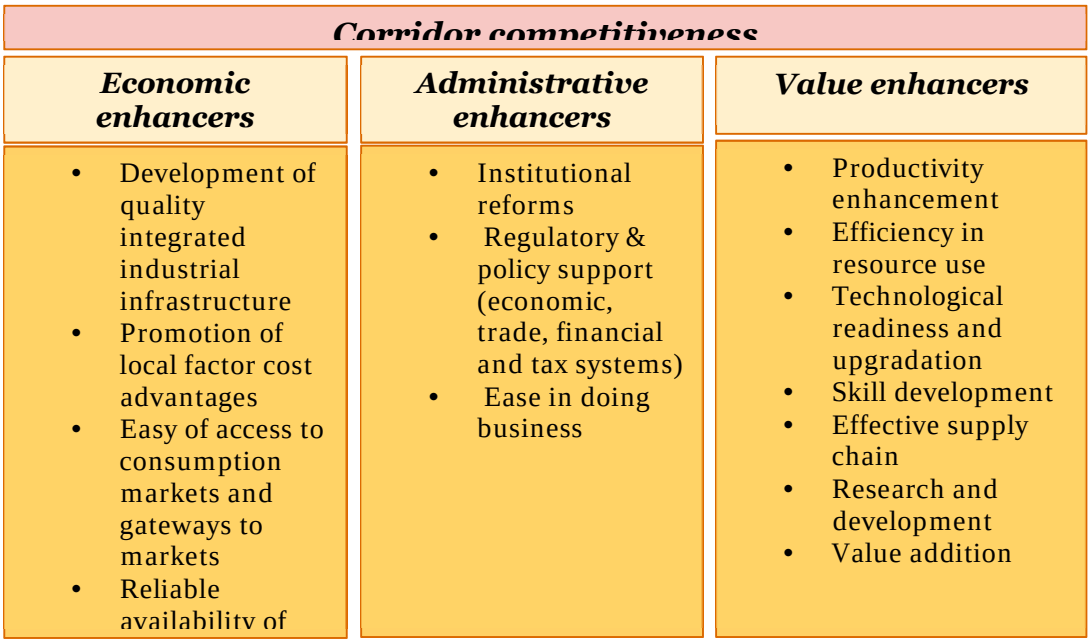
4.3.7 *Exports*

Automobiles, Textiles & Apparels, Computer, electronic and Optical products (CEO), Pharmaceuticals and Food processing sectors are likely to drive exports in the corridor. Under the BAU scenario we have assumed that the percentage of exports to output for all sectors would remain the same in 2014-15 and 2033-34. Under BIS case, we have computed the percentage based on historic performance. However, the increase in percentage of exports to output in 2033-34 has been capped to 25%.



4.3.8 *Corridor competitiveness*

Having identified the strategy to achieve the desired objectives of the vision, it is now important to understand what interventions shall be necessary to enable the sectors to move to a higher trajectory. In this context, a development framework comprising three elements – Economic enhancers, administrative enhancers and value enhancer has been created that attempts at improving the corridor competitiveness across individual sectors



4.3.8.1 Economic enhancers

Quality infrastructure plays a key role in the development of the economy. CBIC region is regarded as a promising investment destination. However, discussion with Japanese companies has highlighted the infrastructure bottlenecks in the region. Some of them are as listed below.

- Ports – The key ports in the region include Chennai, Ennore and Krishnapatnam port. The challenges in these ports include large operational issues, inefficient safety measures and high cost of usage. It would be essential for the government and private players to take necessary steps to improve the competitiveness of the ports in the region.
- Road – At various stretches in the CBIC region there are multiple issues like traffic congestion in areas around the Chennai and Ennore Port and absence of last mile connectivity for industrial parks. Because of this it is difficult for companies to calculate the lead time for their goods. In order to resolve these issues it would be essential for the government to frame a comprehensive road plan considering the estimated future industrial development in the corridor
- Power – The region experiences a chronic shortage of power which impedes the production plans of industries operating in the region. Hence, to solve this it would be essential for the government to frame a comprehensive electricity supply and demand plan
- Railways – The current management of the railway transport is unreliable. There have been cases of damage due to bad management and the lead time cannot be estimated accurately due to frequent delays. Freight railway would be an effective transportation means provided the management and reliability is improved.
- Current linkage of Agri products with the consumption markets needs to be enhanced
- Industrial Estates – State of the Art infrastructure needed for key industrial estates

4.3.8.2 Administrative enhancers

For the corridor to be a hub for industrial development and economic prosperity, it would be essential to have a strong policy framework. Currently, companies operating in the region are facing several policy level issues (based on stakeholder consultations). Some of them are as listed below:

- Due to lack of organised and integrated regulations and guidelines, there is a frequent revision in the rules and guidelines at the port and airports.
- Frequent change in the rules of taxation at the port and airport
- Lengthy and time consuming process for companies to set their manufacturing facility

Specific policy instruments have to be conceptualized to achieve the objectives which are aligned with the CBIC Vision. The instruments should include, but not limited t0, regulations for improving ease of business, mechanisms for development of technology, skill up gradation, initiatives to develop clusters, physical and social infrastructure and methods to synchronize trade and investment policies with manufacturing policies pertinent to the Corridor. The policies and programmes for implementation should aim to increase the competitiveness of industries in the Corridor.

4.3.8.2.1 Ease of business

Government regulations and practices ease or constrain business activity. *Doing Business in India* compares business regulations across 17 Indian cities. A low ranking means that the government has created a regulatory environment conducive to operating a business[13]. The index takes into account local regulations that affect 7 stages in the life of a small or medium-size domestic enterprise: starting a business, dealing with construction permits, registering property, paying taxes, trading across borders, enforcing contracts, and closing a business.

Table 4.3.2: Business regulations in India - Ranking of Indian cities

Rank	City, *State*	Rank	City, *State*
1	Ludhiana, Punjab (easiest)	10	Mumbai, Maharashtra
2	**Hyderabad, Andhra Pradesh**	11	Indore, Madhya Pradesh
3	Bhubaneshwar, Orissa	12	Noida, Uttar Pradesh
4	Gurgaon, Haryana	**13**	**Bengaluru, Karnataka**
5	Ahmedabad, Gujarat	14	Patna, Bihar
6	New Delhi, Delhi	**15**	**Chennai, Tamil Nadu**
7	Jaipur, Rajasthan	16	Kochi, Kerala
8	Guwahati, Assam	17	Kolkata, West Bengal
9	Ranchi, Jharkhand		

Source: Doing Business database

While all cities in India have a similar legal and institutional framework, local regulations and the implementation of national laws vary. And these variations across India in the regulatory ease of doing business show the potential for regions to learn from one another.

The states in the CBIC region are performing well on parameters such as dealing with construction permits, resolving insolvency trade across borders; however they lag behind on parameters such as ease of starting a business, registering property, paying taxes, enforcing contracts etc.

13 *The Hindu*

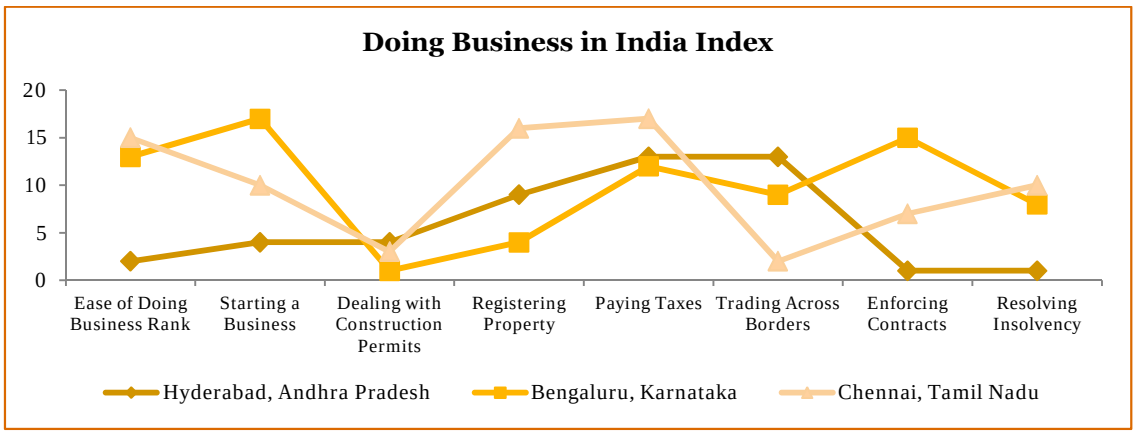


Figure4.3.6: Doing Business in India - Index

Since regulatory reforms can help businesses operate efficiently in the formal sector. "Reforms that cut red tape, clarify property rights, and streamline regulatory compliance can yield big payoffs for firms and workers" (the World Bank). There is a need to focus on reforming procedural and regulatory formalities in the CBIC region to reduce compliance burden on industries.

4.3.8.3 Value enhancers

To attract investments in the corridor it would be essential to ensure improved performance of sectors operating in the region. This would be possible by addressing the challenges of the key sectors. Productivity of companies across majority of the sectors needs to be improved. For example, the labour productivity of Food processing and electronic components is 10 times lesser than competing nations. Capital productivity of textile and electrical equipment sectors in India is far lower than that of China. The corridor's development strategy should focus on improving the productivity across these sectors as they are critical to corridor's performance. It is important to have a strong indigenous value chain addition element. Many districts within the corridor have water availability challenges and hence, industries within the corridor need to focus on efficient use of water and land by using technology. Necessary steps need to be taken to promote use of latest and efficient technologies to enable growth of the manufacturing sector. It would also be essential to ensure that the technology used is sustainable and supports value addition across sectors. The corridor is a hub for MSMEs and special incentives are required by the MSMEs within the corridor for acquiring technology. A well developed cluster can give a unit located in it a cost advantage of up to ~ 8% on account of:

- Increased supply chain responsiveness,
- Consolidation of suppliers,
- Decreased time-to-market,
- Superior infrastructure and access to talent and
- Lower logistics costs.

Hence, there is a need for coordinated effort by governments and private sector to create clusters in the CBIC region and to stimulate cluster synergies to reap above benefits. To increase the effectiveness of supply chain in the clusters in CBIC, investments need to be made to increase access to raw materials, information and innovations.

4.4 Analysis of CBIC-Key growth drivers

This section represents analysis of key growth drivers for every high potential sector in the CBIC corridor. The approach to the sector selection and identification of the sectors with the highest potential within CBIC has been undertaken in the Interim Report I. This section presents analysis of each selected sector, including growth trends and future outlook at global and national levels. It also deals with identification of growth drivers for each sector and its sub-sectors at the district level.

Analysis of each prospective sector includes listing down the key districts for investment in the corridor and key interventions required and strategy for development of each sector along the CBIC. Each section on individual

sector concludes with identification of the factors to be enabled in the CBIC cluster to ensure success of each selected sector. Below the consultant summarized the past growth trends and possible investment districts for key sectors:

Table 4.4: Summary of key sectors – historical growth rates and key districts for investment

Sector	Output growth India (CAGR)	Key districts for investment in the corridor
Computer, electronics and optical products	15% (2006-11)	Chennai, Kancheepuram, Bengaluru urban, Bengaluru rural
Metallurgy	14% (2004-12)	Chitradurga, Anantapur, Chittoor, Nellore, Tiruvallur, Thiruvannamalai, Kancheepuram, Tumkur, Bengaluru rural
Textiles and Apparel	17% (2006-11)	Tiruvallur, Dharmapuri, Kancheepuram, Bengaluru Rural, Bengaluru Urban, Chitradurga
Food processing	20% (2009-11)	Nellore, Chittoor, Tiruvannamalai, Dharmapuri
Pharmaceuticals	14% (2008-12)	Bengaluru Urban, Bengaluru Rural, Chennai, Kancheepuram, Nellore
Chemical and petrochemicals	11% (2009-13)	Bengaluru Urban, Bengaluru Rural, Ramnagara, Chennai , Tiruvallur
Electrical machinery	23% (2009-11)	Kancheepuram, Chittoor, Chennai, Bengaluru urban, Bengaluru Rural, Krishnagiri, Tiruvallur
Machinery	14% (2009-11)	
IT and financial	8% (2008-12)	Bengaluru Urban, Bengaluru Rural, Chennai

The sub-sections below describe each of identified high potential sectors in detail:

4.4.1 *Computer, Electronic and Optical products (CEO)*

The global electronics industry, which is at USD 1,750 billion, is the largest and fastest growing manufacturing industry in the world[14]. The production of electronics products has continued to shift from developed countries (US, Japan, Europe) to developing countries especially in Asia Pacific region. Component manufacturers moved in the same direction. Asia's contribution to electronics components has increased from 42% to 52%[15] between 2008 and 2011. With 5 out of top 10 countries, Asia dominates the electronics market[16]. The global electronics industry is expected to reach USD 2,400 billion by 2020.

Over the last couple of decades India has been the epicenter of consumer demand fuelled by a phenomenal GDP growth. Electronics market in India grew at a rate of 14% between 2007-08 and 2011-12. While demand increased across all sectors, demand for high technology products, specifically electronic products has registered significant growth and going by current estimates, the demand for electronics in the country is projected to increase from USD 45 billion in 2009 to USD400 billion by 2020[17].

India exports around 17% of its total electronics hardware production. Indian Electronics Hardware exports have shown steady growth rates of 15% (CAGR, between FY 2001 to 2008), yet India remains a net importer with electronics imports. Amongst the segments being exported, Communication and Broadcast Equipment (CBE) is the leading segment having registered a 14% 5-year CAGR. In 2011-12 CBE was predominantly exported to the Middle East countries (28%), African countries (19%), South Asian countries, including Singapore and Hong Kong (15%), EU (13%) and North America (11%). Electronic Components (EC) is the second largest segment contributing to exports that have grown at CAGR of 26%. In 2011-12 electronics components were shipped to EU (33%), North America (16%); South Asian countries, including Singapore and

[14] *Source: www.apit.ap.gov.in*
[15] *Source: World Electronic Industries (www.decision.eu), http://www.custerconsulting.com*
[16] *Source: Human Resource and Skill Requirements in the Electronics and IT Hardware Industry, NSDC*
[17] *Source: Task Force Report*

Hong Kong (16%) and Middle East countries (12%). Asia dominates the electronics market[18]. Over 40% of semiconductor manufacturing is done in China.

Owing to increased wage rates in China, manufacturers are looking for alternate locations within Asia. Indian CEO exports are expected to increase from USD 4 billion to USD 80 billion by 2020[19]. Tamil Nadu leads India's CEO exports with a share of 46%, followed by Karnataka (17%), Uttar Pradesh (14%), Maharashtra (12%) and Kerala (3%).

4.4.1.1 Key growth drivers for the sector

Until 1984, the CEO sector was primarily government owned. The late 1980s witnessed a rapid growth of the electronics industry due to sweeping economic changes, resulting in the liberalization and globalization of the economy. The economic transformation was motivated by two compelling factors - the determination to boost economic growth, and to accelerate the development of export-oriented industries, like the electronics industry. The electronics industry has recorded very high growth in subsequent years. The easing of foreign investment norms, allowance of 100 percent foreign equity, reduction in custom tariffs, and delicensing of several consumer electronic products attracted remarkable amount of foreign collaboration and investment. The domestic industry also responded favorably to the policies of the government. The opening of the electronics field to private sector enabled entrepreneurs to establish industries to meet hitherto suppressed demand.

Improvements in the electronics industry have not been limited to a particular segment, but encompass all its sectors. Strides have been made in the areas of commercial electronics, software, telecommunications, instrumentation, positioning and networking systems, and defense. The result has been a significant trade growth that began in the late 1990s.

Though all sub-segments grew at a CAGR of over 10%, CBE and EC grew at the highest CAGR – 24% and 22% respectively between 2008 and 2013. The largest sub-segment is CBE whose share has improved from 22% to 31% between 2008 and 2013 due to increasing mobile and broadband penetration in the country, and focus of the government on telecommunication infrastructure development. EC segment's contribution to the sector has increased to 15% from 11% in 2007-08 on account of growing share of exports in low-end components and introduction of domestic high-end manufacturing (wafers, photovoltaic, solar cells, etc.)

Some of the key reasons for a spur in demand are -

- **Growth in population**
- **Growth in per capita income and increased consumer spending for electronic products** - Electronics goods have become a necessary utility, hence, affordable. The quick rate of obsolescence in technology is making products cheaper and affordable for lower income groups as well.
- **Investment in infrastructure** -Average 37% of total annual expenditure by the Government of India has been dedicated to energy, transport and communication
- **Focus on innovative products at low cost** - India is a price-sensitive market; it has a substantial demand for cost-effective products. Products that meet basic requirements at penetration price points have good potential and can create a market
- **Increased spent on IT products** - With public and private sector in India adopting automation, the demand for IT equipment is increasing. Government of India has announced National e-governance Plan (estimated budget of more than USD 9 bn). There are 31 mission mode projects being undertaken.

The Indian Electronics Industry offers a potential investment opportunity in various segments, which include telecommunications, consumer electronics, computer hardware and software, and medical electronic systems.

- *Consumer Electronics* would be predominantly driven by digitization, higher disposable income, availability of financing, affordable products, retail chains are the future growth drivers for the segment. Growth in household spending would have spin off effects in Telecommunications and IT Hardware as well.
- *Communication and Broadcast Equipment (CBE)* would be mainly driven by future increasing mobile penetration, entry-level mobile phones and an increasing rural subscriber base/mobile penetration to B and C circles with mobile connections. Further, increasing number of wire line and wireless broadband (Broadband Wireless Access/WiMax as well as demand for Consumer Premises Equipment and Fibre to the Home are likely to drive demand in the long term.

[18] *Source: Human Resource and Skill Requirements in the Electronics and IT Hardware Industry, NSDC*
[19] Source: DEITY – National Electronics Policy 2012

- *Computer Hardware* would be driven by increasing household spend on IT, education, as well as domestic IT demand by Indian companies especially in the small and medium businesses (SMB) segment, e-governance initiatives under the National e-Governance Programme (NEGP), IT based education in schools as well as growth of IT and ITES industry, growth in telecom infrastructure and awareness and affordability of technology will drive the market of computer hardware
- *Electronics Components (EC)* and high-tech manufacturing: Wafer fabs, ATMPs, solar PV manufacturing, storage devices, displays, display panels and nano-technology products are the ones to drive the segment demand owning to industry's effort to shift to high-end products. In line with energy conservation measures, LED manufacturing is also likely to be a high-potential area. Increasing subscriber base, growth in rural mobile telephony, broadband penetration and connectivity are the major demand drivers
- *Strategic Electronics* would be driven by sustained GDP growth and increasing defence spending.

The above streams would have downstream effect on Industrial Electronics and components. Electronics Manufacturing Services and R&D based exports will also be a major driver of growth in the industry. Increased value addition in these areas will further drive demand for production, sales and after sales support, which will increase demand for skilled human resources.

4.4.1.2 Key nodes for CEO investment in the corridor

Tamil Nadu offers good engineering talent, a sound manufacturing culture and ecosystem, strong base for design skills, excellent transport connectivity in terms of sea ports and airport, and a well developed tertiary sector that offers myriad services to support manufacturing. Tamil Nadu has been traditionally dominating the CEO industry by holding 21% (2010-11) of the national sector output. The districts of Tamil Nadu in the CBIC region contribute 93% (2010-11) of the sector's output from the state. All the developments have been in and around Chennai which contributes 64% to the state output. Kancheepuram which is adjunct to Chennai has been witnessing steady growth leading to its share to be 34% of the state's output.

In the case of Karnataka, it account for 9% (2010-11) of the national output. The districts in Karnataka within the CBIC region contribute 54% (2010-11) of the state sector output. Amongst the developments in the Corridor, 93% of concentration is in Bengaluru Urban (88%) and Bengaluru Rural (5%) districts and 7% in Kolar districts. Though the performance of the CEO sector in AP has been 11% of the national output, the presence of the CEO sector in the districts in the CBIC region in Andhra Pradesh is nominal, resulting in limiting the contribution to 0.68% of the corridor output.

Hence, the top districts for promoting investments in the CEO sector within CBIC are envisaged to be Chennai, Kancheepuram, Bengaluru Urban and Bengaluru Rural.

Table 4.4.1: Current Strengths for CEO products sector in the Corridor

District	Current Strengths and Challenges
Chennai	• Abundant availability of skilled manpower - Chennai ranks 4th in the highest number of employees in India's IT & ITES sector and has one of largest available human resource bases • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports • Excellent road & rail connectivity with other cities • **Poor supply of electricity & high rate of electricity units**
Kancheepuram	• Availability of skilled labour • Excellent seaport connectivity, with proximity to Chennai (~40 km) and Ennore sea ports (~45 km) • Excellent road connectivity through the world class East Coast Road and upcoming upgraded NH4 & 45 • Presence of several industrial parks and industrial estates with land availability • **Inadequate availability of power & and its fluctuations** • **Water availability a challenge**

District	Current Strengths and Challenges
Bengaluru urban	• Availability of skilled resources • Presence of large industrial clusters like Bommasandra Industrial Area and Peenya Industrial Area • Houses several R&D institutions owing to the ready availability of quality manpower • **Water is scarce and there are frequent power outages** • **Connectivity with Mangalore (~250 km) and Chennai (~320 km) sea ports for import of raw materials needs to be improved** • **Availability of Industrial land**
Bengaluru Rural	• Availability of skilled resources • Proximity to urban node • Well developed industrial estates like Hoskote • Proximity to the international airport in Bengaluru. • **Water is scarce and there are frequent power outages**

Source: District profiles, MSME profiles, industry reports and PwC analysis

4.4.1.3 Key interventions required and strategy for developing CEO sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations which need to be provided by coordinated effort by government and private sector to develop the CEO sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

Based on literature review and comprehension of state policies (Electronic Hardware Policy 2012-2017 of Government of Andhra Pradesh, Karnataka ESDM Policy 2013) for the sector, we have summarized the key interventions required for the CEO sector, along with the existing challenges in the sector:

Table 4.4.2: Shortcomings and key interventions required for increasing investments in the corridor - CEO sector – economic enhancers

Enhancers	Current shortcomings	Key interventions required
Economic	• Industrial infrastructure (Water availability, power availability, linkage with ports) has several limitations that is impacting performance • Acquiring land to set up manufacturing facilities is a time consuming process in the three states. • The poor logistics infrastructure is leading to inventory pile up. • Poor linkages with suppliers, end product manufacturers, distributors, retailers	• Rail connectivity to sea-ports should be improved to promote exports from the Corridor. • Road connectivity with demand centres needs to be improved. • CEO industries could be exempted from the purview of power cuts within the corridor and usage of renewable energy should be incentivised*. • Government to play an active role in acquiring land parcels for industries and developing key • Develop freight corridor between Bengaluru rural and Chennai seaport, to promote exports.

Source: Sector policies

Table 4.4.3: Shortcomings and key interventions required for increasing investments in the corridor - CEO sector – Administrative enhancers

Enhancers	Current shortcomings	Key interventions required
Administrative	• When compared to low cost destinations such as China, Taiwan and Singapore, India's current tax structure makes the final product less competitive. There are no duties on finished goods imported, however there are duties/taxes levied on imported components/inputs making domestic finished goods less competitive, hence encouraging low cost imports. • Inverted duties due to dual use inputs such as plastics, copper, aluminium, etc continue to trouble hardware manufacturers. Specific items are covered under Customs Notification 25/99, although the procedure for claiming this benefit is extremely convoluted and time consuming. • The corporate tax rates are amongst the highest in India and are compounded by multiple indirect taxes. Central Sales Tax, special additional duty and high value added tax (VAT) on raw materials, components and basic inputs, are the adversaries[20] to the sector. The anomaly in tax system are resulting in slowing down and having a regressive impact on the industry • The stability of taxation is another issue. • As of now, there are no preferential laws or incentives in place which enforce usage of domestic products. This results in excessive import of low cost products*. • Under the current labour laws, the ability of an organization to align employee strengths with demand cycles is curtailed. Flexibility in labour laws is essential to cater to seasonal variation in demand. Regulations around overtime and contracts also make it difficult to meet the highs and lows of demand[21].	• The Goods and Services Tax needs to be implemented to replace most of indirect taxes. • Need to formulate a 'Duty Drawback Scheme' with respect to state taxes that do not get refunded to the export units in the normal course of implementation of state tax laws[22]. • Introduction of preferential laws or incentives to encourage or enforce usage of domestically manufactured products. • Single Window System for necessary permissions and clearances. Concerned Industry association inputs/suggestions/approval/ recommendation may be obtained for necessary clearances*.

Source: Sector policies

20 Source: The Economic Times - Electronics industry demands for GST from next fiscal, February 2014
21 Source: Electronic Hardware Policy 2012-2017 of Government of Andhra Pradesh
22 Source: Karnataka ESDM Policy 2013

Table 4.4.4: Shortcomings and key interventions required for increasing investments in the corridor - CEO sector – Value enhancers

Enhancers	Current shortcomings	Key interventions required
Value	• Reliance on imports of components from China, Taiwan and Korea. • There is a severe shortage of trained manpower in the industry across levels. • Limited R&D focus - Competitors such as China and Taiwan are way ahead in the volumes game. The focus area should be adding more value to the existing products and creating new products through investment in R&D. • Slow upgradation to latest available and most efficient technology and techniques • Small and medium industry is a growing segment and a key driver of growth for electronics manufacturing. This segment needs proper financing at competitive cost which is currently not available thus hindering growth of the industry.	• Promote skill development in sync with the employment potential of the sector • R&D should be the key focus area in CBIC projects. Intellectual Property (IP) creation by local units should be given prime importance. • Common facilitation Centre/Incubation Centre/Cluster should be established with full pledged testing facilities to meet the global quality parameters such as EMC, Safety Testing, RF, Microwave Testing, Environmental Testing, and Endurance Testing & Other Functional Testing. These should be closer to the industrial clusters. • Financial incentives such as investment subsidy (MSMEs), interest rebate, Tax reimbursement of VAT / CST, subsidy on new capital equipment for technology upgradation, subsidy on the expenses incurred for quality certification; with a cap could be provided. • Opportunities should be explored to tie up with major electronic companies located globally to give Marketing and Technology access to local electronic design and manufacturing companies based in CBIC*. • A package of incentives should be offered for encouraging electronics exports including measures such as dollar loans, export guarantees etc*. • The usage of domestically made electronics should be encouraged especially for developmental initiatives by governments.

*Source: Sector policies, * - Source: Electronic Hardware Policy 2012-2017 of Government of Andhra Pradesh*

4.4.1.4 Computer, electronics and optical (CEO) sector

Table 4.4.5: Competitiveness analysis for CEO sector

Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
USA, Japan, China, South Korea, Germany, Malaysia, Taiwan, Singapore, UK	24th rank	1. Dependence on imported raw materials 2. Low quality of human resources 3. Physical infrastructure 4. Research and Development and Technology	1. <u>Raw material</u> a. The industry is significantly dependent on imports of raw materials. This has resulted in making the Indian products less competitive in the international market. Imported raw material approximately constitutes to 30-40% of the total raw material used in India 2. <u>Human resources</u> a. Availability of quality manpower is declining and there is acute shortage of skilled and trained personnel. Attrition rate is also high in the sector as the salary packages are not competitive with ITES sector 3. <u>Physical Infrastructure</u> a. Lack of adequate physical infrastructure like transport system, roads, ports, airports etc. adversely affect the competitiveness and productivity of the sector. b. Uninterrupted power supply is a necessary condition for operation of IT hardware and electronics units as power fluctuations lead to breakage of entire system. 4. <u>Research and Development and Technology</u> a. Due to low level of technical research and development, Indian industry is dependent on technical know-how of advanced countries like USA, Germany and Japan. Further in this sector, continuous innovations are leading to rapid changes in design and technology that give a competitive advantage in terms of cost, speed and quality. In the absence of economy of scales, Indian organizations find it unviable to procure and continuously upgrade the technology and machinery	1. <u>Raw material</u> a. Strengthening the global supply chain network as the industry is highly dependent on the import of raw materials which would affect the competitiveness. The cost of the supply network or logistic management network also needs to be assessed through value chain analysis b. Government should ensure hassle free import of raw material and components by streamlining the import policy and systems and through simplification of import procedures 2. <u>Human resources</u> a. Development of technical institutes as per the requirement of the sector will ensure proper skill development and would help in solving the problem of unavailability of technical manpower b. Industry associations should be involved in developing the curriculum of technical institutes to ensure that the course is designed keeping in mind the changing environment 3. <u>Physical infrastructure</u> a. PPP model should be promoted for the development of necessary infrastructure in the corridor 4. <u>Research and Development and Technology</u> a. Government should strengthen R & D in the sector especially the applied research like product development through special grants to leading Research Institutes/ Universities and Technical Institutes

Source: Productivity and competitiveness of the Indian Manufacturing, IT Hardware and Electronics sector, National Manufacturing Competitiveness Council, GoI

4.4.1.5 Recommendations summary

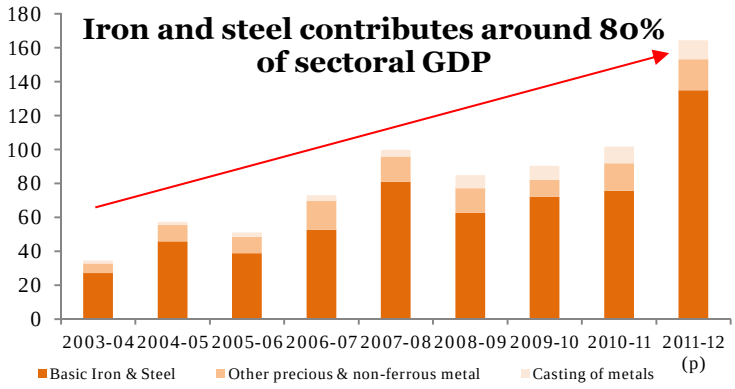
To promote CEO sector manufacturing within India and to exports from the CBIC region, infrastructure bottlenecks need to be removed. Opportunities should be explored to tie up with major electronic clusters located globally to give Marketing and Technology access to local electronic design and manufacturing companies based in CBIC. A package of incentives should be offered for encouraging electronics exports including measures such as dollar loans, export guarantees etc

The key districts in the CBIC region are Chennai, Kancheepuram, Bengaluru Urban and Bengaluru rural which are driving the output in the sector are urbanized. The following factors are to be enabled in the CBIC clusters in these districts to ensure success of the CEO sector –

Key factors to be enabled in the CBIC cluster to ensure success of the CEO sector		
Semiconductors, Electronics Components and Parts	**Computer Hardware**	**Consumer Electronics**
• Economies of scale • Establishment of export markets • Established contacts with end products manufacturers • Access to the latest available and most efficient technology and techniques • Highly skilled workforce availability	• Economies of scale • Effective cost controls • Having links with suppliers • Having an extensive distribution/collection network • Development of new products – sizeable expenditures on R&D • Competitive pricing	• Easy access to distributors and retailers • Brand strength • Established links with suppliers • Strategic alliances with technology leaders • High levels of R&D expenditures • Highly skilled workforce availability • Local and efficient manufacturing to reduce cost.

4.4.2 *Metallurgy*

4.4.2.1 Sector performance

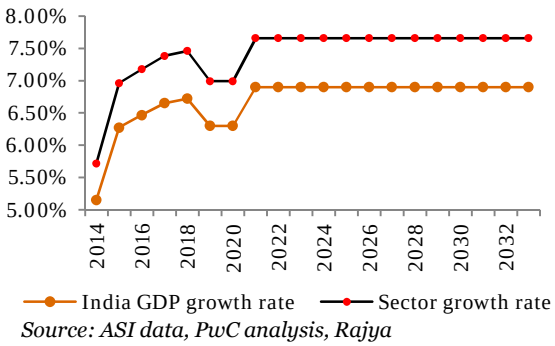


Source: Annual survey of Industries, PwC Analysis

Figure 4.4.1: Contribution of sub-sectors to metallurgy sector GDP

However, between 2011-12 and 2013-14, India registered a slow growth rate in manufacturing sector as a whole, with 2.7%, 1% growth rates in successive periods from 2012-13 to 2013-14. In line with national GDP and manufacturing GDP, the growth rates during these two years are expected to be

In 2012, Indian metallurgy sector registered an output of around US$ 140 Bn [23] and contributed to around 2% of the national GDP[24]. In terms of sub-sectoral contribution, Iron and Steel industry contributes to around 80% of the sectoral GDP. At constant prices, the sector has registered growth of around 14% CAGR between 2003-04 and 2011-12. The high growth rate has been primarily driven by Iron and steel industry, which grew at 14.6% during the period.



Source: ASI data, PwC analysis, Rajya

Figure 4.4.2: Growth rate of India's GDP vs. Metallurgy sector

[23] *Exchange rate of 60 Rs = 1 US$*
[24] *Annual survey of industries data, MOSPI and PwC Analysis*

around 1%. Going forward, the national demand for the sector is expected to grow between 6-8%[25].

Globally, metallurgy sector comprising iron & steel, aluminium, copper, nickel, lead, zinc, tin, silver and other basic metals, provides key inputs for a number of industries in the manufacturing sector. In 2012, at around US$ 855 Bn, metallurgical sector constituted around 5% of global trade. The sectoral demand also drives the primary mining sector, which contributed about US$ 757 Billion (around 4%) to global trade during the same period.

The landscape of metallurgy sector has been changing over the past decades. While during early 70s, the production centres were primarily located at industrially advanced locations, recent years have shown **significant shift of production centres to countries that have the mineral resource (iron ore, bauxite, coking coal, etc) or are near to the mineral resource**. In absence of sufficient resources in the vicinity, countering imported raw material price fluctuations by vertical integration (through acquisition of upstream assets) has been a key feature of the sectoral strategy. The second dominating factor for the structural shift has been because of energy prices. Being energy intensive industries, increasing energy prices along the west has also contributed to relocation/emergence of production centres along the less expensive destinations.

Metallurgy sector is expected to be a key sector which may contribute to CBIC's success in terms of attracting investments to the corridor. The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh, together contribute to ~17% of the metallurgy sector output of India. Within the states, these districts have traditionally accounted for ~12% of the total metallurgy sector investment in these 3 states. CBIC region has presence of end-use industries for metallurgy sector like automobiles, defence, construction, etc which are likely to act as demand pullers for the Metallurgy industry in the state. Within the corridor however, the presence of key metallurgy industries is weak currently.

Our industrial assessment of the corridor districts suggest that the metallurgy sector has the potential to create 4%-10% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively).

4.4.2.2 Key growth drivers for the sector

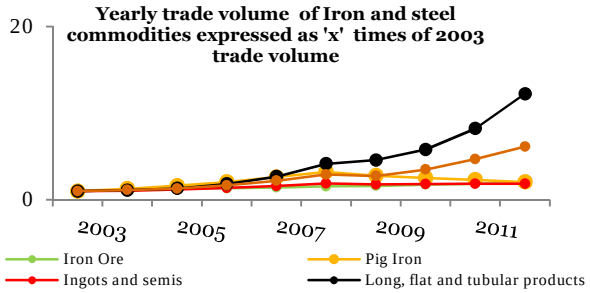
The metallurgy sector output acts as feedstock or intermediate raw material for many of the end use industries like defence, aerospace, construction, machinery, electrical, packaging, automobiles, etc. Many of these key industries are present in the corridor. The key drivers of demand for the metallurgy sector is as highlighted below:

Increased consumption intensity

Given that most of the sectors like defence, aerospace, construction, machinery, electrical, packaging, automobiles, etc contribute to the sectoral demand in one way or the other; volume-wise the trends are likely to be in line with trade and GDP trends. Increased activity in power, infrastructure, transportation and FMCG segments are likely to drive up Iron & Steel and aluminium consumption in the country.

Increase in demand for exports

While three decades back, the international trade would be usually skewed around upstream segment with ore as the major commodity, trends are changing over the past decade. Along the value chain, **demand for finished products is growing faster than any other segment along the value chain.** For example, in Iron and steel industry- long, flat and tubular products like rod, rail, sheet, plate, hot rolled coil, etc are emerging as fast growing commodities of trade. Similar is the trend for aluminium as well.



Source: World Steel Organisation, PwC analysis

Figure 4.4.3: Yearly trade volume of Iron and steel commodities expressed as 'x' times of 2003 trade volume

[25]Based on long term India GDP projections by IMF and Standard chartered, and sectoral elasticity co-eff to GDP as indicated by Working group on Iron and Steel,2012

4.4.2.3 Key nodes for metallurgy investment in the corridor

The districts in Karnataka within the CBIC influence zone account for ~4% of all the metallurgy sector investments in the state. Large scale units are not present along the CBIC influence area in Karnataka. Some of the prominent medium and small scale units are Danish Steel cluster, Jindal Aluminium extrusion, South India Iron, Sunvik Steel, Welspun Corp steel pipe unit. Going forward, Chitradurga and Tumkur may emerge as key locations for investments into large scale industries due to proximity to raw materials, while Bengaluru rural and Tumkur may emerge as locations for finished product industries.

In Tamil Nadu, the CBIC influence zone districts account for ~22% of all the metallurgy sector investments in the state. Currently MALCO is the only large scale unit present in the corridor region. Going forward, Tiruvallur, Thiruvannamalai and Kancheepuram may emerge as key locations for import based industries in the sector due to proximity to ports. Due to proximity to demand centres, these areas are also likely to show some potential for downstream industries like steel pipes and tube casting units, aluminium castings, etc.

The districts in Andhra Pradesh, within the CBIC influence zone, account for ~20% of total metallurgy sector investments in the state taking place in these districts. Satavahana and Lanco are the key large scale units present here. Nellore is likely to generate more interest for Aluminium industry due to proximity to ports as well as raw materials relative to other CBIC districts.

4.4.2.4 Key interventions required and strategy for developing metallurgy sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the metallurgy sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.2.4.1 Economic enhancers

For the shortlisted districts along the corridor, we have summarized the key interventions required by GoI, along with the existing status and challenges in these districts:

Table 4.4.6: Existing status, challenges and interventions required to increase investment in corridor – Metallurgy sector

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required	Key sub-segments that may emerge
Chitradurga, Anantapur, Chittoor	• Raw material availability (iron-ore) • Availability of skilled resources in Bellary, Shimoga and Bengaluru • Proximity to gas grid through Dabhol-Bengaluru natural gas pipeline	• Proximity to end-use industry cluster of auto & auto components, Defence, machinery, construction	• With the recent iron ore mining ban, availability of high-grade lump is difficult • Compatibility of exiting units to pellet use is low, that reduces use of iron-ore fines. • Power tariffs are high in the region.	• Rail connectivity to Chennai, Mangalore & Krishnapatnam ports • Infrastructure of road connectivity with other demand centres • Special attention on fast-tracking land acquisition. Stakeholder consultations need to be done early on to avoid issues later • Incentives for creation of pellet units to enable better use of Iron ore fines.	• Iron ore beneficiation units • Pellet plants • Iron and Steel units

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required	Key sub-segments that may emerge
Nellore	• Proximity to Chennai, which has access to skilled resources • Proximity to Krishnapatnam, Durgarajapatnam, Katupalli & Ennore ports. • Railway connectivity to ports	• Proximity to demand centres domestically at Chennai, Bengaluru and Hyderabad. • Large food-processing and textile industries in the corridor may give rise to packaging requirements in aluminium	• Connectivity to domestic bauxite and alumina sources • High power tariffs	• Improve freight capacity for Nellore-Chennai railway line • Railway connectivity to West Godavari, East Godavari mines • Further allocation of Bauxite mines to companies setting up alumina and aluminium industries in Nellore region • Power plants in the region	•Aluminium & aluminium products
Tiruvallur, Thiruvannamalai and Kancheepuram, Tumkur Bengaluru rural	• Proximity to Chennai, Ennore and Katupalli ports	• Proximity to demand centres in Chennai and Bengaluru can improve demand for extrusion units and packaging materials • Industrial development along the corridor may give rise to increased demand for aluminium and Iron & Steel	• Iron ore sources are not there in vicinity. Steel industries looking at importing ore and coal may look at this region.	• Railway connectivity to Salem, Nilgiri and Madurai mines • Further allocation of Bauxite mines to companies setting up alumina and aluminium industries in these region • Improved connectivity from Bellary to Chennai covering these regions to enable transport of feedstock from Iron & steel units	•Iron and Steel units •Long & flat Iron & steel products •Aluminium & aluminium products

Source: District profiles, Industry reports, PwC analysis

4.4.2.4.2 Administrative enhancers

The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh do not have any specific policy dedicated to the metallurgy sector. The states are guided by the national level policies, where the draft National Steel Policy 2012 is yet to come out in concrete form. While the physical infrastructure shortcomings may get addressed through the economic enhancers, Government should consider a robust policy and regulatory framework to ensure the sector's growth in the corridor.

Government should take definitive measures to resolve certain issues pricing and availability of power. The current pricing of power makes the production cost for the metallurgy expensive compared to other states like Jharkhand. In addition, metallurgy sector players are often faced with delays in land acquisition. The policy measures should ensure faster process in which relevant stakeholders are taken into consideration and to avoid public protests in future. Recent events in other states in Aluminium and Steel sector could be a deterrent for investors if not addressed properly.

We recommend that the Government of these states should propose a dedicated policy for the sector, which may increase the attractiveness of the sector along the corridor. We propose the following interventions be looked at:

Short term:

- ***Policy implementation*** - A dedicated committee may be appointed comprising members from all stakeholder agencies across the three states. Location identification should be done in consultation with local communities to reduce opposition during implementation. Fast-tracked and transparent approval processes in setting up industry would improve sectoral performance. Implementation the National Steel Policy should be fast-tracked. The steps envisaged under the policy are not specific to only steel, and implementation can benefit entire metallurgy sector.

- ***Technology linkages*** - Government initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernising.

- ***Pelletization*** - There are limited reserves of high-grade Iron-ore lumps in the region. However, iron-ore fines are available and are currently exported in high quantities due to non-availability of pellet units to treat and use fines. Pelletization can help to an extent in better usage of iron-ores fines and can also help ramp up export revenue by moving up the value chain.

- ***Pellet compatibility*** - Pellet use in BF in India is low, whereas in technologically advanced plants, the preferred burden is a mixture of sinters and pellets with minimum dependence on lumps[26]. Incentives for use of pellets by large scale industries in the region can help in reviving as well as expanding the footprint of the sector in the region. PSU like Bhadravathi Steel Plant which is facing raw material issue, can be incentivised to modernise towards pellet compatible smelters.

- ***Location strategy*** - In aluminium subsector, Nellore is closest to bauxite sources and also will have access to Krishnapatnam and other ports. Further leases to Bauxite mining may be allocated to only those companies who intend to set up alumina and primary aluminium production units in the corridor. Businesses with existing bauxite assets abroad or long term contracts for bauxite/alumina procurement may look at Tiruvallur, Thiruvannamalai and Kancheepuram as key locations.

- ***Thermal coal linkages*** - Energy prices can be a key deterrent. While in the long run, state power utilities may need to reduce power tariffs; in the shorter term, industrial units developing captive power plant may be able to optimise energy prices to an extent. Facilitation to investors in securing coal linkages nationally and internationally (like long term contracts with Indonesia) will be beneficial.

Medium term strategy:

- ***Power tariff subsidies*** - In medium term, power tariff subsidies for industries in the corridor (say for the first 10 years of operation) can be looked at. It may be argued that such initiatives may be detrimental to public finance. But this argument really needs to be studied from the trade-off perspective i.e. loss to public finance due to subsidy vs. increase in state tax revenue base due to more industries.

- ***Pellet compatibility*** - Once pellet units evolve sufficiently and existing industries are revived, smelters may be encouraged to look at Chitradurga, Tumkur, Anantapur as key locations for installing pellet compatible plants.

- ***Reducing dependency on coking coal*** - As coking coal is not available in the region, incentives for iron and steel industries to adopt Direct Reduction and Smelting Reduction processes may be provided.

- ***Scrap recycling & state owned enterprises*** - Scrap and waste metal recycling is an untapped area in India. Stakeholder discussions reveal that while iron and steel scrap consolidation industry is organised to an extent, the same is to a large extent unorganised in aluminium industry. Scraps can counter raw material availability for industries with electric arc furnaces. Setting up state owned enterprises in this direction with appropriate regulations will provide a boost to the industry.

Long term strategy:

- ***Research & development*** - A world class research institute with focus on mineral exploration may be set-up by the three states jointly to further look into mineral reserves, and to explore ways for environmentally sustainable mining.

[26] *Centre for techno-economic mineral policy options –relevance of iron ore pelletization industry in India*

4.4.2.4.3 Value enhancers

Skill development:

The building and construction hardware sector in Karnataka, which also includes metallurgy sector to an extent is expected to generate an incremental demand of 95,800 people from 2012-22[27]. At this rate, key districts identified as potential metallurgy nodes within the corridor including Bengaluru rural, Chitradurga, Tumkur, Anantapur, Kancheepuram, Chittoor and Nellore may show deficit in the availability of labour by 2022.

With India's ambition to produce 200 million tonnes of steel, the need of skilled metallurgical, electrical and mechanical engineers may be substantial leading to a shortfall nationally. Government can take proactive measures to create employable work-force. Government led initiatives inform of Knowledge Transfer Partnership, where students get more industry exposure, can play a key role in creating the right institute-industry linkages.

4.4.2.5 Recommendations summary

Domestic demand: Our research suggests that certain sub-segments like Iron & Steel and Aluminium have tremendous domestic potential and the capacities in most cases are likely to see under-capacity situation beyond 2022. The State Governments should focus on creating the necessary infrastructure like road connectivity to major cities; major end-use industrial cities/estates/industrial parks etc. within the identified metallurgy sector nodes along the corridor, to enable more investments in the region. In terms of skills, more institute-industry interactions should be encouraged to provide the right industry exposure to students and create employable work-force.

Strategy: Metallurgy sector in the short to medium term shall be highly driven by domestic demand rather than exports. The current issue in the corridor has been primarily raw material scarcity in the region. However, to an extent the issue can be resolved through value chain streamlining. The mismatch in value chain arises from the fact that iron-ore fines are available in the region, but pelletisation is slowly growing in the region and pellet use capabilities in the region are low. Incentives to make use of iron-ore fines through encouraging pellet units and modernisation of smelters to pellet-compatible plants can play a good role. For aluminium, the industry will be comparatively better-off if placed around Nellore due to closer proximity to raw material. The downstream units are likely to be around the urban demand centres. Once the upstream smelter production improves, the downstream units may also develop cost advantages through reduced feed transport cost. Overall, improved connectivity between source-plan-demand centres is likely to improve the value chain throughout. Initiatives focused at optimising power tariffs as well as availability, and providing investors with a production cost advantage will further increase interests.

To boost the metallurgy sector growth in the country, Government of India came out with the draft National Steel Policy in 2012. The Draft National Steel Policy is a landmark development for the industry, with recommendations that is likely to have a positive impact across metallurgy sector, rather than just steel. The policy accords high importance to aspects of transparent and fast tracked process for obtaining clearance, permits; inclusive committee on site selection of projects locations; initiatives to cut delays and appropriate steps to streamline factors of production. The policy has also recognised the fact that the current trend in investment has been along the regions having mineral resource. As the industries are increasingly becoming dependent on international resources, the need to redistribute the incoming investments along the coastal regions has been envisaged. Appropriate steps to improve port capacity and connectivity have been proposed, which includes creation of a Mineral Development Fund to cater to infrastructure financing of initiatives like dedicated freight corridor, railways lines connecting mines to plant. Implementation of this policy will certainly provide a boost to investments in CBIC. However, above all things, coordinated and effective implementation will be important.

[27] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*

4.4.3 *Medical equipments*

4.4.3.1 Sector performance

Figure 4.4.4: Asia Pacific outlook

Source: Frost & Sullivan Healthcare Outlook (2012-2015)

With the rapid growth in Asia-Pacific population, the demand in the medical equipment market is estimated to register double digit growth. The demand scenario is therefore certainly favourable for companies in the sector. India itself can develop into a key market.

At domestic level, the market is also expected to grow substantially. The market size of medical equipment in India is expected to grow to USD 2.4 Bn by 2017 from its current size of US$ 1.3 Bn. While substantial number of companies like Wipro GE, Siemens, Philips, L&T medical, Draeger medical, BPL India, Allenger have entered the market, India still imports more than 60% of its medical equipment requirements primarily from US and EU. Another key aspect to look at is the fact that Indian imports are generally high technology products requiring high R&D. This indicates a need for investment in R&D space domestically. In terms of sub-sector performance, Imaging and Therapeutics constitute almost 83% of the market demand. Portable devices are slowly entering into the market with more focus on glucometers and blood-pressure measuring instruments.

Globally, the medical device industry is one of the most vital and dynamic sectors of the global economy. Revenue from sales of medical devices worldwide was **estimated at a little over US$ 210 billion for 2008 at CAGR of about 6.2%[28]. In 2012, the industry is estimated to have grown to US$ 270 Bn in sales[29]**. These sales figures are being achieved by an industry that comprises more than 27000 medical device companies worldwide and employs altogether about one million people. However, the revenue figures currently indicate an oligopolistic industry. 30 companies account for **89% of the estimated US$ 270 billion in global sales revenue**. In addition, 68% of the revenue among these companies is generated by companies headquartered in United States. Globally, the United States dominates 60% market share of medical devices sale. Sales from manufacturers in **middle-income countries account for an estimated 10% of the world market**. The top five countries by projected sales revenue—**China, Brazil, Mexico, India, and Turkey account for 60% of the total middle-income country market (and 6% of the world market**). In terms of consumer market, **four fifths of global medical device sales revenue comes from sales in the Americas and Europe.** Ten countries account for nearly 80% of world consumption, with the United States at the top of the list (41%), followed by Japan (10%).

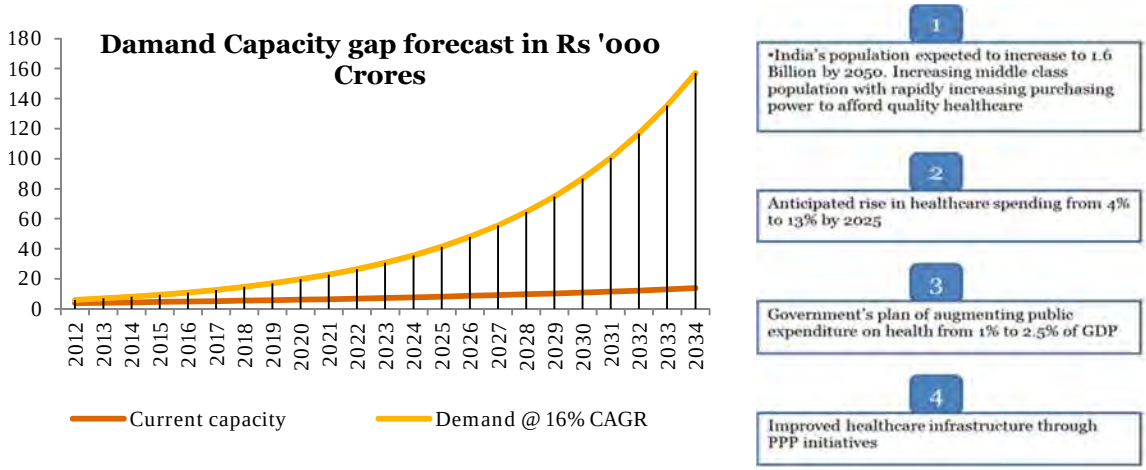
The dynamics of the sector are also changing fast. Traditionally the industry is used to double-digit revenue growth, hefty margins and more predictable regulatory pathways. However, with increasing pricing competition and profit stress firms are becoming more global in scope, moving beyond traditional markets and embracing new global sales opportunities in areas with growing middle classes and expanding healthcare needs and budgets. But the evolution of the industry as a whole is also a one of value chain integration. For example, companies like Frenesius which started out manufacturing dialysis machines have vertically integrated into care segment also with more investments spread across machines, clinics and drugs. Product innovation has been another key area of strategising driven by increased focus on mobile-healthcare system.

The medical instrument segment certainly emerges to be a key sector which may contribute to CBIC's success in terms of attracting investments to the corridor. The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh is substantially strong in medical instrument industry in comparison to national scenario. And, CBIC region happens to be the home of most of the sectoral industry including GE Wipro, BPL, Trivitron, B Braun, Mediworld, etc, comprising mostly large scale and medium scale industries. Growing population and presence

[28] *World Health Organisation - http://whqlibdoc.who.int/publications/2010/9789241564045_eng.pdf*
[29] *http://www.mpo-mag.com/issues/2013-07/view_features/the-top-30-global-medical-device-companies-564773/*

or urban demand centres like Chennai and Bengaluru are likely to act as demand pullers for the medical instrument industry.

4.4.3.2 Key growth drivers for the sector



Source: WHO report, FICCI, Frost & Sullivan report, PwC analysis

Figure 4.4.5: Demand capacity gap forecast – Medical equipment

Growing working age population is likely to create substantial demand for healthcare sector, which in turn creates demand for medical instruments. In the short to medium term, the sector is likely to be driven by domestic demand rather than international demand.

There is significant opportunity for both existing players to expand and new players to enter the market. The current market size is around Rs 8000 crores. However, @16% CAGR, the expected demand in the sector is likely to grow to Rs 157 thousand crores (around US$ 26 billion) by 2034. Without further investment, a substantial demand domestically will have to be catered through imports. This indicates a significant level of opportunity that the sectoral players may have in India.

4.4.3.3 Key nodes for medical instrument investment in the corridor

The districts in Karnataka within the CBIC influence zone account for ~50% of the entire medical instrument sector investments in the state. Large scale units like GE Wipro, BPL and Ziess are currently based out of Bengaluru Rural and Bengaluru Urban districts. B Braun, Trivitron and Mediworld have their presence in Andhra Pradesh and Tamil Nadu. Going forward, Krishnagiri, Ramnagara, Kancheepuram, Tiruvallur& Thiruvannamalai areas may also emerge as attractive locations due to proximity to demand centres. However, districts having presence of electrical and electronic clusters may be further preferred. Developing medical hubs in cluster approach with electronics and electrical manufacturers may be beneficial.

4.4.3.4 Key interventions required and strategy for developing medical equipment sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the medical equipment sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.3.4.1 Economic enhancers

For the shortlisted districts along the corridor, we have summarized the key interventions required by GoI, along with the existing status and challenges in these districts:

Table 4.4.7: Existing status, challenges and interventions required to increase investment in corridor – Medical equipment sector

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required	Key sub-segments that may emerge
Bengaluru Rural, Bengaluru Urban, Chennai, Krishnagiri, Ramnagara, Kancheepuram, Tiruvallur& Thiruvannamalai	• Availability of skilled resources	• Proximity to demand centres	• Uninterrupted power supply which is required for testing, calibration purposes	• Power related interventions. • Clustering approach with electronics and electrical industry in development of medical equipment hubs	Imaging, Therapeutic, Patient monitoring and portable devices

Source: Industry reports, PwC analysis

4.4.3.4.2 Administrative enhancers

We recommend that the Government of these states should propose a dedicated policy for the sector, which may increase the attractiveness of the sector along the corridor. We propose the following interventions be looked at:

- Quality standardization agencies have limited role currently. This creates a brand issue for small scale players. Establishment of sector-specific quality standardization agencies, independent quality testing labs, etc with focus on internationally comparable standards can also enhance brand image of the sector internationally.

- As has been discussed before, Indian manufacturers are more oriented towards low-tech equipments and not hi-tech ones that require investment in R&D. A government led R&D lab with pooled investment from the small scale sector can enhance competitiveness and expansion of small scale industries. Else, incentives for companies to invest more in R&D for both domestic and international requirement would be beneficial.

- A mixed clustered approach with electronics and electrical industry should be adopted for the medium and small scale industries in the sector. This would lead to appropriate economies of scale and scope, enhancing production cost advantage.

- Currently the demands for quality and high-tech products are generated mainly by the private multi-speciality hospitals. Public sector procurements are based on lowest price and not on quality/technology specifications. In addition, the demand from public sector has been also restricted. Focus on cost has led to increased imports from China. Stringent import norms through quality based scrutiny of imported products are likely to provide boost to domestic manufacturing in the sector. In addition, focus of public sector procurement on technology oriented products offering value for money can drive the high-tech industry, which is currently low in India. Increased demand of hi-tech equipments from district health centres will help in rationalising the spread of this sector across districts rather than clustering around urban centres.

- Uninterrupted power supply is crucial for these industries. Improving the power supply scenario and optimising power tariffs can help these industries to move towards an optimised production cost.

- Telemedicine is evolving as a major medium of penetrating Indian Landscape. This is likely to provide boost to portable and homecare device segments. Policies oriented towards encouraging telemedicine can provide indirect boost to the sector.

- Promotion of medical technological parks would be a key initiative to attract overseas medical equipment manufacturers. Trivitron Healthcare has created a first-of-its-kind, world class manufacturing facility in India, on a sprawling 20-acre land near Chennai. Aloka Co Ltd from Japan is setting up a manufacturing plant in Chennai.

4.4.3.4.3 Value enhancers

Skill development:

- Government of India has already taken up various R&D initiatives in the sector through agencies like SAMEER, CEERI, WML, CMERI, etc. However, enhancing skill levels through increased exposure in R&D to students and improving employability is a challenge. Skill levels in electronics and electrical are high around Bengaluru and Chennai. However, government led initiatives like Knowledge Transfer Partnership can play a key role in creating the right linkages. Knowledge Transfer Partnerships can be implemented in following way:

    - Specific research funds can be created dedicated to the sector (or a pool of related sectors) and can be allocated to interested Institutes. Interested institutes and companies can register under knowledge transfer partnership. Registered companies can show interest on the topics of research and can partner with a registered institute who shows interest. The industry can contribute 50% to the research fund requirements and 50% can be contributed from the fund that is created. The industry also provides access to infrastructure to the institute to carry on research. Each partnering institute can nominate KTP associates from amongst students to work under the supervisor. Such initiatives can improve skill-industry connect and improve employability.

4.4.3.5 Recommendations summary

With a rapidly increasing population and middle-class segment, Indian medical equipment industry has promising opportunities. The growth is more likely to be driven by domestic demand rather than exports at this point of time. However, appropriate business environment is a pre-requisite. The medical equipment instrument industry is an extension of electronics and electrical sectors and is likely to be dependent on the same. Developing medical hubs in conjunction with electronics and electrical clusters is likely to create the right ecosystem. Branding is another key aspect. Price pressures are increasing imports without structured quality considerations and exports often face with quality barriers. Quality is essential and appropriate quality related guidelines will reduce sub-optimal quality imports and shall drive domestic industry, while also creating scope for exports. This is likely to create the desired Indian brand. R&D is essential for the industry to grow along hi-tech products which the domestic industry is currently lacking. Enhanced R&D related grants and appropriate mechanisms to create the researcher-manufacturer linkage will be essential. Uninterrupted power supply would be critical for the industry. Arrangement of appropriate power facilities to medical hubs can make the corridor further attractive to investors.

4.4.4 *Textiles and Apparels (T&A)*

4.4.4.1 Sector performance

The Indian textile industry is one the largest and oldest sectors in the country and among the most important in the economy in terms of output, investment and employment. The sector employs nearly 45 million people directly and 45 million people indirectly and after agriculture, it is the second highest employer in the country. Its importance is underlined by the fact that it accounts for around 4% of Gross Domestic Product, 14% of industrial production, 9% of excise collections, 18% of employment in the industrial sector, 11% of the country's total exports earnings and 27% of foreign exchange inflows.

Textiles and Apparel sector is traditionally divided into manufacture of textiles (77% of the sector) and manufacture of wearing apparel (23% of the sector). Manufacture of textiles sub-segment is further divided into spinning, weaving and finishing of textiles, which constitutes 83% of the manufacture of textiles and manufacture of other textiles. Manufacturing of wearing apparel is constituted by manufacturing of wearing apparel, manufacturing of made-up textile articles and manufacturing of knitted and crocheted apparel. Further segmentation in India is given reproduced on the chart below.

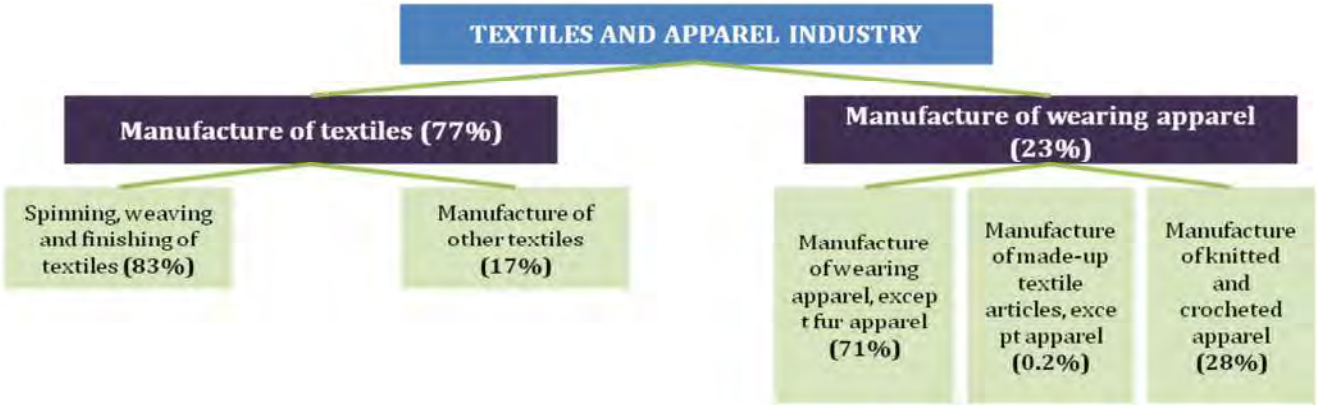


Figure 4.4.6: Segment separation of Textiles and Apparel industry in India

Technical textile[30] is an important part of the overall textile sector in India. Technical textile segment is emerging, with a huge potential to attract investment, create additional jobs and earn sizeable precious foreign exchange. Indian Technical Textiles segment employs 0.5 million technical people and 0.4 million non-technical people[31]. Global technical textile industry is estimated at USD135 billion, to which India contributed USD 15 billion in 2012-13.

The technical textiles can be classified into 12 major segments based on end use –agrotech, buildtech, clothtech, geotech, hometech, indutech, meditech, mobitech, oekotech, packtech, protech and sportech. Packtech is the largest segment with 33% share. Meditech, sportech, geotech and oekotech are smaller, but fastest growing segments.

The world textile and apparel industry transformed since the expiry of Multi-Fibre Arrangement in 2004, which governed the extent of textile trade between nations. The global T&A industry is estimated to be worth about USD 4,395 bn. In the global T&A industry, Textiles account for 60% of the market and apparel, the balance 40% of the market[32]and currently global trade in textiles and clothing stands at around USD 700 bn. The United States (US) market is the largest, estimated to be growing at 5% per year, and in combination with the European Union (EU) nations, accounts for 64% of clothing consumption. Among other countries, Japan, Australia and New Zealand are significant consumers of textiles[33]. Consumption in the global apparel industry is highly concentrated in three main regions: the US, the EU, and Japan.

4.4.4.2 Key growth drivers for the sector

The T&A sector in India is valued at USD 110 billion (2012)[34]. With the growing demand in the global market for textiles, especially technical textiles and apparels, the sector in India is estimated to grow to a size of USD 220 billion by 2020[35]. During the twelfth five year plan period, spinning, weaving and finishing of textiles is expected to grow at a CAGR of 8%; whereas the second component of textiles segment – other textiles – is estimated to grow at a CAGR of 12%. Manufacturing of wearing apparel is anticipated to grow at a CAGR of 10%.

India's textiles and apparel industry is one of the largest contributing sectors of India's exports worldwide. In terms of exports, it is among the top 5 global players, constantly expanding its share in world trade. India's exports of Textiles and Apparels is expected to grow to USD 64 billion by 2017 and USD 80 billion by 2020[36] from USD 29 billion in 2011. During the year 2012-13, Readymade Garments accounted for almost 39% of the total textiles exports. Apparel and cotton textiles products together contribute nearly 74% of the total textiles exports[37]. The USA and the EU account for about two-thirds of India's textiles exports. The other major export destinations are China, U.A.E., Sri Lanka, Saudi Arabia, Republic of Korea, Bangladesh, Turkey, Pakistan, Brazil, Hong-Kong, Canada and Egypt etc.

[30]Technical Textiles are high performance textiles which find application in many other areas apart from clothing
[31]Source: Baseline survey of the technical textile industry in India, Office of the Textile Commissioner
[32] Source: IBEF
[33]Source: Textile Industry Report by D&B Research
[34] Source: The Confederation of Indian Textile Industry (CITI).
[35]Source: IBEF 2012
[36]Source: Technopak
[37]Source: Note on Textiles & Clothing Exports of India. Ministry of Textiles, GoI

The two-fold increase in global textile trade is also likely to drive India's exports growth. High growth of Indian exports is possible due to increased sourcing shift from developed countries to Asia and India's strengths as a suitable alternative to China for global buyers. India, in particular, is likely to benefit from the rising demand in the home textiles and apparels segment, wherein it has competitive edge against its neighbours like Bangladesh, Sri Lanka.

Some of the key reasons for a spur in demand are -

- Availability of raw material
- Availability of cheaper labour
- Increasing population and rising per capita income - in general, an increase in the population leads to greater demand for consumer products, particularly for fundamental necessities such as basic apparel. However, demand is more heavily influenced by per capita disposable income.
- Shift in preference to branded products is expected to boost the demand.
- Growth in global Textiles and Apparels industry - Bangladesh, Vietnam, **India**, Cambodia, and Pakistan are especially expected to play key roles in the global textile industry, while exports from China have been decreasing due to increased prices of raw materials and labour costs.
- Growth of new consumption markets
- Global expansion of modern retail business
- Boom of air and sea shipments
- Favourable trade policies

Based on the past trend of growth and estimated end user segment growth, the market size of Technical Textiles in India is projected to be USD 36 billion[38] by 2016-17 with a growth rate of 20% per annum.

Some of the key reasons for a spur in demand for technical textiles are

- *Growth of Industry Sectors* - various technical textile products are consumed by different industries like automotive, healthcare, infrastructure, oil & petroleum, etc. With increased investments in these industry sectors, higher consumption and growing exports, the industrial sector is poised for a considerable growth. This will further increase the consumption of technical textiles.
- *Increasing Per Capita Income of Consumer* – the future growth in income is expected to increase riding on the back of a healthy growing economy. This rise will enable consumers to make more discretionary expenditure on technical textile products.
- *Increasing Adaptability Level/Acceptance of Products* - with growing awareness and income, consumers will realize, and be willing to pay for the superior functionality of technical textile products such as wipes, diapers, sanitary napkins, disposable sheets, pads, etc.
- Clothtech demand is driven by rising consumption of clothing and accessories
- Rising incomes and growing households to drive demand for hometech
- Rapid urbanization, rising working population, an increase in disposable income and increasing affordability of vehicles are drivers of demand for automobiles in the country and this will drive the mobitech segment.

4.4.4.3 Key nodes for Textiles and Apparels investment in the corridor

Tamil Nadu has been traditionally dominating the Textiles and Apparels industry by contributing 22% (2010-11) of the national sector output. Chennai is globally known as an exporter of woven garments with about 2,400 registered exporters. However, the districts in the CBIC region in Tamil Nadu account for 5% (2010-11) of the national sector output. The districts in Tamil Nadu within the CBIC influence zone account for 37% of all the Textiles & Apparels sector investments in the corridor[39]. Tiruvallur (16%) had the maximum investments in the sector in Tamil Nadu, followed by Dharmapuri (10%), Kancheepuram (8%) and Chennai (3%).

In the case of Karnataka, the districts in the CBIC region contribute 2% (2010-11) of the national sector output which is 65% of Karnataka's historic share in the national sector output. The districts in Karnataka within the CBIC influence zone account for 61% of all the Textiles & Apparels sector investment in the corridor[40].

[38]Source: The Economic Times
[39] *Source: Capex CMIE database*
[40]*Capex CMIE database*

Bengaluru Rural (33%) had the maximum investments in the sector in Karnataka, followed by Bengaluru Urban (17%) and Chitradurga (10%). The presence of the Textiles and Apparels sector in the districts in the CBIC region in Andhra Pradesh is nominal, resulting in limiting the contribution to 2% of the sector's output in the Corridor. Based on our analysis we anticipate Tiruvallur, Dharmapuri, Kancheepuram, Bengaluru Rural and Urban and Chitradurga to the drive the growth of the sector in the Corridor.

Table 4.4.8: Existing asset profile, challenges and interventions required to increase investment in corridor – Textiles and Apparels sector

District	Existing asset profile – strengths and challenges
Tiruvallur	• Proximity to Chennai for availability of labour • Proximity to Chennai and Ennore ports and Chennai airport. • Well connected with all major district head quarters by road. • Existing presence of industry - has 794 MSMEs into ready-made garments & embroidery employing 12,166
Dharmapuri	• Raw material available • Traditional industries like silk reeling, silk twisting, manufacturing of readymade garments, power looms are present in Dharmapuri district. • It has an important readymade garment cluster. • There are 1573 MSMEs into cotton textiles employing 7865. There are 152 MSMEs into woollen, silk & artificial thread based clothes employing 760 and 89 MSMEs into ready-made garments & embroidery employing 445.
Kancheepuram	• It is known for its richest silk. • Unskilled labour is available. • Excellent seaport connectivity, with proximity to Chennai (~40 km) and Ennore sea ports (~45 km) • Excellent road connectivity through the East Coast Road and upcoming upgraded NH4 & 45 • Presence of several industrial parks and industrial estates with land availability. • Over 5o thousand people employed in the cluster • Inadequate availability of power & and its fluctuations
Bengaluru Rural and Urban	• Both districts together have 499 textile units offering 16,631 employment opportunities in the district. • Bengaluru Urban is well connected to all the districts in cotton producing and silk producing districts in Karnataka. • Has accessibility to raw materials from Salem, Erode, Coimbatore and Ahmedabad • There is insufficient supply of manpower within both the district; it has the ability to attract skilled manpower from across the state and the country. • Water is scarce and there are frequent power outages • The apparel industry is concentrated in Bommanahalli, Bommasandra, Peenya, Yashwantpur and Rajaji Industrial Estate and Industrial Town. • Has excellent market linkages in terms of subcontractors which enables flexible changes in production schedule and product
Chitradurga	• Chitradurga is amongst the cotton producing districts in Karnataka and closer to the other cotton producing districts in Northern Karnataka. • Excess skilled manpower available. • Based on discussion with industry players it is understood that many youth go out to Bengaluru to work in garment industry. Thus, there are opportunities to set up garment factories in Chitradurga district to leverage on the cheap labour availability. • Proximity to Bengaluru International Airport • Molkalmuru sub district which is about 80 kilo meters from Chitradurga town is famous for its hand woven silk textiles

Source: District profiles, industry reports, PwC analysis

4.4.4.4 Key interventions required and strategy for developing Textiles and Apparels sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations which need to be provided by coordinated effort by government and private sector to develop the Textiles and Apparels sector along the identified districts in the Corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

We have summarized the key interventions required for the Textiles and Apparels sector, along with the existing challenges in sector:

Table 4.4.9: Current shortcomings and key interventions necessary in the corridor – Textiles and Apparels sector

Enhancers	Current shortcomings	Key interventions required
Economic	• Power costs and availability is a major challenge in the corridor • Linkage with ports for exports • Continued availability of raw material through interventions. • The core technical textiles are fairly import intensive with around 26% of the domestic demand being met by imports, since imports are cheaper as compared to indigenous production	• Subsidizing unit rates of power or encourage usage of non conventional energy sources. • Develop dedicated/captive power generating sources specifically for the major textile clusters. Bring in other alternate sources of power supply systems such as renewable energy etc. Improve road infrastructure
Administrative	• Higher taxes and duties • Stability of taxation is another issue. • There are procedural hurdles to international trade in the Textiles and Apparels sector. • The mandatory usage of technical textile products is largely driven by rules and regulations or standards of respective industries / end user segments. The developed countries have standards and specifications in place and have ensured enforcement of the same.	• Regulations need to be focused on controlling raw material exports to ensure stable prices in the country and to make the sector more competitive and productive. • Taxes need to be regulated and stable[41] o Reduce excise duty on plant protection products. o Exempt the technical textiles samples for free distribution, from excise duty o Reinstate the customs duty on parts of umbrella, including umbrella panels o Exempt the Mobiltech products that are used in manufacturing of vehicles for exports, from levy of Sales Tax (CST) o Remove VAT levied on non-woven fabric o Exempt the export oriented technical textile units from Service Tax o Introduce Anti-Dumping duty on radial truck and bus tyre imports from China • Single Window System for necessary permissions and clearances. Recommendations for facilitating the growth of technical textiles in • Revise the subsidy rates for plant protection products (agrotech) under NHM
Value	• Lack of economies of scale • The availability of trained manpower is a key issue in the apparel sector since it is a relatively labour intensive industry. • There is a low degree of modernisation in the Indian weaving industry. India has much lower investment in special purpose machines, which perform specific functions and add value to the product. Very few export establishments have invested in cutting machines or finishing machines. • Due to low value addition, low productivity and increasing costs of raw materials and labour, handloom fabrics have traditionally suffered a cost handicap in the marke	• Automation needs to be induced to resolve the problems of shortage of labour and increasing and lead to higher productivity. • There is a need for effective implementation of skill development initiatives and co-ordinated efforts are required from all stakeholders • Design is a critical ingredient in the fast changing textile fashion technology, the existing textile design centers need to be strengthened and more such institutes need to be opened, especially for the support of textiles and apparel sector. • Technology is critical; therefore, modern units with upgraded technology should be encouraged. Governments will need to coordinate with banks and term lending institutions to encourage modernization of spinning mills to improve their productivity and quality[42]. • R & D Design development should be encouraged. • Value addition at every stage should be enhanced • Proper information systems to monitor the performance of the industry

Source: PwC analysis

41 Source: Baseline survey of the technical textile industry in India, Office of the Textile Commissioner
42 Source: Tamil Nadu-Textile Policy

4.4.4.5 Textiles and Apparels

Table 4.4.10: Competitiveness analysis of Textiles and Apparels sector

Sector	Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
Textiles and Apparels	**Textiles** China, EU-27, the US, RP Korea and Hong Kong, China, Taipei, China, Turkey, Pakistan **Apparels** - China, EU-27, Hong Kong, China; Bangladesh, Turkey and Vietnam, Indonesia (In the order of ranking) (Source: WTO data 2011)	**Textiles** – 3rd largest **Apparels** – 5th largest	1. Policy regime 2. Quality of production 3. Cost of production	1. <u>Policy regime</u> a. There is a loss of international competitiveness of the Indian T & A sector due to the exchange rate fluctuations. b. The T&A industry comprises mostly of small-scale, non-integrated spinning, weaving, finishing and apparel-making enterprises. Such a structure arose due to the policies on tax, labour and other regulations that favoured small-scale, labour-intensive enterprises, while discriminating against large-scale, capital-intensive operations. c. Lack of an exit policy, and rigid labour laws. 2. <u>Quality of production</u> a. Technology is critical; T&A sector is weighed down with low technology & ICT usage. b. Skilled labour - Quality of the present educational and training system is not catering to the requirements of the industry. 3. <u>Cost of production</u> a. Raw material accounts for about 30% of the fabric cost and 13% of the garment cost. India has an abundant supply of locally grown long staple cotton, which lends it a cost advantage in the home textile and apparels segments. b. Labour productivity - Textile industry in India is the second largest industry in terms of employment. Considering the employment aspects, the important determinant of competitiveness could be its labour productivity. Wages and salaries constitute less than 10% of total cost. India enjoys a significant lead in terms of labour cost per hour overdeveloped countries like US and newly industrialized economies like Hong Kong c. Quality of infrastructure (both social and physical) in	1. <u>Policy regime</u> a. In order to offset the loss of international competitiveness of the Indian T&A sector due to the exchange rate fluctuations, government needs to carry on with reimbursement schemes such as duty drawback, market development assistance etc., on a continuous basis. b. Concerned Ministries, Departments, State government need to be focus on reducing the transit time and cost at the international check points to make Indian textile products more competitive. c. Amendment to Labour Laws is needed, to permit longer hours of overtime with due compensation, and to allow flexi-hiring of labour, especially to support apparels sector. 2. <u>Quality of production</u> a. Modernization of the units and up gradation of technology is imperative. Both advanced as well as indigenous technology needs to be integrated in the system. There is a need to encourage more of technical innovation (through R&D efforts) through better design, technology, diversity of production etc. in the production process. there is need to work out time bound refund mechanisms from Technology Up gradation Fund (TUF) provided by Government for the modernization of the units. b. Vocational training through ITIs, Textile Design & Management Institutions specially in the area of Apparel Manufacturing, Quality Control and Designing needs to be encouraged so that

Sector	Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
				the respective state is short of the requirements. It has been found that one of the major cost components in the production is the energy consumed during the production process that offsets the competitiveness of the sector. In the case of physical infrastructure, the order of priority as given by the units for special attention for development and maintenance is: Power (40%), Road (30%), Rail (18%), Port (10%) and Airport (2%). In the case of social infrastructure, the order of priority as reported by the units for special attention for development and maintenance is: Technical institutions (56%), Higher education (26%), Special medical centers (12%), General hospital (5%) and Schools (1%). d. India hasn't been able to make Optimal capacity utilization due to lack of Knowledge, training, TPM & TQM, Disguised Unemployment and Lack of professional management. e. The study by Nordas (2005) suggests that the distance from the major markets is going to act as a major constraint in the form of transaction cost. Hence, Mexico, the Caribbean, Eastern Europe and North Africa are likely to remain important exporters to the US and the EU respectively, which are the major importers and possibly maintain their market shares. f. Fragmented capacities, low scales of operation g. Textiles imports have risen much faster than the textile exports implying that the cost of exports in terms of imports doubled during this period. Thus, globalization seems to affect Indian textile trade through increased competition. Major markets for the import have been People's Republic of China, USA, and Nepal etc. h. Currently the prevailing interest rates for the loans in India are much higher than the interest rates in competing countries such as China.	skilled work force is available. 3. <u>Cost of production</u> a. Raw material exports need to be controlled with a view to ensure stable yarn prices in the country and to make the sector more competitive and productive. b. In the case of physical infrastructure, availability of Power and Road need to be improved. Moreover the cost of power needs to be reduced. The option of subsidizing unit rates of power or encouraging the use of other viable options such as non conventional energy sources should be considered. Since increasing transit time ultimately results in avoidable additional costs, roads need to be improved. c. There is a need for rationalizing the existing interest rates for making available working capital as well as fixed capital investments. The existing requirement of Collateral security for getting bank loans is also a major problem for the small and the medium sized manufacturing units.

Source: Productivity and competitiveness of Indian Manufacturing Sector, 2010: Textiles and Garments, National Manufacturing Competitiveness Council, GoI and Note on Textiles & Clothing Exports of India, Ministry of Textiles, Government of India

4.4.4.6 Recommendations summary

The Textiles and Apparels sector market value is estimated to be at USD 220 billion by 2020 (IBEF 2012). The growth could be supported by technology upgradation, especially by fostering research and development; skill up-gradation, design development and value addition endeavours; facilitating development of diversified segments to cater to both export and domestic markets and establishing single window facilities for approvals and clearances; provision of power, water etc. Promote Textiles and Apparels exports from the CBIC region, physical infrastructure needs to be improved, favourable trade policies (including reduced and stable taxes and duties) need to be formulated, domestic production needs to be made competitive to reduce dependence on imports and superior quality need to be ensured.

4.4.5 *Food Processing*

4.4.5.1 Sector performance

The global Food Processing industry was estimated to be USD 3,200 billion in the year 2010[43]. The contribution of Food Processing sector to GDP is lowest for Japan at less than 3% and the highest for China at around 25%. In India, the sector contributes to 9% of GDP and around 12% of manufacturing sector contribution.
Across all regions, the major sub-sectors on the basis of demand are Meat, Poultry, Fruits and Vegetables and Sugar. These sub-sectors contribute to more than 70% of the demand of Food Processing sector. The major regions that contribute to more than 60% of the global retail sales of processed foods are United States and the European Union. Currently, around 58% of produced food is consumed by developing countries. This is expected to increase to over 70% by 2050 supported by the fact that over 35% of the world's population currently lives in China and India.

Food processing industry is one of the largest industries in India and is estimated to be worth USD 121 billion in 2012 and accounts for 32% of country's total food market[44]. With a huge agriculture sector, abundant livestock, and cost competitiveness, India is fast emerging as a sourcing hub for processed food. Around 90% of the output of food processing sector is contributed by four sub-sectors - vegetable oil, grain mill and starch, dairy and other food products. Output of the sector has increased from over USD 62 billion in 2008-09 to over USD 90 billion in 2010-11[45] and is expected to grow at a CAGR of ~10% till 2015[46].

One of the major constraints of the food processing industry is the low level of processing in India vis-a-vis other countries.

Table 4.4.11: Percentage of food processed in India vis-a-vis in developed countries - 2010

Segment	India	Developed countries
Fruits and Vegetables	2.2%	65%
Marine	27%	60%
Poultry	6%	NA
Meat	20%	70%

Source: Emerging Markets Insight

The rate at which sub-sectors are expected to grow over the next few years is as shown in the table below.

[43] *Gyan Research and Analytics Pvt. Ltd, 2012*
[44] *D&B Research*
[45] *Annual Survey of Industries (Conversion 1USD = 60 Rupees)*
[46] *D&B Research*

Table 4.4.12: Sub-sector wise projected growth rates – Food processing sector

Segment	Growth rate
Marine	4%
Fruits and vegetables	6%
Vegetable oil	5%
Dairy	8%
Grain mill and starch*	10%

* Average growth rate of food processing sector

Source: D&B Research, ASSOCHAM, Feedback consulting

The Ministry of Food Processing Industries (MOFPI) has formulated a **Vision 2015 Action Plan** that includes trebling the size of the food processing industry, raising the level of processing of perishables from 6 per cent to 20 per cent, increasing value addition from 20 per cent to 35 per cent, and enhancing India's share in global food trade from 1.5 per cent to 3 per cent.

Our industrial assessment of the corridor districts suggest that food processing sector has the potential to create 8-14% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively).

4.4.5.2 Key growth drivers for the sector

A number of growth drivers are fuelling the processed food sector in India. These include:

- **Increasing disposable incomes, rapid urbanisation and changing eating habits** - Increasing demand for functional food coupled with awareness about healthy/nutritional foods has increased spending on health foods. Further, changing lifestyles has resulted in willingness to pay premium prices for quality products
- **Policy drivers**
    - Government of India has been promoting the concept of Mega Food Parks and is anticipated to set up 50 such parks across the country by the end of 12th Five Year Plan, to attract FDIs
    - Low entry barriers
    - Various tax incentives and policy initiatives taken by the government to increase the share of India processed food industry in the global market has encouraged entrepreneurs to set up food processing units, specially export oriented units
- **Availability of resources** - India has numerous advantages like availability of abundant raw materials, skilled workforce and low labour costs
- **Increasing investments in support infrastructure** – Investments have been increasing in development of infrastructure like cold chain facilities and transportation
- **India emerging as a procurement hub** - India is gradually emerging as a procurement hub for agri related produce. There has been a gradual but significant improvement in product and packaging quality over a period of time, which has infused greater confidence in the importing nations for Indian products

4.4.5.3 Key nodes for food processing investment in the corridor

The districts in Andhra Pradesh and Tamil Nadu within the CBIC influence zone account for ~30% of each state's investment in food processing sector. Amongst all the districts in the corridor Nellore, Chittoor and Tiruvannamalai are the major contributors to investment in food processing sector. The three districts together account for more than 55% of the investment in the corridor.[47]

[47] *CMIE CapEx database*

Districts that fall in Tamil Nadu and Andhra Pradesh in the CBIC influence area account to more than 80% of the total investment in food processing sector in the corridor. Karnataka districts contribute to a smaller share of less than 20% of the investments in the corridor. Key districts are Bengaluru Urban and Bengaluru rural.

The key industrial parks (operational and upcoming) in the corridor include Srini Food Park in Chittoor, IFFCO Kisan SEZ Limited in Nellore and SIPCOT -Bargur Industrial Complex in Krishnagiri. The top few investors in the corridor include Bannari Amman Sugars Ltd, Indu Projects Ltd, Emami Biotech, Lotte India Corporation and Hatsun Agro Products. The key upcoming projects in the corridor include a Dairy plant by IFFCO, sugar plants by Dhanalakshmi Srinivasan Sugars Pvt. Ltd and India Cane Power.

Investments in top 8 districts of the corridor contribute to more than 85% of the total investment in food processing sector in the corridor. The major districts are Nellore and Chittoor from Andhra Pradesh; Chennai, Dharmapuri, Krishnagiri, Tiruvallur and Tiruvannamalai from Tamil Nadu and Bengaluru from Karnataka. The key factors of production existing in these districts for food processing sector are as listed in the table below.

Table 4.4.13: Existing asset profile, key success factors and sub-segments district wise for Food processing sector in the corridor

District	Existing asset profile	Opportunities
Nellore	• Proximity to raw materials like rice, paddy, jowar etc which is a key driver for grain based industries • Krishnapatnam port is located in the district which is a key driver for exports in food processing sector • The district has a long coastline which has been the major driver for development of marine processing industry	• Krishnapatnam port, once developed as a full-fledged port would create demand for industries that are export oriented including export oriented units • IFFCO Kisan SEZ that is being developed as an agro park in the district
Chittoor	• The district is rich in horticulture produce specially mangoes which is the key driver for development of fruit processing industries • Availability of livestock and fodder for the animals has resulted to Chittoor being the 2nd largest milk producing district in India • The district is home to Srini Mega Food Park which is one of the pilot projects under the Mega Food Park Scheme • Proximity to Chennai Port	• NIMZ announced in the district will ensure Government support in infrastructure development and single window clearances; • More than 30% of the total MSMEs in the district are in Food Processing sector
Tiruvannamalai	• Availability of raw materials like Fruits and vegetables • Good connectivity to urban centres like Kancheepuram • Availability of sugarcane and water making the district prominent in Sugar manufacturing. The largest sugar-mill in the country is in this district • Availability of cheap skilled and unskilled labour	• SIPCOT industrial complex and SEZ can be developed as a top Sugar industry cluster
Dharmapuri	• District is rich in agricultural raw materials and horticulture, specially Mangoes resulting to emergence of Fruit processing segment • Also rich in coconut cultivation – key driver for coir processing units • Availability of livestock, hence achieved self sufficiency in milk production leading to manufacturing of dairy products	• Proximity to SIPCOT industrial complex at Hosur • District economy is mainly agrarian in nature. Hence, there is tremendous scope for development of food processing industries

Source: District profiles, Industry reports, PwC analysis

4.4.5.4 Key interventions required and strategy for developing food processing sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the Food Processing sector along the identified districts in the corridor. These recommendations have been segregated as economic, administrative and value enhancers.

Table 4.4.14: Current shortcomings and key interventions necessary in the corridor – Food processing sector

Enhancers	Current shortcomings	Key interventions required
Economic	• Nellore and Chittoor are key districts for Marine and fruit processing respectively, they lack cold chain facilities • Strong linkages wit raw material and agriculture consumption markets. One of the key challenges of Chittoor fruit processing cluster is the weak linkage between farmers and processing units • Linkage with Chennai Port needs to be improved • High post harvest and handling losses	• There should be efforts **to encourage setting up of agro-processing facilities** as close to the area of production as possible to avoid wastage and reduce transportation cost • Area specific agro food park clusters could be developed, dedicated to the processing of the predominant produce of that area • Strong agriculture market linkages • Incentives for setting up warehousing/cold storage infrastructure and customized transportation network development
Administrative	• Unorganised sector • Lack of specific plan to attract private sector investments across the value chain • Complex regulatory system • Absence of adequate and economic options of finance, specially for MSMEs	• Develop a comprehensive policy for food processing sector • Effort needed to **organise the sector by creating clusters** to improve the bargaining power of enterprises and to enable them to pool resources. • Provide **support** to clusters in form of credit, inputs, expertise and marketing links. • **Marketing campaign** for food clusters should be launched. Household entities could be encouraged if entitled to tax benefit schemes and export promotion schemes • Necessary steps to be taken to overcome the long and fragmented supply chain and create direct farm linkages
Value	• Majority of the rice mills in the state of Tamil Nadu use old technology which leads to high consumption of electricity and water and emits high pollution. This leads to increase in cost of production. Majority of the small scale shrimp farmers lack the financial and technology means to implement modern farm management practices	• A **technology bank** to enable food processing units at a cluster level to have access to production supply units around the world using internet. • The government should consider **developing a Futures Market or an equalisation fund** for food grains, pulses, fruits, vegetable, milk, meat and poultry in the interest of the farmers and the processors ensuring minimum price stability to the farmer and a sustained supply of raw material to the processor or compensation for shortages • Essential to have sector specific and region specific

Enhancers	Current shortcomings	Key interventions required
	• The fruit processing and rice mill cluster in Chittoor suffers from poor linkages with development institutions and limited facilities for facilities and research. • Shortage of skilled labourers • Lack of product diversification and value added products	courses for development of skill and addressing the skill gap issue of the sector • Specific incentives to be given to encourage product diversification and increase production of value added products

Source: PwC analysis

4.4.5.5 Competitiveness of food processing sector

Table 4.4.15: Competitiveness analysis for Food processing sector

Sector	Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
Food Processing	**Meat** – Brazil, USA, Australia, Netherlands **Marine** – Norway, China, USA, Canada **F&V -** China, Netherlands, USA, Belgium, Brazil, Thailand and Spain **Dairy** - New Zealand, USA, Netherlands, Australia, France **Vegetable oil -** Malaysia, Indonesia, Argentina, Netherlands, Brazil, and Spain **Grain mill**	22nd rank	1. Lack of support infrastructure 2. Inefficient labour laws and lack of skill development 3. High cost and availability of raw material 4. Research and development & Technology up gradation 5. Low quality standards 6. Low value addition	1. <u>Support infrastructure</u> a. Lack of special infrastructure for food processing sector like warehouses, cold storages, packaging centres, value added centres, modern abattoirs etc b. Irregular power supply has hampered the productivity and competitiveness of the sector 2. <u>Labour laws and skill development</u> a. Majority of the MSMEs in the Food processing sector hire skilled and unskilled employs on contract basis. Their salary structure is not competitive which leads to a high attrition rate b. Majority of the workers/ supervisors are unaware of various food safety and quality requirements and lack competency or knowledge on Food processing/ packaging techniques 3. <u>Raw material</u> a. As per a survey conducted by GoI, it was noted that in the last few years the raw material costs as a percentage of total cost of production has increased in the case of over 90% of the processing units b. In Food processing sector in India, raw material costs range from 50-60% of total sales whereas in countries like China they are around 40%. c. The cost of raw material is high due to various factors like high transportation costs and wastage of raw materials during transportation. There is multiplicity of taxes at different stages of procurement,	1. <u>Support infrastructure</u> a. Last mile connectivity should be improved in order to strengthen the linkage between raw material supplier and processing units b. Incentives should be given to processing units to set up captive power plants. Additional incentives could be given to players for setting up conventional power plants which would ensure sustainability c. The logistics and support infrastructure like warehouses and cold chain facilities could be developed under PPP and incentives/tax holidays could be given to private players for setting up of these facilities d. There is an urgent need for technology induction facilitating use of Controlled Atmosphere /Modified Atmosphere Chambers, IQF facilities etc to be linked to the farm or collection hubs through reefer vans and ensuring an end to end cold chain 2. <u>Labour laws and skill development</u> a. As the sector faces acute shortage of skilled labour, an apex organization could be formed that would be responsible for skill development and training in this sector. b. Specialized Training Centers/cells catering to the needs of the food processing industry may be created in the existing Technical as well as Management Institutes. c. Essential to review and simplify the old labour laws keeping in mind the needs of the sector 3. <u>Raw material</u> a. Government should promote reliable and strong supply chain network between raw material suppliers and processing units on PPP basis

Sector	Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
	and starch– Germany, Italy, France, Belgium, USA			transportation and processing which further adds to the cost of raw materials and products 4. <u>Research and development and technology up gradation</u> a. Research and development in the Food processing sector is not carried out on a large scale specially in areas like product development, packaging and food technology 5. <u>Quality standards</u> a. Poor quality of food products is one of the major reasons hampering exports of the sector b. Use of chemicals/drugs is a major concern for majority of the processing units targeting the export market	b. There is a need to introduce uniform tax rates in all states avoiding multiplicity of taxes at different stages. c. Systems and procedures may be simplified. The need for documentation/ paperwork at multiple checks posts and in different states, customs formalities, needs to be reduced. 4. <u>Research and development and technology up gradation</u> a. Government may grant sponsored research and provide special research grants to leading Agricultural research institutes/universities and technical universities b. The linkage between government agencies, universities, industry and other stakeholders like cooperatives, farmer organizations etc needs to be strengthened. c. Government need to promote technology upgradation specially in the unorganized and MSME sector by providing incentives d. Priority should be given to develop indigenous technology to reduce dependence on imports 5. <u>Quality standards</u> a. Awareness on quality standards could be created through seminars, newsletters and training programmes. b. Processing units should be encouraged to implement standards such as ISO, HACCP etc. c. Special Cells at regional/state level could be created that would work as facilitating centers for implementation of standards and getting certification

Source: Productivity and competitiveness of Indian Manufacturing Sector, 2010: Food Processing sector, National Manufacturing Competitiveness Council, GoI

4.4.6 *Recommendations summary*

In addition to the steps mentioned above, the following segment specific steps need to be taken to promote investment in the CBIC region:

Meat: Global analysis indicates it is a top demand driver. United States, EU and Saudi Arabia are the markets that have been driving the consumption and will be important to pursue them in future. In spite of having a large livestock, the processing levels in India are low when compared to developed countries. Further, only 1% of the total meat is converted to value-added products like sausages, ham etc. This has limited India's value added exports globally. Key products with increasing demand are Buffalo and poultry meat. The vision for food processing also attempts at improving processing level in Meat industry by developing fast growing meat breeds, enhancing focus on research and development and organisation of the sector. Similar initiatives should be taken in the region to increase investment. Most of the meat items have been exported from Chennai port and strong linkages with the port will be critical. The industry is of SME nature and due attention will be required around - supporting them for market access, improving mechanisation in the processes etc will be required for the development of the sector within the corridor.

Marine: The sub-sector is export oriented. Major markets are China, EU, Japan and US. It would be important to focus on these markets. Currently, the level of processing is very low (fish processing is around 26%) and hence efforts should be made to improve this. Majority of the processing facilities are concentrated in clusters with low capacity utilisations and high percentage of small scale industries. It would be essential to provide them with adequate infrastructure like cold chain facilities, credit facilities, promote value addition in the sector by providing incentives like reducing import duties and giving suitable packaging options and enable market access. Key district of focus in the corridor region is Nellore. Most of the marine products have been exported from Chennai port and strong linkages with the port will be critical.

Fruits and vegetables: Global analysis indicates it is a top demand driver. United States, UAE and Saudi Arabia are the markets that have been driving the consumption and will be important to pursue them in future. Focus should be on increasing the current low level of processing of less than 3% by addressing the production issues like low yield, inefficient farming, high handling losses, low shelf lives, high post harvest losses and producing varieties that are inappropriate for processing. For this it would be essential to focus on strengthening the value chain and invest in research and development. Majority of the enterprises are in the small sector, hence it would be essential to provide them with marketing support, lower duties and taxes on packaging material, providing them with cost effective and latest technology and low finance options. Chittoor, Dharmapuri and Krishnagiri are the key districts driving investment in this segment the corridor.

Vegetable oil: The revenue of the sector is driven by domestic sales. The key concern of the sector is the low capacity utilisation levels (average capacity utilisation of sector is less than 40%) due to increasing imports. It would be essential for the government to calibrate the import duty structure in India to protect the domestic industry. The sector has a relatively low employee per output ratio which implies that it is fairly mechanised. Hence, use of efficient and latest technologies would be important. Port proximity is a key driver of investment for companies operating in this segment as majority of the raw materials are sourced from other countries to increase cost competitiveness. The vision of food processing aims at increasing the share of branded edible oils. To achieve this it would be essential to encourage private sector participation across the region specially Nellore.

Dairy: The vision of the corridor for increasing investments in the Dairy segment specially in districts that fall in Tamil Nadu should be in line with the national vision for food processing that aims at increasing the level of processing, enhancing commercialisation of Indian ethnic milk products and increasing India's share in global exports which is currently less than 1% of milk and milk products produced in the country. To achieve this, the key steps to be taken include training the unorganised sector, reduce excise duties on dairy products, increase productivity, improve hygiene conditions, invest in R&D for development of machinery and develop packaging solutions for enhancing shelf lives.

Grain mill and starch: The segment is driven by both domestic and export demand. The focus products to increase the exports of the segment include wheat flour, maize flour and rice flour. Target markets for exports should be United States, UAE, Oman and Indonesia. The key challenge of the sector is the prevalence of unorganised sector and use of old and inefficient technologies by MSMEs leading to low quality of products. It would be essential to give incentives to promote new and cost-effective technologies. Key focus districts in the corridor include Nellore, Chittoor and Tiruvannamalai.

4.4.7 *Pharmaceuticals*

4.4.7.1 Sector performance

Indian pharmaceutical sector is estimated at ~USD 18 billion (~INR 990 billion) in FY 2012[48]. The sector registered a compounded growth of ~14% during the period FY 2008-12. The Indian pharmaceutical industry is expected to grow at an optimistic CAGR of ~15% over the period FY 2012-23 to reach USD 133 billion by 2023[49]. In terms of domestic and export market, the export market is expected to grow at much faster rate (CAGR of ~18-20%) than the domestic market (CAGR ~12-15%). Exports are increasing due to greater acceptance of generic drugs worldwide combined with a larger number of drugs going off-patent and increasing Indian Abbreviated New Drug Application (ANDA) filings. Therefore, by 2015, the share of exports to total pharma turnover is expected to exceed the domestic market sale. The developed markets of USA and UK are the major markets for exports contributing ~28% of the total exports made. During the fiscal 2012, India exported ~INR 633 billion worth of drugs & pharmaceuticals. This shows the ability of Indian pharmaceutical firms to meet the stringent quality norms of the western markets.

A key development in the past five years has been the industry's change in geographic focus, as global players have sought to offset sluggish growth within their traditional markets. To that end, emerging economies like China, India, Russia, Eastern Europe, South America and the Middle East have become major growth markets for the industry. Growth in these emerging regions has been underpinned by greater government investment in healthcare, increasing demand for drugs to treat diseases and strengthening regulatory and intellectual property requirements. In addition, many companies have set up research facilities in these countries to lower costs. This shift signals the end of the industry's traditional dominance by countries like the United States, Europe and Japan. Amongst emerging economies, India is touted as one of the most attractive destination for pharmaceuticals manufacturing.

The Indian pharmaceuticals sector is subdivided into 3 major categories: Active Pharmaceutical Ingredients (API), Formulations and Contract Research and Manufacturing Services (CRAMS).Currently, API accounts for ~55% of the total market followed by formulations (32%) and CRAMS (12%)[50]. With the demand for generics increasing in the foreseeable future, the API market is set to increase further. The high number of USFDA and UKMHRA approved plants (200+) in India, availability of talent pool and low R&D and production costs are pushing the CRAMS market, which includes contract manufacturing (CMO) and contract research (CRO).

The pharmaceuticals sector emerges to be a key sector which may contribute to CBIC's success in terms of attracting investments to the corridor. The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh, together contribute to ~25% of the pharmaceuticals sector output of India. The CBIC districts are a high contributor to the overall output of pharmaceuticals at the national level. On an average, the corridor districts accounted for more than 50% of the pharmaceuticals sector investment in these states of Karnataka, Tamil Nadu and Andhra Pradesh[51].

Our industrial assessment of the corridor districts suggest that the chemicals & petrochemicals sector has the potential to create 3%-9% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively).

4.4.7.2 Key growth drivers for the sector

India's strong GDP growth, higher life expectancy, growing population, rising disposable income, improving literacy, under-penetrated market, cost advantage and higher penetration of health insurance are some of the important factors driving the pharmaceutical industry in India.

[48] *Sectoral Risk Outlook: Pharmaceutical sector, D&B, 2012*
[49] *Growth projections as per Department of Pharmaceuticals, Govt. of India; PwC analysis*
[50] *Sectoral Risk Outlook: Pharmaceutical sector, D&B, 2012*
[51] *Capex CMIE database*

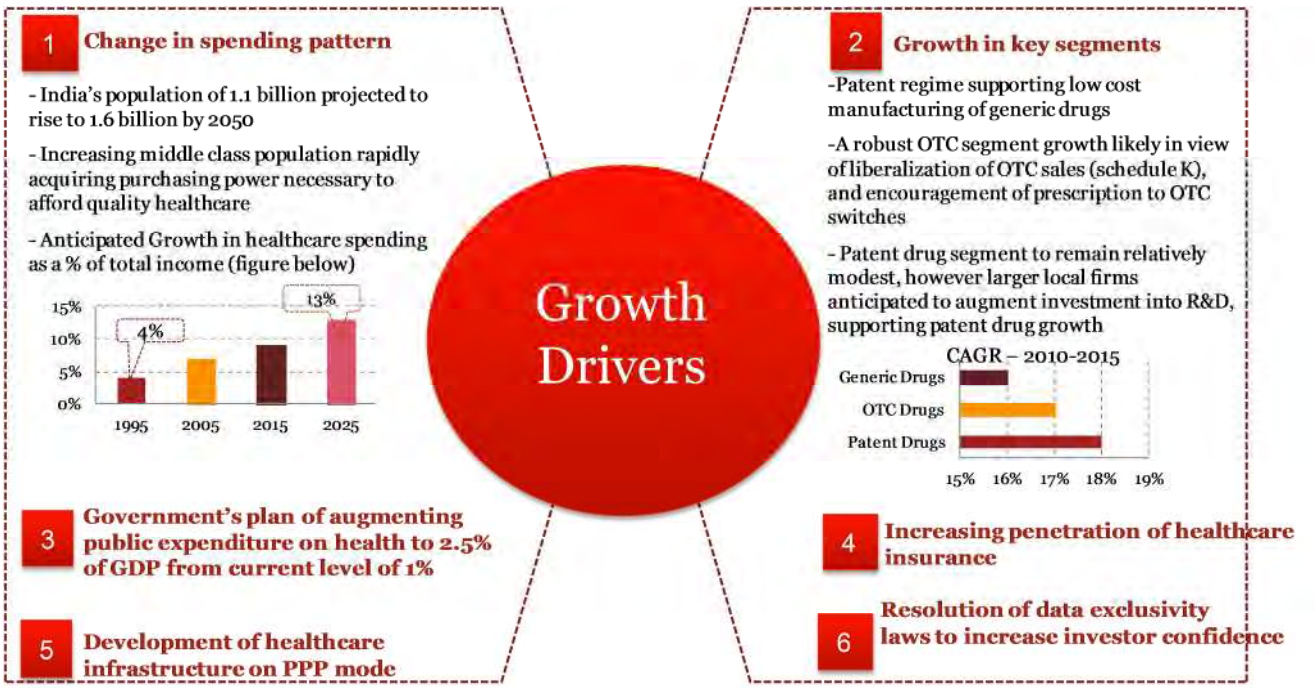


Figure4.4.7: Demand drivers for India's pharmaceutical industry

India's large talent pool of trained chemist possesses strong technical capabilities to manufacture products with exceptional quality standards. India has credit of having the largest number of US FDA approved facilities outside the US. Also, increasing number of Indian pharma companies have been getting international regulatory approvals for their plants from agencies like MHRA (UK), MCC (South Africa), TGA (Australia), MCC (South Africa).

Japanese Government decision to replace the expensive patented drugs with cheaper generic versions comes as a shot in the arm for the Indian pharma segment. To enable this, Japan has signed a free trade agreement with India to ensure smooth supply of API/bulk drugs from various API suppliers. This move is expected to boost the exports of the API to the world's 2nd largest pharmaceutical market.

According to Pharmexcil, pharmaceutical production costs are almost 50% lower in India when compared with developed countries[52]. This enables Indian Pharmaceutical Companies to offer low cost drugs that are 5% - 50% lower when compared with the developed nations. As a result of India's growing compliance with internationally harmonized standards such as Good Laboratory Practices (GLP), Current Good Manufacturing Practices (CGMP) and Good Clinical Practices (GCP), the country is emerging as the most favoured destinations for collaborative Research & Development for bioinformatics and CRAMS.

4.4.7.3 Key nodes for pharmaceuticals investment in the corridor

The districts in Karnataka within the CBIC influence zone account for ~90% of all the pharmaceuticals sector investments in the state[53]. Bengaluru emerges as the key district for pharmaceuticals investment among the corridor districts in Karnataka, accounting for more than 75% of the investments in this sector.

The districts in Tamil Nadu within the CBIC influence zone are also the hubs of pharmaceuticals manufacturing in the country, accounting for a hefty ~63% of all the pharma sector investments in the state[54]. Kancheepuram emerges as the key district for chemicals investment among the corridor districts in Tamil Nadu, accounting for more than 75% of the investments in this sector within the corridor districts in Tamil Nadu. The pharma industries are clustered around the Alathur's SIDCO Industrial Estate and Sriperumbudur Industrial Park in Kancheepuram. Chennai emerges as the other popular investment destination for the pharmaceuticals manufacturers in the state, accounting for 14% of all pharma sector investments in Tamil Nadu.

[52] *Sectoral Risk Outlook: Pharmaceutical sector, D&B, 2012*
[53] *Capex CMIE database*
[54] *Capex CMIE database*

The districts in Andhra Pradesh within the CBIC influence zone account for ~2% of all the pharma sector investments in the state and do not have significant investments in the sector[55]. Key interventions required and strategy for developing pharmaceutical sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the pharmaceutical sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.7.3.1 Economic enhancers

Table 4.4.16: Existing status, challenges and interventions required to increase investment in corridor – Pharmaceuticals sector

Bengaluru Urban and Rural	
Existing status and current asset profile	• Strong availability of skilled resources for R&D and manufacturing • Seaport connectivity with Mangalore (~250 km) and Chennai (~320 km) sea ports for exports is constrained • Presence of multiple pharma institutes & training centres • Access to high quality skilled workforce • Access to airport infrastructure
Demand factors	• The Suvarna Karnataka Development Corridor has proposed a Pharmaceutical & Bio-Tech zone covering Bengaluru Urban district. • Proximity to a cosmopolitan domestic market in and around Bengaluru • 4th Largest technology cluster in the world
Key shortcomings	• Vision for future land allocation is biased for services industry, hence availability of contiguous land for chemical industry may be a challenge
Key interventions required	• Ensure land availability for pharmaceutical manufacturers following best practices for manufacturing
Chennai	
Existing status and current asset profile	• Excellent seaport connectivity, with proximity to Chennai seaport • Abundant availability of skilled manpower • Excellent road & rail connectivity with other cities • Proximity to existing chemicals cluster for feedstock availability • Land availability in close proximity to city infrastructure for easy access to high quality skilled workforce (especially airport infra)
Demand factors	• Proximity to a cosmopolitan domestic market in and around Chennai
Key shortcomings	• Non-availability of product display and business promotion centre, etc. • Lack of post manufacturing storage and distribution network • Insufficient clinical research facilities. • Non-availability of pure water which is an important ingredient in the processing, formulation and manufacturing of pharmaceutical products. • Shortage of skilled manpower as services is attracting most of the talent pool • Over dependence on import of raw materials • Poor and obsolete technologies amongst the MSME players • Poor R & D infrastructure facilities – no dedicated research facility for the Pharmaceuticals sector • Inability to compete with MNC due to lack of marketing support
Key interventions required	• Creation of dedicated R&D institute for promoting product innovation • Setting up several institutes for creating highly skilled manpower for the pharmaceuticals sector • Product promotion centres for SME players • Establishing clinical research facilities, with private partnerships • Create backward linkages for raw materials which are largely imported • Promote technology transfer between developed national players and local players
Kancheepuram	
Existing status and current asset profile	• Excellent seaport connectivity, with proximity to Chennai (~40 km) seaport • Proximity to existing chemicals cluster for high quality feedstock • Presence of several industrial parks and industrial estates with land availability

[55] *Capex CMIE database*

Bengaluru Urban and Rural	
	• Excellent road connectivity through the world class East Coast Road and upcoming upgraded NH4 & 45 • Proximity to Chennai, which has access to highly skilled resources
Demand factors	• Proximity to a cosmopolitan domestic market in and around Chennai
Key shortcomings	• Inadequate availability of quality power • Mismatch of technologies between existing micro players and MNCs leading to lack of support by MNCs • Long time gap for processing and sanctioning of CFC proposals • Need for more sick unit rehabilitation studies and rehabilitation packages • Absence of dedicated research institutes and high quality research organizations
Key interventions required	• Ensure adequate power availability • Assistance in technology transfer through collaborations with MNCs • Reducing time required for clearances and approvals • Incentives for revival of sick units
Nellore	
Existing status and current asset profile	• Presence of several industrial parks and industrial estates with land availability • Existing chemicals cluster, which is getting stronger eventually
Demand factors	• Government focus to develop the region into an industrial hub
Key shortcomings	• Absence of dedicated research institutes and high quality research organizations • Lack of highly skilled workforce; services is attracting most of the talent pool • Acute shortage of power for MSMEs in the district • Lack of pharmaceuticals sector training institutes • Lack of infrastructure for waste and water treatment, effluent treatment, water infrastructure, etc.
Key interventions required	• Establish quality institutes to address the skill gap • Ensure power availability to industry • Ensure adequate policy initiatives to develop basic infrastructure for pharmaceuticals industry like water, waste, effluent, power, etc.
Key sub-segments that may emerge	Bulk drugs/APIs

Source: District profiles, Industry reports, PwC analysis

4.4.7.3.2 Administrative enhancers

The Government of India understands the potential that the pharmaceuticals sector holds in the country, and has been supporting the growth of this sector through policy level push, at the same time regulating it through a robust regulatory framework. The National Pricing Policy 2012 announced by the Government, is a key regulatory framework for pricing of drugs (essential medicines and formulations) so as to ensure availability of required medicines at reasonable prices even while providing sufficient opportunity for innovation and competition to support growth of industry. The policy proposes to cap the prices of 348 essential medicines and formulations at an average price of three best-selling brands. The Government has also allowed 100% FDI through automatic route for Greenfield investments in drugs and pharmaceuticals including those produced by the use of recombinant technology. For brown field investments, FIPB approval is required.

Beyond these initiatives, the Government has also introduced zero duty for technology upgrades in the pharmaceutical sector through the Export Promotion Capital Goods Scheme (EPCG) scheme. The GOI has extended support for speedy approval of manufacturing and exports of formulations by reducing the approval time for No Objection Certificate (NOC) manufacturer and NOC export license from 12 weeks to 2 weeks. The Government is also in the process of setting up 7 new National Institutes of Pharmaceutical Education and Research (NIPER), to cater to the industry requirement of highly skilled resources.

Among corridor level states, Karnataka government has recently announced a policy for the pharma sector, which intends to provide ready-to-use infrastructure for establishing pharmaceutical enterprises on cluster concept through pharma parks at potential locations of the State. With some incentives and concessions, the Karnataka state pharmaceuticals policy may act as a catalyst for growth and development of the pharmaceutical sector. The policy focuses on human resource development to make available readily employable manpower at all levels to the pharmaceutical sector, and marketing support to Karnataka-based companies through price preference in government tenders. Other features of the policy include enhancing facilitation mechanism, enabling investors to set up projects with ease and less transaction cost, encouraging the sector through various additional incentives and concessions.

The Government of Tamil Nadu has extended incentives for the sector through the state industrial policy 2007-11 and the policy note 2011-12. Tamil Nadu also has a state level policy for the special economic zones within the state under the SEZ Act 2009. The incentives under this policy are, therefore, extended to the pharmaceuticals sector players in the SEZ space. The Tamil Nadu Biotechnology Policy and special bio-parks have been introduced to support pharmaceutical and biotechnology industries in the state.

The Government of Andhra Pradesh has also extended incentives for the sector through the state industrial policy 2010-15 and the state SEZ policy. An exclusive Life Sciences Promotion Policy has also been announced recently by the state, to promote and attract investors in the areas of biotechnology, medical devices, bio services, pharmaceuticals and neutraceuticals segments.

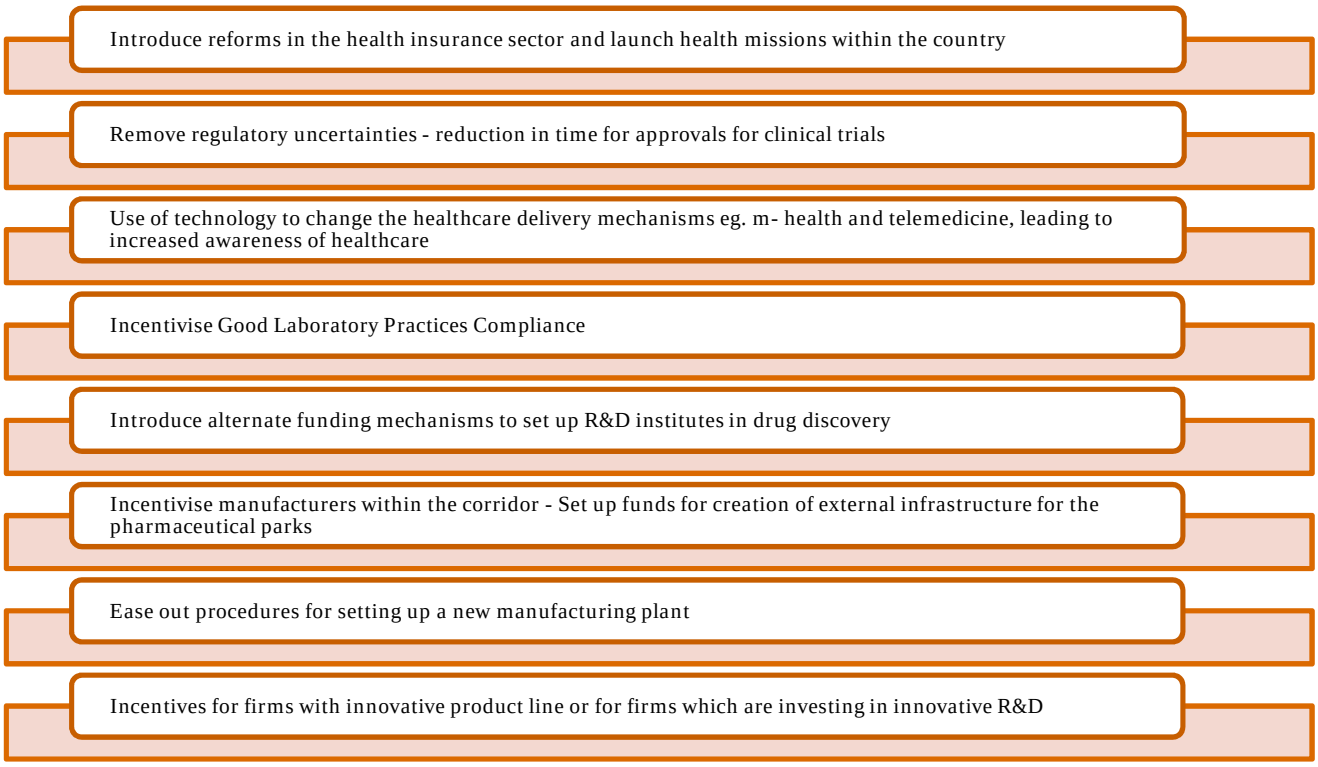
We recommend that the respective state governments facilitate value addition in the pharmaceuticals through incentivising R&D in product innovation. Special incentives can be earmarked for firms which are setting up plants in adherence to Good Laboratory Practices (GLP). The Government may also incentivise certain special segments within pharmaceuticals, where India has developed strength and needs to consolidate. Incentives for bulk drugs development with focus on Drug discovery and development, cleaner technology, Polymorphism, Nanotechnology etc[56] can be considered.

Government may look at removing regulatory uncertainty in the pharmaceuticals manufacturing space, such as reduction in delay in approvals for clinical trials. Although India has 15% of the world's population and 20% of the global disease burden, less than 2% of global clinical trials take place in India. Improved regulatory framework will strengthen the growth of clinical research organisation (CRO) industry (especially the bioavailability and bioequivalence (BA/BE) studies). This would also have strong bearing for the future of research and development (R&D) in India. According to data from the Drug Controller General of India (DCGI), new drug approvals dropped by 56.25% during 2011 to 98 from 224 in 2010.

Government may also introduce reforms in the health insurance sector and launch health missions within the country, to boost the confidence of domestic manufacturing to cater to local demands. Future reforms are required in the insurance sector to include coverage of outpatient expenses, including drug related expenditure by increasing access to essential drugs at affordable prices[57].

At corridor level, Government may chalk out policies for setting up dedicated pharmaceuticals manufacturing parks. Government should take the lead and develop external infrastructure linkages, on similar lines as that of PCPIR and Industrial Estates. Government may also consider extending special incentives to setting up manufacturing plants with innovative product line or for firms which are investing in innovative R&D. The policies should be aimed at easing out the procedural delays and ensure swift clearances at all levels, providing the project is compliant with Good Manufacturing Practices.

[56] http://pharmaceuticals.gov.in/pharma_niper.pdf
[57] *India Pharma Inc. Gearing up for the next level of growth, PwC publication 2010*



Sources: India Pharma Inc. Gearing up for the next level of growth, PwC publication 2010

4.4.7.3.3 Value enhancers

4.4.7.3.3.1 Research & Development:

The pharmaceuticals sector in India is one of the major contributors to the R&D spend in the country among manufacturing sectors, and the share of pharma R&D in the total manufacturing sector and chemicals sector R&D spend has been steadily rising. In spite of this trend, comparison at a global scale reveals that Indian pharma R&D is still lagging behind, with a mere 4% R&D-sales ratio as against 10%-15% R&D-sales ratio average at global level[58].

The key challenge in India with respect to R&D is that most of the firms are focusing on process R&D or the thrust is for minor product improvement, and this is also limited to medium to large scale companies. Typically firms with revenues above Rs 300 crore and earning 50-60% of revenues from international markets of US, Europe and Japan, are the ones who are taking these R&D initiatives, while the large number of smaller pharma firms is not able to afford the same[59]. The area of product innovation is largely unexplored in India, as most of these process imitative R&D firms have competence for drug manufacturing but lack necessary skill for drug discovery. One of the key reasons cited for this by the industry is the lack of highly trained R&D professionals in the country. This is one area which the Government can focus on for the CBIC region. We recommend that GoI establishes dedicated research institutes for innovative product R&D and bridges the lacuna of highly skilled R&D professionals. Within product R&D, Government should facilitate research in the niche generic product, which is expected to emerge into a potential large segment across the globe. The government should also actively promote collaborative activity in this field by facilitating more JV and Licensing Deals, between Indian companies and MNCs. Government may create a R&D fund to be used for establishing and promoting innovative drug research centre within the corridor.

4.4.7.3.3.2 Skill development:

The chemicals & pharma sector in Karnataka is expected to generate an incremental demand of 9,600 people from 2012-22[60]. Pharmaceuticals sector's skill demand trend is similar to chemicals sector, as it is an end-use

[58] *Performance of Pharmaceutical companies in India, Springer*
[59] *Performance of Pharmaceutical companies in India, Springer*
[60] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*

industry for chemicals intermediates. Within the corridor states, Karnataka is likely to face a supply gap of 1.9 million people, which also includes around 20-30% of the unemployable workforce joining from educational institutions[61]. Several key districts identified as potential pharma nodes within the corridor, including Bengaluru urban, Bengaluru rural, Ramnagara, and Nellore, have shown deficit in the availability of labour by 2022[62].

We recommend that Government should work in collaboration with industries, to upgrade and design new courses in the institutes which cater to the industry requirements. Government may look at establishing a new National Institutes of Pharmaceutical Education and Research (NIPER) in one of the districts of Bengaluru or Chennai, which will provide adequate skilled resources for the industry.

4.4.7.4 Recommendations summary

Our research suggests that India has a strong domestic demand for generic generics and for niche generics, with gradual increase in demand for niche generics. Government should focus on promoting product innovation than product imitation, and establish centres of R&D for drug discovery and research. Government should provide incentives to firms which are investing in R&D facilities for innovative product development. Government should ensure that the logistics and supply chain gaps are bridged in a fashion that the essential drugs, whose prices are being controlled, remain affordable to the end users. Government should ensure that local linkages of feedstock are available with the pharmaceutical manufacturers, and may take an approach of creating mutually dependent clusters of chemicals manufacturing and pharmaceuticals manufacturing. Although average logistics costs as a % of sales is only 1.5-2%, the logistics efficiencies are important for competitiveness and shelf-presence. Hence, Government should ensure excellent connectivity between these industrial hot spots within the CBIC and the demand centres within the country. Since power availability is critical for the sector, Government should ensure that these districts have adequate power availability for the industry. Further, the domestic market is highly fragmented and largely served by the SMEs, therefore, adequate support should be provided in terms of credit facilities during initial years of operations, marketing support, quality power availability and manpower availability. Government should especially focus on developing quality institutes for the pharmaceuticals sector, which may provide the necessary skilled resources.

India is strong on all the sub-segments including formulations and APIs. India is also gaining ground in contract research and clinical trials. Government should ensure that the regulatory and compliance framework are fast tracked to provide quick approvals for products which are compliant to the guidelines. Government of India should focus on establishing dedicated port linkages to ease the logistics between the corridor districts to the sea ports. Government should establish Product Promotion Centres for linking these SMEs with larger firms outside India, which are semi-regulated or not very stringent in regulations, in order to boost exports from the sector. Government can help the SMEs in partnering with MNCs in emerging markets. Such alliances benefit from the R&D (formulation development) and manufacturing capabilities of the Indian partners and the extensive marketing and distribution footprint of the MNCs in those markets. Hence, going forward, India may leverage its strengths in the supply of low-cost, quality medicines across the world and partner with foreign companies to drive growth and play a larger role in global pharma market.

On an overall level, the basic infrastructure of developed land with effluent treatment, waste treatment, water and power infrastructure should be ensured by the state Governments along the corridor districts. Power availability is a key issue faced by most of the MSMEs and hence, Government may look at ensuring adequate quality power for these industrial districts.

4.4.8 *Chemical and petrochemicals*

4.4.8.1 Sector performance

The Indian Chemicals & Petrochemicals sector grew from USD 62 billion in 2009 to **~USD 94 billion** in 2013 at a CAGR of 11%, and is expected to reach **USD 195 billion by 2023**, growing at a CAGR of ~10-12%[63]. The chemical and petrochemical sector presently constitutes around 14% of the domestic industrial activity. Indian chemicals & petrochemicals sector is expected to increase its share in the global market to ~5% from its current

[61] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*
[62] *Source: National Skill Development Corporation publication on skill gap*
[63] *Department of Chemicals and Petro-Chemicals, GoI*

3% contribution. Globally, the chemicals industry is seeing a marked shift in geographical terms, with manufacturing moving closer to the end use markets of Asia. With the gradual off-shoring of end-use industries for chemicals & petrochemicals like textiles, auto & auto components, electronics etc. to the Middle East and Asia, the manufacturers have shown there keen interests in expanding their presence in these markets. This also gets supported by the lower manufacturing and logistics costs in these regions. Within Asia, China and India are emerging as dominant destinations, owing to a large domestic consumer base. The existing plants in European and South Korean markets are expected to become the global pressure points for plant closures, owing to lower competitiveness against peer set-ups in Asian and Middle East economies[64]. India currently has a huge opportunity to attract these international majors in chemicals manufacturing.

Hence, the chemicals & petrochemicals sector emerges to be a key sector which may contribute to CBIC's success in terms of attracting investments to the corridor. The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh, together contribute to ~16% of the chemicals sector output of India. Within the states, these districts have traditionally accounted for ~14% of the total chemicals sector investment in these 3 states. Karnataka has presence of end-use industries for chemicals sector like automobiles and pharmaceuticals (including biotechnology), which are likely to act as demand pullers for the chemical industry in the state. Within the corridor there are two key refineries - 10.5 MMTPA plant in Manali by Chennai Refinery Ltd, and 1 MMTPA plant in Nagapattinam by Chennai Refinery Ltd.

Our industrial assessment of the corridor districts suggest that the chemicals & petrochemicals sector has the potential to create 5%-8% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively).

4.4.8.2 Key growth drivers for the sector

The chemicals & petrochemicals sector output acts as feedstock or intermediate raw material for many of the end use industries like pharmaceuticals, auto & auto components, paints, infrastructure, food processing, glass industry, urban asset management, etc. The key driver for the chemical industry as a whole is the end use industry segment, which is a direct outcome of increased consumption and population across the globe. Chemicals & petrochemicals act as an intermediate raw material for most of the end use products, ranging from food additives to electronics and automotives. Many of these key industries are present in the corridor .Therefore, different set of end-use industries act as drivers for the different segments under the chemicals & petrochemicals sector.

The key drivers of demand for the chemicals and petrochemicals sector is as highlighted below:

Increased consumption intensity

Compared to the developed world (the US, Europe) or China, the current penetration of specialty chemicals within India's end markets is low. With an increased focus on improving products, usage intensity of specialty chemicals within these end markets will rise in India over the next decade. For example, India's current expenditure on admixtures is only USD 1/ m^3 of concrete, compared to USD2/ m^3 in China and USD 4.5/ m^3 in USA. With increasing demand for higher quality construction and increasing awareness of concrete admixture benefits, the industry could double the intensity of admixture consumption in India. Similarly, the usage of pesticides in India is 0.58 kg/ha compared to 2 kg/ha in China, 10.8 kg/ha in Japan, 16.5 kg/ha in South Korea and global average of 3 kg/ha[65].

Increase in demand for exports

India's chemical sector is well poised for a strong growth in exports in certain value added segments like petrochemicals, specialty chemicals, pharmaceuticals and agrochemicals. India maintains its position as a net naphtha exporter. With the development of PCPIRs in the country, the value added segments like specialty chemicals, petrochemicals and knowledge chemicals will experience a very strong surge in exports.

Improved consumption standards

Consumption standards are policies implemented by the government to promote the safe use of products. Most developed countries (e.g. the US, Germany) have implemented stringent consumption standards across various

[64] *The Future of European Chemical Industry, KPMG International*
[65] *Knowledge paper titled "Emerging India: Sustainable Growth of the Chemical Sector" by TSMG, 2012*

end-use markets. As the economy develops, India will need to regulate products more stringently, and strengthen consumption standards, which in turn will promote increased usage of specialty chemicals. This would also result in phasing out of obsolete technologies and will pave the way for new technologies in the country. This would eventually result in fresh investments and therefore a strong push for the sector.

4.4.8.3 Key nodes for chemicals & petrochemicals investment in the corridor

The districts in Karnataka within the CBIC influence zone account for ~4% of all the chemicals sector investments in the state[66]. Bengaluru emerges as the key district for chemicals investment among the corridor districts in Karnataka, accounting for more than 95% of the investments in this sector. The key industrial parks within the district which act as focal points for the chemical investments include the Bidadi Industrial park, Peenya industrial area and Bommasandra industrial area.

In Tamil Nadu, the CBIC influence zone districts account for a hefty ~51.9% of all the chemicals sector investments in the state[67]. The districts of Chennai, Tiruvallur and Kancheepuram together account for ~98% of all investments in the chemicals sector across the corridor districts within Tamil Nadu. Kancheepuram emerges as the key district for chemicals investment among the corridor districts in Tamil Nadu, accounting for more than 75% of the investments in this sector within the corridor districts in Tamil Nadu. The chemicals industries are clustered around the industrial township of Manali, which houses several upstream refinery projects for CPCL, fertilizer manufacturing project for Madras fertilizers, among others. Chennai emerges as the other popular investment destination for the chemicals manufacturers in the state. Key investing companies in the corridor districts within Tamil Nadu include the likes of Chennai Petroleum Corporation Ltd. (CPCL), Indo Rama Synthetics (India) Ltd., Philips Carbon Black Ltd., Madras Fertilizers, EID Parry, Aditya Birla Nuvo, Nilkamal, Nippon Paint, Praxair, etc. The influence zone districts have a number of institutes and training colleges ensuring availability of skilled resources for the industry. However, there is an absence of any dedicated research institute for the sector within the corridor influence in Tamil Nadu.

The districts in Andhra Pradesh, within the CBIC influence zone, do not have a stronghold in the chemicals & petrochemicals sector, with only ~1.7% of total chemical sector investments in the state taking place in these districts. Nellore has generated renewed interest among investors across sectors, as Government is focusing to develop it into an industrial hub.

4.4.8.4 Key interventions required and strategy for developing chemicals & petrochemicals sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the chemicals & petrochemicals sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.8.4.1 Economic enhancers

For the shortlisted districts along the corridor, we have summarized the key interventions required by GoI, along with the existing status and challenges in these districts:

[66] *Capex CMIE database*
[67] *Capex CMIE database*

Table 4.4.17: Existing status, challenges and interventions required to increase investment in corridor – Chemical and petrochemical sector

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required
Bengaluru urban	• Raw material availability from Mangalore refinery, located at ~250 km • Availability of skilled resources for specialty chemicals • Seaport connectivity with Mangalore (~250 km) and Chennai (~320 km) sea ports for import of raw materials • Connected to gas grid through Dabhol-Bengaluru natural gas pipeline • Presence of industrial clusters like Bommasandra Industrial Area and Peenya Industrial Area	• Presence of end-use industry cluster of auto & auto components ensures demand for specialty chemicals & plastics • Strong urbanization creates a market for specialty chemicals like construction chemicals & plastics • Presence of bio-tech cluster creates demand for specialty chemicals like industrial enzymes and catalysts – Biotech park in Bengaluru • 10% of the MSME units in the district are in agri & food processing, leading to strong demand for plastics in packaging	• Feedstock availability is a challenge as no refinery exists in close proximity (<50 km); limited natural gas availability for industrial use • Vision for future land allocation is biased for services industry, hence availability of contiguous land for chemical industry may be a challenge • Absence of dedicated R&D institute for components like Specialty Chemicals • Polluting industries can be close to an urban location. Segments like speciality chemical, plastics can be explored	• Dedicated freight corridor between Bengaluru urban and Chennai seaport required to promote exports of specialty chemicals • Rail connectivity to sea-port should be improved to promote exports from the corridor • Improved infrastructure of road connectivity with other demand centres to cater to plastics demand • Land to be allotted to chemical manufacturers following best practices, especially specialty chemicals units • Government may set-up a plastic processors park in the district • Set up a dedicated R&D centre and Centre of Excellence for Specialty Chemicals
Bengaluru Rural	• Raw material availability from Mangalore refinery, located at ~300 km • Proximity to Bengaluru, which has access to skilled resources • Existing industrial asset includes Hoskote Industrial estate	• Proximity to end-use industry cluster of auto & auto components to ensure demand for specialty chemicals and plastics • Horticulture is one of the key industries in the district which ensures demand for agro-based chemicals	• Feedstock availability for downstream chemicals manufacturing is a challenge • Existing connectivity to seaport (Chennai) requires tremendous improvement	• Develop freight corridor between Bengaluru rural and Chennai seaport, to promote exports of specialty and agro-based chemicals • Rail connectivity to sea-port should be improved to promote exports from the corridor • Improved infrastructure of road connectivity with other demand centres • Land to be allotted to chemical manufacturers following best practices, especially specialty, agro chemicals units • Government may set-up a plastic processors park in the district

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required
Ramnagara	• Presence of Bidadi Industrial Area • Proximity to Bengaluru, which has access to skilled resources • Connected to Dabhol-Bengaluru natural gas pipeline which terminates in Bidadi	• Suvarna Karnataka Development Corridor envisages the creation of a Automobile Zone	• Feedstock for segments like plastics is not available in proximity	• Ensure natural gas availability for establishing backward linkages for specialty chemicals manufacturing • Improve connectivity to seaport and rail for promoting exports of specialty chemical • Land to be allotted to chemical manufacturers following best practices, especially specialty, agro chemicals units • Establish backward linkages for manufacturing petrochemical products
Chennai	• Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports (both with POL berths) • Abundant availability of skilled manpower • Excellent road & rail connectivity with other cities • Proximity to existing chemicals & petrochemicals cluster – feedstock availability for downstream industries	• Presence of end-use industry cluster of auto & auto components, leather, paper and electronics ensures demand for specialty chemicals & plastics • Strong urbanization creates a market for specialty chemicals like construction chemicals & plastics	• Absence of dedicated R&D institute • Lack of feedstock availability	• Ensure feedstock availability of natural gas and naphtha to manufacture key organic chemicals and fertilizers • Improved infrastructure of road connectivity with other domestic demand centres • Land to be allotted to chemical manufacturers following best practices, especially specialty chemicals units • Government may set-up a plastic processors park in the district • Set up a dedicated R&D centre and Centre of Excellence for Specialty Chemicals • Establish product promotion centres for MSME players
Tiruvallur	• Excellent seaport connectivity, with proximity to Chennai (~40 km) and Ennore sea ports (~45 km) [both with POL berths] • Abundant availability of skilled manpower • Home to chemicals & petrochemicals cluster at Manali– feedstock availability for downstream industries	• Proximity to end-use industry cluster of auto & auto components in Chennai - ensures demand for specialty chemicals and plastics • Presence of textile clusters at Pallipet and R K Pet - ensures demand for specialty chemicals • Agriculture is one of the key contributors to the economy in the district - ensures demand for agro-based chemicals	• Land, water and power availability and reliability of supply	• Ensure land availability for large scale projects , especially integrated petrochemicals manufacturing projects following best practices • Establish excellent road and rail connectivity to other domestic demand centres, especially for fertilizers, plastics and petrochemicals products • Establish product promotion centres for MSME players

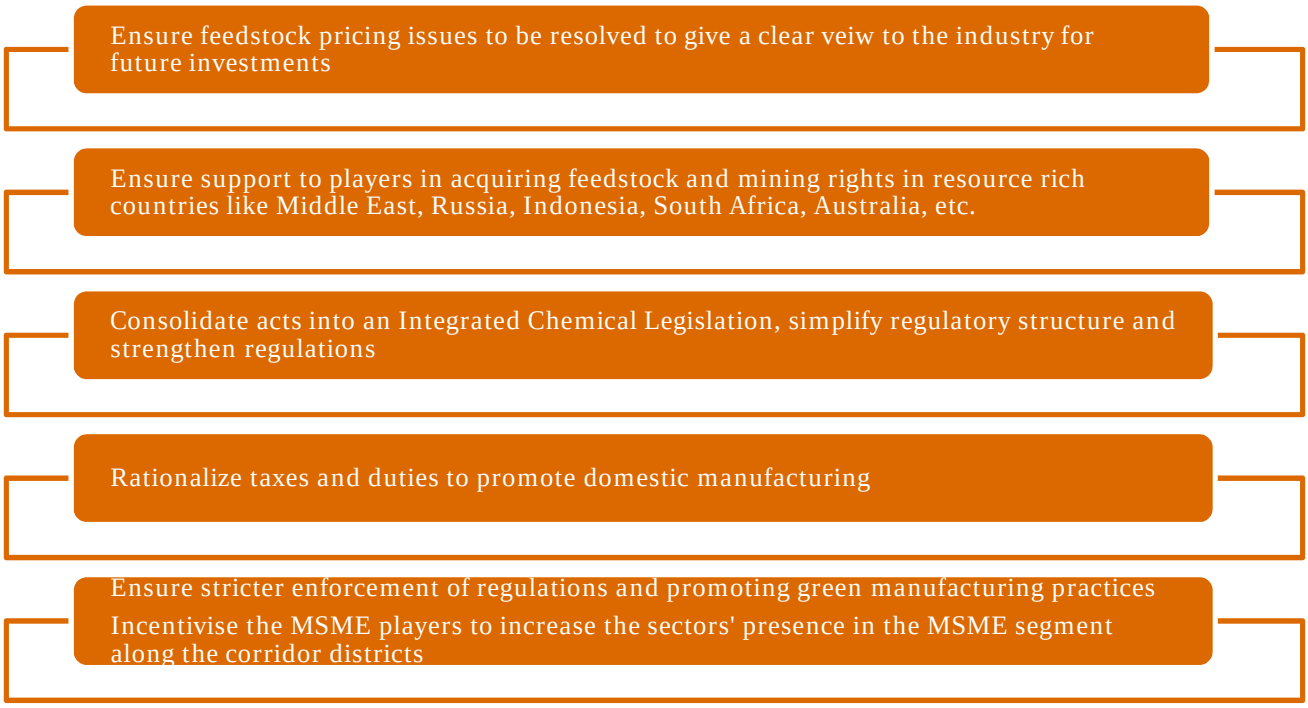
Source: District profiles, Industry reports, PwC analysis

4.4.8.4.2 Administrative enhancers

The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh do not have any specific policy dedicated to the chemicals and petrochemicals sector. The states are guided by the national level policies, where the draft National Chemical Policy 2012 is yet to come out in concrete form. While the physical infrastructure shortcomings may get addressed through the economic enhancers, Government should consider a robust policy and regulatory framework to ensure the sector's growth in the corridor.

Government should take definitive measures to resolve certain issues pricing of domestic natural gas. The current pricing of natural gas makes it unviable for the basic chemicals manufacturers (methanol) to compete against cheaper imports. Similarly, chemicals & petrochemicals sector players face high cost of compliance to environment norms and the compliance procedures are time consuming. The policy measures should ensure that while quality of chemicals manufacturing is not compromised, the ease of doing business should be ensured.

We recommend that the Government of these states should propose a dedicated policy for the sector, which may increase the attractiveness of the sector along the corridor. We propose the following aspects to be addressed through a dedicated policy for this sector:



4.4.8.4.3 Value enhancers

Skill development:

The chemicals & pharma sector in Karnataka is expected to generate an incremental demand of 9,600 people from 2012-22[68]. Karnataka is likely to face a supply gap of 1.9 million people, which also includes around 20-30% of the unemployable workforce joining from educational institutions[69]. Key districts identified as potential chemicals & petrochemicals nodes within the corridor including Bengaluru urban, Bengaluru rural, Ramnagara, and Nellore have shown deficit in the availability of labour by 2022[70].

District name	Labour availability scenario in 2022
Bengaluru Urban	**Deficit**

[68] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*
[69] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*
[70] *Source: National Skill Development Corporation publication on skill gap*

District name	Labour availability scenario in 2022
Bengaluru Rural	**Deficit**
Ramnagara	**Deficit**
Chennai	NA
Tiruvallur	NA
Kancheepuram	NA
Nellore	**Deficit**

Source: National Skill Development Corporation publication on skill gap

It is also estimated that India will need over 14,000 highly skilled, chemical engineers within the next decade to join the specialty chemical industry alone, and a potential short fall of 8,000 to 10,000 chemical engineers is indicated driven by limited talent from Tier 1 universities and lack of attractiveness of the chemical sector for employment. Hence, the shortfall of resources will be a national phenomenon and Government can take proactive measures to create a hub of chemicals sector resource building along the CBIC. We recommend that Government should work in collaboration with industries, to upgrade the current chemical departments in Tier 2 universities to become state-of-the-art departments (in terms of infrastructure, faculty qualifications, industry interaction, and administration). Government should also ensure new ITIs, vocational training institutes and diploma institutes along the identified districts.

Chemical Sector is one of the largest consumers of Industrial Water and also contributed highly to industrial wastes. Efforts need to be made for improving efficiency of water use and promoting recycle, reuse concepts. India also needs to provide support for developing quality infrastructure for effluent treatment and management.

- Promote industry based on efficiency; incentivise industry players to follow best practices of manufacturing like higher efficiency, latest technologies
- Promote recycle & reuse concepts, especially for water
- Promote technologies such as 'zero discharge' of industrial effluents
- Extend special incentives to large scale and innovative projects along the corridor, on a case to case basis
- Promote investments in R&D and green technologies, fiscal incentives such as accelerated depreciation, tax benefits, subsidies etc.
- Establish a CBIC Chemical Innovation Fund to encourage commercialization efforts for innovations generating inclusive growth

4.4.8.5 Recommendations summary

Domestic demand: Our research suggests that certain sub-segments like petrochemicals, fertilizers and specialty chemicals have tremendous domestic potential and the capacities in most cases are either facing under-supply situation or will see under-capacity situation beyond 2020. The Government should focus on creating the necessary infrastructure like road connectivity to major cities; major end-use industrial cities/estates/industrial parks etc. within the identified chemicals sector nodes along the corridor, to enable more investments in the region. For products like methanol, Government should ensure rational import duties and enhance end-use industry based on this feedstock. For products like PVC and EDC, necessary linkages of roads should be created and incentives should be accorded to promote domestic manufacturing, within the corridor. Government should also target the specialty chemicals segment to flourish within the corridor districts. Government should ensure higher number of technical institutes and training centres to bridge the impending labour gap for this sub-segment along the corridor districts. Chennai, Kancheepuram, Tiruvallur, Bengaluru urban, Bengaluru rural, Ramnagara and Nellore should have preferential ease of land allotment for chemical sector players. Government should also ensure that naphtha allocations are sufficient to the fertilizer industry within the corridor and may extend special project linked incentives to mega projects for fertilizer manufacturing in the corridor.

Strategy for export demand: The key sub-segments that are having strong export oriented demand are the specialty chemicals and agrochemicals segment. Government of India should focus on establishing dedicated port linkages to ease the logistics between the corridor districts to the sea ports. Government should also ensure that the sea ports are capable enough to handle such liquid chemicals. Beyond this, special incentives may be extended to the players for establishing their units within the corridor districts. Government should accord the status of innovative projects to key projects which are based on latest technologies in these segments. Green chemicals should be promoted and special incentives should be extended to companies following green manufacturing practices.

On an overall level, the basic infrastructure of developed land with effluent treatment, waste treatment, water and power infrastructure should be ensured by the state Governments along the corridor districts. Power availability is a key issue faced by most of the MSMEs and hence, Government may look at ensuring adequate quality power for these industrial districts. On the MSME front, the Government initiatives should be focused on establishing product promotion centres along the key corridor districts, which can connect the MSME units to both domestic as well as global market. Government should ensure that the MSMEs are extended proper project funding and are given due assistance during the initial years. A dedicated cell for monitoring the MSME sector progress for the chemical sector players within the corridor districts may also be considered.

To boost the chemical sector growth in the country, the Government of India came out with the draft National Chemical Policy (NCP) in 2012. The Draft National Chemical Policy, 2012 released by the Ministry of Chemicals and Fertilizers, Department of Chemicals and Petrochemicals, Government of India in 2012 is a landmark development for the industry. The policy accords high importance to aspects of research and development, safety, sustainability and green chemicals. The policy articulates the need for a consolidation of multiple regulations and policies into a single holistic framework. Sustainability is one of the mainstays of the policy. It encourages companies to seek 'Responsible Care' certification. It envisages identification of focus areas and then supporting educational and research institutes to develop low water intensive, environmentally compliant and safe green processes. Incentives for green products and processes are also discussed in the draft framework. Industry specific guidelines for chemical disaster management are on the anvil, with coordination from the National Disaster Management Authority.

The Government has also allowed 100% FDI in the chemicals sector. The manufacturing of most chemical products inter-alia covering organic/inorganic, dyestuffs & pesticides is de-licensed. This is also an important policy push from the Government to attract investments in the sector. Apart from this, the Government of India has also announced various incentives for specific sub-sectors like the scheme for setting up of plastic parks and the petrochemical policy in 2007. The Government of India has also come up with a policy for promotion of Petroleum Chemicals and Petrochemicals Investment Regions (PCPIR) in May, 2007, with the objective of accelerating promotion of investment in the chemical / petrochemical sectors so as to make India a hub for both domestic and international markets taking advantage of global shift in demand and production for petrochemicals. These factors have a strong impact on the investment scenario in the chemical sector in India and the upcoming National Policy is set to further strengthen the scenario of the sector.

4.4.9 *Electrical machinery and machinery sectors*

4.4.9.1 Sector performance

Globally robust economic growth in developing countries, such as China and India, along with rapid urbanization trends and growth in fixed investment spending (especially in infrastructure such as roads and electricity generation) boosted demand for electric machinery and machinery in the region. Demand in these sectors is fuelled by end-use sectors, like construction, power, infrastructure development, and supported by large size of Asia Pacific economies which are also home for 55% of the world's population.

Global trade in electrical equipment products accounts for about **4% of the total global trade**. Global exports reached USD 688 billion in 2012, with China being the leading exporter of electrical equipment – 18% share, followed by Germany, USA and Japan. **Global machinery trade** accounts for about **11% of the total global trade**. Global exports reached USD 2,049 billion in 2012 with China emerging as the leading exporter (18% in total global exports) followed by traditionally countries with traditionally strong machinery manufacturing capacities – Germany, USA and Japan.

The Indian electrical machinery sector output grew at 23% CAGR between 2008-09 and 2010-11 and reached USD 33 billion (Rs. 198,395 crore) by 2010-11[71]. Its share in total national manufacturing output amounted to 4%. Exports of electrical machinery for the corresponding period were USD 3.5 billion (Rs. 20,742 crore) and contributed around 2% to the total exports of goods from India.[72]There are four major sub-sectors that contribute 88% of the sector's output in India. They include electric motors, generators and transformers, batteries and accumulators, wiring and wiring devices and domestic appliances. According to the Department of Heavy Industries projections, overall growth of the sector is forecast around 13-14% till 2022.

The India machinery sector output grew at 14% CAGR between 2008-09 and 2010-11; its output amounted to USD 37 billion (Rs. 2,22,185 crore).[73] Exports of machinery for the corresponding period were USD 6.8 billion (Rs. 40,805 crore) and contributed around 4% to the total exports of goods from India.[74]This sector includes two major sub-sectors – general and special purpose machinery. Share of general purpose and special purpose machinery is 55% and 45% respectively. Further analysis suggests that engines and turbines, machinery for mining, quarrying and construction and agricultural machinery are the leading segments of the sector. Apart from these segments, healthy demand is projected for other types of special purpose machinery, like machinery for metallurgy, plastic processing machinery and machine tools. Overall demand forecast for general purpose machinery is 16%[75] and for special purpose machinery is around 9-10%[76].

The corridor states of Tamil Nadu, Karnataka and Andhra Pradesh together contribute to 26% of electrical machinery output and 25% of machinery output in India. The districts of these states that fall under influence of CBIC, have traditionally accounted for 90% of the total electrical machinery investments and 76% of machinery investments in these three states.

Given the high growth trajectory of the sectors and huge domestic market potential and strong performance of the sectors in the districts under corridor's influence, electrical machinery and machinery sector are poised to emerge as key sectors which may contribute to CBIC's success in terms of attracting investments to the corridor. The area under the CBIC also includes large-scale engineering development zones such as Hosur in Krishnagiri, Integrated Business Cities– Mahindra World City in New Chennai, Sri City along the border of Andhra Pradesh and Tamil Nadu, Jinani Industrial area near Bengaluru, Mannavaram manufacturing facility in Chittoor, etc.

Our industrial assessment of the corridor districts suggests that the electrical machinery sector has the potential to create 11%-12% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively). Machinery sector has the potential to create 8%-16% of the industrial land demand in the corridor districts (considering BAU &BIS scenarios respectively).

4.4.9.2 Key growth drivers for the sector

The key drivers of demand for the electrical machinery and machinery sectors are as highlighted below:

Growing power sector in India, including shift towards setting up higher efficiency supercritical power plants in India

Capacity addition plans of Government for Indian power sector is the key growth driver for the sector. Total installed capacity as on June 2013, including renewable energy sources of the country is 226 GW. By the end of 12th and 13th Five Year Plans it is envisaged to add 89 GW and 94 GW of installed capacities respectively.

Mandatory standards were recently stipulated by BEE for Distribution Transformers unto 200 kVA, which fuelled the growth of the sub segment along with massive capacity additions in power transmission and distribution sector.

[71]*Annual Survey of Industries*
[72]*International Trade Center*
[73]*Annual Survey of Industries*
[74]*International Trade Center*
[75] DHI, Average of DHI projections for separate segments
[76] Dun& Bradstreet, Crisil research - for separate sub-segments

Massive capacity additions along with necessary replacement of ageing (20-25 years) equipment and shift towards setting up higher efficiency supercritical power plants have facilitated growth of the electrical machinery and machinery sectors.

Accelerated infrastructure expansion and growing urbanization in India

The Indian Government's investment in infrastructure projects is a major factor driving the growth of the electrical machinery market in India. During the 11th Five Year Plan (2007-2012) investment on infrastructure projects amounted to US$436 billion. The Indian Planning Commission has estimated a total investment of more than US$1 trillion for infrastructure projects during the 12th Five Year Plan (2012-2017). The various infrastructure projects undertaken by the government such as road and railway construction, mining, irrigation, urban infrastructure, and real estate development require extensive use of electrical machinery.

Machinery sector growth is driven by massive construction activities and infrastructure development (roads and urban infra, housing and office space sector) as well as expansion of operations of such major end-consumers of material handling equipment as ports, wholesale and retail sectors, warehousing, and industries like heavy engineering, construction equipment, cement etc.

Planned investment in infrastructure (more than US$1 trillion) and growing urbanization will drive the construction industry to grow at 16–17% CAGR over the next 10 years; hence development of mining, construction and quarrying machinery segment is on high trajectory.

Growing Telecom Industry

The growing telecom industry in India is the second largest telecommunications market in the world, closely following China, which is the largest in the world. In 2013, around 500,000 telecom towers were installed in the country. Internet traffic is expected to touch around 2.8 Exabyte's per month in 2018. The increasing penetration of telecommunications technology in the rural areas and the advent of 3G and 4G facility, has spurred the growth of the Telecom industry in India. This steady growth rate has increased the demand for electrical equipment such as cables and generators. For instance, generators are installed in towers to run the radio frequency transceivers. Electrical equipment is also used in the generation and transmission of signals. Thus, the increasing growth of the Telecom industry increases the market potential for the Electrical Equipment market in India.

Farm mechanization

Drivers in increased farm mechanization include availability of credit (direct institutional credit for agriculture has grown from USD 32 billion in 2006 to USD 80 billion in 2012); Labour shortage due to migration of agri labour to urban areas for industrial jobs; Government support in the form of subsidies to promote farm mechanization; Decline in availability of animal power (commercial banks reluctant to extend loans for bullocks) have driven increase in farm mechanization. This trend facilitated has driven demand for agriculture machinery segment, one of the largest segments of special machinery sector.

Increasing FDI in electrical machinery and machinery sectors

The Government of India has allowed a 100% FDI in the electrical machinery and machinery sectors. The FDI in the electrical machinery sector has grown at a CAGR of 14% from 2010 to 2013. In 2013, the FDI in Electrical Equipment industry amounted to USD 3.20 billion compared to USD 3.08 billion in 2012. Thus, the increasing investment from foreign players has led to the growth of the electrical machinery market in India.

Machinery sector has registered 33% CAGR in FDI between 2010 and 2013. FDI of USD 4.6 billion (or 2.3% of total FDI in the country) was attracted into machinery sector in 2013, which led to the growth of machinery market in India as well.

4.4.9.3 Key nodes for electrical machinery and machinery investment in the corridor

ELECTRICAL MACHINERY

The districts in Tamil Nadu within the CBIC influence zone account for **97% of all the investments in the state in the electrical machinery sector**. Key investing companies in the corridor districts within Tamil Nadu include Base Corporation Ltd., Exide Industries Ltd., Easun Reyrolle Ltd., Alstom T & D India Ltd., BSH Household Appliances Mfg. Pvt. Ltd., OBO Bettermann India Pvt. Ltd., Venture Lighting India Ltd., Amco Batteries Ltd., SMC Pneumatics (India) Pvt. Ltd., Matsushita Electric Indl. Co. Ltd., etc.

The districts of Karnataka within the CBIC influence zone account for **90% of all the investment in the state.** Key investing companies in the corridor districts within Karnataka include Alstom T & D India Ltd., TE Connectivity India Pvt. Ltd., Stove Kraft Pvt. Ltd., Easun Reyrolle Ltd., ABB India Ltd., BPL Ltd., AEG Power Solutions (India) Pvt. Ltd., AO Smith India Water Heating Pvt. Ltd., BS Refrigerators Ltd.

The districts of Andhra Pradesh within the CBIC influence zone account **for 79% of all the investment in the state.** Key investing companies in the corridor districts within Andhra Pradesh include Amara Raja Batteries Ltd., Regen Powertech Pvt. Ltd., WS Industries (India) Ltd., G R Cables Ltd., Bhagyanagar India Ltd., Bhagyanagar India Ltd., Vijai Electricals Ltd.

Bengaluru urban is an established center of electrical machinery with **investment present across multiple sub-sectors of the sector, predominantly in domestic appliances and generators, transformers and switchgears. Its share in the total investments in the corridor at various stages is 21%.**

Kancheepuram emerges as a leading district in electrical machinery among corridor districts in Tamil Nadu. Its share in the total investments among corridor's districts is 20%.

Chittoor has emerged as a center of batteries and accumulators manufacturing with indigenous manufacturer – Amara Raja. On account of reinvestment activities the district commands 16% share in the investments in the sector among districts in the influence zone of the corridor.

Krishnagiri is another prominent center of electrical machinery manufacturing with 14-16%% of total investments in the CBIC districts. Hosur is the largest hub of electrical machinery manufacturing activities the district.

MACHINERY

The districts in Tamil Nadu within the CBIC influence zone account for **76% of all the investments in the state.** Key investing companies in the corridor districts within Tamil Nadu include BGR Turbines Co. Pvt. Ltd., BGR Boilers Pvt. Ltd., Caterpillar India Pvt. Ltd., Bharat Heavy Electricals Ltd., Toshiba JSW Power Systems Private Ltd., Winwind Power Energy Pvt. Ltd., Ashok Leyland John Deere Construction Equipment Co. Pvt. Ltd., Mitsubishi Heavy Industries India Precision Tools Ltd., etc.

The districts of Karnataka within the CBIC influence zone account for **62% of all the investment in the state**. Key investors include Suzlon Energy Ltd., YG Cutting Tools Corpn. Pvt. Ltd., Triveni Turbine Ltd., Tata Hitachi Construction Machinery Co. Ltd., Leeboy India Construction Equipment Pvt. Ltd., Kirloskar Toyota Textile Machinery Pvt. Ltd. etc.

The districts of Andhra Pradesh within the CBIC influence zone account **for 76% of all the investment in the state.** 97% of investments are in Chittoor district on account of Mannavaram Greenfield Power Equipment Manufacturing Facility by NTPC BHEL Power Projects Pvt. Ltd. which is currently under implementation. Other key investors include Mahindra & Mahindra Ltd., Ramky Enviro Engineers Ltd., MMD (India) Pvt. Ltd., Paschal Formwork (India) Pvt. Ltd., Sujana Universal Inds. Ltd., Kobelco Construction Equipment India Pvt. Ltd., Kobelco Cranes Co. Ltd., Sujana Universal Inds. Ltd. etc.

Kancheepuram is an established hub in machinery manufacturing among corridor districts in Tamil Nadu with 29% share in total investments in machinery sector among corridor districts**. Chittoor** is another hub with 28% share mostly on account of Mannavaram project. Other important centers of machinery investments include **Chennai** (17%), **Tiruvallur** (9%) and **Bangalore rural** (7%).

4.4.9.4 Key interventions required and strategy for developing electrical machinery and machinery sectors along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the machinery and electrical machinery sectors along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.9.4.1 Economic enhancers

For the shortlisted districts along the corridor, we have summarized the existing status and challenges in these districts:

Table 4.4.18 Existing status, challenges and interventions required to increase investment in corridor – Machinery and Electrical Machinery

District	Existing status and current asset profile	Demand factors	Key shortcomings
Kancheepuram	• Excellent road (NH-4 via Sriperumbudur and Kancheepuram and NH-32 through the entire district) • Very good rail connectivity within district and hinterland • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports • Availability of educational institutions at Chennai and suburbs with IIT Madras and the Anna University	• Kancheepuram is one of the largest industrial areas of Tamil Nadu with number of manufacturing industries • Diversified manufacturing makes it a good market for electrical machinery and machinery sectors	• Inadequate quality of power (power cuts and fluctuation) • Mismatch of technology between the existing micro players and MNCs which are coming in the district; this leads to lack of market support from big players
Chittoor	• Excellent road connectivity (NH-40 (to Chennai), NH-42, NH-69, NH-71, NH-716 (to Chennai) • Excellent rail connectivity in parallel with NH network (except NH-69) • Some availability of educational institutions (18 engineering colleges) and proximity to Bengaluru, which has access to skilled resources	• Established dealership network within the state and around the country • Proximity to end-use industry cluster of auto & auto components to ensure demand for batteries and accumulators	• Narrow market base
Chennai	• Excellent road and rail connectivity within district and hinterland • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports • Good availability of educational institutions - Around 240 engineering colleges, 19 universities, IIT Madras	• Presence of ancillary units and large units that helps leveraging this synergy both by large companies and MSMEs • Construction activities create demand for products of multiple sub-sectors of electrical machinery and machinery sectors	• Poor supply of electricity and high rate of electricity charges • Congested ports
Bengaluru urban	• NH-4, NH-7 & NH-209 goes through district and connect to other parts of Karnataka and other States • Chennai Port is situated at a distance of 315 Km • Good availability of skilled manpower	• Presence of ancillary units and large units that helps leveraging this synergy both by large companies and MSMEs • Construction activities create demand for products of multiple sub-sectors of electrical machinery and machinery sectors • Presence of large number of engineering units creates demand for machinery equipment	• Issues related to quality of the raw material specifically with the consistency or rather the lack of it (More than one third of MSME units work with material supplied by the buyer or directly by a supplier picked by the buyer) • Need to establish feedback for the supplied products from end-users to MSMEs through dealers network
Bengaluru Rural	• NH-4 and NH-48 goes through district and connect to other parts of Karnataka and other States. • Availability of well developed rail network – a total railway route of 204.39 km • Mangalore Port is situated at a distance of 320 km		
Krishnagiri	• Excellent road connectivity (NH-7, NH-42, NH-48,	• Krishnagiri hosts one of the largest	• Inconsistency in availability of

District	Existing status and current asset profile	Demand factors	Key shortcomings
	NH-66) in central, northern and eastern parts of the state • Good rail connectivity (eastern and central areas of the state)	industrial complexes in the country – Hosur – with a very diversified manufacturing base • Large number of small engineering companies is present – bases for good symbiosis between large plants and ancillary units	quality raw material and its high price fluctuation • Lack of testing centres • High dependence on traders by majority of MSME units
Tiruvallur	• Excellent road (NH-5 via Gummidipoondi and NH-205 via Ambattur and Tiruvallur) • Rail connectivity within district and hinterland is available predominantly in southern and coastal parts of the district • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports	• Presence of electrical and other engineering units in Kakkalur near Tiruvallur town and in Gummidipoondi and Villivakkam Block in Ambattur Industrial Estate	• Power crisis (power cuts and high electricity charges) • Transportation bottlenecks • Lack of proper infrastructure and other physical communication facilities

Source: District profiles, Industry reports, PwC analysis

Some shortcomings are universal for the sector at national as well as district level. They are summarised along with recommendations to the GoI for addressing these issues:

Table 4.4.19: Current status, shortcomings and recommendations – Machinery and Electrical Machinery

Issue	Sub-sectors for which issue is critical	Status in India/Corridor	Recommendations
Availability of Critical Raw Materials	• Electric motors, generators, transformers and electricity distribution and control apparatus • Engines and turbines	• Constrained availability of certain critical raw materials such as Cold Rolled Grain Oriented (CRGO)/ Cold Rolled Non-Grain Oriented (CRNGO) Steel, Amorphous Steel etc. and volatility in raw material prices is hurting domestic industry • Electrical industry is largely dependent on imported CRGO/ CRNGO electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported by domestic manufactures from very few suppliers worldwide (only 14 mills are operating worldwide). Out of 14 only 3 mills are BIS certified; currently it is mandatory to obtain BIS certification for all the suppliers. Any delay in the registration of foreign suppliers with BIS leads to supply constraints to domestic industry	**Short term measures:** • Ensure secure supplies of critical raw material in the short run • BIS certifications guidelines to be modified to avoid delays in registration of foreign suppliers **Long term measures:** • In the long run promote and ensure setting up units manufacturing CRGO and CRNGO electrical steel in the country to

Issue	Sub-sectors for which issue is critical	Status in India/Corridor	Recommendations
			remove dependency on raw material imports
Rail and road connectivity	All sub-sectors manufacturing heavy machinery: • Electric motors, generators, transformers • Engines and turbines, • Fluid power equipment • Ovens, furnaces and furnace burners • Lifting and handling equipment • Agricultural and forestry machinery • Metal-forming machinery • Machinery for metallurgy • Machinery for mining, quarrying and construction	• Rail connectivity is stated as necessary by heavy machinery manufacturers in order to transport over dimensional consignments (ODC) and over dimensional components to assembly units. Availability of rail sidings as a last mile connectivity to the main rail network is also essential • Problems in transporting heavy and ODC >98 MT on NHAI bridges. As per procedure, various zonal railways involved give clearance for the movement of such ODCs.[77]	• Increase rail network connectivity as necessary requirement to transport ODC cargoes • Address issues of moving the ODC by NHAI
Proximity to port	Sub-sectors dependent on supplies of raw material (electrical steel)	• All three states are having access to the sea and have developed ports infrastructure Manufacturing clusters of Kancheepuram, Chennai and Tiruvallur are in advanced position in terms of port connectivity, whereas Bangalore urban/rural, Chittoor and Krishnagiri are landlocked districts The long term vision of the Government of India is to increase exports of electrical machinery and other machinery segments. Hence availability of port infrastructure is essential FoP for the sector • The segments dependent on electrical steel require proximity to ports as their raw material is imported	• Create dedicated corridors connecting land-locked districts with existing ports to enhance their attractiveness for the units dependent on imported raw material • It is also important to promote the vision of the GoI to boost country's share in electrical machinery exports
Uninterrupted power supply	All sub-sectors	• Power shortages are prevalent in many of the Indian states, including states within the corridor. Electricity rates are another point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply

[77] *Report of the Working Group on Capital Goods & Engineering Sector for the 12thFive Year Plan (2012-2017), DHI*

Issue	Sub-sectors for which issue is critical	Status in India/Corridor	Recommendations
Availability of indigenous testing facilities	Electric motors, generators, transformers and electricity distribution and control apparatus Engines, turbines and related equipment	• The electrical equipment testing facilities available in India are quite inadequate. Vendors have to send their equipment to foreign countries for testing which is time-consuming and expensive. • The process results in increased prices and directly affects the end-users. Moreover, the local players do not have enough capital to set up testing facilities as the investment required is huge.	• Facilitate setting up of indigenous testing and calibrating facility for equipment testing

4.4.9.4.2 Administrative enhancers

We recommend that the Governments of these states should propose dedicated policy interventions for the sectors, which may increase the attractiveness of the sectors along the corridor. The policy measures should ascertain that while quality of raw material and end-user product is not compromised, the ease of doing business is ensured.

We propose the following aspects to be addressed through appropriate administrative enhancers:

Table 4.4.20: Current shortcomings and key interventions at administrative level – Machinery and Electrical Machinery

Current shortcomings	Key interventions required
• **Duty structure: Inverted duty structure in FTAs and other economic parameters favours imports as preferred source of supply and leaves domestic players in unfavourable position** • **Unregulated imports of second hand equipment (heavy machinery segment): though it helps reducing project cost in the short run, it negatively impacts end users and discourages indigenous equipment manufacturers**	• **Substitute Imports:** – Calibration of duties and taxes on imported equipment is required to remove disadvantage for domestic players – Address adverse tax structure for local manufacturers in India – Imports of second hand machinery should be regulated
• **Impediment to new technologies: Issues with absorption of new technology by domestic manufacturers and end-user industries:** – **Need for improvement in design of procurement process and policies of central and state utilities (bundling of projects by utilities leads to sub-optimal capacity utilization)**	• **Develop standard procurement policies and product specifications** – Initiate adoption of new procurement mechanisms by utilities that do not discourage technology development (currently selection based on L1 criterion – Propose creation of dedicated funds for R&D in the sector.
• **Quality issues: Absence of standard procurement policies and not clearly defined product specifications, lack of standardization of product specifications, design parameters and ratings leads to approval of goods of inadequate quality**	• **Introduction quality control mechanisms and certification systems in the sector** – Facilitate setting up a quality control system and allied mechanisms to ensure product quality control (supplies from vendors and end-products) – Certification facilities for imported raw material are to be improved
• **Government delays in project approvals** – **The Government of India often takes time in approving infrastructure projects which results in a delay of products and services reaching the consumers. The delays are in terms of forest clearance, land acquisition approval, process approval, and financing.**	• **Rationalize government approval to reduce project delays** – Forest clearance, land acquisition approval, process approval, and financing are to be rationalized to remove delays in execution of projects that provide large orders for electrical machinery and machinery manufacturers
• **Accessibility of technology to the sector players (predominantly MSMEs)**	• Facilitate support infrastructure development, like common facility centers, product development centers • Popularize national level programmes for modernization of end-user industries (textiles, auto and public transport, power sector)
• **Availability of loan facilities (to MSMEs)**	• Address issue of financing availability for MSMEs

Current shortcomings	Key interventions required
MSMEs are often face reluctance from bankers to finance their projects as well as usually constrained by high cost of capital	
• **Exports of electrical machinery and machinery require special attention:** – **India's share in global export of electrical equipment is around 0.7% and machinery – 0.5%.** – **The export promotion schemes of the government are not easily available for project exports** – **Lack of competitive long term export financing options**	• **Export promotion policies** related to – export financing – taxation – marketing etc would immensely help the Indian exporters compete better in global trade

Source: Industry reports, PwC analysis

4.4.9.4.3 Value enhancers

The electrical machinery and machinery sector is highly diversified. Though the country highly depends on imports of electrical machinery and machinery, the past decade witnessed entrance of large international players that set up facilities in India in a form of JVs with domestic manufacturers. At present, sufficient indigenous capacities got created to produce the required equipment domestically (barring supercritical technologies and several highly specialised equipments).

In spite of high diversity, the sectors still focuses on being equipment or component suppliers and have not graduated to offering complete solutions. This may become a sector evolutionary step to provide integrated solutions and integrate value chain. Having recognized that the sector is lagging behind in terms of value addition, Twelfth Five Year Plan recommends to national and state governments mandating minimum 30% local value addition for capital goods[78].

Availability of skilled workforce and operational capacity building is another set of issues faced by both large players and MSMEs in these sectors. Electrical machinery sector alone is forecast to require more than 5 million of direct manpower and another 10 million of indirect manpower by 2022.[79]

Table 4.4.21: Current shortcomings & key interventions – Value enhancers – Machinery & Electrical Machinery

Current shortcomings	Key interventions required
• **No significant investment in technology development through R&D on account of:** – **Lack of academic / R&D support institutions to undertake R&D** – **High cost of R&D especially in modern technology machine tools.**	• Support/incentives to be provided to the manufacturing units in setting of R&D facilities
• **Skills erosion across electrical machinery and machinery sectors on account of IT development and other employment avenues.**	• Specialised courses are to be introduced across various streams of electrical machinery and machinery sub-sectors to create employable personnel • Facilitate setting up sector specific ITIs/Vocational training centres, capacity building centers and common training facilities • Roll out programs for formal education and operational capacity building in MSME

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79 *Indian Electrical Equipment Industry Mission Plan 2012-22, MHI*

Current shortcomings	Key interventions required
• **Automation equipment to improve productivity, reduce wastage and improve quality levels is not available in the country**	• In the short run – for the time bound period facilitate reduction of import duty on automation equipment • Develop a roadmap for setting up facilities for manufacturing of required equipment indigenously
• **Low value addition - Technology profile of domestic products is from basic to intermediate.**	• Incentivize/mandate foreign players to increase value addition in India under technology transfer agreements • Amend FDI policy to facilitate technology transfer by giving preference to joint ventures with Indian firms, not 100% foreign owned companies

Source: Industry reports, PwC analysis

4.4.9.5 Recommendations summary

The electrical machinery and machinery sectors are primarily driven by domestic demand. The economy size and high growth trajectory, focus on power sector development, rapid industrialization and infrastructure developments have facilitated creation of indigenous capacities to cater to domestic demand. At present, manufacturing facilities for almost all important sub-sectors have been established in the country. The following measures should be undertaken to support the development of electrical machinery and machinery sectors to primarily cater to domestic market and in the long run to develop significant export capacities:

In the short run:

- Secure raw material availability for the sector by establishing seamless certification procedures for imported electrical steel to avoid interruptions on account of non-certified products.
- Certain protectionist measures may have to be adopted to support indigenous manufacturers, like putting restrictions on second hand equipment, mandating foreign partners to foster technology transfers along with setting up manufacturing facilities, etc.
- Promote technologies upgradation, new technology introduction and accordingly modify the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery and machinery manufacturers.
- Develop testing facilities, quality control systems and certification mechanisms to help enhancing value of the manufacturing output in these sectors.

In the long run:

- Facilitate establishment of indigenous raw material production capacities (electrical steel)
- Bridge skill gap and provide skill development support:
    - Establishment of linkages between industry and academia – active involvement of public and private participation
- Introduce measures to ensure that all sub-sectors of electrical machinery and machinery move up the value chain and evolution from component or equipment manufacturing to provide complete industry solutions.
- Focus on gradual transition from import dependent to export oriented electrical machinery and machinery sectors:
    - Promote exports by facilitating dedicated line of credit
    - Introduce programs to promote indigenous brands to the global market by identifying target markets and developing country-specific export strategies.

4.4.10 *IT and financial*

4.4.10.1 Definition of the sector

Under the condition of volatile economic environment in 2012, global IT sector has recorded a steady turnover of USD 1.9 trillion and registered 4.8% growth against 2011. BPO/BPM services grew at the rate of 4.9% (slightly above industry average) and contributed majorly to the sector performance. This segment was followed by IT services and packaged software segments each with 3.3%growth.

IT services, BPO/BPM services and software products continued to lead, accounting for over USD 1 trillion – 58%of the total IT spend.

A.T. Kearney's 'Global Services Location Index' positions India as the leading destination of service industry in the world. As this index shows, India takes an outstanding position in among global peers competition. The major success drivers include financial (c0st) competitiveness and highly skilled English-speaking workforce.

Table 4.4.22: Top 10 countries of Service industry index

Rank	Country	Financial Performance	People Skills and availability	Business Environment	Total Score
1	India	3.11	2.76	1.14	7.01
2	China	2.62	2.55	1.31	6.48
3	Malaysia	2.78	1.38	1.83	5.99
4	Egypt	3.10	1.36	1.35	5.81
5	Indonesia	3.24	1.53	1.01	5.78
6	Mexico	2.68	1.60	1.44	5.72
7	Thailand	3.05	1.38	1.29	5.72
8	Vietnam	3.27	1.19	1.24	5.70
9	Philippines	3.18	1.31	1.16	5.65
10	Chile	2.44	1.27	1.82	5.53

Source: A.T. Kearney Global Services Location Index

India's IT sector (including hardware) is estimated to have generated USD 108 billion in revenue during 2013 compared to USD 101 billion in 2012, implying a growth rate of 7.4 per cent[80] The IT sector (excluding hardware) generated USD 95.1 billion in revenues in 2013.As the exhibit below shows, market size of IT sector in India has been steadily growing. Compared to the domestic market, share of export market has sizeably increased. The contribution of the IT sector to India's GDP rose to approximately 8% in 2013.

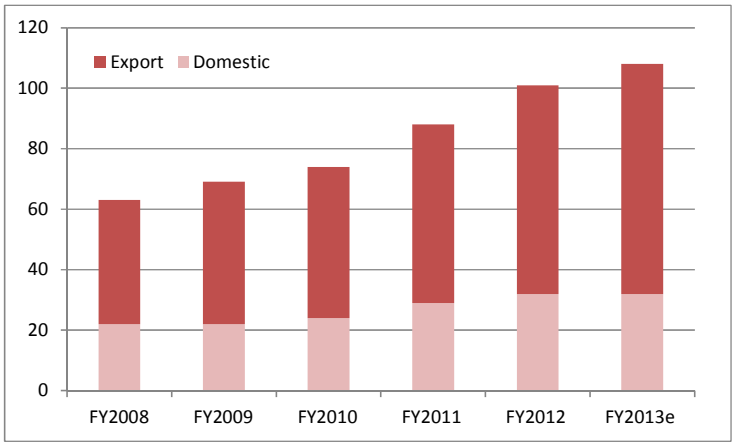


Figure4.4.8: Market size of IT industry in India (USD billion)

Source: IBEF

[80] IBEF

During 2013 total exports from the IT sector (excluding hardware) have been estimated at USD 76 billion; the industry have grown at a CAGR of 13.1% between 2008 and 2013 despite downward trend in global economic growth scenario. Export of IT services has been the major contributor, accounting for 57.9% of total IT exports (excluding hardware). BPM, the second largest segment, accounted for 23.5% of total IT exports during 2013.

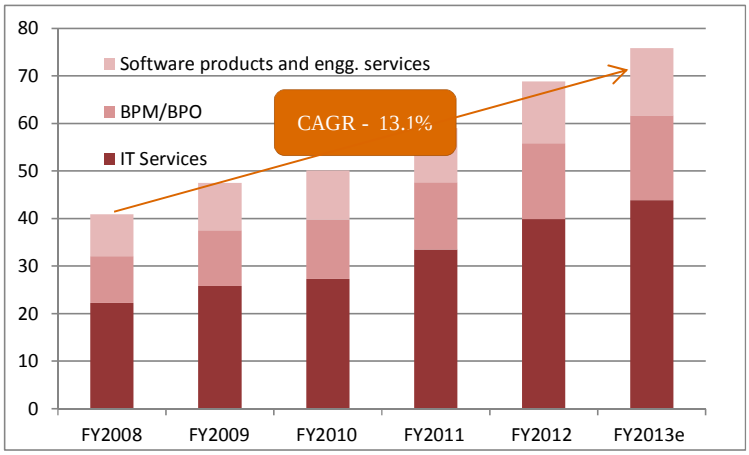


Figure4.4.9: Export revenue of Indian IT sector - (USD billion)

Source: IBEF

IT services and Business process management (IT-BPM) is the largest segment of the IT sector in India and is the leader both in domestic and export markets. It accounted to 81% of the total market size in 2013 and over 80% of exports from the sector in the same year.

Around 85% of total IT-BPM exports from India are across four sectors: BFSI, telecom, manufacturing and retail. BFSI is a key business vertical for the IT-BPM industry. It generated export revenue of around USD 31 billion during 2013, accounting for 41% of total IT-BPM exports from India.

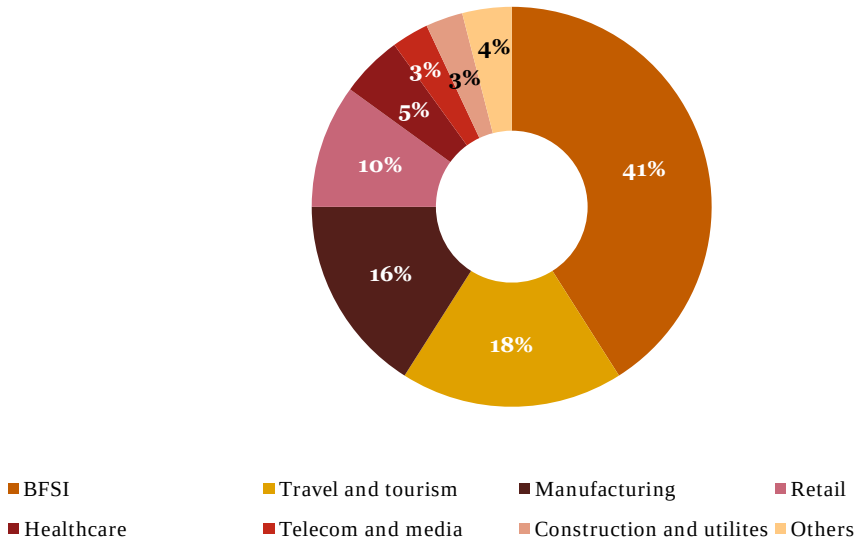


Figure4.4.10: Export revenue across IT-BPM segments. %, 2013

Source: IBEF

Disruptive technologies, such as cloud computing, social media and data analytics, are offering new avenues of growth across verticals for IT companies. Gaming and animation is among the fastest growing segments, driven by raise in disposal income of population and rapid technological changes.

4.4.10.2 Key growth drivers for the sector

The key drivers of demand for the IT sector are as highlighted below:

Growing global demand

Globally offshore expenditures for IT sector have grown at CAGR of 8% between 2011 and 2013. Global BPM spending was estimated to expand at a CAGR of around 7% during 2011–13.[81]

Domestic growth

Computer penetration in India is steadily growing and is expected to continue to increase. Government IT expenditures are also growing and it is expected to be a major contributor to domestic demand by 2013–14.

Talent pool

Frequently referred as one of the youngest nations in the world, India undoubtedly holds the leading position in availability of young, highly qualified workforce with required technical skills and the English language proficiency. About 4.7 million graduates are estimated to have been added to India's talent pool in 2013.

Infrastructure

Robust IT infrastructure across various cities in India such as Bengaluru (Karnataka is termed as the 'Knowledge Capital of India'. The state houses 550,000 IT professionals which is about 1/3rd of the total IT professionals in the country. Delivery centres of Indian IT companies are spread across various countries.

Policy support

Tax holidays have been extended for IT sector (Software Technology Parks of India (STPI) and SEZs)

Government ensured procedural ease and single window clearance for setting up facilities (for example, SEZ scheme since 2005 benefits IT companies with single window approval mechanism, tax benefits, etc.)

4.4.10.3 Key nodes for IT sector investment in the corridor

Having accessed the sector presence in the districts of the corridor, it is evident that there are two major clusters where IT sector is concentrated – Bengaluru and Chennai. 74% of investments (completed and ongoing projects) in IT sector in the corridor's districts are in Karnataka and concentrated in Bengaluru urban and Bengaluru rural districts.[82]

Tamil Nadu is another important destination for investments in IT services sector with 26% share in IT sector projects (completed and at various implementation stages). The city of Chennai, Chennai district and Kancheepuram are the places that host the largest number of IT sector project among the districts under CBIC corridor in Tamil Nadu.

Chennai ranks 4thin the highest number of employees in India's IT & ITES sector. It is the 4th in highest number of higher education institutes. Chennai has the largest resource pool in the form of graduating students suitable for this sector. Since 2000, old Mahapalipuram road (OMR) is also known as the IT corridor of Chennai. Till 2006, IT development in this micro market was mainly driven by government nodal agencies – TIDCO, ELCOT and SIPCOT. However, post 2006 major private players including RMZ, Shapoorji & Pallonji, Tata Realty and others have developed IT parks along this road.

[81] IBEF
[82] Capex database

Examples of key industrial parks include Electronics city, ITPL (International Technology Park), STPIs (Software Technology Parks established under STPI scheme). . These parks are located in suburban areas with distance of around 20 km away from the city center. These industrial parks are equipped with high quality infrastructure and secure better accessibility from airport /city center, thereby attracting both domestic and foreign investments.

As these examples show, basically IT/financial industry is located and clustered in the suburban area of Tier I cities. However, STPI scheme promotes Tier II and III cities as well. In this region, two cities – Bengaluru and Chennai has large scale of IT/financial industry.

Focus can be given to the Bengaluru city area, but Bengaluru urban area might be recommended as well since Bengaluru urban area is suffering from lack of available land. Considering Karnataka governments emphasis on creation of ICT center beyond Bengaluru urban areas, we can see the area of Bengaluru rural area as a potential area for sector expansion.

Another prominent focus center can be Chennai district as it has all necessary infrastructure established in this area as well as it is one of the prominent centers of IT sector in the country.

Other than the scenario above, we can also consider scenario to grow up industry in rural areas. IT/financial sector is strongly absorbing employment in this region. Although currently IT/financial sector city is centered in major Tier-I cities, it is also possible that the cluster will spread to tier-II/III cities and further to rural areas. Spreading the industrial cluster beyond the outreach of tier-I city has benefits in terms of economics and competitiveness – as described already, rising wages is key issue of IT/financial sector in India. Therefore through the spread of cluster to rural area, cost could be reduced and the industry can get competitiveness compared to other countries.

4.4.10.4 Key interventions required and strategy for developing IT/Financial sector along CBIC

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the IT/Financial sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

4.4.10.4.1 Economic enhancers

IT sector requires good quality electricity and telecommunication infrastructure. Focused approach to creation of these infrastructure components will help improving investment climate for IT service companies.

The sector is highly sensitive to the availability of high quality social infrastructure and residential facilities as it primarily employs highly qualified workforce.

For the shortlisted districts along the corridor, we have summarized the key interventions required by GoI along with the existing status and challenges in these districts:

Table 4.4.23: Existing status, challenges and interventions required to increase investment in corridor – IT and Financial services

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required	Key sub-segments that may emerge
Bengaluru urban and Bengaluru rural	• Existing IT/BPO parks around Bengaluru, located at ~20 km for the city • Availability of	• Increase of global expenditure for IT and allied sectors Growing domestic demand, increased	• Lack of land for new industrial park • Lack of quality infrastructure Insufficient R&D	• Improvement of infrastructure of existing IT/BPO parks • Provisioning	IT services BPM (BFSI, telecom and manufacturing) Emerging verticals in

District	Existing status and current asset profile	Demand factors	Key shortcomings	Key interventions required	Key sub-segments that may emerge
	existing power and telecommunication infrastructure • Availability of skilled resources	government expenditure for IT-enabled solutions • Digitalisation of manufacturing sectors and end products • Growth of IT oriented industries – e.g. gaming and animation	facilities • Availability of skilled workforce in future • Future shortfall of skilled workforce	for uninterrupted power supply and improvement of telecommunication infrastructure	BPM (such as education, healthcare and retail)
Chennai	• High concentration of IT parks around Chennai city (IT corridor of Chennai) • Availability of existing power and telecommunication infrastructure • Availability of highly skilled resources				

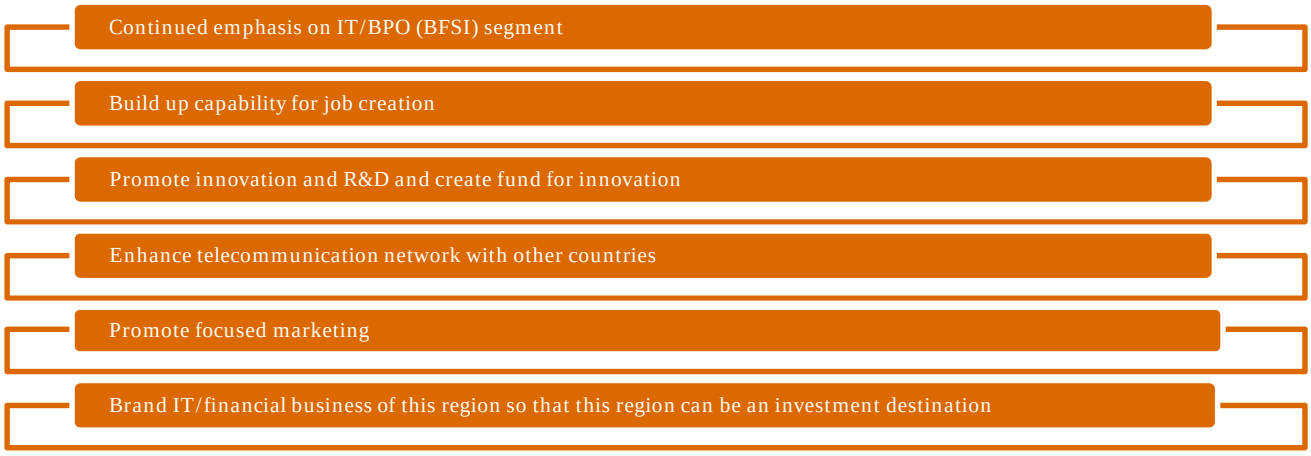
Source: District profiles, Industry reports, PwC analysis

4.4.10.4.2 Administrative enhancers

The corridor states of Karnataka, Tamil Nadu have specific policies dedicated to the IT and financial sector.

The state of Karnataka has a clear vision of IT/financial sector. On the other hand, Tamil Nadu state ceased to update its IT policy after 2008 and there is no updated version of dedicated vision for IT sector. The IT policy of Andhra Pradesh for the period from 2010-2015 was issued in 2010.

We recommend that Tamil Nadu and Andhra Pradesh will create a dedicated policy for the sector, which may increase the attractiveness of the sector along the corridor. We propose the following aspects to be addressed through a dedicated policy for this sector:



4.4.10.4.3 Value enhancers

Skill development:

The IT and Financial sector in Karnataka is expected to generate an incremental demand of 2,000,000 people in 2020[83]. Karnataka is likely to face a supply gap of 1.9 million people, which also includes around 20-30% of the unemployable workforce joining from educational institutions[84]. Key districts identified as potential IT and

[83] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*
[84] *Source: National Skill Development Corporation publication on skill gap in Karnataka, 2012*

Financial services nodes within the corridor including Bengaluru urban, Bengaluru rural have shown deficit in the availability of labour by 2020[85].

District name	Labour availability scenario in 2022
Bengaluru Urban	**Deficit**
Bengaluru Rural	**Deficit**

Source: National Skill Development Corporation publication on skill gap

The IT landscape will be completely transformed by 2020 on the demand side. This will call for transformation of business models, infrastructure and talent on the supply side. New opportunities will appear, calling for talent development.

According to estimates, the IT sector will create employment opportunities for 28 million (30 million according to another estimate by NASSCOM) by 2020. In order to fill this gap, government of Karnataka is proposing following measure to fill the gaps.

- Create sustainable talent pool to cater to the demand of 150,000 direct, high quality jobs in this sector.
- Create a pipeline of 1,000 master trainers for faculty development
- Develop a common assessment program for IT/ ESDM Academies
- Setup infrastructure for biometric profiling of IT professionals

4.4.10.5 Recommendations summary

The following components are essential for maintaining the competitive edge of the sector:

Focused approach to the existing IT infrastructure facilities that required improvement and expansion. It is important to strengthen the existing telecommunication infrastructure and concentrate on improvement of R&D base for the sector along with creation/augmentation of R&D infrastructure in the field of IT.

From infrastructure aspect, the basic infrastructure of developed facilities with stable electricity and infrastructure should be ensured by the state Governments along the corridor districts. This will work as primary infrastructure which improves investment climate for IT/financial sector in this region. On top of basic infrastructure, core hubs for industrial development are required. Industrial parks which can be a centralised hub for IT/ financial industry should be developed in the corridor. With such accumulation of industries, synergies among related industries and enhancement of incubation function will be facilitated. Government may focus on improvement of basic infrastructure whereas IT related parks may be promoted for development on PPP basis.

It would be essential to further ensure flexibility in policy to support and adopt new and emerging technology paradigms in IT sector.

Estimated future skill gap should be bridged by concentrated effort of creation a sustainable pool of skilled workforce. We also propose to concentrate efforts on promotion of indigenous R&D and product development capabilities.

4.4.11 *Auto and auto components*

4.4.11.1 Sector Performance

Auto sector's basic value chain is simple and quite similar to other sectors - R&D, Procurement and Production and Sales. Currently R&D is not shifted to India and usually each OEM locates this function to mother country or R&D center in the global value chain. For sales, of course the function is completed in India.

When we see production value chain, it is a bit complicated. Auto mobile is composed of greater amount of components and it has characteristics with its layer structure. Usually it is defined with 4 layers – OEM

[85] *Source: National Skill Development Corporation publication on skill gap*

(assembler)/ Tier 1 /Tier 2/Tier3. OEM assembles main components and Tier 1 supplies main components to OEM including engine/power train/ steering/ transmission/ suspension. Following downstream suppliers (tier 2/tier3) provide components to upstream suppliers and their role is usually defined based on each function (pressing/moulding/cutting/founding/forging/plating etc)

Indian OEMs (e.g. Tata/Mahindra/Ashok Leyland/Hindustan motors), all of the functions starting from Tier 3 to assembly is basically competed in India (of course there are cases when they import components from outside India, but their basic attitude is to use domestic components). On the other hand, foreign OEMs (e.g. Toyota/Nissan/Hyundai/Ford) which are seeing Indian domestic market and export from in India locate part of its function in India.

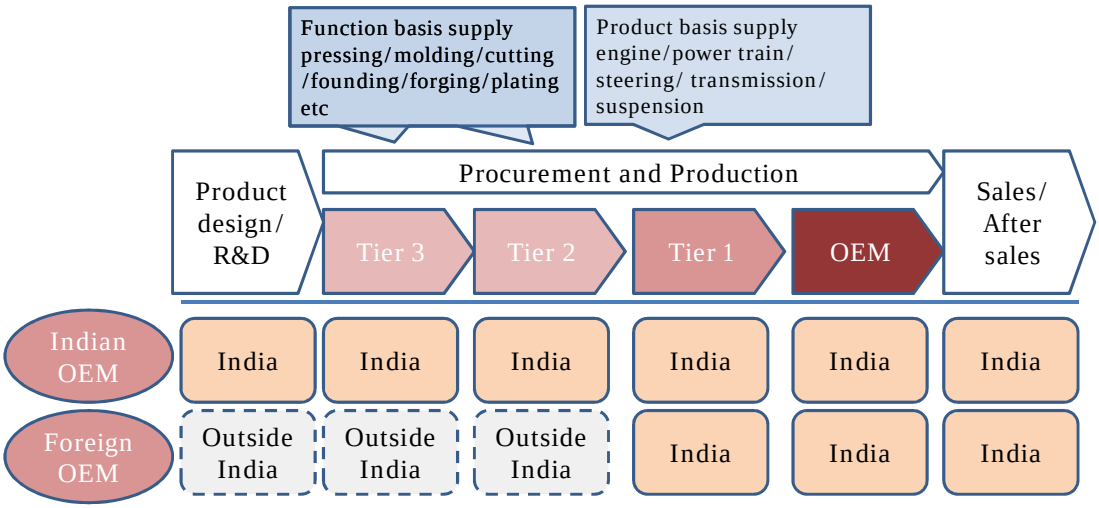


Figure 4.4.11: Past Trends in production of passenger vehicle production (in million units)

For example, Japanese OEMs locate its tier-1 supplier in India and tier-1 suppliers are supplying components from the factories adjacent to OEM's assembly base. On the other hand, tier-2 and tier-3 supplier still have not set up base in India. Most of the cases they are producing components outside India – for example Japan or Thailand. The components produced outside India are shipped to tier-1 supplier in India. (Some OEMs are thinking of requesting tier-2 and tier-3 suppliers to set up bases in India)

When we see Indian suppliers, there are various types of suppliers. Types of supplies are different by type of OEMs since requirement standards are different between Indian local OEM and foreign OEM.

No.1 Foreign Supplier- As the shown below show, currently foreign OEMs are supplied mainly from foreign OEMs. These supplies are mainly looking at local market, but they are also looking at export of components from India. (e.g. Yorozu/Kokusan denki)

No.2 Indian Global Supplier-There are well skilled local OEMs existing in the market and they are supplying components to global OEMs as well as local OEMs. They are also looking at export of components from India. (e.g. Amtek/Bharat)

No.3 and No.4 Indian local large supplier/ Indian local small supplier – They are not looking at export market and basically they are supplying components to Indian local OEMs. They are well localised and sometimes quality is not acceptable for global OEMs. Their capacity needs to be enhanced in order to be included in the value chain of global OEMs.

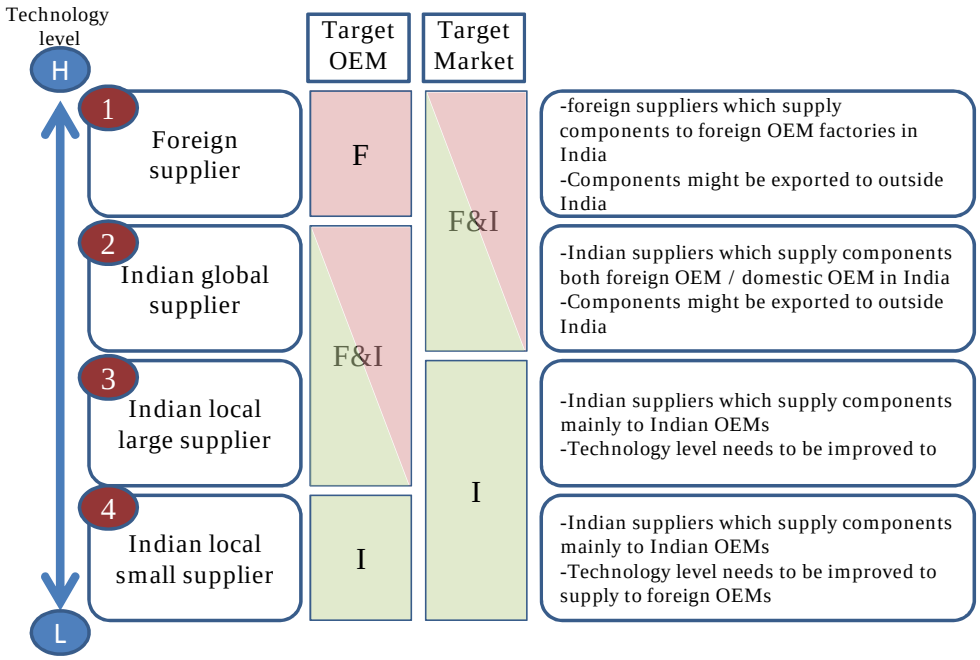


Figure 4.4.12: Past Trends in production of passenger vehicle production (in million units)

As a performance of Indian auto sector, production of Indian Auto mobile industry was growing rapidly in these several years. Number of passenger vehicles grew up rapidly a CAGR 19.5% between FY 09 and FY12, as shown in the graph below. In contrast with the rapid growth up to FY12, growth of production has damped in these two years due to economic down trend. Between FY12 and FY14, CAGR of this period was only 0.5%, which means production growth was stagnant.

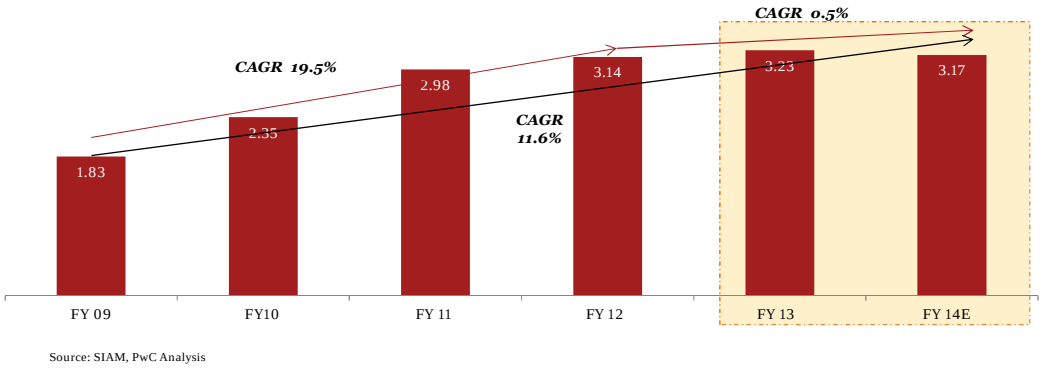
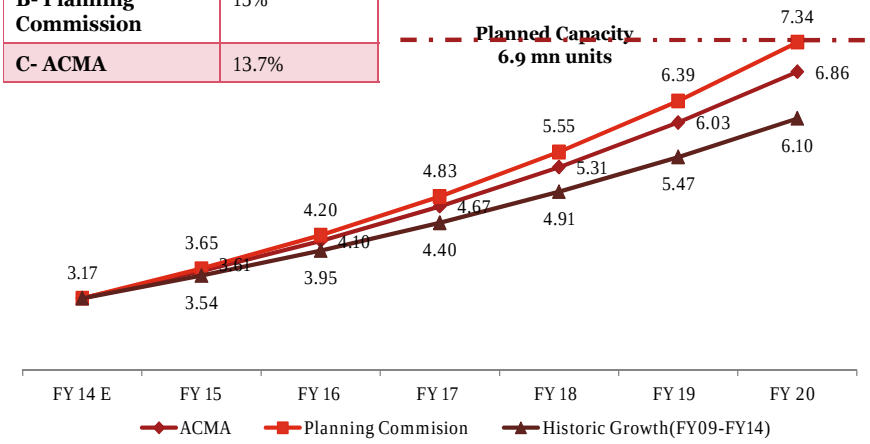


Figure 4.4.13 : Past Trends in production of passenger vehicle production (in million units)

Although currently auto industry is experiencing down trend and stagnation, the number of vehicle production is expected to grow up until 2020. There are various scenarios and growth forecasts, but we can see a stable growth CAGR number from 11.5 to 15% in various sources. By following the scenario of ACMA where we see a growth rate of 13.7% up to 2020, total production volume will reach 6.9 million units, more than double the current number.

Growth Scenario	Growth rate Considered
A- FY09-14 (Actual)	11.5%
B- Planning Commission	15%
C- ACMA	13.7%

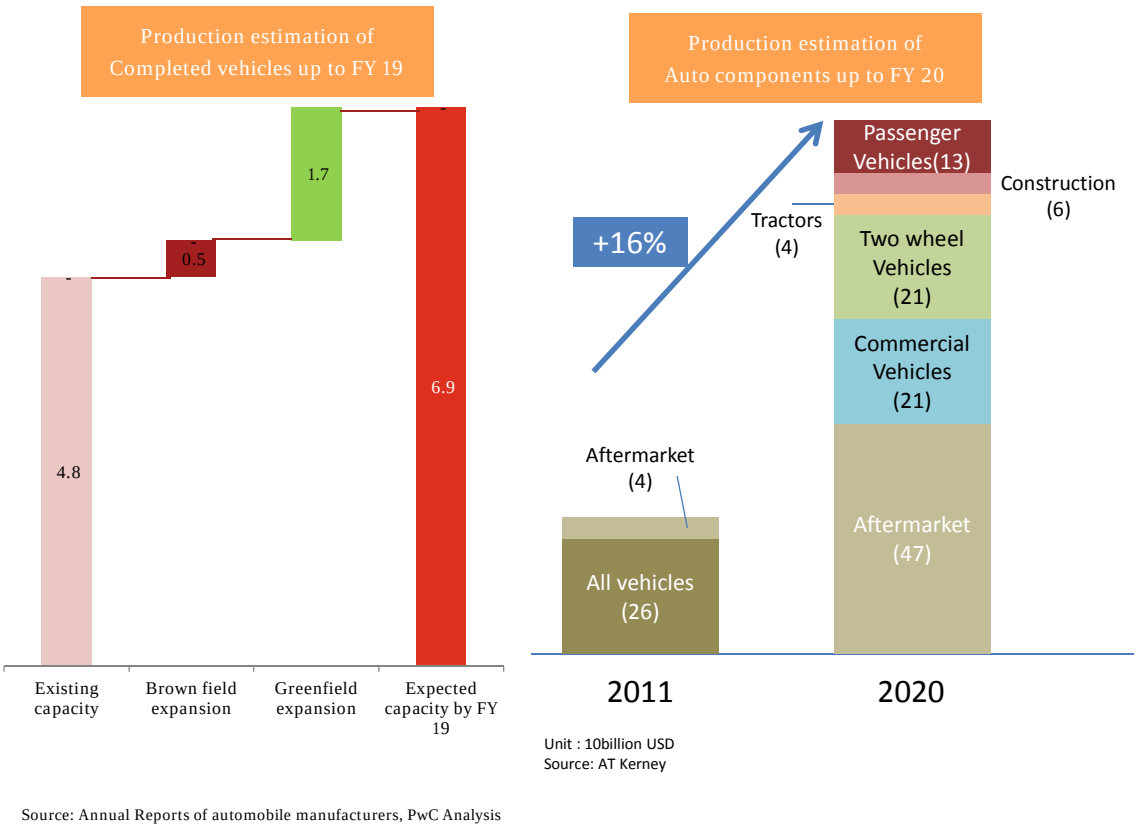


Source: ACMA, Planning commission, PwC Analysis

Figure 4.4.14: Past Trends in production of passenger vehicle production (in million units)

The source of production increase can be expected both from expansion of existing factory and investment to new green field factory. The graph below shows the source of incremental production capacity and we can see that most of incremental production increase is coming from green field investment. It is expected that new investment into factories will support production of automobiles in India

In parallel with completed vehicle industry growth, growth of component industry is also expected. In 2020, of the total auto component industry production value, around 40% is expected come from passenger vehicle, 20% from commercial vehicle, and 20% from two wheeler vehicles.



Source: Annual Reports of automobile manufacturers, PwC Analysis

Figure 4.4.15: Past Trends in production of passenger vehicle production (unit: million units for completed vehicles, billion USD for auto components)

India's auto sector is looking at both domestic market and export market. The figure below shows the trend of domestic sales and vehicle export. Domestic sales grew up until FY 12 constantly. However, the number has suddenly dropped in FY 13 due to down trend of Indian domestic economy.

Export market is moving in a different manner from domestic sales – it is growing up rapidly but the number and trend is not subject to economic down trend in India. When we compare domestic sales and export sales, export market is experiencing greater growth rate though domestic sales has larger volume compared export market. When we compare the number of domestic sales CAGR (8.5% between FY09 and 14) and export market CAGR (11% between FY09 and 14) obviously export market is experiencing rapid growth in average. Also, when the CAGR of Exhibit 3 (entire market growth – CAGR 11.6% between FY 09 and 14) is compared with export market CAGR the number is almost the same and we can say that the export market has grown up in parallel with entire market. Although export market volume is subject to demand of entire the world, we can expect that the volume will experience continuous growth reflecting continuous growth of demands especially in emerging counties of Middle East, Africa and Asia.

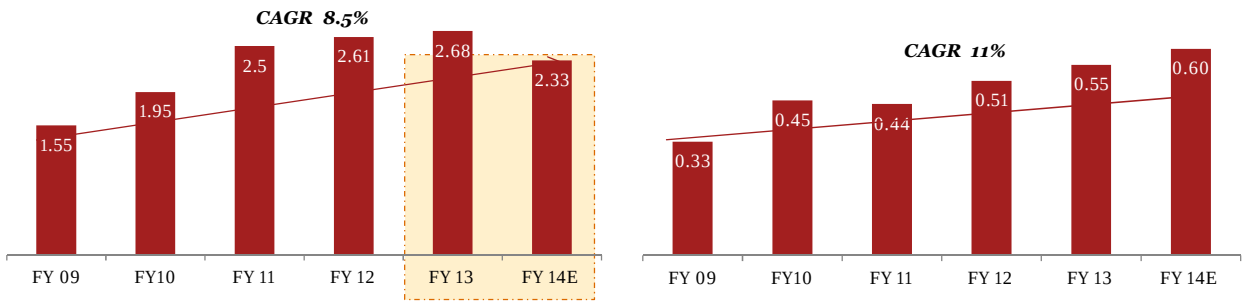


Figure 4.4.16: Past Trends of domestic vehicle sales and exports (in million units)

When we look at sub segments of auto industry, two sub segments can be identified for growth areas:

One area is auto component area. As indicated in exhibit 5, this segment is expected to grow up with CAGR 16% up to 2020 and this rate is above the rate of entire auto sector shown in exhibit 3. If India can experience growth throughout the value chain from parts to OEM that will definitely boost the growth of entire the auto industry.

Another dimension is type of cars – the exhibit below show share by vehicles and share by companies. One of the characteristics of Indian market is that relatively smaller size cars have bigger share in the market. India has potential to become a global hub for vehicle export of smaller size vehicles. This segment is also expected to grow up rapidly in the future.

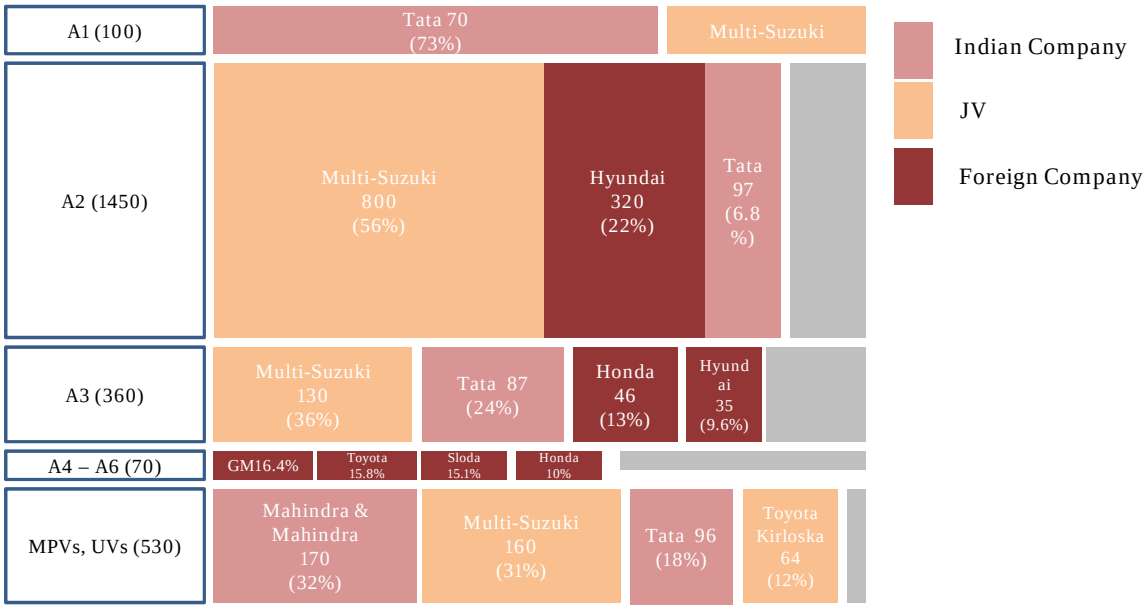


Figure 4.4.17 : Type of vehicle and share by manufacturers

Key growth drivers for the sector

CBIC region is expected to grow up as a cluster of auto industry. However, there are competitors across Asia as well as in India. In order to attract more investment in a longer term, the region needs to achieve future growth and expected to remain its unique position as investment destination

As a whole nation of India, it is expected to achieve continuous growth of auto industry. India's economic growth is believed to continue and industry growth will be sustained with strong backbone of powerful domestic purchase power. One of characteristics of Indian auto industry is concentration on smaller size (compact) vehicles and through concentration on this segment it is also expected that India can also be a global hub for compact vehicle production.

In order to survive in the competition and to achieve sustainable growth, CBIC region needs to attract investment in auto industry. Following drivers are especially important to achieve growth in this region:

Key driver of growth: Shorter Term

Infrastructure improvement for OEMs

CBIC region has strong potential in India since this region harnesses sea port and there is a characteristic of proximity to market abroad- considering the competition with other investment clusters in India, key success factor for this region is to keep attracting export-oriented OEMs. From OEM perspective, this region has competitiveness not only because of geological location but also because of cost competitiveness when compared with ASEAN region. Keep attracting export-oriented OEMs to this region with improved investment climate will lead to continuous growth of this region as a hub of vehicle export.

Already several OEMs are investing in this region including Nissan, Hyundai and they are building up factories with their own investment with the support of state government in terms of land provision, electricity supply

etc. Basically their operation is stable due to this well managed infrastructure within industrial park. Meanwhile, infrastructure for vehicle export is not necessarily well managed. Especially infrastructure connecting to port in Chennai region is weak and leading to unstable operation of export activities.

Since most of the OEMs are focusing on export from this region, improvement of export oriented infrastructure including connecting road construction, port evacuation capacity increase will surely ensure future increase of OEM's investment into this region. Otherwise export oriented OEMs might look for another location and investment to this region might decrease.

Tax/permit process improvement for export

Indian's tax system is complicated and most of foreign players are suffering from the complicated system which is lack of consistency. Sometimes they are imposed of tax which they did not expect and this is working as a barrier to promote export business in this region. In addition, CST (Central State Tax) which is imposed when crossing the state borders is also working as obstacle to develop their business across state borders.

Infrastructure improvement for tier-2/tier-3 suppliers

For foreign suppliers, currently investment scope is limited and value chain is not completed within India/CBIC region – only tier 1 suppliers are investing in the region and investment of downstream layers have not almost happened yet. Most of tier-2 and tier-3 foreign suppliers are delivering their work from home country or ASEAN countries (e.g. Thailand). If this investment happens by foreign tier-2 and/or tier-3 players, we can expect technology transfer from foreign players to Indian local downstream players as well as pure increase in investment in this region.

In order to increase the investment of suppliers, bottlenecks which they are facing needs to be removed. One of the bottlenecks they are facing now is lack of reliable utility (especially electricity). Therefore, supply of reliable utility infrastructure could be one of the ways to improve the situation. Development of industrial park could be one of the easiest ways to supply reliable utility infrastructure.

Longer Term

Capacity development of suppliers and achievement of industrial growth as export oriented industry

As described in previous section, currently there are suppliers which are lack of technologies/skills (these are included in the categories of "India local large supplier" and "India local small supplier"). These companies cannot supply components to foreign OEMs since they cannot meet requirements of foreign OEMs. It is important to fulfil the gaps of skills and technologies and bottom up entire level of supplier industry in this region. If these suppliers can be grew up enough to export components from this region, this could also be advantageous for this cluster since they harness inherent cost competitiveness and there is a possibility this region grows up as regional hub of auto suppliers.

In order to further push forward growth of supplier's industry, there are ways which government can take – including MSME protection policy, infrastructure improvement for suppliers (for production and export) etc.

Enhancement of R&D function and growth us R&D hub ("going to digital") –

One of key characteristics auto industry is experiencing these days is that industry is going to more digital side. Consumers are shifting to combine mobility with communication. Therefore, automobiles tend to be combines communication devices. Also, gasoline engine vehicle is gradually shifting to EVs – there is an advantage of less emission – and new technology is expected to be applied to more number of vehicles. Considering this situation, enhancement of R&D function could be one of key driver for continuous growth. CBIC includes IT/electricity cluster and there might be synergies expected between auto sector and these sectors for R&D function enhancement. In order to promote and enhance R&D capability, government's investment into such function and development of R&D oriented industrial hubs could be effective.

Key nodes for auto sector investment in the corridor

Based on the proposed framework for industrial development strategy for CBIC, we propose certain key interventions/recommendations for the Government to develop the chemicals & petrochemicals sector along the identified districts in the corridor. These recommendations have been segregated as economic enhancers, administrative enhancers and value enhancers.

For the shortlisted districts along the corridor, we have summarized the key interventions required by GoI, along with the existing status and challenges in these districts:

District	Existing status and current asset profile
Chennai	• Excellent road and rail connectivity within district and hinterland • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports • Good availability of educational institutions - Around 240 engineering colleges, 19 universities, IIT Madras • Existing OEM plant of Ashok Leyland • Land availability
Tiruvallur	• Excellent road (NH-5 via Gummidipoondi and NH-205 via Ambattur and Tiruvallur) • Rail connectivity within district and hinterland is available predominantly in southern and coastal parts of the district • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports • Existing OEM plant of Hindustan Motors
Kancheepuram	• Excellent road (NH-4 via Sriperumbudur and Kancheepuram and NH-32 through the entire district) • Very good rail connectivity within district and hinterland • Excellent seaport connectivity, with proximity to Chennai and Ennore sea ports Availability of educational institutions at Chennai and suburbs with IIT Madras and the Anna University • Existing OEMs including Renault-(Oragadam) Ford(Chengalpattu) and Hyundai (Sriperumbudur • Connecting road to port needs to be improved
Chittoor	• Excellent road connectivity (NH-40 (to Chennai), NH-42, NH-69, NH-71, NH-716 (to Chennai) • Excellent rail connectivity in parallel with NH network (except NH-69) Some availability of educational institutions (18 engineering colleges) and proximity to Bengaluru, which has access to skilled resources • Inadequate supply of electricity and water (utilities) Insufficient number of industrial parks for smaller scale suppliers
Bangalore Urban	• NH-4, NH-7 & NH-209 goes through district and connect to other parts of Karnataka and other States • Chennai Port is situated at a distance of 315 Km • Good availability of skilled manpower
Bangalore Rural	• NH-4 and NH-48 goes through district and connect to other parts of Karnataka and other States. • Availability of well developed rail network – a total railway route of 204.39 km • Mangalore Port is situated at a distance of 320 km • Existing OEMs including Toyota

In order to identify node location, following points need to be considered:

- Land availability
- Existing auto industry in order to develop auto cluster
- Accessibility to connecting infrastructure
- Availability of utilities

Of these points, especially land availability and existence of auto industry is important – without land availability nodes cannot be built up and without existence of current industry auto cluster cannot be grown up.

From these aspects, there are two districts recommended in this corridor. One is Kancheepuram in TN since already there are multiple OEM factories and it is easily to expect that this district will grow up as core hub of auto sector. Accessibility to port infrastructure and availability of utilities are not enough secured, therefore these points need to be improved in order to grow up this region as a node for auto sector.

Another district recommended is Bangalore Rural, since this region is adjacent to Bengaluru city and has presence of foreign OEMs. This region is advantageous in terms of accessibility to human resources and R&D resources in Bengaluru city and it can be expected that this region will grow up in a context different from TN. Similar to the case of Kancheepuram land availability, utility and access to port infrastructure needs to be improved.

Key Interventions required and strategy for developing auto industry sector along CBIC

Intervention	Challenges	Recommendations
Economic	• Inadequate transport infrastructure is one of the bottlenecks to attract investment of foreign OEMs • Inadequate infrastructure for supplier is one of the bottlenecks to attract investment of suppliers	• **Development of export oriented transportation infrastructure.** Especially connectivity Chennai suburban area and costal area is weak. Therefore construction of road connecting Chennai suburban area and costal area of Chennai is recommended. • **Improvement of port capacity.** The ports in Chennai region is always using up its capacity and investment into new port might be required. Also, operational improvement of port might be required since it is taking a lot of time to evacuate cargo at current status. • **Development of industrial park for stable supply of utilities**. Most of suppliers are suffering from lack of stable supply of utilities. Therefore supply of utilities through development of industrial park could help improvement of their operation.
Administrative	• Complicated tax system/double imposition of taxes • Lack of specific plan to attract FDI investments across the value chain	• **Improvement of tax regime:** Develop a comprehensive and structured tax regime • **Development of industrial growth policy**: specific plan and specific policy to attract FDI for Tier-2/Tier-3 industry.
Value	• Inadequate facilities available for research and development • Future shortage of skilled labourers • Future challenges for product diversification and value added products	• **Education of skilled labour:** As automobile industry grows up in this region, it is expected that needs for skilled labours will rise up. In order to provide sufficient amount of labours, establishment of facilities to educate enough amount of skilled labours will be required • **R&D center development and R&D function enhancement**: Most of the R&D function is outsourced from this region. However, in order to achieve sustainable growth, development of R&D hub in this region is necessary.

4.4.11.2 Automobiles

Table 4.4.24: Competitiveness analysis of Automobile sector

Sector	Competing countries	Relative ranking of India	Key factors for lower competitiveness of India	Assessment of factors for lower competitiveness	Interventions required to increase competitiveness of India
Automobiles	China, Germany, USA, Japan, France, Korea	19th rank	1. Low level of Research and Development 2. Labour issues 3. Issues across the value chain	1. Research and Development a. R&D expenditure as a percentage of turnover is low in the Indian Auto-component sector ranging between 0 to 1.5% while it is slightly higher at 0.5-3% in the Automobile sector b. The industry does not possess good design facilities c. In India, the share of R&D cost is less than 2% whereas in companies based in Europe the costs range between 2-4% 2. Labour issues a. . However, wages paid to temporary workers, on an average, are one fourth to half of those paid to permanent workers. However, since contract workers are temporary, it is difficult to train and retain them as skilled employees. b. Some of the key issues in the sector include cap on the number of contract labourers, limits on over-time and magnitude of extra-compensation, shortage of skilled manpower. These issues have led to a lower labour productivity of India in comparison to competing nations 3. Value chain a. A lot of foreign OEMs bring along with them a part of the supplier network. This has affected the Indian auto supply chain. The major reason for this is non-availability of required quality/technology in India and availability of low cost products in other countries b. Foreign OEMs in India import 10-100% of their requirement whereas Indian OEMs import less than 2% of their requirement c. The supply chain has also been affected by regulatory norms related to emission	1. Research and Development a. Policy interventions are essential to improve R&D facilities in the country b. A scheme for special credit for R&D could be started c. The Government needs to significantly strengthen non-proprietary R&D and design capacity that has strong connections with research institutes like IITs 2. Labour issues a. Labour reforms, especially on flexibility in the regulations related to hire and fire policies, would encourage recruitment of more permanent workers, which would have overall positive effect 3. Value chain a. Necessary steps need to be taken by the government to promote Indian products, improve cost competitiveness and promote quality in the automobile sector

Source: Determinants of Competitiveness of the Indian Auto Industry, National Manufacturing Competitiveness Council, GoI

4.4.11.3 Recommendations summary

CBIC region has already started to grow up as a concentrated cluster of auto sector. Proximity to overseas market as well as domestic market is inherent attractiveness of this region for auto industry. Auto sector's characteristics are its complex value chain and structure - at least there are OEM layer and supplier layer. In order to address continuous growth, it is important to attract investment to both two layers. Investment to OEM layer would addresses investment to supplier layer through enhancement of growth as an auto industry hub in this region. Similar to this flow, if we can attract investment to suppliers, it will lead to future investment by OEMs since one of key criteria for OEMs when they make a decision for investment is maturity of supplier industry. Therefore, we can expect investment by more OEMs when the region has enough maturity of supplier industry.

One of key factors that influences investment decision both for OEMs and suppliers are investment climate. If the region can develop an investment climate which is preferable to both OEMs and suppliers, this "virtuous cycle" can be enhanced and it is expected that rapid growth of auto region can be realised. Investment climate improvement includes infrastructure improvement – connectivity improvement and development of industrial hub as well as institutional improvement including tax regime change. It is desired that auto sector oriented node will be developed somewhere in the corridor at a location where current OEMs and suppliers are located and where connectivity/ utility infrastructure is available.

As a destination of investment, there is a competition with industrial clusters of adjacent countries as well as domestic industrial clusters. For example, obviously CBIC is always competing with domestic industrial clusters – NCR region and west region as an investment destination of auto industry. At the same time, CBIC region is competing with export oriented auto industry clusters across Asia – including Thailand and Indonesia. Investors (OEMs and suppliers) are always comparing these regions as a destination and in order to attract more OEMs and suppliers. Hence, it is quite important to harness investment environment which is superior to these competitors.

4.5 CBIC – Key interventions

A summary of key interventions to enhance the competitiveness of the corridor is represented below:

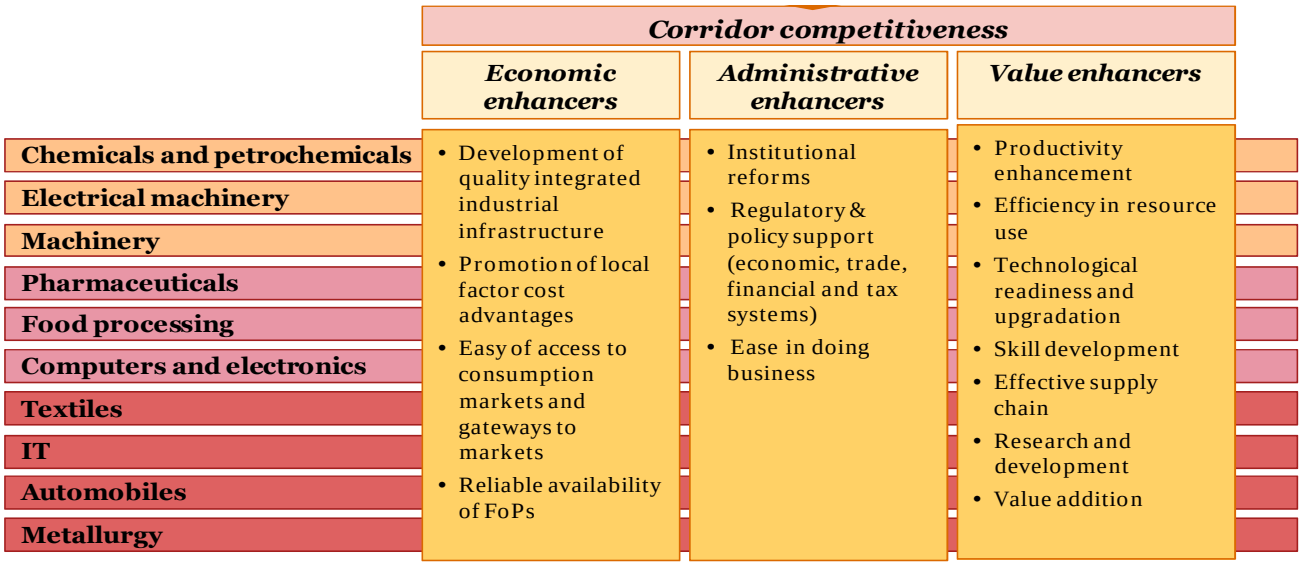


Table 4.5.1: Key Interventions

Sector	Economic enhancers	Administrative enhancers	Value enhancers
Auto	• Government needs to focus on developing the entire value chain by focusing on cost competitiveness, promote quality in the automobile sector and dissuade OEMs from bringing supplier network • Connectivity infrastructure for industrial parks with key ports within the corridor • Port capacity addition required • Ensure stable supply of water and power	• One of the key issues faced by foreign investors in India is the complicated and inconsistent tax system. There is a frequent change in the tax laws. Additionally, CST also acts as a hindrance for inter-state transactions. • Currently, majority of the investments in the sector are in the OEM and Tier I sector. Majority of the foreign players are importing Tier I and Tier II parts from their base location. Hence, Specific plans need to be made to promote investment of Tier-2/Tier-3 industry members in India.	• 10-30% of the total production workers are employed on contract basis. Reducing the number of contract labourers by giving flexibility in regulations to hire employees. • The Government needs to significantly strengthen non-proprietary R&D and design capacity that has strong connections with research institutes like IITs • Facilitate additional courses to cater to upcoming demand for skilled workforce in the corridor
CEO	• Availability of industrial land and improved availability of power • Improved logistics infrastructure and integration with global supply chain network	• Tax structure needs to be improved. India's current tax structure makes the final product less competitive and encourages low cost imports • Preferential market access for local companies needs to be improved. • Flexibility in labour laws is essential to cater to rapid seasonal variation in demand.	• Reliance on imports for raw materials needs to be reduced • China and Taiwan are key competitors that have invested heavily in research and development. Economies of scale create global competitiveness. The focus area should be adding more value to the existing products and creating new products through investment in R&D. • Availability of quality manpower
Pharmaceuticals	• High quality of utility infrastructure required – water availability and treatment, power availability and quality • Establishing clinical research facilities with private partnerships	• Incentivize R&D in product innovation and Good Laboratory Practices (GLP) • Improve regulatory mechanism for approval of clinical trials • Introduce reforms in health care insurance sector	• Facilitate assistance in technology transfer through collaborations with MNCs • Upgrade and design new courses in the institutes which cater to the industry requirements • Create dedicated R&D institute for promoting product innovation and facilitate creation of product promotion centers for SME players
Food Processing	• Development of support infrastructure in the form of warehousing/ cold storage infrastructure and customized transportation network required • Reduction in raw material costs and losses by bringing in efficient logistics network. Last mile connectivity should be improved in order to strengthen the linkage between raw material supplier and processing units	• Government should promote reliable and strong supply chain network between raw material suppliers and processing units on PPP basis • There is a need to introduce uniform tax rates in all states avoiding multiplicity of taxes at different stages. • Systems and procedures may be simplified. The need for documentation/ paperwork at multiple checks posts and in different states, customs formalities, needs to be reduced.	• Awareness on quality standards could be created through seminars, newsletters and training programmes • The linkage between government agencies, universities, industry and other stakeholders like cooperatives, farmer organisations etc needs to be strengthened • Government should provide support to clusters in form of credit, inputs, expertise and marketing links • Focus on improving the quality of products

Sector	Economic enhancers	Administrative enhancers	Value enhancers
			Specific incentives to be given to encourage product diversification and increase production of value added products
Machinery and Electrical Machinery	• Ensure availability of raw material (CGRO/CNGRO* electrical steel) – clear certification mechanism for importers in the short run and setting up indigenous facilities for electrical steel production in the long run • Strengthening rail network (specially Bengaluru rural, Krishnagiri, Thiruvallur) as necessary requirement to transport over dimensional consignments • Set up indigenous testing and calibrating facilities for equipment testing	• Promote technologies upgradation, new technology introduction and accordingly modify the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery and machinery manufacturers. • Quality control mechanisms and certification systems in the sector to ensure product quality control (supplies from vendors and end-products) • Transition from import dependent to export oriented sectors: in the short run - support indigenous manufacturers, by putting restrictions on second hand equipment, mandating foreign partners to foster technology transfers along with setting up manufacturing facilities; in the long run – export promotion polities; preference to joint ventures, not 100% foreign owned companies	• Establishment of linkages between industry and academia – active involvement of public and private participation to bridge growing skill erosion • Support/incentives to the manufacturing units in setting of R&D facilities (especially MSMEs) • Enhancement of value addition – incentives to the foreign players to increase value addition in India under technology transfer, roadmap for setting up facilities for manufacturing of automation equipment indigenously
Metallurgy	• Rail connectivity from mines and industrial units of Bellary to Chitradurga, Anantapur and Chittoor districts to Krishnapatnam, Managlore and Chennai Ports • Railway connectivity from Nellore to West Godavari, East Godavari mines • Expanded power generation and transmission initiatives adding sufficient capacity and covering identified nodes	• Policies to provide power tariff subsidies for first 5-10 years of operation • Further allocation of mines to companies planning to set up smelter units in the corridor • Creation of state owned enterprises focused on scrap consolidation and recycling. This would address raw material bottlenecks as well as make the industry greener.	• Technological linkages with countries like Japan who have been top exporters in spite of scarcity of raw materials • Knowledge Transfer Partnerships to create larger institute-industry interface and focus on employable workforce • Improved R&D on mineral exploration and environmental friendly linkages
Medical instruments	• Infrastructure for uninterrupted power supply • Mixed cluster approach with electronics and electrical industry to enable synergies	• Quality standard norms to discourage low quality imports and give boost to domestic industry • State level healthcare initiatives in segments like telemedicine/portable clinics that can provide boost to portable device segment • Enhance branding of the industry in the corridor through initiatives like medical technology parks	• Incentives for R&D in hi-tech medical equipment segment e.g. pooled fund to support R&D within SMEs • Better grants in biomedical instrument or like subjects to attract brighter research talent • Focus on creating employable workforce
Textiles and Apparels	• Subsidizing unit rates of power or encourage usage of non conventional energy sources. Develop dedicated/captive power generating sources specifically for the major textile clusters. • Concerned Ministries, Departments, State government need to be focus on reducing	• Regulations need to be focused on controlling raw material exports to ensure stable prices in the country and to make the sector more competitive and productive • Reimbursement schemes such as duty drawback, market development assistance etc to reduce the impact of exchange rate fluctuations	• Technological upgradation, modernization of units and Automation needs to resolve the problems of shortage of labour, poor quality of product and will lead to higher productivity • Vocational training through ITIs, Textile Design & Management Institutions specially in the area of Apparel Manufacturing, Quality Control and

Sector	Economic enhancers	Administrative enhancers	Value enhancers
	the transit time and cost at the international check points to make Indian textile products more competitive.	• Labour laws need to be made more flexible to permit longer hours of overtime with due compensation, and to allow flexi-hiring of labour	Designing needs to be encouraged so that skilled work force is available • Amendment to Labour Laws is needed, to permit longer hours of overtime with due compensation, and to allow flexi-hiring of labour, especially to support apparels sector
Chemical and Petrochemical	• Develop freight corridor between Bengaluru rural and Chennai seaport, to promote exports of chemicals and petrochemicals • Improve rail connectivity between Bengaluru rural and Chennai seaport • Ensure feedstock availability of natural gas and naphtha	• Consolidate acts into an Integrated Chemical Legislation, simplify regulatory structure and strengthen regulations and ensure stricter enforcement of regulations and promoting green manufacturing practices • Rationalize taxes and duties to promote domestic manufacturing • Incentivize the MSME players to increase the sectors' presence in the MSME segment along the corridor districts	• Set up a dedicated R&D centre and Centre of Excellence for Specialty Chemicals • Incentivize industry players to follow best practices of manufacturing like higher efficiency, latest technologies; promote “zero discharge” technologies • Establish a CBIC Chemical Innovation Fund to encourage commercialization efforts for innovations generating inclusive growth

4.6 Competitiveness of the corridor – key interventions

The Global Competitiveness Report 2013-14 by the World Economic Forum accesses quality of infrastructure (including roads, railroads, ports and air transport infrastructure) as one of many different components measuring different aspects of competitiveness. We have analysed the criticality of infrastructure components for each sector and mapped this assessment against major competitors of India in the global trade market for sector to highlight the importance of strengthening of the relevant infrastructure components that lag behind the global export leaders.

Industries	Water	Power	Road Connectivity	Rail connectivity	Ports	Airports
Metallurgy	3	4	4	4	6	1
Medical equip	1	4	5	5	1	1
Food	3	6	5	5	6	1
Textiles	4	3	5	5	4	5
Electrical	6	3	5	5	5	1
Machinery	6	3	5	5	5	1
Chemicals	4	4	4	6	5	5
Pharma	4	4	4	6	5	5
Auto	3	4	5	4	5	1
Computer, electronic	1	4	5	5	6	6

1 Low 6 Medium 5 High 4 Critical

On a scale of 1-7, following is India's score against competing countries for manufacturing sector investment

Quality of roads	India – 3.6, China 4.5, Thailand – 5.0, Korea – 5.8,
Quality of railroad infrastructure	Thailand 2.6, China 4.4, India 4.8, Korea -5.6,
Quality of port infrastructure	India 4.2, China 4.5, Thailand – 4.6, Korea – 5.5
Quality of air transport infrastructure	China 4.5, India 4.8, Korea 5.2 and Thailand – 5.7

Quality infrastructure will play a key role in the development of CBIC region for CBIC region to be regarded as a promising investment destination the following key interventions will be needed:

- Ports – The key ports in the region include Chennai, Ennore and Krishnapatnam port. The challenges in these ports include large operational issues, inefficient safety measures and high cost of usage. It would be essential for the government and private players to take necessary steps to improve the competitiveness of the ports in the region. The connectivity of industrial areas and raw material sources with key ports needs to be improved, along with focus on capacity addition of cargo handling capacity at key ports.
- Road – At various stretches in the CBIC region there are multiple issues like traffic congestion in areas around the Chennai and Ennore Port and absence of last mile connectivity for industrial parks. Because of this it is difficult for companies to calculate the lead time for their goods. In order to resolve these issues it would be essential for the government to frame a comprehensive road plan considering the estimated future industrial development in the corridor
- Power – The region experiences a chronic shortage of power which impedes the production plans of industries operating in the region. Cost of power is another barrier for many industries within the corridor. Sectors like Textiles, Metallurgy, Food Processing have large power requirement and hence, to solve this it would be essential for the government to frame a comprehensive electricity supply and demand plan
- Railways – Sectors like Electrical Machinery, Machinery, Chemical and Petrochemicals have a strong requirement for railways infrastructure. The current management of the railway transport is unreliable. There have been cases of damage due to bad management and the lead time cannot be estimated accurately due to frequent delays. Absence of sufficient rail sidings, rakes for containerised cargo have impacted the performance of these key sectors. A dedicated freight corridor between Bangalore and Chennai will positively impact the performance of many key industry sectors.
- Industrial Clusters: Globally competitive industrial parks with strong connectivity infrastructure corridor need to be developed to enhance the competitiveness of industry sectors

Beyond the availability of quality industrial infrastructure, Government will have to focus on various other parameters that would be essential to improve the competitiveness of the corridor. Some of them are detailed below.

As per the last World Bank survey on ease of doing business, the states in the CBIC region are performing well on parameters such as dealing with construction permits, resolving insolvency trade across borders; however they lag behind on parameters such as ease of starting a business, registering property, paying taxes, enforcing contracts etc. Availability of land for industries, quality manpower, and support for project clearances are the other set of key interventions for industries within the corridor. There is a need to focus on reforming procedural and regulatory formalities in the CBIC region to reduce compliance burden on industries. Focusing on the competitiveness of the sectors to attract investments in the corridor it would be essential to ensure improved performance of sectors operating in the region. Productivity of companies across majority of the sectors needs to be improved. For example, the labour productivity in electronic components is 10 times lesser than competing nations. Capital productivity of textile and electrical equipment sectors in India is far lower than that of China. The corridor's development strategy should focus on improving the productivity across these sectors as they are critical to corridor's performance. Investments in research and development, modernization and technological upgradation, skill development of human resources will be critical to achieve competitiveness at global level.

5 Node Selection

5.1 Introduction

The CBIC is poised to play a pivotal role as one of the key contributors to the economic development of the southern part of India as well as the whole country. One of the objectives for the JICA CBIC study is to identify suitable nodes to be taken up for industrial development within the CBIC area. In this regard, JICA study team carried out the following work: (i) analysis of node development potential including the potential zones at a broad level, ii) assessment of the potential area at a sub-district level for development of the industrial nodes, iii) confirmation of the situation and potentials of shortlisted nodes including prospects of investment from Japanese Companies, and iv) proposing the industrial nodes for master plan and development plan to be formulated under Part B. Those results were described in the chapter.

5.2 Identification of broad locations for zones

5.2.1 Discussions with state governments

As per the discussions undertaken with the respective state governments to understand their broad views on land availability and suitability of potential zones, the following locations have been suggested as the proposed destinations for industrial nodes. The below locations have been proposed by the state governments based on factors such as presence of existing ecosystems, demand from industries and the intended development plans of the states.

Table 5.2.1: Potential zones proposed by the State governments

State	District	Area / Region
Tamil Nadu	Krishnagiri	i. Hosur
	Kanchipuram	ii. Madurantakam
	Vellore	iii. Serkadu
	Tiruvallur	iv. Ponneri
Karnataka	Kolar	v. Kolar Industrial Area vi. Vemgal Industrial Area
	Tumkur	vii. NIMZ Vasanthnarsapura viii. Sira
	Chitradurga	ix. Chitradurga – Challakere
	Ramnagara	x. Bidadi Industrial Area
Andhra Pradesh	Nellore	xi. Krishnapatnam SEZ
	Nellore	xii. Naidupeta & Attivaram
	Anantapur	xiii. Lepakshi SEZ
	Chittoor	xiv. NIMZ Pileru

Source: Interactions with state governments

5.2.2 *Methodology and Assessment Framework for identification of broad locations for zones*

The above potential zones (including other surrounding / neighbouring areas in the states) have been further analyzed using a set of important factors reflecting key attributes such as:

- Presence of existing city development plans / urban master plans
- Distribution of existing industrial development
- Accessibility to regional trunk road infrastructure
- Proposed land acquisition plans for future industrial development

Based on the above analysis, the potential broad zones were classified into two categories:

- Category A: High priority regions with the potential to provide faster return on investments
- Category B: Regions with low potential to provide faster return on investments

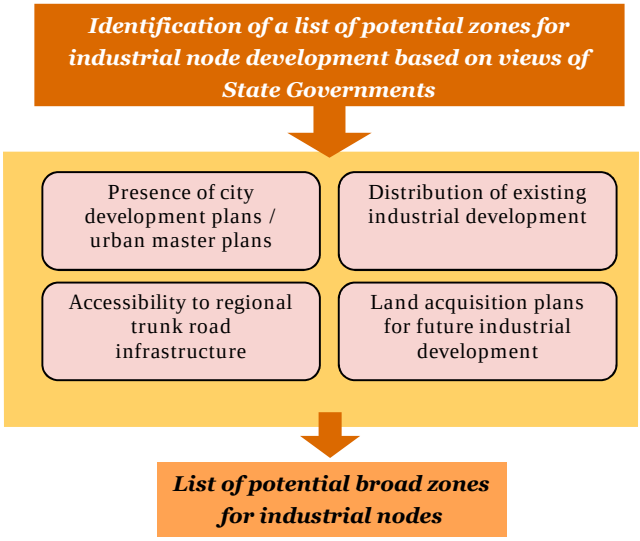


Figure 5.2.1: Methodology and assessment framework for the broad selection of industrial nodes

For the Category A area, further analyses at Sub-District level were conducted with a set of eight assessment criteria that includes the following:

1. Accessibility to regional trunk roads
2. Existence of protected/restricted areas
3. Government land availability and availability of proposed industrial development areas
4. Water availability
5. Assessment of urban planning strategy
6. Existing and planned industrial areas
7. Accessibility to major transport facilities (port and airport)
8. Accessibility to electricity network

5.2.3 *Target Sub Districts*

Total 49 sub districts (12 Talkus from Karnataka, 25 Mandals from AndraPradesh, and 12 Taluks from Tamil Nadu) are assessed under the identified potential zones. The locations are shown below.

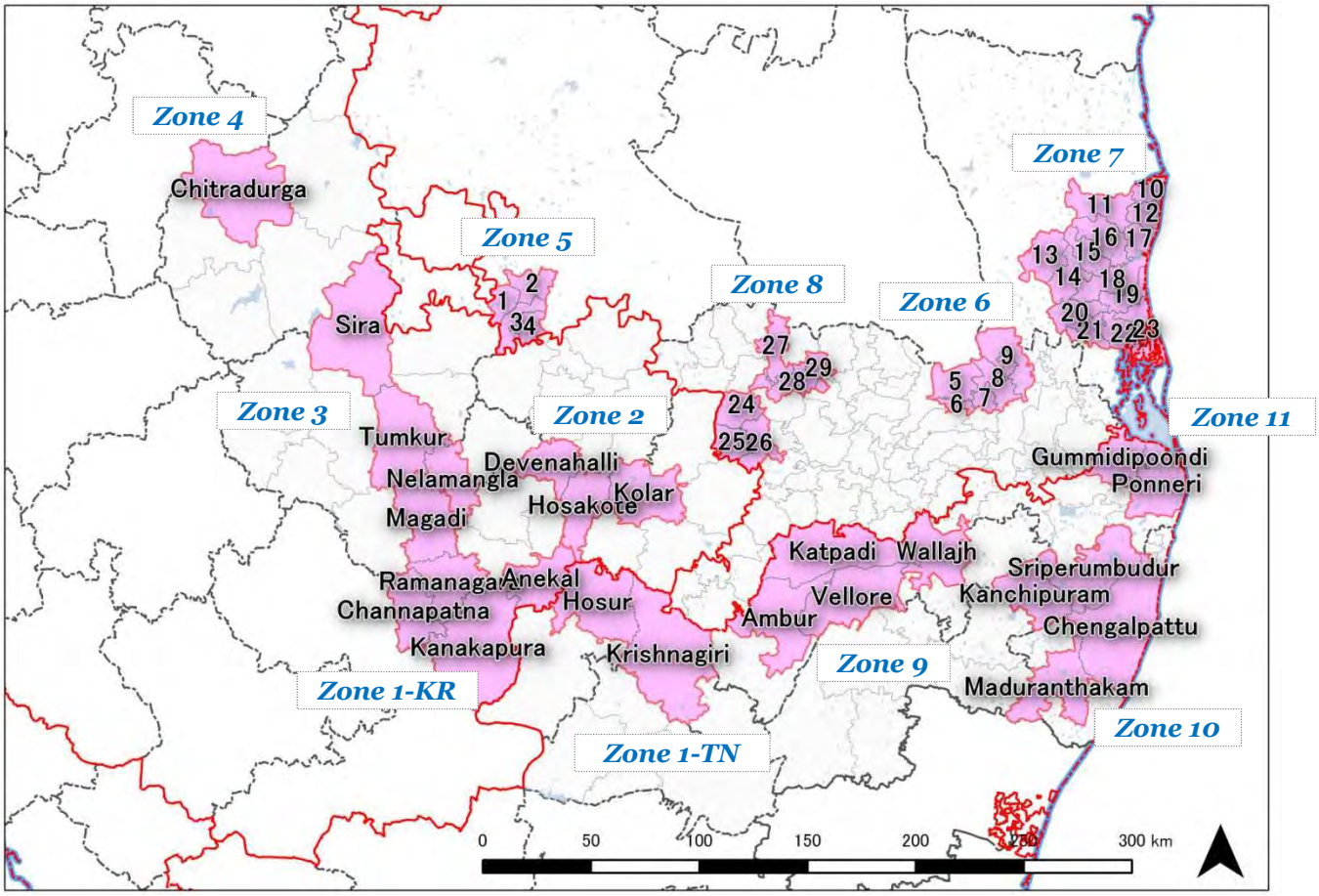


Figure 5.2.2: Location of Potential Sub Districts

Table 5.2.2: List of Potential Sub Districts

Zone	State	District	Taluks (TN, KR) / Mandals(AP)
1-KR	Karnataka	Ramanagara	Magadi, Ramanagaram, Channapatna, Kanakapura
		Bangalore Urban	Anekal
2	Karnataka	Bangalore Rural	Devanhalli, Hoskote
		Kolar	Kolar
3	Karnataka	Tumkur	Sira, Tumkur
		Bangalore Rural	Nelamangala
4	Karnataka	Chitradurga	Chitradurga
5	Andhra Pradesh	Anantapur	1.Parigi, 2.Somandepalle, 3.Hindupur, 4.Lepakshi
6	Andhra Pradesh	Chittoor	5.Tirupati (Urban), 6.Tirupati (Rural), 7.Renigunta, 8.Yerpedu, 9.Srikalahasti
7	Andhra Pradesh	Nellore	10.Indukurpet, 11.Nellore, 12.Thotapalligudur, 13.Sydapuram, 14.Gudur, 15.Manubolu, 16.Venkatachalam, 17.Muthukur, 18.Chillakur, 19.Kota, 20.Ojili, 21.Naidupet, 22.Chittamur, 23.Vakadu
8	Andhra Pradesh	Chittoor	24. Madanapalle, 25.Ramasamudram, 26.Punganur, 27. Gurramkonda, 28.Vayalpad, 29.Kalikiri
9	Tamil Nadu	Vellore	Ambur, Katpadi, Vellore, Walajapet
10	Tamil Nadu	Kanchipuram	Kanchipuram, Sriperumbudur, Chengalpattu, Madurantakam
11	Tamil Nadu	Tiruvallur	Ponneri, Gummidipundi
1-TN	Tamil Nadu	Krishnagiri	Hosur, Krishnagiri

5.2.4 *Overview of Current Industrial Development*

Current industrial sectors of potential zones were analyzed and the result is shown in the next page. The sectors that have an investment of more than Rs. 250 crores have been plotted as current key sectors in the zones. Further, the key strengths of the zones have been highlighted in the attachment.

The analysis indicates that Zone 1, 10 and 11 are some of the strongest industrial areas within the CBIC area. These zones have some of the highest committed projects (CMIE data indicates these regions have over 20% of State's committed investments) that will create robust industrial spaces in the future. Another notable feature is the presence of strong MSME clusters (over 10 % of State's MSMEs) in these areas will provide inputs needed by large industries.

Table 5.2.3: Summary of key sectors by zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
Presence of Key sectors											
Automobiles	√	√	√					√		√	
Chemical & Petrochemical	√									√	
Electrical Machinery	√					√	√			√	
Electronics	√									√	
Food Processing	√	√				√	√	√			
Machinery	√	√	√							√	√
Metallurgical industries	√				√	√	√			√	√
Pharmaceutical	√									√	
Textiles	√			√						√	√
IT & Financial Services	√	√							√	√	
>10% of state's MSMEs	Districts in KN - √ District in TN - X										√
>20% of state's investment	Districts in KN - √ District in TN - X									√	
>10% of state's GSDP	Districts in KN - √ District in TN - X									√	√
<100 km to international airport – B'lore/Chennai	√	√	√							√	√
<100 km to port						√	√			√	√

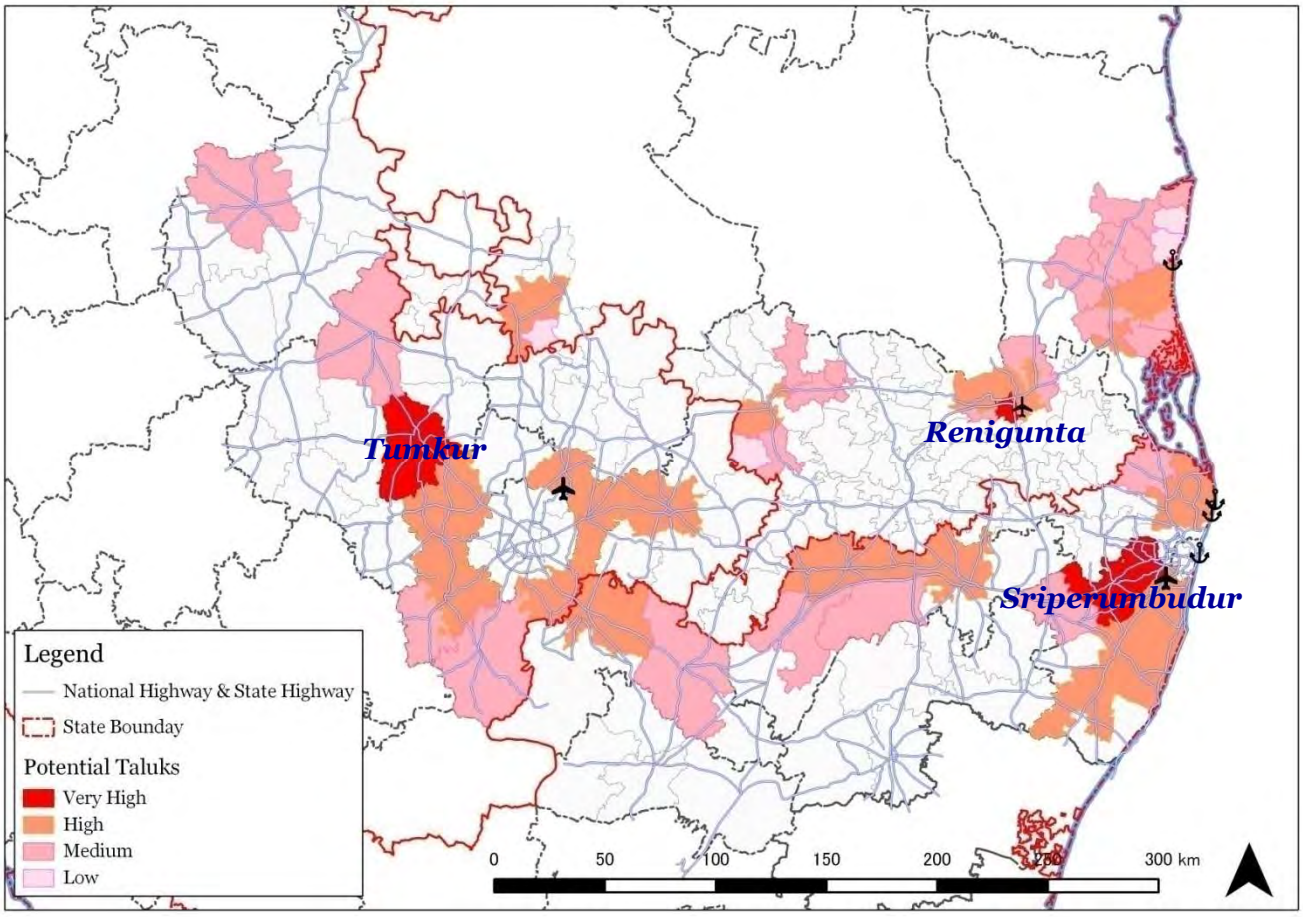
5.3 Identification of potential area at a sub-district level

5.3.1 Accessibility to Regional Trunk Roads

Seamless connectivity and accessibility to the regional trunk road network (National highway and State highway) is a major infrastructure parameter for the success of manufacturing industries as it supports movement of raw materials and finished goods. It is widely accepted that accessibility to regional trunk roads is one of the key factors to operate of industrial city/node smoothly as it enables transportation of raw materials/products and movement of workers. For this purpose, the areas include dense trunk road network can be considered as high-potential areas.

Table 5.3.1: Assessment Criteria 1 – Linear Density of Trunk Road Network

Potential Assessment	Description
Very High	Area with and over 0.20 km/sq.km trunk road density
High	Area with and over o.10 under 0.20 km/sq.km trunk road density
Medium	Area with under 0.1 km/sq.km trunk road density
Low	Area without any national highway and state highway



Source : JICA Study Team Analysis

Figure 5.3.1: Assessment of Road Network Accessibility

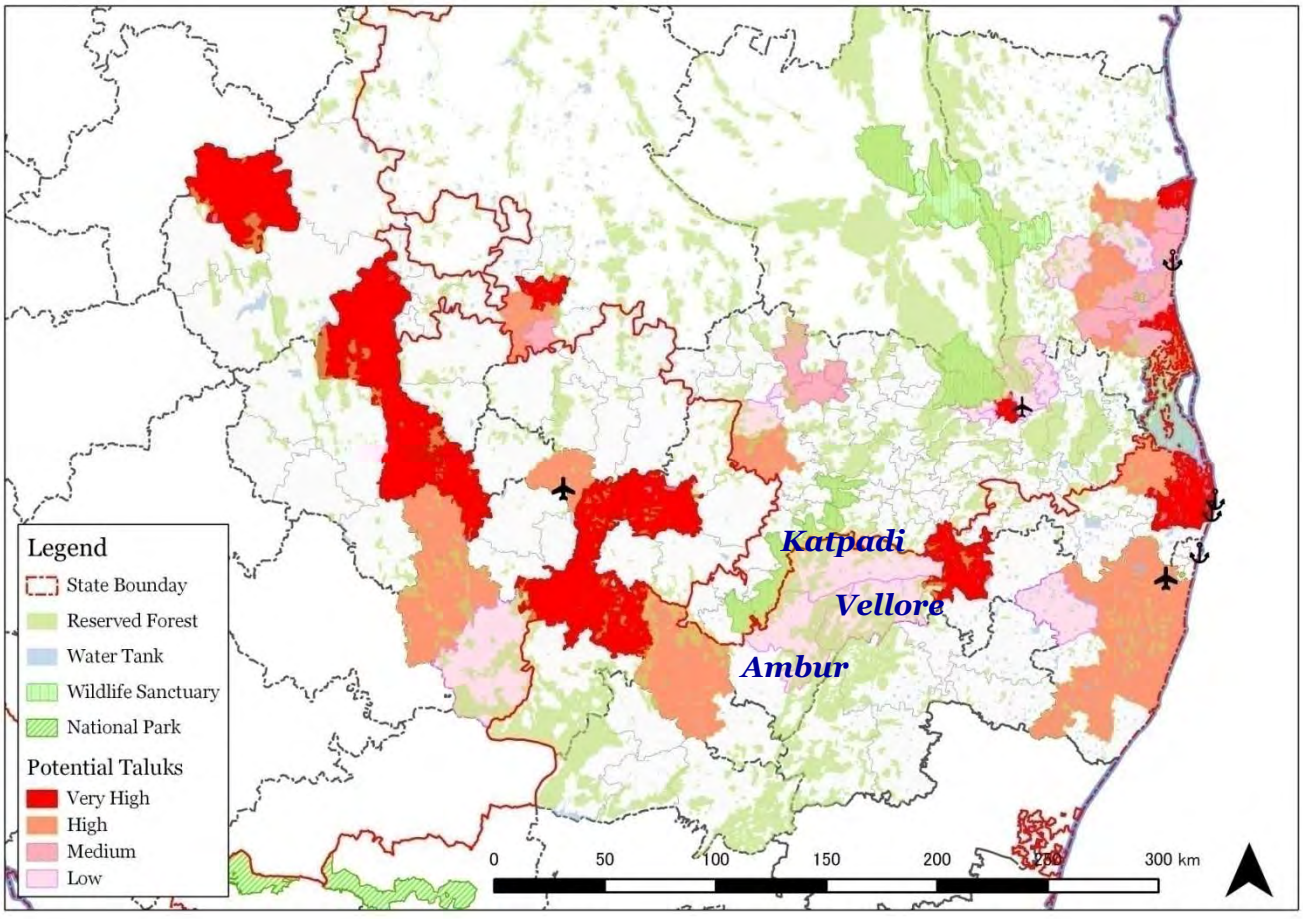
Areas including multiple interchanges (e.g. Tumkur, Sriperumbudur and Renigunta) show high density of trunk road network.

5.3.2 *Existence of Protected/Restriction Area*

Reserved forest, water bodies and protected area like wildlife sanctuary and national park are restricted areas for the new development. For this reason, the area covered by widely protected/restricted area should not be considered in selection of industrial nodes.

Table 5.3.2: Assessment Criteria 2 – Distribution of Protected/Restriction Area

Potential Assessment	Description
Very High	Area with under 10 % of protected/restriction area
High	Area with and over 10 under 20 % of protected/restriction area
Medium	Area with and over 20 under 30 %of protected/restriction area
Low	Area with and over 30 % of protected/restriction area



Source : JICA Study Team Analysis

Figure 5.3.2: Assessment of Protected/Restriction Area

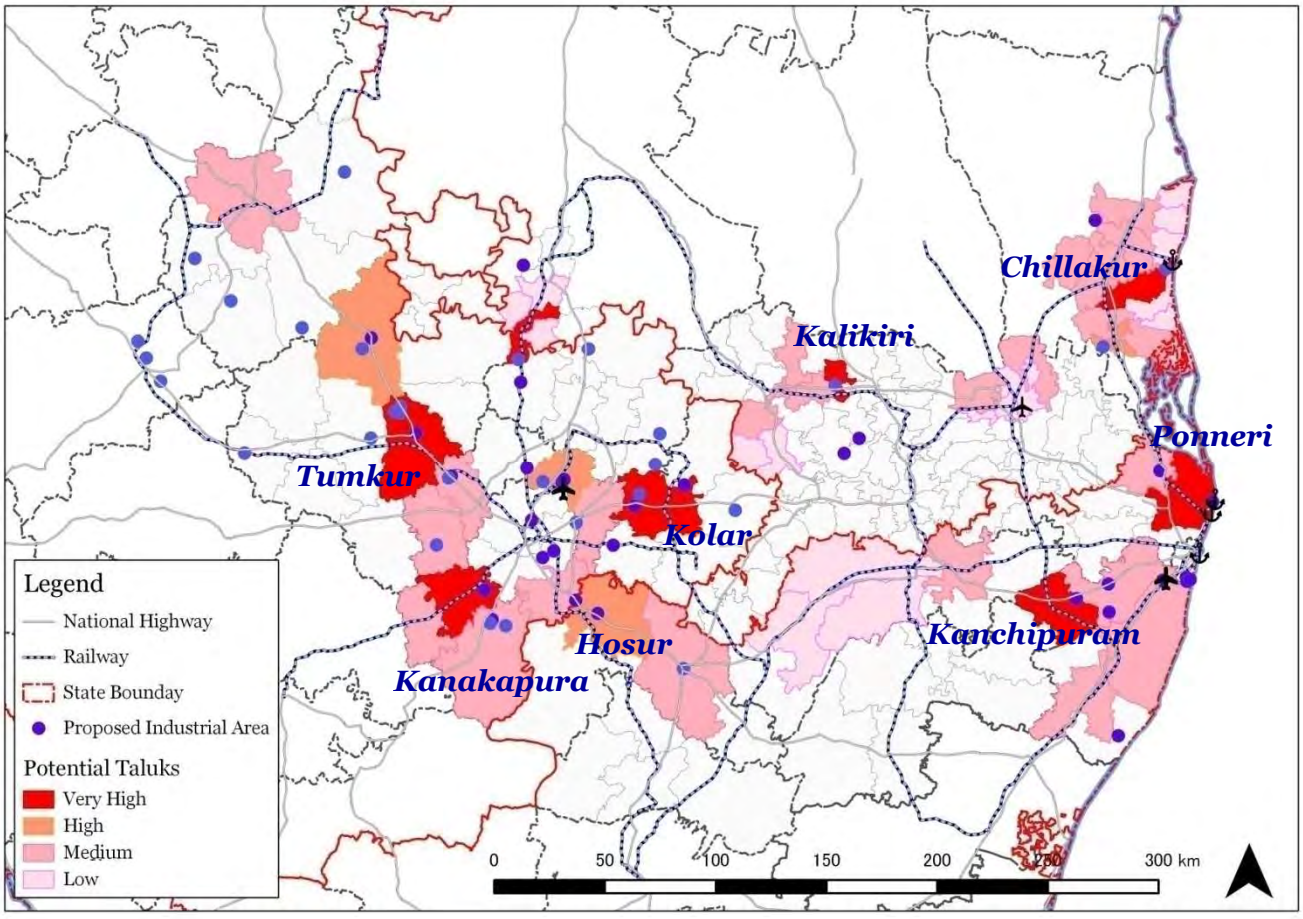
Areas which include wide reserved forests (esp. Vellore, Ambur and Katpadi) are assessed as low potential as covered in the analysis above.

5.3.3 *Government Land Availability and proposed plans*

Although some sub districts have government land, some of them are unsuitable for the urban development due to current land use (e.g. built-up area, agricultural use, etc.) or land disposition (e.g. forest, water bodies, rocky area, etc.). However, the governments have initiated several development plans for particular areas and those areas have been assessed. The areas containing suitable government land or planned industrial development can be considered as high potential areas.

Table 5.3.3: Assessment Criteria 3 – Government Land Availability and Proposed Plans

Potential Assessment	Description
Very High	Area with over 3,000 ha of government land bank or planned area
High	Area with over 1,000 ha under 3,000 ha of government land bank or planned area
Medium	Area with under 1,000 ha of government land bank or planned area
Low	Only small plots (under 20 ha) are available



Source : JICA Study Team Analysis

Figure 5.3.3: Assessment of Government Land Availability and Proposed Industrial Development

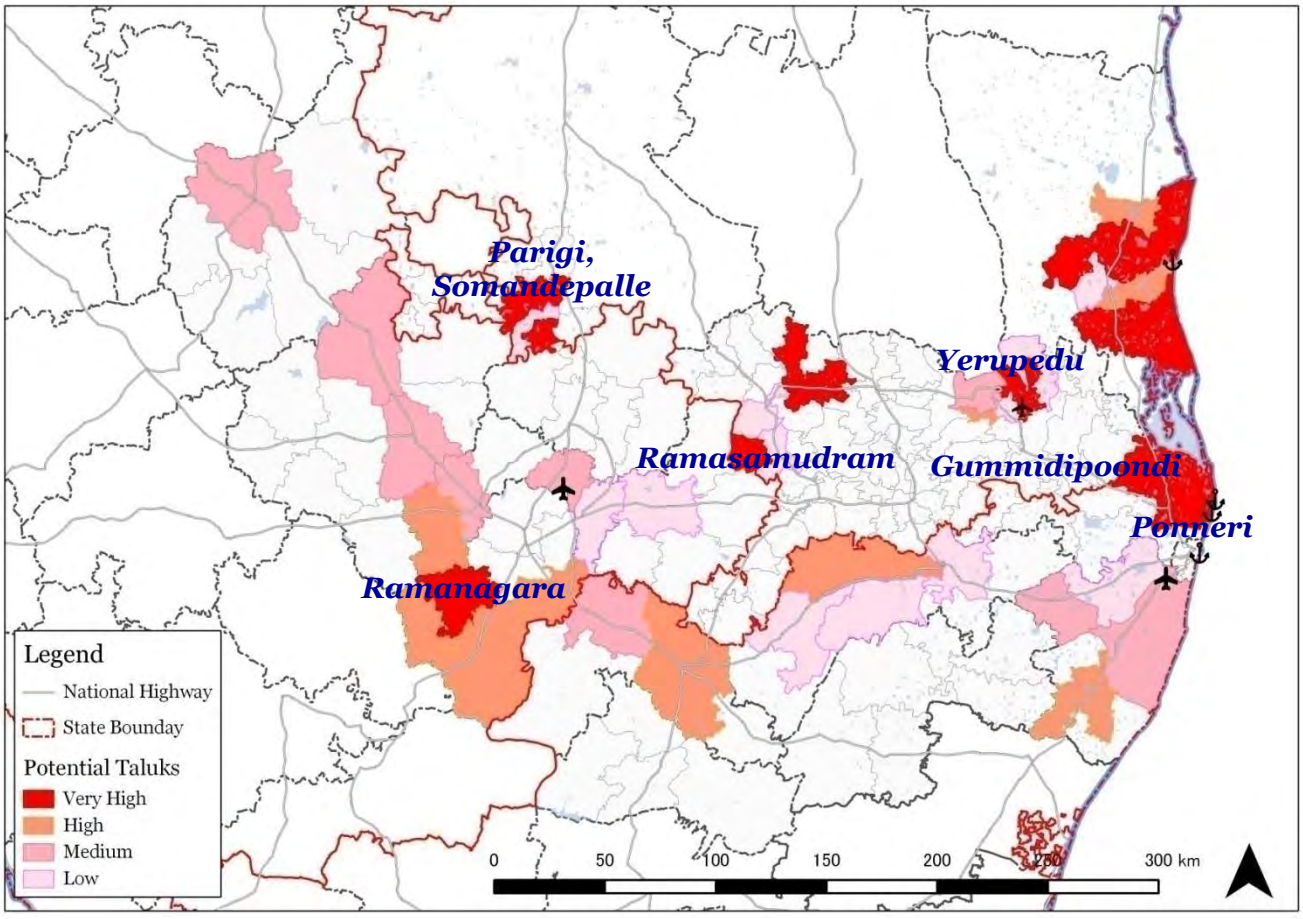
According to discussion with government and other related organizations, the following development sites were evaluated as promising: Ponneri and Hosur Taluk in Tamil Nadu State, Kanakaapura, Tumkur and Kolar District, Kalikiri and Chillakur Taluk area.

5.3.4 *Water Availability*

The areas selected as industrial nodes would undergo urban expansion owing to development of industries and supporting social infrastructure needs. Adequacy of water availability is a one of the key issues to sustain such new developments. The analysis presented below shows the gap between water supply and demand. The areas that either have supply in excess of demand or negligible gap in water supply compared to the demand can be considered as high potential areas.

Table 5.3.4: Assessment Criteria 4 – Gap between Water Supply and Demand

Potential Assessment	Description
Very High	Area with water supply in excess of demand
High	Area with over 80 % and under 100 % of water supply against water demand
Medium	Area with over 70 % and under 80 % of water supply against water demand
Low	Area with under 70 % of water supply against water demand



Source : JICA Study Team Analysis

Figure 5.3.4: Assessment of Water Availability

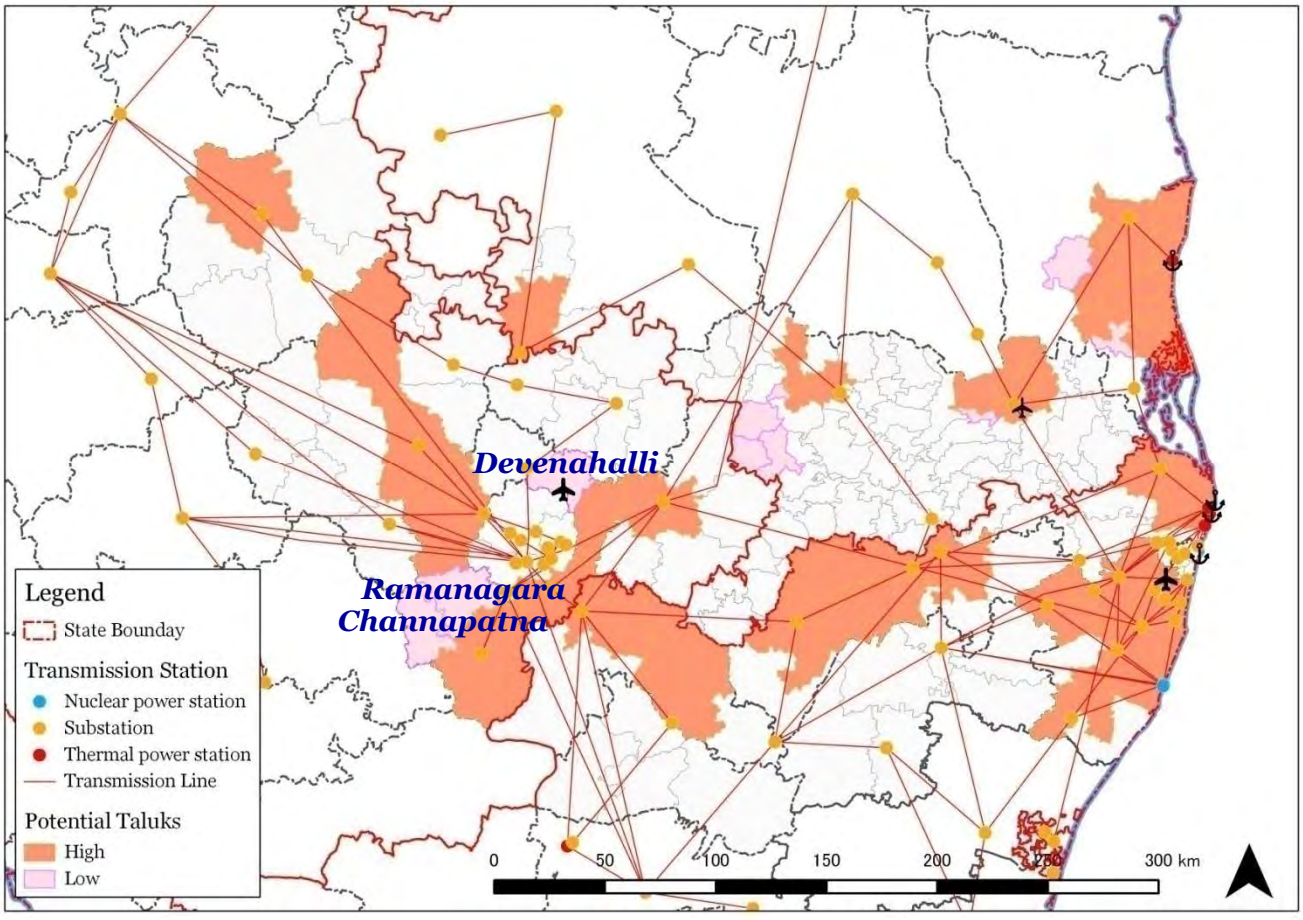
The areas of Ramanaga, Gummidipoondi, Ponneri, Parigi, Somandepalle, Ramasamudram, Yeripedu and other coastal Mandals in Andhra Pradesh area have enough water availability against current population.

5.3.5 *Power Availability*

The transmission line network is shown in the following figure. Majority of areas fall under the zones having high voltage transmission lines; however Ramanagara, Channapatna, Devenahalli and some of Mandals in Chittoor district and Nellore district of Andhra Pradesh State are far from transmission lines. These areas need to install connection lines for development.

Table 5.3.5: Assessment Criteria 5 – Accessibility to Electricity Network

Potential Assessment	Description
High	Area with high voltage transmission line
Low	Area without high voltage transmission line



Source : JICA Study Team Analysis

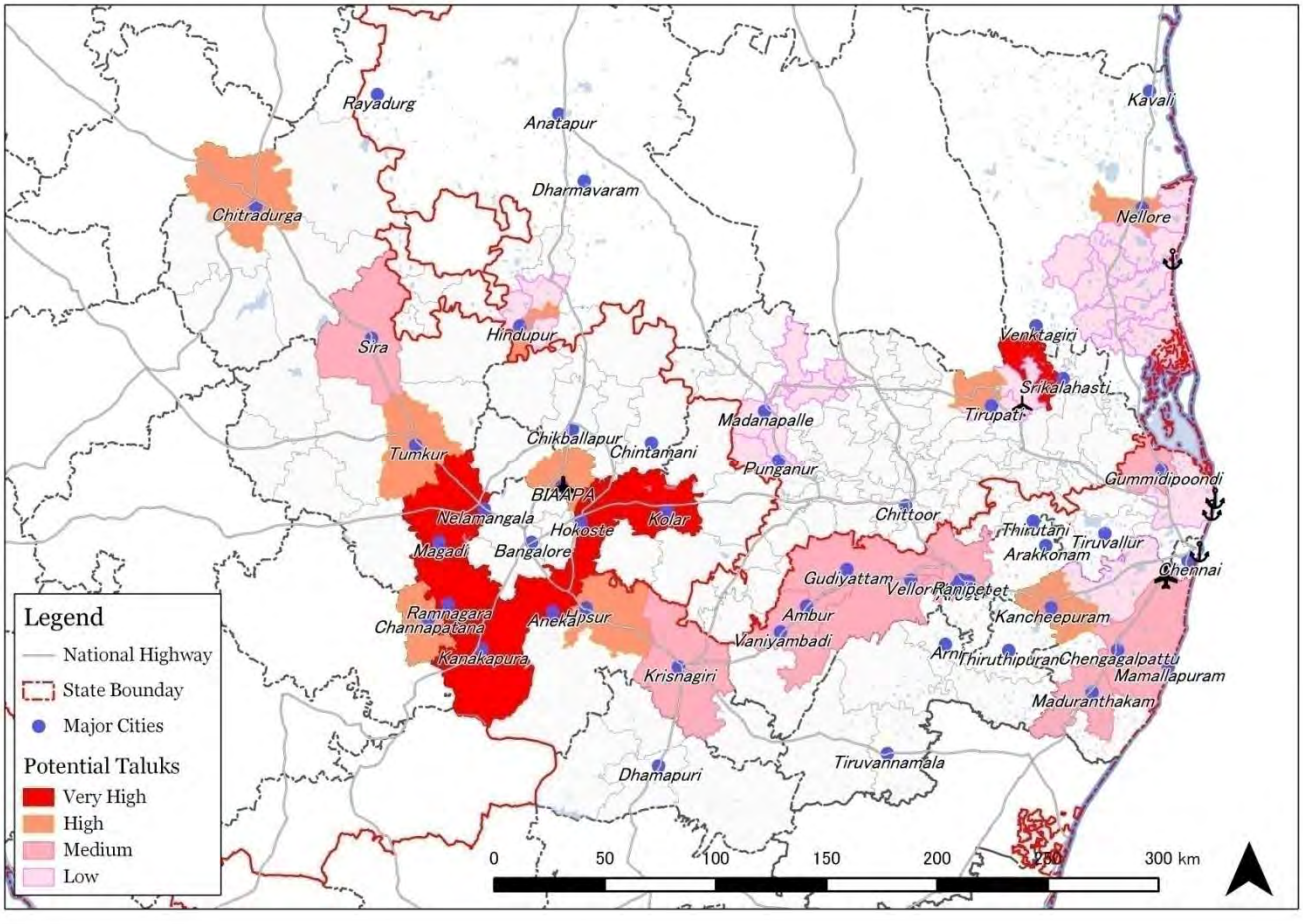
Figure 5.3.5: Assessment of Accessibility of Electricity Network

5.3.6 *Assessment of Urban Planning Strategy*

Based on the City Development Plan (CDP) or Urban Master Plan (UMP) developed for highly populated cities, the potential and direction for future expansion of urban areas and future land use were assessed.

Table 5.3.6: Assessment Criteria 6 – Urban Planning Strategy

Potential Assessment	Description
Very High	Area containing large industrial area and urban expansion by existing CDP or UMP
High	Area containing large industrial area or urban expansion by existing CDP or UMP
Medium	Only limited area is planned as expansion of urban area, but already developed
Low	Area without CDP and UMP



Source : JICA Study Team Analysis

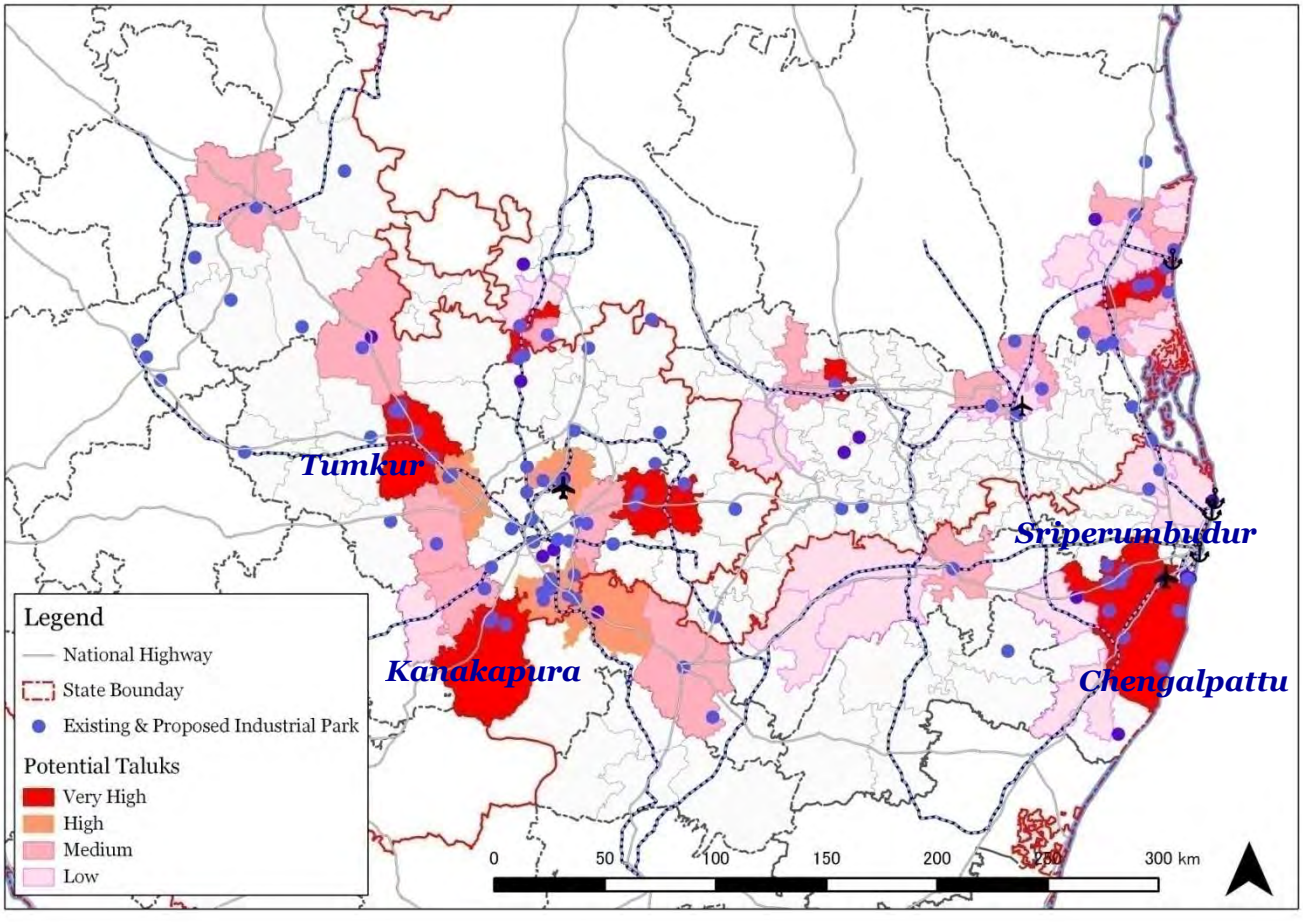
Figure 5.3.6: Assessment of Urban Planning Strategy

5.3.7 *Existing and Planned Industrial Area*

Areas with large area of existing/proposed industrial parks or accumulation of industrial parks are recognized as high potential area for industrial development. The categorization according to this evaluation criterion is described in the table below.

Table 5.3.7: Assessment Criteria 7 – Existing / Planned Industrial Parks

Potential Assessment	Description
Very High	Area with over 3,000 ha of total area of existing/proposed industrial parks and more than 2 industrial parks
High	Area with over 3,000 ha of total area of existing/proposed industrial parks or more than 2 industrial parks
Medium	And over 1 medium size industrial park (and over 200 ha)
Low	Only small industrial area (under 200 ha) is available



Source : JICA Study Team Analysis

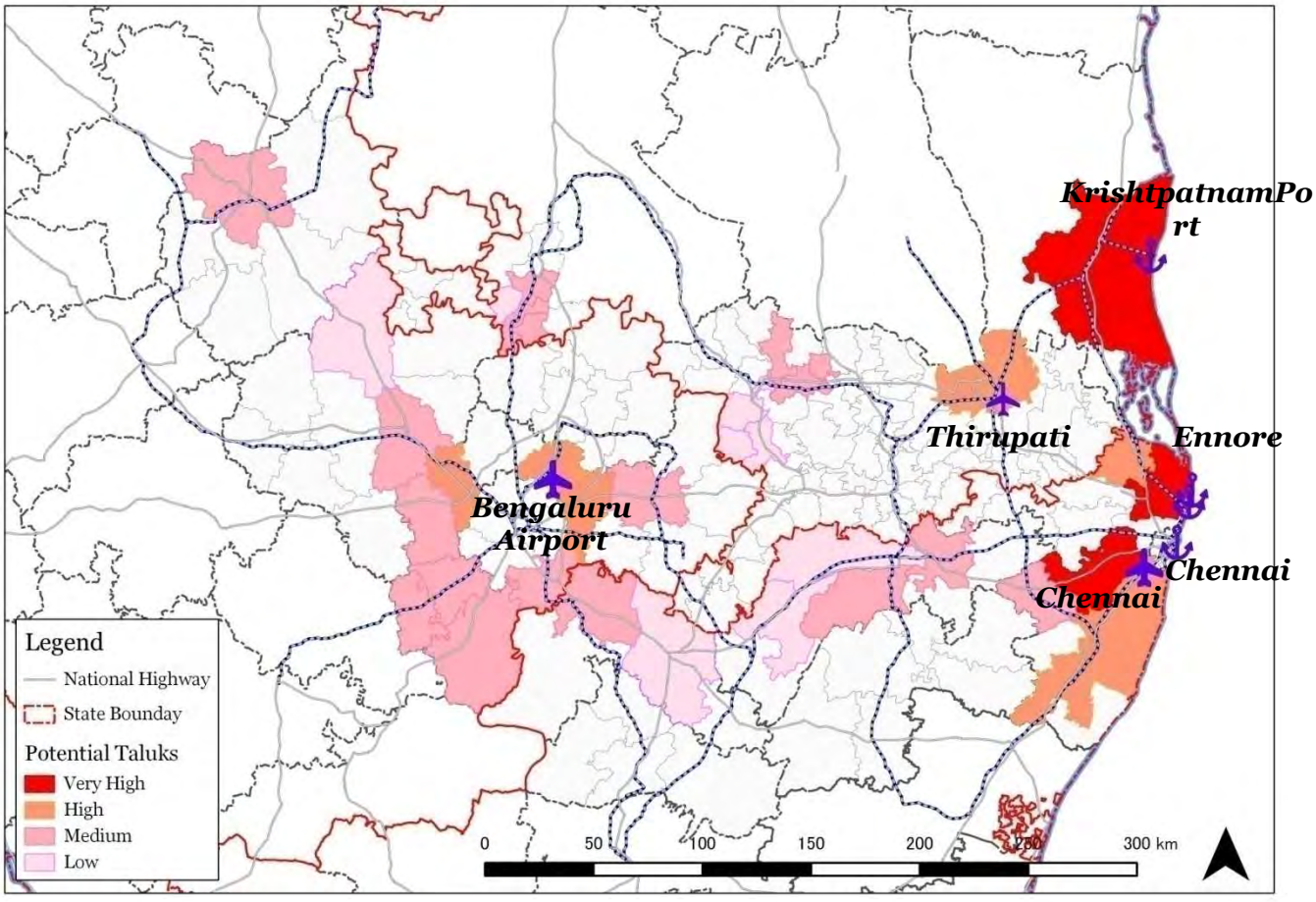
Figure 5.3.7: Assessment of Existing and Proposed Industrial Parks

5.3.8 *Accessibility to Gateways*

To ensure smooth transportation of raw materials and products, accessibility of major transportation (port and airport) should be a factor for site selection. On this point, coastal areas and the areas located close to these facilities have big advantages.

Table 5.3.8: Assessment Criteria8 – Accessibility to Major Transport Facilities

Potential Assessment	Description
Very High	Area with port within 50 km radius
High	Area with port within 100 km radius or airport within 50 km
Medium	Area with airport within 100 km radius
Low	Area without port and airport within 100km radius

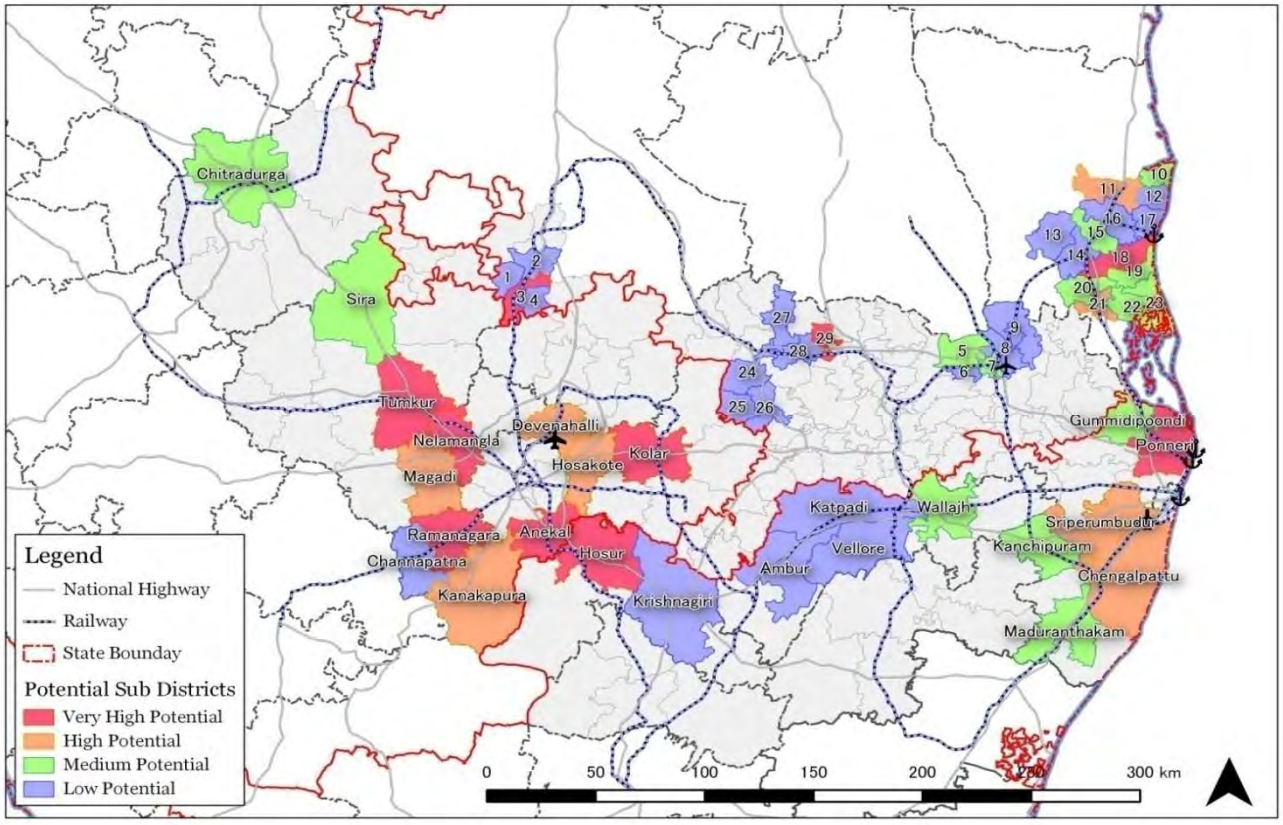


Source : JICA Study Team Analysis

Figure 5.3.8: Assessment of Accessibility to Major Transport Facilities

5.3.9 *Potential assessment result at sub district level*

As a result of potential sub districts assessment, 9 sub districts are selected as Very High potential sub districts (red) and 9 sub districts are selected as High potential sub districts (orange). The assessment results are shown on the map below.



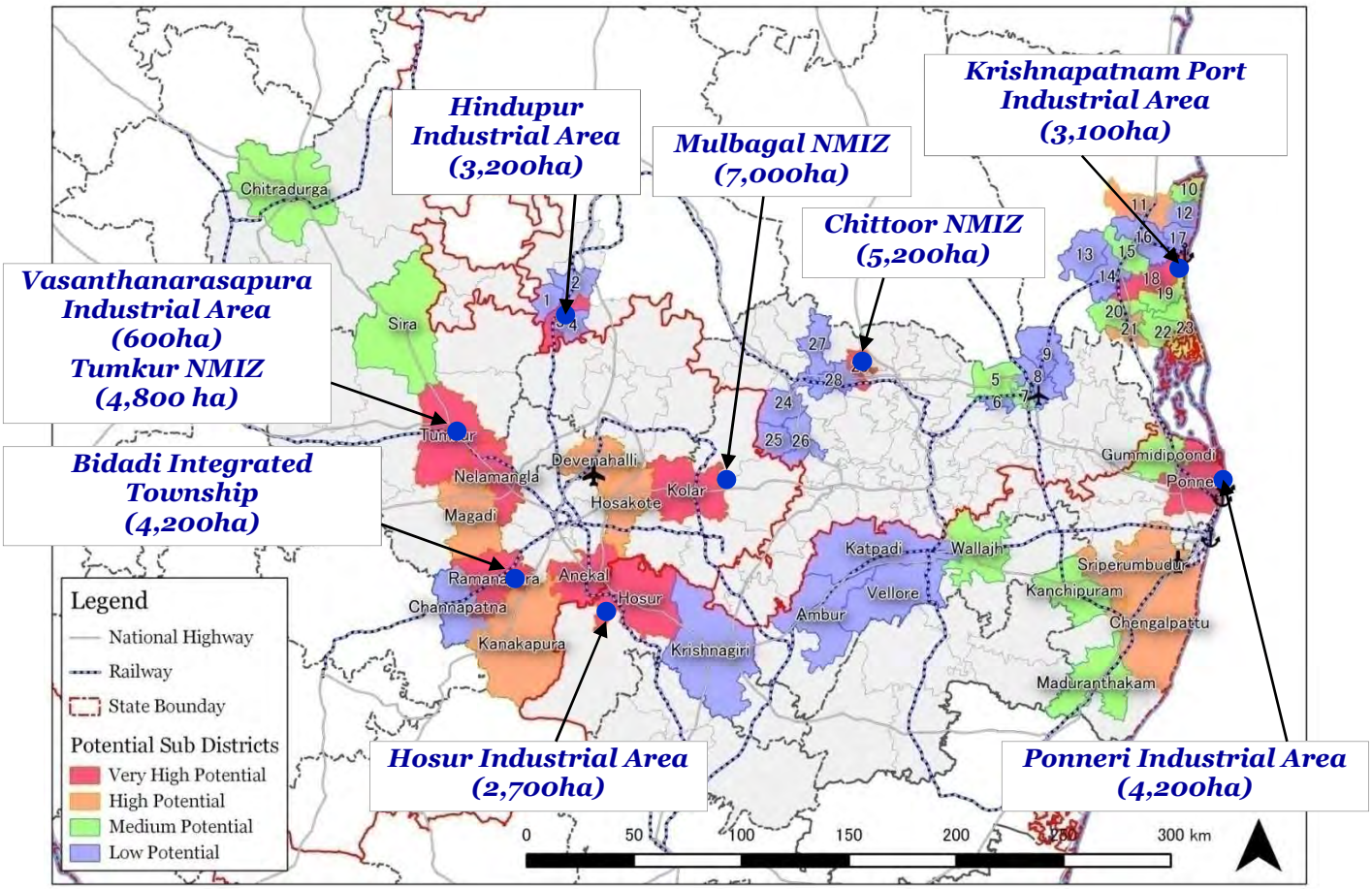
Source : JICA Study Team Analysis

Figure 5.3.9: Potential Assessment Result at Sub District Level

5.4 Shortlist of Industrial Nodes

5.4.1 Locations of Potential Sub Districts and Candidates of Industrial Nodes

Based on the potential assessment at sub-district level, the industrial nodes were discussed with the state governments. In case of Tamil Nadu State, Ponneri Taluk (4,200 ha) and Hosur Taluk (2,700 ha) were proposed as industrial nodes. In Karnataka State, Kolar NMIZ (7,000 ha), Kanchugaranahallikaval industrial area (4,200 ha), Vasanthanarasapura industrial area (600 ha) and Tumkur NMIZ (4,800 ha) were proposed. In Andhra Pradesh State, Hindur industrial park (3,200 ha), Pileru NMIZ (5,200 ha) and Krishnapatnam (3,100 ha) were proposed as industrial nodes. It is emphasized that these proposed industrial nodes are located in the very high/high potential sub districts.



Source : JICA Study Team Analysis

Figure 5.4.1: Location of candidate industrial nodes

5.4.2 Shortlist of Industrial Nodes

The advantages, the development requirement, and the possibility of industrial node development for sub-districts with very high/high potential were analyzed. As a result, these are the candidate nodes that are shortlisted in CBIC area.

Table 5.4.1: Summary of Potential Sub District and Candidate Industrial Nodes (Karnataka State)

Zone No.	ZONE-1 (Karnataka State)				ZONE-2			ZONE-3	
District	Bangalore Urban	Ramanagara			Kolar	Bangalore Rural		Tumkur	Bangalore Rural
Sub-District	Anekal	Kanakapura	Magadi	Ramanagaram	Kolar	Devanhalli	Hoskote	Tumkur	Nelamangala
Potential Assessment	A	B	B	A	A	B	B	A	A
Advantage	➢ Bangalore Metropolitan Development Authority plans 4 township development and setting-up of new urban planning area. It is expected that these areas would emerge as satellite cities around Bengaluru. ➢ The total population of Zone-1 is around 1.34 million (population census 2011). ➢ Satellite ring road has been planned as priority project and will contribute to reduction of the traffic congestion in Bangalore Urban District. ➢ It is possible to access both ports of Mangalore and Chennai ports in future. ➢ The location is preferable for foreign managers, engineers and researchers, since majority of foreigners stay in Bangalore Urban District ➢ The gap of water balance between supply and demand is very small.				➢ Bangalore Metropolitan Development Authority plans one township development and setting-up of new urban planning area near airport. ➢ The total population of Zone-2 is around 0.56 million (population census 2011). ➢ The area of forest and water body is limited to less than 10% of zone. ➢ Good accessibility to airport. ➢ The accessibility to both Bengaluru and Chennai will be improved through development of the Chennai – Bengaluru expressway.			➢ Both sub-districts have set-up urban planning area. ➢ Nelamangala sub-district plans expansion of urban area in their city plan. ➢ The total population of Zone-3 is around 0.80 million (population census 2011). ➢ The area of forest and water body is limited to less than 5% of zone. ➢ The zones are located along of NH-4 as major corridor in South India. In addition, they have good accessibility to Mangalore.	
Requirement	➢ Satellite ring road is required for linkage of satellite towns and therefore it should be realized as early as possible. ➢ The establishment of industrial node along with development of				➢ Alignment of expressway should be reflected to node development plan			➢ Satellite ring road is required for linkage with satellite towns. ➢ New or expansion of water supply	

Zone No.		ZONE-1 (Karnataka State)				ZONE-2			ZONE-3	
District		Bangalore Urban	Ramanagara			Kolar	Bangalore Rural		Tumkur	Bangalore Rural
Sub-District		Anekal	Kanakapura	Magadi	Ramanagaram	Kolar	Devanhalli	Hoskote	Tumkur	Nelamangala
Potential Assessment		A	B	B	A	A	B	B	A	A
		Satellite ring road will be effective way. ➢ Existing land use as Agricultural area should be transferred as urban area in order to receive the migration from Bangalore Urban District.				➢ New or expansion of water supply scheme is required due to the large gap of water supply and demand. ➢ Existing land use as Agricultural area should be transferred as urban area in order to receive the migration from Bangalore Urban District.			scheme is required due to the large gap of water supply and demand ➢ Existing land use as Agricultural area should be converted as urban area in order to accommodate potential migration from Bangalore Urban District.	
Industrial Node Development Possibility	Area*3	0 ha	300 ha	686 ha	4,507 ha	7,761 ha	1,132 ha	405 ha	3,387 ha	805 ha
	Proposed Plan	➢ Kanchugaranahallikaval industrial area (4,200 ha) in Ramanagaram sub-district was planned and it will be potential industrial node for short term development.				➢ Kolar NMIZ (7,000ha) in Kolar sub-district was planned and it will be potential industrial node for short term development.			➢ Vasanthanarasapura industrial area (600ha) and Tumkur NMIZ (4,800ha) were planned and it will be potential industrial node for short term development.	

Table 5.4.2: Summary of Potential Sub District and Candidate Industrial Nodes (Tamil Nadu State)

No.	ZONE-1	ZONE-10		ZONE-11
	Tamil Nadu			
District	Krishnagiri	Kanchipuram		Tiruvallur
Sub District	Hosur	Sriperumbudur	Chengalpattu	Ponneri
Potential Assessment	A	B	B	A
Advantage	➢ The total population of Zone-12 is around 0.54 million (population census 2011) ➢ The area of forest and water body is limited to less than 9% of zone.	➢ The total population of Zone-6 is around 1.08 million (population census 2011) ➢ The area of forest and water body is limited to less than 15% of zone. ➢ Peripheral ring road was planned as priority project and will contribute to reduction of the traffic congestion. ➢ It is easy to access both exiting port and airport of Chennai in future.		➢ The total population of Zone-11 is around 0.39 million (population census 2011) ➢ It is possible to formulate an integral plan with power plant and port development. ➢ Peripheral ring road has been planned as a priority project and will contribute to reduction of the traffic congestion. ➢ The gap of water balance between supply and demand is very small. ➢ The area of forest and water body is limited to less than 10% of zone.
Requirement	➢ The area is closely linked to Bengaluru and the development should be harmonized with development plan of Karnataka Government. ➢ New or expansion of water supply scheme is required due to the large gap of water supply and demand. ➢ The development plan should be harmonized with existing urban plan.	➢ New or expansion of water supply scheme is required due to the large gap of water supply and demand ➢ The development plan should be harmonized with existing urban plan. ➢ There is some area along coast with a risk of tsunami. ➢ Existing land use as Agricultural area should be transferred as urban area to		➢ There is some area along coast with a risk of tsunami. ➢ The node plan should be harmonized with existing urban plan of CMA. ➢ Existing land use as Agricultural area should be transferred as urban area in order to receive the migration from Chennai Metropolitan Area.

No.		ZONE-1	ZONE-10		ZONE-11
		Tamil Nadu			
District		Krishnagiri	Kanchipuram		Tiruvallur
Sub District		Hosur	Sriperumbudur	Chengalpattu	Ponneri
Potential Assessment		A	B	B	A
		➢ Existing land use as Agricultural area should be transferred as urban area in order to accommodate potential migration from Bangalore Urban.	accommodate potential migration from Chennai Metropolitan Area.		
Industrial Node Development Possibility	Proposed Area*3	2,700 ha	365 ha	940 ha	4,200 ha
	Proposed Plan	➢ No development area is proposed.	➢ Ponneri industrial area (4,200 ha) in Ponneri sub-district was planned and it will be potential industrial node for short term development.		➢ Hosur industrial area (2,700 ha) in Hosur sub-district was planned and it will be potential industrial node for short term development.

Table 5.4.3: Summary of Potential Sub District and Candidate Industrial Nodes (Andhra Pradesh State)

No.		ZONE-5	ZONE-7			ZONE-8
State			Andhra Pradesh			
District		Anantapur	Nellore			Chittoor
Sub District		Hindupur	Nellore	Chillakur	Naidupet	Kalikiri
Potential Assessment		A	B	A	B	A
Advantage		➢ The total population of Zone-9 is around 0.20 million (population census 2011)	➢ The total population of Zone-7 is around 0.76 million (population census 2011) ➢ It is expected to be urban core along coast in future ➢ There is the traffic flow from Andhra Pradesh State to Bangalore. ➢ There is priority project for improvement of NH-5 from Andhra Pradesh State to Chittoor			➢ The total population of Zone-8 is around 0.05 million (population census 2011) ➢ The area of forest and water body is limited to less than 5.2% of zone. ➢ The gap of water balance between supply and demand is very small.
Requirement		➢ New or expansion of water supply scheme is required due to the large gap of water supply and demand. ➢ It is very far from Bangalore to the proposed area. Therefore, it is difficult to commute every day from Bangalore. ➢ The development plan should be harmonized with existing urban plan. ➢ Existing land use as Agricultural area should be transferred as urban area in order to accommodate potential migration from Bangalore Urban District.	➢ The area of forest and water body is more than 20 %. Therefore, the development should avoid such area. ➢ It is very far from Chennai to this site, and as a result, it is difficult to commute every day from Chennai. ➢ Tirupati Airport is domestic purpose only. ➢ Existing land use as Agricultural area should be transferred as urban area in order to accommodate potential migration from Chennai District.			➢ The location is not preferable as residential area for foreign managers, engineers and researchers. ➢ The development plan should be harmonized with existing urban plan. ➢ Existing land use as Agricultural area should be transferred as urban area in order to accommodate potential migration from Chennai District.
Industrial Node	Proposed	3,756 ha	35 ha	4,047 ha	1,698 ha	5,200 ha

No.		ZONE-5	ZONE-7			ZONE-8
State			Andhra Pradesh			
District		Anantapur	Nellore			Chittoor
Sub District		Hindupur	Nellore	Chillakur	Naidupet	Kalikiri
Potential Assessment		A	B	A	B	A
Development Possibility	Area*3					
	Proposed Plan	➢ Hindupur industrial park (3,200 ha) in Hindupur sub-district was planned and it will be potential industrial node for short term development.	➢ Krishnapatnam Port Area Development (3,100 ha) in Chillakur sub-district was planned and it will be potential industrial node for short term development.			➢ Pileru NMIZ (5,200 ha) in Kalikiri sub-district was planned and it will be potential industrial node for short term development.

*1: 17 Potential sub districts are selected from 53 sub districts by JICA Study Team's analysis
*2: BMRDA stands for Bangalore Metropolitan Development Authority
*3: Total area of government land bank and proposed industrial development area by government or related organization

5.5 Regional Structural Plan

Based on the priority road projects identified in the CBIC area as well as proposed location of shortlisted industrial nodes, the regional structure plan was formulated. The following connectivity and linkage were considered and, as a result, the regional structure plan shown in the map below.

i) Existing NH-4, NH-44, NH-7 and NH-4 from Chennai to Chitradurga form the primary corridor in the CBIC Region. The corridor passes through Sira, Tumkur (proposed industrial node), Bengaluru Metropolitan Area, Hosur (proposed industrial node), Walajapet, and Kanchipuram as major cities from Chitradurga to Chennai Metropolitan Area. Accordingly, the connectivity amongst cities and urban cores has been strengthened through the principal corridor.

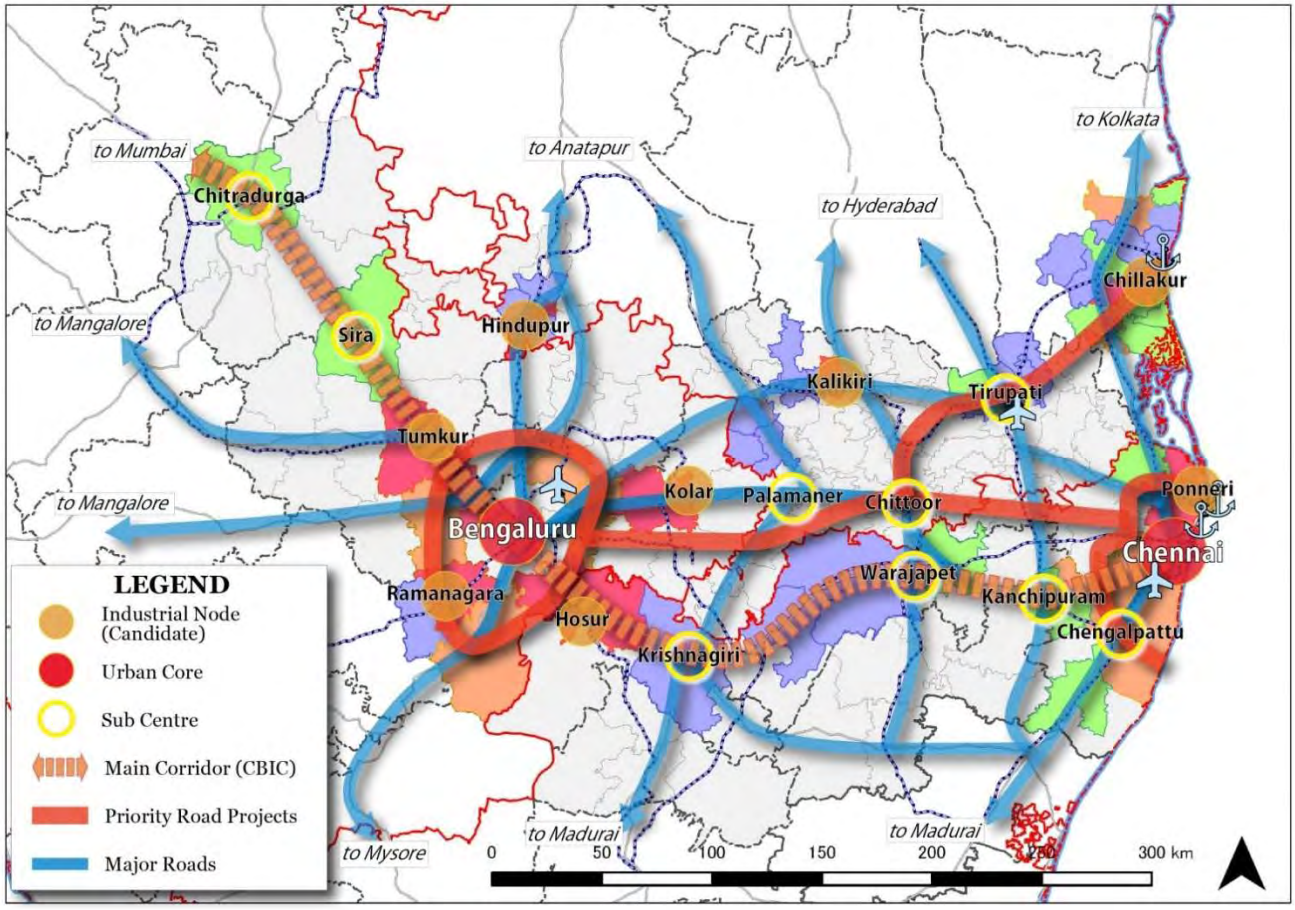
ii) The urban function of Bengaluru Metropolitan Area should be decentralized due to the rapid urbanization, and accordingly, a part of industrial and settlement area should be reorganized around the satellite township ring road to be developed. The satellite township ring road will also contribute to enhancement of the connectivity and linkage between Tumkur (proposed industrial node), Ramangara, Kanakapura (proposed industrial node), and Hosur (proposed industrial node).

iii) In Chennai Metropolitan Area, Peripheral Ring Road should be set-up urgently, since the population and urbanization have been increased rapidly. Satellite townships along the ring road should also be planned. Ponneri (proposed industrial node) near Ennore port could be one of the satellite townships.

iv) Four lanes for NH–18A and SH-61 are proposed as the priority road projects. This will contribute to strengthening the connectivity and linkage between Chittoor, Tirupati, and Naidupet (proposed industrial node). In addition, improvement of SN-99 and NH-205 should be considered in order to enhance the connectivity between Kolar (proposed industrial node), Kalikiri (proposed industrial node) and Tirupati.

v) Improvement of a linkage between Chennai and Bengaluru by highway or high speed railway could be considered as one of the priority projects. If so, the connectivity between Kolar (proposed industrial node), Palamaner, and Chittoor could be improved. In addition, the linkage between Chennai Metropolitan Area and Bengaluru Metropolitan Area will be strengthened.

It is emphasized that above linkages should be strengthened in parallel with new industrial node development to maximise the growth of the economy.



Source: JICA Study Team analysis, Respective state governments

Figure 5.5.1: Structure Plan for CBIC Area

5.6 Priority of Shortlisted Industrial Nodes

5.6.1 Status on Land Details of Shortlisted Industrial Node

In addition to the above analyses, further review on land details, potentials for the linkage with industries, especially Japanese companies, and the existence of a master plan were conducted in order to deal with detrimental factors for implementation stage and provide information on the applicability to further Japanese support under the next phase.

5.6.1.1 Summary of Land Details

To confirm the land condition in shortlisted industrial node, land details were surveyed. Majority of proposed areas are still in the process of land acquisition, and only land area of Ponneri industrial node have been procured completely by the government or governmental organization.

If the current land use belongs to the category of greenfield, the land acquisition or land use conversion will be easier than the land under brownfield. In addition, the necessity of resettlement of existing habitants was confirmed. From this perspective, it is considered Bidadi integrated township has some difficulty, since this area belongs to brownfield.

In terms of presence of core Japanese companies near the planned areas, only Toyota is located next to planned area (Bidadi integrated township). Toyota is operating its factory with some Japanese sub-contractors. Accordingly, the development of this area can contribute to existing Japanese companies.

Table 5.6.1: Comparison of Land Details

State	Planned Area	Area (ha)	Status					Core Japanese Company Nearby
			Land Acquisition	Acquisition Price (USD/sq.m)	Land Price	Current Land Use	Habitation	
TN	Ponneri Industrial Area	4,200	100% acquired	-	Fixed by Govt.	Greenfield	No habitation	17km from TOSHIBA JSW
	Hosur Industrial Area	2,700	30% acquired	N/A	Yet to fix	Greenfield	Limited habitation	10km from NISSAN
KA	Bidadi Integrated Township	3,700	24% acquired	N/A	Yet to fix	Partially brownfield	Presence of settlement	TOYOTA
	Tumkur NIMZ	5,400	27% acquired	27	Yet to fix	Greenfield	No habitation	-
	Mulbagal NIMZ	6,900	Yet to acquired	2	Yet to fix	Greenfield	No habitation	50km from HONDA
AP	Hindupur Industrial Area	3,200	Yet to acquired	N/A	Yet to fix	N/A	N/A	-
	Chittoor NIMZ	5,200	30% acquired	4	Yet to fix	Greenfield	Limited habitation	-
	Krishnapatnam Industrial Area	4,900	42% acquired	N/A	Fixed by KPCT	Greenfield	No habitation	60km from Sri City

Note : TN (Tamil Nadu State), KA (Karnataka State), AP (Andhra Pradesh State)
Source : TIDCO, SIPCOT, KIADB, APIIC and JICA Study Team

5.6.1.2 Current Conditions

Tamil Nadu State

1. Ponneri Industrial Area

The land of this proposed area is acquired completely by TIDCO and Salt department of Ponneri sub-district office. However, this area is facing the coastal line and it is covered by “Flood Plain” area

according to the geomorphology map published by Tiruvallur district office. For this reason, land development to fill up the site, development of dyke and other equipment investment (e.g. reservoir to control flooding, pumping system) are necessary from viewpoints of foreign investors. Approximate 50% of land is identified as disaster risk area from the results of field survey and satellite image analysis of rainy season. The ground conditions and the location map are shown as below.

- High disaster risk area: the area which is identified flooding/water surface on satellite image in the rainy season
- Medium disaster risk area: the area neighbouring "High disaster risk area" or the area with water used land use (paddy field, fish ponds etc.)

Table 5.6.2: Breakdown of Ground Condition

Type of Area	*Necessity of Filling Up*	*Area (ha)*	*Ratio (%)*
High Disaster Risk Area	Necessary	1700	40
Medium Disaster Risk Area	Necessary	300	7
Access Road	Not Necessary	300	7
Port Development Area	Not Necessary	1,100	26
Other (water bodies and channel)	Not Necessary	800	19
Total		**4,200**	**100**

Source :Google earth Pro and JICA Study Team

Figure 5.6.1: Location of Proposed Area in Ponneri

2. Hosur Industrial Area

This area is separated to 2 areas. The first area which is already acquired completely by SIPCOT is 900ha (Phase-3 of Hosur Industrial Area) and it is located 10km from centre of Hosur to East. The

area faces NH-7; good road accessibility is one of the advantages of this area. On the other hand, the other proposed area (1,800 ha) is located in gently hill area in south of Hosur. Distance from Hosur centre is almost same as Phase-3 of Hosur Industrial Area, the land acquisition hasn't been started yet. In addition, local corporation of NISSAN (Ashok Leyland Nissan Vehicles Pvt. Ltd.) has a factory in Hosur.

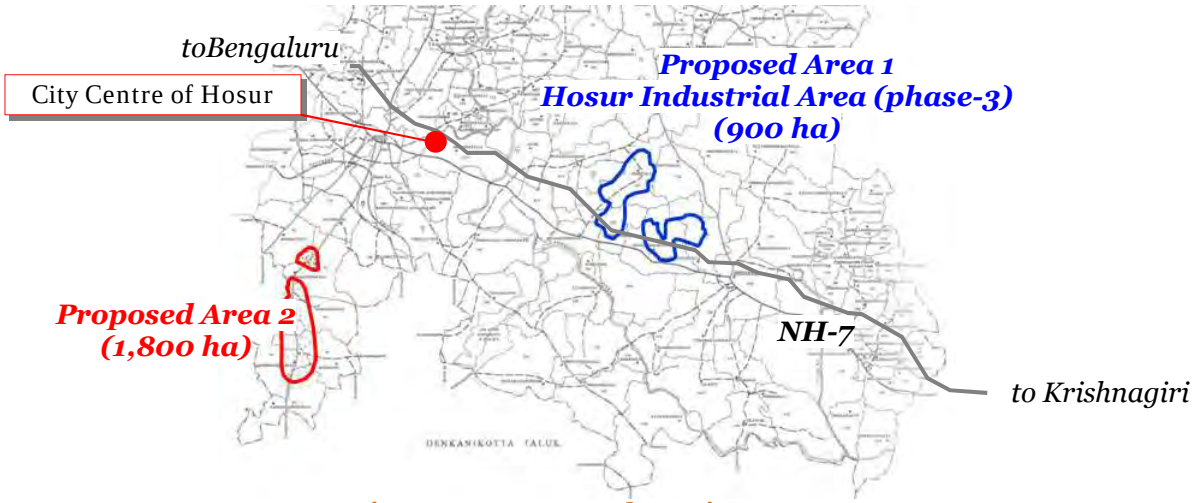
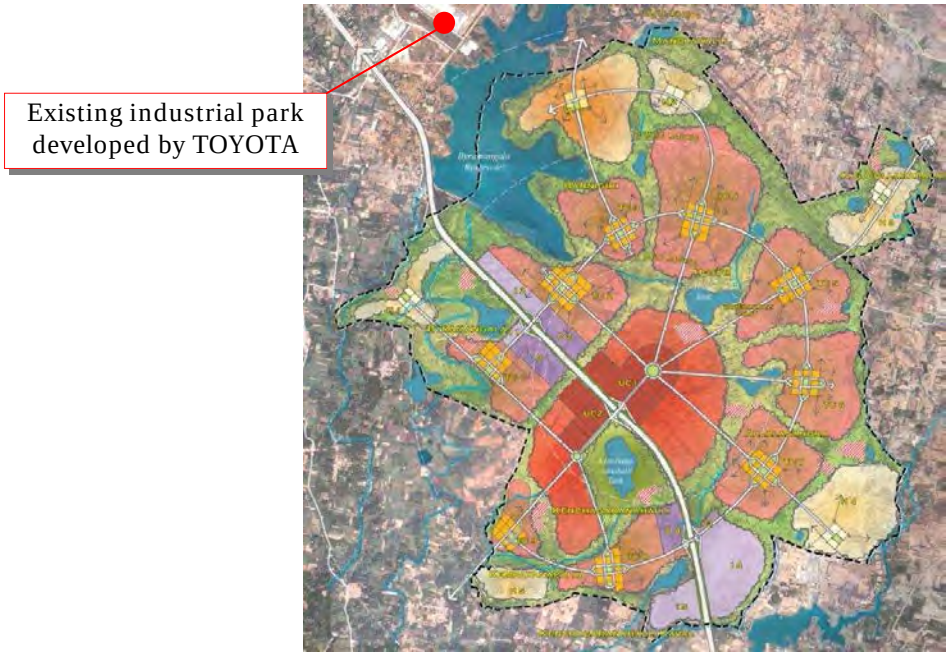


Figure 5.6.2: Proposed Area in Hosur

Karnataka State

1. Bidadi Integrated Township

The Bangalore Metropolitan Regional Development Authority (BMRDA) had proposed the project to develop five integrated satellite townships in 2006 as part of its plan to decongest Bangalore. And "Bidadi Integrated Township" is one of the satellite townships. Regarding to development of this area, although a consortium of DLF Limited (Indian real estate company) and Dubai developer awarded the tender with an investment of Rs. 600 billion in a five-year period in 2007, DLF was later shelved after the private firm withdrew from the project amid opposition from farmers to part with their lands. In 2011, BMRDA retender and 4 builders (GVK Group, Reliance Infrastructure, Hindustan Construction Corporation and Rajesh Exports) bid to do what DLF couldn't. However, BMRDA is still in the process of Land Acquisition and Rehabilitation and Resettlement Bill (LARB) for this area, the result of tender hasn't showed as well. The following conceptual plan was proposed in first tender of DLF.



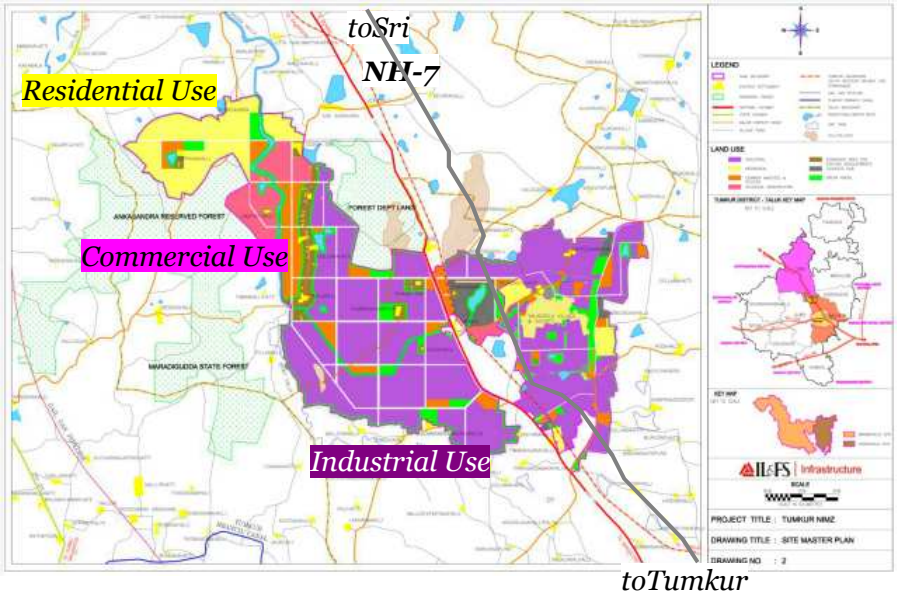
Note : Designed by urban design consultant based on California
Source :Calthorpe Associates HP (http://www.calthorpe.com/bidadi)

Figure 5.6.3: Conceptual Plan of "Bidadi Knowledge City"

One of the big advantages of this area is existence of Japanese companies. TOYOTA Kirloskar Motor Pvt. Ltd., TOYOTA Tsusho India Pvt. Ltd. and other related Japanese suppliers are operating their factories next to the this proposed area.

2. Tumkur NIMZ

Tumkur National Investment and Manufacturing Zone (NIMZ) is planned for the expansion project of the existing industrial park (Vasanthanarasapura Industrial Area). Majority of factories which are operating in the existing industrial park are Indian companies. In addition, the master plan of this area is already planned as shown below.



Source :KIADB

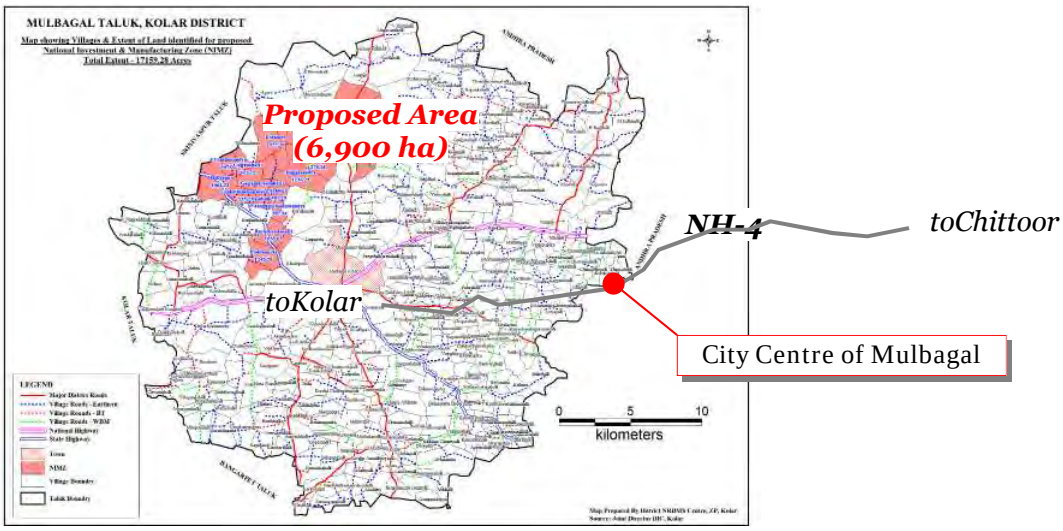
Figure 5.6.4: Master Plan of Tumkur NIMZ

3. Mulbagal NIMZ

Mulbagal NIMZ is located in 10km from Mulbagal centre (Mulbagal is 90km east from Bengaluru). The area is wider (7,000 ha) compared with other proposed areas, but it is considered that there are some difficulties for the land development of this area. As represented by local stone industry, rock layer is spread widely in Mulbagal. Therefore, some parts of land in Mulbgal NIMZ are very rocky and need big initial investment in the phase of land development. The master plan has been planned for this area.

Source: JICA Study Team

Figure 5.6.5: Current Condition of Mulbagal NIMZ (left : rocky ground, right : access road)



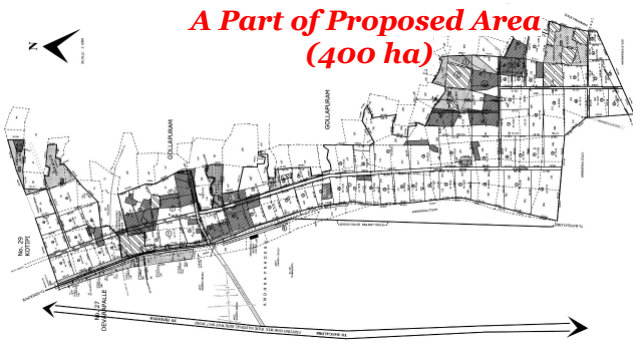
Note : Dark pink highlighted area is the proposed area of Mulbagal NIMZ
Source :KIADB

Figure 5.6.6: Master Plan of Tumkur NIMZ

Andhra Pradesh

4. Hindupur Industrial Area

Hindupur Industrial Area is scattered to some parcels of land (One of the major industrial area "Gollapuram Industrial Area" is approx. 400 ha), and it is not continuous land.

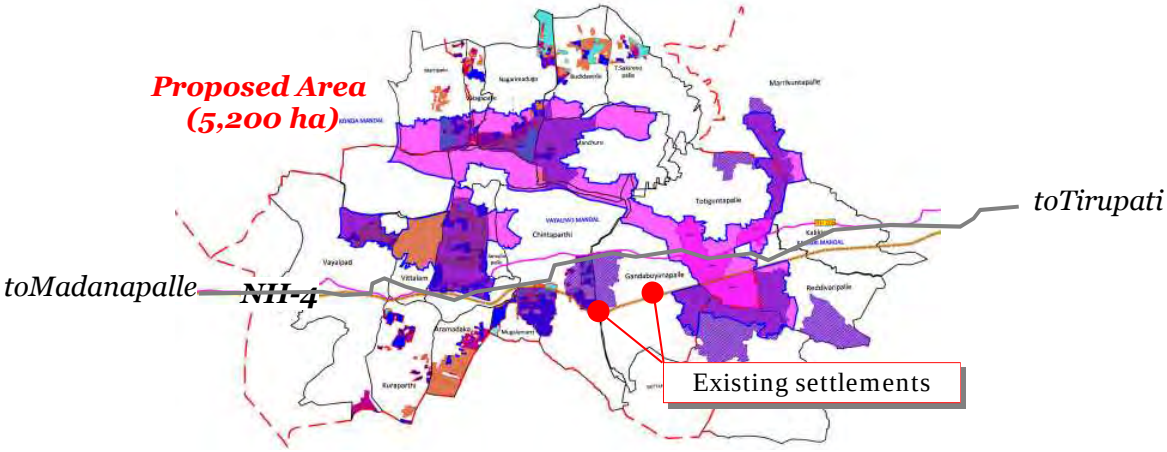


Source: KIADB

Figure 5.6.7: Layout Plan of Gollapuram Industrial Area

5. Chittoor NIMZ

Majority of this area is greenfield currently. As of February in 2014, approx. 30% of land has been acquired by government and local government. On the other hand, some parts of remaining area is still utilized as agricultural field in rainy season (ownership belongs to government and only land lease rights are held by local farmers). Although the distance to the nearest airport (Tirupati airport) is about 60 km, but this area is far from ports. For this reason, it is considered the potential of transport is lower compared with other planned areas.

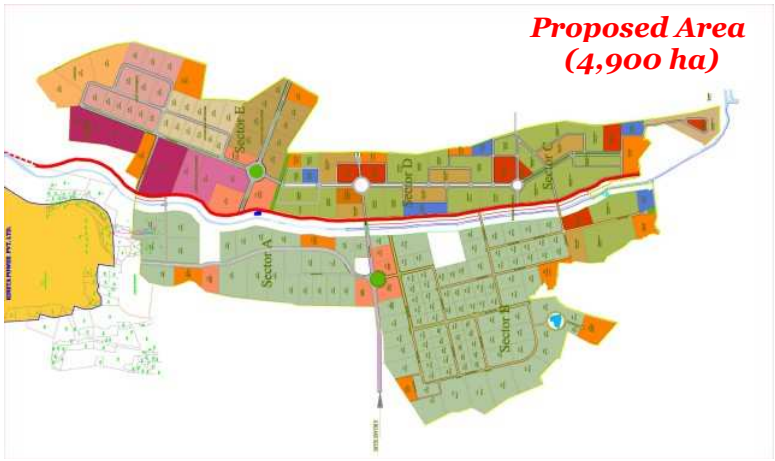


Note : Pink hatched area is proposed as "Chittoor NIMZ".
Source :Chittoor District Office

Figure 5.6.8: Boundary of Chittoor NIMZ

6. Krishnapatnam Industrial Area

This planned area is located in south of Krishnapatnam port as industrial development of 4,900 ha, and KPCT (Krishnapatnam Port Company Ltd.) already planned the layout plan for this area. Additionally, KPCT has plans to develop plant facilities (power plant, water treatment plant and waste water plant) near this area, and it is expected to provide stable operational environment for the factories in the future.



Source :KPCL (Krishnapatnam Port Company Ltd.)

Figure 5.6.9: Layout Plan of Krisnapatnam Industrial Area

5.6.1.3 Conformity of the Possibility of Development Master Plan

As mentioned previously, Tumkur NIMZ and Krishnapatnam have already designed development master plans by KIADB and KPCT. The status of study of shortlisted node is summarized below:

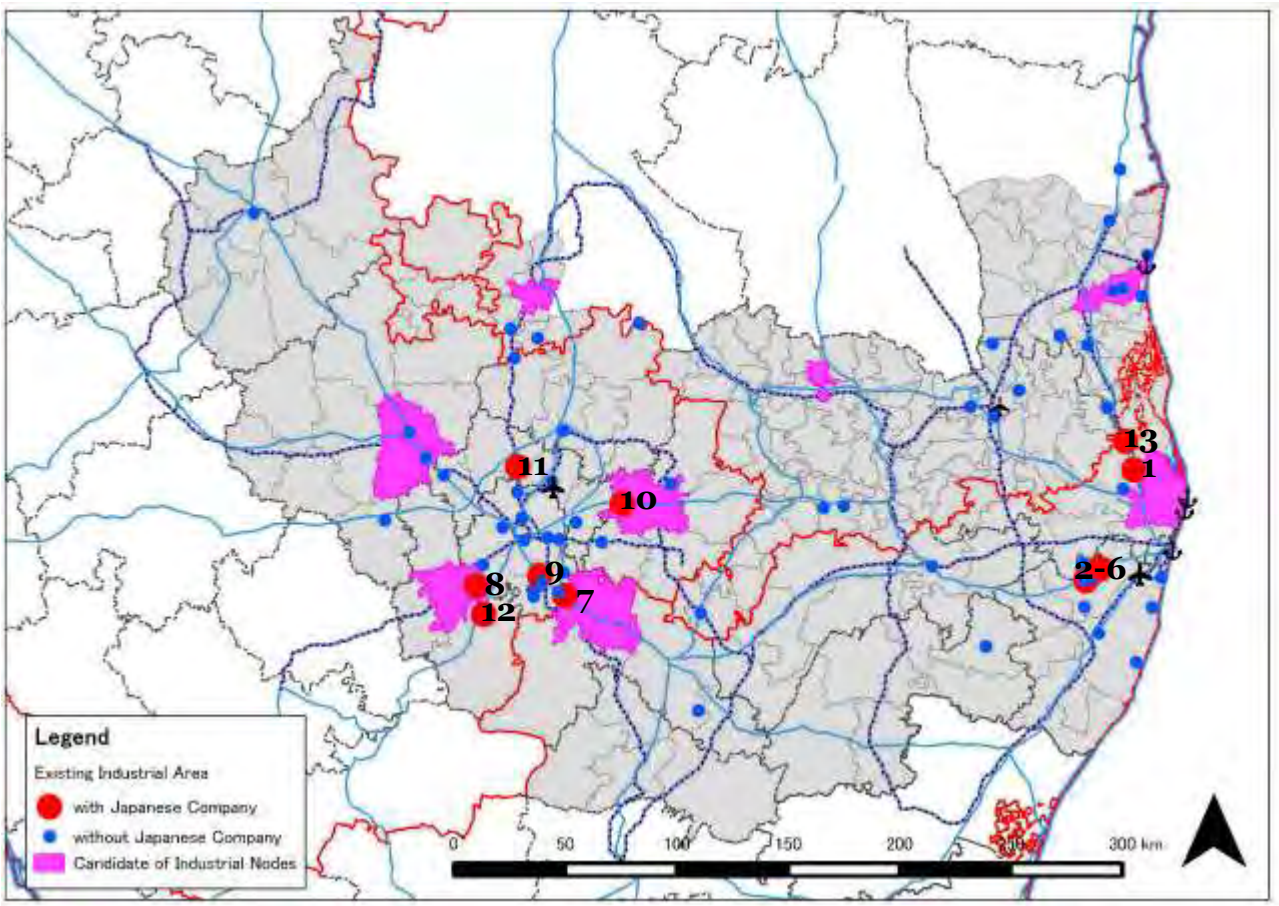
Table 5.6.3: Conformity to the possibility of developing Master Plan by the Government

State	*Planned Area*	*Presence of ongoing Master Plan*
TN	Ponneri Industrial Area	-
	Hosur Industrial Area	-
KA	Bidadi Integrated Township	-
	Tumkur NIMZ	Master plan developed by KIADB
	Mulbagal NIMZ	-
AP	Hindupur Industrial Area	-
	Chittoor NIMZ	-
	Krishnapatnam Industrial Area	Master plan developed by KPCL

Note : TN (Tamil Nadu State), KA (Karnataka State), AP (Andhra Pradesh State)

5.6.1.4 Location of the Core Japanese Companies

In CBIC area, the factories which are operated by major Japanese companies are located in 30 to 50km radius from centre of 2 metropolitan areas (Chennai and Bengaluru) so far. According to the interview / survey held with the Japanese companies, development conditions of plant facilities, accessibility to the metropolitans and gateways are key factors of site selection. The following figure shows locations of major Japanese factories in CBIC.



Note : Numbers on the red circles (Industrial park with Japanese companies) are linking to "No." in Table as below.
Source :JETRO and JICA Study Team

Figure 5.6.10: Location of the Core Japanese Companies in CBIC

Table 5.6.4: List of the Core Japanese Companies in CBIC

No.	*State*	*Name of Industrial Park*	*Name of Japanese Major Companies*
1	TN	Gummidipoondi	MITSUBA SICAL India Ltd.
2	TN	Irungattukottai	The Indo Asahi Glass Co.,Ltd. / Aloka Trivitron Medical Technologies Pvt. Ltd.
3	TN	Sriperumbudur	NICHIAS Industrial Products Pvt. Ltd. / JTEKT SONA Automotive India Ltd.
4	TN	Oragadam	**Nissan Motor India Pvt. Ltd.** /**Komatsu India Pvt. Ltd.** / NSK-ABC Bearings Ltd. etc
5	TN	Mahindra World City	Fujitec India Pvt. Ltd / JSP Foam India Pvt. Ltd. etc
6	TN	Vallam Vadagal	**India Yamaha Motor Pvt. Ltd.** etc
7	TN	Hosur	**Ashok Leyland Nissan Vehicles Pvt. Ltd.**
8	KA	Bidadi	**Toyota Kirloskar Motor Pvt. Ltd.** / TOYOTA Tsusho India Pvt. Ltd. etc

9	KA	Electronics City	Aisin Automotive Karnataka Pvt. Ltd. / FANUC India Pvt. Ltd. / Yokogawa India Ltd. etc
10	KA	Narsapur	**Honda Cars India Ltd.** / Bando India Pvt. Ltd.
11	KA	Doddaballapura	Musashi Auto Parts India Pvt. Ltd.
12	KA	Harohalli	TOKAI Rubber Auto-parts India Pvt. Ltd.
13	AP	Sri city	**Isuzu Motors India Pvt. Ltd.** / **Kobelco Construction Equipment India Pvt. Ltd.** / NHK Spring India Limited, etc

Note : TN (Tamil Nadu State), KA (Karnataka State), AP (Andhra Pradesh State)
Major Automobile Companies and heavy machinery companies are highlighted
Source : JETRO, Sri city and JICA Study Team

5.6.1.5 Prospects of Investment from Japanese Companies

Industry accumulation which formulates an industry cluster will promote technical progress and innovation, the essential inputs for economic development. It is expected that the potential of industry accumulation will be one of the important factors which affect investments from private companies. An industry cluster could be categorized in several types based on the nature of its origin, such as an industrial cluster formulated: (i) by a core company with related companies in its value chain; (ii) due to the availability of skilled laborers/technologies at the region, which results in industry accumulation including small and medium sized enterprises; and (iii) by the presence of particular material/products critical to the industry.

For the analyses of industry potential under (ii) above, top four manufacturing industries for which Japan has provided FDI most for the past 9 years were selected and the presence of these industries at the target location were analysed by a district level. The top four industries are: (a) chemical/pharmaceutical; (b) auto/transport machinery; (c) electrical machinery; and (d) food. The standard deviation was calculated among potential zones to see above the average or below the average for each State.

5.6.1.6 Priority of Shortlisted Industrial Nodes for Further Study

According to the information as previously mentioned, additional information of eight shortlisted nodes were provided to JICA and three nodes are recommended for the master plan and development plan study to be implemented under Part B.

Based on the information, Ponneri industrial area from Tamil Nadu state, Tumkur NIMZ from Karnataka state and Krishnapatnam industrial area from Andhra Pradesh state will have high priority for the further study. The reasons for the recommendations aresummarized below.

<u>Tamil Nadu state: Ponneri industrial area</u>
Although Ponneri industrial area has superiority as an industrial node 1) in direct accessibility to Kattupalli port to ensure smooth transportation, and 2) the area is located close to the Bay of Bengal and the development projects for two desalination plants(total capacily is 160 MLD) are planed. On the other hand, land filling to protect this area from probable flood is necessary to attract foreign investors. 3) Commutable from Chennai, which suggesting high potential to attract foreign factories since urban life can make it easier for foreign people to work and live. The area of 4,200 ha, further, is owned by Government, suggesting development procedure will be smoother when it comes to land acquisition, which is possibly one of the biggest obstacles to develop areas.

<u>Karnataka state: Tumkur NIMZ</u>
Tumkur NIMZ has the highest advantage in accessibility to regional trunk road as well as access to NH-7, which stretches between Bangalore and Chitradurga through Tumkur NIMZ. This area has more government land than Bidadi, another potential area. In addition, the area has an existing

industrial park (Vasantha Narasapura Phase1-3), and one Japanese consortium is planning to develop the factory in the area. The surrounding area is planned to expand with the Tumkur NIMZ master plan, it is in the phase of notification for the land acquisition as of May 2014. In the view of short term development, this is the highest potential industrial node in Karnataka state.

Andhra Pradesh state: Krishnapatnam industrial area

Krishnapatnam Industrial Area has higher potential than the two other candidate nodes in the state in terms of railway accessibility, future power plant and water treatment plant development, cheaper land prices and large scale port development. In addition, companies in Sri City are also are also expected to benefit from the development of Krishnapatnam Industrial Area as a node.

6 Strategies for Infrastructure Development

Infrastructure plays a critical role to achieve the objectives of the corridor detailed in the previous section,. Availability and affordability of adequate infrastructure is a necessary element to enable development of industrial sector.

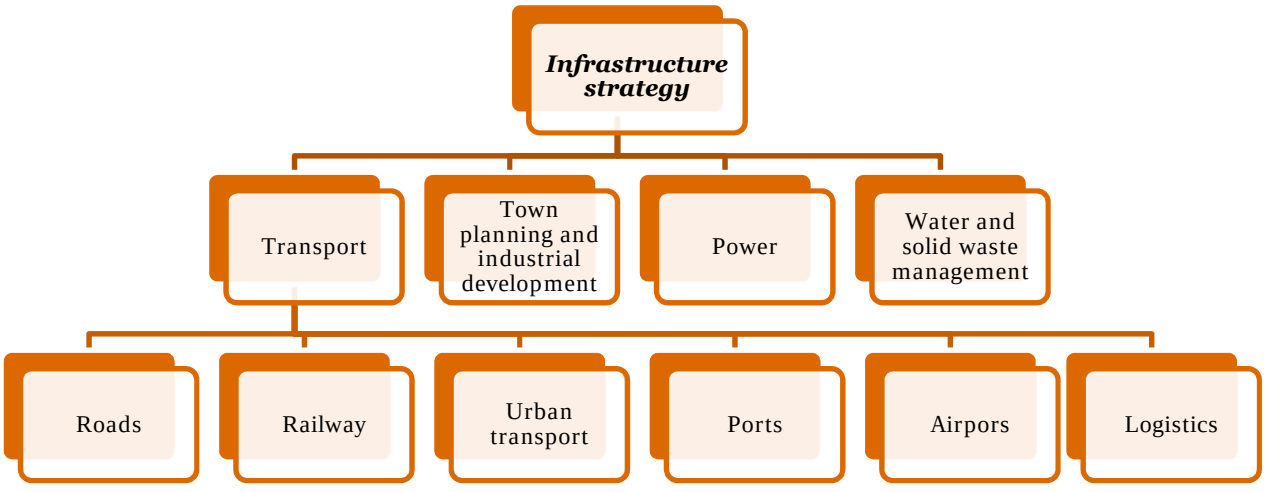
The infrastructure needs and criticality differ from sector to sector. For some sectors, power plays a key role, for some road and port connectivity play and key role and for others availability of water is critical. A snapshot of relative importance of infrastructure components for key sectors is as shown in the figure below.

Industries	Water	Power	Road and rail connectivity	Ports	Airports
Food processing	5	6	5	6	1
Textiles and Apparels	4	5	5	4	5
Machinery and Electrical Machinery	6	5	5	5	1
Pharmaceuticals	4	4	5	5	5
Automobiles	5	4	4	5	1
Computer, electronics and optical products (CEO)	1	4	5	6	6

1 Low 6 Medium 5 High 4 Critical

In order to ensure achieve the industrial vision of the corridor, it would be essential to have a well thought and planned infrastructure strategy. A multi pronged approach would be needed to address the infrastructure needs of the corridor.

Infrastructure strategy of the corridor has been framed to address the needs of the sectors. Infrastructure elements included in the strategy are transport, town planning and industrial development and water and solid waste management.



6.1 Transport Infrastructure

The Global Competitiveness Report 2013-14 by the World Economic Forum assesses quality of infrastructure (including roads, railroads, ports and air transport infrastructure) as one of many different components measuring different aspects of competitiveness.

On a scale of 1-7, following is India's score against competing countries for manufacturing sector investment.

	India	China	Thailand	Korea
Quality of **roads**	3.6	4.5	5.0	5.8
Quality of **railroad** infrastructure	4.8	4.4	2.6	5.6
Quality of **port** infrastructure	4.2	4.5	4.6	5.5
Quality of **air transport** infrastructure	4.8	4.5	5.7	5.2

India's score against competing countries is relatively low for road and port infrastructure and the country's railroad and air transport infrastructure are relatively close to competing countries standards. The corridor also experiences limitations and transport issues similar to those faced by the nation. The issues faced by the corridor are multi fold ranging from insufficient infrastructure, poor last mile connectivity and cumbersome procedures.

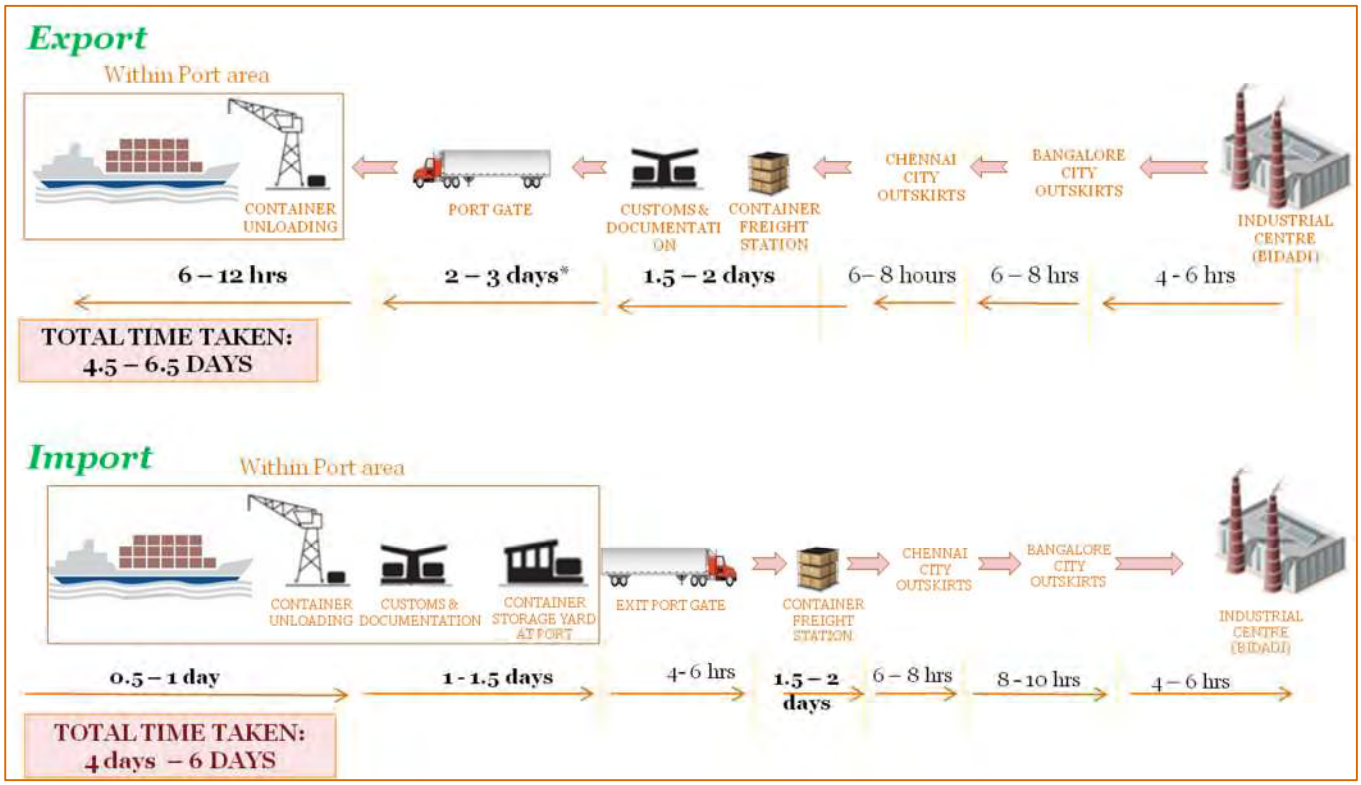


Figure 6.1.1: Time taken in movement of Export and Import containers between Chennai Port and Bidadi Industrial Area

*The time of 2-3 days outside the port gate at Chennai Port is the average time spent by trailers waiting outside the port gate. This is due to several reasons including incomplete documentation on part of the truck drivers, possible evacuation issues out of the port etc. (Source: Stakeholder interactions at Chennai and Bangalore)

Good connectivity is one of the biggest contributors for efficient port operations since limitations in land-side evacuation for a port can severely handicap the port performance. During our interactions with key stakeholders in the Corridor region, many of the stakeholders cited challenges in port connectivity as one of the major bottlenecks with transportation of import containers from Chennai port to Bidadi industrial area taking an average time of around four and half days and transportation

of export containers from Bidadi industrial area to the vessel at Chennai Port taking an average of a little over four days. The tables below and the transport chain shown on the previous page depict the average time taken for movement of import and export containers from and to the Chennai port:

FOR IMPORT CONTAINERS

Table 6.1.1: Activity - Time chart for transportation of Import Containers from Chennai Port to Bidadi

Sr. No.	Activity	Average time taken	Status of container after completion of activity
1.	Unloading of container from vessel	0.5 - 1 day	At Berth
2.	Customs & documentation and exit from Port gate	1 – 1.5 days	At exit gate of Chennai Port
3.	Exit from port gate and arrival at CFS	4 – 6 hrs	CFS at Thiruvottiyur
4.	Completion of CFS processes, customs procedures (if required) and assignment to destination	1.5– 2 days	Container ready to exit CFS
5.	Exit from CFS and travel to Chennai city outskirts	6 – 8 hrs	At Chennai city outskirts
6.	Transit on Highway (NH-4) from Chennai city outskirts to arrival at outskirts of Bengaluru	8 – 10 hrs	At Bengaluru city outskirts
7.	Transit from Bengaluru outskirts to Bidadi	4 - 6 hrs	Destination at Bidadi
TOTAL TIME TAKEN		**Around 4 days – 6 days**	

An import container spends more than 3.5 days reaching the outskirts of Chennai after unloading from vessel at Chennai Port

Source: Primary research

FOR EXPORT CONTAINERS:

Table 6.1.2: Activity - Time chart for transportation of Export Containers from Bidadi to Chennai Port

Sr. No.	Activity	Average time taken	Status of container after completion of activity
1.	Transit from Bidadi to Bengaluru outskirts	4 – 6 hrs	Bengaluru outskirts
2.	Transit on Highway (NH-4) from Bengaluru city outskirts to arrival at Chennai outskirts	8 – 10 hrs	Chennai Outskirts
3.	From Chennai outskirts to Container Freight Station (CFS) at Thiruvottiyur	6 – 8 hrs	CFS at Thiruvottiyur
4.	Completion of customs procedures and other activities at CFS	1.5 – 2 days	Exit from CFS
5.	From CFS to reaching the Chennai Port Entry gate	2 - 3 days	Port Entry gate
6.	Time taken for entry at Port gate up to loading on to the vessel	6 - 12 hours	Export container loaded on the vessel
TOTAL TIME TAKEN		**4 days 12 hours – more than 6 days 12 hours**	

An export container spends more than 3.5 days reaching from the Chennai city outskirts to the vessel of which 2 – 3 days are spent waiting in the queue outside entry gate at Chennai Port.

Source: Primary research

The key issues of the corridor are:

- **Lack of sufficient ring roads** to divert freight traffic away from the cities
- **Poor last mile connectivity** resulting in severe **evacuation challenges at ports**
- **Lengthy & cumbersome** customs procedures
- **High volume capacity ratio** in certain important road sections across the corridor
- **Heavy road based transport** (~80-85%) compared to rail

The proposed road and rail connectivity projects which are planned to enhance capacity evacuation at the ports in the CBIC region shall also contribute to further improvement in the port performance parameters. The transport strategy of the corridor aims at addressing the issues and challenges across all transport sectors including port, roads, rail, urban transport, airport and logistics. Strategy across all the segments has been the detailed out in section 6.2 to 6.8.

6.2 Ports

6.2.1 Sector overview

Ports function as the gateways for movement of raw material and finished goods through the corridor region. The six ports (four existing ports and the two proposed ports) are likely to be these main gateways for the proposed Chennai Bengaluru Industrial Corridor. These ports include the major ports of Chennai and Ennore in Tamil Nadu as well as the non-major ports of Kattupalli Port in Tamil Nadu and Krishnapatnam Port in Andhra Pradesh. Additionally, a green-field major port at Durgarajapatnam in Andhra Pradesh and a captive non-major port at Cheyyur in Tamil Nadu have also been planned.

Chennai Port is one of the largest ports in India and handles cargo such as containers, crude, POL, fertilizer, fertilizer raw material, edible oil, general cargo etc. in large volumes. During 2012-13, Chennai Port handled a total cargo of around 53.40 MTPA vis-a-vis 55.70 MTPA in 2011-12. The main reason for the decrease in traffic at Chennai port can be attributed to the reduction in the import traffic which mainly used to comprise of coal, iron ore and containers. Till recently, large quantities of dry bulk cargo (i.e. coal and iron ore) were being handled at Chennai Port. However, handling of such cargo was stopped due to the ban imposed in October 2011 by the Madras High Court on handling dusty cargo at the port. This resulted in traffic of commodities such as coal and iron ore to shift to Ennore Port. Ennore Port Limited, which is the only corporatized major port in India, was originally developed as a satellite port to the port of Chennai is expected to benefit due to the ban imposed on handling dirty cargo at Chennai Port. The total traffic at Ennore Port increased from around 14.96 MTPA in 2011-12 to around 17.89 MTPA in 2012-13. The major contribution to the increased port traffic at Ennore was the increase in imports of dirty cargo at the port.

The other existing port located within the CBIC region in the state of Tamil Nadu is the Kattupalli Port at the Kattupalli Shipyard which was built as a joint venture between L&T and TIDCO. Kattupalli port currently has two berths for container traffic and started operations in 2012-13. The other existing non-major port in the CBIC region is located at Krishnapatnam in the state of Andhra Pradesh and this port handles a large variety of cargo including coal, containers, edible oil, fertilizers and project cargo. The following table provides information on the existing commodity-wise capacities at each of the four ports discussed above.

(Capacity in MTPA)

Table 6.2.1: Commodity-wise capacity at the four existing ports in the CBIC region

COMMODITY -> PORT	Iron Ore	Coal (Thermal)	POL	Fertilizers	Gen / Break Bulk Cargo	Containers	TOTAL CAPACITY
CHENNAI PORT	8.0	-	17.67	-	17.92	42.00	85.59
ENNORE PORT	6.0	21.0	3.0	-	1.0	-	31.0
KATTUPALLI PORT	-	-	-	-	-	22.92	22.92
KRISHNAPATNAM PORT			52.08			22.92	75.00
Total cargo handling capacity at existing four ports in the CBIC region							**214.51**

Source: IPA 2012-13 data; websites of respective ports

The following table provides an overview of the major commodity types handled at each port for export and import:

Table 6.2.2: Major import & export commodities handled at the four existing ports in CBIC region

Port	Export	Import
CHENNAI PORT	Containers, Food grains (Whear & Others), POL (Product), Other ores, Sugar, Cement, Other Dry Bulk and Break Bulk	Containers, POL (Crude & Product), Edible Oil, Other Liquid, Iron Ore (Pellets), Fertilizers & Fertilizer Raw Materials, Sugar, Other Break

Port	Export	Import
		Bulk & Dry Bulk Cargo
ENNORE PORT	Break Bulk Cargo, Cars	Thermal Coal, Coking Coal, POL (Product & LPG), Other Liquid Cargo, Break Bulk cargo
KATTUPALLI PORT	Containers	Containers
KRISHNAPATNAM PORT	Containers, Barytes, Granite, Food grains (Rice, Wheat, Maize etc.), Other break bulk cargo	Containers, Thermal Coal, Coking Coal, Edible Oil, Gypsum, Project Cargo, Sugar, Other Break Bulk cargo

These ports serve the primary hinterland of northern Tamil Nadu, south and central Andhra Pradesh and south-east and central Karnataka. The diagram shown below depicts the combined primary hinterland of these four existing ports. Among the four ports in the CBIC region, Chennai accounts for more than 66% of all container traffic in the 1500 km coastline between Turicorin and Vishakhapatnam. In addition to this, among the four existing ports in the CBIC region, Chennai Port accounts for more than 95% of all traffic among the operational ports (others being Kattupalli and Krishnapatnam). A container terminal at Ennore has been proposed and expected to be built over the next 5-6 years. Also, Krishnapatnam & Kattupalli are also expected to significantly enhance their container handling capacity in the next 10 years.

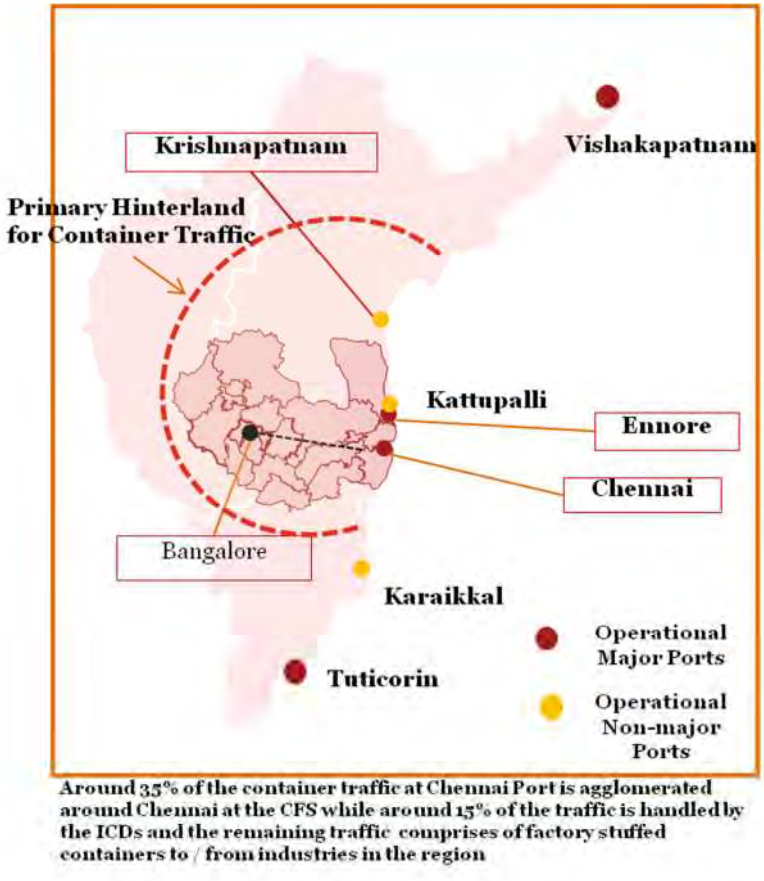


Figure 6.2.1: Combined primary hinterland for container traffic of the Chennai, Ennore, Kattupalli and Krishnapatnam Ports

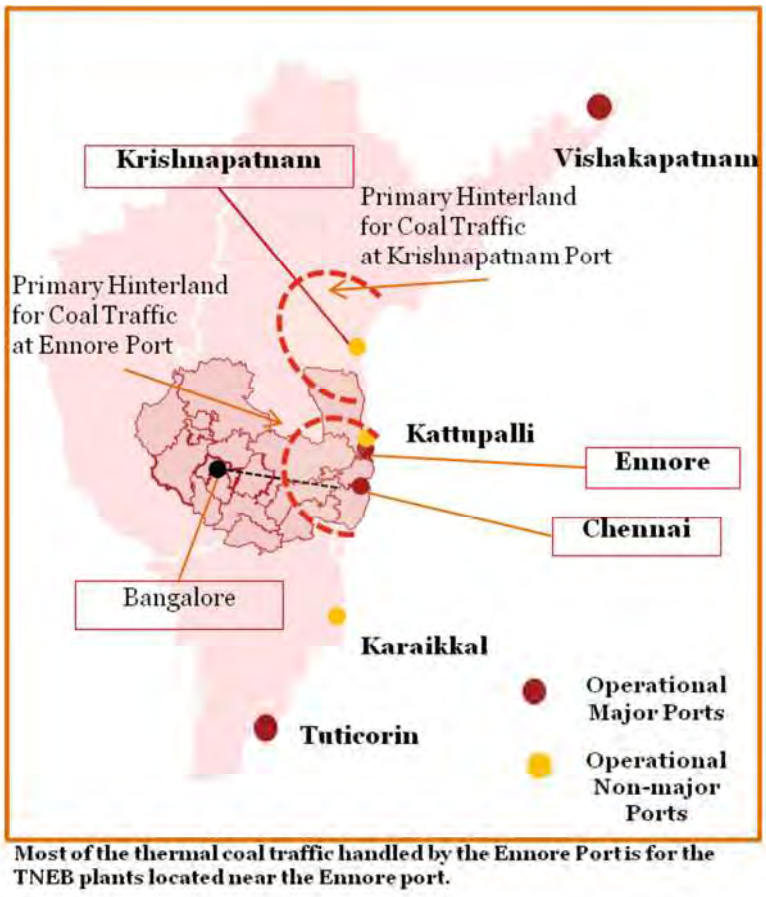


Figure 6.2.2: Primary hinterland for Coal traffic handled at Ennore & Krishnapatnam ports

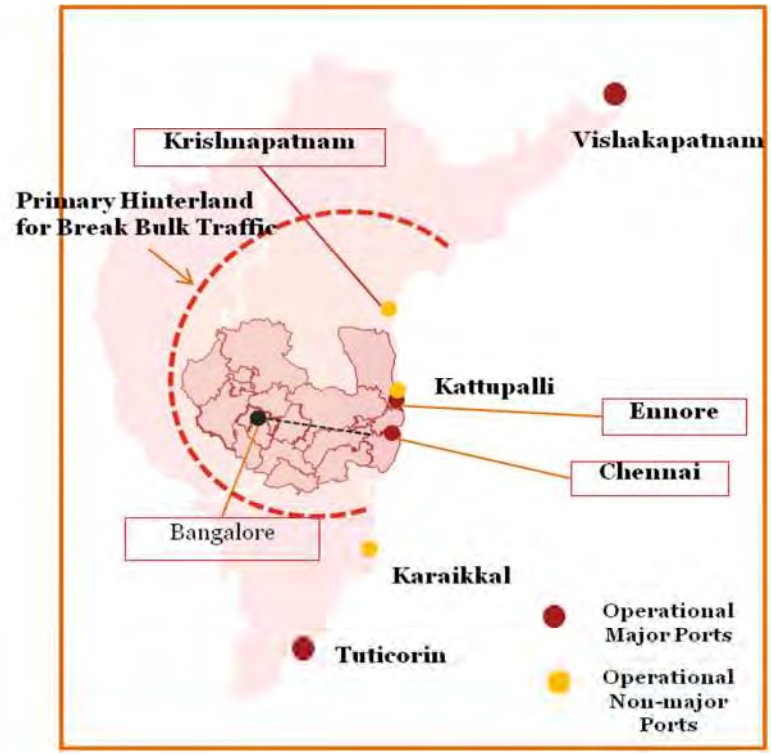
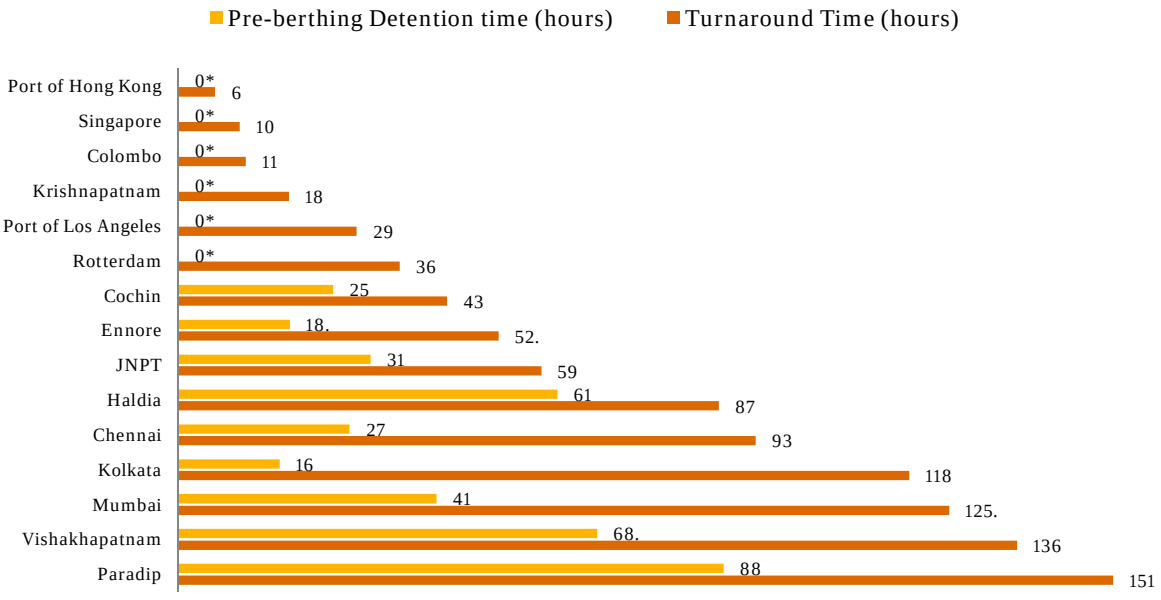


Figure 6.2.3: Primary hinterland for Break Bulk Traffic at the existing ports in the CBIC region

While the non-major ports of Krishnapatnam and Kattupalli have become recently operational, the cargo handling capabilities at the older ports of Chennai and Ennore are severely handicapped due to the challenges in land-side evacuation facilities at these two ports. As discussed in detail in the Interim Report 1 for this Study, the high vessel turnaround times and the pre-berthing detention time at the two major ports are mainly a result of the bottlenecks and inefficiencies in the port operations and landside evacuation facilities. A comparison of the key performance indicators: pre-berthing detention time and the turnaround time are depicted in the graph below:



Port performance efficiency parameters - Turn Around Time & Pre-berthing Detention time

* Almost negligible pre-berthing detention time

(Source: Indian Ports Association data 2011-12, websites of respective ports, secondary research)

Figure 6.2.4: Port performance efficiency parameters - Turn Around Time & Pre-berthing Detention time

The average pre-berthing time per vessel for Chennai Port was around 27 hours during 2011-12 while the average pre-berthing detention time on port account at Chennai port was 0.9 hours for the same period. Similarly, the total pre-berthing detention time per vessel for Ennore Port was around 18 hours with around 0.02 hours due to port account. The average turnaround time at Chennai and Ennore Ports was around 93 hours and 52 hours while the turnaround time on port account at the two ports was 52 hours and 1.9 hours respectively as per the IPA data for 2011-12.

As per IPA 2012-13 data, the Chennai Port witnessed an improvement in pre-berthing detention time with the average pre-berthing detention time at Chennai Port being around 19.1 hours while on port account the pre-berthing detention time was 0.8 hours. However, for Kamarajar Port during 2012-13, the average pre-berthing detention time increased to a total of 31.9 hours while on port account the pre-berthing detention time increased to 0.05 hours. As per the IPA 2012-13 data, the average pre-berthing time at the Chennai Port also witnessed an improvement over 2011-12. The total average turn-around time at Chennai port was around 77.7 hours while on port account it was 46.3 hours. Similarly, in 2012-13 the average turnaround time at Kamarajar Port was 70.8 hours while on port account the average turn-around time was around 2.2 hours only. The Ministry of Shipping has issued instructions to the major ports in India to consider upgradation of the equipment at the ports as per their business and operational requirements. The Chennai Port Trust has initiated relevant steps in this direction and the port performance parameters are expected to further improve after the completion of the equipment modernization process.

Commodities handled at the ports in CBIC region:

The major commodities handled at the ports in the CBIC region include coal (thermal & coking coal), iron ore and other ores, crude and POL products, containers, fertilizers/ FRM, food grains, other break bulk and cars.

Iron ore

India contributes to more than 7% production and stands fourth in terms of quantity produced following China, Brazil and Australia. Orissa, Chhattisgarh, Karnataka and Goa are the major iron ore producing states in India with around 22.7% of total production coming from captive mines and rest from merchant mines. Iron ore production in the form of lumps, fines and concentrates was at 167 million tonnes in the year 2011-12 showing a decrease of about 19% compared to that preceding year. This was mainly because of the suspension of mining operations in Karnataka due to the order of the Supreme Court of India.

While the fines are converted into sinters for use by steel plants and the concentrates and fines are also converted into pellets. These are exported and are also utilized by sponge iron units. Exports are mainly to China (93%), Japan (4%) and Korea (2%). The pellets are used as feed in blast furnace. Pelletisation is being seen as an increasing trend as it is advantageous in production activities since it provides a uniform size, known composition and strength to the ore.

However, the recent ban on mining has resulted in a stoppage of iron ore exports from India. This ban was mainly enacted to stop the illegal mining and also to protect the environment. Additionally, the increase in the export duty from 5% (2009) to 30% further affected the exports of iron ore. The ban on exports of iron ore started in 2011 and this ban in Karnataka, Goa and Orissa led to huge shortage of iron ore in the country. India also recently started importing pellets and lumps. Recently, some grade A mines (around 16 out of 115 mines) have resumed operations in Karnatakata however, in view of the continuing ban on iron ore exports and the heavy export duty, the export of iron ore from ports in India is expected to be nil for the next 5 years.

The ports which export iron ore from India are Calcutta, Paradip, Kakinada, Ennore, Chennai, New Mangalore and Goa. Due to the recent ban on iron ore exports, the Marmagoa port is the most affected followed by Chennai, Ennore and Paradip ports. Moreover, India exported iron ore in the spot market and thus was impacted by the volatility in the international spot markets. Ennore Port had recently entered into a BOT agreement for an iron ore terminal of 6MT with SICAL. Also Krishnapatnam port which was basically built to handle iron ore and coal has now started concentrating on coal handling only.

Coal

India produces various grades of coal, which are used for different applications but the coal in India is low in sulphur content, low on calorific value and high in fly ash content. Most of the power plants which are planned to use domestic coal are recommended to blend with imported coal to compensate indigenous coal supply shortage. (CEA 2012). The primary sources of imported thermal coal are Indonesia, Australia and South Africa and Coal is shipped through Panamax or capesize vessels which need deep drafts. Procurement of imported coal is done through long term agreements which are settled annually by the Empowered Joint Committee (EJC). Ennore Port is taken as a satellite port to Chennai Port handling thermal coal requirement of TNEB. Also coal traffic forms around 70% of the total cargo handled at Krisnapatnam port, which is one of the deepest ports in India.

Containers

The container cargo in India witnessed around 13% CAGR growth since 2001 with the highest growth being witnessed in the ports on the western shore of India. The graph depicts the region-wise growth in container traffic. The percentage share of containers has remained almost the same since 2001 for the ports in the eastern shore, western shore and the southern ports in India. The percentage share of containers in 2012 was around 8%, 68% and 24% respectively for the east coast ports, north west

ports and the ports in south India. Historically, the west coast ports have witnessed the highest share of container cargo followed by the ports in south India.

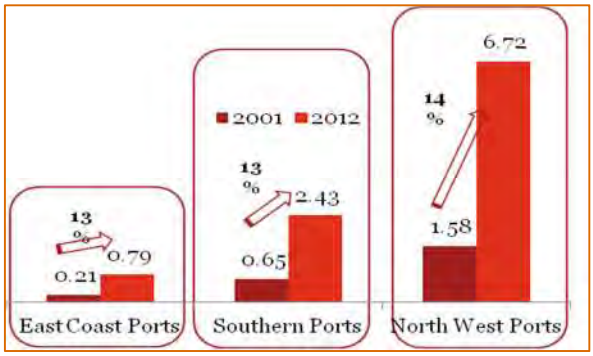


Figure 6.2.5: Growth in container traffic across ports in India

Crude and POL products

India remains a net importer of crude to meet its domestic requirements with around 80% of the crude requirements being imported while the POL products are both imported and exported. Even though refinery capacity in India has grown at a CAGR of over 8%, the demand off-take has resulted in high utilization rates of these refineries. The domestic crude oil production only accounts for about 20% of crude oil requirement of existing 213 mtpa refining capacity while rest has to be met through imports. Ports in the CBIC region as well as ports at other locations in India handle imported crude and POL movement as well as the coastal movement within the country.

Break bulk

The break bulk traffic at the ports includes commodities such as food grains, fertilizers/ FRM, cement, newsprint, and also cars. While certain commodities such as fertilizers / FRM are mainly imported into the country, certain commodities such as cars are exported. India's fertilizer consumption is expected to increase from 57 million tons to about 68 million tons and the domestic capacity additions in the sector are expected to supply only about 39 million tons of these requirements by 2018. In the long run, the recent urea policy may attract investments and thus reduce potential of urea imports; however these capacity additions are expected to take at least 4-5 years to come on stream.

Chennai port recently had an interaction with few of the importers and logistics players for the improvement in the fertilizers import numbers. The stakeholders in the interaction pointed few drawbacks which are showing downward trend in imports such as restricted movement of fertilizer products from port premises via road transport, non-availability of more rakes from railways from moving out, crane utilization and slow discharge rates.

Historical traffic scenario summary

The port traffic volume data from 2008-2013 has been utilized for the purpose of future traffic projections. The table below shows the total traffic volume data for the Major Ports in India as well as for Chennai Port, Ennore Port, Kattupalli Port and Krishnapatnam Port.

Table: Traffic Volume data for All India Major Ports and Ports at Chennai, Ennore, Katupalli and Krishnapatnam

			Total traffic (in '000 Tonnes)							
Financial Years	**All India Major Ports**	**Year-on-Year Change (%)**	**Chennai**	**Year-on-Year Change (%)**	**Ennore**	**Year-on-Year Change (%)**	**Katupalli**	**Year-on-Year Change (%)**	**Krishnapatnam**	**Year-on-Year Change (%)**
2004	344799		36710		9277		-	-	-	-
2005	383625	11.3%	43806	19.3%	9480	2.2%	-	-	-	-
2006	423407	10.4%	47248	7.9%	9168	-3.3%	-	-	-	-
2007	463782	9.5%	53414	13.1%	10714	16.9%	-	-	-	-
2008	519314	12.0%	57154	7.0%	11563	7.9%	-	-	-	-
2009	530533	2.2%	57491	0.6%	11500	-0.5%	-	-	8211	-
2010	561090	5.8%	61057	6.2%	10703	-6.9%	-	-	16107	96.2%
2011	570032	1.6%	61460	0.7%	11009	2.9%	-	-	15919	-1.2%
2012	560137	-1.7%	55707	-9.4%	14956	35.9%	10	-	15418	-3.1%
2013	545790	-2.6%	53404	-4.1%	17885	19.6%	12	20.0%	21236	37.7%

(Krishnapatnam Port initiated its commercial operations in 2009 and Kattupalli Port started commercial operations in 2012)

CAGR of traffic volume	All India Major Ports	Chennai Port	Ennore Port
From 2004 to 2013	5.2%	4.3%	7.6%
From 2004 to 2008	10.8%	11.7%	5.7%
From 2008 to 2013	1.3%	-1.7%	11.5%

The pre-Lehman collapse period (i.e. pre-2008) witnessed a strong year-on-year percentage increase in the port traffic volumes for the all India major ports as well as the ports at Chennai and Ennore. The post-Lehman period (i.e. 2008 and after) presents a more realistic scenario of the traffic volumes at the ports considering the latest status. Also the CAGR growth rate for all India ports from 2004 – 2008 was around 10.8% while post 2008 the CAGR has been only around 1.3%. Ennore Port traffic has witnessed a sudden surge in the recent years mainly due to the ban on handling of dirty cargo at the Chennai Port and the movement of this dirty cargo traffic from Chennai Port to Ennore Port.

During the course of our traffic projections for the major commodity categories, while we have considered the historical commodity-wise port traffic in the region, we have also considered the specific economic factors impacting each commodity type. Thus, the traffic projections have been derived after considering various factors impacting the commodity-specific traffic at the ports in the region.

6.2.2 *Demand forecast*

In order to forecast the traffic potential at the ports in the CBIC region over the next 20 years, analysis has been conducted for the historic cargo trends and its relationship with various factors that may influence the demand for the particular commodity. The future traffic projections have been done for the following broad category of commodities:

- Containers
- Dry Bulk
  - Coal (Thermal coal, coking coal and other coal)
  - Iron Ore and other ores
- Break bulk
  - Break Bulk including food-grains, fertilizers, fertilizer raw materials and other miscellaneous break bulk (excluding cars)
  - Cars
- POL (Crude and POL products)

These commodity-wise traffic projections have been computed for the Business-As-Usual (BAU) scenario as well as for the Business-Induced-Scenario (BIS) including the impact of the CBIC development. The sections below briefly discuss the methodology followed for projecting commodity-wise traffic:

Methodology for projecting commodity-wise port traffic for the Business-As-Usual (BAU) Scenario

Traffic projections for Containers:

Container traffic in India has a very high degree of correlation with the manufacturing component of GDP of the country. Thus, for the purpose of projecting container traffic at ports in the CBIC region, a regression has been done for the container traffic at the ports in the CBIC region and the manufacturing component of the Gross District Domestic Product of the districts located in the influence zone of the corridor region to arrive at the future growth rates. Thereafter, these growth rates are applied to the container traffic witnessed at the ports in the corridor region to forecast the future traffic projections for container traffic in the region.

Traffic projections for Dry Bulk:

For the purpose of projecting future traffic, dry bulk is classified into two broad categories i.e. Coal (Thermal coal, Coking coal and other coal) and Iron ore and other ores.

Thermal Coal:

Estimation of coal required for power generation in the future, in the states of Andhra Pradesh, Karnataka and Tamil Nadu, has been done by segregating the requirement into three parts.

1. Coal requirement for existing power plants

The power generation from the existing capacity has been estimated, keeping in mind the life of each existing plant. Some of the existing plants have been retired post expiry of their economic life (typically 40 years). The total coal requirement has been calculated for the total generation, out of which it has been assumed that only 15% of the coal would be imported and 50% of the domestic coal would be transported through the coastal shipping route. These plants have then been mapped district wise to arrive at the port wise coal demand.

2. Coal requirement for new power plants

a. Already planned and to be implemented by FY 2021

The generation for future capacity additions has been estimated considering a 90% Plant Load Factor (PLF). The coal required for generating these units has then been calculated based on the average GHR and GCV. Since it is expected that most of the new capacity additions would be based on imported coal, the ratio of imported coal has been taken as 60% in the short term and gradually increased to 100% in the long term. Further, 50% of the domestic coal required has been assumed to be shipped along the coast. This requirement has then been mapped as per the source district of the power plant.

b. Unplanned but expected after FY 2021

Addition to generation capacity post FY 2021 has been done on a normative basis, taking a historical growth in capacity. Apart from this, coal based power plants have also been suggested to meet any supply shortfalls. The total coal requirement for these power plants has been estimated in the same way as in the previous case. However, as these projects have still not been planned, the district wise break-up of coal requirement is not available and only their total requirement at the port can be estimated. Having said that, it is pertinent to note that most of these plants would be coastal power plants and therefore located in close proximity to the ports.

From the above coal requirement estimated for the states of Tamil Nadu, Andhra Pradesh and Karnataka, the coal requirement for the existing power plants serviced and the proposed power plants planned to be serviced by the ports in the CBIC region was calculated.

Iron Ore and other ores

In the past, iron ore traffic at the ports used to form a considerable part of the total port traffic in the region. However, the recent ban by the Government of India on the export of iron ore as well as the stoppage of handling iron ore traffic at Chennai port has dealt a double blow to the iron ore traffic at the ports in the region. Some ports like Ennore port had recently developed iron ore handling terminals (of 6 MTPA capacity) in 2012 with the aim of catering to the increasing iron ore traffic at the ports. As discussed in detail in the previous section and due to the recent developments, historical CAGR of iron ore traffic at the ports in the region is around -56.56% while the projected growth rates as per the Maritime Agenda 2010-2020 is around 11.56%. However, for the traffic projections for the BAU scenario, we assume that the ban on export of iron-ore is likely to continue up to 2018 and the iron ore exports are likely to resume from FY 2019 only. The iron ore traffic at the ports is likely to grow at 2% p.a. for the first three years and thereafter increase by 1% after every three years and attain a maximum of 4% p.a. up to 2034. The table below depicts the growth rates assumed for iron ore traffic at the ports in CBIC region.

Table 6.2.3: Growth rates for forecasting iron ore traffic at ports in CBIC region

	Up to 2018	2019-2021	2022-2024	2025-2034
Yearly growth rates assumption for Iron Ore traffic at ports in CBIC region	0% (Ban on iron ore export to continue)	2%	3%	4%

However, the other ores and other dry bulk traffic which includes commodities like limestone etc. are likely to continue. Thus, the historical growth rate of 4.41% has been adopted to project the future traffic for other ores and other dry bulk at the ports.

Traffic projections for Break Bulk

The break bulk traffic has been classified into two broad categories (i) Break Bulk including Food-grains, Fertilizers, FRM and other break bulk excluding Cars and (ii) Cars. The historical CAGR over the last 5 years was computed for each of the commodities and comparison was made with the growth rates as per the Maritime Agenda. The following table provides information on the past CAGR as well as the proposed growth rates for each of these commodities:

Table 6.2.4: Comparison of historical CAGR witnessed and projected growth rates as per Maritime Agenda

Commodity	Historical Growth Rates (%) (Last 5 yrs) (from IPA traffic data)	Maritime Agenda 2010-2020 Projected Growth Rates (%)
Fertilizers & FRM	-11.8%	5.1%
Food-grains	69.6%	4.4%
Misc. Break Bulk (excld. Cars)	11.8%	10.5%
Cars	13.8%	10.5%

Source: Maritime Agenda 2020-21 and IPA data

For projection of the future traffic for the commodities including fertilizers, FRM, food grains and miscellaneous break-bulk (excluding cars), the growth rates as per the Maritime Agenda were found reasonable and hence used for computing traffic projections up to 2034. However, the future growth rate of cars is expected to be in line with the historical CAGR and thus, the growth rate of cars is assumed at 13.8% up to 2034.

Traffic projections for Liquid Bulk:

The traffic projections for liquid bulk have been broadly done considering the two main classifications: (i) Crude and (ii) POL, edible oil and other liquid cargo. The crude oil imports at the Chennai Port are mainly for the Manali Oil refinery situated at Chennai. The other existing refineries in South India meet their crude oil import requirements through other ports located in the region while the proposed Nagarjuna Oil refinery at Cuddalore district is developing a captive jetty and Single Point Mooring mechanism for meeting its crude requirements. The Manali Oil refinery is proposed to add an additional 0.6 MTPA of refining capacity in 2017 (Source: Ministry of Oil and Natural Gas website) thereby taking the total refining capacity of the Manali Refinery to 11.1 MTPA. The crude oil requirement in the region is likely to grow with the growth of industrialization as well as growth in population. Thus, for projecting crude oil traffic post 2018, a step-function approach has been adopted assuming that additional refining capacities are added every 8 years. The port traffic due to other POL products, edible oil and other liquid cargo at the ports is increased at CAGR of 4.92% which is the growth rate witnessed in the POL traffic over the last 5 years.

Methodology for projecting commodity-wise port traffic for the Business-Induced-Scenario (BIS) (Accelerated scenario with the influence of the Chennai-Bengaluru Industrial Corridor):

For computing the accelerated scenario commodity-wise traffic projections, the growth rates have been taken in line with the industry growth rate projections. The BAU growth rates are assumed up to 2018 since it is assumed that the accelerated impact of the CBIC shall start from FY 2019 onwards. Thus the accelerated scenario is assessed based on the following computed rates:

Table 6.2.5: Growth rates for forecasting BIS scenario traffic at ports in CBIC region

Commodity	Growth rates for traffic projections in BAU scenario	Accelerated (BIS) scenario - growth rates up to FY 2018 (Same as BAU)	Accelerated (BIS) scenario - growth rates - FY 2019 and beyond	Corresponding industries for BIS growth rates
Iron Ore	2.7%	2.7%	4.7%	
Other Dry Bulk (Other Ore)	4.4%	4.4%	7.4%	
Coking & other coal	3.6%	3.6%	8.1%	Metallurgy industry
Crude	4.2%	4.2%	11.6%	Chemical & Petrochemical industry
POL, Edible Oils, LPG & Other Liquids	4.9%	4.9%	11.6%	Chemical & Petrochemica

Commodity	Growth rates for traffic projections in BAU scenario	Accelerated (BIS) scenario - growth rates up to FY 2018 (Same as BAU)	Accelerated (BIS) scenario - growth rates - FY 2019 and beyond	Corresponding industries for BIS growth rates
				l industry
Misc. Break Bulk (excld. Cars)	10.5%	10.5%	13.9%	Machinery industry
Cars	10.5%	10.5%	13.8%	Automobile industry
Fertilizers & FRM	5.1%	5.1%	9.1%	Food processing industry
Food grains	4.4%	4.4%	9.1%	Food processing industry
Containers	8.8%	8.8%	13.01%	Electrical machinery, pharmaceutical, textiles and apparels industry

The following table provides the annual commodity-wise traffic projections for the BIS case for the ports in the CBIC region.

Table 6.2.6: BAU and BIS traffic numbers for ports in corridor region

	Year	AGGREGATE PROJECTIONS – Cargo Traffic – BAU Scenario (MTPA)	AGGREGATE PROJECTIONS – Cargo Traffic – BIS Scenario (MTPA)
ACTUAL	2008	68.7	68.7
	2009	76.8	76.8
	2010	87.9	87.9
	2011	88.3	88.3
	2012	86.1	86.1
	2013	92.4	92.4
PROJECTIONS	2014	106.5	106.5
	2015	120.3	120.3
	2016	129.5	129.5
	2017	141.5	141.5
	2018	152.1	152.1
	2019	169.1	172.7
	2020	179.4	187.8
	2021	195.0	209.7
	2022	207.3	229.6
	2023	224.4	255.4
	2024	238.6	279.9
	2025	255.3	308.6
	2026	276.1	338.9
	2027	293.1	372.0

Year	AGGREGATE PROJECTIONS – Cargo Traffic – BAU Scenario (MTPA)	AGGREGATE PROJECTIONS – Cargo Traffic – BIS Scenario (MTPA)
2028	313.4	411.0
2029	333.5	452.7
2030	355.2	500.9
2031	374.6	550.7
2032	399.2	613.7
2033	423.5	685.1

While this section discusses the demand-side scenario with the commodity-wise traffic projections as well as the overall port traffic projections in the CBIC region for BAU and BIS case, the following section details the supply side factors (sea-side cargo handling capacity at ports as well as ports' yard storage capacity and the cargo handling capacity provided by the port connectivity – both road and rail) and further discusses the commodity-wise demand-supply gaps at ports in the CBIC region.

6.2.3 *Demand - Supply analysis*

Future Supply-side analysis

As discussed in the previous section, a port's cargo handling capacity is a function of its (a) sea-side capacity, (b) yard storage capacity and (c) evacuation capacity provided through land-side connectivity via road and rail. This road based evacuation capacity is further dependent upon the capacity of road connectivity and the capacity of the port's access gates. While the sea-side cargo handling capacity and the storage area can be enhanced by various means like reclamation of land from the sea, the enhancement of land-side evacuation poses a challenge. In this section, for analysing the port's cargo handling capacity, the projects which are currently under implementation as well as confirmed / committed projects have been considered to evaluate the berth-side capacity as well as the land-side connectivity capacity at the ports.

The following sections discuss the committed port capacity expansion projects as well as land-side connectivity enhancement projects.

Committed / Confirmed projects[86] for port capacity expansion

The list of committed / confirmed projects for capacity expansion in ports are captured as under:

Table 6.2.7: List of committed / confirmed projects for Chennai & Ennore ports

Name / Description of the Committed / Confirmed Projects	Port	Present Status of the Project	Likely year of commissioning / capacity addition	Capacity addition
		CAPACITY EXPANSION / UPGRADATION / CONVERSION OF EXISTING FACILITIES		
Development of Container Terminal 3 by Conversion of Jawahar Dock (JD) East berths 2,4& 6	Chennai Port	Feasibility study in progress	2020*	0.8 Mn TEU
Conversion of Bharathi Dock - 2 (BD-2) berth to a Ro-Ro terminal	Chennai Port	Feasibility study in progress	2016	Around 7,000 cars
Upgradation of existing coal handling facility at Ennore Port (due to mechanization of Coal Berth – 2) for TNEB	Ennore Port	Under construction	2015	4 MTPA

[86] Committed / confirmed projects are defined as those projects which are either in the construction stage at present or projects for which the preparation of DPR / Feasibility study is in progress or the project is in the bidding stage.

Name / Description of the Committed / Confirmed Projects	Port	Present Status of the Project	Likely year of commissioning / capacity addition	Capacity addition
NEW CAPACITY ADDITION				
New Container Terminal – 1 at Ennore Port	Ennore Port	Awarded	Phase I : 2017; Phase II: 2019	16.8 MTPA
Development of LNG import terminal at Ennore Port	Ennore Port	Under construction	2018	5 MTPA
Development of Coal Berth III for TNEB at Ennore Port	Ennore Port	To be developed by EPL^. Approval for Rail sidings received.	2017	9.5 MTPA
Multi-purpose cargo terminal at Ennore Port	Ennore Port	Concession Agreement signed with SPV of M/s Chettinad International Bulk Terminal Pvt. Ltd.	2016	2 MTPA
Development of SBM facility for Crude Oil handling	Ennore Port	Preliminary DFR has been prepared by CPCL	2020	15 MTPA
Liquid Berth as part of Project Outer Harbour at Chennai Port	Chennai Port	Chennai Port Trust is in process of restructuring the erstwhile MEGA Container Terminal Project and has appointed a Financial & Transactional Advisor. The consultant has submitted traffic study report and costs for the project will be finalised after tariff assessment.	2018	2.31 MTPA
Two Multi-purpose berths as part of Project Outer Harbour at Chennai Port	Chennai Port		2021	4.62 MTPA
Container Terminal 1 as part of Project Outer Harbour at Chennai Port	Chennai Port		2019	14.13 MTPA
Container Terminal 2 as part of Project Outer Harbour at Chennai Port	Chennai Port		2026	14.13 MTPA
Ro-Ro Berth as part of the Project Outer Harbour at Chennai Port	Chennai Port		2020	0.25 mn cars
OTHERS				
Development of Barge handling facilities for bunkering at Chennai Port under PPP mode	Chennai Port	Project Awarded. Financial closure awaited. Environmental clearance yet to be received	--	
Dredging (18 m CD) Phase-II at iron ore terminal in Ennore Port	Ennore Port	Project in progress at present. To be completed in 2014-15	2015	
Dredging (15 m CD) Phase-III at container terminal in Ennore Port	EnnorePort	To start after completion of Phase II dredging	-	

^EPL – Ennore Port Limited

** Port's estimate is 2017. But 2020 is the likely date of commissioning considering current legal issues surrounding the project*

Source: Stakeholder interactions

In addition to the above projects in the confirmed / committed stage, additional planned projects which are currently in the conceptual / ideation stage at the Chennai & Ennore ports include:

Table 6.2.8: List of proposed projects at ideation stage for Chennai, Ennore ports

Name / Description of the Project at Ideation/ Conceptual Stage	Port	Present Status of the Project	Likely year of commissioning / capacity addition	Capacity addition
Capacity addition to the Common User Iron Ore Terminal at Ennore Port	Ennore Port	Ideation	--	6 MTPA
Creation of Dry dock facilities OR Extension of West Quay to south at Chennai Port	Chennai Port	Ideation	--	--
Development of new Container Terminal at	Chennai Port	Currently at	--	Approx.

Name / Description of the Project at Ideation/ Conceptual Stage	Port	Present Status of the Project	Likely year of commissioning / capacity addition	Capacity addition
West Quay at Chennai Port		Ideation stage. Project to be taken up after completion of Container Terminal 3 project depending upon traffic demand		0.52Mn TEUs
Development of new Ro-Ro Terminal at Chennai Port	Chennai Port	Currently at Ideation stage. Chennai Port to decide on the project depending upon demand scenario after completion of conversion of BD-2 to Ro-Ro terminal	--	--
Container Terminal – 2 at Ennore Port	Ennore Port	Ideation	2022	35 MTPA
Container Terminal – 3 at Ennore Port	Ennore Port	Ideation	2027	35 MTPA
Additional Coal Berth (Coal Berth IV) for TNEB	Ennore Port	Ideation	2019	9.5 MTPA
Additional Common user Coal Terminal on BOT Basis	Ennore Port	Ideation	2018	10 MTPA
Additional Common user Multi-Liquid Terminal on BOT basis	Ennore Port	Ideation	2018	3 MTPA
Additional Car Export Terminal – 1	Ennore Port	Ideation	2018	Approx. 3 lac car units
Additional Car Export Terminal – 2	Ennore Port	Ideation	2022	Approx. 3 lac car units

The following are the capacity expansion projects at other ports in the CBIC region as well as green-field projects proposed for development in the CBIC region:

Table 6.2.9: Proposed capacity expansion projects planned at other ports in CBIC region

Proposed facility development	Port / Location	Present Stage of the Project	Capacity addition expected
Capacity addition at existing facilities			
Capacity addition at Krishnapatnam port	Krishnapatnam Port	Ideation	Capacity Upgradation from existing 75 MTPA to 200 MTPA in 2021
Container Berths 3 & 4 at Kattupalli Port	Kattupalli Port	Ideation	25 MTPA expected in

Proposed facility development	Port / Location	Present Stage of the Project	Capacity addition expected
			FY 2018
Berth 5 – Ro-Ro Terminal	Kattupalli Port	Ideation	8 MTPA expected in FY 2018
Mutli-purpose Berth at Kattupalli Port	Kattupalli Port	Ideation	8 MTPA expected in FY 2019
Liquid / POL Terminal at Kattupalli Port	Kattupalli Port	Ideation	8 MTPA expected in FY 2022
LNG Terminal at Kattupalli Port	Kattupalli Port	Ideation	8 MTPA expected in FY 2022
Proposed green-field developments			
Coal handling facilities at Cheyyur for the proposed UMPP – Captive port for the proposed UMPP	Cheyyur	Ideation	Approx. 14 - 1 5 MTPA
Durgarajapatnam Port (green-field major port proposed by the Government of India)	Durgarajpatnam	Ideation	Approx. 34 MTPA (in Phase 1) with total capacity around 150 MTPA
Creation of Dry Port at Sriperumbudur on PPP mode	Sriperumbudur	Ideation	--

Source: Stakeholder interactions

As visible from the above tables, the existing ports in the CBIC region have planned significant capacity additions on the berth side to cater to the increased future traffic scenarios.

Port connectivity improvement projects:

The National Highways Authority of India (NHAI), the State government, the Indian Railways and various state agencies are in process of implementing a significant number of projects to enhance the road and rail connectivity to ports thereby improving the land-side evacuation facilities at the ports of Chennai, Ennore and Kattupalli. The map on the following page depicts the various existing and proposed road connectivity routes to three ports – Chennai, Ennore and Kattupalli in the state of Tamil Nadu.

As depicted in the map, the vehicles travelling to and from the Chennai and Ennore Ports, at present, follow the NH-4, NH-45 or the NH-205 and travel up to the Maduravoyal junction or the Ambathur junction and then follow the Chennai Bypass road up to Madhavaram. These vehicles further follow the Chennai Inner Ring Road and the Ennore Expressway to reach the Chennai Port or the Chennai Inner Ring Road and the TPP road to reach the Ennore & Kattupalli ports.

With a view to improve the connectivity of the ports in the region and thereby to improve the land-side evacuation facilities at these ports, the following projects have been planned:

Table 6.2.10: Proposed land-side evacuation projects for ports in CBIC region

Name / Description of the Committed / Confirmed Projects	Port	Present Status of the project	Likely year of commissioning / capacity addition
ROAD CONNECTIVITY IMPROVEMENT PROJECTS			
Development of an elevated expressway to Chennai Port from	Chennai Port	Confirmed	Started in 2012,

Name / Description of the Committed / Confirmed Projects	Port	Present Status of the project	Likely year of commissioning / capacity addition
Maduravoyal			this project is likely to be completed by end of FY 2018.
Development of Coastal Road to the east of container Terminal II	Chennai Port	Confirmed	Internal road connectivity improvement project of Chennai Port
Expansion of the North Chennai Thermal Power Station (NCTPS) Road	Ennore Port	Confirmed	2018
Development of the Northern Port Access Road	Ennore Port	Confirmed	2017
The Ennore Manali Road Improvement (EMRIP) project	Ennore Port & Chennai Port	Confirmed	2015
Development / expansion of road connectivity projects to Krishnapatnam Port	Krishnapatnam Port	Confirmed	FY 2014 / 2015
RAIL CONNECTIVITY IMPROVEMENT PROJECTS[87]			
Development of a rail link to Ennore Port from the north of Minjur Railway station on the Chennai – Gudur line (Single Line)	Ennore Port	Preparation and submission of DPR and final land survey by EPL is in progress. Issue of NIT & LOA expected by October and December, 2014 respectively. Likely to be operational by 2018.	
Doubling and electrification of the existing rail connectivity to Krishnapatnam Port	Krishnapatnam Port	2015	

Source: Stakeholder interactions

The road connectivity improvement projects are shown on the map in the following page:

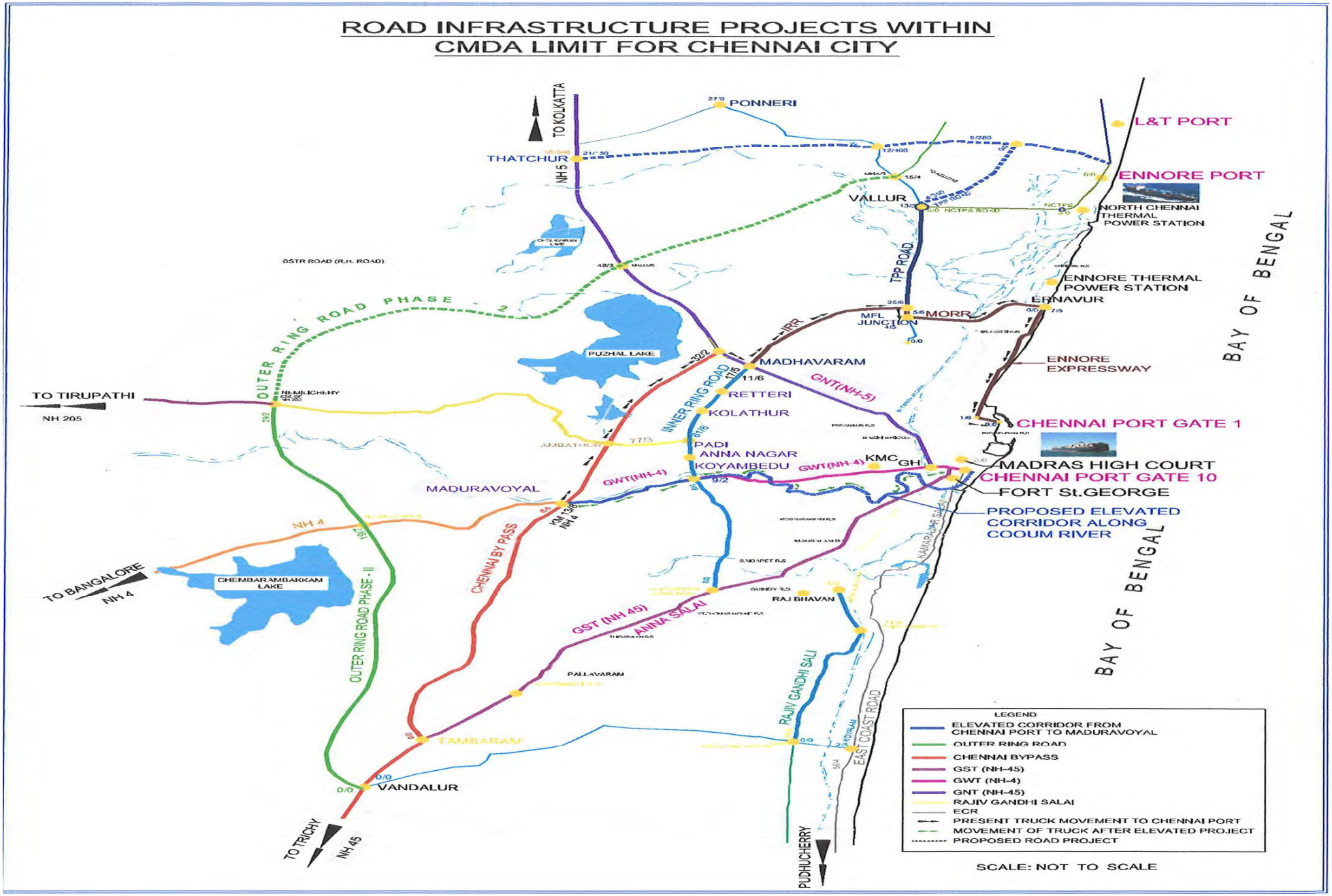


Figure 6.2.6: Map depicting proposed port connectivity road projects for Chennai, Ennore & Kattupalli ports

While the port capacity augmentation plans shall enhance the overall cargo handling facilities at the ports in the CBIC region, the land-side evacuation of cargo as well as the port access gate limitations is likely to remain a matter of concern. The following section evaluates the impact of the proposed land-side evacuation related projects as well as analyses the ultimate possible evacuation capacity that such land-side port connectivity road and rail projects shall provide to the ports at Chennai, Ennore & Kattupalli.

Limitation of port capacity due to constrained land-side connectivity:

A. Chennai Port:

Constraints due to road based evacuation:

The Chennai port handled around 53 MT of cargo during 2012-13. However, the congestion on the access routes to and from the Ports remains a matter of concern to the port users. The table below depicts the maximum evacuation (in tonnage) of cargo possible considering the present and the proposed connectivity project developments for the Chennai port:

Table 6.2.11: Proposed Road connectivity projects for enhancing land-side road based evacuation capacity at Chennai port

PORT	PORT ACCESS/ EXIT GATE	ROUTE DESCRIPTION	Year of operation	No. of Lanes	Capacity (PCU per day)	Total % of Trucks & Lorries as per Traffic Survey	Total Tonnage capacity possible to be transported by Trucks, Lorries & MAVs (MPTA)[88]
CHENNAI PORT	Gate No. 1, 2, 2A	Ennore Expressway via Manali Oil Refinery Road up to IRR junction	Operational	4 Lane with 1.6 km stretch of 2-lane	45,000 (for the 4-lane section) & 11,000 for 2-lane section	74.6%	8.9 (capacity of the 2-lane section)
	Gate No. 1, 2, 2A	EMRIP (share of Chennai Port traffic)	2015	4	45,000	80.8%	31.8
	Gate No. 10	Elevated Maduravoyal Corridor (Tolled)	2018	4	45,000	47%	23.1
	Gate No. 10, 2, 2A	Poonaamallee High Road	Operational	4	Port traffic not permitted on this route at present		
Maximum traffic handling capability for Chennai port based on the above road-based routes: Up to 2014 : 8.9 MTPA 2015 – 2017 : 31.8 MTPA 2018 and beyond: 55.0 MTPA							

Source: Traffic Survey data as per Highways Department, GoTN – Origin & Destination Survey Report and Traffic Census Report for Port Connectivity Roads for decongestion study results – July 2012 shared with the Study Team and Traffic Survey results for Maduravoyal Elevated road project and EMRIP road project shared by NHAI with the Study Team.

[88] Assuming an average PCU – vehicle conversion factor = 4 for trucks, lorries and MAVs and average weight of 12 tonnes per vehicle and port operations for 365 days a year.

Limitations due to port gates:

The road evacuation capacity is further limited by the capacity of the port's access gates. At present 4 gates (Gate No. 1, 2, 2A and 10) out of the total 10 gates at Chennai Port are operational (as per our interactions with Chennai Port officials). The average time taken by a truck to pass through a lane at the gate at Chennai port is around 3 minutes[89]. However, at international ports the cargo vehicles take an average of only 1 minute per vehicle to pass through the port gates[90]. According to the OCDI Study and assuming that the recommendations of the Study are implemented which enable the ports to allow ingress of trucks at a faster rate (assuming 1 minute is the average time taken by a truck to pass through the port gate) the table below shows the maximum possible number of trucks and cargo tonnage which can pass through the gates of the Chennai Port:

Table 6.2.12: Limitation imposed on cargo movement due to access gates at Chennai port and maximum tonnage handling possible at Chennai Port with improved truck gate movement

PORT	AFTER PROPOSED DEVELOPMENT			No. of Operational Hours^	No. of Trucks per day with best TAT of 1 minute	Estimated no. of trucks (annual)	Maximum Tonnage handling possible (MTPA)[91]
	GATE No.	ENTRY LANES	EXIT LANES				
CHENNAI – Existing	1	2	2	24^	5,760	21,02,400	25.2
	10	2	2	8^	1,920	7,00,800	8.4
	2	2	0	24^	2,880	10,51,200	12.6
	2A	0	2	24^	2,880	10,51,200	12.6
TOTAL FOR CHENNIAI PORT (EXISTING)							**58.8**
CHENNAI – Proposed (after 2018)	1	2	2	24^	5,760	21,02,400	25.2
	10 – Elevated corridor from Maduravoyal to Chennai Port						23.1*
	2	2	0	24^	2,880	10,51,200	12.6
	2A	0	2	24^	2,880	10,51,200	12.6
TOTAL FOR CHENNIAI PORT (After development of Maduravoyal Elevated corridor project in FY 2018)							**73.6**

*from table 4-14

^As per information provided by the Chennai Port officials.

As visible from the above table, the development of the proposed Maduravoyal Elevated Road Corridor project is expected to enhance the overall access gate capacity of the Chennai Port.

[89] As per OCDI Study on "Data Collection Survey on the Improvement of Port Operations" Final Report, February 2014

[90] As per OCDI Study on "Data Collection Survey on the Improvement of Port Operations" Final Report, February 2014. At international ports like Singapore, Hong Kong, Port of Los Angeles the time taken by container trucks to pass trhough port gates is less than a minute.

[91] Assuming average weight of 12 tonnes per truck and port operations of 365 days / year.

Constraints due to rail based evacuation:

Table 6.2.13: Constraints due to rail based evacuation at Chennai port

PORT	Railway link	Max. trains possible per day	Max tonnage possible per train	Total tonnage possible for transportation by rail (MTPA)
CHENNAI	Existing Rail Link (Single Line)	12[92]	3,200*	14.02
	Existing Rail Line to Northern Yard – (Single Line)	12	3,200*	14.02 (Currently unused)
Maximum traffic handling capability for Chennai port based on the operational rail routes =				**14.02**

*Assuming total tonnage possible per train for break bulk = 3200 tonnes, dry bulk = 3400 tonnes and containers = 90 TEUs / train (i.e. around 1700 tonnes / train). Average of 3200 tonnes / train

The currently available rail based evacuation capacity in use at Chennai port is around 14.02 MTPA only. The rail based maximum evacuation possible for the Chennai port is around 28 MTPA including the currently unused railway line from Royapuram to the Northern Yard. The total possible cargo evacuation possible based on the existing and proposed (committed projects) road and operational rail connectivity to the ports is shown in the table below:

Table 6.2.14: Total land based evacuation possible for Chennai Port

Year	Road based evacuation capacity (MTPA) (1)	Port access gate capacity (MTPA) (2)	Total road-based cargo handling capacity (MTPA) = Min(Road & Access gate capacity) (3)	Rail based evacuation capacity in use (4)	Total Land-side evacuation capacity at Chennai Port = (3) + (4)
2014	8.9	58.8	8.9	14.0	**23.0**
2015	31.8	58.8	31.8	14.0	**45.8**
2016	31.8	58.8	31.8	14.0	**45.8**
2017	31.8	58.8	31.8	14.0	**45.8**
2018	55.0	73.6	55.0	14.0	**69.0**
2019	55.0	73.6	55.0	14.0	**69.0**
2020 and beyond	55.0	73.6	55.0	14.0	**69.0**

The total berth side capacity for commodities transferrable via road and rail (i.e. for non-liquid commodities) for Chennai Port and corresponding land-side based evacuation capacity for the respective years is:

[92] Computed from Chennai port website data for 2010

Table 6.2.15: Comparison of Berth Side capacity and total land-side evacuation capacity at Chennai Port

Year	Total berth-side capacity for Dry Bulk (excluding Coal), Break Bulk and Containers (MTPA)	Total Land-side evacuation capacity at Chennai Port (MTPA)	Effective traffic handling capacity at Chennai Port (MTPA)
2014	67.9	23.0	**23.0**
2015	67.9	45.8	**45.8**
2016	67.9	45.8	**45.8**
2017	67.9	45.8	**45.8**
2018	67.9	69.0	**69.0**
2019	67.9	69.0	**69.0**
2020 and beyond	82.9	69.0	**69.0**

The above table depicts that while additional berth side facilities for capacity addition at Chennai port are planned, the total cargo handling capability of Chennai port shall be handicapped by the limited land-side evacuation capacity at the Chennai Port reaching a maximum of around 69 MTPA in 2020. As per the above two tables, the Chennai Port's access gate capacity is more than the road capacity for the port thereby signifying that the proposed road connectivity capacity addition through the committed road connectivity projects shall remain insufficient to handle cargo at the Chennai Port.

The increasing urbanization in the Chennai city in general and specifically around the Chennai port are likely to disallow any further road and rail based connectivity projects to Chennai Port thereby limiting the cargo handling capacity at the port. One of the possible options to enhance land-side based evacuation capacity at the port can be utilization of the currently unused railway line from the Royapuram railway station to the Northern yard at Chennai port. Usage of this railway line is likely to provide an additional 14.02 MTPA cargo handling capacity to Chennai port thereby increasing the total cargo handling capacity for dry bulk (i.e. other ores and other dry bulk except coal and iron ore), break bulk and container cargo from 69.04 MTPA in 2020 to 83.06 MTPA. The following table depicts the total land side capacity addition possible for Chennai port after utilization of the currently unused railway line.

Table 6.2.16: Excess / Deficit in land-side evacuation capacity at Chennai port

Year	Effective traffic handling capacity at Chennai Port (MTPA) (using existing operational railway line and existing and committed road connectivity projects)	Additional Land-side evacuation capacity possible through use of currently unused Royapuram – Northern Yard Chennai Port connectivity (MTPA)	Effective traffic handling capacity at Chennai Port (MTPA)	Total berth-side capacity for Dry Bulk (excluding Coal), Break Bulk and Containers (excluding POL Traffic) (MTPA)	Gap between Berth-side and land-side evacuation cargo handling capacity (MTPA) (-ve denotes shortfall on land-side capacity)
2014	23.0	14.0	37.0	67.9	**-30.8**
2015	45.8	14.0	59.9	67.9	**-7.9**
2016	45.8	14.0	59.9	67.9	**-7.9**
2017	45.8	14.0	59.9	67.9	**-7.9**
2018	69.0	14.0	83.0	67.9	**15.1**
2019	69.0	14.0	83.0	67.9	**15.1**
2020 and beyond	69.0	14.0	83.0	82.9	**0.1**

Thus, the potential use of the currently unused railway facility (single line) from Royapuram to the Northern yard of Chennai port is likely to provide a balance between the increased berth side capacity (due to the committed capacity expansion projects) and the land-side based evacuation capacity for the port of Chennai.

B. Ennore & Kattupalli Ports:

Constraints due to road based evacuation:

The table below depicts the maximum evacuation (in tonnage) of cargo possible considering the present and the proposed connectivity project developments for the Ennore & Kattupalli ports. At present most of the cargo traffic at Ennore Port is transported via rail movement and conveyor systems (to the TNEB power plants located near the port).

Table 6.2.17: Constraints due to land-side road based cargo handling capacity for Ennore & Kattupalli ports

PORT	PORT ACCESS / EXIT GATE	ROUTE DESCRIPTION	No. of Lanes	Capacity (PCU per day)	Total % of Trucks & Lorries as per Traffic Survey	Total Tonnage capacity possible (MPTA)[93]
ENNNORE & KATTUPALLI	Port gate exit	Via Port Access Road, NCTPS Road up to IRR (existing)	2	11,000	59.1%	7.1
		Via Port Access Road, NCTPS Road up to IRR (after proposed expansion of EMRIP and NCTPS Roads - 2017)	4	45,000	59.1%	29.1
		Northern Port Access Road (proposed - 2018)	4	45,000	93%	45.8
Maximum traffic handling capability for Ennore & Kattupalli ports based on the above road-based routes: Up to 2016 : 7.1 MTPA 2017 : 52.9 MTPA 2018 and beyond: 74.9 MTPA						

Source: Traffic Survey data as per Highways Department, GoTN – Origin & Destination Survey Report and Traffic Census Report for Port Connectivity Roads for decongestion study results – July 2012 shared with the Study Team and Traffic Survey results for Maduravoyal Elevated road project and EMRIP road project shared by NHAI with the Study Team.

Thus, from the table above the total cargo evacuation possibility for the Ennore and Kattupalli ports is approximately around 75 MT per annum via the existing and proposed road connectivity projects in the region from 2018 and beyond.

Limitation of port capacity due to constraints on port access gates:

Assuming that the trucks at Ennore & Kattupalli ports take an average of 1 minute to pass through the truck gates, the table below shows the maximum possible number of trucks and cargo tonnage which can pass through the gates of the Ennore and Kattupalli ports:

[93] Assuming an average PCU – vehicle conversion factor = 4 for trucks, lorries and MAVs and average weight of 12 tonnes per vehicle and port operations for 365 days a year.

Table 6.2.18: Limitation imposed on cargo movement due to access gates at Ennore & Kattupalli ports

PORT	AFTER PROPOSED DEVELOPMENT			No. of Operational Hours	No. of Trucks per day with best TAT of 2 minutes	Estimated no. of trucks (annual)	Maximum Tonnage handling possible (MTPA)[94]
	GATE No.	ENTRY LANES	EXIT LANES				
ENNORE	Exit Gates	2	2	24	5,760	21,02,400	**25.2**
KATTUPALLI	Exit Gate	1	1	24	2,880	10,51,200	**12.6**
TOTAL FOR ENNORE & KATTUPALLI PORTS							**37.8**

Constraints due to rail based evacuation:

Table 6.2.19: Constraints due to rail based evacuation at Ennore port

PORT	Railway link	Max. trains possible per day	Max tonnage possible per train	Total tonnage possible for transportation by rail (MTPA)
ENNORE PORT	Existing Rail Link (Single Line)	24	3,200*	28.0
	Proposed Rail link connecting Minjur to Ennore Port– (Proposed Single Line – 2018)	24	3,200*	28.0
Maximum traffic handling capability for Ennore port based on the operational rail routes =				**56.0**

*Assuming total tonnage possible per train for break bulk = 3200 tonnes, dry bulk = 3400 tonnes and containers = 90 TEUs / train (i.e. around 1700 tonnes / train). Average of 3200 tonnes / train.

The currently available rail based evacuation capacity in use at Ennore port is around 28.0 MTPA only while the total rail based maximum evacuation capacity shall increase to 56.0 MTPA by 2018. The total possible cargo evacuation based on the existing and proposed road and rail connectivity (committed projects) to the ports is shown in the table below:

Table 6.2.20: Total Land-side evacuation capacity at both Ennore & Kattupalli ports combined

Year	Road based evacuation capacity (MTPA) (1)	Port access gate capacity (MTPA) (2)	Total road-based cargo handling capacity (MTPA) = Min(Road & Access gate capacity) (3)	Rail based evacuation capacity (4)	Total Land-side evacuation capacity at Ports = (3) + (4)
2014	7.1	37.8	7.1	28.0	**35.1**
2015	7.1	37.8	7.1	28.0	**35.1**
2016	7.1	37.8	7.1	28.0	**35.1**
2017	52.9	37.8	37.8	28.0	**65.8**
2018	74.9	37.8	37.8	56.0	**93.9**
2019	74.9	37.8	37.8	56.0	**93.9**
2020 and beyond	74.9	37.8	37.8	56.0	**93.9**

[94] Assuming average weight of 12 tonnes per truck and port operations of 365 days / year

Thus, the total land-side based cargo handling capacity for Ennore & Kattupalli ports combined is around 94 MTPA. Also, while the total road-based evacuation capacity is likely to increase to 75 MTPA in 2018, the access gate capacity at the two ports shall limit this capacity to only 37.84 MTPA. Thus, additional / new port access gates to accommodate an additional ~40 MT of traffic should be made operational for the two ports to match the road side capacity by 2017.

Assuming that the additional / new gates become operational at the two ports, the total road-based and rail-based evacuation capacity shall increase to around ***131 MTPA*** for the two ports combined. On the other hand, the total berth side cargo handling capacity (for Bulk, Break Bulk and Containers) at the two ports combined in 2020 is likely to be around 94 MTPA (considering committed projects). The evacuation capacity is expected to be sufficient to handle the land side cargo handling capacity of 94 MT.

With the development of additional terminals (like the proposed Container Terminal – 1 at Ennore Port) and with the expected increase in port traffic at Kattupalli port, the road based evacuation is expected to increase significantly in the years ahead. The table below depicts the excess / deficit of the land-side evacuation capacity at the two ports combined.

Table 6.2.21: Excess / Deficit in land-side evacuation capacity at Chennai port

Year	Effective traffic handling capacity at Ennore & Kattupalli Ports (MTPA)	Total berth-side capacity for Dry Bulk, Break Bulk and Containers (excluding POL traffic) (MTPA)	Gap between Berth-side and land-side evacuation cargo handling capacity (MTPA) (-ve denotes shortfall on land-side capacity)
2014	35.1	33.9	**1.2**
2015	35.1	55.9	**-20.7**
2016	35.1	55.9	**-20.7**
2017	65.8	77.0	**-11.1**
2018	93.9	120.3	**-26.4**
2019	93.9	151.0	**-57.1**
2020 and beyond	93.9	151.0	**-57.1**

Based on the above, the total combined cargo handling potential at the Chennai, Ennore & Kattupalli ports is as below:

Table 6.2.22: Total cargo handling potential at Chennai, Ennore & Kattupalli ports

Year	Total cargo handling potential combined at Ennore, Chennai & Kattupalli ports (MTPA) (excluding POL)(MTPA) – after consideration evacuation related constraints	Total POL traffic handling potential for the Ennore, Chennai & Kattupalli Ports (MTPA)	Total cargo handling potential combined at Ennore, Chennai & Kattupalli ports (MTPA) (including POL) – after consideration evacuation related constraints
2014	71.4	20.6	92
2015	100.4	20.6	121
2016	105.4	20.6	126

Year	Total cargo handling potential combined at Ennore, Chennai & Kattupalli ports (MTPA) (excluding POL)(MTPA) – after consideration evacuation related constraints	Total POL traffic handling potential for the Ennore, Chennai & Kattupalli Ports (MTPA)	Total cargo handling potential combined at Ennore, Chennai & Kattupalli ports (MTPA) (including POL) – after consideration evacuation related constraints
2017	141.4	20.6	162
2018 & beyond	189.1	30.9	220

C. Krishnapatnam Port:

The total cargo handling possible for the port at Krishnapatnam is depicted in the table below. The port's cargo handling capacity is proposed to be enhanced from the existing 75MTPA to around 200 MTPA in 2021. As per the table below, the gate capacity at Krishnapatnam shall be required to be enhanced to meet the road cargo handling capacity.

Table 6.2.23: Road-based evacuation capacity at Krishnapatnam Port

Year	ROAD capacity (MTPA)	Gate capacity (MTPA)	Rail capacity (MTPA)	Total land-side capacity potential (with gate capacity expansion to meet road capacity) (MTPA)
2014	31.8	25.2	37.3	69.2
2015 & beyond	31.8	25.2	100.4	132.3

This total land-side capacity (both road and rail) shall be sufficient to cater to around 132 MTPA cargo handling. In 2021, the Krishnapatnam port plans to enhance the total berth side capacity up to 200 MTPA. It is anticipated that the capacity addition would be guided by changes in market demand adequately. To accommodate the expected increase in berth capacity, an additional land-side evacuation capacity of approximately 70 MTPA shall be required, primarily through road as rail based evacuation increase is expected minimally beyond 2028. Besides, the gate capacity at the port would also need to be expanded to handle the total road based evacuation at the port. These developments could be handled by the port based on the pattern of changes in demand over the medium term and the resultant strategies of the port.

Demand supply gaps

Based on the demand and capacity analysis presented above, the aggregate broad commodity wise gaps for the corridor ports are as below. The shortfall in capacity compared to demand arises for certain commodities such as bulk, driven by coal requirements for energy, and POL from 2025 onwards.

Table 6.2.24: Commodity-wise Demand-Supply gaps at 100% capacity utilization

Year	Bulk [Surplus / (Gap)]		Break bulk [Surplus / (Gap)]		POL [Surplus / (Gap)]		Containers [Surplus / (Gap)]	
	BAU	BIS	BAU	BIS	BAU	BIS	BAU	BIS
2014	23.1	23.1	6.7	6.7	5.6	5.6	25.2	25.2
2015	17.6	17.6	12.1	12.1	5.2	5.2	34.8	34.8
2016	13.4	13.4	11.4	11.4	4.8	4.8	31.0	31.0
2017	27.8	27.8	13.5	13.5	4.4	4.4	44.8	44.8
2018	36.5	36.5	27.1	27.1	13.6	13.6	79.4	79.4

Year	Bulk [Surplus / (Gap)]		Break bulk [Surplus / (Gap)]		POL [Surplus / (Gap)]		Containers [Surplus / (Gap)]	
	BAU	BIS	BAU	BIS	BAU	BIS	BAU	BIS
2019	40.5	40.1	30.4	30.1	12.7	11.3	86.7	85.2
2020	36.2	35.5	26.9	26.1	27.2	23.7	84.8	81.4
2021	37.9	36.7	34.7	33.4	39.7	33.9	162.1	155.7
2022	24.0	22.3	28.9	27.0	55.1	46.6	164.2	154.1
2023	15.5	13.3	27.6	25.0	54.6	43.0	157.5	143.0
2024	10.5	7.6	26.2	22.7	54.0	38.9	150.2	130.4
2025	8.5	4.9	24.6	20.1	53.3	34.4	142.4	116.2
2026	2.2	(2.0)	20.7	14.9	48.3	29.3	136.9	103.2
2027	(13.7)	(18.9)	15.0	7.8	47.6	23.7	142.0	99.3
2028	(21.2)	(27.3)	12.9	4.0	46.8	17.4	132.0	78.8
2029	(22.6)	(29.7)	10.6	(0.2)	46.0	10.3	121.1	55.6
2030	(30.7)	(38.9)	8.1	(5.1)	45.2	2.5	110.8	29.3
2031	(35.4)	(44.8)	5.4	(10.6)	44.4	(6.2)	99.8	(0.2)
2032	(44.1)	(58.2)	2.3	(16.8)	43.5	(15.9)	87.9	(33.8)
2033	(51.4)	(73.7)	(1.0)	(23.9)	42.5	(26.8)	75.1	(71.7)

Source: JIC Study Team analysis and projections
Note: Positive figures indicate surpluses; negative figures in brackets indicate gaps

Globally, the optimal capacity utilization of ports is approximately 70%. Operating beyond 70% utilization levels normally pose restrictions on achieving quicker turnaround time of vessels, movement & storage of cargo and faster evacuation. The supply demand gaps shown above are based on the assumption that

the ports would be able to handle cargo up to 100% of their capacity. ***Assuming a 70% efficiency level, the demand supply gaps in various segments are captured as under:***

Table 6.2.25: Commodity-wise Demand-Supply Gaps (Assuming 70% capacity utilization)

Year	Bulk [Surplus / (Gap)]		Break bulk [Surplus / (Gap)]		POL [Surplus / (Gap)]		Containers [Surplus / (Gap)]	
	BAU	BIS	BAU	BIS	BAU	BIS	BAU	BIS
2014	2.4	2.4	2.8	2.8	(1.4)	(1.4)	6.9	6.9
2015	(4.3)	(4.3)	6.3	6.3	(1.8)	(1.8)	12.6	12.6
2016	(8.5)	(8.5)	5.7	5.7	(2.2)	(2.2)	8.8	8.8
2017	(0.4)	(0.4)	6.9	6.9	(2.7)	(2.7)	17.2	17.2
2018	4.5	4.5	16.1	16.1	3.5	3.5	40.0	40.0
2019	4.3	4.0	18.2	17.9	2.5	1.2	43.5	42.0
2020	0.4	(0.3)	15.4	14.7	12.5	9.1	40.4	37.0
2021	(0.9)	(2.1)	20.6	19.3	21.2	15.3	92.8	86.4
2022	(10.6)	(12.3)	16.2	14.3	31.8	23.2	92.4	82.4
2023	(19.1)	(21.3)	14.9	12.3	31.2	19.6	85.7	71.2
2024	(24.0)	(26.9)	13.5	10.0	30.6	15.6	78.5	58.7
2025	(26.1)	(29.7)	12.0	7.4	30.0	11.0	70.7	44.5
2026	(32.1)	(36.5)	8.7	2.9	24.9	6.0	64.3	30.5
2027	(44.9)	(50.1)	4.1	(3.1)	24.2	0.3	65.1	22.4
2028	(52.4)	(58.5)	2.1	(6.9)	23.5	(6.0)	55.0	1.9
2029	(53.8)	(60.9)	(0.2)	(11.2)	22.7	(13.0)	44.2	(21.4)
2030	(61.9)	(70.1)	(2.7)	(16.0)	21.9	(20.8)	33.9	(47.6)
2031	(66.6)	(76.0)	(5.5)	(21.5)	21.0	(29.6)	22.8	(77.3)
2032	(75.3)	(89.4)	(8.6)	(27.8)	20.1	(39.4)	10.9	(110.8)
2033	(82.6)	(104.9)	(11.9)	(34.9)	19.2	(50.3)	(1.8)	(148.7)

Source: JIC Study Team analysis and projections
Note: Positive figures indicate surpluses; negative figures in brackets indicate gaps
The above figures are based on a 70% efficiency level of berth capacities of ports

While at a 100% capacity utilization level, the gaps in demand and supply occur over the long term from the year 2025 onwards. However, at a 70% utilization level, which is a pragmatic reflection of the likely scenario on ground, the capacities of the region's ports are expected to fall short of demand for bulk and POL products earlier during the short and medium term itself as indicated in the table above. While the design capacity appears adequate to meet the demand up to 2025, operation of the berths at the port at 100% utilization levels would not be pragmatic and would require efficiency improvement measures to ensure that the utilization levels are brought up closer to 85%-90% to effectively minimize the demand supply gaps. ***The infrastructure***

development strategy, explained below, takes into account the demand supply gaps observed above assuming an optimal berth utilization level of 70%.

Container Traffic

Short Term Scenario:

At present, the movement of container traffic to and from the ports of Chennai, Kattupalli and Krishnapatnam occurs mainly via road. Ennore port does not have container terminal facility at present however the port has signed the Concession Agreement with M/s Adani Ports & SEZ Ltd. for development of the Container Terminal – 1 at Ennore Port.

Over the short term, the major bottleneck in the transportation of containers is expected to be the limited road capacity available at the roads connecting the ports. The graph alongside depicts the short term scenario wherein the road based evacuation capacity at the ports is likely to act as the bottleneck in the movement of containers to and from the ports. The expansion of port gate to meet the berth capacity is however relatively easier to address.

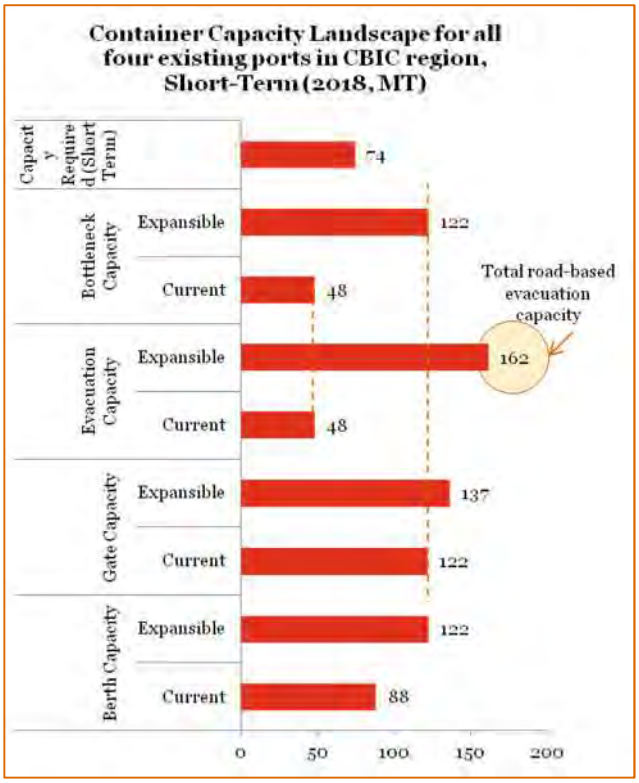


Figure 6.2.7: Container Capacity landscape for existing ports in the CBIC region

However, there is significant capacity addition planned in enhancing road connectivity to the ports in the CBIC region. Some of these proposed projects are the ongoing elevated road corridor from Maduravoyal to Chennai Port, the Ennore – Manali Road Improvement Project, the proposed Northern Port Access Road etc. Thus the enhancement in the road-based evacuation capacity over the short term is expected to resolve the current congestion issue at the ports for the movement of road-based cargo including container cargo. The ports in the region shall also need to undertake port-gate capacity enhancement projects to meet the traffic flow requirements. Thus, successful implementation of the gate-side and road-evacuation based debottlenecking initiatives is likely to result in sufficient container handling capacity generation at the existing ports in the corridor region in 2018. Thus, as the figure alongside depicts, the total road-based evacuation capacity in 2018 is expected to reach around 162 MTPA while the container capacity required to cater to enhanced traffic at the ports is expected to be around 74 MTPA - thereby signifying that the road based capacity expansion programs are likely to be sufficient to cater to the increased capacity over the short term at the existing ports in the CBIC region.

Medium Term Scenario:

Over the medium term, the major capacity additions expected for containers in the region include the proposed Container Terminal – 2 project at Ennore Port and the conversion of the JD Dock into the Container Terminal at Chennai Port. The restructured MEGA Container Terminal Project in the form of the Project Outer Harbour is also expected to add around 0.74 MnTEUs container capacity in 2019 and a total container capacity of 1.48 Mn TEUs up to 2026 to the ports in the CBIC region.

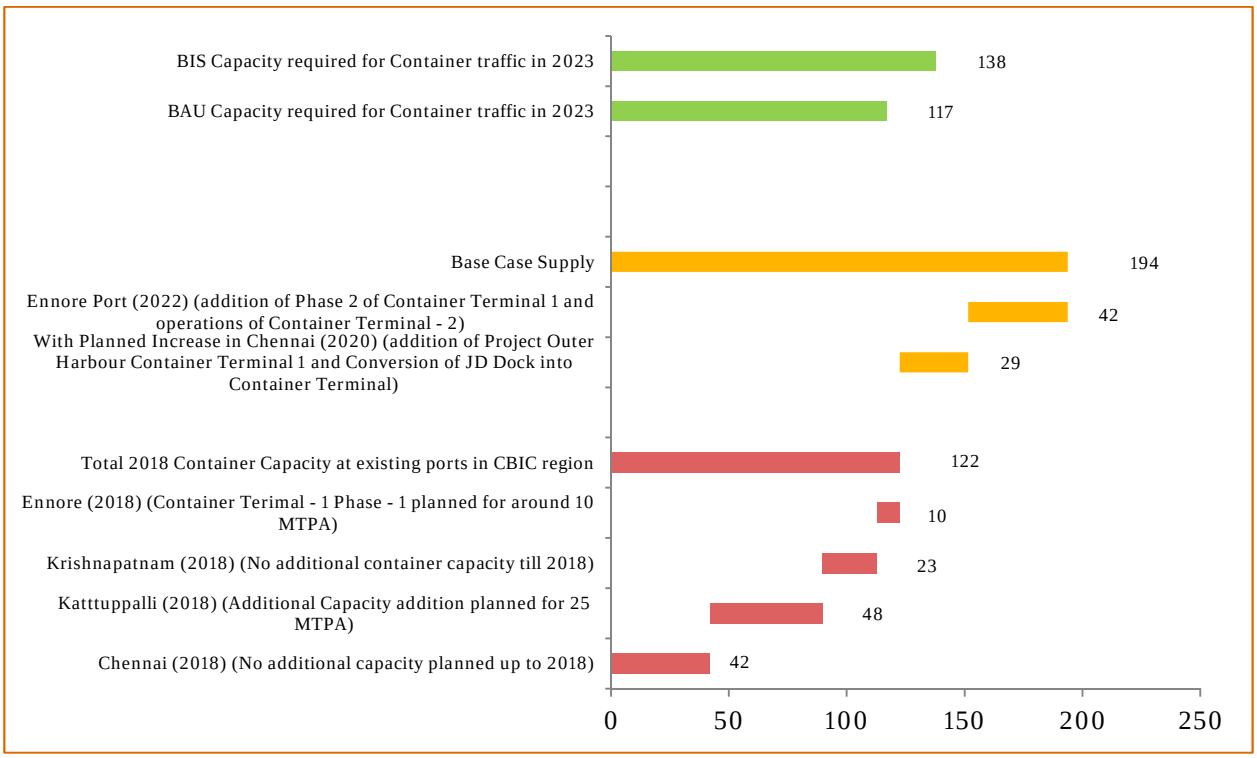


Figure 6.2.8: Medium Term Container capacity and demand landscape at existing ports in the region

As the graph above suggests, the planned additions in container capacity at the ports (Chennai, Ennore & Kattupalli) in the CBIC region are likely to be sufficient to meet the capacity requirements in the BAU and BIS scenario. However, the container berth capacity expansion projects planned over medium term also face some risks and overcoming / mitigating these risks is essential to ensure sufficient capacity at the ports in the region.

In addition to the project risks some additional key risks which need to be anticipated and hedged in the medium term scenario are:

i. <u>Investments in proposed infrastructure development may not materialize as assumed:</u>

This is a key risk pertaining to the proposed capacity additions planned over the medium term. The conversion of the JD Dock into Container Terminal has a legal stay on the opening of the bids for the project and thus there is a timeline risk for the project's start and completion dates.

For the proposed Container Terminal -2 project at the Ennore Port, the overall cost estimates for the project and the feasibility are not known. The land indicated (around 125 acres) is typically sufficient to handle around 1.1 to 1.3 MnTEUs (i.e. 16 to 20 MTPA) of container traffic and handling 35 MTPA of container traffic at Container Terminal – 2 shall require significant amount of additional land area. Also, in order to achieve the commissioning for the project as per the expected time of 2022, the process for the development of project DPR would need to be initiated immediately.

Table 6.2.26: Key projects planned for container capacity addition at the Chennai, Ennore & Kattupalli ports over the short & medium term

Project description	Key Risks foreseen
Conversion of JD Dock into Container Terminal at Chennai Port	Time-line risks are foreseen with respect to achievement of the commissioning timelines for the project since the issues pertaining to the bid opening are pending with the Courts.
Container Terminal – 2 at Ennore Port	As the Container Terminal -2 at Ennore port is proposed to be commissioned by FY 2021-22, the preparation of the Project DPR shall be required to be initiated at the earliest to achieve the commissioning timeline. A potential delay in the initiation of preparatory and detailed studies may lead to a delay in the project commissioning.
Project Outer Harbour at Chennai Port	The erstwhile planned MEGA Container Terminal project had to be shelved due to the unattractive bids received by the Chennai Port Trust. The restructuring of the erstwhile MEGA container terminal project is underway and the traffic study for the Project Outer Harbour has been recently submitted to the Port Trust. The preparation of the feasibility reports and the DPR shall be required to be started at the earliest in order to meet the commissioning timelines for the proposed Project Outer Harbour.
Container Terminals 3 & 4 at Kattupalli Port	Kattupalli Port plans to develop the container terminals 3 & 4 with additional capacity of around 25 MTPA by 2018. Timelines risks for the projects are present and detailed studies for the project as well as the start of construction shall be required to be initiated at the earliest to meet the commissioning timelines.

ii. <u>The capital investments are not being targeted to handle changing shipping trends across the globe:</u>

The recent trend in the shipping industry has witnessed world-wide liners witnessing increasing realizations by deploying larger vessel sizes. Liners save around 20%-25% per slot when the vessel size increases from 4,000 TEU to 7,000 TEU. The order book of container ships also indicates a growing trend of Very Large Container vessels across the world. As these larger vessels get deployed on the main lines, the comparatively smaller vessels of around 6,000-8,000 TEUs are expected to move to the feeder network. Thus, for the ports to be able to serve the main line larger vessels, such ports require deeper drafts to be able to serve vessels of more than 10,000 TEUs capacity over the future decades. The Krishnapatnam port with a much deeper draft compared to the ports at Chennai, Ennore and Kattupalli may be in a better position to serve the larger sized container vessels in the future.

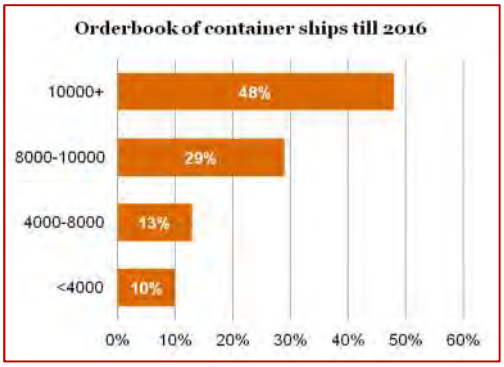
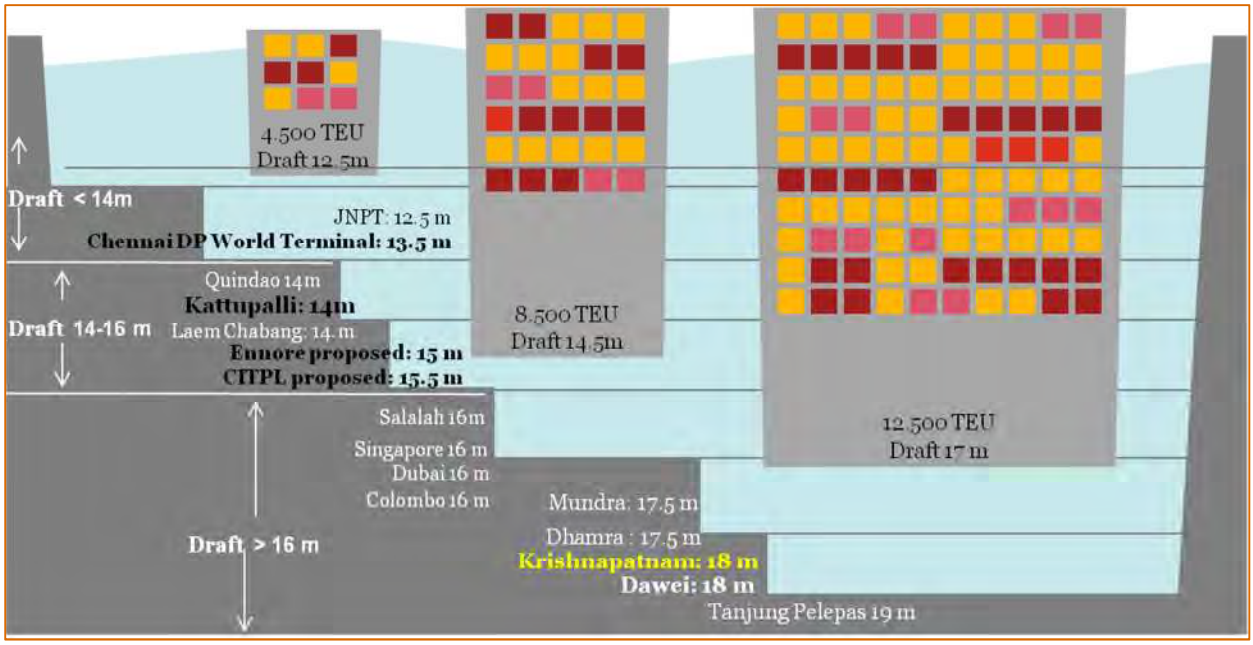


Figure 6.2.9: Orderbook of container ships till 2016

Table 6.2.27: Comparison of slot costs with change in vessel size

Vessel Sizes (in TEUs)	Slot Costs (USD per slot)		
	Asia-ME	Asia-Mediterranean	Asia-North Europe
4000-4500	500	950	1050
7000-8500	350	700	800
10,000-12,500	300	600	680

iii. Availability of deeper drafts at berth and absence of land-based evacuation issues at neighbouring ports: The steam distance from Western and Eastern port to Krishnapatnam is only around 100-140 NM more than Chennai, which is an additional 3-4 hours time difference or only around 1-4% of the total transit time taken. However, the availability of deeper draft at Krishnapatnam as well as the proposed availability of deeper draft at Ennore port (after the proposed dredging activity is completed) is likely to attract the larger vessels which require deeper drafts. The figure below depicts a comparative analysis of the drafts availability at the ports in the region and the corresponding vessel sizes which can be accommodated at the respective drafts.



Thus, **Figure 6.2.10: Comparative analysis of berth drafts and container vessels at ports in the CBIC regoin and international ports**

going forward, the ports located in or close to urban agglomerations may be disadvantaged to handle increased traffic. As has been witnessed in other ports along the Indian coastline, the ports located in or close to urban agglomerations are likely face challenges in terms of ease of cargo evacuation from the ports. This is likely to result in a natural movement of cargo away from the cities to ports located away from the urban agglomerations. Thus, considering the growth of greater Chennai agglomeration area development of evacuation infrastructure at both Chennai and Ennore ports may become more expensive and difficult to implement.

Thus, based on the development plans, land availability details as well as the project implementation and commissioning schedule provided to the JICA Study Team by the Chennai Port Trust, Ennore Port and

Kattupalli Port, in the medium term the proposed container capacity addition projects are likely to meet the BAU demand as well as the BIS case demand. There are some key risks present which have been discussed above and preparatory measures shall be required to be initiated at the earliest to materialise the proposed capacity addition. There may be possibility of delays in the planned projects and thus, we would suggest that the concerned authorities may undertake a comprehensive regional study to re-evaluate the development status of the proposed projects and likelihood of materialization of the proposed capacities and a suitable port development strategy may be developed depending upon the findings of such a study.

Long Term Scenario:

In the long run, while the ports at Chennai, Ennore, Kattupalli and Krishnapatnam shall be able to cater to the container traffic in the BAU scenario, the requirement for 1-2 additional deep sea ports for handling the container traffic in the BIS case shall arise. The graph alongside depicts the long term scenario in both the BAU and BIS case along with the proposed capacities at the existing ports in the CBIC region.

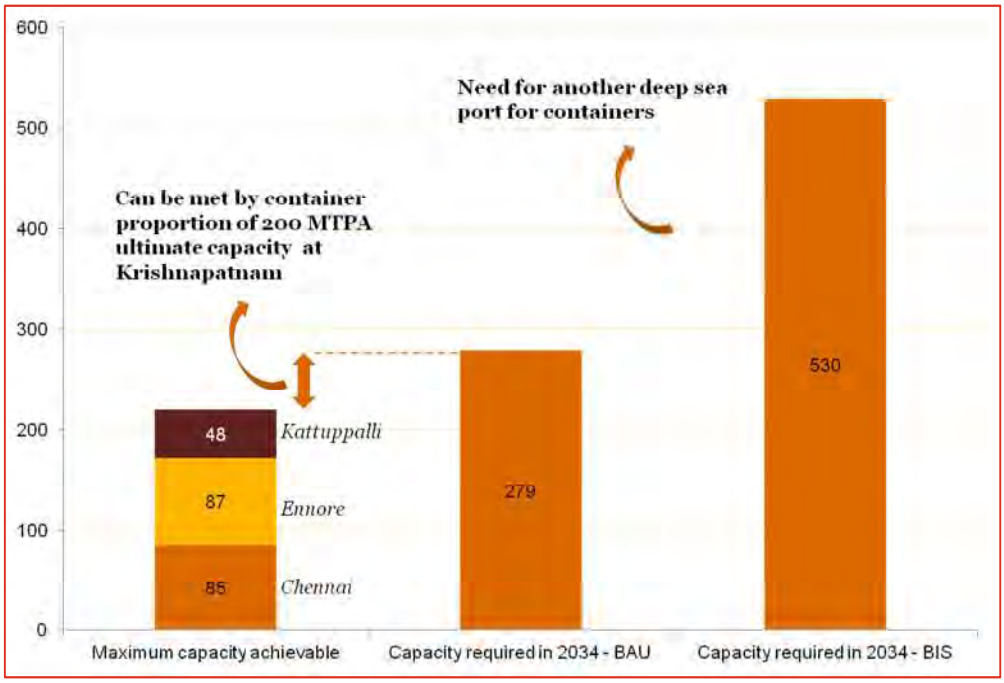


Figure 6.2.11: Container Traffic and Capacity in CBIC - Long Term scenario

Coal Traffic

Coal is the second major commodity which is expected to form a substantial portion of the port traffic in the CBIC region. The Chennai Port has recently stopped handling thermal, coking and other coal as well as other dusty cargo due to its emphasis on handling clean cargo. Due to this, the coal traffic is likely to shift to Ennore Port which also caters to a substantial coal requirement of TNEB power plants in the region. Krishnapatnam is also likely to emerge as the port of choice for coal traffic in the CBIC region and is expected to cater to the UMPP as well as other thermal power stations in the vicinity. Cheyyur, which is planned to be developed as a captive coal handling port, is likely to cater to the requirement of the Cheyyur UMPP.

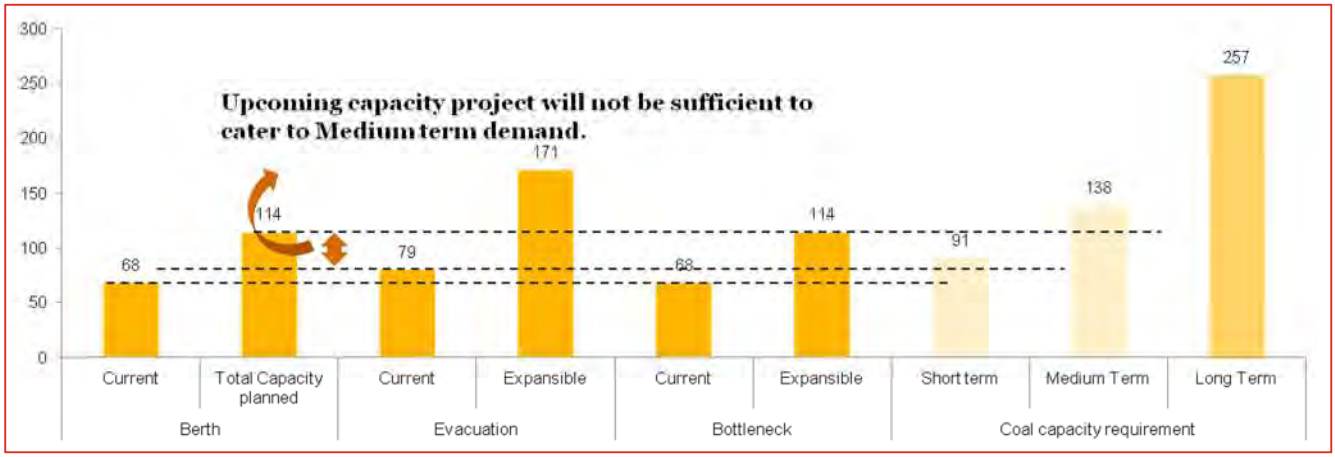


Figure 6.2.12: Berth capacity addition, evacuation capacity and capacity requirements in the Short, Medium & Long Term for CBIC region

As the figure above suggests, while the short term requirements can be met by the proposed capacity additions planned in the short term at the ports in the CBIC region, a medium-to-long term coal strategy shall be important to meet the coal handling capacity requirements in the region.

Overall scenario:

To summarise, the anticipated capacity additions over the short to medium term are likely to be sufficient to cater to the demand over the similar timelines. The graph below depicts the capacity requirement and capacity creation over the short, medium and long terms.

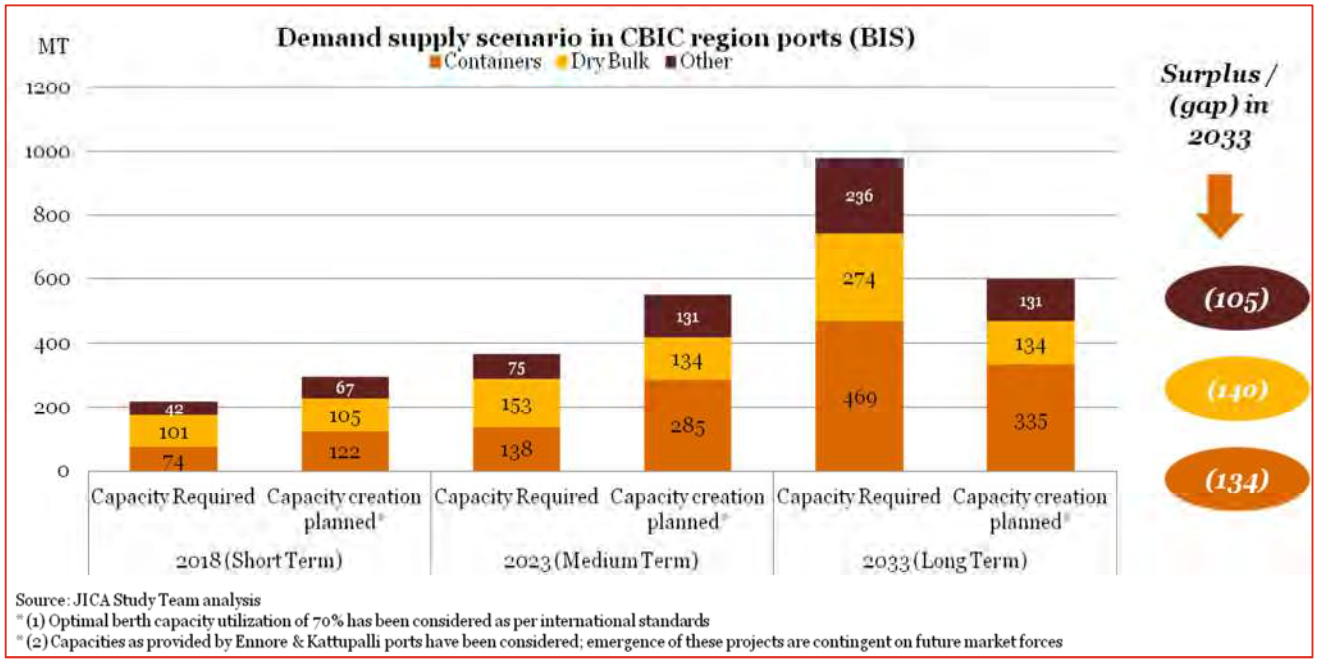


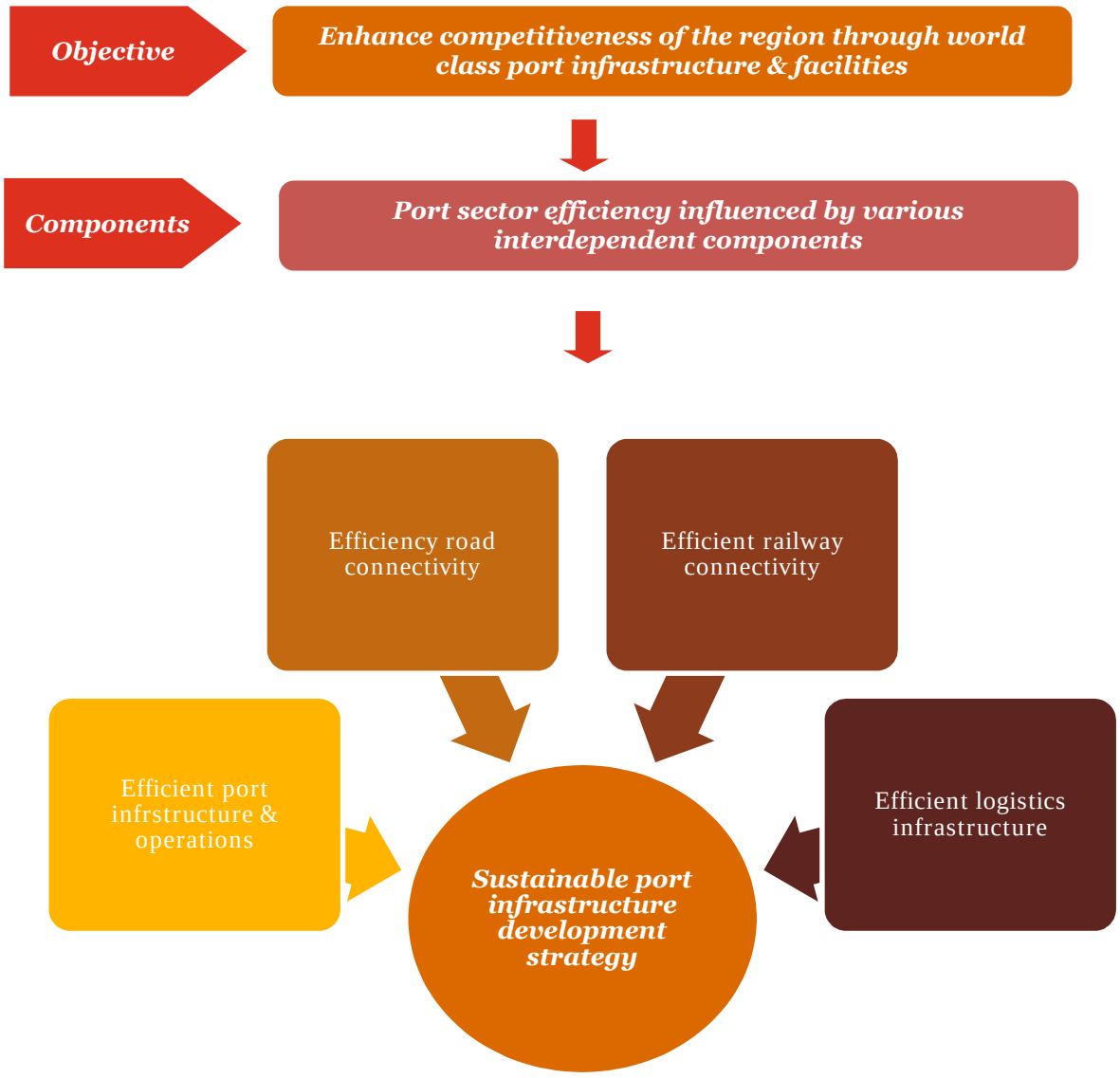
Figure 6.2.13: Overall commodity-wise demand-supply gap scenario in the Short, Medium & Long Term in CBIC region - BIS case

However, the demand-supply gap over the long term necessitates the need for creating additional port capacity in the region in addition to the four existing ports at Chennai, Ennore, Kattupalli and Krishnapatnam and the proposed captive port at Cheyyur. At the same time, these capacity additions at the ports are likely to be

influenced by the future market forces and the emergence of connectivity enablers around the Chennai, Ennore and Kattupalli ports is likely to be critical in sustaining the demand over the short and medium terms. At the same time, over the short and medium term, efficiency improvement at the existing ports should be targeted and Techno-Economic feasibility studies for future development projects should be initiated.

6.2.4 *Infrastructure development strategy*

The strategy for development of port infrastructure in the CBIC region is dependent on various inter-dependent variables. These include the infrastructure within the ports, the operations in the ports, connectivity to the ports via road and rail, and presence of efficient logistics infrastructure that enable efficient management and modal shift of cargo from various modes, primary from road to rail and vice versa that ultimately enables faster evacuation.



The primary goal in the development strategy of port infrastructure would be to facilitate faster and efficient movement of cargo at the ports. This is dependent on various factors such as presence of world class port infrastructure, connectivity by road & rail and logistics infrastructure to ensure smooth modal shifts in the region. These parameters are discussed below:

Port side infrastructure: Port side infrastructure in the region would require significant development over the medium to long term. It would be important to not only create the capacity in ports, but also ensure that

the ports are operated on par with world class standards. It would be important to ensure that the CBIC region creates adequate port side infrastructure to accommodate larger vessels and target improving the turnaround time. These are dependent on factors such as the length of the berths, availability of sufficient draft and approach channels.

Road connectivity: The CBIC region currently poses significant challenges in access to ports through roads. It would be necessary to ensure that connectivity to the ports through roads is improved so as to improve the evacuation capacity at the ports. As noted earlier, the low evacuation capacity at Chennai port poses limitations on the port's ability to fully utilize its capacity. Therefore, over the short term, it would be important to improve road connectivity to ports such as Chennai. Challenges due to rapid urbanization and stiff land use patterns pose limitations on improvement of road connectivity infrastructure beyond a particular level. In such circumstances efficient traffic management in urban ports & gradual movement of cargo to newer ports in lesser urbanized regions would be required over the longer term.

Rail connectivity: Movement of cargo through rail over relatively longer distances, say from the Bangalore and surrounding regions, would be economical compared to transportation through roads. There is insufficient rail connectivity to ports in the CBIC region at present. Further, there is limited railway access into the port terminal area especially in Chennai port which necessitates last mile movement of cargo by road which reduces the efficiency and time taken for movement of goods. The CBIC region would require more rail friendly terminals for efficient movement of cargo in the future.

Logistics infrastructure: Development of efficient logistics infrastructure to promote swifter & efficient modal shift is necessary for movement cargo from the production centres to the gateways and vice versa. Such logistics infrastructure is critical for improving operating efficiency at the ports. For instance, customs procedures forming part of such facilities could result in minimal traffic at the port entry points, resulting in faster turnaround of vessels and improving the throughput in ports which is necessary for improving competitiveness in the region.

The various development goals and targets are provided in the following section.

6.2.5 *Development goals & target performance indicators*

The various development goals for creation of world class sustainable port infrastructure and improvement of its interdependent components are captured as under. The successful operation of ports is not only dependent on the presence of port infrastructure but also presence of efficient connectivity through road and rail. To this extent, the various goals pertaining to improvement of port & connectivity infrastructure is included in the table below.

Category of infrastructure	Short term	Medium term	Long term
Port infrastructure & operations 	• Improve internal operations at the ports of Chennai and Ennore (recommendations of OCDI) • Commissioning of committed berth improvement projects at Chennai & Ennore	• Commissioning of committed berth improvement project at Krishnapatnam • Create world class port capacity to accommodate larger vessels to handle increased trade through larger berth sizes, deeper draft and channels • Creation of fully automated processes at new terminals / ports • Modernization of existing ports through automation of critical processes of cargo handling & storage	
Road connectivity 	• Improve road connectivity to ports (planned projects of phase 1)	• Creation of enhanced internal road connectivity within ports & their terminals; integration of internal road infrastructure with planned port automation initiatives • Creation of enhanced external connectivity to new ports (discussed in	

Category of infrastructure	Short term	Medium term	Long term
		the roads strategy)	
Rail connectivity 	• Improve rail connectivity to terminals at existing ports (planned projects of phase 1)	• Creation of enhanced internal connectivity within ports & their terminals; integration of internal road infrastructure with planned port automation initiatives • Creation of enhanced external rail connectivity to new ports (discussed in the rail strategy)	
Logistics infrastructure 	• Strategic options studies to improve connectivity, operations of existing CFSs	• Creation of multi-modal logistics parks (with customs facilities where necessary) to facilitate faster & efficient customs clearance and modal shift of cargo from road to rail & vice versa (discussed in the logistics strategy) • Establishment of direct connectivity (road / rail) from inter-modal logistics parks to ports (discussed in logistics strategy)	

The various development goals integral to the ports sector pertaining to improvement of efficiency, capacity and connectivity over the short & longer terms are captured as under.

Development goal # 1: **Improvement of port operations at the ports of Chennai & Ennore**

One of the main causes of congestion in Chennai port is due to inadequate documentation, lack of adequate management of traffic, inspection methods and presence of idling trailers within the port. As measure to address these issues, a separate study has been commissioned by JICA to OCDI. OCDI have recommended short to medium term measures for improvement of operations at Chennai port. These recommendations (discussed in the following section under the development plan) are central to improving the throughput and efficiency at Chennai port. As Ennore port prepares to handle containers in future, it will also be important for the port to adhere to effective management of its traffic and operations as suggested for Chennai port.

Development goal # 2: Implementation of committed berth capacity improvement projects

Chennai, Ennore and Krishnapatnam ports have committed to improving their respective berth capacities over the short to medium term. Timely commissioning of these projects is critical for sustaining demand over the short to medium term. The specific projects are discussed in the next section.

Development goal # 3: Improve road connectivity to ports

It would be important to ensure that the planned projects for improving connectivity to the ports of Chennai & Ennore identified as part of the preliminary study on CBIC by JICA be implemented on time. The implementation of these projects is currently being tracked by the Prime Ministers' Office on a regular basis. These projects, identified in the development plan below, are critical for improvement of connectivity to the ports of Chennai & Ennore. Additional details of these projects are discussed in the road sector strategy.

Development goal # 4: Improve rail connectivity to existing ports

One of the goals would be to ensure that the railway connectivity projects pertaining to access to ports (identified as part of the preliminary study on CBIC by JICA) also be implemented on time. These projects would be critical for improving railway access to the existing ports in the CBIC region. Similar to the road sector projects cited above, these railway projects are also being tracked on a regular basis by the Prime Ministers' Office. Additional details of these projects are discussed in the rail sector strategy.

Development goal # 5: Conduct strategic options study to maximise efficiency and connectivity at existing CFSs

The existing CFSs would need significant improvement in terms of its processes and connectivity from hinterland and to ports. There has been rapid urbanization around the CFSs leading to changing land use patterns thus resulting in challenges in creation of additional connectivity infrastructure. A strategic options study is required to be conducted for improvement of the existing facilities to the maximum extent possible in order to help improve their efficiency and connectivity to the ports. Additional details of these projects are discussed in the logistics sector strategy.

Development goal # 6: Create world class port capacity and modernization of existing ports

Timely commissioning of the berth capacity improvement projects at Krishnapatnam, Chennai and Ennore ports would be critical to meeting the growing demand over the short to medium term. In order to ensure competitiveness of the region, it would be important to ensure that the additional port capacity that is required to be created are developed to world class standards over the long term. It would be essential to achieve full automation of port infrastructure and processes to improve turnaround and cargo throughput to world class standards. It would be important to achieve the following specific objectives:

- Development of adequate rail & road linkages within ports
- Fully automated cargo handling & movement from road & rail sidings to vessels
- Fully automated cargo storage facilities

The development plan outlined in the following section captures additional details on the nature of infrastructure required. Besides, to improve the efficiency of existing ports over the medium to longer term, it would be essential to take up port modernization projects in batches. Facilitation of automated and well controlled systems could form part of the modernization plan. This would enable in not only providing efficient services, but also increasing the throughput of the ports and the turnaround time with marginal alternations to the port's physical features.

6.2.6 *Development goals & target performance indicators*

The various development goals for creation of world class sustainable port infrastructure and improvement of its interdependent components are captured as under. The successful operation of ports is not only dependent on the presence of port infrastructure but also presence of efficient connectivity through road and rail. To this extent, the various goals pertaining to improvement of port & connectivity infrastructure is included in the table below.

Category of infrastructure	Short term	Medium term	Long term
Port infrastructure & operations 	• Improve internal operations at the ports of Chennai and Ennore (recommendations of OCDI) • Commissioning of committed berth improvement projects at Chennai & Ennore	• Commissioning of committed berth improvement project at Krishnapatnam • Create world class port capacity to accommodate larger vessels to handle increased trade through larger berth sizes, deeper draft and channels • Creation of fully automated processes at new terminals / ports • Modernization of existing ports through automation of critical processes of cargo handling & storage	
Road connectivity	• Improve road connectivity to ports (planned projects of phase 1)	• Creation of enhanced internal road connectivity within ports & their terminals; integration of internal road infrastructure with planned port automation initiatives	

Category of infrastructure	Short term	Medium term	Long term
		• Creation of enhanced external connectivity to new ports (discussed in the roads strategy)	
Rail connectivity 	• Improve rail connectivity to terminals at existing ports (planned projects of phase 1)	• Creation of enhanced internal connectivity within ports & their terminals; integration of internal road infrastructure with planned port automation initiatives • Creation of enhanced external rail connectivity to new ports (discussed in the rail strategy)	
Logistics infrastructure 	• Strategic options studies to improve connectivity, operations of existing CFSs	• Creation of multi-modal logistics parks (with customs facilities where necessary) to facilitate faster & efficient customs clearance and modal shift of cargo from road to rail & vice versa (discussed in the logistics strategy) • Establishment of direct connectivity (road / rail) from inter-modal logistics parks to ports (discussed in logistics strategy)	

The various development goals integral to the ports sector pertaining to improvement of efficiency, capacity and connectivity over the short & longer terms are captured as under.

***Development goal # 1:* Improvement of port operations at the ports of Chennai & Ennore**

One of the main causes of congestion in Chennai port is due to inadequate documentation, lack of adequate management of traffic, inspection methods and presence of idling trailers within the port. As measure to address these issues, a separate study has been commissioned by JICA to OCDI. OCDI have recommended short to medium term measures for improvement of operations at Chennai port. These recommendations (discussed in the following section under the development plan) are central to improving the throughput and efficiency at Chennai port. As Ennore port prepares to handle containers in future, it will also be important for the port to adhere to effective management of its traffic and operations as suggested for Chennai port.

Development goal # 2: Implementation of committed berth capacity improvement projects

Chennai, Ennore and Krishnapatnam ports have committed to improving their respective berth capacities over the short to medium term. Timely commissioning of these projects is critical for sustaining demand over the short to medium term. The specific projects are discussed in the next section.

Development goal # 3: Improve road connectivity to ports

It would be important to ensure that the planned projects for improving connectivity to the ports of Chennai & Ennore identified as part of the preliminary study on CBIC by JICA be implemented on time. The implementation of these projects is currently being tracked by the Prime Ministers' Office on a regular basis. These projects, identified in the development plan below, are critical for improvement of connectivity to the ports of Chennai & Ennore. Additional details of these projects are discussed in the road sector strategy.

Development goal # 4: Improve rail connectivity to existing ports

One of the goals would be to ensure that the railway connectivity projects pertaining to access to ports (identified as part of the preliminary study on CBIC by JICA) also be implemented on time. These projects would be critical for improving railway access to the existing ports in the CBIC region. Similar to the road

sector projects cited above, these railway projects are also being tracked on a regular basis by the Prime Ministers' Office. Additional details of these projects are discussed in the rail sector strategy.

Development goal # 5: Conduct strategic options study to maximise efficiency and connectivity at existing CFSs

The existing CFSs would need significant improvement in terms of its processes and connectivity from hinterland and to ports. There has been rapid urbanization around the CFSs leading to changing land use patterns thus resulting in challenges in creation of additional connectivity infrastructure. A strategic options study is required to be conducted for improvement of the existing facilities to the maximum extent possible in order to help improve their efficiency and connectivity to the ports. Additional details of these projects are discussed in the logistics sector strategy.

Development goal # 6: Create world class port capacity and modernization of existing ports

Timely commissioning of the berth capacity improvement projects at Krishnapatnam, Chennai and Ennore ports would be critical to meeting the growing demand over the short to medium term. In order to ensure competitiveness of the region, it would be important to ensure that the additional port capacity that is required to be created are developed to world class standards over the long term. It would be essential to achieve full automation of port infrastructure and processes to improve turnaround and cargo throughput to world class standards. It would be important to achieve the following specific objectives:

- Development of adequate rail & road linkages within ports
- Fully automated cargo handling & movement from road & rail sidings to vessels
- Fully automated cargo storage facilities

The development plan outlined in the following section captures additional details on the nature of infrastructure required. Besides, to improve the efficiency of existing ports over the medium to longer term, it would be essential to take up port modernization projects in batches. Facilitation of automated and well controlled systems could form part of the modernization plan. This would enable in not only providing efficient services, but also increasing the throughput of the ports and the turnaround time with marginal alternations to the port's physical features.

6.2.7 *Development plan & suggested projects*

The development plan & suggested projects for improvement of the port infrastructure in CBIC are presented below which are closely aligned to the development goals enumerated in the previous section.

Improvement of port operations at the ports of Chennai & Ennore

The interventions proposed by OCDI as part of the study commissioned by JICA are presented below. These interventions include judicious use of the existing CFSs and CWCs in order to minimize traffic at the ports especially caused due to trucks that have inappropriate documentation. Other solutions including shifting of the trailer inspections to the off-dock parking area and improvements to strengthen the parking lot have been suggested. Besides, relocation of the customs gate to the port gate has been suggested to reduce congestion in the terminal gate where the customs procedures are currently undertaken. A host of information technology linked solutions have also been suggested so as to improve operations of the port.

Interventions at Chennai Port	*Horizon*
Termination of export containers having insufficient documentation at CFSs and CWC	Short term
Shift trailer inspections to the off-dock parking area instead of at the port gate	Short term
Relocation of customs gate from the terminal gate to the port gate	Short term
Regulation of idling trailers in the port	Short term
Establishment of a common portal web system	Medium term
Authentication of trailer's port pass by introducing information technology systems	Medium term
Doubling of port gate capacity from 4 to 8 lane	Medium term

The above measures and additional studies have been proposed for Chennai port. In contrary, the OCDI study team is of the opinion that the land around Ennore is relatively less urbanized than Chennai thereby providing more flexibility for improving connectivity and port operations. However, it may be noted that the area around Ennore port is also fast urbanizing given expansion of Chennai city limits under the CMDA. ***It is suggested further suggested that a detailed assessment be undertaken for improvement of efficiency of Ennore Port to proactively create the systems and procedures to ensure effective management of the port to cater to future needs.***

Commissioning of committed berth capacity improvement projects at existing ports

In order to successfully meet the demand over the short to medium term, timely implementation of the below berth capacity improvement projects are critical. Implementation of these projects should be monitored on a periodic basis to ensure timely commissioning.

Committed berth capacity improvement projects	Anticipated capacity addition	Expected date of commissioning
Phase 2 of Krishnapatnam	125 MT	2021
LNG Terminal at Ennore	5 MT	2018
Container Terminal – 1 at Ennore	16.8 MT	Phase – 1: 2017; Phase – 2: 2019
Multi-purpose cargo terminal at Ennore	2 MT	2016
Upgradation of existing coal handing facility at EnnorePort (due to mechanization of Coal Berth for TNEB)	4 MT	2015
Coal Berth III for TNEB at Ennore	9.5 MT	2017
Container Terminal 3-Conversion of JD East - 2,4& 6 at Chennai Port	0.8 Mn TEU	2020*
Conversion of Bharathi Dock - 2 (BD-2) berth to a Ro-Ro terminal	Around 7,000 cars	2016
Liquid Berth as part of Project Outer Harbour at Chennai Port	2.31 MTPA	2018
Two Multi-purpose berths as part of Project Outer Harbour at Chennai Port	4.62 MTPA	2021
Container Terminal 1 as part of Project Outer Harbour at Chennai Port	14.13 MTPA	2019
Container Terminal 2 as part of Project Outer Harbour at Chennai Port	14.13 MTPA	2026
Ro-Ro Berth as part of the Project Outer Harbour at Chennai Port	0.25 mn cars	2020
Development of SBM facility for Crude Oil handling	15 MTPA	2020

** Port's estimate is 2017. But 2020 is the likely date of commissioning considering current legal issues surrounding the project*

Improve road connectivity to ports

The following road connectivity projects aimed at improving connectivity to ports (identified as part of phase 1 of the CBIC study) should be tracked and implemented on priority. It is to be noted that the below projects are critical to improving the efficiency of Chennai and Ennore ports. The timeliness of these projects could result in better evacuation from the ports, especially from Chennai, leading to faster movement of cargo and achieving a better turnaround time. It is to be noted that increasingly investors in the CBIC region are keen to relocate their shipments to alternative competitive ports in the region as the time taken at Chennai port at present results in severe transaction costs leading to loss of competitiveness. It is therefore utmost important to

improve connectivity to Chennai and Ennore ports. Besides, it would also be important to fast track the proposed road improvement project from the Bangalore region to Krishnapatnam.

Critical road connectivity projects	*Port*	*Horizon*
Elevated Expressway to Chennai Port	Chennai Port	Short term
Development of Coastal Road to the east of container Terminal II	Chennai Port	Short term
North Chennai Thermal Power Station (NCTPS) Road	Ennore Port	Short term
Northern Port Access Road	Ennore Port	Short term
EMRIP project	Ennore Port	Short term
Road connectivity projects to Krishnapatnam Port from Bangalore region	Krishnapatnam Port	Short term

In addition to the committed projects above, the below new projects are envisaged. It would be important to expand the gate capacity at Ennore to meet the expected evacuation capacity by road over the short term. Further, given the anticipated increase of capacity at Krishnapatnam to 200 MT by 2021, the road and gate capacities would also require expansion.

Critical road connectivity projects	*Port*	*Horizon*
Expansion of the gate capacity by 40 MT by 2018	Ennore Port	Short term
Expansion of the gate and road capacity to meet design capacity of 200 MT (exact quantum to be determined by Krishnapatnam Port officials)	Krishnapatnam Port	Medium term

Improve rail connectivity to existing ports (planned projects of phase 1)

The below proposed rail connectivity projects are important for faster traffic movement of cargo at Ennore and Chennai port. Currently, there are limited rail links to the port which would be required to be strengthened to facilitate faster movement of goods through rail. The below projects (identified during phase 1) of the study should be implemented on priority over the short term.

Critical rail connectivity projects	*Port*	*Horizon*
Rail link to Ennore Port from the North of Minjur Railway station on the Chennai – Gudur line	Ennore Port	Short term
Rail link from Avadi to Guduvancherry via Sriperumbudur and Oragadam	Chennai & Ennore Ports	Short term
Ennore Port-Avadi/Tiruvallur Rail link	Ennore Port	Short term

While rail connectivity at Krishnapatnam port is expected to be sufficient over the short to medium term, it may require expansion over the longer term depending on changing cargo flows and modal shifts in traffic. The below project could be taken up by Krishnapatnam port officials:

Critical rail connectivity projects	*Port*	*Horizon*
Expansion of the rail capacity to meet design capacity of 200 MT (exact quantum to be determined by Krishnapatnam Port officials)	Krishnapatnam Port	Long term

Conduct strategic options study to maximise efficiency and connectivity at existing CFSs

Rapid urbanization has been witnessed in the peripheral regions of Chennai often leading to challenges in expanding infrastructure, especially that of connectivity, to cater to growing traffic demand over the recent years. Most of the CFSs are located in the urban limits of CMDA and have very poor connectivity from the industrial centres / highways to the CFSs and from the CFSs to the ports. One of the recommendations of OCDI is to mandatorily route traffic through the CFSs with the objective of terminating trailers with inappropriate

documentation at the CFSs itself. This when implemented is expected to result in heavy congestion at the CFSs which are already plagued with congestion at entry and exit points and thereby could witness issues in evacuation to ports. It is henceforth suggested that a strategic options study be commissioned to evaluate in detail the scope for improvement of the CFSs attached to Chennai and Ennore ports in order to help them attain the maximum possible efficiency to handle increased traffic in future.

Creation of additional port capacity

It is anticipated that additional port capacity would be required in the medium to long term in the CBIC region to cater go the anticipated rise in demand. The segment specific strategies are discussed a under:

Bulk

Bulk cargo in the region mainly comprises of thermal coal driven by the power demand. The demand supply gaps in the bulk segment in 2018, 2023 and 2033 are captured as under:

Demand supply gap in the Bulk segment (MT)	2018	2023	2033
BAU	-	(15)	(107)
BIS	-	(18)	(140)

Source: JICA Study Team Analysis
Note: The demand supply gap is based on the assumption of optimal berth capacity utilization of 70%

As opposed to creation of inland power plants away from the coast that were located closer to the coal mines, the dependence on coal imports (which is expected to rise over the years in India) has led to a shift in locating most of the new power plants closer or attached to ports in order to minimize lead times in availability and transportation costs of coal. The TNEB power plant attached to Ennore and the proposed Ultra Mega Power Project (UMPP) in Cheyyur attached to the port in Cheyyur are examples of such initiatives. The existing ports in the region may not be able to efficiently serve future power plants as the power plants may be located at a distance from the ports increasing the dependency on rail infrastructure for transportation of coal thereby impacting lead times. It is anticipated that the capacity for serving the thermal coal demand for the region be undertaken in line with planning process of the power plants to meet future energy demand.

POL, edible oils, LPG and other liquids

The demand supply gaps in the POL segment in 2018, 2023 and 2033 are captured as under. The gaps are likely to arise over the long term starting from the year 2025 and 2028 onwards in the BIS and BAU cases respectively.

Demand supply gap in the POL segment (MT)	2018	2023	2033
BAU	-	-	-
BIS	-	-	(72)

Source: JICA Study Team Analysis
Note: The demand supply gap is based on the assumption of optimal berth capacity utilization of 70%

The evacuation for POL is normally undertaken off shore and through pipelines, which is not expected to pose significant challenges. Further, the POL cargo would have a tendency to shift to new port locations planned with refining capacity. It is anticipated that the POL demand can be adequately handled by existing ports in the short to medium term (except for a minimal shortage in the short term) and long term demand can be met by ports developed with refining capacity. The planning for such ports can be taken up involving the Ministry of Petroleum & Natural Gas and Ministry of Shipping over the long term, the planning for which could begin in the short term.

Break bulk

The demand supply gaps in the break bulk segment in 2018, 2023 and 2033 are captured as under. The gaps are likely to arise over the long term starting from the year 2025 and 2028 onwards in the BIS and BAU cases respectively.

Demand supply gap in the Break Bulk segment (MT)	2018	2023	2033
BAU	-	-	(0.6)
BIS	-	-	(33)

Source: JICA Study Team Analysis
Note: The demand supply gap is based on the assumption of optimal berth capacity utilization of 70%

Owing to the possibility of containerizing break bulk cargo, it is anticipated that much of the break bulk gap be addressed through the capacities of existing and ports and through containerization.

Containers

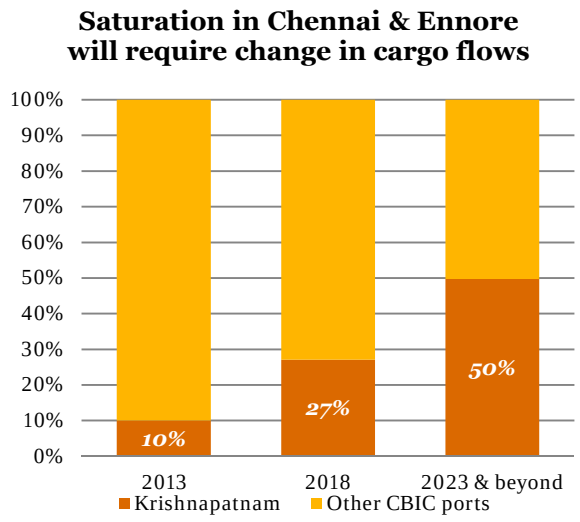
The demand for containers is expected to fall short over the long term in both the BAU and BIS cases. The demand supply gaps during the years 2018, 2023 and 2033 are as under:

Demand supply gap in the Containers segment (MT)	2018	2023	2033
BAU	-	-	-
BIS	-	-	(134)

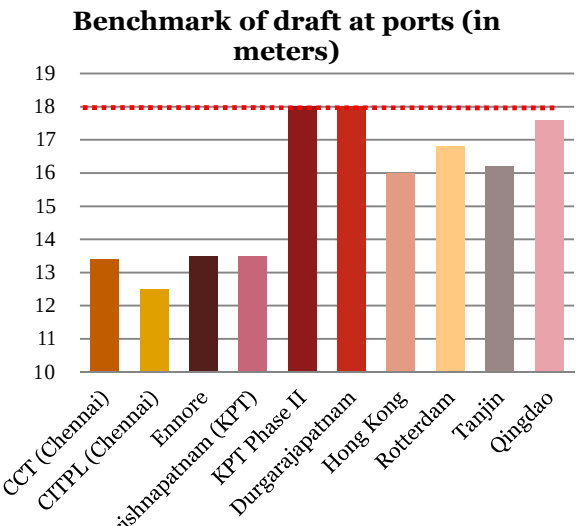
Source: JICA Study Team Analysis
Note: The demand supply gap is based on the assumption of optimal berth capacity utilization of 70%

While in the BAU case, the capacities at existing ports is expected to be nearly sufficient, there is a strong need for additional container handing capacity in the BIS case. It is presently not known whether Krishnapatnam would have the ability to expand beyond its planned overall capacity of 200 MT. In case further expansion is not possible, a new port with container handling capacity would be required. The alternative port location of Durgarajapatnam could be considered for development to fill this gap. Planning for the port could be taken up during the period 2018-23 so as to commence operations during the years 2028-30.

The ports of Chennai & Ennore are expected to have a joint container handling capacity of ~172 MTPA in the long term. It is anticipated that no further expansion is possible in these ports due to berth side limitations and evacuation issues due to growing urbanization and changing land use patterns. As such, it is expected that Krishnapatnam would begin to account for a greater share of traffic in the CBIC region over the medium (27%) to long term (50%).



Source: JICA Study Team analysis



Source: Research by JICA Study Team

Further, the draft in the ports of Chennai & Ennore are around 13.5 meters limiting their abilities to handle large sized vessels (DWT 250,000 & above).

Ports in India such as Mundra are designed to handle ships of the size of ~250,000 DWT, owing to presence of a draft of over 18 meters that considerably reduce the costs of shipping by around 30%-40% thus making sea transportation costs competitive.

The CBIC region exhibits critical competitive advantages for creation of large "next generation" ports having the ability to attract large vessels contributing to significant reduction in costs of transportation of cargo. Some of the key factors that are critical for creation of world class ports are presence of a deeper draft, presence of Greenfield locations to exercise freedom of planning of port infrastructure and associated storage & connectivity infrastructure, and presence of a strong economic hinterland capable of generating large volumes of cargo.

Presence of deeper draft to accommodate larger vessels

Presence of a large economic hinterland for generaing large cargo volumes

Greenfield locations for creating rapid evacuation infrastructure

Krishnapatnam port (phase II) and the planned Durgarajapatnam port have a draft of 18 meters, which could be one the deepest in the world and higher compared to Qingdao in China which has the deepest operating draft of 17.6 meters.

Large volumes of containers are required to attract large sized vessels. Large sized vessels (18,000 TEU and above) reduce the costs of transportation by almost 30-40%. The port of Yangshan off the coast of Shanghai, which attracts large sized vessels, is preparing for a capacity expansion to 13 million TEUs by 2020. Khalifa Port in UAE, which also attracts large sized vessels, has planned a capacity expansion to 12 million TEUs by 2030. The container traffic in the CBIC region is expected to reach 10 million TEUs and 19 million TEUs in the BAU and BIS cases respectively in 2033. Almost 50% of these volumes are expected to be handed in the Krishnapatnam belt. Though the CBIC region accounts for significant volumes, the abilities of the ports of Krishnapatnam and Durgarajapatnam to adequately expand their capacities to global levels would need to be examined. Further, the ports would need to have a turning radius of 1.7 to 2 times the lengths of ships are required for accommodating large sized vessels, which also needs to be examined.

The areas around Krishnapatnam port and proposed Durgarajapatnam port are relatively less urbanized and Greenfield thereby providing the advantage to develop world class port infrastructure in a phased manner with enhanced scope for evacuation at the ports. It is necessary that the development plan for these ports consider regulating the development around these ports in a manner that the efficiency of these ports is retained over a longer time horizon of 30-50 years.

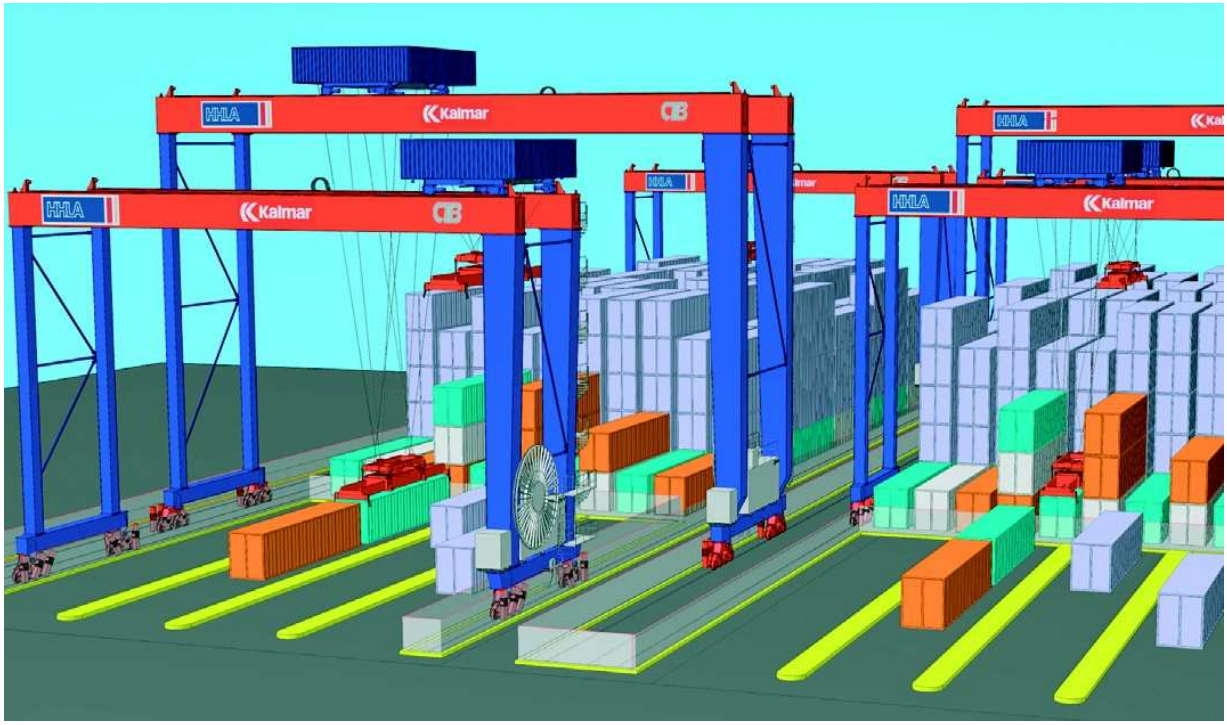
Considering the above factors, Krishnapatnam and Durgarajapatnam have the potential to emerge as next generation ports potentially emulating the standards of ports such as Mundra that have the capacities to handle large sized vessels. This requires further examination from technical perspectives and it is suggested that the

above competitive advantages be sufficiently considered in the expansion of Krishnapatnam port[95] and development of Durgarajapatnam port.

Mangalore port is another important port on the western coast of the State of Karnataka and has potential for handling exports and imports to and from countries locatied to the west of India. The Government of Karnataka plans to develop the ports on the western coast of the state with an eye on the strategic and economic benefits of these ports. However, additional detailed studies are required to determine the issues related to seamless & ecologically sustainable road and rail connectivity of the port at Mangalore to the proposed CBIC region. It is important for Government of Karnataka to fast track development of road connectivity from the Bangalore region to Mangalore that includes a proposal for tunnelling in the Western Ghats region. Development of connectivity to Mangalore port could enable strategic utilization of the port for trade with countries to the west of India.

Some best case examples of automated solutions for ports are discussed and recommended for consideration in development of phase 2 of Krishnapatnam port and the proposed Durgarajapatnam port.

Automated stacking cranes: Automated stacking cranes allow fully automated management of container stack yards. These cranes are normally 80 feet high and 110 feet wide and have been developed to handle up to 10 rows of containers. Innovative crane engineering would allow the cranes to perform the loading and unloading function without operators. This has been possible owing to sophisticated optical systems on the cranes that recognize containers using RFID technology by receiving signals from the port management computer. Such automation provides significant improvement in terminal productivity and also enhances the reliability of container handling in ports (Courtesy: TMEIC).



Automated stacking crane (Courtesy: www.maritimejournal.com)

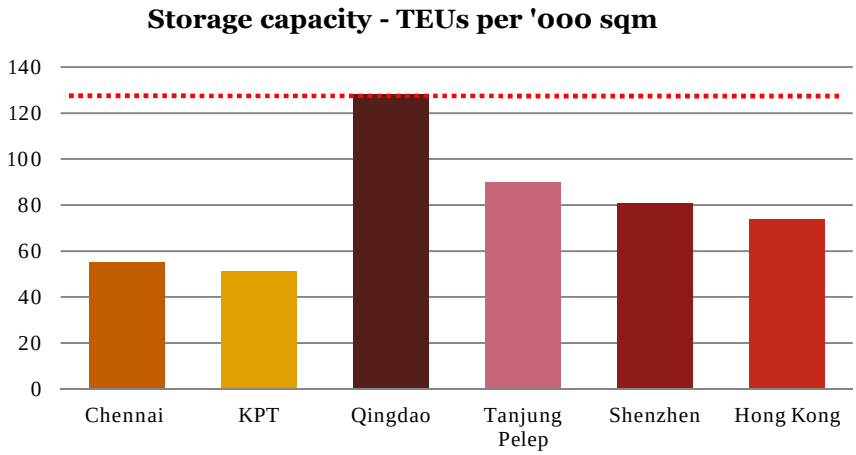
[95] It is anticipated that the expansion plans of Krishnapatnam port shall be guided through a formal regulatory & approval process involving the State Government of Andhra Pradesh

Automated stacking crane (Courtesy: www.terex.com)

Automated guided vehicles: Most modern container ports such as Rotterdam have automated guided vehicles for movement of cargo within the ports. These vehicles help in movement of cargo from the storage yard to the stacking area. These vehicles are programmed with automated sensors and geographical positioning devices that automatically guide the vehicles to their destination. These vehicles are fully automated without any human interface and controlled through the port central computer processing system.

Automated Guided Vehicles (Courtesy: www.terex.com)

Automated storage in ports: Currently, the storage in ports per '000 square meter at Chennai and phase 1 of Krishnapatnam port are around 55 and 51 TEUs respectively. The average container storage capacity per '000 square meter in Qingdao port is roughly 128 TEUs. There is significant scope for improvement of the storage facilities in the CBIC ports to reach to global standards. Further, the possibility of creating world class container storage facilities should be explored in development of new ports in the region.



Source: Research by JICA Study Team

One of the solutions that could be considered for betterment of storage facilities in ports is through automated storage yards. These automated storage solutions include automated shore-side cranes with reach capacity to handle over 20 containers fitted with optical character recognition facilities; the automated guided vehicles shuttle containers between the ship and storage yard. The storage yard would typically feature electric semi-automatic container-stacking cranes with remote control loading of boxes to on-dock rails or truck chassis.

Automated cargo storage yard (Courtesy: www.cargobusinessnews.com)

Fully automated unloading facilities for handling bulk cargo: Currently, the port of Ennore has semi-automated facilities for handing of bulk cargo. Fully automated (driverless) unloading of bulk-cargo, would significantly enhance the efficiency of ports. Considering the demand for bulk cargo like that of coal (for power production), it would be essential to create fully automated cargo handling facilities to increase the turn-around time and competitiveness of ports. Some the specific examples of fully automated unloading equipments are provided below (Courtesy: iSAM AG, Port of Hamburg).

Fully automatic bulk cargo unloaders typically are equipped with 3D laser scanners, internal navigation systems and sophisticated industrial computer systems that intelligently gauge physical situations (size & position of the vessel etc.) and provide instructions to the unloaders.

Central port computer system: Automated ports with automated guided vehicles and automated cranes receive their instructions from a central port computer system. These computer systems are highly sophisticated machines with sound logic and ability to provide instructions to various automated machines with a greater degree of accuracy.

Internal connectivity infrastructure at ports: It would be essential to create adequate road & rail connectivity to the terminal areas in future ports, integrated into the port's automated cargo handling systems to ensure faster turnaround time at ports.

The above port automation options are illustrative in nature and it is recommended that the technological advancements prevalent at the time of undertaking the development plans for the ports be adequately considered.

Integrated plan for modernization of existing ports in the CBIC region

Besides creation of state-of the art facilities at new ports, it would also be essential to develop an integrated plan to improve and modernize the facilities at the existing ports of Chennai, Ennore and Kattupally to attain a higher degree of performance and competitiveness. Such modernization could be taken up in a phased manner over the medium term. A strategic options study for determination of the contours of the integrated strategy for modernization is recommended to be initiated by the respective port authorities over the short term. The modernization projects could typically include storage area automation, automation of container & bulk cargo handling and creation of additional multi-modal facilities at ports for faster evacuation. It is recommended that the integrated strategy be developed in line with the external connectivity enhancement projects planned for improving access to the ports and changing development landscape around these ports.

6.2.8 *Phasing plan*

A summary of the suggested projects as part of the port sector strategy is provided as under with the indicative horizon period for phasing:

Sr.	Category	Projects	Cost (USD million)	2018	2023	2033
A.	Port efficiency improvement	Termination of export containers having insufficient documentation at CFSs and CWC	NA	◇		
		Shift trailer inspections to the off-dock parking area instead of at the port gate	NA	◇		
		Relocation of customs gate from the terminal gate to the port gate	NA	◇		
		Regulation of idling trailers in the port	NA	◇		
		Establishment of a common portal web system	NA		◇	
		Authentication of trailer's port pass by introducing information technology systems	NA		◇	
B.	Road connectivity improvement	Elevated Expressway to Chennai Port	Included in road strategy	◇		
		Development of Coastal Road to the east of container Terminal II		◇		
		North Chennai Thermal Power Station (NCTPS) Road		◇		
		Northern Port Access Road		◇		
		EMRIP project		◇		
		Road connectivity projects to Krishnapatnam Port		◇		
		Expansion of the gate capacity by 40 MT at Ennore Port	NA	◇		
		Expansion of the gate and road capacity to meet design capacity of 200 MT (exact quantum to be determined by Krishnapatnam Port officials)	NA		◇	
C.	Rail connectivity improvement	Rail link to Ennore Port from the North of Minjur Railway station on the Chennai	Included in the	◇		

Sr.	Category	Projects	Cost (USD million)	2018	2023	2033
	projects	– Gudur line	rail strategy			
		Rail link from Avadi to Guduvancherry via Sriperumbudur and Oragadam		◇		
		Ennore Port-Avadi/Tiruvallur Rail link		◇		
		Expansion of the rail capacity to meet design capacity of 200 MT (exact quantum to be determined by Krishnapatnam Port officials)	NA			◇
D.	Improvement of existing CFSs	Strategic options study to maximise efficiency & connectivity at existing CFSs	NA	◇		
E.	Existing berth capacity improvement projects & New berth capacity creation projects	Phase 2 of Krishnapatnam	2,250		◇	
		LNG Terminal at Ennore	700	◇		
		Container Terminal – 1 at Ennore	240	◇		
		Multi-purpose cargo terminal at Ennore	33	◇		
		Upgradation of coal handing facility at Ennore for TNEB Terminal	12	◇		
		Additional Coal Berth III at Ennore	45	◇		
		Container Terminal 3-Conversion of JD East -2,4& 6 at Chennai Port	80		◇	
		Additional Coal Berth IV for TNEB at Ennore	45		◇	
		Conversion of BD-2 berth to a Ro-Ro terminal at Chennai Port	0.70	◇		
		Additional Common User Coal Terminal on BOT basis	NA	◇		
		Additional Common User Multi-Liquid Terminal on BOT basis	NA	◇		
		Additional Car Export Terminal - 1	NA	◇		
		Additional Car Export Terminal - 2	NA		◇	
		SBM facility for Crude oil handling	NA		◇	
		Container Berths 3 & 4 at Kattupalli Port	NA	◇		
		Berth 5 - RoRO Terminal at Kattupalli Port	NA	◇		
		Multi-purpose berth at Kattupalli Port	NA		◇	
		Liquid / POL terminal at Kattupalli Port	NA		◇	
		LNG Terminal at Kattupalli Port	NA		◇	
		Liquid Berth - Project Outer Harbour Terminal	NA	◇		
		Multi-purpose berth - 1 : Project Outer Harbour Terminal	NA		◇	
		Multi-purpose berth - 2 : Project Outer Harbour Terminal	NA		◇	
		Container Berth 1 : Project Outer Harbour Terminal	NA		◇	
		Container Berth 2 : Project Outer Harbour Terminal	NA			◇
		RoRo Berth : Project Outer Harbour Terminal	NA		◇	
		Container Terminal II at Ennore	NA		◇	
		Container Terminal III at Ennore	NA			◇

Sr.	Category	Projects	Cost (USD million)	2018	2023	2033
F.	Creation of additional port infrastructure (containers)	Detailed study and implementation plan for creation of additional container handling capacity in the CBIC region (indicative project cost provided)	3,600			◇
G.	Integrated plan for modernization of Chennai, Ennore & Kattupally ports	Detailed study and integrated implementation strategy / plan for modernization of Chennai, Ennore & Kattupally ports; the modernization improvements could focus on improvement of capacity and storage are improvements through additional land reclamation, in consideration of the planned connectivity improvement projects and changing landscape.	NA	◇		

6.3 Road

6.3.1 Sector Overview

6.3.1.1 Road Infrastructure

6.3.1.1.1 Intercity Road Network

The Chennai – Bengaluru Industrial Corridor consists of two major urban centers viz, Chennai and Bengaluru. They are linked by national highways, which also pass through many of the major towns within the CBIC area. There are 16 Natioanl Highways which pass through the CBIC area for at least a portion of their lengths.

Chennai and Bengaluru are connected by NH 4 (Chennai to Mumbai) which passes through via Chittoor in Andhra Pradesh. NH 46 branches out from NH4 at Ranipet and runs to Krishnagiri where it meets NH 7 (Varanasi to Kanyakumari) which passes through Bengaluru. Krishnagiri is a major node for the NH network in the CBIC area as NH 66 and NH 219 also terminate there. NH 66 runs along the southern portion of the CBIC boundary, connecting Krishnagiri with Pondicherry. NH 219 links Krishnagiri to Madanapalle in the Chittoor district of Andhra Pradesh, with connections to NH 4, NH 205 and NH 234.

NH 5 begins at Chennai and traverses the eastern portion of the CBIC area along its alignment to Jharpokaria in Orissa (where it connects to Kolkata). NH 205 begins from Chennai urban area and connects the city to Anantapur in Andhra Pradesh, passing through Renigunta in Chittoor district. NH 45, knows as the Grand Southern Trunk Road, originates from Chennai and connect to Theni in southern Tamil Nadu passing through Chennai and Kanchipuram districts of the CBIC area.

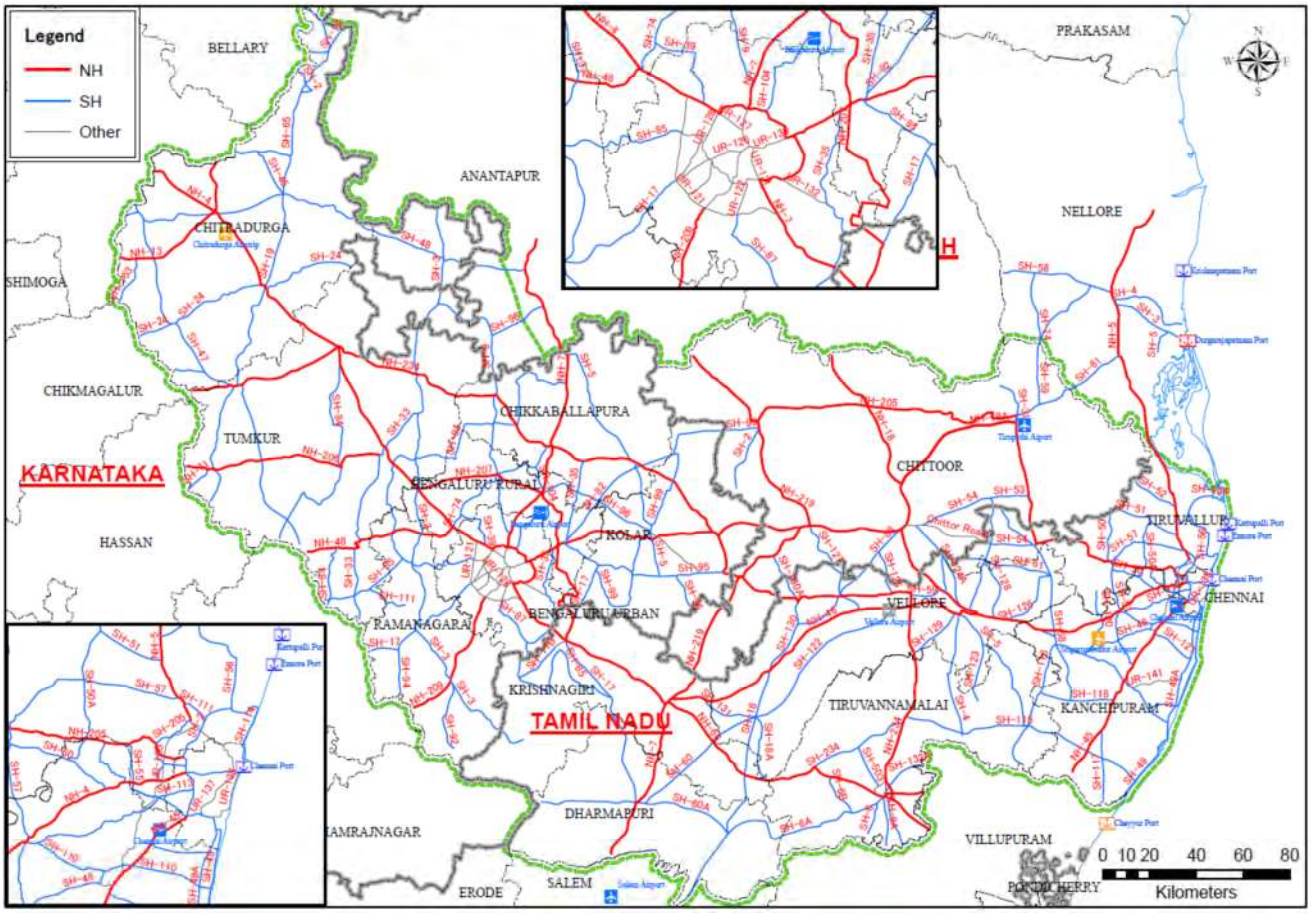
NH 209 begins from Bengaluru and passes through the periphery of the CBIC area to go to Dindigul in southernTamil Nadu. NH 207 is a short highway that connects Hosur in Tamilnadu and Nelamangala on the periphery of Bengaluru. NH 48 begins at Nelamangala and connects the Bengaluru periphery with the port of Mangalore on India's west coast.

Other major National Highways within the CBIC area include NH 13 between Sholapur and Mangalore which passes through Chitradurga, NH 18 between Chittoor and Kurnool and NH 18A which connects Tirupati to NH 18. NH 206 begins at Tumkur (where it connects to NH 4) and runs to Honnavar.The other major National Highway in the CBIC area is NH 234, which begins at Mangalore on the west coast and terminates at Thiruvannamalai in Tamil Nadu, passing through SIra, Chikaballapur, Chintamani, Katpadi and Polur.

Table 6.3.1: Intercity Road Network in CBIC Area

Road Category	Length (km)			Total
	Tamil Nadu	Karnataka	Andhra Pradesh	
National Highway	961	1,195	786	2,942
State Highway	2,414	2,403	526	5,343
Total	**3,375**	**3,598**	**1,312**	**8,285**

Source: JICA Study Team



Source: JICA Study Team

Figure 6.3.1: Intercity Road Network in CBIC Area

6.3.1.1.2 Urban road network

Chennai Metropolitan Area

Chennai has 4 major National Highways that originate within the city. These include:

- NH4 (Chennai to Mumbai, known within the city as Poonamallee High Road)
- NH 5 (Chennai to Kolkata, known within the city as Grand Northern Trunk Road)
- NH 45 (Chennai to Theni, known within the city as Anna Salai)
- NH 205 (Chennai to Anantapur, known within the city as Chennai – Tiruvallur Road)

The details of urban road network in Chennai Metropolitan Area are explained in Chapter 6.5.

Bengaluru Metropolitan Area

There are two National Highways which pass through Bengaluru city itself. These are :

- NH 4 (Chennai to Mumba, known within the city as Old Madras Road)
- NH 7 (Varanasi to Kanyakumari known within the city as Bellary Road)

Additionally a number of National Highways begin at locations close to Bengaluru. These include:

- NH 48 begins at Nelamangala, near Bengaluru and terminates at the port city of Mangalore.
- NH 207 begins near Nelamangala and connects to Hosur, which is in Krishnagiri district and on NH 7.

The details of urban road network in Bengaluru Metropolitan Area are explained in Chapter 6.5.

6.3.1.2 Current Government Initiatives

6.3.1.2.1 National Highway Development Project

The National Highways Development Project is a project, executed in several phases to improve the road network in India. The project is overseen by the National Highways Authority of India. It has involved the widening of roads and building of new links between all of India's major cities.

The first phase established the Golden Quadrilateral network, which linked India's 4 major cities of Delhi, Mumbai, Kolkata and Chennai by 4-lane Highways. The second phase focused on the North-South and East-West corridors while subsequent phases have seen the widening of 4-lane roads to 6-lane.

A number of these projects have been carried out by Public Private Partnership (PPP) models such as the BOT (Build, Operate, Transfer), BOOT (Build, Operate, Own and Transfer) and DBFOT (Design, Build, Finance, Operate and Transfer). The policy of the NHDP is for 60% of the planned infrastructure development (approximately 50,000 km) to be implemented through PPP (BOT/Toll).

The latest phase of the project, the Ministry of Road Transport and Highways drew up the Expressways Development Project, whose policy is to build 18,637 km new expressways by 2022 through PPP scheme.

Table 6.3.2: NHDP and Other NHAI Projects (Status: 31st October 2011)

Classifications			Length (km)
NHDP	Phase I & II (GQ)	4-laning of the Golden Quadrilateral	5,846
	Phase I & II (NS-EW)	4-laning of East – West Corridors	7,300
	Phase III	4-laning of high density national highway	12,109
	Phase IV	2-laning with paved shoulders	14,799
	Phase V	6-laning	6,500
	Phase VI	Development of expressways	1,000
	Phase VII	Development of ring roads, bypasses and so on	700
	Total		48,254
Port Connectivity projects			380
Other projects			1,390
Total by NHAI			50,024

Source: NHAI Web Site

6.3.1.2.2 Major Projects in CBIC Area

Major projects in Tamil Nadu State, Karnataka State, and Andhra PradeshStatus collected by data collection survey are summarized by status and category as shown in Table 6.3.3. Detail information of the projects and corresponding maps are attached in Annex- Major Project in CBIC Area

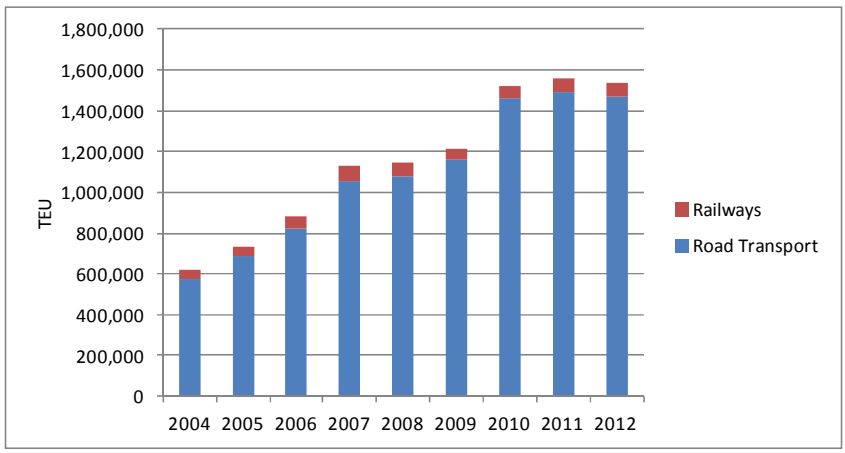
Table 6.3.3: NHDP and Other NHAI Projects(Status: 31st October 2011)

Status	Category	Tamil Nadu	Karnataka	Andhra Pradesh
Ongoing	Intercity	4	5	1
	Urban Arterial	4		
Announced Plan	Intercity	3	6	2
	Urban Arterial	2	1	
Under Study	Intercity	3	1	5
	Urban Arterial	3	2	

Source: JICA Study Team

6.3.1.3 Sector Issues on Industrial Development

Freight transport volume in CBIC area has been increased recently as shown in the below figure. Average growth rate of container handling volume of Chennai port is 13% and major cargo destinations are in and around of Chennai (45%) and neighbouring cities of Bengaluru, Hyderabad, and Selam (55%).Share of road transport in container transport is about 95% against about 5% by rail. It is foreseen that further growth of container transport by road and pertaining road development.



Source: Chennai Port Authority

Figure 6.3.2: Container Movement by Road Transport & Railways: 2004 to 2012of Chennai Port

Shortening of delivery time and reduction of delivery cost on logistics are essential for industrial promotion and major issues on road infrastructure development are selected in consideration of following priority area on road infrastructure development. The selection of the major issue is made from the aspect of urban logistics, regional logistics, road infrastructure, and operation and maintenance of road infrastructure in consideration of those different road traffic characteristics. Major issues are selected as shown in Table 5.1.4 and underlined issues which are related to logistic road network formulation and road capacity enhancement are subjected to examination of road infrastructure development strategy.

Priority Road Infrastructure Development Area:

- Mutual connection among road, port, airport, and logistic facilities（CFS･ICD･Industrial Park)

Debottlenecking on road traffic

Table 6.3.4 Major Issues on Road Infrastructure Development for Logistic

Aspect		Priority Road Infrastructure Development Area			
		Mutual connection among road, port, airport, and logistic facilities（CFS･ICD･Industrial Park)		Debottlenecking on road traffic	
		Problem	Issue	Problem	Issue
a.Urban Logistics	Operation and Maintenance	-	-	a-2.Parking cargo vehicle on port access road cause traffic congestion a-3.Traffic ban on city centre area for heavy freight vehicle cause inefficient logistic	a-2.Reduction of Parking Cargo Vehicle by Port Cargo Handling System Improvement a-3.Development of Elevated Freight Highway

Aspect		Priority Road Infrastructure Development Area			
	Infrastructure	a-1.Inadequate port access roads development in Chennai from arterial road network	a-1.Development of Port Access Roads（Urban Ring Roads, etc）	a-4.Through traffic in urban road network a-5.Insufficient bridge load bearing on port access roads a-6.Narrow roads to be bottleneck for large scale container trailer	a-4.Segregation of Through Traffic by Urban Ring Road and Bypass a-5.Reinforcement and Reconstruction of Damaged Bridge a-6.Widening for Large Scale Container Trailer
b.Regional Logistics	Operation and Maintenance	-	-	b-4.Deteriorated pavement condition mainly on access roads to logistic facilities (CFS・ICD・Industrial Park) cause loss of logistic speed and cargo quality	b-4.Improvement of Pavement Maintenance system
	Infrastructure	b-1.Delay of expressway development by NHDP b-2.Lack of functional classification of logistic roads based on connectivity b-3.Insufficient development of access roads connecting between arterial roads and logistic facilities (CFS・ICD・Industrial Park)	b-1.Development of Expressway b-2.Road Development based on Functional Classification of Logistic Road Network b-3.Development of Access Roads between Arterial Roads and Logistic Facilities based on Benefit Principle	b-5. Narrow roads to be bottleneck for large scale container trailer b-6. Insufficient bridge load bearing on port access roads	b-5. Widening for Large Scale Container Trailer b-6.Reinforcement and Reconstruction of Damaged Bridge

Source: JICA Study Team

a-1. Development of Port Access Roads（Urban Ring Roads, etc）

Development of access roads to Chennai Port and Ennor Port from various place in CBIC area is important because that those ports are important gates for logistics of CBIC area. Port access roads from arterial roads such as NH5, NH205, NH4, NH45, Inner Ring Road, and Outer Ring Road are under construction. Chapter 6.5.6.1 mentioned about function and development status of those port access roads.

a-2.Reduction of Parking Cargo Vehicle by Port Cargo Handling System Improvement

Parking of cargo vehicle for delivering port cargo on port access road is parmanent and this cause traffic congestion on the port access road. Expantion of container terminal and port cargo handling system improvement are important issue to reduce parking cargo vehicle.

Source: JICA Study Team

Figure 6.3.3 Traffic Congestion on TPP Road due to Parking of Waiting Cargo Vehicle

a-3.Development of Elevated Freight Highway

Development of full time freight highway connecting to port is important to shorten delivery time. Early development of Chennai Port to Maduravoyal elevated freight highway is essential to operate freight vehicle in day time. Chapter 6.5.6.1 mentioned about function and development status of Chennai Port to Maduravoyal elevated freight highway.

a-4.Segregation of Through Traffic by Urban Ring Road and Bypass

There are some kinds of bottlenecks on road network to be an obstacle of reliability of transit time. Segregation between intercity traffic and intra urban traffic is major issue on both intercity roads and intraurban roads. Urban ring road and urban bypass are effective infrastructural measures to segregate above traffics. Therefore, timely development of urban ring road is essential to formulate efficient urban arterial road network. For example, traffic congestion permanently occurs on sections which are outside of outer ring road on major radial road of NH4 and NH7 at Bengaluru Metropolitan Area. And, network development is essential to mitigate traffic congestion. On the other hand, ring road development might have difficulty on land acquisition, in case urbanization expands expecting ring road position.

Table 6.3.5 is shown comparison of development ratio and year of urban ring road amongst major metropolitan area in east and south-east asia. Each ring road has introduced stage construction on the development, and most critical issue is land acquisition and subsequent revision of structural type. This is generally causes high increment of project cost and delay of development schedule, such as southern part of Bangkok Outer Ring Road.

Therefore, prompt ring road development in Metropolitan Area should be considered.

Table 6.3.5 Comparison of Development Ratio of Urban Ring Road

	Beijing	Soul	Bangkok	Jakarta	Chennai	Bengaluru
Plan (km)	433	168	165	120	279	363
Completion (km)	433	168	165	108	84	94

	Beijing	Soul	Bangkok	Jakarta	Chennai	Bengaluru
Completion Year	2009	2007	2012	-	-	-
Development Ratio (%)	100	100	100	90	30	26

Source: JICA Study Team

Source: JICA Study Team, based on MLIT Japan report

Figure 6.3.4 Comparison of Urban Ring Road Development

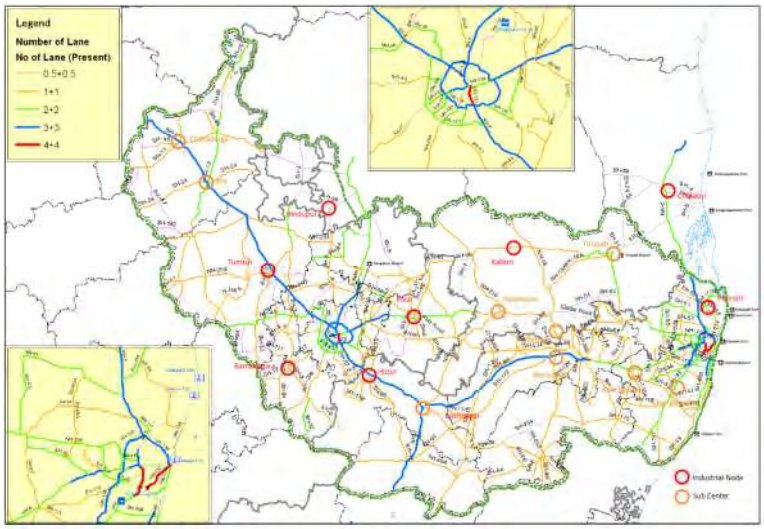
a-5.Reinforcement and Reconstruction of Damaged Bridge (b-6)

There exist many 20 to 30 years aged PC-bridge and RC-bridge on national highway of India. Deterioration of those bridge is serious concern in terms of load bering for heavy vehicle. Bridge maintenance by private operator adopt symptomatic treatment system generally and bridge maintenance by public operator also adopts symptomatic treatment system. It is desirable to ensure load bering of bridges on CBIC logistic road netowrk and reduction of life cycle cost that preventive treatment measure with appropriate inspection and evaluation should be introduced.

a-6.Widening for Large Scale Container Trailer (b-5)

There are many narrow road sections (one lane per direction) on road network connecting Industrial Node, Sub Centre, and logistical node and facilities, and road structure of those road sections are not suitable to accommodate heavy freight traffic such as international grade container trailer smoothly.

To develop high capacity road infrastructure for smooth logistic traffic, the logistic road network should be planned with a clear hierarchy, making use of the existing network and facilities to meet future demand effectively and economically.



Source: JICA Study Team

Figure 6.3.5: Number of Lanes of Connecting Road for Industrial Nodes and Sub Centres

b-1. Development of Expressway

Development of Bengaluru – Chennai Expressway is planned in NHDP and Bengaluru – Chennai Expressway is important road link to formulate important primary road network of CBIC logistic road network with NH4, NH7, NH46, and NH5. There are two existing corridors between Chennai and Bengarulu. One is north corridor consisted with NH4 and another is south corridor consisted with NH7, NH46, and NH4. Timely development of Bengarulu – Chennai Expressway is important issue to play important role as third corridor between Chennai and Bengarulu with mass and high-speed logistic service.

b-2.Road Development based on Functional Classification of Logistic Road Network

Logistic road network should be classified into functional classification based on connectivity of road link and standard geometry by functional classification should be provided properly to ensure traffic and access functions of logistic road network. Functions of logistic road network are classified into Primary road, Secondary road, Tertiary road, and Urban Primary road and relation between functional classification and connectivity is shown in Table 6.3.6.

Table 6.3.6 Road Network Functions and Connectivity

<table>
<tr><th colspan="7">Function</th></tr>
<tr><td colspan="2">International Logistic Network</td><td>International Gate Connection</td><td colspan="4">Regional Logistic Network</td></tr>
<tr><td rowspan="2">Arterial National Highway (GQ/NSEW)</td><td rowspan="2">Expressway</td><td rowspan="2">Chennai, Bengaluru - Ports, Air Port</td><td colspan="2">National Highway / State Highway</td><td rowspan="2">Urban Ring Road, Urban Bypass</td><td>District Road / Other Road</td></tr>
<tr><td>a. Inter-Metropolitan, Urban Core, Sub Center, District Center</td><td>b. ①-a、④-Port, Air Port</td><td>a. Inter-Metropolitan, Urban Core, Sub Center, District Center</td></tr>
<tr><td>①</td><td>②</td><td>③</td><td>④</td><td>⑤</td><td>⑥</td><td>⑦</td></tr>
<tr><td colspan="3">Primary</td><td colspan="2">Secondary</td><td>Urban Primary</td><td>Tertiary</td></tr>
</table>

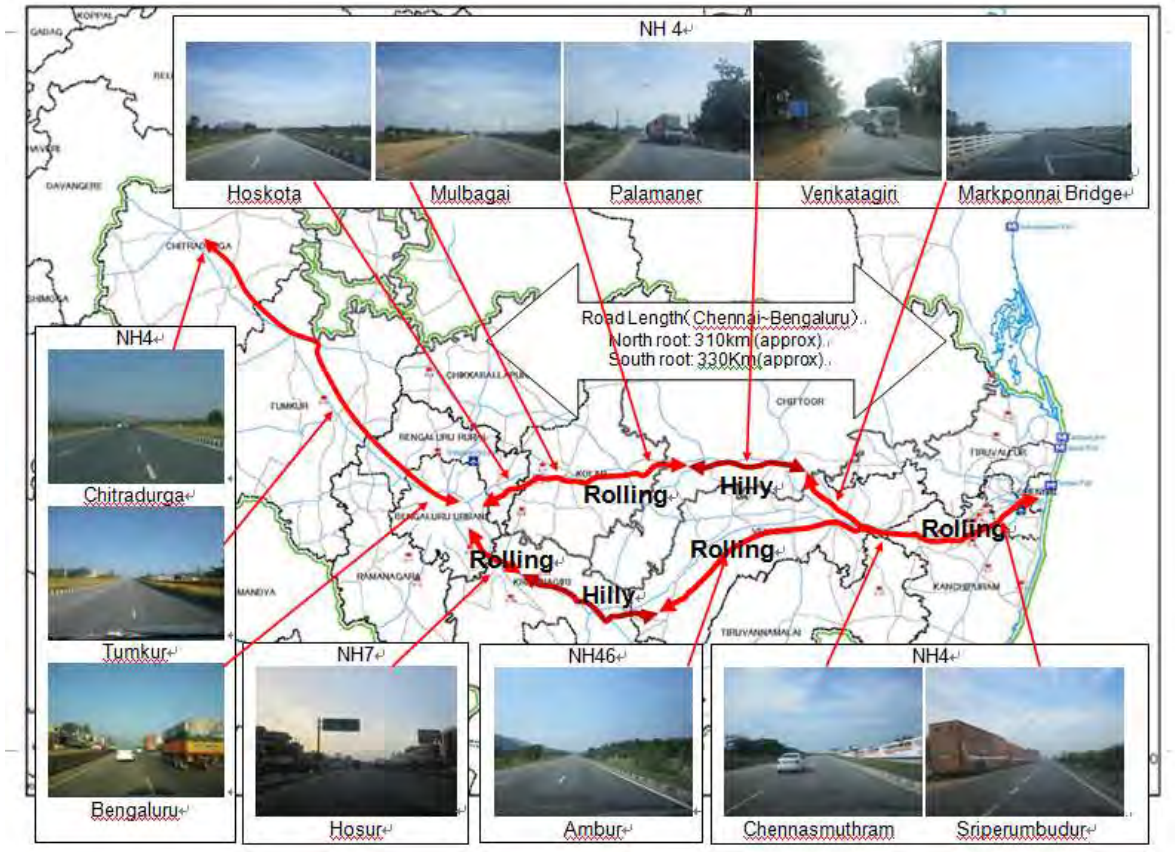
Source: JICA Study Team

b-3.Development of Access Roads between Arterial Roads and Logistic Facilities based on Benefit Principle

As for development of tertiary roads which is access road to CFS, ICD, and industrial park, public sector should implement timely and appropriate operation and maintenance for public roads and private sector roads should basically be maintained by beneficiary liability.

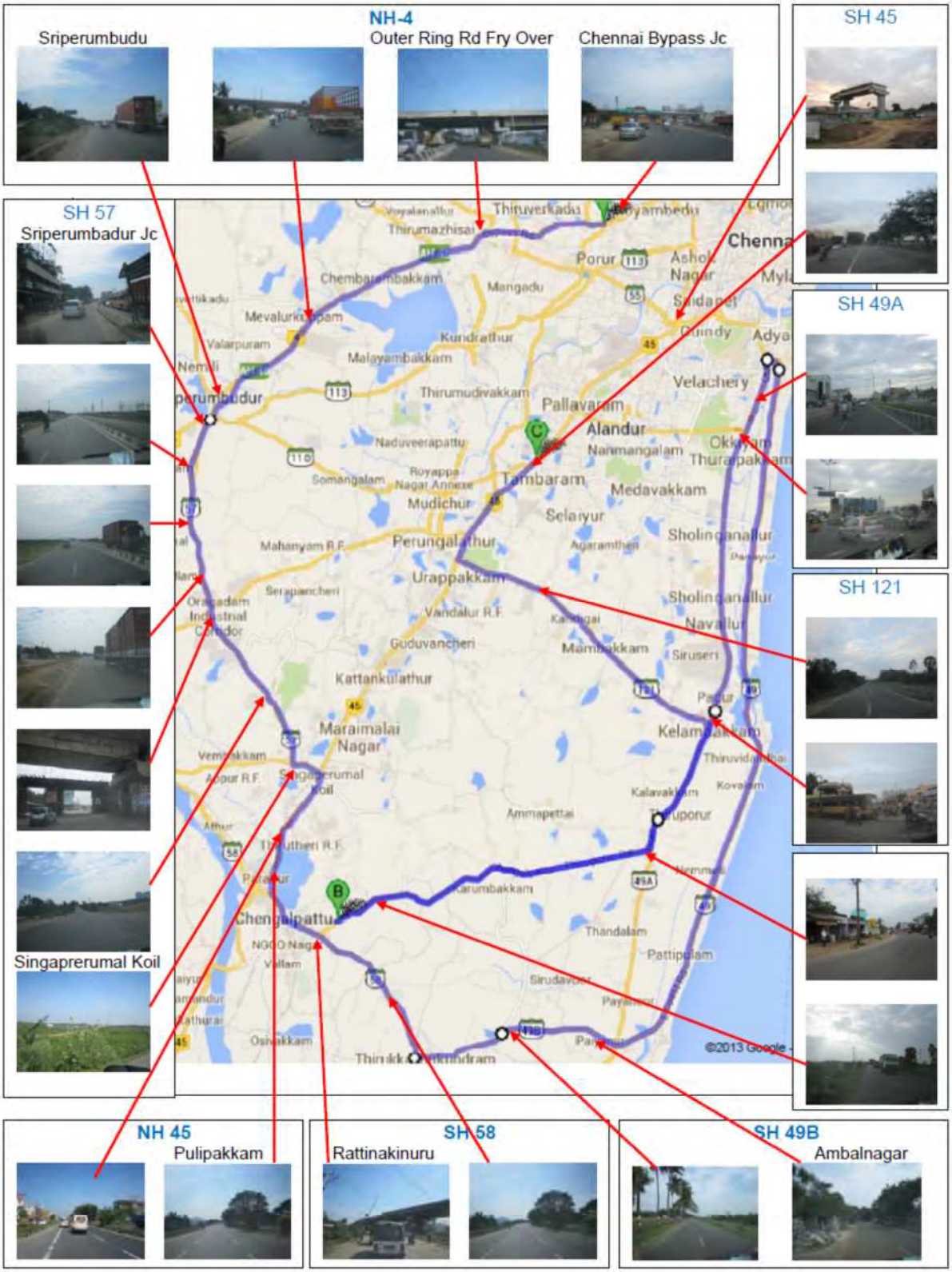
b-4.Improvement of Pavement Maintenance System

Pavement condition on some parts of arterial roads in CBIC area were investigated by Study Team as shown in Figure 5.1.6 and 5.1.7 and the pavement condition of those roads are generally fair. However, maintenance of pavement has been carried out by symptomatic treatment system for private and public operated roads. Introduction of preventive treatment system for reduction of life cycle cost of pavement should be encouraged to alleviate the financial burden of governments.



Source: JICA Study Team

Figure 6.3.6 Road Conditions in Chennai – Bengaluru Area



Source: JICA Study Team

Figure 6.3.7:Road Conditions in Chennai Metropolitan Area

6.3.2 *Demand Forecast*

6.3.2.1 General

Accurate traffic demand forecast is a major issue on road traffic planning and there is no specific method to check the accuracy. However, traffic forecast is closely related to socio-economic development of the study area. And, the Indian Roads Congress has suggested Econometric Method to consider economic growth of concerned area for traffic forecasting. Therefore, predicted future growth of socio-economic parameter of concerned districts in Andhra Pradesh, Karnataka, and Tamil Nadu in foregoing chapter was examined and growth of Gross District Domestic Project (GDDP) adopts to the traffic forecast. And, JICA study team applied Link-wise simple traffic demand forecast method with using GDDP instead of traditional four-step transportation model method due to limited study resources in this study.

6.3.2.2 Methodology

Econometric method suggested widely in India relates traffic with GDP. The suggested model can beexpressed by the following equation.

Tg = e x Eg

Where Tg = Traffic Growth Rate

e = Elasticity of Traffic Demand

Eg = Economic Growth Rate

Growth rate of the GDDP at district level indicated in foregoing section has been considered for assessing the traffic growth rates of all vehicles.

In the link-wise traffic demand forecast, segmentation of zones along the link relates to accuracy of the forecast. Thus it is essential to assess theeconomic growth rates at the district level for assessing the traffic growth rates on a link.

The elasticity values suggested by earlier studies of the study area and neighbour area in India has been examined and adopted elasticity values by vehicle type are presented in Table 6.3.7.

Table 6.3.7: Elasticity of Traffic Demand

Vehicle Type	2014-2019	2019-2029	2029-2039
MC	1.25	1.00	0.88
Buses	0.90	0.80	0.70
Cars	1.00	0.80	0.70
Trucks	1.40	1.20	1.00
LCVs	1.50	1.30	1.10

Source: JICA study team, based on Time Series Data on Road Transport Passenger and Freight Movement – 1951-91 IRC:SP:45

Traffic growth rate by district by vehicle type for Business As Usual (hereinafter referred to as BAU) and Business in Induced Scenario (hereinafter referred to as BIS) has been determined as shown in Table 6.3.8.

Vehicle Capacity Ratio is assessed on road links and following link capacity (DSV – LOS-B) of 1, 2, and 4 (Dual-2 - 2x2), 6 (Dual-3 - 2x3), and 8 (Dual-4 - 2x4) lanes road facilities are considered for assessing the traffic on a link/section:

T1 – 1,800 PCUs

T2 – 17,500 PCUs

T4 – 45,000 PCUs

T6 – 60,000 PCUs

T8 – 85,000 PCUs

Table 6.3.8: District-wise Traffic Growth by Vehicle Type (Year-on-Year2013, BAU, BIS)

District		2013/2018							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	Auto Rickshaw
Chennai	BAU	1.15	1.04	1.04	1.73	1.61	1.61	1.44	1.44
	BIS	1.71	1.54	1.54	2.56	2.39	2.39	2.13	2.13
Tiruvallur	BAU	1.15	1.04	1.04	1.73	1.61	1.61	1.44	1.44
	BIS	1.71	1.54	1.54	2.56	2.39	2.39	2.13	2.13
Kancheepuram	BAU	1.15	1.04	1.04	1.73	1.61	1.61	1.44	1.44
	BIS	1.71	1.54	1.54	2.56	2.39	2.39	2.13	2.13
Tiruvannamalai	BAU	1.59	1.43	1.43	2.38	2.22	2.22	1.98	1.98
	BIS	1.84	1.66	1.66	2.76	2.58	2.58	2.30	2.30
Vellore	BAU	1.70	1.53	1.53	2.55	2.38	2.38	2.12	2.12
	BIS	1.93	1.73	1.73	2.89	2.70	2.70	2.41	2.41
Dharmapuri	BAU	1.17	1.06	1.06	1.76	1.64	1.64	1.47	1.47
	BIS	1.68	1.51	1.51	2.51	2.35	2.35	2.09	2.09
Krishnagiri	BAU	1.17	1.06	1.06	1.76	1.64	1.64	1.47	1.47
	BIS	1.68	1.51	1.51	2.51	2.35	2.35	2.09	2.09
Bangalore urban	BAU	1.65	1.48	1.48	2.47	2.31	2.31	2.06	2.06
	BIS	1.76	1.59	1.59	2.64	2.47	2.47	2.20	2.20
Bangalore rural	BAU	1.77	1.59	1.59	2.65	2.47	2.47	2.21	2.21
	BIS	2.10	1.89	1.89	3.15	2.94	2.94	2.63	2.63
Ramnagara	BAU	1.77	1.59	1.59	2.65	2.47	2.47	2.21	2.21
	BIS	2.10	1.89	1.89	3.15	2.94	2.94	2.63	2.63
Kolar	BAU	1.47	1.32	1.32	2.20	2.06	2.06	1.84	1.84
	BIS	1.47	1.32	1.32	2.20	2.06	2.06	1.84	1.84
Chikkaballapura	BAU	1.47	1.32	1.32	2.20	2.06	2.06	1.84	1.84
	BIS	1.47	1.32	1.32	2.20	2.06	2.06	1.84	1.84
Tumkur	BAU	1.61	1.45	1.45	2.42	2.25	2.25	2.01	2.01
	BIS	1.84	1.66	1.66	2.76	2.58	2.58	2.30	2.30
Chitradurga	BAU	1.45	1.31	1.31	2.18	2.03	2.03	1.82	1.82
	BIS	1.61	1.45	1.45	2.42	2.25	2.25	2.01	2.01
Chittoor	BAU	1.12	1.00	1.00	1.67	1.56	1.56	1.40	1.40
	BIS	1.48	1.33	1.33	2.22	2.08	2.08	1.85	1.85
Anantapur	BAU	1.12	1.00	1.00	1.67	1.56	1.56	1.40	1.40
	BIS	1.48	1.33	1.33	2.22	2.08	2.08	1.85	1.85
Nellore	BAU	1.44	1.29	1.29	2.15	2.01	2.01	1.79	1.79
	BIS	1.69	1.52	1.52	2.53	2.36	2.36	2.11	2.11
District		2013/2023							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	AutoRickshaw
Chennai	BAU	1.19	1.07	1.07	2.27	2.04	2.04	1.66	1.66
	BIS	2.61	2.35	2.35	4.98	4.47	4.47	3.64	3.64

District		2013/2018							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	Auto Rickshaw
Tiruvallur	BAU	1.19	1.07	1.07	2.27	2.04	2.04	1.66	1.66
	BIS	2.61	2.35	2.35	4.98	4.47	4.47	3.64	3.64
Kancheepuram	BAU	1.19	1.07	1.07	2.27	2.04	2.04	1.66	1.66
	BIS	2.61	2.35	2.35	4.98	4.47	4.47	3.64	3.64
Tiruvannamalai	BAU	2.25	2.03	2.03	4.30	3.86	3.86	3.15	3.15
	BIS	3.04	2.73	2.73	5.81	5.21	5.21	4.24	4.24
Vellore	BAU	2.58	2.32	2.32	4.94	4.43	4.43	3.61	3.61
	BIS	3.32	2.98	2.98	6.34	5.69	5.69	4.63	4.63
Dharmapuri	BAU	1.23	1.11	1.11	2.35	2.11	2.11	1.72	1.72
	BIS	2.51	2.26	2.26	4.80	4.31	4.31	3.51	3.51
Krishnagiri	BAU	1.23	1.11	1.11	2.35	2.11	2.11	1.72	1.72
	BIS	2.51	2.26	2.26	4.80	4.31	4.31	3.51	3.51
Bangalore urban	BAU	2.43	2.18	2.18	4.64	4.16	4.16	3.39	3.39
	BIS	2.78	2.50	2.50	5.31	4.76	4.76	3.88	3.88
Bangalore rural	BAU	2.79	2.51	2.51	5.34	4.78	4.78	3.90	3.90
	BIS	3.95	3.55	3.55	7.54	6.77	6.77	5.51	5.51
Ramnagara	BAU	2.79	2.51	2.51	5.34	4.78	4.78	3.90	3.90
	BIS	3.95	3.55	3.55	7.54	6.77	6.77	5.51	5.51
Kolar	BAU	1.93	1.74	1.74	3.69	3.31	3.31	2.70	2.70
	BIS	1.93	1.74	1.74	3.69	3.31	3.31	2.70	2.70
Chikkaballapura	BAU	1.93	1.74	1.74	3.69	3.31	3.31	2.70	2.70
	BIS	1.93	1.74	1.74	3.69	3.31	3.31	2.70	2.70
Tumkur	BAU	2.32	2.09	2.09	4.44	3.98	3.98	3.24	3.24
	BIS	3.04	2.73	2.73	5.81	5.21	5.21	4.24	4.24
Chitradurga	BAU	1.89	1.70	1.70	3.61	3.24	3.24	2.64	2.64
	BIS	2.32	2.09	2.09	4.44	3.98	3.98	3.24	3.24
Chittoor	BAU	1.12	1.00	1.00	2.13	1.91	1.91	1.56	1.56
	BIS	1.97	1.77	1.77	3.76	3.37	3.37	2.75	2.75
Anantapur	BAU	1.12	1.00	1.00	2.13	1.91	1.91	1.56	1.56
	BIS	1.97	1.77	1.77	3.76	3.37	3.37	2.75	2.75
Nellore	BAU	1.89	1.70	1.70	3.61	3.23	3.23	2.64	2.64
	BIS	2.54	2.29	2.29	4.86	4.35	4.35	3.55	3.55
District		2013/2028							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	AutoRickshaw
Chennai	BAU	1.22	1.10	1.10	2.98	2.57	2.57	1.91	1.91
	BIS	3.98	3.58	3.58	9.70	8.36	8.36	6.22	6.22
Tiruvallur	BAU	1.22	1.10	1.10	2.98	2.57	2.57	1.91	1.91
	BIS	3.98	3.58	3.58	9.70	8.36	8.36	6.22	6.22
Kancheepuram	BAU	1.22	1.10	1.10	2.98	2.57	2.57	1.91	1.91
	BIS	3.98	3.58	3.58	9.70	8.36	8.36	6.22	6.22
Tiruvannamalai	BAU	3.19	2.88	2.88	7.79	6.71	6.71	4.99	4.99
	BIS	5.00	4.50	4.50	12.20	10.51	10.51	7.82	7.82

District		2013/2018							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	Auto Rickshaw
Vellore	BAU	3.92	3.53	3.53	9.56	8.24	8.24	6.13	6.13
	BIS	5.71	5.14	5.14	13.92	11.99	11.99	8.92	8.92
Dharmapuri	BAU	1.29	1.16	1.16	3.15	2.71	2.71	2.02	2.02
	BIS	3.77	3.39	3.39	9.18	7.91	7.91	5.88	5.88
Krishnagiri	BAU	1.29	1.16	1.16	3.15	2.71	2.71	2.02	2.02
	BIS	3.77	3.39	3.39	9.18	7.91	7.91	5.88	5.88
Bangalore urban	BAU	3.58	3.22	3.22	8.72	7.51	7.51	5.59	5.59
	BIS	4.38	3.94	3.94	10.67	9.20	9.20	6.84	6.84
Bangalore rural	BAU	4.41	3.97	3.97	10.75	9.26	9.26	6.89	6.89
	BIS	7.41	6.67	6.67	18.07	15.57	15.57	11.58	11.58
Ramnagara	BAU	4.41	3.97	3.97	10.75	9.26	9.26	6.89	6.89
	BIS	7.41	6.67	6.67	18.07	15.57	15.57	11.58	11.58
Kolar	BAU	2.54	2.28	2.28	6.19	5.33	5.33	3.97	3.97
	BIS	2.54	2.28	2.28	6.19	5.33	5.33	3.97	3.97
Chikkaballapura	BAU	2.54	2.28	2.28	6.19	5.33	5.33	3.97	3.97
	BIS	2.54	2.28	2.28	6.19	5.33	5.33	3.97	3.97
Tumkur	BAU	3.34	3.01	3.01	8.15	7.02	7.02	5.22	5.22
	BIS	5.00	4.50	4.50	12.20	10.51	10.51	7.82	7.82
Chitradurga	BAU	2.45	2.21	2.21	5.98	5.15	5.15	3.84	3.84
	BIS	3.34	3.01	3.01	8.15	7.02	7.02	5.22	5.22
Chittoor	BAU	1.11	1.00	1.00	2.71	2.34	2.34	1.74	1.74
	BIS	2.61	2.34	2.34	6.35	5.47	5.47	4.07	4.07
Anantapur	BAU	1.11	1.00	1.00	2.71	2.34	2.34	1.74	1.74
	BIS	2.61	2.34	2.34	6.35	5.47	5.47	4.07	4.07
Nellore	BAU	2.51	2.26	2.26	6.12	5.27	5.27	3.92	3.92
	BIS	3.83	3.44	3.44	9.33	8.04	8.04	5.98	5.98
District		2013/2033							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	AutoRickshaw
Chennai	BAU	0.99	0.89	0.89	3.78	2.96	2.96	1.93	1.93
	BIS	4.76	4.28	4.28	18.22	14.27	14.27	9.29	9.29
Tiruvallur	BAU	0.99	0.89	0.89	3.78	2.96	2.96	1.93	1.93
	BIS	4.76	4.28	4.28	18.22	14.27	14.27	9.29	9.29
Kancheepuram	BAU	0.99	0.89	0.89	3.78	2.96	2.96	1.93	1.93
	BIS	4.76	4.28	4.28	18.22	14.27	14.27	9.29	9.29
Tiruvannamalai	BAU	3.55	3.19	3.19	13.59	10.64	10.64	6.93	6.93
	BIS	6.45	5.81	5.81	24.72	19.36	19.36	12.60	12.60
Vellore	BAU	4.66	4.20	4.20	17.86	13.99	13.99	9.11	9.11
	BIS	7.70	6.93	6.93	29.48	23.09	23.09	15.03	15.03
Dharmapuri	BAU	1.06	0.95	0.95	4.06	3.18	3.18	2.07	2.07
	BIS	4.42	3.98	3.98	16.92	13.25	13.25	8.63	8.63
Krishnagiri	BAU	1.06	0.95	0.95	4.06	3.18	3.18	2.07	2.07
	BIS	4.42	3.98	3.98	16.92	13.25	13.25	8.63	8.63

District		2013/2018							
		Car & Jeep / Vans & Tempos	Mini Bus	Bus	LCV	Trucks & 2 Axle Rigid & 3 Axle Rigid	MAV	M/Cycles	Auto Rickshaw
Bangalore urban	BAU	4.13	3.71	3.71	15.80	12.38	12.38	8.06	8.06
	BIS	5.40	4.86	4.86	20.69	16.21	16.21	10.55	10.55
Bangalore rural	BAU	5.45	4.91	4.91	20.88	16.35	16.35	10.65	10.65
	BIS	10.90	9.81	9.81	41.74	32.69	32.69	21.29	21.29
Ramnagara	BAU	5.45	4.91	4.91	20.88	16.35	16.35	10.65	10.65
	BIS	10.90	9.81	9.81	41.74	32.69	32.69	21.29	21.29
Kolar	BAU	2.61	2.35	2.35	10.00	7.83	7.83	5.10	5.10
	BIS	2.61	2.35	2.35	10.00	7.83	7.83	5.10	5.10
Chikkaballapura	BAU	2.61	2.35	2.35	10.00	7.83	7.83	5.10	5.10
	BIS	2.61	2.35	2.35	10.00	7.83	7.83	5.10	5.10
Tumkur	BAU	3.77	3.39	3.39	14.43	11.30	11.30	7.36	7.36
	BIS	6.45	5.81	5.81	24.72	19.36	19.36	12.60	12.60
Chitradurga	BAU	2.50	2.25	2.25	9.56	7.49	7.49	4.88	4.88
	BIS	3.77	3.39	3.39	14.43	11.30	11.30	7.36	7.36
Chittoor	BAU	0.87	0.78	0.78	3.33	2.61	2.61	1.70	1.70
	BIS	2.70	2.43	2.43	10.36	8.11	8.11	5.28	5.28
Anantapur	BAU	0.87	0.78	0.78	3.33	2.61	2.61	1.70	1.70
	BIS	2.70	2.43	2.43	10.36	8.11	8.11	5.28	5.28
Nellore	BAU	2.62	2.35	2.35	10.02	7.85	7.85	5.11	5.11
	BIS	4.51	4.06	4.06	17.29	13.54	13.54	8.82	8.82

Source: JICA Study Team

6.3.3 *Demand-Supply Gaps*

6.3.3.1 Present Case

Vehicle congestion ratio in present case is calculated based on collected road inventory data and traffic data. Distribution of vehicle congestion ratio of national highway and state highway in each state are shown in Almost 90% of roads are lower than vehicle congestion ratio of 1.0 in Tamil Nadu State and Andhra Pradesh State, and it is about 80% in Karnataka. Major reason of the lower value in Karnataka is lower capacity of some small roads (0.5 lane per direction) against actual operational capacity for calculation purpose.

Table 6.3.9 and Table 6.3.10, respectively. Almost 90% of roads are lower than vehicle congestion ratio of 1.0 in Tamil Nadu State and Andhra Pradesh State, and it is about 80% in Karnataka. Major reason of the lower value in Karnataka is lower capacity of some small roads (0.5 lane per direction) against actual operational capacity for calculation purpose.

Table 6.3.9: Distribution of Present Vehicle Congestion Ratio of National Highways

V/C	Share of Congestion Ratio by State (%)		
	Tamil Nadu	Karnataka	Andhra Pradesh
> 1.5	0	9	0
1.0 - 1.5	13	14	0
0.5 – 1.0	29	20	35
0.0 – 0.5	58	57	65
Total	100	100	100

Source: JICA Study Team

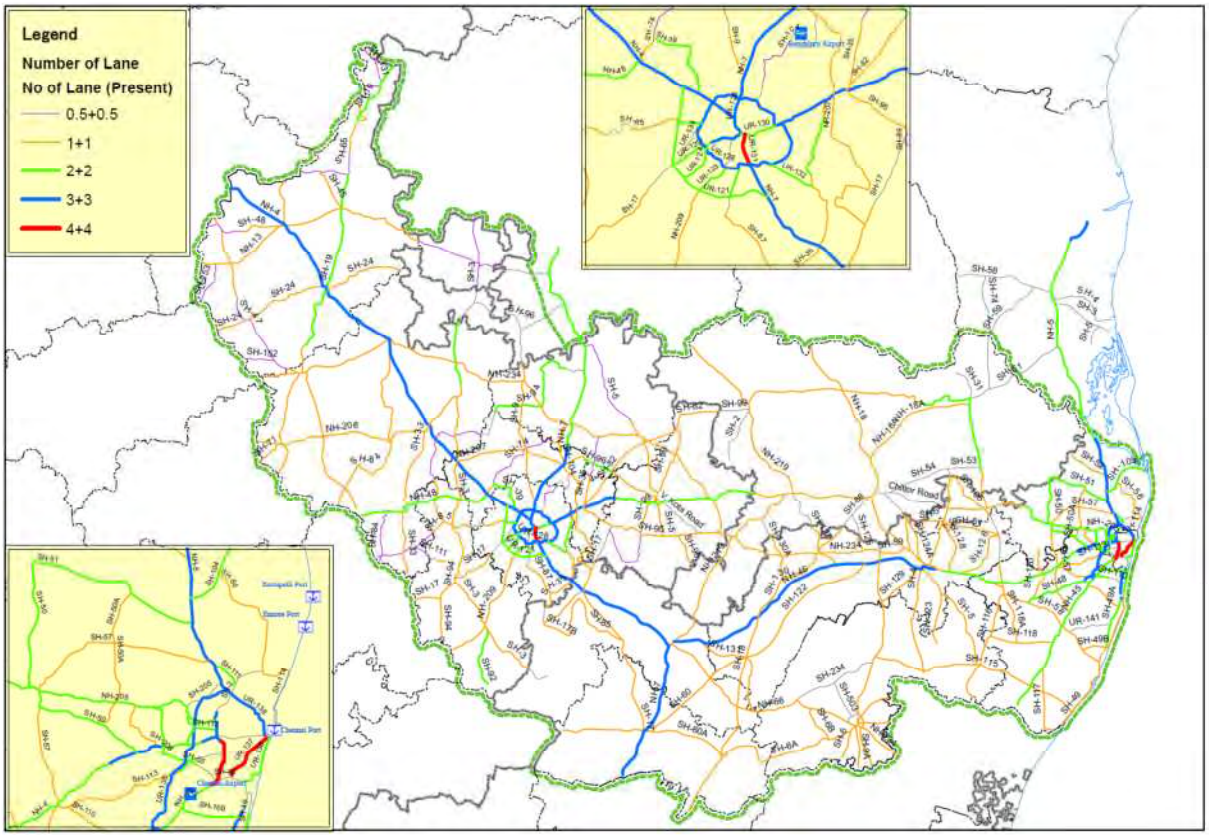
Table 6.3.10: Distribution of Present Vehicle Congestion Ratio of State Highways

V/C	Share of Congestion Ratio by State (%)		
	Tamil Nadu	Karnataka	Andhra Pradesh
> 1.5	2	17	Under Investigation
1.0 - 1.5	4	6	Under Investigation
0.5 – 1.0	22	13	Under Investigation
0.0 – 0.5	71	64	Under Investigation
Total	100	100	

Source: JICA Study Team

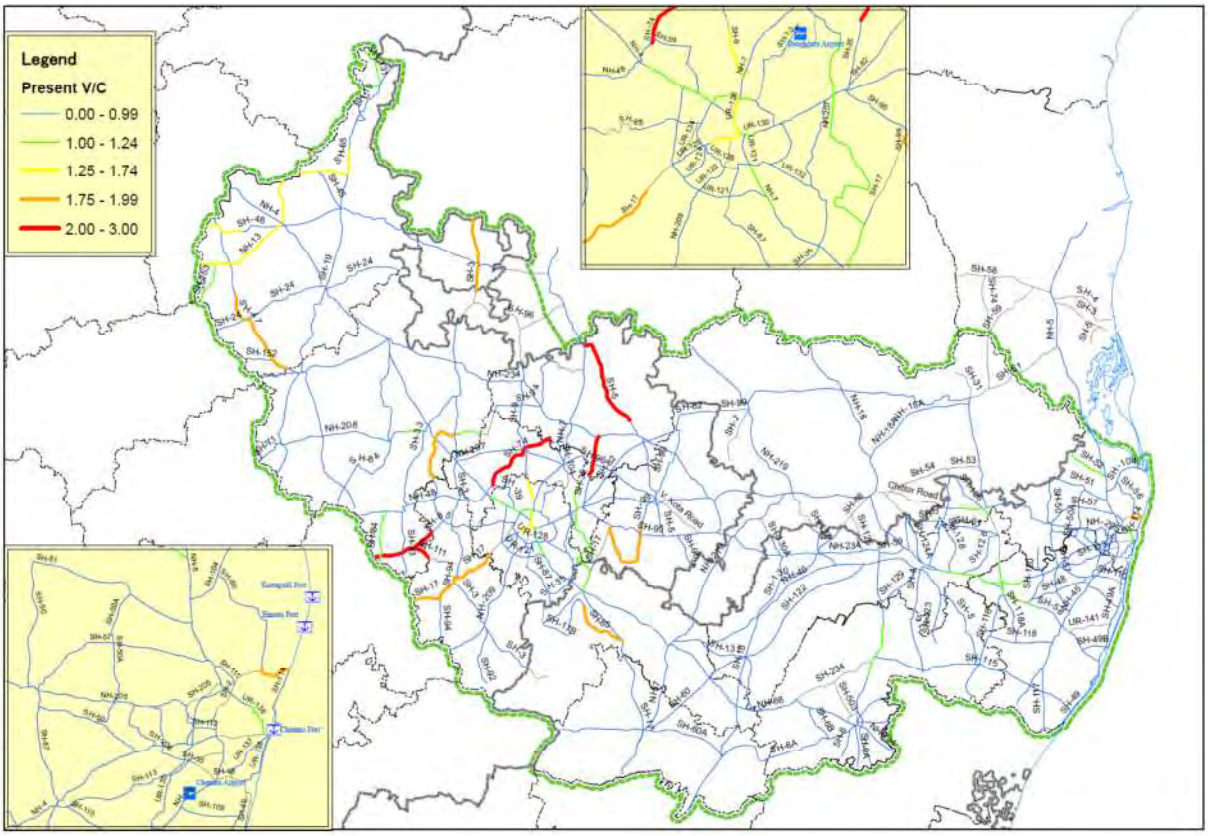
According to vehicle congestion ratio shown inFigure 6.3.9, vehicle congestion ratio is generally proportional with scale of urbanization. High congestion ratio (V/C>1.0) is found at Bengaluru section on NH4, NH7, NH207, at Chennai section on NH4, and at Chitradurga section on NH13. Very high congestion ratio (V/C>1.75) are found in Karnataka state and most of those sections are some small roads (0.5 lane per direction) against actual operational capacity.

Vehicle number in above urbanization area has rapidly increased, while road network development to segregate intercity and intra urban traffic by urban ring road and urban bypass has not adequately developed.



Source: JICA Study Team

Figure 6.3.8: Number of Lanes in CBIC Area (Present)



Source: JICA Study Team

Figure 6.3.9: Volume Capacity Ratio in CBIC Area (Present)

6.3.3.2 Future Case

Vehicle congestion ratio in 2018, 2023, 2028, and 2033 without road development is calculated based on present road condition and future traffic volume forecasted based on the methodology mentioned in 6.3.2.2to see demand supply gap in BAU and BIS cases.

6.3.3.2.1 BAU Case

As a result the calculation of BAU case, share of over 1.0 vehicle congestion ratio of national highway network reach almost 50% in year 2018 in Karnataka state. Meanwhile, the share in Tamil Nadu state reach almost 50% in year 2023 and the share in Andhra Pradesh state do not reach 50% even in year 2033. The share rapidly grows in Karnataka state and the share exceeds 90% in year 2033 as shown in Table 6.3.11 to Table 6.3.13. The share of state highway network in Tamil Nadu state and Karnataka state consecutively increase with the national highway network. The share in Tamil Nadu state and Karnataka state reach almost 50% in year 2028 and year 2023, respectively as shown in Table 6.3.14to Table 6.3.15. State highway congestion ratio in Andhra Pradesh is not shown because traffic data has not identified for Andhra Pradesh.

Table 6.3.11: Distribution of Vehicle Congestion Ratio of National Highways in Tamil Nadu (BAU)

V/C	Share of Congestion Ratio of Tamil Nadu State (%)			
	2018	2023	2028	2033
> 1.5	7	17	48	48
1.0 - 1.5	16	30	17	25
0.5 – 1.0	64	44	27	19
0.0 – 0.5	13	9	8	8
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.12: Distribution of Vehicle Congestion Ratio of National Highways in Karnataka (BAU)

V/C	Share of Congestion Ratio of Karnataka State (%)			
	2018	2023	2028	2033
> 1.5	30	49	71	84
1.0 - 1.5	13	22	12	11
0.5 – 1.0	34	24	16	5
0.0 – 0.5	23	5	0	0
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.13: Distribution of Vehicle Congestion Ratio of National Highways in Andhra Pradesh (BAU)

V/C	Share of Congestion Ratio of Andhra Pradesh State (%)			
	2018	2023	2028	2033
> 1.5	0	0	0	0
1.0 - 1.5	0	0	20	20
0.5 – 1.0	57	57	37	37
0.0 – 0.5	43	43	43	43
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.14: Distribution of Vehicle Congestion Ratio of State Highways in Tamil Nadu (BAU)

V/C	Share of Congestion Ratio of Tamil Nadu State (%)			
	2018	2023	2028	2033
> 1.5	5	8	19	35
1.0 - 1.5	7	15	30	21

V/C	Share of Congestion Ratio of Tamil Nadu State (%)			
0.5 – 1.0	30	38	31	23
0.0 – 0.5	59	39	20	21
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.15: Distribution of Vehicle Congestion Ratio of State Highways in Karnataka (BAU)

V/C	Share of Congestion Ratio of Karnataka State (%)			
	2018	2023	2028	2033
> 1.5	22	38	49	56
1.0 - 1.5	12	10	8	20
0.5 – 1.0	18	25	26	16
0.0 – 0.5	48	28	16	7
Total	100	100	100	100

Source: JICA Study Team

Although accuracy of the traffic demand forecast method applied in this study is lower than traditional four-stage transportation model method, it is obvious that prompt supply of road capacity in efficient manner is essential for sustainable industrial development in CBIC area as well as for comprehensive regional development.

According to transitional vehicle congestion ratio shown in Figure 6.3.10, vehicle congestion is spread from Urban Core of Chennai and Bengaluru and Chitradurga. Transition of vehicle congestion direction in Bengaluru area starts from westbound, south-east bound, and eastbound. Meanwhile, transition of vehicle congestion direction in Chennai area starts from westbound and southbound. Above vehicle congestion directions shows about economical connectivity amongst major city, centre, and node in and around CBIC area. Above direction should be taken into account this master plan study.

6.3.3.2.2 BIS Case

As a result the calculation of BIS case, share of over 1.0 vehicle congestion ratio of national highway network reach almost 50% in year 2018 in Tamil Nadu state and Karnataka state. The share in Andhra Pradesh state reaches 50% in year 2023. The share rapidly grow in three states and the share exceeds 90% in year 2028 in Tamil Nadu state and Karnataka state, and in year 2033 in Andhra Pradesh state as shown in Table 6.3.16 to Table 6.3.18. Meanwhile, the share of state highway network in Tamil Nadu state and Karnataka state consecutively increase with the national highway network. The share in Tamil Nadu state and Karnataka state exceeds 50% in year 2023 as shown in Table 6.3.19 to Table 6.3.20. State highway congestion ratio in Andhra Pradesh is not shown because traffic data has not identified for Andhra Pradesh. However, direction of state highway congestion ratio in Andhra Pradesh is also similar with other two states.

Table 6.3.16: Distribution of Vehicle Congestion Ratio of National Highways in Tamil Nadu (BIS)

V/C	Share of Congestion Ratio of Tamil Nadu State (%)			
	2018	2023	2028	2033
> 1.5	18	64	88	94
1.0 - 1.5	30	23	7	5
0.5 – 1.0	39	7	5	1
0.0 – 0.5	12	6	1	0
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.17: Distribution of Vehicle Congestion Ratio of National Highways in Karnataka (BIS)

V/C	Share of Congestion Ratio of Karnataka State (%)			
	2018	2023	2028	2033
> 1.5	34	67	84	90

1.0 - 1.5	15	10	7	5
0.5 – 1.0	35	18	10	5
0.0 – 0.5	16	5	0	0
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.18: Distribution of Vehicle Congestion Ratio of National Highways in Andhra Pradesh (BIS)

V/C	Share of Congestion Ratio of Andhra Pradesh State (%)			
	2018	2023	2028	2033
> 1.5	0	20	57	66
1.0 - 1.5	20	37	9	34
0.5 – 1.0	37	38	34	0
0.0 – 0.5	43	4	0	0
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.19: Distribution of Vehicle Congestion Ratio of State Highways in Tamil Nadu (BIS)

V/C	Share of Congestion Ratio of Tamil Nadu State (%)			
	2018	2023	2028	2033
> 1.5	12	30	64	84
1.0 - 1.5	15	21	15	14
0.5 – 1.0	33	34	18	2
0.0 – 0.5	41	15	2	0
Total	100	100	100	100

Source: JICA Study Team

Table 6.3.20: Distribution of Vehicle Congestion Ratio of State Highways in Karnataka (BIS)

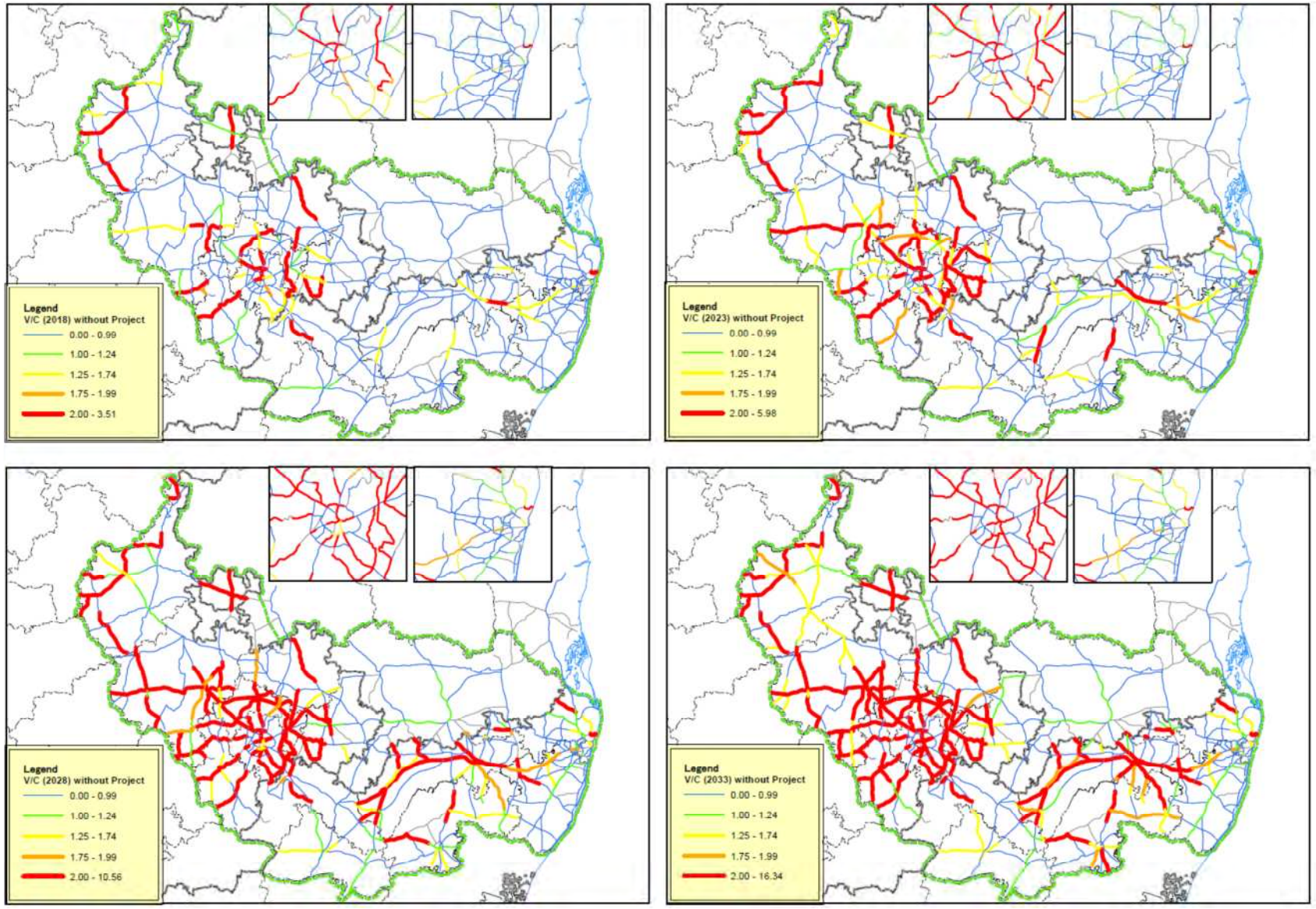
V/C	Share of Congestion Ratio of Karnataka State (%)			
	2018	2023	2028	2033
> 1.5	24	43	54	70
1.0 - 1.5	15	8	17	17
0.5 – 1.0	15	27	25	10
0.0 – 0.5	47	23	5	3
Total	100	100	100	100

Source: JICA Study Team

6.3.3.2.3 Application for Master Plan

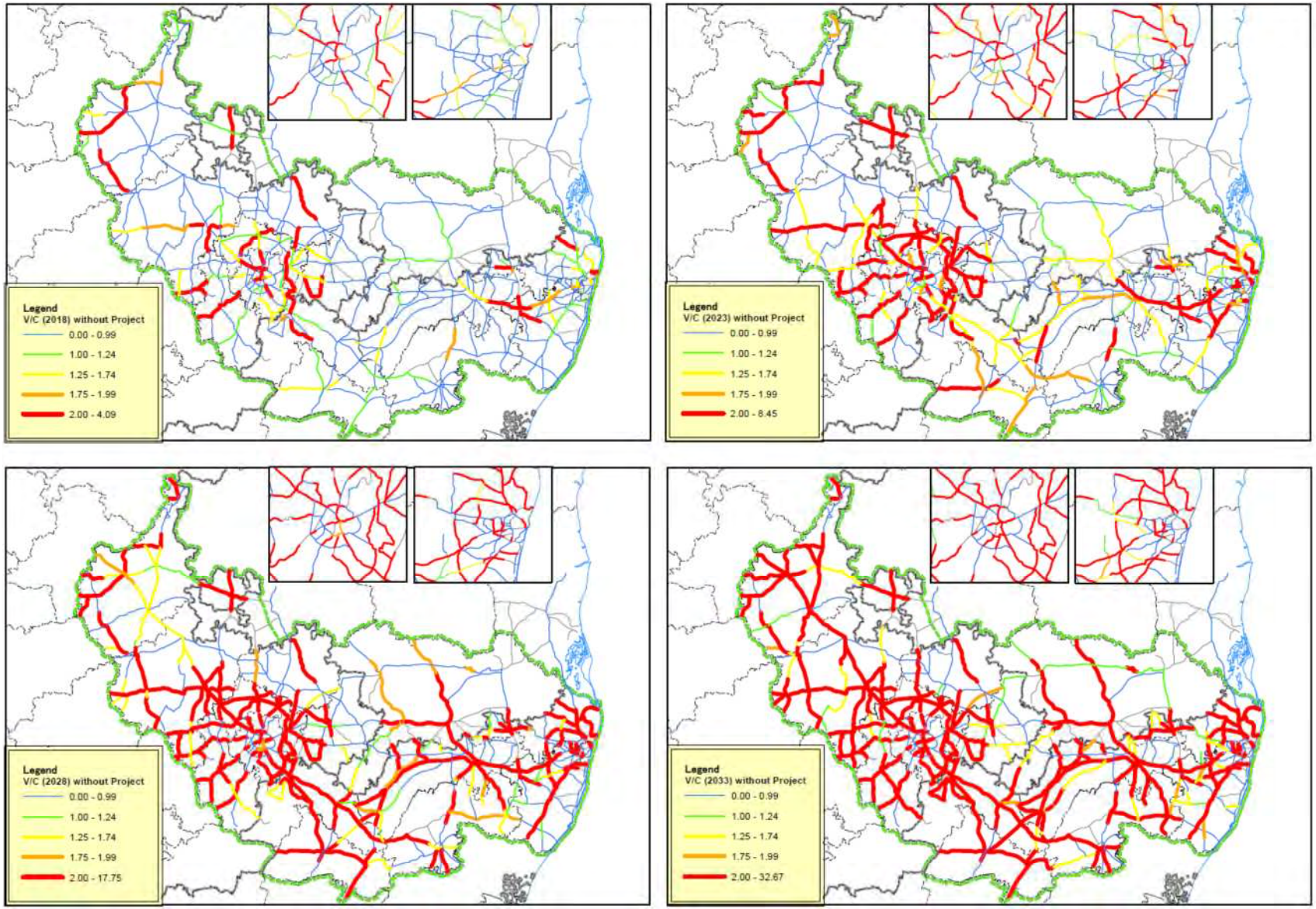
Application of economic growth rate for traffic demand forecast is examined with comparison of investment scale between BAU case and BIS case. As a result of the examination, about 900 km roads exceed 1.25 volume capacity ratio in year 2033 in BAU case. Meanwhile, about triple road length of the BAU exceed 1.25 volume capacity ratio in year 2033 in BIS case and this will require huge investment cost and unrealistic road widening such as 10 lanes to 20 lanes.

Considering above examination result and expected congestion mitigation by traffic dispersion in road network which is not able to simulate by applied link-wise simple traffic demand forecast method in this study, BAU base economic growth rate is applied for traffic demand forecast.



Source: JICA Study Team

Figure 6.3.10: Volume Capacity Ratio (BAU, 2018, 2023, 2028, 2033, without project)



Source: JICA Study Team

Figure 6.3.11: Volume Capacity Ratio (BIS, 2018, 2023, 2028, 2033, without project)

6.3.4 *Infrastructure Development Strategy*

6.3.4.1 Planning Principles

CBIC area consists of Tamil Nadu state, Karnataka State, and Andhra Pradesh state, and vehicle production, vehicle parts production, leather manufacture, and IT software production are major industries in those active industrial area. This area is also expected to contribute GDP expansion from 16% to 25% by manufacturing sector promotion by National Manufacturing Policy (NMP). Sustainable growth by development of new industrial node and attraction of investment is essential to achieve above target. Moreover, improvement of industrial connectivity and expansion of infrastructure for industrial activity are needed to induce promising industry contributing to gross capital formation in CBIC area.

To realize world standard industrial activity in CBIC area, efficient connection among industrial node, logistic node and facilities, arterial roads, and ports is important to contribute productivity of concerned private sector. Moreover, aspects of reliability of transit time, shortening of lead time, and reduction of goods damage by transport should be taken into account.

Accordingly, road sector development plan should support to encourage speedy, seamless, and low cost logistic system in CBIC area, and following aspects should be taken into account.

①Strengthening of logistic Road Network

②Enhancement of logistic Road Network Capacity and Level of Service

Networking among port, railway, airport, logistic node, and industrial node and elimination of traffic bottleneck section and point are emphasized in road infrastructure development plan. Accordingly, road traffic congestion mitigation at urban area, facilitation of national primary highway network usage such as Golden Quadrilateral and North South East West Corridor, national highway and state highway formulating trunk road network with national primary highways, and access road connecting logistic node and facilities are most priority measures.

6.3.4.2 Development Strategies

The infrastructure development strategy for road sector is set considering demand supply gap analysis and the planning principle mentioned in foregoing sections as shown in Table 6.3.21.

Table 6.3.21: Road Development Strategies

Category	Objective & Strategy	Description
Infrastructure	Objective	● To support encouraging speedy, seamless, and low cost logistic system in CBIC area
	Strategy	a) Strengthening of logistic Road Network ● Formulation of major logistic network (Primary Logistic Road Network) ● Formulation of network between major logistic network and major logistic nodes and facilities(Secondary Logistic Road Network) ● Development of access-controlled expressway network ● Congestion mitigation in metropolitan areas and major cities b) Enhancement of logistic Road Network Capacity and Level of Service ● a Widening of existing roads to respond future traffic demand

Source: JICA Study Team

6.3.4.2.1 Strengthening of logistic Road Network

A long-term logistic road network strategy provides a useful basis to guide road infrastructure investments. The overall road network is prepared based on the estimated traffic demand and with consideration of the following:

- Metropolitan Areas, Industrial Nodes, Sub Centres, and District Centres should be provided with high grade road infrastructure and logistic services.

- International linkages with global markets should be strengthened.

- To maximize infrastructure capacity, the logistic road network should be planned with a clear hierarchy, making use of the existing network and facilities to meet future demand effectively and economically.

Accordingly, following strategic measures are proposed as Strengthening of Logistic Road Network:

a) Formulation of major logistic network (Primary Logistic Road Network)

b) Formulation of network between major logistic network and major logistic node and facility (Secondary Logistic Road Network)

c) Development of access-controlled expressway network

d) Congestion mitigation at Metropolitan Areas and major cities

<u>Formulation of Major Logistic Network/ Development of access-controlled expressway network</u>

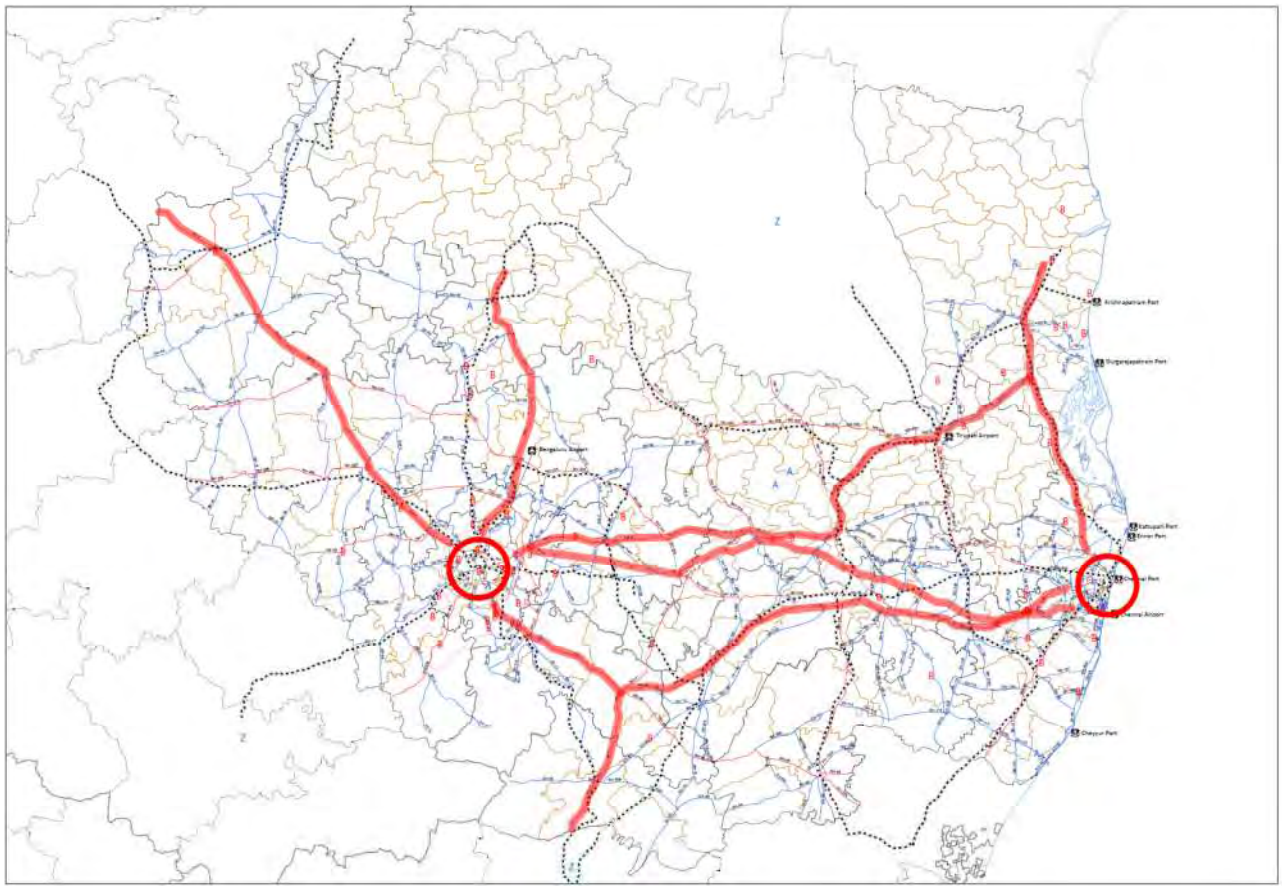
International Gateways:

- Airports and ports will function as major international gateways for goods movement. Chennai port, Ennore port, Krishnapatnam port, Chennai international airport, and Bengaluru international airports will function as international gateways.

Primary Network:

- Trunk National Highway : Golden Quadrilateral (NH4, NH5, NH7, NH46), North South East West Corridor (NH7)

- Expressway（Bengaluru – Chennai Expressway）



Source: JICA Study Team

Figure 6.3.12: Proposed Primary Logistic Road Network

Formulation of network between major logistic network and major logistic node and facility

Secondary Network:

- The above primary network should be further supplemented and strengthened with strategically configured secondary network. A general guideline at this level of transport network is to link as follows:

a. Urban Core - Sub Centre - District Centre

b. Primary Network –a

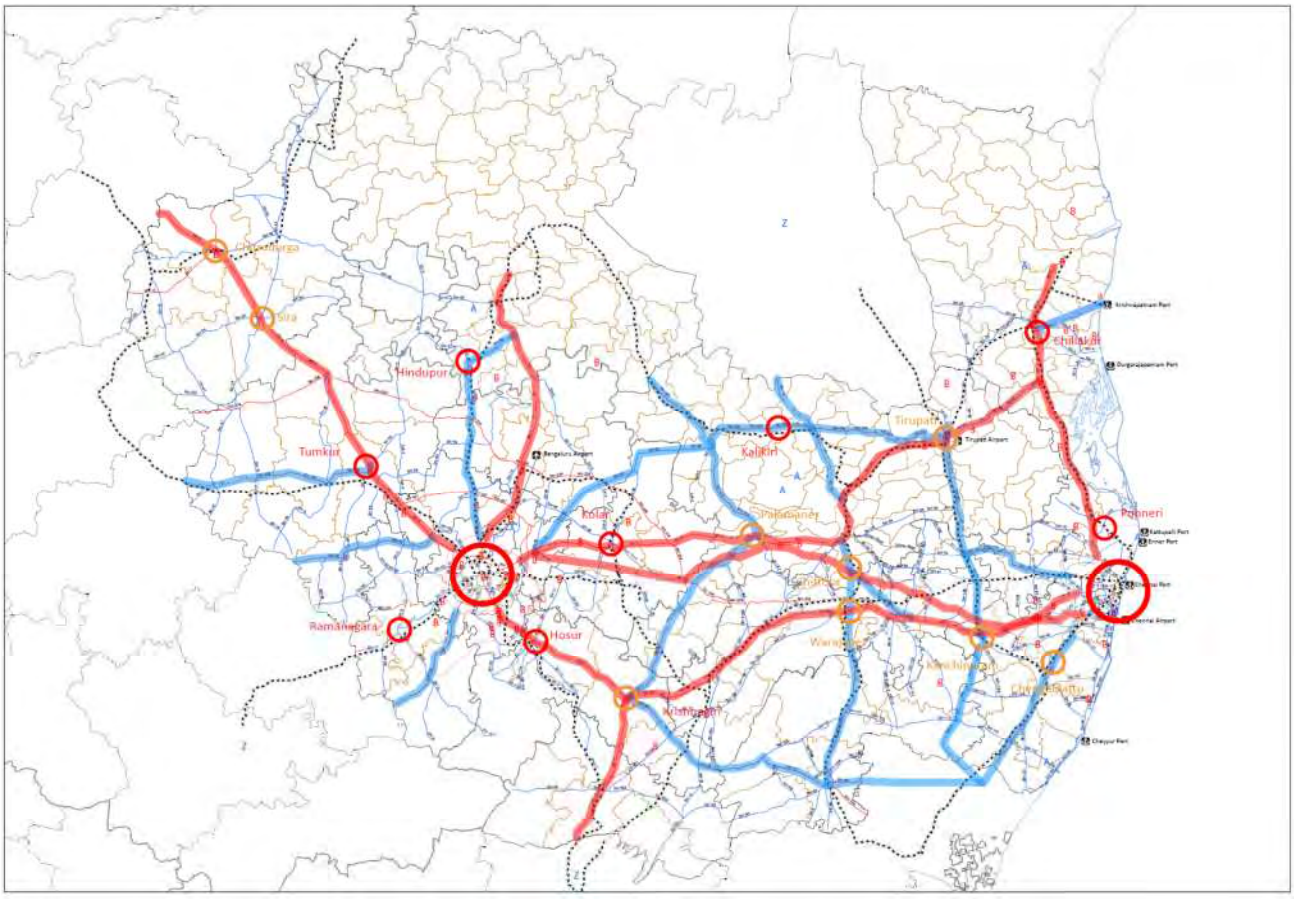
c. a - Port, Air Port.

Tertiary Network:

- Although this level of road is not fully considered in this study, the needed function are connecting as follows:

a. Primary Network, Secondary Network, Urban Primary Network - Logistic base (ICD, CFS, Industrial Park)

b. Logistic base (ICD, CFS, Industrial Park) –Logistic base (ICD, CFS, Industrial Park)



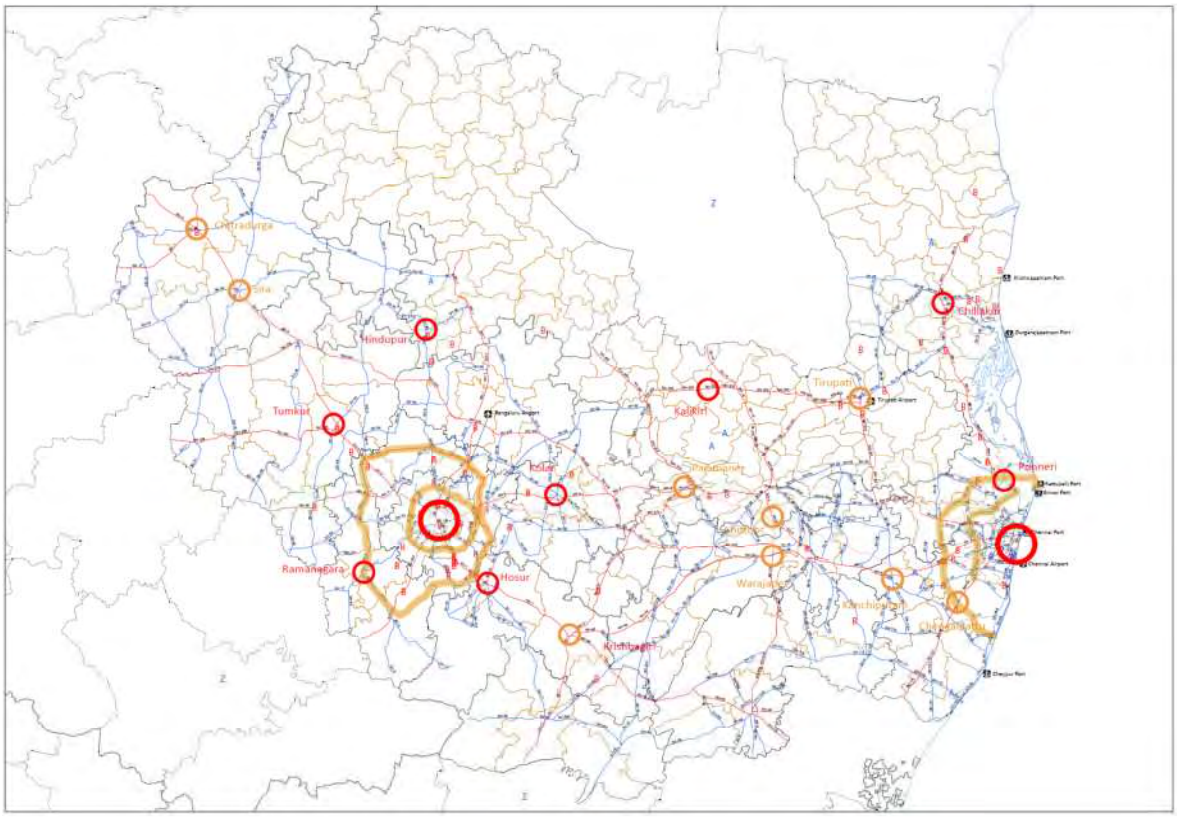
Source: JICA Study Team

Figure 6.3.13: Proposed Secondary Logistic Road Network

Congestion mitigation at Metropolitan Areas and major cities

Urban Primary Network:

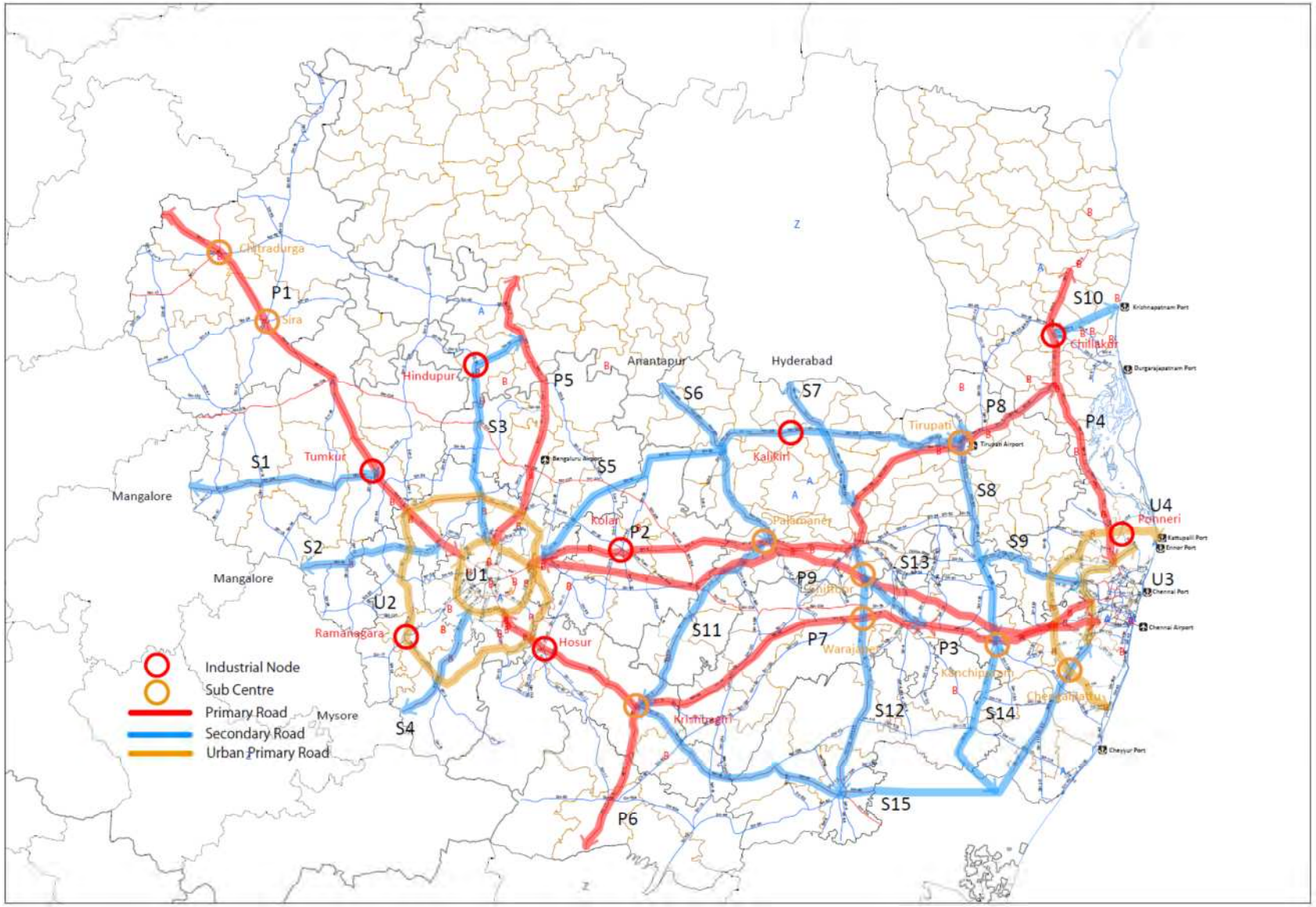
- Expanding and growing metropolitan areas, particularly in Chennai and Bengaluru require an effective and integrated interface between intercity roads and intra-urban roads



Source: JICA Study Team

Figure 6.3.14: Proposed Urban Primary Road Network

On the basis of the foregoing discussion, a conceptual long-term logistic road network plan has been formulated and the network is divided into corridors as shown in Figure 6.3.15. Corridor function on the logistic road network is summarised inTable 6.3.22.



Source: JICA Study Team

Figure 6.3.15:CBIC Logistic Road Network

Table 6.3.22: Corridor Function on CBIC Logistic Road Network

Classification	Corridor ID	Road Name	Section		Function						
					International Logistic Network		International Gate Connection	Regional Logistic Network			
					Arterial National Highway (GQ/NS EW)	Expressway	Chennai, Bengaluru - Ports, Air Port	National Highway / State Highway		Urban Ring Road, Urban Bypass	District Road / Other Road
								a. Inter-Metropolitan, Urban Core, Sub Center, District Center	b. ①-a、④-Port, Air Port		①②③④⑤⑥-Logistic base, Inter Logistic base
					①	②	③	④	⑤	⑥	⑦
Primary	P1	NH4	Chitradurga	Bangalore North	○						
	P2	NH4	Bangalore East	Chittoor	○		○				
	P3	NH4	Fallujah	Chennai	○		○				
	P4	NH5	Mathavaram	Nellore	○		○				
	P5	NH7	Penukonda	Bangalore North	○						
	P6	NH7	Bangalore South	Dharmapuri	○		○				
	P7	NH46	Krishnagiri	Fallujah	○		○				
	P8	NH18-NH18A-NH205-SH61	Chittoor	Chittamur			○				
	P9	Bangalore-Chennai Expressway	Bangalore East	Chennai		○	○				
Secondary	S1	NH206	Tumkur	Tiptur					○		
	S2	NH48	Nelamangala	Knigal					○		
	S3	SH9-SH96	Gorantla	Bangalore North				○			
	S4	NH209	Bangalore South	Kanakapura				○			
	S5	SH82-SH99-NH205	Hoskote	Renigunta (Urban)				○	○		
	S6	NH205-NH219	Mulakalacheruvu	Palamaner				○			
	S7	NH18	Kalakada	Puthalapattu				○	○		
	S8	NH205-SH58	Renigunta	Kancheepuram				○	○		
	S9	NH205	Tiruttani	Chennai				○	○		
	S10	New	Nellore	Muthukur					○		
	S11	NH219	Palamaner	Krishnagiri				○			
	S12	SH83-SH9	Chittoor	Tiruvannamala				○	○		
	S13	NH4	Gudipala	Fallujah					○		
	S14	SH116-SH5	Kancheepuram	Tindivanam					○		
	S15	NH66-NH45	Krishnagiri	Chengalpattu				○	○		
Urban Primary	U-1	Peripheral Ring Road	Bangalore North	Bangalore East						○	
	U-2	Satellite Ring Road	Nelamangala	Nelamangala						○	
	U-3	Outer Ring Road	Ponneri	Chennai						○	
	U-4	Peripheral Ring Road	Ponneri	Chengalpattu						○	

Source: JICA Study Team

6.3.4.2.2 Enhancement of logistic Road Network Capacity and Level of Service

Forecasted growth in traffic demand necessitates an increase in the capacity of certain arterial road sections. Road capacity provision for excessive traffic demand is basically implemented by widening of existing roads since corresponding road network of the CBIC logistic road network has been developed.

Accordingly, following strategic measures are proposed as Enhancement of logistic Road Network Capacity and Level of Service:

a. Widening of existing roads to respond future traffic demand

Widening of existing roads to respond future traffic demand

Necessity of road capacity provision by widening of existing roads is examined for the future traffic demand in 2018, 2023, 2028, and 2033 (BAU) calculated in section Future Case6.3.3.2. . The examination is made based on following conditions:

- New road link is not considered because applied traffic demand forecast method is not able to simulate traffic distribution amongst road links
- Committed road projects shown in Table 6.3.24are considered (Widening projects only)

Widening is provided when volume capacity ratio exceeds 1.25 in consideration of traffic condition by classification of V/C shown in

Widening is proposed up to 8 lanes regardless of common practice in India (6 lanes on National Highway) due to large number of forecasted traffic volume

Table 6.3.23

Widening is proposed up to 8 lanes regardless of common practice in India (6 lanes on National Highway) due to large number of forecasted traffic volume

Table 6.3.23: Description of Traffic Condition by Classification of V/C

V/C	Traffic Condition
<1.0	No saturated traffic condition Smooth traffic
1.0 – 1.25	Less than 1-2 hours/day saturated traffic condition Possible 1-2 hours/day traffic congestion
1.25 – 1.75	Saturated traffic condition at peak hours Possible 3-4 hour at morning & evening/day traffic congestion
1.75<	Generally saturated traffic condition in all day Chronic traffic congestion

Source: "Road Capacity Manual" Japan Road Association, 1984

Table 6.3.24: Committed Projects on CBIC Logistic Corridors

CBIC Logistic Corridors					Committed Projects				
Classification	Corridor ID	Road Name	Section		Project ID	Section		Proposed Number of Lanes	Term S: - 2018 M: 2018-2023
Primary	P1	NH4	Chitradurga	Bangalore North					
	P2	NH4	Bangalore East	Chittoor	KO3	Bangalore East	Mulbagal	4 (Widening)	S
					AA2	Gangavaram	Chittoor	4 (Widening)	S
	P3	NH4	Fallujah	Chennai					
	P4	NH5	Mathavara	Nellore	TO1	Mathavaram	Sullurpeta	6 (Widening)	S

CBIC Logistic Corridors					Committed Projects				
Classification	Corridor ID	Road Name	Section		Project ID	Section		Proposed Number of Lanes	Term S: - 2018 M: 2018-2023
			m						
	P5	NH7	Penukonda	Bangalore North					
	P6	NH7	Bangalore South	Dharmapuri					
	P7	NH46	Krishnagiri	Fallujah	TO3	Krishnagiri	Fallujah	6 (Widening)	S
	P8	NH18-NH18A-NH205-SH61	Chittoor	Chittamur	AA1	Puthalapattu	Renigunta	4 (Widening)	S
	P9	Bangalore-Chennai Expressway	Bangalore East	Chennai	TA1	Bangalore East	Chennai	6 (New)	M
Secondary	S1	NH206	Tumkur	Tiptur	KU1	Tumkur	Tiptur	4 (Widening)	S
	S2	NH48	Nelamangala	Knigal					
	S3	SH9-SH96	Gorantla	Bangalore North					
	S4	NH209	Bangalore South	Kanakapura					
	S5	SH82-SH99-NH205	Hoskote	Renigunta (Urban)					
	S6	NH205-NH219	Mulakalacheruvu	Palamaner					
	S7	NH18	Kalakada	Puthalapattu					
	S8	NH205-SH58	Renigunta	Kancheepuram	TO5	Renigunta	Tiruttani	4 (Widening)	S
	S9	NH205	Tiruttani	Chennai	TO5	Tiruttani	Chennai	4 (Widening)	S
	S10	New	Nellore	Muthukur					
	S11	NH219	Palamaner	Krishnagiri					
	S12	SH83-SH9	Chittoor	Tiruvannamala					
	S13	NH4	Gudipala	Fallujah					
	S14	SH116-SH5	Kancheepuram	Tindivanam					
	S15	NH66-NH45	Krishnagiri	Chengalpattu	TA2	Chengalpattu	Cheyyur	6 (Widening)	S
Urban Primary	U1	Peripheral Ring Road	Bangalore North	Bangalore East	KA7	Bangalore North	Bangalore East	8 (New)	S
	U2	Satellite Ring Road	Nelamangala	Nelamangala	KO1	Nelamangala	Hoskote	4 (Widening)	S
	U3	Outer Ring Road	Ponneri	Chennai	TO9	Ponneri	Poonamalloe	6 (New)	S
					TA5	Poonamalloe	Chennai	6 (New)	S
	U4	Peripheral Ring Road	Ponneri	Chengalpattu					

Source: JICA Study Team

Examination result of volume capacity ratio and necessary road capacity provision by widening of existing roads in 2018, 2023, 2028, and 2033 is shown inTable 6.3.25, Figure 6.3.16, and Figure 6.3.17.

Demand supply gap is still obvious even after 8 lanes provision on Chennai to Bengaluru section through NH7, NH46, and NH7, and ring and radial roads at Chennai and Bengaluru Metropolitan Areas after year 2033 as shown in Figure 6.3.15. To provide further road capacity to above critical corridors, expressway between Chennai and Bengaluru and urban ring roads at Chennai and Bengaluru Metropolitan Areas should be developed timely to disperse excessive corridor traffic demand.

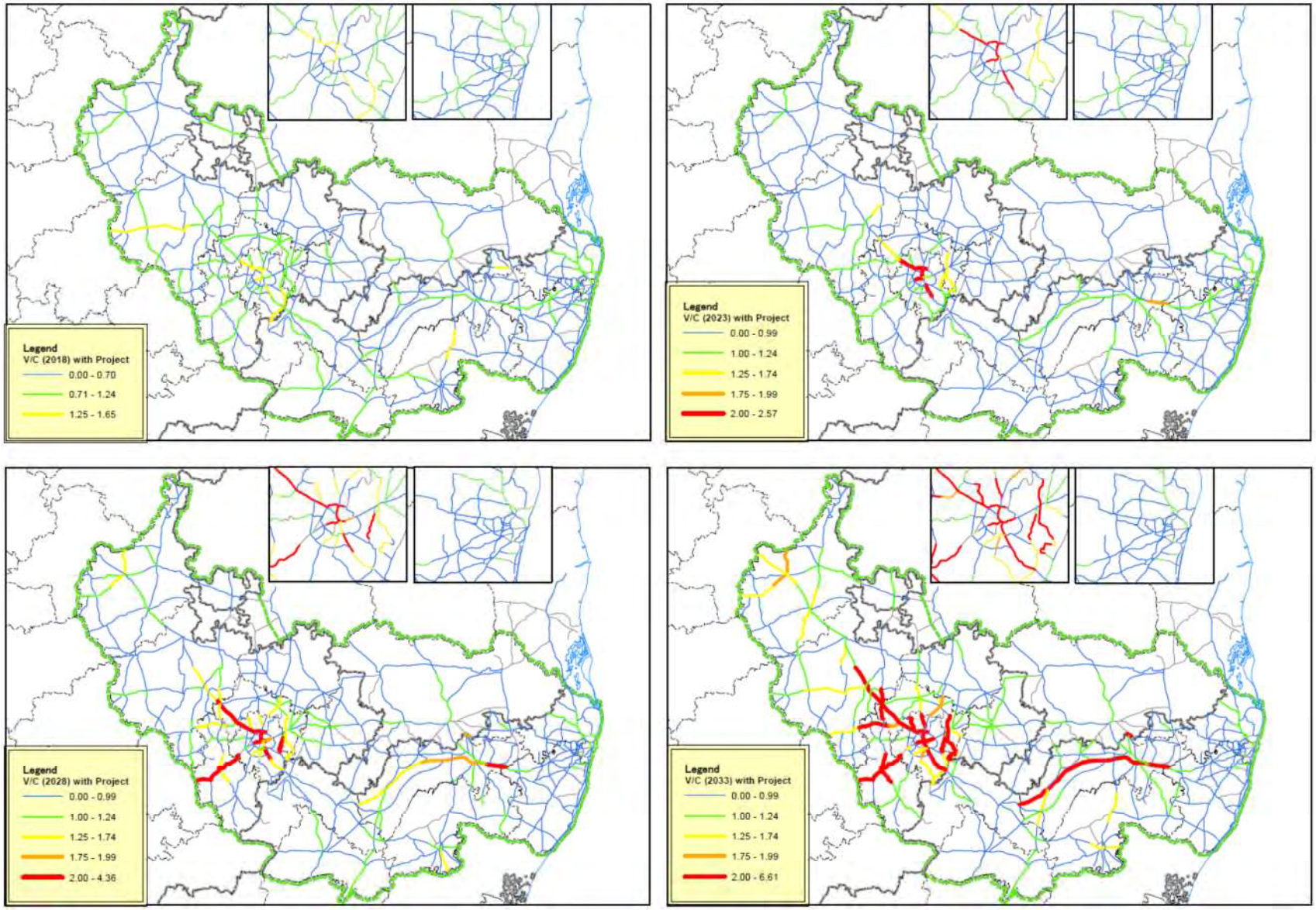
Table 6.3.25: Volume Capacity Ratio and Necessary Road Widening

Classification	Corridor ID		Road Name	Section		Length (km)	V/C w committed projects & projects					Number of Lanes					
							Present	2018	2023	2028	2033	Present	Committed Project	Proposed			
														2018	2023	2028	2033
Primary	P1	a	NH4	Chitradurga	Hiriyur	75	A	A	A	B	C	6	-	6	6	8	8
		b		Hiriyur	Tumkur	87	A	A	A	B	B	6	-	6	6	6	8
		c		Tumkur	Bangalore North	60	A	B	C	E	E	6	-	6	8	8	8
	P2	a	NH4	Bangalore East	Kolar	40	A	A	A	B	B	6	-	6	6	6	6
		b		Kolar	Palamaner	72	A	A	A	B	B	4	4	4	4	4	4
		c		Palamaner	Chittoor	44	A	A	A	A	A	2	4	4	4	4	4
	P3	a	NH4	Wallujah	Kancheepuram	37	B	B	D	E	E	4	6	8	8	8	8
		b		Kancheepuram	Chennai	47	A	B	B	A	A	4	6	6	6	8	8
	P4	a	NH5	Nellore	Chilakur	47	A	A	A	A	A	4	-	4	4	4	4
		b		Chilakur	Pnneri	89	A	A	A	A	A	6	6	6	6	6	6
		c		Pnneri	Mathavaram	22	A	B	A	B	B	6	-	6	6	6	6
	P5	a	NH7	Penukonda	Gorantla	33	A	A	A	A	A	4	-	4	4	4	4
		b		Gorantla	Chikkaballapura	58	A	A	A	A	A	4	-	4	4	4	4
		c		Chikkaballapura	Bangalore North	51	A	B	B	C	D	6	-	6	6	8	8
	P6	a	NH7	Bangalore South	Anekal	23	A	B	E	E	E	6		6	8	8	8
		b		Anekal	Krishnagiri	58	A	B	A	A	A	6		6	6	6	6
		c		Krishnagiri	Dharmapuri	42	A	A	A	A	A	6	-	6	6	6	6
		d		Dharmapuri	Dharmapuri	26	A	A	A	A	A	6	-	6	6	6	6
	P7	a	NH46	Krishnagiri	Vellore	112	A	A	B	C	E	6	6	6	6	8	8
		b		Vellore	Fallujah	36	A	B	B	D	E	6	6	6	8	8	8
	P8	a	NH18	Chittoor	Puthalapattu	18	A	B	A	B	B	2	-	2	2	2	2
		b	NH18A	Puthalapattu	Renigunta (Urban)	66	A	A	A	A	A	2	4	4	4	4	4
		c	NH205-SH61	Renigunta (Urban)	Chittamur	52	A	A	A	A	A	2	-	2	4	4	4
	P9	a	Bangalore-Chennai Expressway	Bangalore East	Chennai	270	-	-	-	-	-	-	6	-	6	6	6
Secondary	S1	a	NH206	Tumkur	Chiknayakanhalli	58	A	C	B	A	C	2	4	4	4	8	8
		b		Chiknayakanhalli	Tiptur	35	A	C	A	B	B	2	4	4	4	6	8
	S2	a	NH48	Nelamangala	Knigal	70	A	B	B	C	E	4	-	4	6	8	8
	S3	a	SH96	Gorantla	Dod Ballapur	86	A	B	A	A	B	2	-	2	4	4	4
		b	SH96	Dod Ballapur	Bangalore North	27	C	B	A	A	C	2	-	4	4	8	8
	S4	a	NH209	Bangalore South	Kanakapura	60	A	B	A	A	B	2	-	2	4	6	8
	S5	a	SH82	Hoskote	Kolar	21	A	B	A	B	B	2	-	2	4	6	8
		b	SH82	Kolar	Srinivaspur	40	A	A	A	A	A	2	-	2	2	4	4
		c	SH99	Srinivaspur	Madanapalle	42	A	A	A	A	B	2	-	2	2	2	2
		d	NH205	Madanapalle	Pileru	55	A	A	A	A	A	2	-	2	2	2	2
		e	NH205	Pileru	Renigunta (Urban)	73	A	A	A	A	A	2	-	2	2	2	2
	S6	a	NH205	Mulakalacheruvu	Madanapalle	40	A	A	A	A	A	2	-	2	2	2	2
		b	NH219	Madanapalle	Palamaner	58	A	A	A	A	A	2	-	2	2	2	2
	S7	a	NH18	Kalakada	Pileru	32	A	A	A	A	A	2	-	2	2	2	2
		b		Pileru	Puthalapattu	35	A	B	A	B	B	2	-	2	2	2	2
	S8	a	NH205	Renigunta (Urban)	Tiruttani	57	A	A	A	A	A	4	4	4	4	4	4
		b	SH58	Tiruttani	Kancheepuram	39	A	A	A	A	A	2	-	4	4	4	4
	S9	a	NH205	Tiruttani	Thiruvallur	40	A	A	A	A	A	2	4	4	4	4	4
		b		Thiruvallur	Chennai	15	A	A	A	A	A	4	4	4	4	4	4

Classification	Corridor ID		Road Name	Section		Length (km)	V/C w committed projects & projects					Number of Lanes					
							Present	2018	2023	2028	2033	Present	Committed Project	Proposed			
														2018	2023	2028	2033
	S10	a	New	Nellore	Muthukur	33	-	-	-	-	-	2	-	4	4	4	4
	S11	a	NH219	Palamaner	Venkatagirikota	38	A	A	A	A	A	2	-	2	2	2	2
		b		Venkatagirikota	Krishnagiri	64	A	A	A	A	A	2	-	2	2	2	4
	S12	a	NH4-New	Chittoor	Katpadi	32	A	A	A	A	A	2	4	4	4	4	4
		b	NH234	Katpadi	Vellore	20	A	A	A	A	A	2	-	2	2	2	2
		c		Vellore	Polur	25	B	C	B	A	C	2	-	2	4	8	8
		d		Polur	Tiruvannamala	41	A	A	A	A	A	2	-	2	2	2	2
	S13	a	NH4	Gudipala	Fallujah	35	A	A	A	B	B	2	-	4	4	6	8
	S14	a	SH116-SH5	Kancheepuram	Tindivanam	84	A	A	A	A	B	2	-	2	2	2	4
	S15	a	NH66	Krishnagiri	Uthangarai	48	A	A	A	A	A	2	-	2	2	2	2
		b		Uthangarai	Tiruvannamala	55	A	B	A	B	B	2	-	2	4	4	6
		c		Madurantha kam	Chengalpattu	46	A	A	A	A	A	4	6	6	6	6	6
		d		Chengalpattu	Chengalpattu	15	A	A	A	A	A	4	6	6	6	6	6
Urban Primary	U1	a	Peripheral Ring Road	Bangalore North	Bangalore South	65	-	-	-	-	-	-	8	-	8	8	8
		b		Bangalore South	Bangalore North	45	A	A	A	A	A	4	-	4	4	4	4
	U2	a	Satellite Ring Road NH207	Nelamangala	Hoskote	99	A	B	A	A	B	2	4	4	4	6	8
		b		Hoskote	Hosur	45	B	B	C	C	E	2	-	4	6	8	8
		c	New	Hosur	Kanakapura	52	-	-	-	-	-	-	-	-	4	6	8
		d	SH3	Kanakapura	Nelamangala	98	A	A	A	C	E	2	-	4	4	4	4
	U3	a	Outer Ring Road	Ponneri	Poonamallee	30	-	-	-	-	-	-	6	6	6	6	6
		b		Poonamallee	Chennai	31	-	-	-	-	-	-	6	6	6	6	6
	U4	a	Peripheral Ring Road	Ponneri	Uthukkottai	41	-	-	-	-	-	-	-	-	4	4	4
		b		Uthukkottai	Chengalpattu	70	A	B	B	A	A	2	-	2	4	4	4
		c		Chengalpattu	Chengalpattu	28	-	-	-	-	-	-	-	-	4	4	4
						3488											

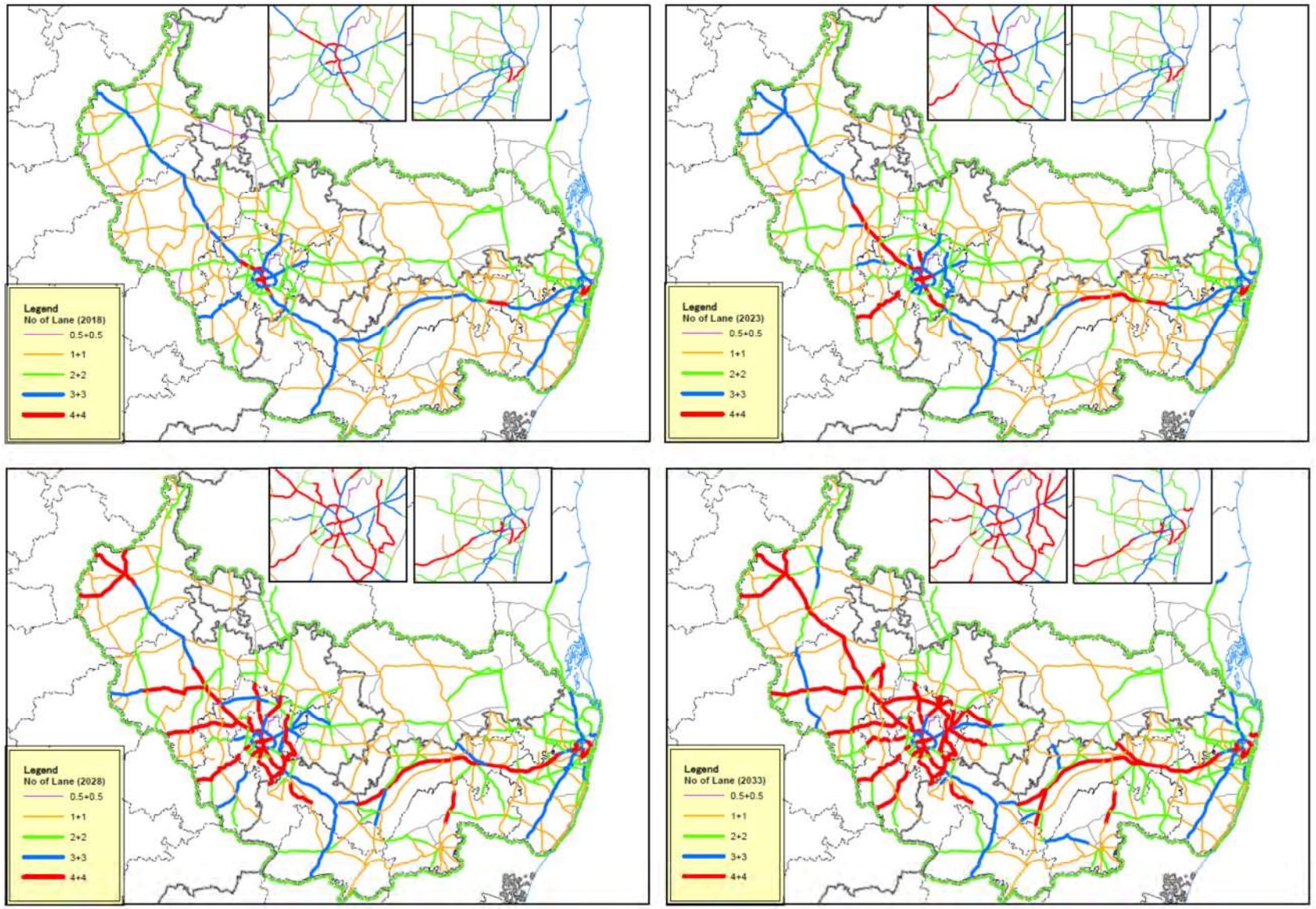
Note: V/C (A; 0-1.0, B; 1.0-1.25, C; 1.25-1.75, D; 1.75-2.0, E; 2.0-)

Source: JICA Study Team



Source: JICA Study Team

Figure 6.3.16: Volume Capacity Ratio (2018, 2023, 2028, 2033, with widening projects)



Source: JICA Study Team

Figure 6.3.17: Necessary Widening for Future Traffic Demand (2018, 2023, 2028, 2033)

6.3.5 *Development Goals and Target Performance Indicators*

Road development plan basically focus on network formulation and capacity provision in consideration of sector issues. Road networking should also be considered redundancy to ensure regular logistic transport service and network substitutability in emergency case. Therefore, proposed road network should basically provide dual connection to important logistic nodes.

As for the capacity provision, vehicle capacity ratio is index to judge necessity of capacity increment for individual road section. Table 6.3.26shows traffic condition under particular volume capacity ratio and 1.25 is set as border line of capacity increment in this study.

Table 6.3.26: Description of Traffic Condition by Classification of V/C

V/C	Traffic Condition
>1.0	No saturated traffic condition Smooth traffic
1.0 – 1.25	Less than 1-2 hours/day saturated traffic condition Possible 1-2 hours/day traffic congestion
1.25 – 1.75	Saturated traffic condition at peak hours Possible 3-4 hour at morning & evening/day traffic congestion
1.75 <	Generally saturated traffic condition in all day Chronic traffic congestion

Source: "Road Capacity Manual" Japan Road Association, 1984

Above target performance indicators are fairly considered in road networking and capacity provision of road development strategy as mentioned in section 6.3.4.2.

6.3.6 *Development Plan and Suggested Project*

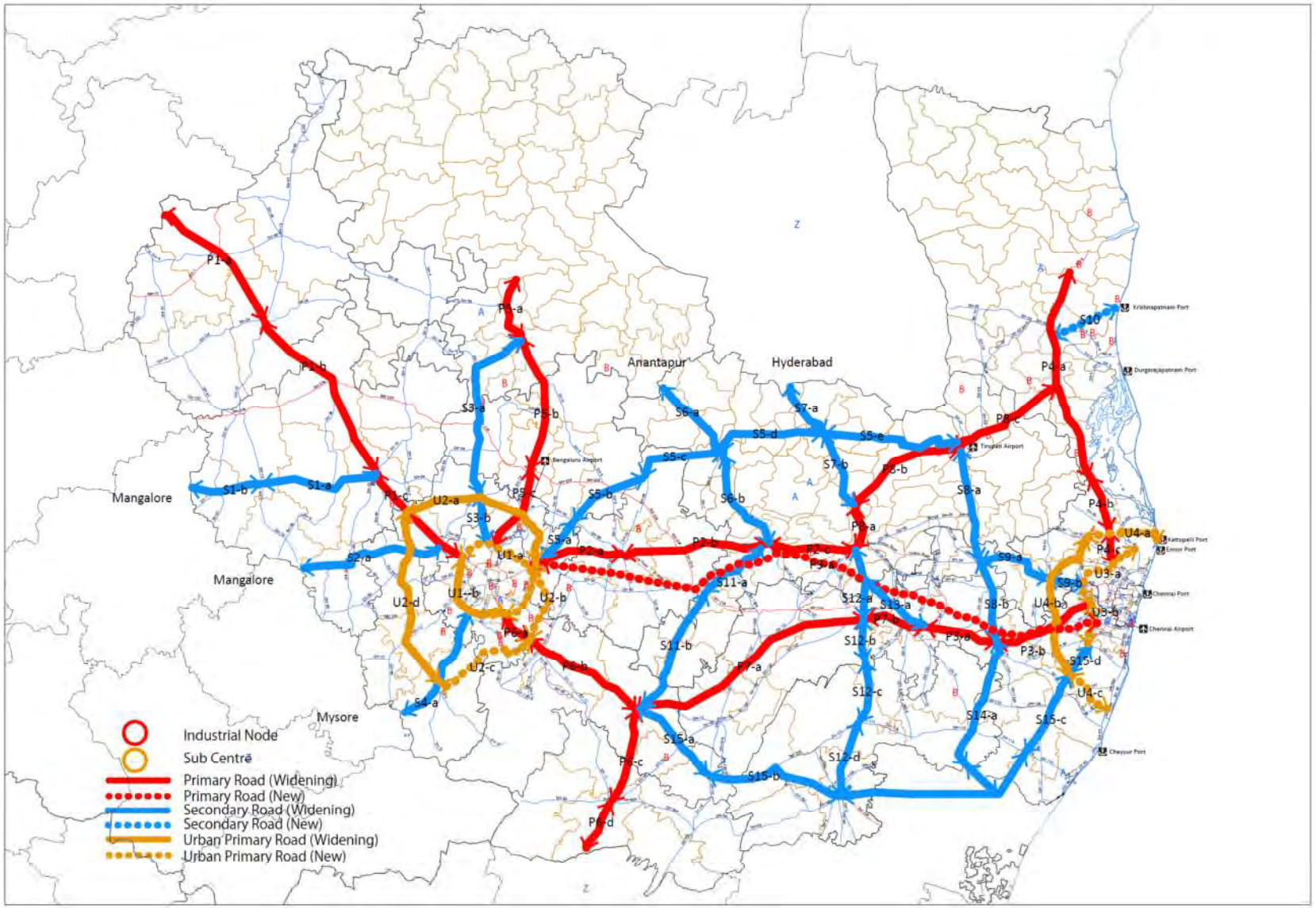
Based on proposed logistic road network and examination result of necessary widening for future traffic demand in the road development strategy, master plan candidate projects are identified as shown Table 6.3.27and Figure 6.3.18. This project list includes ongoing projects as well as projects proposed in the various development plans. Project cost is also estimated in accordance with the proposed master plan candidate projects as shown in Table 6.3.27.

Table 6.3.27: Current and Proposed Road Projects on identified Logistic Corridors within the CBIC area

Classification	Corridor ID		Road Name	Section		Length (km)	Number of Lanes						Project Cost (mil. USD)			
							Present	Committed Project	Proposed				2018	2023	2028	2033
									2018	2023	2028	2033				
Primary	P1	a	NH4	Chitradurga	Hiriyur	75	6	-	6	6	8	8	0	0	90	0
		b		Hiriyur	Tumkur	87	6	-	6	6	6	8	0	0	0	104.4
		c		Tumkur	Bangalore North	60	6	-	6	8	8	8	0	72	0	0
	P2	a	NH4	Bangalore East	Kolar	40	6	-	6	6	6	6	0	0	0	0
		b		Kolar	Palamaner	72	4	4	4	4	4	4	0	0	0	0
		c		Palamaner	Chittoor	44	2	4	4	4	4	4	52.8	0	0	0
	P3	a	NH4	Wallajah	Kancheepuram	37	4	6	8	8	8	8	81.4	0	0	0
		b		Kancheepuram	Chennai	47	4	6	6	6	8	8	56.4	0	56.4	0
	P4	a	NH5	Nellore	Chilakur	47	6	-	4	4	4	4	0	0	0	0
		b		Chilakur	Ponneri	89	6	6	6	6	6	6	0	0	0	0
		c		Pnneri	Mathavaram	22	6	-	6	6	6	6	0	0	0	0
	P5	a	NH7	Penukonda	Gorantla	33	4	-	4	4	4	4	0	0	0	0
		b		Gorantla	Chikkaballapura	58	4	-	4	4	4	4	0	0	0	0
		c		Chikkaballapura	Bangalore North	51	6	-	6	6	8	8	0	0	61.2	0
	P6	a	NH7	Bangalore South	Anekal	23	6	-	6	8	8	8	0	27.6	0	0
		b		Anekal	Krishnagiri	58	6	-	6	6	6	6	0	0	0	0
		c		Krishnagiri	Dharmapuri	42	6	-	6	6	6	6	0	0	0	0
		d		Dharmapuri	Dharmapuri	26	6	-	6	6	6	6	0	0	0	0
	P7	a	NH46	Krishnagiri	Vellore	112	6	6	6	6	8	8	0	0	134.4	0
		b		Vellore	Wallajah	36	6	6	6	8	8	8	0	43.2	0	0
	P8	a	NH18	Chittoor	Puthalapattu	18	2	-	2	2	2	2	0	0	0	0
		b	NH18A	Puthalapattu	Renigunta (Urban)	66	2	4	4	4	4	4	79.2	0	0	0
		c	NH205-SH61	Renigunta (Urban)	Chittamur	52	2	-	2	4	4	4	0	62.4	0	0
	P9	a	Bangalore-Chennai Expressway	Bangalore East	Chennai	270	-	6	-	6	6	6		1100		
Secondary	S1	a	NH206	Tumkur	Chiknayakanhalli	58	2	4	4	4	8	8	0	69.6	127.6	0
		b		Chiknayakanhalli	Tiptur	35	2	4	4	4	6	8	0	42	42	42
	S2	a	NH48	Nelamangala	Knigal	70	4	-	4	6	8	8	0	84	84	0
	S3	a	SH96	Gorantla	Dod Ballapur	86	2	-	2	4	4	4	0	103.2	0	0
		b	SH96	Dod Ballapur	Bangalore North	27	2	-	4	4	8	8	32.4	0	59.4	0
	S4	a	NH209	Bangalore South	Kanakapura	60	2	-	2	4	6	8	0	72	72	72
	S5	a	SH82	Hoskote	Kolar	21	2	-	2	4	6	8	0	25.2	25.2	25.2
		b	SH82	Kolar	Srinivaspur	40	2	-	2	2	4	4	0	0	48	0
		c	SH99	Srinivaspur	Madanapalle	42	2	-	2	2	2	2	0	0	0	0
		d	NH205	Madanapalle	Pileru	55	2	-	2	2	2	2	0	0	0	0
		e	NH205	Pileru	Renigunta (Urban)	73	2	-	2	2	2	2	0	0	0	0
	S6	a	NH205	Mulakalacheruvu	Madanapalle	40	2	-	2	2	2	2	0	0	0	0
		b	NH219	Madanapalle	Palamaner	58	2	-	2	2	2	2	0	0	0	0
	S7	a	NH18	Kalakada	Pileru	32	2	-	2	2	2	2	0	0	0	0
		b		Pileru	Puthalapattu	35	2	-	2	2	2	2	0	0	0	0
	S8	a	NH205	Renigunta (Urban)	Tiruttani	57	4	4	4	4	4	4	0	0	0	0
		b	SH58	Tiruttani	Kancheepuram	39	2	-	4	4	4	4	46.8	0	0	0
	S9	a	NH205	Tiruttani	Thiruvallur	40	2	4	4	4	4	4	48	0	0	0
		b		Thiruvallur	Chennai	15	4	4	4	4	4	4	0	0	0	0

Classification	Corridor ID		Road Name	Section		Length (km)	Number of Lanes						Project Cost (mil. USD)			
							Present	Committed Project	Proposed				2018	2023	2028	2033
									2018	2023	2028	2033				
	S10	a	New	Nellore	Muthukur	33	2	-	4	4	4	4	39.6	0	0	0
	S11	a	NH219	Palamaner	Venkatagirikota	38	2	-	2	2	2	2	0	0	0	0
		b		Venkatagirikota	Krishnagiri	64	2	-	2	2	2	4	0	0	0	76.8
	S12	a	NH4-New	Chittoor	Katpadi	32	2	-	4	4	4	4	38.4	0	0	0
		b	NH234	Katpadi	Vellore	20	2	-	2	2	2	2	0	0	0	0
		c		Vellore	Polur	25	2	-	2	4	8	8	0	30	55	0
		d		Polur	Tiruvannamala	41	2	-	2	2	2	2	0	0	0	0
	S13	a	NH4	Gudipala	Wallajah	35	2	4	4	4	6	8	42	0	42	42
	S14	a	SH116-SH5	Kancheepuram	Tindivanam	84	2	-	2	2	2	4	0	0	0	100.8
	S15	a	NH66	Krishnagiri	Uthangarai	48	2	-	2	2	2	2	0	0	0	0
		b	NH66	Uthangarai	Tiruvannamalai	55	2	-	2	4	4	6	0	66	0	66
		c	NH45	Maduranthakam	Chengalpattu	46	4	6	6	6	6	6	55.2	0	0	0
		d	NH45	Chengalpattu	Chengalpattu	15	4	6	6	6	6	6	18	0	0	0
Urban Primary	U1	a	Peripheral Ring Road	Bangalore North	Bangalore South	65	-	8	-	8	8	8	900			
		b		Bangalore South	Bangalore North	45	4	-	4	4	4	4	0	0	0	0
	U2	a	Satellite Ring Road NH207	Nelamangala	Hoskote	99	2	4	4	4	6	8	118.8	0	118.8	118.8
		b	New	Hoskote	Hosur	45	2	-	4	6	8	8	54	54	54	0
		c	New	Hosur	Kanakapura	52	-	-	-	4	6	8	0	0	62.4	62.4
		d	SH3	Kanakapura	Nelamangala	98	2	-	4	4	4	4	117.6	0	0	0
	U3	a	Outer Ring Road	Ponneri	Poonamallee	30	-	6	6	6	6	6	161			
		b		Poonamallee	Chennai	31	-	6	6	6	6	6				
	U4	a	Peripheral Ring Road	Ponneri	Uthukkottai	41	-	-	-	4	4	4	0	90.2	0	0
		b		Uthukkottai	Chengalpattu	70	2	-	2	4	4	4	0	84.0	0	0
		c		Chengalpattu	Chengalpattu	28	-	-	-	4	4	4	0	61.6	0	0
						3,488							1942	2,087	1,132	710
													5,871			

Source: JICA Study Team



Source: JICA Study Team

Figure 6.3.18: Current and Proposed Road Projects on identified Logistic Corridors within the CBIC area

6.3.7 *Phasing Plan*

6.3.7.1 Criteria for Phasing Plan

Project implementation should basically follow the examination result of necessary widening for future traffic demand. However, project implementation of proposed new project such as Bengaluru – Chennai Expressway and urban ring roads in Chennai and Bengaluru Metropolitan Area should be considered other factors such as timing of land acquisition and development coordination with connecting facilities.

Phasing criteria is examined based on above consideration. The selection criteria for project phasing are proposed as follows:

(1) Phasing should be given in line with schedule of ongoing project

(2) Widening should not be prior investment against traffic demand to minimize investment cost

(3) Ring roads at metropolitan area should be implemented timely in consideration of urbanization trend and land acquisition

(4) Proper implementation sequence amongst neighbouring projects should be consider network rationality

6.3.7.2 Phasing Plan

Based on the identified project and the criteria for phasing plan, phasing plan of the logistic road network is formulated as shown inTable 6.3.29and Figure 6.3.19 to Figure 6.3.21.

6.3.7.3 Conclusion

- In total, Fifty four projects (including committed projects) for a length2, 975km have been proposed as strategic road infrastructure project.
- Seven projects are new project and forty seven projects are widening projects.
- Total project cost of the logistic road network project is 5,871million USD. Project costs of each term are 1,942 million USD in short-term, 2,087 million USD in medium-term, and 1,842 million USD in long-term.

Table 6.3.28: Summary of Identified Projects on CBIC Logistic Road Network Plan

Classification	Number of Project	Total Length (km)	Project Cost (million USD)			
			2013-2018	2019-2023	2023-2028	2029-2033
Primary	14	1007	271	1,305	342	104
Secondary	28	1251	320	492	555	425
Urban Primary	12	717	1,351	290	235	181
	54	2975	1,942	2,087	1,842	
			5,871			

Source: JICA Study Team

Table 6.3.29: Phasing Plan of CBIC Logistic Road Network Plan

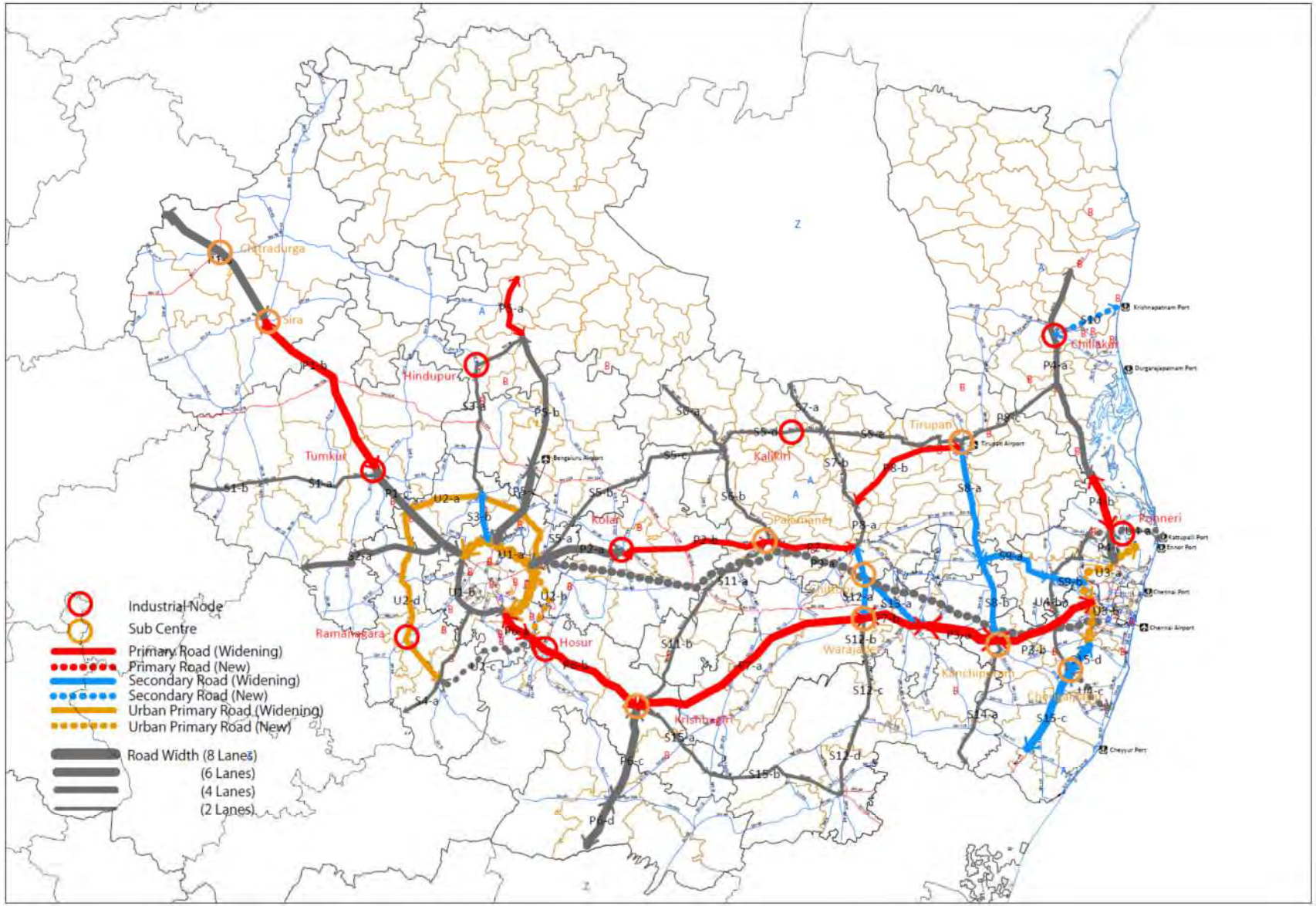
Classification	Corridor ID		Road Name	Section		Length (km)	Project Cost (mil. USD)				Implementation Schedule																					
							2018	2023	2028	2033	-2018					-2023					-2028					-2033						
Primary	P1	a	NH4	Chitradurga	Hiriyur	75	0	0	90	0													30	30	30						
		b		Hiriyur	Tumkur	87	0	0	0	104.4																35	35	35			
		c		Tumkur	Bangalore North	60	0	72	0	0						36	36														
	P2	a	NH4	Bangalore East	Kolar	40	0	0	0	0																					
		b		Kolar	Palamaner	72	0	0	0	0																					
		c		Palamaner	Chittoor	44	52.8	0	0	0	26	26																			
	P3	a	NH4	Fallujah	Kancheepuram	37	81.4	0	0	0	41	41																			
		b		Kancheepuram	Chennai	47	56.4	0	56.4	0	28	28												28	28						
	P4	a	NH5	Nellore	Chilakur	47	0	0	0	0																					
		b		Chilakur	Pnneri	89	0	0	0	0																					
		c		Pnneri	Mathavaram	22	0	0	0	0																					
	P5	a	NH7	Penukonda	Gorantla	33	0	0	0	0																					
		b		Gorantla	Chikkaballapura	58	0	0	0	0																					
		c		Chikkaballapura	Bangalore North	51	0	0	61.2	0											31	31									
	P6	a	NH7	Bangalore South	Anekal	23	0	27.6	0	0									14	14										
		b		Anekal	Krishnagiri	58	0	0	0	0																					
		c		Krishnagiri	Dharmapuri	42	0	0	0	0																					
		d		Dharmapuri	Dharmapuri	26	0	0	0	0																					
	P7	a	NH46	Krishnagiri	Vellore	112	0	0	134.4	0											34	34	34	34						
		b		Vellore	Fallujah	36	0	43.2	0	0									22	22										
	P8	a	NH18	Chittoor	Puthalapattu	18	0	0	0	0																					
		b	NH18A	Puthalapattu	Renigunta (Urban)	66	79.2	0	0	0			26	26	26																
		c	NH205-SH61	Renigunta (Urban)	Chittamur	52	0	62.4	0	0									31	31										
	P9	a	Bangalore-Chennai Express	Bangalore East	Chennai	270		1100								220	220	220	220	220										

Classification	Corridor ID		Road Name	Section		Length (km)	Project Cost (mil. USD)				Implementation Schedule																					
							2018	2023	2028	2033	-2018					-2023					-2028					-2033						
			way																													
Secondary	S1	a	NH206	Tumkur	Chiknayakanhalli	58	0	69.6	127.6	0						35	35						43	43	43							
		b		Chiknayakanhalli	Tiptur	35	0	42	42	42						21	21							21	21					21	21
	S2	a	NH48	Nelamangala	Knigal	70	0	84	84	0						28	28	28					28	28	28							
	S3	a	SH96	Gorantla	Dod Ballapur	86	0	103.2	0	0								34	34	34											
		b	SH96	Dod Ballapur	Bangalore North	27	32.4	0	59.4	0	16	16												30	30						
	S4	a	NH209	Bangalore South	Kanakapura	60	0	72	72	72						36	36				36	36				36	36				
	S5	a	SH82	Hoskote	Kolar	21	0	25.2	25.2	25.2						13	13							13	13				13	13
		b	SH82	Kolar	Srinivaspur	40	0	0	48	0														24	24						
		c	SH99	Srinivaspur	Madanapalle	42	0	0	0	0																					
		d	NH205	Madanapalle	Pileru	55	0	0	0	0																					
		e	NH205	Pileru	Renigunta (Urban)	73	0	0	0	0																					
	S6	a	NH205	Mulakalacheruvu	Madanapalle	40	0	0	0	0																					
		b	NH219	Madanapalle	Palamaner	58	0	0	0	0																					
	S7	a	NH18	Kalakada	Pileru	32	0	0	0	0																					
		b		Pileru	Puthalapattu	35	0	0	0	0																					
	S8	a	NH205	Renigunta (Urban)	Tiruttani	57	0	0	0	0																					
		b	SH58	Tiruttani	Kancheepuram	39	46.8	0	0	0				23	23																
	S9	a	NH205	Tiruttani	Thiruvallur	40	48	0	0	0				24	24																
		b		Thiruvallur	Chennai	15	0	0	0	0																					
	S10	a	New	Nellore	Muthukur	33	39.6	0	0	0	20	20																			
	S11	a	NH219	Palamaner	Venkatagirikota	38	0	0	0	0																					
		b		Venkatagirikota	Krishnagiri	64	0	0	0	76.8																				26	26	26
	S12	a	NH4-New	Chittoor	Katpadi	32	38.4	0	0	0				19	19																
		b	NH234	Katpadi	Vellore	20	0	0	0	0																					
		c		Vellore	Polur	25	0	30	55	0						15	15							28	28						
		d		Polur	Tiruvannamala	41	0	0	0	0																					
	S13	a	NH4	Gudipala	Fallujah	35	42	0	42	42	21	21									21	21							21	21
	S14	a	SH116-	Kancheepura	Tindivanam	84	0	0	0	100.8																		34	34	34

Classification	Corridor ID		Road Name	Section		Length (km)	Project Cost (mil. USD)				Implementation Schedule																					
							2018	2023	2028	2033	-2018					-2023					-2028					-2033						
			SH5	m																												
	S15	a	NH66	Krishnagiri	Uthangarai	48	0	0	0	0																						
		b		Uthangarai	Tiruvannamala	55	0	66	0	66						33	33													33	33
		c		Maduranthakam	Chengalpattu	46	55.2	0	0	0				28	28																	
		d		Chengalpattu	Chengalpattu	15	18	0	0	0				9	9																	
Urban Primary	U-1	a	Peripheral Ring Road	Bangalore North	Bangalore South	65	900					225	225	225	225																	
		b		Bangalore South	Bangalore North	45	0	0	0	0																						
	U-2	a	Satellite Ring Road NH207	Nelamangala	Hoskote	99	118.8	0	118.8	118.8	30	30	30	30							30	30	30	30			30	30	30	30		
		b	New	Hoskote	Hosur	45	54	54	54	0				27	27				27	27				27	27							
		c	New	Hosur	Kanakapura	52	0	0	62.4	62.4											31	31							31	31		
		d	SH3	Kanakapura	Nelamangala	98	117.6	0	0	0		29	29	29	29																	
	U-3	a	Outer Ring Road	Ponneri	Poonamallee	30	161				32	32	32	32	32																	
		b		Poonamallee	Chennai	31																										
	U-4	a	Peripheral Ring Road	Ponneri	Uthukkottai	41	0	90.2	0	0						30	30	30														
		b		Uthukkottai	Chengalpattu	70	0	84.0	0	0						42	42															
		c		Chengalpattu	Chengalpattu	28	0	61.6	0	0						31	31															
						3,488	1,942	2,087	1,132	710	1,942					2,087					1,132					710						
							5,871																								

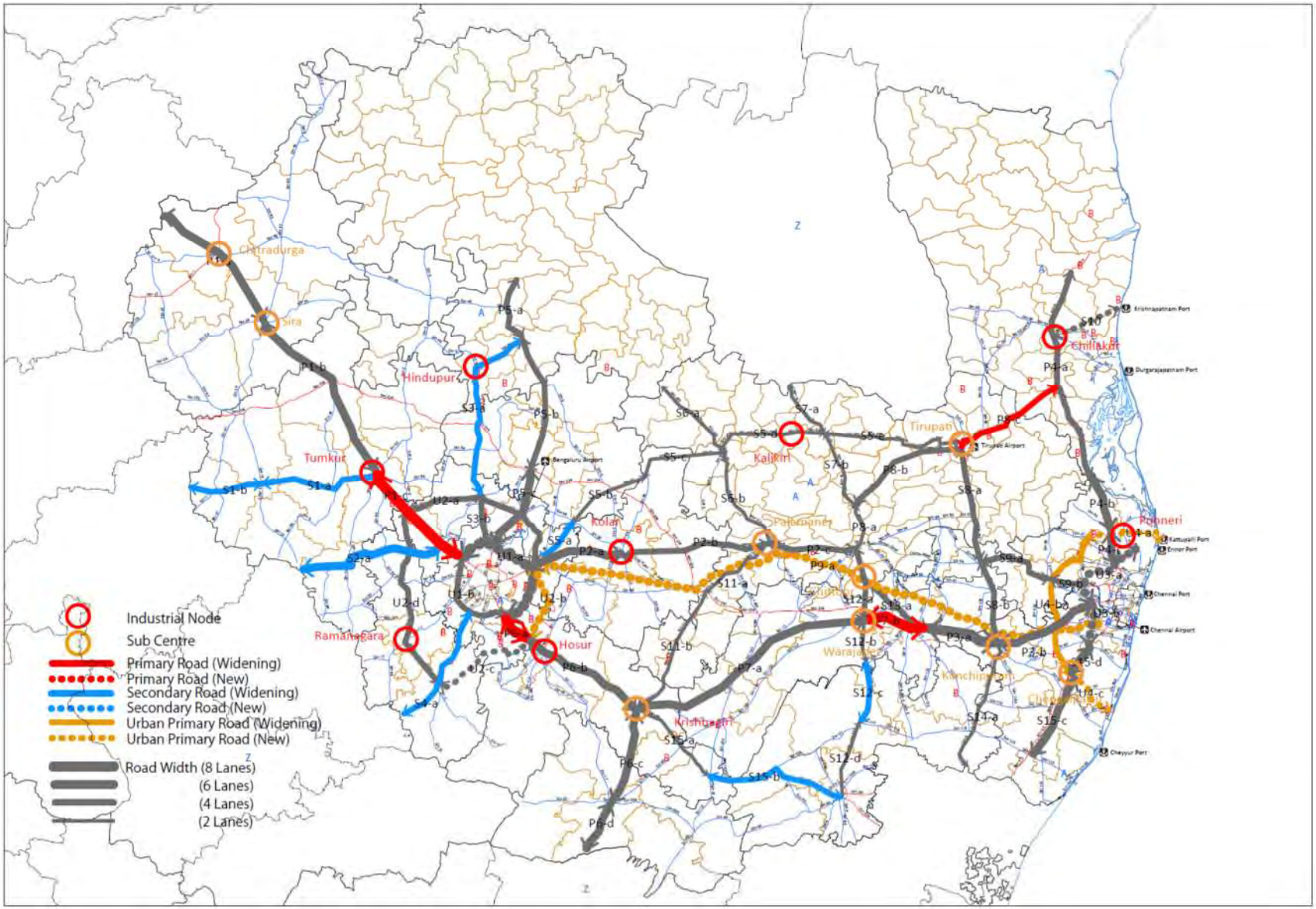
Note: V/C (A; 0-1.0, B; 1.0-1.25, C; 1.25-1.75, D; 1.75-2.0, E; 2.0-)

Source: JICA Study Team



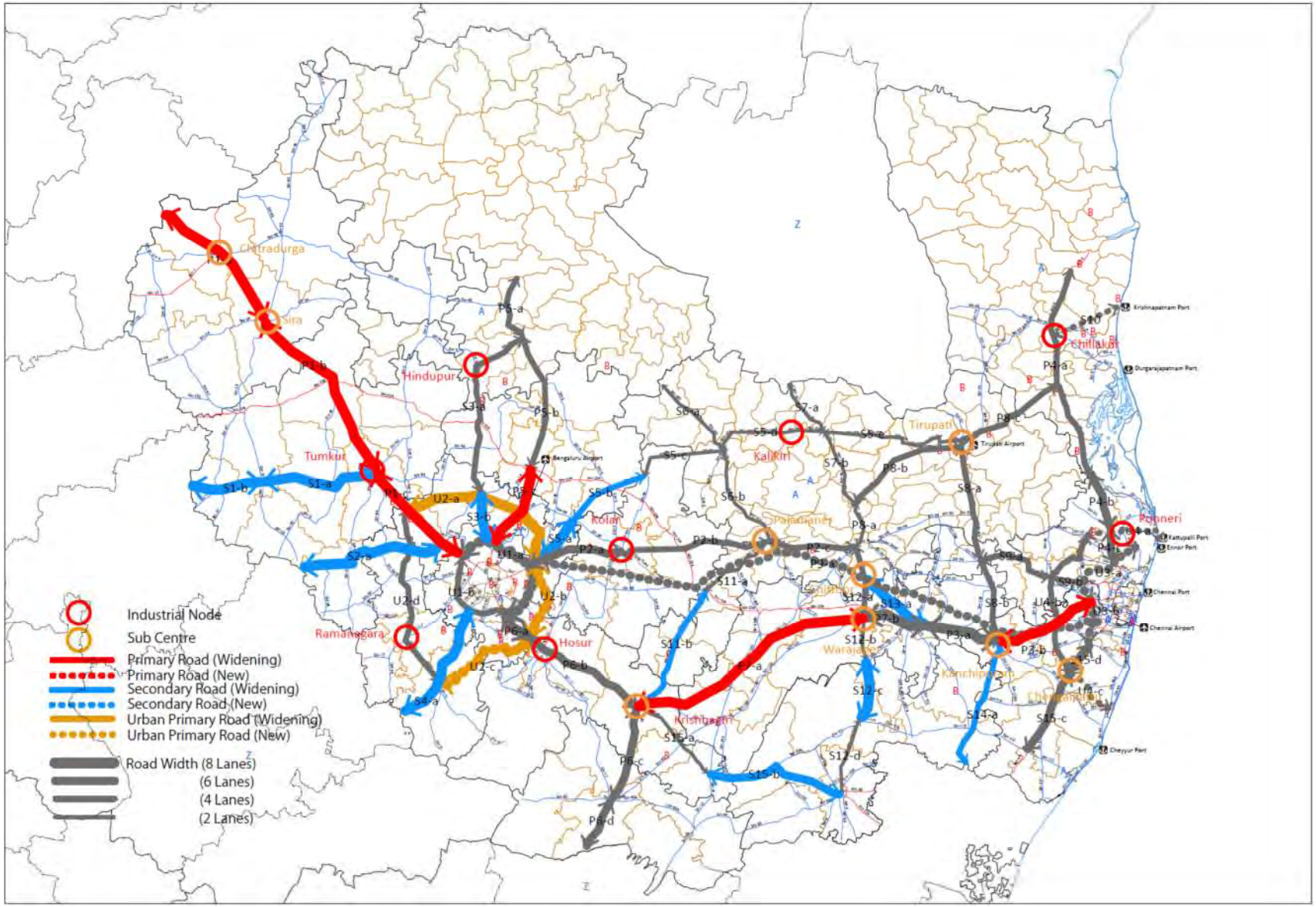
Source: JICA Study Team

Figure 6.3.19: Phasing Plan of CBIC Logistic Road Network Plan (～2018)



Source: JICA Study Team

Figure 6.3.20: Phasing Plan of CBIC Logistic Road Network Plan (2019～2023)



Source: JICA Study Team

Figure 6.3.21: Phasing Plan of CBIC Logistic Road Network Plan (2024～2033)