Comprehensive Integrated Master Plan for Chennai Bengaluru Industrial Corridor Final Report

Ponneri Industrial Node Development Plan

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Japan International Cooperation Agency

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1. Executive Summary

Corridor Development for Industrial Growth

National Manufacturing Policy (NMP) of India envisages manufacturing sector as key economic driver for realizing fast-tracked GDP growth and creation of incremental employment opportunities. In the past 10 years, Indian manufacturing has grown at an average rate of 7.3%. However it is still only 15% of Indian's overall GDP and hence assumes vast growth potential. The government had set the vision in the 2012 policy statement to grow India's manufacturing sector to contribute 25% to the nation's GDP from current 15% by year 2022. To meet the ambitious vision of the NMP and provide further boost to industrial growth, there is a need to raise global competitiveness of the Indian manufacturing sector.

The infrastructure gap in the country impacts the competitiveness of manufacturing industry. Equally, the financing and institutional capacity constraints imply that rapid build-up across all areas is unrealistic. In this context, the Industrial Corridors have been proposed to prioritize industrial and infrastructure projects in a defined regional boundary to leverage resultant agglomeration benefits. These will form the foundation for developing successful models of development to meet the 12-14% p.a. growth targets.

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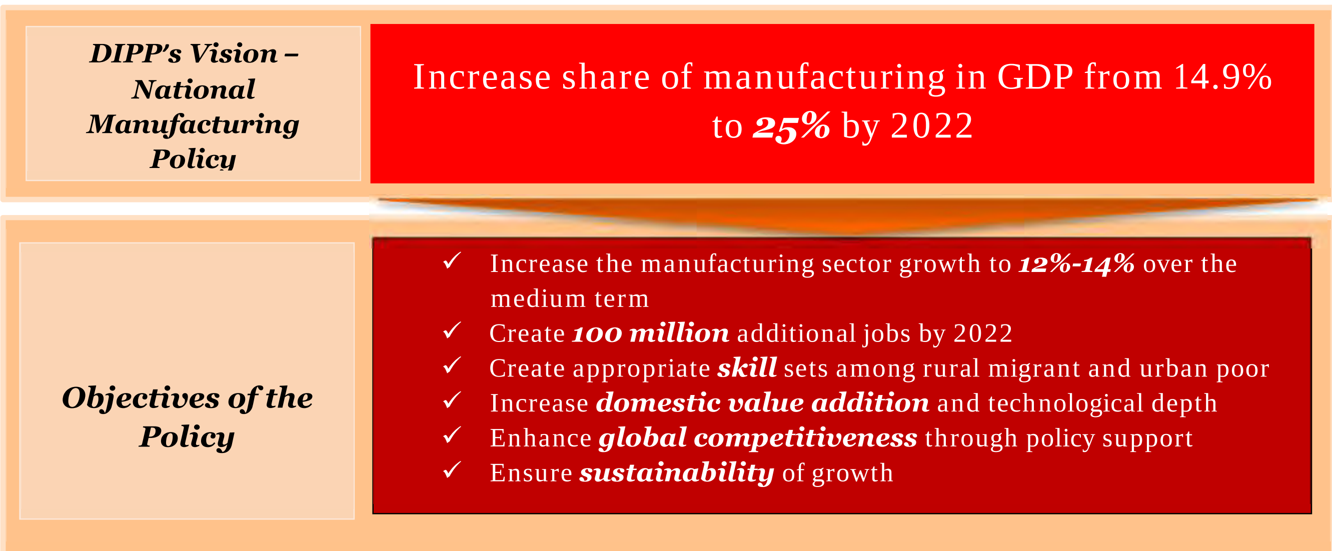


Figure 1.1: Vision and Objective of National Manufacturing Policy

The CBIC is poised to play a pivotal role in the economic development of the region and be the engine for manufacturing growth in the country.

Chennai-Bengaluru Industrial Corridor (CBIC) comprises of "sets of projects" – including industrial parks at delineated nodes, access to sufficient utilities (power, water, etc), and connectivity through road and rail, to markets, ports and airports. Such prioritized infrastructure investment in the region can yield higher economic activity in short run, as opposed to prioritizing similar projects with each line ministry independently. The plan to develop CBIC is aligned to this strategy to achieve accelerated industrial agglomeration and regional development.

The corridor is planned to cover 16 districts spread across the states of Tamil Nadu, Karnataka and Andhra Pradesh. Industrial and economic clusters of Bengaluru and Chennai are developing rapidly. There is significant interest in the region from international investors including increasing number of private Japanese companies.

CBIC Development Plan envisages enhanced regional competitiveness to attract substantial international and national capital investment

The corridor development plan envisages developing the region as a world class hub for attracting domestic and foreign investment in industries by providing world class infrastructure, required connectivity to the eastern ports, logistics infrastructure, associated soft infrastructure and policy support to allow for rapid inclusive industrial growth with sustained employment creation.

Vision for Chennai Bengaluru Industrial Corridor (CBIC)	
Global Manufacturing Center *"Be known as a global leading manufacturing center towing world economic growth and generating national employment opportunities."*	***Top Investment Destination*** *"Be one of the top three preferred investment destinations in Asia and the most preferred in India with high efficiency and competitiveness."*
Leading Innovation Hub *"Be known as the leading innovation hub and knowledge capital of India through presenting innovative progress in industrial sector."*	***Model of Inclusive Growth*** *"Exhibit a model of inclusive growth pattern and ensure high level of environmental standards."*

The success of the corridor development vision will hinge on translating hard and soft infrastructure proposals into reality. 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.

Selection of Industrial Nodes in CBIC

JICA study team, in consultation with respective state governments, had proposed eight potential destinations as Industrial Nodes to be included in the CBIC. These were based on broad views on land availability and suitability of potential zones; the following locations have been suggested as the proposed destinations for industrial nodes based on 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

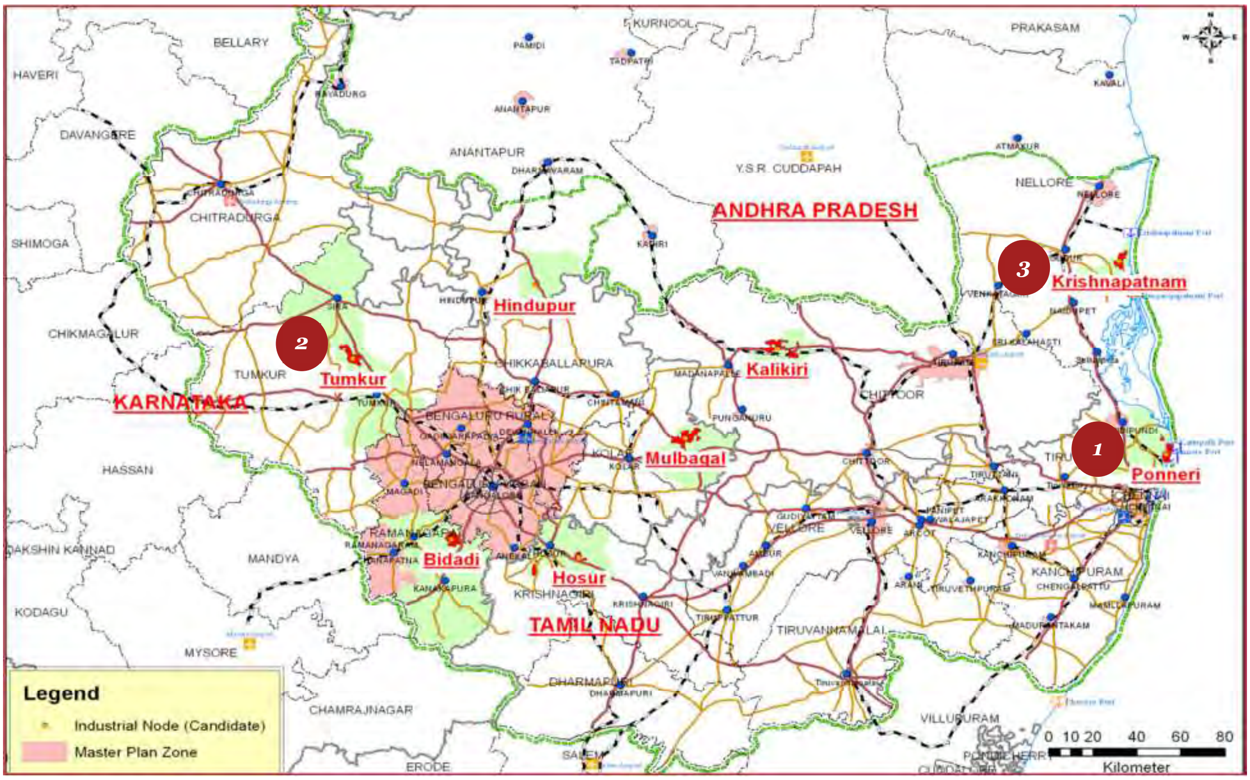


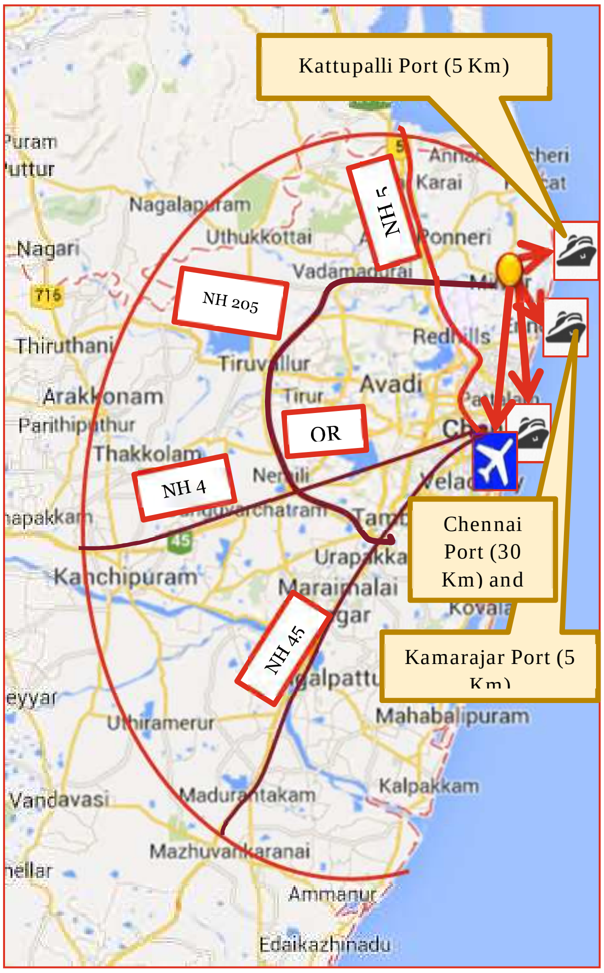
Figure 1.2: Nodes selected for CBIC including three nodes selected for Master plan development

Development of Industrial Node at Ponneri

The JICA Perspective Plan for CBIC identified Ponneri as a prospective industrial node for CBIC along with seven other nodes in Tamil Nadu, Karnataka and AP – including Hosur in Tamil Nadu.

Location Advantage in Chennai, Tiruvallur and Kanchipuram Industrial Cluster

The proposed land for Ponneri Node in Tiruvallur district located at 36 km from the city centre of Chennai. Tiruvallur district is an established industrial hub and the node in particular has the distinct advantage of proximity to all the sea ports in Chennai region. Also, the node has the advantage of being located in Tiruvallur which borders Chennai and Kanchipuram districts. These three are the most industrialized districts in the state. Cumulatively, there are 29 industrial estates in these 3 districts which are in close proximity to the node.



District/ State

- Tiruvallur District/Tamil Nadu

Distance from Metropolitan/major city

- 36 km from city center of Chennai

Accessibility to trunk road & rail network

- 10 km from SH 56
- 30 km from NH 5
- Nearest rail head is at Minjur-5 Km

Accessibility to Port/Airport

- Adjacent to Kattupalli port and Ennore Port
- 50 Km from Chennai Airport

Major industrial locations in the surrounding area

- 45 km from Gummidipoondi industrial area(600ha)
- 60 km from Thervoykandigai industrial area (320ha)
- 70 km from Sri city(2,020ha), Tada, AP/TN border

Demographic profile

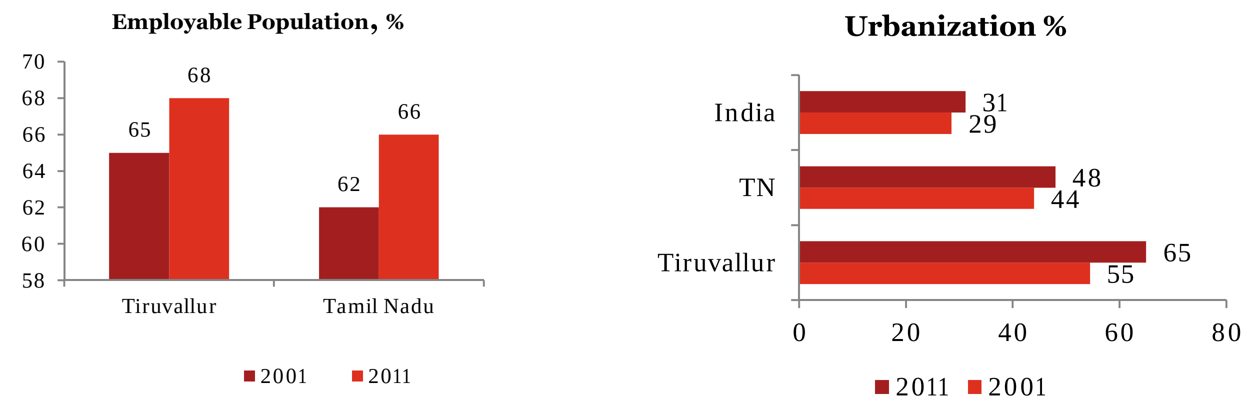
- Population density is higher than other sub-districts of Tamil Nadu (400-600 people/sq.km)
- Population-**37.28 lakhs**,
- Urbanisation level is higher than that of TN state

Source: JICA Study team

Figure 1.3: Port and Road connectivity to Ponneri node

High urbanization, great demographic dividend and large population involved in high value adding sectors are strengths to leverage upon for Ponneri Node

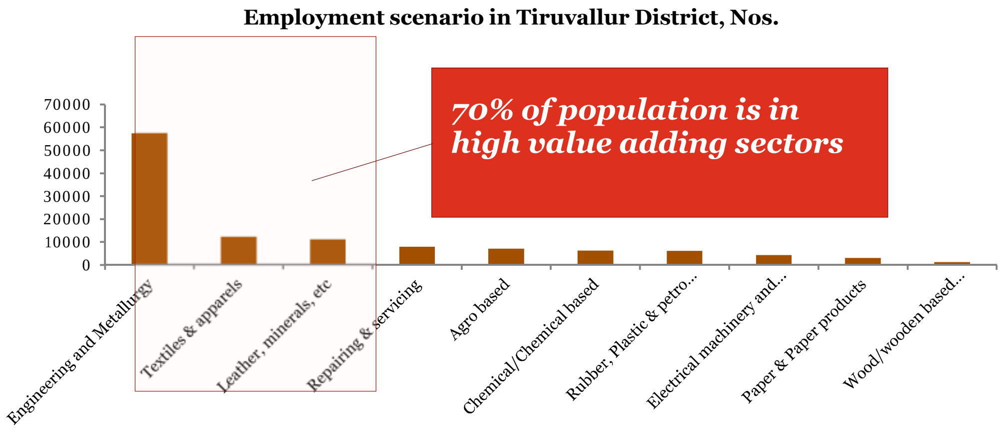
The urbanization levels in Tiruvallur district are higher than the state and national average making it suitable for industrial investment (Tiruvallur is at 55% urbanization while Tamil Nadu and India stand at 48% and 31% respectively as per Census 2011). Also, the population within the age group of 15-59 years considered to be the ones in the employable band is higher in Tiruvallur district as compared to the state's average (Tiruvallur vs Tamil Nadu at 68% vs 66%). The high demographic dividend favors Tiruvallur and makes it a good choice for development of this Industrial node.



Source: Census 2001 and 2011, PwC Analysis

Figure 1.4: Demographic profile of Tiruvallur district

About seventy percent of the working population in Tiruvallur district is employed in industrial sector which is high on value addition as compared to primary sectors. This demonstrates high degree of skill possessed by the workforce in the district placing it on a higher pedestal for industrial development.

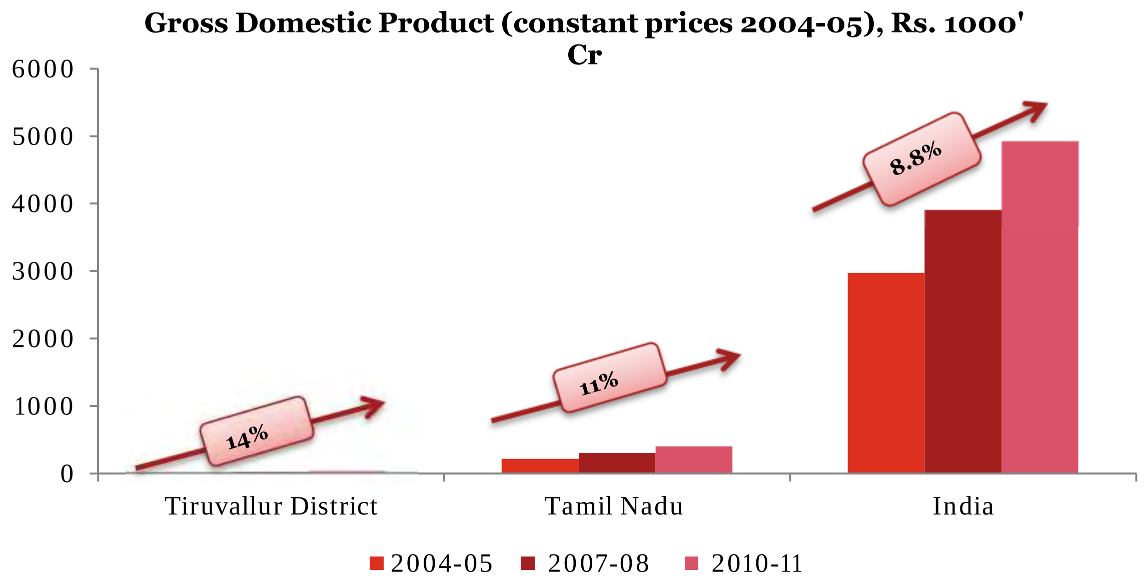


Source: Census 2011, Ministry of MSME, Tiruvallur District, GoI

Figure 1.5 Employment scenario in Tiruvallur district

Tiruvallur district economy growing at a higher rate as compared to the state witnesses a visible shift towards manufacturing in spite of a dominant service sector add to its strengths

The Tiruvallur district economy has grown at 14% CAGR in the last 10 years while the state of Tamil Nadu and the country has managed to grow at 11% and 8.8%respectively. Also, it may be observed that over the period from 2004-05 to 2010-11, the share of services sector notwithstanding its dominance has been modest at 57%-58%. A notable feature is the increasing share of manufacturing sector from 26% to 31% during the same period. This makes Tiruvallur district an eligible candidate for focused industrial development which will further extract greater economic value.



Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

Figure 1.6 Break-up of GDDP of Tiruvallur district

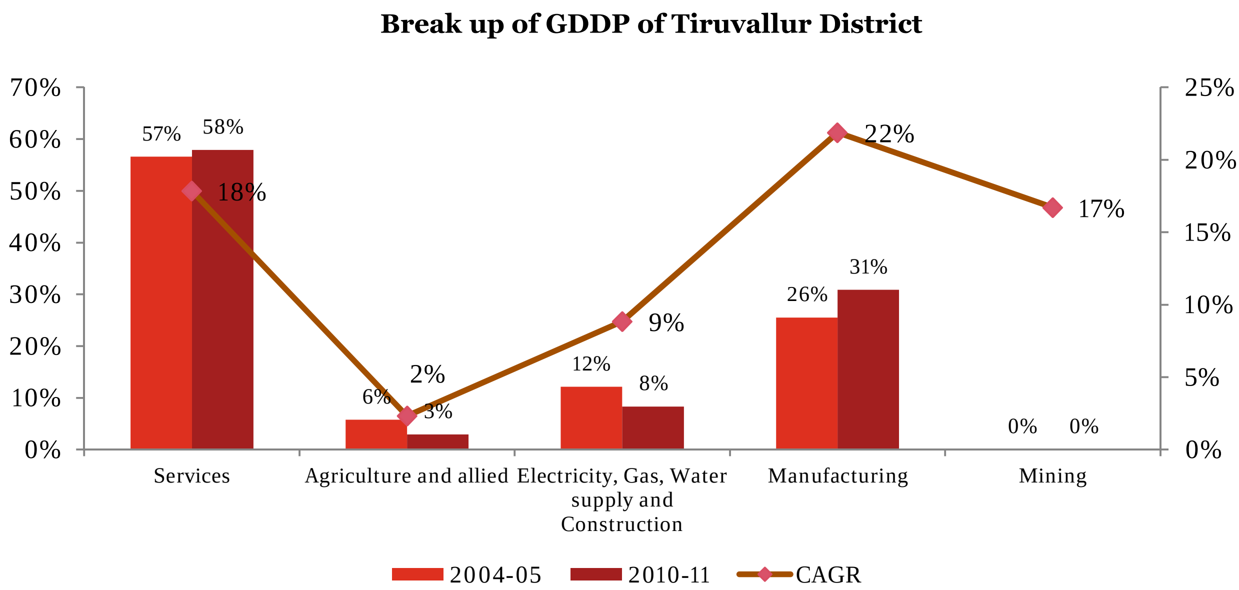
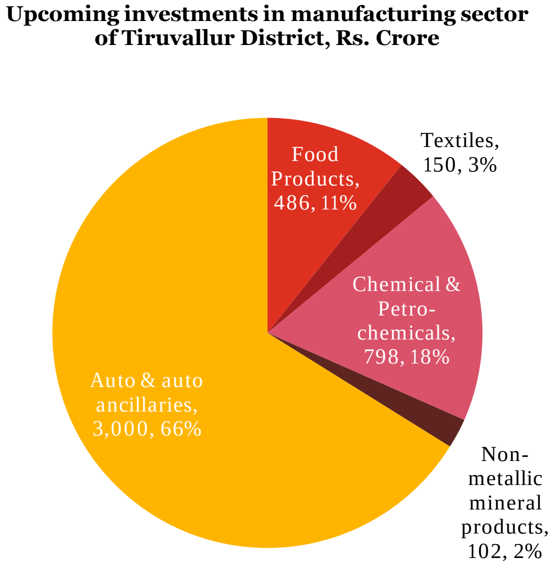


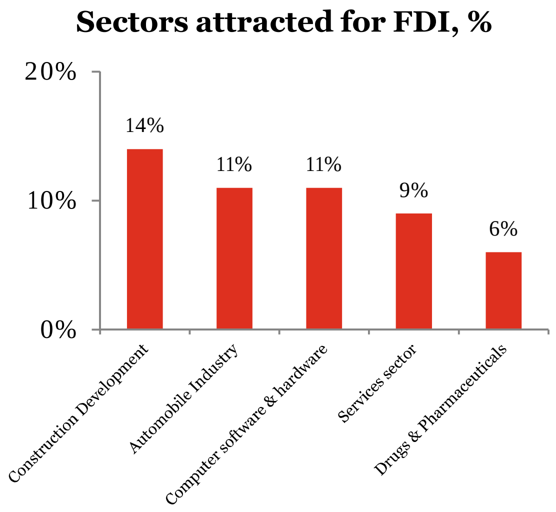
Figure 1.7 Gross Domestic Product, constant price 2004-05

The Auto and Auto components sector which contributes significantly to the state's FDI has the largest pipeline of investments in manufacturing sector lined up in Tiruvallur district

The state attracts maximum FDI from Mauritius and Singapore. However, the ultimate source of these FDI could be different owing to the tax friendly regulations of these countries. It is pertinent to note that construction development, automobile and computer software related sectors together contribute to more than a third of FDI investments into the state. The automobile sector which is the 2nd largest FDI aggregator in the state accounts for about 65% of the investment pipeline in manufacturing sector in the Tamil Nadu. As, Tiruvallur, Kanchipuram and Chennai are established automobile hubs, significant share of this pipeline is expected to land in Tiruvallur district.



Source: Capex database



Source: RBI's Regional Office – Chennai – including TN and Pondicherry as on 31-12-2012. Extracted from www.dipp.nic.in

Figure 1.8 Manufacturing investments and FDI in Tiruvallur district

As part of upcoming investments, along with the development of ***plastic park*** which is considered as a part of land use planning for Ponneri IN, the following are few more projects which are proposed to develop in the node region.

L&T Shipbuilding yard cum port complex: TIDCO has promoted a major heavy industry in the nodal area viz. a large Shipbuilding yard cum Port complex through L&T Shipbuilding Ltd., Joint Ventured with TIDCO and Larsen and Toubro Ltd. This shipbuilding has a state of the art ship lift and modern / well laid out manufacturing shops. This yard is also capable of fabricating Modular structures for Off-shore platforms. A dry dock for building large specialized carriers such as LNG Carriers and for building large commercial vessels in the next three to five years' timeline is planned to be developed as part of this shipyard.

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Heavy Engineering Hub: TIDCO is also promoting an Integrated Industrial Infrastructure in about 700 acres area for Engineering Components Manufacturing units in the Ponneri Industrial Node area. This is known as Heavy Engineering Hub. It is expected that over a 15 years' timeline, this Heavy Engineering Hub would attract a business potential of about Rs.6, 000 crores.

Development Potential

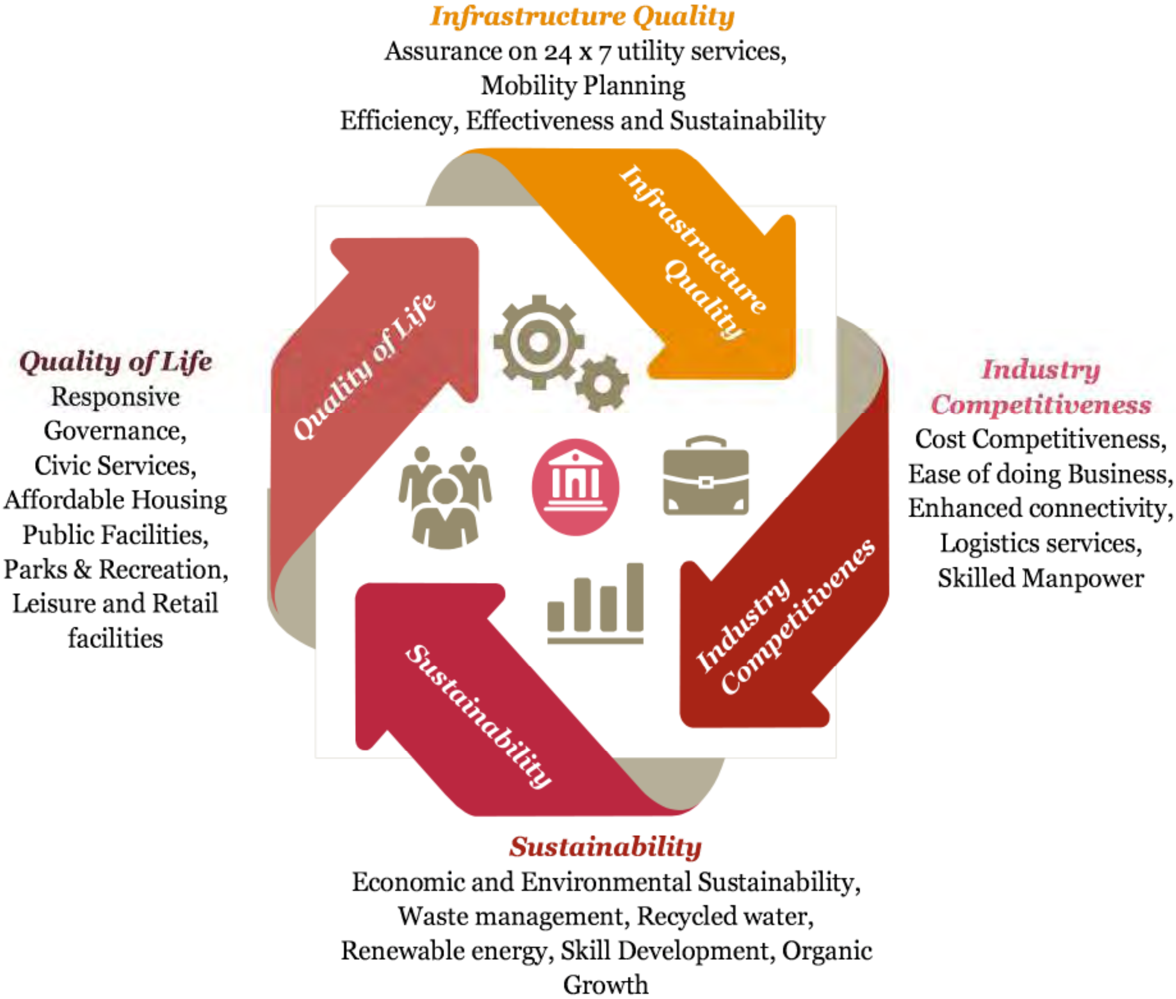
The following matrix summarizes current strategic positioning of Ponneri Node with analysis of the strength, weakness, opportunity and challenges.

Table 1.1: Development Potential of Ponneri Node

	Advantages	*Challenges*
Internal	*Strength:* ● Proximity to the Kamarajar Port (5 km) and Chennai Port (An access road construction is planned.) ● Proximity to Chennai ● Availability of workers and foreign technical experts in Chennai ● Proximity to diverse industrial clusters around Chennai ● Stable energy supply available due to thermal power stations ● Availability of coal and natural gas ● Existence of development plan of plastic industry by TIDCO ● Stored ash for land development ● Proximity to existing container freight stations & logistics facilities around the Chennai region ● Additional water resources from existing (Minjur) and potential desalination plants, and recycling water from Chennai	*Weakness:* ● Necessity of countermeasures for influence to atmosphere air condition from two existing and a planned thermal power stations ● Necessity of rising ground level in some areas ● Heavy traffic congestion due to the weak access to Ennore port (Northern Port Access Road is necessary as soon as possible) ● Limitation of surface and ground water resources ● Necessity of multi-modal logistics facilities to enable multi-modal transfer of industrial goods ● Necessity of adequate railway connectivity
External	*Opportunity:* ● Lack of capacity of high quality industrial park near Chennai for potential investors ● Availability of abundant work force from Chennai ● Lack of industrial parks directly connected to major ports within CBIC ● Growing interest of foreign investors to India due to expectation to initiatives of new regime and prime minister ● Political momentum and re-attention of foreign investors to South India due to the creation of the CBIC Master Plan ● Enhancing competitiveness of industries, especially special economic zones ● Improving logistics facilities around the node region to enable local domestic distribution networks ● Improving connectivity through ring roads could expedite movement of goods from the port to the hinterland	*Threat:* ● Rapid improvement of investment environment the north east coast area of CBIC such as Krishnapatnam in Andhra Pradesh that has a well-developed private port ● Risk mitigation efforts required considering the location close to coast ● Possibility of cost escalation for land acquisition due to dissemination of the CBIC Master Plan ● Growing congestion in and around the Chennai region, and delays in development and commissioning of planned ring roads, e.g. Outer Ring Road Phase 2 and Peripheral Ring Road

Vision for Ponneri Node - Building Competitiveness

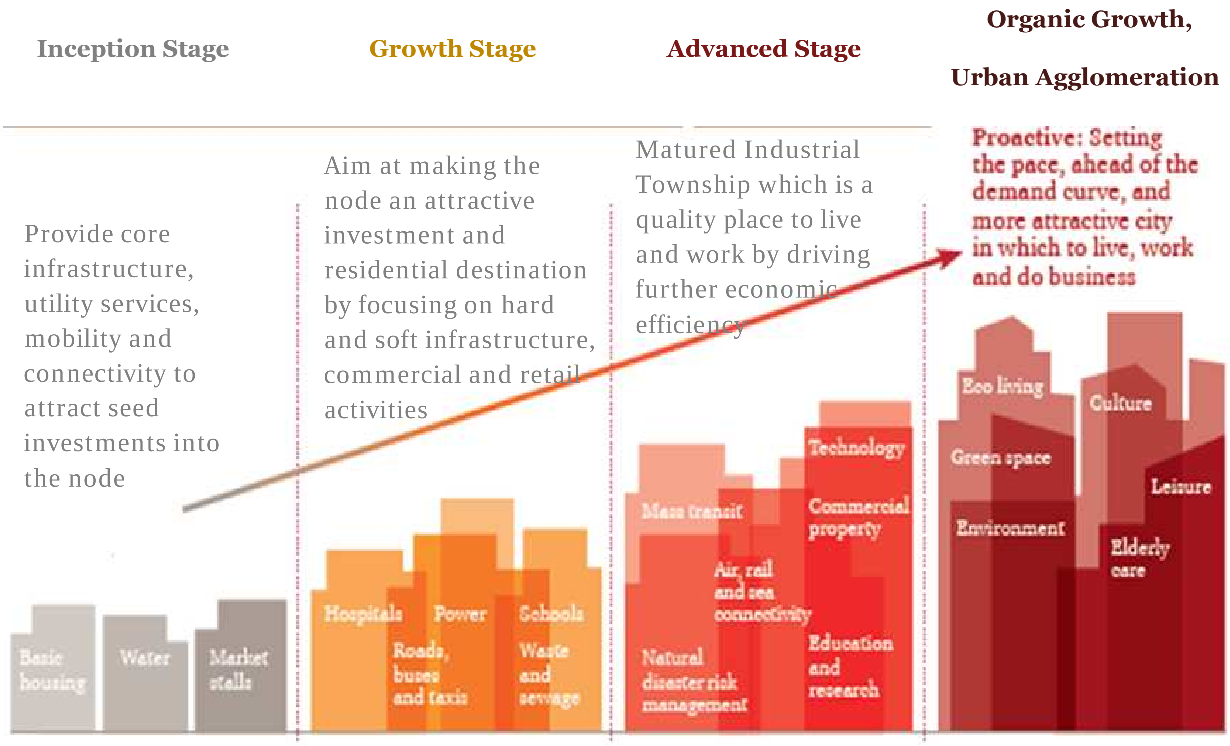
Study team identified the targeted functions to be strengthened and key driving forces for Ponneri Node as below.



Source: JICA Study Team

Figure 1.9: Core Functions to be developed for Ponneri Node

The Master Plan for Ponneri has been developed to allow for a phased growth over 20 years period, starting from the present mix of Greenfield and accommodation of brownfield development (planned by existing infrastructure agencies in the node) stage to advanced industrial city stage over the planning period.



Source: PwC "City of Opportunities"

Knowledge Park in the node region

Knowledge Park will provide an environment for innovation and developments in various fields. Such kind of park in the node region would create space for growth and enhancement in the relevant industrial sectors. Obtaining the right anchor tenants is important to ensure the sustainable operations of the park. Having tenants with a brand recognizable in the country or in the international environment presents the park as a conducive business platform and an attractive investment destination for other high value investors.

Knowledge Park can be integrated and developed as a part node establishment. Along with the four components (Infrastructure quality, industry competitiveness, sustainability and quality of life) taken care in the node, human capital establishment with right combination of skills for the industries would enhance the livability and sustainability in the region.

Industrial Development Vision

Out of the sectors that have been identified for CBIC region development, the following sectors were identified based on the inherent strength of these sectors in Tiruvallur district. Traditional sectors have been identified based on historic investment and activity in the district. Potential sectors are those that are still in the nascent stages but have a promising future.

Traditional Sectors for Ponneri Node

- Automobiles and Auti components
- Chemicals & Petrochemicals
- Machinery
- Computer, electronic and optical products
- Metallurgy
- Textiles & Apparels

Potential sectors for Ponneri Node

- Electrical Machinery
- Pharmaceuticals
- Medical Equipment

We have conducted an in- depth assessment of the most important of the traditional sector group and have identified the area/ elements to be focused on, for development of these sectors in Ponneri node and the key findings from the same are presented below.

- Auto and Auto components
- Chemicals and Petrochemicals
- Machinery
- Computer Electronics and Optical products

Auto and Auto Components

The following is the summary of the growth drivers for the auto and auto components sector and followed by the challenges currently being faced by the sector.

Drivers for Growth

- High growth in consumer demand
- Potential global demand for smaller cars
- Presence of major OEM players, Tier-I, Tier-II suppliers in region
- Connectivity to Ports
- Availability of large tracts of industrial land
- Proximity to R&D base

Issues and challenges

- **Price competitiveness is Low** - cost of manufacture of a passenger vehicle in China is 23% lower than in India owing to higher taxes and their cascading impact in India.
- **Connectivity issue-** Connectivity to ports and quality of ports requried to promote export in auto and auto component industry.
- **Labour issue -** Current labour laws are too favourable to unions.

Key recommendations for the development of the sector in Ponneri Node are summarized as below.

Table 1.2 Summary of key recommendations for auto and auto components sector

Components	Issues	Key factors of strength/consideration
Economic Enhancers		
Proximity to port	• Availability of port infrastructure is essential FoP for the sector • Evacuation at port and last mile connectivity delays transportation	• The location of Ponneri node has a strategic advantage for transportation facilities. It is located in close proximity to both Kamarajar and Kattupalli Ports. • The proposed Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area.
Road	• Although there is a potential growth export market, port connectivity and quality of port is sufficient enough to handle automobile export activities. • Some parts are precision. Since bad condition of road, package cost is high to protect products, otherwise they get damaged. • Suppliers often fail to deliver parts to OEMs just in time.	• Chennai-Bengaluru Express Way should be considered as priority to enhance connectivity to Chennai Port. • Dedicated Freight Corridor may be considered as priority to enhance connectivity to Ports. • Extending the connectivity with Chennai Metropolitan Area through NH-5 or SH-56 to the south is also planned. This needs to be expedited and is critical for the success of the node • Planned for 4-lane internal roads for both industries and residential access.

Components	Issues	Key factors of strength/consideration
Power	• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • Provide alternate sources of power • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Planned for 29 sub-stations within the node to have uninterrupted power supply.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• The logistics hub of 166,859 sq. m is planned for storage of freight within the node which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop.
Value enhancers		
R&D facilities	• Products need to be innovative and efficient to match global trend that is shifting towards efficient and more eco-friendly vehicles. However, since the sector remains unorganized, the effort towards R&D is not focussed and thus latest technology is not implemented. • Strong IPR protection is required to encourage R&D activities. However, Legal framework of IPR is weak, and not enforcement. Foreign investors usually are not willing to transfer their technology to domestic companies.	• GoTN should promote R&D activities through fiscal incentives and also through promotion of tie ups between industry and academia. • GoTN may promote IPR awareness by seminars or workshops on IPR • National Automotive Testing and R&D Infrastructure Project (NATRiP) has been established in Oragadam near Chennai by Ministry of Heavy Industries & Public Enterprises. This is about 30 km distance form Ponneri Node. • TN Skill Development Corporation should facilitate the integration of technical skills of the youth with the industry.
Availability of indigenous testing facilities	• Inadequate infrastructure for Research and development in the sector • 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 • Augmentation on certified testing centres for products and raw materials to reach BIS standards.
Administrative enhancers		
Ease of doing business	• Delays in obtaining clearances from pollution control board which hampers the smooth functioning of plant.	• Simplification of licensing system • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all clearances required by any industrial unit.

Components	Issues	Key factors of strength/consideration
Policy and regulatory framework	• 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.
Workforce/ labour	• Approx. 40% is contract workers. Labour productivity is less due to instability of contract workers. • The productivity in auto ancillary segment which is prominent in Tiruvallur district is on the lower side compared to national average. • Labour laws are not flexible.	• GoTN may consider relaxation of labour laws in case of contract labour wherein they are deemed to be permanent if worked more than 450 days which may not be required. • GoTN may consider introducing incentives to industries for recruitment, training and wages to support labour productivity.

Chemicals and Petrochemicals

The following is the summary of the growth drivers for the auto and auto components sector and followed by the challenges currently being faced by the sector.

Drivers for growth

- Increased consumption intensity
- Increasing demand for exports
- Impoved consulption standards

Issues and Challenges

- Limited feedstock availability including natural gas and napha
- Infrastructure constraints including port, railway and pipelines
- Dispersed clusters
- R&D facilities
- Administrative structure and traxation

Key recommendations for the development of the sector in Ponneri Node are summarized as blow.

Table 1.3 Summary of key recommendations for Chemicals and Petrochemicals sector

Components	Issues	Key factors of strength/consideration
Economic Enhancers		
Proximity to port and raw material	• Availability of port infrastructure is essential FoP for the sector	• The location of Ponneri node has a strategic advantage for transportation facilities. It is located in close proximity to both Kamarajar and Kattupalli Ports. These enable the import of feedstock in close proximity. • The Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area. • The master plan provides for 4-lane internal roads for both industries and residential access.

Components	Issues	Key factors of strength/consideration
Water	• One of the highest consumers of water –	• As per demand estimates about 1199 acres are likely to be taken up by chemicals and petrochemical industry in the node by the year 2033. This requires very high quantum of industrial water for operations. Sources with capacities greater than 500 MLD have been identified in the region. Though not dedicated, these sources can sufficiently serve the requirement of potable and non-potable water in the near term for the mix of industries in Ponneri node. • Minjur desalination plant, WTPs in Chennai Metro Area, new desalination plant, and recycled water from Kodungaiyur STP and secondary treated sewage from STPs are the sources of water identified for Ponneri Node.
Environment	• Development of port, other industries disrupts production • Lack of drainage for common water for the industries	• Careful planning of new industries is required as the segment is highly sensitive to water contamination • Introduction of green principles in manufacturing is to be promoted • Common effluent treatment plant can be developed by the government for similar industries within the district
Power	• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • Provide alternate sources of power • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Current plan provides for 29 sub-stations within the node to have uninterrupted power supply.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• The logistics hub of 166,859 sq. m is planned for storage of freight within the node which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop.
Value enhancers		
R&D facilities	• International practice suggests availability of R&D facilities for new product development within industrial park	• R&D laboratories can be proposed to serve the product development requirement of this industrial node as well as other chemical & petrochemical units within CBIC/country
Availability of indigenous testing facilities	• Inadequate infrastructure for Research and development in the sector • Local players do not have enough capital to set up testing facilities as the investment required is huge.	• There is a need to facilitate setting up of indigenous testing and calibrating facility for equipment testing • Upgradation of certified testing centres for products and raw materials to reach BIS standards. • A testing canter for petroleum and chemical products needs to be established within the industrial area of the node. The testing center at Guindy in Chennai would be the closest to the node at present. • A Specialty Chemicals Forum needs to be established with representation from industry, customers and the

Components	Issues	Key factors of strength/consideration
		Government. This forum will study other countries' regulations and develop consumer standards, and work towards their introduction and implementation.
Recycling of water and provision of ETP	• Since the sector is highly water dependent, recycling and reuse of water would suffice the need.	• Promote industry based on efficiency; incentivize industry players to follow best practices of manufacturing like higher efficiency, latest technologies • Promote technologies such as 'zero discharge' of industrial effluents. • A hazardous waste treatment and disposal plant is proposed in the master plan for this purpose.
Administrative enhancers		
Ease of doing business	• Delays in obtaining clearances from pollution control board which hampers the smooth functioning of plant.	• Simplification of licensing system • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all industries required by any industrial unit.
Policy and regulatory framework	• Availability of minimal industrial licensing for hazardous chemicals.	• Government is continuously reducing the list of reserved chemical items for production in the small-scale sector, thereby facilitating greater investment in technology upgradation and modernization.

Machinery

The following is the summary of the growth drivers for the auto and auto components sector and followed by the challenges currently being faced by the sector.

Drivers for Growth

- Growing power sector
- Accelerated infrastructure expansion and growing urbanization
- Growing Telecom Industry
- Farm mechanization
- Increasing FDI
- Nuclear capacity addition

Issues and challenges

- **Import Oriented Trade**
- Availability of raw materials
- technological constraints
- Infrastructure constraints
- Uninterrupted power supply
- Availability of Indigenous testing facilities

Key recommendations for the development of the sector in Ponneri Node are summarized as blow.

Table 1.4 Summary of key recommendations for Machinery sector

Components		Issues	Key factors of strength/consideration
Economic enhancers			
Connectivity	**Rail**	• Rail connectivity is necessary to transport over dimensional consignments (ODC) and avoid problems in transporting heavy and ODC >98 MT on NHAI bridges. • Availability of rail sidings as a last mile connectivity to the main rail network is also essential	• Increasing rail network connectivity is a necessary requirement to transport ODC cargoes • The logistics hub of 166,859 sq. m has been planned for storage of freight which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop. • Current plan includes 5.1 km of access line to the node. • The construction of the proposed Northern Rail Link between Minjur and the new container terminal at Ennore Port will be essential to allow the development of a rail access to Ponneri node.
	Road	• Availability of port infrastructure is essential FoP for the electrical machinery units • The segments dependent on require proximity to ports as their raw material is imported	• Ensure seamless connectivity to port • The Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area. • Extending the connectivity with Chennai Metropolitan Area through NH-5 or SH-56 to • Planned for 4-lane internal roads for both industries and residential access.
Power supply		• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Planned for 29 sub-stations within the node to have uninterrupted power supply.

Components	Issues	Key factors of strength/consideration
Value enhancers		
Availability of indigenous testing facilities	• Inadequate electrical equipment testing facilities in the country • 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 in the node, which can become a testing facility center for the state as well as neighbouring states
Availability of Critical Raw Materials	• 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 the long run government should promote and ensure setting up units manufacturing CRGO and CRNGO electrical steel in the country to remove dependency on raw material imports • There are established engineering clusters with established business environment and supply chains in the state – Chennai, Tiruvallur, Kancheepuram, Vellore, Dharmapuri, Coimbatore, etc. It makes it attractive for new units to enter.
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • 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
Administrative enhancers		
BIS certification guidelines	• Electrical industry is largely dependent on imported electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported 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 • BIS certifications guidelines to be modified to avoid delays in registration of foreign suppliers
Technology upgradation and modernization	• Current level of technology adopted in the sector is not up to the world standards leading to low productivity and high process time • The sector is known for large	• Under existing STI Policy 2013 assistance to MSMEs in installing modern machinery should be extended – funding solutions to MSME units at competitive rates encourage technology upgradation

Components	Issues	Key factors of strength/consideration
	number of MSMEs involved as vendor base for large units • Access to technology is limited for MSMEs and sighted as one of the constraints by sector stakeholders	and modernization • Modifications to the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery manufacturers are to be introduced • The State Government have formed the TamilNadu Skill Development Mission (TNSDM), which will enter into partnership with industry to identify skill gaps and design course material leading to Modular Employable Skills (MES) Certification or other industry acceptable Certification.

Computer Electronics and Optical Products

Computer Electronic & Optical (CEO)

The following is the summary of the growth drivers for the auto and auto components sector and followed by the challenges currently being faced by the sector.

Drivers for growth

- Strong sector support from Centre, inverted duty structures corrected in Budget 2015
- Reduction in VAT for mobile phones in TN state Budget 2015
- High domestic market growth
- Well developed eco-system around Bengaluru
- Availability of skilled labour
- Strong support by State Government

Challenges and Issues

- ***Logistics Costs*** - High cost of power, logistics, transaction cost (tax and custom duty structure) etc.
- ***Difficulties in 'Just in time' supply*** **-** Inadequate infrastructure such as bad roads, higher turn- around time of ports and railways

Key observations for the development of the CEO sector in Ponneri Node are summarized as below.

Table 1.5: Summary of key recommendations for CEO sector

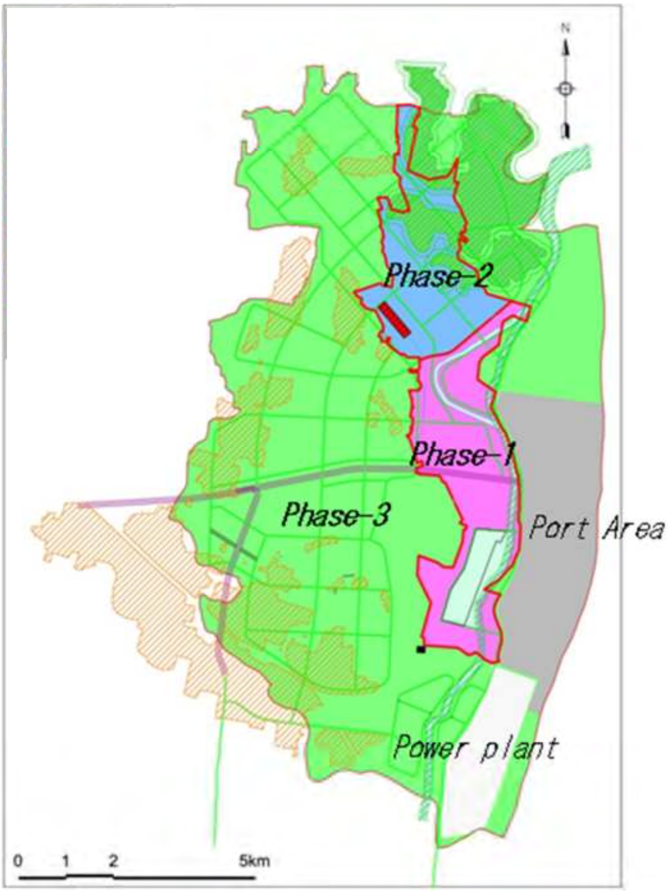
Components		Issues	Key factors of strength/consideration
Economic enhancers			
Connectivity	Road	• Some parts are precision parts and get damaged due to bad condition of road, • Difficulty in just in time supply • Connectivity to Airport	• External connectivity to the node planned via Northern Port Access Road. • Connectivity to existing airport to be achieved through the Outer Ring Road and
	Rail	• Rail transport has no guaranteed delivery time by Indian Railways.	• Dedicated Freight Corridor may be considered as a CBIC priority project. The operation of DFC needs to be efficient

Components	Issues	Key factors of strength/consideration
		with delivery ensured in time bound manner.
Power	• High tech manufacturing needs uninterrupted and assured power supply	• To ensure that the planned power generation projects come up in time. • Transmission and Distribution network within the node has been planned as part of the master plan preparation.
Logistic	• Need improved ports connectivity, road network and warehousing capabilities to build capacity for future • Warehousing and cargo handling facilities at Airports	• Invite logistics firms as synergistic and optional tenants to set-up base in ear-marked clusters within the node • The new airport planned at Sriperumbudur needs to be state of the art which should accommodate the specific needs of this sectors' international air cargo transportation requirements.
Urban Transport	• Inadequate public transportation to Ponneri Node for commuting	• Extension of Chennai Metro Rail and upgradation of suburban rail network on the Chennai-Gummidipoondi line has been suggested
R&D promotion	• Products need to match global trend	• R&D activities promotion through fiscal incentives to make it inclusive and to ensure participation from small time players. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged for exchange of ideas and sharing of infrastructure.
Cluster development/Technology infrastructure	• Higher landed cost for raw material procurement due to absence of component supply base. • Need centralized testing and certification agencies and additional support	• High tech park with global standards may be established
Hi tech manufacturing skill	• Requires adequately trained manpower for hi-tech manufacturing	• Training institutes for on-demand training be established • Establish with foreign investment and partnerships
Administrative enhancers		
IPR regime	• Strong IPR protection is required to encourage R&D activities.	• Promote IPR awareness by seminars or workshops on IPR
Quality control	• It is mandatory to obtain BIS certification to manufacture.	• GoTN needs to ensure smooth application process

Land Use Plan

Delineation of the Node

The node covers a total area of 21,966 acres. Of this, the areas marked as Phase 1 and Phase 2 in the diagram below is 4,480 acres, which covers the land already in the possession of TIDCO and the Salt Department. This land will be taken up for development initially on priority; its boundary is shown below (the red line). The boundary has been proposed in consultation with nodal agency. Overall, the entire node is proposed to be developed completely over 20 years. The node area boundary is indicated by the green line. The node area comprises ten villages (Kalanji, Kattupalli, Puzhidhivakkam, Vayalur, Kattoor, Ebrahampuram, Athipattu, Ennore, Neidavoyal and Nandiampakkam).

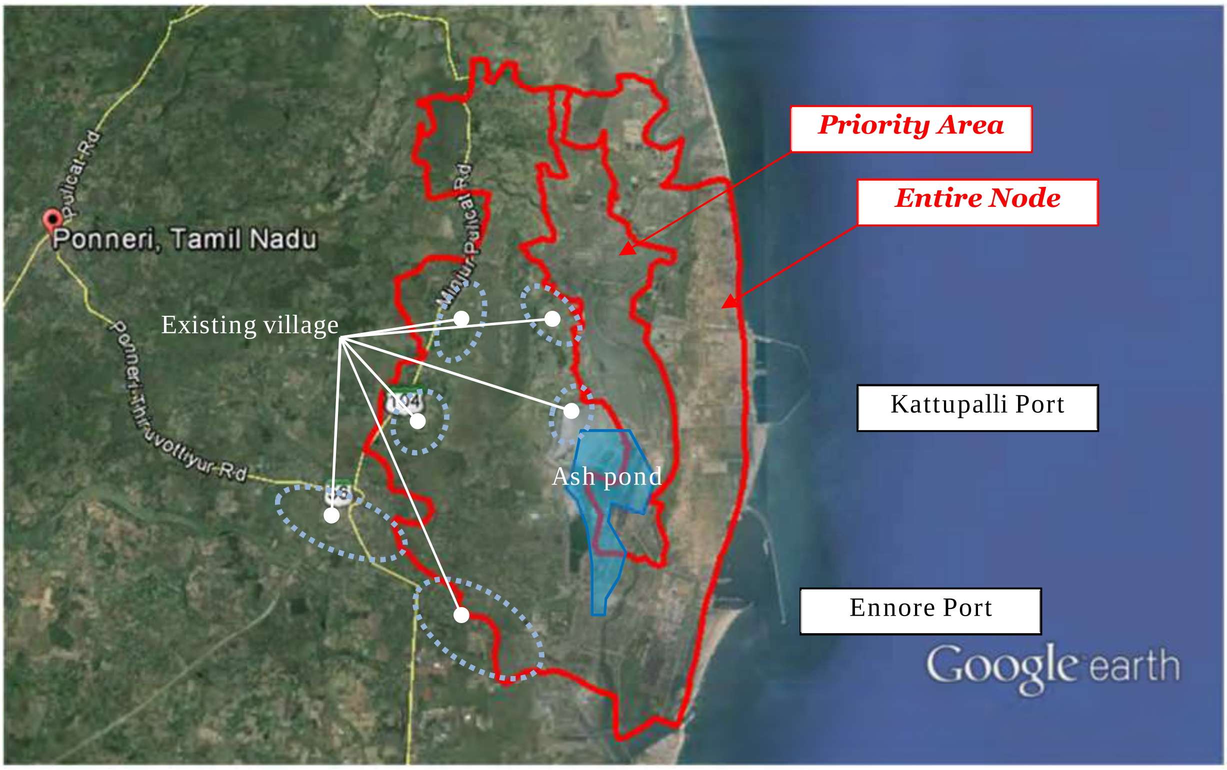


Source: JICA Study Team

Figure 1.10: Node Boundary and Priority Area Boundary of Ponneri

Current Land Use

The current land use pattern and distribution of settlements are indicated in the figure below:



Source: JICA Study Team

Figure 1.11: Priority Area of Ponneri Node

- Salt manufacturing is one of the main local industries in this area. Hence, there are salt fields at some locations across the area.
- A few settlement areas are located outside the priority area.
- A wide canal passes through the site; the port areas are on the east side of the canal.
- Ennore Port and Kattupalli Port are located along the coast; two thermal power plants and a 100 MLD desalination plant are also located near this site. In addition, a coal yard is located next to the ash pond. The southern part of the site is mainly utilised for industrial purposes.
- A few mangrove forest areas are located along the canal. However the areas are limited.

Land Acquisition Status

In Phase 1 & 2, TIDCO own 950 acres, i.e. 21% of total priority area (4480 acres). The land acquisition for the remaining priority area is yet to be completed by TIDCO (except existing built up areas such as CPCL Desalination plant and coal terminal).

Land in the rest of the node (i.e. 21,163 acres outside the priority area) needs to be acquired subsequently.

Table 1.6: Land Acquisition Status of Ponneri Node as of July 2014

Area		Acquisition Status	Remarks
Priority Area	*384.6 ha (950 acres)*	Completed	Land owned by TIDCO
	1101 ha (2720 acres)	Yet to be Acquired	Land owned by Salt Department and private owners
	162 ha (400 acres)	-	Others (includes water body, canal, etc.)
	165.182 ha (408 acres)	-	Land owned by CPCL and Coal Terminal
	1,813 ha (4,480 acres)	Partially Completed	Out of this land only 2522 acres to be used for Industries
Overall NODE Area	***8,565 ha (21,163 acres)***	Yet to be acquired	Some of the lands are covered by existing industries, ports, existing village settlements, water bodies etc. and should be excluded during acquisition. Only 7130 acres to be allotted for Industries and 2604 acres for Residential development. Rest of the land
Total	***8893 ha (21,966 Acre)***		This figure of 21,966 acres (not necessarily the sum of Phase 1,2 and 3) excludes undevelopable area (need not be acquired) of 4300 acres. Further, land available with other establishments etc when excluded, this 21966 further reduces to 13581 acres to be used for Industrial, Residential development and common infrastructure

Review of Existing Development Plan

There are several existing industries within the Ponneri Node and its vicinity. However no integrated plans have been prepared and the projects have been developed as standalone projects sans integrated planning. Therefore, it is essential to have an integrated and comprehensive plan for the area's development. The items to be considered and proposals are summarized below:

Table 1.7: Items to be considered in Existing Plan (Ponneri)

Bottle necks	Proposal
Transportation	
• Railway access to the priority area is not available.	• Rail access has to be planned. In addition, a logistics centre is required to ensure seamless freight transfers.
• Connectivity from NH-5 to port is weak	• Smooth implementation of the "Northern Access Road" development and widening of other state highways are needed to increase the development potential of the area.
• A lack of public transport facilities, since there are very few habitations in the area.	• Frequent public transportation connections Chennai have to be proposed to attract skilled and unskilled workers for the Node.
Land Use	
• Residential development may not be suitable in the coastal area of the node, due to accumulation of industrial development (e.g. Two thermal power plants, Cement plants and Liquefied Petroleum Gas bottling plants are under operation)	• However, Industrial development can be encouraged due to the presence of existing heavy industries. For example, chemical plants or metal industry facilities are suitable for the area, since the site is very close to ports.
• Water logging area is spread in some areas along the existing canal	• Improvements to the canal have to be carried out to enhance industrial development potential.

Source: JICA Study Team

Projected Industrial Land Demand

Considering appropriate development scales and discussion with nodal agencies, JICA Study Team proposes to develop the node in three phases; Phase-1 (2016-2019) and Phase-2 (2020-2024) for the Priority Area, and Phase-3 (2025-) for the remaining areas.

Based on industrial analysis for Ponneri Node by JICA Study Team, the major future industries will be traditionally strong sectors including "Auto", "Chemical & Petrochemicals", "Machinery", "Computer, Electronic and Optical products", "Metallurgy", "Textiles & Apparels", and other potential industries. The estimated land demand of those industries to achieve the growth scenario is shown in the following table.

Table 1.8: Land Demand of Ponneri Node

(unit: acre)

		Phase-1 (2016-2019)	Phase-2 (2020-2024)	Phase-3 (2025-)
Traditionally Strong Sector	Auto	388	1600	3613
	Chemical & Petrochemicals	71	290	656
	Machinery	173	713	1610
	Computer, electronic and optical product	49	203	458
	Metallurgy	33	137	310
	Textiles & Apparels	74	305	689
	(Sub-total)	788	3247	7336
Potential Sector	Medical equipment	66	271	611
	Electrical Machinery	66	271	611
	Pharmaceuticals	66	271	611
	(Sub-total)	**197**	**812**	**1834**
Total		985	4059	9169

Source: JICA Study Team

Projected Population

The future population of the node, consisting of the working population and residential population was projected in conjunction with the projected land offtake. Consequently, the working population is estimated at 888,074 with 400,000 people be resident population within the Ponneri Node in 2033-34.

Table 1.9: Population Framework

	Phase-1 2016-19	Phase-2 2020-24	Phase-3 2025 onwards
Working Population	90,665	373,475	888,074
Residential Population	0	0	400,000

Source: JICA Study Team

Land Use and Phasing Plan

Based on the development framework and the development concepts above, the required area for each land use category in the priority area and the whole node area is estimated as the following tables.

Table 1.10: Estimation of Developable Area for Ponneri Node (Priority Area)

No.	Item	Area		Remarks
1	**Developable land**	1,232.3ha	3,045 acres (2,522 acres)	20% of remaining land for road network 3,045(acres)*0.8=2,522(acres)
2	**Mangrove colonies**	60ha	149 acres	URDPFI Guidelines 2014 Ministry of Urban Development, P-240, Table6.6 Industrial area/SEZ
3	**Canal and water bodies (Include CRZ Area)**	151ha	373 acres	—
4	**Chettinad Coal Terminal**	258ha	258 acres	—
5	**CPCL Desalination Plant**	61ha	150 acres	—
6	**Plastic Industrial Park**	124ha	306 acres	—
7	**TIDCO Land**	66ha	162 acres	—
8	**Arterial Road (Existing Plan)**	15ha	37 acres	—
	Total	**1,813ha**	**4,480 acres**	—

Source: JICA Study Team

Table 1.11: Estimation of Developable Area for Ponneri Node (Proposed Area)

	Total (Acre)
Industrial area	9,652
Residential area	2,604
Existing settlement	2,186
Infrastructure(road & plant)	1,325
Water body & green area	1,610
Others	1,871
Total	**19,248**
Existing Port area	2,718
Grand Total	**21,966**

Source: JICA Study Team

Infrastructure Development Plan

Overview

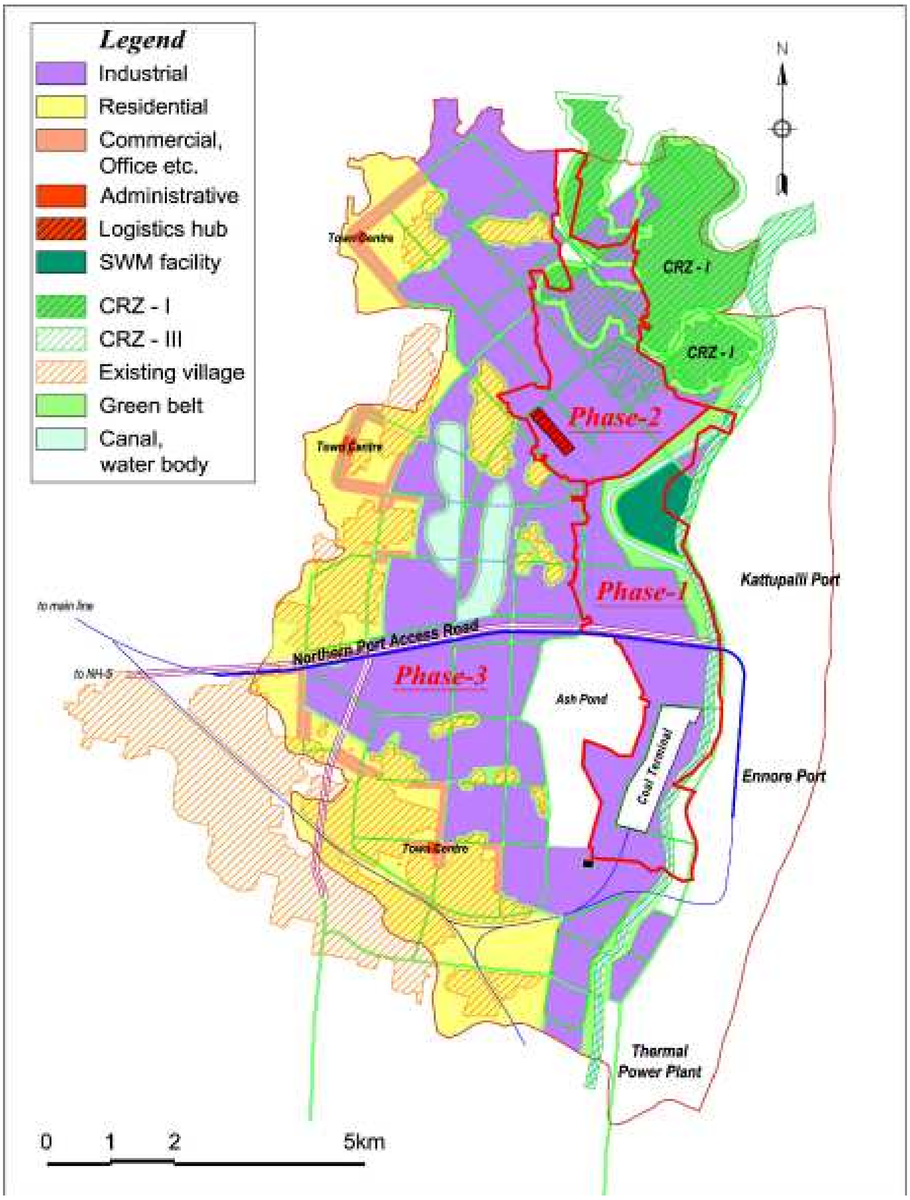


Figure 1.12: Infrastructure Development Plan

Road

Current Situation

Major industrial linkage to/from Ponneri node will be developed with Chennai, Bengaluru, Chennai Port, Ennore Port, Krishnapatnam Port and Sri City. These linking roads are either of four or six lane capacity. There are few congested road sections on major industrial linkage to/from Ponneri node based on volume capacity ratio at present condition. Traffic congestion basically occurs on roads located in city area of Chennai and Bengaluru, while other roads are not congesting at present condition.

External roads near Ponneri node are Port Access road, NCTPS Road and SH56. Port Access Road, NCTPS Road and SH56 via NH5 are currently main access road of Ponneri node. Present road condition of NH5 and Port Access Road, NCTPS Road, and SH56 are fairy maintained. As for internal road, some road sections are being constructed with either two or four lanes.

External roads of Ponneri node are being developed and those roads are likely to be in operation by the year 2016 through: i) direct connectivity from NH5 (A direct connectivity from Thachur on NH-5 to Ennore Port and Kattupalli Port (Northern Port Access Road)), and ii) Chennai Outer Ring Road (ORR).

Demand Supply Analysis for External Node Infrastructures

Demand supply gaps of main access routes connecting to the three access points of Ponneri node are estimated and utilization of railway is proposed for access route of access point B and C because V/C are 1.13 and 1.54, respectively, in middle term without utilization of public transport. Existing railway stations are located near access point B and C and planned railway capacity of the railway is adequate to accommodate node related passengers. Result of demand supply analysis for all access points are shown in the following table.

Table 1.12: Result of Demand Supply Analysis by Access Points

Year		2019			2024			2034		
Access Points		A	B	C	A	B	C	A	B	C
Number of Lanes (Access Road)		4	4	4	4	4	4	4	4	4
Demand Supply Gap (V/C)	Roads	0.18	0.32	0.44	0.44	0.78	1.01	0.53	0.90	1.02
	Railway		0.31	0.48		0.59	0.93		0.39	0.62

Source: JICA Study Team

Framework for Infrastructure Development for Node Development

Four principle development issues on roads and public transport sector are established based on present condition and future traffic demand of the sector and the development vision as follows:

- Promotion of Public Transport : Promotion of public transport, development of pedestrian and cyclist facilities, and development of transfer facilities among different transport facilities
- Smooth Transit in Node : Efficient networking and good accessibility to station of public transport, and efficient traffic control at intersections to prevent bottleneck on road network
- Segregation of Cargo Traffic : Segregation measures on road structure and road network
- Environmental Conservation : Introduction of low-emission type vehicle into public transport system

Development Plan

Based on proposed internal and external node development plans and identified projects, implementation plan with preliminary cost estimate for internal and external node developments are proposed. The following table shows the ones about internal node development plans.

Table 1.13: Implementation Plan with Preliminary Cost Estimate for Internal Node Development Plans

(Unit: INR crore)

Items/FYE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Internal Road works	109	147	133	0	0	6	32	41	0	0	0	0	0	0	0	186	186	186
Intersection works	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Bridges Works	13	13	13	7	7	7	7	7	0	0	0	0	0	0	0	0	0	0
Flyover Bridge Works	32	26	23	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0
Road Facilities	146	157	168	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Internal Public Transport Facilities Works	0	1	22	0	0	0	1	22	0	0	0	0	0	0	0	0	0	0
External Road Works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External Public Transport Facilities works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major River Bridge Works	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flyover Bridge Works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**318**	**365**	**379**	**10**	**10**	**16**	**43**	**78**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**186**	**186**	**186**

Source: JICA Study Team

The following table shows the ones about external node development plans. This will be outside the purview of the node level managing entity. Hence, the same would not be considered while arriving at the total project cost.

Table 1.14: Implementation Plan with Preliminary Cost Estimate for Internal Node Development Plans

(Unit: INR crore)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
External Infrastructure	0	0	23	103	0	0	0	0	13	0	0	0	0	0	0	0	0	0

Source: JICA Study Team

Railway

Current Situation

A rail connection to the Chennai-Nellore mainline is available through a spur line running from Athipattu station to the coal handling terminal at Ennore Port. Rail connectivity will be improved through a Rs. Crore 150 project to construct a new northern access line to Ennore Port to link up with the new container terminal. This line, construction of which is expected to be complete by 2017/18, will run close to the southern boundary of the node and hence will provide a rail access to a logistics hub to be provided within the node. The presence of ports in close proximity to the node suggests that rail access will only be for long distance transport of inputs or domestic distribution of outputs.

Demand Forecast

The demand forecast for Ponneri was based on input/output forecasts prepared by the JICA Study Team. The following table presents the forecasts of the rail modal volume and share used as a basis for scaling the rail facilities at Ponneri.

Table 1.15: Forecast Rail share of container and break bulk freight volume

Traffic category	2017/18	2022/23	2027/28	2032/33
Containers				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	18,448	31,679	54,398	93,411
- Empty Inbound (TEU)	26,892	46,178	79,296	1,36,165
Total	46,117	79,191	1,35,984	2,33,510
Containers - rail volume				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	11,711	20,110	34,533	59,300
- Empty Inbound (TEU)	0	0	0	0
Total	12,488	21,444	36,824	63,233
Containers - rail share (%)				
- Loaded inbound (TEU)	100%	100%	100%	100%
- Loaded outbound (TEU)	63%	63%	63%	63%
- Empty Inbound (TEU)	0%	0%	0%	0%
Total	27%	27%	27%	27%
Break bulk				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	2,19,125	3,76,278	6,46,136	11,09,533
Total	2,95,389	5,07,235	8,71,014	14,95,688
Break bulk - rail volume				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	0	0	0	0
Total	76,263	1,30,958	2,24,878	3,86,156
Break bulk - rail share %				
- Inbound	100%	100%	100%	100%
- Outbound	0%	0%	0%	0%
Total	26%	26%	26%	26%
Petrochemicals - inbound pipeline (t)	4,63,993	7,96,759	13,68,179	23,49,410

Source: JICA Study Team

Development Plan

The logistics hub is proposed near the centre of the node and will be connected to the proposed Minjur – Ennore line via a 3.6 km electrified line. Since hubs cannot be electrified for overhead traction (as it would obstruct loading), there will be receiving sidings outside each hub to allow for electric locomotives to run around and push trains into the hub. The line is expected to cost Rs. 26.5 Crores (USD 4.5 million).

The Ponneri logistics hub itself will have 3 lines – one to receive steel and 2 to handle container traffic. It is expected to cover an area of 166,859 square metres and will also have a container freight station, warehouses, trailer parking and workshops as required. It will be developed in two phases. at a total cost of Rs. 95 crores (USD 15.8 millon) (non escalated prices).

The capital costs and identified O&M costs for the Ponneri logistics hub and railway access line over period are given below.

Table 1.16: Ponneri Railway Access Line and Logistics Hub - Cost Summary

Cost Details (Rs. Crore)	Phase-1 & 2 2017 to 2027	Phase-3 2028 to 2038	Total
Railway Access Line and Wagons			
a) Capital Cost of Railway Access Line	26.52	-	26.52
b) Maintenance Cost of Railway Access Line	20.63	62.96	83.59
c) Capital Cost of Container Wagons	10.61	19.12	29.73
d) Maintenance Cost of Container Wagons	7.37	23.51	30.88
Logistics Hub			
e) Capital Cost of Logistics Hub	85.36	9.63	94.99
f) O & M Cost of Logistics Hub	46.43	84.17	130.60
Total	**196.93**	**199.38**	**396.31**

Source: JICA Study Team

Water

Current Situation

The water tanks in the Kosasthalaiyar sub basin are proximate to the node. However, these have historically been used exclusively for irrigation purpose and hence no water for industrial purposes can be allocated to utilize these tanks. Therefore, the surface water expectation from the water bodies is limited to cater to the water requirements of Ponneri node. At present, ground water is being used mainly for domestic purposes besides being used for some minor agricultural activities. Therefore, ground water cannot be potential resource to contribute to satisfying the water requirements of Ponneri node development either for Potable or for Non-potable usage.

The Minjur Desalination Plant has been operated in order to improve the domestic water supply conditions of Chennai Metropolitan Area. However, presently this desalination plant is supplying a small amount of water for a port activity. Therefore, there is a possibility to allocate water to the Ponneri Node from the Minjur Desalination Plant if the water demand of Ponneri Node to the plant is in a possible range. The detailed water demand of 45MLD of tertiary treated sewage has not decided yet, and CMWSSB has a plan to increase the total capacity of tertiary treatment facility to 60MLD based on the demand, accordingly, there is a possibility that the tertiary treated sewage will be allocated to the Ponneri Node.

Framework for Infrastructure Development

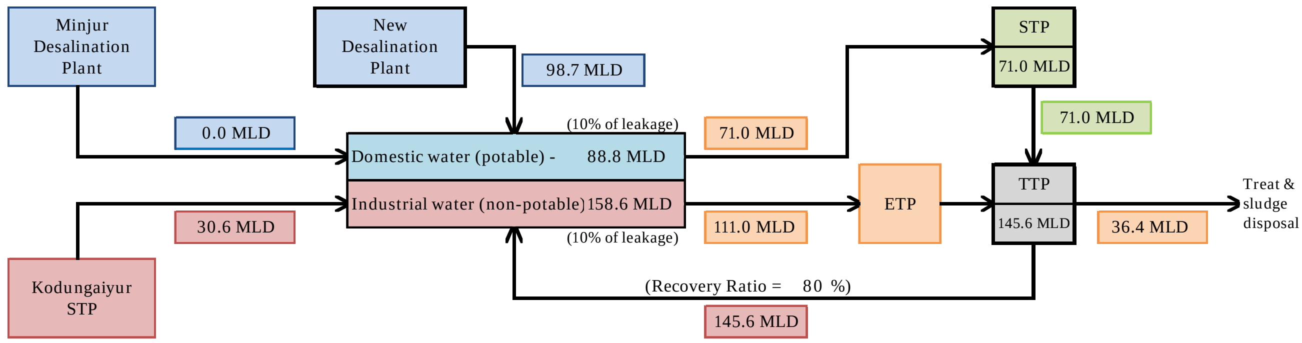
To realize sustainable development of the Ponneri Node, stable water supply, good sanitary conditions, preservation of water environment and prevention of flood event are imperative. Development framework of water infrastructures including those for water supply, wastewater management and stormwater management are proposed as follows:

- 24 x 7 supply of water to 100% industries and households with direct water supply connection will be achieved.
- 100% connection of industries and households to sewer network and 100% coverage of primary and secondary treatment of the sewage will be achieved.
- 100% coverage of road network with storm water drainage network will be achieved.
- Because of the very limited surface water resource and ground water resource around Ponneri Node, freshwater will be allocated from the newly-developed desalination plant or the Minjur Desalination Plant which is close to Ponneri Node for the drinking purpose only.

- Similarly, the tertiary treated sewage will be allocated from Kodungaiyur STP which is located at about 20km south of Ponneri Node for the industrial purpose only.

Water Balance

Based on the above-mentioned framework, the ultimate water balance of Ponneri Node for the phase 3 is estimated as described in the following Figure.



WTP: Water Treatment Plant, STP: Sewage Treatment Plant, ETP: Effluent Treatment Plant, TTP: Tertiary Treatment Plant for Recycling of sewage and industrial wastewater

Source: JICA Study Team

Figure 1.13: Water Balance for the Phase 3

Development Plan

The capital costs and O&M costs for the three phases are summarized in following Table.

Table 1.17: Summary of Capital Cost for Water Sector

No	Component	Phase-1 (2016-18)		Phase-2 (2019-21)		Phase-3 (2022-33)	
		capital cost	Avg. annual O&M cost	capital cost	Avg. annual O&M cost	capital cost	Avg. annual O&M cost
1	Potable water supply system	665	23	521	54	12,863	517
2	Non-potable water supply system	2,878	104	1,725	224	8,278	661
3	Sewerage system	337	16	256	30	2,521	148
4	Treated sewage & effluent colletion system	671	30	595	65	4,427	279
5	Stormwater drainage system	492	25	781	64	3,208	225
Total		**5,042**	**197**	**3,878**	**436**	**31,296**	**1,831**

** All figures are in million INR*

Source: JICA Study Team

Solid Waste Management

Current Situation

The only one TSDF (landfill and incinerator) in Tamil Nadu state is located at the linear distance of around 25 km and at the road distance of around 40 km away from Ponneri Node. The TSDF is close enough to Ponneri Node and has a sufficient capacity to treat both incinerable and land fillable hazardous waste to be generated at Ponneri Node area in the future.

Development Framework

Appropriate solid waste management is essential for providing a safe and hygienic living environment. It also helps to promote sustainable development of the node and reduces the impact on the environment. Development concept and policies for solid waste management in the node, as well as the programs of which activities to be conducted by responsible parties to achieve those policies are proposed as follows.

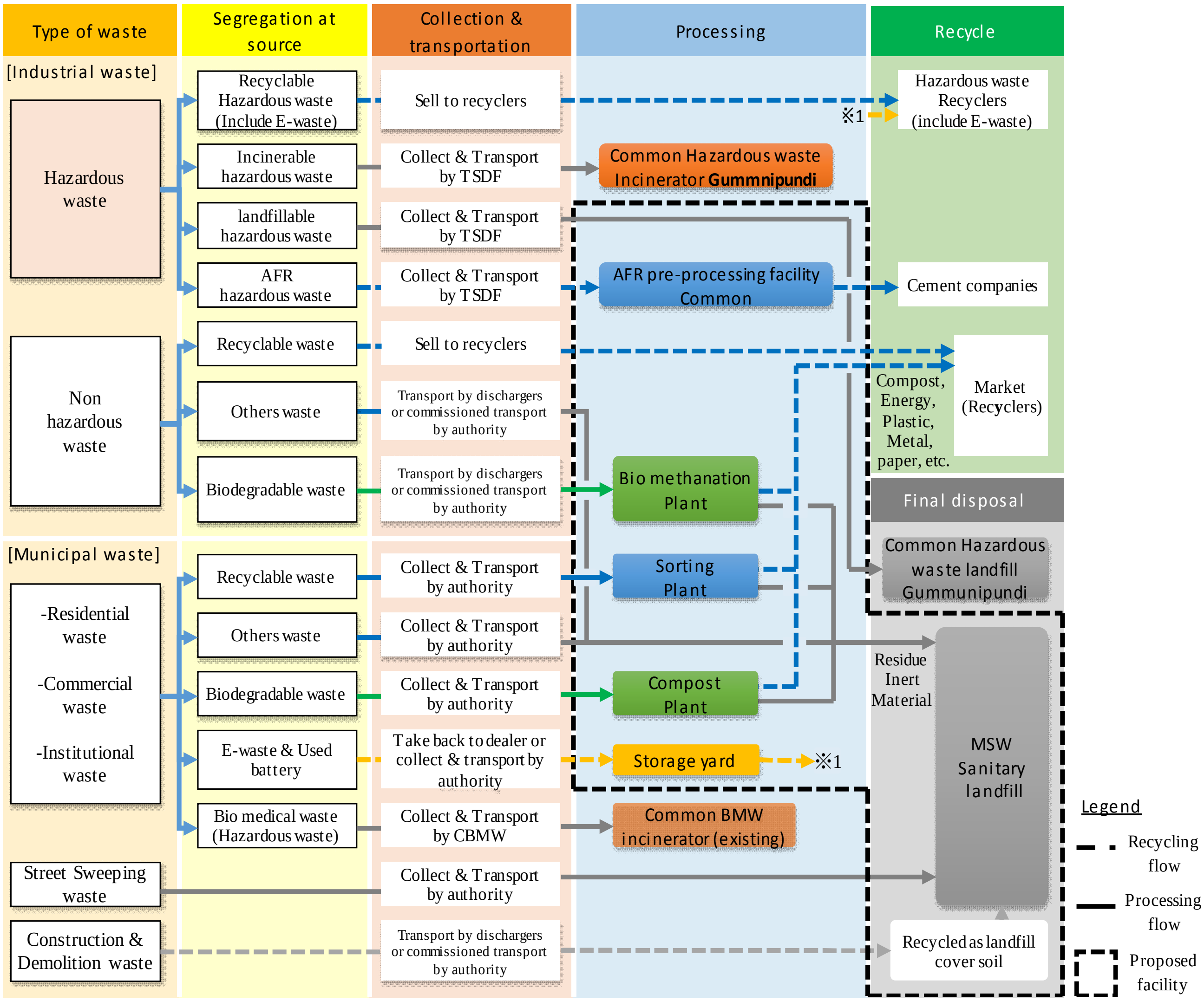
Table 1.18: Development concept, policy and program for solid waste management in the Node

<table>
<tr><td>Concept</td><td colspan="3">Building a sustainable sound material-cycle society</td></tr>
<tr><td>Development Policy</td><td colspan="3">1) Establishment of an appropriate waste management
2) Reduction in the volume of waste that goes into the final disposal through3R promotion
3) Selection of environmentally and economically sustainable waste treatment system
4) Coordination among the stakeholders
5) Capacity development of institutions relevant to waste management
6) Integrated waste management facilities</td></tr>
<tr><td rowspan="3">Development program</td><td colspan="2">Within a node</td><td>Include the outside of a node</td></tr>
<tr><td>Hazardous waste management (AFR pre-processing facility) (Private or PPP)</td><td>Municipal solid waste management (including non-hazardous industrial waste) (Developer)</td><td>Waste management (state government)</td></tr>
<tr><td>■Hazardous waste management facility development program
- Devising of a plan for pre-treatment for AFR
- Development of a collection and transportation system
- Development of a AFR pre-processing facility</td><td>■Municipal solid waste management facility development program
- Development of a municipal solid waste management plan
- Development of the collection and transportation system
- Development of municipal solid waste treatment facility
■Capacity development program for appropriate waste management
- strengthening capacity in operation of solid waste management
■Program on 3R Promotion
- Awareness rising on 3R activities
- Development and promotion of markets for reused and recycled products
- Promotion of cooperation with NGOs and recyclers
- Development of a focal point for awareness rising</td><td>■Institutional capacity development program for the authorizing organization (state government, etc.)
- Strengthening the management capacity in controlling illegal dumping, temporary storage, and inappropriate treatment
- Establishment of a monitoring and auditing institution and its capacity development
■Support program for the private industries
- Support for zero-waste technology for the private companies, as well as for the cooperation among the private businesses</td></tr>
</table>

Source: JICA study team

Solid Waste Management in the Node

The following diagram shows the entire process flow for hazardous and municipal solid waste management respectively, based on the above-mentioned programs.



Source: JICA Study Team

Figure 1.14: Solid waste management in the Nodefor the Phase 3

Development Plan

The capital costs and O&M costs for the three phases are summarized in the following table.

Table 1.19: Summary of Capital Cost and O&M Cost for Solid Waste Management Sector

Item	Component	Phase 1 (Upto 2019)		Phase 2 (Upto 2024)		Phase 3 (Upto 2034)	
		Capital cost	Phase Total O&M cost	Capital cost	Phase Total O&M cost	Capital cost	Phase Total O&M cost
Hazardous waste infrastructure	1) AFR pre-processing facility	0	0	316	36	1,178	2,018
MSW infrastructure	1) Composting plant	0	0	0	0	278	306
	2) Biomethanation plant	9	4	18	21	70	155
	3) Sorting plant	0	0	0	0	77	201
	4) Sanitary landfill	1	0	3	2	170	147
	5) Stockyards for e-waste, etc.	8	-	8	-	8	-
	6) Collection vehicle	9	6	3	12	188	260
	7) Garage & workshop	5	-	2	-	28	-
Soft component		Period	Phase Total	Period	Phase Total	Period	Phase Total
■ Capacity development program for appropriate waste ■ Program on 3R Promotion		2 years	86	1 year	43	3 years	128.4
■ Institutional capacity development program for the authorizing ■ Support program for the private industries		2 years	107	1 year	54	2 years	107.0

Source: JICA Study Team

Power Infrastructure

The upcoming power demand at the node has been studied and the same has been compared with existing power infrastructure availability on ground to assess the demand supply gap. It was found that from the distribution and transmission perspective additional capacities would be needed on ground for meeting the upcoming demand. We see that for Meeting power demand at varying scenarios the node needs close to 236 MW in phase II (till FY 2024) which increases to 1085 MW in phase III (till FY 2032). This is illustrated below for reference.

Table 1.20: Scenarios for design gap (MW), PwC analysis

Category	Total Demand (MW)	Maximum gap for system design (MW)
Phase I (2019)	69.91	48.94
Phase II (2024)	235.8	165.05
Phase III (2032)	1,084.51	759.16

When we consider the available sources for meeting the gap, the node has several power plants in its domain. However, on assessment of spare capacity, we found that the current generation plants have power purchase agreements for entire quantum of power with utilities outside the node. Hence, these plants might not be available for power procurement in the node. Therefore upcoming power plants in the area (Ennore-II, Ennore SEZ, and NCTPC-III) have been proposed for power consumption in the node for Phase II & III.

On the transmission side, considering the load requirement at the node for ensuring robustness, a Main Receiving Sub Station (MRSS – 132kV, sub-station) has been planned for taking up the entire supply for distribution in the node. As per the requirement of the power system, a Gas insulated sub-station with spare capacity has been planned in node. This sub-station provides the maximum reliability and efficiency for power transmission. The technical details of the MRSS have been attached as an appendix to the report.

On the distribution side, based on the load requirement around 6 sub stations of 48 MVA each have been planned for taking up the load in Phase I & II. All these distribution sub-stations would be connected via 33kV lines to MRSS sub station and would have 11kV feeders (5 each) for consumer load. These are standard sub stations that have been used in previous city design and provide robustness in design as well as are efficient in preventing losses and pilferage. We have also estimated the tentative tapping points as well as total land requirement for MRSS as well as distribution sub stations. Benchmarking of the design has also been undertaken with similar initiatives by private players for improving distribution network performance e.g. NDPL in Delhi, Torrent Power in Agra, Power grid in Vishakhapatnam etc. This is important for assessing the practicality of the design on ground.

Table 1.21: Distribution sub-station requirement (Nos.)

Characteristics	2016-19	2020-24	2025-32
Total demand expectation for system design (MW)	48.94	165.05	759.16
System design for 80% loading condition in the node(MW)	61.17	206.31	948.95
System power factor	0.8	0.8	0.8
Total installed capacity (MVA)	76	258	1,186
Capacity of each distribution sub-station (MVA)	48*	48	48
Additional distribution sub-station requirement (Nos.)	2	4	26

* As per discussion with TNEB, in urban area 3x16MVA capacity indoor Substation is installed.

From the generation perspective, in order to ensure robust availability of supply to consumers around 1000 MW would be needed in phase III for the node. Considering the thermal generation already existing in the node it would be economical to consider these sources as possible sources of electricity for the node. For the sake of redundancy, considering the nature of electricity, it is not necessary that generation for the entire capacity needs to be within the node. Provided the node has adequate transmission availability and commercials of the arrangement make sense, power can easily be procured from outside the node at delivery points of transmission sub stations. The same has also been estimated for the node. Around 20% of the power would be procured from the Southern Grid via Mellur sub-station. Several regulatory provisions like allowance of open access at transmission level as well as reduction in cross subsidy for the node can enable cheaper power for the node as an incentive for the consumers.

Most of the power consumed in the node is expected to be from conventional power stations. However, considering the regulatory provisions for large energy consumers, a certain percentage of power needs to come through renewable sources. This can be enabled in the node via local renewable energy sources like solar and wind. The node has been assessed to fall in a region in TN which is conducive to solar as well as wind energy. Hence, around 43 MW of solar and wind generation would be expected in phase II which will increase to 195 MW in phase III. The key objective of the generation design has been to ensure adequate power availability for consumers at the transmission delivery point of the node (MRSS bay).

While calculating the investment requirement for implementation on ground, we have taken industry specific numbers derived from past tenders for procurement in Karnataka, Tamil Nadu and AP. For in node generation, the investment would be undertaken for specific industries which are looking to set up the capacities and for procured generation, no additional investment in generation is envisaged to meet the node requirement. Lastly on the smart metering front, the meters at consumer end would be paid for by consumers as is the industry norms. Hence, these have also not been taken in the analysis. However some provisions for success demonstration projects in smart domain has been kept to encourage industries to go for smart solutions. Overall the node would need close to INR 2,933 crore for ensuring robust power supply till FY 2034.

Table 1.22: Additional Investment requirements (INR crore) [Escalated prices]

Characteristics	Phase I	Phase II	Phase III
Investment requirements	**68**	**391**	**2,475**

Post investment assessment, an operational plan for the Node has been prepared which provides the basic objectives, relevant stakeholder participation framework and the key steps in order to ensure seamless and reliable power to the consumer base of the node. This provides the necessary stakeholder ownership for various activities. An Input based franchisee model (IBF) has been shortlisted as a feasible model for operation of the node distribution infrastructure. Critical success factors include integration with other utilities, Integration with small scale renewable generation, Energy efficiency, customer empowerment and capital availability. A key aspect to the operation plan is the proposed infrastructures inter linkage with the 'smart grid concept'. This is essential to develop node specific capabilities to integrate possible renewable energy sources within the node and also provide a seamless business experience, both to the customers and the employees operating the network.

Economic Impact Analysis

While analyzing possible benefits to be created with development of each industrial node, both permanent and temporary aspects of the benefits to be realized were considered.

Key Economic Benefits

Some of the key benefits that would be expected include:

Direct benefits:	Indirect benefits:
• Gross economic value added • Employment generation • Land development and monetization in industrial node • Industrial investments in industrial node • Taxes collection by the state/central government	• Indirect potential employment generation by sector • Exports promotion prospects • Availability of quality industry/infrastructure o Enhanced mobility and alternate transportation o Efficient and responsible infrastructure use o Availability of work-life balance benefits o Intangibles such as social welfare change

Direct benefits

a) Direct Employment Generation

Employment generated in proposed industrial nodes will comprise of direct and indirect employment opportunities. Direct employment refers to employment directly related to the production of products or services across sectors identified as focus sectors in each industrial node. By the end of phase 3, the total number of employment opportunities will be ***337,454 jobs.***

Table 1.23: Direct potential employment of Ponneri Industrial Node

	Total direct employment
Traditionally strong sectors	***234,085***
Auto	118,045
Chemicals & Petrochemicals	15,711
Machinery	53,603
Computer, electronic and optical products	26,037
Metallurgy	3,164
Textiles & Apparels	17,525
Potential sectors	***103,368***
Total	**337,454**

Source: JICA Study Team for CBIC

b) Industrial investment

Industrial land is expected to attract tenants from various sectors identified for Ponneri Industrial node as focus sectors. Total land for traditionally strong sectors with higher probability to get occupancy is **6,228** acres. Potential sectors are projected to occupy 1,557 acres of industrial land in Ponneri IN. Together these tenants are expected to infuse Rs. 200,512 crore (USD 33.4 billion) of investment in the by the end of projected period.

Table 1.24: Industrial Investment

	Industrial Investment, Rs. Crore
Traditionally strong sectors	***157,058***
Auto	85,082
Chemicals & Petrochemicals	16,683
Machinery	27,721
Computer, electronic and optical products	16,671
Metallurgy	6,043
Textiles & Apparels	4,858
Potential sectors	43,454
Total	**200,512**

Source: PwC projections

Indirect benefits

The total indirect employment generated due to the development of Ponneri node is expected to be 506,180. It should be noted that the number of jobs created within the node would be a portion of above indirect employment creation due to integrated nature of economies in the region.

Apart from these, the other indirect benefits likely to accrue may be due to

- Export promotion benefits
- Availability of quality industrial infrastructure with enhanced connectivity to major logistics and trade hubs
- Enhanced mobility and alternate transportation for travel within and outside the node
- Efficient and responsible infrastructure use with improved accessibility at affordable levels.
- Availability of work-life balance benefits

Permanent benefits

Permanent benefits include potential gross value added from various manufacturing activities across sectors identified as highly potential for Ponneri IN as well as some relevant services. Total permanent employment adjusted to deadweight and displacement assumptions (net employment) till 2052 is anticipated to be 317,003 and total direct GVA contribution is expected to amount to USD 2156 million.

Benefit-Cost Ratio

When costs and benefits are evaluated on an NPV basis, it was observed that the total net present value of benefits is expected to be USD 2,454 million. The NPV of estimated benefits is at 1.3 times the NPV of estimated costs.

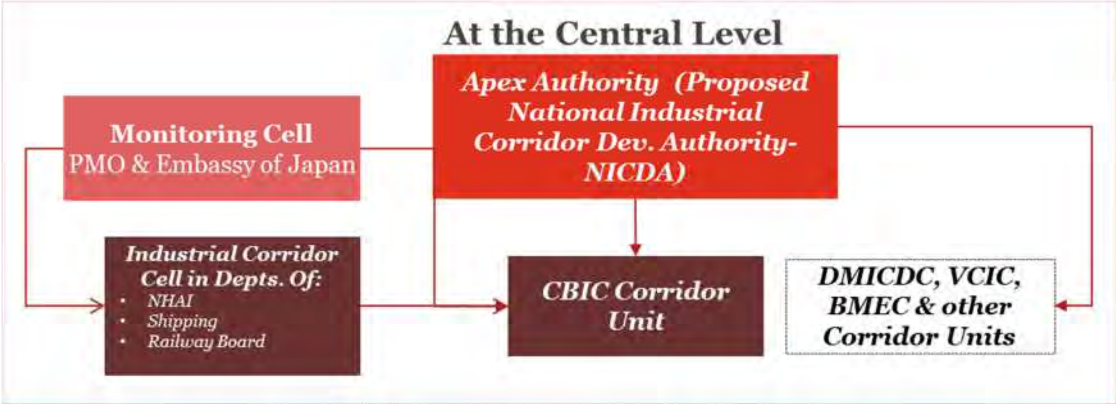
Thus, development of Ponneri Industrial Node can be considered economically beneficial given the costs anticipated for development of this industrial node, without taking Optimism Bias under consideration.

Institutional and Financing Framework

Based on assessment of relevant acts for development of large industrial areas in India as elaborated above, a summary of learnings has been presented for CBIC to help formulate a robust institutional and financing structure for development of industrial nodes and the industrial corridor in its entirety. Incorporating these learnings and through extensive stakeholder consultations with DIPP, JICA, and relevant state government departments such as TIDCO/Industries Department/Planning and Development Department, the institutional framework for Ponneri Node has been formulated.

Proposed Institutional structure for Ponneri and CBIC in Tamil Nadu

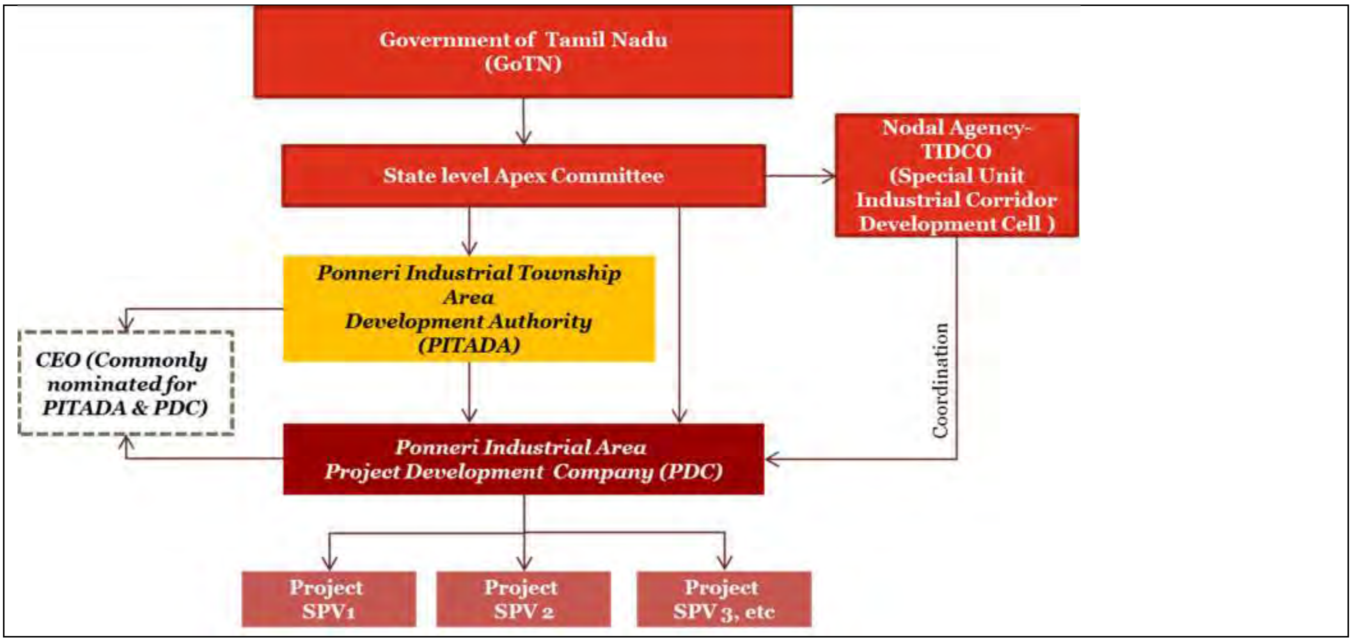
Taking into key considerations the key learnings for CBIC and suggestions from GoTN, the following institutional structure has been proposed for Ponneri Node:



- Proposed National Industrial Corridor Development Authority (NICDA) to oversee all industrial corridor development in India including DMIC
- NICDA will act as a project development partner to all SPVs and State Government agencies for implementation of industrial cities/projects in the various industrial corridors
- CBIC corridor unit to be formed below NICDA
- Key central agencies such as NHAI, Ministry of Shipping & Railway Board will be represented on the NICDA Board. They may form special cells within each department to facilitate planning, implementing and monitoring of critical external infrastructure projects
- Monitoring cell comprising of PMO and Japan embassy to form the apex level monitoring body

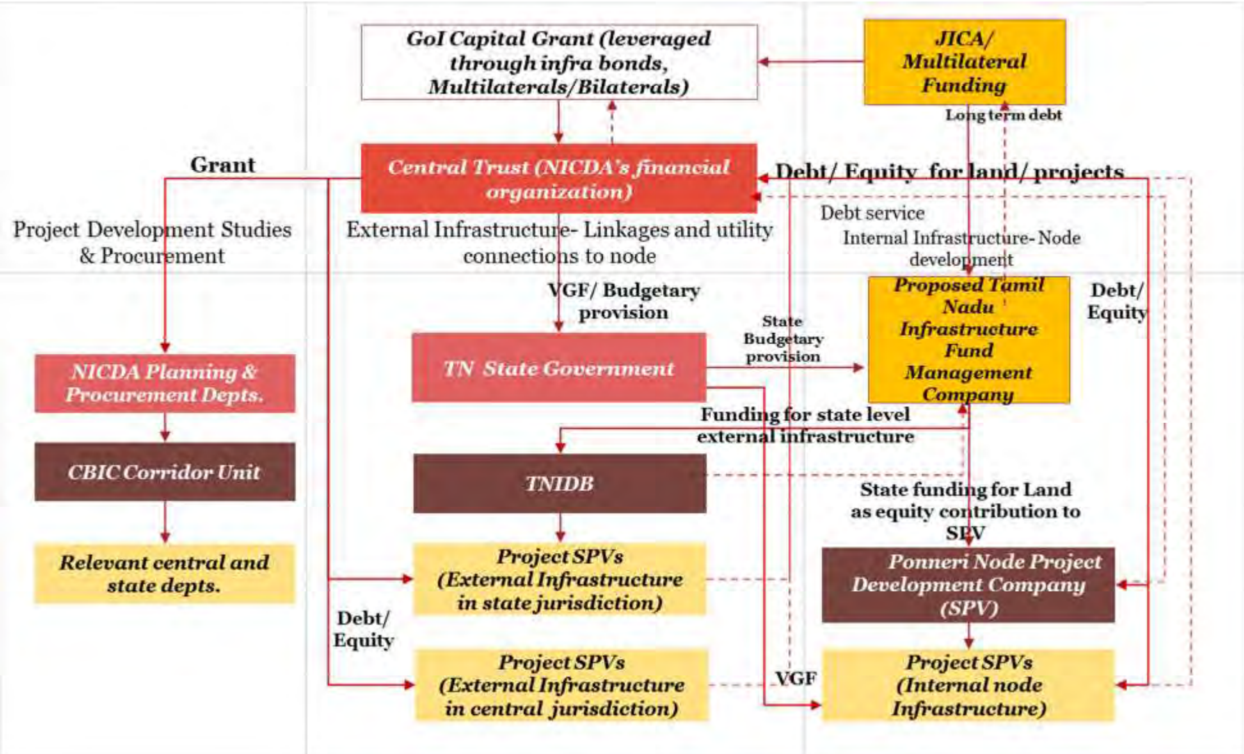
Figure 1.15: Central level institutional structure for CBIC in Tamil Nadu

The role of State Governments is critical every stage of the node development starting with land acquisition, development of trunk infrastructure like power and water. Here again, the corridor projects compete for attention with other industrial parks of the State Industrial Development Corporation. The SIDC projects, without the need for SPV with Central Govt, etc, appear to better meet the short term need of quick wins. The State Transcos and Discoms' priorities are also to improve service to existing industrial areas.



Finally, each component of the Corridor development has different implementing agencies, and competes with several projects. The National Industrial Corridor Development Authority (NICDA) would have the challenging task of coordinating across Central and State Government agencies to prioritise the corridor projects. There are lessons in the Early Bird Projects planned in DMIC, which faced challenges in bringing relevant stakeholders on board. Therefore it is recommended to have a “Corridor Projects’ Unit” in each line department in the State Governments. They would need adequate institutional capability and empowerment, and a separate budget. Such focused “Units”, in coordination with the NICDA, could provide the priority and impetus needed for the corridor and the nodes to be delivered in tandem.

Financing Framework



It is proposed that JICA funding may be made available both at NICDA level (at centre), and JICA can directly fund the state through the proposed Tamil Nadu Infrastructure Fund Management Company (TNIFMC)

TNIFMC has been proposed to manage the new infrastructure finance vehicles (IFV), and will be enabled to roll out and manage new IFVs - the Infrastructure Debt Fund (IDF), Alternative Investment Fund (AIF) and Infrastructure Investment Trust (InvIT) as per guidelines of market regulator, the Securities and Exchange Board of India. It is envisaged to be a fourth generation financial institution in the state and will be set-up in partnership with banks, insurance companies and reputed private financial institutions.

This option will enable faster fund routing from JICA directly to the state government

Financial Assessment and Plan

The financial model has been built for the master SPV which will be responsible for undertaking the development of the Ponneri Industrial node. The development of the node will entail land acquisition and development for let out to industry and support infrastructure, creation and operation of support infrastructure, collection of revenues from the occupants of the land towards upfront land lease, infrastructure usage fee. Alternately, the SPV also has the option of managing just land acquisition, development and sale of land with only none or some or all of the support infrastructure facilities. This means that the SPV has the option of offloading specific infrastructure components to separate SPV’s which will be independent entities. The two options provided in the financial model are as under.

Financial Model Option	Description
Option -1 – Master SPV only	Only one SPV (Master SPV) that controls land acquisition and development together with creation, operation and maintenance and revenue appropriation from all support infrastructure like road, rail, water, power solid waste management etc.
Option – 2 – Master SPV and multiple SPVs	Master SPV controls land acquisition, development and operations and also chooses to retain some or none of the support infrastructure facilities. The one's not under the control of the master SPV will function as separate SPVs.

Costs

Based on detailed technical assessment and master planning, cost estimates for developing Ponneri Industrial Node have been arrived at using national and international benchmarks for unit costs

Table 1.25: Project Cost

Project Cost	Amount (Rs. Crore)	Percentage
Land acquisition cost	13509	41%
Land development	5633	17%
Roads	2806	9%
Railway	116	0%
Water and Effluent Treatment Facilities	6175	19%
Solid Waste Management	389	1%
Power infrastructure cost	2933	9%
Contingency (5% of cost excl. land)	903	3%
Interest During Construction	249	1%
Total	**32713**	**100%**

Source: JICA study team

When represented phase wise, the distribution of projected capex spending is as follows:

Table 1.26: Project Cost - Phase wise

Item	Phase I Upto FY 19	Phase II FY 20-24	Phase III FY 25 onwards
Land acquisition cost	9,351	4,158	0
Land development cost	1,735	2,066	1,833
Roads	1,234	232	1,340
Railway	96	1	19
Water and Effluent Treatment Facilities	432	458	5,285
Solid Waste Management	3	51	335
Power infrastructure cost	68	391	2,475
Contingency	178	160	564
Interest During Construction	217	31	0
Total	**13,314**	**7,547**	**11,851**

Source: JICA study team

It is to be noted that two master scenarios were envisaged for the purpose of the financial model. These are as follows:

- One Master SPV for the entire node responsible for ownership of all land to be given under long term lease and the infrastructure ownership along with the obligation of infrastructure service delivery.

- One Master SPV and multiple SPV's, one each for infrastructure components which can be developed and operated as separate companies through individual Concession Agreements.

The above table pertains to the first scenario which envisages all development and delivery by one master SPV.

Financing Structure

Aligned to the DMIC model, it has been assumed that the Master Developer SPV will be constituted with centre and state government participation (and private sector, in cases where the state wishes) and land is brought into the SPV as equity contribution. Base case financing structure for development of Ponneri node:

Table 1.27: Means of Finance

	INR cr.	% contribution of TPC
Equity (Brought in as value of Land and other expenses))	12592	41%
Debt (Land development & infrastructure cost)	9814	27%
Internal Accruals	10307	32%
Total	**32713**	**100%**

Source: JICA study team

Scenario Analysis for Project viability

Under the current financing structure, and cost and revenue assumptions, the **project IRR stands at 10.97% and Equity IRR at 10.85%**. Other scenarios have been analysed to assess any improvement in project viability by altering key project parameters such as tariff etc and by unbundling entities for independent operations. The same have been presented below:

- ***Land lease rentals***: The base case price of acquisition has been assumed at Rs. 0.7 crore per acre. This rate has been assumed as there is significant investment necessary for land development (Rs. 0.5 crore per acre at current prices). The lease price is assumed at Rs. 1.5 crore per acre. It has been observed that the project financials are highly sensitive to land procurement price and land lease rentals.

- ***Unbundling project components***: Under this scenario, it has been assumed that infrastructure services can be unbundled from the Master Developer's purview and separate SPVs such as Water SPV, Power SPV etc can be created, which are self- sustainable by themselves through user charges. Improvement in project viability for Master Developer is assessed by such unbundling. However, there is a need to create bankable projects out of the individual SPV's for each of these utilities.

- ***Demand offtake***: Under this scenario, land off-take has been increased/ decreased y-o-y to assess impact on project viability.

From the above analyses, it was observed that the financial model is highly sensitive to land related parameters like acquisition price and lease price. There is also high sensitivity observed when it comes to unbundling of the Power utility into a separate SPV. Unbundling of power sector SPV results in fall of Project IRR of the master SPV by more than 3% from the base case levels.

Investment Environment Improvement

Recommendation to Tamil Nadu Government

Tamil Nadu is characterized by the high number of the ITIs & ITC, but still need to improve in the other realms. The above analysis, especially, shows that there is still room for improvement in certain key areas which have been summarized below.

Recommendation for Tamil Nadu

Table 1.28: Recommendation for Tamil Nadu

Perspectives	Detail of the Recommendations
Infrastructure	• Set PMU to Collaborate with relevant State Governments and Central Government and solve issues which hinder the project implementation. • Discuss funding scheme with JICA or any other possible funding agency in consultation with the Central Government/CBIC Committee.
Land Acquisition/Building approval	• Drive SIPCOT to improve the land banks and enhance the allotment process. • TN Guidance Bureau is the first point of contact for land identification • Timely update of land allotment, land use, location, market process, etc. for providing the information for investors to understand the industry allotments and availability.
Skill Development	**1) Implement actions under Tamil Nadu Vision 2023.** • Aimed at skilling 2o Million persons over the next 11 years. • Establishing best in class institutions as centers of Excellence in various fields • Allocated specific funds for education and skill development program for the coming years **2) Formulate State Policy to Set up knowledge Park inside the Node** • Incentive industries to participate in the Training and Placement of workforce • provide Indigenous support facilities such as Equipment Testing, Quality Control to promote innovative product development
Business Process	• To develop and include tracking system, helpline, information such as contact details of nodal officers, incentive schemes available, • To appoint dedicated person for each investor to support project clearances and coordinate with line of departments • Create or upgrade of single-window agency to become a one point contact for all approvals till final approval. • **Country specific investment facilitation desk in industries department or in proposed PMU.**
Industrial park/Cluster	• Establish the standard to ensure the quality of infrastructure provided (water, power, waste management etc.) • Formulate the operational guideline on priority basis to encourage establishment of Industrial Parks by private investors , taking Vision 2023 envision as target and establish the support mechanism inside the Industries Department.

Way Forward

Following actions will be required by the State Government of Tamil Nadu as a next step.

Legal/Regulatory Framework

Basic legal/regulatory framework needs to be developed and enacted.

a) Declaration of Industrial Township of the proposed Ponneri node as aligned to Article 243Q and Tamil Nadu Industrial Township Area Development Authority Act

b) Review of samples of State Support Agreement (SSA) and Share Holder Agreement (SHA) (Draft Shared with GoTN) and starting a dialogue with DIPP to discuss and sign the agreements

- Need to identify the role and responsibilities of each stakeholder, i.e. NICDA, State, and private sector

Institutional Framework

Based on the legal/regulatory framework, details of roles and responsibilities among central and state governments, and private sectors, setting up necessary organizations and building organization structure, hiring appropriate human resource will be required.

a) Issue of Government Order for Establishment of Institutional Structure as agreed by GoTN

b) Setting up Development Authority which will assume the role of the municipal body for the node

c) Setting up a node development SPV

d) Developing a framework on the involvement of private sector to the node and infrastructure development

- Set up a strategy to have effective involvement of private sector
- Conduct market soundings with potential private developers
- Develop action plan and road map

e) Establishment of Program Management Unit within [TIDCO] as a transition unit to lead coordination with Central Govt and State Govt Agencies and facilitate the implementation of the role of State under SSA and SHA

Financial Framework

Since the node development includes the large area development and various infrastructure developments, an integrated financial strategy will be required.

a) Prioritizing node and infrastructure development projects

b) Development of a funding plan considering economic and financial implication of prioritized projects on competitiveness of the node

c) Identification of alternatives on funding source including own budget, funds from central government, donor support funding (a project specific loan, a budget support loan) etc.

d) Developing necessary monitoring mechanism of project progress

Operation

Following steps will be required for physical node development and improvement of soft infrastructure.

a) EIA (to be initiated by DIPP)

b) Land assessment of the node to identify the details of necessary land development work

c) Preparation for land acquisition plan for the part of land which is not owned by GoTN currently within Master Plan Area so as to avoid the higher acquisition price due to speculation

d) Identification and preparation of priority projects under State responsibility

e) Developing a framework to implement necessary steps in response to recommendation on investment environment improvement including assurance of infrastructure services, supply of skilled labour, streamlining of business process etc.

2. Introduction

2.1. Context of Industrial corridors for sustainable growth

The need to raise the global competitiveness of the Indian manufacturing sector is imperative for the country's long term-growth. Government of India (GoI) envisages manufacturing sector is key economic driver which contributes to its GDP growth and creation of additional employment opportunities. In the past 10 years, Indian manufacturing has grown at a robust average rate of 7.3%, putting itself on the map of some of the best performing manufacturing economies. National Manufacturing Policy is a prominent initiative taken by GoI for development of manufacturing sector.

DIPP's Vision – National Manufacturing Policy	Increase share of manufacturing in GDP from 14.9% to ***25%*** by 2022
Objectives of the Policy	✓ Increase the manufacturing sector growth to ***12%-14%*** over the medium term ✓ Create ***100 million*** additional jobs by 2022 ✓ Create appropriate ***skill*** sets among rural migrant and urban poor ✓ Increase ***domestic value addition*** and technological depth ✓ Enhance ***global competitiveness*** through policy support ✓ Ensure ***sustainability*** of growth

Figure 2.1: Vision and Objective of National Manufacturing Policy

Looking back at the trend of some fast growing emerging economies in the past 10 years, it seems that these countries inherently have strong manufacturing presence. Economies like Thailand, Indonesia and Malaysia have increased their manufacturing GDP contribution by 15-21% in the past 45 years. The challenge for India is to achieving that in much shorter time frame as compared to 45 years.

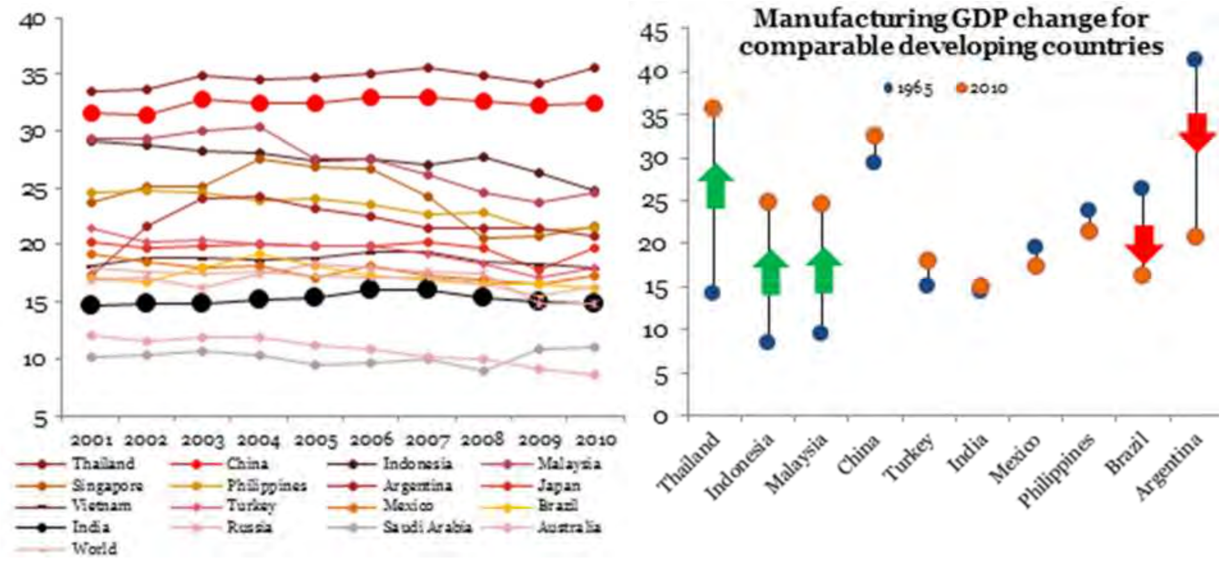


Figure 2.2: Trend in manufacturing contribution to GDP across developing countries

Given the concern about the stagnant and low share of manufacturing sector in India's GDP, the national Manufacturing Policy was framed with a view to accelerated development, inclusive growth and provision of gainful employment[1]. Realisation of primary objectives of the policy, such as increasing manufacturing sector growth to 12-14% over the medium term, enhancing share of manufacturing in GDP from 14.9%-25% and increasing the rate of job creation in manufacturing to 100 million additional jobs by 2022, is envisioned through measures such as business process simplification, industrial training and skill up- gradation, and most importantly by **large- scale clustering and aggregation of industrial units**.

Furthermore, GoI has recently come up with a national programme, **"Make-In-India"** to promote manufacturing sector in a comprehensive manner. The program aims to facilitate investment, foster innovation, enhance skill development, protect intellectual property, and build best-in-class manufacturing infrastructure. On the other hand, contribution of manufacturing sector to overall GDP in India is still lower as compared to that of fast developing economies in the region like Thailand, China, Indonesia and Malaysia.

Thus, what is seen is that at the national level, there is clearly an opportunity to steer industrial corridor development in a collective & coordinated fashion.

[1] Excerpts from National Manufacturing Policy, Annex to Press Note 2 (2011 series)

1: Delhi Mumbai Industrial Corridor
2: Amritsar- Delhi- Kolkata
3: Chennai- Vizag- Kolkata
4: Chennai- Bengaluru & Bengaluru- Mumbai

Figure 2.3: Industrial Corridor Development Projects

Tamil Nadu being a well-known destination for manufacturing industry plays a key role in aligning industrial development with national targets with the right set of critical projects that enable attainment of the collective vision; thereby **necessitating the need for induced cooperation between stakeholders at the national & state levels.** The strategy to develop the Chennai-Bengaluru Industrial Corridor (CBIC) is aligned to this plan to achieve accelerated development and regional industry agglomeration in the states of Tamil Nadu, Karnataka and Andhra Pradesh.

2.2. Objective of the Study

Joint Statement between Government of Japan (GoJ) and Government of India (GoI) in December 2011 emphasized the importance of hard and soft infrastructure at Chennai-Bengaluru area, and Japan offered 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: (i) feasibility studies for prioritized infrastructure projects; (ii) development of infrastructure; (iii) technical assistance for performance improvement support.

JICA study was conducted in consultation with related stakeholders with the following objectives:

- 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)
- Identify components of infrastructure that need to be created, the system enablers that need corrections to enable better functioning of the economy and industry and development of the above nodes as a starting point to promote manufacturing and growth in the CBIC region.

The scope of work is divided to two parts, Part A and Part B which correlate to the study objectives. Part A aimed to prepare comprehensive regional perspective plan for CBIC region, which was conducted during October 2013-June 2014. The main steps include (i) defining the delineation of the Corridor; (ii) reviewing industry and infrastructure; (iii) shortlisting of nodes; and (iv) developing a comprehensive regional plan. After the completion of Part A, GoJ and GoI selected three nodes for the further study under Part B, namely Ponneri in Tamil Nadu, Tumkur in Karnataka, and Krishnapatnam in Andhra Pradesh.

Part A	Part B
Comprehensive Regional Perspective Plan for the CBIC region Strategy for transforming the region into a globally competitive investment destination Identification of suitable nodes	**Master Plan and Development Plan for 3 nodes**

Target year:	**20 years (2014-2033)**
Target Area:	States of Karnataka, Andhra Pradesh and Tamil Nadu, along the **corridor between Chennai-Bengaluru-Chitradurga** spanning around **560 km** (linear length)

Figure 2.4: Study Framework

2.3. Selection of Nodes for Industrial Development

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.

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.

- Spanning over a length of 560 kms, the CBIC covers an area of ~***91,000 sq. kms*** (~3% of area of all of India) ***covering around 17 districts*** in the three states of Tamil Nadu, Karnataka and Andhra Pradesh under its influence area.

- Identified nodes for industrial development along CBIC, range between 25- 70 sq. kms, and are comparable to the size and functioning of satellite cities such Cyberabad (A.P) and Kengeri (Karnataka), complete with all municipal functions

The above potential zones (including other surrounding / neighboring 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

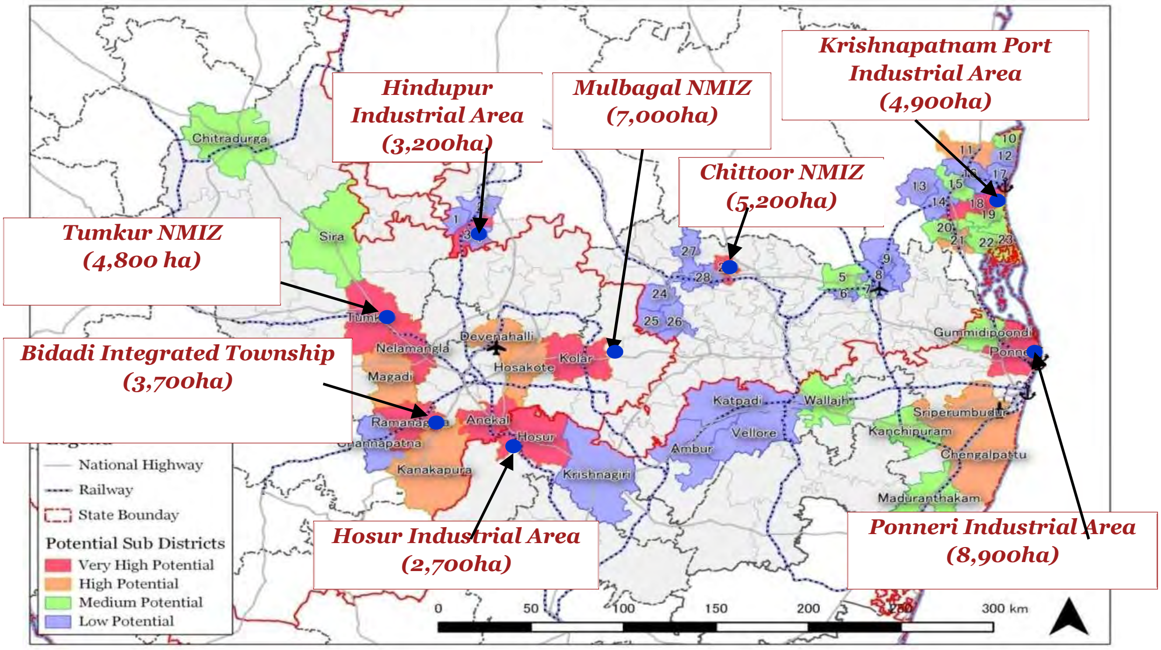
Based on the above analysis, the potential broad zones were classified into two categories:

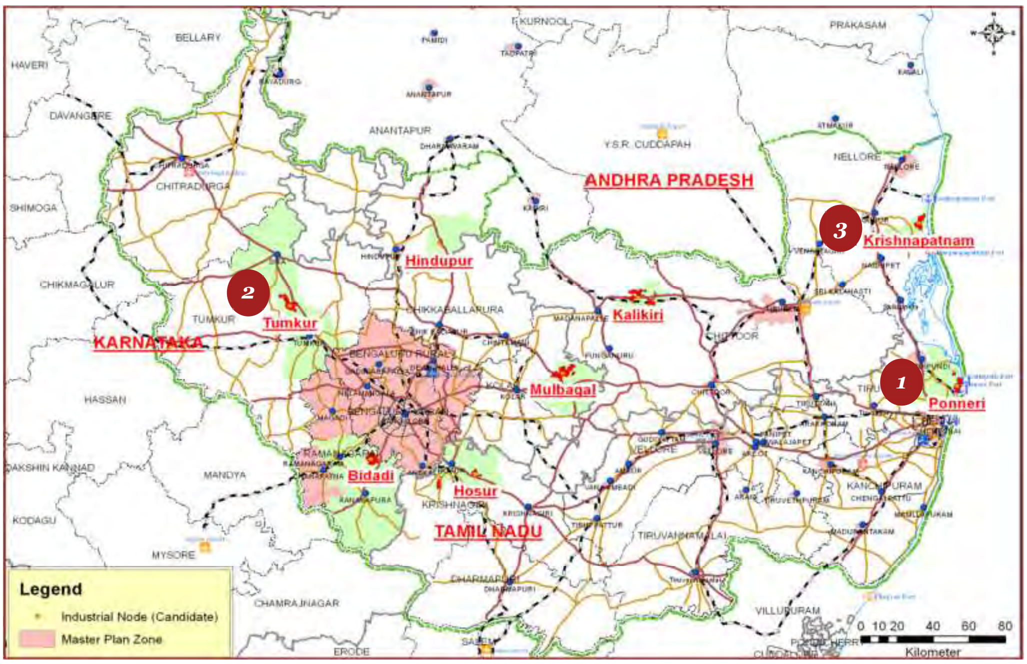
- Category A: High priority regions with the potential to provide faster return on investments
- Category B: Regions with low potential to provide faster return on investments

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

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.





Selection of Ponneri IN

Figure 2.5: Nodes selected for CBIC including three nodes selected for Master Plan Development

Ponneri Industrial Node is located in north of Tamil Nadu in Tiruvallur district which is in close proximity to Ennore Port and Kattupally port. Ponneri Node is 37 km away from Tiruvallur, the district headquarters. It is 18 Km away from Kamarajar Port and 15 Km away from Kattupalli Port. Ponneri node is located 36 Km away from center of Chennai, Capital city of Tamil Nadu. It is accessible to grand trunk road SH 56 and NH 5 within 10 to 30 km and the nearest rail head is at Minjur which 5 km away. Gummidipoondi, Thervoykandegai and SriCity are the nearest locations where some industry establishment has taken place.

2.4. Approach & Methodology

A concept master plan and development plan for three nodes in about 10-12 months and consist of the following key modules / stages for the three selected nodes.

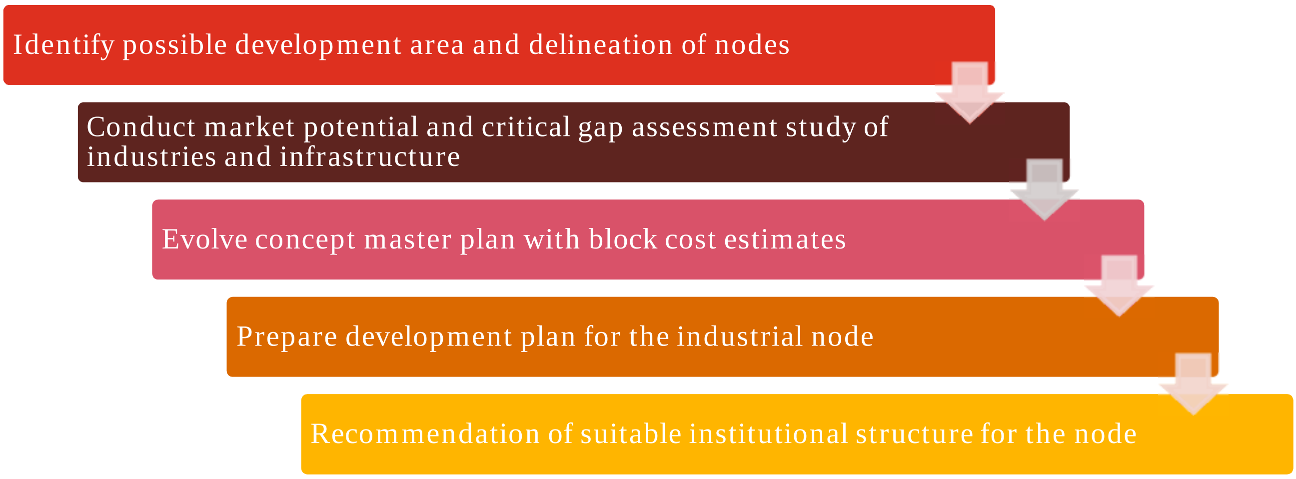


Figure 2.6: Approach to the CBIC Study

2.4.1. Approach for analysis of Traditional and Potential Sectors

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

Figure 2.7: 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;

TOP SECTORS	
Food processing	**Electronics**
Automobiles	**Textiles**
Chemicals and petrochemicals	**Pharmaceuticals**
Metallurgical industries	**Electrical machinery**
Machinery	**Medical equipment**

Figure 2.8: Industry Sectors to be promoted within the corridor

2.4.2. Infrastructure Development Plan for the Node

The necessary infrastructure support will induce private participation in node development and encourage creating world class industrial node which will enable to attract companies producing high value products or to support producing higher value added products. The increase in value added would contribute to increase competitiveness of the industrial cluster at the region and lead to further increase in private sectors development to the region.

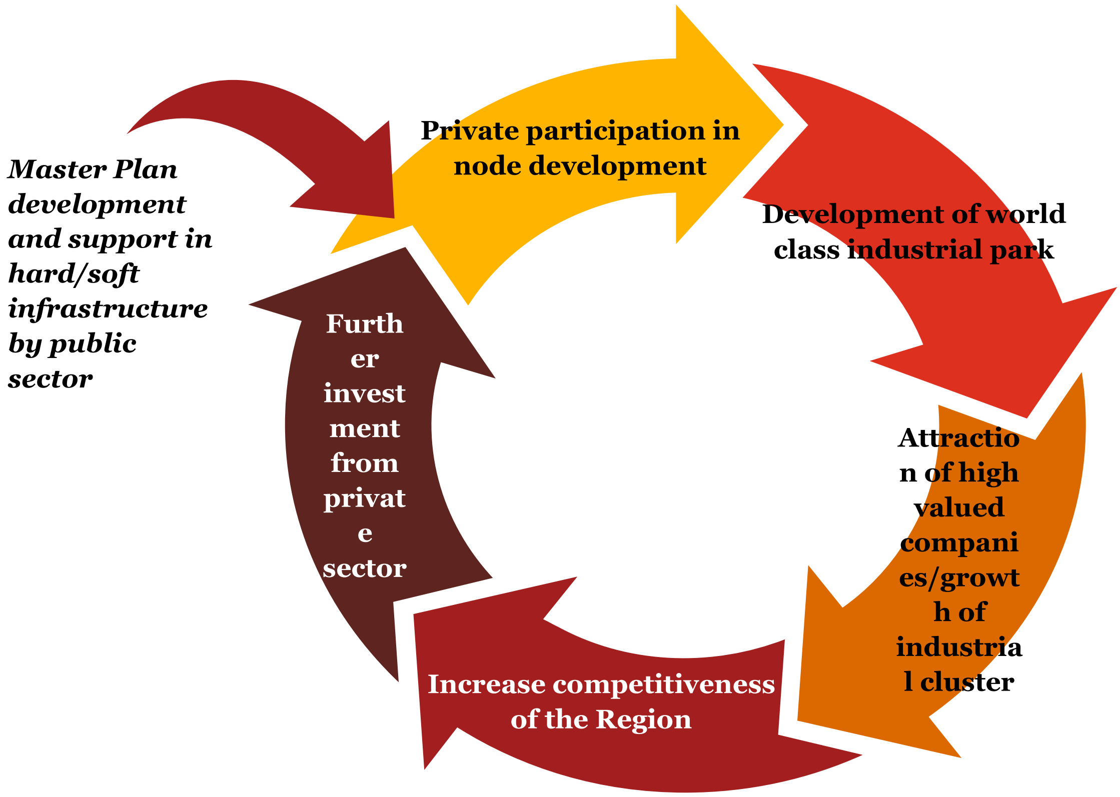


Figure 2.9: Public Private Partnership in Node Development

2.5. Vision for CBIC

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. The corridor is expected to predominantly cover significant areas of 16 districts spread across the states of Tamil Nadu, Karnataka and Andhra Pradesh. Both Bengaluru and Chennai are developing rapidly and accept increasing number of private companies including Japanese players. The Corridor assumes a prime position in the overall development map of India as one of the key contributors to the economies of South India in specific and India in general. The proposed Corridor shall also form an important part of the Government of India's plan for providing impetus to manufacturing in the region.

As is evident from the socio-economic indicators, CBIC region is already strong on majority of the aspects that form basis of any industrial region. In addition, CBIC falls in three of highest GDP contributing states in the country, together accounting for 1/5th of national GDP as well as industrial NDP. These figures indicate the natural competitive advantage that CBIC already has. Going forward, the industrial strategy of CBIC has to focus on leveraging upon the existing strengths.

It is critical to improve hard and soft infrastructure to enhance competitiveness in the CBIC region to attract high-quality international and national companies for industry promotion of CBIC region. The foundation for developing successful models of development needs to be created.

Table 2.1: Vision for CBIC

Vision for Chennai Bengaluru Industrial Corridor (CBIC) for 2033:	
Global Manufacturing Center *"Be known as a global leading manufacturing center towing world economic growth and generating national employment opportunities."*	***Top Investment Destination*** *"Be one of the top three preferred investment destinations in Asia and the most preferred in India with high efficiency and competitiveness."*
Leading Innovation Hub *"Be known as the leading innovation hub and knowledge capital of India through presenting innovative progress in industrial sector."*	***Model of Inclusive Growth*** *"Exhibit a model of inclusive growth pattern and ensure high level of environmental standards."*

2.6. Coverage of the Report

Daft Final Report (DFR) covers the critical gap assessment between industry development scenario and infrastructure and block cost estimates along with concept master plan and development plan of each node. Suitable institutional framework for the development of CBIC region will be analyzed and discussed.

The main contents of the final report are summarized in the table below.

- **Overview of Tiruvallur District and Vision for the Node** including the socio-economic profile of the district
- **Analysis of Traditional and Potential Industrial Sectors for Tiruvallur district and Ponneri** including benchmarking against the global best practices in the industry and key policy implications
- **Land Use Plan** for the selected Industrial node with detailed land use and precise details of activity zones, industrial and infrastructure facilities, detailed development control, regulations, etc.
- **Infrastructure Development Plan for the Node including the plan** for roads, water supply, power, railway connectivity, logistics and civic infrastructure.
- **Economic Cost Benefit Assessment** including a broad economic cost benefit assessment with estimation of likely costs associated and benefits that can be accrued with various proposed project components envisaged as part of the Industrial node (viz. potential employment generation by sectors, export promotion prospects, availability of quality industry/infrastructure, etc.).
- **Financial Planning and Assessment** for the development of the SPV including the equity and debt structures and the associated commercial debt servicing plan.
- **Regulatory and Implementation Framework** for creating enabling environment to promote local industries, improve quality of life, upgrade human skills, create world class infrastructure and attract global investments.

3. Overview of Tiruvallur district and Ponneri Industrial Node

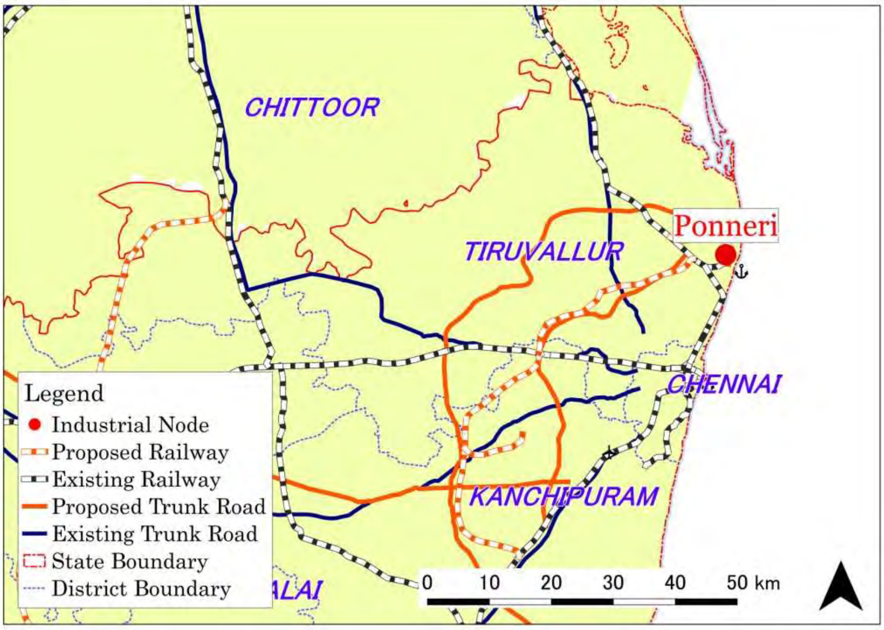
3.1. Regional Assessment of Ponneri Area

The proposed node is located 36 km north of Chennai, the capital city of Tamil Nadu, in the southeast corner of Ponneri taluk (sub-district). The site is adjacent to the ports of Ennore and Kattupalli, located to its east. Geographically, the node lies on the eastern coastal plains, along the Coromandel Coast. Being located in a coastal region, it falls under Coastal Regulation Zone (CRZ) III. The node's location is at the northern end of the proposed Peripheral Ring Road (PRR). Once the Northern Port Access Road (the northern arm of the PRR) is completed, the connectivity to other industrial areas along the PRR (e.g. Oragadam industrial area, Sriperambadur industrial area etc.) will be improved. In addition, a freight railway line connects Ennore port to the Chennai – Nellore mainline, passing close to the southern edge of the node. One of the biggest advantages of this area is its access to nearby ports. The overview of the Ponneri area is summarised below:

Table 3.1: Overview of the Ponneri Area

Particular	Description
District/ State	• Tiruvallur district/ Tamil Nadu state
Distance from Metropolitan	• 36 km from the city centre of Chennai
Accessibility to trunk road network	• 10 km from SH 56 • 30 km from NH 5
Accessibility to railway network	• There is only freight railway access to the area
Accessibility to major transport facilities (port, airport)	• Adjacent to Kattupalli port and Ennore port • 50 km from Chennai airport
Major industrial locations in the surrounding area	• 45 km from Gummidipoondi industrial area(600ha) • 60 km from Thervoy Kandigai industrial area (320ha) • 70 km from Sri city(2,020ha)

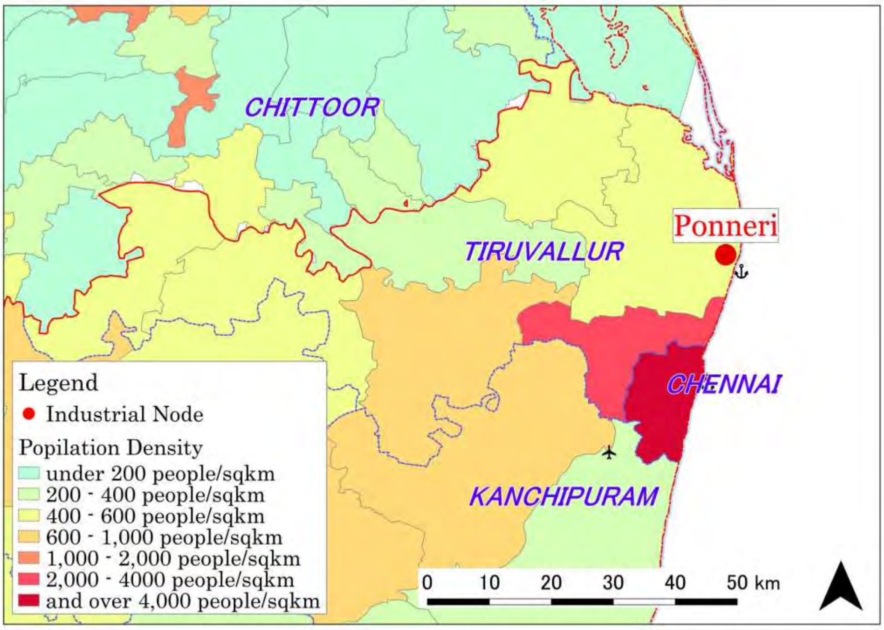
Source: JICA Study Team



Source: JICA Study Team

Figure 3.1: Infrastructure Map of Ponneri

A portion of Ponneri Taluk (sub-district) is within the boundary of the Chennai Metropolitan Area (CMA). However, the Ponneri node itself is outside of the CMA and has not been covered by any urban master plans so far. TIDCO and other autonomous government bodies have established some individual infrastructure development projects (e.g. thermal power plants, desalination plants etc.) around the Ponneri node. This area has been earmarked as a utility provision hub for Chennai city. Ponneri sub-district is one of the fastest growing industrial areas close to Chennai. The population density is higher than other sub-districts of Tamil Nadu (density of Ponneri sub-district: 400 – 600 people/sq.km). The majority of settlements are located along NH-5 and the railway line. However there are very few settlements within the Ponneri Node itself.



Source: JICA Study Team

Figure 3.2: Population Density in 2013 of Ponneri and the Surrounding Area

In the following section the economic and social profile of the adjourning areas of the Node and the Node (Tiruvallur district with focus on 50-100 km radius from the Node) has been presented. The section also covers major industrial hubs/clusters and status of industrial infrastructure at the state level and located in adjoining areas to Ponneri IN.

3.2. Socio-Economic Profile of Tiruvallur District

3.2.1. Vital Social Characteristics

Tiruvallur district is moderately populated, highly dense and urbanized districts of Tamil Nadu. The population density was 776 persons per Sq.Km in 2001 and it increased to 1049 persons per sq.km in 2011 at a CAGR of 3%. The density is more than the state when compared as a whole.

The urbanization rate in Tamil Nadu increased from 44% in 2001 to 48% in 2011 which has grown at a CAGR of 1% which is similar to the growth in TN-CBIC districts. As observed, there is a significant increase in the urbanization levels in Tiruvallur district from 2001 to 2011. This district witnessed a surge from 55% in 2001 to 65% in 2011 which increased at a rate of 2%.

The development of industries in the district is attracting more and more people into the district as it offers good employment opportunities. Due to the migration observed, the living standards have improved

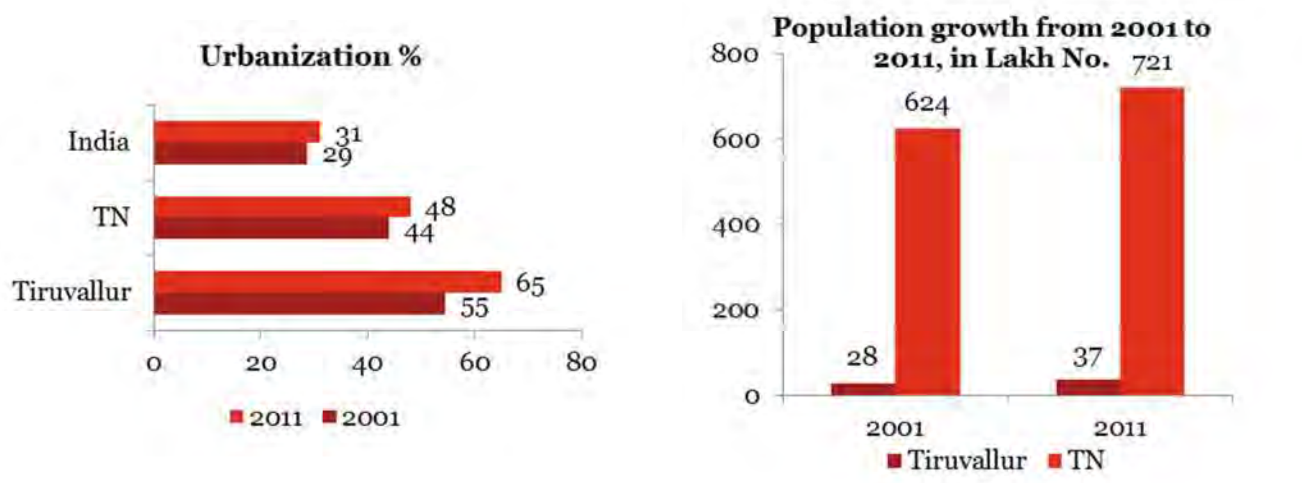


Figure 3.3: Demographic profile of Tiruvallur district

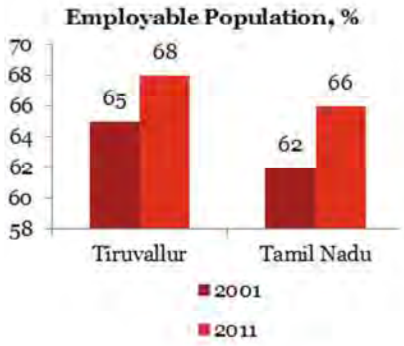
Source: Census 2001 and 2011, PwC Analysis

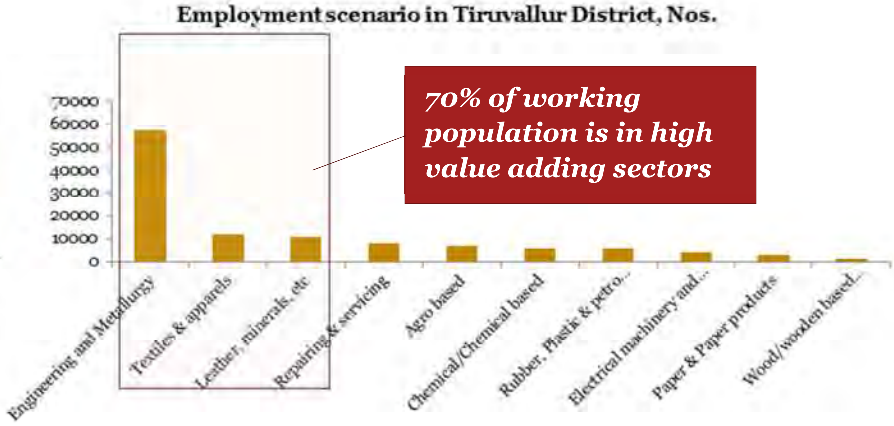
The presence of strong industrial base and settling of urban population in the district makes it stand higher than the state and country.

3.2.2. Employment

Engineering, metallurgy and Textiles sector contribute to 70% of the employment in the region. The district profile of employees is shown below. It is observed that more than 60 % of the employees are indulged into key sectors concentrated in Engineering and metal based (50%), and Textiles & apparels (10%).

On comparison of the share of employable population out of the total population in case of Tiruvallur district as well as Tamil Nadu, it is observed that the share of Tiruvallur district has increased from 65% to 68% during the period 2001-2011. During the same period, the share on employable population in Tamil Nadu has increased from 62% to 66%. With increasing level of employability and Tiruvallur district consistently leading the Tamil Nadu state in this aspect, it is evident that availability of manpower is not a cause for concern

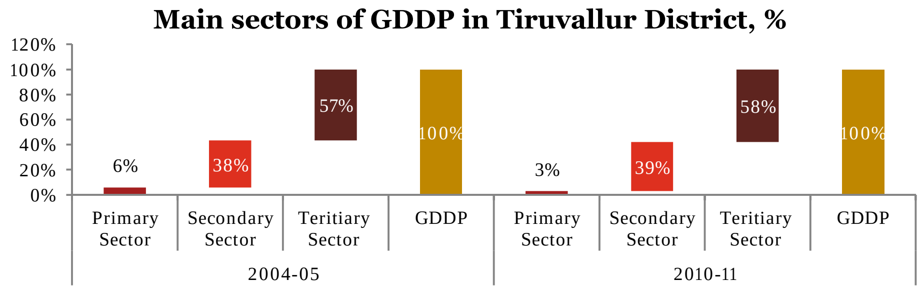


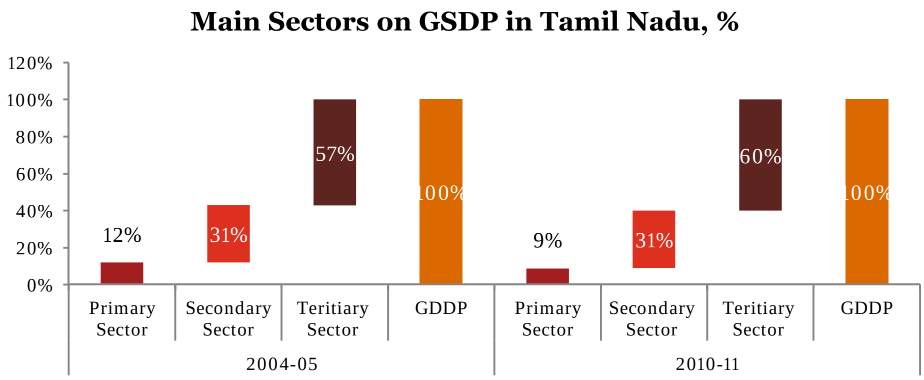


Source: Census 2011, Ministry of MSME, Tiruvallur District, GoI

Figure 3.4: Employable population and employment scenario in Tiruvallur District

Tiruvallur is among the top 3 districts of TN in terms of employable population and majority of the population is in high value adding sectors.





Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

3.2.3. Gross District Domestic Product

Secondary sector is a key contributor to the economy. The split of economic activity into primary, secondary and tertiary sectors in Tamil Nadu shows the contribution by manufacturing sector is maintained from 2004-05 to 2010-11 and a marginal improvement in tertiary sector. The contribution is shifting towards secondary and tertiary sectors from Primary sector.

Tiruvallur is observed to be the fastest region developing as an industrial area. The contribution made by secondary sector to the economy of Tiruvallur district is 39%, whereas at a national level the secondary sector contributes only 25%. This shows that Tiruvallur provides a strong base for future development.

It is observed that the share of secondary sector at the state level has remained steady at 31%. The share of primary sector decreased to about 3% from 6% earlier which indicates the economic activity shifting towards the other two sectors- secondary and tertiary sectors.

In case of Tiruvallur district, there is a slight increase in the share of secondary sector from 2004-05 to 2010-11 from 38% to 39% which is more when compared with the state.

The share of tertiary sector is maintained the same from 2004-05 to 2010-11. On an overall basis, the share of respective sectors is on par with the state.

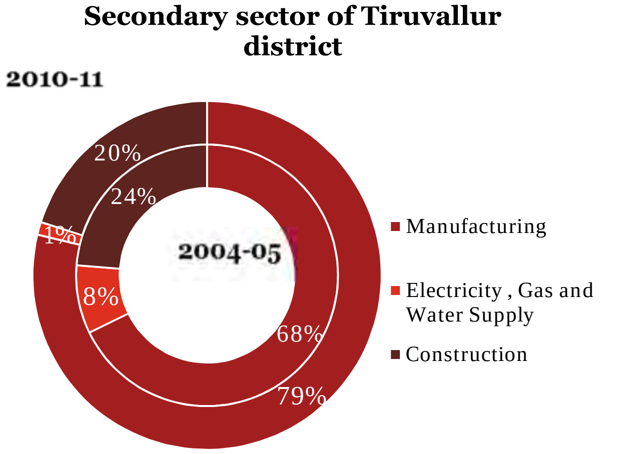
The strong industrial base present in this district can help in directing further growth and improvement. This is substantiated herein below.

Secondary sector of Tiruvallur district is dominated by manufacturing, and is observed to be steady.

Secondary sector of Tiruvallur district contributed 8% to the state's GDP in 2010-11 and has grown from Rs. 4586.61 crore to Rs. 10613.98 crore at a CAGR of 18% between 2004-05 and 2010-11.

Manufacturing is a dominating segment of the secondary sector in Tiruvallur, which has grown at 22% CAGR between 2004-05 and 2010-11. However, the share of this sector is steady from 2005 to 2011 which is about 38%.

Manufacturing segment is the largest sector in the district followed by construction.



Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

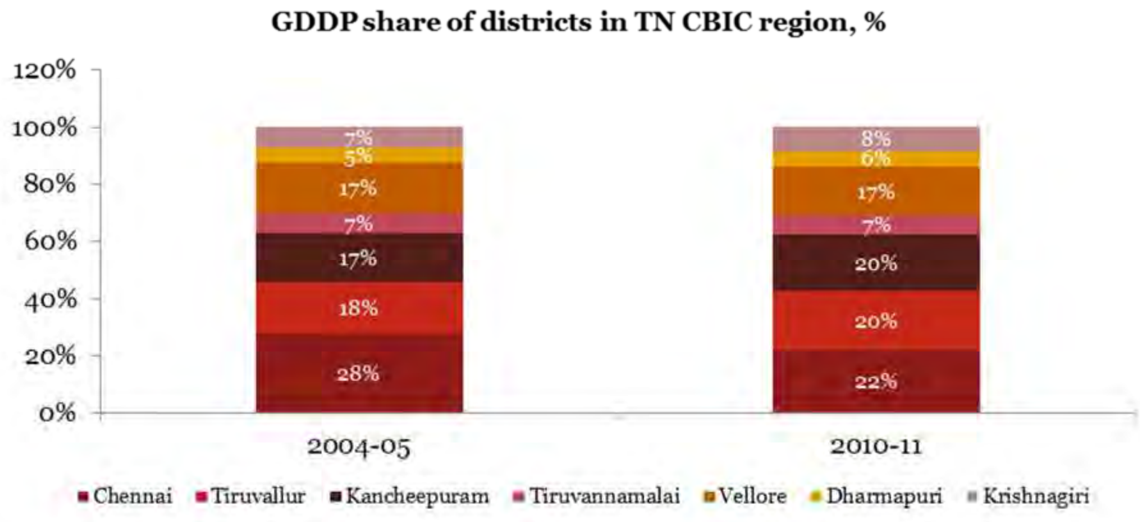
Figure 3.5 : Composition of secondary sector in Tiruvallur district

The contribution of manufacturing segment was Rs. 3109 crores in 2004-05 which increased to Rs. 8359 crores in 2010-11. However, the contribution from other segments; construction and electricity, gas and water supply decreased 2004-05 to 2010-11. A drastic decrease is observed in Gas, Electricity and water supply from 8% to 1%.

Manufacturing sector of Tiruvallur district

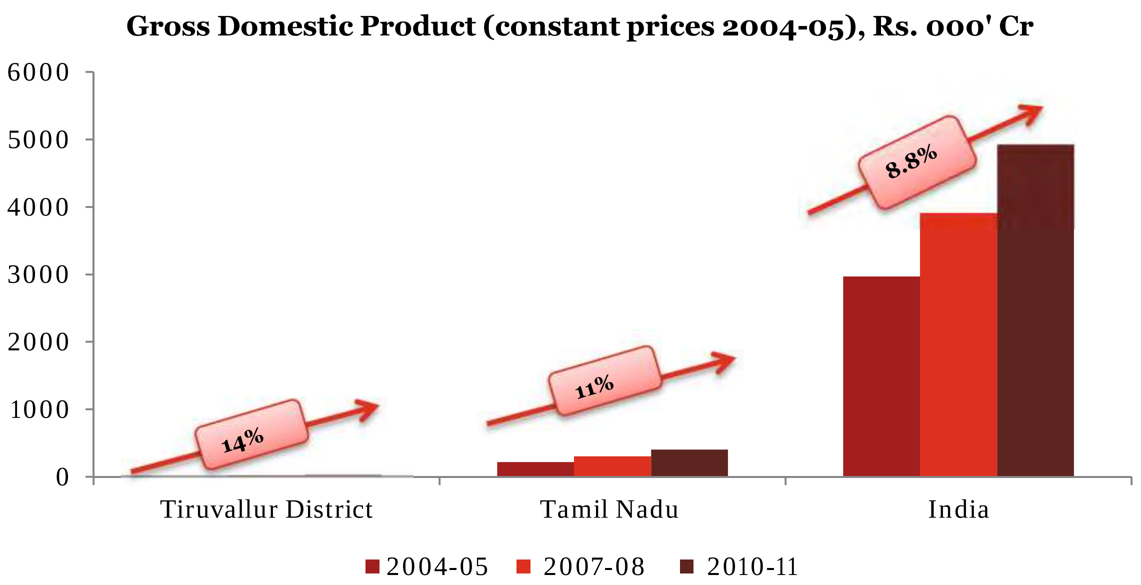
Strong manufacturing sector performance of Tiruvallur has made the district second largest contributor to the State GSDP. The significant contributors of GDDP in TN-CBIC districts are Tiruvallur and Kanchipuram. The contribution of Chennai is spilling over to these districts due to space constraints as Chennai is already a large metropolis. This has led to saturation of space and thus the city is forced to grow horizontally extending itself to neighboring districts. This kind of saturation observed in Chennai district is paves way for the development of adjacent districts of Tiruvallur and Kanchipuram. And, Tiruvallur which is one of the biggest beneficiaries of the saturation in Chennai contributes about 20% to the TN CBIC region which is the second major contributor in the region

Notwithstanding the TN-CBIC region, Tiruvallur is also emerging as one of the economically powerful and significant regions in the country. The growth rate of GDDP in Tiruvallur is about 14% during the period from 2004-05 to 2010-11 which more than the growth rates of Tamil Nadu (11%) and India (8.8%). This is substantiated in the chart below.



Source: District Income estimates, 2004-2005 to 2010- 2011, Dept. of Economics and statistics, GoTN, PwC Analysis

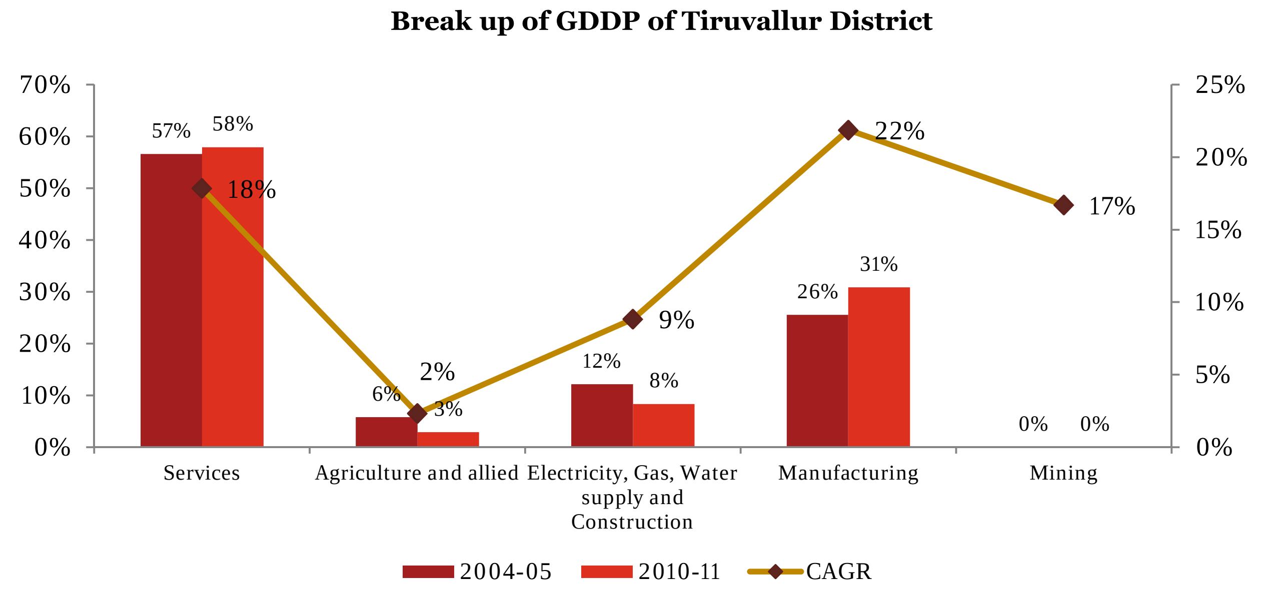
Figure 3.6: Share of districts in TN CBIC region



Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

Figure 3.7: Gross Domestic Product (Constant Prices 2004-05)

GDDP of Tiruvallur district shows that manufacturing sector is a leading component. The share of the sector in district's GDDP has increased from 26% in 2004-05 to 31% in 2010-11. It is observed that the concentration of economic activity in the region is shifting towards manufacturing. Though service sector holds the maximum share, the pace at which the service sector is growing is modest compared to the manufacturing sector in the district.



Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

Figure 3.8: Break-up of GDDP in Tiruvallur District

Manufacturing is the key component which contributes maximum to this sector. The share of it increased from 68% in 2004-05 to 79% in 2010-11.

The manufacturing sector in Tiruvallur district has registered and unregistered components. The contribution of registered units is Rs. 2984 Cr in 2004-05 and Rs.8203 Cr in 2010-11. The growth observed is 22% p.a. The share of un-registered manufacturing decreased from 5% in 2005 to 2% 2011. The district is dominant with registered manufacturing units which replicates the healthy contribution to the economy. This also indicates presence of organized manufacturing units in large numbers. This results in better value proposition and also results in greater per capita income[2].

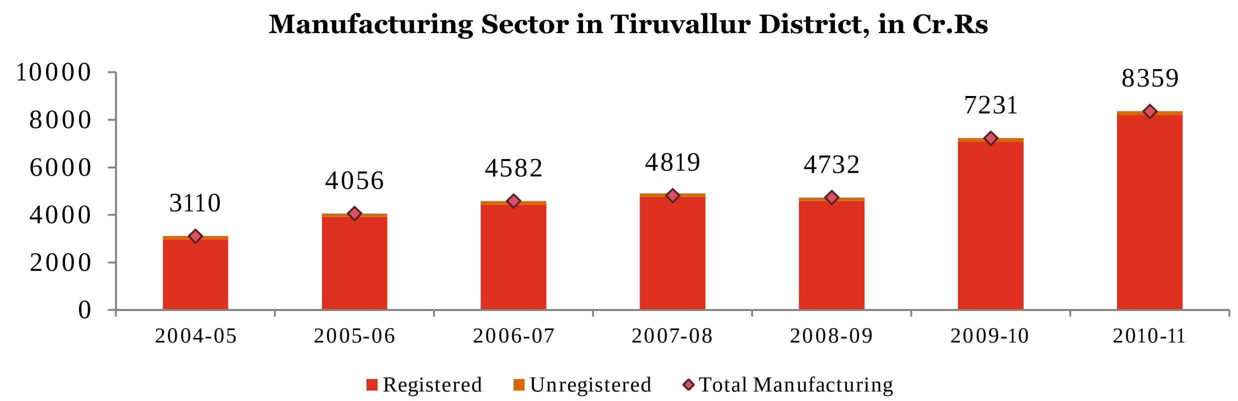


Figure 3.9: Manufacturing sector in Tiruvallur District

Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

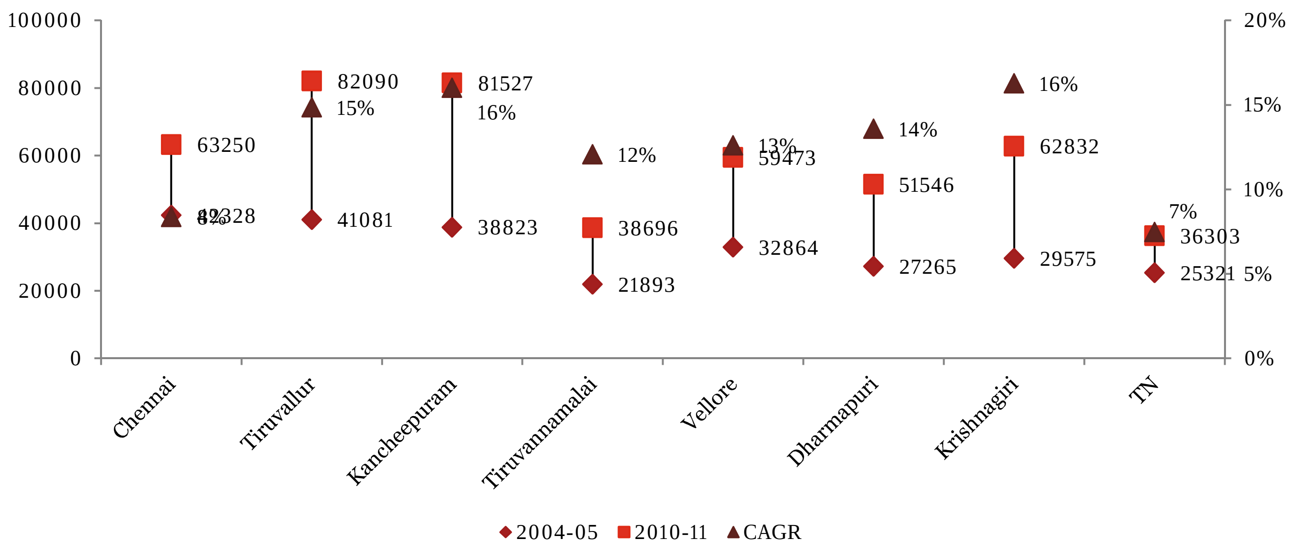
Analysis of large segments of GDP of Tiruvallur district reveals that Manufacturing is a very sizeable player – about 39% contribution to GDDP by 2010-11.

[2] It is generally true that earnings in an organized environment are higher than the same activity performed in an unorganized environment.

Auto, Chemical and Petrochemical segments are likely to dominate future manufacturing investments in Tiruvallur district. Services sector is leading the investment which is about 73%, in which the transportation services of road, rail, ship and air are together attracting 95%.

3.2.4. Per Capita Income

Per capita income of Tiruvallur district is more than state average and is also highest among TN CBIC districts. Per capita income in Tiruvallur district has increased from Rs. 41,081 in 2004-05 t0 Rs.82,090 in 2010-11 and has grown at a CAGR of 15%. It is higher than the per-capital income in Tamil Nadu. The Per capita income at 2010-11 is highest in Tiruvallur district as compared to other districts of TN-CBIC region. The significant growth in this parameter is due to the growth and improvement observed in manufacture sector of Tiruvallur district. Tiruvallur is the highest contributor (about 29% in 2010-11) of GDDP in manufacturing sector among all the districts in the CBIC influence region falling within Tamil Nadu.



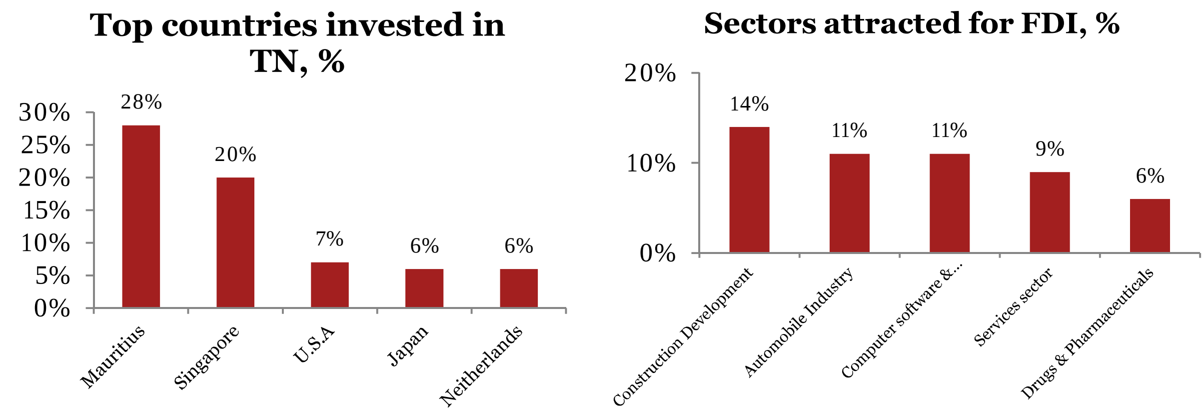
Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoTN, PwC Analysis

Figure 3.10: Per capita income of Tiruvallur district and Tamil Nadu

More than 50% of the population is into high value adding manufacturing sectors which is leading to highest Per capita income in Tiruvallur district among TN CBIC districts.

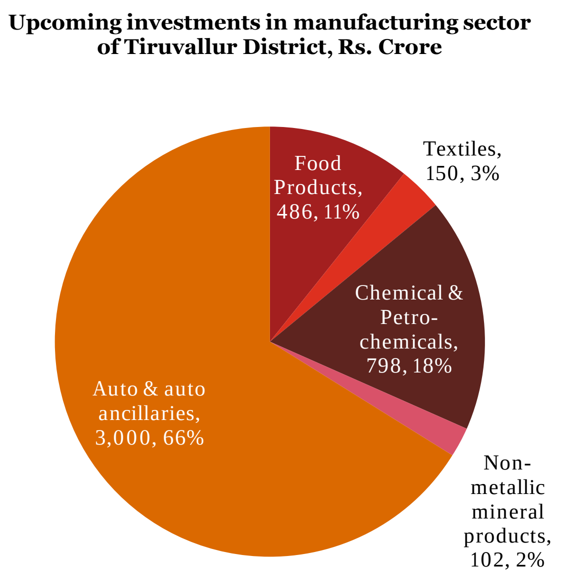
3.2.5. FDI

About 46% of top 25 FDIs in Tamil Nadu are in manufacturing sector. The total Foreign Direct Investments in Tamil Nadu are US $ 10.07 billion which caters to 5.34% share of the country's FDIs. TN stands fourth in share of cumulative FDIs in the country.



Source: RBI's Regional Office – Chennai – including states of Tamil Nadu and Pondicherry as on 31-12-2012. Extracted from www.dipp.nic.in

Figure 3.11: Top Countries and Top Sectors attracting FDI in TN



Source: Capex Data

Figure 3.12 Upcoming investments in manufacturing sector of Tiruvallur district, Rs. Crore

Mauritius and Singapore are the one among the top countries investing in TN. However, ultimate origin of FDI could be some different countries because Mauritius and Singapore are tax heavens and generally investment is routed through these two countries to avail tax advantages. The most attractive sectors are Construction development and automobiles.

Auto sector caters to 11% of the total FDI into the Tamil Nadu state and this is one of the top sectors.

The major component of investments is happening in services sector that is about 73%, in which the transportation services of road, rail, ship and air are together attracting 95%.

19% of the investments are going into electricity generation and distribution. About 6 % of overall investments are being done in manufacturing sector.

The investments of upcoming projects in manufacturing are identified to be happening in auto and auto ancillaries, Chemicals & Petro chemicals, Food products, textiles and non-metallic minerals.

The segment of investments happening in auto and auto ancillaries are into tubes and tyres manufacturing. The major chunk of investment is done Michelin India Tamil Nadu Tyres Pvt ltd is implementation a project named Tiruvallur Radial Tyres & Tubes.

A Plastic park is coming up at Vayalur and the investment happening is about Rs.243 Cr. Philips Carbon Black Ltd. is taking up Tamil Nadu Carbon black Project of about Rs.500 Cr.

A green field sugar and distillery project and a beer and alcohol project are announced and are expected to come up in this district.

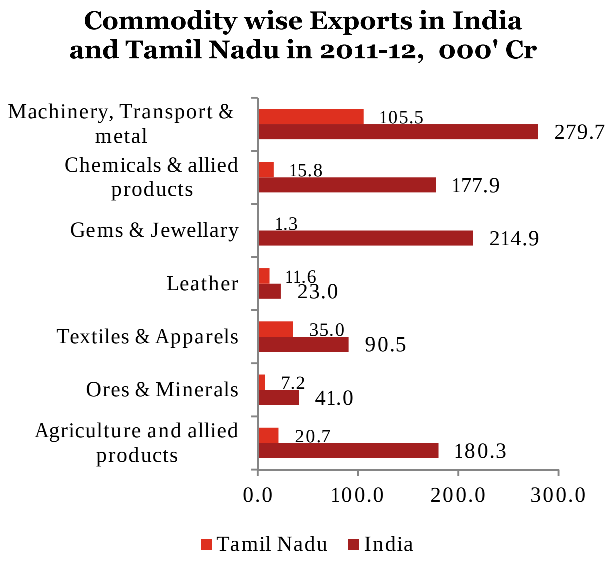
Non-metallic mineral products are relatively subdued accounting for only 2% of the total investments.

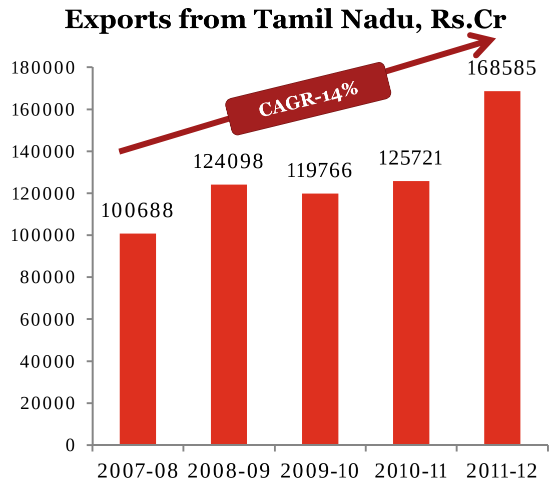
It is observed that the investments are attracted towards auto and auto ancillaries and machinery from the sectors like textiles and food processing. Other attractive sectors observed are machinery and metallurgy.

Manufacturing base has been set in the region with auto, machinery and metallurgy as attractive sectors.

3.2.6. Exports

Tamil Nadu has a significant share in the sectors of leather, heavy engineering, auto industry and textiles & apparels. The share of exports from state in Indian exports was 12% in 2007-08 and is 11 % in 2011-12. The average share of around 13% has been maintained during the same period.





Source: Economic survey of India, 2013-14, Guidance Bureau, GoTN

Figure 3.13: Export Scenario in Tamil Nadu

Engineering and automobile clusters are concentrated in the districts of Kanchipuram, Chennai, Tiruvallur and Hosur of Tamil Nadu. The presence of textile industries, chemical and petrochemicals and food processing also marks Tiruvallur District for exports. Moreover, the proximity of district to ports in and near Chennai exhibits the potential for export oriented sectors. Also, it is to be noted that the sectors which contribute to export from Tiruvallur district are all high value adding sectors.

3.3. Industrial Infrastructure Profile

3.3.1. Industrial Activities

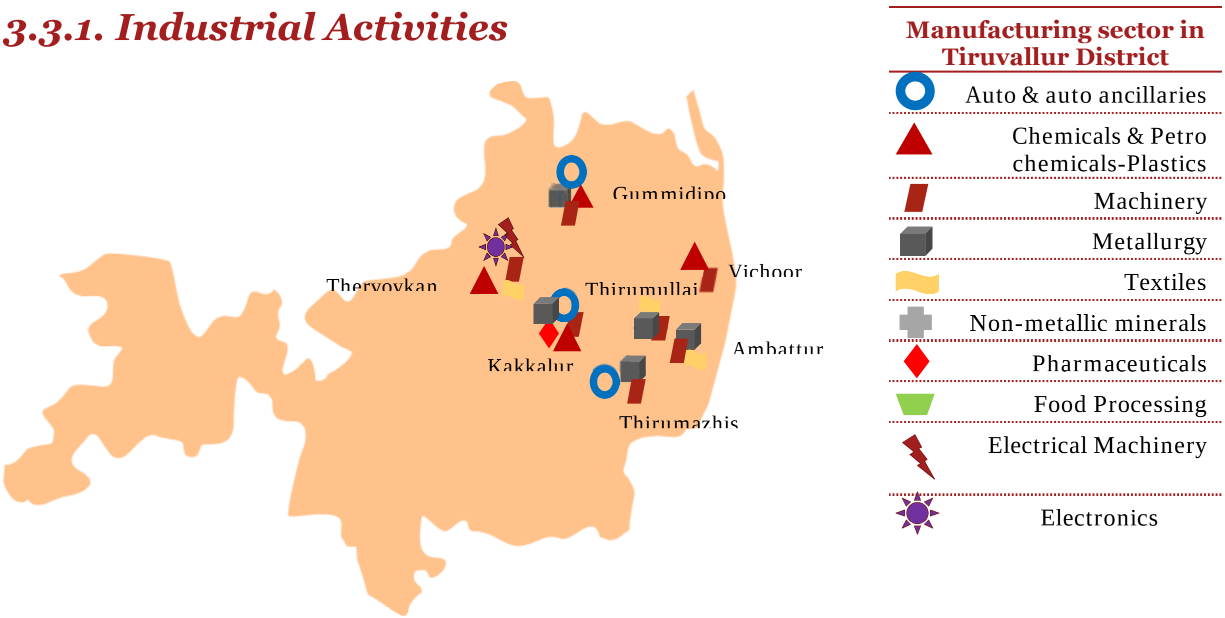


Figure 3.15: Concentration of industries in Tiruvallur District

Industrial activities are concentrated in close proximity to sea port. They are developed into a cluster in the interior parts as well as near the coastal line of Tiruvallur. The distance of the industry location may vary between 10-30 Km from the sea. Both export oriented and domestic goods are manufactured in this region. It is observed that the sectors present in this district are similar to that of top ten sectors identified for CBIC region.

Other than these, industries relevant to construction materials like brick manufacturing, wood and paints are also present in this region.

3.3.2. Industrial Areas

Many key industrial areas exist in Tiruvallur, Chennai and Kanchipuram districts but many are either saturated or on the verge of saturation. The industrial estates developed by Government are done by the bodies; SIPCOT (State Industries Promotion Corporation of Tamil Nadu Ltd) and SIDCO (Small Industries Development Corporation). SIPCOT had developed in Gummidipoondi and Thervoykandigai in Tiruvallur District and SIDCO developed in Ambattur, Thirumazhisai, Gummipoondi, Kakkalur, R K Pet, Vichoor and Thirumullavoyal. Other than these there is an IE developed by TIIC (Tamil Nadu Industrial Investment Corporation) at Mogappair, Electrical Estate at Kakkalur and TALCO developed in Madhavaram. The IEs in Porur, Alapakkam, Puzhal, and Velappanchavadi are developed by private players.

S. No	Industrial Park	S. No.	Industrial Park
1	Moccaram Industries, Velappanchavadi	9	Talco IE, Madhavaram
2	Sidco Industrial Estate, Chennai	10	Nagappa Industrial Estate, Puzhal
3	SIDCO Industrial Estate, Ambattur	11	SIDCO IE, Thirumazhisai
4	M.M. Industrial Estate, Alapakkam	12	Electrical Industrial

S. No	Industrial Park	S. No.	Industrial Park
			Estate, Kakkalur
5	G.K.Industrial Estate, Porur	13	SIDCO IE, Kakkalur
6	SIDCO IE, Thirumullaivoyal	14	SIPCOT Industrial Complex Gummidipoondi
7	Ekambara Naiker Industrial Estate, Alapakkam	15	SIDCO & SIPCOT IE, Gummidipoondi
8	SIDCO IE, Vichoor	16	SIDCO IE, R K Pet

Source: www.tiruvallur.nic.in

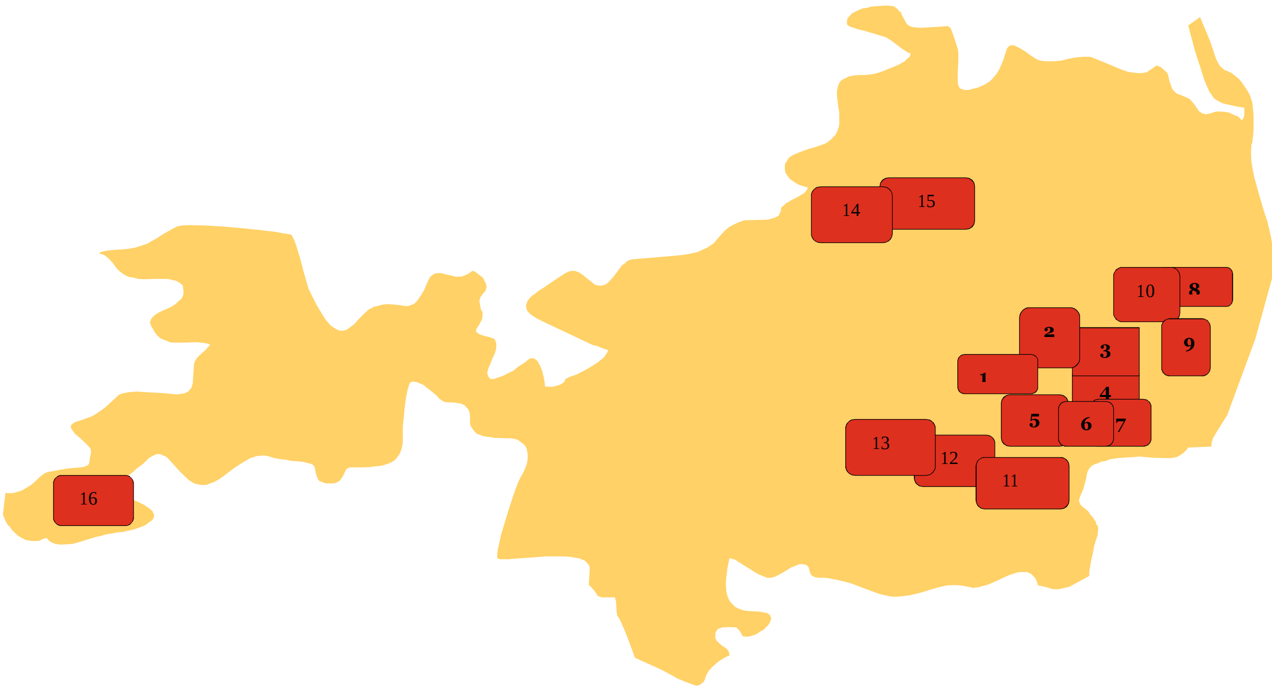


Figure 3.16: Industrial estates in Tiruvallur district

Table 3.2: Industrial Estates in proximity to the node

Name of park	Total extent/allotable land, acres	Vacant plots, acres	Ownership
Tiruvallur District			
Mahindra Worldcity Industrial park Phase II, Gummidipoondi	1,400	700	
Gummidipoondi (I& II)	1,242	11	SIPCOT
Thervoy Kandigai	1,127	218	SIPCOT
Plastic Park at Vayalur (upcoming)	-	300	TIDCO

Name of park	Total extent/allotable land, acres	Vacant plots, acres	Ownership
Kanchipuram District			
SIPCOT -Sriperumbudur Industrial Park Expansion (Vallam Vadakal)	1,780	880	SIPCOT
Irungattukkottai Industrial Park	1,513	-	SIPCOT
Sriperumbudur (I, II & III)	939	4	SIPCOT
Pillaippakkam Industrial Parks	847	29	SIPCOT
Electronic/Telecom Hardware/ Hi Tech SEZ-Sriperumbudur	571	69	SIPCOT
Sriperumbudur Aerospace Park	300	150	SIPCOT
Flextronics Technologies P Ltd , Sriperumbudur	250	-	SIPCOT
Nokia, Sriperumbudur	211	-	SIPCOT
Foot Wear and Leather Products SEZ at Irungattukottai	154	54	SIPCOT
Mappedu Industrial Complex	122	-	SIPCOT
Footwear Component Park, Irungattukkottai	53	-	SIPCOT
Oragadam	1,223	19	SIPCOT
Oragadam Industrial Park Phase II	616	300	SIPCOT
National Automotive Testing and Research & Development Infrastructure Project (NATRIP), Oragadam	304	-	SIPCOT
Chennai			
Mahindra World City	1,500	-	
Chennai Integrated Industrial Parks (Ascendas)	1,500	400	SIPCOT
Siruseri Industrial Parks	781	62	SIPCOT
Electronic Hi Tech SEZ –Oragadam	348	20	SIPCOT
Sojitz-Motherson	285	150	SIPCOT
IT/ITES SEZ at Siruseri	190	-	SIPCOT
DLF IT-ITES SEZ	57		SIPCOT
Aerospace Park	50	25	SIPCOT
TRIL IT-ITES SEZ	25	-	SIPCOT
Tidel Park	10		SIPCOT
TICEL Bio Park	5	1	SIPCOT

Source: SIPCOT

3.3.3. Industrial Agglomeration

Large industrial agglomeration around the node will offer industrial base advantages. The area under 50 km radius is considered from TN-AP border. This covers Chennai, Tiruvallur and Kanchipuram districts. Tiruvallur district as such consists of 16 industrial estates where 11 are developed by Government and 5 are developed by Private Organizations. The industrial parks are marked in the following diagram.

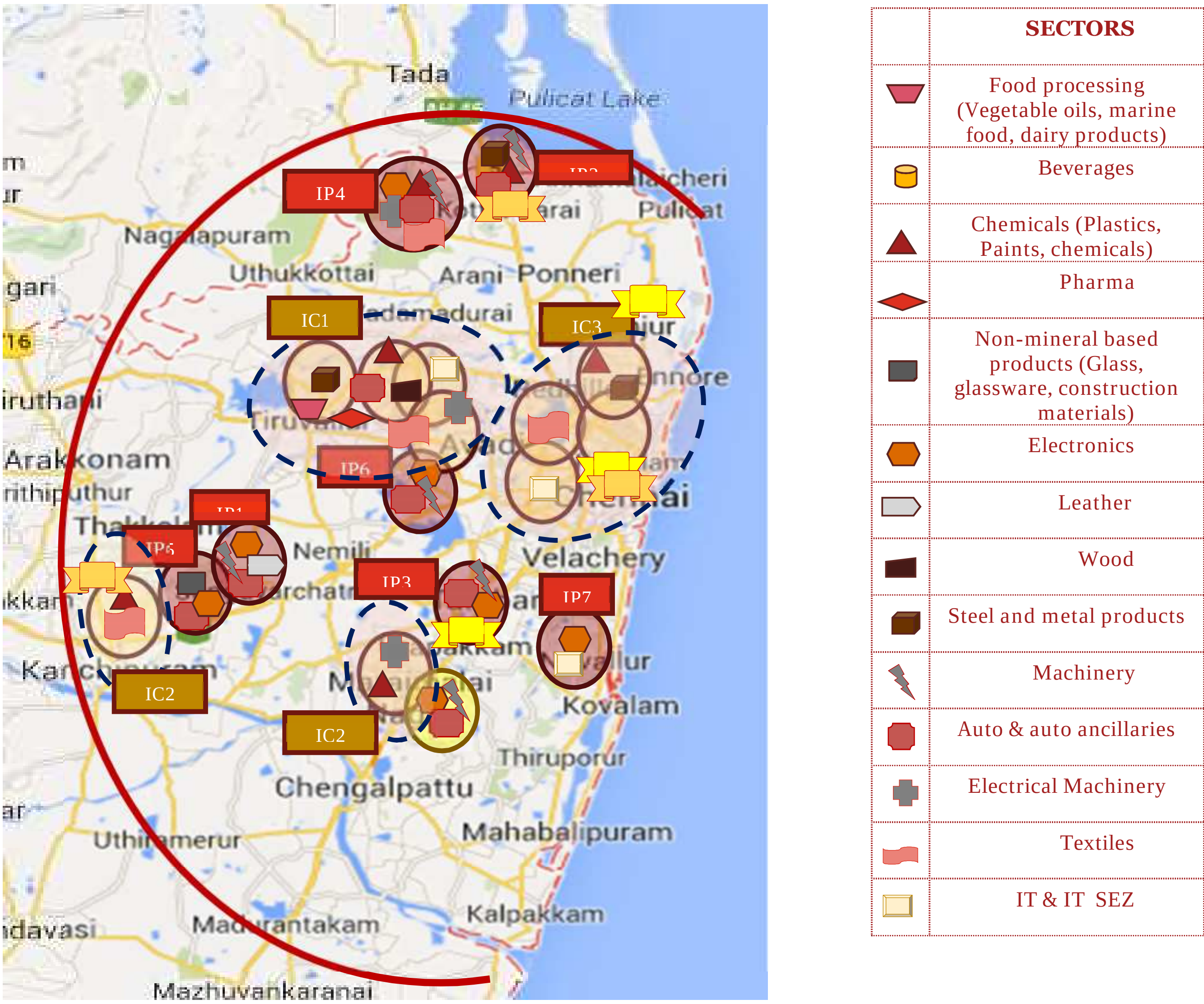


Figure 3.17: Industrial Parks in proximity to the node

	OPERATIONAL IPs (SIPCOT)/SEZs		OPERATIONAL INDUATRIAL CLUSTERS (SIDCO)		UPCOMING & ONGOING IPs/SEZs
IP1	Irungattukottai	IC1	Ambattur, Kakkalur, Thirumazhisai, Tidel park		Sriperumbudur Park Expansion, Chennai Integrated Industrial Parks (Ascendas), Mahindra WorldCity Phase II, Oragadam Phase II
IP2	Gummidipoondi	IC2	Kanchipuram and Maramalainagar		Sojitz-Motherson, DLF IT-ITES, Aerospace park, TRIL IT-ITES SEZ, TICEL Bio Park, Plastic Park at Voyalur
IP3	Oragadam, Electronic HiTech SEZ, National Automotive testing & research & Development Infrastructure Project (NATRIP)	IC3	Villivakkam, Guindy, Arumbakkam, Kodungaiyur		
IP4	Thervoykandigai				
IP5	Sriperumbudur (I,II&III), Hi Tech SEZ, Flextronics Technologies Pvt Ltd, Nokia,				
IP6	Pillaipakkam				
Ip7	Siruseri				

3.3.4. Upcoming Infrastructure and industrial projects

Along with the development of ***plastic park*** which is considered as a part of land use planning for Ponneri IN, the following are few more projects which are proposed to develop in the node region.

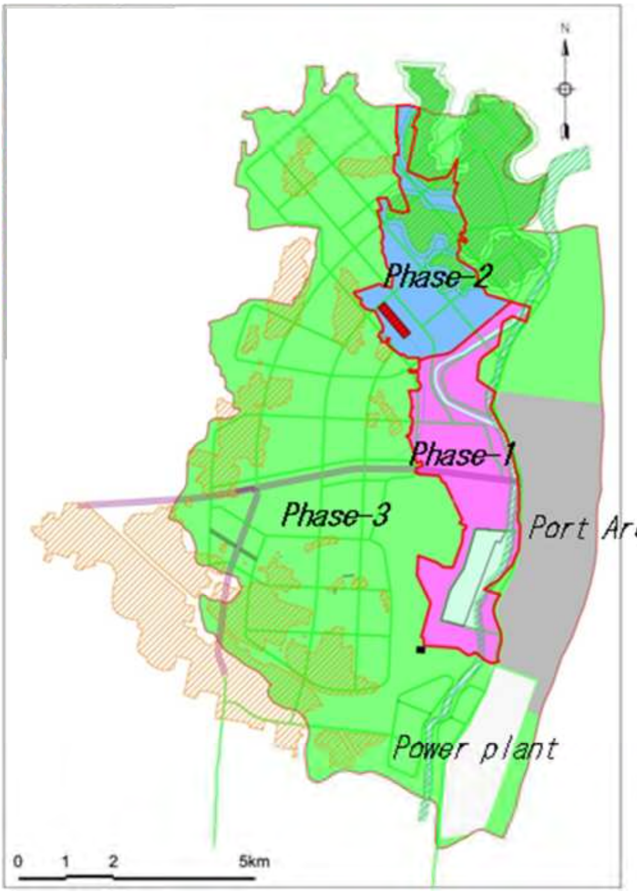
1. ***L&T Shipbuilding yard cum port complex***: TIDCO has promoted a major heavy industry in the nodal area viz. a large Shipbuilding yard cum Port complex through L&T Shipbuilding Ltd., Joint Ventured with TIDCO and Larsen and Toubro Ltd. This shipbuilding has a state of the art ship lift and modern / well laid out manufacturing shops. This yard is also capable of fabricating Modular structures for Off-shore platforms. A dry dock for building large specialized carriers such as LNG Carriers and for building large commercial vessels in the next three to five years' timeline is planned to be developed as part of this shipyard. The lands available within the premises of L&T Shipbuilding Ltd. will be utilized for these facilities.

2. ***Heavy Engineering Hub***: TIDCO is also promoting an Integrated Industrial Infrastructure in about 700 acres area for Engineering Components Manufacturing units in the Ponneri Industrial Node area. This is known as Heavy Engineering Hub. It is expected that over a 15 years' timeline, this Heavy Engineering Hub would attract a business potential of about Rs.6,000 crores. It is planned to have two enclaves namely shipbuilding industry components enclave and the second enclave for automotive components and electrical equipments sectors. The lands for this hub development are under acquisition.

3.3.5. Overview of Ponneri Industrial Node

Delineation of Node

The node covers a total area of 21,966 acres. Of this, the areas marked as Phase 1 and Phase 2 in the diagram below is 4,480 acres, which covers the land already in the possession of TIDCO and the Salt Department. This land will be taken up for development initially on priority; its boundary is shown below (the red line). The boundary has been proposed in consultation with nodal agency. Overall, the entire node is proposed to be developed completely over 20 years. The node area boundary is indicated by the green line. The node area comprises ten villages (Kalanji, Kattupalli, Puzhidhivakkam, Vayalur, Kattoor, Ebrahampuram, Athipattu, Ennore, Neidavoyal and Nandiampakkam).



Source: JICA Study Team

Figure 3.18: Node Boundary and Priority Area Boundary of Ponneri

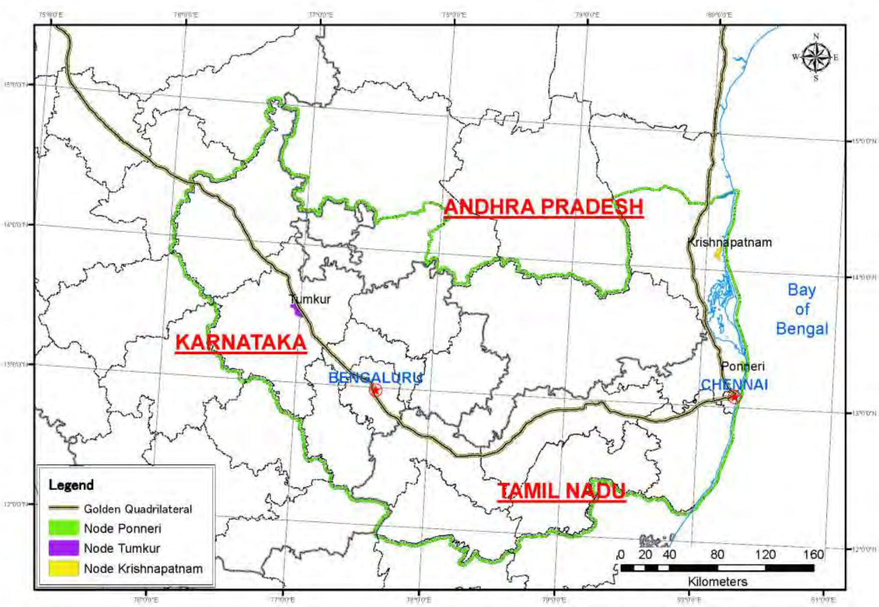
Table 3.3: Extent of Villages and the wet land included in the Node

Village	Wet land (Acre)	Total Extent (Acre)
Kalanji	68	1,130
Kattuppalli	223	2,460
Puzhidhivakkam	N/A	2,560
Vayalur	1,697	5,750
Kattoor	1,307	2,215
Ebrahampuram	70	980
Athipattu	1,037	2167
Ennore	N/A	1748
Neidavoyal	1,156	2,061
Nandiampakkam	760	892
Total	**6,319**	**21,963**

Source: JICA Study Team created based on village data

Topography

The locations of the selected three nodes in the CBIC region including Ponneri Node are illustrated as follows:



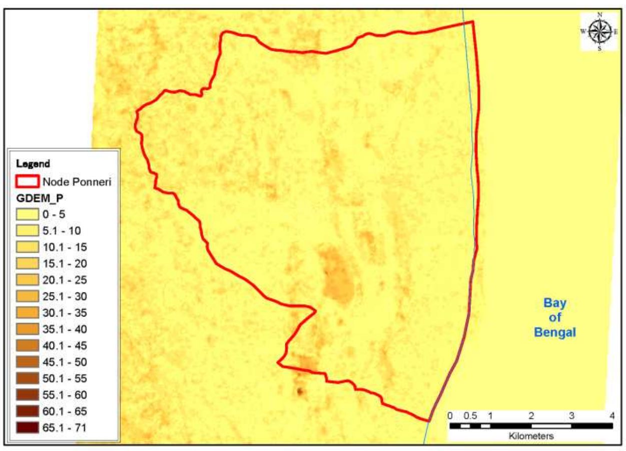
Source: Global Map

Figure 3.19 : Location of Nodes

The area of Ponneri Node was defined through consultations with the Tamil Nadu Industrial Development Corporation (TIDCO) of the Tamil Nadu state government. The proposed node is located in Ponneri taluk, Tiruvallur district as the northeast of Tamil Nadu. The district is bordered by Chennai and Kancheepuram districts to the South and Vellore district to the West as shown in the following figure.

Source: Global Map

Figure 3.20:Location of Ponneri taluk



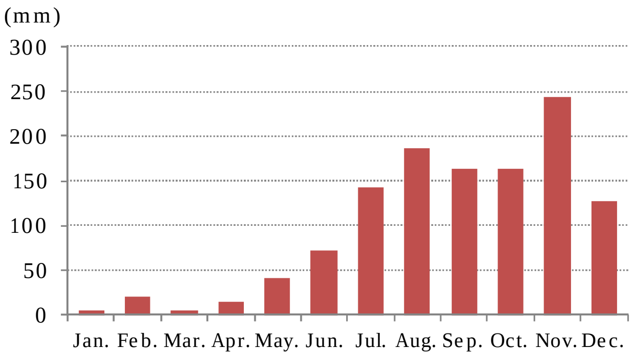
Source: ASTER GDEM(METI and NASA)

Figure 3.21:Geography of Pooneri taluk

The proposed Ponneri node site is located in Puzhuthivakkam, Kattupalli, Vayalur and Kalanji villages of Ponneri Taluk, Tiruvallur district, Tamil Nadu State. The node lies along the Buckingham canal, which runs along its eastern edge, and is also adjacent to Sengazhani Medu Colony. Uranampattu Village and the NCTPS ash pond are located on its western side.

Natural Conditions

The prevailing climate in Tiruvallur district is hot during April and May, similar to the rest of Tamil Nadu. Due to its geographical location, the region is very humid except between January and March. The average temperature of the district varies from 37.9 °C at a maximum to a minimum of 18.5°C. The total annual rainfall is 1,184 mm. The following figure shows the average monthly rainfall for the past five years (2009-2013) in the district.



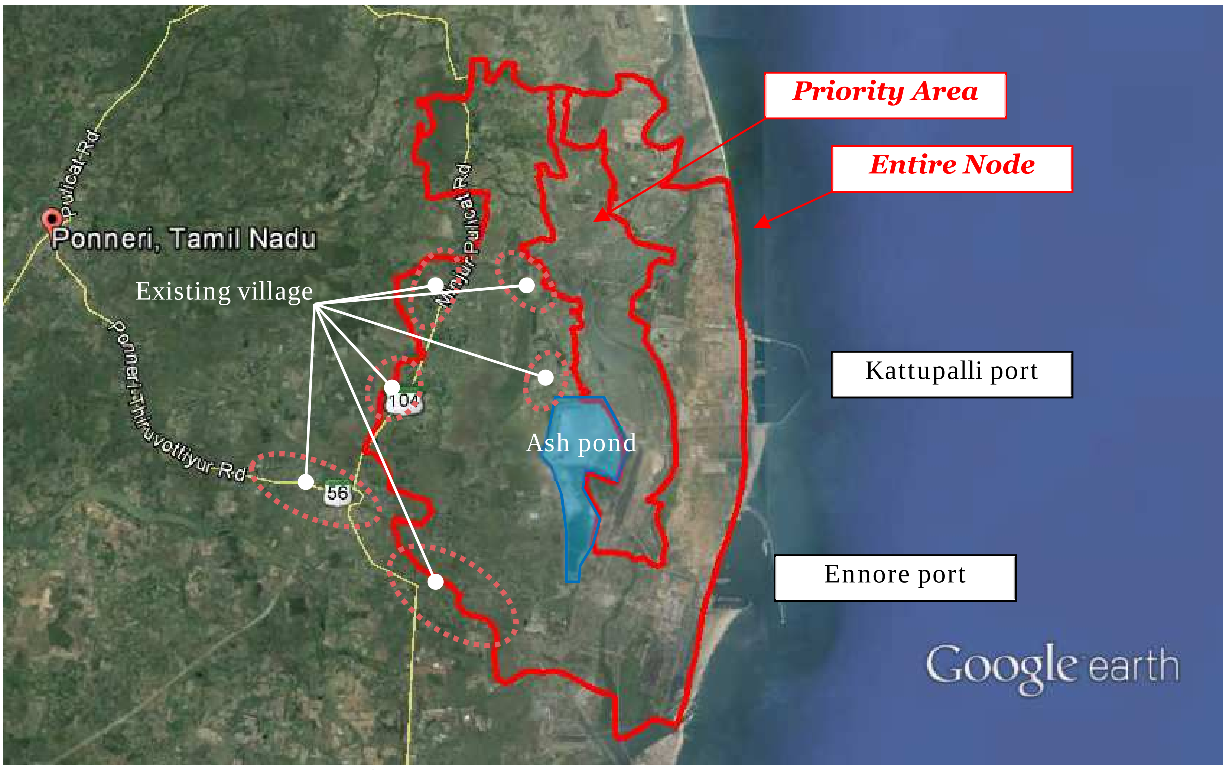
Source: JICA Study Team Based on Information from Hydromet Division, New Delhi India Meteorological Department

Figure 3.22: Average Monthly Rainfall for Past Five Years in Tiruvallur District

Current Land Use/Distribution of Settlement and Social Facilities

Land Use & Settlement

The current land use pattern and distribution of settlements are shown in the following figure and findings are summarised below.



Source: JICA Study Team based on data of Google Earth

Figure 3.23: Priority Area of Ponneri Node

- Salt manufacturing is one of the main local industries in the area. Hence, there are salt fields at some locations across the area. A portion of the northern area of the node is divided into rectangles, indicating plots for salt pans.
- A few settlement areas are located outside the priority area.
- A wide canal passes through the site and 2 ports are located on the east side of the canal.
- Ennore Port and Kattupalli Port are located along the coast. 2 thermal power plants and a 100 MLD desalination plant are also located near the node site. In addition, a coal yard is located next to the ash pond. The southern part of the site is mainly utilised for industrial purposes.
- A few mangrove forest areas are located along the canal. However the areas are limited.

Source: JICA Study Team

Figure 3.24: Access Road to the Site

Source: JICA Study Team

Figure 3.25: Vacant Land North to Kattupalli Port

Social Facilities

Social facilities (e.g. Government hospital, primary schools and secondary schools) have mostly been established within the town of Ponneri. In addition, private technical colleges (e.g. RMK College of Engineering, Velammal Institute of technology etc.) are located along NH-5 near Ponneri town. However, there are no health centres and schools within the priority area, and only a limited number of schools are located inside the entire node area.

Ground Conditions

Some water logged locations are found in the area adjacent to the canal as shown in the following photo. Land conditions will have to be improved in order to construct structures and develop infrastructure including roads.

Source: JICA Study Team

Figure 3.26: Low Lying and Marshy Land in the Site (Taken on 1st April, 2014)

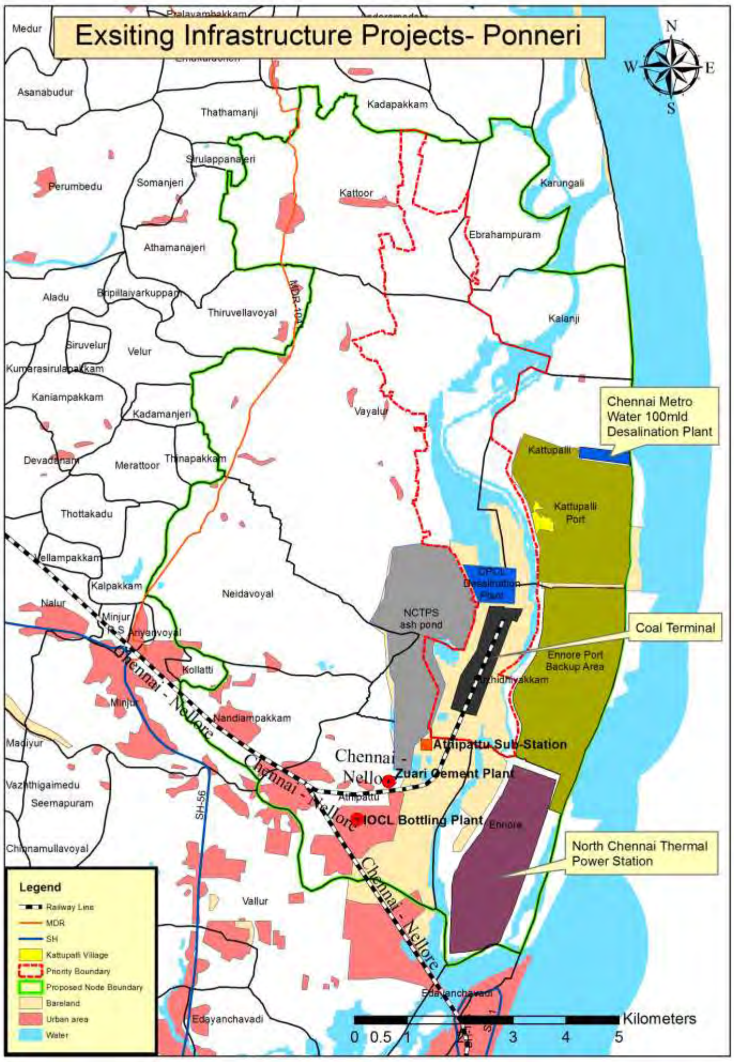
Existing Infrastructure Facilities

The Ponneri Node area includes some existing infrastructure facilities such as the CPCL desalination plant and Chettinad Coal terminal among others as listed in the following table and figure. The CPCL desalination plant is located adjacent to the Buckingham canal. Although the area covers an extent of 61 ha, only a limited part of this area is actually utilised. The Chettinad coal terminal is surrounded by the CPCL desalination plant, Buckingham canal and the Ash Pond. These existing industries are expected to be integrated and linked with the Ponneri Node development plan.

Table 3.4: List of Existing Infrastructure Facilities and Its Area in Ponneri Node

Existing Facility	Extents
CPCL desalination plant	61 ha (150 acres)
Chettinad coal terminal	101 ha (250 acres)
ZUARI cement plant	11.63 ha (28.75 acres)
Athipattu sub station	16.97 ha (45.67 acres)
IOCL bottling plant	50 ha (123.5 acres)

Source: TIDCO and Village Land Records.



Source: JICA Study Team

Figure 3.27: Existing Infrastructure Facilities in Ponneri Node

Land Acquisition Status

In Phase 1 & 2, TIDCO own 950 acres, i.e. 21% of total priority area (4480 acres). The land acquisition for the remaining priority area is yet to be completed by TIDCO (except existing built up areas such as CPCL Desalination plant and coal terminal).

Land in the rest of the node (i.e. 21,163 acres outside the priority area) shall be acquired subsequently in phase 3 excluding existing industries, village settlements, water bodies etc.

Table 3.5: Land Acquisition Status of Ponneri Node as of July 2014

Area		Acquisition Status	Remarks
Priority Area	*384.6 ha (950 acres)*	Completed	Land owned by TIDCO
	1101 ha (2720 acres)	Yet to be Acquired	Land owned by Salt Department and private owners
	162 ha (400 acres)	-	Others (includes water body, canal, etc.)
	165.182 ha (408 acres)	-	Land owned by CPCL and Coal Terminal
	1,813 ha (4,480 acres)	Partially Completed	Out of this land only 2522 acres to be used for Industries
Overall NODE Area	***8,565 ha (21,163 acres)***	Yet to be acquired	Some of the lands are covered by existing industries, ports, existing village settlements, water bodies etc. and should be excluded during acquisition. Only 7130 acres to be allotted for Industries and 2604 acres for Residential development. Rest of the land
Total	***8893 ha (21,966 Acre)***		This figure of 21,966 acres (not necessarily the sum of Phase 1,2 and 3) excludes undevelopable area (need not be acquired) of 4300 acres. Further, land available with other establishments etc when excluded, this 21966 further reduces to 13581 acres to be used for Industrial, Residential development and common infrastructure

Note: The field survey has to be done and confirm the exact figures for each land.
Source: JICA Study Team

4. Node Development Vision

4.1. Approach

Considering the growing national and global competitive environment, it is important to enhance key strength as the driver of the node development and realize a competitive node. Node vision is structured in line with areas to be strengthened for increasing competitiveness of the node for industry promotion.

As a first step, SWOT analysis on the node is conducted based on inputs on existing and potential infrastructure and industries at the node. In addition, existing national and state policies on industry and SEZ development are reviewed as a bone of the node development policy. For a second step, possible competitive edge for the node is identified. Considering a node is a large area development including industrial and social function like a city, the city competitiveness framework, which identifies 10 key functions of the city, is utilized for the assessment. The above outputs are integrated with the inputs from GoTN during the consultation.

4.2. Potential as a Global Engineering hub for Industrial Development

Ponneri's *Unique Selling Proposition* is its proximity to the Chennai city, the sea ports in Chennai, Ennore and Kattuppalli and the industrial and commercial eco-system including established industrial clusters in the Tiruvallur district and in the neighbouring districts of Chennai and Kanchipuram, specifically known for their prowess in engineering, auto and auto components industry etc.. Presence of this ecosystem can help in catapulting it into an Engineering hub with global fame making it a preferred choice for industrial investment in Engineering related sectors with available resources for sustainable living and healthy lifestyle.

Strategically placed at only 40 kms from the Central Business District of Chennai; just 5 km from the Ports in Ennore and Kattuppalli., Ponneri has major potential to develop as the industrial hub for **Engineering sector companies**. The Ponneri Industrial Node is proposed to be well connected with the industrial clusters around Chennai and will benefits from leveraging on the network effect of being a part of this cluster.

4.2.1. SWOT Analysis

The following matrix summarizes current strategic positioning of Ponneri Node with analysis of the strength, weakness, opportunity and threat. It is useful for evaluating development potential of the region which could provide direction to the future vision and strategy for the further development. The analysis is based on survey of existing land use, state of infrastructure and industries, as provided in further detail in subsequent sections.

Table 4.1: SWOT Analysis for Ponneri Node

	Advantages	Challenges
Internal	*Strength:* ● Proximity to the Ennore Port (5 km) and Chennai Port (An access road construction is planned.) ● Proximity to Chennai ● Availability of workers and foreign technical experts in Chennai ● Proximity to diverse industrial clusters around Chennai ● Stable energy supply available due to thermal power stations ● Availability of coal and natural gas ● Existence of development plan of plastic industry by TIDCO ● Stored ash for land development ● Proximity to existing container freight stations & logistics facilities around the Chennai region ● Additional water resources from existing (Minjur) and potential desalination plants, and recycling water from Chennai	*Weakness:* ● Necessity of countermeasures for influence to atmosphere air condition from two existing and a planned thermal power stations ● Necessity of rising ground level in some areas ● Heavy traffic congestion due to the weak access to Ennore port (Northern Port Access Road is necessary as soon as possible) ● Limitation of surface and ground water resources ● Necessity of multi-modal logistics facilities to enable multi-modal transfer of industrial goods ● Necessity of adequate railway connectivity
External	*Opportunity:* ● Lack of capacity of high quality industrial park near Chennai for potential investors ● Availability of abundant work force from Chennai ● Lack of industrial parks directly connected to major ports within CBIC ● Growing interest of foreign investors to India due to expectation to initiatives of new regime and prime minister ● Political momentum and re-attention of foreign investors to South India due to the creation of the CBIC Master Plan ● Enhancing competitiveness of industries, especially special economic zones ● Improving logistics facilities around the node region to enable local domestic distribution networks ● Improving connectivity through ring roads could expedite movement of goods from the port to the hinterland	*Threat:* ● Rapid improvement of investment environment the north east coast area of CBIC such as Krishnapatnam in Andhra Pradesh that has a well-developed private port ● Risk mitigation efforts required considering the location close to coast ● Possibility of cost elevation for land acquisition due to dissemination of the CBIC Master Plan ● Growing congestion in and around the Chennai region, and delays in development and commissioning of planned ring roads, e.g. Outer Ring Road Phase 2 and Peripheral Ring Road

Source: JICA Study Team

4.2.2. View of Tamil Nadu State Government

The study team has gone through consultation meetings with the Tamil Nadu State Government for developing the Master Plan. From diverse opinions expressed in those meetings, the following views for the Ponneri node development are extracted. Those are not precisely representing a consolidated view of the Government, but valuable for taking the issue, interest and drive for the Government into consideration.

The Ponneri node shall be;

- A success model of industrial development fully materialized.
- The best practice of private sector participation to large scale land development. Private sector is supposed to be land developers, facility providers and industrial park operators.

- A lucrative growth center for potential investors with sustainable mechanism, e.g. simplification and exemption of procedures deregulation
- A provider of employment opportunities and new ideas/innovations to Tamil Nadu State.
- A major industrial park in India operated by Tamil Nadu States.
- A major industrial cluster in the Chennai region with Petro and Petro-Chemical Industries, food processing and export oriented industries.
- Self-reliant region consisting of residential, commercial and industrial areas.

4.3. Vision for Ponneri – Building a Competitive Node

In the Master Plan's context, the Competitiveness of Node means comparative advantages, which enable it to attract high quality human and capital resources, investments, technologies and knowledge base. To build and strengthen the competitiveness of the Node, key factors providing a comparative advantage against similar investment destinations both in India and globally were identified.

Based on SWOT analysis above, inputs from state government and key requirements for industrial and urban growth, it is envisaged that the Ponneri Node should have the following characteristics to build Node Competitiveness:

- **Industry Competitiveness** - Technological Advancement, Cost Competitiveness, Ease of doing business, Enhanced Connectivity, Logistics Services, Skilled Manpower
- **Infrastructure Quality** - Assurance on utility services (24 x 7), Mobility and Connectivity, Efficiency, Effectiveness and Sustainability of all infrastructure services
- **Sustainability** - Environmental Sustainability, Economic Sustainability, Waste management, Water Management and Recycling, Renewable Energy, Skill Development, Organic Growth.
- **Quality of Life** – Responsive Governance, Civic Services, Affordable, Public Facilities, Parks & Recreation facilities, Leisure and Retail facilities.

Infrastructure Quality

Assurance on 24 x 7 utility services,
Mobility Planning
Efficiency, Effectiveness and Sustainability

Quality of Life

Responsive Governance,

Civic Services, Affordable Housing Public Facilities,

Parks & Recreation,

Industry Competitiveness

Cost Competitiveness, Ease of doing Business,

Enhanced connectivity, Logistics services,

Sustainability

Economic and Environmental Sustainability,

Waste management, Recycled water, Renewable energy, Skill Development, Organic Growth

According to the above framework, the Study team identified target functions to be strengthened and key driving forces for Ponneri Node as below. Targeted functions to be enhanced may include intellectual capital & innovation, technology readiness, sustainability and the natural environment, and Ease of Doing Business. The details are described in the following sections.

Table 4.2: Target Functions to be developed for Ponneri Node

Vision	Targets	Driving Forces
Industry Competitiveness	Technological Advancement	High Technology including promotion of R&D with collaboration between industry and academia should be promoted
	Cost Competitiveness	Exploiting proximity to a large metropolis and a coastal city like Chennai should promote Ease of access to port infrastructure and ecosystem players in close proximity will make it cost competitive.
	Ease of doing business	Node will focus on local parameter to support tenant industries by supporting: Ease of starting business, ease of entry, support for foreign embassies or consulates, and workforce management risk
	Enhanced Connectivity	**Connectivity by Road and rail for freight and passenger movement within and**

Vision	Targets	Driving Forces
		outside the node should be fostered for efficient functioning of the node
	Logistics Services	**Logistics Hub needs to be planned with Rail link to serve the requirements of the industries within the node**
	Intellectual and Capital Innovation	Node will aim to score on key Intellectual and Capital Innovation measuring parameters which includes: Innovation Cities Index, entrepreneurial environment, intellectual property protection, libraries with public access, math/science skills attainment, literacy and enrollment, percent of population with higher education, and world university rankings.
	Skilled Manpower	Availability of skilled manpower, education and also professional services like accounting, legal, consulting etc. is an advantage due to proximity of the node with a large metropolis like Chennai
Infrastructure Quality	Assurance on utility services (24 x 7)	The node should have 24x7 supply of water and power for both industrial and domestic needs
	Mobility and Connectivity,	High capacity telecom infrastructure for improved telephony and broadband services will be the backbone of economic activity within the node
	Efficiency, Effectiveness and Sustainability infrastructure	• ***Efficient and Stable Infrastructure*** – Water management, power supply, solid waste management, transportation, logistics • ***One Stop Service*** – Support for diverse local procedures, e.g., application, authorization, licensing, contract, tax and land related procedures, etc. • ***Quick and Easy Trouble Shooting***- Stable trouble shooting capacity • ***Special Incentives*** – Simplification and exemption of procedures, delegation, tax reduction, subsidy, concessional loan etc.
Sustainability	Environmental Sustainability	Sustainability and the natural environment can be measured by objective description of those cities that are in the forefront of sustainable policies and practice. Indices include recycling policies, low natural disaster risk, thermal comfort (the average deviation from optimal room temperature), air pollution, and public park space to measure urban sustainability objectively.
	Economic Sustainability	Government to foster innovation through promotion of R&D initiatives and tie ups between industry and academia to promote sustainable innovation and supply of manpower to the industries in the region. This cooperation is achievable as Chennai is home to a lot of industrial houses and also technical/engineering institutions.
	Waste management	Waste disposal and management methods need to be environment friendly with available capacity of waste treatment.
	Water Management and Recycling	"Smart Water Management" The scarcity of the water resource is one of the key challenges for Ponneri and recycled water is planned to be actively used for industrial water. The concept of infrastructure development at the

Vision	Targets	Driving Forces
		node will be aligned with the smart city concept. Recycling water and waste will help the node to be environmentally sustainable.
	Renewable Energy	The Government should incentivize investment in renewable energy to ensure reduced carbon footprint
	Skill Development	Similar to the smart city vision, the major purpose of node development in the CBIC regions is to create advanced space for manufacturing production which could attract highly skilled people and highly value added industries from all over the world.
	Organic Growth	Ponneri is located near Bangalore city where many of multinational companies' R&D centers in India and houses 1/3rd of the total IT professionals in the country. Chennai is spreading out, and Ponneri could be beneficial recipient of investment with spill-over effect with leveraging the skilled workers.
Quality of Life	Responsive Governance	Have Ponneri Node under a separate authority to ensure greater attention on quality of public services in the region
	Civic Services,	Authority and the Development Company to be under the same leadership to start with to ensure better coordination. Privatization
	Affordable Housing	Housing needs to be planned within the node so as to avoid unregulated development in close proximity to the node.
	Public Facilities	The proposed Authority should have regulations in place to ensure that basic public facilities such as parking lots for trucks, food and sanitation facilities for drivers and the like are provided
	Parks & Recreation	Retail and leisure establishments and improved law and order to enable people within the node to have access to night life facilities
	Leisure and Retail	

Source: JICA Study Team

4.3.1. Planned Growth Strategy

The industrial node at Ponneri is proposed to become the seed for organic growth of the node into a fully functional industrial township with all the necessary ingredients for fueling further economic development of the township through urban agglomeration. The Master Plan envisages the development, i.e., competitiveness enhancement, of the node occurs through the following organic development phases:

- **First phase**, as ***Inception stage***, where the node development is focused on ensuring availability of core infrastructure to meet essential industrial needs, such as 24x7 utilities services (water, power, waste management, effluent treatment); mobility, connectivity and skilled workforce. In addition, the foundation is laid for future organic development of the node in terms of infrastructure, economic competitiveness, quality of life and environment sustainability.

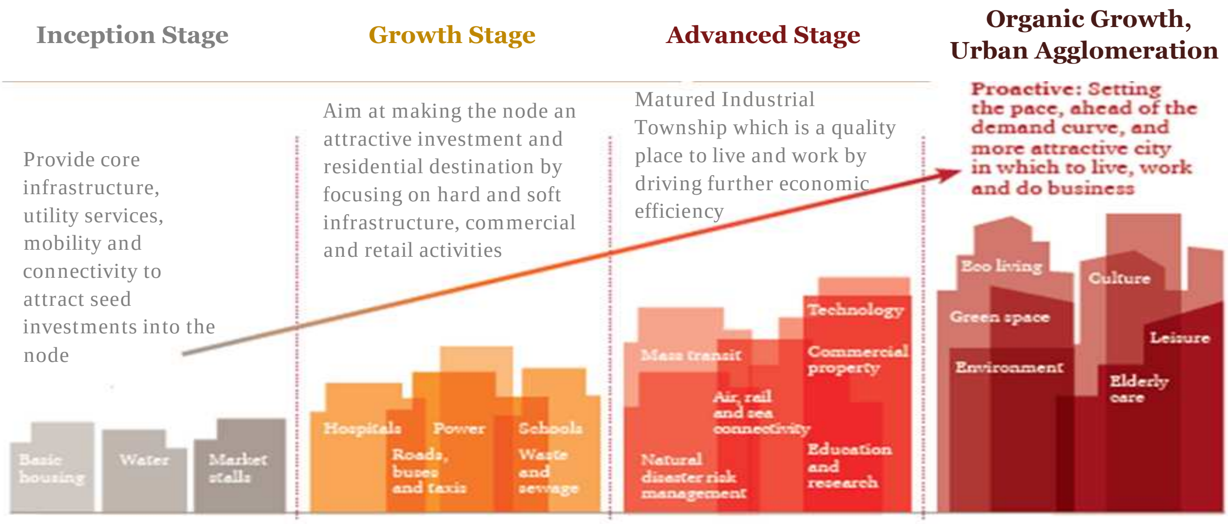
  In addition, the nodes will also start accommodating a proportion of workers within the nodes as Resident Workers. In this stage, the Node is trying to provide the basic infrastructure so as to be able to attract investors to take industrial land parcels and create a seed development. The land allocation in this stage should ideally be closely placed so that the core infrastructure is efficiently utilized. However, large anchor tenants should also be given preference to choose appropriate locations within the node which best suit their requirements. The node development strategy at this stage is to become attractive ***industrial hub*** for attracting core tenants and provide effective infrastructure to make the node viable to live, work and do business.

- **Second phase**, i.e. the ***Growth Stage***, after accumulation of set of core tenants, the node infrastructure should be enhanced by building soft infra such as healthcare, primary and secondary education, enhanced transport connectivity within a city and to surrounding areas. In addition, the node should also build other technical institutions which are required to meet other functional needs of the tenant firms. At this stage, the node development strategy is to become a fully functional ***industrial township*** with resident workers and other commercial activities within the township to support sustainable living

- **Third phase**, i.e. the ***Advanced Stage***, the infrastructure development is geared more toward improving economic growth and productivity enhancement to gain competitiveness and economic efficiency. This may include mass transit; commercial property development, introduction of knowledge based service industries, global connectivity, advanced university education and research, and enhanced natural-disaster risk management etc. At this stage, the node development becomes more proactive as a ***town*** which is able to drive economic activity in and around the node boundary through organic growth i.e., setting the pace, ahead of the demand curve, and becoming more attractive place in which to live, work and do business.

- ***Future Organic Growth*** of the town through ***urban agglomeration*** or city development will focus on more advanced human needs to improve all aspects of quality of life and sustainability, including elderly care, green space, leisure and cultural assess, and environmental infrastructure.

The proposed master plan envisages the above growth through a planned and controlled development in of the node in initial phases. However it is envisaged that as the node matures into a functional industrial township, it will further fuel economic activity in and around the node to allow for more organic growth of the node into vibrant agglomeration of industrial and economic activities.



Source: PwC India

4.3.2. Private Sector Participation in Node Development

According to the analysis on industrial parks in CBIC, involvement of private sector is an essential factor for the success of creating high quality industrial park. For instance, the majority of the foreign investors admit that quality of recently developed private industrial parks is higher than the existing ones. The know-how of privates sectors on development of land, construction of facilities, and provision of operation support services should be utilized as much as possible in order to develop high quality industrial park.

The Ponneri node aims at a level of quality exceeding the above mentioned advanced industrial parks. The advantage of the Ponneri node is the hard and soft-infrastructures which are supposed to be provided by the Government based on the CBIC Master Plan. The mixture of the infra-merit and benefit of private development enables it to realize the best quality as an industrial park in the international standard. Since demand of global investors towards high quality industrial parks near Chennai area is considerably high, the Ponneri Node will attract certain number of high valued manufactures. The high quality industrial cluster formed by those companies will contribute to further improve investment environment and strengthen global competitiveness of CBIC. Furthermore, the improved business environment attracts more investors to the region. As such, the essence of private development vision is to create a virtuous cycle through showing a unique success model of the Ponneri Node.

4.3.3. Knowledge Park in the node region

Currently, the research and development expenditure in India is less than 1% of GDP, which puts it way behind major economies like Japan, USA and China who spend considerably on R&D. Extensive research opens avenues of high productivity, innovation and conservation; and thus, India needs to align its focus on research and development. India should pursue developing new products and technologies, other than just manufacturing products based on prototypes developed by foreign countries.

To take this vision forward, it is proposed spearheading movement in this direction and develop a Knowledge Park in the node region. Given that Ponneri is proposed to be a heavy engineering hub, the Park can provide an environment for innovation and developments in various fields pertaining to the viable sectors in the node. Such kind of park in the node region would create space for growth and enhancement in the relevant industrial sectors. Obtaining the right anchor tenants is important to ensure the sustainable operations of the park. Having tenants with a brand recognizable in the country or in the international environment presents the park as a conducive business platform and an attractive investment destination for other high value investors.

Knowledge Park can be integrated and developed as a part node establishment. Along with the four components (Infrastructure quality, industry competitiveness, sustainability and quality of life) taken care in the node, human capital establishment with right combination of skills for the industries would enhance the livability and sustainability in the region.

Industry-academia collaboration (primarily with universities and public research organizations) plays a pivotal role in developing a successful Knowledge park. The emphasis on the exploitation of technology has given universities a new relevance to the global economy, and ST parks act as a bridge between research and the marketplace. They are also sites where interaction and networks leading to innovation are fostered. Synergies can emerge between research institutions and companies through the sharing of premises and the sharing of knowledge. Access to well qualified work force can be fulfilled with the synergy created.

Apart from work force creation, the other three components showed in the above picture are aligned with node development strategy. When these components are fulfilled the high-value adding personnel will eventually be enthralled to be a part of node and offer their services.

Positioning of Ponneri based on these four components is shown below-

Infrastructure

Strengths & Opportunities

- ✓ Proximity to the Ennore Port (5 km) and Chennai Port (An access road construction is planned.
- ✓ Proximity to existing container freight stations & logistics facilities around the Chennai region
- ✓ Proximity to diverse industrial clusters around Chennai

Challenges

- ✓ Heavy traffic congestion due to the weak access to Ennore port
- ✓ Necessity of adequate railway connectivity

Business Environment

Strengths & Opportunities

- ✓ Proximity to diverse industrial clusters around Chennai
- ✓ Stable energy supply available due to thermal power stations
- ✓ Availability of coal and natural gas
- ✓ Political momentum and re-attention of foreign investors to South India due to the creation of the CBIC Master Plan

Challenges

- ✓ Necessity of multi-modal logistics facilities to enable multi-modal transfer of industrial goods

Human Capital

Strengths & Opportunities

- ✓ Availability of abundant work force from Chennai
- ✓ Availability of workers and foreign technical experts in Chennai
- ✓ Presence of skill development and training centers across sectors in Tamil Nadu

Challenges

- ✓ Significant efforts may be required to reach required standards of labour skill and productivity

Livability

Strengths & Opportunities

- ✓ Additional water resources from existing (Minjur) and potential desalination plants, and recycling water from Chennai
- ✓ Proximity to Chennai

Challenges

- ✓ Necessity of rising ground level in some areas
- ✓ Necessity of countermeasures for influence to atmosphere air condition from two existing and a planned thermal power stations

Successful Science and Technology parks in the World

Surrey Research Park, UK
•**Area:** 70 acres
•**Type of activities:** Technology, Science, Health, and Engineering
•***Business Environment:*** worked together with the local and county planning authorities. Three stakeholders were envisaged from the outset: the University, the planning authority and tenant companies
•***Tenants:*** The park houses 118 tenants.

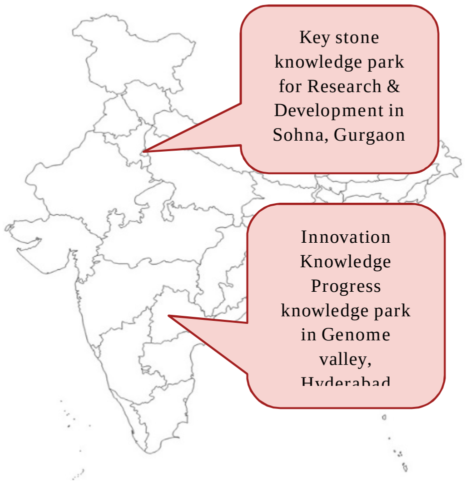
Berlin Adlershof, Germany
•**Area:** 1,038 acres
•**Type of activities:** Photonics and Optics, Renewable Energies and Photovoltaics, Microsystems and Materials, IT and Media, Biotechnology and Environment Analytics
•***Business Environment:*** Successful model of how public subsidies can stimulate sustainable development of private industry. Government funding accounts for only 6.4% of the park's budget.
•***Tenants:*** Focuses on small tenants. Currently, there are 996 companies and 17 scientific institutes.

Tsukuba Science City, Japan
•***Area:*** 6,672 acres
•**Type of activities:** Electronics, Biotechnology, Mechatronics, New materials, Information engineering, Space development, Environmental science, Natural resources and energy, Earth sciences, Civil engineering and construction, Agriculture
•***Business environment:*** In early 1960s, the Government decided to move research institutions affiliated to the government offices and national educational institutes to TSC.
•Given the concentration of national research institutes, this forms a "pull" factor for private sector to establish themselves in the City, especially after the Tsukuba International Science and Technology Exposition in 1985.
•***Tenants:*** Houses about 60 educational and research organisations

Research Triangle Park, North Carolina, USA
•***Area:*** 7,000 acres
•**Type of activities**: Micro-electronics, telecommunications, biotechnology, chemicals, pharmaceuticals, and environmental sciences
•***Business Environment:*** Drawing upon the strengths and synergies between North Carolina's academic, government and industry base, RTP was created to attract and grow R&D operations.
•The Research Triangle Foundation is a private, financially independent not-for-profit.
•***Tenants***: The park houses over 190 organisations. High profile tenants at the RTP include IBM, Nortel, GlaxoSmithKline, SAS, Cisco Systems and Bayer CropScience.

Hsinchu Science and Industrial Park, Taiwan
•***Area:*** 3,316 acres
•***Type of activities:*** IT-focused (Semiconductor, Optoelectronics), Biotechnology, Technology, Avionics and aviation, Biomedical. Solar energy industries. Knowledge-based services. Pharmaceuticals, Medical, R&D, production
•***Business Environment:*** Government policies to attract firms into the Park included a 5-year tax holiday; a maximum income tax rate of 22%; duty-free imports of machinery, equipment, raw material and semi-finished products; and capitalisation of investors' patents and know-how as equity shares.
•The Government also directly entered into industrial production, establishing joint venture companies with private capital.
•***Tenants:*** The park houses many Taiwanese heavyweights such as Taiwan Semiconductor Manufacturing Co. (TSMC) and United Microelectronics Corp. (UMC) — the world's two largest contract chip-makers

Knowledge parks in India



Keystone Knowledge park [3] is a state of art R &D building with 20,500 sq. meters of lab space with 4.5 meters floor to floor height and having Bio-Safety Provision up to BSL3 level. This is conceptualized to drive research and innovation oriented companies to North India. This is established with well-versed amenities. Keystone Central is LEED Gold rated, enabling tenants to optimize their operational costs while demonstrating their commitment to sustainability. It is associated with private funding. This attracts industries from pharmaceutical, biotechnology, petrochemicals, new materials, crop protection, Agri Biotech labs, chemicals, Nanotechnology sectors along with plug and play office space. Key stone SEZ is well connected to this park.

Innovation Knowledge Progress (IKP) knowledge park [4] has been receiving continuous support from both State and the Central Government. 600 sq.km has been designated by Andhra Pradesh in three blocks in Genome valley for life sciences development. It is recognised by SIRO (Scientific & Industrial Research Organisation) is entitled to customs and excise duty waivers. The Park has received partial funding from National Science and Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology (DST) to establish the Life Science Incubator and from Department of Scientific & Industrial Research (DSIR), Government of India, to establish the Virtual Information Centre. The park has promoted 65 companies so far. It leases ready-to-use laboratories for short periods (3 years). Some of the companies have set up their own facilities in the park. It is armed with in-house funding support and also some grant programs.

[3] http://www.keystonesez.com/
[4] http://www.ikpknowledgepark.com/

5. Industrial Development Analysis

5.1. Proposed Industries Mix for Ponneri Industrial Node

5.1.1. Focus sectors selected for CBIC region

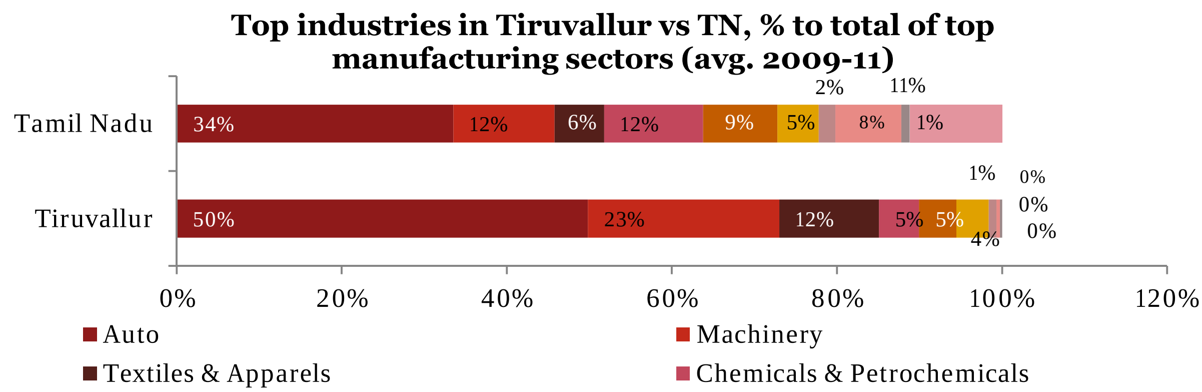
Initial study identified focus sectors for CBIC region. In depth analysis for identifying potential industries for the corridor was undertaken as a part of Interim Report 1 under Part A of this study. As per the analysis undertaken, the following manufacturing sectors are the key drivers of industrial growth in the CBIC region:

TOP SECTORS	
Food processing	Electronics
Automobiles	Textiles
Chemicals and petrochemicals	Pharmaceuticals
Metallurgical industries	Electrical machinery
Machinery	Medical equipment

Figure 5.1.: Sectors shortlisted as potential sectors for the corridor

Rationale for initial viable sectors for Ponneri node

The consultant has analyzed the manufacturing output (i.e. manufacturing GDDP) of Tiruvallur district and arrived at the top industries contributing to the industrial economy of the district. The leading sector is automobiles and auto components, followed by metallurgy and allied industries, electrical machinery and machinery sectors. The strength of automobile sector is due to large presence of existing base and also auto sector players in Chennai and Kanchipuram districts. It is also the sector that has witnessed largest share of investments in the past including FDI. The share of each of the top sectors in Tiruvallur and TN is given in the figure below:



Source: ASI reports of 2009, 2010, 2011, PwC analysis

Figure 5.1: Top sectors in Tiruvallur district vs TN

The consultant has selected sectors in Tiruvallur district that are also the focus sectors for entire CBIC region. The consultant also assumed that basis of industrial development will be formed by the sectors traditionally present in Tiruvallur district for which the district offers certain factors of production and which also form a part of CBIC region focus sectors. The remaining CBIC focus sectors fall under the category of "highly potential". Since they are proposed to be promoted for development in the CBIC region as a whole, it is assumed that with time the necessary FoPs will be created for them and it may be expected that select segments of these sectors may come to Ponneri Industrial Node. Based on stakeholder interactions, the consultant has also taken into consideration availability / requirement for factors of production pertaining to each of the CBIC focus sectors. However, a view on current position of Ponneri is necessary before which we determine the critical factors of production for the region and subsequent determination of the kind of sectors that can be attracted here. The following section describes the current industries in Ponneri followed by the critical factors of production.

Selected Sectors for Ponneri node

Six traditional sectors and four highly potential sectors were finalized for Ponneri node. The choice of Traditional and Potential sectors has been assessed based on past investments in manufacturing in Tiruvallur district in relation to the total manufacturing investments in the CBIC districts of Tamil Nadu. Built on analysis of industrial base in Tiruvallur district, the consultant suggests that the following sectors, traditionally present in Tiruvallur, are to be considered as focus sectors for Ponneri IN.

Automobiles and Auti components

Chemicals & Petrochemicals

Machinery

Computer, electronic and optical products

Metallurgy

Textiles & Apparels

There are also several sectors that hold a very high potential for the CBIC region. In case of Tiruvallur, the following sectors will be analyzed as highly potential for Ponneri IN:

Electrical Machinery

Pharmaceuticals

Medical Equipment

Depending on various factors of production and sectoral facts, the following sectors have been selected for detailed analysis:

Auto and auto components

- Tamil Nadu has a very well established Auto component manufacturing base with Over 80 automobile components manufacturers.
- Automobiles & Auto components together are the highest contributor (20%) to the total Industrial output of the State.
- Tiruvallur is one of the biggest beneficiaries of the saturation in Chennai region due to space constraints. Manufacturing units of renowned companies like Royal Enfield, Ashok Leyland and Mitsubishi Motors have their establishment in Tiruvallur.

Chemicals and petrochemicals

- Sector is contributing to 30% of India's exports (2013), with refined petroleum products at 20.6% share of total C&P exports.

- Chemical and Petrochemical sector in Tamil Nadu accounts for 7% of the total output.
- Manali is a petrochemical industry hub. About 3% of investments of TN are in this region.
- Attributed to the state's strategic location, favorable manufacturing costs and presence across the value chain, the state has emerged as a major exporter of chemicals.

Machinery

- Tamil Nadu with well-established clusters secures second position in general purpose and special purpose machinery with 18% and 11% contribution to total India's output respectively.
- The state has large MSME base in engineering sector which forms necessary vendor base to attract large anchor units.
- This sector constituted 14% of the total investments in manufacturing in the region and hence is a significant contributor to the state's industrial output and also employment.

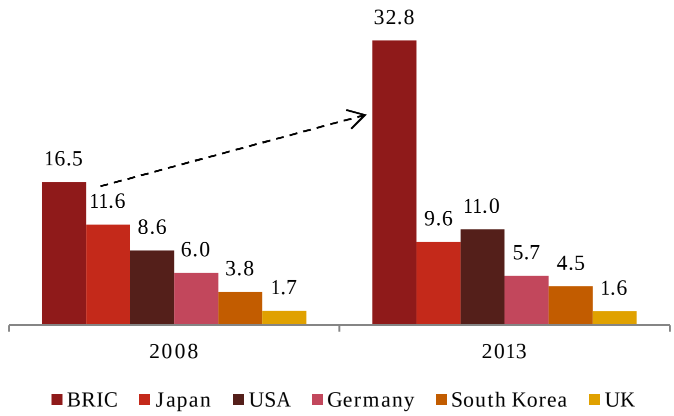
5.2. Industry Analysis of Top Sectors for Ponneri node

5.2.1. Auto and auto components

Sector performance

The global automobile market has witnessed a significant change since 2008-09, owed to economic crisis which led to a decreased market share and dipping sales figures for most of the global players. In the wake of this change, developing regions like Asia Pacific have shown greater potential as against developed economies where the investments are gradually retracting[5].

Asia Pacific region (India, China, Far East countries) are bound to witness highest growth in the next few years with a regional contribution of more than 60% to world automobile market[6].



Source: Auto facts

Figure 5.2 Top Contributors to the Automobile Production (in Million Units)

A closer evaluation of country wise breakup of Automobile production unveils that the production numbers of BRIC nations collectively doubled from 16.5 million units in 2008 to 32.8 million units in 2013. **This substantiates the fact that the BRIC nations together with other developing nations of Asia Pacific region will drive the Automobile market in the future.**

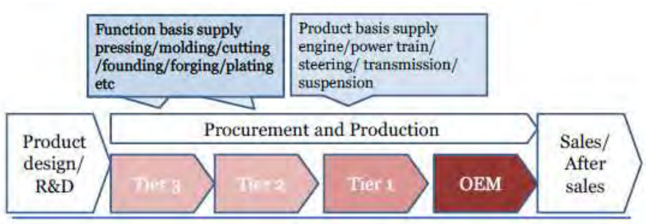


Figure 5.3 Value chain in Auto Sector

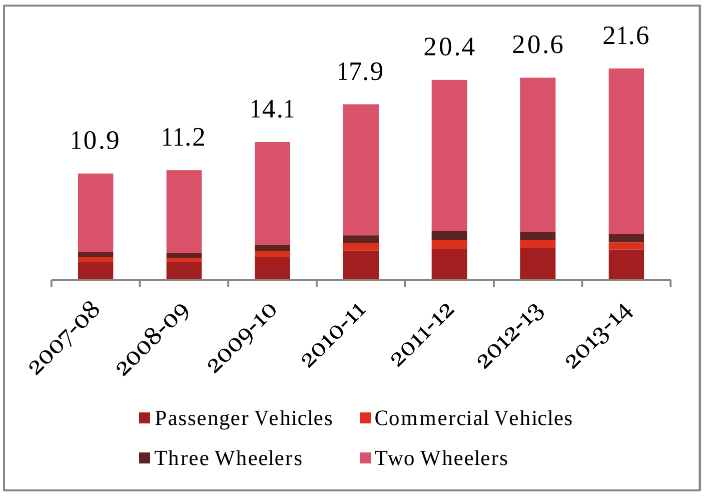
The Automobile Industry has a distinguished place in the Indian manufacturing sector. India contributes around 3-4% to the total global production of passenger cars

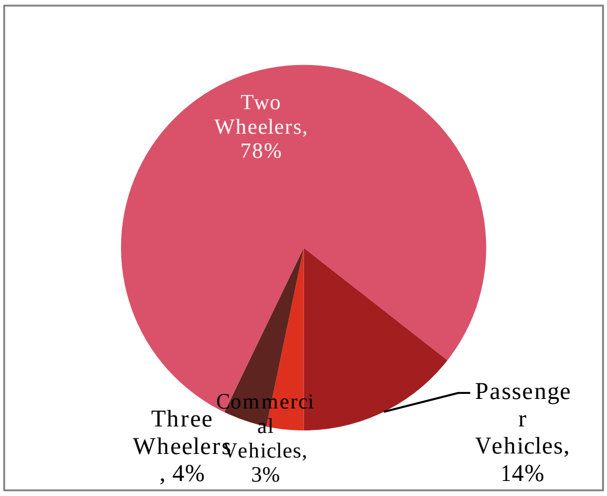
[5] PwC Report on Automobile economic Outlook and employment situation
[6] Auto facts

and commercial vehicles. In contrast to the global economic slowdown, Indian automobile industry has registered a steady growth rate in past few years with the total production numbers following a CAGR of 6%-7%. The overall vehicle production inclusive of all the categories doubled from 10.85 million units in FY08 to 21.55 million units in FY14. As evident from the market share of different categories of vehicles shown in the 2nd graph, two wheelers dominate the automobile sector in India with a share of 78% in the total vehicle production. In parallel with vehicle industry growth, growth of auto component industry is also expected. Market potential is estimated to grow to USD 150 billion by FY20 from USD 56 million in FY11. Contribution of GDP manufacturing of auto sector recorded 47.8%[7].

Indian Original Equipment Manufacturers (OEM) (e.g. Tata/Mahindra/Ashok Leyland/Hindustan Motors), provide all of the functions starting from Tier 3 to assembly are present in India. There are cases when they import components from outside India, but their basic tendency is to use domestic components. On the other hand, foreign OEMs (e.g. Toyota/Nissan/Hyundai/Ford) are seeking Indian domestic market to locate their Tier 1 suppliers in India. Currently Tier-2 and Tier-3 supplier are producing components outside India that are imported to Tier-1 supplier in India. However, foreign OEMs are also seeking Tier-1, Tier-2 vendor base in India, which will ensure presence of the entire value chain of the auto sector in India.

There are prominently well-established clusters in 3 regions of the country. The NCR cluster in the north is home to the biggest car manufacturer of India, Maruti Suzuki together with few other OEMs especially in the two-wheeler segment. While the western cluster sports a mix bag of OEMs across all the categories of vehicles, the southern cluster (Chennai cluster) has a dominance of passenger car manufacturers along with large scale commercial vehicle production. In terms of Two-wheeler production India is 2nd largest producer in the world. The market share of two wheelers accounts for approx. 80% of sales by volume in 2012-13.





Source: SIAM

Figure 5.5: Production trend of Vehicles in India (in million)

Figure 5.4: Production of Vehicles in India by volume

There are 16 sub-sectors contributing to auto exports globally. Amongst which top 8 sub-sectors contribute to more than 90% of total global exports. Nearly 80% of the global exports comprise the products cars (51%) and Parts & accessories of motor vehicles (27%). Germany leads in both the top subsector exports mentioned above, followed by Japan and United States in both the categories.

Export of auto and auto components is also witnessing robust growth with 28% of CAGR growth from 2002 to 2012. 68% of export is motor vehicles and 29% is parts and accessories. India has improved its share of exports from 0.21% in 2003 to 1.03% in 2013 (rank 31 to 22). Consistency is maintained in the exports of top two

[7] SIAM

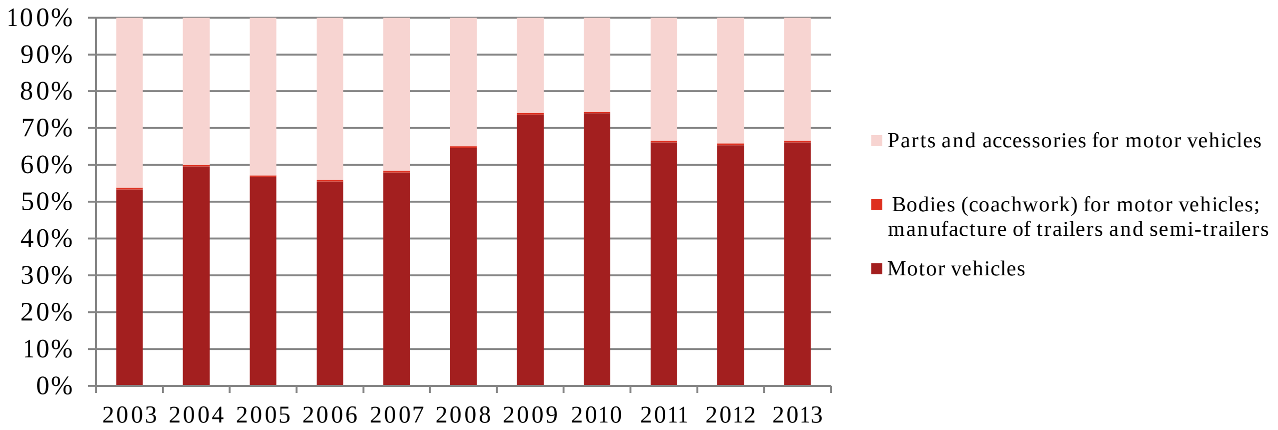
commodities cars and parts and accessories of motor vehicles. India has improved its contribution to exports in Motorcycles, side-cars from 1.32% in 2003 to 7.97% in 2013 (Rank 14 to 3) of Global exports in this subsector.

Rank (2013)	Tractors	Public-transport type passenger motor vehicles	Cars (incl. station wagon)	Trucks, motor vehicles for the transport of goods	Parts & access of motor vehicles	Motorcycles, side-cars	Parts and accessories of motorcycles & cycles	Trailers & semi-trailers; other vehicles not mechanically propelled
1	Germany (1)*[8]	Japan (2)	Germany (1)	Mexico (5)	Germany (2)	China (2)	China (2)	Germany (1)
2	United States of America (2)	China (24)	Japan (2)	United States of America (2)	United States of America (1)	Japan (1)	Taipei, Chinese (3)	United States of America (2)
3	Mexico (10)	Germany (1)	United States of America (6)	Germany (3)	Japan (3)	**India (14)**	Japan (1)	China (4)
4	Netherlands (3)	Poland (11)	Canada (3)	Thailand (11)	China (15)	Italy (3)	Singapore (7)	Netherlands (6)
5	France (4)	Korea, Republic of (3)	Korea, Republic of (9)	Japan (4)	Korea, Republic of (11)	Thailand (13)	Italy (4)	Poland (14)
India	**16 (22)**	**16 (19)**	**19 (30)**	**24 (36)**	**21 (33)**	**3 (14)**	**21 (33)**	**37 (49)**

Source: Intracen, PwCAnalysis

Figure 5.6 Global ranking of export of auto and auto components

Indian exports are dominated by Motor vehicles in the recent years. The exports are being shifted towards the motor vehicles from parts and accessories of motor vehicles. This shows a gradual shift to a higher position in the value chain of auto industry.



Source: intracen.org

. Figure 5.7 Dynamics of Indian Export

[8] The no. in the bracket is rank in the year 2003.

Viability drivers

National Level

Growth in consumer demand

- Demand from domestic market is 80% of total vehicle production. Domestic sales have grown 11% in last 6 years and trend is expected to continue.
- Market highly under penetrated – 15 cars/1000 people when compared to USA and Germany (500 – 600 cars/1000 people)
- India witnessed high growth rate in terms of motorcycle productions and the second largest producer after China globally.

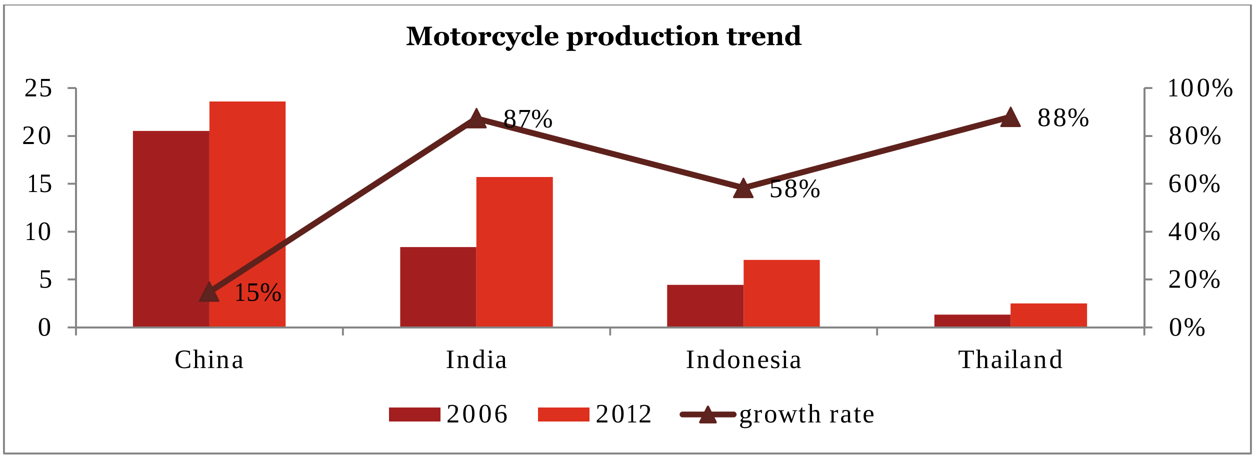


Figure 5.8Motor vehicle production trend

Source : Trends in Motorcycle fleets worldwide, PwC analysis

Policy Drivers

- The National Strategy for Manufacturing, drawn by the National Manufacturing Competitiveness Council (NMCC), has identified "**automobiles sector"** as a priority area. The Government of India has taken a number of initiatives to promote growth in the sector.
- Automotive Mission Plan (AMP) 2016 has been formulated. The AMP targets exports worth US$ 40–45 billion in 2016, including component exports worth US$ 20–25 billion and outsourced engineering services worth US$ 2–2.5 billion. The AMP targets a total turnover of US$ 145 billion by 2016.

Potential Global demand for smaller cars

Customer's purchase behavior is shifting globally toward efficient and eco-friendly vehicles. China as well as Europe has been witnessed the trend as shown below. India based car manufacturers have expertise on small car production. Top passenger vehicles models are Maruti Suzuki Alto (Mini) and Maruti Suzuki Swift (Compact). 75% of sales of motor vehicles were less than US$12,000. Accessibility to potential domestic market, Ponneri is strategically located where manufactures can enter export market through the ports in and around Chennai and coastal Tamil Nadu to access Asian market.

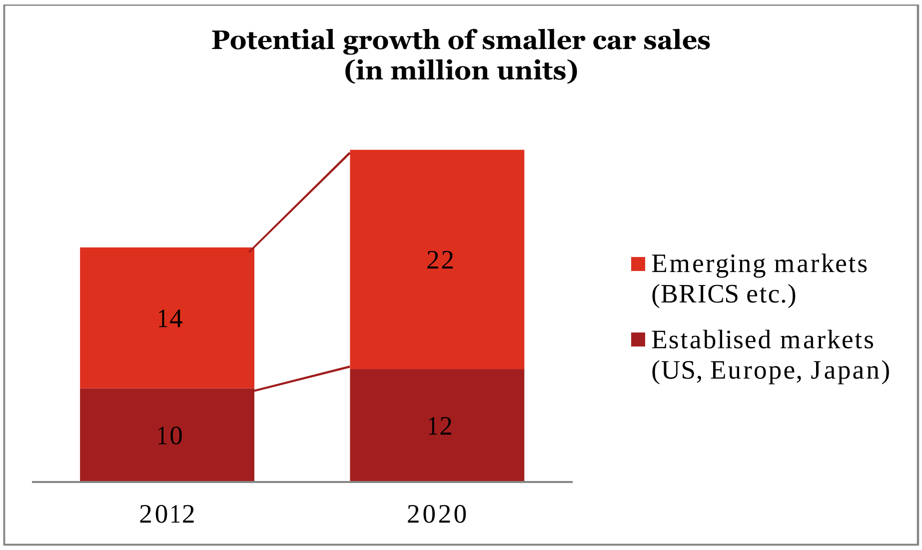


Figure 5.9: Potential growth of smaller car sales

Source: *The road to 2020 and beyond: What's driving the global automotive industry*

Ponneri Node Level

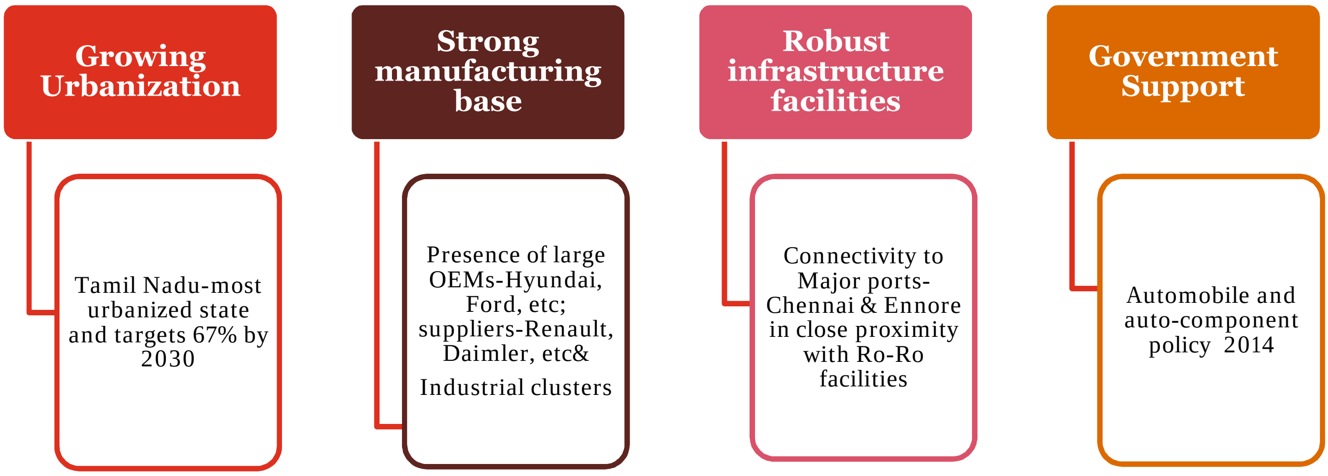
Tamil Nadu has a very well established Auto component manufacturing base with Over 80 automobile components manufacturers accounting for a turnover of over USD 1.3 billion as of 2013-14. The segment wise break up of production of auto components highlights that Industry is highly concentrated in manufacturing of body and structural parts-35% followed by engine & exhaust manufacturing at 17%. Electronics & Electrical, Suspension & Braking, and Drive transmission and Steering have equal share of 13% each. Auto components industry in Tamil Nadu individually account for around 7 % of the total auto components industrial output of India. In the period from 2004-2013, the investments have grown at a CAGR of 15% in the sector reiterating the investor's confidence in the state.

Auto sector contributes about 50% of the manufacturing sector output of the entire district of Tiruvallur. Ashok Leyland, Royal Enfield, Hindustan Motors (Mitsubishi), MRF etc. are some of the major players in the automobile sector in the region. In this sector, there are three subsectors that have been identified to be high on global demand as per the analysis presented earlier. These are as under:

- Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
- Manufacture of parts and accessories for motor vehicles
- Manufacture of motor vehicles

It is to be noted that the component "coach work" which is absent in Tiruvallur district is relevant only in case of buses and trucks. However, in case of cars and other automobiles, the coach or body of the vehicle is an integral part of the automobile equipment itself.

Viability factors which would enable the growth and development of this sector Ponneri Industrial Node which is located in Tamil Nadu are mentioned below-



- **Growing urbanization**

Tamil Nadu is also the 2nd highest state in terms of the number of vehicles registered in India with a CAGR of 12% in last decade. The growing rate of Urbanization and per capita income coupled with rising demand for automobiles creates a perfect amalgamation of opportunities for the automobile manufacturing sector

- **Strong manufacturing base-Presence across value-chain**

The Automobile clusters in Tamil Nadu are pre dominantly located in and around the Chennai region. The presence of large OEM's like Hyundai, Ford, Ashok Leyland, Nissan- Renault, Royal Enfield, Daimler etc. together with their suppliers like TVS-Lucas, Amalgamations group, Rane group, Samvardhana group, MRF Tyres, etc ensures smooth functioning of the supply chain from the manufacturing point of view. It also ensures cost effectiveness and timely delivery. The presence of well-established clusters in the state ensures minimizing the risk on supply side thereby ensuring smooth functioning of the supply chain and timely delivery.

- **Robust infrastructural facilities**

Tamil Nadu has a share of around 21.2% in the total automobile exports from India. This is attributed to the fact that the state is home to Chennai and Ennore ports which are the major automobile export terminals of India with well-established Ro-Ro terminals and parking facilities. The combined share of these ports in exports of passenger vehicles is more than 70%.

- **Government Support**

In order to retain the State's leadership position, enhance its competitive edge and address the critical issues faced by this industry, Government of Tamil Nadu has come out with a separate and integrated policy for Automobile and Auto component Sector in Tamil Nadu. This is to promote competitiveness and cutting costs for industry. The policy addresses the specific infrastructural issues, augmentation facilities for skilled labor, generation of employment, improvement in linkages of value chain, R&D activities and institutional arrangements.

Challenges and Disabilities Factor

Despite the robust growth of auto and auto components sector in India, the number of car production in 2013 remained almost one fourth of China as shown as below. Major car production countries recorded high GDP per capita, such as USA, Japan, and Germany. Though, China's GDP per capita, was lower than these countries; it is positioned as the top country for car production.

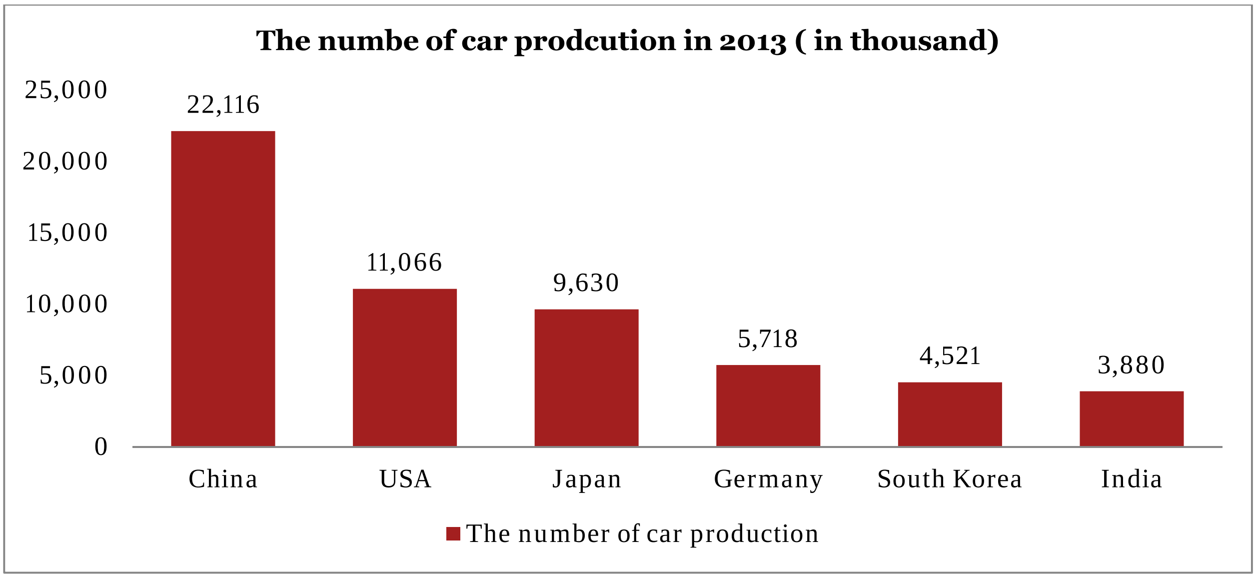


Figure 5.10 The number of Car production

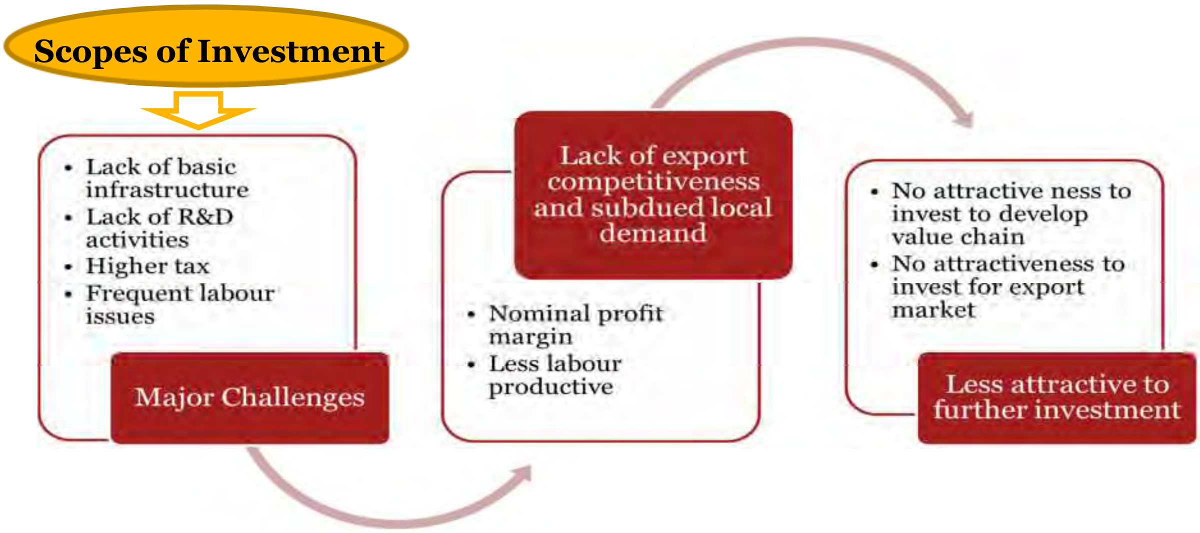
Source: OICA

Growth of auto component industry is directly linked to the growth of automobile industry. More than 65% auto component is sold to the OEMs[9]. At the same time, export market is becoming an important growth driver in recent years. However, India's share of global export for auto and auto components account only for 1%, while 13% of auto components are being exported[10]. Components being exported are engine parts (31%), drive and transmission (19%), suspension and braking parts (12%), electrical parts (9%), body and chassis parts (12%), and equipment (10%). Although the component industry in India has holistic capability to manufacture the entire range of auto components, the Indian auto components sector has over 500 organized sector players, and the 5000 organized players. India continues to be a net importer of auto components with its trade deficit for automotive components having expanded to USD 4.4 billion in 2009-10 from USD 210 million in 2004-05[11].

Price competitiveness is the critical factor in auto and auto component sector. Automotive Mission Plan 2006-2016 observed that the cost of manufacture of a passenger vehicle in China is 23% lower than in India with the principal difference owing to higher taxes and their cascading impact in India. Higher labour productivity and lower infrastructural costs makes China more competitive[12].

[9] Automotive Mission Plan 2006-2016
[10] Overview of Indian automotive component Industry, Tata strategic group management
[11] INDIAN AUTO COMPONENTS INDUSTRY: RIDING THE TIDE
[12] *Automotive Mission Plan 2006-2016*

At the same time, compared to other developed counties of major auto manufacturers such as USA and Japan, there is high potential of growth in auto and auto component sector as showcased in a rapid sales growth of Volkswagen. Sales figure in India was 30,319 vehicles in 2010 as against 2,801 cars sold in the year 2009, a big leap of over 500 per cent[13]. In addition, Volkswagen announced in 2014 the commencement of export of some models like Polo, Vento manufactured in Pune plant.



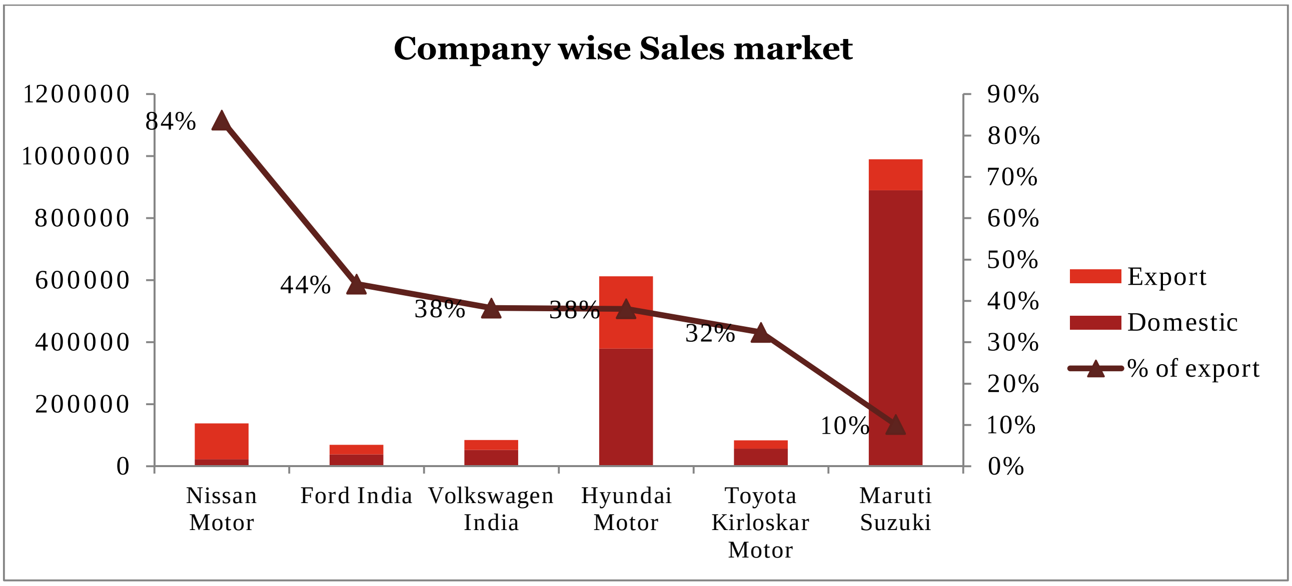
It is critical to improve current challenges for further development of this sector. Major challenges of auto and auto components manufactures in India highlighted during the stakeholder meetings are lack of infrastructure, lack of R&D activities, and frequent labour issues. These challenges cause lack of export market and subdued local market. Hence it is not attractive for investors to develop entire value chain and to enter into export market. There are scopes of investment to cut off the cycle for sector development.

- **Connectivity issues**

Connectivity to ports and quality of ports are critical factors for export performance of auto and auto components sector. The sector is leading industry in Tamil Nadu. Chennai cluster accounts for 35% of the output by value and 60% of the exports. The figure shows companies located close to ports such as Nissan Motor, Ford, Hyundai recorded high export share, whereas export percentage of companies located inland such as Volkswagen India is nominal.

The quality of ports is another hindrance to promote export in auto and auto component industry. Ports in Mumbai are closest for Volkswagen India but it is reported that the company is looking at the Ennore Port due to the infrastructure constraints and lack of dedicated Ro-Ro facilities[14].

[13] Volkswagen website
[14] Automotive logistics (http://www.automotivelogisticsmagazine.com/news/vw-india-exports-vento-to-mexico)



Source: PwC Analysis, JETRO

Figure 5.11: Company wise Sales market in 2013-14 (in number)

Improvement of railway facility and operation may require promoting rail transport and export for auto and auto component sector. Though Tiruvallur stands very strong in proximity to connectivity infrastructure, the issue persists in evacuation of the cargo at the gateways and capacity of the road infrastructure is questionable.

As the table below shows, the traffic by rail is nominal for auto and auto related sector. Given the strong potential for Toyota and another major auto companies to increase substantially both their exports and domestic distribution of finished vehicles from the Bidadi complex, the problems associated with Toyota's use of rail should be addressed to promote goods movement in CBIC region.

Table 5.1 Commodity wise traffic

(in '000 tonnes)	Chennai region (Chennai, Kanchipuram, Tiruvallur, Tiruvannamalai, Vellore)			Bengaluru region (Bengaluru, Chamrajnagar, Kolar, Mandya, Tumakuru)		
Originating	Rail	Road	Total	Rail	Road	Total
Car, Vans, etc	0	308	308	70	212	282
Two Wheelers	0	111	111	0	162	162
Tyre and Tube	0	173	173	0	181	181
Spare parts	0	222	222	0	245	245
Terminating	Rail	Road	Total	Rail	Road	Total
Car, Vans, etc	39	169	208	38	213	252
Two Wheelers	0	143	143	0	148	148
Tyre and Tube	175	175	0	0	188	188
Spare parts	4	228	232	2	216	216

Source: Pre-feasibility study Chennai Bengaluru Dedicated Freight Corridor

- **Labour issues**

Automobile sector is labour intensive sector. The ratio of temporary workers accounts for as large part of auto industry as approximately 40% in average.

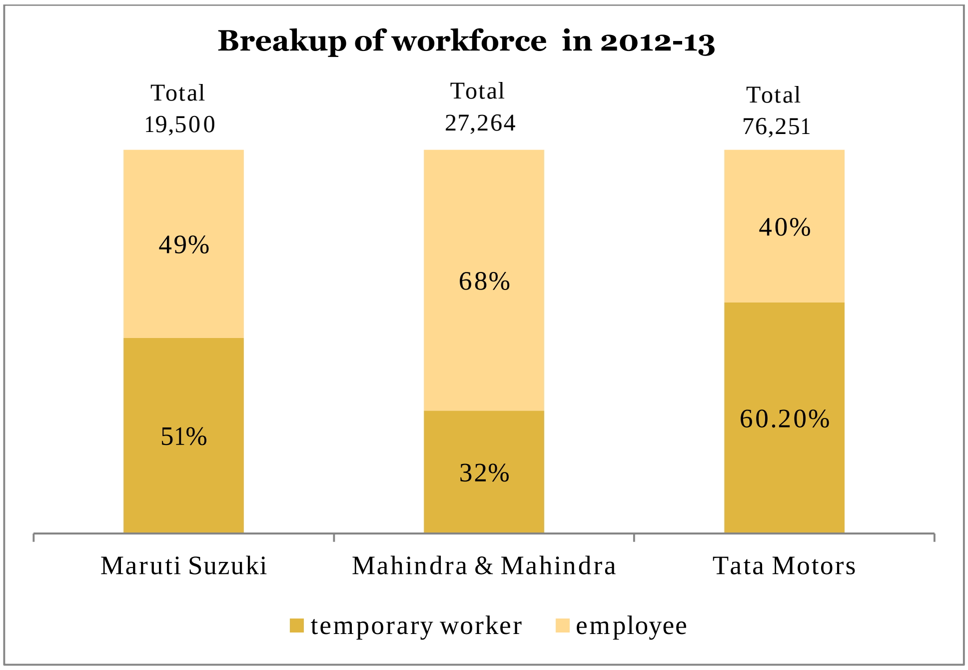


Figure 5.12: Breakup of workforce in 2012-13

Source: Permanent Problems of Temporary Workers in Automobile Industry

Many auto sectors raised the labour related issues because current labour laws are too favorable to workers. In this respect, Rajasthan has taken initial steps to relax labour laws. Amendments to federal labor laws, including the Industrial Disputes Act, 1947 (IDA), Factories Act, 1948 (FA) and the Contract Labour (Regulation and Abolition) Act, 1970 (CLRA), have been approved by the Cabinet Ministers in the State of Rajasthan. Similar initiatives may be taken by other States.

Labour law reforms in Rajasthan

The proposed amendments include proposals to:

a. allow industrial establishments employing up to 300 workmen, to retrench (terminate) workmen without seeking prior permission of the government. Currently, under the IDA, an industrial establishment employing at least 100 workmen is required to, inter alia, seek prior permission of the government before retrenching a workman.

b. raise the threshold of number of workmen engaged as contract labor by an employer for the purpose of applicability of the CLRA from 20 to 50. Currently, under the CLRA, an employer must obtain prior approval of the labor department if it wishes to engage a minimum of 20 contract laborers.

c. raise the threshold of number of employees for the purpose of applicability of the FA from 10 to 20 (in factories where work is being carried out with aid of power) and from 20 to 40 (in factories where work is being carried out without the aid of power),

d. raise minimum membership from 15% to at least 30% of the total workforce in order for a labor union to be recognized.

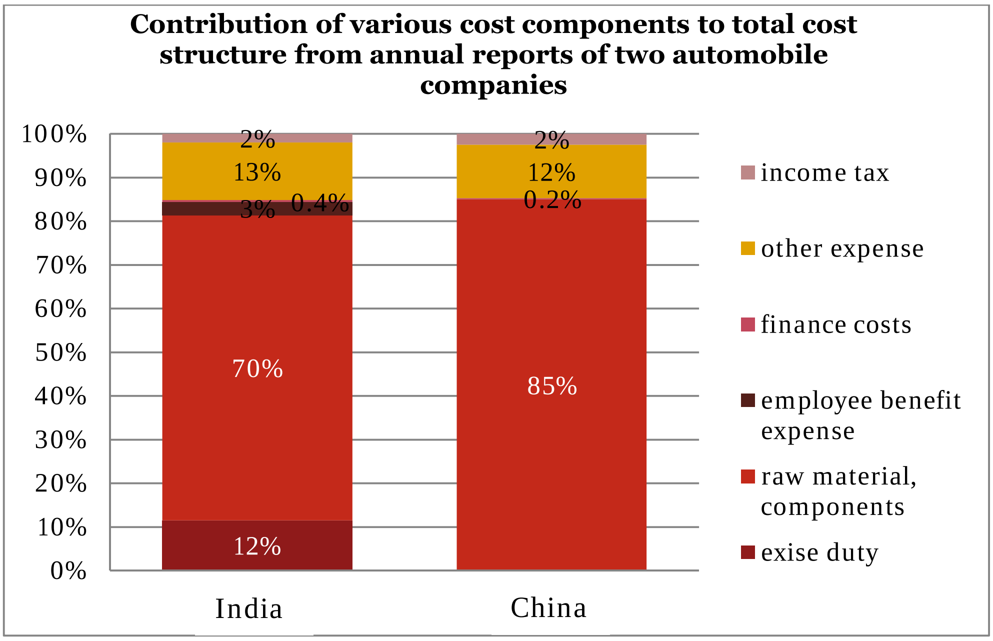
e. introduce a three-year statute of limitations for raising industrial disputes (under the IDA)

Source : International Labor & Employment Law Committee Newsletter, June 2014

International Benchmarking against Global Competition

Cost structure

Cost competitiveness is critical factor to promote manufacturing. The chart below shows the comparison of the cost structure extracted from the Annual Report of two major automobile companies in India & China. As seen below, India can be much more competitive if expenses such as excise duty (which is nil in China) are reduced by the Government. Also such duty and other miscellaneous expenses such as high finance cost considerably reduce the profit margin in India. Also unlike many other countries, certain taxes within the Indirect tax regime cannot be off- setted by passing on to the end users thereby increasing the overall cost for the manufacturer, reducing their cost- competitiveness in the global market.

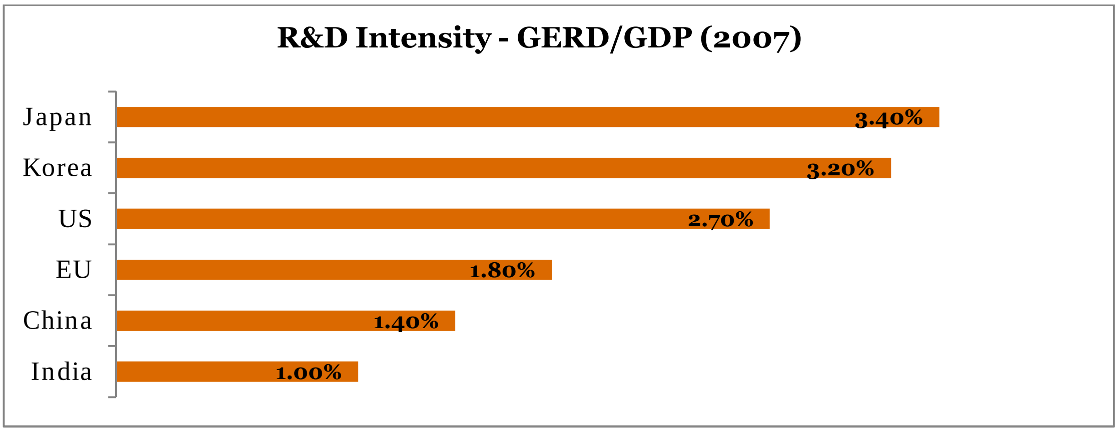


Source: Annual reports 2013-14 of two leading automobile companies in India and China, PwC Analysis

Figure 5.13: Comparison of cost structure of Auto companies in India & China

R&D expenditure

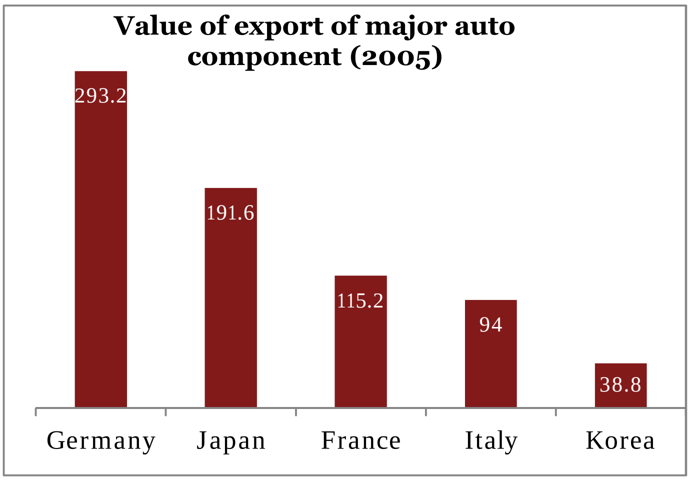
R&D is critical for suppliers as well as OEMs to catch the global trend and engage themselves in the value chain. As per stakeholder meetings, foreign investors need to import some of auto parts from abroad because the quality does not meet the requirement. Enhancement of technology to improve the quality of parts is critical to promote auto manufacturing in India as procurement source. However, R&D expenditure in India remains lower side compared to the global standard. The graph shows the R&D density, which is the ratio of county's GERD (Gross Expenditure on R&D) to GDP shows the one of the measures of R&D performance, the proportionate of in GDP is shown as below.



Source: Benchmarking analysis report, European Assessment of Global Publicly Funded Automotive Research

Figure 5.14 R&D Intensity

Germany is the global leader in the automotive industry. The automotive industry is the largest industry sector in Germany and it is regarded as the country's most important economic sector. Germany hosts the largest concentration of OEM plants in Europe. German OEMs account for 17% of global passenger car production. In addition, Germany ranked the first in auto components export. India also can be the manufacturing hub for auto and auto components in Asia after China. The key factors of success factors in Germany are as below.



Source : Defining the Role of the Government in the Transnationalisation Efforts of the Indian SMEs in the Auto Components Sector

Figure 5.15: Value of export of major auto components (2005)

Paradigm shift of the OEM business model

Supplier contribution for technical advances

Strong focus on R&D activities

Comprehensive financial assitance

- **Paradigm shift of the OEM business model**

  Business model of OEM has changed as per change in auto purchasing behavior. As witnessed in the growing demand of smaller cars, customers' expectation is changing toward energy efficient and environment friendly vehicles. OEMs in Germany are well engaging themselves with global trend and reinvent themselves in a changing auto market.

- **Supplier contribution for technical advances**

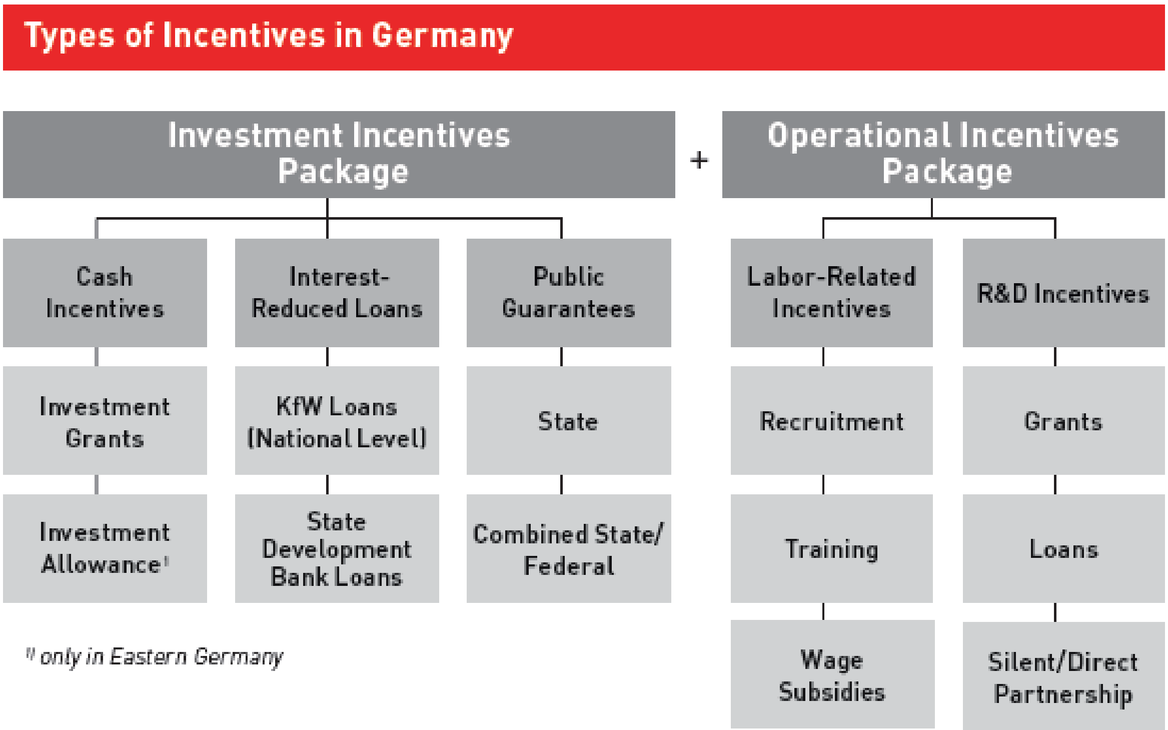
  Technological advances are increasingly taking place on the side of suppliers. OEMs accordingly differentiate themselves in terms of brand reputation and service. While suppliers themselves renovate products through R&D activities, OEMs can focus on marketing to build long-term brand relationship.

- **Strong focus on R&D activities**

  R&D is critical for suppliers as well as OEMs to catch the global trend and engage themselves in the value chain. Industry and the public sector have made a commitment to spend around 3 percent of national GDP per year on R&D activities Germany is the highest concentration of all Europe automotive OEMs' R&D center. Auto industry in Germany accounts for more than one third of the country's total R&D expenditure, which is EUR 19.6 billion in 2011. Germany has the largest patents applicants, around 3,650 patents per year.

- **Comprehensive financial assistance**

  There are various means of financial assistance through various instruments available in Germany to fit the needs of investors. Beside investment incentives such as grants, interest loans and public guarantees, Government offers operational incentive, which includes labour related incentives and R&D related incentives. Labour related incentives cover recruitment, training and wage subsidiary. R&D incentives are offered in the form of grants, loans and silent/direct partnership.



Source: The Automotive industry Germany

Key factors of strength/consideration

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Ponneri emerging as a top destination for food processing can be broadly classified around the three main areas:

Economic enhancers

- Development of quality integrated industrial infrastructure
- Easy acess to consumption markets and gateways to markets
- Reliable availability of FoPs

Value enhancers

- Productivity enhancement
- Efficiency in resource use
- Technological readiness and upgradation
- Skill development
- Researc h and development
- Value addition

Administrative enhancers

- Institutional reforms and eash of doing business
- Regulatory and policy support

Specific issues identified by Auto and auto component units located in close proximity to the proposed node in Tiruvallur district and implications to be considered in design of the industrial node are summarized below:

Table 5.2: Key factors of strength/consideration for Auto and auto components

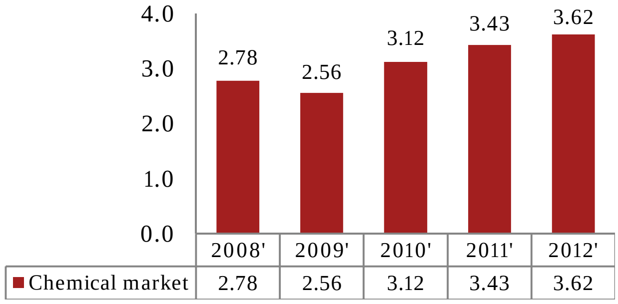
Components	Issues	Key factors of strength/consideration
Economic Enhancers		
Proximity to port	• Availability of port infrastructure is essential FoP for the sector • Evacuation at port and last mile connectivity delays transportation	• The location of Ponneri node has a strategic advantage for transportation facilities. It is located in close proximity to both Kamarajar and Kattupalli Ports. • The proposed Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area.
Road	• Although there is a potential growth export market, port connectivity and quality of port is sufficient enough to handle automobile export activities. • Some parts are precision. Since bad condition of road, package cost is high to protect products, otherwise they get damaged. • Suppliers often fail to deliver parts to OEMs just in time.	• Chennai-Bengaluru Express Way should be considered as priority to enhance connectivity to Chennai Port. • Dedicated Freight Corridor may be considered as priority to enhance connectivity to Ports. • Extending the connectivity with Chennai Metropolitan Area through NH-5 or SH-56 to the south is also planned. This needs to be expedited and is critical for the success of the node • Planned for 4-lane internal roads for both industries and residential access.
Power	• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • Provide alternate sources of power • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Planned for 29 sub-stations within the node to have uninterrupted power supply.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• The logistics hub of 166,859 sq. m is planned for storage of freight within the node which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop.

Components	Issues	Key factors of strength/consideration
Value enhancers		
R&D facilities	• Products need to be innovative and efficient to match global trend that is shifting towards efficient and more eco-friendly vehicles. However, since the sector remains unorganized, the efforts towards R&D are not focused and thus latest technology is not implemented. • Strong IPR protection is required to encourage R&D activities. However, Legal framework of IPR is weak, and not enforcement. Foreign investors usually are not willing to transfer their technology to domestic companies.	• GoTN should promote R&D activities through fiscal incentives and also through promotion of tie ups between industry and academia. • GoTN may promote IPR awareness by seminars or workshops on IPR • National Automotive Testing and R&D Infrastructure Project (NATRiP) has been established in Oragadam near Chennai by Ministry of Heavy Industries & Public Enterprises. This is about 30 km distance form Ponneri Node. • TN Skill Development Corporation should facilitate the integration of technical skills of the youth with the industry.
Availability of indigenous testing facilities	• Inadequate infrastructure for Research and development in the sector • 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 • Augmentation on certified testing centers for products and raw materials to reach BIS standards.
Administrative enhancers		
Ease of doing business	• Delays in obtaining clearances from pollution control board which hampers the smooth functioning of plant.	• Simplification of licensing system • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all industries required by any industrial unit.
Policy and regulatory framework	• 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.
Workforce/labour	• Approx. 40% is contract workers. Labour productivity is less due to instability of contract workers. • The productivity in auto ancillary segment which is prominent in Tiruvallur district is on the lower side compared to national average. • Labour laws are not flexible.	• GoTN may consider relaxation of labour laws in case of contract labour wherein they are deemed to be permanent if worked more than 450 days which may not be required. • GoTN may consider introducing incentives to industries for recruitment, training and wages to support labour productivity.

5.2.2. Chemical and Petrochemical

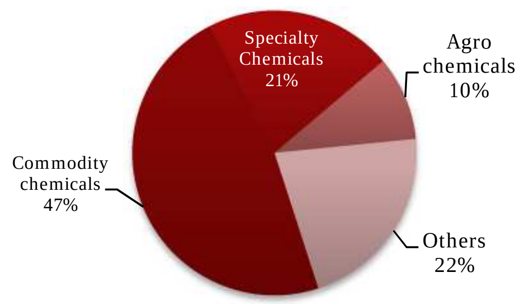
Sector performance

Global chemical industry stood at USD 3.6 trillion in 2012[15], indicating a CAGR of about 7% from 2008. Much of the revival of the industry from 2009 is attributed to improved business sentiment and growing demand of chemicals and petrochemicals from Asia-Pacific, especially emerging regions such as India and China. Commodity chemicals (including petrochemicals) and specialty chemicals account for over 65% of the global market[16].



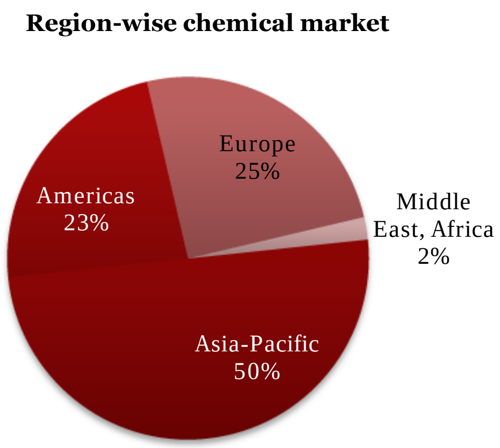
Source: CEFIC, Industry reports

Figure 5.16 Global chemical industry (USD trillion)



Source: CEFIC, Industry reports

Figure 5.17 Segment-wise chemical market



Source: Industry reports

Figure 5.18 Region-wise chemical market

Asia Pacific region accounts for nearly 50% of the global market[17]. China, Japan, South Korea, Taiwan and India have emerged as major demand and production centers. These countries are also among the top ten by chemical sales, collectively accounting for about USD 1.3 billion in 2013[18].

It is to be noted that Middle East and Africa regions are also indicating promising potential. Manufacturing facilities (especially petrochemicals) have been shifting to Middle East attributed to feedstock availability and lower manufacturing costs.

There are 11 subsectors present at global level which comprises of Inorganic chemicals, organic chemicals, fertilizers, textile chemicals (dying, tanning, tannins, etc), consumer chemicals (essential oils, cosmetics, toiletries, etc), soaps, lubricants, modified starches, glues, enzymes, Manmade staple fibers, plastics and articles.

The maximum exports are observed to be happening in crude petroleum oils, petroleum oils, gases and organic chemicals. These together contribute to 80% of the total global exports. The exports of Crude and petroleum products have grown at a rate of 16% and 21% respectively from 2003 to 2013[19].

[15] CEFIC, Industry reports
[16] Industry reports
[17] CEFIC, industry reports
[18] CEFIC
[19] Intracen, Pwc analysis

As such in the last ten years, India improved upon the share of exports in the world from 1% in 2003 to 8% to 2013. Petroleum products, Inorganic chemicals and plastic products contribute maximum to the global exports. It is observed that India has improved in the sub-sector manmade fibers (Rank 16 in 2003 to 4 in 2013) with the increased production in polyester, viscose, acrylic, nylon and polypropylene. The following table shows the leading chemical subsectors in global exports and the Top five countries in each subsector. This clearly depicts, United States of America is an active player in majority of the subsectors followed by Germany and China. [20]

Rank in (2013)	Crude petroleum oils	Coal; briquettes, voids & similar solid fuels manufactured from coal	Inorganic chemicals, precious metal compound, isotopes	Organic chemicals	Fertilizers	Tanning, dyeing extracts, tannins, derives, pigments etc	Essential oils, perfumes, cosmetics, toiletries	Miscellaneous chemical products	Manmade staple fibers
1	Saudi Arabia (1)*	Australia (1)	China (3)	United States of America (1)	Russian Federation (2)	Germany (1)	France (1)	United States of America (1)	China (1)
2	Russian Federation (2)	Indonesia (3)	United States of America (1)	China (11)	Canada (3)	United States of America (2)	Germany (2)	Germany (2)	United States of America (3)
3	United Arab Emirates (95)	Russian Federation (5)	Germany (2)	Belgium (3)	China (7)	China (10)	United States of America (3)	China (10)	Indonesia (10)
4	Iraq (13)	United States of America (6)	Russian Federation (11)	Germany (4)	United States of America (1)	Belgium (4)	Ireland (4)	France (4)	**India (16)**
5	Nigeria (5)	Colombia (7)	Australia (5)	Ireland (2)	Belgium (6)	Japan (5)	United Kingdom (5)	Japan (5)	Japan (6)
India	**99 (57)**	**20 (19)**	**21 (28)**	**12 (17)**	**63 (76)**	**11 (18)**	**18 (23)**	**22 (18)**	**4 (16)**

Source: Intracen, PwC analysis

Indian Chemical Industry is 10th largest in the world by sales turnover, valued at USD 77 billion in 2012-13[21]. Industry accounts to ~3% of the world chemical market[22]. It is expected to reach 5% in 2020. The industry accounts for about 8% of India's GDP, 9% of total exports and about 8% of total imports. With a diverse manufacturing base of over 70,000 different chemicals, the industry is dominated by basic chemicals (petrochemicals/organic chemicals) and specialty chemicals, which collectively account for over 50%. The following exhibit depicts the key segments of chemical and petrochemical industry:

[20] (*)-The no. in bracket shows the rank of country in 2003.
[21] Industry reports, Department of Chemicals & Petrochemicals, GoI
[22] FICCI handbook on Indian Chemicals and Petrochemicals Sector, Oct 2014

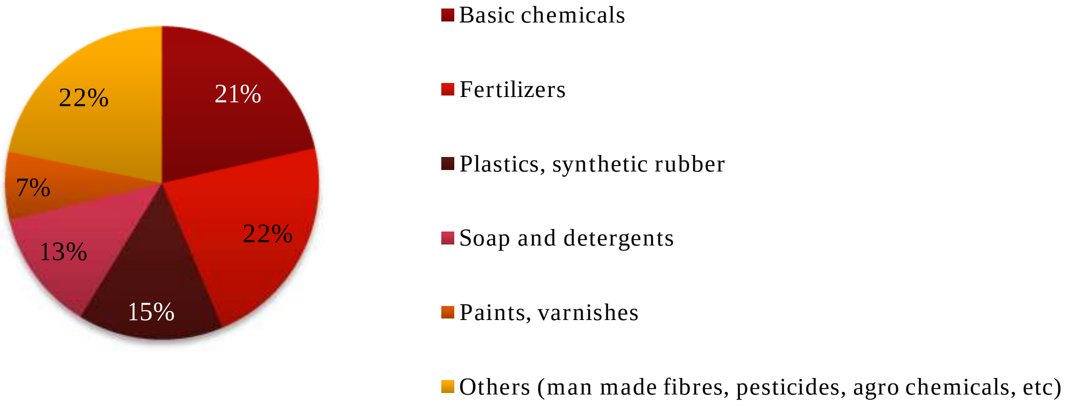


Figure 5.19 Indian Chemical Industry

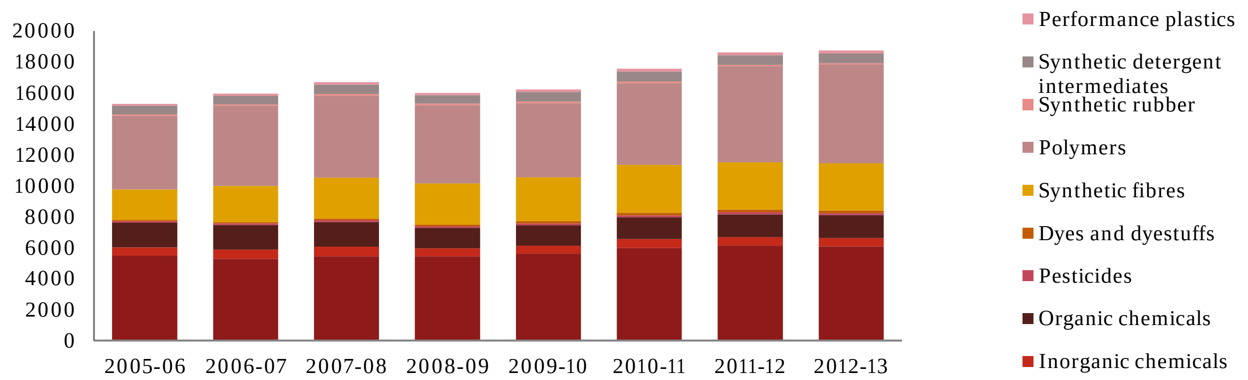
Source: Industry reports

There are more than 15 chemical clusters (industrial estates, SEZs, manufacturing centers) across the country, with majority of the manufacturers in western and southern India. In fact, the two regions collectively account for over 60% of the total chemical and petrochemical output as on 2012-13[23].

Gujarat, Maharashtra and Tamil Nadu have the largest chemical and petrochemical manufacturing base in the country, collectively accounting for over 55% of the total number of working factories in the sector, as of 2012-13[24].

Production of chemicals and petrochemicals grew at a modest rate from 2005-06 to 2012-13, indicating a CAGR of about 3%[25]. While growth in production of alkali chemicals and organic chemicals; collectively accounting for over 50% of chemical production has been almost flat, segments such as dyes and dyestuffs, synthetic fibers and performance plastics have reported an impressive production CAGR of over 5%. Significant capacity additions in synthetic fibers and polymers segments will continue to influence production growth going forward. The following exhibit depicts production trend of major chemicals:

Production trend



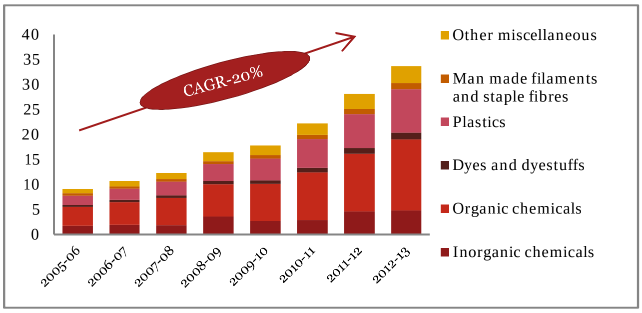
Source: Department of Chemicals & Petrochemicals, GoI

Figure 5.20 Chemicals production trend ('000 MT)

[23] Department of Chemicals & Petrochemicals, GoI
[24] Annual survey of industries, 2011-12
[25] Department of Chemicals & Petrochemicals, GoI

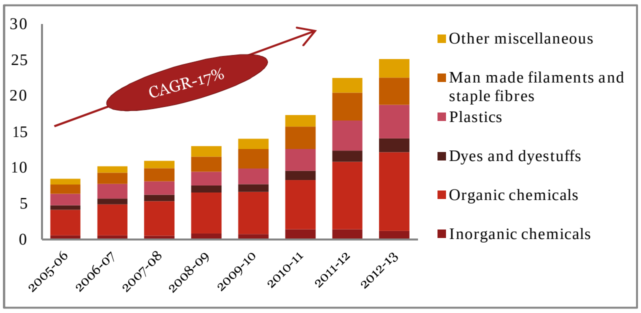
Trade profile

India remains as a net importer of chemicals and petrochemicals. With about USD 34 billion worth of imports in 2012-13, imports have grown at a CAGR of about 20%. Exports, on the other hand, have grown at a CAGR of 17% during the same period recorded at USD 27 billion in 2012-13. The following exhibits indicate import and export trend:



Source: Department of Commerce, GoI

Figure 5.21 Chemicals import trend



Source: Department of Commerce, GoI

Figure 5.22 Chemicals export trend

Currently, C&P sector is contributing to 30% of India's exports (2013), with redefined petroleum products of 20.6% share of total C&P exports. All sub-segments have shown very high growth rate in exports growth, with refined petroleum products, plastics, basic chemicals and other chemicals growing above 15%.

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. 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.

Viability drivers

National Level

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 automotive. 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

Ponneri Node level

The Chemicals and Petrochemicals sector is identified as one of the demanding (traditional) sectors in Ponneri Industrial Node.

Manali in Tiruvallur district is a hub for petrochemical industries. Chennai Petroleum Corporation Ltd (CPCL) has a refinery of 9.5 MMT per annum in Manali. Madras Fertilizers Ltd (MFL) has a unit there producing ammonia, Urea, Nitrogen, Phosphate and Potassium. Other petro chemical industries of Kothari petrochemicals, Manali Petrochemicals also exist here. About 3% of TN investments in this sector are present in Tiruvallur district. The growth of this sector is linked to the growth of auto industry. These are the basic inputs to other sectors like textiles where special chemicals are used and agriculture. Since Tiruvallur is one of the agro based district, the demand for chemical fertilizers exists.

Subsectors under Chemicals & Petrochemicals

- Coke oven Products
- Basic Chemicals, fertilizer and nitrogen products
- Other chemical products
- Man-made fibres
- Plastic Products

The sub-sectors under this category are highly traded products at global level. These stand in top 13 subsectors amongst all the subsectors considered under traditional sectors in Tiruvallur District.

When compared with Tiruvallur district, the subsectors manufacturing of basic chemicals, fertilizers and nitrogen components, chemical products and other chemicals are active. The consultant observes that there is a scope of development in these subsectors by introducing those which are not presently active, thereby becoming a part of global trade.

The subsector analysis showed that the subsectors manufacturing of chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber primary forms, other chemicals and plastic products are shortlisted for Ponneri IN in which the investments can be attracted.

Though refined petroleum products is one of the sub-sectors in which investments can happen in this region, the past trials of TIDCO for the establishment of a large petroleum complex failed due to environmental issues. Thus the dominance in subsectors is expected to be in Manufacture of basic chemicals, fertilizer, plastics and synthetic rubber in primary forms, Manufacture of other chemical products and Manufacture of plastics products

The growth drivers for the chemicals and petrochemical sectors in Tiruvallur district which is part of Tamil Nadu are as highlighted below:

- **Presence across value chain**
- **Per-capita consumption**
- **Domestic market**
- **Low cost of manufacturing**
- **Increasing FDI**
- **Policy support**

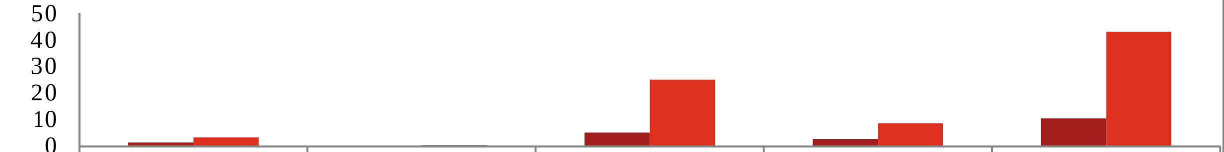
Presence across value-chain

Tamil Nadu is home to several internationally and nationally renowned chemicals and petrochemicals manufacturers. Companies like DCW, CPCL, BASF, SANMAR, ASAHI, etc are present here. Chemical and petrochemical industry is linked to the growth of auto and textile sector which are significantly growing from the past few years.

Tamil Nadu has catered 257 sq.km of land for PCPIR in the southern region which can we be pooled up for feedstock base for our node.

Per-capita consumption

India's per capita consumption of chemicals is much lower than the global average, as evident from the exhibit below. This presents a huge opportunity for growth of the chemical sector in India.



	Polyester	Dyes	Polymers	Soda Ash	Olefins, aromatics, pyrolysis gas, acetylene, hydrogen
India	1	0.04	5	3	11
World	3	0.40	25	9	43

Source: Industry reports

Figure 5.23 India's per capita consumption of select chemicals

Domestic market

A large population, dependence on agriculture, and strong export demand are key growth drivers for the industry. End use market segments including packaging, construction, electronics, automobile, textiles expected to grow at a rate of above 8%.

Low cost of manufacturing

Manufacturing cost is lower in India than most developed economies, which is also evident by a robust growth in exports of over 17%.

Increasing FDI

Most chemical items fall under the RBI automatic approval route for FDI investment up to 100%.

Policy support

Policy support provided for pooling up infrastructure facilities, tax benefits, land acquisition, funds for technology up-gradation for this industry.

Key challenges and issues

- ***Feedstock availability***

The chemical sector is predominately based on feed stock derivatives from cracking of naphtha in oil refineries providing the building blocks, such as Benzene, Toluene, Xylene, Cresols, etc. At present, the dependency on feedstock is a point of concern. India faces significant challenges in terms of feedstock availability and prices. Organic chemicals based on ethylene/ propylene, xylene, naphthalene and their derivatives are imported in large quantities due to non-availability of cost competitive feedstock. Petrochemical industries should be encouraged to minimize feedstock risk. India is rich in renewable feedstock. Limited availability of natural gas and naphtha hampers the end-users of industry affecting the process in value-chain.

- ***Infrastructural constraints-Lack of world class infrastructural facilities***

Given the poor infrastructure with lack of adequate facilities at ports and railway terminals and poor pipeline connectivity, domestic manufacturers will continue facing difficulty in procuring raw materials at a cost competitive with the global peers[26]. The Existing connectivity to ports from the CBIC region needs significant improvement. Trade profile gets hampered due to inadequate facilities especially, the subsectors dependent on feed stock import where the domestic linkages are absent.

- ***Dispersed Clusters***

At present, the industry clusters are located at multiple with improper linkages. Chemical industry falls under red category industries where by disposal of waste and effluents, and their treatment plays an important role. Provision of infrastructure facilities like ETPs, transportation linkages, power, water, etc is a biggest challenge.

- ***R&D facilities***

To meet the evolving consumer requirements and to compete globally, the industry would need to increase R & D spending substantially from existing 1-2% to at least 5-6 %.[27] It helps the industry to meet the global competitiveness. Specialty chemicals can be a focus area as it has high value, low volume chemicals, known for their end use applications or performance enhancing properties with good future.

- ***Administrative structure and taxation***

Multiple ministries and acts are applicable to this sector. This increases the tangles in obtaining the clearances during establishment. Apart for multiple regulations there is no specific Indian legislation pertaining to issues like registration category, transportation, allowance on utilization, etc. Absence of holistic approach leads to increase in the timelines which affects the growth of the sector. Taxes and duties are relatively on the higher side when compared to other Asian countries.

Benchmarking against Global and Domestic Competition

As discussed earlier, the chemical and petrochemical industry is growing at a CAGR of 7% from 2008. The leading country in this manufacturing sector is USA accounting for 15% of global shipments[28] followed by Germany and Russia. The exports noted as per 2013 in this industry USA grabs the highest share with 7% of total global exports in this sector. It's been consistently maintained at 6% from 2009 to 2012. Most of the top companies like ExxonMobil, Dow chemicals, DuPont, etc are USA based and the renowned company in chemical Industry, BASF is based out of Germany.

Chemical industry is based upon the science and technology involving more of research and development in the presence of world class infrastructure.

Some of the factors which makes USA stand as the leading country in this sector are

- Advanced science and technology
- High scale industrial development
- Availability of raw material
- Growing market
- Presence of multinational companies

As discussed, global chemicals are shifting towards Asia and China is rapidly building capacity and becoming self-sufficient. China is expected to become a net exporter between 2018 and 2025. Between 2009 and 2013, 78% of global new capacity has been installed in China and Middle East.

[26] Knowledge paper 2014, FICCI
[27] DRAFT NATIONAL CHEMICAL POLICY (Draft NCP-2012)
[28] http://selectusa.commerce.gov/industry-snapshots/chemical-industry-united-states

Chemical Industry in US-

Entrants across value chain

- Actual Production
- To produce raw materials or intermediate inputs for other industries
- Manufacturing consumer products and goods
- Chemistry derived products
- **Products**-Synthetic fibres, Electronics, Food packaging, Medicine, Aerospace equipment, Automotive parts
- Produces more than 70,000 products
- 15% of world's chemicals are produced by US.
- **17% of US patents are in Chemistry –** Nano Technology, Computing, Transportation, Space Age

Presence and Methodology

- **Present Globally-**Latin America, North America, Europe, Africa and Middle East, Asia-Pacific
- **Usage of Energy Efficient Methodology**
- Combined use of Heat and Power (CHP)
- Can produce twice than traditional method (coal)
- Energy loss is minimal during transmission. This enables Annual energy savings from products of Chemistry-USD 85 billion.
- Reduction in usage of gasoline consumption

Associations and programs giving way for innovation & encouragement to the sector

- Massive support from Industry Associations like American Chemistry council (ACC), American Cleaning Institute, Society of plastic Industry, etc.
- Global product strategy is being adopted-to protect health and safety.
- High Production Challenge program under Environmental Protection act protecting hundreds of chemical makers.
- American Chemical Society (ACS) supports innovations, commercial chemicals enterprise to support risk and security and also supports green technology.
- ***US is also trying to follow REACH program from European countries which improves the regulation framework .***

Focussed areas and Support

- **Focussed on specialty chemicals** like adhesives, agrichemicals, cosmetic additives, food additives, etc which are intermediary raw materials.
- Shale gas is the key for strong manufacturing base in US.
- Federal Resources supporting the chemical industry in US-
  - **Manufacturing Extension Partnership (MEP)**-To improve their competitiveness, productivity To improve their competitiveness, productivity and technological capabilities
  - **Advanced Manufacturing Office (AMO)-**cost shared projects, tools, training and information focussing on transformational manufacturing processes and materials

Key factors of strength/consideration

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Ponneri emerging as a top destination for food processing can be broadly classified around the three main areas:

Economic enhancers	Value enhancers	Administrative enhancers
• Development of quality integrated industrial infrastructure • Easy acess to consumption markets and gateways to markets • Reliable availability of FoPs	• Productivity enhancement • Efficiency in resource use • Technological readiness and upgradation • Skill development • Researc h and development • Value addition	• Institutional reforms and eash of doing business • Regulatory and policy support

Specific issues identified by Chemical and petrochemical units located in close proximity to the proposed node in Tiruvallur district and implications to be considered in design of the industrial node are summarized below:

Table 5.3: Key factors of strength/consideration for Chemicals and Petrochemical

Components	Issues	Key factors of strength/consideration
Economic Enhancers		
Proximity to port and raw material	• Availability of port infrastructure is essential FoP for the sector	• The location of Ponneri node has a strategic advantage for transportation facilities. It is located in close proximity to both Kamarajar and Kattupalli Ports. These enable the import of feedstock in close proximity. • The Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area. • The master plan provides for 4-lane internal roads for both industries and residential access.
Water	• One of the highest consumers of water –	• As per demand estimates about 1199 acres are likely to be taken up by chemicals and petrochemical industry in the node by the year 2033. This requires very high quantum of industrial water for operations. Sources with capacities greater than 500 MLD have been identified in the region. Though not dedicated, these sources can sufficiently serve the requirement of potable and non-potable water in the near term for the mix of industries in Ponneri node. • Minjur desalination plant, WTPs in Chennai Metro Area, new desalination plant, and recycled water from Kodungaiyur STP and secondary treated sewage from STPs are the sources of water identified for Ponneri Node.
Environment	• Development of port, other industries disrupts production • Lack of drainage for common water for the industries	• Careful planning of new industries is required as the segment is highly sensitive to water contamination • Introduction of green principles in manufacturing is to be promoted • Common effluent treatment plant can be developed by the government for similar industries within the district
Power	• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • Provide alternate sources of power • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from

Components	Issues	Key factors of strength/consideration
		these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Current plan provides for 29 sub-stations within the node to have uninterrupted power supply.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• The logistics hub of 166,859 sq. m is planned for storage of freight within the node which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop.
Value enhancers		
R&D facilities	• International practice suggests availability of R&D facilities for new product development within industrial park	• R&D laboratories can be proposed to serve the product development requirement of this industrial node as well as other chemical & petrochemical units within CBIC/country
Availability of indigenous testing facilities	• Inadequate infrastructure for Research and development in the sector • Local players do not have enough capital to set up testing facilities as the investment required is huge.	• There is a need to facilitate setting up of indigenous testing and calibrating facility for equipment testing • Upgradation of certified testing centres for products and raw materials to reach BIS standards. • A testing canter for petroleum and chemical products needs to be established within the industrial area of the node. The testing center at Guindy in Chennai would be the closest to the node at present. • A Specialty Chemicals Forum needs to be established with representation from industry, customers and the Government. This forum will study other countries' regulations and develop consumer standards, and work towards their introduction and implementation.
Recycling of water and provision of ETP	• Since the sector is highly water dependent, recycling and reuse of water would suffice the need.	• Promote industry based on efficiency; incentivize industry players to follow best practices of manufacturing like higher efficiency, latest technologies • Promote technologies such as 'zero discharge' of industrial effluents. • A hazardous waste treatment and disposal plant is proposed in the master plan for this purpose.
Administrative enhancers		
Ease of doing business	• Delays in obtaining clearances from pollution control board which hampers the smooth functioning of plant.	• Simplification of licensing system • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all industries required by any industrial unit.
Policy and regulatory framework	• Availability of minimal industrial licensing for hazardous chemicals.	• Government is continuously reducing the list of reserved chemical items for production in the small-scale sector, thereby facilitating greater investment in technology upgradation and modernization.

5.2.3. Machinery

Sector performance

Rapid urbanization and industrialization of Asia Pacific emerging economies is driving multifaceted heavy engineering sector demand. These strong demand drivers impact growing demand from Asia Pacific economies. Global machinery market size of Asia Pacific region have reached 35% in 2011 – 5% increase for the past five years, leaving behind Europe (traditionally strong machinery manufacturing sector).

Figure 5.24: Machinery sector market is gradually shifting to Asia Pacific region

Source: Marketline Industry reports 2007, 2011

Globally machinery exports are led by China, Germany, USA, and Japan. Italy, UK and France are also large players in machinery sector.

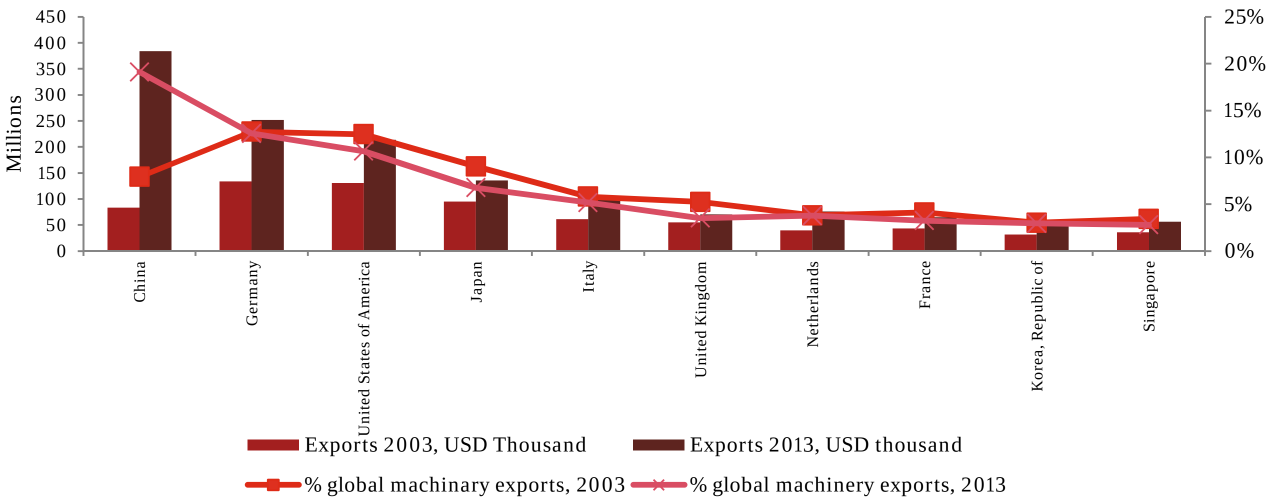


Figure 5.25: Top exporting countries based on value of Exports

The subsectors mentioned in the table below contribute to more than 50% exports of the world. All these sub-sectors have been observed to be grown at 9% on an average from 2003 to 2013. Automated data processing machines contributed maximum to the global exports followed by parts and accessories and printing machinery. Engines, turbines and other machinery for mining and construction are expected to have growth rates in India. India majorly contributes to export of these goods in the global trade. India's share in global machinery exports have increased from 0.21% in 2003 to 0.66% in 2013 on a growth rate of 22%.

Rank (2013)	Automatic data processing machines; optical reader, etc	Parts& access of computers & office machines	Printing machinery; machines for uses ancillary to printing	Turbo-jets, turbo-propellers and other gas turbines	Tap, cock,valve for pipe,tank for the like,incl pressure reducing valve	Air, vacuum pumps; hoods incor p a fan	Machinery part	Machines& mech appl having indiv functions, nes	Part for use solely/principally with the motor engines	Pumps for liquids; liquid elevators
1	China (1)[29]	China (2)	China (16)	United Kingdom (2)	China (4)	China (6)	United States of America (1)	Germany (2)	Germany (1)	Germany (1)
2	United States of America (2)	United States of America (1)	Japan (2)	France (4)	Germany (1)	Germany (1)	China (12)	Japan (1)	Japan (2)	United States of America (2)
3	Mexico (6)	Netherlands (10)	Germany (1)	Germany (3)	United States of America (3)	United States of America (3)	Germany (2)	United States of America (3)	United States of America (3)	China (8)
4	Netherlands (3)	Singapore (6)	Netherlands (8)	United States of America (1)	Italy (2)	Japan (2)	Singapore (3)	Italy (4)	China (19)	Italy (3)
5	Thailand (14)	Taipei, Chinese (5)	Singapore (20)	Japan (7)	Japan (5)	Italy (4)	Italy (6)	Korea, Republic of (5)	Mexico (5)	Japan (4)
India	**35 (32)**	**28 (33)**	**35 (26)**	**33 (38)**	**16 (32)**	**20 (33)**	**24 (42)**	**25 (27)**	**21 (27)**	**20 (27)**

Source: intracen, PwC analysis

Machinery is sub-divided into two sub-sectors special purpose machinery and General purpose machinery as per Annual Survey of Industries. Special purpose machinery has registered high growth at a CAGR of 16% and has grown from Rs. 79,174 crore in 2008-09 to Rs. 122,570 crore in 2011-12. General purpose machinery is the largest segment in terms of volumes of output. It has grown from Rs. 91,009 crore in 2008-09 to Rs. 129,978 crore in 2011-12 at a GACR of 13%.

The figure shows heavy machinery output in India.

All the key segments of General purpose machinery sector are projected to grow at strong growth rates till 2017.

Growth in engines and turbines sector is expected to slow down due to existing orders that have been placed or additional capacities planned under 12th and 13th Five Year plans. The power sector also experiences delays in projects implementation.

5-year CAGR of lifting and handling equipment is 18% (3-year CAGR was considered for uniformity of the graph). The segment is projected to grow at similar pace on

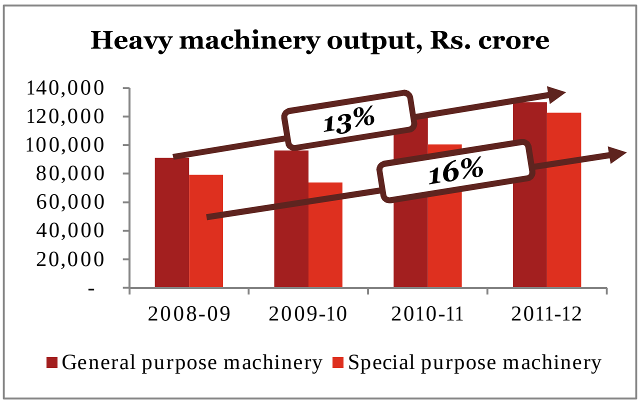


Figure 5.26 Heavy machinery output

[29] The no. in the bracket represents rank in 2003.

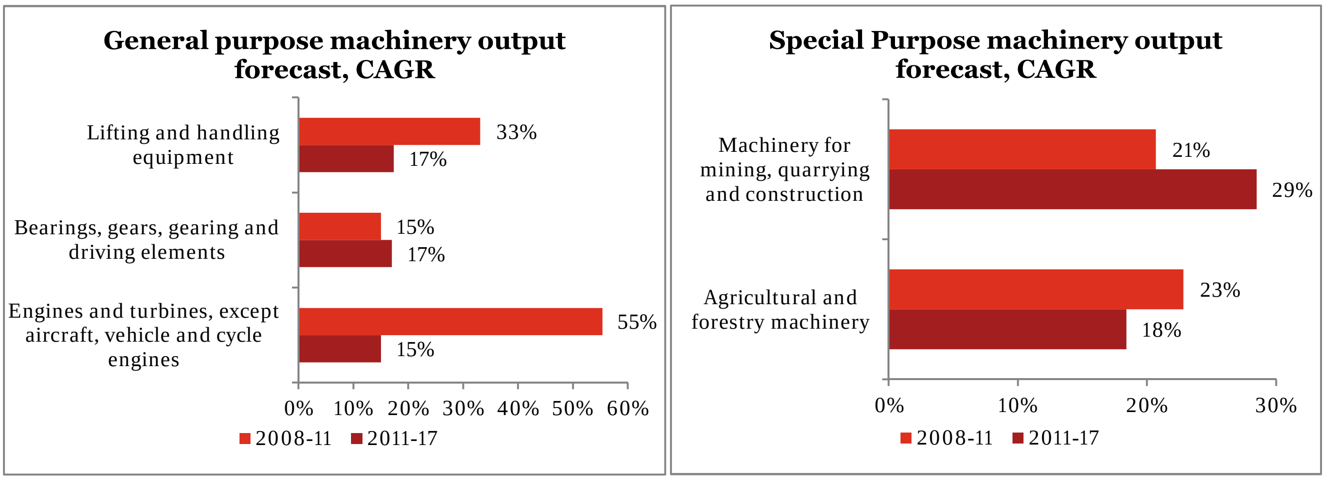
account of strong demand from infrastructure, heavy engineering and automobile sector.

Bearing, gears, gearing and driving elements sub-segment will grow in accord with automobile industry expansion and growth of end-user industries for the sub-segment (industrial machinery, special purpose machinery).

High growth trajectory sub-segments of special purpose machinery sector are expected to sustain strong growth momentum in the next five years

Agriculture and forestry machinery will grow at a healthy 18% CAGR for the next six years on account of continued shortage of labour in rural areas and continued migration of labour to urban areas (construction activities, growing manufacturing units). Also increased focus of the government on the agriculture mechanisation would mean inclusion of more equipment under various subsidy schemes.

Mining, quarrying and construction equipment will experience higher growth due to continued urbanisation that drives constriction activities as well as strong growth momentum in thermal electric installed capacities.



Source: Department of Heavy Industries

Figure 5.27: Projected growth rates for machinery sector in India

Machinery export growth in India has registered remarkable growth over the past 10 years; however, the last 5 years have witnessed 2.5 times slower growth. In spite of machinery exports growth in value terms, India's share in global machinery trade accounted for 0.2% of the world exports in 2003, it reached 0.4% in 2008, and slightly increased to reach 0.5% in 2012.

General purpose machinery (GPM) exports have shown strong growth over the last 10 years. They are around 30% of GPM production in India and account for about 75-80% of total machinery exports. The largest groups of exports from India included engines and turbines and pumps, compressors, taps and valves

Share of engines and turbines in overall general purpose machinery export basket has grown from 21% to 25% between 2003 and 2012. Exports growth for engines and turbines was nominal due to huge demand potential in the domestic market during the last five years.

Lifting and handling equipment is a smaller segment but its share steadily increased from 3% in 2003 to 9% in 2012; the segment has registered healthy CAGR as well.

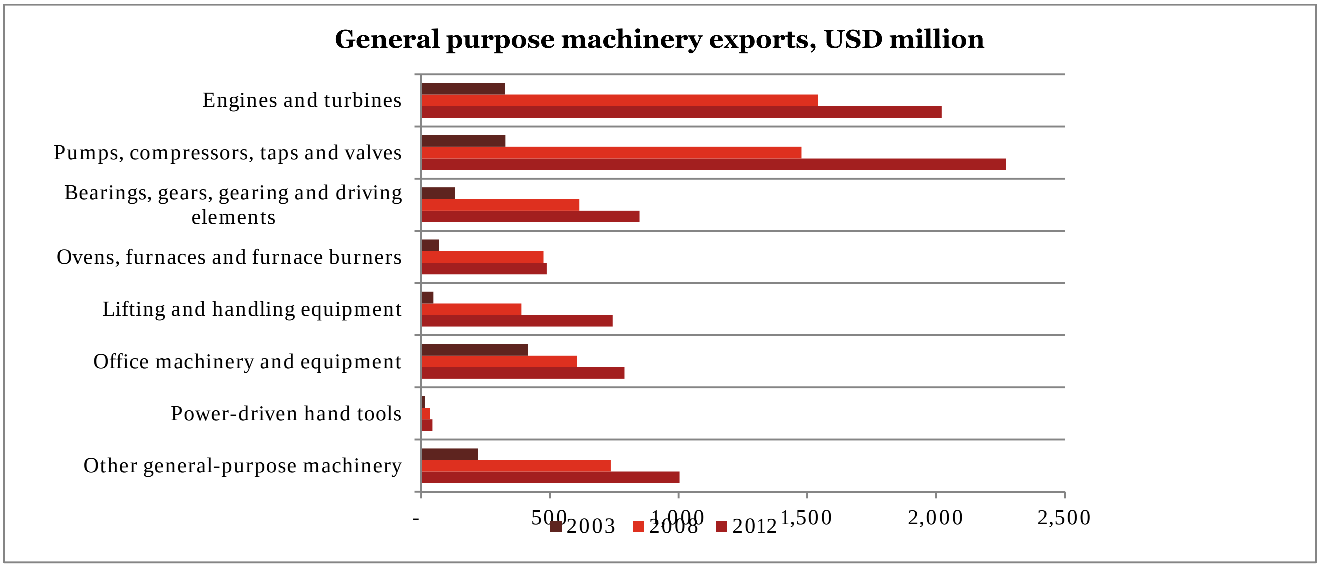


Figure 5.28: General purpose machinery exports from India

Source: ITC, PwC analysis

Special purpose machinery exports growth on the other hand have been led by growth in agricultural and forestry machinery, metal forming machinery and machinery for mining and construction.

Special purpose machinery exports are about 8-10% of special purpose machinery production in India. The largest groups of exports from India in special purpose machinery segment included metal forming machinery and machinery for mining, quarrying and construction. Exports growth for both segments was nominal due to huge demand potential in the domestic market during the last five years. Share of both segments in total special machinery export basket remained high for the whole decade – 30% of each segment.

Agricultural, food processing and textile machinery segments registered high growth over the past decade and the last five years as well. Their share in total exports of special machinery has grown as well. In 2012 agri machinery accounted for 9% share of total special purpose machinery exports, food processing machinery – 6% and textile machinery – 12%

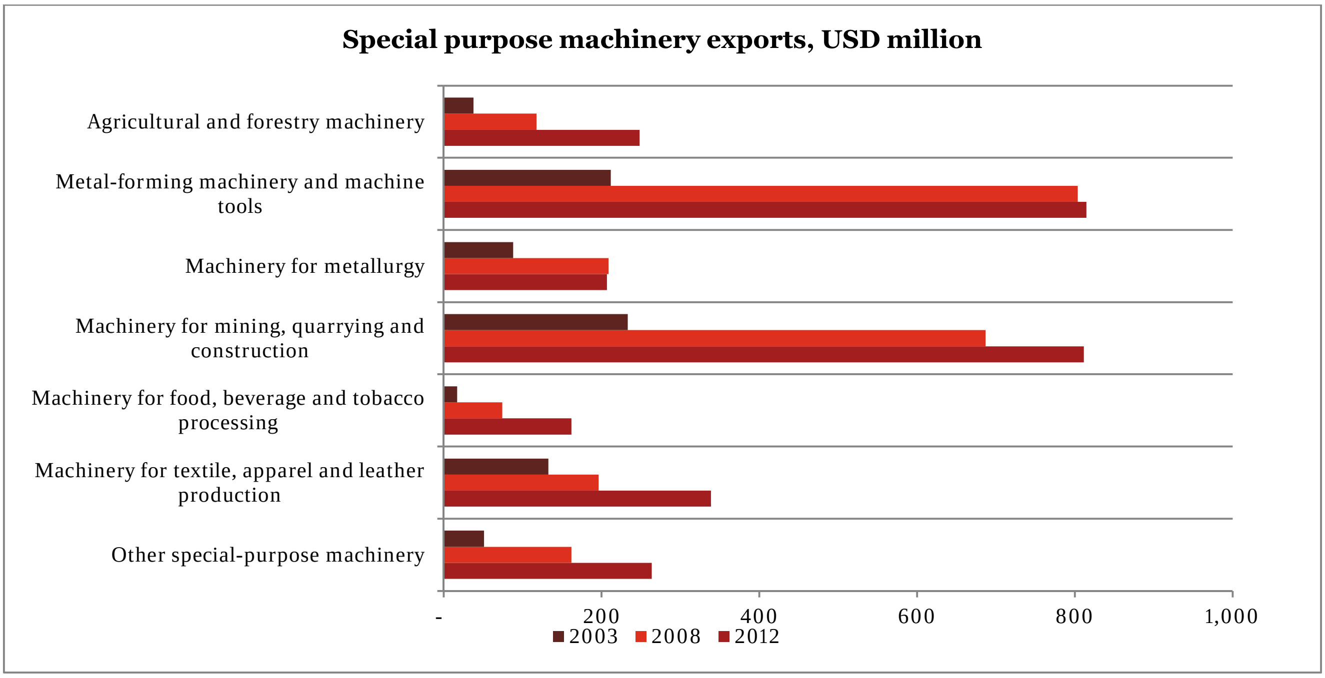


Figure 5.29: Special purpose machinery exports from India

Source: ITC, PwC analysis

Machinery industries are predominantly concentrated around Tiruvallur, Tiruchirappalli, Chennai Kancheepuram and Dharmapuri. Companies like Caterpillar have a large manufacturing base in Tiruvallur district which has brought in a lot of vendors. In addition Kobelco also has a manufacturing unit in Oragadam in Kanchipuram district neighboring Tiruvallur.

Viability drivers

1. *National Level*

The growth drivers that would machinery sectors to develop and improve are highlighted below:

Growing power sector

Accelerated infrastructure expansion and growing urbanization

Growing Telecom Industry

Farm mechanization

Increasing FDI

Nuclear capacity addition

Growing power sector

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.

Accelerated infrastructure expansion and growing urbanization

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

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.

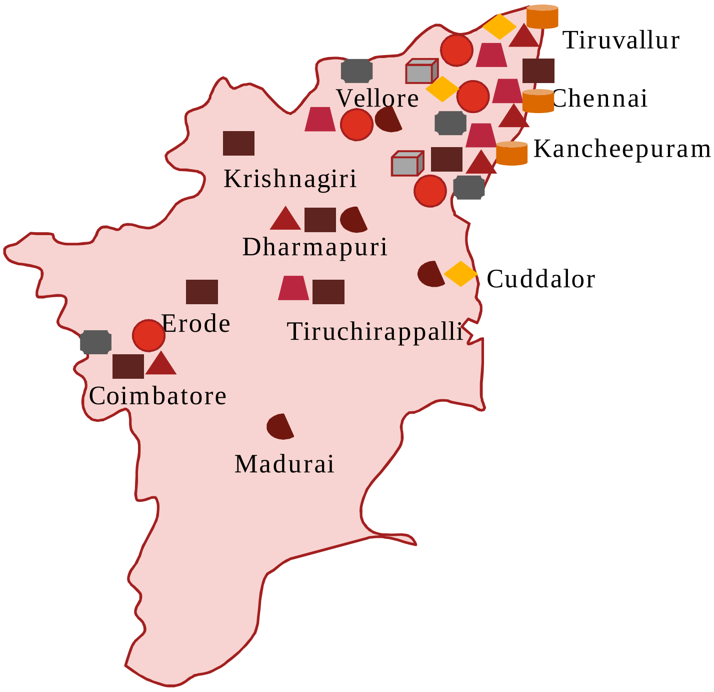
Nuclear capacity addition

Nuclear capacity expansion will provide significant business opportunities to the electrical machinery industry and with the completion of the Indo-US nuclear deal, India is set to receive huge investments in this industry.

2. Ponneri Node Level

Existing industry base concentrated in North-eastern part of the state-giving way for an established supply chain

Over the past decade, investment to the tune of Rs. 8,582 crore has taken place in Tamil Nadu. These projects (86% of completed projects) are predominantly concentrated around Thiruvallur, Tiruchirappalli, Chennai, Kancheepuram and Dharmapuri.



Source: CapEx database

Figure 5.30: Completed projects in heavy engineering sector in Tamil Nadu

Strong availability of skilled workforce, owing to presence of reputed institutions

Tamil Nadu is one of the leading states in terms of availability of skilled workforce and hosts large number of famous engineering colleges and institutions: IIT Madras, Anna University, Coimbatore Institute of Technology, Vellore Institute of Technology, etc.

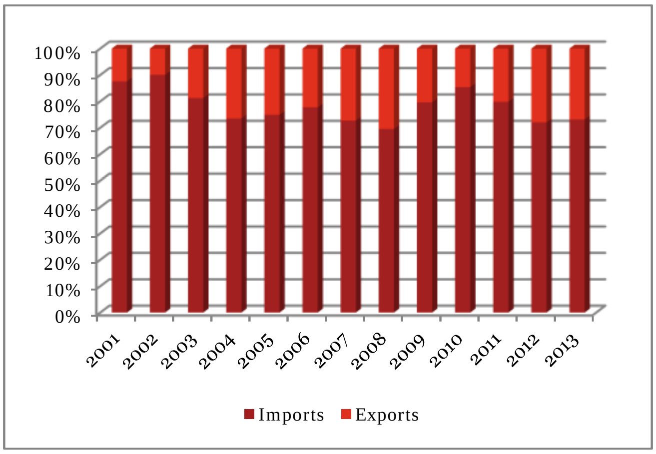
Key challenges and issues

Import oriented trade

Imports and exports of machinery are growing at a CAGR of 26% and 16% respectively. But when compared the percentage of share of imports and exports in total trade, imports are always on the higher end.

It is observed that imports cater to 78% of trade on an average from 2001 to 2013.

This trade deficit needs to be addressed through focus on improving exports by creating necessary infrastructure support along with policy level reforms.



Source: www.intracen.org – International Trade Centre

Figure 5.31: Exports and imports of machinery

Availability of Raw materials

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.

This 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.

Technological Constraints

Dependency on imports of technology components due to lack of supporting process technologies such as precision measuring, material engineering and process control should be given a thought. Huge technology gap is being observed in productivity, methodologies adopted for production and manufacturing tools. This in turn affects the final product quality.

Infrastructural Constraints

Problems in transporting heavy and Over Dimensional consignments (ODC) >98 MT on NHAI bridges. As per procedure, various zonal railways involved give clearance for the movement of such ODC's. This leads to delay in projects. Congestion at ports further delays delivery.

Uninterrupted power supply

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.

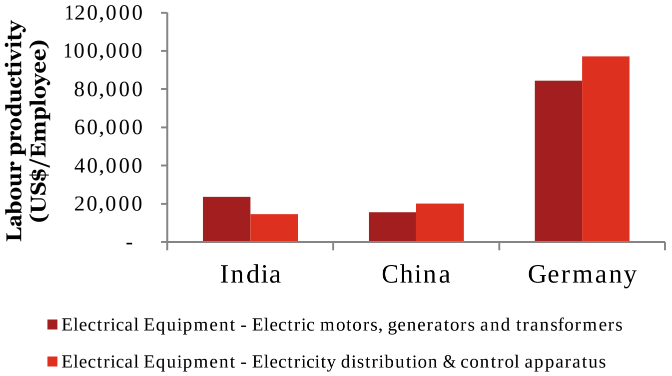
Availability of indigenous testing facilities

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.

Benchmarking against Global and Domestic Competition for the Node

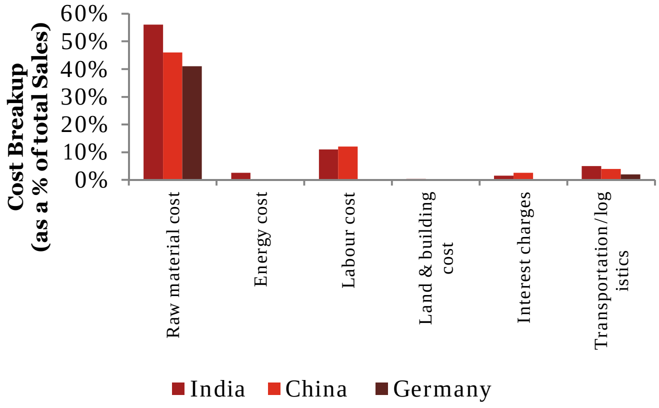
Most of the Indian firms are still in the Stage I of the competence protocol and targeting basic conveniences & cleaning up of operations to achieve competitiveness in Capital Goods. Raw-materials and labour productivity are the key issues which are attracting all the attention of Indian firms. Some of the aspects in Stage 1 like energy conservation, clean & safe working environment, etc. are still to be looked up as measures for competitiveness.



Source: UNIDO's Statistical Country Briefs

Figure 5.32:Labour productivity for equipment

Amongst the competing countries, China has already crossed the first stage managing basic clean-up of operations by managing backward linkages effectively and setting up component and raw-material industries supplying to Chinese firms at very competitive rates. Italy & Germany counterparts have already crossed second stage and focus is on total improvement in systems & business processes by achieving total quality enrichment and enhanced value addition.



Source: www.enterprisesurveys.org, The World Bank

Figure 5.33: Cost structure of electrical equipment

Cost Structure

Cost structure encompasses all the expenses that a firm must take into account when manufacturing & selling a product. Various types of costs that are benchmarked in this section are: Raw material costs, labour costs (including wages), Energy costs, Interest charges, distribution expenses (including transportation & logistics etc.)

Margins can be improved either by increasing sales prices, or by reducing costs. As prices in real terms for many of the industry's staple products have eroded over many years, the focus has long been on reducing costs. Competing countries" (China & Germany for Equipment and China for Process Plant Equipment) competitive advantage vis-à-vis India in terms of costs is presented in the chart 4.29.

India has very high raw material cost (56%) as compared to China and Germany. India's advantage as evident from the charts lies in labour costs and interest charges which are lower in India as compared to the competing countries. Logistics/transportation cost in India is very high as compared to Germany.

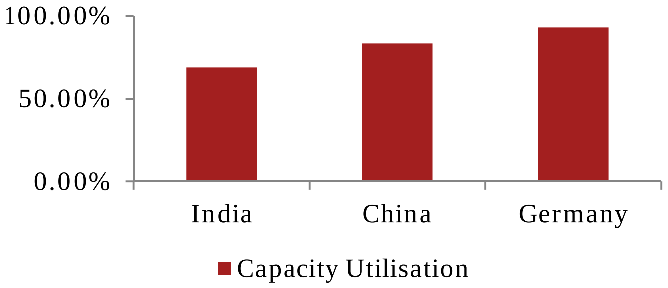
As can be inferred from the comparisons drawn above, raw material & inputs expenses need to be tightened to make India's cost structure in Capital Goods sector competitive as compared to competing countries.

Productivity

Labour Productivity is the measure taken for benchmarking the productivity of Indian Capital goods industry vis-à-vis competing countries. Labour productivity has been estimated as a ratio of Gross value added (GVA) to the number of workers.

Higher labour productivity of competing countries (China & Germany) for Electrical equipment is one of the sources of competitive advantage over India, as shown in the chart 5:

India has comparative advantage over China in labour productivity for electrical motors, generators and transformers manufacturing, while the latter has slight advantage in electricity distribution & control apparatus. Germany emerges as a clear leader in both the categories having labour productivity more than four times than both the competing countries. This is due to Germany's higher gross value added which is achieved with lesser workforce.

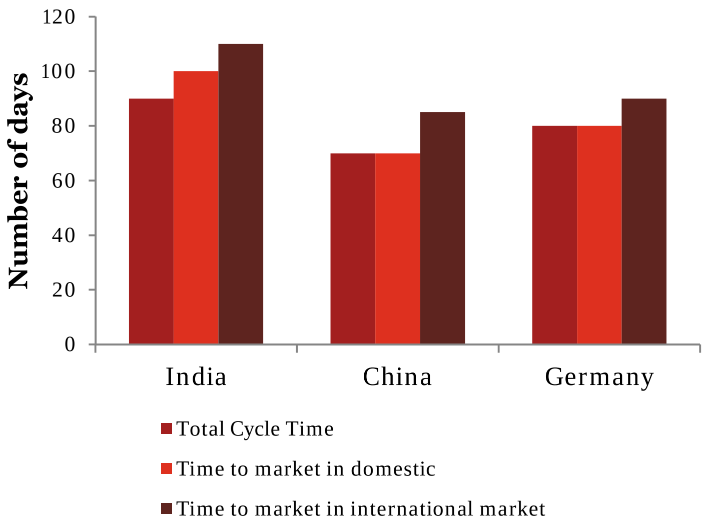


Source: www.enterprisesurveys.org, The World Bank

Figure 5.34: Capacity utilization for electrical equipment

Process Time

Process time is a very important parameter for competitiveness as it is indicative of the overall time a firm uses for production and delivery to the target market. Countries which are able to achieve faster turnaround time and have quicker time to market usually enjoy competitive advantage in the market. Various parameters which are considered for comparison in this section are: Average time taken for exports/imports clearance and Average stock in hand (average inventory held by a firm in terms of number of production days)



Source: Dun & Bradstreet Analysis

Figure 5.35: Process time for electrical equipment

India stands at clear point of disadvantage as compared to competing countries (China, Italy& Germany) because of higher process time as depicted in the chart 6:

As can be seen from the graph, the average time taken to market electrical equipment in India in the domestic market as well as international market is high as compared to China and Germany. Also the total cycle time in India is high. This clearly depicts India's competitive disadvantage in the sector.

The insufficient logistics support to the industry in terms of transportation of raw materials and aggregates, lack of quality power supply, lack of quality water supply etc. have added to the operating cost and eroded the competitive advantage of the domestic players with respect to overall production cycle time and overall time to market.

Capacity utilization

Capacity utilization is a metric used to measure the rate at which potential output levels are being met or used. Displayed as a percentage, capacity utilization levels give insight into the overall slack that is in the economy or a firm at a given point in time and refers to the extent to which an enterprise or a nation actually uses its installed productive capacity. Thus, it refers to the relationship between actual output that 'is' produced with the installed equipment and the potential output which 'could' be produced with it, if capacity was fully used.

India's comparative disadvantage as compared to competing countries (China and Germany) in capacity utilization is shown in the chart 4.32.

Key factors of strength/consideration

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Ponneri receives interest from Machinery units can be broadly classified around the three main areas:

Economic enhancers	Value enhancers	Administrative enhancers
•Development of quality integrated industrial infrastructure •Easy acess to consumption markets and gateways to markets •Reliable availability of FoPs	•Productivity enhancement •Efficiency in resource use •Technological readiness and upgradation •Skill development •Researc h and development •Value addition	•Institutional reforms and eash of doing business •Regulatory and policy support

Specific issues identified by electrical machinery units located in proximity to the proposed node in Tiruvallur district and implications to be considered in design of the industrial node are summarized below:

Table 5.4: Key factors of strength/consideration for Machinery Sector

Components		Issues	Key factors of strength/consideration
Economic enhancers			
Connectivity	**Rail**	• Rail connectivity is necessary to transport over dimensional consignments (ODC) and avoid problems in transporting heavy and ODC >98 MT on NHAI bridges. • Availability of rail sidings as a last mile connectivity to the main rail network is also essential	• Increasing rail network connectivity is a necessary requirement to transport ODC cargoes • The logistics hub of 166,859 sq. m has been planned for storage of freight which will be developed connecting to the new railway access line to Ponneri Node. It has a provision for container yard, steel storage yard, warehouse and a work shop. • Current plan includes 5.1 km of access line to the node. • The construction of the proposed Northern Rail Link between Minjur and the new container terminal at Ennore Port will be essential to allow the development of a rail access to Ponneri node.
	Road	• Availability of port infrastructure is essential FoP for the electrical machinery units • The segments dependent on require proximity to ports as their raw material is imported	• Ensure seamless connectivity to port • The Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area. • Extending the connectivity with Chennai Metropolitan Area through NH-5 or SH-56 to

Components	Issues	Key factors of strength/consideration
		• Planned for 4-lane internal roads for both industries and residential access.
Power supply	• Power shortages are prevalent in many of the Indian states, including states within the corridor. • Electricity rates are a point of concern of various stakeholders.	• Resolving power shortages issue requires immediate intervention given unanimity of the stakeholders on prevailing issues with power supply • About 1084 MW of power would be required by the end of 2033. Design for 759 MW was identified to be worked on. NCTPS I, NCTPS II, Vallur TPS, Ennore TPS are the existing plants that would cater to the supply. Apart from these Ennore SEZ and NCTPS-III power plants coming up to cater in long run. • Planned for 29 sub-stations within the node to have uninterrupted power supply.
Value enhancers		
Availability of indigenous testing facilities	• Inadequate electrical equipment testing facilities in the country • 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 in the node, which can become a testing facility center for the state as well as neighbouring states
Availability of Critical Raw Materials	• 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 the long run government should promote and ensure setting up units manufacturing CRGO and CRNGO electrical steel in the country to remove dependency on raw material imports • There are established engineering clusters with established business environment and supply chains in the state – Chennai, Tiruvallur, Kancheepuram, Vellore, Dharmapuri, Coimbatore, etc. It makes it attractive for new units to enter**.**
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • 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

Components	Issues	Key factors of strength/consideration
Administrative enhancers		
BIS certification guidelines	• Electrical industry is largely dependent on imported electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported 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 • BIS certifications guidelines to be modified to avoid delays in registration of foreign suppliers
Technology upgradation and modernization	• Current level of technology adopted in the sector is not up to the world standards leading to low productivity and high process time • The sector is known for large number of MSMEs involved as vendor base for large units • Access to technology is limited for MSMEs and sighted as one of the constraints by sector stakeholders	• Under existing STI Policy 2013 assistance to MSMEs in installing modern machinery should be extended – funding solutions to MSME units at competitive rates encourage technology upgradation and modernization • Modifications to the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery manufacturers are to be introduced • The State Government have formed the TamilNadu Skill Development Mission (TNSDM), which will enter into partnership with industry to identify skill gaps and design course material leading to Modular Employable Skills (MES) Certification or other industry acceptable Certification.

5.2.4. Computer, Electronics and Optical products (CEO)

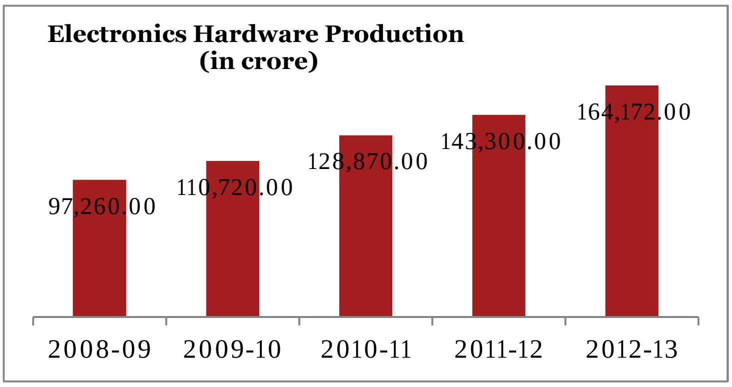
The global electronics industry which is USD 1,750 billion is the largest and fastest growing manufacturing industry in the world[30]. The production of electronics products has continued to shift from developed countries (US, Japan, Europe) to developing countries especially in Asia Pacific region. Asia's contribution to electronics components has increased from 42% to 52%[31] between 2008 and 2011. With 5 out of top 10 countries, Asia dominates the electronics market[32]. The global electronics industry is expected to reach USD 2,400 billion by 2020.

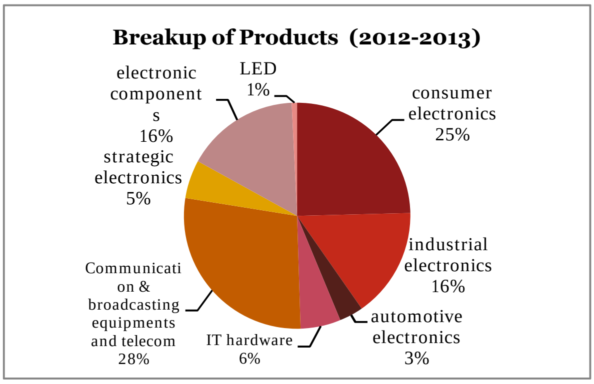
Over the last couple of decades consumer demand of CEO has been fuelled by a phenomenal GDP growth in India. Electronics market in India grew at a rate of 14% between 2007-08 and 2011-12. While demand increased across all sectors, demand for high technology products, specifically electronic products have registered significant

[30] www.apit.ap.gov.in
[31] World Electronic Industries (www.decision.eu), http://www.custerconsulting.com
[32] Human Resource and Skill Requirements in the Electronics and IT Hardware Industry, NSDC

growth and going by current estimates, the demand for electronics in the country is projected to be USD400 billion by 2020[33].

Production of electronics hardware continued to experience significant growth over past years. Out of total production, consumer electronics (25%) and Communication and broadcasting equipment and telecommunication including mobile handsets accounts (28%) accounts for more than 50%.

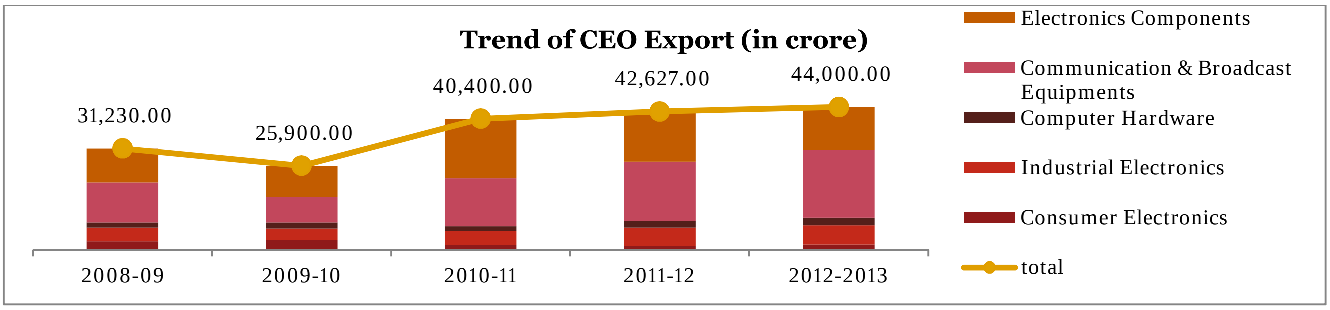




Source: Electronics and Information Technology, Annual Report, 2012-13

Figure 5.36: Electronics Hardware Production, Breakup of electronics Hardware

The export of CEO is another potential market for India. CAGR of export recorded 23% from 2002 to 2012 and the value of export recorded INR 44,000 crore.



Source: Electronics and Information Technology, annual report 2012-13

Figure 5.37: Trend of CEO Export (in crore)

Indian CEO Exports expected to increase from USD 4 billion to USD 80 million by 2020[34]. Export of electronics hardware accounts for 50% of total CEO export. Tamil Nadu leads India's electronics hardware exports with a share of 46%, followed by Karnataka (17%), Uttar Pradesh (14%), and Maharashtra (12%).[35]

However, currently, India's exports stand at only around 17% of its total electronics hardware production. Owing to increase wage rates in China, manufacturers are looking forward for alternate locations within Asia.

[33] *Task Force Report*
[34] DEITY – National Electronics Policy 2012
[35] ESC

Viability Drivers for Future Investment

i) **National level related**

Strong Govenrment support

- Electronics Manufacturing Clusters Scheme is a scheme introduced by the Government of India to attract investments in Electronics Systems Design and Manufacturing Sector. Sriperumbudur, Oragadam areas in Kanchipuram district which neighbour Tiruvallur are established Hitech electronics SEZs

Domestic market growth

- 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. Investors can access to the domestic market across India as the node is proximate to Chennai which is well connected to rest of the country by all modes.

- *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 Fiber to the Home are likely to drive demand in the long term.

- *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 will 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

ii) Ponneri level related

Tamil Nadu is already positioned as a leader in the IT/ ITeS sector in India. The region is characterized by the presence of complementing ecosystem in the neighbouring district of Kanchipuram. The region has presence across the value chain of electronics hardware sector which include solar panels, consumer electronics, computers and mobile phones. The share for CEO sector is assessed on historic investments in Tiruvallur. Further, the District profile published by MSME Department also substantiates presence of Electronics industries in the Kakkalur block of Tiruvallur district. Given the mature eco- system, the CEO sector has been selected as one of the focus industry sectors for detailed assessment for Ponneri Node. Below are growth drivers for Electronics manufacturing in Ponneri:

Developed cluster	Availabilty of skilled labour	Strong support by State Government

- **Developed and upcoming clusters**

  Sriperumbudur, Kanchipuram district, is India's largest Electronics cluster. The district is a home to some of the global players in electronic hardware such as Samsung. Notable areas include Hi-Tech SEZ at Sriperumbudur Industrial park, Kanchipuram District for the manufacture of Electronic/ Telecom Hardware and Support services, Hi-Tech SEZ at Oragadam Industrial Growth Centre, Kanchipuram district for Electronic Hardware and related support services. Besides, there are other upcoming electronics manufacturing clusters in Coimbatore and Hosur. This indicates strong potential for the state and the region. Thus, the development of Electronics industry in Ponneri Node can be in tandem with the cluster in Sriperumbudur. The proposed node will be at an advantageous position to effectively exploit it's proximity with the well developed electronics cluster in Sriperumbudur.

- **Availability of skilled labour**

  Abundant workforce and supply base available in catchment. There are institutions including engineering colleges, polytechnics in Chennai that can provide sufficient skilled workforce to the region.

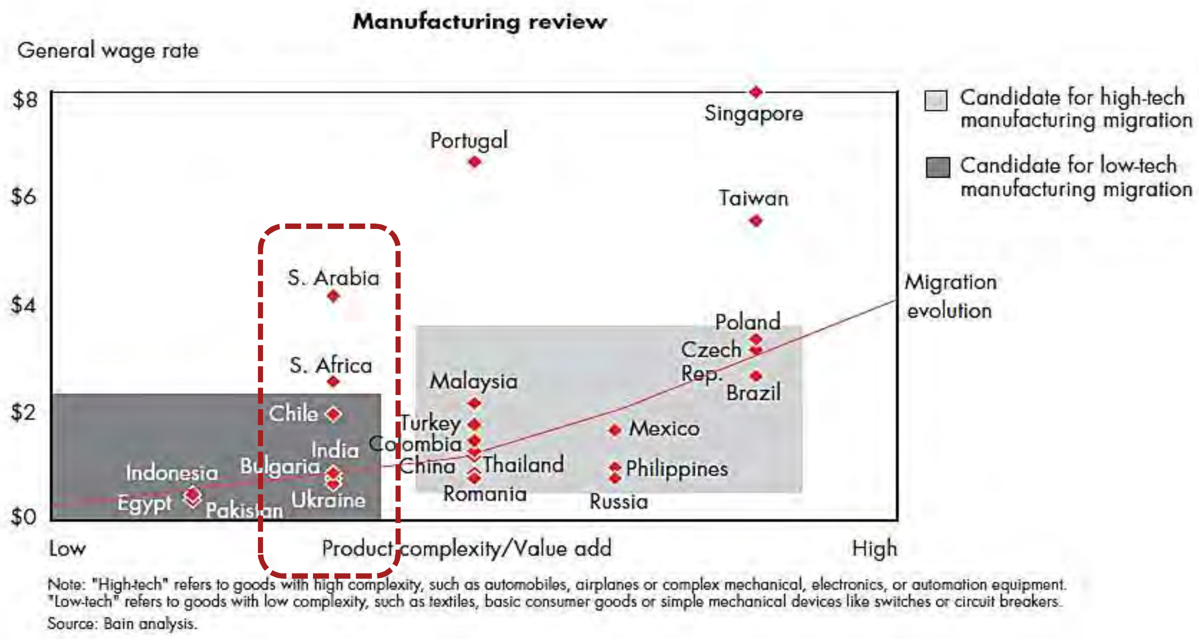
- **Strong Support by State Government**

  GoTN has formulated an Industrial Policy in 2014 which also covers this sector under its ambit. The incentives under this policy include capital subsidy, exemption from electricity tax, stamp duty concession and infrastructure subsidy for environment protection.

Key Challenges and Issues

While the CEO demand market in India is rapidly growing, the growth of domestic manufacturing is lagging far behind. Total market in 2015 is expected to be 64.85 USD billion, while domestic manufacturing in 2015 is expected to be USD 41 billion, which makes the demand supply gap USD 23.84 billion[36]. For large scale investment in high technology engineering investments, India will have to migrate from low tech-manufacturing segment as shown in the figure below.

[36] INDIAN ESDM MARKET - ANALYSIS OF OPPORTUNITY AND GROWTH PLAN, An IESA - Frost & Sullivan Report



Source: Making move to low -cost countries, Bain & Company, 2005

Currently. India depends largely on imports in this sector. The imported value of CEO in 2012 recorded USD 27,362 million and trade deficit was USD 19,623 million. Hence it is critical that key challenges hampering the growth of Electronics Manufacturing in India be addressed.

In terms of export, India's share in global exports of CEO is only 0.4%. 27% of exports are computers and peripheral equipment, and 34% is communication equipment.

Figure 5.38: Trade deficit of CEO import/export, Source: ASI

Cost disadvantage against import of final profucts	Difficulties in just-in-time supply

Figure 5.39: Key challenges hampering the CEO Market in India

- **Cost disadvantage against import of final products**

Infrastructure disabilities cause cost disadvantages in terms of manufacturing in India. Impact of disabilities on cost structure is show in the table below. Major disability factors arise from lack of eco-system for component supply base, low labour productivity and higher power costs in India.

Impact of Disabilities on Cost Structure, % (Manufacturing in India vs in China)

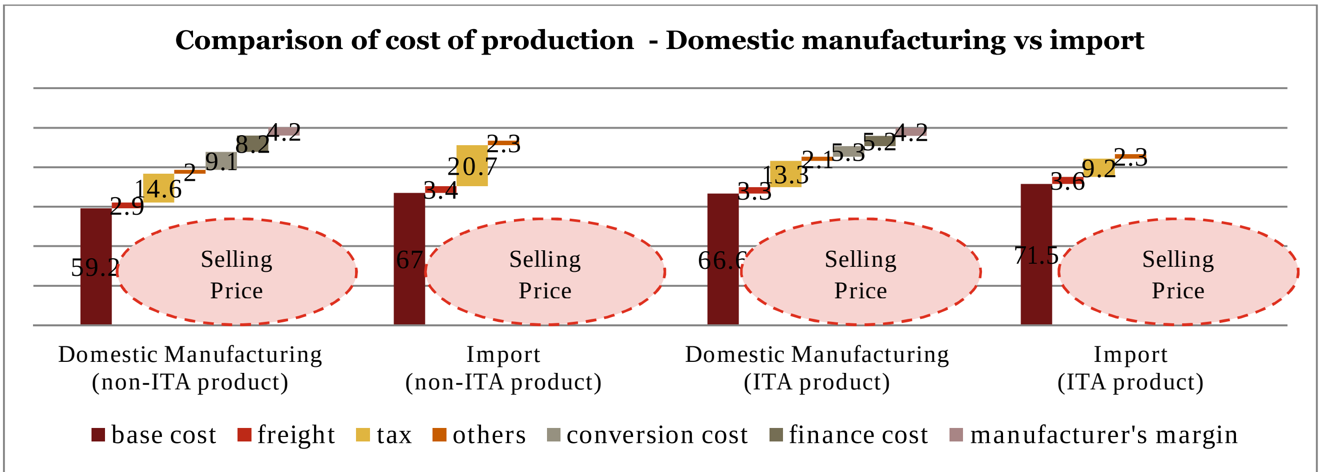
Note: Assume power costs contribute to 5% of overall costs. Assume other overhead costs are same between India and China

Table 5.5: Impact of Disabilities on Cost Structure

Cost Account	India	China	Disability Factors in India
Raw Material Cost	85 (+12.5%)	85	• Landed cost for raw material procurement due to absence of component supply base. (Excise Duty: 12.5% is imposed in case of domestic procurement.) • High finance cost due to high interest rate for the purpose of raw material inventory cost
Raw Material Freight Costs	3	1.2	
Labour	2	2	• Similar labour costs to China, due to lower wages in India offset by lower productivity
Power and Overheads	10	7	• High conversion cost due to high power costs and uncertain supply
Total Cost	**100 (+12.5%)**	**95.2**	**~5% (17.3%) cost differential**

Source: Interviews, DIT Task Force Study, Booz & Company analysis

It has been found that due to the above stated cost disabilities of domestic manufacturing, import of the final products are more cost advantageous than domestic manufacturing. Cost disadvantage becomes even more significant in case of ITA (Information Technology Agreement) products, because BCD (Basic Custom Duty) is Nil on ITA products as per international agreement. Following chart shows the indicative computation of domestic manufacturing and import finished products of both ITA product and non-ITA product. After normalizing, domestic selling price is 100, whereas selling imported non-ITA production is calculated as 93.4 in case of non ITA product. Also selling price of imported final products of ITA product calculated as 86.6. Thus the import advantage of finished products is a major hindrance to development of CEO manufacturing in India.



Source: Indian Electronics System Design and Manufacturing (ESDM) Disability Identification Study

Figure 5.40: Comparison of production cost

- **Difficulties in Just in time Supply**

'Just in time' supply is crucial in electronics industry for both domestic sales and export. The time span of model change of this industry is short. In the case in personal computer, the model of products frequently changes in several months. Also, relationships between sellers and manufacturers are not necessarily stable in this industry. Therefore, the market is generally very competitive. However, due to inadequate infrastructure such as bad roads, higher turn- around time of ports and railways, the delivery of goods take more time in India than in other developed counties.

Impact of delay in supply

Case 1:

In late summer 2004 Apple Computer Inc. had to delay the launch of its new iMac due to the delay of the G5 chips (a core component) from IBM. This delay meant Apple Computer Inc. missed at least part of the coming-back-to school sales with an estimated $32 million loss in the US.

Case 2:

A 72-day shutdown of LG Electronics' Changwon manufacturing plant in 1989 resulted in a $750 million loss because of the disruption to their domestic and global distribution.

Source: Supply Chain Strategy for the Consumer Electronics Industry, Wipro

Benchmarking against Global Competition

Cluster development

As discussed above, in India Electronics manufacturing suffers from several factors which impact its competitiveness. The major ones relate to high cost of power, logistic, transaction cost (tax and custom duty structure) etc. The Industry cluster concept is a means for overcoming these disadvantages, with the Central Government promoting cluster development through various incentive schemes.

Strong support of establishment of High Tech Parks helps cluster development. Below are examples of ensured infrastructure and initiatives of high tech parks in other counties. Most of them are yet to be implemented in India. These hard and soft infrastructure need to be developed as part of cluster development initiatives.

Infrastructure	IT facilities	R&D/Skill development	Facilities for employees
•Planned Parking area •Ensured power supply •Sewage treatment •Organized internal road •Public transportation •Testing facilities	•Common information service system •One stop online custom clearance system	•Hosting educational seminars •Training through Industry-Academia Collaboration •Innovative product awards •Adjacent Academic and Research Institutions	•Employee clinics •Cultural and sports events •Safety management, fire fighting •Business Centre

Case studies – Success factors in select leading countries in CEO sector

TAIWAN

Although CEO sector in India is growing, India is still way behind major countries in the production of CEO. It is important for India to study the key success factors from global sector leaders. Given the fact CEO sector is largely dominated by Taiwanese products, key success factors of Taiwan CEO sector are examined and listed below.

Strategic position as key suppliers of components to the global supply chain

Strong Government support for establishment of High Tech Park

Organized quality standard control

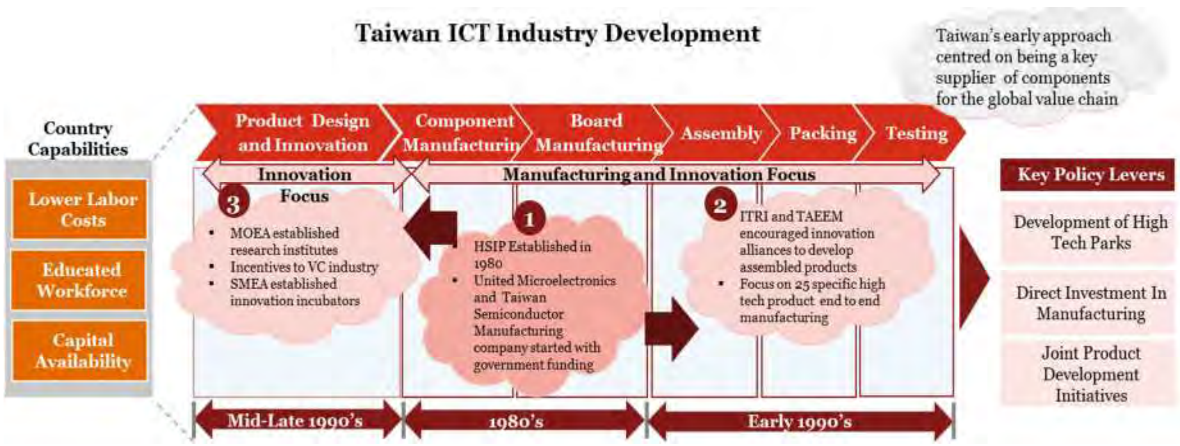
Dedicated R&D facilities

- **Strategic suppliers to global players**

  The Taiwanese have built up strategic suppliers of international firms rather than promoting expensive vertically integrated national big players. It focused on the narrower set of capabilities demanded by the large branded MNC.

- **Strong Government support for establishment of High Tech Park**

  Hsinchu Industrial Park governed by Hsinchu Science Park Bureau (HSPB), Ministry of Science and Technology, is mandated to provide excellent infrastructure and facilities. Also it conducts various activities for industry promotion. It comprises six divisions: Planning, Investment, Environmental Protection and Safety, Business, Construction Management, and Land Development, as well as four offices charged with duties related to secretarial affairs, personnel, budget/accounting/statistics and civil service ethics.



- **Organized quality standard control**

  The Standards Division of the Bureau of Standards, Metrology and Inspection (BSMI) is responsible for drafting standards policies and regulations. This division consists of four sections. The First Section is responsible for general standardization activities including the drafting of regulations, guidance, harmonization planning, administration of the CNS mark, compilation of the standards gazette, and promotion of national standards. The remaining three sections are each responsible for standards in specific industry sectors.

Key strengths, Issues and other factors of consideration

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Ponneri emerges as a top destination CEO sector can be broadly classified around the three main areas:

Economic enhancers

- Development of quality integrated industrial infrastructure
- Easy acess to consumption markets and gateways to markets
- Reliable availability of FoPs

Value enhancers

- Technological readiness and upgradation
- Researc h and development
- Cluster development

Administrative enhancers

- IPR enforcment
- Techonolgoy infrastrucure

Specific issues identified by electronics units located in close proximity to the proposed node in Ponneri district and implications to be considered in design of the industrial node are summarized below;

Table 5.6: Key recommendation for the CEO sector

Components		Issues	Factors of strength/consideration
Economic enhancers			
Connectivity	Road	• Some parts are precision parts and get damaged due to bad condition of road, • Difficulty in just in time supply • Connectivity to Airport	• External connectivity to the node planned via Northern Port Access Road. • Connectivity to existing airport to be achieved through the Outer Ring Road and
	Rail	• Rail transport has no guaranteed delivery time by Indian Railways.	• Dedicated Freight Corridor may be considered as a CBIC priority project. The operation of DFC needs to be efficient with delivery ensured in time bound manner.
Power		• High tech manufacturing needs uninterrupted and assured power supply	• To ensure that the planned power generation projects come up in time. • Transmission and Distribution network within the node has been planned as part of the master plan preparation.
Logistic		• Need improved ports connectivity, road network and warehousing capabilities to build capacity for future • Warehousing and cargo handling facilities	• Invite logistics firms as synergistic and optional tenants to set-up base in ear-marked clusters within the node • The new airport planned at Sriperumbudur

Components	Issues	Factors of strength/consideration
	at Airports	needs to be state of the art which should accommodate the specific needs of this sectors' international air cargo transportation requirements.
Urban Transport	• Inadequate public transportation to Ponneri Node for commuting	• Extension of Chennai Metro Rail and upgradation of suburban rail network on the Chennai-Gummidipoondi line has been suggested
Value enhancers		
R&D promotion	• Products need to match global trend	• R&D activities promotion through fiscal incentives to make it inclusive and to ensure participation from small time players. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged for exchange of ideas and sharing of infrastructure.
Cluster development/Technology infrastructure	• Higher landed cost for raw material procurement due to absence of component supply base. • Need centralized testing and certification agencies and additional support	• High tech park with global standards may be established
Hi tech manufacturing skill	• Requires adequately trained manpower for hi-tech manufacturing	• Training institutes for on-demand training be established • Establish with foreign investment and partnerships
Administrative enhancers		
IPR regime	• Strong IPR protection is required to encourage R&D activities.	• Promote IPR awareness by seminars or workshops on IPR
Quality control	• It is mandatory to obtain BIS certification to manufacture.	• GoTN needs to ensure smooth application process

5.3. Implementation of recommendations

In order to build a comprehensive eco- system for the success of proposed industries within the Ponneri IN, while economic enhancers (critical infrastructure projects in rail/ road etc) may be taken up by the State/ Centre depending on the jurisdiction of the project, other soft components under Value enhancers suggested in the above sections may be developed by the proposed Node Authority through self or by contracting to third party, some others may be developed by formation of Industries Association.

Funding and incentives for some of the proposed value enhancing facilities may be availed through existing Government Support and private participation by following means:

- Technology acquisition and Development Fund: for patent (IPR), environment friendly machines and equipment, environment audit, waste treatment practices
- Central Govt. schemes: for testing facilities, skill development within the NIMZ
- PPP schemes for skill development
- Central Govt. funding for establishment of ITI within NIMZ
- VGF for specialized polytechnics for relevant industry verticals
- Incentives as per auto mobile and auto sector policy of Tamil Nadu for improving skilled personnel and industry labour
- ‘Training incentives’ to be introduced by Government for Auto manufacturers.
- Tamil Nadu hosts large number of famous engineering colleges and institutions: IIT Madras, Anna University, Coimbatore Institute of Technology, Vellore Institute of Technology, etc. which provides a platform for industries to develop relationship in building up the workforce.

6. Land Use Planning for Ponneri Node

6.1. Review of Existing Development Plan

In order to carry out the planning exercise, it is essential to review the existing development plan of the node area. According to DTCP, there is no existing development plan prepared for the Ponneri node area. However, JICA study Team (JST) has conducted several field visits to understand the existing land-use pattern. The JST also reviewed the DPR on Proposed Plastic Park to integrate it with the proposed Master Plan.

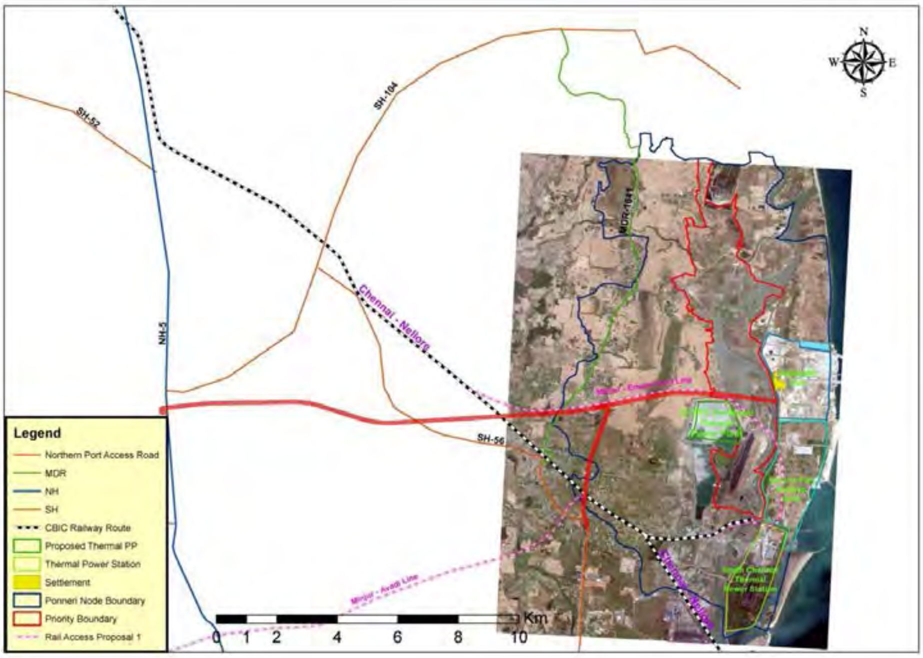
6.1.1. Existing Infrastructure Projects

The planned Northern Port Access Road will connect Kattupalli and Ennore Ports to the National Highway No.5 (NH-5). An extension from the NPAR will also be built to connect to the existing State Highway (SH-56). The planned Minjur-Ennore Port railway line is being built to connect to the existing Chennai – Nellore line and the proposed Minjur – Avadi line. The following table and figure show existing infrastructure projects in the node area and planned alignments of those projects.

Table 6.1: List of Existing Infrastructure Projects in Ponneri Area

Category	Project Name	Specification	Remarks
Road	Northern Port Access Road	Proposed length is around 21 km & 4.5 km respectively.	202 ha (500 Acres) (Under the process for land acquisition)
	Extension of State Highway No.56	—	—
Railway	Minjur-Avadi Line	—	—
	Northern Port Rail Link	Proposed length is around 12 km	Approx. 80 acres (DPR in process)

Source: JICA Study Team



Source: JICA Study Team

Figure 6.1: Existing Infrastructure Projects in Ponneri Node

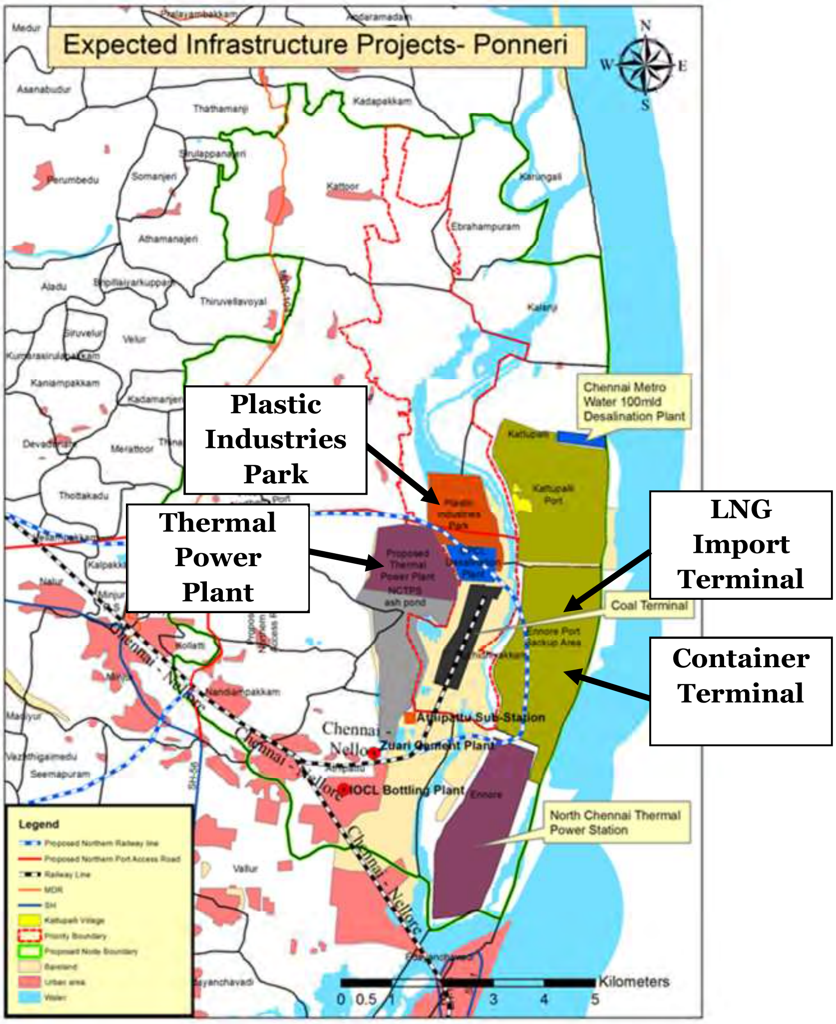
6.1.2. Existing Industrial Projects

A new plastic industries park and a new thermal power plant are proposed near the existing coal terminal. The outline and locations are shown in the following table and figure respectively.

Table 6.2: List of Existing Industrial Projects in Ponneri Node

Proposed Project	Remarks
Plastic Park	124 ha (306 acres) proposed by TIDCO
Power Plant	Capacity (660MW x 2), 500 acres, Cost: 9,600 Crores, operations will be started by 2015-16.
Container Terminal in Kamarajar Port	2 container terminals are proposed inside Kamarajar Port.
LNG Import Termina In Kamarajar Portl	Rs. 5,170 corores, 5 million tonnes per year capacity is proposed.

Source: TIDCO & JICA Study Team



Source: TIDCO & JICA Study Team

Figure 6.2: Existing/ Proposed Industrial Projects in Ponneri Node

6.2. Development Framework

A privately operated industrial park is planned to be developed by Sumitomo Corporation and Mahindra World City Developers at Ponneri area in the short term. The development needs of the area for further industry promotion is high for the short term as a private industrial park and also for the medium and long term as Ponneri Node.

Especially, it is critical to have connectivity from Ponneri Area to NH5, such as Northern Port Access Road, and early implementation of connectivity infrastructure will be the key for the success for the node development and also other industrial parks around the area.

6.2.1. Land for Infrastructure Development

The target year for completion of the development of the Priority Area is year 2023. The development of the other areas in the node is to be started from 2024; the completion year for that portion is yet to be decided officially. Taking account into appropriate development scales and discussion with nodal agencies, JICA Study Team proposes to develop the node in three phases; Phase-1 (2016-2019) and Phase-2 (2020-2024) for the Priority Area, and Phase-3 (2025-) for the remaining areas.

Based on industrial analysis for Ponneri Node by JICA Study Team, the major future industries are to be traditionally strong sectors including “Auto”, “Chemical & Petrochemicals“, “Machinery”, “Computer, Electronic and Optical products”, “Metallurgy”, “Textiles & Apparels”, and other potential industries. The estimated land demand of those industries was examined and the following scenario was assumed to be the effective scenario for necessary infrastructure development.

Table 6.3: Land for Infrastructure Development on Ponneri Node

				(unit: acre)
		Phase-1 (2016-2019)	Phase-2 (2020-2024)	Phase-3 (2025-)
Traditionally Strong Sector	Auto	388	1600	3613
	Chemical & Petrochemicals	71	290	656
	Machinery	173	713	1610
	Computer, electronic and optical product	49	203	458
	Metallurgy	33	137	310
	Textiles & Apparels	74	305	689
	(Sub-total)	788	3247	7336
Potential Sector	Medical equipment	66	271	611
	Electrical Machinery	66	271	611
	Pharmaceuticals	66	271	611
	(Sub-total)	**197**	**812**	**1834**
Total		985	4059	9169

Source: JICA Study Team

6.2.2. Future Population

The future population of the node, consisting of the working population and residential population was projected according to the land demand shown in Section 6.2.1 as well as the following conditions.

- The estimation is based on the population projection which JICA Study Team carried out in the Part-A study.
- Residential areas should be developed only in phase-3; a final total of 400,000 residents are expected to live in Ponneri taking into account population growth and distribution analysis of future population.

- There will be workers who will live outside the node; their families will live in the surrounding sub-districts. Their population is estimated by subtracting the number of workers living within the node from the total number of workers.

As a result, the working population is projected as 1,150,311 people with 400,000 people as the residential population of Ponneri Node in 2033.

Table 6.4: Population Framework

	Phase-1	Phase-2	Phase-3
Working Population	*Phase-1* 2016-19	*Phase-2* 2020-24	*Phase-3* 2025 onwards
Residential Population	*90,665*	*373,475*	*888,074*

Source: JICA Study Team

6.3. Land Use Plan

6.3.1. Spatial Development Concept

TIDCO had earlier carried out a feasibility study for the Ennore SEZ which is partially located in the priority area of the node. However the project wasn't developed. Subsequent to this study, TIDCO planned to develop a plastic industries park. Taking into consideration both this plan and other projects in the surrounding area, JICA Study Team has prepared a new layout plan for Ponneri Node according to the following development concepts.

Road Network

a. The Northern Port Access Road and Kattupalli Port Access Road (running south to north) form the trunk road network, and will have serve as the connecting links from/to the external area.
b. Extending the connectivity with Chennai Metropolitan Area through NH-5 or SH-56 to the south is also planned.

Logistics

c. The logistics sector (i.e. transport of freight) will be improved by developing a new railway access line to Ponneri Node.

Grid Pattern for the Developable Area

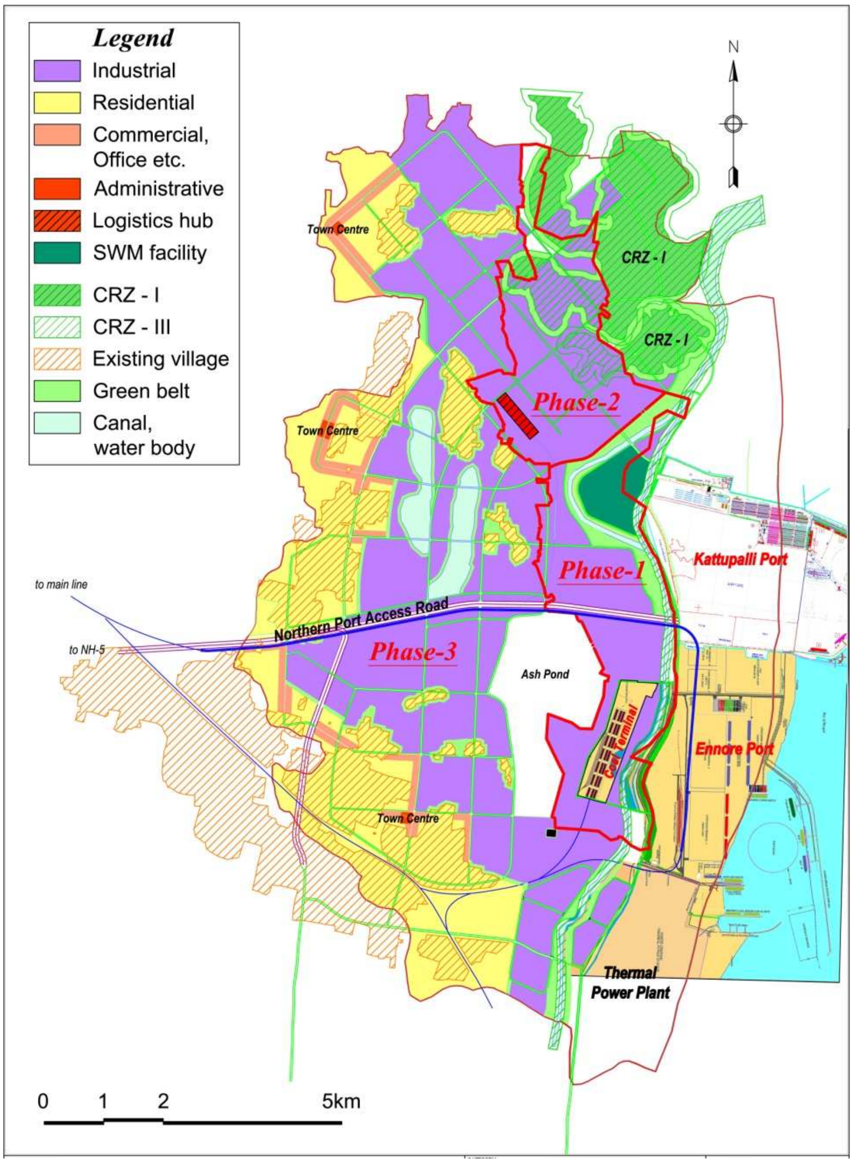
d. The whole area will be framed in a grid pattern of roads forming large blocks of 500 m-1 km size.

Residential Area Development

e. Residential areas to support 400,000 people by 2033 will be developed in phase-3 of Ponneri Node.

Environmental Reservation

f. The canal will be preserved with a buffer zone.
g. The northern area of the node includes portions covered by Coastal Regulation Zone (CRZ)-I. The appropriate buffer zone should be allocated for the CRZ-I areas according to the existing CRZ plan approved by the Environment Department.
h. Highly hydrophilic parkland with a clean and green environment will be designed by allocation of 100m wide buffer zone along the stream in Ponneri Node.



Source: JICA Study Team

Figure 6.3: Layout plan of Ponneri Node

6.3.2. Land Use and Phasing Plan

Based on the development framework and the development concepts above, the required area for each land use category is estimated as shown in the following table.

Table 6.5: Estimation of Developable Area for Ponneri Node (Priority Area)

(Acre)

	Total
Industrial area	9,652
Residential area	2,604
Existing settlement	2,186
Infrastructure(road & plant)	1,325
Water body & green area	1,610
Others	1,871
Total	**19,248**
Existing Port area	2,718
Grand Total	**21,966**

Source: JICA Study TeamDevelopment Plan for Residential Area

The development plan for the residential area is proposed according to "NATIONAL BUILDING CODE OF INDIA (NBCoI) 2005, GoI". The specifications are shown in the following table.

Table 6.6: Specification of Housing Building

	content	amount
Planed Population	➢ Two clusters for residences ➢ 200,000 persons per cluster	400,000 (persons)
Household Members (HM)	➢ National Family health survey (NFHS) 2007	3.5 (persons/family)
Number of families (2033)	➢ (Population of Ponneri)/3.5 (HM)	114,286(a) (families)
Specification of residence	➢ Plot area of one house	38.82 (m^2)
	➢ 8 units form one floor of house	310.56 (m^2)
	➢ Common space per one floor	61.21 (m^2)
	➢ Area of one floor (coverage)	371.77 (m^2)
	➢ Area of three floors	1,115.31 (m^2)
	➢ Number of buildings =114,286(a) / 8(one floor)*3(three stories)	4,762 (building)
	➢ Area of one building <u>Coverage = 35%,Floor volume = 100%</u> (National Building Code of India 9.6.2 Table 4 No.iv)	1,062.2 (m^2)
	➢ Total area volume	5,058,095.24 (m^2)
		505.81 (ha)
	➢ Open Space (15%)	75.87 (ha)
	➢ District road (10%)	58.17 (ha)
Total		639.85 (ha)

Source: JICA Study Team

In addition to the residential area above, the number of and required area for necessary public facilities (e.g. educational facilities, health centres, offices, civic centre etc.) are estimated based on the residential population and "National Building Code of India". The estimated results indicate that the minimum requirement is a total of 414 ha for public facilities. According to the Indian standard, accommodations (hotel, service apartment, guest house etc.) are not considered, however these facilities are also required to accommodate short stay investors. Additionally, development of advanced educational facility such as international school and general hospital serving high quality medical care are recommended to make this area more livable and attractive. The required public facilities in Japanese standard are listed below:

- Administrative facility — Detached office of the municipal office
- Convention facility — Assembly hall, Civic centre
- Cultural facility — Library, Museum, Art Museum
- Educational facility — Kinder garden, Primary school, Junior high school, High school, Vocational training school, College, University
- Welfare facility — Nursery centre, Day-care centre
- Healthcare facility — Medical clinic, Health Centre, General hospital
- Security service facility — Police office, Fire station
- Telecommunication — Post office, Telecom centre
- Commercial facility — Supermarket, Shopping mall
- Others — Bank, Hotel, Research centre, Sport stadium(Play ground)

6.3.3. Implementation Plan (Development Schedule)

Ponneri Node development will include pre-construction work, as well as land road network, railway access line, water supply & treatment facilities, electric supply facilities, solid waste management facilities, and public facilities. The following implementation plan is formulated based on the proposed phasing plan and identified work items and volumes.

Table 6.7: Implementation Plan

Phase	Stage	Work Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1st		Approval of Development Plan																				
		EIA																				
		Selection of Contractor																				
		Detailed Design																				
		Construction																				
2nd		EIA																				
		Selection of Contractor																				
		Detailed Design																				
		Construction																				
3rd	I	Land Acquisition																				
		EIA																				
		Selection of Contractor																				
		Detailed Design																				
		Construction																				
	II	Land Acquisition																				
		EIA																				
		Selection of Contractor																				
		Detailed Design																				
		Construction																				
	III	Land Acquisition																				
		EIA																				
		Selection of Contractor																				
		Detailed Design																				
		Construction																				

Source: JICA Study Team

6.4. Cost Estimate

6.4.1. Land Development

Land development for Ponneri Node will require land grading works and transportation of additional soil to be obtained from outside the node, since Ponneri Node is located in an area of low elevation. This means the land development cost will be relatively high compared to areas of high elevation such as Tumkur. The total land development cost is estimated as **5633 crore INR at escalated prices.** The cost in each phase is shown below.

Table 6.8: Cost Estimate of Land Development (Ponneri Node)

Item	Upto FY 19	FY 20-24	FY 25 onwards
Land development cost	1,735	2066	1,833

Note: Unit rate of land grading works are estimated through interview to local contoractors as follows: 1)Excavation works: 120INR/cu.m, 2) Soil Transportation & embankment: 190/cu.m, 3) Land filling transported from outside: 1,000/cu.m
Source: JICA Study Team

6.4.2. Public Facility Development

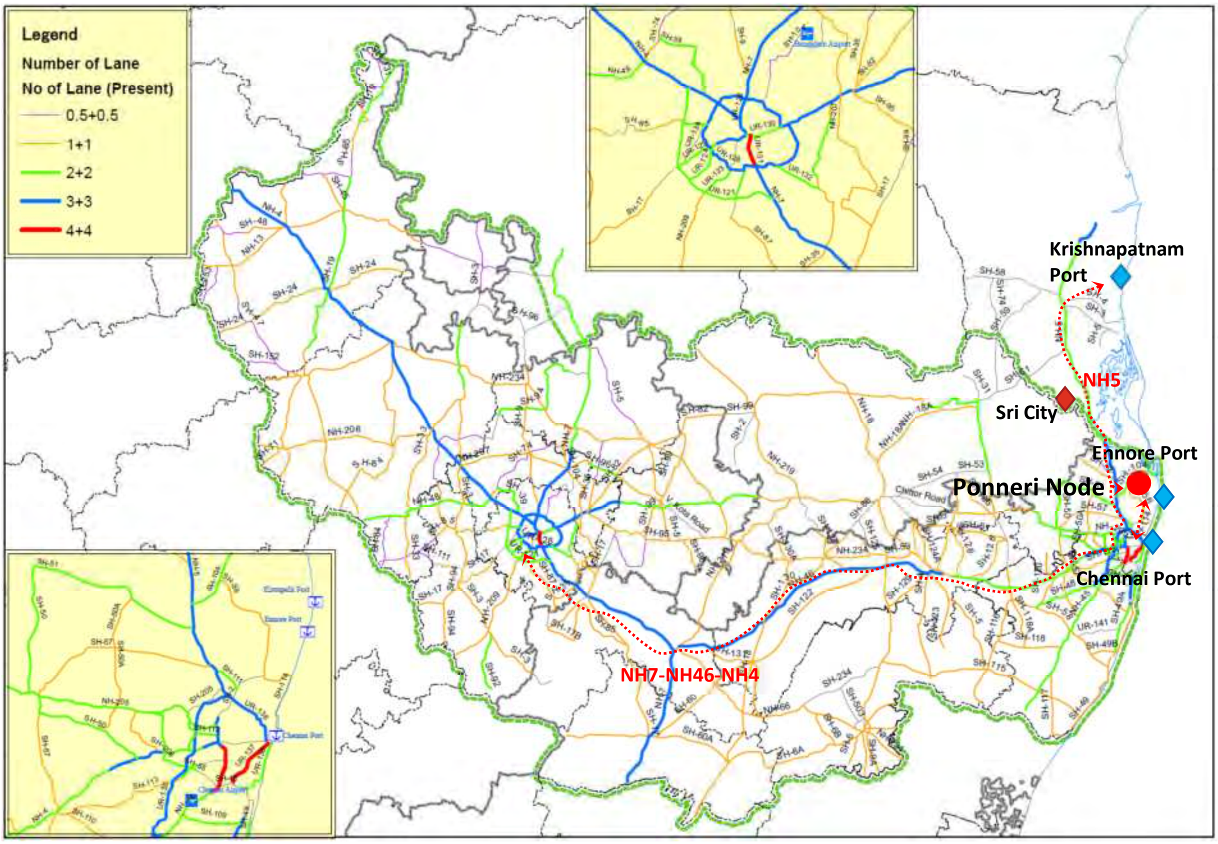
It is imperative that the plan accommodates public facilities like hospital, commercial centres etc. However, interactions with the Government suggest that the node management entity will be involved only in the land development subsequent to which development of industrial, commercial and residential establishments will have to be taken up by different players. Hence, the cost of the same has not been considered. The node management entity however, will be responsible for maintenance of green area within the node.

7. Infrastructure Development Plan

7.1. Roads and Public Transport

7.1.1. Sector Overview

Major industrial linkage to/from Ponneri node will be developed with Chennai, Bengaluru, Chennai Port, Ennore Port, Krishnapatnam Port and Sri City and corresponding roads to the linkages are delineated as shown in Figure 7.1. Present lane number of the roads on linkages is four or six.



Source: JICA Study Team

Figure 7.1: Number of Lanes on Major External Linkage (Ponneri)

Linear distances from Ponneri nodes to major destinations which are related to industrial activities of Ponneri nodes are summarized in table 7.1.

Table 7.1: Distance from Nodes

From	Ponneri			
/Linear Distance(km)	Chennai	28	Ennore Port	7
	Bengaluru	300	Krishnapatnam Port	113
	Chennai Port	20	Sri City	47

Source: JICA Study Team

Land demands and population demands of Ponneri Node in three phases are forecasted by the JICA Study Team as shown in Table 6.5 and Table 7.2.

Table 7.2: Population Demand Forecast in Ponneri Node

	Phase-1	Phase-2
Working Population	88,410	226,276
Residential Population	0	0

Source: JICA Study Team

"DPR of Plastic Industries Park in Thiruvallur District, Tamil Nadu, December 2012" was prepared by Tamil Nadu Industrial Development Corporation. This project is a part of Ponneri node and outlines of ongoing external link projects are as follows:

Direct Connectivity from NH5: A direct connectivity from Thachur on NH-5 to Ennore Port and Kattupalli Port (Northern Port Access Road) is being developed by Government of Tamil Nadu, which is likely to pass south of the project site.*

Chennai Outer Ring Road (ORR): Ending at Minjur (7 km west of the project site). Chennai ORR covers a length of 62.3 km around the Chennai Metropolitan Area (CMA). The project will connect NH-45 (Chennai – Tiruchirappalli) starting at Vandalur to the TPP road, ending at Minjur. The alignment crosses NH-4 (Chennai – Bangalore – Pune), NH-205 (Chennai –Tirupati) and NH-5 (Chennai - Kolkata). Possibility of realigning the Northern Port Access Road with the ORR at Minjur is being examined.

The above projects are likely to be in operation by the year 2016 and will play a significant role in the development of the proposed Plastic Industries Park.

As a reference of internal road development plan of Ponneri node development plan, proposed internal road development plan of the DPR is introduced.

Development issues are selected with consideration of development vision discussed in Chapter 5.3 and envisioned future road and traffic conditions of Ponneri node, such as public transport promotion, smooth transit in node, segregation of cargo traffic, and environmental conservation. Node development plan is examined based on those issues.

7.1.2. Demand Supply Analysis for External Node Infrastructures

General

Traffic demand from/to node is predicted to examine capacity of node access roads and rail. Commuter traffic and cargo traffic are subjected to prediction of the traffic demand. Prediction of the traffic demand and capacity examination are made for each phases.

Methodology

Commuter Traffic Demand

Traffic prediction method for the commuter traffic is explained below:

① Distribute estimated node employee (except employee living in node) to neighboring Sub-District

② Identification of Node Access Point

③ Grouping of Sub-Districts by access points and estimation of total employee by access points

④ Examination of work time zones and peak hour total employee number by access point

⑤ Assumption of type and share of commuting transport modes by access point

⑥ Selection of traffic parameters (occupancy ratio, pcu convert factors, etc.)

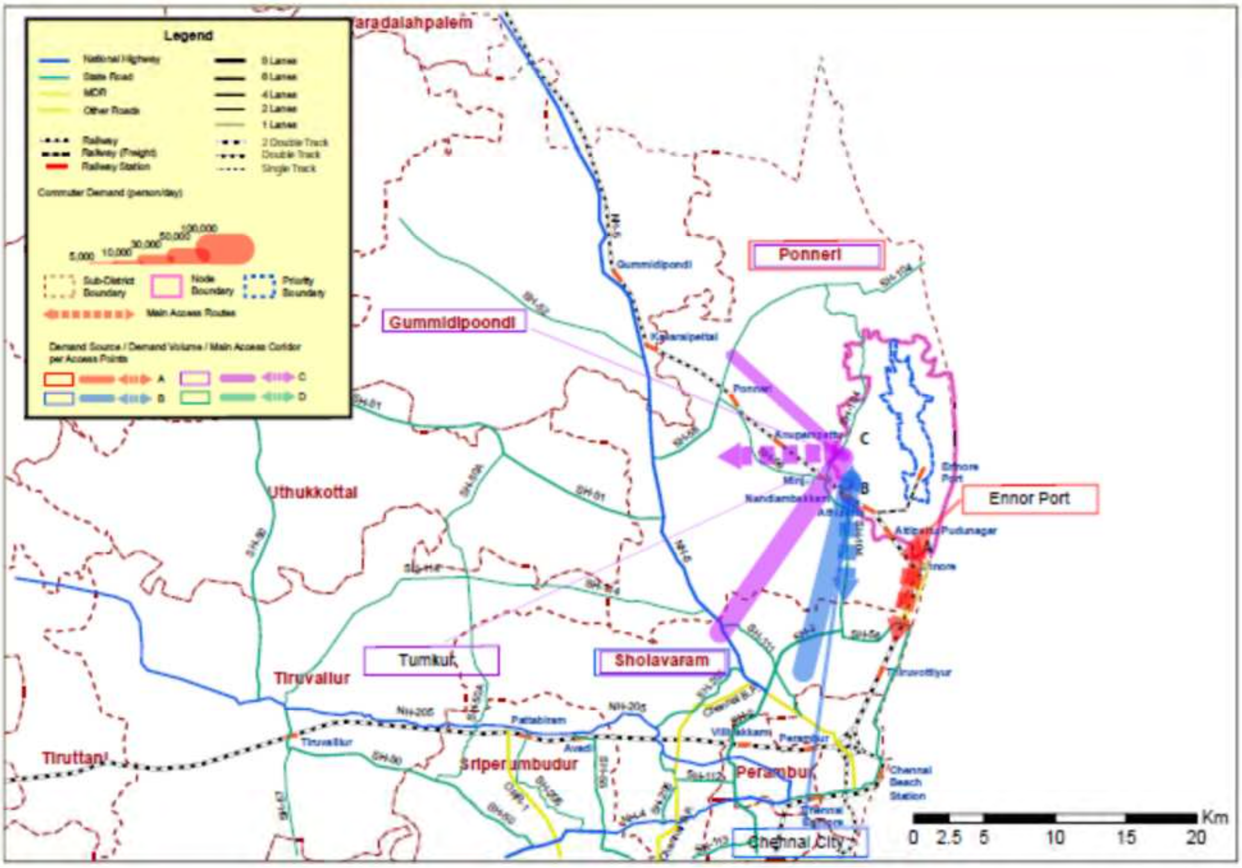
⑦ Estimation of peak hour pcu traffic volume by traffic mode and access points

Source: JICA Study Team

Figure 7.2: Work Flow for Commuter Traffic Demand Estimate

① Distribute estimated node employee （except employee living in node） to neighboring Sub-District:

Estimated node employee in foregoing chapter（except employee living in node） is distributed to neighbouring sub-district in considering of urbanization trend and population frame of sub-districts. Sub-district within about 50km from node centre is selected for the distribution. Urbanization trend and the distribution result to sub-district are shown in Figure 7.3 and Table 7.3, respectively.



Source: JICA Study Team

Figure 7.3: Identification of Node Access Point

② Grouping of sub-districts by access points and estimation of total employee by access points

As hinterlands of each access points, sub-district are categorized into each access points and total employee by access points are estimated as shown in Table 7.3. Some sub-districts distribute employee to two access points due to positional property.

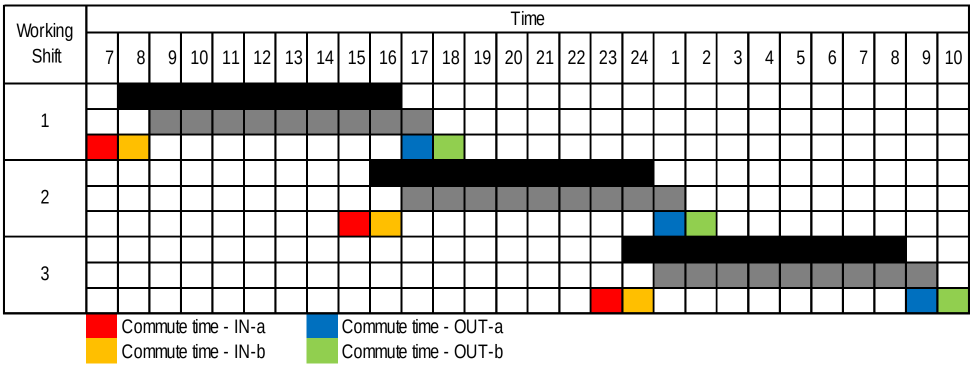
Table 7.3: Grouping of Node Employee by Access Points

Sub-District	Year								
	2019			2024			2034		
	A	B	C	A	B	C	A	B	C
Ponneri	14,864		14,864	38,058		38,058	38,058		38,058
Gummidipoondi			726			1,858			1,858
Sholavaram		27,767	27,767		71,094	71,094		71,094	71,094
Total	14,864	27,767	43,357	38,058	71,094	111,010	38,058	71,094	111,010
	85,987			220,162			220,162		

Source: JICA Study Team

③ Examination of work time zones and peak hour total employee number by access point

Three work time zones in a day is assumed to introduce in node and hourly work time zones in consideration of commuting time dispersion are proposed as shown in Figure 7.4. Peak hour total employee number is estimated based on the work time zones for each access points as shown in Table 7.4.



Source: JICA Study Team

Figure 7.4: Proposed Work Time Zones

Table 7.4: Number of Node Employee in Peak Hour

Year								
2019			2024			2034		
A	B	C	A	B	C	A	B	C
2,477	4,628	7,226	6,343	11,849	18,502	6,343	11,849	18,502

Source: JICA Study Team

④ Assumption of type and share of commuting transport modes by access point

Motor-cycle, Car(including para-transit), and Bus are selected as commuting transport mode and share of 20%, 20%, 60% are assumed as basic share of commuting transports. Mass Transit System, such as BRT, LRT, and Railway is selected, in case that traffic demand exceeds capacity of road transports.

⑤ Selection of traffic parameters (occupancy ratio, pcu convert factors, etc.)

Traffic parameters, such as occupancy ratio and pcu convert factors are selected in consideration of practical example in India as shown in Table 7.5.

Table 7.5: Traffic Parameters

Vehicle Type	Occupancy Ratio	PCU Convert Factor
MC	1.2	0.5
Car	2.0	1.0
Bus	60	3.0
BRT	60	-
LRT	1,500	-
Railway	2,000	-

Source: JICA Study Team

⑥ Estimation of peak hour pcu traffic volume by traffic mode and access points

Peak hour pcu commuter traffic volume are estimated based on peak hour commuter number, commuting transport mode, share of commuting transport mode, and traffic parameter for each access points.

Freight Traffic Demand

Traffic prediction method for the cargo traffic is explained below:

① Identification of input materials and output products by industry, Assumption of origins and destinations, packing type, and transport mode for input materials and output products

② Estimation of input materials and output products volumes based on area of each industries and basic unit of area-output

③ Estimation of input materials and output products by origin and destination, access points

④ Setting of peak hour ratio for cargo traffic and estimation of peak hour cargo traffic by access points

⑤ Selection of traffic parameters (average load by vehicle type, pcu convert factors, etc.)

⑥ Estimation of peak hour pcu traffic volume by traffic mode and access points

Source: JICA Study Team

Figure 7.5: Work Flow for Freight Traffic Demand Estimate

① Identification of input materials and output products by industry, Assumption of origins and destinations, packing type, and transport mode for input materials and output products

Kinds of Input materials and output products are identified for each industry in node. Origin and destinations, type of cargo package, and mode of cargo transport are assumed based on practical example in India. Detailed explanation is mentioned in Section 6.4.2 Estimation of Input Materials and Output Products.

② Estimation of input materials and output products volumes based on area of each industries and basic unit of area-output

Volume of input materials and output products are estimated based on area of each industries and basic unit between area and output. Detailed explanation is mentioned in Section 6.4.2 Estimation of Input Materials and Output Products.

③ Estimation of input materials and output products by origin and destination, access points

Cargo traffics by road transport are totalized per access points with consideration of origin and destination. Result of estimation per access points is shown in Table 7.6.

Table 7.6: Annual Cargo Volume by Access Point

Categories	Origin / Destination	Access Point	Year			
			2019	2024	2029	2034
INBOUND CONTAINER	-	-	-	-	-	-
OUTBOUND CONTAINER	Ennore Port	A	6,160	10,578	18,165	31,193
	Tumkur	C	576	990	1,699	2,918
EMPTY CONTAINER		A	17,671	30,345	52,107	89,477

Categories	Origin / Destination	Access Point	Year			
			2019	2024	2029	2034
INBOUND BULK	Ennore Port	A	76,263	130,958	224,878	386,156
OUTBOUND BULK	Local Chennai	B	213,136	365,993	628,475	1,079,205
	Chennai Airport	B	5,989	10,285	17,661	30,327

Source: JICA Study Team

④ Setting of peak hour ratio for cargo traffic and estimation of peak hour cargo traffic by access points

Peak hour cargo traffic volume per access points are estimated based on annual working days (260 days) and peak hour ratio (0.2) as shown in Table 7.7.

Table 7.7: Peak Hour Cargo Volume by Access Point

Categories	Unit	Year								
		2019			2024			2034		
		A	B	C	A	B	C	A	B	C
Container	TEU/hour	9	0	0	16	0	0	46	0	1
Bulk	ton/hour	15	42	0	25	72	0	74	213	0

Source: JICA Study Team

⑤ Selection of traffic parameters (average load by vehicle type, pcu convert factors, etc.)

Traffic parameters such as average load per vehicle type and pcu convert factors are selected in consideration of practical example in India as shown in Table 7.8.

Table 7.8: Traffic Parameters

Vehicle Type	Load Ratio	PCU Convert Factor
Truck	4 ton/vehicle	3.0
Trailer	2 TEU/vehicle	4.5

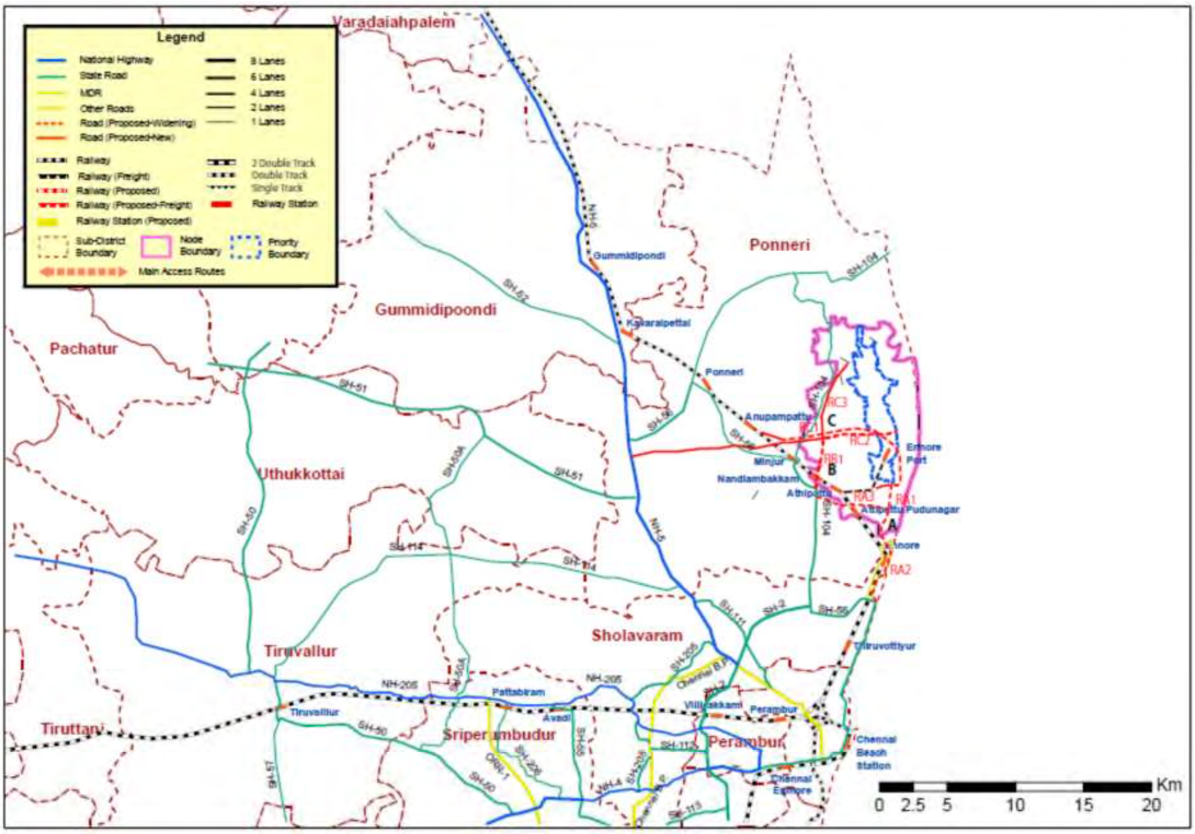
Source: JICA Study Team

⑥ Selection of traffic parameters (average load by vehicle type, pcu convert factors, etc.)

Peak hour pcu cargo traffic volume are estimated based on peak hour cargo volume, transport mode, share of cargo transport mode, and traffic parameter for each access points.

Assumed Access Infrastructure to Node

① Main access roads connecting between sub-districts which are provided node commuters and access points is selected from existing roads with proposed new roads as shown in Figure 7.6. RA1 to RA3 are access route for access point A, RB1 is access route for access point B, and RC1 to RC3 are access route for access point C.



Source: JICA Study Team

Figure 7.6: Access Roads to Ponneri Node by Access Points

② Road capacity of the main access roads is estimated as shown in Table 7.9. Following link capacity (DSV – LOS-B) of 1, 2, 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

Road capacity of one direction is applied for demand supply gap analysis in next section, since one direction of commuter traffic on road is dominant in peak hour. Peak hour traffic ratio is selected 10% based on practical example in India. As for share of traffic which is not related to node on access roads are assumed 25% in consideration of present road traffic conditions.

Table 7.9: Road Capacity of Main Access Roads

Access Point	Main Access Roads	Status	Number of Lanes	Road Capacity (pcu per direction)
A	RA1	Existing	2	17,500
	RA2	Existing	2	17,500
	RA3	Existing	2	17,500
B	RB1	Proposed	-	
C	RC1	Proposed	-	
	RC2	Proposed	-	
	RC3	Proposed	-	

Source: JICA Study Team

③ Railway capacity of main access route is set as shown in Table 7.10. As for share of passenger traffic which is not related to node on public transport is assumed 50% since utilization of existing commuter transport to Chennai is expected.

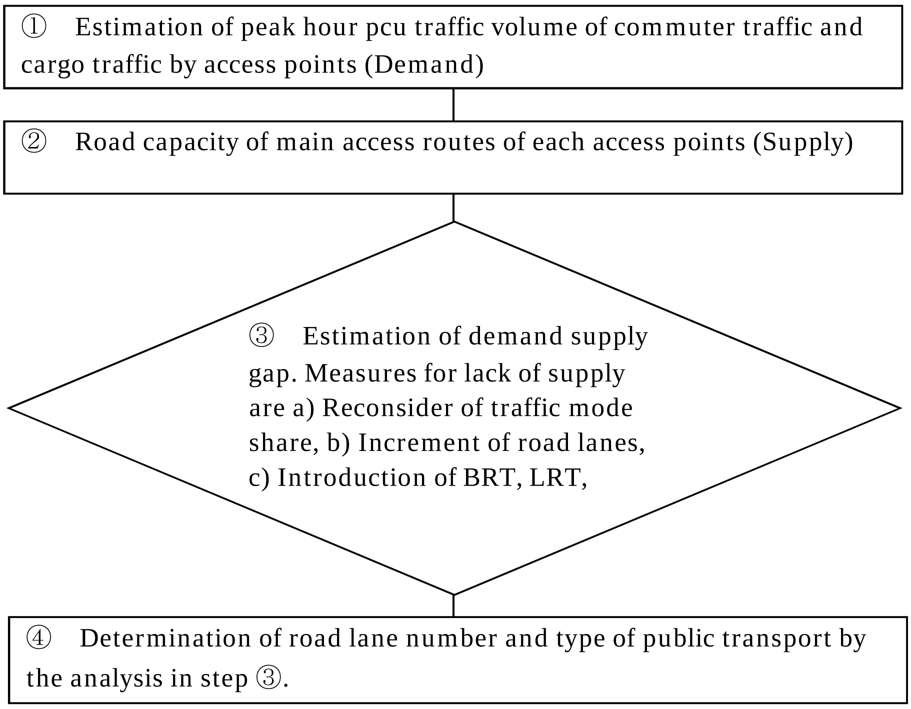
Table 7.10: Capacity and Cost of Public Transport

Type	Metro	LRT	Railway	Mono Rail AGT	BRT	BUS
PPHPD (Passengers per hour per direction)	- 60,000	- 30,000	- 30,000	- 15,000	- 8,000	- 6,000
Construction Cost (Million USD/km)	30-50 (Viaduct)	30-50	10-20	30-50	6-13	-

Source: JICA Study Team

Demand Supply Analysis

Based on traffic demands of each access point estimated in foregoing section, necessary capacity of road and selection of public transport are carried out in accordance with analysis flow shown in Figure 7.7.



Source: JICA Study Team

Figure 7.7: Work Flow for Demand Supply Analysis

Demand supply gap of main access routes of each access points is estimated. Measures for lack of supply are examined to main access routes which does not satisfy demand in accordance with Figure 7.7. As a result, utilization of Railway is proposed for access route of access point B and C because V/C is 1.13 and 1.54, respectively, in middle term without utilization of public transport. Commuter demand of public transport at access point B and C are 2,369 and 3,700, respectively, and those demands are possible to be accommodated by railway in accordance with Table 7.11. Existing railway stations are located near access point B and C and planned railway capacity of the railway is adequate to accommodate node related passengers. Result of demand supply analysis for all access points are shown in the table below.

Table 7.11: Result of Demand Supply Analysis by Access Points

No.	Mode	Unit	Remarks	Year								
				2019			2024			2034		
				A	B	C	A	B	C	A	B	C
1	Modal Share											
	M/C	%		20	20	20	20	20	15	20	20	15
	Car	%		20	20	20	20	20	20	20	20	20
	Bus	%		60	40	40	60	40	45	60	40	45
	Railway	%		0	20	20	0	20	20	0	20	20
2	Converted Commuter Traffic Volume											
	M/C	pcu/hour		206	386	602	529	987	1,156	529	987	1,156
	Car	pcu/hour		248	463	723	634	1,185	1,850	634	1,185	1,850
	Bus	pcu/hour		74	93	145	190	237	416	190	237	416
	Railway	train/hour	2000 commuter /train	0	0	1	0	1	2	0	1	2
3	Converted Cargo Traffic Volume											
	Trailer	pcu/hour		41	0	1	71	0	2	209	0	5
	Truck	pcu/hour		44	126	0	76	217	0	223	640	0
4	Number of Lanes											
	Road			4	4	4	4	4	4	4	4	4
5	Capacity											
	Road	pcu/day	One direction	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
	Road	pcu/hour	peak ratio: 0.1	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
	Road	pcu/hour	Occupancy ratio: 0.25	3,375	3,375	3,375	3,375	3,375	3,375	3,375	3,375	3,375
	Railway	train/hour		0	3	3	0	4	4	0	6	6
	Railway	train/hour	Occupancy ratio: 0.50	0	2	2	0	2	2	0	3	3
6	Demand Supply Gap (V/C)											
	Roads			0.18	0.32	0.44	0.44	0.78	1.01	0.53	0.90	1.02
	Railway			0.00	0.31	0.48	0.00	0.59	0.93	0.00	0.39	0.62

Source: JICA Study Team

7.1.3. Framework for Infrastructure Development for Internal Node Development

Development Vision

Vision for node development is discussed in section 5.3 and followings are expected to node as new industrial and urban core.

- *Center of Manufacturing Trade*
- *Success model of self-reliant Node*
- *Indian R&D Center*
- *Provider of high skilled labors*
- *Employment Generator*

Development of node with world standard quality to facilitate investment of international industrial firms is required to realize above visions. Provision of following values to investors is also important. Infrastructure development is dominant in node development investment and development concept is essential to determine efficiency and convenience of node.

- *Efficient and Stable Infrastructure*
- *One Stop Service*
- *Quick and Easy Trouble Shooting*
- *Special Incentives*

Since global issues of energy conservation and environmental conservation has been common issues of development and technical innovation especially IT technology, advanced technologies related to eco-friendly has been introduced into development. Concept of "Modern City" is examined in India and introduction of public transport, road debottlenecking, development of pedestrian and cyclist facilities are proposed for road traffic sector as shown in Table 7.12. Benchmarks for modern city development in Transport sector is also proposed in Table 7.13.

Table 7.12: Three Pronged Approach of Modern City Scheme

Category	Three Pronged Approach
Urban Mobility	1. Improvements in public transport – Metro Rail, BRT, LRT, Monorail, Trams etc. 2. Improvements in infrastructure of other motor vehicles – ring roads, bypasses, underpasses, elevated roads, improvements in the existing road ways 3. Improvements in infrastructure for walking, cycling and waterways

Source: Draft Concept Note on Smart City Scheme 2014.12.03

Table 7.13: Benchmarks for Modern Cities

Parameter	Benchmarks
Transport	1. Maximum travel time of 30 minutes in small & medium size cities and 45 minutes in metropolitan areas 2. Continuous unobstructed footpath of minimum 2m wide on either side of all street with RoW 12m or more 3. Dedicated and physically segregated bicycle tracks with a width of 2mor more, one in each direction, should be provided on all streets with carriageway larger than 10m (not ROW) 4. High quality and high frequency mass transport within 800m(10-15 minute walking distance) of all residences in areas over 175persons / ha of built area 5. Access to para-transit within 300m walking distance.

Source: Draft Concept Note on Smart City Scheme 2014.12.03

Development Issues

① Promotion of Public Transport

East-West and North-South distances of Ponneri Node are about 3km and about 11km, respectively. And, travelling in node is basically undertaken by vehicle traffic. However, promotion of public transport, development of pedestrian and cyclist facilities, and development of transfer facilities among different transport facilities are essential to restraint of private traffic from the aspect of environmental conservation and alleviation of traffic congestion.

② Smooth Transit in Node

Development of efficient public transport and debottlenecking of road network are essential to ensure smooth travel and just in time service in node. Efficient networking and good accessibility to station of public transport are important issue on public transport development. Moreover, efficient traffic control at intersections is important to prevent bottleneck on road network.

③ Segregation of Cargo Traffic

Heavy vehicle for cargo traffic causes big impact on traffic flow and road side environment (noise, vibration), due to mechanical characteristic of the vehicle. Segregation measures on road structure and road network are essential to alleviate above impacts.

④ Environmental Conservation

Environmental conservation measures such as introduction of low-emission type vehicle into public transport system should be promoted to respond environmental related global issues.

Development Concept

Based on development vision and development issues discussed in foregoing section, “Clean & Smart” is introduced as node development concept. Based on this development concept, eco- friendly transport system such as public transport system and pedestrian and cyclist facilities should be promoted. Transfer facilities among public transport facilities, and pedestrian and cyclist facilities should be promoted. Hierarchic road network and road structure considering segregation of cargo traffic should be promoted.

Planning Policy

Road Network Planning

A proper road network contributes to the efficient development of an industrial and urban development area. Since road network would play an essential role in various industrial and urban activities, road network plan should be developed base on land use condition and environmental conditions besides the transport plan. Road network plan has principally taken into account network pattern, road hierarchy, and road density in the process of developing the road network plan.

Network Pattern

Network patterning is as known effective method in network planning. In this study, road network adopts grid patterns because that zoning and blocking of nodes are basically rectangular and this land-use characteristic is suitable for the pattern.

Road Hierarchy

To develop a proper road network, a systematic and hierarchical functional classification is necessary. The hierarchical classification of functions is composed of expressways, primary roads, secondary roads, and tertiary roads.

Primary Road System: The primary road system services the major portions of trips entering and leaving industrial and urban areas as well as the majority of throughway travel that wants to bypass the city centre. In addition, significant intra-urban travel, such as between node centre and outlying residential areas, between industrial zone and logistic center, is served by primary road.

Secondary Road System: The secondary road system interconnects with and augments the primary road system. It provides services to travels with moderate trip lengths at a somewhat lower level of travel mobility than primary roads. This system also distributes travel to geographic areas that are smaller than those identified with those of higher road systems. Secondary roads must serve not only vehicular traffic but also various transportation and non-transportation activities.

Tertiary Road System: The tertiary road system aims to provide access to areas located along the roads and to serve not only vehicular traffic but also nonmotorized vehicle and pedestrian traffic as well as roadside non transportation activities. Some urban streets that have commercial frontage serve fairly substantial volumes of traffic. However, this traffic is of terminal in nature; thus, it does not provide movement throughout the area.

Road Density

Road density is a key index of the road network's appropriateness for keeping a balance with land-use conditions. Target road densities corresponding to types of land use have been introduced in various existing manuals.

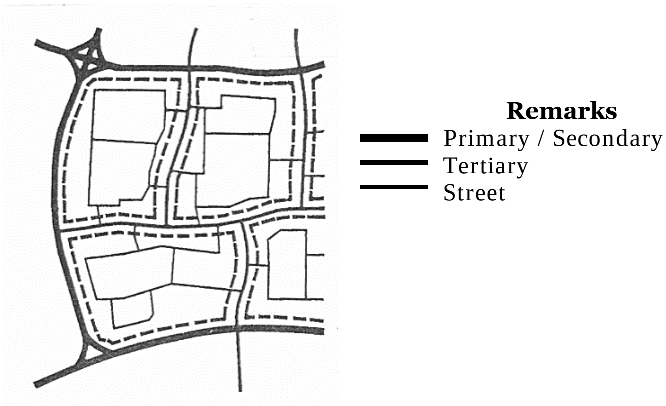
Table 7.14: Example of Target Road Density in Urban Area

Land Use	Target Road Density (km/km^2)
Residential	4
Commercial	6
Semi-Industrial	2
Industrial	1

Source: Ministry of Construction, Japan.

Road Network by Grid Pattern

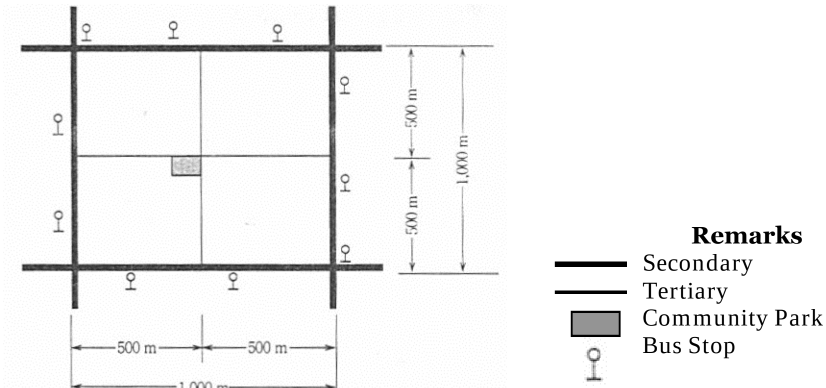
Role of the local roads which categorized as tertiary road is to provide access to trip origin/destination point such as factory, office, school, market and residence to/from upper hierarchy road. Therefore appropriate coordination on the local road network planning in accordance with land use and Primary/secondary road network is essential. Figure 7.8 shows basic concept for establishment of road network pattern with kind of road hierarchy. Hence areas which are surrounded by the road are formed as a community block; scale and shape of the block are considered on the road network establishment.



Source: JICA Study Team

Figure 7.8: Industrial and Urban Road Hierarchy

Figure 7.9 shows standard urban road network segment on road network plan.

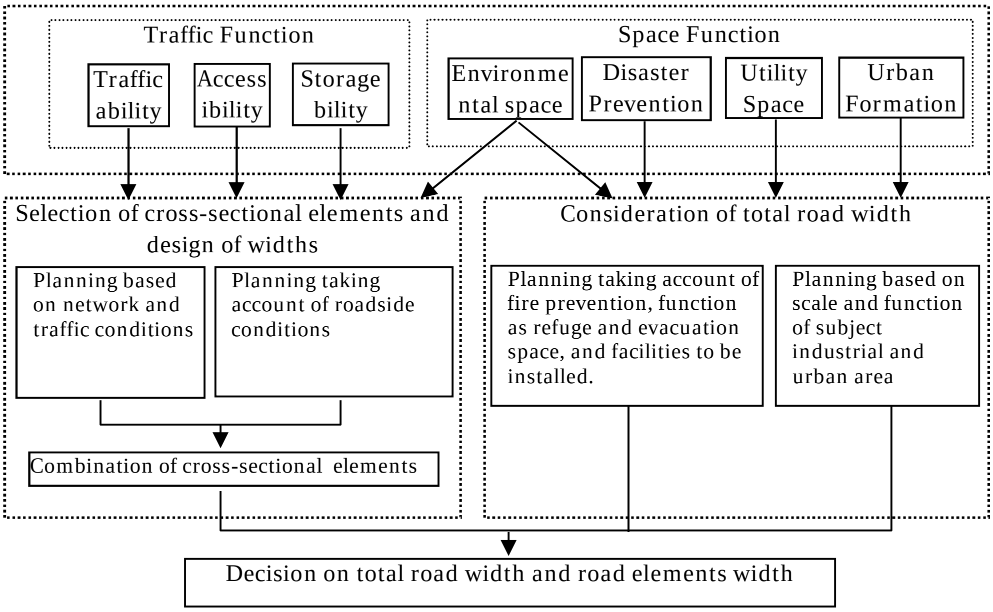


Source: JICA Study Team

Figure 7.9: Standard for Industrial and Urban Road Network Segment

Road Planning

Besides the road network planning, due consideration to road function both in traffic and space is essential in cross-section planning because urban roads would play a role not only as facilities for traffic but also as space for varied purposes. Especially, the space function of medians, shoulders, sidewalks, and service roadways was taken into account in harmony with relevant land-use urban plan.



Source: JICA Study Team

Figure 7.10: Concept of Cross-section Planning Based on Road Functions

Key elements of the urban design guidelines, such as design speeds and widths of typical cross-sectional elements, are considered and proposed as follows:

Design Speed

Design speed is the maximum speed for safe travel that can be maintained for a specified section of a road. The design speed is determined with respect to the terrain, adjacent land use, type of road, and the design speed of adjoining sections. The design speed will directly affect many geometric elements, like the horizontal and vertical alignments, sight distance, provision of super elevation, etc.

Examination of Typical Cross-sections

Cross-sectional elements are proposed with consideration of road functions as shown in Figure 7.10 above. Basic policy for planning of cross-section elements is briefly explained as follows:

Lane Width: Since lane width has the largest effects on running speeds and comfortability levels, the appropriate lane width should be considered when determining design speed.

Median: It is considered that the wider the median is, the higher the road functions become. Also, when a vehicle loses control, it is easily controlled if the median is wider, thereby avoiding serious accidents.

Shoulder: Taking into account the relationship of functionally classified road systems to traffic mobility and land access, it can be said that urban tertiary roads has a relatively higher land access function, while urban primary roads provide a higher level of mobility for throughway movement.

Sidewalk: A sidewalk, which is physically separated from motorized traffic by a curb, consists of the walking space and the lateral space for street lightings, traffic barriers, and other street hardware. The minimum width for a sidewalk should be 1.0m. Consideration of necessary pedestrian walking space was based on the necessary space between pedestrians.

<u>Planted Strip:</u> A planted strip is part of a sidewalk, providing aesthetic elements and serving as buffer strip. The width of a planted strip between the sidewalk and travelled way curb, if provided, should be a minimum of 2.0m to allow maintenance activities.

Road Safety

Major road accidents on urban area are speeding, collision at intersection, and collision between vehicle and pedestrian and cyclist. Collision between heavy freight vehicle and other vehicle is likely to happen in node, since share of freight traffic is high on node traffic and different vehicle characteristics between heavy vehicle and ordinary vehicles. In addition to enforcement and education measures for road traffic accident mitigation, infrastructure measures for above accidents are effective. Countermeasures for above road accidents by infrastructure are summarized in Table 7.15 based on accident analysis and those measures will be introduced into internal node development plan.

Table 7.15: Counter Measures for Road Safety

Accident Type	Countermeasures by Infrastructure
Speeding	- Speed Hump
Collision at Intersection	- Controlled Traffic Signal - Street Light
Collision between vehicle and pedestrian・cyclist	- Controlled Traffic Signal - Mount up footpath - Street Light
Collision between heavy freight vehicle and other vehicles	- Designation of Passage Lane for freight vehicle

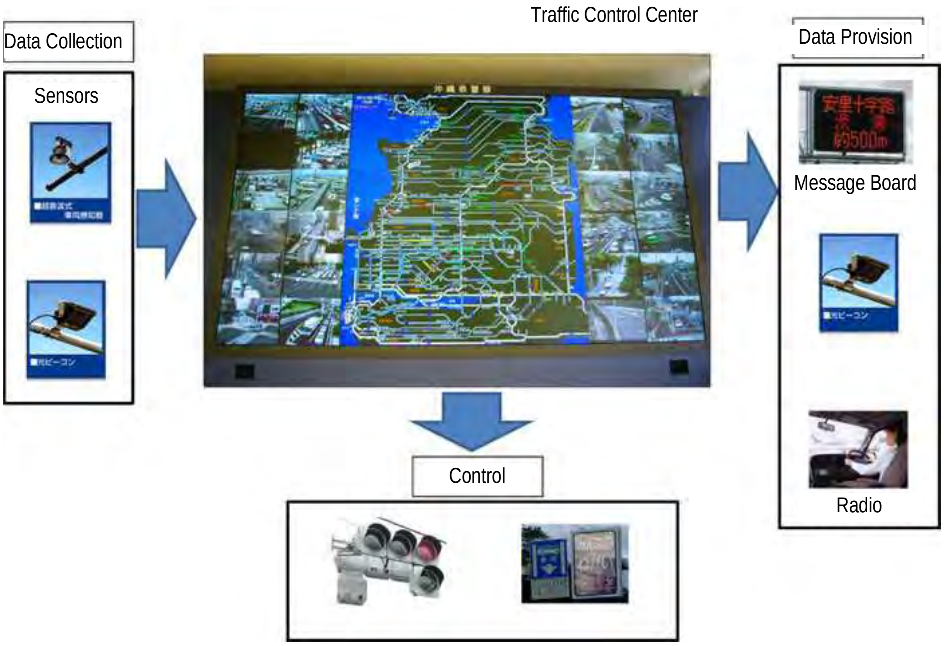
Source: JICA Study Team.

Intersections

Grade separated intersection is generally applied to high traffic crossing with more than 4 lanes roads. In this plan, grate separation is applied to crossing between node access road and express national highway. At-grade intersection is basically applied at other intersections on node access roads.

Intersection in node is basically at-grade due to small traffic in node and effective utilization of land.

There are about 25 at-grade intersections in node and the intersections are located on grid line. Therefore, coordinated intersection control by coordinated traffic signal system with control centre is desirable to ensure efficient traffic control. This system has scalable for increment of number of traffic signal and traffic sensors.



Source: Okinawa Prefectural Police HP

Figure 7.11: Integrated Traffic Control System

Public Transport

Bus System

Bus system is introduced as main public transport system in node in consideration of scale of node area and node population.

Bus Network Plan : Bus network in node should be considered in consideration of transfer between commuting bus from outside of node and node internal circulation bus, and development area in each development phase. However, final decision will be made by bus operator based on road network, bus lines, frequency, bus allocation plan, and etc.

Bus Terminal and Bus Stop Plan : Bus terminal should be planned as transfer facility between commuting bus from outside of node and node internal circulation bus. Bus depot should be planned for maintenance and waiting of bus. Bus stop should be provided every 500m along road to keep 5 minutes walking sphere.

7.1.4. Design Conditions

Road Design

Following Indian design standard is basically applied to road and road related facility design and international standard is adopted when there is no stipulation in Indian design standard.

- IRC 86:1983 GEOMETRIC DESIGN STANDARDS FOR URBAN ROADS IN PLAINS
- IRC 106:1990 GUIDELINES FOR CAPACITY OF URBAN ROADS IN PLAINS
- IRCRC 64:1990 GUIDELINES FOR CAPACITY OF ROADS IN RURAL AREAS
- IRC 73:1980 GEOMETRIC DESIGN STANDARDS FOR RURAL HIGHWAYS

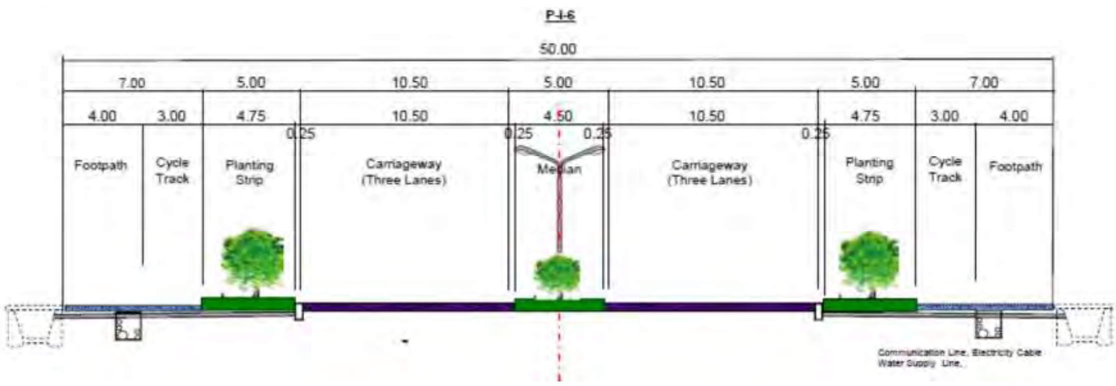
Proposed elements of typical cross sections in this plan are shown in Table 7.16 and Figure 7.12 to Figure 7.29. Figure 7.13, Figure 7.16, and Figure 7.19 show typical cross section of primary road in transitional period. Transitional typical cross sections aim to secure land for widening and efficient widening construction.

Road lighting is installed all type of road and surface drainage water on road area is discharged to out of road area. Utilities such as water supply line, electric cable, and communication line will be accommodated under footpath and concrete box for accommodating above utilities is planned to install on primary road in consideration of efficient maintenance.

Table 7.16: Elements of Proposed Typical Cross Sections

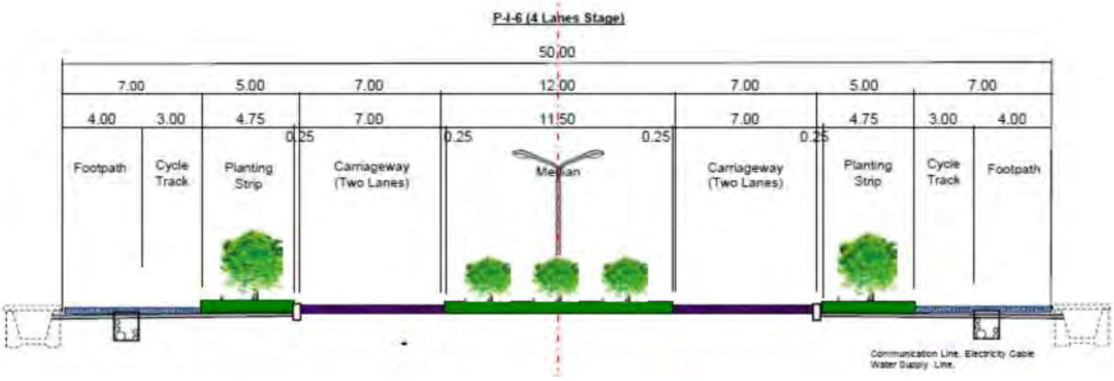
Classification	Type	Earthwork Section																	
		Foot Path	Planting Strip	Parking	Cycle Track	Service Road	Marginal Strip	Planting Strip	traveled way	median	traveled way	Planting Strip	Marginal Strip	Service Road	Cycle Track	Parking	Planting Strip	Foot Path	Total
Primary	P-I-6	4.00	0.00	0.00	3.00	0.00	0.00	5.00	3.50 × 3	5.00	3.50 × 3	5.00	0.00	0.00	3.00	0.00	0.00	4.00	**50.0**
	P-I-4	4.00	0.00	0.00	3.00	0.00	0.00	5.00	3.50 × 2	5.00	3.50 × 2	5.00	0.00	0.00	3.00	0.00	0.00	4.00	**43.0**
	P-6	4.00	0.00	0.00	3.00	0.00	0.00	2.00	3.50 × 3	5.00	3.50 × 3	2.00	0.00	0.00	3.00	0.00	0.00	4.00	**44.0**
	P-4	4.00	0.00	0.00	3.00	0.00	0.00	2.00	3.50 × 2	5.00	3.50 × 2	2.00	0.00	0.00	3.00	0.00	0.00	4.00	**37.0**
	P-6-R	4.00	0.00	2.50	2.00	3.50	0.50	2.00	3.50 × 3	5.00	3.50 × 3	2.00	0.50	3.50	2.00	2.50	0.00	4.00	**55.0**
	P-4-R	4.00	0.00	2.50	2.00	3.50	0.50	2.00	3.50 × 2	5.00	3.50 × 2	2.00	0.50	3.50	2.00	2.50	0.00	4.00	**48.0**
Secondary	S-4	4.00	0.00	0.00	2.50	0.00	0.00	2.00	3.50 × 2	3.00	3.50 × 2	2.00	0.00	0.00	2.50	0.00	0.00	4.00	**34.0**
	S-4-R	4.00	0.00	2.00	2.00	3.50	0.50	2.00	3.50 × 2	3.00	3.50 × 2	2.00	0.50	3.50	2.00	2.00	0.00	4.00	**45.0**
Tertiary	T-4	2.50	0.00	0.00	2.50	0.00	0.00	0.00	3.50 × 2	1.50	3.50 × 2	0.00	0.00	0.00	2.50	0.00	0.00	2.50	**25.5**
	T-2-R	3.00	1.00	2.50	0.00	0.00	0.00	0.00	3.50 × 1	0.00	3.50 × 1	0.00	0.00	0.00	0.00	2.50	1.00	3.00	**20.0**
Classification	Type	Bridge Section																	
					Parapet	Foot Path	Parking	Cycle Track	traveled way	median	traveled way	Cycle Track	Parking	Foot Path	Parapet				Total
Primary	P-6				0.50	2.50	0.00	2.50	3.50 × 3	2.00	3.50 × 3	2.50	0.00	2.50	0.50				**34.0**
	P-4				0.50	2.50	0.00	2.50	3.50 × 2	2.00	3.50 × 2	2.50	0.00	2.50	0.50				**27.0**
Secondary	S-4				0.50	2.50	0.00	2.50	3.50 × 2	1.50	3.50 × 2	2.50	0.00	2.50	0.50				**26.5**
Tertiary	T-4				0.50	2.00	0.00	2.00	3.50 × 2	1.50	3.50 × 2	2.00	0.00	2.00	0.50				**24.5**
	T-2				0.50	2.00	2.50	0.00	3.50 × 1	0.00	3.50 × 1	0.00	2.50	2.00	0.50				**17.0**

Source: JICA Study Team



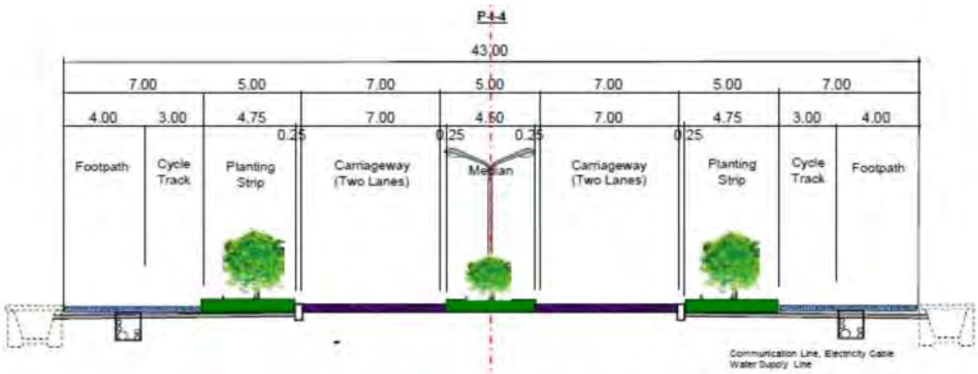
Source: JICA Study Team

Figure 7.12: Proposed Typical Cross Section (Primary-Industry-6Lanes)



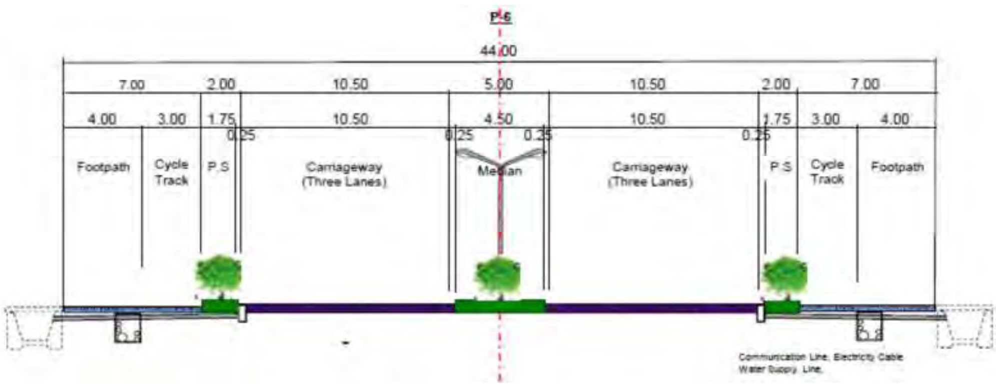
Source: JICA Study Team

Figure 7.13: Proposed Typical Cross Section (Primary-Industry-4Lanes-Stage)



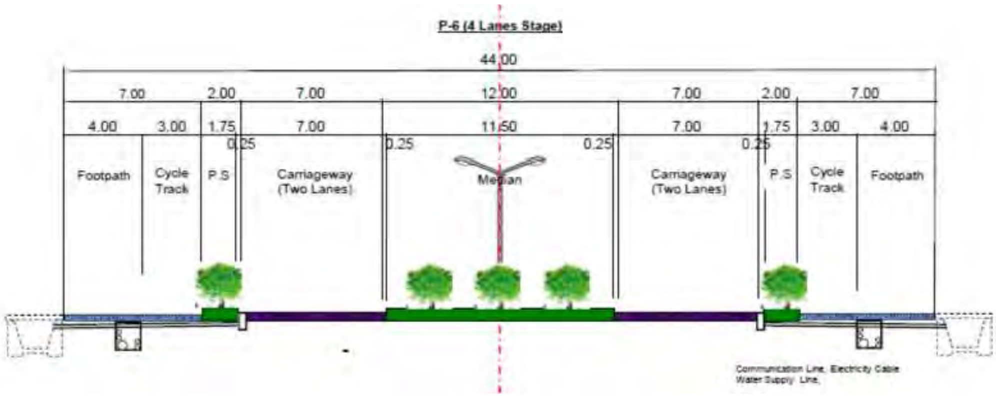
Source: JICA Study Team

Figure 7.14: Proposed Typical Cross Section (Primary-Industry-4Lanes)



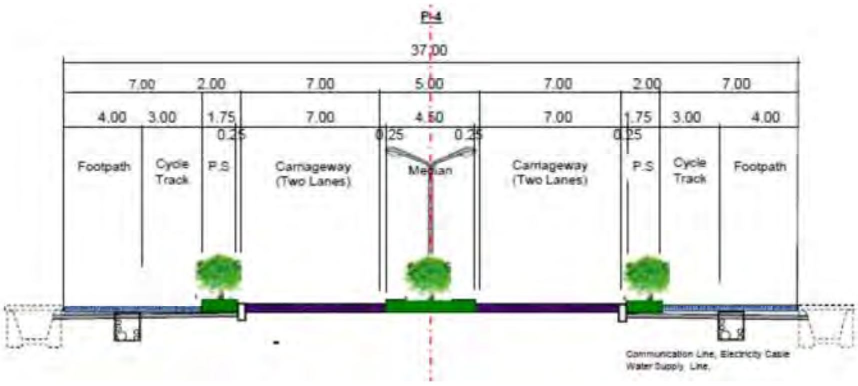
Source: JICA Study Team

Figure 7.15: Proposed Typical Cross Section (Primary-6Lanes)



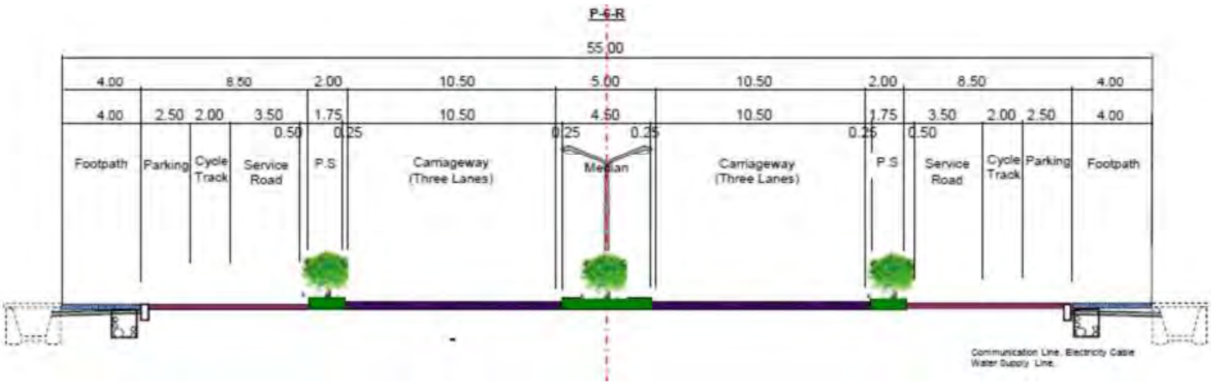
Source: JICA Study Team

Figure 7.16: Proposed Typical Cross Section (Primary-6Lanes-Stage)



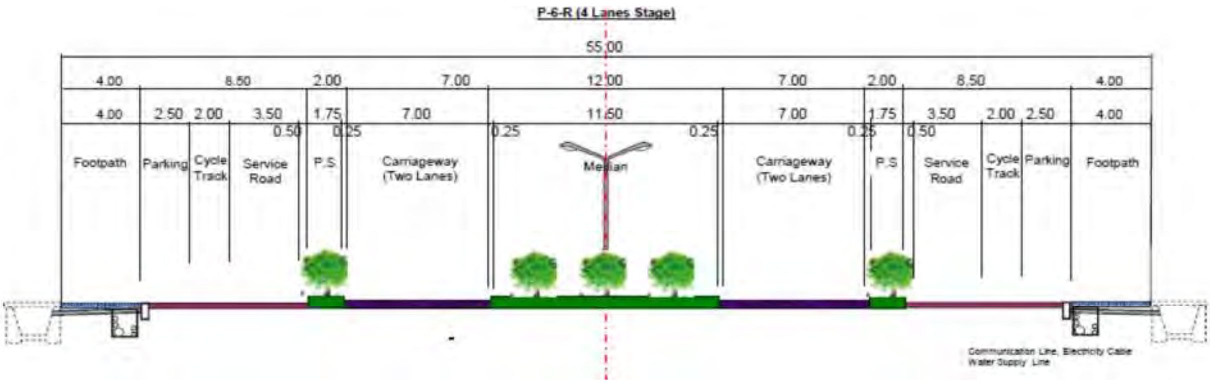
Source: JICA Study Team

Figure 7.17: Proposed Typical Cross Section (Primary-4 Lanes)



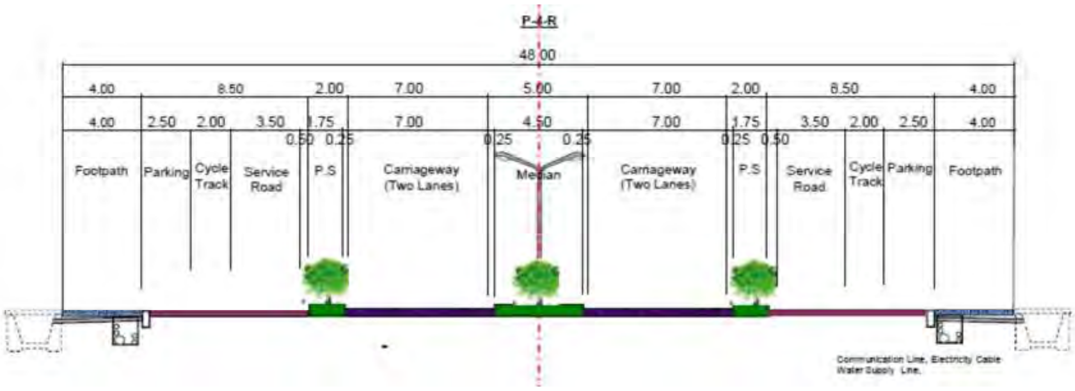
Source: JICA Study Team

Figure 7.18: Proposed Typical Cross Section (Primary-Residential-6 Lanes)



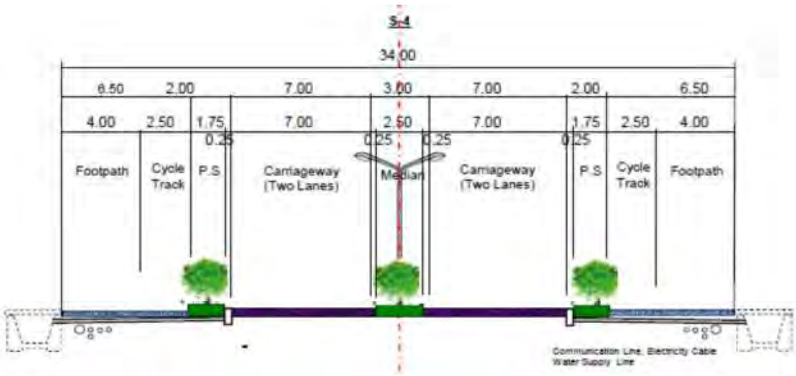
Source: JICA Study Team

Figure 7.19: Proposed Typical Cross Section (Primary-Residential-6 Lanes-Stage)



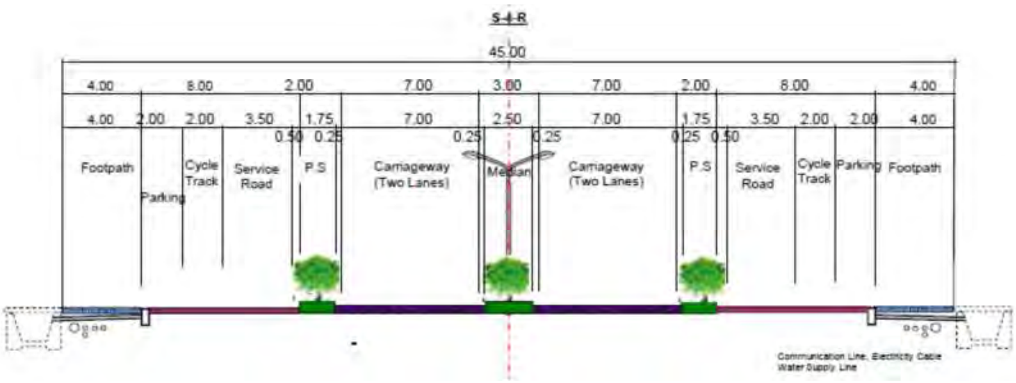
Source: JICA Study Team

Figure 7.20: Proposed Typical Cross Section (Primary-Residential-4 Lanes)



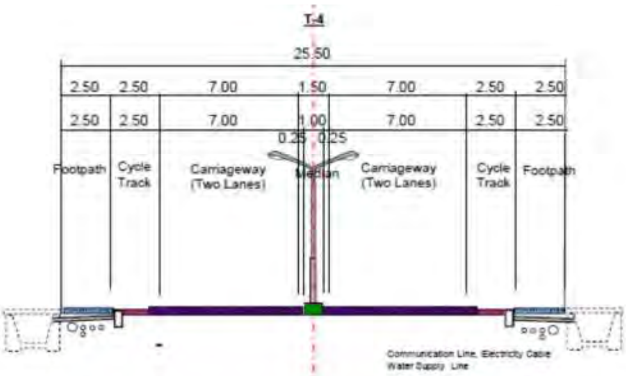
Source: JICA Study Team

Figure 7.21: Proposed Typical Cross Section (Secondary-4 Lanes)



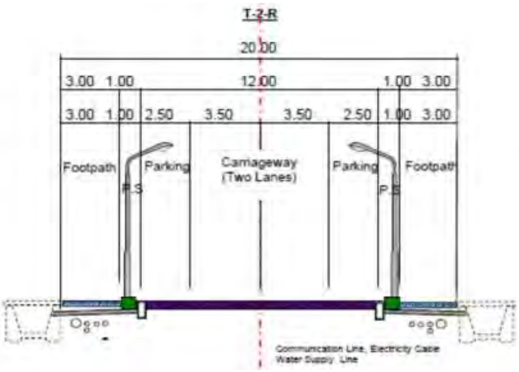
Source: JICA Study Team

Figure 7.22: Proposed Typical Cross Section (Secondary-Residential-4 Lanes)



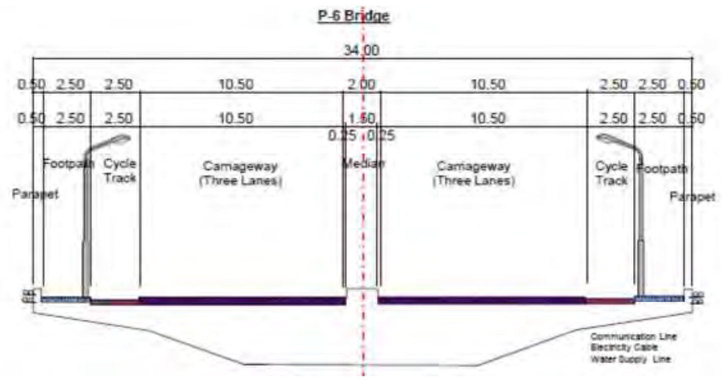
Source: JICA Study Team

Figure 7.23: Proposed Typical Cross Section (Tertiary-4 Lanes)



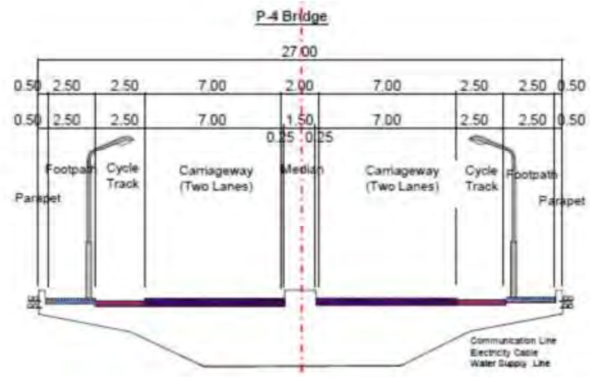
Source: JICA Study Team

Figure 7.24: Proposed Typical Cross Section (Tertiary-Residential-2 Lanes)



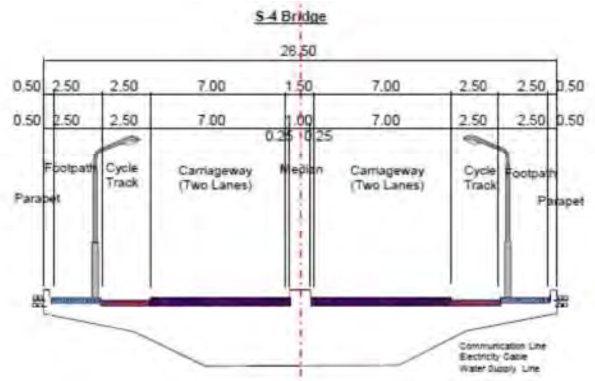
Source: JICA Study Team

Figure 7.25: Proposed Typical Cross Section (Primary-6 Lanes)



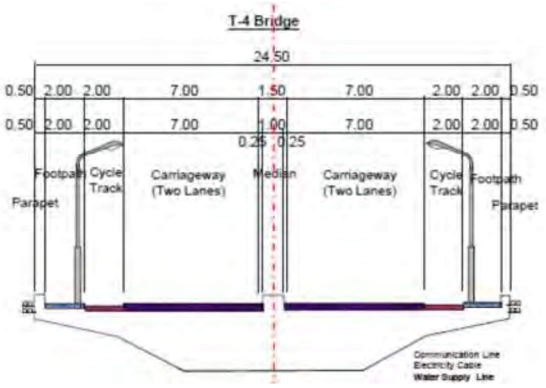
Source: JICA Study Team

Figure 7.26: Proposed Typical Cross Section (Primary-4 Lanes)



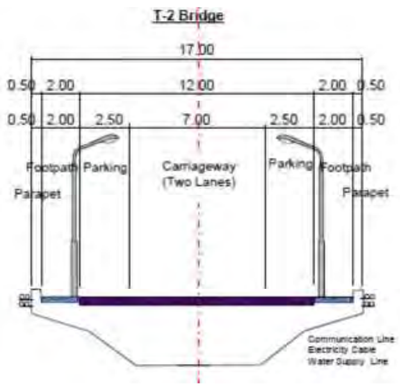
Source: JICA Study Team

Figure 7.27: Proposed Typical Cross Section (Secondary-4 Lanes)



Source: JICA Study Team

Figure 7.28: Proposed Typical Cross Section (Tertiary-4 Lanes)



Source: JICA Study Team

Figure 7.29: Proposed Typical Cross Section (Tertiary-2 Lanes)

Public Transport

Bus System

Bus Terminal : Bus terminal consists of vehicle related facilities, passenger related facilities, management related facilities, and service related facilities. Length and width of platform area is more than 12m and 3m, respectively. Number of platform is 10 locations and total area is 5,000m^2.

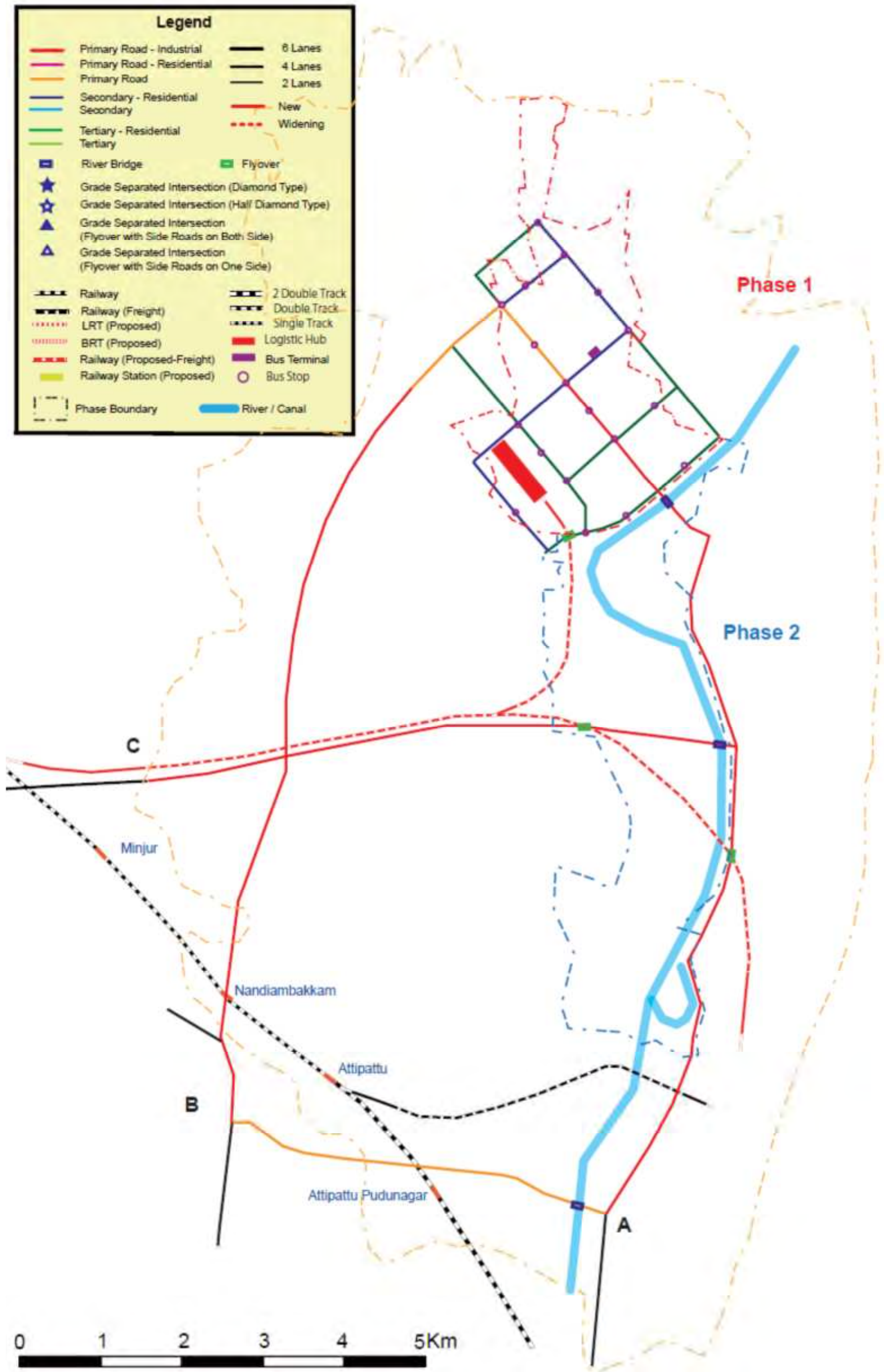
Bus Depot: Bus depot consists of vehicle related facilities and management facilities, and total area is 10,000m^2.

Bus Stop: Type of bus stop is bus bay type and pavement area is 125 m^2.

7.1.5. Development Plan

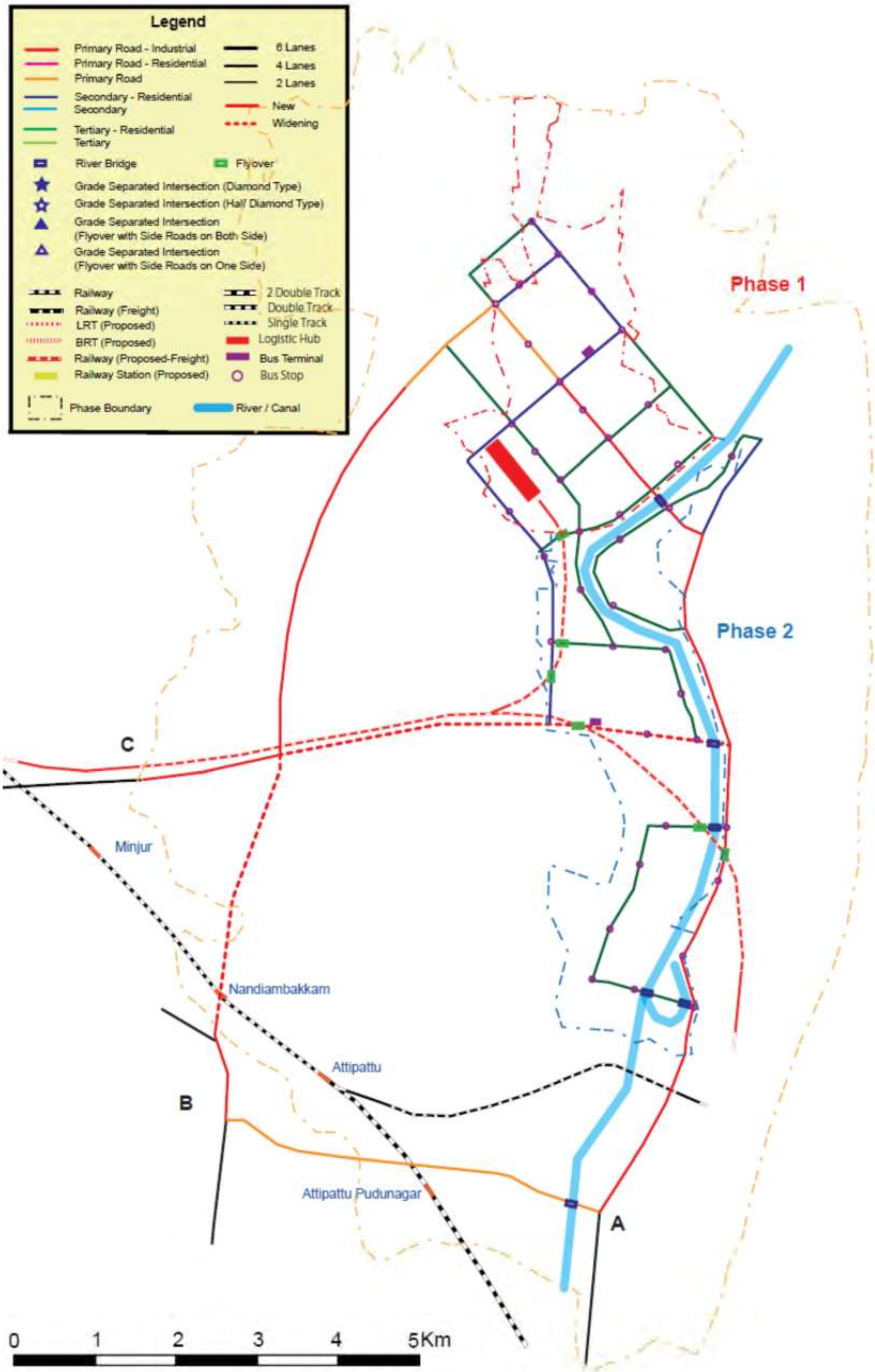
Internal Node Development

Based on planning policy and design conditions and existing road and rail development plans, internal node development plans for each phase and ultimate stage are proposed as shown in Figure 7.30 to Figure 7.32.



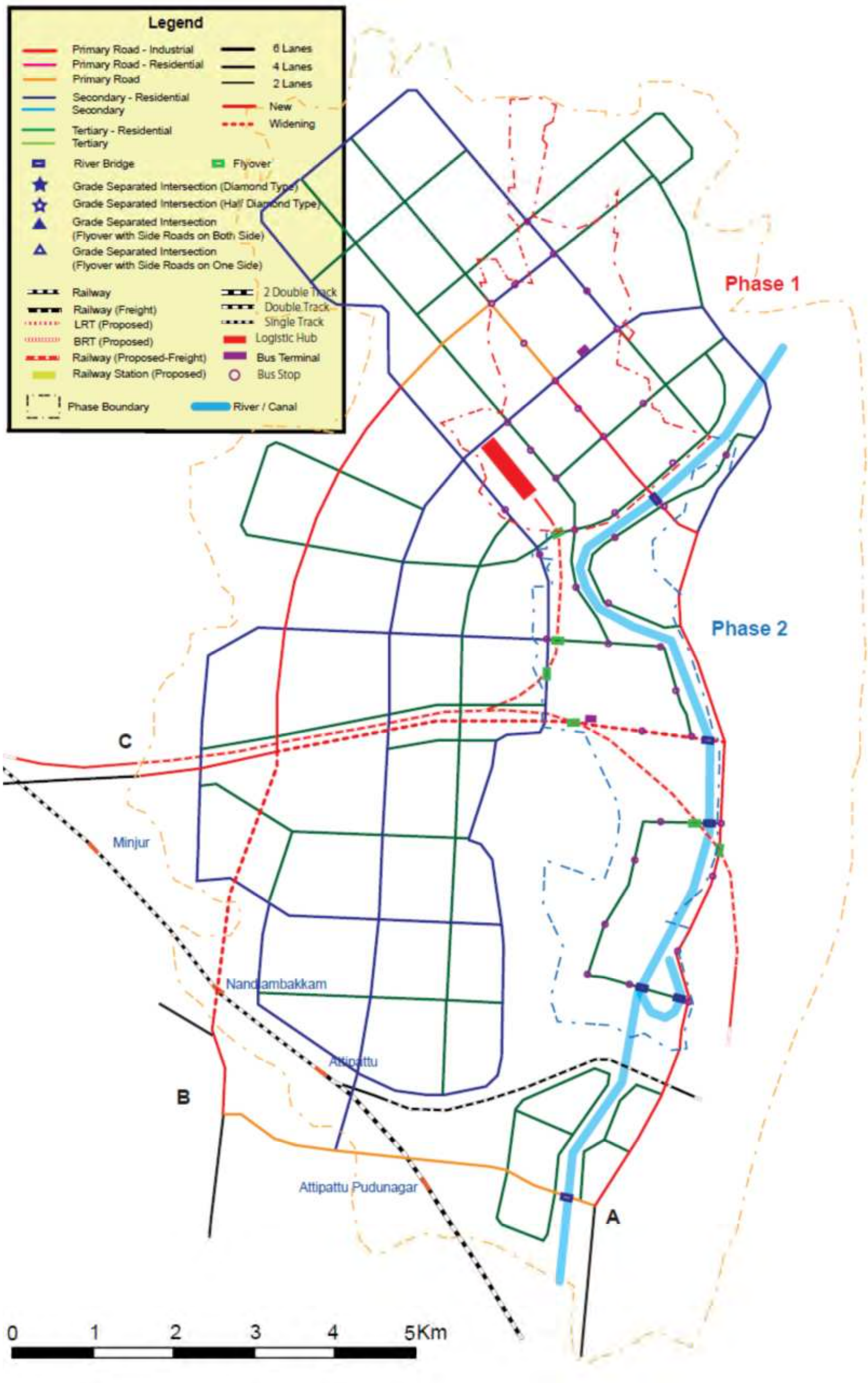
Source: JICA Study Team

Figure 7.30: Road and Public Transport Facilities Development Plan in Internal Ponneri Node (Phase 1)



Source: JICA Study Team

Figure 7.31: Road and Public Transport Facilities Development Plan in Internal Ponneri Node (Phase 2)

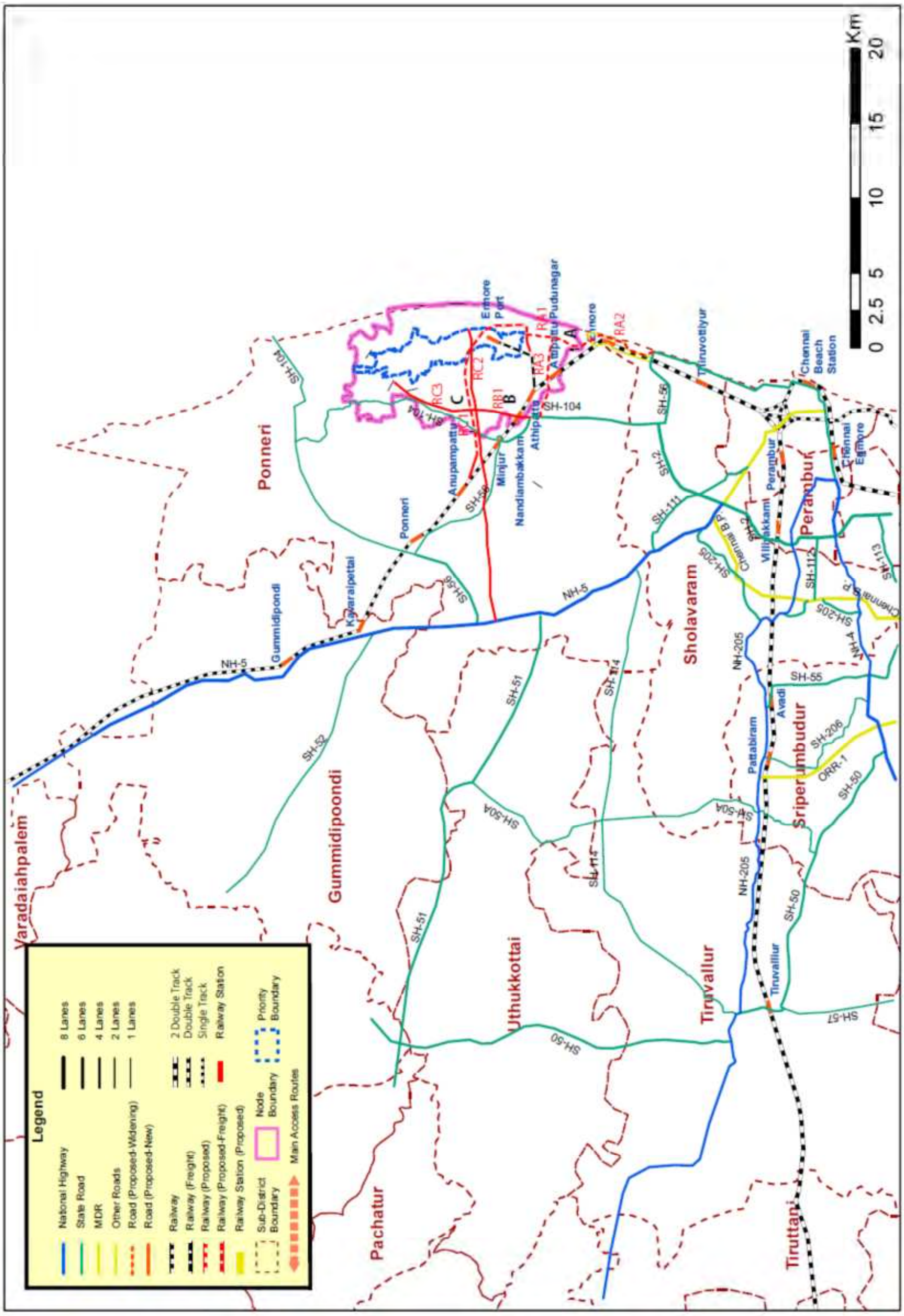


Source: JICA Study Team

Figure 7.32: Road and Public Transport Facilities Development Plan in Internal Ponneri Node (Ultimate Stage)

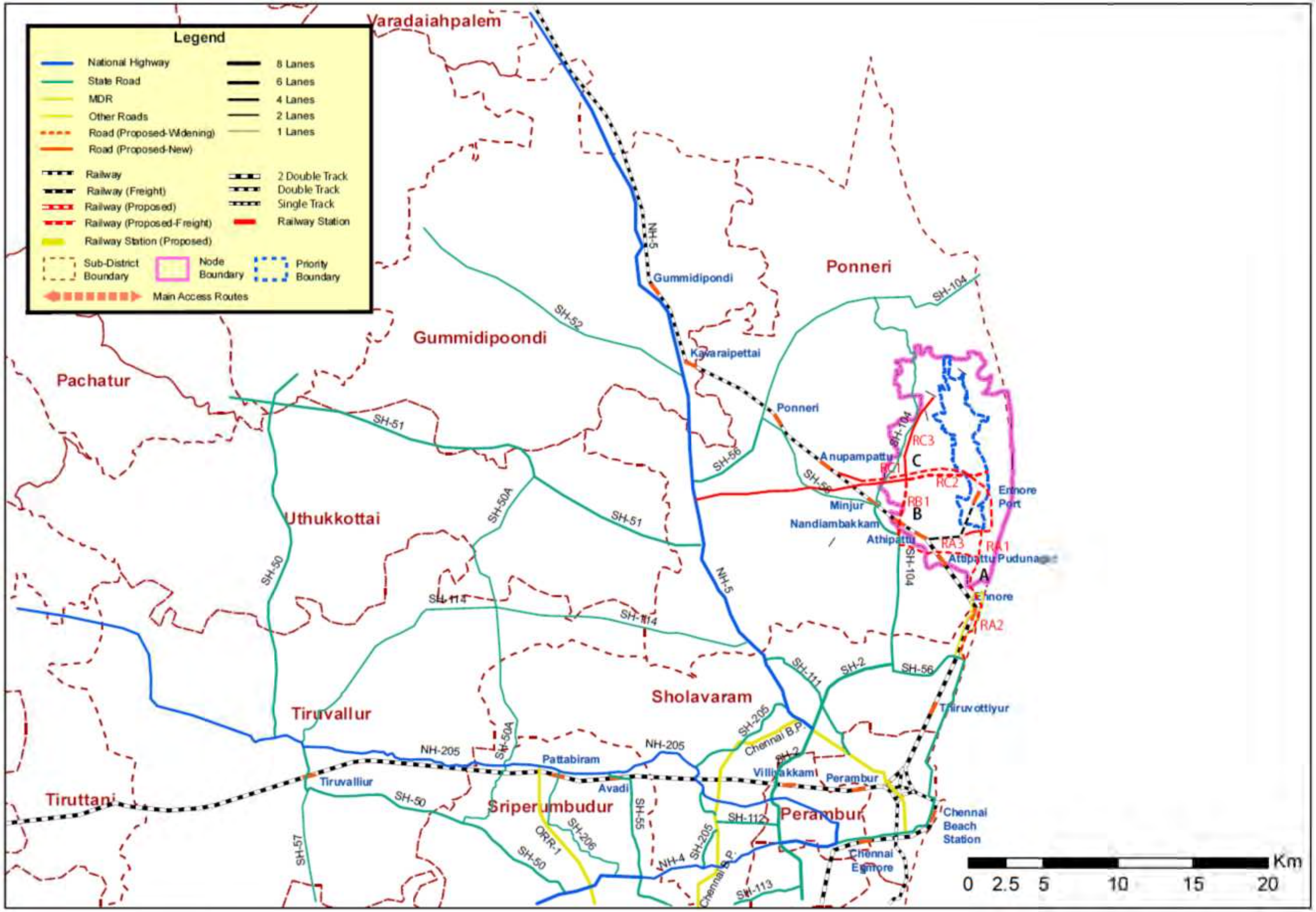
External Node Development

Based on demand supply analysis result and existing road and rail development plans, external node development plans for each phase are proposed as shown in figures below-



Source: JICA Study Team

Figure 7.33: Road and Public Transport Facilities Development Plan in External Ponneri Node (Phase 1)



Source: JICA Study Team

Figure 7.34: Road and Public Transport Facilities Development Plan in External Ponneri Node (Phase 2)

7.1.6. Implementation Plan (Development Schedule)

Internal Node Development

Based on proposed internal node development plan and identified projects, implementation plan for internal node development is proposed as shown in Table 7.17. Annual investment expenditure and total investment cost in each phase are also shown in Table 7.17.

Table 7.17: Implementation Plan for Internal Node

Roads	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Internal Road works	109	147	133	0	0	6	32	41	0	0	0	0	0	0	0	186	186	186
Intersection works	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Bridges Works	13	13	13	7	7	7	7	7	0	0	0	0	0	0	0	0	0	0
Flyover Bridge Works	32	26	23	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0
Road Facilities	146	157	168	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Internal Public Transport Facilities Works	0	1	22	0	0	0	1	22	0	0	0	0	0	0	0	0	0	0
Major River Bridge Works	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flyover Bridge Works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**318**	**365**	**379**	**10**	**10**	**16**	**43**	**78**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**186**	**186**	**186**

Source: JICA Study Team

External Node Development

Based on proposed external node development plan and identified projects, implementation plan for external node development is proposed as shown in the table below. Annual investment expenditure and total investment cost in each phase are also shown in the table below. The components of development include widening of roads from 2 lane to 4 lane capacity and 4 lanes to 6 lane capacity at certain locations. The indicative cost is presented below. However, this will be outside the purview of the node level managing entity. Hence, the same would not be considered while arriving at the total project cost.

Table 7.18: Implementation Plan for External Node

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2033
External Infrastructure	0	0	23	103	0	0	0	0	13	0	0	0	0	0	0	0	0	0

Source: JICA Study Team

7.2. Railways

7.2.1. Sector Overview

The connection of the proposed manufacturing nodes to the railway network will be essential for their commercial viability and competitiveness. Such connections can only be achieved through the development of multimodal transfer terminals, or "Logistics Hubs" within the nodes.

These Logistics Hubs, which are evaluated in detail in the Logistics section of the Final Report, will facilitate the transfer of cargo between road and rail, as well as the handling, storage and, where necessary, customs clearance, of containerized and break-bulk cargo. *They are also the only practical means by which rail can access each node.* Thus the development of the railway network to support the long term viability of the nodes is intertwined with the development of the logistics hubs.

For the Ponneri node, the objective will be to connect the node to the existing railway network via an access line which would take off from a new line to be constructed between Ennore Port and Minjur. This line will be financed by Kamarajar Port Ltd (formerly Ennore Port Ltd). Although a start has yet to be made on construction of this port access line, it is understood that its principal purpose will be to serve the new container terminal at Ennore Port which is scheduled to commence operation on 16 January 2015.[37] There is some possibility that the new line could also connect to Kattupalli Port.

The substantial benefit expected to be realized by the new port access line is that it will allow port railway traffic to and from the north to by-pass heavily congested suburban sections of the Chennai-Nellore mainline. Although 4th lining is underway on some of these sections, some, such as Ennore-Attippattu, remain congested with heavy concentrations of commuter, long distance passenger and freight traffic. Measures to relieve the capacity shortages on the Chennai-Nellore line were outlined in Interim Report 2.

7.2.2. Principles for design of rail nodal accesses

The need to apply efficient railway operating practices will be a major determinant of the size and layout both of the nodal access lines and the logistics hubs. The involved principles are common across all three nodes and were discussed in Annexure 7.2 on Design Methodology for Access Lines and Logistics Hubs.

Foremost among these needs are:

- the need to operate long freight trains between the nodes and designated origins or destinations;
- the need to maintain the integrity of these trains (by banning their break-up or re-marshalling at enroute stations);
- the need to use electric traction for the haulage of these trains; and
- The need to limit enroute delays to technical stops for crew changes or other operational purposes.

These are principles which are already widely applied by Indian Railways, and they need to be observed in the design of railway accesses to the nodes and in the design of logistics hubs.

As is the case with the other nodes, Ponneri can be expected to generate only two types of rail traffic*: containers and break bulk steel.* The composition and lengths of container and steel trains are given below.

[37] Information received at a meeting in New Delhi with the Adviser Infrastructure, Railway Board on 13 November 2014

Table 7.19: Ponneri Node – Train Composition and Length

Train Type	Vehicle Type	No. in consist	Length over couplers (metres)	Overall length (metres)
Containers	WAG 9 electric loco	1	20.50	20.50
	BLCA container flat	45	14.63	658.13
	Brake van	1	15.00	15.00
	Total			693.63
Steel	WAG 9 electric loco	1	20.50	20.50
	BFNS steel wagon	45	14.72	662.22
	Brake van	1	15.00	15.00
	Total			697.72

The use of electric locomotives will require that full length trains are pushed back, rather than pulled, into the hubs, because the operation of high lift cargo handling equipment prevents the complete overhead wiring of the loading/unloading sidings within the hubs. For this purpose, long reception sidings must be provided outside the hubs to permit locomotives to run around and push back their trains.

In all cases, two such reception sidings will be provided, in addition to the running line, in order to accommodate two trains at a time. Although traffic density at Ponneri is unlikely to result in two trains occupying the sidings at the same time, provision of the two siding tracks will allow for future traffic growth. Based on the train specifications in the above table, the length of the siding tracks between turnouts (switches) will be 752 metres, which will accommodate the train lengths plus some allowance for braking.

7.2.3. Features of rail nodal access design at Ponneri

The rail access line connecting the logistics hub at Ponneri with the new Minjur-Ennore Port line will be 3.5 km in length. The length of the line was determined by the location of the hub, which in turn had to avoid swampy land near the river and a nearby concentration of mangrove forest. The line will be single track and electrified.

Owing to the curvature of the line near to the hub, it was not possible to locate the reception sidings immediately outside of the hub. Instead, they had to be situated at a distance of 1.1 km from the hub boundary, which will require train push-back for a total distance of 1.85 km (1.1 km plus the siding length of 752 metres). While this is not ideal, it is not expected that it will impose too much operational inefficiency and additional cost.

Care was taken to ensure sufficiently wide curve radii consistent with the operation of long and heavy trains. It will be observed that the tightest curve on the line is 866 metres.

The layout of the access line, showing its relationship to the logistics hub and the reception sidings is given in the figure below.

7.2.4. Expected difficulty of construction

Photographs taken during a recent visit to the site (see figures below) clearly show its swampy condition. There is little doubt that construction of the line will pose substantial challenges for the railway engineers and contractors. It is quite possible that in addition to soil strengthening, construction of the line may require piling, which could greatly inflate the cost of the project.

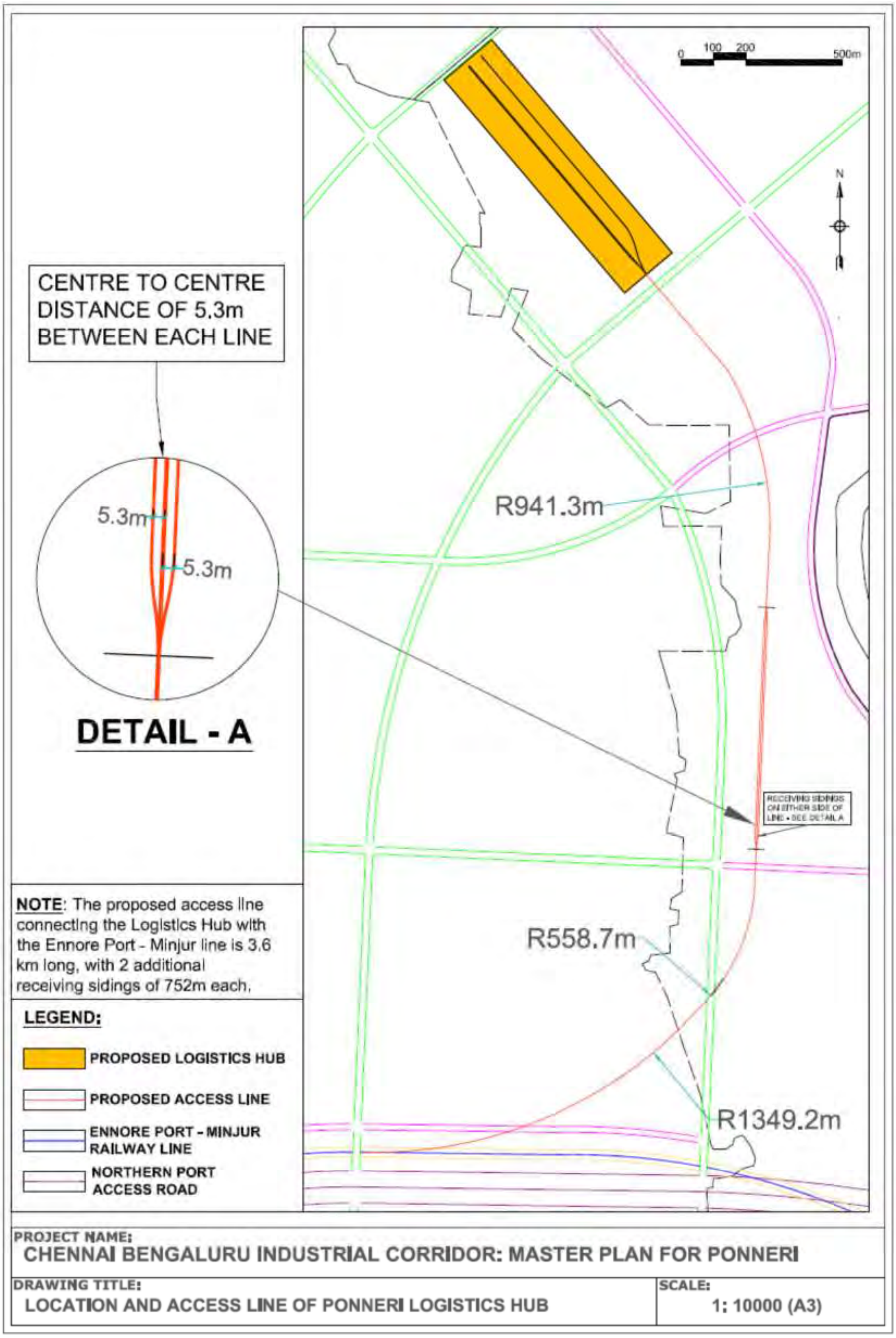


Figure 7.35: Ponneri Node – Layout of proposed rail access line and reception sidings

Figure 7.36: Ponneri Node – View facing

Figure 7.37: Ponneri Node – View facing

7.2.5. Demand Forecast

The demand forecast for Ponneri, as in the case of the other two nodes, was based on input/output forecasts prepared by the Industry Planning team. Table 7.20 presents the forecasts of the rail modal volume and share used as a basis for scaling the rail facilities at Ponneri.

Table 7.20: Ponneri Node – Forecast rail shares of container and break bulk freight volume

Traffic category	2017/18	2022/23	2027/28	2032/33
Containers				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	18,448	31,679	54,398	93,411
- Empty Inbound (TEU)	26,892	46,178	79,296	1,36,165
Total	46,117	79,191	1,35,984	2,33,510
Containers - rail volume				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	11,711	20,110	34,533	59,300
- Empty Inbound (TEU)	0	0	0	0
Total	12,488	21,444	36,824	63,233
Containers - rail share (%)				
- Loaded inbound (TEU)	100%	100%	100%	100%
- Loaded outbound (TEU)	63%	63%	63%	63%
- Empty Inbound (TEU)	0%	0%	0%	0%
Total	27%	27%	27%	27%
Break bulk				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	2,19,125	3,76,278	6,46,136	11,09,533
Total	2,95,389	5,07,235	8,71,014	14,95,688
Break bulk - rail volume				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	0	0	0	0
Total	76,263	1,30,958	2,24,878	3,86,156
Break bulk - rail share %				

Traffic category	2017/18	2022/23	2027/28	2032/33
- Inbound	100%	100%	100%	100%
- Outbound	0%	0%	0%	0%
Total	26%	26%	26%	26%
Petrochemicals - inbound pipeline (t)	4,63,993	7,96,759	13,68,179	23,49,410

A key feature of these forecasts is that inbound empty container volumes are expected to comprise more than 50 per cent of annual TEU volumes. This is due to the extreme imbalance between flows of loaded containers, with loaded inbound containers representing only a small fraction of loaded outbound. While it is likely that a large proportion of outbound freight will be transported from the node in containers, only a small volume of inputs, comprising raw cotton from Nagpur for textile production, will be transported in containers. Thus there will be a need to re-position empty containers for re-loading in the node.

It is likely that Ennore Port will provide a source of empty containers since its imports of loaded containers will exceed its exports (in other words, the opposite of the container balance expected in the node). The proximity of the port to the node suggests that all re-positioned containers would be carried by road.

Rail might be expected to carry more than 60 per cent of outbound containers owing to the likelihood that these flows will be dominated by long hauls to domestic destinations.

Rail will transport (in break bulk form) 50% of the steel input tonnage to the node, probably from Salem. The other 50% which is not reflected in the above table since it would by-pass the logistics hub would be transported by road from Ennore Port.

Realization of the above forecast TEU and break bulk tonnage volumes for rail will translate, on average, to only one inbound steel train and two outbound container trains per day.

7.2.6. Cost estimate

Connection of Ponneri node to the rail network would require construction of an electrified access line (running from the Ennore Port-Minjur mainline) of 3.5 km together with two electrified reception sidings with a combined length of 1.5 km.

The unit construction cost of single electrified line, equipped with automatic block signalling, was estimated at Rs. 53 million per km. This cost was derived from the quoted costs of recent new line construction projects. The overall cost at current estimates (without escalation) would therefore be Rs. 265.21 million, as shown in Table 7.21 below.

Table 7.21: Ponneri Node – Capital Cost for construction of Access Lines (Cost at today's prices)

Access Line	
Length (km)	3.500
Unit construction cost (million Rs/km)	53.00
Total cost (million Rs)	**185.50**
Reception sidings	
Length (km)	1.504
Unit construction cost (million Rs/km)	53.00
Total cost (million Rs)	**79.71**
TOTAL	
Length (km)	5.004
Unit construction cost (million Rs/km)	53.00
Total cost (million Rs)	**265.21**

7.2.7. Development plan

Construction of the access track should be completed in time to allow trains to run to and from Ponneri node in early 2018, coinciding with the scheduled commencement of manufacturing activity. It should be possible to carry out the construction works within 2016/17.

As indicated in Annexure 7.2 of this report which discusses the principles to be applied to rail and logistics hub development, the responsibility for financing the construction of the access lines and reception sidings should rest with the SPV Company which will develop the node.

The investment in the construction of these facilities could be recovered in the land rent to be paid by the hub operator who would also be responsible for organizing rail transport, for paying haulage charges to IR and possibly also for investment in container wagons. The hub operator in turn would pass on these costs to freight customers in the form of consolidated rail haulage charges.

To demonstrate how such a system would work, an assessment was made of the components of these consolidated charges. Although the rate of land rent has yet to be determined, it was assumed that this would be set at a level which would at least recover the track capital and maintenance costs, as shown in the tables below.

Table 7.22: Ponneri Node – Recovery of railway capital, haulage and maintenance charges for Containers

Charge component	2017/18	2022/23	2027/28	2032/33
Net haulage charge - containers (Rs. per ntk)	1.0200	1.0200	1.0200	1.0200
Investment in access line and reception sidings (Rs. per ntk)*	0.0115	0.0067	0.0039	0.0023
Access track maintenance (Rs. per ntk)*	0.0324	0.0308	0.0298	0.0291
Container wagon investment (Rs. per ntk)	0.0170	0.0169	0.0168	0.0167
Container wagon maintenance (Rs. per ntk)	0.0118	0.0117	0.0117	0.0116
Total charge (Rs. per ntk)	**1.0928**	**1.0861**	**1.0822**	**1.0797**
Sources: (1) MOR Statistical Statements				
(2) Consultant's Train Cost Model				
* Calculated across total ntk generated by the node (containers plus steel)				

Table 7.23: Ponneri Node – Recovery of railway capital, haulage and maintenance charges for Steel

Charge component	2017/18	2022/23	2027/28	2032/33
Net haulage charge - steel (Rs. per ntk)	1.1900	1.1900	1.1900	1.1900
Investment in access line and reception sidings (Rs. per ntk)*	0.0115	0.0067	0.0039	0.0023
Access track maintenance (Rs. per ntk)*	0.0324	0.0308	0.0298	0.0291
Total charge (Rs. per ntk)	**1.2339**	**1.2275**	**1.2237**	**1.2214**
Sources: (1) MOR Statistical Statements				
(2) Consultant's Train Cost Model				
* Calculated across total ntk generated by the node (containers plus steel)				

In the case of steel traffic, IR is responsible for the supply and maintenance of wagons. Hence the only addition to haulage charges to be paid by steel customers would be the rate per net tonne-km necessary to recover access track capital and maintenance costs. It is to be noted that the revenue from haulage has been computed at constant tariffs.

7.2.8. Critical success factors

The construction of the proposed Northern Rail Link between Minjur and the new container terminal at Ennore Port will be essential to allow the development of a rail access to Ponneri node. The capital cost of this project (estimated at Rs. Crore 150) will be borne by Kamarajar Port Ltd.

It is proposed that the alignment of Northern Rail Link will broadly follow that of the proposed Northern Port Access Road which has already been fixed.

The scheduling of the Northern Rail Link project is uncertain, but as the Ennore Port container terminal is scheduled to start operation in January 2015, there is a strong possibility that this line will be constructed and in service by the time the manufacturing operations at Ponneri commence in 2017/18.

It is also uncertain as to how Kamarajar Port Ltd intends to recover the capital cost of this project. There is an agreement between the Port Company and IR that the latter would not be charged for operation on the line to and from Ennore Port[38], but the connection of other cargo handling infrastructure to the new line is likely to attract either a direct capital contribution, or the payment of track access charges, to offset these costs. In either case, the SPV will be responsible for a financial contribution which, if passed on through land rent could threaten the viability of the node development project. It is important therefore that this issue be resolved with the port company as soon as possible.

[38] It is understood that that the port operating company has agreed with IR that the new line will be operated as a "siding line" meaning that the railway will not be charged for the operation of trains along the line, for all railway traffic to and from Ennore Port.

7.3. Logistics

7.3.1. Sector Overview

The establishment within each node of intermodal transport terminals, or *Logistics Hubs*, will be an important part of a strategy to minimize the logistics costs and maximize the competitiveness of the manufacturing enterprises within the nodes. These Logistics Hubs will facilitate the transfer of cargo between road and rail, as well as the handling, storage and, where necessary, customs clearance, of containerized and break-bulk cargo. *They are also the only practical means by which rail can access each node.* The same is not true of road transport which can access individual manufacturing establishments within the nodes, via a dense network of local roads which will be provided in each node. Thus, rail connections to the nodes are inextricably linked to the operation of Logistics Hubs and will to a large extent determine the component facilities and layouts of the latter.

By facilitating the transfer of cargo between road and rail, the hubs will blend the capacities of each mode to minimize transport costs over relatively short and long distances respectively.

It is expected that the logistics hubs will be designed to handle only container and break bulk cargo, or in other words, cargo which can be moved in unitized lots (containers, pallets, or bundles.

7.3.2. Principles for design of logistics hubs

In all cases, logistics hubs will be located as close as possible to the geographic centre of the manufacturing industries to be established in the node.

The central feature of each node will be a set of railway sidings for the loading/unloading of containers and the unloading of break-bulk steel. In the Ponneri hub, it is proposed to have two tracks for the loading/unloading of containers and one for the unloading of steel. *These tracks must allow for the receipt and dispatch of full length unit trains running between a single origin and a single destination, without being broken up or re-marshalled.*

Standard trains lengths are 694 metres (an electric locomotive plus 45 BLCA wagons and a brake van) for container trains and 698 metres (an electric locomotive plus 45 BFNS wagons and a brake van) for steel trains. Accordingly, the clear standing length required in the loading/unloading tracks is 700 metres. In the Ponneri hub it will be necessary to install overhead wiring in the first 154 metres of lead track into the steel siding and about 150 metres into the container sidings, to allow electric locomotives to push their trains into the loading/unloading tracks.

The steel and container handling areas will be separated by a chain link fence, and provided with their own security controlled entrances.

In the Ponneri hub, a paved container yard will be provided on either side of the container siding tracks to allow the discharge and loading of wagons by reach-stacker equipment. The tracks would be embedded in pavement to allow cargo handling equipment to work both sides of a train at the same time.

In the steel handling area, a single storage yard will be provided adjacent to the steel siding track and an internal road. The siding track would also be embedded in pavement although top lifting forklifts will work on one side of the train at a time.

In the case of both container and steel trains, handling equipment would work along a frontage of 600 metres.

The CY and steel storage areas are assumed to be dimensioned with lengths of 600 metres and 400 metres respectively. Their widths are determined by the projected cargo volume in the last year of the forecast period (2032/33).

In the case of Ponneri, the required capacity of the CY was determined as a function of average container dwell times and peak arrival rates in the final forecast year, as well as the number of container tiers in the stacks. With an assumption of 3 high stacking of loaded containers and 5 high stacking of empty containers, the required number of ground-slots was calculated as 428 TEU. The CY configuration best corresponding to this requirement is 27 stacks each with a ground area of 4 x 2 TEU, equivalent to 119 square metres. Each stack will be separated by a 13 metre aisle for the operation of reach-stackers. The overall dimensions of each CY will be 600 m x 12.2 m = 7320 m^2. At Ponneri, the container stacks will be two TEU deep, giving a width of 12.2 metres.

Roadways will be provided on either side of the rail sidings to allow direct transfer of containers and steel between wagons and road trailers or trucks. The width of these roadways will be 15 metres, sufficient to permit trucks and trailers to pass sections where reach-stackers or top-lifters are working.

Other facilities to be provided within each hub include: a Container Freight station (CFS - for the stuffing/unstuffing and of containers and for customs inspection of container cargo); a long term warehouse for storage of cargo beyond the free period of 3 days; a two storey administration building with additional space for rental by service providers, such as freight forwarders; a trailer park; a workshop for the container repair and for the maintenance of cargo handling equipment; a railway maintenance store, and gatehouses (for security at both entrances to the hub).

The design of the CFS is based on the assumption that it will handle 40% of the CY throughput of loaded TEU – i.e. that 40% of the loaded TEU volume will be stuffed or unstuffed in the CFS (the balance of 60% being handled at factories located within the node. The area of the CFS will be determined by the number of TEU expected to be handled within the turn time of the container stacks in the final forecast year multiplied by a discharged cargo area of 29.7 metres per TEU, with the addition of 20% for forklift movement areas.

Since the long term warehouse was expected to store about half of the CFS cargo volume, the area of the warehouse was estimated to be half that of the CFS.

7.3.3. Demand forecast

The nodal cargo forecasts were further broken down to derive forecasts for the CFS and warehouse components of the logistics hub, as shown in the table below.

Table 7.24: Ponneri Logistics Hub - Throughput

Category	2017/18	2022/23	2027/28	2032/33
Loaded inbound (TEU)	777	1334	2291	3933
Empty inbound (TEU)	18448	31679	54398	93411
Loaded outbound (TEU)	26892	46178	79296	136165
Empty outbound (TEU)	0	0	0	0
Total (TEU)	46117	79191	135984	233510
CFS t/put (40% of loaded container volume)-TEU	11067	19005	32635	56040
Break bulk handling in CFS - inbound tonnes	4506	7737	13286	22814
Break bulk handling in CFS - outbound tonnes	127568	219058	376162	645937
Steel handling in CY -tonnes	76263	130958	224878	386156
Sub-total (Tonnes)	208337	357752	614325	1054907
Overtime storage volume in CFS and steel yard (5% of total tonnage)	10417	17888	30716	52745
Other L.T. storage volume (20% of CFS volume)	26415	45359	77890	133750

Category	2017/18	2022/23	2027/28	2032/33
Reefer storage volume (50% of L.T. storage volume)	13207	22679	38945	66875

In particular, it was assumed that:

- 40% of the CY throughput of loaded TEU will be stuffed or unstuffed in the CFS;
- Long term storage volume (Cubic metres) will represent about 20% of total break-bulk volume handled in the CFS;
- Reefer storage volume will represent half of the Long Term storage volume.

7.3.4. Features of Ponneri logistics hub design

The proposed layout of the Ponneri logistics hub is given in the table below. The design assumptions and specifications are indicated in the table below.

Table 7.25: Ponneri Logistics Hub - Specifications

Areas of hub components (square metres)	
Container Yard (CY) (7,320 x 2)	14,640
Steel storage yard	8,000
Container Freight Station (CFS)	10,282
Long Term Warehouse	5,000
Trailer Park (including W/shop and Security)	5,700
Administration Building	2,000
Rail Maintenance Store	700
Rail sidings	11,326
Internal roads	75,903
Not utilized	33,308
TOTAL	**166,859**
CY specifications/productivity	
Ground slots (No.)	432
Average stack height (TEU)	3.8
Capacity (TEU)	1,639
Container dwell times (days) :	
Loaded outbound	1.5
Loaded inbound	3.0
Empty inbound	3.0
Peak arrival factor	120%

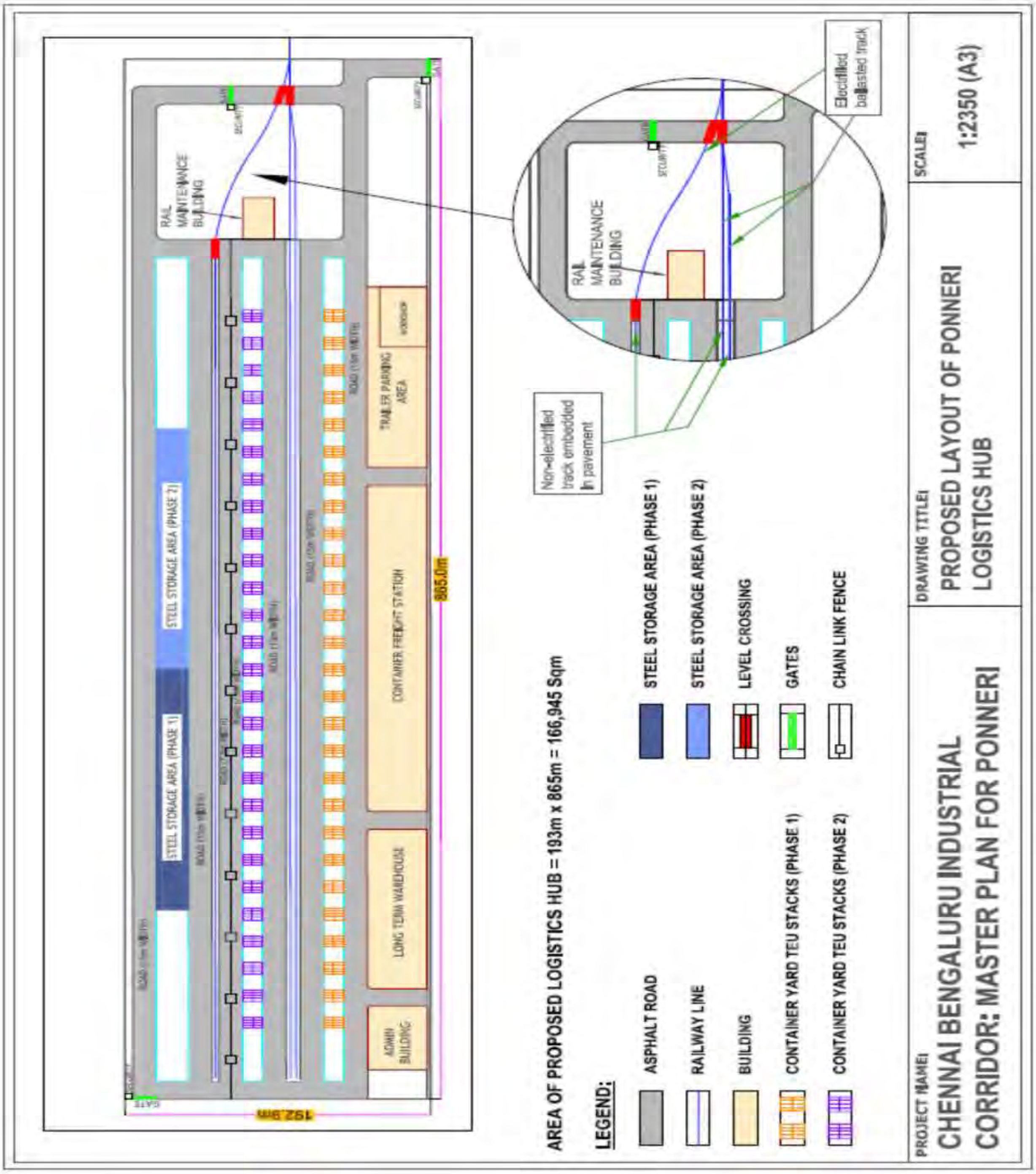


Figure 7.38: Ponneri Logistics Hub - Layout

7.3.5. Cost and revenue estimates

(i) Capital cost estimates

Cargo handling equipment productivity rates and unit purchase costs were obtained from similar projects in India in order to calculate the physical requirement and cost of equipment acquisition, Similarly, unit construction costs were obtained from comparable projects in India for application to the areas of the different hub components in order to estimate the Civil Work cost of the hub construction. These cost estimates, together with an indication of sources, are given below.

Table 7.26: Ponneri Logistics Hub - Capital Cost Estimates

	Phase 1			*Phase 2*			*Total*		
Item	**Area (Sqm) (or) Length (m)**	**Cost per sqm (or) per km (Rs.)**	**Total cost (mn Rs.)**	**Area (Sqm) (or) Length (m)**	**Cost per sqm (or) per km (Rs.)**	**Total cost (mn Rs.)**	**Area (Sqm) (or) Length (m)**	**Cost per sqm (or) per km (Rs.)**	**Total cost (mn Rs.)**
Land rent (TBD)	-	-	-	-	-	-	-	-	-
CY & internal roads	91,123	2,048	186.58	11,320	2,047.51	23.18	1,02,443	2,047.51	209.75
Railway sidings (a)			104.32			50.06	-		154.39
- paved area	6,300	4,000	25.20	3,150	4,000	12.60	9,450	4,000	37.80
- length embedded	1,400	450,00,000	63.00	700	450,00,000	31.50	2,100	450,00,000	94.50
- length electrified plus ballasted	304	530,00,000	16.12	113	530,00,000	5.96	417	530,00,000	22.09
Buildings									
- Admin Building	2,000	19,625	39.25				2,000	19,625.41	39.25
- CFS	10,282	13,084	134.53				10,282	13,083.61	134.53
- L.T. warehouse	5,000	21,588	107.94				5,000	21,587.95	107.94
Security/gatehouse	300	13,084	3.93				300	13,083.61	3.93
Workshop	1,500	18,317	27.48				1,500	18,317.05	27.48
Railway maint.store	700	18,317	12.82				700	18,317.05	12.82
Sub-total (Buildings)			*325.94*			-			*325.94*
Utilities			38.79			4.61			43.40
Sub-total (Bldgs and Infra)			*655.63*			*77.85*			*733.48*
Equipment	**No. (units)**	**Cost per unit (mn Rs)**		**No. (units)**	**Cost per unit (mn Rs)**		**No. (units)**	**Cost per unit (mn Rs)**	
Reachstackers (b)	3	30.00	90.00		30.00	-	3	30.00	90.00
Forklifts for CFS	12	1.01	12.16	8	1.01	8.10	20	1.01	20.26
HD Forklifts	4	6.08	24.31		6.08	-	4	6.08	24.31
Prime movers and trailers (c)	2	3.38	6.75	1	3.38	3.38	3	3.38	10.13
Weighing scales	2	0.61	1.22		0.61	-	2	0.61	1.22
Pallet trolleys	15	0.04	0.55	17	0.04	0.62	32	0.04	1.17
Conveyors			6.34						6.34
Racking system			0.88						0.88
Sub-total			*142.20*			*12.10*			*154.30*
Misc.fixed assets									
Consultancy fee (3%)			23.93			2.70			26.63
Contingency (4%)			31.91			3.60			35.51
Total			***853.68***			***96.24***			***949.92***

Sources for costs
a) Ministry of Railways (Adviser Infrastructure) 13/11/2014
b) Cost of Hyster TIL reachstacker from CONCOR 03/07/2014
c) Second hand prices from OLX.in
All other prices and rates are from the "Emerging Kerala 2012 Logistics Park proposal"

The construction of the hub will be phased. During Phase 1, from 2015/16 – 2025/26 the steel yard and siding as well as one of the two container yards and its siding, and all buildings will be constructed. In Phase 2, from

2026/27 – 2032/33, the second container yard and its siding will be added. Equipment will be added when justified by demand.

(ii) Capital expenditure profile

The capital expenditure profile for the project, which reflects the phasing of the Civil Works cost as explained above, is given in the table below.

Table 7.27: Ponneri Logistics Hub - Capital Expenditure Profile (2014 constant prices)

						Units: Million Rs.	
Year	**Fixed assets**	**Cargo handling equipment**	**Net outflow**	**Consultancy fee (3% of net outflow)**	**Contingency allowance (4% of net outflow)**	**Total Consultancy and Contingency**	**Gross outflow**
2015/16	327.82	0.00	327.82	9.83	13.11	22.95	350.76
2016/17	327.82	132.45	460.27	13.81	18.41	32.22	492.49
2017/18	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2018/19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019/20	0.00	1.05	1.05	0.03	0.04	0.07	1.12
2020/21	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2021/22	0.00	4.42	4.42	0.13	0.18	0.31	4.73
2022/23	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2023/24	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2024/25	0.00	2.06	2.06	0.06	0.08	0.14	2.21
2025/26	0.00	2.06	2.06	0.06	0.08	0.14	2.21
2026/27	77.85	1.16	79.01	2.37	3.16	5.53	84.54
2027/28	0.00	2.10	2.10	0.06	0.08	0.15	2.25
2028/29	0.00	4.50	4.50	0.13	0.18	0.31	4.81
2029/30	0.00	1.09	1.09	0.03	0.04	0.08	1.16
2030/31	0.00	3.15	3.15	0.09	0.13	0.22	3.37
2031/32	0.00	0.11	0.11	0.00	0.00	0.01	0.12
2032/33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033/34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2034/35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035/36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036/37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**733.48**	**154.30**	**887.77**	**26.63**	**35.51**	**62.14**	**949.92**
		Phase 1					
		Phase 2					

(iii) O&M costs

Operating and maintenance costs for the hub include: the wages costs of operating staff, the salary costs of administrative and management staff, and the maintenance costs of fixed assets (pavements, railway sidings, and buildings) and equipment.

For the estimation of wages and salaries cost the staff ratios to throughput for a comparable project in India were used to calculate the numbers of staff in each category. The resulting workforce numbers were then multiplied by unit wage and salary costs from the same source to derive the total wages and salary costs for the hub.

The maintenance costs of fixed assets and equipment were calculated as a percentage of the cumulative investment in each category. For this purpose 1% was assumed for fixed assets and 2% for cargo handling equipment. The resulting stream of wages and salaries and maintenance costs over the forecast period to 2032/33 is given in below tables respectively.

Table 7.28: Ponneri Logistics Hub - Estimates of Wage and Salary Costs (2014 values)

Year	Total operating staff (No.)	Annual Wages Cost (Mn Rs.)	Total salaried staff (No.)	Annual Salary Cost (Mn Rs.)	Total Salaries plus wages (Mn Rs.)
2015/16					
2016/17					
2017/18	111	15.43	29	13.61	29.04
2018/19	120	16.68	31	14.55	31.23
2019/20	120	16.68	31	14.55	31.23
2020/21	120	16.68	31	14.55	31.23
2021/22	129	17.93	33	15.49	33.42
2022/23	135	18.76	35	16.43	35.19
2023/24	144	20.01	37	17.37	37.38
2024/25	144	20.01	37	17.37	37.38
2025/26	144	20.01	37	17.37	37.38
2026/27	153	21.26	39	18.31	39.57
2027/28	171	23.76	44	20.66	44.42
2028/29	180	25.02	46	21.60	46.61
2029/30	195	27.10	50	23.47	50.57
2030/31	204	28.35	52	24.41	52.76
2031/32	213	29.60	55	25.82	55.42
2032/33	231	32.10	59	27.70	59.80
2033/34	231	32.10	59	27.70	59.80
2034/35	231	32.10	59	27.70	59.80
2035/36	231	32.10	59	27.70	59.80
2036/37	231	32.10	59	27.70	59.80
TOTAL		477.80		414.08	891.87
Unit Wages Cost (per annum), Rs.			1,38,975		
Unit Salaries Cost (p.a.), Rs.			4,69,473		

Table 7.29: Ponneri Logistics Hub - Estimates of Fixed Asset and Equipment Maintenance Costs (2014 values)

Year	Fixed asset cumulative investment (Mn Rs.)	Cost of fixed asset repair and main-tenance. (Mn Rs.)	Equipment cumulative investment (Mn Rs.)	Cost of equipment repair and maintenance. (Mn Rs.)
2015/16				
2016/17				
2017/18	655.63	6.56	132.45	2.65
2018/19	655.63	6.56	132.49	2.65
2019/20	655.63	6.56	132.49	2.65
2020/21	655.63	6.56	133.54	2.67
2021/22	655.63	6.56	133.58	2.67
2022/23	655.63	6.56	138.00	2.76
2023/24	655.63	6.56	138.04	2.76
2024/25	655.63	6.56	138.07	2.76
2025/26	655.63	6.56	140.13	2.80
2026/27	655.63	6.56	142.20	2.84
2027/28	733.48	7.33	143.36	2.87
2028/29	733.48	7.33	145.45	2.91
2029/30	733.48	7.33	149.95	3.00
2030/31	733.48	7.33	151.04	3.02
2031/32	733.48	7.33	154.19	3.08
2032/33	733.48	7.33	154.30	3.09
2033/34	733.48	7.33	154.30	3.09
2034/35	733.48	7.33	154.30	3.09
2035/36	733.48	7.33	154.30	3.09
2036/37	733.48	7.33	154.30	3.09
TOTAL		138.91		57.53
R&M cost % of cum. inv.-fixed assets			1.0%	
R&M cost % of cum. inv.-equip.			2.0%	

(iv) *Revenue*

Revenue rates for each services provided within the logistics hub were obtained from a comparable project in India. These were escalated to 2014 values and then applied to the relevant throughput values to derive annual revenue amounts. The following revenue assumptions were made.

- Av. No.lifts/TEU (Assume 40% require 1 lift and 60% require 2 lifts) = 1.6
- Average cargo storage beyond 3 days (days) = 2
- Average cold storage, days = 7
- Charge per lift (Rs. per TEU) = 500
- Stuffing/destuffing (Rs. per TEU) = 1500
- Break bulk handling (Rs. per tonne) = 116.99
- Overtime CFS storage (Rs. per tonne per day beyond 3 days) = 175.48
- Office lease rental (Rs. per square metre per month) = 314.81
- Cold storage rental (Rs. per cubic metre per day) = 20.66
- Warehouse rental (Rs. per square metre per year) = 3022.14
- Area available for warehouse rental, square metres = 3750

The calculation bases and the resulting revenue flows are indicated below.

Table 7.30: Ponneri Logistics Hub - Estimated Revenue Flows (2014 values)

Fiscal years	*CY volume*	*No. of lifts pa*	*CY container lifting revenue, Mn Rs.*	*CFS stuffing/ unstuffing volume. TEU*	*CFS revenue, Mn Rs.*	*Break bulk handling volume, tonnes*	*Break bulk handling revenue, Mn Rs.*	*Overtime storage volume, tonnes*	*Warehouse storage revenue, Mn Rs,*	*Cold storage revenue, Mn Rs.*	*Warehouse rental space, Sqm*	*Warehouse rental income, Mn Rs.*	*Office rental space, Sqm*	*Office rental income, Mn Rs.*	*Total Revenue Mn Rs.*
2017/18	46117	73787	36.89	11067	16.60	208337	24.37	10417	3.66	1.91	3750	11.33	500	1.89	96.65
2018/19	52731	84370	42.19	12655	18.98	238220	27.87	11911	4.18	2.18	3750	11.33	600	2.27	109.00
2019/20	59346	94954	47.48	14242	21.36	268103	31.36	13405	4.70	2.46	3750	11.33	700	2.64	121.34
2020/21	65961	105538	52.77	15830	23.74	297986	34.86	14899	5.23	2.73	3750	11.33	800	3.02	133.69
2021/22	72576	116121	58.06	17417	26.13	327869	38.36	16393	5.75	3.01	3750	11.33	900	3.40	146.03
2022/23	79191	126705	63.35	19005	28.51	357752	41.85	17888	6.28	3.28	3750	11.33	1000	3.78	158.38
2023/24	90549	144879	72.44	21731	32.60	409067	47.86	20453	7.18	3.75	3750	11.33	1100	4.16	179.31
2024/25	101908	163053	81.53	24457	36.69	460382	53.86	23019	8.08	4.22	3750	11.33	1200	4.53	200.23
2025/26	113267	181227	90.61	27183	40.77	511696	59.86	25585	8.98	4.69	3750	11.33	1300	4.91	221.16
2026/27	124626	199401	99.70	29909	44.86	563011	65.86	28151	9.88	5.16	3750	11.33	1400	5.29	242.09
2027/28	135984	217575	108.79	32635	48.95	614325	71.87	30716	10.78	5.63	3750	11.33	1500	5.67	263.02
2028/29	155489	248783	124.39	37316	55.97	702442	82.18	35122	12.33	6.44	3750	11.33	1560	5.89	298.53
2029/30	174995	279991	140.00	41997	62.99	790558	92.48	39528	13.87	7.25	3750	11.33	1620	6.12	334.05
2030/31	194500	311199	155.60	46678	70.02	878674	102.79	43934	15.42	8.05	3750	11.33	1680	6.35	369.56
2031/32	214005	342407	171.20	51359	77.04	966791	113.10	48340	16.97	8.86	3750	11.33	1740	6.57	405.08
2032/33	233510	373615	186.81	56040	84.06	1054907	123.41	52745	18.51	9.67	3750	11.33	1800	6.80	440.59
2033/34	233510	373615	186.81	56040	84.06	1054907	123.41	52745	18.51	9.67	3750	11.33	1800	6.80	440.59
2034/35	233510	373615	186.81	56040	84.06	1054907	123.41	52745	18.51	9.67	3750	11.33	1800	6.80	440.59
2035/36	233510	373615	186.81	56040	84.06	1054907	123.41	52745	18.51	9.67	3750	11.33	1800	6.80	440.59
2036/37	233510	373615	186.81	56040	84.06	1054907	123.41	52745	18.51	9.67	3750	11.33	1800	6.80	440.59
Total (20 years)			2279.03		1025.52		1505.58		225.84	117.97		226.66		100.49	5481.08

Source: Emerging Kerala 2012 Logistics Park proposal

(v) *Revenue and O&M cost comparison*

The comparison of the revenue and O&M cost streams, shown in the table below, indicates a healthy surplus of revenue over costs for the Ponneri Hub.

Table 7.31: Ponneri Logistics Hub - Comparison of Revenue with O&M Costs

Year	Wage costs (operating labour) Mn Rs.	Salary costs (admin and customs personnel) Mn Rs.	Fixed asset repair and main-tenance, Mn Rs.	Equipment repair and main-tenance, Mn Rs.	Adminis-trative overhead, Mn Rs.	Total O&M cost, Mn Rs.	Total revenue, Mn Rs.	Net revenue, Mn Rs.
2017/18	15.43	13.61	6.56	2.65	7.65	45.90	96.65	50.76
2018/19	16.68	14.55	6.56	2.65	8.09	48.52	109.00	60.48
2019/20	16.68	14.55	6.56	2.65	8.09	48.52	121.34	72.82
2020/21	16.68	14.55	6.56	2.67	8.09	48.55	133.69	85.14
2021/22	17.93	15.49	6.56	2.67	8.53	51.18	146.03	94.86
2022/23	18.76	16.43	6.56	2.76	8.90	53.41	158.38	104.97
2023/24	20.01	17.37	6.56	2.76	9.34	56.04	179.31	123.27
2024/25	20.01	17.37	6.56	2.76	9.34	56.04	200.23	144.19
2025/26	20.01	17.37	6.56	2.80	9.35	56.09	221.16	165.07
2026/27	21.26	18.31	6.56	2.84	9.79	58.77	242.09	183.32
2027/28	23.76	20.66	7.33	2.87	10.92	65.55	263.02	197.47
2028/29	25.02	21.60	7.33	2.91	11.37	68.23	298.53	230.31
2029/30	27.10	23.47	7.33	3.00	12.18	73.09	334.05	260.96
2030/31	28.35	24.41	7.33	3.02	12.62	75.74	369.56	293.82
2031/32	29.60	25.82	7.33	3.08	13.17	79.01	405.08	326.07
2032/33	32.10	27.70	7.33	3.09	14.04	84.27	440.59	356.32
2033/34	32.10	27.70	7.33	3.09	14.04	84.27	440.59	356.32
2034/35	32.10	27.70	7.33	3.09	14.04	84.27	440.59	356.32
2035/36	32.10	27.70	7.33	3.09	14.04	84.27	440.59	356.32
2036/37	32.10	27.70	7.33	3.09	14.04	84.27	440.59	356.32
TOTAL (20 YEARS)	477.80	414.08	138.91	57.53	217.66	1305.97	5481.08	4175.11
Admin overhead rate		20%						

7.3.6. Development plan

Construction of the logistics hub should be completed to coincide with the commencement of manufacturing activity in early 2018. Construction would be undertaken within the two year period 2015/16-2016/17 and initial equipment acquisition within 2016/17.

Responsibility for construction would rest with the hub operator selected by a process of competitive bidding. Financing of the project with an initial capital cost estimated at Rs.949.92 million would be provided from equity funds (60%) and a Japanese ODA loan (40%).

7.4. Power

7.4.1. Sector Overview

The historical trend of power requirement in the three states – Karnataka, Andhra Pradesh and Tamil Nadu was analysed. Electricity demand forecasts for the Business as Usual (BAU) scenario was made based on the latest 18th EPS (Electric Power Survey). The EPS used the base year of FY 2009-10, deviations from the actual data observed for the years FY 2011 to FY 2013 were revised. With a massive investment coming up in the Chennai Bangalore Industrial Corridor (CBIC), accelerated scenario was also considered. Further the electricity demand was classified for each state across domestic, commercial, industrial, agricultural, transportation and miscellaneous. Upcoming power projects were analysed to estimate the supply of power in short term in the three states. Demand and supply gap was analysed with focus on capacity addition plans to assess the power position of the states.

Table 7.32: Demand and supply gap analysis in the various scenarios

Scenario	Year	Demand (MW)	Supply (MW)	Gap (MW)
Current	FY2013-14	35,223	27,310	7,913
Short Term	FY2017-18	42,548	50,680	(8,132)
Mid Term	FY2022-23	64,324	-	13,644
Long Term	FY2032-33	147,948	-	97,268

It is imperative that the generation growth required for the plant be matched with corresponding growth in distribution and transmission sector. The transmission infrastructure development plans comprise of plans for meeting the generation capacity additions, system strengthening, reducing congestion, establishing point to point evacuation links from generating plants etc. The state transmission utility of Tamil Nadu, TANTRANSCO has planned for approximately USD 1,667 million of transmission investment over the next 2 years.

During the year 2013-14, 28 nos. 33 kV substations have been erected, 10,007 kms of LT lines and 4,089 kms of HT lines have been energized. TANGEDCO had also effected service connections to 10.04 lakhs new consumers. To strengthen the distribution network further, it is programmed to lay 15,000 kms of High Tension and Low Tension lines during 2014-15. Moreover, it is proposed to enhance capacity of 120 numbers of power transformers in the substations. TANGEDCO has planned to replace the existing aged HT/LT lines at an estimated cost of Rs 1,054.22 crores in a phased manner.[39]

7.4.2. Framework of Infrastructure development

Needs of a consumer

In order to design a robust city power infrastructure from ground's up, it is critical that we understand the needs of the prospective consumers that would be based out of the upcoming node. For example, in large industries like textile, automobiles etc. energy forms almost 20-25% of the total operating costs (second only to raw material costs). In such a case, the attractiveness of the node to industrial consumers would primarily depend on continuous availability of quality and cost-effective electricity. This section captures key consumer expectations from power supply perspective. *(Source: Primary interactions with state industrial associations, 2014):*

[39] http://www.investingintamilnadu.com/files/whats_new_docs/Energy_Policy_Note_2014_15.pdf

1. Reliability: A consumer establishing a base in the node would need round the clock electricity so as to avoid usage of local back-up power supply sources like diesel sets etc. that would increase consumer' capital burden and also have a higher environmental impact. The design philosophy is built around the objective that all consumers in the node will have access to round the clock quality power.

2. Quality: Many industries like textile, telecom etc. use sensitive voltage regulated equipment. In case the power supply from the utility is of poor quality (voltage instability, interruptions etc.), the life of such equipment can be affected. In such cases, installations of voltage regulators/UPS etc. are additional capital costs that the consumers' needs to incur. Hence, ensuring the quality of supply for all consumers has been a key consideration in the infrastructure design.

3. Affordability: The desired levels of reliability and efficiency have to be balanced through optimum pricing of the electricity that is within industry benchmarks. The consumer would want electricity tariffs that are affordable for the overall business operations. The high costs can prompt consumers to look for open access procurement making the present distribution network plans redundant. In extreme situations, this could also lead to consumer relocation to a more favorable node/area. The overall cost of electricity is dependent on a number of external and internal factors and is under regulatory purview. However, from a design perspective, there has been a constant focus on avoiding unnecessary capital expenditure without impacting the other design considerations.

4. Safety: Equipment failures are one of the most prevalent reasons for hazards to consumer property/life. A consumer would want, in all cases, that the network should have automatic procedures to protect him from hazards like fire/short circuits etc.

5. Customer Service: A consumer wants that the utility should be responsive to his queries/problems. In the present system of private utilities in metros like Delhi, consumers are aware of the best practices in customer management like internet based payment, grievance management cells, pre-payment discount based billing, independent kiosks for customer grievance resolutions etc. It would be the expectations of all consumers coming into the node that these basic facilities should be provided from the distribution utility.

6. Sustainability: Nowadays the element of sustainability forms an integral part of all power systems design. This means that the power generation /transmission/distribution should be done in a manner to have least carbon consumption. For generation it may mean installing more renewable based plants. However for transmission it may mean effective voltage level regulation or for distribution it can mean installation of smart grid for consumers and keeping losses within prescribed limits.

Needs from power systems

Corresponding to these consumer needs, a power system would need to have the following features:-

1. Redundancy of operations – As consumer needs dictate that the system should be available round the clock enough redundancy in the operations needs to be built in for supply assurance. For transmission it can mean designing the system such that for every line failure, the system can assure power to affected consumers via 2 different routes (N-2 principle) or for distribution it may mean ring main interconnections of feeders as well as sub stations.

2. Maximum efficiency– The system should have minimal losses for the node. Considering the transmission and distribution loss levels in the country exceed 25% on an average across utilities *(Source: "The Performance of State Power Utilities for the years 2010-11 to 2012-13", PFC report),* the node should target maximum increase in efficiency. We have seen utilities like TPDDL and BSES have been able to reduce Aggregate Technical and commercial losses to less than 11% in large area like Delhi. Considering that we are using new equipment and smart technology for implementation in the node, the target for the node should be to achieve at least 8-10% losses in the phase II.

3. Integration with multiple sources of supply: The proposed power system would need to seamlessly integrate with the in-node distributed renewable energy sources. With the envisioned increase of renewable energy share in India's power generation, there would be similar renewable capacity additions within the proposed node and hence integration issues would be of prime importance. It is therefore essential to preemptively address any such issues during the design stages itself. Introduction of smart distribution control systems would provide the much needed flexibility to manage the entire power value chain.

4. Integrate operations on IT platform for maximum efficiency: With the development of power systems, the power grid within a control area, becomes much more complicated due to increasing number of nodes and renewable energy interconnections. An integrated power system control center is essential in maintaining system reliable and security operations. Use of latest information and communication technologies would provide a platform to enhance the functions and performance of power system control center. Smart power dispatch concept will be the trend of future control center development. This needs to be enabled in the current design of the node.

5. Transmission system stability: Majority portion of the investment in India's transmission sector are directed towards construction of new transmission lines and substation. Whereas spending towards the improvement of the stability of the system is low. It is our expectation that the state power transmission company would increase the investment in the region surrounding the node, which shall improve the quality of the electricity transmission and efficiency.

Needs from generators

Corresponding to consumer as well as power system features the power generators would need the following features:-

1. Operational Flexibility: Conventional power plants supplying power to the node should be able to cater to variations in demand and use of renewable source integrated into the grid. This would mean running at varying loads as per the use of energy by industries and other consumers.

2. Energy Efficiency: The design of the power plant should make generation fuel efficient at any load. This would mean getting more energy from the same amount of fuel and ensuring sustainability of power generation.

3. Fuel flexibility: Power generation plants should be designed in a way that cascading plants can lead to use of multiple sources of generation including gaseous and liquid fuels, including biofuels. Smart plants should be able to switch from one fuel to another without stopping.

7.4.3. Design Conditions

Considering the varying stakeholder expectations, the infrastructure design conditions have been prescribed upfront for the various network components.

Grid Substation

The grid substation design can broadly be segregated across primary and secondary equipment base. While primary equipment would be on the input side, the secondary equipment on the distribution side of the substation.

Primary equipment

The key design expectations from the substation primary equipment will cover the following:

1. Reliability: Controllability of power transfer, high efficiency, improvement in carrying capacity, increased situational awareness, redundancy improvement.

2. Safety: Limitation of touch and step potential (voltage), risk of fire or explosion, avoidance of unauthorized users or intrusion by continuous surveillance, and seismically qualified equipment.

3. Environmental impact: Site-adapt aesthetic, lowering above-ground level, limitation of electromagnetic and electric field, low level of noise emission, and use of waste recycling.

4. Flexibility: Plug-and-play design, integrated compact design, low level of maintenance and easier operation.

5. Footprint: minimum technical losses as possible.

6. Costs: low cost equipment, minimized life-cycle cost.

Secondary equipment

The secondary equipment design will mainly focus on the following criteria:

1. Reliability: Secondary equipment should be integrated and compact. The secondary functions should have extensive communication, typically done using fiber optics, coaxial cables and wireless means. The protections devices should be available as redundant systems which can work independently of each other.

2. Interoperability: the implementation of IEDs should allow seamless communication within secondary system, as well as interfacing to network management system. The communication protocols should allow for interoperability between different IEDs that communicate among themselves

3. Controllability: improved local manual and automatic functions, achieve high speed response in real-time.

4. Re-configurability: future changes, upgrades and retrofits are simplified and can be done with minimal time and effort (manpower).

5. Economic Benefits: green-field substation design should take into account energy market participation, profit optimization and system operation risk reduction in a combined consideration.

With the focus on the above needs and CERC and state regulatory guidelines, following conditions would have to fulfill by the proposed system design.

Distribution network

In distribution, the location of the sub stations should be such that it caters to the rising demand of the node in an efficient manner. Technical considerations of the state dictate that any 11kV line should not exceed 5-10 Kms in length. Similar is the consideration in case of LT level line which can't exceed more than 500 meters to enable technical losses reduction for the state. This dictates the location of the sub stations to be nearer to the consumption point.

Distribution networks in India incur a loss of more than 10% on electricity transmission from nearest distribution sub-station to the consumption point. This is the key reason that metropolitan cities are now moving to underground systems for transmission of electricity. From a design perspective, the key to designing an ideal smart network is to meeting the consumer needs from the infrastructure. Based on the consumer needs in 6.4.2 (Framework on Infrastructure Development), a distribution network needs to have the following features for success:-

1. Easy maintenance – Distribution networks are prone to outages due to local constraints. In such systems, the ability of the utility to easily maintain the system is one of the prime criteria for new system installations.

2. Stability - Indian power sector is experiencing a rapid growth in the renewable energy share, especially from solar and wind sources. For this node, while wind energy would not be generated inside the node, there are possibilities of solar based distributed generation across the geographic spread of the node. It therefore becomes essential to utilize the unpredictable renewable supply, both from inside the node and outside, while balancing the expectation of reliability and cost. As already mentioned earlier, smart grid interventions would need to be implemented for better integration.

3. Fast installation and operation – Ease of installation and operation of the system is also an important criterion for designing the distribution network.

4. Maintains the ambience of the node – With development of infrastructure, the ambience of the node also is a criterion for selection of any distribution network.

5. Can be automatically controlled via a control center – With multiple utilities integrating, power systems should also be able to integrate with the system and controlled via a common control center.

On these parameters, underground distribution networks are assessed:-

Table 7.33: Underground distribution network: Characteristics

Advantages of underground distribution network	Disadvantages of underground distribution network
Joint-Use – Underground utilities can utilize a joint-use trench and reduce the overall construction costs of a project. A single trench commonly shared by all utilities will result in lower construction costs. Customer installed conduit, duct bank and manholes can also reduce the cost to install utilities underground.	**Costs** – Underground utilities have higher installation costs typically in the range of 1.5 times to 2 times the overhead cables. However with sharing across utilities the cost can come down when considering the Lifecycle cost.
Increased Public Safety – Burying utilities can reduce the potential for fatalities and injuries as well as outages as a result of contact with overhead conductors. In addition, burying utilities can eliminate the potential for fatalities and injuries as a result of collisions of vehicles	**Cable Failures/Repair Costs** – It is more difficult and time consuming to repair subsurface utilities. Also, Property owners provide unauthorized screening of pad-mounted equipment and underground cables.
Aesthetics – A primary reason to bury overhead utilities is aesthetic. Aesthetic benefits include increased property values by preserving the natural beauty of the land, more attractive streetscapes with greater pedestrian activity, and a better quality of life. The one time investment of undergrounding produces aesthetic rewards for generations. Undergrounding results in fewer poles and improved pedestrian access.	**Excavation** – Disruption in service can occur as private property or lawns are excavated. However this may not be applicable green field projects.

From the assessment, underground distribution networks present a better case for the node as compares to conventional distribution network. It is operated through a RMU (Ring Main unit) which is an individual switchgear unit to handle medium level distribution. This is placed on top of a tray which is feeding the incomers for the distribution network. The outcomes from the RMU are being fed into the consumer transformers for consumption. Please refer to the annex on the illustrative diagrams of the network for the node.

The distribution network will follow the following design conditions in line with the industry standards:

1. Maximum loading for the substations is considered as 80%, remaining 20% would be as spare capacity, thus increasing operational flexibility

2. 'Ring Main Unit' designing is considered while designing the distribution network, which would increase reliability

3. Underground cabling system would ensure safety against storms and other environmental problems. It would also increase the aesthetics and looks

4. Monitoring and automation thorough SCADA, load balancing and fault monitoring activities would be some of the key design conditions

5. The technical losses, for the various network component, will follow the following norms:

Table 7.34: Loss level for the node power network

System level	Loss % (Min-Max)
Step-up transformers & EHV transmission system	0.5% - 1.0%
Transformation to intermediate voltage level, transmission system & step down to sub-transmission voltage level	1.5% - 3.0%
Sub-transmission system & step-down to distribution voltage level	2.0% - 4.5%
Distribution lines and service lines	3.0% - 7.0%
Total	**7.0% - 15.5%**

The overall network design has been done based on the aforementioned design principles.

7.4.4. Demand Forecast

Existing gap in infrastructure

The demand is estimated to be spread across three key categories – Industrial, Domestic and Others including lighting, commercial etc. The table below demonstrates phase I, phase II and Phase III power demand estimate for the node.

Table 7.35: Power demand estimates for various years, PwC analysis

Category	FY 2016	FY 2019	FY 2022	FY 2025	FY 2028	FY 2031	FY 2033
Industrial (MW)	8.69	43.20	97.90	183.74	320.37	541.28	642.83
Residential (MW)	9.21	16.56	32.79	60.94	118.60	230.94	290.56
Others (MW)	2.04	10.16	23.02	43.20	75.32	127.25	151.12
Total expected demand (MW)	19.94	69.91	153.71	287.88	514.28	899.47	1,084.51
Diversity Factor (DF)*	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Maximum demand (MD)	13.96	48.94	107.59	201.51	360.00	629.63	759.16

From the estimates in phase I around 70 MW of demand is expected in the node. However, in phase II this demand is expected to increase to 235 MW. This is due to rise in industries and corresponding domestic demand coming up in the region. In Phase III the demand is expected to stabilize around 1084 MW for the region as industry growth in the node also stabilizes. Assumptions made for the forecasting of the demand are mentioned in Appendix.

Considering the supply numbers, existing sub stations have minimal spare capacity for any load coming from new industry growth. Hence, due to the segmented nature of the available capacities across sub stations, it is imperative that the node creates fresh infrastructure in order to sustain for coming 20 years.

Table 7.36: Gap assessment for the node

Category	FY 2016	FY 2019	FY 2022	FY 2025	FY 2028	FY 2031	FY 2033
Maximum demand (MD)	13.96	48.94	107.59	201.51	360.00	629.63	759.16
Total available capacity as per existing infrastructure (MW)	25.50	25.50	25.50	25.50	25.50	25.50	25.50
Usable capacity for the node	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Demand for which system needs to be designed (MW)	10.46	45.44	104.09	198.01	356.5	626.13	755.66

In phase II it would be required power infrastructure to cater to the demand of almost 165 MW. This will increase to 755 MW in phase III.

Table 7.37: Scenarios for design gap (MW), PwC analysis

Category	Total Demand (MW)	Maximum gap for system design (MW)
Phase I (2019)	69.91	48.94
Phase II (2024)	235.8	165.05
Phase III (2032)	1,084.51	759.16

Considering the philosophy for design, it would be required to have varying strategies for meeting existing and upcoming demand. In phase I considering that the expected demand is close to 70 MW, this can be met by present system of the utilities with marginal outside additions. However, in phase II and III, it would be required to have sizable additions from outside in order to ensure round the clock power to the node.

7.4.5. Development Plan

Available sources for meeting the gap

The node has about 3660 MW of thermal capacity operational. This capacity currently is being transmitted to outside the node for consumption. Also, the node has about 2000 MW of capacity coming up in the near term. Currently with lack of demand in the node, this power is also expected to be transmitted outside the node for consumption in the southern grid.

Table 7.38: Status of existing and upcoming power plants in node

Power Plant	Capacity (MW)	Location	Ownership	Status of the plant
NCTPS-I	3 X 210	Kalanji	TANGEDCO	Operational
NCTPS-II	2 X 600	Kalanji	TANGEDCO	Operational
Vallur TPS	3 X 500	Vallur	NTPC/ TANGEDCO	Operational
Ennore TPS	3 X 110	Ennore	TANGEDCO	Operational
NCTPS-III	1 X 800	Kalanji	TANGEDCO	Upcoming post FY 17
Ennore SEZ	1 X 660	Ennore	TANGEDCO	Upcoming post FY 17
Ennore-II	1 x 660	Ennore	TANGEDCO	Upcoming post FY 15

Hence, for meeting the gap the most effective methodology would be to tap the existing power plants in the node. However, the existing and upcoming power plants would already have tie ups for power sale. Hence, an assessment has been undertaken on the spare capacity available for the node in these existing plants.

Table 7.39: Spare capacities of the existing power plants

Power Plant	Capacity (MW)	Status of the plant	Existing Tie ups (MW)	Beneficiaries	Spare Capacity (MW)
NCTPS-I	3 X 210	Operational	100%	TANGEDCO	0%
NCTPS-II	2 X 600	Operational	100%	TANGEDCO	0%
Vallur TPS	3 X 500	Operational	100%	Multiple States	0%
Ennore TPS	3 X 110	Operational	100%	TANGEDCO	0%

From the analysis, we understand that the existing plants have 100% of capacity tied up with outside node PPAs. In the coming 3 years, Ennore II power plant is available for supply to the node in case the existing power sale agreements of the generation plants can't be modified.

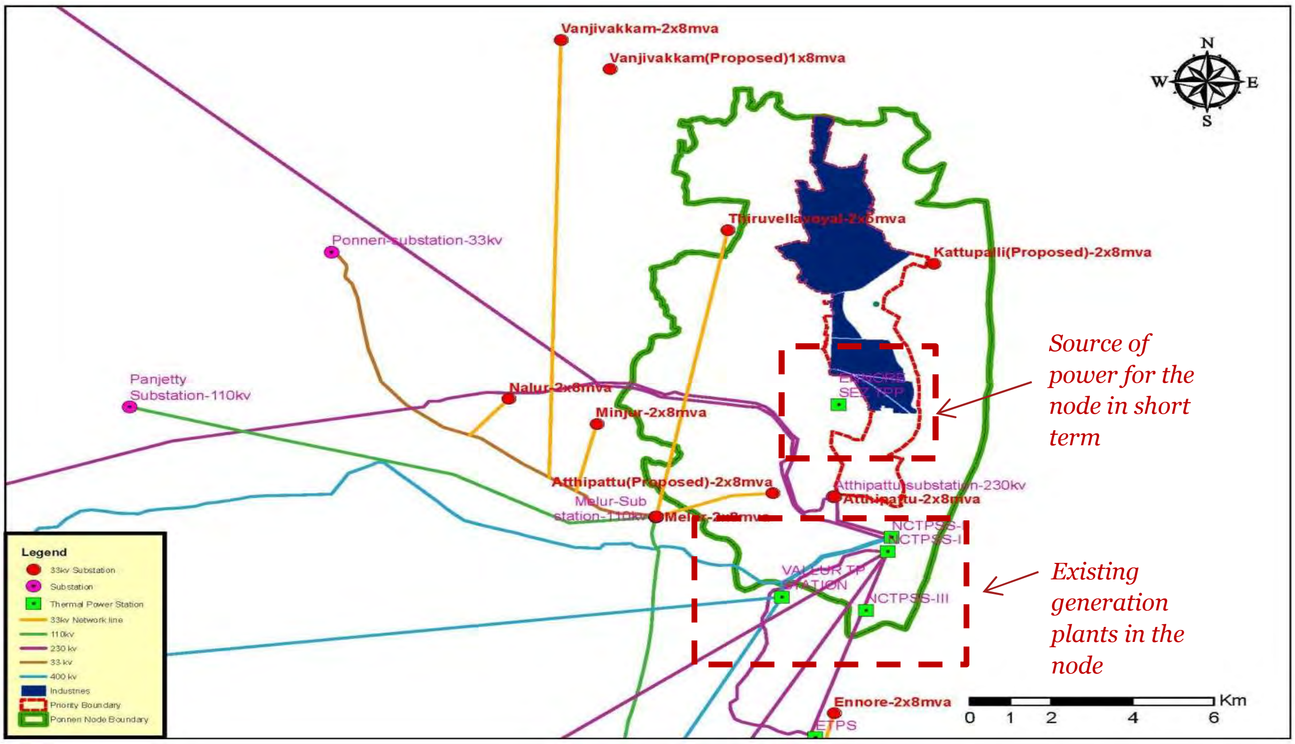


Figure 7.39: Short term availability of power for the node

In the Phase II (2024) we would have Ennore SEZ and NCTPS-III power plants coming up in the node which can be used for power consumption. These would also be sufficient for the long term procurement.

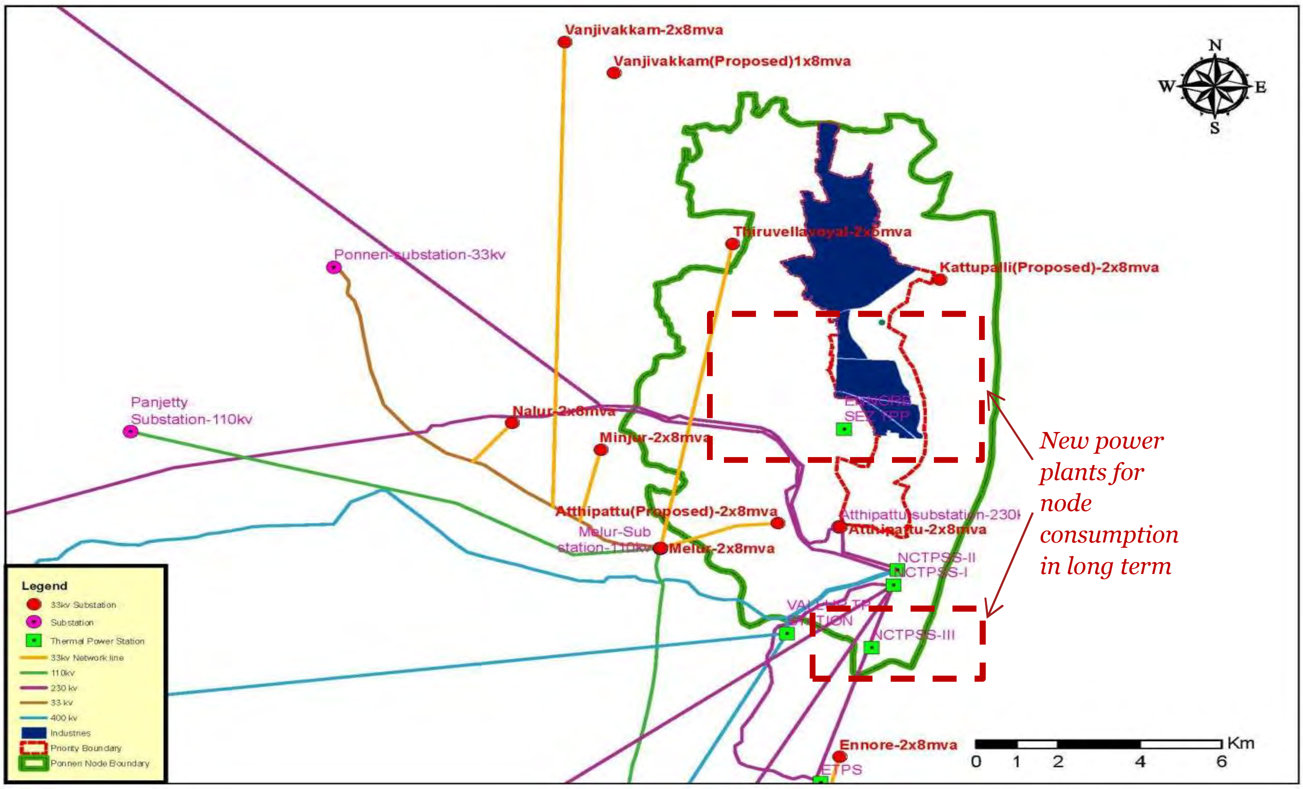


Figure 7.40: Short term availability of power for the node

Sub-station requirement

For the distribution network, the additional sub stations should ensure that the power availability is ensured for the consumers. Hence, the S/S should be able to meet the upcoming demand in phase II as well as phase III. Typically, we have distribution substations in the range of 33kV/11kV with capacities varying from 15-48 MVA capacity of handling load. Taking this in mind, we can design the optimal number of distribution sub stations required for meeting the demand.

Table 7.40: Distribution sub-station requirement (Nos.)

Characteristics	2016-19	2020-24	2025-32
Total demand expectation for system design (MW)	48.94	165.05	759.16
System design for 80% loading condition in the node(MW)	61.17	206.31	948.95
System power factor	0.8	0.8	0.8
Total installed capacity (MVA)	76	258	1,186
Capacity of each distribution sub- station (MVA)	48*	48	48
Additional distribution sub-station requirement (Nos.)	2	4	26

* As per discussion with TNEB, in urban area 3x16MVA capacity indoor Substation are installed.

Also, considering the high demand coming in the region, we also propose installation of a Main Receiving Sub Station (MRSS) in the region that would feed the other distribution sub stations. This would be based on GIS based technology and would be owned and operated by transmission utility of the state.

Table 7.41: Transmission sub-station requirement (Nos.)

Characteristics	2016-19	2020-24	2025-32
Total installed capacity (MVA)	76	258	1,186
Current Transmission Capacity with augmentation (MVA)	20.00	20.00	20.00
Proposed addition in transmission capacity (MVA)	0	300	1,200
Key characteristics of transmission S/S	2 X 150 MVA, 220/ 33 kV Gas Insulated Sub-station for the region		

The plan for distribution and transmission capacity augmentation would ensure that for any consumer (industry/commercial/domestic/other) the node would have adequate infrastructure for ensuring the availability of electricity. This MRSS (Main Receiving Substation) would either be fed through a direct 220 kV line from the generation station (Existing in phase I or proposed in the phase II/III) or would be fed from a new designed transmission sub-station outside the node.

Location and tapping points

In line with the aforementioned philosophy, each sub-station has been sized to meet a maximum of 48 MVA load to ensure higher network reliability. The sub-station location is as per the following characteristics:

1. The location needs to be close to higher demand areas of the node (typically industries)
2. The locations should be optimized to ensure that internal network is minimized for cost optimization
3. The phasing of the sub stations should be such that tapping points are covered initially and then progressively, we can look into flow of demand into the node to ensure optimality in design.

Further, the locations of the sub stations have been proposed based on the available spare capacity in the existing transmission network as below:-

1. In the 2016-19 period, the input flow would be from the Mellur transmission Sub-station (132kV, 2X150 MVA) into the proposed sub-station S1 for fulfilling demand of the node. Additionally, we would also use proposed power plant (Ennore-II) for power transmission into the network. Exact quantum of power would depend upon the exact PPA signed by the power plant.
2. In the 2020-2024 period, the 132kV feeder from Mellur transmission sub-station as well as 132kV from generation plant of Ennore-II would feed the Main Receiving Sub Station (MRSS) in the node which in turn would feed 33/11kV sub stations (S1 to S6). In addition, the S6 substation would also have interconnections with Vanjivakkam and S4 would be connected to Thiruvellavoial for better system reliability and possibility of future augmentations.
3. In the phase III, the 132kV feeder from Mellur transmission sub-station as well as 132kV from generation plants Ennore-II, NCTPS-III, Ennore SEZ would feed the Main Receiving Sub Station (MRSS) and additionally planned MRSS in the node which in turn would feed 33/11kV sub stations (S1 to S6) as well as newly developed sub stations (S7 to S26).

The following is the final input-output configuration proposed for the Ponneri supply network:-

Table 7.42: Ponneri input-output configuration

Sub Station	Input	Output
Ennore-II Generation plant bay	Generation plant Ennore-II	MRSS bay (132kV S/C Line)
Mellur transmission S/S (132kV, 2X150 MVA transmission S/S)	Panjetty sub-station	MRSS bay (132kV S/C Line)
Main Receiving Sub Station (MRSS) within the node	• 132kV feeder from Mellur transmission • 132kV feeder from generation plant Ennore-II in the node • 132kV feeder from Ennore SEZ in the node • 132kV feeder from NCTPS-III in the node	Distribution S/S (S1 to S26) – 33kV
Sub-Stations (1-26)	MRSS Bay (33kV), S4: Thiruvellavoial S6: Vanjivakkam	5 X 11kV feeder for consumers

The following section describes the interconnections diagrammatically for reference. The subsequent pictorials show indicative locations of the proposed substations across the short (phase I), medium (phase II) and long term (phase III) in line with the proposed demand growth.

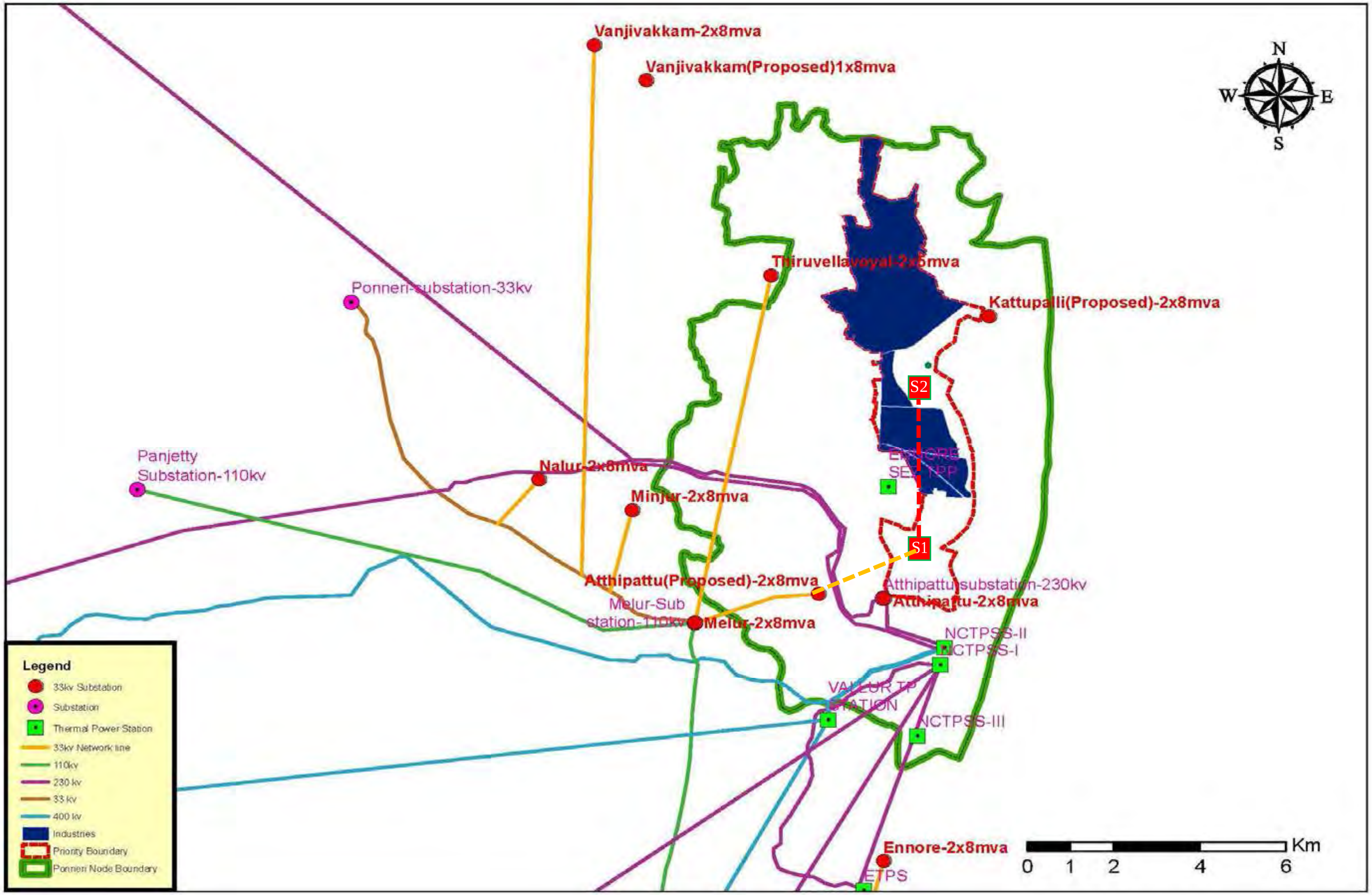


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Figure 7.41: Sub-station locations for Phase I

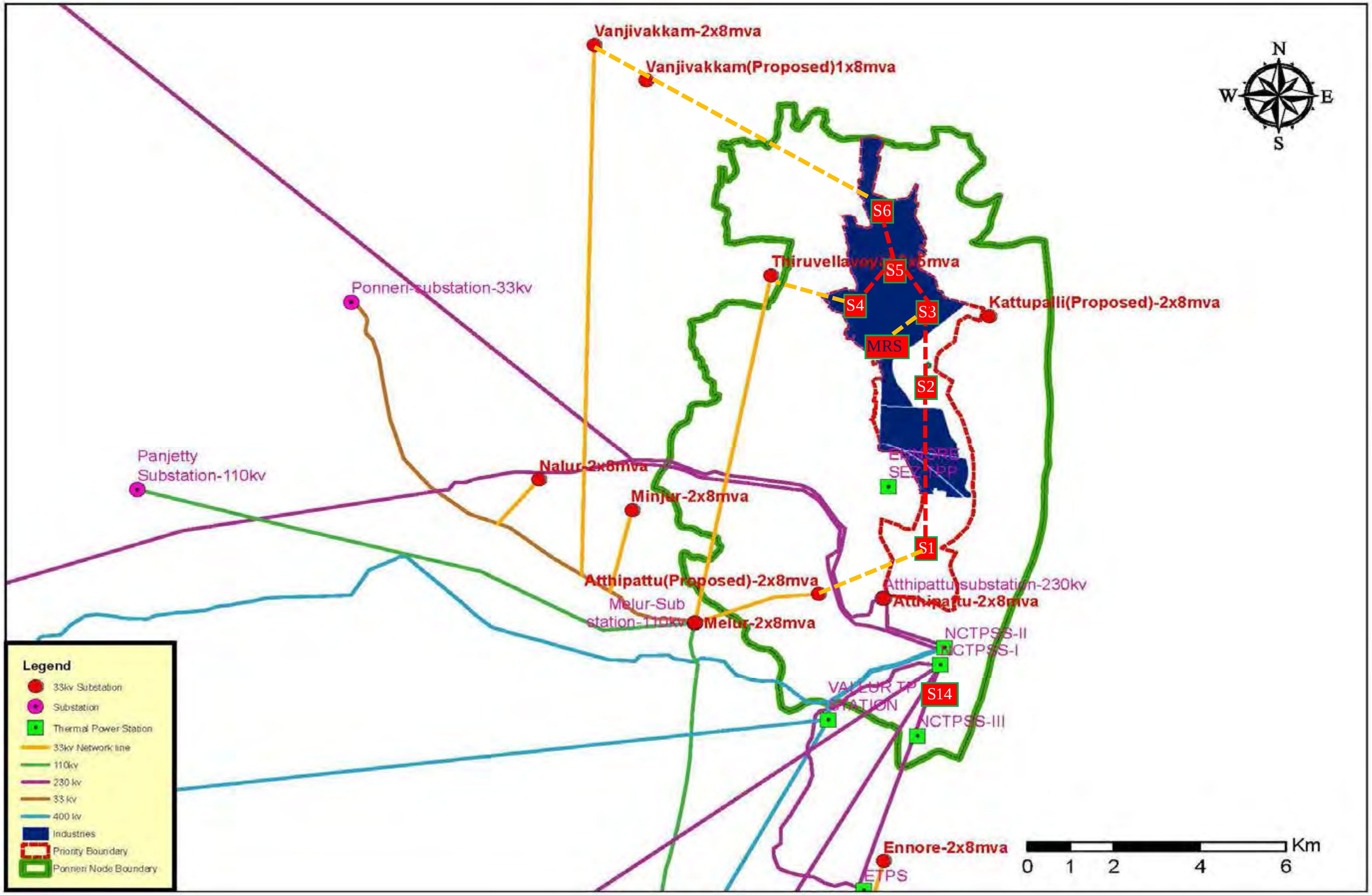


Figure 7.42: Sub-station locations for Phase II

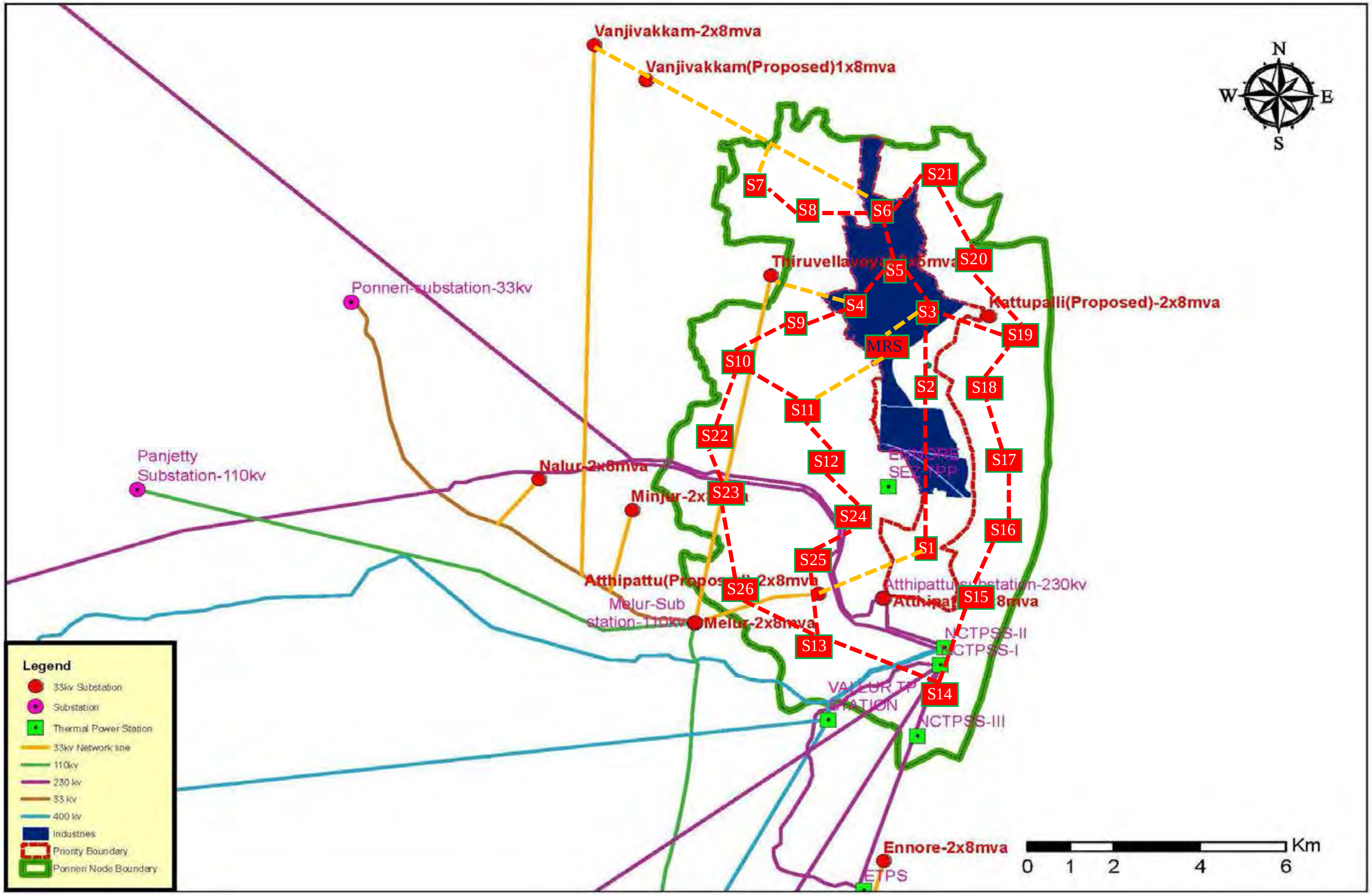


Figure 7.43: Sub-station locations for Phase III

The figures above shows the proposed locations of the sub stations for optimal energy distribution for consumers. The Main Receiving Sub Station (MRSS) for the node will act as transmission interface for the node and would be connected to a transmission sub-station in the vicinity of the node by transmission utility. In the phase III we will have 20 more sub stations coming up in the area. The locations of these stations would be dependent upon the demand growth post the phase II. Hence, it would not be possible to ascertain with certainty the locations of these 20 sub stations in the present assessment. However tentative locations are proposed in this report.

Land requirement for proposed substations

The land requirement of the sub stations can be determined by taking standard area requirement per sub-station. As per industry norms, the following is the land requirement for sub stations:-

Table 7.43: Standard land requirement for sub-stations

Characteristics	Area requirement (Sq. Mts.)
Distribution sub-station (33/11kV) – 3x16 MVA	2,878
Transmission receiving sub-station- 2x150 MVA, 220/33kV GIS Based sub-station	24,280

As per the standard sub –station requirement, we see that the land requirement for distribution and transmission infrastructure would be as follows:-

Table 7.44: Land requirement for Ponneri

Characteristics	2016-19 (Sq. Mts.)	2020-24 (Sq. Mts.)	2025-32 (Sq. Mts.)
Distribution infrastructure	5,756	17,268	74,828
Transmission infrastructure	0	24,280	97,120
Incremental land requirement from distribution and transmission perspective	5,756	35,792	130,400
Cumulative land requirement	5,756	41,548	171,948

In the phase I we would need close to 5,756 Sq. mt. of area for the distribution infrastructure. This would increase to close to 41,548 Sq. mt. of area for distribution and transmission infrastructure in the phase II and stabilize to 171,948 Sq. mt. in the phase III.

Input/output line interconnections

Based on the design philosophy, underground networks are chosen for implementation on the nodes on primary roads. These networks would be in the form of 11kV feeders from substations to consumer end. The network would flow along with road sides. Based on the master plan, primary roads have been chosen for 11kV main feeders as well as distribution transformers. On secondary roads, lower voltage lines like 440V etc. are being proposed. The actual route of these secondary road lines will be dependent upon the distribution utility and the actual node infrastructure development. The map below shows the proposed distribution network superimposed on the master plan for road. This also details down the key feeders from each sub-station. Kindly note that in underground networks, electricity lines are kept separate from with gas lines for safety reasons.

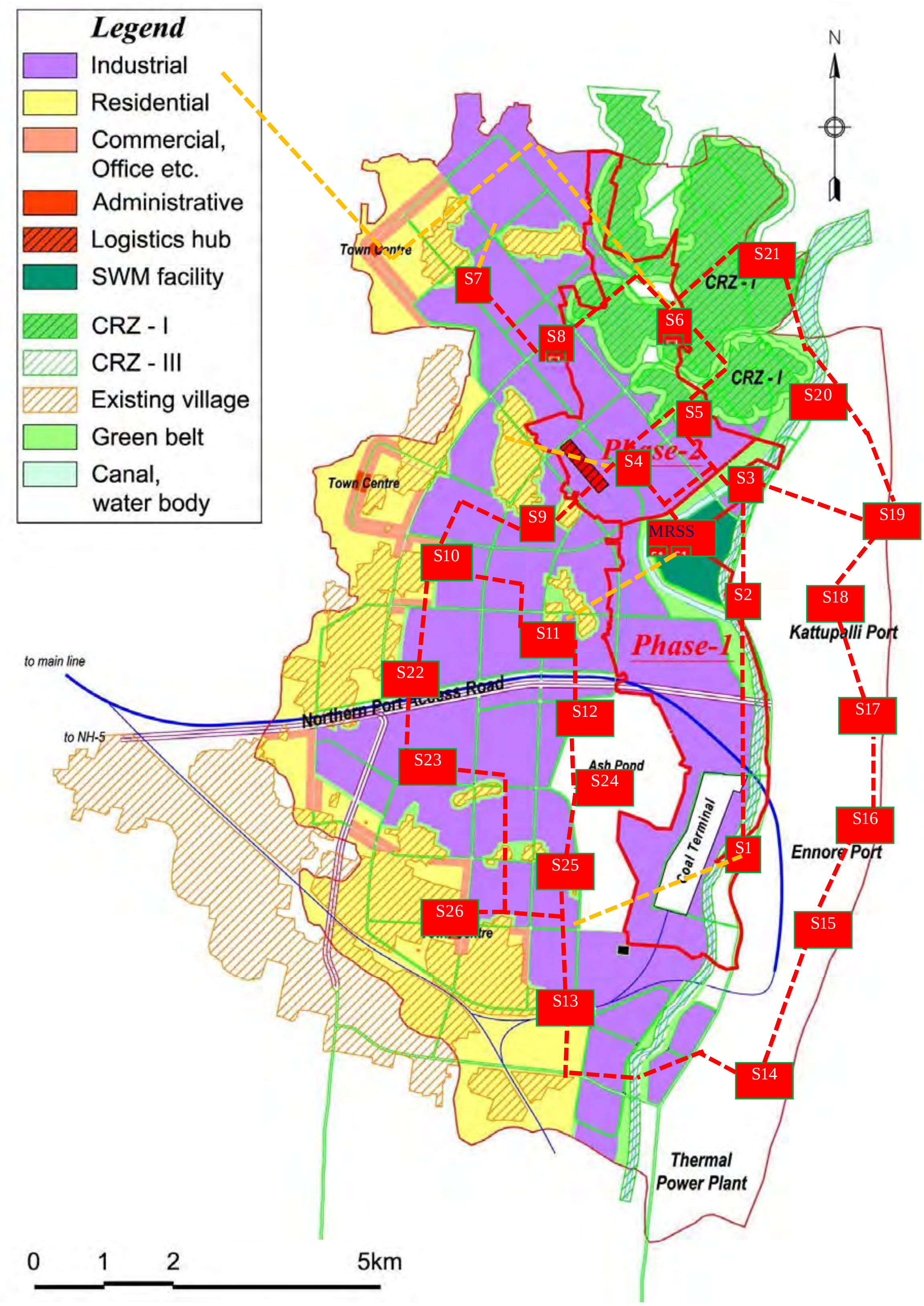


Figure 7.44: Proposed distribution network for the node superimposed on master plan for roads

7.4.6. Recommendations on generation

It is important to understand that generation unlike transmission /distribution is non location specific. This means that any plant based in Tamil Nadu can supply power to the node provided it has spare capacity and has transmission evacuation availability. Considering this, generation has been segmented into two key parts- In node generation and procured generation. In node generation is the energy that has been generated in the node itself for the consumption of the node. Typically this would be from captive renewable plants developed by industries at the time of commissioning. Procured generation would be generated by a power plant outside the node and electricity thus generated would be supplied via transmission S/S at the periphery of the node into MRSS. Below section details each and assessing feasibility of adequate generation for consumption:-

In node generation

As the present node has more than 3-4 thermal plants conventional power projects coming up in the phase II/III, in node generation would be sufficient for meeting the energy demand for the node. In addition to these captive renewable generation that consumers install in industries/homes would also be used.

The following table illustrates the upcoming power plants in the node. Considering the quantum of the power plants, the node would have enough in-house thermal generation to meet the upcoming node demand. In our design, we have connected 220kV transmission lines from Ennore-II to the MRSS for distribution within the node. In the phase II/III, we shall have 132/220kV lines from Ennore SEZ and NCTPS-II also getting connected to MRSS for redundancy of operations.

Table 7.45: Upcoming power plants in node

Power Plant	Capacity (MW)	Location	Ownership	Status of the plant
NCTPS-III	1 X 800	Kalanji	TANGEDCO	Upcoming post FY 17
Ennore SEZ	1 X 660	Ennore	TANGEDCO	Upcoming post FY 17
Ennore-II	1 x 660	Ennore	TANGEDCO	Upcoming post FY 15

RE consists of 12.6% of the supply in India and almost 70% are from wind power and that under “Strategic Plan for New and Renewable Energy Sector for the Period 2011-17” of MNRE, this would double until the end of 2016 with increasing role of wind and solar. However there are some technical limitations on extent to which such distributed generation can be viable in a closed loop system. Central Electricity Authority in its LGBR report, 2014 states that for stability of the grid in a region, the renewable should not exceed 18% of the total generated units. Also, seasonal nature of the renewable energy also poses limitations on continuous process industries in the region. Taking CEA standards for the node *(Assumption: Node being a close environment)*, 18% of the total generation would be coming from renewable energy.

Table 7.46: Renewable energy source: Expected capacity addition (MW)

Category	Total Conventional energy demand (MW)	Maximum Installed Capacity from Renewable Energy Sources (MW)*
FY 2016	21.43	4.000
FY 2022	227.26	40.00
FY 2033	430.46	78.00

* Renewable energy source generate 1.4 MU /MW/annum as compared to 7 MU/MW/annum from conventional energy sources. Taking this into account, maximum installed capacity from renewable energy has been estimated.

These power plants would be connected at 11kV voltage levels with the distribution S/S or would be consumed directly by industries at the point of consumption.

Procured generation

From the generation perspective for ensuring that the node has reliable round the clock power, the transmission sub stations of Mellur and Vanijvakkam are to be energized with adequate capacity for the node. These sub stations currently are connected to the Southern grid and hence are fed by plants across the southern grid. Looking at the current generation position of the state, we see that in the phase I the state plants would have spare capacity for feeding the node. However, in the phase II/III, additional capacity would be needed for meeting the state demand.

Considering the nature of electricity procurement, it may not be possible to judge the availability of electricity for the node. Hence, we need to look at the entire region:-

Table 7.47: Demand and supply gap for the node

Scenario	Total Demand (MW)	Supply (MW)	Gap (MW)
FY 2016	42,548	50,680	NA
FY 2022	64,324	-	13,644
FY 2033	147,948	-	97,268

It may not be feasible for the report scope to cover the entire regional energy gap, but some new developments like integration of southern grid to national grid and increase of base load capacity in the region are making it easier for the region to provide power to consumers.

For the node to ensure that power is available for the consumers, the following aspects need to be tackled:-

1. High priority of dispatch from existing generation plants should be maintained for the node. This is managed by TANTRASCO and PGCIL.

2. Allowance of open access to the node at transmission level to ensure the procurement for adequate power for the node. Managed by PGCIL and TANTRANCO.

3. Central thermal power companies can also be approached for ensuring that a fixed quantum of electricity can be provided to the node in the phase II/III.

7.4.7. Operational Plan

This operational plan provides the basic objectives, relevant stakeholder participation framework and the key steps in order to ensure seamless and reliable power to the consumer base of the node.

Objectives for the operational plan:

- **Access to all:** providing electricity availability to all categories of consumers;
- **24 X 7 reliable supply**: ensuring round-the-clock electricity supply for all strata of consumers;
- **Quality power as per specified norms:** delivering the power in accordance to the defined specification;
- **Affordable to all consumers in the node:** offering the power at optimized cost to all the consumers within the node area.

These objectives can only be realized with the help of detailed plan of action which encompasses the participation of all the stakeholders

The following steps as necessary for achieving the above mentioned objectives are: ***Relevant Stakeholders***

Meticulous planning: A detailed blueprint for power distribution and transmission network and infrastructure needs to be drawn out for identifying the required interventions that shall be required within the node. Also, with respect to the demand estimation of the node a power procurement plan needs to be developed which shall also form an essential input for the power distribution and transmission design layouts.	• Utility Planning Division, • Layout and Design Engineering Firms • Policy Makers • State Government
Execution & Commissioning: Time bound asset construction and commissioning is very important in order to deliver the project and adhere to the timelines as envisaged during the planning phase. This would require a fair amount of participation from the execution team of the utilities, vendors and the procurement and commissioning partners.	• Utility Commissioning Team, • Engineering & Procurement Firms • Vendors
Efficient distribution & retail supply: Discom would be the interface between the end consumers and sector stakeholders on one end of the value chain while interfacing with the generation sources as well as the inter-state and intra-state transmission network on the other end. In order to achieve this, following needs to be done • Appropriate load forecasting techniques with optimized power procurement plan is required for supply and distribution of power. • Integration of the core business operations of the Discom that would draw real time data from sensors and energy meters installed across various medium and low voltage network nodes. This would also form a central control center which would be responsible for network operations and running analytics on real time business data. The business reports would be available online for all key stakeholders including regulators, government and other state and central government power entities.	• Utility Operations Team • Utility Commercial Team • State Regulatory Authority

Critical success factors:

- **Integration with other utilities:** Seamless integration with other utilities/applications that would be serving the node consumers. These utilities may be provided requirement based access to the Discom IT applications with an aim to enhance the overall customer service experience. The access can be either over internet or other relevant communication channels like mobile communication etc.
- **Integration with small scale renewable generation:** The utilization of renewable electricity generation sources can provide two fold benefits of meeting the electricity demand and also managing the carbon footprints. The focus has now started shifting towards small scale and distributed renewable generation sources installed at customer premise. The consolidated capacities of such sources can contribute significantly to a Discom's supply capacities subject to the Discom's capability to integrate these sources with its electrical grid.

- **Energy efficiency:** Managing the carbon foot prints without compromising on the real energy need is the challenge which can be overcome by adopting a proactive approach to energy efficiency. Promoting energy efficiency would require a two-fold approach:

- Preemptive measures inculcated as part of the node design to ensure better utilization of electricity. This can be through standard specifications for equipment across high electricity consumption process/activities like water supply management etc.; policy mandates on constructing energy efficient buildings, promoting LED based public lighting that can have alternative electricity supply through integrated solar based generation units etc.
- Reactive adjustments to the changing electricity requirement across various constituents of the modern city, including residents, during the operational stage. This is a continuous process which shall have a standard approach of identification of electricity intensive consumer/geographic segments and taking policy or operational initiatives to minimize unnecessary consumption or shift such consumptions during off-peak hours to smoothen the overall demand curve.
-

- **Customer Empowerment:** It is imperative to develop a customer centric operating model for the Discoms to create a sustainable business environment. The empowerment would be through a number of initiatives such as:
  - Enhance customer awareness through better information sharing;
  - Be proactive in assessing customer expectations through predictive analysis of past behavior;
  - Bringing flexibility in business operations to promptly adapt to the changing customer needs;
  - Reach out to the customer through, new avenues like internet, mobile, social network etc., instead of making the customer reach out to the business;

- **Capital availability:** Availability of sufficient funds from the financial institutions is of the utmost importance for the success of the plan and eventually operating it sustainably thereafter.

- **Smart grid interventions:** The need for developing and operating the proposed distribution infrastructure on smart grid principles would require usage of smart electrical equipment and state-of-the art ICT solutions. Few solutions/interventions tailored for the node would be:-

  - Renewable energy control center: to better integration of renewable electricity supply with grid supply from conventional sources.

  - Installation of System Integrity Protection Scheme (SIPS): to detect abnormal system conditions, decide on possible course correction and take the best-fit corrective action wherever possible.

  - Advanced metering infrastructure: at consumer end for real time data assimilation from end consumers to assist in rational demand estimates and better supply management.

  - Integrated distribution management system (DMS): for integrated operations of the power value chain within the node. In this case, the value chain would comprise of primarily the distribution voltage levels.

Suggestions on prospective operational model for the node area

Distribution of power in a state/region is managed by the Discoms in the respective state/region. The priority of any specific area, within a Discom's licensee area, is almost similar across all regions owing to the Discom's universal service obligations. The Discom, should therefore, not be expected to provide any specific operational preference to the proposed node area in terms of maintaining round the clock supply of quality power and customer service.

It would therefore be preferred that the Discom should appoint a third party for undertaking the distribution of electricity in the proposed node area on behalf of the Discom. As per the Electricity Act, 2003, such entity will not be required to obtain separate license from the concerned State Electricity Regulatory Commission. In the India context, such models are in use in a number of urban areas and are referred to as 'input based franchisee (IBF) '.

Table 7.48: Comparison of operating frameworks

Comparison parameters	*Distribution Franchisee*	PPP Model	Utility based procurement
Asset ownership	• *Asset ownership remains with the utility* • *Private agency in the distribution franchisee area would be provided assets on lease for the years of operation*	• Asset ownership is transferred to the SPV created • A separate license is required for operation	• Assets owned by the distribution utility
Tariff	• *Tariff in line with state tariff* • *Concessional tariff might be applicable on power procurement*	• Tariff would be based on cost of power procurement by the licensee • Separate ARR would be filed by the utility	• State regulated tariff would be applicable on industries. No concessional tariff would be applicable. • Entire state's cross subsidy would be applicable on consumers
Political stability	• *Stable model as per current mode of operation*	• Non stable model of operation • Manpower concerns as the utility would have to withdraw manpower from the licensee area	• Stable model as current mode of operation
Complexity in operation	• *Moderate complexity in operation*	• Highly complex – Not operational in the country	• Limited as the model is based on current mode of operation
Performance standards	• *Separate performance standards (more robust that utility) would be applicable*	• State wise performance standards applicable	• State wise performance standards applicable
Capital Investment	• *Capital investment would be incurred by the private agency*	• Capital investment would be incurred by the SPV	• In domain of utility which are cash starved in target states • Also capital expenditure bound by ARR norms and can't be targeted for a particular node
Quality of supply	• *Focused approach by the private agency in reducing T&D losses as well as improve service*	• Focused approach by the private agency in reducing T&D losses as well as improve service	• Although utility can look for focused quality improvement in the node area, however it may not be feasible for the utility based models to provide round the clock power for the node

Table 7.49: Comparison of various DFs

Comparison parameters	Outsourcing	Revenue Franchisee	*Input based franchisee*
Responsibility	• Metering, billing, collection	• Revenue collection based on a given target	• *Supply onwards from input points; O&M; metering, billing, collection; release of new connections; capex*
Compensation and Bid Criteria	• Fixed fee	• Fixed fee with incentive	• *DF has right on revenue. Utility receives input rate. DF gets depreciated value of capex at the end of the contract*
Benefits	• Operational efficiency	• Collection efficiency	• *Operational & collection efficiency, reduced staffing, service improvement, technical efficiency*

Source: Policy Group Quarterly, 'Bhiwandi Electricity Distribution Franchisee Model: A Resolute step

The IBF is selected by competitive bidding and is responsible for maintenance, operation and upgrading of the distribution network. The IBF would also have the provision of procuring bulk power from the market, at competitive prices, subject to necessary approvals. The overall ownership of the franchisee area remains with the Discom but the IBF has to meet a certain minimum operational standards as specified in the contract between the Discom and the IBF.

Table 7.50: Contribution and benefits to Consumers, Discom and IBF

	Contribution	Benefits
Consumers	• Growth in consumption	• Improvement in services • Good quality and better available hours of power supply • Consumer delight • Reduction in cost of power
Licensee	• Distribution infrastructure establishment • Supplying power • Employee management	• AT&C Loss reduction • Collection efficiency improvement • Better control on the recovery of cost • Better maintenance of distribution system
Franchise	• Business management • Investments in improving system	• Financial gains • Consumer access

> **"In case [Name of the Utility] is unable to provide sufficient energy to meet the requirement of the franchise area, the franchisee may request [Name of the Utility] to source the energy, that is in deficit, from the open market."**
>
> -Clause 5.4.2, Standard Bidding Document for Input Based Urban Distribution Franchise, June 2012 MoP
>
> **"[Name of the Utility] shall also assist the Franchisee in obtaining information from [Name of the State Transmission Company] about the transmission capacity for power purchase."**
>
> -Clause 5.4.3, Standard Bidding Document for Input Based Urban Distribution Franchise, June 2012 MoP

7.4.8. Risk Assessment

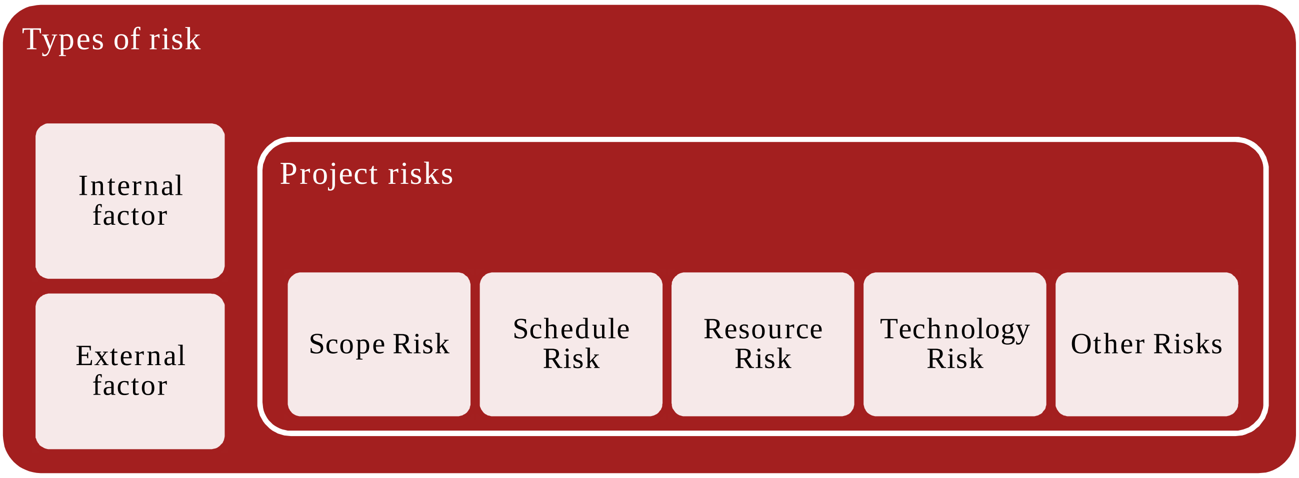


Figure 7.45: Risk Overview

Scope Risk

The basis of the power infrastructure design is the need or demand for the power. Further the demand has been forecasted based on the projection of the upcoming industries in the node area. Defining what power infrastructure is required would include uncertainties in business environment.[40]

If the industries don't come up in the phased manner or at the planned locations with minor variations then changes would have to be made in the master plan. Apart from power sourcing, transmission and distribution would also vary with the variations in the master plan.

Scope risks can be minimized and managed with savvy planning. Defining the project clearly, managing the changes in scope throughout the duration of the project, making use of risk registers to better manage risks, identifying the causative factors, and the appropriate responses to risky situations and developing greater risk tolerance in collaboration with the customer, would pay great dividends in the long run.

Schedule Risk

Keeping to timeline would be one of the most difficult factors for the implementing agency. For example setting up a substation with latest technology would require importing key parts; this may be delayed due to logistics problems. Also external factors like cyclones, rains may delay the schedule of implementation

[40] http://www.tutorialspoint.com/management_concepts/project_risk_categories.htm

When formulating the critical path, ensure that any holidays that arise are in-built into the equation, so that realistic expectations are created, right from inception. Defining re-work loops too is also recommended, wherever possible. Sufficient buffer time would be required between phases to bride the delays in a particular phase. Also internal project milestones would be necessary to timely monitor the progress.

Resource Risk

People and funds are any project's main resource base. If the people are unskilled or incompetent to perform the task at hand, if the project is under-staffed from the beginning, or if key project members come on aboard far after the inception of the project, there is an obvious project risk that has ill-planned human resources as its base.

Similarly, from a financial perspective, if insufficient funds are provided to carry out the necessary tasks, be it relevant training programs for the people in question or be it inadequate investments in technology or required machinery, the project is doomed to fail from inception.

Estimating project costs accurately, allocating a suitable budget to meet these costs, not placing undue expectations on the capacity of the staff in question and avoiding burn-out at a later date are all factors that help minimize the project resource risk.

Technology Risk

The technologies used are relatively new in India. The modern city project is being viewed as a pilot project. The technologies suggested and proposed to be used may become obsolete or not technically/financially un-viable even during the phase of the project. This would pose significant risk.

Track on upcoming technologies would have to be done. Also strong technical partners would be required who would ensure backward compatibility of the new technologies with existing ones. This would require higher funding but would also ensure minimization of the risk.

Other risks

There are various other risks which pose threat to the project. This may include external risks arising from factors (exogenous variables, which cannot be controlled) such as economic factors (market risks, pricing pressure), natural factors (floods, earthquakes), and political factors (compliance and regulations of government).

7.4.9. Investment and O&M Costs

Phase I elements and costs

Table 7.51: Elements and costs for Phase I

Sl.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
A	33kV Incoming Overhead line				
	From 110kV Melur Substation to Proposed Substation (S1)	25	KM	9.14	228.5
B	33kV Underground Feeders from MRSS and interconnections between 33/11kV Substations				
	Installation of XLPE (E) 33KV insulated ISI marked and of approved make. Aluminum conductor armored cables suitable for working voltage up to 33000 volts in existing masonry cable trench on M.S. cable trays for Substation inter connection				
	Substation S1 to S2	14	KM	22	308
C	33/11kV indoor Substation with following specifications				
	3x16MVA Power Transformer including 33kV and 11kV indoor breaker and SCADA	2	Nos.	600	1,200
D	11kV Underground Distribution system				
	Installation of XLPE(E) 11KV insulated ISI marked Aluminium conductor armoured cables suitable for working voltage upto 11000 volts in existing masonry cable trench on M.S. cable trays with 11kV Ring Main Unit (RMU) for HT connection and 11/0.430kV Package Substations for LT connection and street lighting	96	Km	38	3,648
E	Cable trench for Cable laying	100	Km	5	500
	Total				5884

In phase I and total cost of INR 11,356.5 lacs (Present Value) would be required.

Phase II elements and costs

Table 7.52: Elements and costs for Phase II

Sl.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
A	Main Receiving Substation				
	3x100MVA, 110/33kV GIS Based Substation	1	Nos.	9,000	9,000
B	110kV Overhead transmission line to MRSS	25	Km	58.25	1,456.25
C	33kV Incoming Overhead line				
i	From 33kV Vanjivakkam Substation to Proposed Substation (S6)	15	KM	9.14	137.1
ii	From 33kV Thiruvellavoial Substation to Proposed Substation (S4)	8	KM	9.14	73.12
D	33kV Underground Feeders from MRSS and interconnections between 33/11kV Substations				

Sl.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
	Installation of XLPE (E) 33KV insulated ISI marked and of approved make. Aluminium conductor armored cables suitable for working voltage up to 33000 volts in existing masonry cable trench on M.S. cable trays for Substation inter connection				
i	MRSS to Substation S1	8	KM	22	176
ii	MRSS to Substation S2	8	KM	22	176
iv	MRSS to Substation S3	2	KM	22	44
v	MRSS to Substation S4	8	KM	22	176
vi	MRSS to Substation S5	8	KM	22	176
vii	MRSS to Substation S6	10	KM	22	220
viii	Substation S5 to S6	8	KM	22	176
ix	Substation S2 to S3	8	KM	22	176
x	Substation S4 to S3	8	KM	22	176
xi	Substation S4 to S5	8	KM	22	176
E	33/11kV indoor Substation with following specifications	4	Nos.	550	2,200
i	3x16MVA Power Transformer including 33kV and 11kV indoor breaker and SCADA				
F	11kV Underground Distribution system				
i.	Installation of XLPE(E) 11KV insulated ISI marked Aluminum conductor armored cables suitable for working voltage up to 11000 volts in existing masonry cable trench on M.S. cable trays with 11kV Ring Main Unit (RMU) for HT connection and 11/0.430kV Package Substations for LT connection and street lighting	192	Km	38	7296
G	Cable trench for Cable laying	200	Km	5	1,000
	Total				**22834**

In phase II and total cost of INR 33,778.5 lacs (Present Value) would be required.

Phase III elements and costs

Figure 7.46: Elements and costs for Phase III

Sl.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
A	Main Receiving Substation				
	3x100MVA, 110/33kV GIS Based Substation	3	Nos.	9,000	27,000
B	110kV Overhead transmission line to MRSS	75	Km	58.25	4,368.75
C	33kV Underground Feeders from MRSS and interconnections between 33/11kV Substations				

Sl.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
	Installation of XLPE (E) 33KV insulated ISI marked and of approved make. Aluminium conductor armoured cables suitable for working voltage upto 33000 volts in existing masonry cable trench on M.S. cable trays for Substation inter connection				
i	MRSS to all substation and Substation interconnection	340	KM	22	7,480
D	33/11kV indoor Substation with following specifications	20	Nos.	550	11,000
i	3x16MVA Power Transformer including 33kV and 11kV indoor breaker and SCADA				
E	11kV Underground Distribution system				
i.	Installation of XLPE(E) 11KV insulated ISI marked Aluminium conductor armoured cables suitable for working voltage upto 11000 volts in existing masonry cable trench on M.S. cable trays with 11kV Ring Main Unit (RMU) for HT connection and 11/0.430kV Package Substations for LT connection and street lighting	960	Km	38	36480
F	Cable trench for Cable laying	500	Km	5	2,500
	Total				**88,828**

In phase III and total cost of INR 1, 43,548.7 lacs (Present Value) would be required.

Cost escalations and O&M cost

Future value of the capital cost would be significantly higher. For estimation of the Future Value, we have considered the inflation rate of 6.9%[41], the average for the year 2010-14.

Table 7.53: Capital cost escalation (in INR lacs)

	Phase I	Phase II	Phase III
Capital cost	5,884	22,834	88,828
Capital cost with escalation	6,800	3,91,00	2,47,500

Operation and Maintenance (O&M) cost varies for distribution companies. For estimation of O&M cost, ratio of Gross Fixed Assets for TANGEDCO for the year 2013 and the corresponding R&M cost for the distribution for 2013 has been considered which stands at 0.0057. The O&M cost for Phase I, II and III are expected to be in the same ratios. *Source: TANGEDCO tariff order dt. 20.6.2013*

[41] http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG/countries

Table 7.54: O&M cost (in INR lacs)

	2013	Phase I	Phase II	Phase III
Fixed Assets/Cumulative capital cost with escalation	10,59,500	6,972	37,067	1,88,512
O&M cost	6,070	96	703	5,425
Total		7,068	37,770	1,93,937

Net Cash outflow for Phase I would be INR 7,068 Lacs, for phase II would be INR 37,770 Lacs, for phase III would be INR 1,93,937 Lacs.

7.5. Water

7.5.1. Sector Overview

Thiruvallur District, where Ponneri Node is located, is a water-stressed area and unit water supply amount in the urban areas around the node is only 73 litter per day per capita (lpcd). This amount satisfies the target unit water supply (70 lpcd) to small-scale urban areas which does not have sewerage system. However, the amount is much less than the target supply (135 lpcd) to developed cities, which are defined as those with sewerage systems. Major water resources for domestic use in Thiruballur District is groundwater. Water resources for industrial purposes in the district are surface water (120.9 MLD: 46.5%) and groundwater (138.3 MLD: 53.2%) and seawater (0.9 MLD: 0.3%).

Regarding sanitary conditions, there is no existing sewerage scheme with sewage treatment in the district, although there is a plan of a sewerage development project in Ponneri Town. As for the flood conditions, the node is located at low lying area which is affected by tide level.

In this section, the following items are studied in order to develop water infrastructures which will support the industrial activities and people's lives in Ponneri Node.

1) Forecast of domestic water demand, industrial water demand, sewage generation and stormwater discharge in the node

2) Determination of water resource balance to satisfy the domestic and industrial water demands

3) Preparation of development plan of potable water supply system, non-potable water supply system, sewerage system, sewage recycle system and stormwater drainage system for the node

4) Preparation of implementation plan to develop the water infrastructures

5) Preliminary cost estimation of the water infrastructures, including construction and operation and maintenance (O&M) costs

7.5.2. Framework for Infrastructure Development

To realize sustainable development of the Ponneri Node, stable water supply, good sanitary conditions, preservation of water environment and prevention of flood event are imperative. Development framework of water indrastructures including those for water supply, wastewater management and stormwater management are proposed as follows:

- 24 x 7 supply of water to 100% industries and households with direct water supply connection will be achieved.

- 100% connection of industries and households to sewer network and 100% coverage of primary and secondary treatment of the sewage will be achieved.

- 100% coverage of road network with storm water drainage network will be achieved.

- Maximum utilization of water resources by water recycle for industrial uses will be achieved.

7.5.3. Design Conditions

Development Phases of Proposed Node

Ponneri Node will be developed by three phases which are the short term (by 2018), the middle term (by 2022) and the long term (by 2033). Accordingly, the estimation of water demand and sewage generation will target at the years 2018, 2022 and 2033.

Relevant Technical Standards

The development plan of each infrastructure is based on the follwoing technical standard.

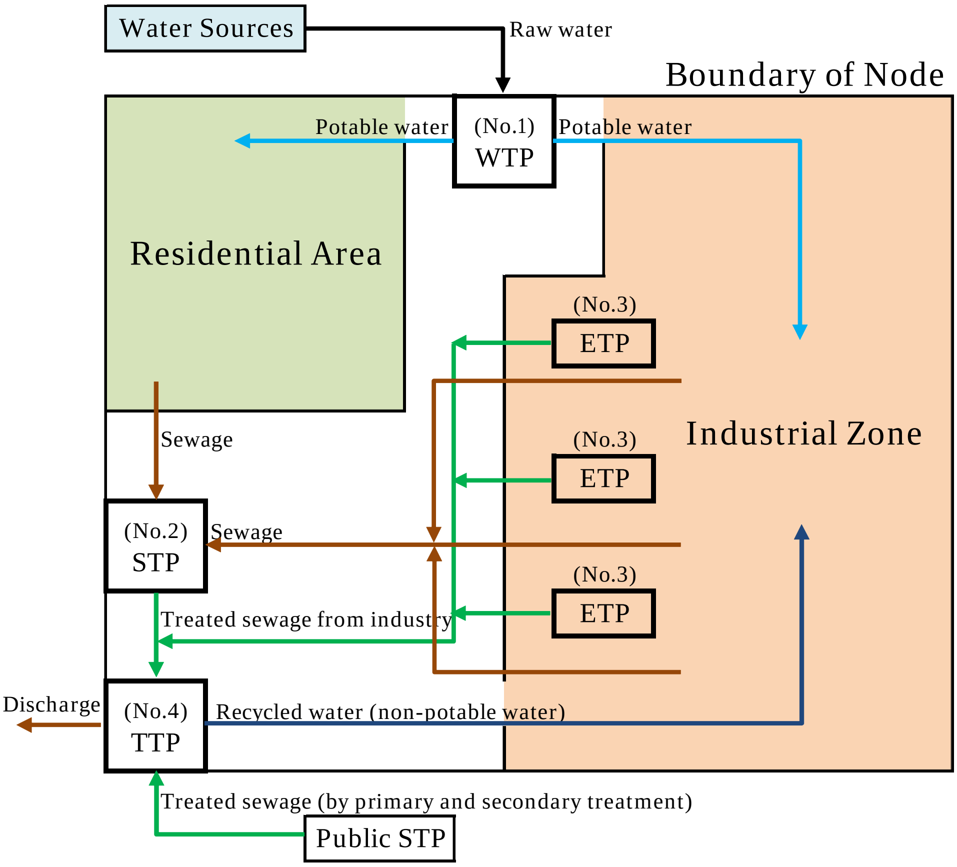
Table 7.55: Applicable Technical Standards for Water Infrastructure Plans

Type of Infrastructure	Technical Standard	Issuing Organization
Domestic water supply system	Manual on Water Supply and Treatment, May 1999	Central Public Health and Environmental Engineering Orgnization (CPHEEO), Ministry of Urban Development
Industrial water supply system		
Sewerage system	Manual on Sewerage and Sewage Treatment System, November 2013	CHEEO, Ministry of Urban Development
Stormwater drainage system	Guidelines on Urban Drainage, 2013	Indian Roads Congress, Ministry of Road Transfer & Highways
	Surface water drainage for low-income communities, 1991	World Health Organization
	Hand Book on Water Supply and Drainage, 1987	Bureau of Indian Standards

Source: JICA Study Team

Required Water Qualities

In the proposed node, several different kinds of water treatment facilities are necessary. The water quality standards to be applied to the treatment facilities depend on function or puropose of the treatment to be done in the facilities. Water flow diagram in Figure 7.47 presents functions of the water treatment facilities in the node and Table 7.56 show the water quality standards to be applied to the facilities according to their functions.



Source: JICA Study Team

Figure 7.47: Water Flow Diagram of the Node

Table 7.56: Applicable Water Quality Standards for the Target Facilities

No.	Target Facility	Applicable Water Quality Standard
1	Water Treatment Plant (WTP)	Indian Standard Specifications For Drinking Water
2	Sewage Treatment Plant (STP)	General Standard For Discharge of Environmental Pollutants (Dischare to Inland Surface Water)
3	Industrial Effluent Treatment Plant (ETP) (To be introduced by each factory)	
4	Tertiary Treatment Plant (TTP) (Sewage Recycle Plant)	Standard for Recycled Water and Facilities Criterion in Japan

Source: JICA Study Team

Selection of the water quality standards to be applied are explained below:

1) WTP (Facility No.1 in Figure 7.47) will supply potable water to both the residential area and the industrial zone, thus the standard for drinking water should be applied.

2) STP (Facility No.2 in Figure 7.47) will treat the sewage collected from the residential area and the industrial zone by primary and secondary treatment. It will convey the treated sewage to TTP. Required treatment level in the STP are the same as those of usual public STP. Therefore, the effluent standard for discharging to inland surface water, which are applied to all usual STPs, are applied to the STP in the node.

3) ETP (Facility No.3 in Figure 7.47) will be introduced at each factory. Treated effluent at the ETP will be sent to TTP (Facility No.4 in Figure 7.47), which will also accept treated sewage from STP, to be recycled for industrial purposes. If ETP discharges untreatable materials at TTP, TTP can not meet the water quality required to the industrial water. To ensure the TTP's function to provide industrial water, ETP

should treat the industrial effluent to satisfy the same water quality level as that from STP. Therefore, the effluent standard for discharging to inland surface water will be applied to ETP.

4) TTP (Facility No.4 in Figure 7.47) will receive the treated sewage and treat additionally to recycle the treated sewage for industrial processes, thus the recycled water should meet the water quality standard required for industrial water. However, there is not a well-suited water quality standard for industrial water in India. Therefore, the standard for recycled water and facilities criterion in Japan which is issued by Ministry of Land, Infrastructure, Transport and Tourism will be applied.

Each applicable regulation of water quality is described in Appendix B.

7.5.4. Demand Forecast

The domestic water demand, the industrial water demand, the sewage generation and the stormwater discharge of Ponneri Node are projected in order to estimate the requuired capacitiy and scale of each infrastructure.

Domestic Water Demand

Residential area will not be developed in Ponneri Node, thus there will not be the residential people in Ponneri Node. Therefore, the domestic water demand for the residential area of the Ponneri Node is estimated to zero (0).

In contrast, the domestic water demand for the industrial zone is estimated wth the following formula which is based on the Manual on Water Supply and Treatment prepared by CPHEEO.

(Domestic water demand for industrial zone) = (Target per capita water consumption: 45LPCD) x (Target employed population)

According to the Manual on Water Supply and Treatment by CPHEEO, in addition, water demand should consider water loss or water leakage, which is allowed up to 15% by the manual. Including the water leakage, domestic water demand in Ponneri Node is estimated as shown in the table below.

Table 7.57: Domestic Water Demand of Ponneri Node

Supply Destination	Unit Water Consumption (LPCD)	Year 2018		Year 2022		Year 2033	
		Population	Water Demand (MLD)	Population	Water Demand (MLD)	Population	Water Demand (MLD)
Residential People Excluding Employees	135	0	0	0	0	285,714	38.6
Employees from the inside of Node	135	0	0	0	0	114,286	15.4
Employees from the Outside of Node	45	75,441	3.4	232,048	10.4	773,788	34.8
Total			**3.4**		**10.4**		**88.8**
Including Water Loss			**3.8**		**11.6**		**98.7**

Source: JICA Study Team

Industrial Water Demand

The industrial water demand is estimated with the following formula:

(Industrial Water Demand) = (Industrial Land Demand) x (Water Consumption per Unit Industrial Area)

For the following reasons, the water consumption per unit industrial area is based on the Japanese standard value which is sourced from Japan Industrial Census (2011), and the planned water consumption value of Mahindra World City which is located near Chennai and is invested by many foreign companies.

- Many international companies from developed countries, including those from Japan, are expected to develop their businesses in the node. Hence unit water consumption in the node will reach to international level.

- Currently, the water productivity of Indian industries is 1/3 – 1/7 times smaller than that of Japan. Under the seriously water scarce conditions in the node, however, for the future the water productivity of industrial water in the proposed node is expected to be improved because Japanese manufacturers will try to achieve high water use efficiency by introduction of water-saving machineries or equipment, and instruction to the workers for utilize water as much as possible. Therefore, the unit consumption of industrial water in the proposed node is assumed to be improved to the Japanese level by the ultimate target year (2033).

- The developer of Mahindra World City has a plan to attract many foreign companies and investors, thus this will become a model of the proposed node.

Based on the above mentioned discussions, the industrial water demand of Ponneri Node is estimated as described in the table below. Water leakage is assumed at 10% following the Manual on Water Supply and Treatment by CPHEEO:

Table 7.58: Industrial Water Demand of Ponneri Node

Industrial Sector	Unit Industrial Water Demand	Year 2018		Year 2022		Year 2033	
		Land Area	Industrial Water Demand	Land Area	Industrial Water Demand	Land Area	Industrial Water Demand
	(MLD/Acre)	(Acre)	(MLD)	(Acre)	(MLD)	(Acre)	(MLD)
Metallurgy	0.0394	33	1.3	85	3.4	326	12.9
Medical Equipment	0.0043	66	0.3	168	0.7	643	2.8
Food Processing	0.0139	0	0.0	0	0.0	0	0.0
Textiles & Apparels	0.0312	74	2.3	189	5.9	725	22.6
Electrical Machinery	0.0029	66	0.2	168	0.5	643	1.9
Machinery	0.0025	173	0.4	443	1.1	1,694	4.2
Chemicals & Petrochemicals	0.0755	71	5.3	180	13.6	691	52.2
Pharmaceuticals	0.0043	66	0.3	168	0.7	643	2.8
Auto	0.0145	388	5.6	994	14.4	3,804	55.2
Computer, electronic and optical products	0.0087	49	0.4	126	1.1	482	4.2
Defence & Aerospace	0.0145	0	0.0	0	0.0	0	0.0
Total		**985**	**16.2**	**2,522**	**41.4**	**9,652**	**158.6**
Including Water Loss			**18.0**		**46.0**		**176.2**

Source: JICA Study Team

Sewage Generation

Based on the Manual on Sewerage and Sewage Treatment Systems prepared Ministry of Urban Development, sewage generation is estimated to be 80% of water supply. Therefore, the sewage generation of Ponneri Node is estimated as described in the table below.

Table 7.59: Sewage Generation of Ponneri Node

Generation Source	Sewage Generation (MLD)		
	Year 2018	Year 2022	Year 2022
Residential People Excluding Employees	0	0	30.9
Employees from the inside of Node	0	0	12.3
Employees from the Outside of Node	2.7	8.3	27.8
Total	**2.7**	**8.3**	**71.0**

Source: JICA Study Team

Industrial Effluent Generation

Generation of industrial effluent depends on the industry type. According to the Japan Industrial Census, the effluent generations vary from 10% to 70%, which are results of water recycle in each industry. In Ponneri Node, effluent generation will be higher than the Japanese case because the study assumes that the industries in the node will mainly use central TTP instead of personal recycle system in each industry, as illustrated in Figure 7.47. Industrial effluent volume in the node is estimated as 70% of the industrial water consumption as presented in Table 7.60 for each phase.

Table 7.60: Industrial Effluent Generation of Ponneri Node

Industrial Effluent	Effluent Generation (MLD)		
	Year 2018	Year 2022	Year 2033
Industrial Effluent	**11.3**	**29.0**	**111.0**

Source: JICA Study Team

Storm water Discharge

(1) Storm water Estimation

The storm runoff is that portion of the precipitation, which drains over the ground. Estimation of such runoff reaching the storm sewers therefore is dependent on the intensity, duration of precipitation, characteristics of the tributary area, and the time required for such flow to reach the storm water drain. The rational method is more commonly used based on the formula given below.

$Q = 10\ C\ i\ A$

Where,

Q: Runoff (m^3/hr)

C: Dimensionless runoff coefficient

i: Intensity of rainfall (mm/hr)

A: Area of drainage district (ha)

Source: "Manual on Sewerage and Sewage Treatment-Part-A", Ministry of Urban Development (MoUD)

(2) Imperviousness

When several different surface types or land use comprise the drainage area, a composite or weighted average value of the imperviousness runoff coefficient can be computed, such as:

$I = [(A_1I_1)+(A_2I_2)+.........+(A_nI_n)] \ / \ [A_1+A_2+.........+A_n]$

Where,

I: Weighted average imperviousness of the total drainage basin

A_1, A_2, A_n: Sub drainage areas

I_1, I_2, I_n: Imperviousness of the respective sub-areas

The percent imperviousness of the drainage area can be obtained from the records of a particular district. In the absence of such data, the Table below will serve as guide.

Table 7.61: Percentage of Imperviousness of Areas

Sl.No	Type of Area	Percentage of Imperviousness
1.	Commercial and Industrial Area	70-90
2.	Residential Area - High Density - Low Density	 61-75 35-60
3.	Parks and Undeveloped Areas	10-20

Source: Manual on Sewerage & Sewage Treatment Systems by Ministry of Urban Development

(3) Frequency of Storm

The frequency of storm for which the sewers are to be designed depends on the importance of the area to be drained. Commercial and industrial areas have to be subjected to less frequent flooding. The suggested frequency of flooding in the different areas is as follows -:

a) Residential Areas

  i) Peripheral areas twice a year

  ii) Central and comparatively high priced areas once a year

b) Commercial and high priced areas once in 2 years

As per World Health Organization (WHO) guidelines on Surface Water Drainage, a return period of five years is widely used to design primary drainage system in tropical cities.

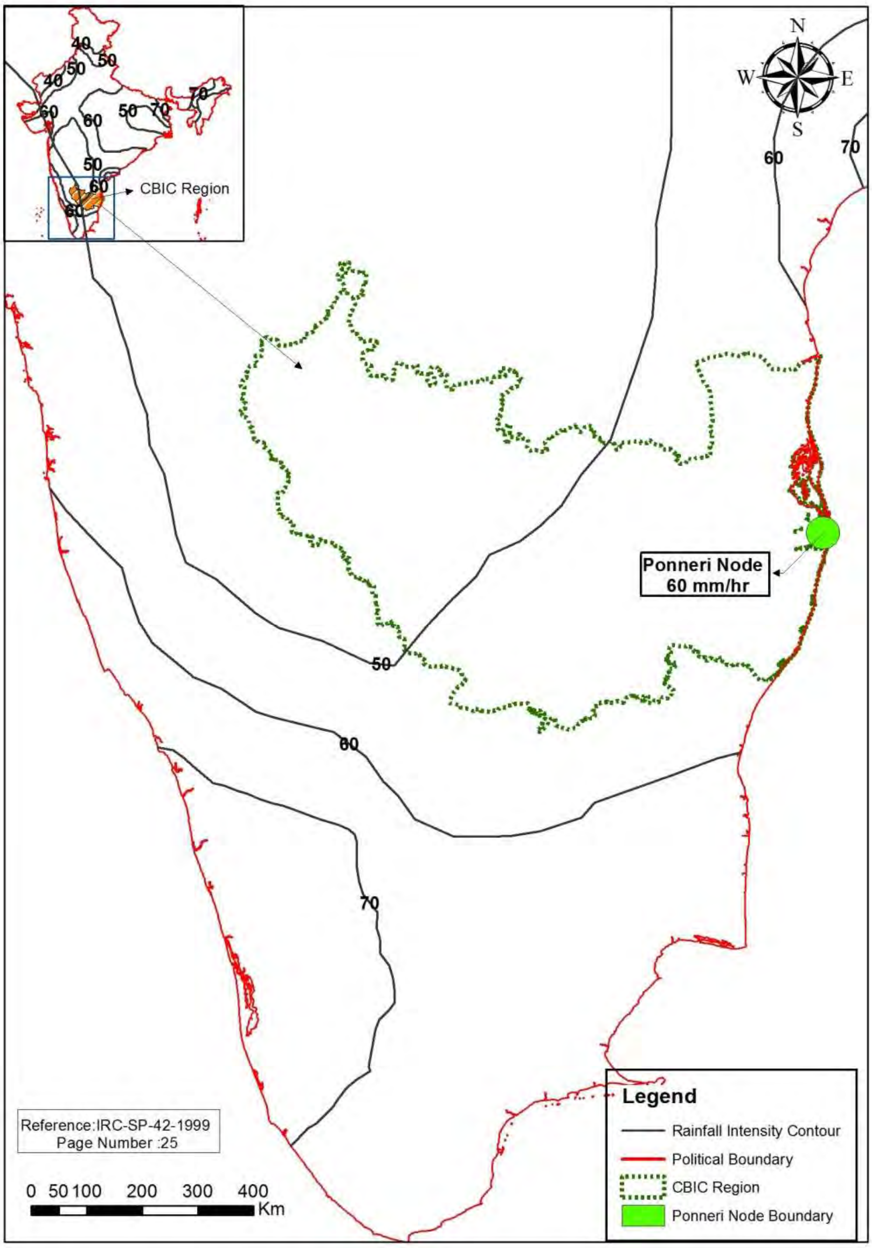
Source: *World Health Organization Publications on "Surface Water Drainage for low Income Communities" & Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) guidelines for "Standards / Requirements for SWD"*

(4) Intensity of Storm

The Intensity of Rainfall to be used in computing the design run-off in equation in the above (1) is related to the concentration time and the frequency of occurrence of the storm.

A point to point design of the Storm Water Drainage System requires repeated selection of the Intensity of Rainfall for increasing Concentration Time intervals. This is possible if the relationship of the Intensity of Rainfall with the concentration Time for a given Frequency of Occurrence is known for the particular catchment. This relationship is known as Intensity – Duration – Frequency (IDF) relationship and can be expressed in the form of a formula or in the form of a graphic curve. Such a relationship can be developed by conducting an analysis of past rainfall records for this area under study.

The CPHEEO Manual on Sewerage and Sewage Treatment states that the intensity of precipitation for the Indian conditions, to be adopted in the design, is usually in the range of 12mm/hr to 20mm/hr. (Manual on Sewerage and Sewage Treatment, Page No. 41, Chapter No. 3.3.1 and Sub chapter no. 3.3.1.). This limit for intensity of rainfall is on lower side. Therefore, for CBIC study, the intensity of rainfall is considered based on the standards of Indian Roads Congress (IRC) vide its publication, IRC: SP-42, 1994, "Guidelines on Road Drainage" Fig-6, one hour rainfall for different recurring intervals. For a five year return period, one hour maximum rainfall will be adopted as per (A) of Fig-6, IRC-42. The Figure 7.48 showing the value of rainfall in one hour, intensity of rainfall (i) in mm/hr based on the Fig-6 of IRC-42.



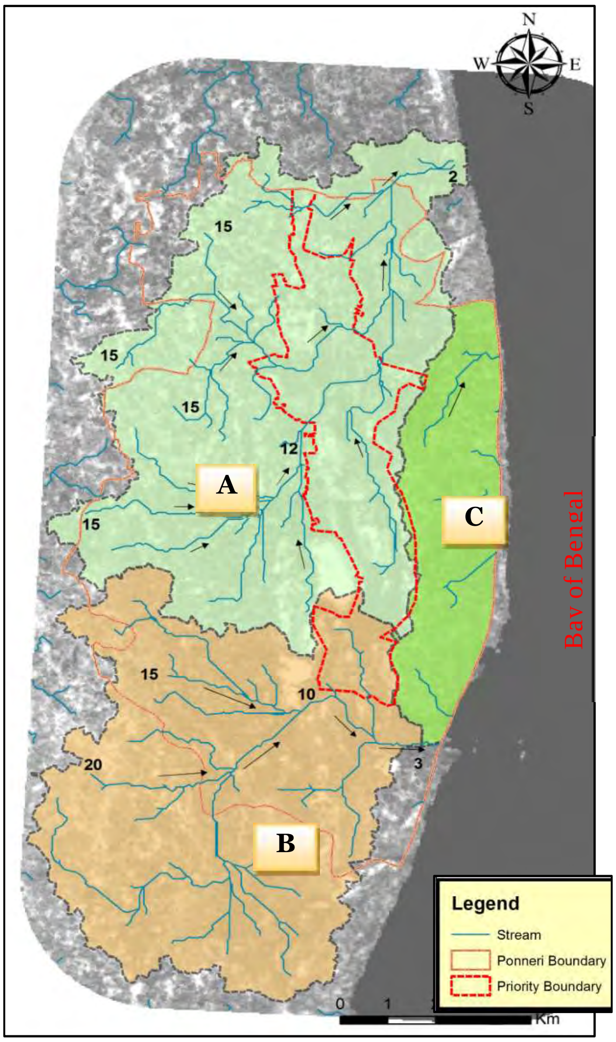
Source: JICA Study Team

Figure 7.48: Rainfall in one hour as per IRC-42

From the Figure 7.48, the rainfall for one hour contours plotted, the intensity of rainfall for Ponneri node is considered as 60mm/hr and the same value adopted for computing storm water discharge through rational formula.

(5) Drainage Basin Plan

The existing drainage basin plan for the catchment area for Ponneri Node contributing to the storm run-off into the node presented in the Figure 7.49. This has been prepared based on elevation data shown in the Figure 7.49 from the satellite image of Ponneri node area. Ponneri Node is divided into three drainage basins viz. A, B & C. Drainage basin "A" will flow from west to East and ultimately disposes Bay of Bengal towards North-Eastern side. Drainage basin, "B" flows from South to North and ultimately disposes to Bay of Bengal on South-Eastern side of the node. Also, the basin "C" flows from West to East and dispose to Bay of Bengal ultimately. The drainage basins "A" & "B" will contribute to the run-off to the priority node area through their catchments and "C" has no contribution of run-off to the node.



Source: JICA Study Team

Figure 7.49: Ponneri Node Drainage Basin Plan

(6) Total Storm water Discharge

Storm Water Discharge is computed using rational formula, as specified in item (1) of this subsection. Ponneri node priority development area is divided into three sub-zones, A-I, A-II, A-III, A-IV, A-V, A-VI & A-VII based on the topography and the disposal of storm discharge. Summary of the storm water discharge in each zone is presented in the Table 7.62.

Table 7.62: Summary of the Storm Water Discharge in each zone

Sl.No	Zone	catchment area (ha)	storm discharge (cum/s)
1.	A-I	165.11	16.51
2.	A-II	160.80	16.08
3.	A-III	813.75	81.37
4.	A-IV	647.19	64.72

Sl.No	Zone	catchment area (ha)	storm discharge (cum/s)
5.	A-V	1034.88	103.49
6.	A-VI	1544.07	154.41
7.	A-VII	2224.52	222.45

Source: JICA Study Team

7.5.5. Development Plan

The water resource balance, the capacity of each infrastructure, the water treatment technology and process of each water treatment facility and the layout plan of each infrastructure are discussed in this section.

Water Resource Balance

As mentioned in the framework for infrastructure development in Section 6.5.2, based on the result of collection of relevant information, the candidate water sources for both potable water and non-potable water in Ponneri Node are listed.

Table 7.63: Potential Water Sources for Ponneri Node

Water source	Possible water use		Capacity
	Potable	Non-potable (Industrial)	
Minjur desalination plant	✓	✓	100 MLD
Other WTPs in Chennai Metro Area	✓	✓	-
New desalination plant (to be developed in the node, if necessary)	✓	✓	-
Recycle water from Kodungaiyur STP		✓	45 MLD
Secondary treated sewage at the other STPs in Chennai Metro Area		✓	More than 400 MLD

Source: JICA Study Team

According to Chennai Metro Water Supply & Sewerage Board (CMWSSB) which is managing the existing WTP, Minjur Desalination Plant can supply the potable water to Ponneri Node for domestic purpose in accordance with the domestic water demand forecast of Ponneri Node. Similarly, according to CMWSSB, Kodungaiyur STP will be able to supply tertiary treated sewage by Reverse Osmosis (RO) process to Ponneri Node for its industrial processes in accordance with the industrial water demand forecast of Ponneri Node.

In addition, as discussed later in Section 6.5.5.2, the node will have a tertiary treatment plant (TTP) by RO process for industrial water recycle. Recovery ratio of the RO process is assumed at 80% in the study. Recently, 70 to 80% of the recovery ratio is common in RO recycle system for industrial purpose. The applied recovery ratio (80%) assumes that the innovation in the water recycle technology will enable improvement in the recovery ratio.

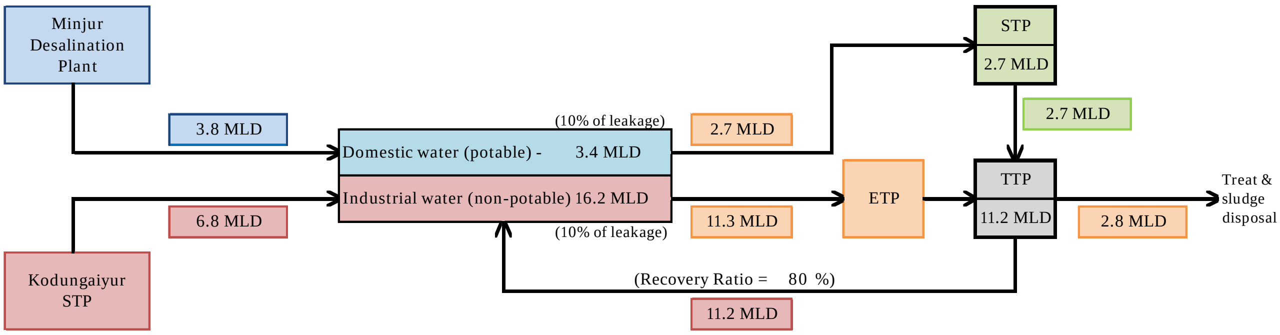
Based on the above-mentioned conditions, the water balance and the water flow from the water sources to the wastewater treatment and recycle are described in Figure 7.50. Expected water supply amount of the water sources by water use is summarized in Table 7.64. Locations of the water sources are presented in Figure : Considerations in preparation of the water balance are below:

- Maximum utilization of industrial effluent by recycling for industrial purpose is planned. It will minimize necessary water amount from Minjur Desalination Plant which was originally constructed to supply water to Chennai Metropolitan Area for domestic purpose.
- In 2020, necessary water amount from Minjur desalination Plant will be 11.3 MLD, which is equivalent to about 10% of the plant’s capacity. The study assumes that the plant will possibly be able to supply water at this amount but, considering the increasing water demand in the metropolitan area, further

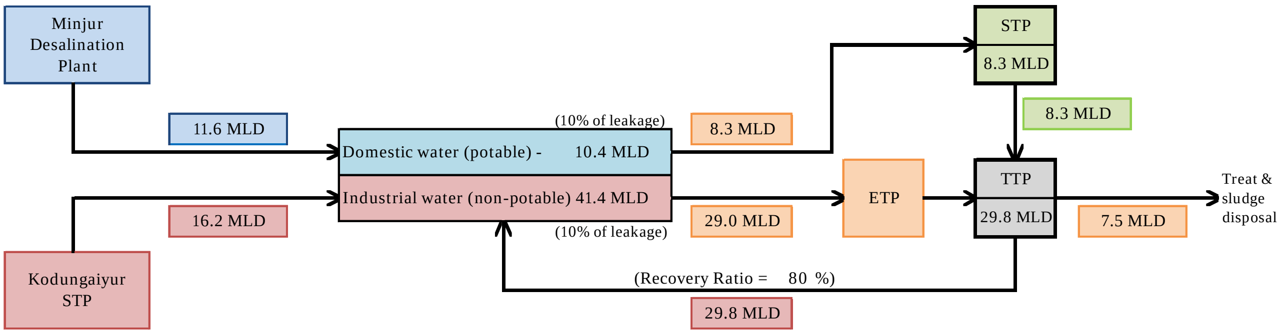
provision to the node from Minjur Desalination Plant should not be expected. New desalination exclusively for the node will need to start operation from 2023.

- In accordance with the commencement of the exclusive desalination plant's operation, water supply from Minjur Desalination Plant will be terminated.

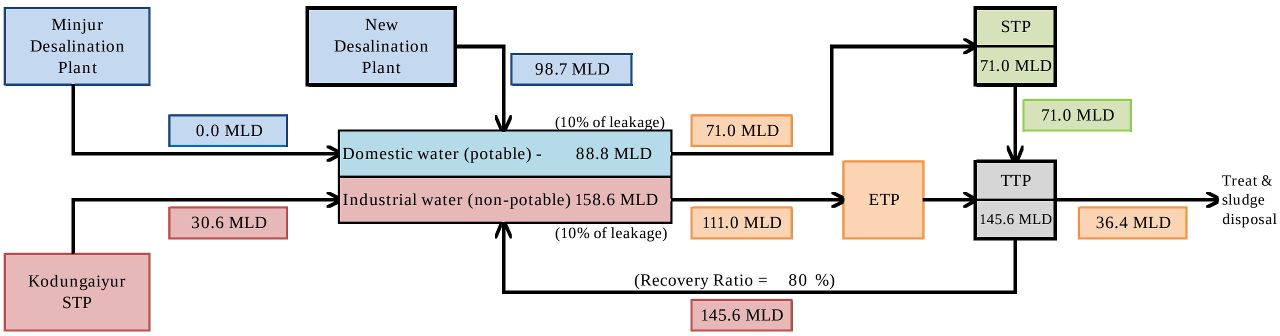
In 2018



In 2022



In 2033



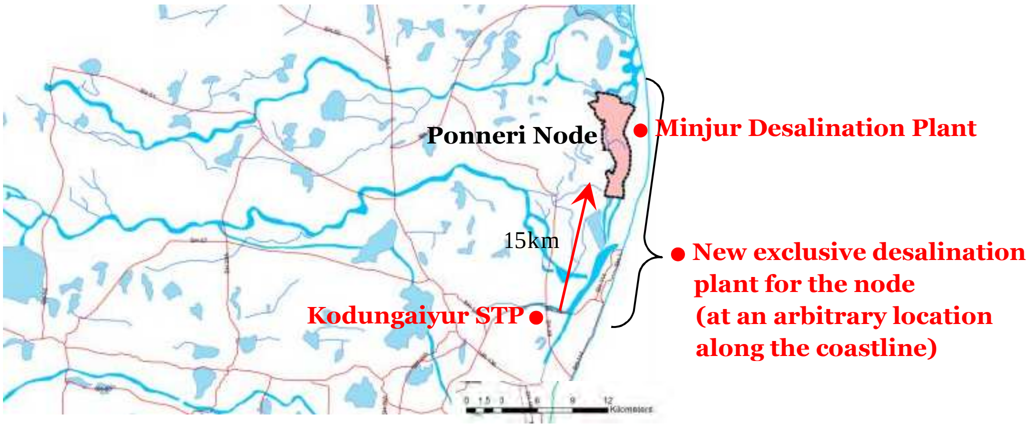
Source: JICA Study Team

Figure 7.50: Water Balance of Ponneri Node

Table 7.64: Supply Amount of Water Sources for Ponneri Node by Phase

Use	Water Source	Supply (MLD)		
		Year 2018	Year 2022	2033
Domestic use	Minjur Desalination Plant	3.8	11.6	0.0
	New exclusive desalination plant for the node	0.0	0.0	98.7
Industrial process	Tertiary treated sewage of Kondungaiyur STP	6.8	16.2	30.6

Source: JICA Study Team



Source: JICA Study Team

Figure 7.51: Location of Water Sources of Ponneri Node

Also, Tamil Nadu Water Supply & Drainage (TWAD) Board has conducted Pre-feasibility study for augmentation of water supply to the industrial areas in the districts covered in CBIC area of Tamil Nadu, however this plan is still in conceptual stage by TWAD Board

Water Treatment Technologies & Processes

(1) Selection of Water Treatment Processes

In Ponneri Node, the water treatment plant (WTP) to supply the potable water to both the residential area and the industrial zone is not required to be developed newly, because Minjur Desalination Plant can supply enough non-potable water to Ponneri Node. Accordingly, the following treatment plants are required to be developed newly in Ponneri Node.

1) Sewage Treatment Plant (STP) to receive the domestic sewage from the the industrial zone and treat them primarily and secondarily

2) Tertiary Treatment Plant (TTP) to receive the secondary treated sewage from the STPs and the treated industrial wastewater from each industry, and treat it tertiarily in order to recycle for industrial processes

In order to meet the required water quality, the Study proposes the water treatment processes to the different types of the teratment plants above as presented in the table below.

Table 7.65: Selected Treatment Processes for Ponneri Node

Water source	Treatment Process	Remarks
Water Treatment Plant (WTP)	Seawater desalination by reverse osmosis (RO) process	Flocculation, coagulation, sedimentation, UF, and RO
Sewage Treatment Plant (STP)	Conventional activated sludge process	Sedimentation and biological treatment
Tertiary Treatment Plant (TTP)	RO process	Flocculation, coagulation, sedimentation, UF, and RO

Source: JICA Study Team

Water treatment plant (WTP) to be constructed in the node will use seawater desalination technology. Seawater desalination technology includes two major methods of RO, which is the most common process in the world recently, and distillation which includes MED (Multi-Effect Distillation) and Multi-Stage Flash (MSF). Usually type of the desalination technology is determined through alternative study according to construction cost; O&M cost, energy availability, actual seawater quality, etc. In this study, however, RO process is preliminarily assumed following the cases of the other desalination plants in India including the plants in Minjur Plant and Nemmeli for Chennai Metropolitan Area.

Conventional activated sludge process, which will be applied to STP in the node, is also a very common process for sewage treatment. STP of the conventional activated sludge process consists of grit chamber, primary sedimentation tank, aeration tank, final sedimentation tank and disinfection tank, and is also the most conventional sewage treatment process in Japan.

As for the tertiary treatment process for industrial purposes, there are various kinds of treatment process depending on required water quality of the recycled water. The commonly-used treatment processes of sewage recycle for industrial purposes are categorized into sand filtration process with coagulating and sedimentation, and membrane processes which includes Micro-Filtration (MF) Process, Ultra Filtration (UF) Process, Nano Filtration (NF) Process and RO Process which vary in the sizes of membrane pores. As recent deterioration of market prices of membranes, in the membrane processes, RO process has become more common because the recycled water by RO process can be used for wide range of industrial uses. Advantages and disadvantages of the sand filtration process and RO process are given below;

1) Sand filtration process with coagulation and sedimentation

- The treated water quality can be used for watering and wash of some machines. However, it cannot be used for purposes that may cause touch of the water with human bodies.
- If an industry needs higher quality of the recycled water, it needs to install more advanced water treatment facilities of its own, such as membrane processes, to improve the water quality.
- The recovery ratio of the process is approximately 99%.
- The construction cost and running cost are lower than the membrane processes. Water production cost including operation cost and amortization cost will be about 3 INR/m^3.

2) RO process

- The treated water quality is so good that the water can be used for very wide range of industrial uses. Although it is not drinkable, there is no sanitary problem even if people touches the water and no scale will be accumulated in pipes or tanks in the industries.
- In principle, all industries can directly use the supplied water through RO process, with no additional treatment.
- The recovery ratio of the process is usually 70 – 80%.

- The construction cost and running cost are high. Water production cost including operation cost and amortization cost will be about 11.5 INR/m^3.

In the Study, considering the advantages and disadvantages above, process is proposed to the TTP in Ponneri Node for the following reasons:

- In order to ensure the maximum utilization of water resources in the node, water recycle system in the node should be controlled by the node operator comprehensively. For that reasons and achieve lower unit prices by enhancing the scale merit, the water recycle system should attract the industries in the node.

- If the tertiary treatment process is sand-filtration, the industries will need to do further treatment for most industrial purposes by their own equipment. The industries will not be attracted to the recycling system because of this additional cost.

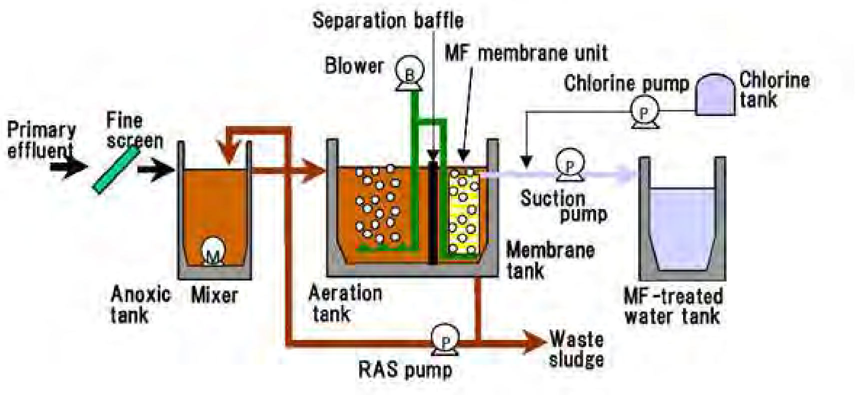
- As explained above, water production cost by RO will be more expensive than that by sand filtration by about 8.5 INR/m^3. Apart from the water treatment cost, however, effluent collection to enable the water recycle and non-potable water transmission and distribution system will cost about 2.5 billion INR even for phase 1. This will bring about 20 INR/m^3 of O&M cost. Therefore, Difference in the treatment cost will not be a critical difference in the economic comparison of the processes. Key driver of the unit price of the recycled water is water transmission and distribution cost.

(2) Alternative Technologies for the Sewage Recycle

1) Membrane Bioreactor (MBR)

MBR is a water treatment technology which is one kind of the activated sludge method processes. MBR is a similar process to the conventional activated sludge (CAS) process but replaces final sedimentation tank in CAS with MF membrane process as presented in Figure 7.52. Treated sewage from MBR is available for wider industrial purposes than the tertiary treated sewage by CAS and the sand filtration. Application of this process to STP enables cost saving in the total cost for secondary and tertiary treatment processes for water recycle. In Japan, Kubota Corporation, Swing Corporation, Hitachi Zosen Corporation, Hitachi Ltd., and several other plant makers own this technology.

In development of the node, water sources for the water recycle are domestic sewage and industrial effluent. Because of the industrial effluent is the already-treated water by each industry, primary and secondary treatment is not necessary for the industrial effluent. Therefore, the Study does not apply MBR in the node. However, this technology still has a possibility to be adopted in the STP to treat the domestic sewage.



Source: http://www.thembriste.com

Figure 7.52: System configuration of MBR

2) High Efficiency RO (HERO)

This technology is one of the RO process of tertiary treatment for water recycle. This technology achieves 95% of the recovery ratio, which is generally 70 to 80% in usual RO process by operating the RO process at high pH condition. By this high recovery ratio, HERO will reduce the brine to be discharged from the RO process.

In this Study, HERO is only an alternative technology for the tertiary treatment process because only a limited number of companies such as UEM, a Toshiba affiliated company in India, own this technology. However, this technology may contribute to significant cost saving for the brine treatment and disposal, especially in India where zero-liquid discharge is required.

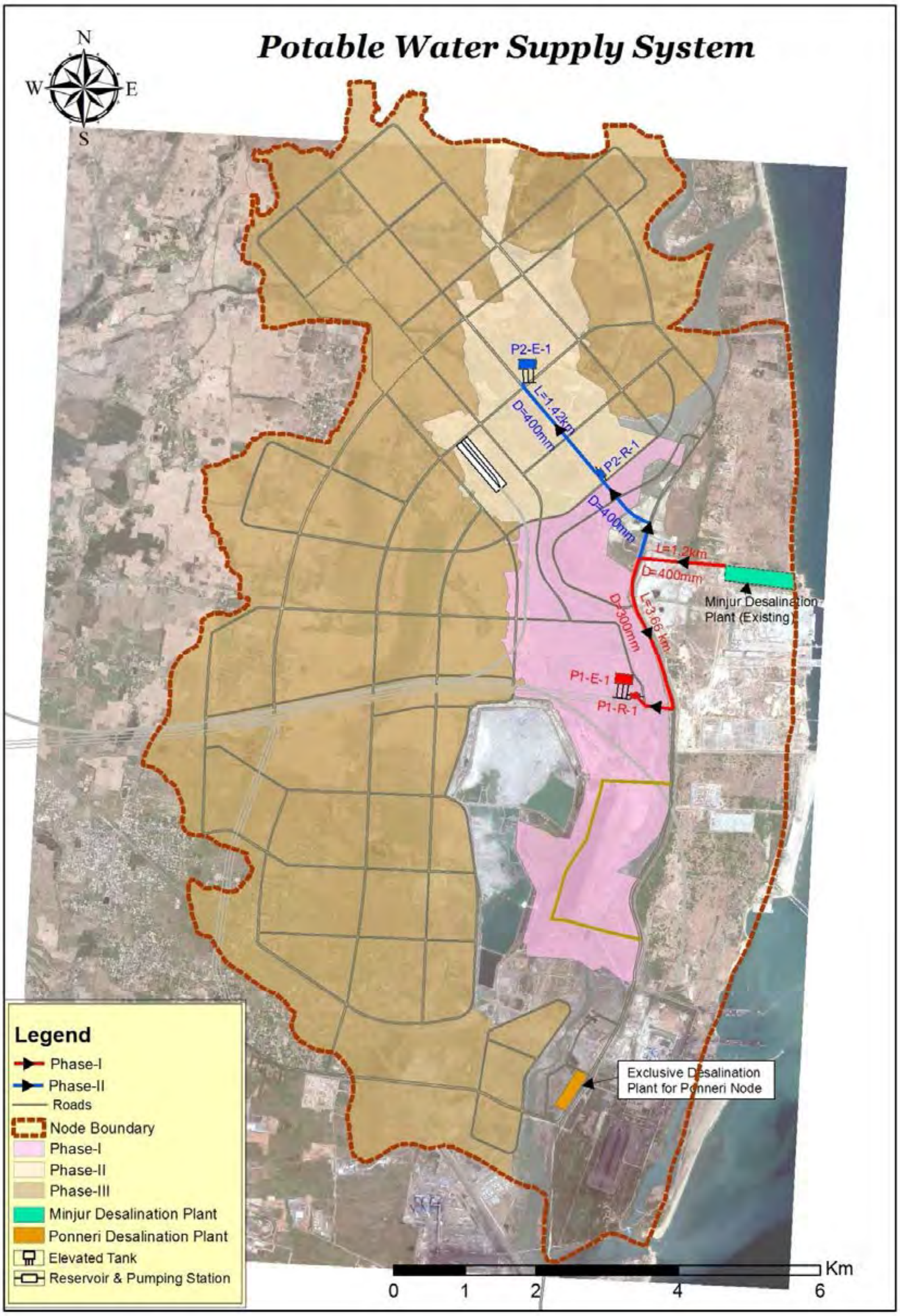
Plan of Potable Water Supply System

(1) Layout Plan and System Outlines

Layout plan of potable water supply system for Ponneri Node is illustrated in Figure 7.53 and outlines of the major facilities in the system are presented in Table 7.66. In phases 1 and 2, the node will supply the desalinated seawater to be received from Minjur Desalination Plant, by which the node does not need exclusive water treatement plant. The water from Minjur Desalination Plant will be received at reservoirs to be constructed for each phase. Reservoirs will be located at the eastern end of the development areas of the two phases so that the desalinated seawater will be transfered by the most direct ways.

Water transmission and distribution system in the node will have independent system for phases 1 and 2. In the both systems, potable water will be distributed via ground reservoir and elevated tank(s). As explained above, reservoris will be located at the eastern ends of the development areas. On the otheer hand, elevated tanks will be located at the demand center so that stable water pressure will be achieved in the node.

In phase 3, Ponneri Node will need to construct its exclusive WTP because the Minjur Desalination Plant will not be able to provide sufficient water to meet the water demand. The exclusive WTP will also be a desalination plant, hence it will be located at the eastern end of the pahse 3 development area. Because the water supply from Minjur Desalination Plant will be terminated in aacordance with the commencement of the new WTP's operation, water from the new plant will be supplied not only to the phase 3 area but alos the phase 1 and 2 areas. In order for such a water sharing, water transmission pipelines from the new plant to the reservoris for phases 1 and 2 will be constructed in pahse 3.



Source: JICA Study Team

Figure 7.53: Layout Plan of Potable Water Supply System

Table 7.66: Outlines of the Potable Water Supply Facilities

Facility	Outlines/Capacity			Remarks
	Phase 1	Phase 2	Phase 3	
Water conveyance system	DIP*1 D=300 - 400 mm L=3.98 km Pump motor output: 15 kW	DIP*1 D=300 - 400 mm L=0.88 km Pump motor output: 15 kW	-	From Minjur Desalination Plant
Water Treatment Plant (WTP)	-	-	100 MLD	Seawater desalination by RO
Reservoir	2.2 ML	3.5 ML	10.0 ML x 4	
Pumping station	1 location	1 location	4 locations	
Elevated Tank	0.4 ML	0.6 ML	1.6 ML x 4	Height: 15 to 25 m
Water transmission pipeline	HDPE*2 D=300 mm L= 0.1 km	DIP*1 D=400 mm L=1.42 km	DIP*1 D=500 - 1000 mm L=20.0 km	
Water distribution pipeline	HDPE*2 D=150-300 mm 100.1 km	HDPE*2 D=150-200 mm 38.1 km	HDPE*2 D=150-300 mm 345.5 km	

*1: DIP: Ductile iron pipe

*2: HDPE: High density polyethylene pipe
Source: JICA Study Team

(2) Plan of Water Conveyance Pipeline from Minjur Desalination Plant

In order to receive desalinated seawater from Minjur Desalination Plant, 4.0 km and 2.1 km of water conveyance pipelines will be constructed from the plant to the reservois in phases 1 and 2 respectively. Assuming 1.o m/s of flow velocity in the pipeline, the pipe diameters for phase 1 and 2 will be 300 mm and 400 mm. Common section of the pipeline from the desalination plant to the branch point will be shared, whose diamete will be 400 mm. Motor output of the water conveyance pumps to be instalelled at the desalination plant will be 15 kW in phase 1 and 2 respectively.

(3) Plan of Water Treatment Plant (Exclusive Seawater Desalination Plant for the Node)

The new seawaer desalination plant will be constructed for phase 3. Its desalination technology will be RO and the capacity will be 90 MLD. Necessary land area for the plant will be approximately 5 ha.

(4) Plan of Water Reservoir

Water reservoir will be constructed to store the treated water for to avoid water supply disruption to be possibly caused by unexpected suspension of operation of the WTP or raw water conveyance system. Volume of the reservoir is planned as half-a-day amount of the water production capacity of the WTP.

(5) Plan of Elevated Tank

In water distribution network, elevated tanks will be constructed to buffer the fluctuation of the water consumption and to stabilize water supply pressure at the water taps. Volume of an elevation tank will be one-hour amount of the hourly maximum water consumption in the distribution area of the tank.

Hourly maximum water consumption is calculated by multiplying the average water consumption and peak factor. According to Manual on Water Supply and Treatment by CPHEEO, peak factor to be applied is 2 to 3 which denepnds on population in the distribution area (e.g Peak factor to be applied is 3.0, 2.5 or 2.0 for the case that the population is less than 50,000, in the range of 50,000 to 200,000, or above 200,000 respectively.). In Krishnapatnam node, the peak factor is set at 2.5 at all elevation tanks. In the node, residential population in elevated tank's distribution is mostly less than 50,000 where peak factor should be 3.0 according to the CPHEEO's manual. On the other hand, the water consumption in indstries tends to be much more moderate or constant and this trend will draw down the peak factor. The adopted peak factor of 2.5 is determined as the intermediate value of the applicable value in the CPHEEO's manual.

(6) Plan of Water Transmission and Distribution Pipelines

Diameter of water transmission and distribution pipes are determined to achieve sufficient water pressure at the water taps in the residentail areas or industrial areas. In the Study, to achieve the sufficient water pressure and to avoid significant powert consumption at pumping stations, diameter of the pipes between the reservoirs and elevation tanks were preliminarh calculated so that the water head loss in the sections would be less than 10 m, using the following Hazen-Williams formula:

$$H=10.666\ C^{-1.85}\ D^{-4.87}\ Q^{1.85}\ L$$

$$D = (H\ C^{1.85} / 10.666\ Q^{1.85}\ L)^{4.87}$$

Where,

H: Loss of water head (m)

C: Coefficient of flow rate = 110 (Standard value)

Q: Design water flow (m^3/s)

L: Pipe length (m)

D: Diameter of pipe (m) (minimum size is 150 mm according to CPHEEO's manual.)

For the distribution pipes after the elevation tanks, pipe diameters were estimated from the coverage of the elevation tanks. Distribution lines will be installed at the both sides of the roads whose right of way is wider than 25 m, while a single distribution line will be installed in the roads whose right of way is less than 25 m.

Plan of Non-Potable Water Supply System

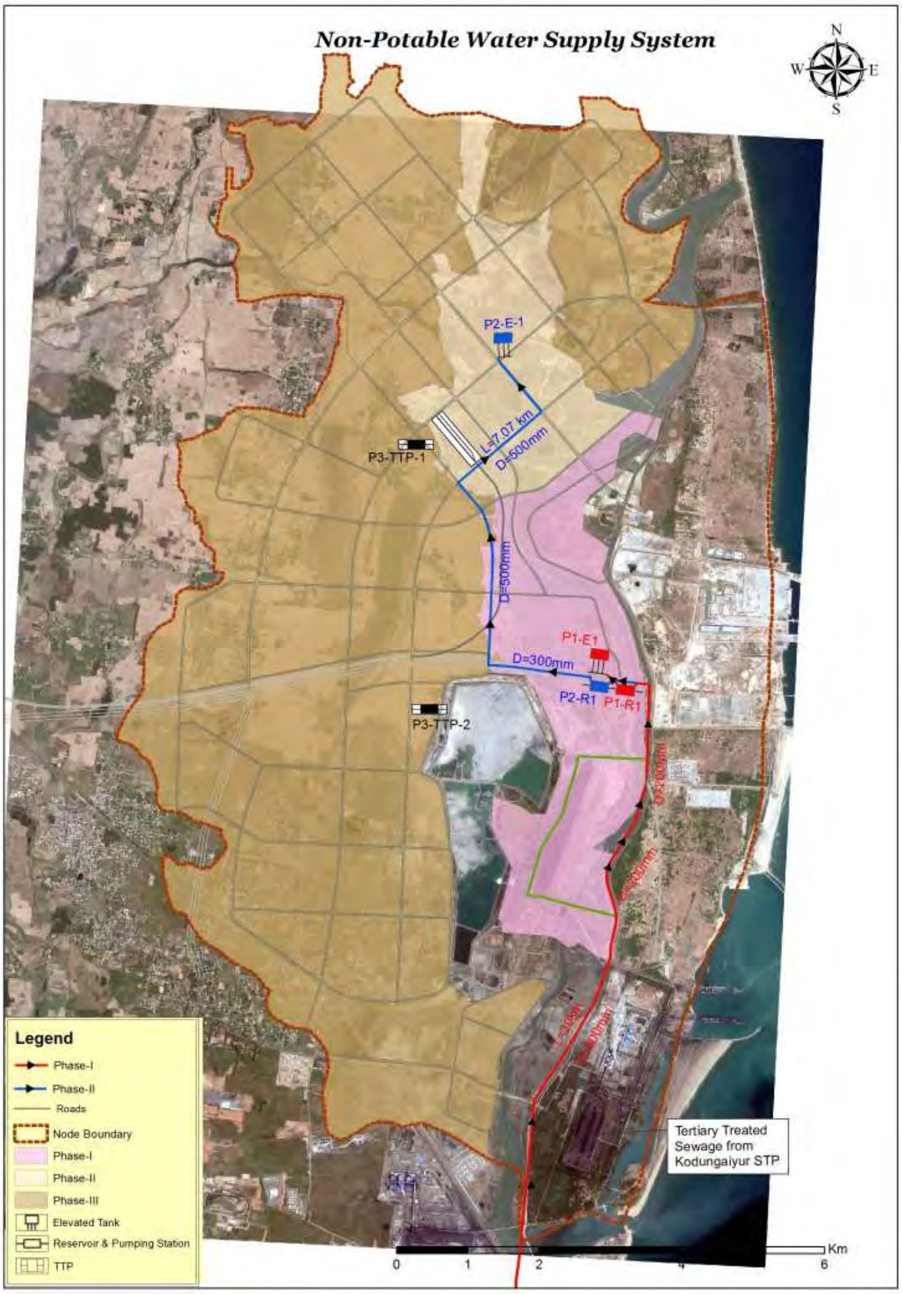
(1) Layout Plan and System Outlines

Non-potable water supply system will supply recycled water for industrial purposes. Layout plan of the non-potable water supply system for Ponneri Node is illustrated in Figure 7.54 and outlines of the major facilities in the system are presented in Table 7.67.

The non-potable water supply system will have a tertiary treatment plant (TTP) for phases 1 and 2, which will carry out the tertiary treatment of the treated sewage from the STP nearby. TTP will be located at the south-eastern part of the node area, which will be the arriving point of the tertiary treated water from Kodungaiyur STP in Chennai Metropolitan Area. This location of the TTP is convenient to combine the tertiary treated water from the two sources and send it to the ditribution network. Close locations of the STP and TTP will also be advantageous in integrated operation and maintenance of the plnats.

Similar to the potable water supply system, water transmission and distribution system of the non-potable water will have independent system for each development phase, and the non-potable water produced in the TTP will be distributed via ground reservoir and elevated tank(s). Both reservoirs, for phaes 1 and 2, will be located near the TTP and the elevation tanks will be located in the the development areas of the phases respectively.

Non-potable water supply system for phase 3 will be developed as completely independent system from that for the phases 1 and 2. TTP will be constructed separately from that for phases 1 and 2 but will be constructed near STP for phase 3. Non-potable water transmission and distribution system will have reservoirs and elevated tanks and pipelines which will cover the entire area of phase 3.



Source: JICA Study Team

Figure 7.54: Layout Plan of Non-Potable Water Supply System

Table 7.67: Outlines of the Non-Potable Water Supply Facilities

Facility	Outlines/Capacity			Remarks
	Phase 1	Phase 2	Phase 3	
Tertiary treated water conveyance system	DIP*1 D=800 mm	Pump motor output:	Pump motor output:	From Kodungaiyur STP

Facility	Outlines/Capacity			Remarks
	Phase 1	Phase 2	Phase 3	
	L= 30 km Pump motor output: 15 kW	40 kW	20 kW	
Tertiary Treatment Plant (TTP)	11.2 MLD	18.6 MLD	57.9 MLD x 2	UF + RO
Reservoir	9.0 ML	14.0 ML	20 ML x 4	
Elevated tank	0.55 ML	0.85 ML	0.55 ML x 4	
Pumping station	1 location	1 location	4 locations	
Water transmission pipeline	HDPE*21 D=300 mm L= 0.1 km	DIP*1 D=500 mm L=5.74 km	DIP*1 D=600 - 1000 mm L=20.0 km	
Water distribution pipeline	HDPE*2 D=150-300 mm 100.1 km	HDPE*2 D=150-200 mm 38.1 km	HDPE*2 D=150-300 mm 345.5 km	

*1: DIP: Ductile iron pipe

*2: HDPE: High density polyethylene pipe

Source: JICA Study Team

(2) Plan of Tertiary Treatment Plant (Sewage Recycle Plant)

The ultimate capacity of the tertiary treatment plant for phases 1 and 2 will be 29.8 MLD. It will be developd by two phases, where 11.6 MLD will be developed by 2018 and 18.2 MLD will be developed by 2022. TTP for phase 3 will have a capacity of 115.8 MLD to be developed by 2033. Treatment process of the both TTPs will be RO

Necessary land area of the TTP for phases 1 and 2 will be 1.5 ha and that for phase 3 will be 4.5 ha.

(3) Plan of Water Treatment and Distribution Facilities

Water transmission and distribution facilities which include reservoris, elevated tanks, water transmission pipes and water distribution pipes are planned by the same conditions and methodologies as the potable water supply system.

Plan of Sewerage System

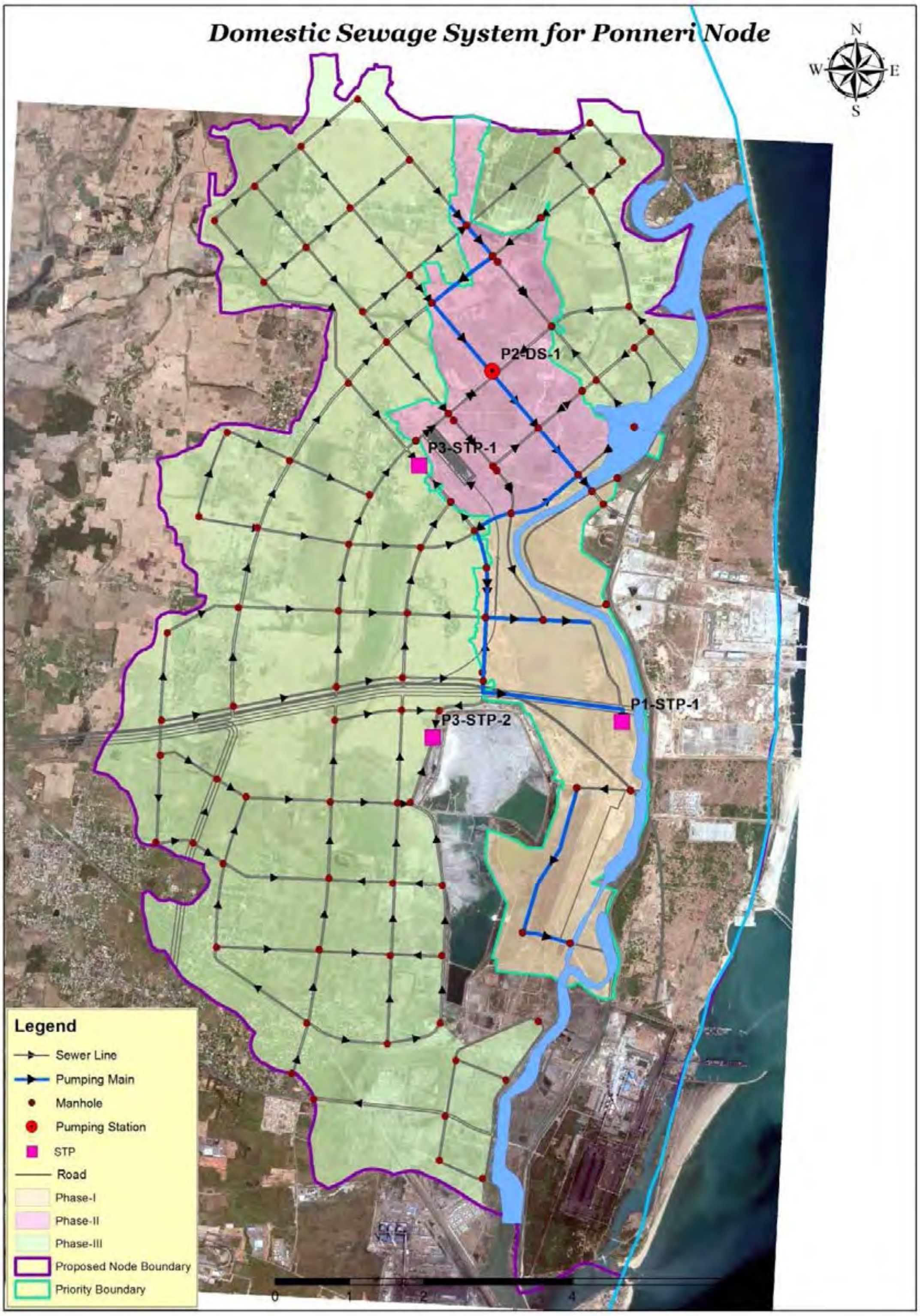
(1) Layout Plan and System Outlines

(2) Layout plan of sewerage system for Ponneri Node is illustrated in Figure 7.55 and outlines of the major facilities in the system are presented in Table 7.68.

(3) STP for phases 1 and 2 will be located at the south-eastern part of the development area of phases 1 and 2. In the same premises of the STP, the TTP will also be located, by which water transfer of the treated sewage to the TTP is efficient in energy consumption and integrated operation and maintenace of the two treatment plant will be possible.

(4) The two phases will have independent sewer networks and the networks will cover all residential and industrial areas in the phases respectively. In the phase 2 area, the collected sewage will be transfered to the STP by a dedicated sewer which will run through the phase 1 area.

(5) Phase 3 will have separate STPs from that for phases 1 and 2. The phase 3 area will be split into two sewerage areas because of its wide spread land area. Each sewerage area will have independent sewer network and a STP.



Source: JICA Study Team

Figure 7.55: Layout Plan of Sewerage System

Table 7.68: Outlines of the Sewerage Facilities

Facility	Outlines/Capacity			Remarks
	Phase 1	Phase 2	Phase 3	
Sewage Treatment Plant (STP)	2.7 MLD	5.6 MLD	31.4 MLD x 2	Conventional activated sludge process
Lift pump station	0 location	1 location	4 location	-
Sewer pipe	RC Pipe* D=200–400mm L=54 km	RC Pipe* D=200–400mm L=255 km	RC Pipe* D=200–1200mm L=199.0 km	-

*: RC: Reinforced concrete pipe
Source: JICA Study Team

(6) Plan of Sewage Treatment Plant

The ultimate capacity of the STP for phases 1, 2 and 3 will be 71.1 MLD, which will be develped by three phases. The first phase will be 2.7 MLD by 2018 and the additional capacities in the second phase 2 will be 5.6 MLD by 2022. The other STPs for phase 3 will be two numbers of 31.40 MLD by by 2033 as presented by the water balance in Figure 7.50.

(7) Sewer Pipe

Sewer pipe will collect the sewage and transfer it to the STP. In the study, diameter and gradient of the sewer pipes are preliminarily determined determined by the following formula.

$$a = Q / v = \sum q * A / v$$

$$D = (4 a / \pi)^{1/2}$$

Where,

Q: Design sewage flow (m^3/s)

v: Velocity of sewage flow (m/s) (Assuming 1.0m/s)

q: Sewage generation per unit area ($m^3/s/ha$)

A: Area of each residential area or industrial zone (ha)

a: Cross-section area of pipe (m^2)

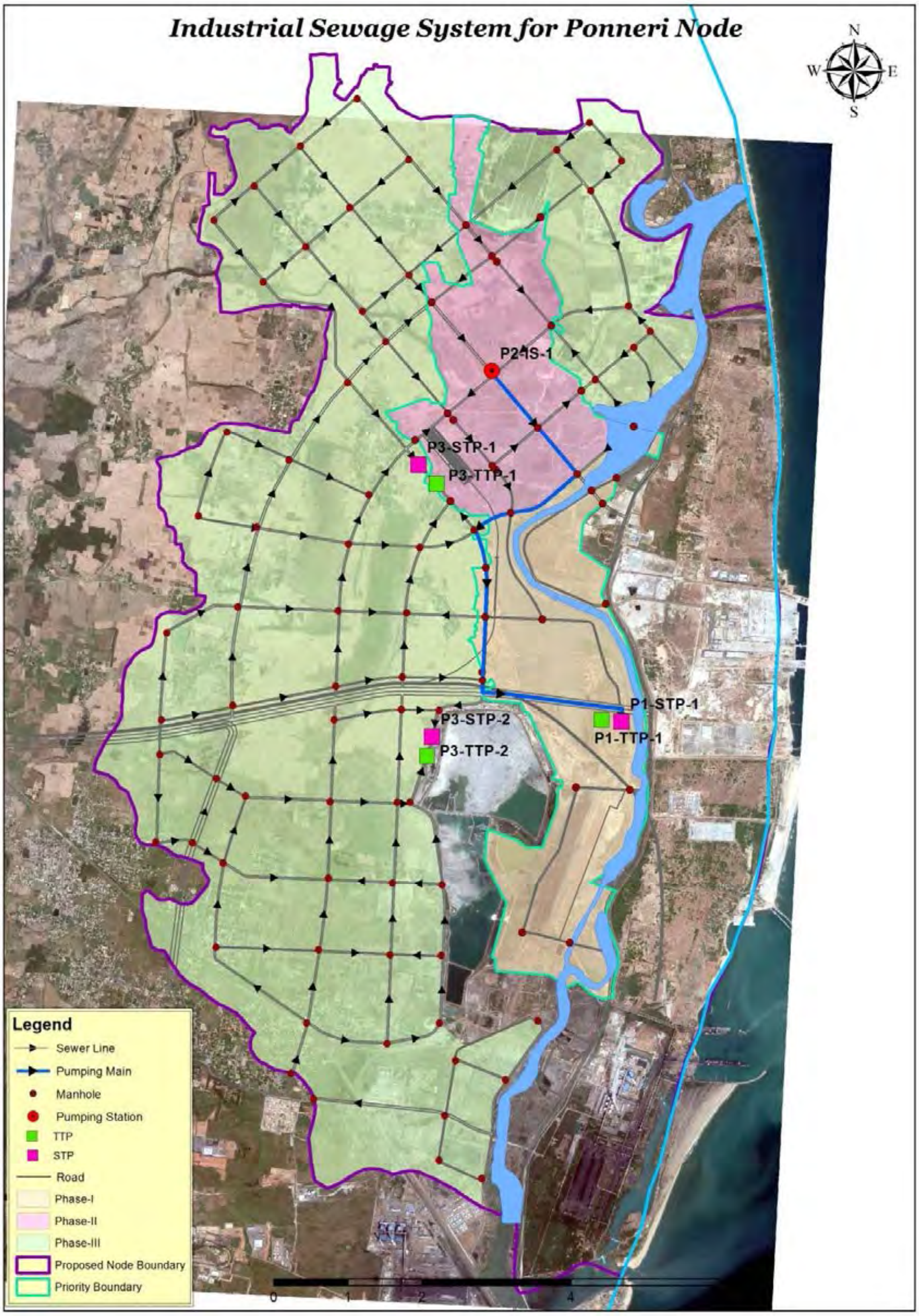
D: Diameter of pipe (m)

Design flows of the sewer pipes are determined by daily sewage amount and the peak factor. Applied peak factor is 2.5 refering to that for water supply. Sewer pipes will be installed in the both sides of the roads in the node.

Plan of Industrial Effluent Collection System

(1) Layout Plan and System Outlines

Industrial effluent collection system will collect the treated effluent from the industries and transfer them to the TTP for water recycling. Layout plan of the effluent collection and transfer system for Ponneri node is illustrated in Figure 7.56 and outlines of the major facilities in the system are presented in Table 7.69. Similar to the case of the sewerage system, the effluent will be collected by the effluent collection pipe via lift pump stations.



Source: JICA Study Team

Figure 7.56: Layout Plan of Industrial Effluent Collection System

Table 7.69: Outlines of Industrial Effluent Collection Facilities

Facility	Outlines/Capacity			Remarks
	Phase 1	Phase 2	Phase 3	
Lift pump station	2 locations	4 locations	8 Locations	-
Sewer pipe	RC Pipe*1 D=300–600mm L=54 km	RC Pipe*1 D=300–700 mm L=255 km	RC Pipe*1 D=300–1,500mm L=199 km	-

*1: RC: Reinforced concrete pipe
Source: JICA Study Team

(2) Plan of Industrial Effluent Collection Facilities

Industrial effluent collection system will cover the all industrial areas in the node. Diameters of the pipes are planned by the same conditions and methodologies so that all industrial effluent will be transfered to the TTP.

Plan of Storm water Drainage System

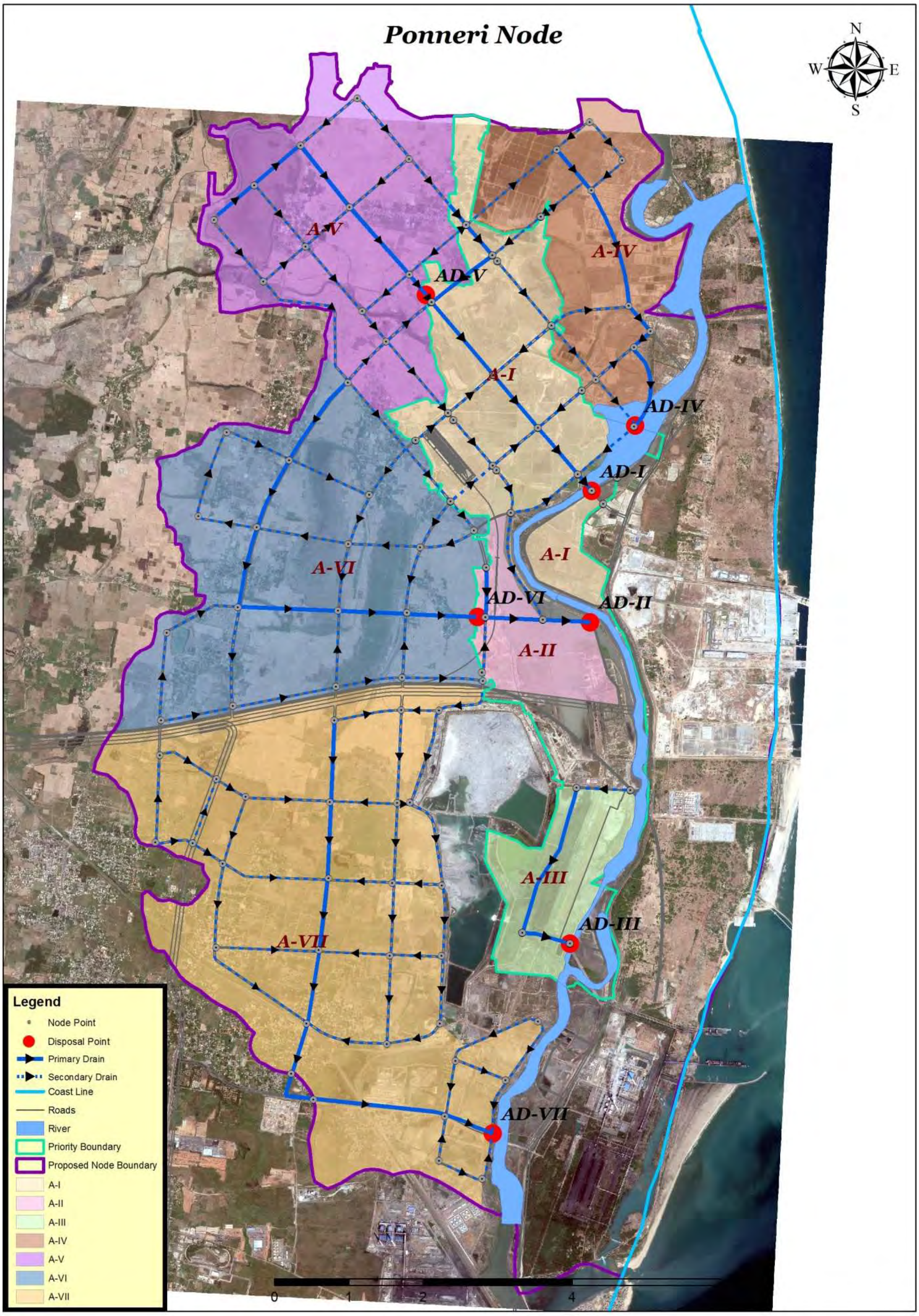
(1) Layout Plan and System Outlines

Stormwater diranage system is to drain the storm run-off from Ponneri Node during rainfall and manage the storm water entering into the node area and from other areas in the catchment. Layout plan of the stormwater drainage system for the node is illustrated in Figure 7.57 and its phase-wise development plan is presented in Figure 7.58. System outlines are given in Table 7.70 and dimensions and length of drainage facilities are summarized in Table 7.71.

The proposed storm water in the priority area of the node is divided into seven drainage zones. The seven drainage zones A-I, A-II, A-III, A-IV, A-V, A-VI & A-VII have been shown in three different colour pattern and these zones are ultimately disposing to Buckingham canal. In the phase development plan shown in Figure: 7.57, drainage zones A-II & A-III are covered in Phase 1, zone A-I is in Phase 2 and the remaining zones A-IV, A-V, A-VI & A-VII are covered in Phase 3.

The storm water collection network length for Zone A-I is 38.99 km, A-II is 11.59 km, A-III is 7.18 km, A-IV is 24.22 km, A-V is 42.12 km, A-VI is 59.59 km and A-VII is 62.51 km, aligned on both sides of the roads. The disposal points for A-I, A-II, A-III, A-IV, A-V, A-VI and A-VII are AD-I, AD-II, AD-III, AD-IV, AD-V, AD-VI and AD-VII respectively as shown in the Figure 7.57. Suitable outfall structures are to be constructed at disposal points.

It is envisaged to improve the existing Buckingham canal in order to ensure the safe conveyance of the storm discharge without creating any backflow or flooding during high tide condition. Also, it necessary to develop the land to safeguard against high tide contour, as Buckingham canal is acting as a Backwater channel. As per Coastal Regulatory Zone (CRZ) notification 2011 by Ministry of Environment and Forests (MoEF), a buffer zone of 100m along the canal is provided, it is required to provide green belt along this buffer zone. Hence it will be necessary to provide flood protection bunds along Buckingham canal to prevent flood during high tide.



Source: JICA Study Team

Figure 7.57: Layout Plan of Stormwater Drainage System

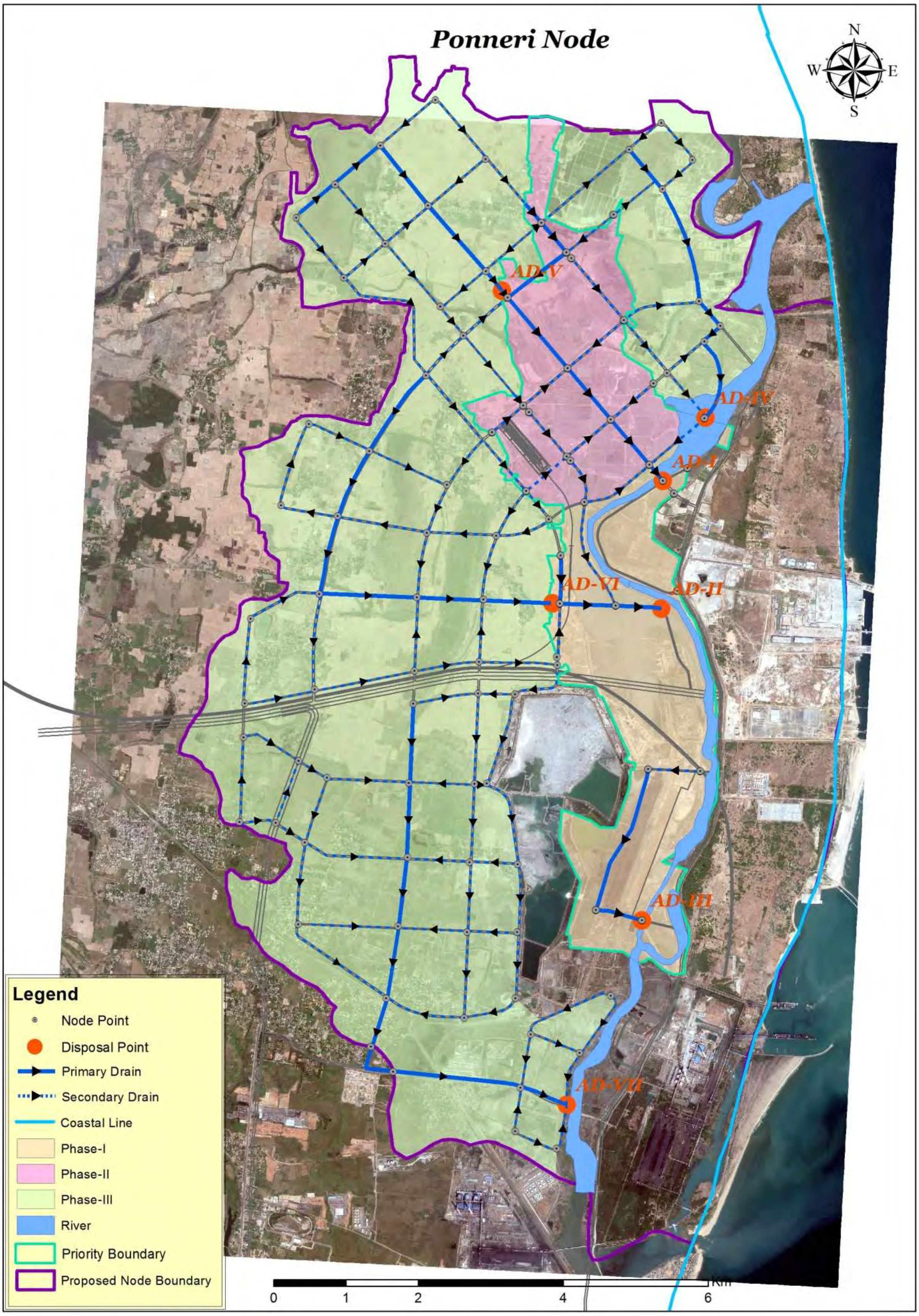
Table 7.70: Summary of Storm water Drainage Network in Ponneri

Sl.No	Zone	catchment area (ha)	storm discharge (cum/s)	Length of network (m)	Disposal	Disposal
1.	A-I	813.75	81.37	38990	AD-I	
2.	A-II	165.11	16.51	11597	AD-II	
3.	A-III	160.80	16.08	7187	AD-III	
4.	A-IV	A-IV	647.19	64.72	AD-IV	Buckingham Canal
5.	A-V	A-V	1034.88	103.49	AD-V	
6.	A-VI	A-VI	1544.07	154.41	AD-VI	
7.	A-VII	A-VII	2224.52	222.45	D-VII	
	Total	**6,590.32**	**659.03**	**2,46.22 km**		

Table 7.71: List of Storm water Drainage Pipe

Size of the Drain (m x m)	Length (km)
1.00 x 1.00	13.76
1.00 x 1.25	8.30
1.50 x 1.25	11.68
2.00 x 1.25	2.06
1.50 x 1.50	1.59
2.00 x 1.50	1.59
2.50 x 1.50	6.24
3.00 x 1.50	2.05
3.00 x 1.75	1.54
3.50 x 1.75	4.10
4.00 x 2.00	0.77
6.50 x 2.25	1.86
7.50 x 2.75	1.65
8.00 x 3.00	0.58
Total length (Km)	**57.77**

Source: JICA Study Team



Source: JICA Study Team

Figure 7.58: Phase Development Plan for Stormwater Drainage System

(7) Storm water Drainage Pipes

Drainage channels will be installed in the boths sides of the roads in the node. The size of the stormwater drain, which is presented in Table 7.71, is computed with the following formula:

$a = Q / v = \sum q * A / v$

A = B x D (Rectangular in size)

Where,

Q:Design stormwater flow (m^3/s)

v: Velocity of stormwater flow (m/s) (*Assuming 1.5m/s*)

A: Area of each residential area or industrial zone (m)

B: Width of drain (m)

D: Depth of flow (m)

7.5.6. Implementation Plan

To correspond to the water demand of the residential areas and industries in the node, all infrastructures should be constructed to be in time for the operation of each phase. Facilities for phase should be operational before 2016, those for phase 2 should be operational before 2019 and those for phase 3 should be operational before 2022. In addition to the internal water related infrastructures, purchasing contract of desalinated seawater from Minjur Desalination Plant should be concluded and necessary facilities should be constructed within 2015. In addition, purchasing contract of tertiary treated sewage from Kodungaiyur STP and its transmission pipeline should be constructed within 2016 to enable the industrial node to correspond to the industries' water demand.

7.5.7. Cost Estimate

Summary of cost estimate of the construction are presented in the table below. Also, the details of cost estimate of the construction and O&M are presented inTable 7.72 and 7.73 respectively. Unit costs for the construction items were refered to the past practices of the similar projects in South India for treatment plants, pumping stations, reservoirs and elevated tanks and standard unit costs of state government for pipe installation works.

Table 7.72: Construction Cost of Water Infrastructures

Item	Phase 1(2016-2018) Cost (Million INR)	Phase 2 (2019-2021) Cost (Million INR)	Phase 3 (2022-2033) Cost (Million INR)	Total (Million INR)
1. Potable Water Supply Works	665	521	12,863	14,049
2. Non-Potable Water Supply Works	2,878	1,725	8,278	12,880
3. Domestic Sewerage Works	337	256	2,521	3,114
4. Treated Sewage and Industrial Effluent Collection Works	671	595	4,427	5,693
5. Drainage Works	492	781	3,208	4,480
TOTAL	5,042	3,878	31,296	40,216

Source: JICA Study Team

Table 7.73: O&M Cost of Water Infrastructures

Item	Phase 1(2016-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
	Annual	Phase Total	Annual	Phase Total	Annual	Phase Total	
	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)
1. Potable Water Supply Works	23	69	54	268	517	5,172	5,509
2. Non-Potable Water Supply Works	104	311	224	1,120	661	6,611	8,042
3. Domestic Sewerage Works	16	48	30	149	148	1,485	1,682
4. Treated Sewage and Industrial Effluent Collection Works	30	89	65	324	279	2,786	3,199
5. Drainage Works	25	74	64	318	225	2,254	2,646
TOTAL	197	591	436	2,180	1,831	18,307	21,078

Source: JICA Study Team

7.6. Solid Waste Management

7.6.1. Sector Overview

The only common TSDF (landfill and incinerator) in Tamil Nadu is the hazardous waste treatment facility in Gummidipoondi, 25km from the Node. After considering the forecast increases in hazardous waste generation (including incinerable waste), it is estimated that this TSDF has sufficient capacity.

As for municipal solid waste, waste management services are provided in Ponneri and Minjur towns, both located close to Ponneri Node, but no services are available in the rural areas around the Node. The recent increase in economic development has however led to increasing levels of waste generation leading to a deteriorating environmental situation in both towns, which has become a matter of concern.

To promote more appropriate waste management, action plans for both towns were prepared and waste management facilities are being upgraded to include recycling. Recycling facilities for composting and plastic waste recycling have been planned. A regional final landfill site covering Arani and Gummidipoondi town in the sub-district adjacent to the village has been planned, but the site is yet to be selected.

Local residents raising NIMBY issues with the establishment of hazardous and municipal solid waste treatment facilities have constrained construction of waste management facilities and promotion of solid waste management. Promoting waste reduction through the 3R policy will be a crucial step in minimising the environmental impact of the facilities and coming to an agreement with the local residents.

In this section, the following items are studied in order to develop the infrastructures to manage the solid waste generated from industrial activities or residents within the Node.

- Forecasts of the future volume of industrial waste.
- Preparation of development plan for the solid waste management system in the Node
- Preparation of an implementation plan to develop the infrastructure
- Preliminary estimation of infrastructure costs

7.6.2. Framework for Infrastructure Development

Appropriate solid waste management is an integral part of providing a secure quality of life and sanitation in the Node area, which in turn leads to sustainable node development. The framework of infrastructure development for building solid waste management facilities to serve the node's priority area and surrounding areas is shown below.

- Hazardous waste management infrastructure

- The common TSDF (landfill and incinerator) in Gummidipoondi located at a distance of around25 km from Ponneri Node, which is close enough to the Node. In addition, the future estimates in the phase A study mentioned that a common AFR facility should be developed in the Ponneri node to promote recycling and reduce the volumes of incinerable and land fillable waste being sent to the TSDF. Principally, the AFR facility should be operated by a private company. Waste should be also accepted from outside the Node as this will make the facility more economically viable. Therefore, a common AFR pre-processing facility for the node is necessary. The hazardous land fillable and incinerable waste that cannot be treated by AFR shall be appropriately treated at the Gummidipoondi common TSDF.

-Recycling of recyclable hazardous waste shall be promoted between individual site operators and recyclers, using market mechanisms and trade contracts.

- Municipal waste management infrastructure

-As for the municipal solid waste, waste management services are provided in Ponneri and Minjur towns near the node. However, no services are available in the rural areas around the node. The recent increase in economic development has however led to increasing levels of waste generation leading to a deteriorating environmental situation in both towns, which has become a matter of concern. To promote more appropriate waste management, action plans for both towns were prepared and waste management facilities are being upgraded to include recycling. Recycling facilities for composting and plastic waste recycling have been planned.

-However neither of these cities proposes to receive any waste from areas outside their jurisdiction. Therefore, a waste management facility for municipal solid waste generated in the node should be established within the node area.

7.6.3. Design Conditions

Design conditions of infrastracures related to solid waste management sector are showned below.

Development Phases of Proposed Node

Ponneri Node will be developed in three phases; the target year for the first phase is 2018 and the target years for the second and third phasesare 2023 and 2033 respectively. Accordingly, the volumes of solid waste generation are estimated for the years 2018, 2023 and 2033. Figures for the years in between are calculated by interpolating values proportionally from the target year figures.

Population Forecast

As discussed above, the targeted residential population and working population of the node in each target year are forecasted as shownin.

Table 7.74: Population Forecast of Ponneri Node

Year	2018	2023	2033
Resident Population	0	0	400,000
Employed Population	88,410	226,276	888,074

Source: JICA Study Team

Forecast of Industrial Land demand

The land demandforeach industrial sector in the Ponneri node is shown below. The output of each industry was calculated based on these land demand figures. Then the future amount of waste is estimated based on these industrial outputs.

Table 7.75: Proposed Land demand of Each Industrial Sector in Ponneri Node

Industrial Sector	Land demand (Acre)		
	Year 2019	Year 2024	Year 2034
Auto	388	994	3,804

Industrial Sector	Land demand (Acre)		
	Year 2019	Year 2024	Year 2034
Chemicals & Petrochemicals	71	180	691
Machinery	173	443	1,694
Computer, electronic and optical products	49	126	482
Metallurgy	33	85	326
Textiles & Apparels	74	189	725
Medical Equipment	66	168	643
Electrical Machinery	66	168	643
Pharmaceuticals	66	168	643
Total	985	2,522	9,652

Source: JICA Study Team

Relevant Technical Standards

The development plan of each facility is based on the following technical standard.

Table 7.76: Applicable Technical Standards for Development Plan

Type of soild waste	Technical Standard
Hazardous waste	- Hazardous wastes(management, handling and Transboundary Movement) rules 2008 - Guidelines for storage of Incinerable Hazardous wastes by operator of CHWTSDF and captive Hazardous waste incinerators - Guideline for Common Hazardous waste Incineration - Criteria for Hazardous waste landfills - Guideline for Proper Functioning and Upkeep of Disposal site - Guidelines for Transportaiton of Hazardous waste
Municipal solid wasste	- Municipal Solid Wastes (Management andHandling) Rules, 2000. - Manual on Solid Waste Management(CPHEEO: Central Public Health &Environmental Engineering Organization, Ministry of Urban Development, GoI) - Technical EIA Guidance Manual for Common Municipal Solid Waste Management Facilities (The Ministry of environment and forests GoI,2010) - Guidelines on Co - processing in Cement/Power/Steel Industry Central Pollution Control Board,Ministry of Environment & Forests, GoI, 2010

Source: JICA Study Team

7.6.4. Demand Forecast

The volume of solid waste generated in the node is projected in order to estimate the required capacity of each facility. The types of solid waste to be planned for, including industrial waste and municipal solid waste, are described below. In the Phase A study, the focus was on hazardous waste with the potential for high impacts. To evaluate node development in more detail, non-hazardous waste generated from each industry is also included in the forecast presented here.

Table 7.77: Type of the target waste for planning

Type	Type of waste
Industrial solid waste	Hazardous waste：land fillable waste, incinerable waste, Recyclable waste, waste treated by AFR
	Non-hazardous waste
Municipal solid waste	Residential waste, commercial waste, Institutional waste, waste from public spaces etc.

Source: JICA study team

Industrial waste demand forecast

Industrial hazardous waste demand forecast

Regarding the establishment of a hazardous waste management facility for waste generated by industrial activities, as indicated before, an AFR facility would be established. Therefore, the forecast for hazardous waste generation in the CBIC area presented in the phase A study is used herein.

Table 7.78: Industrial hazardous waste generated for CIBC area

Year	2018	2023	2033
AFR hazardous wasteTPY	0	41,965	198,232

Source: JICA Study Team

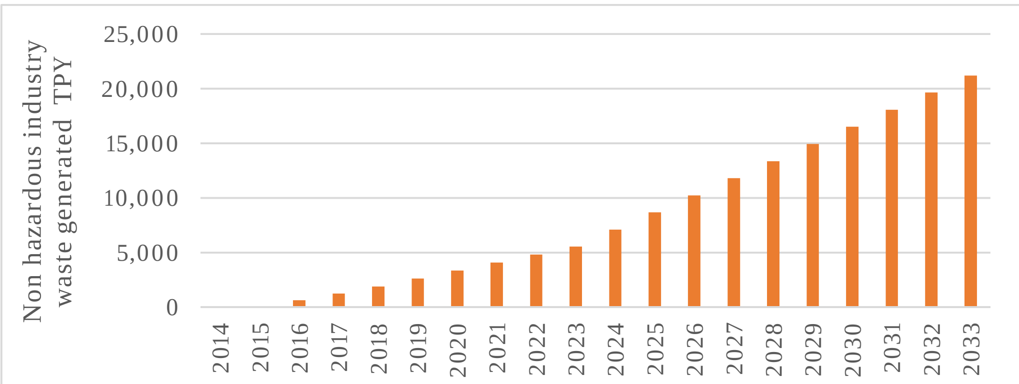
Industrial non-hazardous waste demand forecast

There is no publicly available data on non-hazardous waste generated from each industry. According to the interviews carried out by the JICA Study Team, a number of items are being recycled. Estimations were made for the items for which high levels of recycling are desirable (such as plants and animal residues, animal waste in solid form, glasses, concrete slabs, ceramics, and debris) using the volume of waste generated per output by industry type in Japan, presented in Table 7.92 on the last page of this Chapter 7.6.In addition, food residue from canteens of industry is also discharged. It was calculated as 0.05kg/employee/day according to the interview carried out by JICA Study Team. The estimated amount of non-hazardous waste from the node's industries is shown in the table below.

Table 7.79: Industrial non-hazardous waste generated in the Ponneri Node

	Year	2018	2023	2033
Number of employees		75,441	232,048	888,074
Canteen waste	TPD	3.8	11.6	44.4
Plants & animal residues, animal solid residues	TPD	0.1	0.2	0.6
glasses, concrete slabs, ceramics, and debris	TPD	1.3	3.4	13.1
Total	TPD	5.2	15.2	58.1

Source: JICA study team



Source: JICA study team

Figure 7.59: Non-hazardous industry waste generated

Municipal Solid Waste Demand

Municipal solid waste demand was calculated based on the total estimates for residential waste, which is the product of the projected residential population and the amount of waste generated per capita per day. The estimate for the total residential waste is then used to identify the total volume and also the volumes of other categories using the ratio of waste by type (for commercial, institution and public places etc.).

1. Waste type, characteristics, and waste kg/capita/day for household, commercial, office, public spaces, etc.

The estimate, presented in the following table, was made with reference to the proposal by Ponneri town panchayat in 2013-14 on solid waste management for resource recovery.

Table 7.80: Date of waste generation based on generators in Ponneri town panchayat

	Waste generator	Total waste t/day	Generation ratio %	population	kg/capita/day
1	Residential waste	5.5	49.5%	31,833	0.1728
2	Commercial waste, institutional waste	3.9	35.1%	-	-
3	Street cleaning waste	1.7	15.3%	-	-
	Total	11.1	100.0%	-	-

Source：Calculated by JICA study team based on the Solid waste management proposal for resource recovery project 2013-2014 by Ponneri panchayat.

Table 7.81: Details of qualitative analysis of MSW at Ponneri town panchayat

	Waste type	%
1	Plastic	5.9%
2	Paper	3.4%
3	Cloth	3.9%
4	Bio-degradable	63.7%
5	Rubber	1.5%
6	Glass	2.0%
8	Metal	2.5%
10	Silt	17.2%
Total		100.0%

Source: calculated by JICA study team based on the solid waste management proposal for resource recovery project 2013-2014 by Ponneri town panchayat.

2. The amount of waste generated per capita per day of residential waste for future

The amount of waste generated per capita per day for the target year 2033 is set as 0.7kg/capita/day which was determined by referring to the figures for Indian and Asian municipalities shown in the table below. The figures for other years were calculated using the figure of 0.1728kg/capita/day for the year 2014 in Ponneri town panchayat as the base.

Table 7.82: Waste generated per capita per day of other municipalities of Asia

	waste generated /capita/day	Note
Bengaluru	0.651	BBMP Master plan for MSWM 2007 (2033 estimated figure)
Bangkok	0.88	APO(2007)
Jakarta	0.6	UNEP(2005)
Japan (Tokyo Tama area)	0.796	Tokyo municipal Government Committee (2011)

Source: JICA study team

The amount of municipal solid waste, based on the waste generated per capita set above, was calculated by the following equation. The amount of commercial waste, institutional waste and wastes from public spaces etc. was calculated by using of amount of residential waste and the ratio of each waste type generated in Ponneri town panchayat.

The amount of Residential waste generated = Residential waste generated per capita per day ×population of each year

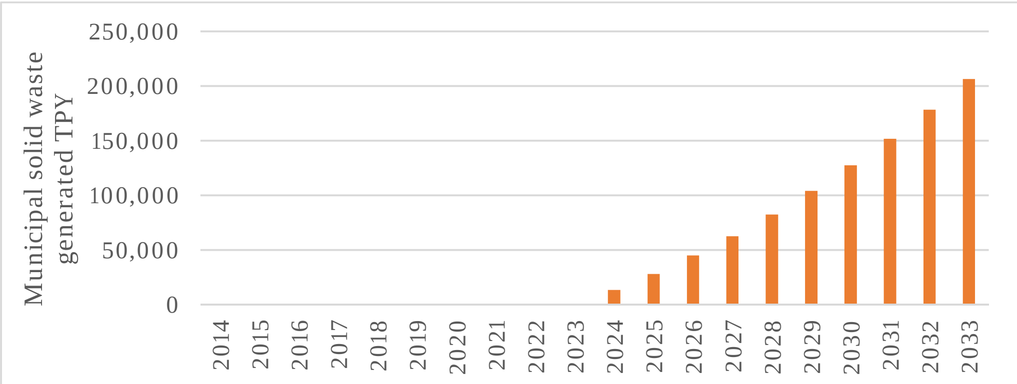
3. Future demand of municipal solid waste

Estimated future projections of the volumes of municipal solid waste generated for each category such as residential, commercial, institutional and public spacesetc.is presented in Table below.

Table 7.83: Future prediction of Municipal solid waste generation in the Node

	year	2018	2023	2033
Resident population		0	0	400,000
waste generated per capita per day	kg/capita/day	0.3510	0.4225	0.7
Residential waste	TPD	-	-	280
Commercial, institutional waste	TPD	-	-	199
Waste from public spaces, etc.	TPD	-	-	87
Total	TPD	-	-	566

Source : JICA study team



Source : JICA study team

Figure 7.60: Municipal solid waste generated TPY

7.6.5. Development Plan

Appropriate solid waste management is essential for providing a safe and hygienic living environment. It also helps promote sustainable development of the node and reduces the impact on the environment. To maximise the effectiveness and efficiency of solid waste management, it is important to consider the entire process of waste management, from waste generation to final disposal, and to develop an integral system including both infrastructure development and soft components like organisation.

Scope of the development plan

The scope covered by this development plan is set as follows.

- In this development plan, it is assumed that the developer of the Node is responsible for the solid waste management in the Node area.

- A common AFR facility for CBIC area operated by a private company or PPP mode is to be developed as mentioned before.

Development concept and policy

Various concepts and measures necessary for the solid waste management in the node, including the modern city concept (which is the vision for the node's urban development), have been considered. As a result, the following development concept and policies for the solid waste management have been identified.

Table 7.84: Concept and Policy for solid waste management in the Node

	Items	Outline
Development concept	Building a sustainable Sound Material-Cycle Society	To achieve the development of a modern city, the vision of the urban development of the Node, building of sustainable sound material-cycle society is aimed through the solid waste management.
Development Policy	**1)** Establishment of an appropriate waste management	To secure safe and clean living environment in the Node area, appropriate waste management from generation to final disposal should be conducted so that the environmental impact be minimized.
	2) Reduction in the volume of waste that goes into the final disposal through 3R promotion	To establish a Sound Material-Cycle Society, reduction in the volume of waste that goes into the final disposal site shall be achieved through3R promotion at each stage of waste management, namely generation, discarding, collection, treatment, and final disposal. Reduction of waste shall also be sought in the private business activities through promotion of a sound material-cycle based production.
	3) Selection of environmentally and economically sustainable treatment system	Any technology adopted for each stage of waste management, i.e. collection, transport, recycling, treatment, and landfilling shall be environmentally and economically sustainable. Also collection system shall be designed considering easy recycling and processing. Participation of private industries which could contribute to economically efficient and effective waste management shall be considered.
	4) Coordination with the stakeholders	Without understanding and cooperation of stakeholders such as citizens and private businesses who are generating waste, it is not possible to achieve a sustainable sound material-cycle society. Therefore, the coordination with the stakeholders shall be promoted. The protest movement of inhabitants such as NIMBY issues is easily happened in case of construction of any waste management facilities. However, waste management facilities are absolutely necessary to maintain public sanitation according to the future increase of solid waste with economic development. To build consensus with the inhabitants, waste management system that would minimize the environmental impact should be developed, and smooth consensus building with the inhabitants shall be achieved through conducting public consultation.
	5) Capacity development of institutions relevant to waste management	To execute the above mentioned policies, capacity of institutions, controlling authorities as well as individuals in each relevant to waste management shall be strengthened.
	6) Integration of waste management facilities	Any waste management facilities, either for hazardous or municipal solid waste, shall be integrated as much as possible at one location to reduce environmental burden and to increase efficiency of the process by sharing land use and necessary environmental measures. Recycling industries shall be actively invited to promote efficient solid waste management system as a whole.

Source: JICA Study team

Development Program

To achieve the policy mentioned above, the following programs have been identified for waste management, with the activities to be conducted by responsible parties.

Table 7.85: Development concept, policy and program for solid waste management in the Node

Concept	Building a sustainable sound material-cycle society	
Development Policy	7) Establishment of an appropriate waste management 8) Reduction in the volume of waste that goes into the final disposal through3R promotion 9) Selection of environmentally and economically sustainable waste treatment system 10) Coordination among the stakeholders 11) Capacity development of institutions relevant to waste management 12) Integrated waste management facilities	
Development	Within a node	Include the outside of a node

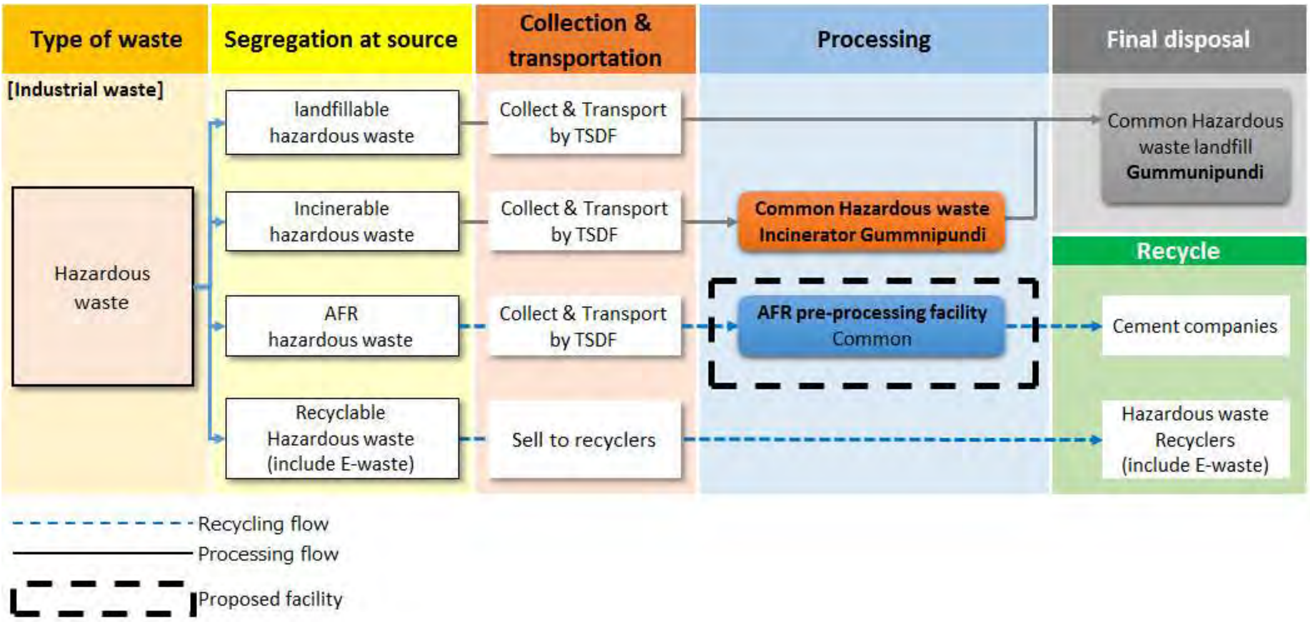
Concept	Building a sustainable sound material-cycle society		
program	Hazardous waste management (AFR pre-processing facility) (Private or PPP)	Municipal solid waste management (including non-hazardous industrial waste) (Developer)	Waste management (state government)
	■**Hazardous waste management facility development program** - Devising of a plan for pre-treatment for AFR - Development of a collection and transportation system - Development of a AFR pre-processing facility	■**Municipal solid waste management facility development program** - Development of a municipal solid waste management plan - Development of the collection and transportation system - Development of municipal solid waste treatment facility ■**Capacity development program for appropriate waste management** - strengthening capacity in operation of solid waste management ■**Program on 3R Promotion** - Awareness rising on 3R activities Development and promotion of markets for reused and recycled products Promotion of cooperation with NGOs and recyclers Development of a focal point for awareness rising	■**Institutional capacity development program for the authorizing organization (state government, etc.)** - Strengthening the management capacity in controlling illegal dumping, temporary storage, and inappropriate treatment - Establishment of a monitoring and auditing institution and its capacity development ■**Support program for the private industries** - Support for zero-waste technology for the private companies, as well as for the cooperation among the private businesses

Source: JICA study team

Hazardous waste management

1.Hazardous waste management facility development program

Common hazardous waste management facilities for the CBIC area shall be developed as per the flowchart shown below. Hazardous waste management shall be done, based on the development policy and infrastructure development plan outlined above. The flow of the processes involved is shown below –wastes are sorted according to their segregation classification and are treated under the responsibility of the waste generator. Upon developing waste management facilities, development of common AFR pre-processing facility plan is required for each phase.



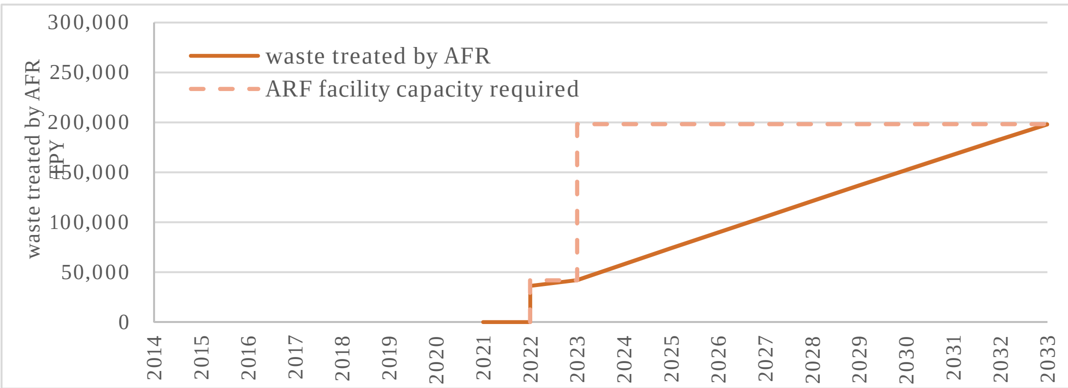
Source: JICA study team

Figure 7.61: Hazardous waste treatment system

- Capacity of Facility

For the hazardous waste treatment system, the scale of the facility for each phase is calculated based on the volume of waste generated. The results are indicated below.

The volume of waste generated from the CBIC area is used for calculating the scale of the facility. However, as it is in principle operated by a private company; solid waste should be accepted from areas outside the node as this will increase the economic viability of the facility. In addition, the capacity of the facility is determined based on volume calculations up to the year 2023. However, prolonging the life of Gummidipoondi common TSDF cannot be possible without scaling up the common AFR pre-processing facility. Therefore, the land area presented includes the area required for future expansion of the common AFR pre-processing facility.



Source: JICA study team

Figure 7.62: Capacity of AFR pre-processing facility

Table 7.86: Facility capacity of each phase

Capacity of facility		2016-2018	2019-2023	2024-2033	Total	Note
AFR pre-processing facility	TPD	0	120	446	566	Operation rate is set as 96%

Source: JICA study team

Municipal solid waste (include Non-hazardous industrial waste)

1. Municipal solid waste (include Non-hazardous industrial waste) processing facility development program

The aim will be to develop an appropriate waste management system to minimise environmental impacts through the entire process of waste management from generation, collection and transportation, treatment and final disposal. Appropriate waste management facilities will play a significant role in this. Details of waste management at each stage are summarised below. To select and identify the ideal system, considerations were given to the development policy of 1) establishment of an appropriate waste management system; 2) reduction in the volume of waste that goes into the final disposal through 3R promotion; and 3) selection of environmentally and economically sustainable treatment system.

- Development of collection and transportation system

Collection and transportation is a starting point for efficient waste management. An efficient collection system can take away waste from the living environment of the people safely and without delay, as well as preventing illegal dumping. In order to implement the collection services efficiently and economically, the collection system should be planed systematically. In the medium to long term, maintenance for the collection vehicles and management machineries shall be conducted periodically and their equipment should be repaired and/or renewed as necessary.

Non-hazardous waste generated from private industrial activities shall be managed by the private industries themselves. All recyclable waste shall be segregated and sold to recyclers; the remaining waste will be separated into “biodegradable waste” and “others waste” by the business operators. Regarding transportation of waste, private business operators should take their own waste to the intermediate treatment facilities. For establishments that do not have a system to transport their waste, waste management companies shall provide collection and transportation services at reasonable prices.

In India, collection of waste by segregation at source into wet and dry waste are conducted or planned in many areas. This method of collection has a great benefit for waste management for the following reasons.

- Promotion of recycling of recyclable materials,
- Prevention of contamination to ensure more appropriate composting, Biomethanation, incineration and landfilling,
- To reduce space required for a landfill by reducing the waste amount, and
- Raising awareness on waste among the waste generators.

Therefore it should be applied as standards it will lead to a reduction of waste that goes into final disposal in the node area.

However, “wet waste” currently includes items such as wet paper or cloth. These items are likely to be incorrectly classified, which should be noted if considering the introducing of composting or Biomethanation. Therefore, "Wet waste" is recommended to be revised and categorised as "Biodegradable waste" based on the aim for thorough separation. Also, “dry waste" currently includes recyclable paper and plastic etc. The classification should be revised and divided into "Recyclable waste" and "Others waste".

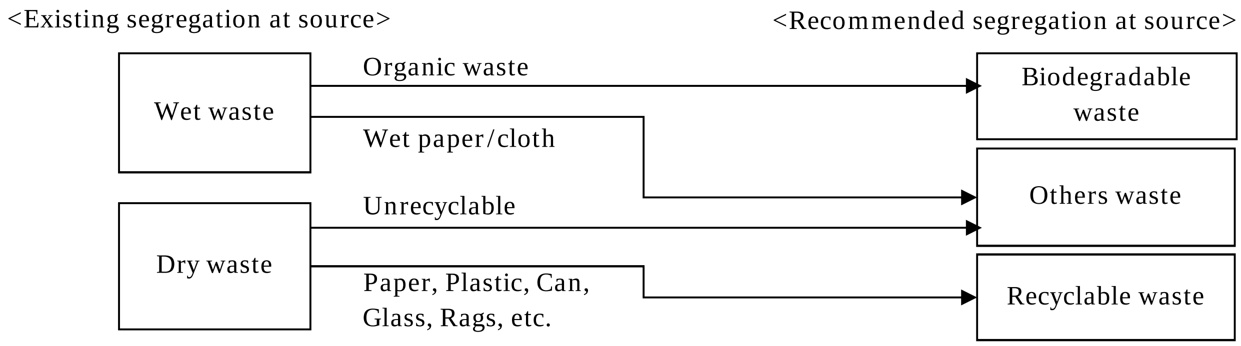


Figure 7.63: Segregation at source

Collection vehicles and machineries required are calculated based on the conditions mentioned below.

- Collections of non-hazardous waste from industries are outsourced to waste management companies.
- Door to door collection by 5ton (10 m^3) compactor trucks for residential houses within the node as these houses are newly built and accessible by collection vehicles.
- Bulk specific gravity of 0.5t/m3 and loading ratio of 96% are set
- Frequency of collection services is set at 3times/week for biodegradable waste and 2times/week for both "other waste" and "recyclable waste".
- Collection trips are set at 3 trips per day.
- 2collection areas

Table 7.87: Collection equipment required

Type of collection vehicle	2018	2023	2033
Compacter	3	4	68
Number purchase vehicle of each phase	3	1	64

Source: JICA study team

- Development of processing facilities

The following technologies for processing of non-hazardous waste in the node area could be considered. The technologies applied for waste processing shall be selected according to characteristics of waste and processing technologies suitable to the future economic and social conditions.

In addition, recyclable wastes amongst the non-hazardous waste generated from industrial activities shall be sold to recyclers by each business entity; the residues will be treated as municipal solid waste. Plastic recycling shall be conducted at AFR facilities and/or at the plastic recyclers.

Table 7.88: Option of municipal solid waste processing technology

	Merit	Demerit	remark
Compost	• reducing waste amount by using organic waste • relatively small initial investment and running cost • relatively simple technology • Experience already accumulated	• difficult to maintain the quality of the product • competing with the low cost chemical fertilizers • availability of the demand for the compost • not suitable for mixed waste of organics and non-organics	• stable demand is necessary for compost • use as cover soil for the landfill site shall be considered alternatively
Biomethanation	• reducing waste amount by using organic waste • recapturing of biogas as renewable energy	• large initial investment and running cost • high skills required for operation • availability of the demand for the	• not many examples available with large-scale facility

	Merit	Demerit	remark
	• increasing experiences in India	sludge	
Waste to Energy (Incinerator)	• effective for hygiene • reducing waste amount power generation available for large facilities • Possible power generation in the cases of with over certain scale.	• large initial investment and running cost • high skills required for operation • not suitable for low calorific waste • potential for NIMBY problem	• various experiences in Japan and high technical convince

Case of each technology in Japan is shown in Annex.

Source: JICA study team

For the reasons mentioned below, a Biomethanation plant is positioned as a processing treatment facility for non-hazardous waste such as food residues from industries and canteens. In addition composting facility is considered as processing facility for municipal solid waste.

- Reduction in the volume of waste that goes into the final disposal through 3R promotion (basic policy)
- Obtaining separated organic waste by implementing segregation at source.
- Lowest cost of development and maintenance for the biodegradable waste of MSW. Selection of environmentally and economically sustainable treatment system(basic policy)
- Food residues from canteens of factories as well as plants and animal residues from food processing industries can be used at Biomethanation plant.
- There is a vast green belt within the Node, and products from composting and the sludge generated from the Biomethanation plant can be applied to those areas.
- Use of renewable energy
- According to the waste demand forecast, the required capacity of the incineration facility will be less than 300t/day before 2030, which makes waste to energy incineration unfeasible. However, the required capacity will exceed 300t/day in 2030 due to a rapid increase in the residential population. Therefore, any proposed updates to facilities after 2033 year should consider utilising waste to energy incineration.

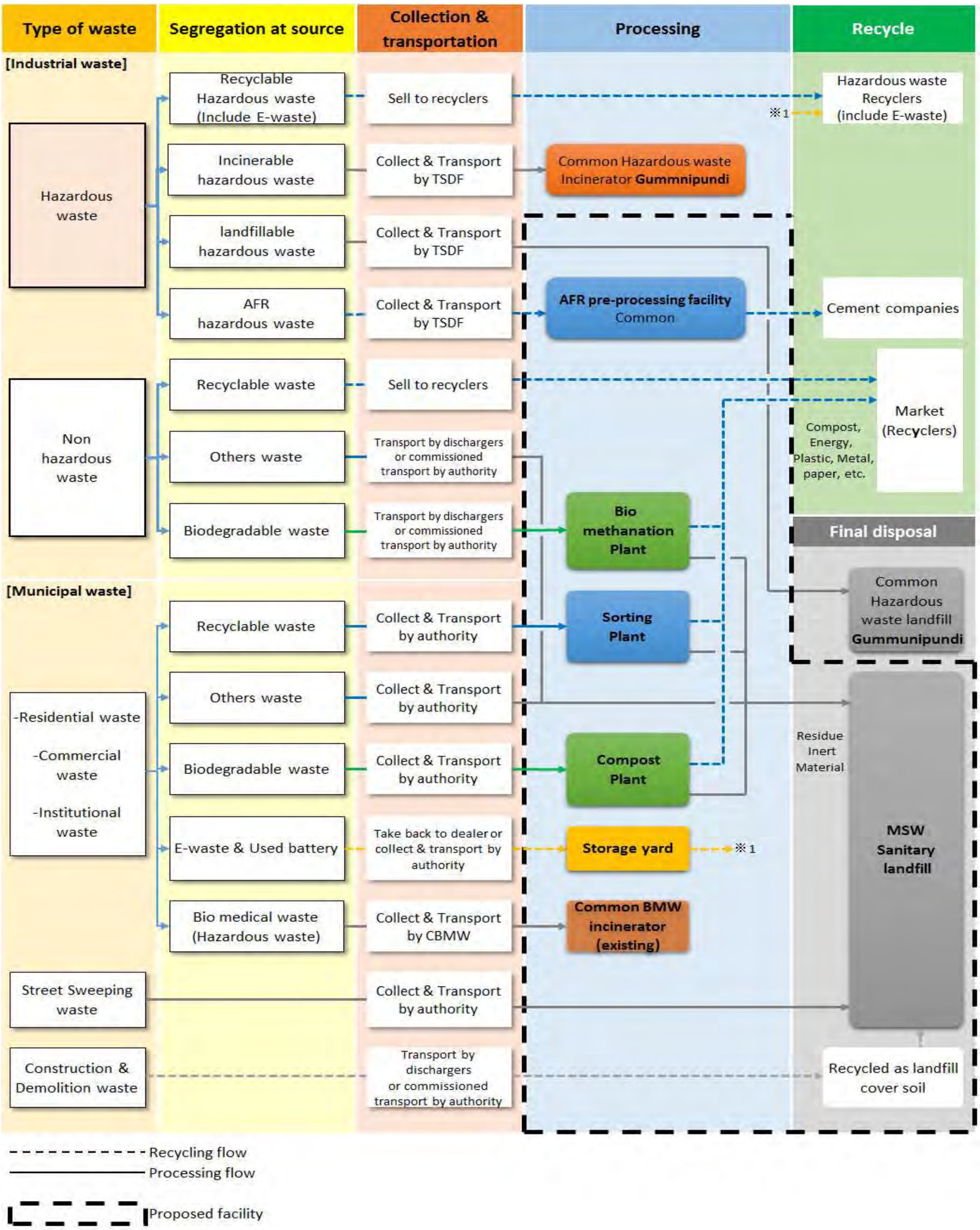
- Development of a landfill site

  The function of a sanitary landfill is to separate residues from the natural environment after intermediate treatment. This is done to prevent any environmental impacts of sanitary management. A sanitary landfill site in accordance with the facility development guidelines in India shall be established.
- Others

  - construction and demolition waste

  Construction and demolition waste typically includes concrete, plaster, metals, and wood. These are usually heavy and bulky. This waste is not treated by the municipality. They are discarded and scattered around low-lying lands, streets and near waste collection containers. The volume of such waste is expected to increase further due to economic growth in the future.
  As a countermeasure for this problem, discarding construction waste at the waste collection point for municipal solid waste shall be prohibited and the waste generator shall take the waste to the landfill themselves or by contracting with a waste management company. A storage area for construction waste shall be allocated within the landfill site and this waste can be used as cover soil for the landfill site or as construction material (establishment of a recycling plant for construction waste might be possible in case the price of virgin materials becomes higher than the recycled materials).The case in Japan is shown in in Table 7.92 on the last page of this Chapter 7.6.In addition, imposing of a landfilling charge shall be considered.

The following diagram shows the entire process flow for hazardous and municipal solid waste respectively, based on the discussions above.

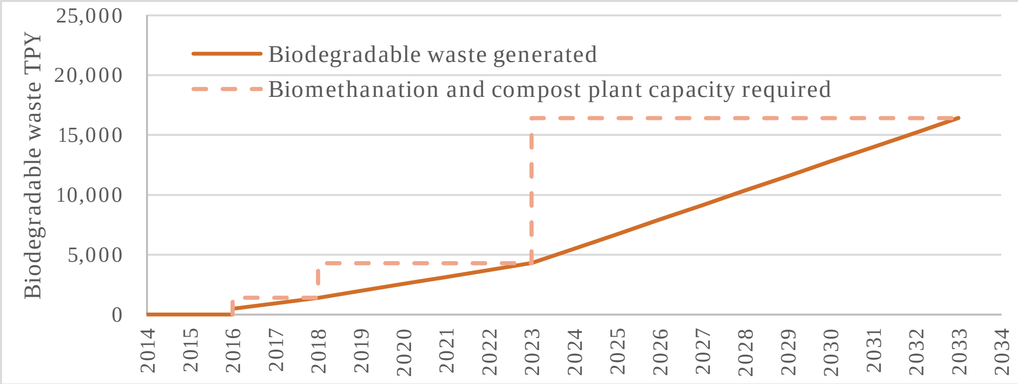


Source: JICA study team

Figure 7.64: Solid waste management in the Node

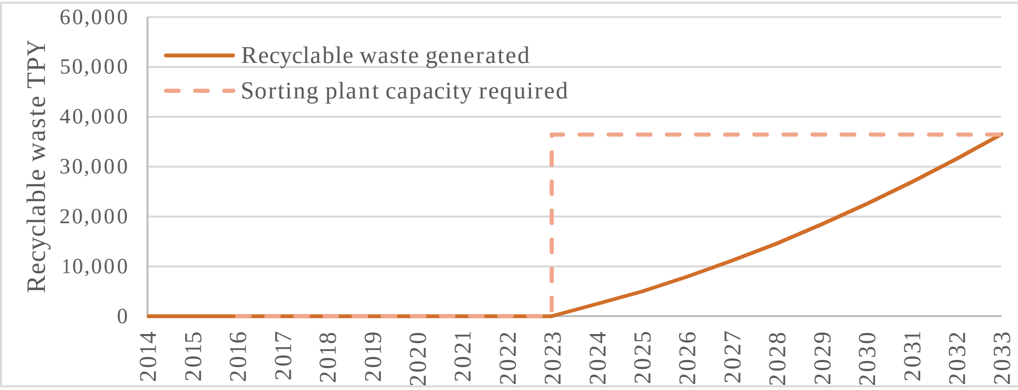
- Capacity of each Facility

The capacity of each facility for each phase is calculated from the amount of waste generation. The results are shown below.



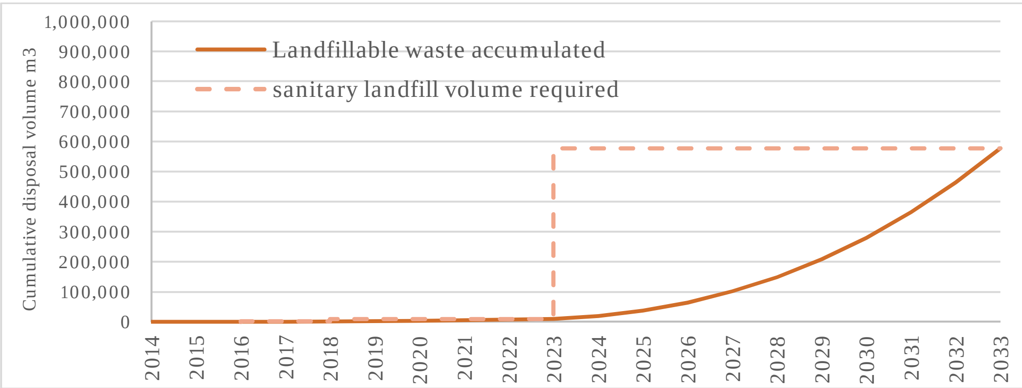
Source: JICA study team

Figure 7.65: Biomethanation and Compost Plant



Source: JICA study team

Figure 7.66: Capacity of sorting plant



Source: JICA study team

Figure 7.67: Capacity of sanitary landfill

Table 7.89: Capacity of each facility

Facility		2016-2018	2019-2023	2024-2033	Total	Note
Compost plant	TPD	0	0	421	421	Operation rate is set as 86%
Sorting plant	TPD	5	10	40	55	Operation rate is set as 86%
Biomethanation plant	TPD	0	0	117	117	Operation rate is set as 84%
Sanitary landfill	m3	1,621	8,315	567,518	577,455	The ratio of landfill capacity used for cover soil is set as 20%

Source: JICA study team

- Development of a municipal solid waste (include non-hazardous industrial waste) management plan

To develop municipal waste treatment facilities, a municipal solid waste management plan shall be identified for each phase by the developer. Especially 1) operation method; 2) setting of an appropriate solid waste management fee and its collection method; and 3) waste management in LB area outside of the node will require careful consideration. In addition, the master plan shall be reviewed every 5 years depending on the industrial development and the increase in the population.

2. Capacity development program for appropriate waste management

To achieve the development policy of establishment of appropriate waste management, capacity development of the parties involved in waste management is indispensable, and therefore measures on capacity development of the individuals and institutions are important.

- Strengthening capacity in business operation of waste management

Capacity development of individuals and institutions in various aspects, such as those outlined below, are necessary to achieve appropriate waste management.

- Capacity to devise the action plans on solid waste management
- Capacity in devising a staff training program
- Technical capacity for facility operation and maintenance
- Capacity to analyse various monitoring data on quantity / quality of waste, etc.
- Capacity to dissemination of information towards establishment of a sustainable sound material-cycle society.

3. Program on 3R Promotion

The reduction of waste that goes into final disposal by controlling the generation of waste and promotion of recycling is considered the most important component of a good solid waste management system. This will minimize the environmental impact from waste management and establish sustainable sound material-cycle society. This also leads to reduction in the cost required for development and maintenance of waste management facilities as well as prolonging the life of the final landfill site. Therefore, the priority should be on the following, in order 1) reduction of waste at the source of generation; and 2) reduction of waste through reuse and recycling of the waste generated. Moreover, 3R promotion including waste reduction in the private sector is important, and the private companies should aim to reduce their volumes of waste by leading the resource based production activities.

- Awareness rising activities on 3R

To achieve establishment of sustainable sound material-cycle society, the role of awareness rising through education is important. For promoting3R to reduce waste at source, obtaining the understanding and cooperation of the local residents and private companies (i.e. the sources of waste generation) is considered of primary importance. Residents and companies can act on their own with 3R on their mind; “knowing” and “thinking” is required from them. Therefore, there should be more active planning and execution of programmes to increase awareness, including enhancement of the programmes undertaken by groups such as

ITC and NGOs in local communities. Environmental education should be promoted via a focal point within the communities as this will lead to residents' awareness levels being raised high enough to "know the reality."

- Development, promotion and networking of markets for reused and recycled products

There are already a number of recyclers and markets for second-hand and recycled products. To advance 3R activities further, the development, promotion and networking of these markets shall be promoted. Recycling industries can be invited to the same location as the waste treatment facility to be built by the project.

- Promotion of cooperation with NGOs and recyclers

With the improvement in the quality of life due to economic development, the volume and the quality of waste will vary. Without understanding and cooperation from stakeholders such as citizens and private companies, the generators of waste, the establishment of sustainable sound material-cycle society cannot be realized. Therefore, active participation by each stakeholder is important, and cooperation with stakeholders such as NGOs and recyclers shall be promoted.

- Development of a focal point for awareness rising on 3R and information disclosure/exchange on other environmental issues

To promote environmental activities as mentioned earlier, a focal point of public relations which can be used for information disclosure and exchange as well as raising awareness on3R and other environmental issues should be established. This should target citizens and corporations and should be part of the functions of waste management facilities. The space can be used by NGOs and community organizations mentioned earlier to conduct their awareness rising activities and also can be used for second-hand markets and flea markets.

Waste management including outside of the Node area

For achieving the establishment of appropriate waste management and reduction of waste through 3R activities as stated in the basic policy, it is important to implement a programme not just in the node area but also in the area outside the node. It is the responsibility of the state government to select the land for development of common hazardous waste management facilities as well as implementation of appropriate municipal solid waste management and monitoring of the related facilities. The programs for the project of the state government in executing its responsibilities are outlined below.

1. Institutional capacity development program for the authorizing organization (state government, etc.)

To secure a safe and clean living environment and to establish a sustainable sound material-cycle society, appropriate waste management is indispensable. Inappropriate waste treatment methods currently used must be removed. For this to be realised, capacity development of the state government staff in monitoring and authorising management practices of citizens and private companies has primal importance.

- Strengthening the management capacity in controlling illegal dumping, inappropriate temporary storage, and treatment

There are cases of inappropriate practices regarding both hazardous waste and municipal solid waste at present. By the development of appropriate waste treatment and disposal facilities, illegal dumping and/or inappropriate temporary storage of waste should be stopped. For this to be realised, management capacity of private companies handling waste and the administrative staff (state PCB) controlling illegal dumping, inappropriate temporary storage and treatment should be strengthened.

- Establishment of a monitoring and auditing institution and its capacity development

For appropriate waste management, setting up of a third party organization such as IWMA (associations of waste generating companies conducting monitoring of management practice by contractors) should also be promoted along with the capacity development of administrative staff (state PCB).

2. Support environmental technology program for the private industries

To promote zero emissions of waste through the use of waste as resources for industries, support and information should be provided on the latest recycling technologies and dialogue exchange among the companies should be facilitated. Technical support for development of cleaner production methods with low environmental impacts shall also be provided for the establishment of a sustainable and sound material-cycle society.

7.6.6. Implementation plan to develop the infrastructures

Each capacity of the infrastructure ateact target year is shown below.

Table 7.90: Capacity of each infrastructure facility for each target year

Infrastructure			by 2016	by 2018	by 2023	Total
Hazardous waste facilities	AFR pre-processing facility	TPD	0	120	446	566
		ha	0.00	2.75	10.23	12.98
MSWfacilitiess	Composting plan	TPD	0	0	421	421
		ha	0.00	0.00	8.50	8.5
	Biomethanation Plant	TPD	5	10	40	55
		ha	0.20	0.30	1.00	1.50
	Sorting plant	TPD	0	0	117	117
		ha	0.00	0.00	1.18	1.80
	Sanitary Landfill	m3	1,458	8,540	567,518	577,455
		ha	0.90	5.30	10.52	10.70
	Collection vehicle Garage & workshop	Unit	3	0	64	68
		ha	0.06	0.00	0.36	0.45
	Stockyards for e-waste, etc.	ha	0.11	0.11	0.11	0.32
	Space for future recycling industrial facilities	ha	0.25	1.14	6.50	7.25
Total		ha	1.53	9.59	39.02	43.50

**A space for future recycling industrial facilities is calculated as 20% of the total space of solid waste management facilities.*

Source: JICA Study team

7.6.7. Preliminary cost estimation of infrastructures

The cost estimation for the infrastructure is indicated below.

Table 7.91: Preliminary cost estimation of infrastructure

1. Capital Cost — Cost: INR mil.

Item	Description		Unit	Unit Rate (INR mil.)	Phase 1(2014-2018) Quantity	Phase 1(2014-2018) Cost (INR mil.)	Phase 2 (2019-2023) Quantity	Phase 2 (2019-2023) Cost (INR mil.)	Phase 3 (2024-2033) Quantity	Phase 3 (2024-2033) Cost (INR mil.)	Total Quantity	Total Cost (INR mil.)
Hazardous waste infrastructure	1) AFR pre-processing facility	includes infrastructure & Equipment	TPD	2.64	0.0	0.0	119.9	316.3	446.5	1,178.0	566.4	1,494.3
MSW infrastructure	1) Composting plant	includes infrastructure & Equipment	TPD	0.66	0.0	0.0	0.0	0.0	421.0	278.2	421.0	278.2
	2) Biomethanation plant	includes infrastructure & Equipment	TPD	1.76	5.0	8.8	10.0	17.6	40.0	70.4	55.0	96.8
	3) Sorting plant			0.66	0.0	0.0	0.0	0.0	117.0	77.3	117.0	77.3
	4) Sanitary landfill	includes infrastructure (roads, water drainage, electricity) & Equipment(JCB, bulldozer, weighbridge, etc.)	1000t	0.40	1.5	0.6	7.6	3.0	422.3	169.8	431.4	173.5
	5) Stockyards for e-waste, etc.		ha	77.00	0.1	8.3	0.1	8.3	0.1	8.3	0.3	24.9
	6) Collection vehicle		vehicle	2.94	3.0	8.8	1.0	2.9	64.0	188.1	68.0	199.9
	7) Collection vehicle garage & workshop		ha	77.00	0.1	4.6	0.0	2.3	0.4	27.7	0.5	34.7

2. Operation and Maintenance Cost

Item	Description		Unit	Charges (%)	Phase 1(2014-2018) Annual (INR mil.)	Phase 1(2014-2018) Phase Total (INR mil.)	Phase 2 (2019-2023) Annual (INR mil.)	Phase 2 (2019-2023) Phase Total (INR mil.)	Phase 3 (2024-2033) Annual (INR mil.)	Phase 3 (2024-2033) Phase Total (INR mil.)	Total (INR mil.)
Hazardous waste infrastructure	2) AFR pre-processing facility	Routine maintenance (repair every year), periodic maintenance (each 5 years)	I.s.	15%	0.0	0.0	0.0	36.0	194.7	2,017.7	2,053.7
MSW infrastructure	1) Composting plant		I.s.	10%	0.0	0.0	0.0	0.0	27.8	306.0	306.0
	2) Biomethanation plant		I.s.	15%	1.3	4.0	4.0	21.1	14.5	154.9	180.0
	3) Sorting plant		I.s.	25%	0.0	0.0	0.0	0.0	19.3	201.0	201.0
	4) Sanitary landfill		I.s.	7%	0.0	0.1	0.3	1.5	13.0	146.9	148.6
	5) Collection vehicle		I.s.	25%	2.2	6.5	2.4	12.0	26.0	259.8	278.2

3. Cost of soft component

Item	Phase 1(2014-2018) Period	Phase 1(2014-2018) Phase Total (INR mil.)	Phase 2 (2019-2023) Period	Phase 2 (2019-2023) Phase Total (INR mil.)	Phase 3 (2024-2033) Period	Phase 3 (2024-2033) Phase Total (INR mil.)	Total Period	Total (INR mil.)
■Capacity development program for appropriate waste management & ■Program on 3R Promotion	2 years	86	1 year	43	3 years	128.4	6 years	256.8
■Institutional capacity development program for the authorizing organization (state government, etc.) & ■Support program for the private industries	2 years	107	1 year	54	2 years	107.0	5 years	267.5

Source: JICA study team

Table 7.92: Indicators of industry waste in Japan

				1.871	JPY/INR
Type of industry		Plants & animal residues, and	animal solid residues	glasses, concrete slabs, ceramics	Debris
Classification of India	Classification of Japan	t/Crore	t/Crore	t/Crore	t/Crore
Food Processing	Textile industry	1.26604	0.05051	0.00393	0.00019
Textiles & Apparels	Textile industry	-	-	0.00131	0.00019
Pharmaceuticals	Chemical industry	0.01628	-	0.02301	0.01534
Chemicals & Petrochemicals	Chemical industry	0.01628	-	0.02301	0.01534
	Petroleum and coal products manufacturing	-	-	0.00636	0.08943
	Plastic Products Manufacturing	-	-	0.00692	0.00019
Metallurgy	Steel industry	-	-	0.22245	0.15098
	Non-ferrous metal manufacturing industry	-	-	0.03461	0.00730
Machinery	General-purpose machinery and equipment manufacturing industry	-	-	0.01684	0.00505
	Production equipment manufacturing	-	-	0.01459	0.02114
Computer, electronic and optical products	Business equipment manufacturing	-	-	0.01684	0.00037
	Electronic components and devices and electronic circuit manufacturing industry	-	-	0.01048	0.00037
	Electrical machinery, equipment manufacturing industry	-	-	0.02470	0.00037
	Information and communication equipment manufacturing	-	-	0.00337	0.00019
Electrical Machinery	Electrical machinery, equipment manufacturing industry	-	-	0.02470	0.00037
Auto	Transportation equipment manufacturing	-	-	0.00711	0.00486
Defence	Transportation equipment manufacturing	-	-	0.00711	0.00486
Medical Equipment	Other manufacturing	-	-	0.08718	0.00412

Source: Survey report of Industrial waste emissions and processing status, in fiscal 2010 (summary version) /March 2013. Ministry of the Environment Japan, Department of waste management and recycling

8. Economic cost benefit assessment

8.1. Methodology for economic cost benefit assessment

Creation of industrial nodes under the umbrella of CBIC is envisaged as a massive development that would catalyse economic growth within the delineated region. It will have obvious impact on economy of each participating state as well. The project is expected to create various investment opportunities for industrial sectors identified as focus sectors in the CBIC region.

While analysing possible benefits to be created with development of each industrial node, the consultant considered permanent and temporary aspects of the benefits to be created.

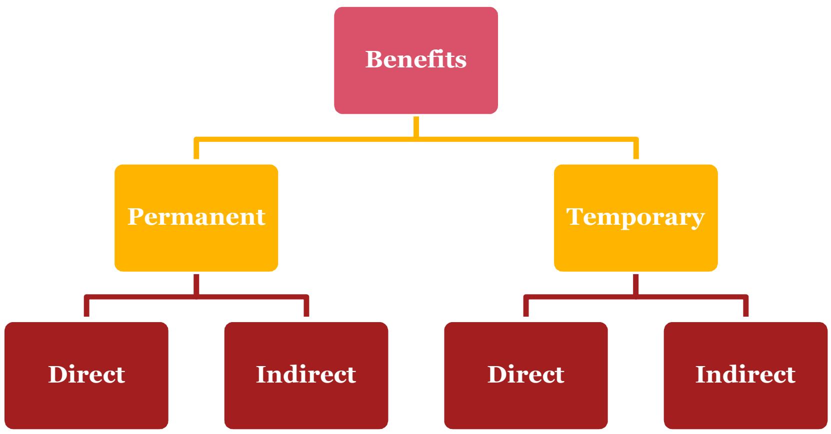


Figure 8.1: Segmentation of Benefits to be created by CBIC Development

Temporary benefits mostly evolved around creation of direct and indirect employment during the construction period of each industrial node. In monetary terms these benefits include construction gross value added (GVA) to be created in the course of construction activities at the site.

Permanent benefits arise out of creation of direct and indirect employment opportunities across manufacturing and services sectors with respect to each node. In monetary terms these benefits will include gross value added in manufacturing and some relevant services that are expected to be created once the tenant industries commence manufacturing/support services activities.

Both types of benefits have been translated into monetary equivalent using GVA per capital.

8.2. Assumptions

The methodology of economic cost benefit assessment was based on the following assumptions:

GVA per capita has been projected taking into consideration real GDP growth projections by Standard Chartered.[42] [43]

[42] Standard Chartered - The Super Cycle lives: EM growth is the key (November 2013)
[43] Ratio beyond 2031 has been assumed to be 1.0 (PwC)

Table 8.1: GDP growth ratio

Real GDP growth, % p.a.	0.056	0.069	0.063	0.069
Ratio		1.23	0.91	1.10

GVA per capita

It has been calculated using GVA by kind of relevant economic activity for industrial nodes and employment in India.

Table 8.2: GVA per capita

Sectors	GVA by kind of economic activity at constant (2005) prices - US dollars, 2009[44]	Employment, India, 2009[45]	GVA per capita
Construction	83,643,310,443	52,160,000	1,604
Manufacturing	173,141,000,000	48,540,000	3,567
Transport, storage and communication	102,167,000,000	19,360,000	5,277
Wholesale, retail, hotels	179,354,000,000	47,990,000	3,737
Total	**1,067,340,000,000**	**460,180,000**	**2,319**

Multiplier assumptions

Multiplier effect usually considered as every direct employment creates number of indirect employment opportunities and hence additional indirect income sources. Higher multiplier has been assumed for construction sector (under temporary benefits estimates) based on the proposed multiplier by the Planning Commission. Permanent multiplier in overall manufacturing sector has been taken based on international benchmarking and estimates of historical manufacturing multiplier of the Indian economy

Table 8.3: Construction and manufacturing multipliers

Multiplier assumptions	
Temporary multiplier (construction)	1.8x[46]
Permanent multiplier (manufacturing)	1.5x[47]

Deadweight and displacement assumptions

Deadweight is defined as the gross direct effect of the reference case as a percentage of the gross direct effect of the intervention option. In case of each node the consultant has considered output/GVA growth rate projected for CBIC region to arrive at the deadweight. CAGR of BAU scenario is 6.3% and CAGR of BIS scenario is 14.6%. The figure below presents the following:

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[44] http://unstats.un.org/unsd/snaama/selCountry.asp
[45] Planning commission data tables, Table 62, http://planningcommission.nic.in/data/datatable/index.php?data=datatab
[46] Planning commission, REPORT OF THE WORKING GROUP ON CONSTRUCTION FOR THE 11TH FIVE YEAR PLAN (2007-2012), planningcommission.nic.in/about us/committee/.../wg11_constrn.pdf
[47] Interim Report 3 projections

E0 - baseline

E2 - E0 - BIS scenario

E1 - E0 - BAU scenario

E2 - E1 - impact/addition (14.6%-6.3%) = 8.3%

Deadweight is a difference between BIS scenario growth rate (14.6%) and impact (8.3%) = 6.3% which is 41% of 14.6% growth rate CBIC output is expected to grow over the projected period.

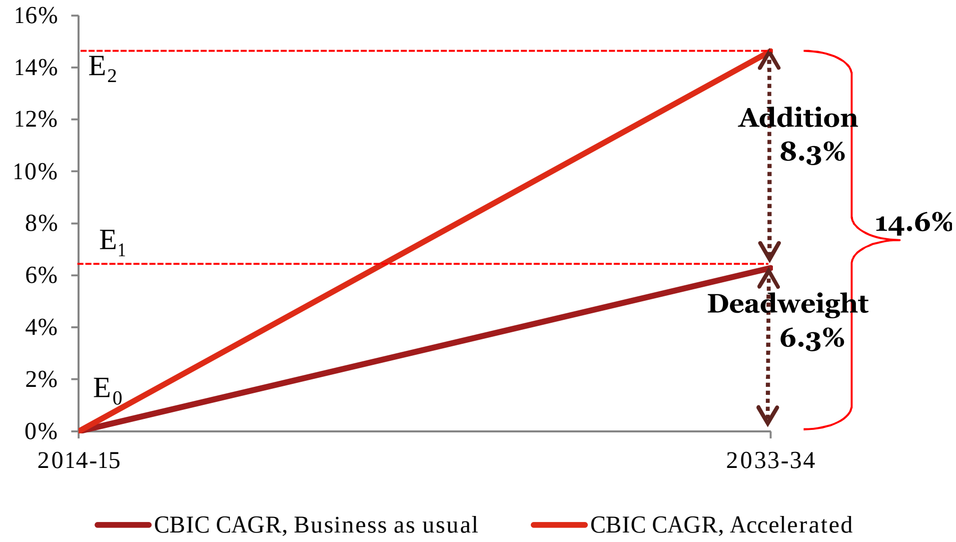


Figure 8.2: Deadweight assessment[48]

Displacement is the proportion of intervention benefits accounted for by reduced benefits elsewhere in the target area. Displacement arises where the intervention takes market share (also referred as product market displacement) or labour, land or capital (referred to as factor market displacement) from other existing firms within the geographical area under influence of the intervention.[49]

The following ready reckoner[50] has been adopted as a guideline to assume displacement percentage:

Table 8.4: Displacement ready reckoner

Level	Description	Displacement
None	No other firms / demand affected	0%
Low	There are expected to be some displacement effects, although only to a limited extent	25%
Medium	**About half of the activity would be displaced**	**50%**

[48] Adapted from Additionality and Economic Impact Assessment Guidance Note, A Summary Guide to Assessing the Additional Benefit, or Additionality, of an Economic Development Project of Programme, November 2008, by Dr. Alastair H. McPherson, Scottish Enterprise, p. 7
[49] Additionality and Economic Impact Assessment Guidance Note, A Summary Guide to Assessing the Additional Benefit, or Additionality, of an Economic Development Project of Programme, November 2008, by Dr. Alastair H. McPherson, Scottish Enterprise, p. 10.
[50] Same as above

Level	Description	Displacement
High	A high level of displacement is expected to arise	75%
Total displacement	All of the activity generated will be displaced	100%

Given the nature of development in Ponneri and the neighbouring areas, medium displacement effects are anticipated

8.3. Summary and quantification of key economic benefits

Some of the key benefits that would be expected include:

Table 8.5: Expected Key Benefits

Direct benefits:	Indirect benefits:
• Employment generation • Land development in industrial node • Industrial investments in industrial node • Taxes collection by the state/central government	• Indirect potential employment generation by sector • Exports promotion prospects • Availability of quality industry/infrastructure o Enhanced mobility and alternate transportation o Efficient and responsible infrastructure use o Availability of work-life balance benefits

8.3.1. Direct benefits

Direct potential employment generation by sector

Employment generated in proposed industrial nodes will comprise of direct and indirect employment opportunities. Direct employment refers to employment directly related to the production of products or services across sectors identified as focus sectors in each industrial node. By the end of phase 3, the total number of employment opportunities will be 337,454

Table 8.6: Direct Potential Employment Generation by Sector

	Base case
Traditionally strong sectors	***234,085***
Auto	118,045
Chemicals & Petrochemicals	15,711
Machinery	53,603
Computer, electronic and optical products	26,037
Metallurgy	3,164
Textiles & Apparels	17,525
Potential sectors	***103,368***
Total	**337,454**

Developed land in industrial node

Total developable land in industrial node is 13,581 acres. The major saleable elements of this land will be industrial land – 9169 acres and residential and commercial land – 2213 acres and besides 2199 acres to be used for creation of infrastructure facilities. Population projected to reside in industrial node is 1.85 million.

Table 8.7: Land demand, acres

	Developable land, acres
Traditionally strong sectors	
Auto	3613
Chemicals & Petrochemicals	656
Machinery	1610
Computer, electronic and optical products	458
Metallurgy	310
Textiles & Apparels	689
Potential sectors	***1,834***
Total industrial area	**9169**
Residential area	**2213**
Total developable land	**11382**

Source: PwC projections

Industrial investment

Industrial land is expected to attract tenants from various sectors identified for Ponneri Industrial Node as focus sectors. Total land for traditionally strong sectors with higher probability to get occupancy is **6,228** acres. Potential sectors are projected to occupy 1,557 acres of industrial land in Ponneri IN. Together these tenants are expected to infuse Rs. 200,512 crore (USD 33.4 billion) of investment in the by the end of projected period.

Table 8.8: Estimation of Industrial Investment

	Industrial Investment, Rs. Crore
Traditionally strong sectors	***157,058***
Auto	85,082
Chemicals & Petrochemicals	16,683
Machinery	27,721
Computer, electronic and optical products	16,671
Metallurgy	6,043
Textiles & Apparels	4,858
Potential sectors	43,454
Total	**200,512**

Source: PwC projections

8.3.2. Indirect benefits

Indirect potential employment generation by sector

Direct employment results in generation of employment in the businesses that supply goods and services to the manufacturing/service sectors of the node, i.e. indirect employment. Finally, when these directly and indirectly generated incomes are spent and re-spent on a variety of items in the broader economy (e.g., food, clothing, entertainment), it gives rise to induced employment effects. For the purpose of this analysis both indirect and induced potential employment is called indirect potential employment.

Indirect employment in industrial node is expected to amount to 506,180.

Exports promotion prospects

Availability of quality industrial infrastructure

Prime aim of planned development lays in creation of state-of-the-art industrial infrastructure facilities within the node. It also envisages development/enhancement of transportation system in the vicinity of the node and its proper connection to the major logistics and trade hubs.

Enhanced mobility and alternate transportation

A detailed and comprehensive master planning of the industrial area aims at introduction of efficient transportation network to connect the node to the trade, residential, retail and other commercial centers in the vicinity of the node. Residential area is envisaged to have interconnected streets and provision for future expansion of roads and transportation facilities in case of further incremental development.

Efficient and responsible infrastructure use

Development of industrial nodes proposed as a part of CBIC region is a planned approach brings opportunities to locate, design and phase infrastructure incrementally combined with residential and other proposed uses. This approach offers improvement of systems' operating efficiency and financial feasibility. Also it is able to make affordable and accessible sustainable technologies in various areas, including manufacturing process, support services and habitant development.

Availability of work-life balance benefits

This planned development will facilitate employment creation in the node where residential facilities are also proposed. This approach gives more people the option of living near work and also provides them with opportunities to avail better facilities for their families, including healthcare, residential, shopping, education and recreation facilities.]

8.3.3. Detailed cost- benefit analysis for all nodes

8.3.4. Temporary benefits

Temporary benefits include potential gross value added from construction activity as a result of development of proposed Ponneri industrial node. Total temporary employment is anticipated to be 87,325 and total temporary GVA is expected to amount to USD 3039 million.

Total direct temporary employment is expected to be 31,187 and corresponding indirect employment is projected to amount to 56,137.

Table 8.9: Temporary employment to be generated in Ponneri Industrial Node

Total temporary employment	Phase 1	Phase 2	Phase 3
Direct temporary employment	11,165	7,604	15,699
Indirect temporary employment	20,097	13,686	28,259
Total temporary employment	31,262	21,290	43,958

Table 8.10: Total temporary impact in monetary terms, Ponneri Industrial Node

	Phase 1	Phase 2	Phase 3
Direct temporary impacts – Infrastructure	580	520	1,835

development cost, USD mn			
Indirect GVA impacts USD mn	81	73	262
Total temporary impacts, USD mn	661	593	2,097

8.3.5. Permanent benefits

Permanent benefits include potential gross value added from various manufacturing activities across sectors identified as highly potential for Ponneri IN as well as some relevant services. Total permanent employment adjusted to deadweight and displacement assumptions (net employment) till 2052 is anticipated to be 317,003 and total direct GVA contribution is expected to amount to USD 2156 million.

Table 8.11: Permanent net employment to be generated in Ponneri Industrial Node

Total permanent net employment	Nos
Direct permanent net employment	126,801
Indirect permanent net employment	190,202
Total permanent net employment	**317,003**

Table 8.12: Projected GVA benefits, Ponneri Industrial Node

Total GVA	USD mn
Net additional direct GVA	2156
Net additional indirect GVA	3234
Total additional net GVA	**5390**

8.3.6. Benefit-cost ratio

Total net present value of benefits is expected to be USD 2,455 million. The summary of costs and benefits is given in the table below.

Table 8.13: Summary of Net Present Costs and Benefits, Ponneri Industrial Node

Summary of costs and benefits	
Total projected costs, USD mn	2,935
Total projected benefits GVA, USD mn	5,390
Total net benefits, USD mn	**2,455**

Having calculated the net present value of projected costs and benefits till 2033-34, the project is estimated to have a benefit-cost ratio of 1.3 ignoring any optimism bias in the estimated costs and benefits.

Table 8.14: Benefits-Cost Ratio for Ponneri Industrial Node Development

Full-term NPV	
NPV of projected costs USD mn	1,282
NPV of projected benefits USD mn	1,617
Benefit - Cost Ratio (BCR)	**1.3x**

Thus, development of Ponneri Industrial Node can be considered economically beneficial given the costs anticipated for development of this industrial node. Implementation of this project taking into consideration the unbundling of utilities and their development by individual SPVs will further improve benefit-cost ratio.

9. Financial Assessment and Planning

9.1. Basic assumptions for the Financial Model

The financial model has been built for the master SPV which will be responsible for undertaking the development of the Ponneri Industrial node. The development of the node will entail land acquisition and development for let out to industry and support infrastructure, creation and operation of support infrastructure, collection of revenues from the occupants of the land towards upfront land lease, infrastructure usage fee. Alternately, the SPV also has the option of managing just land acquisition, development and sale of land with only none or some or all of the support infrastructure facilities. This means that the SPV has the option of offloading specific infrastructure components to separate SPV's which will be independent entities. The two options provided in the financial model are as under.

Table 9.1: Options considered in the financial model

Financial Model Option	Description
Option -1 – Master SPV only	Only one SPV (Master SPV) that controls land acquisition and development together with creation, operation and maintenance and revenue appropriation from all support infrastructure like road, rail, water, power solid waste management etc.
Option – 2 – Master SPV and multiple SPVs	Master SPV controls land acquisition, development and operations and also chooses to retain some or none of the support infrastructure facilities. The one's not under the control of the master SPV will function as separate SPVs.

9.1.1. Timelines

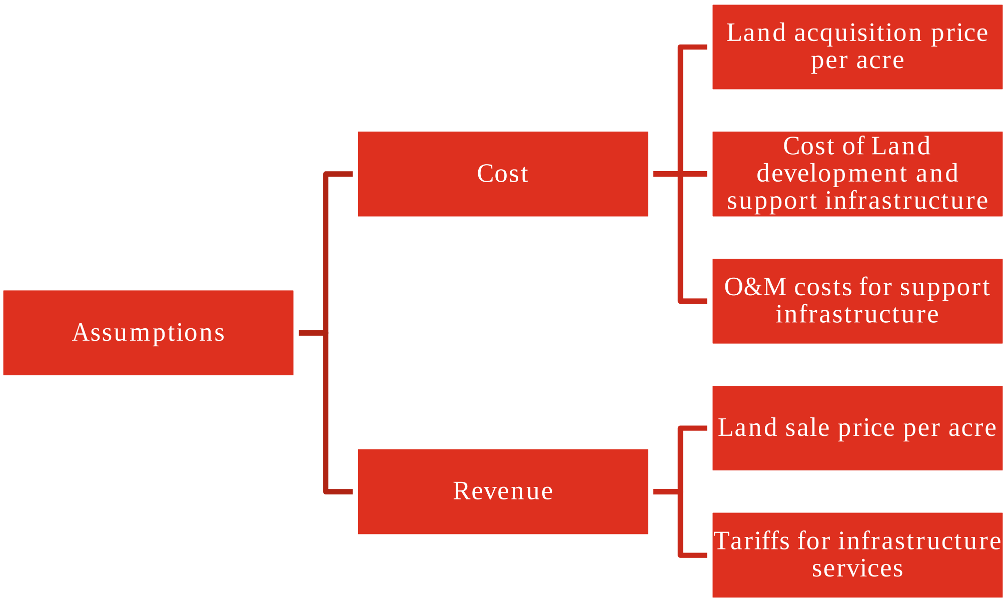
The Financial Model has been prepared by assuming that the commencement of construction activity for the support infrastructure and the land offtake will happen in the financial year 2016-17. The perspective plan for the CBIC region and so the node is till 2033-34. As a result, the capacity expansion and the ultimate land offtake are not slated to be later than this date. However, the financial model period is kept at 35 years (form the year 2016-17) by assuming that no capacity creation would be effected at the node later than 2033-34. The costs for capacity creation have been estimated at constant prices with the base year as the current year i.e. 2014-15. The same has been escalated using an index which grows exponentially at 5%. To sum up, the assumptions mentioned herein are reproduced in the table below:

Table 9.2: Financial Model timelines

Particulars	Timeline
Base Year for Costs and Tariffs	2014-15
Construction Start Date	2016-17
First year of Operation	2017-18
Last year of Financial Model	2052-53
Financial Model Period (Operational years)	35 years

Source: Financial Model prepared by JICA Study Team for Ponneri Node

As mentioned above, the base year for cost estimates has been assumed as the current year (2014-15) as the estimates are being made from the current year onwards. The cost and revenue estimates are in the following areas as shown in the diagram below.



The costs for land development and creation of support infrastructure have been estimated for each year based on the capacity that is injected into the node. The costs and tariffs have been escalated using the same index growing at 5% year on year. The price of land acquisition and sale per acre is as shown in the table below.

Table 9.3: Land acquisition price and sale price assumptions

Particulars	Rs. Crore
Land acquisition price per acre	0.70
Land development cost per acre	0.50
Total Cost of developed land per acre	1.20
Selling price of land per acre	1.50

9.2. Project cost

The Project cost has been estimated through detailed analysis of Infrastructure requirement based on the nature of industry and the extent of offtake of land for industry. The Project cost has been considered including the cost of land acquisition and land development, development of support infrastructure within the node, contingency and the derived value of Interest during construction. The estimation of quantity has been made based on detailed technical assessment and master planning for the node, the costs have been benchmarked with national and international values for unit costs. The Capital cost estimate has been provided in the table below.

Table 9.4: Project Capital Cost

CAPEX	Cost.(Rs. Crore)	Share (%)
Land acquisition cost	13509	41%
Land development	5633	17%
Roads	2806	9%
Railway	116	0%
Water and Effluent Treatment Facilities	6175	19%
Solid Waste Management	389	1%
Power infrastructure cost	2933	9%
Contingency (5% of cost excl. land)	903	3%
Interest During Construction	249	1%
Total	**32713**	**100%**

Source: JICA Study Team for CBIC.

From the table above, it may be observed that out of the total project cost of Rs. 32,713 crore, a significant 56% of it goes towards land acquisition and development (13509+5633). The second most significant element of cost is in the creation of water and effluent treatment facilities. The total developable area identified by the SPV has been estimated at 13, 581 acres.

It is to be noted that two master scenarios were envisaged for the purpose of the financial model. These are as follows:

- One Master SPV for the entire node responsible for ownership of all land to be given under long term lease and the infrastructure ownership along with the obligation of infrastructure service delivery.
- One Master SPV and multiple SPV's one each for those infrastructure components which can be developed and operated as separate companies through individual Concession Agreements.

The above table pertains to the first scenario which envisages all development and delivery by one master SPV.

9.2.1. Key cost assumptions

Considering the scenario of master developer undertaking the responsibility for land and all infrastructure, the following are the key financing assumptions for the purpose of the financial model.

9.2.2. Financing Assumptions

Financing structure:

Aligned to the DMIC model, it has been assumed that the Master Developer SPV will be constituted with centre and state government participation (and private sector, in cases where the state wishes) and land is brought into the SPV as equity contribution. Base case financing structure for development of Ponneri node:

Table 9.5: Proposed financing structure

Financing Component	INR cr.	% contribution of TPC
Equity (Brought in as value of Land and other expenses))	12592	41%
Debt (Land development & infrastructure cost)	9814	27%
Internal Accruals	10307	32%
Total	**32713**	**100%**

The Commercial loan is assumed to be borrowed at an interest rate of 12% (with monthly rests) for a door to door tenor of 14 years with a moratorium of 3 years.

9.2.3. Project Phasing

Based on the prerogative of corridor development, the development is continuous over the years ending in FY 2033-34. However, the following table shows the quantum of investment required in the short term, medium term and long term which have been respectively identified as the years 2016-19, 2020-24 and 2025-34. The capital costs to be incurred have been presented in the table below.

Table 9.6: Project Cost – Phase wise

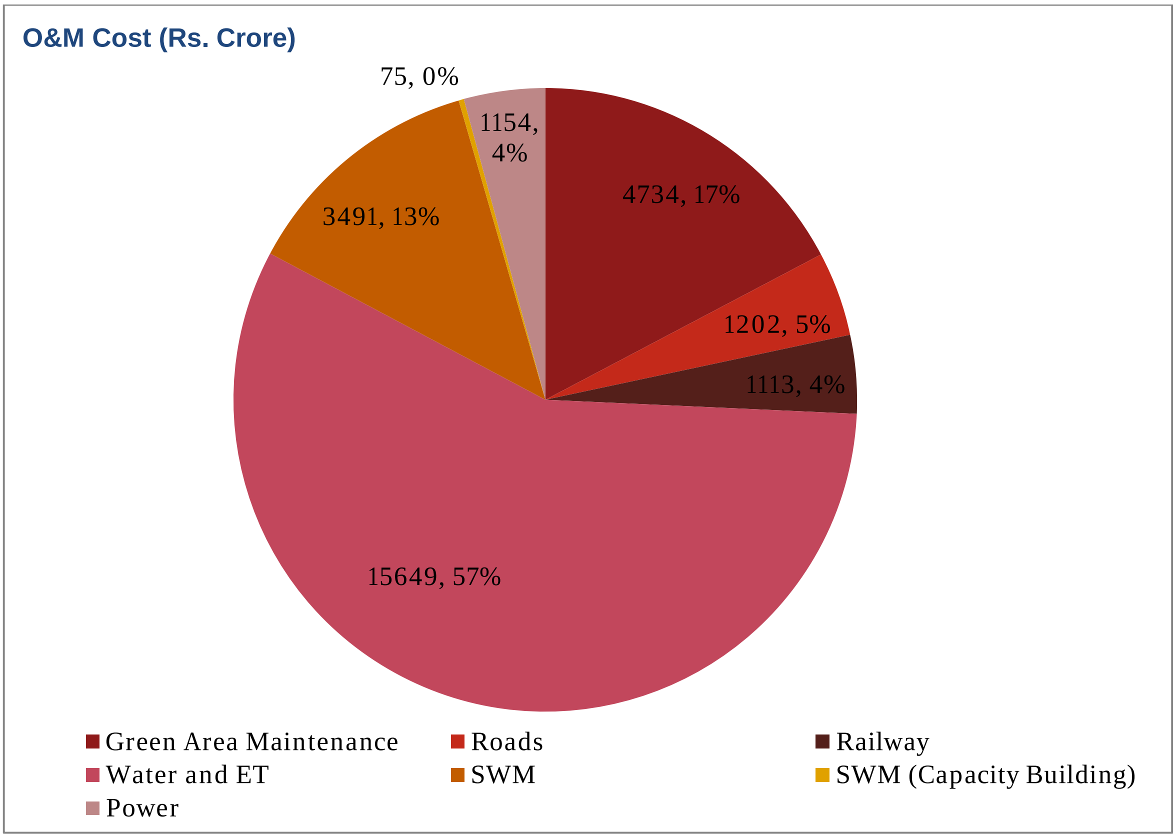
Item	Phase I Upto FY 19	Phase II FY 20-24	Phase III FY 25 onwards
Land acquisition cost	9,351	4,158	0
Land development cost	1,735	2,066	1,833
Roads	1,234	232	1,340
Railway	96	1	19
Water and Effluent Treatment Facilities	432	458	5,285
Solid Waste Management	3	51	335
Power infrastructure cost	68	391	2,475
Contingency	178	160	564
Interest During Construction	217	31	0
Total	**13,314**	**7,547**	**11,851**

Source: JICA Study Team for CBIC.

It is to be noted that the phasing of development of other infrastructure has been planned with dependence on the land offtake. The land offtake is assumed to be completed in the financial year 2029.

9.2.4. Operating costs

The Operations and Maintenance expenses have been arrived at based on benchmarks at both national and international level. The key determinants are the capacity of the infrastructure component, corresponding manpower required and the extent of maintenance that is required based on the industry characteristics. A 5% y-o-y escalation has been assumed. The following chart shows the break-up of O&M costs for the Ponneri Node under the current scenario of Master SPV managing all infrastructure components of the node.



Source: JICA study Team Analysis

Figure 9.1: Break up of O&M cost

From the above chart, it may be observed that the water and effluent treatment system accounts for maximum O&M at 57%. For the power system, the cost of procurement of power has been excluded and the tariff considered for revenue is only the margin per unit of power sold. Hence, the cost of power procurement has not been considered in the model. Other significant components of O&M include Power, Solid Waste Management. Maintenance of Green area has been assumed at 5% of the total revenues.

9.2.5. Revenues

Revenue streams envisaged for the project include land lease upfront lease rentals (99 yr. lease based on prevailing practice in Industrial Estates of SIPCOT), user charges from provision of utilities such as power, water, logistics and railways, sale of recyclable wastes and service fee mark- up of 10% of Green area maintenance, for provision of utilities. An y-o-y escalation of 5% has been assumed. Land lease rentals form more than 35% of total revenues due to higher rentals seen at Ponneri which is proximate to Chennai city. Revenue estimations are based on ongoing market rates for land lease rates in Ponneri, and user charges for utilities in the area. There is a huge difference between the initial cost of procurement of the land and the sale price as Ponneri requires substantial amount to be spent on Land development.

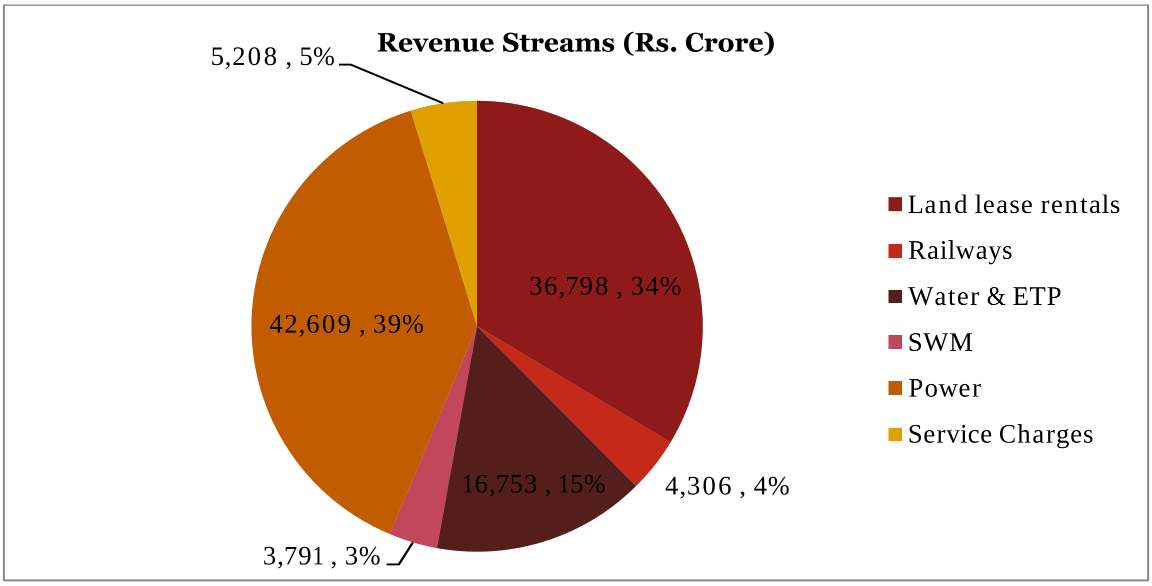


Figure 9.2: % share of revenue streams

Key revenue assumptions:

From the above chart, it may be observed that land lease rentals and power revenues are the ones accounting for the highest share with each contributing to more than a third of total revenues. The share of lease rentals is even more pronounced as the land bank would exhaust in the year 2029 itself. The land lease rentals have been assumed at Rs. 1.5 crore per acre to begin with and consume a 10% escalation year on year. For the elements, Water and Effluent Treatment and Solid Waste Management, the tariffs have been assumed by attempting to bring about parity in NPV of revenues with the NPV of estimated O&M costs.

Table 9.7: Tariff assumptions

Item	Rate
Land lease rental	Rs. 1.5 cr/ acre
Water Tariff o Potable o Non potable	 o Rs. 10/ KL o Rs. 30/ KL
Power	Net margin of 0.93 Rs. Per unit
SWM	Mark- up of 15% over break even Tariffs for Each Category - Rs per tonne o MSW: Rs. 860 o Non-hazardous waste: Rs. 803 o Land fillable hazardous waste: Rs. 588 o Hazardous waste treated by AFR: 1384
Railways	Various sources such as handling at container yard, Warehousing, Cold Storage, Office rentals etc.

Revenues have been based on the above assumptions, and as seen in the chart below is Cash Flow Available for debt Service (after O&M) to meet loan debt service obligations.

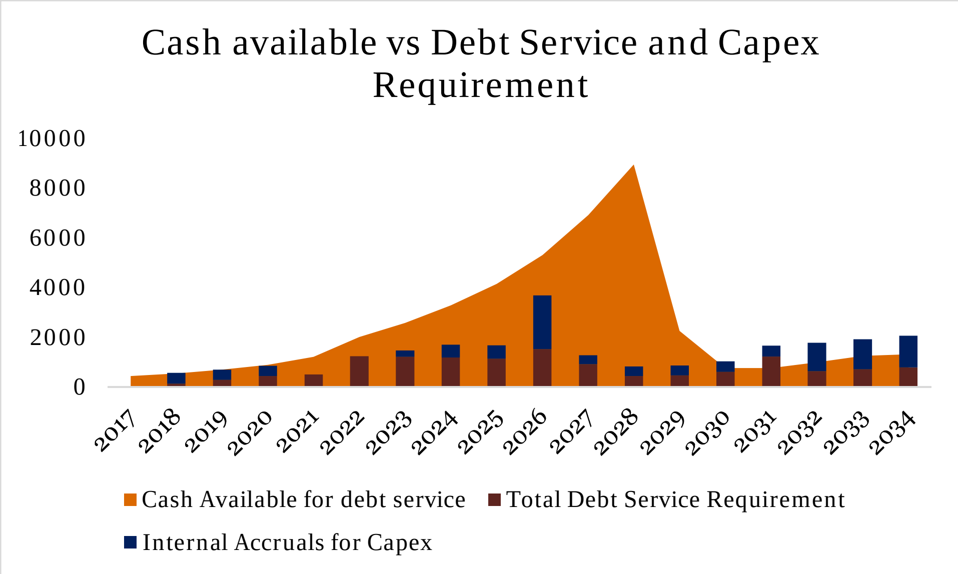


Figure 9.3: Debt Service assessment

Also shown below is the chart containing the various cost components vis a vis revenues. It may be observed that the initial commitment towards capital cost is high. This is projected to be met by capital infusion towards the project cost. The revenues exceed the cost estimates in the year 2021 and subsequently, the cost requirements are met by internal accruals (as mentioned earlier) created by the revenue surplus. This indicates comfortable financial position.

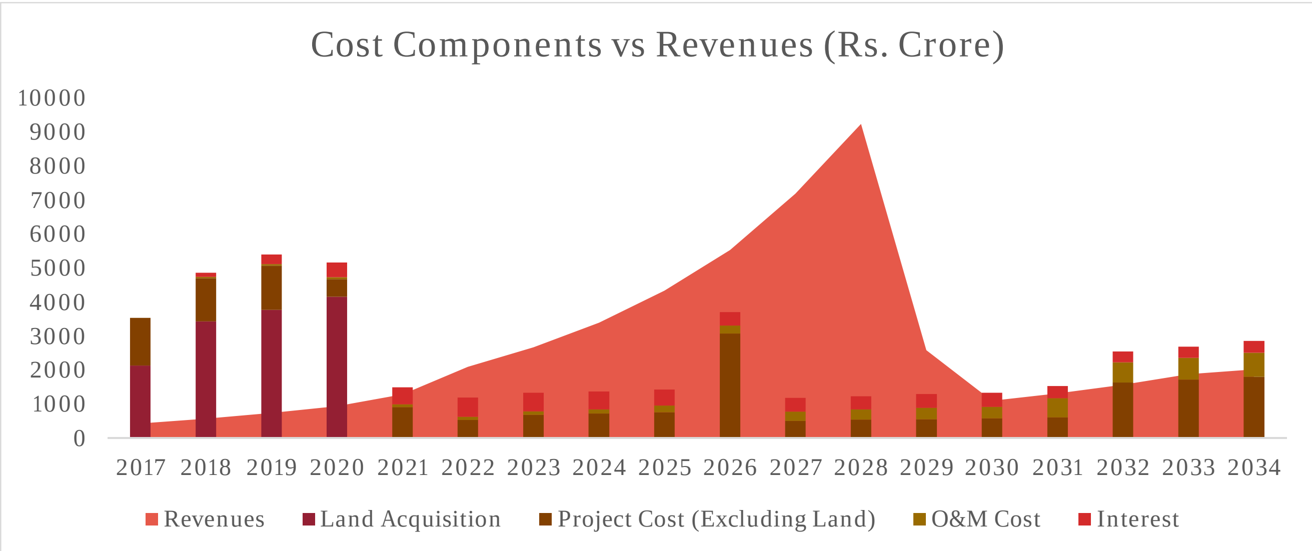


Figure 9.4: Cost vs Revenues

9.2.6. Scenario and Sensitivity Analysis for Project viability

Under the current financing structure, and cost and revenue assumptions, the project IRR stands at 10.97% and Equity IRR at 10.85%. Other scenarios of unbundling entities for independent operation have been assumed

1. Land lease rentals: Currently the ongoing lease rentals at Ponneri have been assumed with a 10% y-o-y escalation. It is to be noted that the Master Developer can sell land only to the extent of total area under industrial and residential land- use. Other areas such as road, green space, water body etc are essentially

non- saleable areas and form around 16% of total land area under proposed project. A scenario was assumed to reduce the initial lease rentals to Rs. 1.35 crore per acre and another scenario to bring down the base year lease rentals to Rs. 1.2 crore per acre.

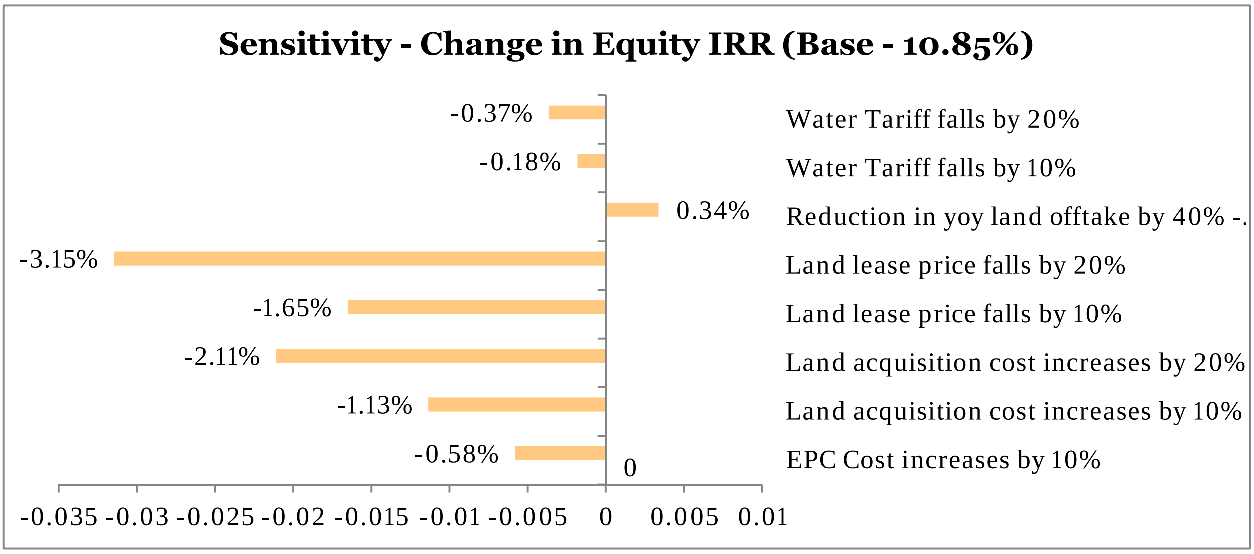
2. Escalation in land acquisition price by 10% and 20%: The impact on Equity IRR was assessed for this scenario and presented in the chart below.

3. Increase in EPC cost.

4. Fall in land sale price by 10% and 20%

5. Fall in water tariffs for both industrial and potable water by 10% and 20%. This scenario has been assumed as water tariffs are a sensitive issue.

The outcome of the above scenarios is summarised in the chart shown hereunder. From the chart below, it may be observed that the model is most sensitive to the land lease rentals followed closely by the price of land acquisition.



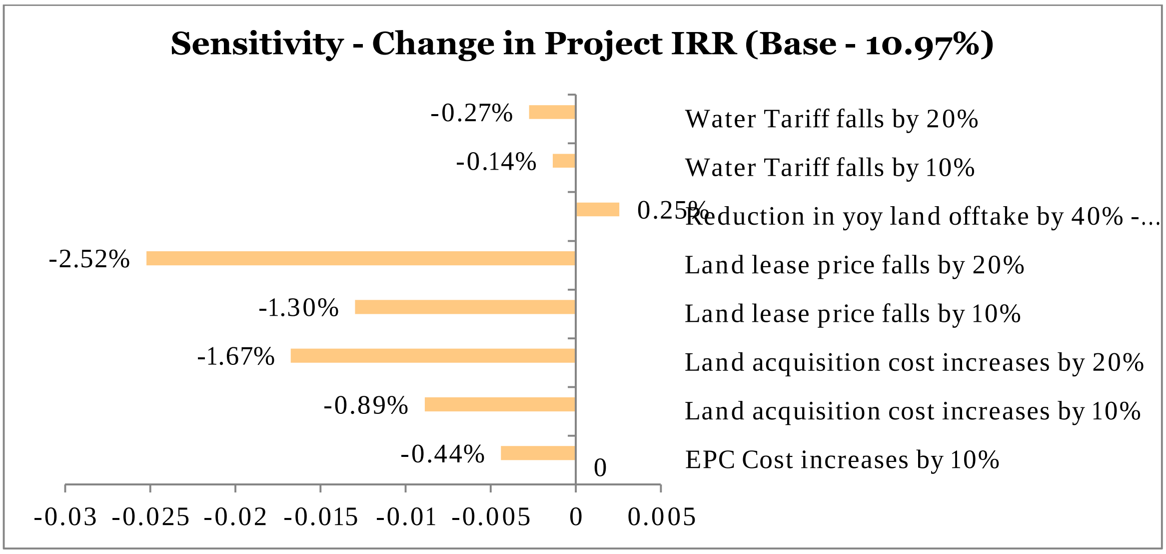
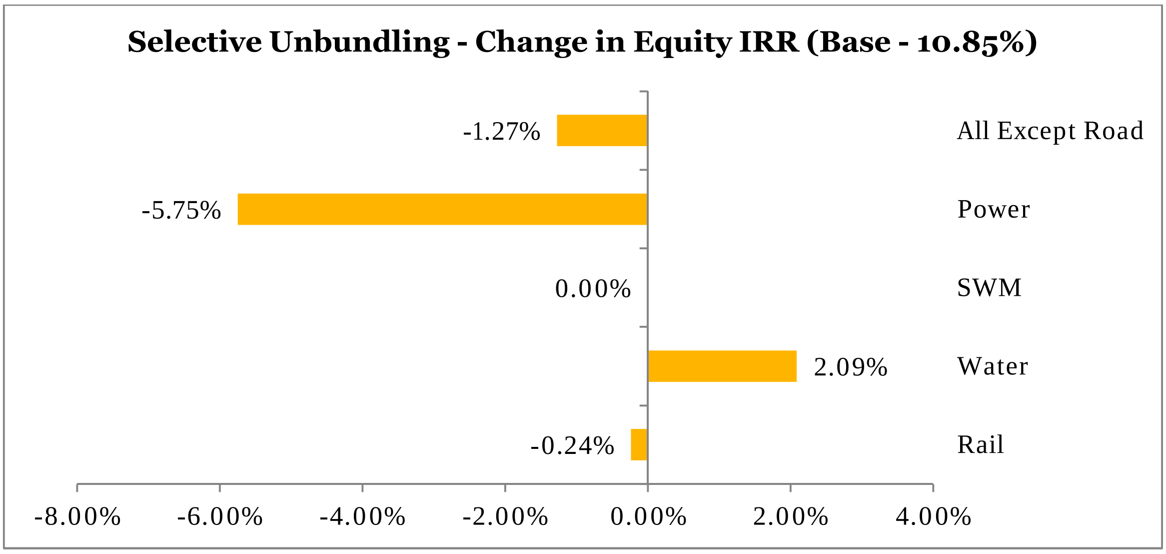


Figure 9.5: Sensitivity Analysis

The above sensitivity analysis has been performed for the scenario of the Master SPV managing the entire infrastructure without unbundling of SPV. From the above, it may be observed that the financial model is most sensitive to the land acquisition price and the next most sensitive aspect is the land sale price.

The other sensitivity analysis has been performed by assuming unbundling of certain infrastructure services through separate SPV's



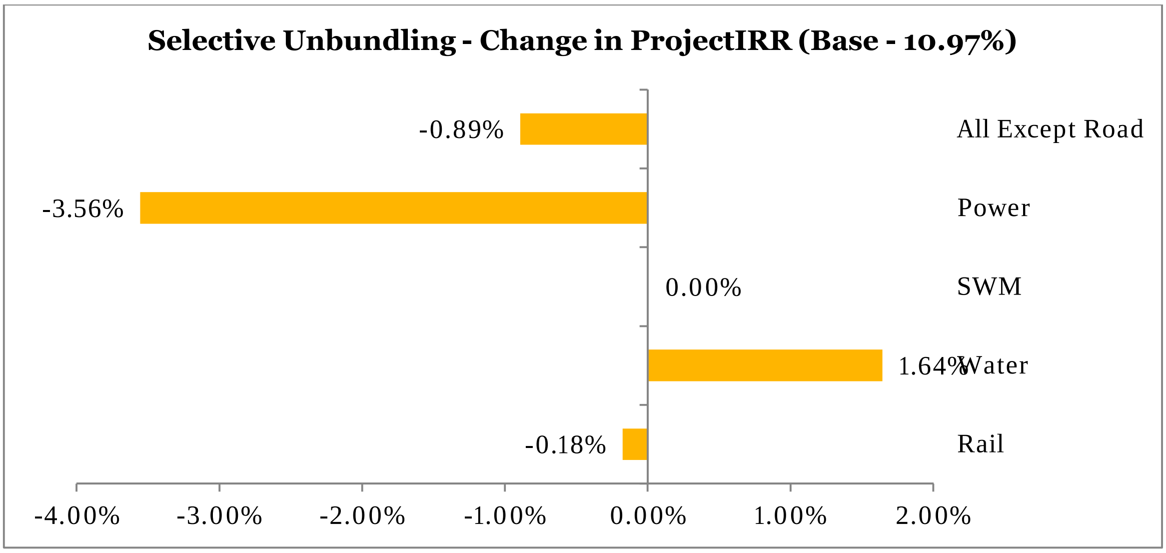


Figure 9.6: Sensitivity Analysis

From the above, it may be observed that the unbundling of water and solid waste management utilities results in an increase in IRR while the unbundling of power or rail utility results in a fall in IRR. The scenario pertaining to unbundling of roads is not envisaged as there is no revenue model for the road utility. Hence, under all circumstances, the road utility is assumed to be vested with the master SPV.

Unbundling project components: Under this scenario, it has been assumed that infrastructure services can be unbundled from the Master Developer's purview and separate SPVs such as Water SPV, Power SPV etc can be created, which are self- sustainable by themselves through user charges and any additional Govt. grant/ sub-ordinate loan etc (if applicable). Improvement in project viability for Master Developer is assessed by such unbundling. However, there is a need to create bankable projects out of the individual SPV's for each of these utilities.

10. Environmental and Social Considerations for Node Development Plan

10.1. Introduction

The following three(3) Nodes were selected as prioiptized Nodes by Indian Government and JICA referring the fact findings and assessment results of the JICA CBIC Study Team.

- Ponneri Node
- Tumakuru Node
- Krishnapatnam Node

The development plans for the prioritized nodes have been preparing by the JICA Study Team in the Part B of the CBIC Study.

10.2. Necessary Environmental Studies for the Prioritized Nodes

The JICA Study Team (JST) interviewed to Delhi Mumbai Industrial Corridor Development Cooperation Limited (DMICDC) to ask the necessity for conducting any environmental and social considerations on the development plan on 25th November 2013. As a result, the Environmental Clearance (EC) for the development plans will have to be obtained from Ministry of Environment and Forests (MoEF), Govt. of India.

As per the EIA notification 2006, the project proponent shall submit the prescribed application form"Form1" with proposed terms of reference (TOR) to the Expert Appraisal Committee for determination of the TOR for EIA study. The TOR will be conveyed to the project proponent by the Expert Appraisal Committee within sixty days of the receipt of Form 1.

10.3. Framework for EIA Studies for the Prioritized Node Developments

Figure 10.1: Review Meeting on 25th July, 2014

The framework for EIA studies for the prioritized node developments were confirmed in the "Review Meeting" chaired by Mr. Shatughna Singh, the additional director of DIPP, held on 25th July, 2014. The summary of the discussion is as following.

- The EIA studies for the development plans are under responsibility of the DIPP. The DIPP will entrust the implementation of the EIA studies to the DMICDC, including procurement of environmental consultants. The JST will support the DMICDC in terms of preparation of TORs for the EIAs.
- The JST will prepare the first draft of the development plans for the three prioritized Nodes by the end of October after finalization of the Node boundaries. The first draft of the development plans will be finalized for Draft Final Report by the end of December 2014.

The implementing schedule for EIA studies for the prioritized node developments were discussed between JST and DMICDC on 23rd September, 2014.

The summary of the discussion is as following.

- The procurement for the EIA consultant will be conducted only after getting official approval on the Node development plans including Node boundaries from the related local govt. The selection of EIA consultant will be carried out based on the international tender system. Approximately three months will be necessary for the process.
- The application form for the EIA ("Form 1"with Draft TOR for EIAs) will be prepared by the DMICDC using in-house consultant.
- The initial environmental examination (IEE) level study on the development plans for the Nodes will be conducted in the course of the technical assistance for CBIC study by the JST. The study will be conducted based on the JICA Guidelines. It is expected that the results of the IEE level study will be useful information for the preparation of "Form 1" and Draft TOR.

10.4. Initial Environmental Examination (IEE) Study

10.4.1. Objectives and Methodologies

(1) Objectives

In the Part A of the Study, the development policies for realizing the proposed regional structure plan were clarified, first. Then, the environmental impact items which should be considered in the realization of the plan were selected using environmental checklist. The evaluation was conducted based on the selected environmental impact items in terms of positive and negative impacts.

In this chapter, the environmental study on Initial Environmental Examination (IEE) Study level for the individual development plan for prioritized Node was conducted in the course of technical assistance for environmental and social considerations. It is expected that the results of the study will be reflected to the terms of the references for environmental impact assessment (EIA) study.

(2) Methodologies

- To grasp present condition of the Node area
- To discuss the contents of the development plan
- To conduct environmental scoping through consideration on the present environmental condition and the contents of the development plan
- To clarify the matters for consideration in the EIA study based on the results of the environmental scoping

10.4.2. Outline of the Node

(1) Topography

The node area is almost flat and the node lies along the Buckingham canal, which runs along the eastern edge and Sengazhani Medu Colony, Uranampattu Village & the NCTPS ash pond are located on its western side.

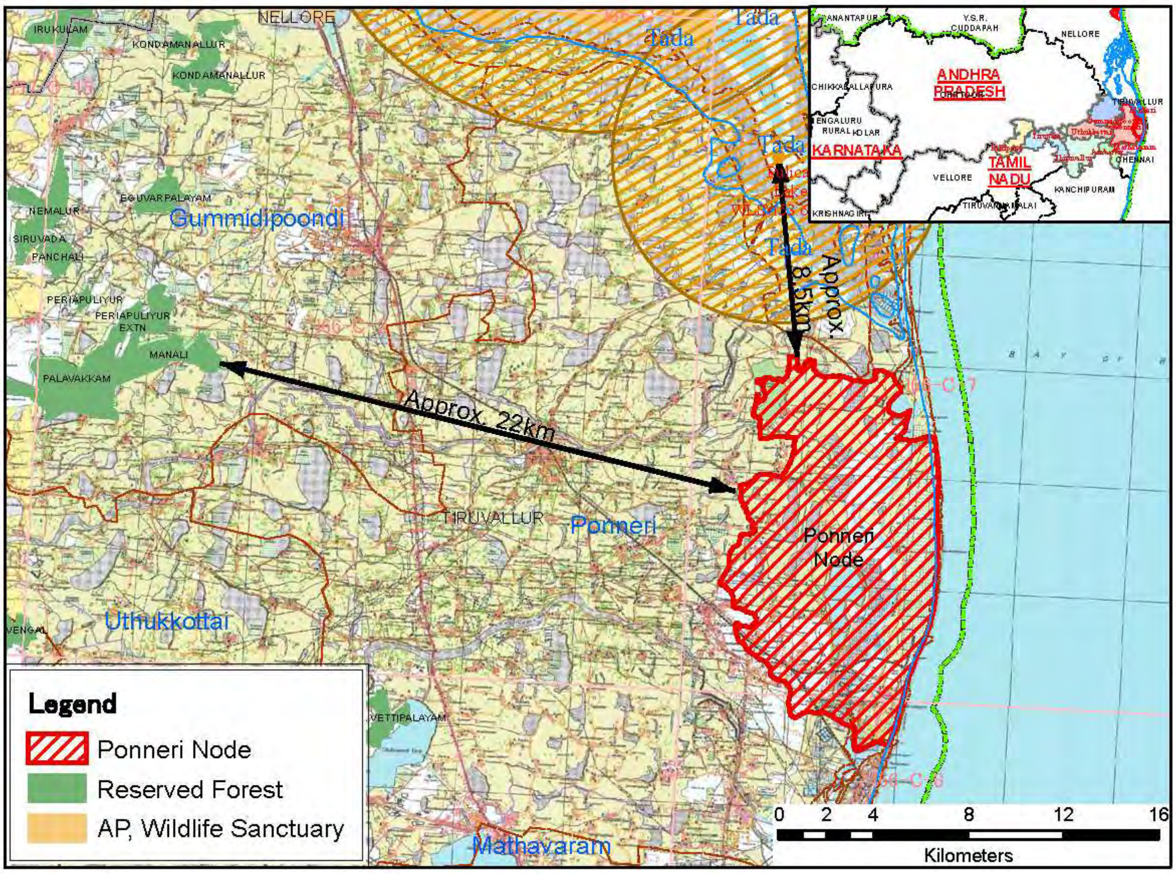
(2) Climate

The district receives an average rainfall of 1104.4 mm, of which the Northeast Monsoon contributes about 690 mm. The actual rainfall received during the agricultural year 2001 - 02 was 1,164.4mm.

The average temperature of the district is maximum 37.9°C and minimum 18.5°C respectively. The prevailing climate is hot during May and April, similar to the rest of Tamil Nadu. Due to its geographical location, the region is very humid except between December and February.

(3) Sensitive Area

Although the Pulicat Bird Sanctuary is located at north of the site, no sensitive areas are contained in the site as shown in the Figure 10.2.



Source: JICA Study Team

Figure 10.2: Location of Sensitive Area

A few mangrove forest areas are located along the canal as shown in the Figure 10.3. (The Figure 10.4 is the general view of the forest). According to the Forest Department of Tamil Nadu State Government, the forest area is not notified, however, the local people utilize them as fishing point etc. The environmental considerations for the development of the Node will be necessary accordingly.

Figure 10.3: Mangrove Forest Area

Figure 10.4: General View of Mangrove Forest Area

(4) Land use

The current land use pattern and distribution of settlements are as follows:

– Salt manufacturing is one of the main local industries in this area. Hence, there are salt fields at some locations across the area. A portion of the northern area of the node is divided into rectangles, which indicates that the plots are being used as salt pans.
– A few settlement areas are located outside the priority area.
– There is no health center and schools within the priority area, and only limited schools are located inside entire node area.
– A wide canal passes through the site; the port areas are on the east side of the canal.
– Ennore Port and Kattupalli Port are located along the coast; 2 thermal power plants and a 100 MLD desalination plant are also located near this site. In addition, a coal yard is located next to the ash pond. The southern part of the site is mainly utilized for industrial purposes.
– Water logged areas are found spread the area adjacent to the canal. There is a need to improve the land conditions to construct structures and develop infrastructures include road.

(5) Land Acquisition Status(as of November 2014)
The land acquisition status for "Priority Area" in the Ponneri Node is as shown in the Table 10.1. Out of 1,801 ha, 817 ha of land belonging to Salt Department is not acquired yet.

Table 10.1: Land Acquisition Status of Ponneri (Priority Area)

<table>
<tr><th>No</th><th colspan="2">Category and use of Land</th><th>Acres</th><th>Ha</th><th>Status</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Land with TIDCO</td><td>Land for Plastic Park (300 ac)</td><td rowspan="4">950</td><td rowspan="4">384</td><td rowspan="4">Government Land</td></tr>
<tr><td>Land for L&T LNG Pipeline (100 ac)</td></tr>
<tr><td>Land for TIDCO/IOCL Terminal (350 ac)</td></tr>
<tr><td>Patta Land (200 ac)</td></tr>
<tr><td>2</td><td colspan="2">Land to be acquired by TIDCO from Salt Department</td><td>2,020</td><td>817</td><td>To be acquired</td></tr>
<tr><td>3</td><td colspan="2">Patta Land for Engineering Component hub</td><td>700</td><td>283</td><td>Government Land</td></tr>
<tr><td>4</td><td colspan="2">CPCL Plant</td><td>150</td><td>61</td><td>Private Land</td></tr>
<tr><td>5</td><td colspan="2">Coal Terminal</td><td>258</td><td>104</td><td>Private Land</td></tr>
<tr><td>6</td><td colspan="2">Buckingham canal</td><td>373</td><td>151</td><td>Area may vary during rainy seasons</td></tr>
<tr><td colspan="3">Total</td><td>4,451</td><td>1,801</td><td></td></tr>
</table>

Source: JICA Study Team

The general view of the site is shown in the Figure 10.4.

Source: JICA Study Team

Figure 10.5: Ponneri Node

10.4.3. Development Plan

The contents of the development plan for Ponneri Node are as shown in the Table 10.2.

Table 10.2: Project Component (Ponneri)

Sector	Contents of Construction
Road	● Internal Roads (Primary Roads (Industrial), Primary Roads (Urban), Secondary Roads, Tertiary Roads) ● Bridges ● Intersections (Level Intersection (signalized), Grade-separated intersection) ● Bus facilities (Bus terminal, Bus bay) ● External Roads (Widening, New)
Railway	● Single track electrified access line from proposed Minjur-Ennore Port line (distance approx. 3 km) ● Three track electrified arrival/departure yard outside the Logistics Hub, to permit re-positioning of locomotive and push-back into hub.
Logistics	The logistics Hub, containing: ● Separated paved loading/unloading yards for containers and steel ● Non electrified Railway loading/unloading tracks (3) embedded in pavement ● Container Freight Station (CFS) for stuffing/unstuffing of containers with partitioned area for customs inspection of cargo ● Warehouse for long term storage of cargo ● Two storied Administration Building with space for rental by cargo agents, etc. ● Container trailer park ● Workshop for container repair and maintenance of handling equipment ● Separate security controlled entrances for containers and steel
Power & Renewable Energy	● Substation ● Solar and wind power plants ● Thermal generation power plant
Water supply	(Drinking water and industrial water) ● Water purification plant for water from Dam ● Sewage disposal plant ● Tertiary water treatment plant for sewage recycling ● Partially water supply from desalinization plant
Drainage	(Rainwater) ● Storm Water Drainage System with proper disposal arrangement.
Solid Waste Management	(Municipality waste) ● Biomethanation Plant ● Sanitary landfill
	(Hazardous solid waste) ● Plant for Alternative Fuels and Raw Materials(AFR)

Source: JICA Study Team

10.4.4. Environmental Scoping

The environmental scoping through consideration on the present environmental condition and the contents of the development plan was conducted using matrix table consisting of 30 environmental impact items referring the environmental check list of the JICA Guidelines. The rating of the environmental impacts was carried out for pre-construction/construction stage and operation stage, respectively. The rating criteria are as follows.

A: Serious impact is expected.

B: Some impact is expected.

C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done)

-: No impacts are expected.

Table 10.3: Environmental Scoping and the Reasons

	No	Likely Impacts	Rating		Description
			Pre-construction / Construction	Operation	
Social Environment	1	Resettlement	C	-	● No involuntarily resettlement due to land acquisition (817 ha) will be occurred because there is no settlement in the Priority Area (1,800 ha). However, some settlements are found at the outside of the Priority Area in the Node area. So, in the future, there is a possibility to occur involuntarily resettlement due to land acquisition at the areas. ● Also, there is a possibility to occur involuntarily resettlement due to land acquisition necessary for construction of external roads and railways. ● The establishment of income restoration program for affected families is necessary in that case.
Social Environment	2	Local economy such as employment and livelihood, etc.	-	-	
Social Environment	3	Land use and utilization of local resources	-	-	
Social Environment	4	Social institutions and local decision-making institutions	-	-	
Social Environment	5	Existing social infrastructures and services	-	-	
Social Environment	6	The poor, indigenous and ethnic people (inclusive gender and right of children)	-	-	
Social Environment	7	Misdistribution of benefit and damage	-	-	
Social Environment	8	Cultural heritage	-	-	
Social Environment	9	Local conflict of interests	-	-	
Social Environment	10	Water Usage or Water Rights and Rights of Common	-	-	
Social Environment	11	Sanitation	-	B	● The stable and safe supply of drinking water for labors working at factories is necessary.
Social Environment	12	Hazards (Risk) Infectious diseases such as HIV/AIDS	B	-	● Influx of labors for construction activities into the area might cause prevailing of infectious diseases such as HIV/AIDS
Natural Environment	13	Topography and Geographical features	-	-	
Natural Environment	14	Soil Erosion	-	-	
Natural Environment	15	Groundwater	-	-	
Natural Environment	16	Hydrological Situation	-	-	
Natural Environment	17	Coastal Zone	-	-	
Natural Environment	18	Flora, Fauna and Biodiversity	C	C	● The mangrove forest found along the canal flows in the site might be affected in the construction and operation stages.
Natural Environment	19	Meteorology	-	-	
Natural Environment	20	Landscape	-	-	
Natural Environment	21	Global Warming	-	-	
Pollution	22	Air Pollution	A	A	● The construction of coal fired plants might induce air pollution. The increasing of number of vehicle at surrounding of the site during construction and operation might cause air pollution.
Pollution	23	Water Pollution	-	A	● The water pollution at canal flowing in the site might be caused due to establishment of factories.

	No	Likely Impacts	Rating		Description
			Pre-construction / Construction	Operation	
	24	Soil Contamination	-	-	
	25	Waste	–	A	● The solid waste will be generated due to establishment of factories.
	26	Noise and Vibration	A	A	● The noise and vibration caused by vehicles during construction, In addition, the increasing of the number of vehicles at surrounding areas in the future might cause noise and vibration.
	27	Ground Subsidence	-	-	
	28	Offensive Odor	-	-	
	29	Bottom sediment	-	-	
	30	Accidents (inclusive traffic accident)	A	A	● Traffic jam and car accident might be caused by vehicle for construction activities. ● In operation stage, the entering of the tracks for freight to CFS and buses for commuting of labors (approx.500, 000 people) into existing local road network might cause traffic jams and car accidents.

Source: JICA Study Team

10.4.5. Conclusions

(1) Summary of the Results of the Environmental Scoping

The summary of the results of the environmental scoping is shown in the Table 10.4. These items should be taken consideration in the TOR of EIA study.

Table 10.4: Summary of Matters for Consideration

Item	Matters for Consideration
Social Environment	● Appropriate land acquisition ● Appropriate income restoration programme such as provision of job opportunity for farmers living in the project site ● Traffic jam caused by incorporation of large size vehicle into local transportation network
Natural Environment	● Appropriate conservation of Mangrove forest found in the project site ● Appropriate sewage treatment for water quality control of the canal in the project site
Pollution Control	● Air pollution caused by new coal fired power plant(660MW×2) ● Counter measures for air pollution, noise and traffic accidents caused by increasing of traffic volume adjacent to the project site ● Appropriate treatment for solid waste generated in the project site

Source: JICA Study Team

(2) Draft TOR for EIA Study

The draft TOR for EIA study considering the matters for consideration resulting from the environmental scoping was prepared as following. It is expected that DMICDC will prepare the TOR referring the draft TOR for EIA study.

The TOR will be approved by the Expert Appraisal Committee after submission to MoEF.

1) Policy, legal, and administrative framework for EIA study

2) Project Description

- Site location, co-ordinates and land requirements

- Proposed Development / Activities
- Justification for site and the project
- Proposed development plan
- Power and water supply requirement and source
- Water balance, waste generation and proposed control measures
- Project development phasing

3) Present Environment

i) Natural Environment

a) Physical Environment
Secondary information on topography, geology and hydrology of the area will be collected within 15 km radius of the site.

b) Climate
Temperature, rainfall, wind direction, wind speed, relative humidity

c) Ecology
Information on flora and fauna will be gathered through primary surveys for the study area. Related information will also be collected from District forest Offices/Botanical and zoological survey of India (BSI and ZSI) offices. The result of the surveys will be interpreted to identify threatened and endangered species as per Red data book and wildlife Act 1972.

ii) Socio -Economic Environment

Demographic information, economic activities, literacy profile, land use, infrastructure resource, economic facilities, cultural heritage

iii) Environmental Quality

a) Air Quality
Information on air quality will be collected through monitoring of ambient air quality. The monitoring parameters will be suspended particulate matter (PM2.5 and PM 10), Oxides of nitrogen (NOx), Sulfur Dioxide (SO2), Hydrocarbons (Methane, Non Methane), and carbon monoxide (CO).

b) Water quality
The surface and ground water samples will be collected for analysis of following parameters (as par IS10500/Indian Standard Specification for drinking water).

- Physical parameters: pH, Temperature, conductivity, Turbidity and color;
- Chemical Parameters: Alkalinity, TDS, TSS, Salinity, oil & Grease, DO, Chlorides, Total hardness, Calcium, Magnesium, Sulphate, Fluorides, Nitrate, Iron, Phenolic compound, COD,BOD, Phosphate, Anionic Detergents, PCB, Total Petroleum Hydrocarbon and heavy metals like copper, Mercury, Barium, Cadmium, Arsenic, Lead, Zinc, Chromium, Manganese: and
- Bacteriological Parameters: Total Coliform, Faecal Coliform

c) Noise
Ambient noise quality will be monitored to determine hourly equivalent noise levels. The results of the findings will be analyzed to work out Lea hourly, led day and led night.

iv) Traffic Volume

Information on traffic volume will be collected for roads connecting the project site by traffic volume monitoring. The traffic volume counts will be recorded continuously for 24 hours at one time during the study period to assess the existing total daily traffic, peak hour traffic and traffic Composition.

4) Environmental impacts Assessment

Assessment of impacts for environmental components will include the impact for construction and operation:

- Estimation of water balance and assessment of impact on regional water demand and availability of fresh water for developmental activities:
- Assessment of wastewater characteristics, treatment and disposal provisions;
- Assessment of solid waste disposal, storage facility and potential for soil contamination;
- Assessment of impact on Land use, ecology, socio-economic of the study area;
- Assessment of impact on traffic and Noise; and
- Assessment of impact on community in the immediate surrounding

5) Analysis of alternatives

Reasons for selecting the present site with details of alternative sites examined earlier and rejected/selected on merits with comparative statement.

6) Environmental Management Plan (EMP)

Description on mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels. Social impacts and concerns will also be identified and an outline rehabilitation and resettlement(R&R) Framework will be prepared.
An EMP suggesting economically feasible control technologies and procedures to minimize any impact on environment will be developed. The EMP will include;

- Pollution control measures (Air, water, noise, soil etc.)
- Water conservation, treatment and disposal
- Solid/Hazardous waste management
- Training and monitoring requirement for the project
- Occupational health and safety Measures
- Requirements for green belt and landscaping
- Traffic Management plan

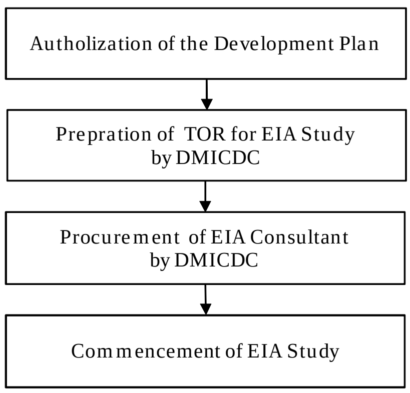
7) Public Consultation

Public consultation will be carried out for the project as per the procedure defined in the EIA notification, 2006. After completion of the public consultation, the environmental concerns expressed during the consultation shall be incorporated to finalize EIA/EMP.

10.5. Recommendations (Necessary Action and Schedule)

10.5.1. EIA

The EIA studies for the development plans are under responsibility of the DIPP. The DIPP will entrust the implementation of the EIA studies to the DMICDC, including procurement of environmental consultants. The necessary action and schedule for EIA after establishment of development plan is as shown in the Figure 10.6 and Table 10.5.



Source: JICA Study Team

Figure 10.6: Necessary Action for EIA study

Table 10.5: Expected EIA Schedule

	Month	1	2	3	4	5	6	7	8	9	10
Submission of Draft Final Report											
Authorization of The Development Plan											
Preparation of Draft TOR for EIA Study by **DMICDC**											
Procurement of EIA Consultant **(3 months)**											
Implementation of EIA Study											

Source: JICA Study Team

10.5.2. Land Acquisition

As shown in the Table 10.4, 817 ha of lands are not acquired yet. The land will be disposed from Salt Department to Tamil Nadu Industrial Development Corporation (TIDCO). They have been discussing about two alternatives for compensation, namely cash compensation and providing alternative land. The early procurement of alternative land is essential if Salt Department prefers the latter alternative.

Although the procedure of land acquisition is complex and time-consuming, the land acquisition for project site is indispensable for the realization of the development plan. It is highly recommended to monitor the progress of land acquisition progress carefully.

11. Institutional & Financing Framework

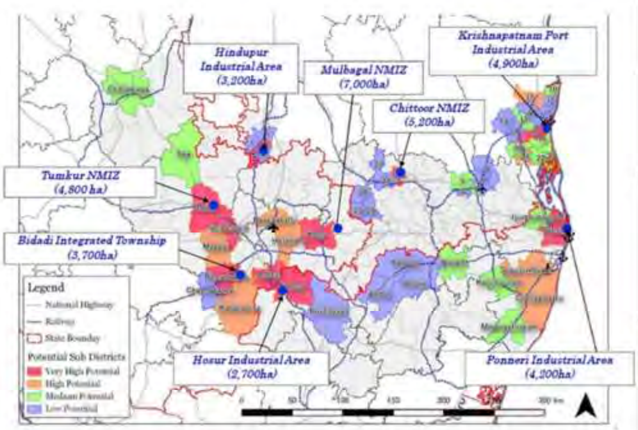
Realisation of primary objectives of the National Manufacturing Policy[51] (NMP) are envisioned through measures such as business process simplification, industrial training, skill up- gradation, and most importantly by promotion of **large- scale clusters and aggregation of industrial units**. Aligned to this Govt. of India has planned/ approved around 5 industrial corridors[52] and 16 NIMZs[53] since the inception of the NMP.

For the development of such mega scale projects there is a need for induced co- operation among various stakeholders at the central, state and local government levels to steer corridor development in a collective & coordinated manner.

Induced co- operation an underlying criticality for development of CBIC

- Spanning over a length of 560 kms, the CBIC covers an area of ~***91,000 sq. kms*** (~3% of area of all of India) ***covering around 17 districts*** across three states of Tamil Nadu, Karnataka and Andhra Pradesh under its influence area.

- Identified nodes for industrial development along CBIC, range between 25- 70 sq. kms, and are comparable to the size and functioning of small satellite cities such Cyberabad (A.P) and Kengeri (Karnataka), complete with all municipal functions



State	Planned Area	Area Sq. km
Tamil Nadu	Ponneri Industrial Area	42
	Hosur Industrial Area	27
Karnataka	Bidadi Integrated Township	37
	Tumkur NIMZ	48
	Mulbagal NIMZ	70
Andhra Pradesh	Hindupur Industrial Area	32
	Chittoor NIMZ	52
	Krishnapatnam Industrial Area	49

Figure 11.1: 8 industrial nodes selected along CBIC

- Co- ordination for project implementation would be required across multiple jurisdictions (states), between different levels of urban local bodies within states, state entities, central entities, private sector developers, multilateral agencies, funding institutions, project affected people, citizens

[51] Increasing manufacturing sector growth to 12-14% over the medium term, enhancing share of manufacturing in GDP from 16-25% and increasing the rate of job creation in manufacturing to 100 million additional jobs by 2022
[52] DMIC, CBIC, BMEC, VCIC, AKIC
[53] Of these, eight are along the Delhi Mumbai Industrial Corridor (DMIC). Besides, eight other NIMZs have been given in-principle approval: (i) Nagpur in Maharashtra, (ii) Chittoor in Andhra Pradesh, (iii) Medak in Andhra Pradesh (now Telengana), (iv) Prakasam in Andhra Pradesh (v) Tumkur in Karnataka, (vi) Kolar in Karnataka, (vii) Bidar in Karnataka, and (viii) Gulbarga in Karnataka.

- Range of project activities involved towards node development, such as planning, financing, implementation and operation & maintenance across the project life-cycle can be mapped to multiple stakeholders. Some of the key project related activities that need to be undertaken on ground for development of such nodes will include:

Table 11.1: Indicative roles and responsibility framework for list of project related activities for CBIC

	Planning				***Development of internal and external infrastructure (inc. financing)***							***Ease of doing business***		
	Land delineation	*Master Planning (Node/ external)*	*Land acquisition*	*Clearances*	*Urban Transport*	*Energy*	*Roads*	*Rail*	*Water supply & Sewerage*	*Ports*	*Airports*	*Single window clearance*	*Routine issues*	*Policy and Regulations*
Central Govt		✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔
State Govt	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
SPV		✔		✔	✔	✔	✔	✔	✔	✔	✔			✔
Multilateral agency					✔	✔	✔	✔	✔	✔	✔			✔
Industry Associations				✔								✔	✔	✔
Private Sector					✔	✔	✔	✔	✔	✔	✔			

Co-operation and co-ordination between multiple stakeholders will be crucial for timely and successful delivery of projects thus mandating the need for a clear project implementation framework and institutional structure for Ponneri node and CBIC development.

11.1. Approach towards Formulation of Institutional Framework for CBIC

Basic approach of institutional and financial framework analysis is depicted in the diagram below. Existing structure and precedents such as DMIC cases are examined and necessary improvements are incorporated in a proposed suitable structure for CBIC.

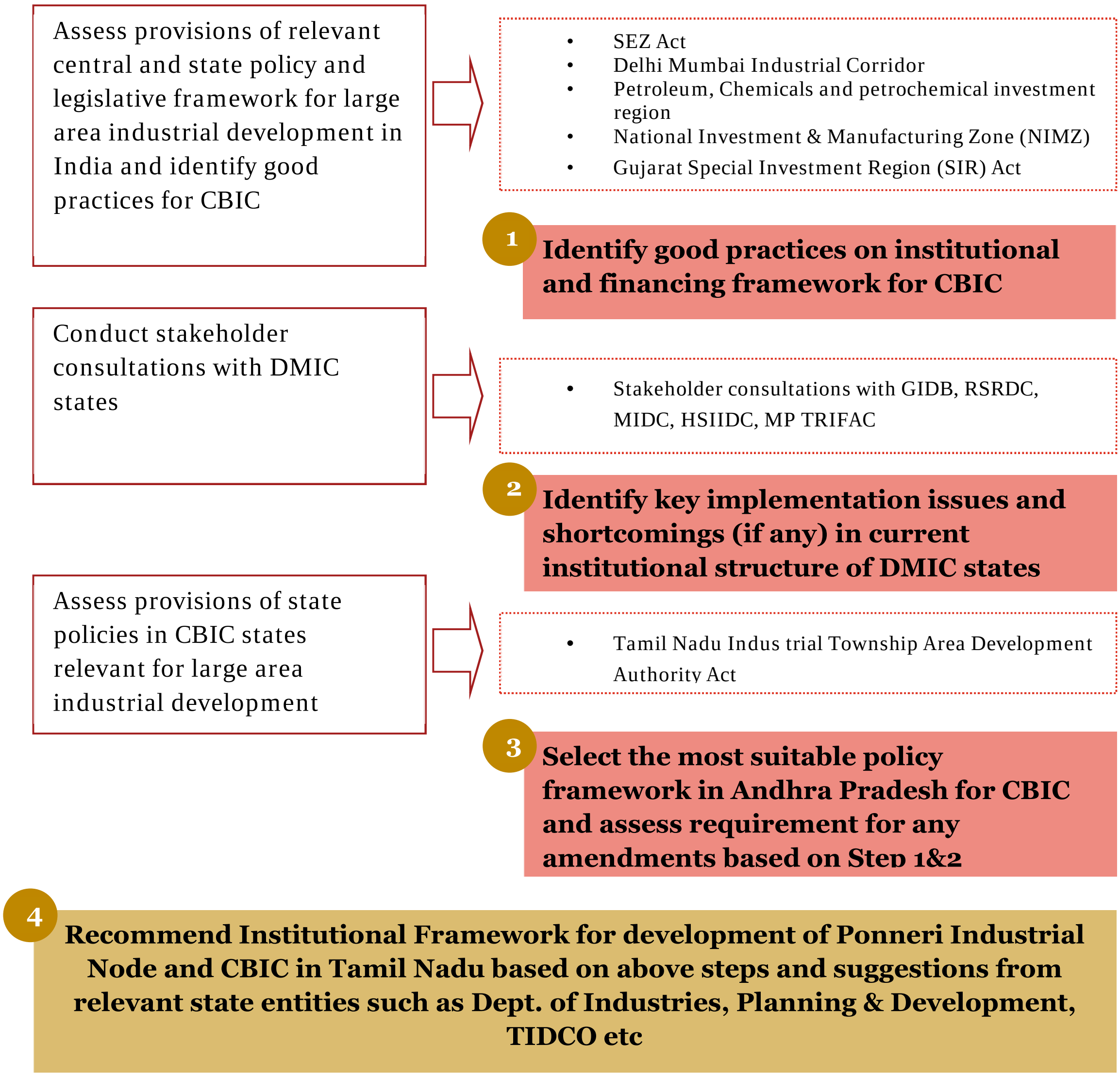


Figure 11.2: Approach towards Formulation of Industrial Framework for CBIC

11.1.1. Assessment of key provisions of administrative and implementation framework for large area industrial developments in India

With a view to overcome the shortcomings experienced on account of the multiplicity of controls and clearances; absence of world-class infrastructure, and an unstable fiscal regime and with a view to attract larger foreign investments and provide a boost to manufacturing in India, the Special Economic Zones (SEZs) Policy was announced in April 2000. Prior to the SEZ Policy, large scale industrial development projects were implemented as industrial areas/ estates under the purview of central/ state level Industrial development corporations (or boards), where the respective government entity would acquire and develop land, and provide basic infrastructure and lease/ sell industrial plots to investors. The private sectors role was restricted to implementation and operation of industrial units within the estate.

With the advent of the SEZ policy, private sector role increased significantly from O& M of industrial units, to conceptualization, implementation and operation of large scale SEZ areas in the range of 500 HA and more (for multi- product SEZs) combining processing area and areas for residential, civic amenities, including provision of all necessary utilities and other infrastructure. In order that the private developer perform the role akin to an urban local body enabling it to provide and operate multiple municipal functions efficiently (all civic amenities and infrastructure including roads, sewerage systems, open spaces, green spaces, education facilities, power, water supply and housing etc) within the delineated area, the SEZ Act provided necessary enablers such as:

- **Constitution of SEZ authority**, a body corporate chaired by a Development Commissioner (of IAS rank), and comprising representation from Central/ State government, the developer and other nominated members empowered to acquire land, prepare master- plan, guidelines for land- use, FAR etc for the SEZ, levy user- charges for services, dispose land/ property ass sale/ lease etc;
- Simplified procedures for development, operation, and maintenance of the SEZ and for setting up units and conducting business in SEZs;
- Single window clearance for setting up of an SEZ; and for setting up a unit in a Special Economic Zone;
- Single Window clearance on matters relating to Central as well as State Governments;
- Simplified compliance procedures and documentation

Subsequently, mega industrial areas were planned under the Delhi- Mumbai Industrial Corridor project (DMIC) in the influence areas of proposed western Dedicated Freight Corridor (DFC) sanctioned under the Eleventh Five Year Plan (2007-12), covering an overall length of 1483km and passing thru the States of U.P, NCR of Delhi, Haryana, Rajasthan, Gujarat and Maharashtra. In order to achieve the ambitious vision of DMIC[54], 24 special investment nodes, 11 investment regions (min. area of 200 sq. kms) and 13 industrial areas (min. area of 100 sq. kms) have been identified for joint development by central and state governments. Private sector participation (through PPP) is largely envisaged in the development of the investment areas through formation of Special Purpose Companies (for both critical external infrastructure and trunk infrastructure within the investment areas) for project implementation, operation, and maintenance in the DMIC region.

Implementation Framework under DMIC

To undertake the mammoth project of DMIC covering 7 mega industrial nodes (as part of the first phase) and running through six states, a 4 tier institutional framework has been created.

[54] Double employment potential in 7 years; Triple industrial output in 9 years; Quadruple exports from the region in 8-9 years; Target growth 13-14% per annum for manufacturing sector on sustained basis over next three years

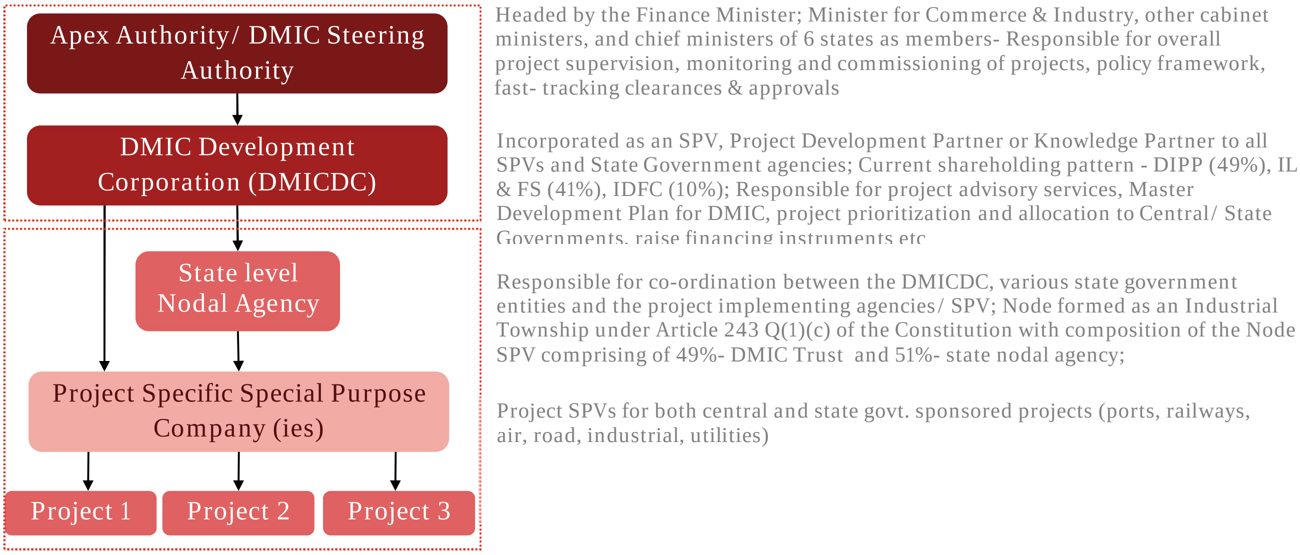


Figure 11.3: DMIC Project Implementation Framework

Node Level Structure

For implementation of individual nodes, a node/ city level SPV (Node Authority) is proposed to be set up. Composition of the SPV is to comprise of 49%- DMIC Trust and 51%- State nodal agency. The node/ city level SPV may have suitable representation from private sector wherever the State Government decides to involve the private sector (private equity participation in a node/ city level SPV to be limited to 49%, currently none of the SPVs have envisaged private sector as an equity partner in the node level SPV). The SPV is to be notified as an Industrial Township under any relevant State Act or **Article 243Q of the constitution** by the respective State Governments, empowering the SPV to discharge the dual role of a municipal body and planning and authority.

Article 243 Q (1) of the Constitution is of particular relevance to large area industrial development in India which allows for constitution of an area as “Industrial Township”. It empowers for constitution of an Industrial Township Authority to act in the capacity of a municipal body, secure planned development and maintenance of the industrial area; and provide, operate and maintain utilities and civic amenities within the industrial township.

This will empower and ring- fence the SPV to function on its own with little dependency on the state government, thereby facilitating faster and smoother project implementation and monitoring.

Each SPV is managed by:

- A board of 6 directors
  - 3 nominated by DMIC Trust
  - 3 nominated by relevant State Industrial Development Corporation (SIDC)
- Chairman of the Board- Principal Secretary, Industries
- CEO & MD of the SPV
  - Appointed by Board Chairman in consultation with CEO of relevant SIDC
  - Minimum 3 year term; Responsible for day to day operations of the SPV
- Business team of professionals to support CEO & MD – appointed by the Board

The node level institutional structure follows existing legislative framework applicable under each of the DMIC states. **While some states have combined the planning and development function into a single node level SPV, other states have segregated these functions, where the node level SPV acts as**

the Planning Authority for the node and a separate Project Development Company is formed for implementation of projects within the node.

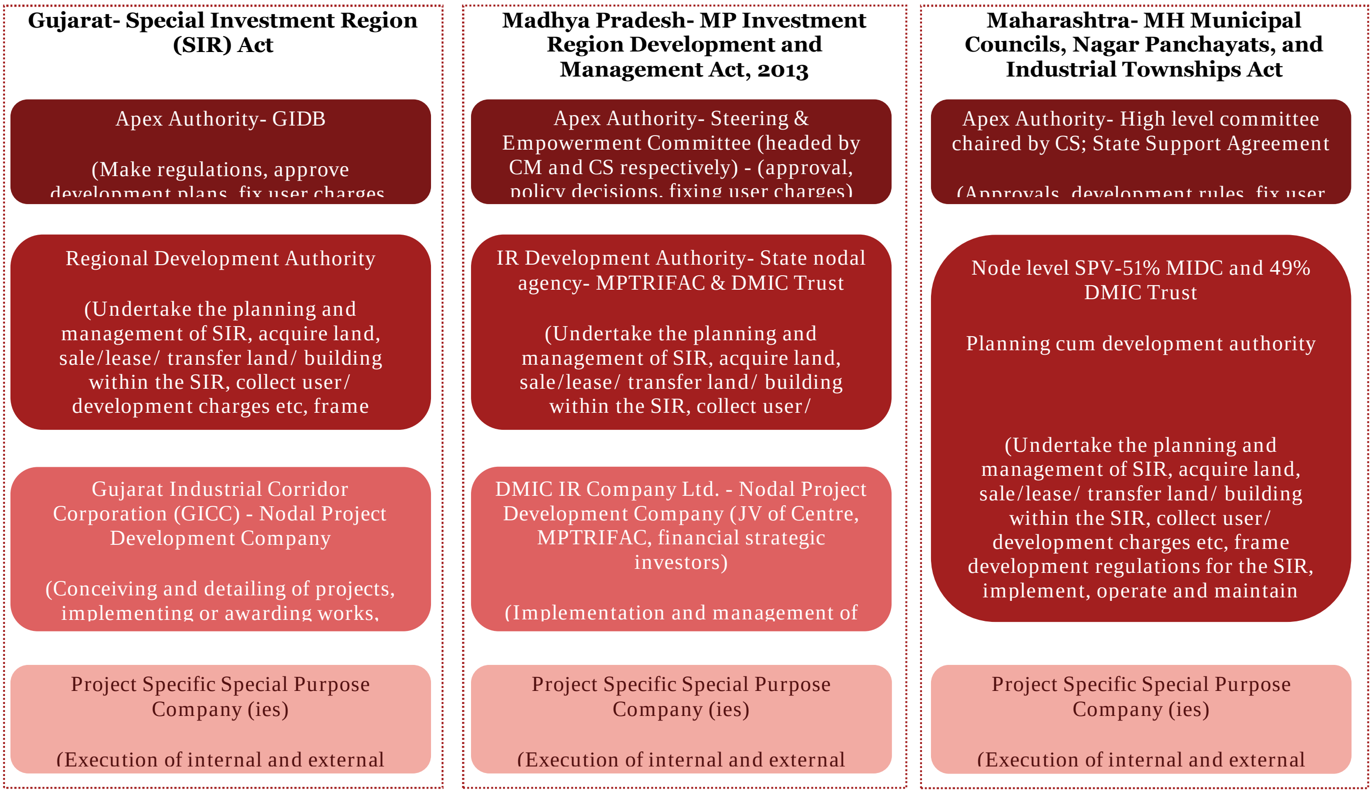


Figure 11.4: Node Level Institutional Structure in Other Indian States

Financing framework

A "DMIC Project Implementation Fund" has been tablished as a Trust with an inter-ministerial Board of Trustees headed by Secretary, DEA. Central Government will provide a grant-in-aid of Rs 17,500 crore to the Fund/Trust over the next 5 years beginning 2011-12, for the development of the 6 industrial cities @ Rs 2500 crore per city on an average, subject to a ceiling of Rs 3000 crore per city. The Fund/ Trust would leverage the resources provided by GoI to raise long term funding from financial institutions and raise Tax Free Bonds, Capital Gains Bonds, Credit Enhancement, etc for financing the development of these cities. Alternately, the nodal/ city level Special Purpose Vehicles (SPVs) will be further able to raise long term debt finance through credit enhancement by appropriate credit enhancement features from the Fund/Trust.

Equity in node/ city level SPVs and in project specific SPVs and holding companies will be held by the Fund/ Trust subject to limits specified (upto 50% in node SPVs and 100% in project SPVs). All investment into the SPVs by GoI will be routed through the Fund/ Trust so that all debt service payments by SPVs and proceeds from equity disinvestment from SPVs, can be ploughed back into the Fund corpus, enabling the Fund/ Trust to undertake the development of more such industrial cities in the DMIC region in future.

The Corpus of the Trust would be used for:

- Providing equity and/ or debt to the nodal/ city level SPVs for development of non-PPP infrastructure and for investment in project specific SPVs that may be set up by a node/ city level SPV;
- Providing equity and/or debt to other project specific SPVs and sectoral holding companies consisting of project specific SPVs; and

- Providing grant to DMICDC for project development.

The Board of Trustees are empowered to appraise all proposals placed before it with the recommendations of DMICDC and approve and sanction equity and/ or debt to SPVs and grant to DMICDC for project development upto a ceiling of Rs 300 crore. All proposals exceeding Rs 300 crore are to be submitted to the Cabinet Committee on Infrastructure (CCI), after appraisal by the PPPAC[55] of the Ministry of Finance or the Trust as the case may be.

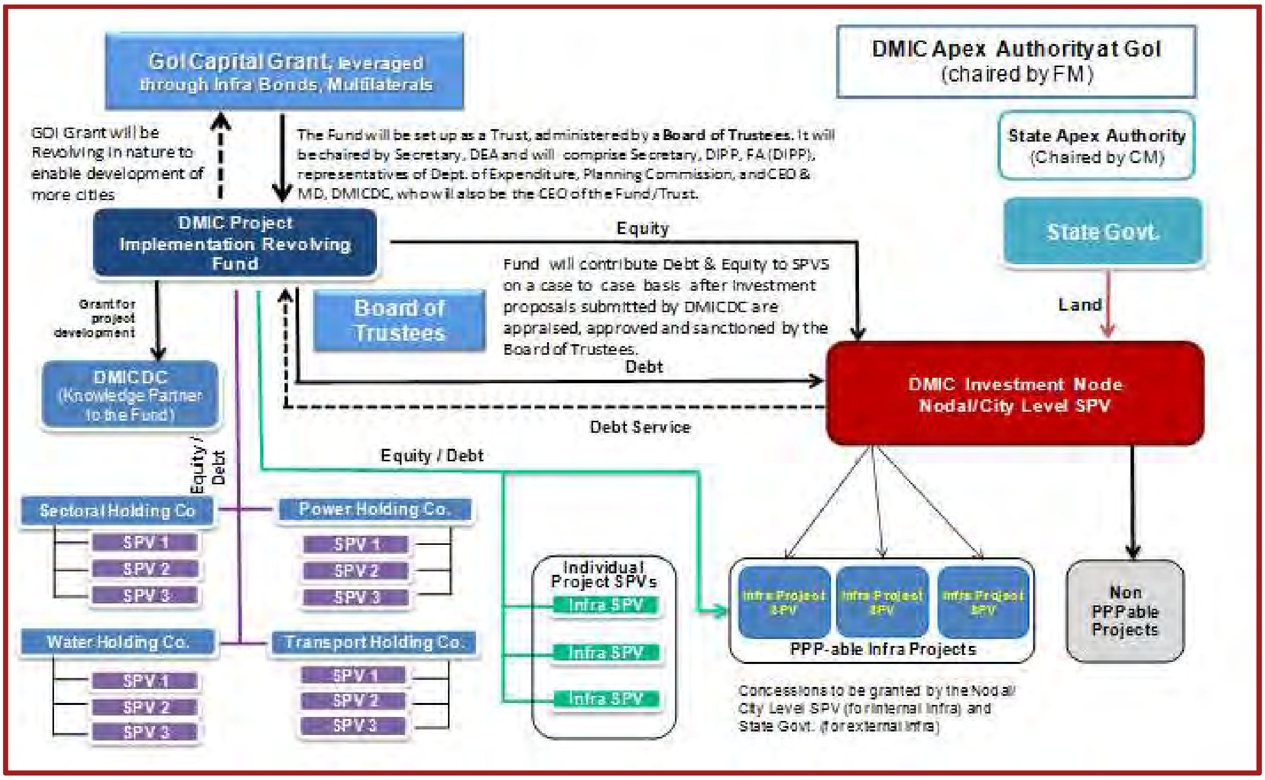


Figure 11.5: Financing Framework for DMIC

Given that fund flow is highly centralised through the DMIC Project Implementation Revolving Fund, there is strict monitoring in terms of disbursement and collections. The revolving nature of the fund ensures self-sustainability where revenues from node/ project SPVs are ploughed back into the fund for further use. Fund access is routed through Node SPV's, and also directly to holding companies and individual project SPVs enabling faster fund routing.

Proposed National Industrial Corridor (NICDA)

In order to put in place an overall enabling institutional, funding and operational framework for the development of Industrial Corridors in India, the proposal has been mooted to form a umbrella organisation in the form of NICDA. **It is proposed that NICDA will form the Apex Authority for all industrial corridors including DMIC, and will subsume the roles of current Central Trust and DMICDC, thereby acting as a project advisory body (akin to DMICDC) and a funding body (akin to Central Trust).** It is understood that principles for functioning of NICDA has been approved and the same is pending for Cabinet Approval by GoI.

[55] SIPP and CEO, DMICDC will be members of PPPAC to appraise and fast- track PPP projects in the DMIC region

It is envisaged that each industrial city in the industrial corridor shall be implemented by a SPV set up under the Companies Act, as a Joint Venture between GoI, represented through NICDA and the respective State Government on the lines of institutional structure approved for DMIC. The node/city level SPV may have representation from private sector wherever the State Government decides to involve them.

11.1.2. Key implications from DMIC structure

To understand the pros and cons of the current implementation framework under DMIC, stakeholder consultations were held with the state nodal agencies of DMIC states and private sector. Based on this a consultation matrix is presented below:

Table 11.2: Key Implications from DMIC Structure

Issue	Remarks	Enabling measures
Land acquisition	No transparency in valuation of land, resistance towards land acquisition due to poor compensation, no means of land monetization by the land owner as a result of proposed development	• Gujarat mechanism of land pooling through Town Planning scheme • Customized land acquisition and R&R packages to enable land owners to reap the benefit of such development
Challenge in creation of Node Development Authority	Conflict regarding cessation of existing local bodies within the delineated area in some DMIC states	• Gujarat SIR acts allows for retaining existing village settlements + plus 200 m buffer zone, administration of which remains with the gram panchayats, even after formation of RDA and hence there is hardly any resistance • Other state acts such as Karnataka and AP provision for revenue share of property tax collected with existing local authority within the delineated area
Financing arrangement for development of node and external infrastructure	• In some cases, state's contribution as equity in the SPV exceeds 51% due to higher land valuations. • Cost of acquisition is a huge burden for the state. • Lack of transparency in apportionment of Trust Funds esp. for external infrastructure projects • Funds from GoJ is planned to be utilized project by project basis and sometimes less incentives are provided to States, Ministries considering availability of grant funding from GoI	• The excess amount may be shared between the state and Central Trust to retain original equity share • The excess amount may be treated as state loan to the SPV, conditions for which are clearly indicated in the Shareholder agreement • Scientific methodology (based on economic benefit etc) to be adopted for prioritization of projects and fund planning to be done accordingly •
Project advisory and procurement	Lack of clarity in whether project advisory services are undertaken by DMICDC/ respective state and central line departments	• Centralised monitoring and funding of project advisory and procurement services through DMICDC to various central/ state departments • Clear distinction between projects to be taken up by DMICDC and other state/ central departments
External infrastructure projects	Lack of ownership for planning and monitoring of critical external infrastructure projects	• Industrial corridor cell maybe proposed in key central agencies such as NHAI, Shipping, Railway Board etc to plan, implement and operate projects

Issue	Remarks	Enabling measures
	for the node	under their jurisdiction • State level nodal agency may be identified to implement external infrastructure projects (under state jurisdiction) through respective state departments • For developing unviable external infrastructure by NHAI etc, funding options may be identified based on prioritized project list through options such as Central grant, International Finance Assistance etc
Delivery capability of state nodal agency and other departments	• State nodal agency lacks capacity to deliver enhanced role of implementing nodes in the range of 25- 50 sq. kms • Ownership of state agencies for projects is lacking	• Industrial corridor cell maybe created in state nodal agency and sufficiently capacity by hiring of external experts/ project management units etc • State high level empowered committee maybe suitably chaired at CM/ CS levels and represented with key department officials for proper monitoring of project status • Representation of JICA at state high level committee and node level SPV management board may be included, to enhance collaboration & knowledge transfer
State representation in Apex Level Committee	• Lack of state representation in DMIC Steering/ Apex committee	• High level representation from state Finance Department may be made part of DMIC Apex committee apart from Chief Minister of the State
Lack of co-ordinated industrial development in the state	• Lack of centralised state agency undertaking planning and monitoring of all large area industrial developments in the state- NIMZs, PCPIRs, Industrial Corridors etc	• Based on the existing legislative provisions of the state or through suitable amendment, a single nodal agency may be identified to oversee all large area industrial developments in the state akin to Gujarat Industrial Corridor Corporation formed under the SIR Act
Private sector participation (PSP) in Node level SPV	• Current structure restricts PSP to project level SPVs	• By segregating planning and development functions to Node Authority (Govt. body) & Project Development Company (Govt. + private sector), private sector efficiency in land monetization and project implementation and monitoring can be leveraged, while retaining all planning and statutory functions with the Node Authority. • Contractual and/ or revenue share mechanisms from collected taxes maybe worked upon between the node authority and the PDC, in case the PDC provides any statutory services • Private sector may either participate through equity infusion in PDC (Master Developer SPV) or through sub- SPV's for provision of viable services within the node through the PPP route

Successful operational examples of private sector participation in large area industrial developments in India- JUSCO & GIFT city Models

GIFT city

Gujarat International Finance Tec-City is planned as a financial central business district for the global financial services sector with the state of the art connectivity, infrastructure and transport access. GIFTCL is a Public Limited Company with IL&FS and GUDC both holding 50% each of the share capital of the Company. GIFT is being developed on 886 acres of land. GIFT facilitates Multi Services SEZ of 261 Acre and Domestic Finance Centre and associated social infrastructure on 625 acres. The SEZ is divided into two parts; 131 acres for Processing Area and 130 acres for Non-Processing Area

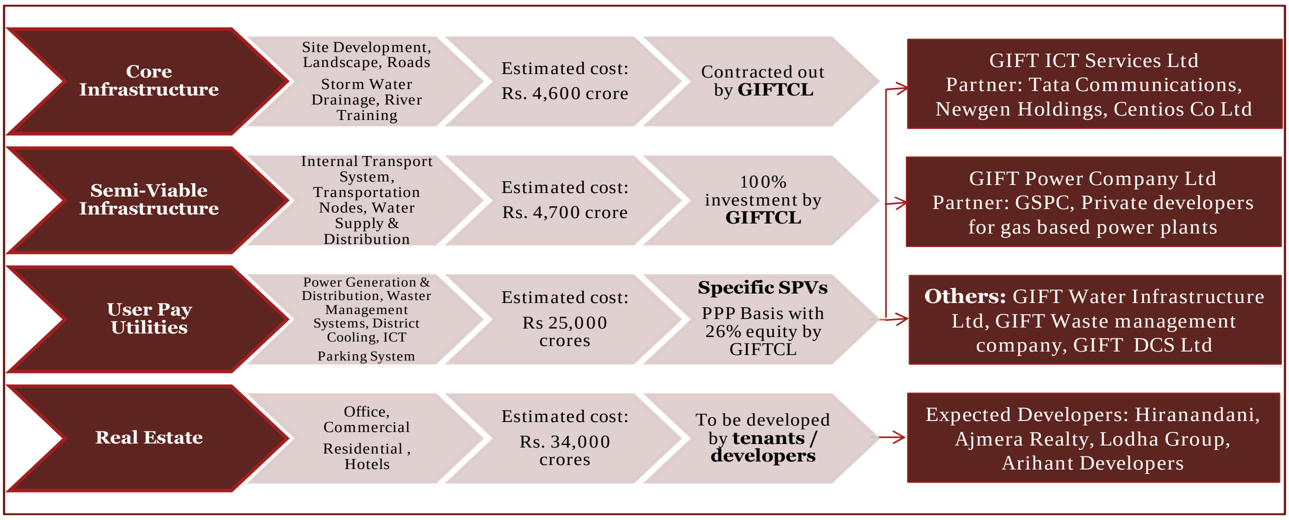
The development of infrastructure within GIFT is the responsibility of GIFTCL, which acts as the master developer. Gujarat government has declared the entire GIFT area as notified under section 264A of the Gujarat Municipalities Act, 1963. Following this the GIFT Urban Development Authority has been constituted as the area development authority for GIFT area as per the Gujarat Town Planning and Urban Area Development Act, 1976. The GIFT Authority will be chaired by State Urban Development Secretary and its members include R&B Secretary, GIFT Chairman, GIFT MD, CEO GUDA, MD GUDC, Gujarat's Chief Town Planner and Gandhinagar District Collector, along with an Additional Collector as Secretary of this committee.

The Project is geared for encouraging significant private sector participation into specific viable components. It is envisaged that while site development and basic infrastructure would be contracted out by GIFTCL, Special Purpose Vehicles (SPV's) have been set up to implement the critical utility components through major private sector participation. **GIFT has 6 subsidiary companies for providing the utilities namely power, water, solid waste management, ICT, District cooling system and transport.**

- GIFT District Cooling Systems Limited
- GIFT Water Infrastructure Limited
- GIFT Waste Management Services Limited
- GIFT SEZ Limited
- GIFT Power Company Limited
- GIFT ICT Services Limited

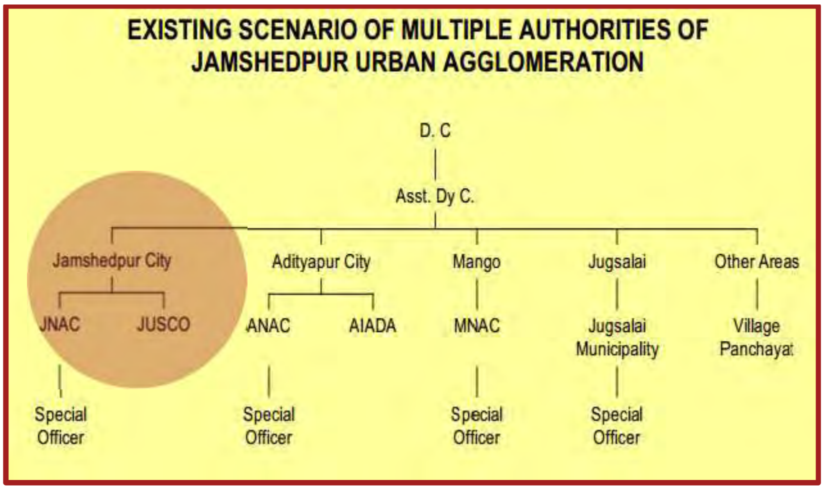
Each SPV presents a separate business case.

Real estate would be developed by individual developers, with GUDC acting as the Single-Window Area Development Authority.



JUSCO

Jamshedpur was formed as a steel township city in early 20th century. Jamshedpur is currently administered by the Jamshedpur Notified Area Committee (JNAC). Civic administration in JNAC is divided into two bodies- JNAC for non- Tata leased lands and Jamshedpur Utilities and Services Company (JUSCO). JUSCO is a 100% subsidiary of Tata Steel was formed in 2004 and is India's first and only private sector comprehensive urban infrastructure services provider. Its core competency is "creation and subsequent O&M of urban infrastructure and services". The governance structure of Jamshedpur Urban Agglomeration is as shown below:



For municipal services provided by JUSCO covering an area of around 64 sq. kms and to over 7 lakh people, JUSCO is empowered to levy user charges determined in consultation with the district administration. At present, JUSCO provides the following services to the residents of Jamshedpur:

- Power Services
- Water and Wastewater Management
- Construction Services
- Municipal Solid Waste (MSW) Management
- Horticulture Services
- Geographic Information System (GIS)
- Integrated Facility Management
- Customer Services: single window complaint lodging and follow-up system for citizens
- Other Services

While JUSCO can provide municipal services within the JNAC area, it has no coercive powers to maintain law and order, for eg: removing encroachments, police services etc.

11.1.3. Summary of key learnings for CBIC

Based on assessment of relevant acts for development of large industrial areas in India as elaborated above, a summary of learnings has been presented for CBIC to help formulate a robust institutional and financing structure for development of industrial nodes and the industrial corridor in its entirety. Incorporating these learnings and through extensive stakeholder consultations with DIPP, JICA, and relevant TN state government entities such as TIDCO, Dept. of Industries, Dept. of Planning & Development etc, the institutional framework for Ponneri Node has been formulated.

√ ***Strong commitment at Central Level:*** *Constitute an Apex Authority at the Central Level in the form of NICDA to oversee and ensure coordinated planning of all industrial corridors. Apex Authority to be sufficiently empowered with high level representation from Finance Minister, other relevant cabinet ministers, important departments such as NHAI/ Railways/Shipping/ AAI/ MoEF,* ***high level representation of participating states*** *from finance depts. and chief minister's offices*

√ ***Co- ordinated planning of industrial corridors:*** *NICDA may have different verticals such as DMIC corridor unit, CBIC corridor unit etc with shared horizontal departments such as Procurement Dept., Planning & Project Development Dept., Finance Dept. (Central Trust), etc*

√ ***Fast- tracking external linkage projects:*** *Departments crucial for external linkages such as NHAI/ Railways/Shipping/ AAI can have a dedicated vertical- Industrial corridor unit, which can facilitate expediting of planning and implementation of such projects*

√ ***Strong commitment at State Level:*** *Apex committee at the state level may be constituted as an umbrella organisation for all industrial corridors/ large area industrial developments in the state to periodically monitor status projects, approvals and clearances, take decisions on policy reform, facilitate ease of doing business etc. Strong commitment in the form of chairing of the committee by CM/ CS, and high level representation from relevant state departments such as Finance, Land and revenue, Industries, Environment, Urban Dev. Dept./ Town Planning Dept., State nodal agency, Board members of mega industrial projects in state will facilitate fast- tracking and smooth implementation of the project. Also,* ***involvement of JICA(and any other multi- lateral agencies involved) at State Apex committee level will ensure adequate knowledge transfer*** *and collaboration for policy, financing and other decisions.*

√ ***Co-ordination entity for external infrastructure:*** *State may appoint a nodal agency responsible for implementation of all external linkage and utility projects. The agency will act as a co- ordination between different state and central departments responsible for implementation of such projects and periodically report to the Apex committee regarding status and any issues.*

√ ***Capacity building:*** *State nodal agency for development of the industrial node/ corridor may be sufficiently capacitated by formation of an Industrial Corridor Unit which will enable fast-tracking of land acquisition, application procedures, clearances etc. The cell may be suitably capacitated with technical experts, project management consultants to enable to nodal agency to sufficiently monitor the progress of projects.*

√ ***Node Autonomy & private sector participation:*** *State may declare the industrial node as an Industrial Township, and grant adequate autonomy to the Industrial Area Authority to act as a planning and development body under any relevant state law, or under Article 243Q of the Constitution, thereby reducing its dependency upon the state government for provision of services and certain clearances. The authority may be empowered to form development regulations for the node, and decide on tariffs/ user charges for services within the node in consultation with the State Govt.*

The planning and development functions may be segregated, such that an Authority is formed which acts essentially as the Planning body with all statutory functions such as approval of master plan, collection of taxes, provisions of statutory functions such as police, etc;
And for the development function a separate SPV in the form of ***Project Development Company*** *(Master Developer) may be formed with representation from centre/ state and the private sector. The Authority may empower this PDC with development rights and enable them to collect any relevant user charges/ development charges fixed in consultation with the Node Authority. Based on the financial viability of node development, private sector participation may be as equity share in the PDC, or as separate SPVs under the Master Developer SPV for provision of specific services.*

11.2. Proposed Institutional and Financing Framework for development of Ponneri Node and CBIC in Tamil Nadu

11.2.1. Institutional Framework

Suitable Legislative Framework

In order to formulate the institutional structure for Ponneri industrial node under CBIC, it is important to understand the relevant legislative framework in Tamil Nadu which allows for such development. In this context, the suitability of 3 relevant state acts were assessed, namely:

- Tamil Nadu District Municipalities Act
- Tamil Nadu Indus trial Township Area Development Authority Act
- Tamil Nadu Town & Country Planning Act

An assessment of provisions of the above acts reveals that the **Tamil Nadu Industrial Township Area Development Authority Act is most suitable for development of Ponneri Node**. A suitability matrix for selection of legislative framework for CBIC development in TN has been presented below.

Table 11.3: Suitability matrix for selection of legislative framework for CBIC in Tamil Nadu

Provisions of the acts	Tamil Nadu Industrial Township Area Development Authority Act	Tamil Nadu District Municipalities Act	Tamil Nadu Town & Country Planning Act
Declaration as industrial area or township/ investment region/Special Area	Yes	Yes	Yes
Special planning authority	Yes	Yes	Yes
Node	Industrial Township Area/ (similar to Article 243 Q)	Industrial Township Area/ (similar to Article 243 Q)	New Town Development Area
Minimum area of delineated area	As per census planning area classifications	As per census planning area classifications	As per census planning area classifications
Area Authority	Industrial Township Area Development Authority	Industrial Township Committee	New Town Development Authority
Functions	Planning Authority, and municipal functions	Planning Authority, and municipal functions	Planning Authority, and municipal functions
Funds	• Grants, loans, advances from Govt. • Taxes, levies, tolls, rents etc • Money received from the disposal of land, buildings property	• Grants, loans, advances from Govt. • Taxes, levies, tolls, rents etc • Money received from the disposal of land, buildings property	

Provisions of the acts	Tamil Nadu Industrial Township Area Development Authority Act	Tamil Nadu District Municipalities Act	Tamil Nadu Town & Country Planning Act
Suitability for CBIC	**4** (Provision for formation of node as Ind. Township area and separate authority, enables private sector representation-industrial units in the implementation of the industrial area)	**2** (Provision for formation of node as Ind. Township and formation of Township Committee which is essentially a state govt. body)	**1** (Although separate planning and municipal body maybe constituted, the body will be a state govt. entity with functioning and representation akin to any Municipal Corporation/ Municipality)

Key considerations

- Land delineated under Ponneri industrial node (priority area) is to the extent of 13581 acres. Most of the land is under possession of TIDCO

- The delineated area currently has existing village settlements under the jurisdiction of Gram Panchayats[56]. It is proposed that the settlements be relocated to an appropriate location within the industrial node and subsumed as part of the economic activity of the node, so that planning for the node will be comprehensive and contiguous.

- It is proposed that the node be declared as an Industrial Township by the state government aligned to Article 243 Q and as per provisions of Tamil Nadu Industrial Township Area Development Authority Act, and a separate Ponneri Industrial Township Area Development Authority be formed which will assume the role of the municipal body for the node. The existing Gram Panchayats will cease to exist upon formation of such Industrial Area Authority.
-

[56] Gram Panchayats within the Node:
  - Vayalur, Kattupalli and Kattoor

Table 11.4: Model comparison

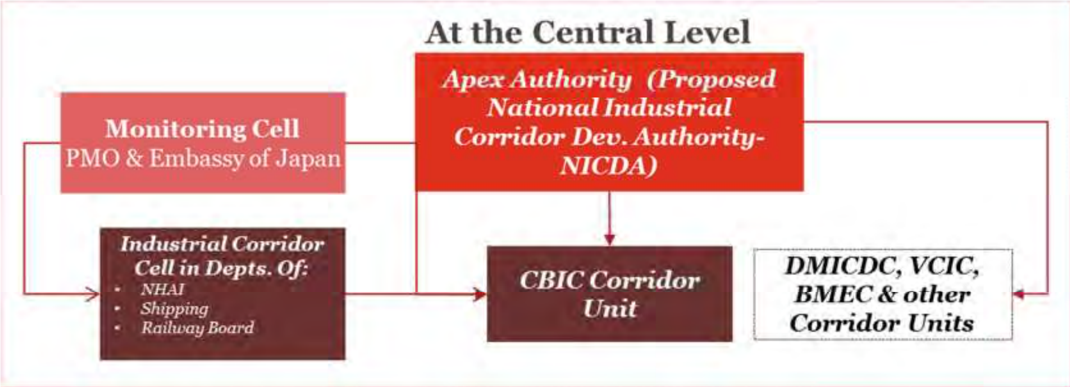
	GIFT City	JUSCO	Sri city	Dahej SEZ	Mahindra World City SEZ (Jaipur)
Land area (acres)	886	15,814.70	7000+	4279.86	3000
private sector equity	No JV: Gujarat International Finance Tec-City Company Limited' (GIFTCL), between Gujarat Urban Development Company Limited (GUDC) and Infrastructure Leasing & Financial Services established a Joint Venture Company	Yes 100% subsidiary of Tata steel	Yes Sri City Private limited (formerly Satyavedu Reserve Infracity Private Limited) , attracting Private Equity Fund	No JV between ONGC(Oil and Natural Gas Corporation) and GIDC (Gujarat Industrial Development Corporation)	Yes JV between the Mahindra Group and TIDCO
Unbundling of utilities	GIFTCL (master developer-site development and basic infrastructure) 6 subsidiary companies (SPV's) with private sector participation were formed for providing the utilities namely power, water, solid waste management, ICT, District cooling system and transport. Each SPV presents a separate business case.	Nil	Nil Power: APSPDCL - Andhra Pradesh Southern Electricity Distribution Company Telecommunication: a number of service providers Gas: various commercial providers	Nil Water: GIDC Drainage/Effluent Disposal: GIDC Power: Torrent Energy Ltd Gujarat State Petronet Ltd. Telecommunication and Data Transmission: Bharat Sanchar Nigam Limited	Nil

	GIFT City	JUSCO	Sri city	Dahej SEZ	Mahindra World City SEZ (Jaipur)
Revenue resources	Development rights Commercial Development Rights: Rs.1250 per sq(GIFTCL) / Rs.1000 per sq(GIFT SEZ) Residential Development Rights: Rs. 950 per sq(GIFTCL)/Rs.750 per sq(GIFT SEZ) Social Facilities Development Rights: Rs.350 per sq (GIFTCL)/Rs.250 per sq (GIFT SEZ)	Municipal service charges (Power Services Water and Wastewater Management, Construction Services, Municipal Solid Waste (MSW) Management, Horticulture Services, Geographic Information System (GIS), Integrated Facility Management, Customer Services: single window complaint lodging and follow-up system for citizens and others.)	Water charge Services charges	Long-term lease (30 years) Short-term lease (5 years) Allotment price – Rs. 1,200 /sq. m. / annum One time application fee One time deposit Service charge – Rs. 12/sq. m. /annum	a 99 year lease

Source: Respective website

Proposed Institutional structure for Ponneri Node and CBIC in Tamil Nadu

Taking into key considerations the key learnings for CBIC and suggestions from GoTN, the following institutional structure has been proposed for Ponneri Node:



- Proposed National Industrial Corridor Development Authority (NICDA) to oversee all industrial corridor development in India including DMIC
- NICDA will act as a project development partner to all SPVs and State Government agencies for implementation of industrial cities/projects in the various industrial corridors
- CBIC corridor unit to be formed below NICDA
- Key central agencies such as NHAI, Ministry of Shipping & Railway Board will be represented on the NICDA Board. They may form special cells within each department to facilitate planning, implementing and monitoring of critical external infrastructure projects
- Monitoring cell comprising of PMO and Japan embassy to form the apex level monitoring body

Figure 11.6: Central level institutional structure for CBIC in Tamil Nadu

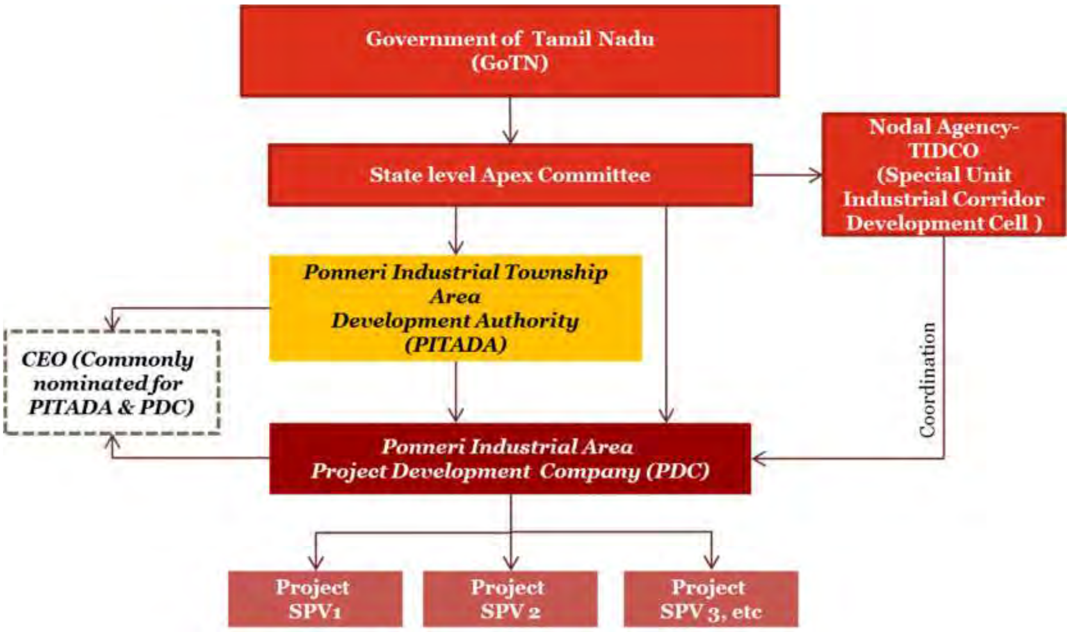


Figure 11.7: State level institutional structure for CBIC in Tamil Nadu

Co- ordinated planning of industrial corridors & Strong commitment at Central Level:

At the Central Level, an apex body in the form of NICDA is proposed to oversee co- ordinated planning, funding and monitoring of industrial corridors in India. It is proposed that a CBIC corridor unit be formed under NICDA to periodically update NICDA upon the progress of CBIC.

Proposed representation of NICDA:

- *Chaired by Union Finance Minister*
- *Minister for Commerce & Industry*
- *PMO*
- *JICA/ other participating multi- lateral agencies*
- *Proposed Niti Aayog*
- *MoEF*
- *Other relevant cabinet ministers*
- *Chairman- NHAI/ Railways/Shipping/ AAI*
- *High level representation of participating states- State*

Strong commitment at State Level:

At the State Level, a state- level apex committee has been proposed to fast- track and monitor progress of all mega industrial projects in the states including CBIC. The committee will monitor progress of node development as well as status of all external infrastructure projects under CBIC. It will co- ordinate with GoK and CBIC Corridor Unit (at central level) to periodically update progress of CBIC development, fast- track approvals and clearances within state jurisdiction and resolve

Proposed representation of State Apex Committee:

- *Convenor- Chief Secretary*
- *Industries Secretary*
- *Tamil Nadu Infrastructure Development Board CEO*
- *Finance Secretary*
- *Revenue Secretary*
- *A nominee of GoI (DIPP)*
- *Board members of mega industrial projects in state NIMZs, VCIC etc*
- *JICA/ multi- lateral agencies*

Figure 11-8: Key features of the proposed institutional structure

Co-ordination entity for external infrastructure

Based on discussions with GoTN, it was felt that the State Level Apex Committee will play the dual role of a monitoring body (through representation as stated above) and co- ordination body through TNIDB, which is the nodal agency for

Capacity building

The state nodal agency TIDCO may be suitably capacitated by creation of a special Industrial Corridor Cell by passing of requisite GO and staffing the cell suitably, to enable it to undertake land acquisition and any other activities for such large scale projects.

Proposed experts for Industrial Corridor cell in TIDCO:

- Subject matters experts in the field of industrial and urban planning
- Project management office (PMO- external consultants)
- Financial advisor
- Liaison officer

Node Autonomy & private sector participation

In order to facilitate private sector participation, it was felt necessary to segregate the planning and development functions of the node, such that Government retains all statutory functions such as framing of development regulations, approvals, NOCs, collection of taxes, etc.

It is proposed that Ponneri Industrial Township Area Development Authority will act as the planning authority for Ponneri node.

Proposed composition of Ponneri Industrial Township Area Development Authority

- CEO
- Chairman from Promoting Agency- TIDCO
- Representation from PCB, TNEB, Dept. of Highways & Minor Ports, Factories, Public Health and Town & Country Planning department, Dept. of Housing
- Rep from Industries in Node
- A technocrat
- Employees Representative

(Composition aligned to Tamil Nadu Industrial Township Area

For the development function a separate SPV may be created, Ponneri Industrial Area Project Development Company (PDC) which may contain private sector participation and be responsible for implementation and operation of the node. The suggested composition for Ponneri node PDC is based on indicative guidelines proposed by NICDA.

Proposed composition of Ponneri Industrial Area Project Development Company:

- TIDCO/ Other GoTN owned PSUs- 51%, majority shareholding in SPV
- Centre- NICDA
- Chennai, Ennore & Kattupalli Ports
- Private sector-Developer/Co-developers- equity share capped at 49% Private sector may either participate through equity infusion in the PDC (Master Developer SPV) or through sub- SPV's for provision of viable services within the node through the PPP route

Technology Collaboration & Knowledge Transfer:

Participation of GOJ (and other relevant multi- lateral agencies) has been proposed both at the Central Level (Monitoring Cell) and the State Apex Committee to attract international investors to the node and related infrastructure development. It will be effective to incorporate necessary development of external (and/or internal) infrastructure, investment environment improvement, and investment promotion from the planning and preparation stage in order to accommodate international investors' view. The investors could facilitate knowledge transfer and technology collaboration in newer areas such as modern City concepts, Green Buildings, Zero Waste Discharge etc. This will also ensure adequate appraisal, due-diligence and monitoring in planning and implementation of projects at State & Central levels. Also such representation will enable project marketing in parent countries of these agencies.

JICA study team (JST) had a detailed presentation to GoTN on 15th October 2014 about the proposed Institutional Structure and some observations were made. Based on that JST again made a presentation in December 2014 to GoTN to finalize the Institutional Structure and the same was approved by GoTN with some minor suggestions. The Structure mentioned here in this report is based on the above.

Table 11.5: Detailed Roles & Responsibility Framework for key stakeholders for development of Ponneri and CBIC in Tamil Nadu

Key Task	Responsibility
Land Delineation for the Node & Project Development Studies	TIDCO is responsible for conducting pre- feasibility assessment for the node, and delineating appropriate land parcel for development
Land Acquisition	TIDCO is responsible for all land acquisition and R&R activities
Preparation and approval of node master plan	The detailed master plan for the node is to be prepared by the Project Development Company and approved by the Ponneri Industrial Area Authority and State Government through the State Level Apex Committee
Preparation of development guidelines for master planning of node	The Node Authority is responsible for preparing any node specific development regulations for Ponneri Node if provisioned for under state legislative framework. Such guidelines may be approved by the State Level Apex committee
Approvals, Clearances, NOCs	Based on the jurisdiction for approvals, the Centre/ State/ Apex Committee & the Node Authority will be responsible for all approvals and clearances. For eg: The Node authority will be responsible for approving all building registrations, node development related NOC's etc; Approvals for external connectivity projects within state jurisdiction will have to be through Apex committee; Any environmental clearance for mega projects shall take the existing route of approval from the Centre through MoEF
Implementation of external infrastructure	All external infrastructure shall be implemented by relevant state and/ or central govt. entities based on the jurisdiction of the project
Co- ordination and monitoring of external infrastructure	The State Apex Committee through TNIDB is responsible for co- ordination & monitoring of external infrastructure. Monitoring such project status shall be conducted by the Monitoring Cell at the central level, esp. for central govt. projects
Land lease/ sale within the node	The Node PDC (Master Dev SPV) is responsible for all land transactions within the node
Provision of statutory function and services within the node	The Node Authority will be responsible for provision of statutory functions within the node. The Node Authority may delegate provision of certain functions such as garbage collection etc to the PDC, for which it may suitably share taxes/ provide fixed fee for provision of such services
Collection of user charges/ development charges	The node PDC is responsible for collection of development and user charges at rates/ tariffs determined based on consultations with the Node Authority & as approved by the State Apex Committee

In addition, it was also proposed that a Project Management Unit be created within Project Development Company with support from JICA/ External Agencies wherein some experts can be deployed for speeding up of project development and implementation and the same was also agreed in the meeting held on ___ December 2014 as mentioned before

11.2.2. Financing Framework

Two options for financing framework have been considered for CBIC development in Tamil Nadu. First option is similar to current practice in DMIC and incorporates recommendations of NICDA. The second option incorporates alternate suggestions provided during stakeholder consultations with DMIC states and JICA.

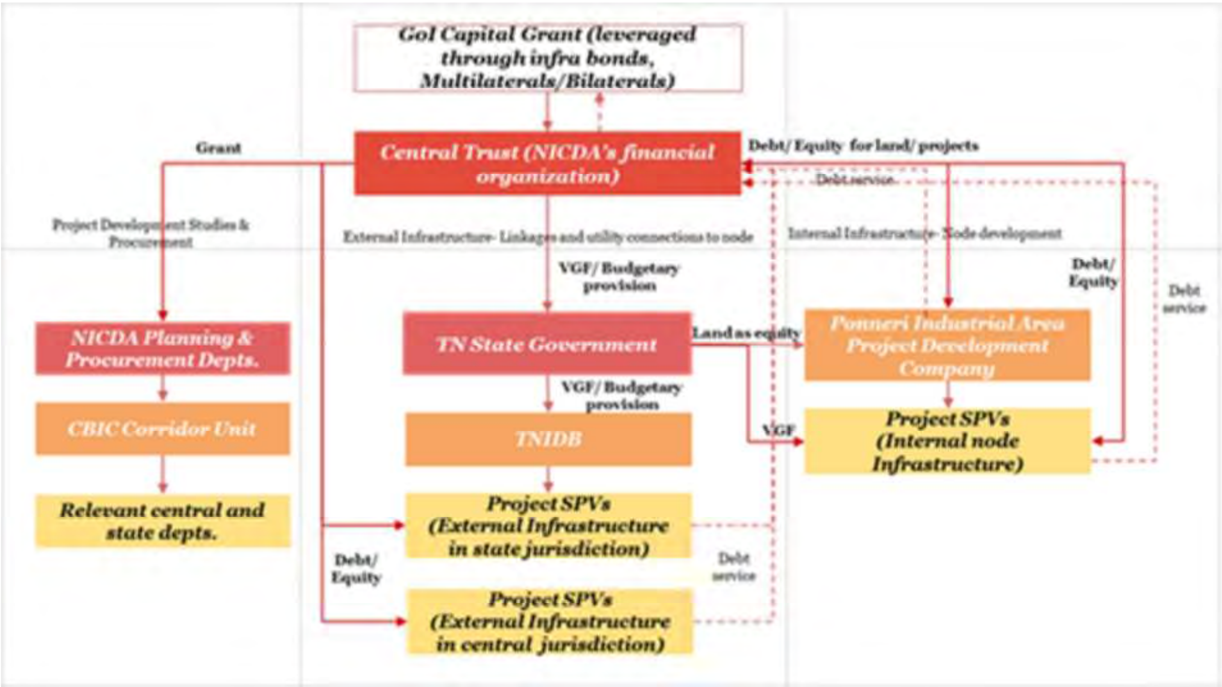


Figure 11.8: Option 1- Financing framework for CBIC in Tamil Nadu

Key features of proposed financing framework:

- **The first option is similar to existing fund flow mechanism under DMIC. All fund routing is through the Central Trust (Financing arm of NICDA).**
  - NICDA undertakes centralised project development and advisory studies through self or through relevant central/ state government entities for critical external infrastructure projects for CBIC. For conducting the same the Central Trust provides grant to NICDA project planning and advisory department which is then routed to different central/ state entities as applicable.
  - NICDA can route funds for external infrastructure within central jurisdiction to relevant central govt. entities (as VGF/ Budgetary provisions) or as Debt/ Equity directly to Project SPVs
  - For external infrastructure within state jurisdiction, funds can be routed to the designated state nodal agency, namely TNIDB, from where it may be routed to relevant state departments (VGF/ Budgetary provisions). Again, NICDA may also chose to directly invest into project SPVs (both internal & external infrastructure) in the form of Debt/ Equity.
  - For the development of the node, GoTN's equity contribution in Ponneri node PDC is in the form of land, NICDA's contribution may be in the form of Debt/ Equity, equity contribution of Chennai/ Ennore/ Kattupalli ports (if applicable) and private sector equity contribution (capped at 49%).

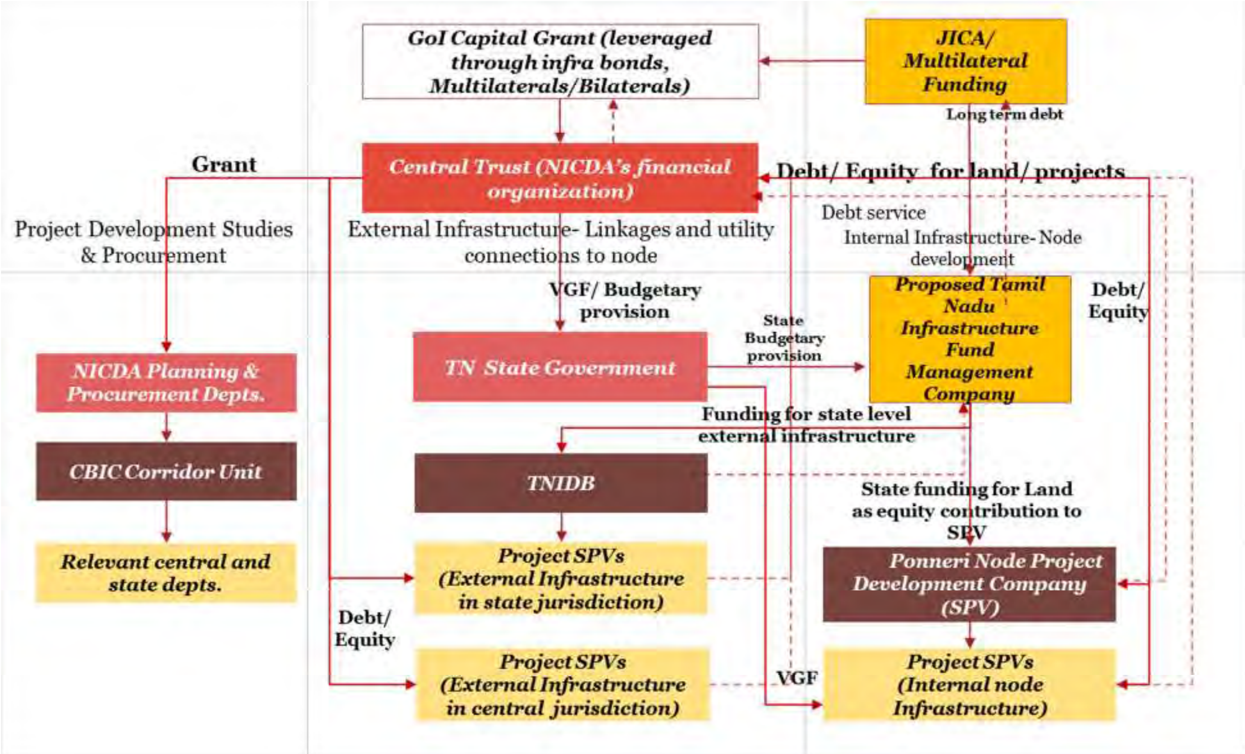


Figure 11.9: Option 2- Financing framework for CBIC in Tamil Nadu

- **In the second option, it is proposed that JICA funding may be made available both at central level and state level, and JICA can directly fund the state through the proposed Tamil Nadu Infrastructure Fund Management Company (TNIFMC) or budget support allocation, such as a program loan.**
  - TNIFMC has been proposed to manage the new infrastructure finance vehicles (IFV), and will be enabled to roll out and manage new IFVs - the Infrastructure Debt Fund (IDF), Alternative Investment Fund (AIF) and Infrastructure Investment Trust (InvIT) as per guidelines of market regulator, the Securities and Exchange Board of India. It is envisaged to be a fourth generation financial institution in the state and will be set-up in partnership with banks, insurance companies and reputed private financial institutions.
  - This option will enable faster fund routing from JICA directly to the state government.

Option 2 has been chosen as the preferred option, based on a round of discussions with the Tamil Nadu State Government (TIDCO/ TNIDB) for Ponneri Node and CBIC development in Tamil Nadu. Aligned to the Madurai- Tuticorin financing framework, TNIFMC will act as the entity to route all funding from state budgetary provisions and JICA funding to state, for CBIC development in Tamil Nadu. Based on further consultations with DIPP and GoTN the above framework will be finalized and presented in the Final Feasibility Report

12. Investment Environment Improvement

12.1. Background

The strength and weakness of CBIC states was reviewed to assess their potential as a global investment destination in comparison with the rival countries/regions as well as investors' view on the ground. Recommendations were thus identified for the CBIC state to enhance the investment environment.

The quantitative analysis of Indian states and cities as well as the global competitors reveals that the positions of the CBIC states in the investment dynamism. This is followed by the qualitative analysis of the comparative advantages/disadvantages of CBIC to clarify the bottlenecks through the result of interview surveys to Japanese companies those already operating in CBIC on the ground.

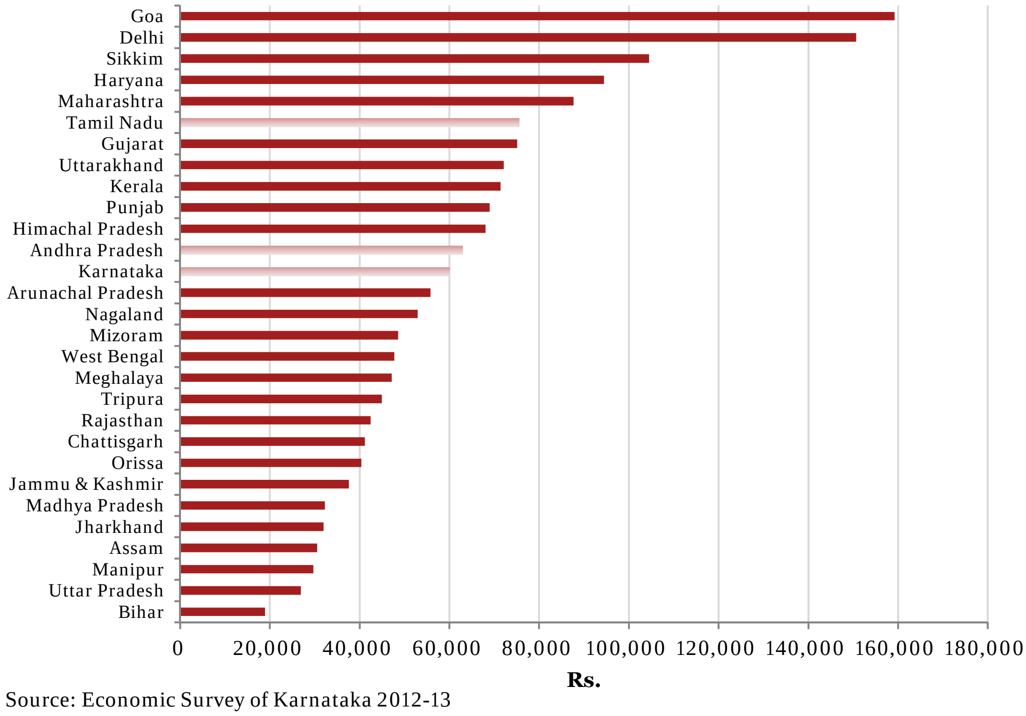
Based on the analysis, we adopted five key perspectives, infrastructure, land acquisition/building approvals, skill development, business process, and industrial park/cluster, to conduct benchmarking study across CBIC states and best practice state to highlight the area for improvements. We have also used the regional examples from South East Asia for benchmarking to indicate additional approaches for improvement. The private sector feedbacks analysis, from the in-depth interview with the companies who find hurdle in entering India, is also analyzed to indicate further area of improvement for the CBIC state to become the key destination of the investment.

Focus of our recommendation hereafter is primarily on the five perspectives where the states have a strong role to play. Although we conducted benchmarking with regional competitors and took indication, the key focus area as a first step remains best practice from the India states and also the feedback from the private sector to make sure our recommendation are practical and ground in the realities in India**.**

12.2. CBIC state investment environment status

12.2.1. Quantitative analysis

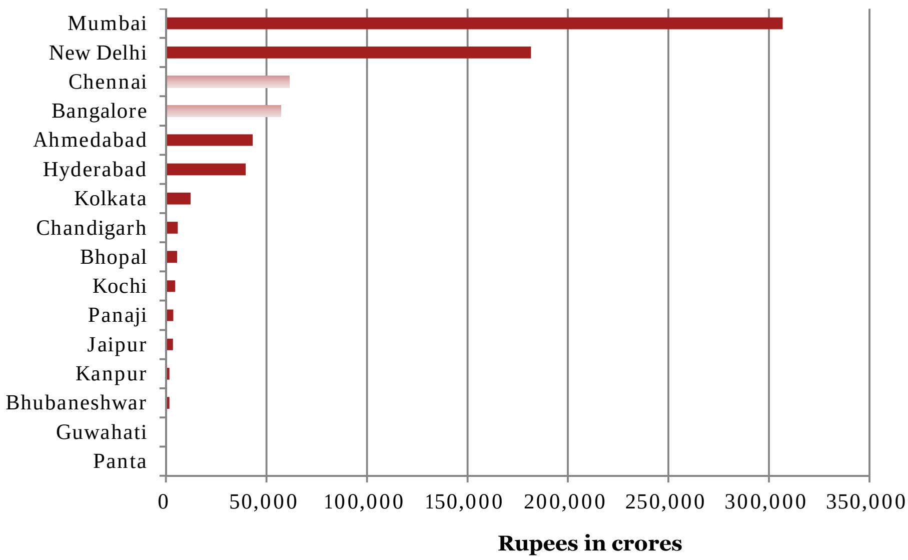
This section deals with "state" and "city" level comparative analysis for CBIC's investment climate. It defines CBIC as the accumulation of Tamil Nadu, Karnataka and Andhra Pradesh States at the state level, and Chennai and Bangalore at the city level. First of all, it goes through the data of per capita 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 three 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

Figure 12.1: Per Capita Income at Current Prices (2010-11)

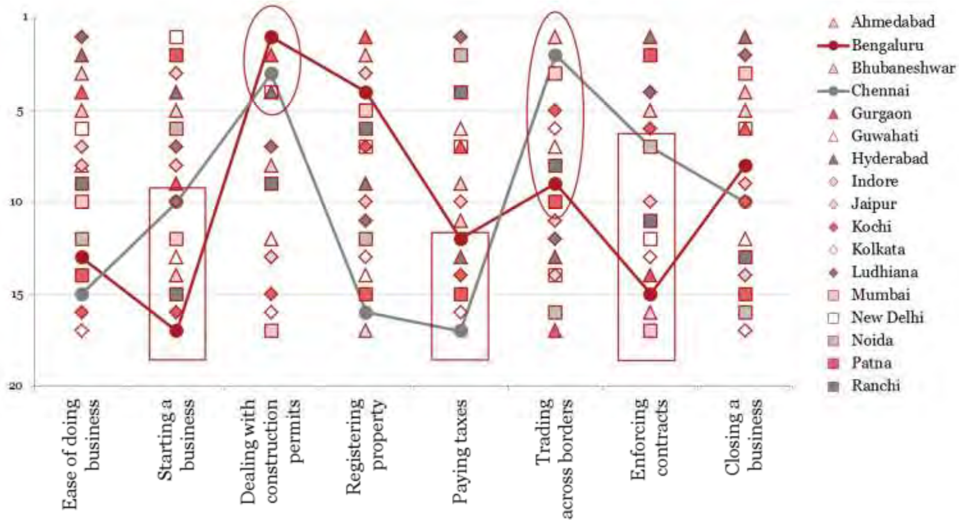
As to FDI inflow, Mumbai and Delhi show outstanding performance on the city level comparison. Chennai and Bangalore are following the top two cities, but Mumbai is collecting four times as much FDI as the two cities in CBIC. The total of two states in DMIC is three times as much as that of two states 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.



Source : GOI - FACT SHEET ON FDI
From APRIL, 2000 to NOVMBER, 2013

Figure 12.2: Received FDI Equity (April 2000 - November 2013)

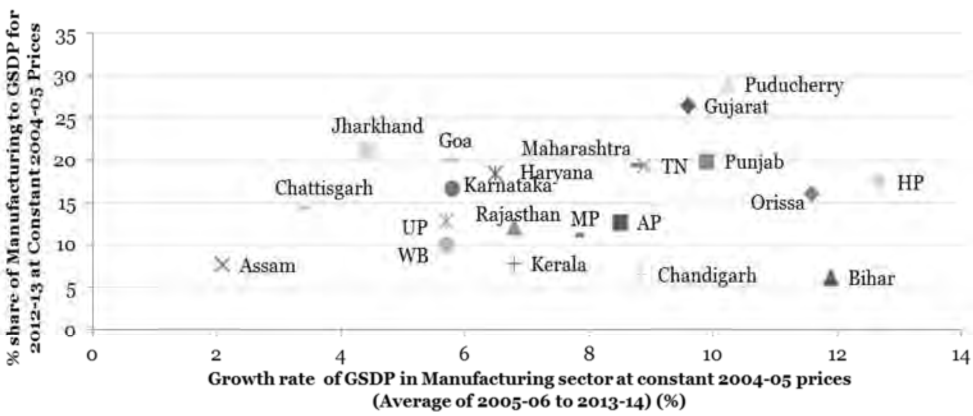
According to the investment climate survey of World Bank for 17 major cities in India, the two cities in CBIC are ranked at the lowest level in terms of ease of doing business, which means aggregate evaluation of investment climate. Chennai is placed in the 15th position. It is inferior to the other 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. (Please refer to Appendix for the details.)



Source: World Bank

Figure 12.3: Doing Business Ranking in India (Latest-2009)

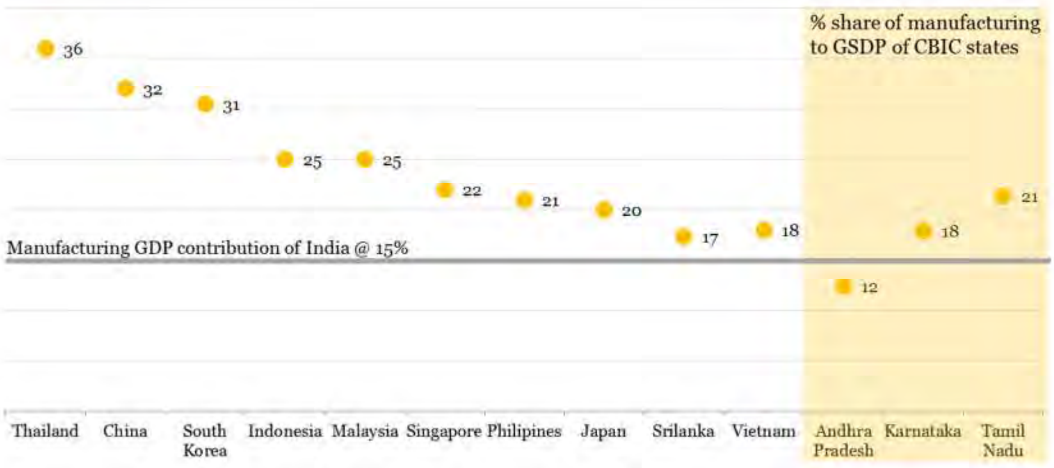
In addition, the manufacturing industry maturity of DMIC states, such as Gujarat, Maharashtra, Punjab and Himachal Pradesh, and Orissa and Puducherry, emerge as top performers at above India average levels. Among the CBIC region, Tamil Nadu is ranked in the top level, while Andhra Pradesh and Karnataka still have much to improve.



Source: http://planningcommission.nic.in/data/datatable/0814/table_64.pdf
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3600125/table/Tab1/

Figure 12.4: Manufacturing industry maturity (2005)

Comparison among CBIC states and other Asian countries also vividly shows that CBIC states lag behind in the manufacturing industry development. The contribution of the manufacturing industry to GSDP is lower than South East Asia countries in all the state, highlighting the strong necessity of investment enhancement.



Source: Council on Competitiveness

Figure 12.5: International comparison of manufacturing GDP contribution (2010) (%)

12.2.2. Qualitative analysis

Interview surveys to the foreign companies which have already penetrated in the CBIC region were conducted. This section describes the key advantages and disadvantages of the investment environment of CBIC from the investor's point of view.

CBIC's Comparative Advantages Attracting Foreign Companies and Investors

According to the 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 labors 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, core cities, Bengaluru and Chennai, locate close to key industrial parks and provide 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 three 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

Quadrilateral 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, three 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 four 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 growing economies. Furthermore, CBIC holds one domestic and two 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 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 three State Governments are positive to further invite foreign investors and continue dialogues with many foreign partners.

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 made with consideration of (i) higher competitiveness than other states and (ii) cost competitiveness with industrial accumulation areas. In order to meet the above conditions, establishment of external or internal infrastructure and development of institute, lands and human resources for industrial accumulation areas like industrial park/cluster should be considered.

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. Based on the interview with foreign companies currently operating or intend to enter India, we describe the key difficulties for their business.

1. Challenges of Infrastructure Bottlenecks

There are challenges of infrastructure bottlenecks inside and outside the industrial areas. 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.

Key feedback from the foreign companies

1) Power

- "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."
- "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."

2) Port

- "The cost for usage of some ports is more than twice that for other ports in India, and over 5 times the international level. Further revision of port charge is necessary."
- "The gate through which the trucks can enter the port for receipt and delivery is very limited. 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."
- "Logistics problems frequently occur at ports, especially at Chennai Port. Due to lack of organized and integrated regulation or guidelines, rules of mandatory submitting documents and licenses for clearance are often changed suddenly by orders of clearance officers at the port. 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."

3) Road

- "In some area in CBIC, the constructions 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. Logistics activities between affiliated companies are facing serious inefficiency"
- "The delay in the construction of an access road in the area surrounding main 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. "

4) Water and sewage treatment

- "Although water connection exists, there isn't sufficient water. In some cases, companies have to have their own bore wells for commercial and residential purpose."

2. Insufficient land acquisition and building approval process

Land availability and building approval are always major bottlenecks in starting business in India. The process requires time and effort, and delay in land allotment affects the schedule of projects in terms of time taken from conceptualization to production. The problems mainly relevant to the land acquisition are the scarcity of the land itself and the lack of transparency of the land allotment process

Key feedback from the foreign companies

1) Land acquisition

- "When serious problems occur on land acquisition in industrial park, private company has to solve by taking all responsibilities."
- "Within one or two years, additional land acquisition might be necessary, but all issues in the investment approval process would be the hindrance to make a decision on new investment, even though they are confident in the increase of demand along with the market growth."

2) Land allotment

- "Unfair allotment is caused by lack of the personal relationships with the authority of land allotment. In such case, it would be only fair to ask government to interfere and deal with land allotments for a more fair allotment process."

3) Land information

- "Information on industrial park is closed and difficult to know for potential investors unless they have connection with the Government officials."
- "Expansion of plant was very tedious process due to lack of land availability and information on land availability. Government should take initiatives to improve the land related information to investors."

3. Low availability of the skill development system

India is characterized by the high quality labour pool in comparison with the other emerging markets and each state has implemented various approaches to enhance it; nevertheless, the pace of the demand growth overcome the supply speed, and many of the business entities suffers from the shortage of quality labour. Also, as the India has positioned itself as the leading nation in the global community, the needs to incorporate gender equality into the labour development rises takes momentum, requiring more comprehensive approaches to the skill development.

Key feedback from the foreign companies

1) Skilled Labour

- "Quality of skilled labour is very poor. They need training but companies except big companies like Toyota, do not have the capability to train them. Hence the quality at institute or college level for Industrial Training Institute (ITI) students should be improved. This can be supported by Government by providing some grants to bring in machines for training such as a turner or a CNC machine at the institutes /colleges. "
- "Although the government is taking some actions like establishing training institutes, skilled labour availability is low. People do not show interest in getting trained in different skills."
- "White collar professionals prefer Bangalore to Tumakuru. It is difficult to retain them."

2) Labour law

- "Labour laws are extremely favorable to workmen, which makes it hard for employers to take suitable actions at a certain situation. Employers do not have any liberty to lay off any labour even though his/her performance is not satisfactory with the work."

3) Labour union

- "There are union issues. These are more majorly because of interface of villages from surrounding areas. Shut down is caused by union issues."

4. Business Process

Concerns were raised with respect to the time and investment that goes into negotiating with line ministries to get permits while starting the business. Although many of the states set up Single window agency to facilitate the business process, many foreign companies have shown low satisfaction for their service; after all, the companies need to conduct multiple visits to various ministries and go through various process to obtain the approval.

Key feedback from the foreign companies

1) 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."

- "Application process and instruction on submission of required documents were clear. However, Single window clearance system was not effective and not practical at all. Clearance certificate is not considered seriously and one has to go behind each line of departments to obtain utilities and approvals."

2) MSMEs

- "Although the states give MSMEs the preferential treatment with incentives and subsidy, MSMEs takes much more time to obtain approvals than major companies. The requirement and difficulties MSEMs hold should be considered."

5. 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.

Key feedback from the foreign companies

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."
- "Application process and instruction on submission of required documents were clear. However, Single window clearance system was not effective and not practical at all. Clearance certificate is not considered seriously and one has to go behind each line of departments to obtain utilities and approvals."

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. "

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. "

12.3. Analytical framework

Through the consultation and interviews with private sectors and past published research, it became clear that a range of issues as well as measures taken by the states have been identified. Out of the result, we adopted five perspectives as the key factors for the investment environment improvement, which are strongly advocated by the private sectors; "A. Infrastructure", "B. Land Acquisition/Building Approval", "C. Skill Development", "D. Business Process" and "E. Industrial Park/Cluster" .

Perspectives	Voice from the foreign companies
A. Infrastructure	•“We suffer from the blackout during the operation time; to avert the risk we purchased self-generation, which has caused the significant cost up” •“Unless the company has the prioritized channel to the power supply from the state or other authority, it needs to have its own power facilities, resulting in way higher cost than the local competitors”
B. Land acquisition/ building approval	•“Land acquisition is always the blocker for the business development”. Without the clear system and procedure in the acquisition, we cannot take risk of investment. •“For the city development, the authority need to take top down approach to acquire land. Gujarat seems to make success with the strong leader”
C. Skilled Labor	•“We are short of the good quality labor at the local factories. Even though the state governments provide the vocational school, the quality does not meet the standard from the foreign companies” •“The labor law is too complicated that the labor management is difficult”
D. Business process	•“We plan to build a power plant , but the registration process takes much time as well as requires a significant amount of man power” •“Each state has different business process; even in one state, we had tough time to understand and reach to the key stakeholders. Unless the business process becomes simplified and transparent , we do not intend to go to other states”
E. Industrial Park/ Cluster	•“Industrial park as well as clusters need to be established as the hub of the growth ; especially Chennai has been successful in establishing automotive hub. Other state can learn from it” •“Internal and external infrastructure need to be built up for the good quality of industry cluster”

Figure 12.6: Feedback from private investors

With these five perspectives, we conducted three dimensional approaches to identify the issue relevant to the investment environment improvement, and identify the indication for the CBIC states;

1. **Benchmarking among CBIC States and best practice in India**
2. **Analysis of the South East Asia**
3. **Feedback from foreign private sectors**

As for the benchmarking among the India, we compare the CBIC states with best practice state in India to understand the status of the each state as well as the key initiative taken by the best practice state. For the second, we also apply the five perspective analysis to the regional competitors, such as Singapore, Thai, Indonesia, and Vietnam mainly to identify indication for the policy. The private sector feedback is also analyzed to build recommendation; the request from the foreign companies sometimes lack feasibility or practicability from the India perspectives, but it surely provide insight for CBIC to overreach the top level of investment destination.

12.4. Analysis

12.4.1. Benchmarking among CBIC state and best practice in India

In this section, the CBIC states and best practice are compared in quantitative and qualitative view based on various information sources. For each perspective, the analyses use multiple parameters relevant to the perspectives to compare the performance of the states and lead to the key indication. The best practices of each perspective are selected based on the quantitative analysis and consultation with various stakeholders.

Infrastructure

This section covers power and port as infrastructure, which are often raised by the private sectors as major bottlenecks regarding the infrastructure.

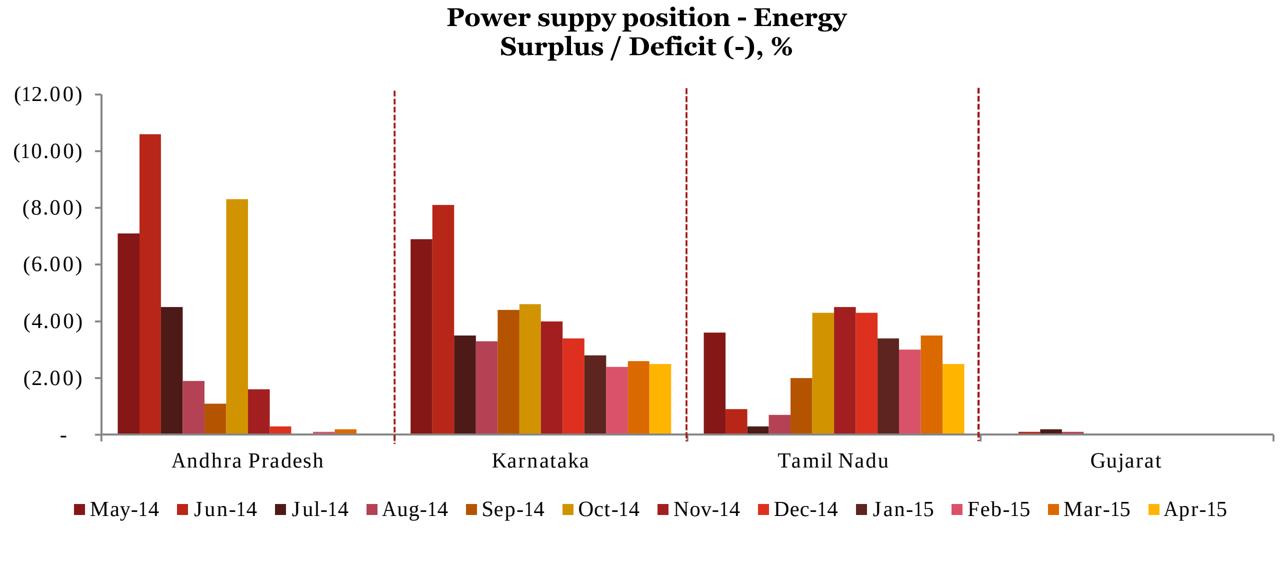
Power

Efficient power supply is essential for the growth of industry and can be done by the provision from not only power authority but also private sectors. Although each state of CBIC region has made effort to improve the power supply, only Andhra Pradesh has achieved substantial improvement over the past 6 months.

The JST has benchmarked power related aspects of CBIC states with Gujarat against two dimensions - availability and tariff

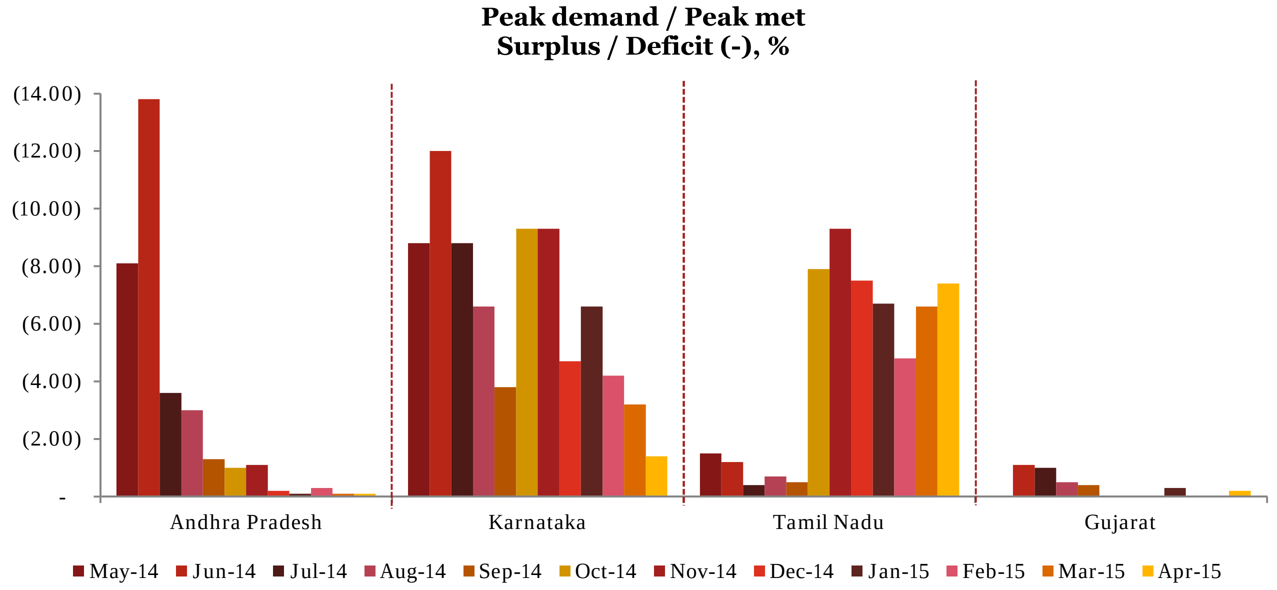
<u>Availability and Tariff</u>

Gujarat has achieved almost zero energy and peak deficit and no power cuts observed by industries and has the lowest industrial power tariff. On the other hand, Karnataka and Tamil Nadu have persistent energy/peak demand deficit last year and mandatory power outages. Power supply positon in Andhra Pradesh has improved substantially over the past year. For the past 6 months it is able to meet peak demand and registered the lowest deficit among other CBIC states.



Source: CEA

Figure 12.7: Power supply position (Energy), CBIC states vs Gujarat



Source: CEA

Figure 12.8: Power supply position (peak demand met), CBIC states vs Gujarat

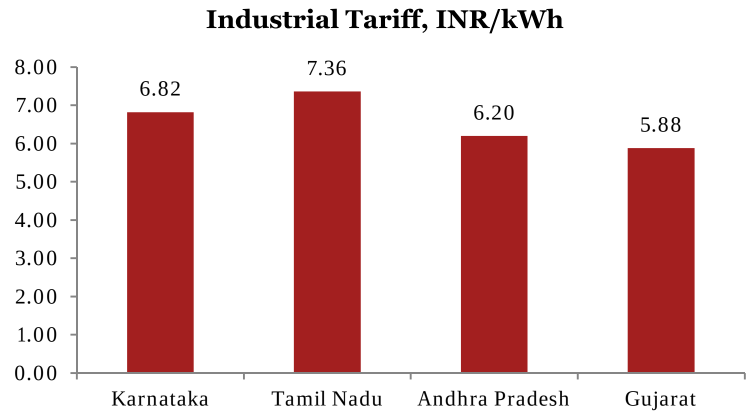


Figure 12.9: Industrial electricity tariff, 2014-15

All CBIC states have open access regulation as well as renewable promotion regulation. CBIC states have taken a leap in renewable energy promotion. Installed capacities are above the benchmarked state of Gujarat with Tamil Nadu in the leading position.

However, Gujarat has taken step further; in Gujarat, the independent demand side management is made and independent feeders for consumers come to the forefront due to the ease of doing business. Gujarat is also implementing the largest solar project in India and targets the energy generation through renewable sources to be 10% of the total energy generation by 2019, and 100% of HT consumers are on smart metering, leading to loss reduction for utilities.

Having utilized private sector participation in electricity generation, Gujarat leads among benchmarked states; all CBIC states have almost equal share of IPP installed capacity in total electrical installed capacity.

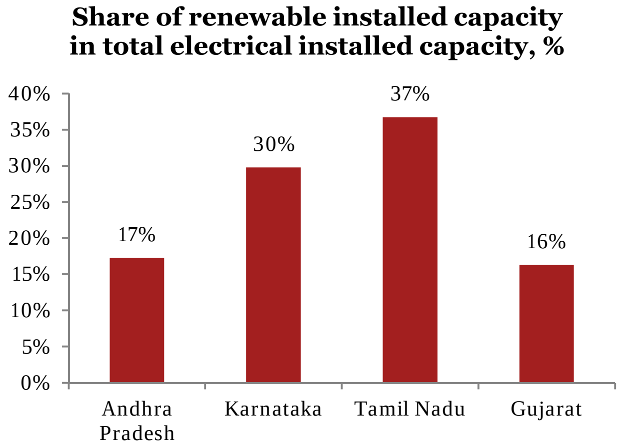


Figure 12.10: IPPs installed capacities

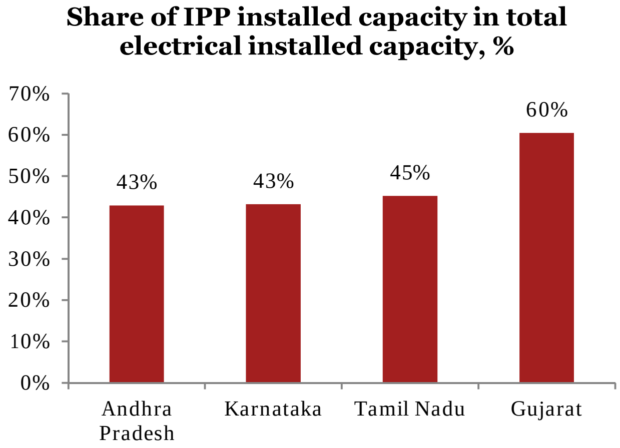


Figure 12.11: Renewable energy installed capacities

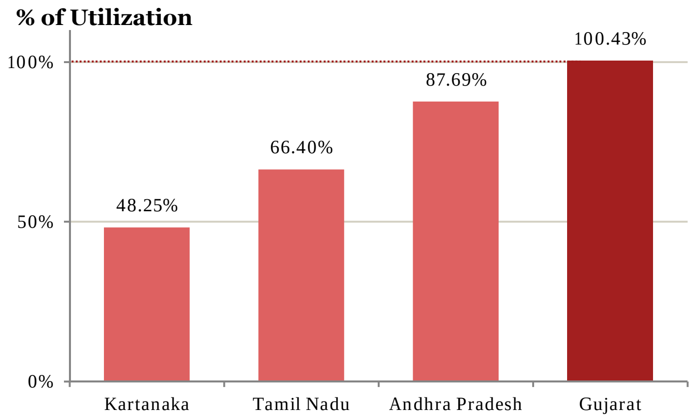
Port

Smooth port operation serves the increase of trading volume and then development of industry in the area. We utilize two key perspectives, utilization and non-major port policy to delve into the CBIC state performance.

Utilization

All states have own Port Policy to achieve various purposes such as to increase its share and cargo volume, then expanding the utilization, which is calculated by the cargo volume per its capacity. Gujarat has Kandla as a key Major Port with fairly high utilization, resulting in the overall highest utilization ratio. Andhra Pradesh has Visakhapatnam as a Major Port with high utilization. Tamil Nadu has three Major Ports, Chennai, Ennore and Tuticorin with fairly high utilization. Karnataka, despite that it has two Major Ports, New Mangalore & Karwar, is characterized by low utilization.

According to ease of doing business study by World Bank, cross-border trading in all CBIC states takes longer time if compared with best practices in India and South East Asian countries.



Source: Basic Port Statistic of India (2012-2013)

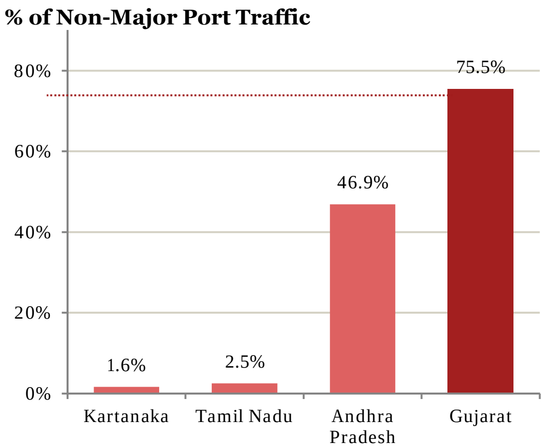
Figure 12.12: Port Utilization of a Major Port in each state

It has been identified by private investors that logistics issues frequently occur due to lack of organized and integrated regulations or guidelines, especially at Chennai port. Several stakeholders from foreign countries have identified that the human cost and time for port clearance in CBIC region takes 10 times as much as that of Singapore, indicating that there are areas for the improvement in operation.

Non-Major Port

The traffic of the Non major port differs much among the state. Gujarat established Non-Major Port Policy and Schemes implemented through Gujarat Maritime Board. This has driven the development of Non-Major Ports. Also since the existing major ports are under tremendous pressure to handle the increasing cargo traffic, causing demurrages and huge loss in foreign exchange, Gujarat set the policy to decongest the overburden on existing major ports on Western India by providing efficient facilities and services and to support the country's domestic and international trade.

Other state lagged behind and still set the government agency the key operator in all the ports. In Karnataka, traffic of Non-Major port is the lowest and also Tamil Nadu's traffic is low well. If CBIC states aim to deal with the increasing cargo volume, they may have to change the entire Non-Major Port scenario.



Source: Basic Port Statistic of India (2012-2013)

Figure 12.13: Non-Major Port per Total in Traffic

Table 12.1: Port Summary

	Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Major Port (mn tons)	237.04	399.55	159.04	193.62
Non-Major Port (mn tons)	110.61	150.93	1251.81	41287.82
Traffic (mn tons)	37.75	100.48	110.85	381.44

Source: Basic Port Statistic of India (2012-2013)

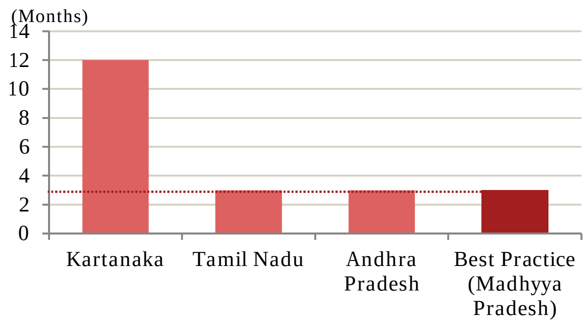
Land acquisition/building approval

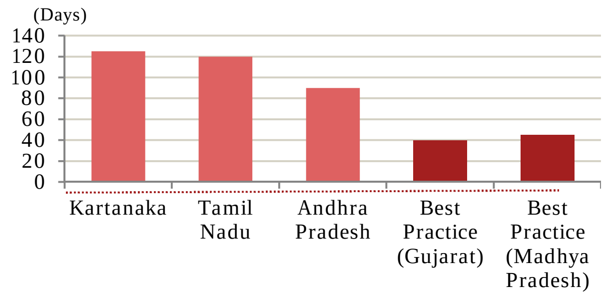
Land acquisition/building approval procedure is compared through two key questions; how much time is taken for the procedure and whether the land acquisition policy is explicitly established. As for the former question, we set three quantitative parameters to compare the maturity of the procedure in CBIC and best practice states; duration of land allocation, land conversion and approval for building plan. For the latter, we examine the policy of each state and highlight the difference

Duration for Land allocation, Land Conversion, and Approval for the building plan

Time required for the allocation of the land for the industry vary depending on the state. In Madhya Pradesh, it only takes 90 days. Andhra Pradesh has promoted computerization & integration of all land records is and shortened the time required for the process to 90 days. The initiative has taken further momentum as part of the Bhu Bharti initiative.

It also takes time to go through the process and obtain approval to convert the land for agriculture to land for industry. Gujarat and Madhya Pradesh, as the best practice states, have made process simpler and reduced the duration to around 40-45 days. Andhra Pradesh also has succeeded in simplifying the process to 90 days under the APIIC's guidance. However, in Karnataka, though land acquisition process is established, the service to ameliorate the land acquisition is still not sufficient, that it takes longer time than other states.

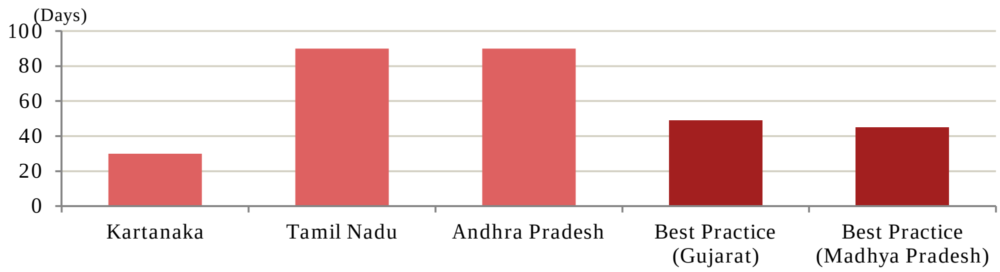




Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP website

Figure 12.14: Duration for Land allocation　　Figure 12.15: Duration for Land conversion

Online approval and tracking system has made the process simpler and reduced the time taken to 34 days in Madhya Pradesh. Karnataka has built CAD based online system which help the builder go through the entire process and shorten the time required to around 30-40 days. However, in Tamil Nadu and Andhra Pradesh, building approval takes longer time than the other states. Although the online system is already functioning, the usability is reported to be sill not sufficient.



Source: DIPP

Figure 12.16: Duration for Approval for the building plan

Land acquisition Policy

All the CBIC state has established the land acquisition policy along with the designated authority, such as KIADB, SIPCOT and APIIC, and provided support to the land acquisition.

However, Gujarat differentiates it from other states by providing more comprehensive support to the land related process; scientific determination of market price through tie –up with academic institution, extensive information on land characteristics from online portal including availability of land, gas, power, distance from port/airport etc, SEZ, Real time land data availability; grievance redressal system of land related issues; and land bank system. Madhya Pradesh also has made continuous approach to simplify the process to reduce the land related legal cases.

In Andhra Pradesh, land bank is available but only information on vacant plots is in public domain and no clear picture on land acquisition status. In addition, it is difficult to acquire land due to new land acquisition act.

Also, in Karnataka, information on the land is not enough for the investor, and the investors need to approach KAIDB to get the information and select the locations out of options KIADB has given. And Existing Land Portal, Kaigarika Bhoomi is not updated regularly, not providing up-to date information. There is not land pool system operating. In Tamil Nadu, land related information is still not easily accessed.

Table 12.2: Land Acquisition Policy

Category	Karnataka	Tamil Nadu	Andhra Pradesh	Best Practice (Gujarat)	Best Practice (Madhya Pradesh)
Authority	• Karnataka Industrial Areas Development board (KIADB)	• SIPCOT	• Andhra Pradesh Industrial Infrastructure Corporation (APIIC)	• Gujarat Industrial Development of Corporation (GIDC)	• MP government takes initiatives
Land acquisition related support	• Land can be obtained by three methods; from KIADB, partial KIADB, and Direct acquisition	• Apply for SIPCOT; Sign an MOU with the TN government	• It assist owner in 4 ways: allotment from existing land banks, industrial parks, government land, and private land	• GIDC provides land banks so that entrepreneurs can acquire land speedy; other support includes, Scientific determination of market price through tie –up with academic institution, extensive information on land characteristics from online portal including availability of land, gas, power, distance from port/airport etc, SEZ, Real time land data availability; Grievance redressal system of land related issues land bank system	• The new policy endorsed in 2014 makes the process clearer to reduce legal case.

Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP web site

Skill Development

According to the feedbacks from private sectors, a lot of enterprises have not been satisfied with the infrastructure of skill development, and requested the re-building of the policies. Skill development can be measured based on three levels; individuals/skilled labors, gender and R&D. With regard to individuals/skilled labors, educational /vocational initiatives and the number of higher education institutions and vocational training infrastructure are counted, and as for gender and enterprises, the policy for gender support and research and development are compared respectively.

Individuals/skilled labors

Each state established the initiatives to proceed with the skill development and institutes with the various curriculums have been developed. In terms of the number of such institutes, it is difficult to compare the status among the states considering the differences in population, land area and the number of students per institute.

In Gujarat, as a best practice, Gujarat skill development mission has driven the skill development through various channels such as establishment of anchor institution, extension of training institution from SEZ and development of short term bridge course through PPP.

Andhra Pradesh initiated Rajiv Yuva Kiranalu to provide skill based training and employment to the youth and private sectors are involved for further trainings. However, skilled labour is still not enough because sector specific training institutions still do not meet some criteria and the curriculum followed by educational institutions does not much the skill level of labour. Additionally, it is prevalent in Karnataka that the skilled labour is not sufficient due to the not-enough quality curriculum. Private sectors in Tamil Nadu stated that the number of vocational facilities is quite high but still need to be developed to meet the demand for skilled labour.

Table 12.3: Initiatives for Skill Development

Karnataka	Tamil Nadu	Andhra Pradesh	Best Practice (Gujarat)
• Karnataka Vocational Training & Skill Development Corporation (KVTSDC) was established.	• GoTN has established the Tamil Nadu Skill Development Mission (TNSDM) as a joint effort between the public sector and the private sector	• Rejiv Yuva Kiranalu is initiated by AP Govt to provide skill based training and employment to the youth • NSDC training partners are established: Britti Prosikshann, Centum WSI etc; the partners have 63 centers in 22 districts with almost 60K students trained	• Gujarat skill development mission has driven the skill development initiatives through various channels.

Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP web site etc

Table 12.4: The number of Higher Educational Instituted and Vocational Training Infrastructure

		Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Higher Educational Institution	Polytechnics Engineering	289 187	351 491	263 707	-
	Others	-	Art & Science college: 633	MCA: 644 MBA: 926 Pharmacy: 290	University/College: 489 Private: 605
Vocational Training Infrastructure	ITIs + ITC	1,488	1,747 (Government IT: 62)	775	816
	Others	-	Industrial school: 933	Women: 25 Polytechnic: 251	VTPs: 575 Private: 69

Source: National Skill Development Corporation (NSDC)

Gender Support

All CBIC states have each Industrial Policy for women entrepreneurs. Andhra Pradesh, Tamil Nadu and Gujarat will provide subsidy and skill development programs for women entrepreneurs. Especially, in Tamil Nadu, subject to the related labour laws and the parameters of the Industrial Employment (Standing Orders) Act, 1946 (Central Act 20 of 1946), flexibility in employment conditions including flexible working hours for women and shorter and longer duration of working hours, 24x7 operations (3 shifts), employment of women in the night shifts and flexibility in hiring contract labour will be permitted

Research & Development

Technology is a key element for the increase of competitiveness and acceleration of innovation. All CBIC states encourage enterprises to proceed with Research & Development in Technology with subsidy and fund. However, Gujarat, as a best practice, not only provides financial support but also facilitate to set up R & D institution and promote co-work with universities.

Table 12.5: Policy for Research & Development

Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Karnataka is one of the top five states in India in the area of R&D spending Minimum Two R&D centres per annum will be promoted and Technology Development Fund of '100.00 crore will be provided to assist for MSMEs.	The government encourages development of "Centres of Excellence and Innovation", which network with Angel Investors and Venture Capitalists to provide mentoring and financial support to start-ups. For capital goods to be used in setting up hi-technology R&D centres, VAT would be zero rated.	Andhra Pradesh has more than 50 prestigious and central and state R&D laboratories · Cellular and Molecular Biology · Centre for DNA Fingerprinting and Diagnostics · -Indian Institute of Chemical Technology -National institute for Nutrition · International Crops Research institute for the Semi-Arid-Tropics (ICRISAT) · National Geophysical Research Institute (NGRI). - The necessary budget for Technology Development Fund has been provided.	Incubation Centres associated with Universities and Management Institutions will be promoted to encourage research/inventions in to industrial project.

Source: Industrial Policy in each state

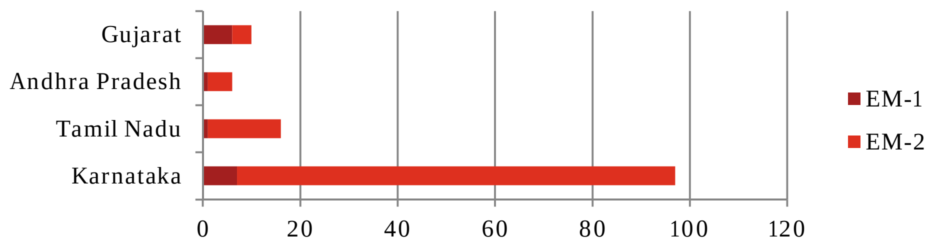
Business Process

In India, business process has been reputed as complicated and taking a considerable time in some states. With the state government effort, there has been significant improvement in the business process of CBIC states. However, some of the foreign companies still require the improvement to ameliorate the process and ease the investment. In a best practice, application of Single Window mechanism serves for attracting the investors. Registration process and single window mechanism are compared with best practice.

Registration Process

This point deals with the time and effectiveness of process for Entrepreneur's Memorandum (EM). Andhra Pradesh and Gujarat takes a short time for the approval. It is noted that Gujarat has an online monitoring system for entrepreneurs to catch up status, and help them take actions if any delay takes place.

On contrary, Karnataka, although it has an online registration and tracking system, still require multiple visits to the concerned departments. It is considered that the system itself is not well developed, that not many of the departments depend on the system to deal with the process. It also still takes time in investment application process of Tamil Nadu because investors have difficulties to know the status due to lack of system integration.



Source: Survey on Business Regulatory Environment for Manufacturing –State Level Assessment

Notes: EM means the initial registration required at central level, when an investor sets up an entity in India.

Figure 12.17: Business Regulatory Compliances for EM Registration

Single Window Mechanism

All CBIC states are utilizing Single Window Mechanism in order to simplify and shorten the process. Gujarat, as a best practice, has succeeded in deploying online system called Investor's facilitation portal (IFP) along with hand-on support to business owners. IFP also provides the various services, information dissemination, facilitating and monitoring investment proposals, and supports business owner to obtain environmental clearance from GPCB.

In CBIC, Andhra Pradesh established the State Investment Promotion Committee (SIPC) as a single window under Single Window Clearance ACT 2002 and SIPC provides information on doing business easily available online. However, some key procedures are not included in the Single Window mechanism like multiple and lengthy approvals, duplication of functions in the departments and licenses duplications. Karnataka may need to improve the application process, that it is reported that even with a window organization, such as KUM, the applicants need to take additional documentation work as well as multiple visits to various departments. In Tamil Nadu, since Single Window for MSMEs does not work well, it prevents from expanding industrial clusters.

Table 12.6: Single Window Mechanism

Category	Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Single Windows	Yes, but still require multiple visit to relevant departments for follow up (Udyog Mitra)	Yes with multiple common applications	Yes (run by SIPC) established under state level approval committee (SLAC) to obtain fast track support to the large investment projects	Yes with investor's facilitation portal Also the fast track support to the large investment projects is provided
Time for approval	-	30 days	45 days	-

Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP web site etc

Industrial park/cluster

Industrial parks as well as clusters have been developed and operated by states' own scheme as a hub of industry. Some states make good practices through the collaboration of public and private sector, but others still have areas to be remedied in terms of operation and policy. Authority, operational scheme, and adoption of Green Practices were analyzed.

Authority

Development of Industrial park/cluster is assisted and implemented by each state government. Gujarat Industrial Development Corporation (GIDC) has promoted entrepreneurs to invest by securing industrial parks/clusters in operation. All CBIC states have an institution like KIADB, SIPCOT and APIIC and provide infrastructure such as roads and street lighting, electricity supply.

Karnataka

- KIADB along with the government of Karnataka has instituted numerous initiatives to provide an impetus for the establishment of industrial clusters in the state
- Various industrial policy has been set to provide incentives, such as new textile policy, mineral policy, grape processing and wine policy etc
- KIADB proveides information on land availability online.

Tamil Nadu

- SIPCOT has been instrumental in promoting the formation of cluster
- identified special industrial estates earmarked for automobile companies
- utilize the single windows system to attract the investment
- provide fiscal incentives such as tax exemptions and reduction
- SIPCOT proveides information on land availability online.

Andhra Pradesh

- APIIC has promoted development of industry and industrial area.
- The government has established "industrial infrastructure up gradation scheme" to enhance the cluster development
- The government promoted the sector specific policy to form the industrial cluster

Gujarat

- Gujarat Industrial Development Corporation (GIDC) was established under the *Gujarat Industrial Development Act of 1962*

Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP web site etc

Figure 12.18: Authority for Industrial Park Development by State

Operational Scheme

In addition to forming industrial clusters and developing infrastructures, operation and maintenance are key factors for investors to achieve sustainable development in the area. In Gujarat, GIDC set 32 A (Act) to determine the process for the maintenance and the Corporation is authorized to levy service charge / development as per respective Act. Gujarat Policy also mentions incentive of 50% of total expenditure limited to Rs.200 million dedicated to development of Core infra Core Infrastructure within the industrial park, also provides for assistance on Common ETP at 40-75% of total project cost

The government of Andhra Pradesh amended its Act and also provides APICC with Local Authority Status on maintenance of industrial parks. Some power under the Andhra Pradesh Panchayat Raj (APPR) Act were transferred to APIIC subject to condition that APIIC shall remit 35%/50% of the Property Tax/Revenues collected to the concerned Local bodies.

On the other hand, Tamil Nadu has an Industrial Policy to encourage maintenance of industrial parks with finance. There are some claims from residents due to the lack of maintenance and insufficient infrastructure. Karnataka has also set the policy but there is no mechanism and no fund for the maintenance and has problems like lack of internal road of industrial area, connectivity to the highways and port connectivity, In Andhra Pradesh, the availability and the condition of utilities and infrastructure in the Industrial Parks/Clusters/Estates or SEZs developed by APIIC is not as good as the infrastructure maintained in the private parks.

Adoption of Green Practices

All CBIC states aim for the sustainable industrial development and have intention to adopt green practices with a policy. Particularly, Gujarat and Karnataka set Zero Discharge policy and intend to install more environmental friendly equipment, system and standards with a wide range of incentives in water consumption, power saving and solid waste management.

Table 12.7: Policy for Green Practices

	Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Green Policy & relevant subsidy	**Yes**	**Yes**	**Yes**	**Yes**
Authority & key activities	Dept. of Commerce and Industries (DCI) will create awareness, educate and engage the industry in reducing environment pollution.	TN will promote integrated solar generation and manufacturing parks which will house the entire ecosystem for solar manufacturing including wafer, cell and module making, and Balance of System(BoS) component manufacturing. Dedicated Effluent Treatment Plants (ETP) and / or Hazardous Waste Treatment Storage and Disposal Facility (HWTSDF) set up by individual manufacturing units would be eligible for an Environment Protection Infrastructure subsidy	AP promotes gas based industry for environment friendly industrial development with greater efficiency and cost effectiveness.	GoG provides a wide range of incentives to encourage all sectors to comply environmental standards. GoG aims at zero discharge from specific industrial sectors over a period of 10 years by getting carbon credit and reducing carbon foot print.

Source: Industrial Policy of each state

12.4.2. Analysis of the South East Asia

Benchmarking with the ASEAN countries is conducted to identify the area of improvement on the above five perspectives. Many foreign companies have made a lot of investments to ASEAN countries due to the attractive business environment in terms of ease of doing business, well developed infrastructure and adequate living standard. Singapore is awarded as the best country in the world from the view point of "Ease of doing business", published by World Bank in 2014. Thailand, Vietnam and Indonesia are ranked as 26th, 78th and 114th、 respectively. Given that India is ranked as 142nd in doing business, the comparisons with those regional competitors are expected to provide insights for the India states to make enhancement of the investment environment.

Infrastructure

Benchmarking is conducted on "Power", "Port" and "Road".

Power

In ASEAN countries, stable power supply is realized by privatization, advanced technologies utilization and high awareness of energy saving with a strong initiative.

Parameter

- Power Generation & Distribution
- Power Capacity and Demand
- Renewable Energy
- Electricity Tariff

Power Generation & Distribution

Power supply and distribution system has/had been developed by the public authority delegated by the government to secure power supply and then privatization of power countries has been directed for stable supply. In Singapore, power supply system was developed by Public Utility Board (PUB) at first, then power generation and distribution were managed by Themasek Holding, a government institution and now most of the power generation is operated by private sectors. In Thailand, Electric Generation Authority of Thailand (EGAT) has promoted privatization, and IPP has been introduced to cover power supply. In addition, EGAT has promoted installing energy efficient appliance and spreading energy saving awareness with finance support.

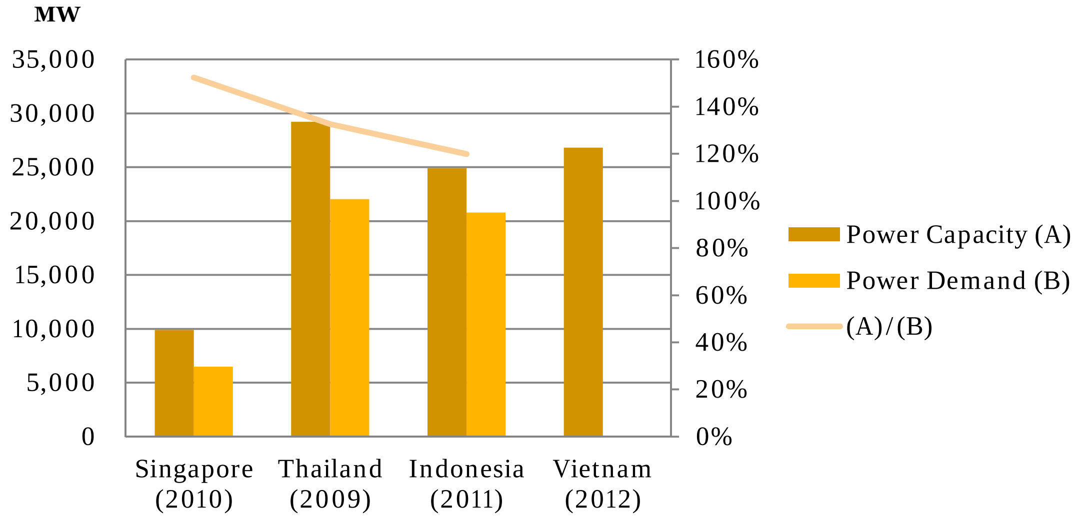
Table 12.8: Power Generation and Distribution

Category	Singapore	Thailand	Indonesia	Vietnam
Public authority	Power Supply System had been developed by Public Utility Board.	Public authority, EGAT has led the liberalization of the electricity biz in tandem with the involvement of the private sector since 1990.	Public authority, Perusahaan Listrik Negara (PLN) has led the liberalization, and gradually opened the biz to the private sectors	VietNam Electricity (EVN) is a public corporation, having an installed electricity generation and a distribution network
Activities for privatization	Tuas Power, Senoko Power and Power Seraya were established under a government institution, Temaseck Holdings in 1995 and privatized from 2008. Power Grid as a distribution company and Power Supply as a sales company were established under Temaseck Holdings in 1995. While Power distribution is solely done by Power Grid, Power sales have been privatized.	Private power supply companies like EGCO and RATCH were established separately from EGAT in 1992 The private IPP business is progressing by establishing their business in Thai Industrial parks and is building their own power supply system.	Electrical transmission business is limited to PLN but power generation business is allowed by IPP Since the power development plans in 2006 was launched, the power supply situation has improved.	Generation and distribution have been partially privatized and IPP and BOT have been introduced. The government have plans to expand the Fire Power Plants and introduce nuclear power generations

Source: JDC, EGAT, JPEC

Power Capacity & Demand

Singapore has an enough capacity to supply power stably against the power demand at the peak. Thailand and Indonesia also provides relatively stable power supply. Especially the gap between demand and supply of Indonesia appears to be small.

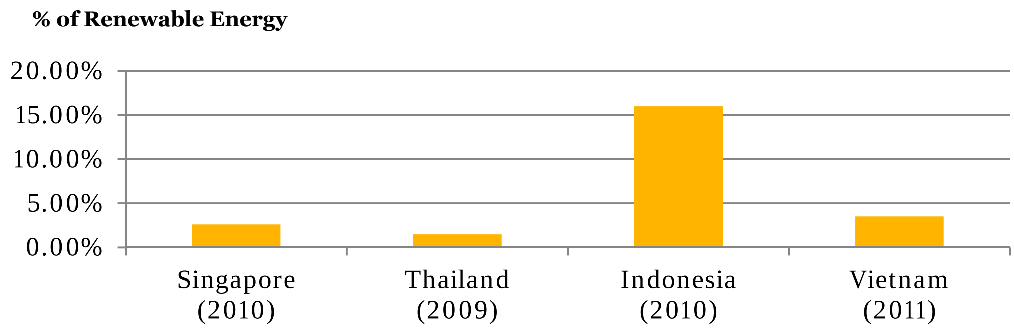


Source: JETRO, EGAT, PLN

Figure 12.19: Power Capacity and Demand (MW)

Renewable Energy

Each country promotes to introduce renewable energy as an alternative, environment friendly energy source. Especially, Indonesia is one of the counties which have the most geothermal resources in the world. Utilizing geothermal and water resources, Indonesia has a plan to expand the capacity of such power plants. Singapore promotes a sustainable development; positions business of clean energy like solar as a strategic and growing field and expect 7,000 job-creations and SGD 1.7 billion GDP by 2015.

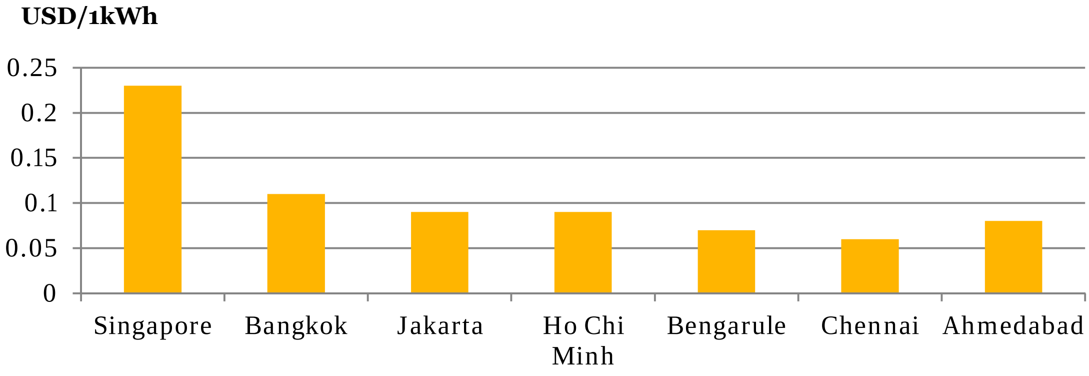


Source: JETRO, JBIC

Figure 12.20: Ratio of renewable energy

Electricity Tariff

Electricity tariff in Singapore is substantially higher than other ASEAN countries and all the CBIC states. The high cost may be an obstacle for foreign investors to start business with intensive energy use in Singapore. On the contrary, India keeps the lower level than other competitors.



Source: JETRO (2013)

Figure 12.21: Electricity Tariff

Port

It is crucial that ports have been developed and operated by the authority with a strong initiative. Each country has the authority and has been operated the ports smoothly.

Parameter

- Port Authority
- Traffic of Cargo Container
-

<u>Port Authority</u>

Singapore is located in the heart of Southeast Asia and connected six hundred ports in one hundred twenty countries with daily sailing to every major port of call in the world. Ports in Singapore have been expanded through the training of petroleum with Middle-East Countries and chemical, commodities and electronics among Asian countries. Port of Singapore Authority (PSA) has enormously contributed the establishment of the hub port dealing with the trade all over the world for its competitiveness and implemented various activities such as operation and maintenance, water & raw materials supply, collection of garbage and delivery. In Thailand and Vietnam, subject to the act, port development and operation has been directed.

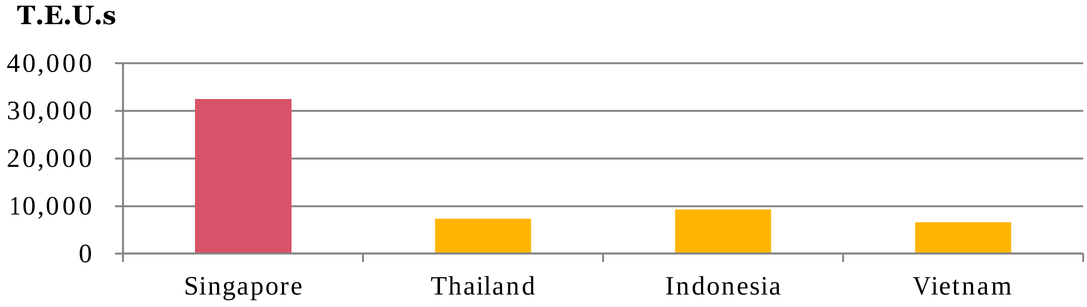
Table 12.9: Port Authority

	Singapore	Thailand	Indonesia	Vietnam
Authority/Association	Port of Singapore Authority (PSA) was established under the Ministry of Communication in 1964 and has developed port and related facilities	The Port Authority of Thailand (PAT) was established under the Port Authority Act B.E. 2494 (1951) as an autonomous body under the general supervision of the Ministry of Transport and Communications.	PT. Pelabuhan Indonesia (PELINDO) I-IV, which are national port companies, manages and operated ports and related facilities.	Vietnam Seaport Association (VPA) has 40 members ports with annual cargo throughput accounting for more than 80%
Key activities	PSA International has been voted "Best Global Container Terminal Operating Company" for eight years since 2005 at the Asian Freight & Supply Chain Awards.	On 29 November 2000, the amendment of Port Authority of Thailand Act 1951 was made and announced in the Government Gazette to enable to PAT to be registered as the Limited Company or Public Company to engage in other businesses within the scope of PAT's objectives and to join with other persons or shareholders in the limited.	Port development and operation were partially privatized in accordance with an agreement with IMF.	Master Plan for Vietnam Seaport system till 2020 was approved in 1999 by the Prime Minister. According to regions, Vietnam seaport system is divided into 6 groups.

Source: PSA, PAT, JBIC, Vietnam Maritime Administration, VPA

Traffic of Cargo Container

Singapore was the 2nd largest in cargo container trans-shipments all over the world in 2013 and has been awarded for the best effective operation since 2005 at the Asian Freight & Supply Chain Awards. The utilization of container trans-shipments reaches 80% in Singapore.



Source: World Bank (2012)

Figure 12.22: Traffic of Cargo Container (T.E.U.s)

Road

Authorized and focused institutions develop roads and related facilities and achieved high ratio of surfaced road.

Parameter

- Authority of Road Development
- Surfaced Road

Authority of Road Development

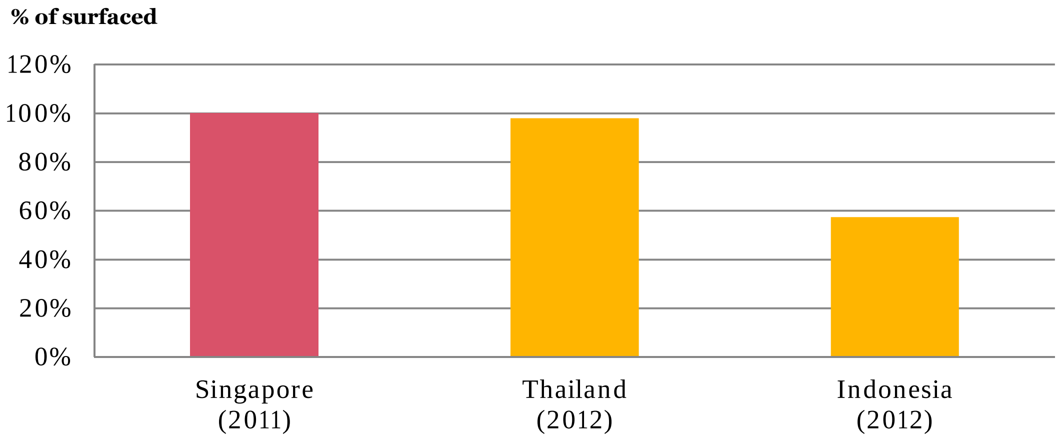
In Singapore, Land Transport Authority (LTA) has not only developed the structured roads but also committed to ensure the safety of motorists and commuters. In Thailand also, under the Ministry of Transport (MOT), the government administrations such as Department of Highway, Department of Rural Roads and state enterprises have developed road and carried out maintenance.

Table 12.10: Authority to develop roads

Singapore	Thailand	Indonesia	Vietnam
Land Transport Authority (LTA) manages and operates all of the land transportation like metro, road and vehicles. LTA is committed to ensuring the safety and security of motorists and commuters, for example, installation of some device and technology/system.	Under the Ministry of Transport (MOT), the government administrations like Department of Highway and Department of rural roads and the state enterprises have developed road and carried out maintenance. . "Asia Highway", which is connected to neighbor countries, is over 5,000km and has 2 traffic lines (Limited highway: 67,000km)	PT/Marge (PEERSERO), which is a national company, develops and operates highways Private sectors are allowed to enter other roads business. - Total Length : 470,000km	Ministry of Transport has developed the roads and expressways through the recent reorganization of the sectors with the creation of the Directorate for Roads of Vietnam (DRVN) and other administrations.

Source: LTA, MOT, JBIC, ADB

Singapore has achieved 100% of surfaced road and Thailand also has developed the roads over 98%. However, Indonesia has a room to improve this situation.



Source: World Bank, JBIC

Figure 12.23: Ratio of surfaced road

Land Acquisition/building approval

In Southeast Asia, acquisition of lands for industrial use is smoother than that in India with authority based on the coherent and transparent policy with sufficient supports.

Parameter

- Policy
- Support System

Policy

For industrial use, Industrial Estate Authority of Thailand (IEAT) leads the land acquisition with the strong power delegation and transfers the lands to foreign investors. According to Constitution, fair compensation shall be paid to all rights holders affected by the land acquisition. Since land space is limited in Singapore, the government agencies control land system in order to optimize the land use and increase land productivity for its competitiveness.

Table 12.11: Land Acquisition Policy

	Singapore	Thailand	Indonesia	Vietnam
Authority	URD (reorganized into Urban Redevelopment Agency (URA) under the Ministry of National Development)	Industrial Estate Authority of Thailand (IEAT)	- (The government can acquire)	- (The government can expropriate land with important national projects)

	Singapore	Thailand	Indonesia	Vietnam
Features in Policy	URD was 41,000 ha (58% of Singapore land) is a government owned land, which are managed by SLA, HDB, JTC and URA.	IEAT can transfer the expropriated land to operators specified by IEAT as for business purposes related to industrial park development. Foreign companies can own the land with the approval from IEAT's approvals A JV with more than 50% funded by Thai investors can purchase lands except for ones in industrial parks.	The price of compensation is decided by an independent investigation team approved by the Department of National Land. Tenant companies purchase through industrial park business lots with Rights to Build according to Basic Agrarian Law (1960). .	The government can expropriate land with important national projects under new Constitution and the Land Law 2004. Foreign companies and foreign parties with partnership agreements shall not hold the ownership of land in accordance with the Land Law (2003).

Source: JDI, JETRO, JBIC, JTC, IEAT,

Support System

In order to proceed with the land acquisition smoothly, support systems have been established. In Thailand, according to the provisions of the Constitution, the government sets up a process of public hearings with land owners affected by projects and discloses information before the process of land acquisition. Also, IEAT specifies clearly the application procedure online and provides the following information as "One-stop service center" regarding industrial parks/clusters.

- The latest situation in the industrial park
- The locations
- The number of factories
- Project progress reports

In Indonesia, a process of land acquisition is defined in 2012 No. 71 Presidential Decree as an administrative instruction of 2012 No. 2 Land Acquisition ACT (enforced in January 2012). The Investment Coordinating Board (BKPM), which executes all by applying "On-door integrated service", can go through the procedures for acquisition of land rights, although the actual implementation is still a challenge.

Skill Development

As one of the best practices in ASEAN countries, special curriculum is built in partnership with high academic institution as well as the private sectors who potentially hire those labors.

Parameter

- Policy
- Skill Development Infrastructure

Policy

Each country has a policy/plan to direct skill development in order to raise the competitiveness of industry. In Singapore, the Ministry of Trade and Industry launched Strategic Economic Plan in order to enhance skill development and the Ministry of Manpower and its below institute, Workforce Development Agency (WDA) established Skill Development Fund (SDF) for skill training and education. Additionally, Singapore, through Human Capital Leadership Institute, develops human resources for not only domestic purpose but also regional one.

Table 12.12: Skill Development Policy

Singapore	Thailand	Indonesia
Skill Development has been enhanced under the Ministry of Trade and Industry. Work force Development Agency (WDA) established under Ministry of Manpower (MOM) is responsible for implementation of training from basic to technical skills and established Skills Development Fund (SDF). Human Capital Leadership Institute established under Ministry of Manpower (MOM) in 2010 has collaborated with universities and make a strong effort to develop human resources	IEAT establishes the human resource development centers in IEAT industrial parks to enhance the workers' skills.	(No specific authority identified for the skill development) The Gross Enrolment Rate of university education increases from 18% in 2009 to 25% in 2014, according to the national Medium-Term Development Plan (RPJMN) 2010-2014, However, no industrial park provides a human resource development program.

Source: JDI, EDB, OVTA

<u>Skill Development Infrastructure</u>

Skill Development Infrastructure such as Institute of Technological Education (ITE) and training centers plays an important role for skill development. Singapore Government has made a lot of investments for training and education by ITE. ITE is a principal provider as a skill training institute and has three colleges. In Thailand and Vietnam, training centers and educational schools were established in Industrial Parks and collaboration with higher educational institutes and private sectors are directed.

Table 12.13: Skill Development Infrastructure

Singapore	Thailand	Vietnam
The Institute of Technical Education (ITE), Singapore, was established as a post-secondary education institution in 1992 under the Ministry of Education (MOE). - ITE is a principal provider of career and technical education and key developer of national occupational skills certification and standards to enhance Singapore's workforce competitiveness. **Under its "One ITE System, Three Colleges" Model of Education and Governance, ITE has three Colleges, comprising ITE College Central, ITE College East and ITE College West. WDA established fund for kill development.**	**The following human resource development centers were established.** - Training centers of the Automobile Association and the Institute of Electrical and Electronics in Bangpoo industrial estate - Ayutthaya High-tech industrial park (Banker industrial Estate) - Training center (Thai-German Institute) in Amata Nakorn Industrial Estate - Swinburne School of Engineering in Laem Chabang industrial estate (This school has provided a special curriculum for workers in the industrial park.) - IEAT cooperate with NIDA (National Institute of Development Administration) and is planning human resource development in environmental control at each industrial park and is set to establish a master's course in environmental engineering.	**A private industrial park called VSIP established Vietnam/Singapore technical training school in the adjoining land to VSIP. It provides 4 courses, Electrical Equipment, Mechanical Maintenance, Electronic Engineering and Mechanical Engineering since 1998.** - In 2011, a Japan/Vietnam technical training school was established as a JV of a Japanese Consultation Company in Ho Chi Ming and a Vietnamese local building materials manufacturing company.

Business Process

One of key factors of Business Process is that the authorities delegated some module of works in a transparent manner to cover multiple modules such as permission/approval of applications, of which authorities belong to Ministries, consulting the investment of the owners, e-service infrastructure building, provision of information etc.

The detailed comparison of ASEAN countries and CBIC states on the business process in terms of cost and time are described in the annexures; but the time boundary is regulated by the institutes and laws in ASEAN countries.

<u>Parameter</u>

- Single Window Mechanism

<u>Single Window Mechanism</u>

Single Window Mechanism is a key factor for foreign investors to proceed with administration procedures smoothly. In Singapore, Enterprise One Portal offers a single point of access to a wide range of comprehensive information on government assistance with a call center and was awarded as Enterprise Challenge (TEC) Public Service Innovation (2006). Economic Development Board (EDB) also supports to invite manufacturing companies to Singapore.
In Thailand, Industrial Estate Authority of Thailand (IEAT) has been delegated the authority not only for receipt of applications but also for permissions, of which belongs to some Ministries. Moreover, IEAT established Information Center and Consultation Center and provides E-service; application form and tracking system. While Investment Coordinating Board (BKPM) in Indonesia also provides the similar services to foreign investors with Thailand, the Investment review committee in Vietnam can accept the application paper work but only deliver it to the right point.

Table 12.14: Single Window Mechanism

Category	Singapore	Thailand	Indonesia	Vietnam
Single window mechanism	**Yes** Enterprise One Portal, which is managed by Singapore Spring under the Ministry of Trade and Industry Also, the Economic Development Board (EDB) was established under Ministry of Trade and Industry (MTI) for the purpose of technical support service to manufacturing companies.	**Yes** IEAT has been delegated the authority for permission in accordance with Industrial Estate Act, Article 42/1979	**Yes** The Investment Coordinating Board (BKPM) was established in 1973 directly under the President and executes all at once by applying "One-door integrated service"	**Yes** **The investment review committee for each industrial park is established by the prime minister of Vietnam in order to smooth administrative procedure for foreign companies.**
Key functions	**(Not specified)**	· Information Center one-stop service center · Benefit, Permission, Approval center one-stop service center · Permission /Approval center for industrial park developers · Consulting about the investment and simplifying and smoothing procedures · E-Service	• Easing the conditions for permissions/approvals • Simplifying the procedure • Shortening the duration • Indicating and reducing the fees	· Providing the proper guidance to the companies in the industrial parks · Accepting investment application paper work and delivering to the proper organization · Permitting and approving the investment up to US$ 40 million regarding export, /import, building permission or granting VISAs.

Source: JDI, Enterprise One Portal, Trade Net, BOI, IEAT, BKPM

Industrial Park/cluster

In the best practice among ASEAN countries, guidance on the industrial park/cluster and Corporate Governance are well developed and detailed to operate industrial park/cluster efficiently and ease the actual implementation. With R&D investment, innovations for competitiveness are realized in terms of Environment and Technology.

Parameter

- Institutes for Development of Industrial Park
- Maintenance of Industrial Park

<u>Institutes for Development of Industrial Park</u>

JTC Corporation in Singapore has well developed corporate governance system in order to operate industrial parks smoothly and focuses on three aspects: deepening the cluster knowledge and capabilities; increasing land productivity; and expanding its innovation capacity.

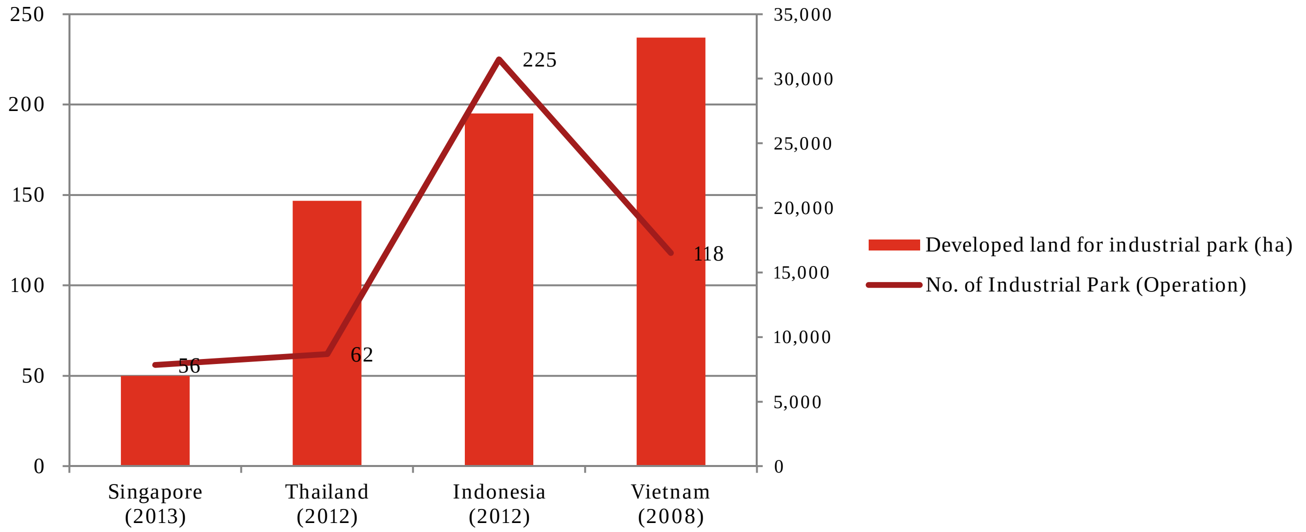
In Thailand, BOI and IEAT established the detail guideline on the procedures.

Table 12.15: Institutes for development of Industrial Park

Singapore	Thailand	Indonesia	Vietnam
JTC Corporation has managed and operated Industrial parks and provided information on Industrial Parks to investors.	IEAT regulate and guide the industrial park development	The President or BKPM makes an investment approval and then Ministry of Commerce and Industry issue a principle license.	(Not specified) Based on Law on Investment, Industrial Park Development has been carried out.

Source: JDI, JTC Corporation, BOI, IEAT, BKPM

The following chart indicates the number of Industrial Parks under operation and area of the developed land for industrial park in Singapore, Thailand, Indonesia and Vietnam.



Source: JDI, ASEAN-JAPAN Center

Figure 12.24: The No. and area of Industrial Park

<u>Maintenance of Industrial Park</u>

With respect to operation and maintenance of industrial parks, detailed guidelines and powerful leadership are essential for its competitiveness and sustainable development.

JTC Corporation is looking at developing innovative infrastructure solutions that not only optimize land use and address the challenges of environmental sustainability, but also provide a unique competitive advantage for industries in Singapore with sophisticated and green technologies. In Thailand, IEAT committee takes responsibilities to carried out maintenance and operation with detailed guidelines.

Table 12.16: Maintenance Policy for Industrial Park

Singapore	Thailand	Indonesia	Vietnam
JTC Corporation maintains infrastructure within Industrial Parks with clear guidelines.	**The IEAT committee makes decisions about important matters such as infrastructure development.**	**Ministry of Commerce and Industry conducts coordination, such as linked infrastructure with industrial park development including a technological standard of infrastructure like roads, water dispose works and power supply.**	**Ministry of Planning/Investment and Vietnam Board of Management of the IZ are given authority by the Prime Minister and deal with the problems related to Industrial Park Development including linked infrastructure.**

Source: JDI, JTC Corporation

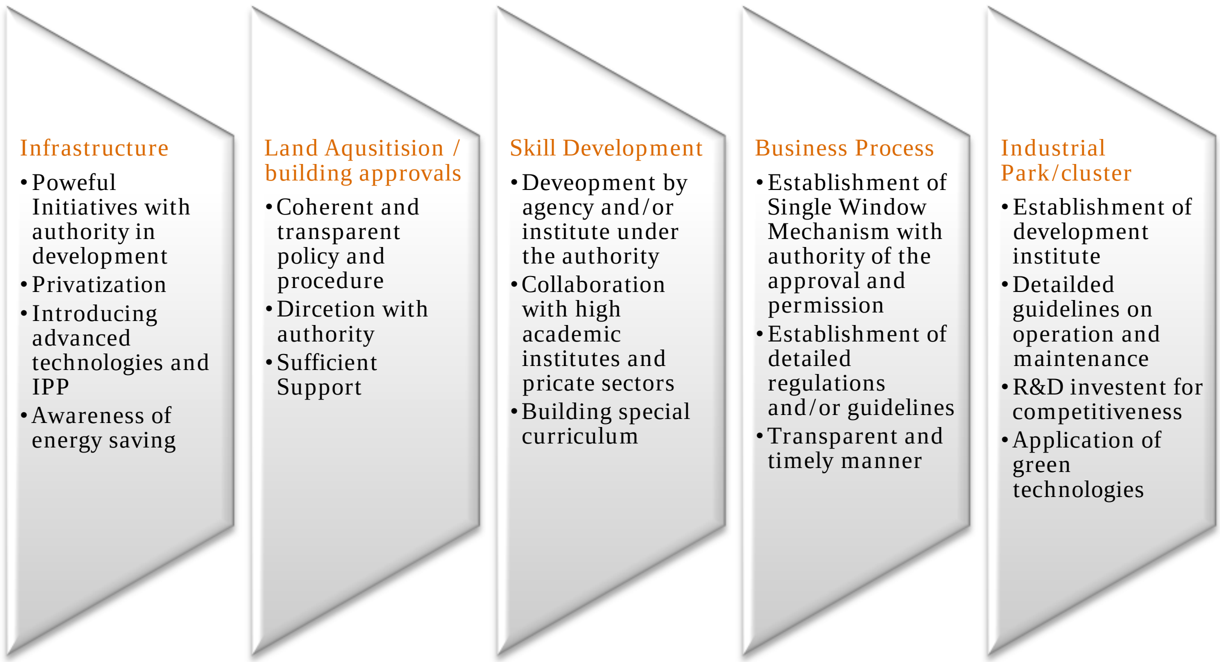


Figure 12.25: Summary of Key Implication

12.4.3. Feedback from the foreign private sector

Foreign companies provide feedbacks on the key hindrance for their further investment in India based on the 5 perspectives in this chapter. They, however, also provide additional feedbacks on the investment environment; some of the feedbacks are surely relevant to the enhancement of the investment environment, but require drastic changes for the state policy. Others are ones that relate to the cross states approaches, not limited to each CBIC state activity.

Feedback for all the states

1. Low 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.

Especially in many of the India infrastructure projects, the project structures are divided into small pieces for bidding and fall into price competition; as the result, the project size tends to be less flexible and less profitable,, making the foreign companies hesitate to bring in investment

Also another concern related to the profitability is the price ceiling set by the authority; the price for the utility is set at not high enough to recover costs, coercing the business entity to run red, then making it hard to expand the business or even continue business. Many of the energy related companies request the flexible price program at least for the initial phase, but currently such options are not admitted in any state.

2. Business uncertainty

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.

Also, the unexpected change in the India's political landscape adds further uncertainty in the business environment. India is characterized by the drastic change in the industry policy depending on the political party. The change in the ruling party, thus, often causes the funding or subsidy committed by the previous party ineffective, and makes the private sector's project plan meaningless which heavily depends on the funding. With the risk, it appears too risk for the foreign companies to invest in significant size even with the support from the current political party.

3. Feeble infrastructure for Tier 2 players

Tier 1 enterprises are often treated with sufficient infrastructure support from the central or state government in terms of power, water, transportation etc. On the other hand, Tier 2,3 parts supplier who actually provide critical elements of the products, are not provided with minimum level of the supports. It is reported that the one of the Tier 2 suppliers suffer from 7 hours blackout per day; this may hinder them from operating in India, making critical impact on the Tier 1 player.

4. Weak foundation for Intellectual property

Intellectual property rights (IPR) are crucial for foreign companies to fully operate in India from R&D. Many foreign companies complained the lack of the IPR regulatory framework in India, including slow registration process, complicated application and approval steps, and the lack of transparency in the standard for screening.

India Government, mainly led by CGPDTM under DIPP, has made progress in many areas, such as digitization of the IPR related process and data, standardization of the application processes across the states, and increase in the number of staff to ameliorate the process. The Modi government also plans to establish clear IPR policy based on the regulatory framework in 2015 to enhance the momentum of IPR, and also plan to expand the staff in the Patent office in order to speed up the pending application clearance. With those efforts, the number of the intellectual property applied by the foreign companies has increased sharply in many industries, especially in automobile and telecommunications.

However, in spite of those measures, many foreign companies still have addressed their concern over the IPR policy in India and showed their intention to conduct R&D investment outside the India. In order to attract further investment into India, especially the investment which contribute to enhancement of manufacturing industry, the current approaches need to be driven forward.

5. Unstandardized business process

Business processes are very complicated and require a significant amount of man hour to comprehend even in one state. However, the issue is that all the states have different styles in the business registration / application / approval / clearance process in India and require the companies to re-learn the entire process if they intend to expand their business. It causes big time loss and a significant investment, that it has now become major hindrance for the foreign companies.

6. Burdensome tax system

CBIC is characterized by the high tax rate, but the another burden on the private sector is CST which occur for the cross state business. Currently, when the products or parts for the final products go across the state boarder, it requires the CST on each transaction. This increases the amount of cost for the products, and decreases the price competitiveness. Given the tough competition faced by the foreign companies against the local companies in light of the price, it is critical to reduce the CST.

Also, another issue related to the tax is the frequent change in the tax policy. It is reported that the tax system has changed randomly due to the political party change or natural disasters. Although some states provide tax incentives for the investment support, those uncertainty offset them, or even make the situation worse. Many of the private sectors prioritize the stability in the tax system; the unexpected change in the tax system has often caused the anxiety in the private sector, then deterring them from further investment"

12.5. Recommendations to improve investment environment

12.5.1. Recommendation for Tamil Nadu

The above analysis shows that the each CBIC state has both of strength and weakness in the investment environment and has conducted various approaches to enhance it. Although the analysis shows that there is some commonality in their approaches, such as single window approach to ameliorate the business process or State-led policy to improve the industrial parks, but the details in their approach differ depending on the each state status.

However, it is also obvious that in comparison with the best practice states, all the CBIC state still have big room to improve. In this section, we summarize the basic recommendation for Tamil Nadu to improve the investment environment based on the five perspectives we employed in the analysis.

Tamil Nadu

Tamil Nadu has enhanced the investment environments through various approaches, and shows strength among the CBIC states especially in the port capacity & road quality, last-mile connectivity to ports, business process and industrial parks. However, the node would be safer position as it in close proximity to the ports.The state still has much room for improvement in comparison with the best practice, especially in power supply and skill development. We highlight the needs for the authority to establish co-work relationship with the private sector to improve those areas.

Recommendation for Tamil Nadu

Table 12.17: Recommendation for Tamil Nadu

Perspectives	Detail of the Recommendations
Infrastructure	• Set PMU to Collaborate with relevant State Governments and Central Government and solve issues which hinder the project implementation. • Discuss funding scheme with JICA or any other possible funding agency in consultation with the Central Government/CBIC Committee.
Land Acquisition/Building approval	• Drive SIPCOT to improve the land banks and enhance the allotment process. • TN Guidance Bureau is the first point of contact for land identification • Timely update of land allotment, land use, location, market process, etc. for providing the information for investors to understand the industry allotments and availability.
Skill Development	**2) Implement actions under Tamil Nadu Vision 2023.** • Aimed at skilling 2o Million persons over the next 11 years. • Establishing best in class institutions as centers of Excellence in various fields • Allocated specific funds for education and skill development program for the coming years **2) Formulate State Policy to Set up knowledge Park inside the Node** • Incentive industries to participate in the Training and Placement of workforce • provide Indigenous support facilities such as Equipment Testing, Quality Control to promote innovative product development
Business Process	• To develop and include tracking system, helpline, information such as contact details of nodal officers, incentive schemes available, • To appoint dedicated person for each investor to support project clearances and coordinate with line of departments • Create or upgrade of single-window agency to become a one point contact for all approvals till final approval. • **Country specific investment facilation desk in industries department or in proposed PMU.**
Industrial park/Cluster	• Establish the standard to ensure the quality of infrastructure provided (water, power, waste management etc.) • Formulate the operational guideline on priority basis to encourage establishment of Industrial Parks by private investors , taking Vision 2023 envision as target and establish the support mechanism inside the Industries Department.

12.6. Policy Recommendation on Improvement of Soft Issues

As indicated in the previous chapters, despite the significant potential of the region, investors and industry players show concerns on current and future investment environment. There are various actions which are recommended by investors and industry players in order to make CBIC as a preferred destination of their investment. They can be categorized into two types due to the level of the issues and commonalities of the actions: actions need to be taken by state government, and actions need to be taken by the central government (or CBIC unit positioned at the central level). This section summarizes the latter. It is recommended to set up a necessary program to consider the detail action plans on soft issues in the next phase.

12.6.1. Improvement of Investment Environment

Policy support

To Provide mid- long term policy guidance for private sector

Many of the private sectors suffer from the unexpected change in the policy from the government. Especially when the leading party changes where the company invested, the incentive programme or subsidy committed by the previous authority can be altered or even cancelled, that it affects the business feasibility of the private sector. Such anxiety has become hurdle for the company to make investment on their own risk.

It is strongly recommended that the central government be involved in the discussion on the key policy that affects the private sector's business decision, and provide a certain level of necessary commitment from the central government to keep the promise to the private sector and to promote private investments and FDI even if the political party changes take place at the state level. Such commitment is expected to provide confidence to the private sector, and is to encourage them to conduct a large scale investment from their own budget.

Implementing Agency: DIPP, MOF, Ministries in charge of each sector

To Establish infrastructure to support IPR

The number of the patent application has increased rapidly over the 10 years, and the number of those received by the authority has reached over 40,000, four times more than that of 10 years back. The number has already reached the 8th largest in the world, following Germany and Russia, and is expected to increase more.

However, despite such sharp increase in the interest, many investors and industry players show their strong concern over the insufficient understanding of the patent system in India. Some of the reason is attributed to the lack of knowledge from investor sides, but some parts are argued that the government needs to take proactive actions if the Government of India requests manufacturing industry to shift from other countries in India, which are considered most patent related industry.

To that end, the central government is expected to take three activities to establish the solid foundation for intellectual property: i) to conduct seminars for private sectors to enhance awareness on Patent law and application process/requirement in India and to encourage IPR registration; ii) to conduct workshops for Government IPR officials to familiarize with the concepts; and iii) to play a role of PMU to appoint a point of contact person in charge of any IPR related matter including litigations, who can coordinate with relevant Government IPR officials when required. The IPR is a very complicated area from the foreign companies' point of view, those types of knowledge sharing approach are strongly in need.

Implementing Agency: DIPP

To Set up appropriate standards on technical and environmental aspects

Along with the increasing volume of the foreign investment and the expanding number of foreign residents, the sustainability has become one of the key issues. Especially foreign companies, who already have their footholds in the India, strongly request further approaches to be taken by central government on technical and environmental standards in order to enhance environmental friendly, sustainable development, and eventually improve the living and working conditions.

It is, however, noted that such standards will increase the cost for the installation and establishment of facilities, especially the cost of technologies utilized. Given the many of the state government suffer from the budget deficit and cost oriented decision making tends to be made, the overall direction needs to be made by the central government, and needs to start from pilot cases and to be evangelized across the country.

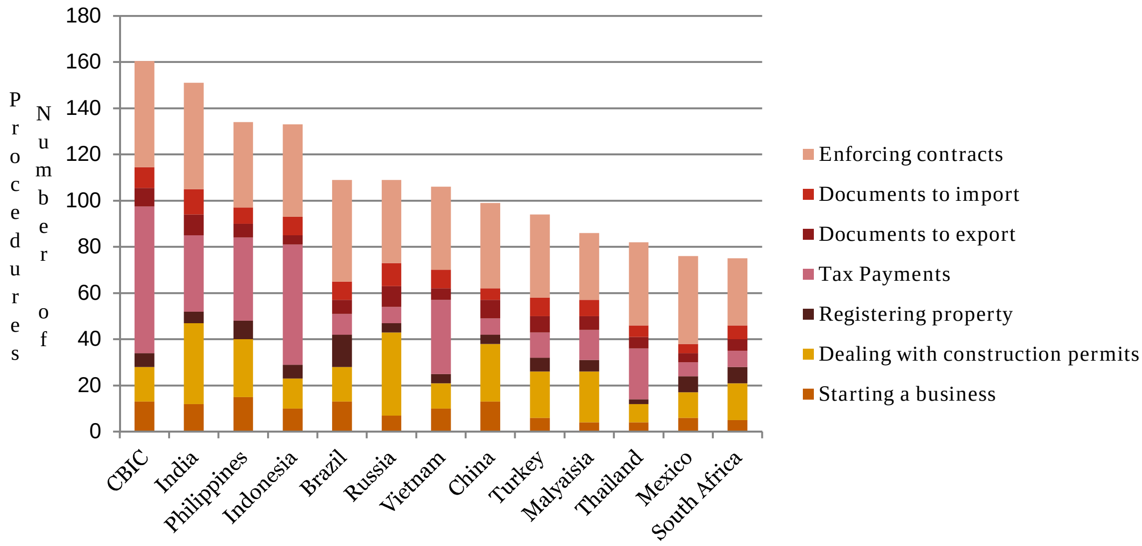
The recommendation for the central government, thus, is three steps: i) to develop the framework/guidelines for development of industrial parks with safety and environmental standards; ii) to test the above standards in specific industrial parks with governmental initiative and adjust the framework/guidelines based on the feedback; and iii) to hold a round table discussion with State's representatives on a regular basis to share successful models and the experiences

Implementing Agency: DIPP

To Reduce, Simplify and Clarify Procedures on Approval and Authorization

In order to develop CBIC to a world class investment destination, the Government of India and the related State Governments are recommended to reduce, simplify and clarify the procedures for approval and authorization.

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



Source: World Bank

Figure 12.26: Number of procedures

The comparison of necessary periods of major administrative procedures in CBIC and 12 countries are shown in the table below. The Best Practice and Average show the most competitive practice and the average, respectively, among 12 countries. It is recommended for CBIC Region to set the target period at least at the level of the average in order to enhance the global competitiveness.

Table 12.18: Period of Procedures in CBIC Region

Name of Procedures	Period of Procedures in CBIC Region	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 interview survey for the investors in CBIC also highlighted the perception on above mentioned status. The land acquisition, import/export procedures, and environmental assessment are the most frequently identified areas where bottlenecks of soft-infrastructure exist. The challenges are summarized below.

Table 12.19: Key Bottlenecks in Administrative Issue in CBIC Region

Key Issues	Bottlenecks
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.
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 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.
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.

The central government can improve the situation in four ways: i) the central government coordinate the technical consultant to establish IT base solution to enable single window process and simplified procedure, which include in the area of import/export operation at ports/airports, environment approvals etc., and enhance the usability of the system; ii) along with the digitization, it can also increase the information itself accessible to the public, which is expected to enlighten the citizen and the private sector, and encourage them to proactively take action in driving the business; iii) to assign PMU to monitor the business process status regularly and evaluate based on the feedback from the field, so that the central government can provide incentives to each government to stimulate the competition, and promote the improvement of the entire states; and iv) to show strong commitment to lead the initiatives on debottlenecking, such as land acquisitions of strategic industrial parks etc.

Implementing Agency: DIPP, Ministries in charge of each sector

To Set Competitive Tax Rate

As has been identified by investors for a long time, the tax burden for foreign investors in CBIC region is more than the other rival countries and regions. The higher tax rates critically deteriorate the attractiveness of CBIC as an investment destination.

Comparison of major tax rates in CBIC and other rival countries are shown below. The Best Rate and Average Rate show the most competitive practice and the average, respectively, among 12 countries. It is considered to be necessary for CBIC Region to achieve at least the average tax rates in order to be a globally competitive investment destination which is chosen and preferred by major global investors.

Table 12.20: 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 central government can improve the situation by reviewing the optimal tax system considering the competitiveness of the CBIC region as a destination of investments.

Implementing Agency: DIPP, MOF

Business profitability

To Enable private participation in Node Development

Some of the foreign companies, especially the infrastructure related service provider, argue that it is difficult for them to establish the sustainable business model in India without the government subsidy or incentives to cover uncontrollable risks by the private sectors, such as tariff, demand etc. This means that given the government support tends to be time limited, many of the projects are not likely to be profitable for the private sectors in the long term, which make them hesitate to investment in the first place.

One of the key reasons why the above mentioned issue has often been observed is that many companies tend to be receptive to the government tender, and not be able to take part in from the planning phase. In other words, they argue that they cannot build their positions as business partner to the government, rather stay as simple vendors to individual projects. As long as such sentiment is shared and hard to be taken away in some of the key private sectors, the win-win relation between India and Japan cannot be sustainable.

One solution for the central government to take is to establish a foundation for collaboration between India and Japan from upstream phase; that is, the central government can build framework for private sectors to be involved in the development planning phase in the node, and to actively build the new business model in tight collaboration with the government. The business model can be built with integration of the various sectors businesses such as real state, power, railway etc., or in collaboration with the international financial organization.

Implementing Agency: DIPP, Ministries in charge of each sector

To Enable the infrastructure service provider to sustain the user charge based business

As described in the previous section, to build the profitable business model is difficult for some of the private sector; especially for the infrastructure related service provider, establishment of the user charge based business is crucial, but at the same time, hard to establish in India. This makes it hard for them to collect the initial investment cost, and also re-invest to maintain the business in the long term.

To support the private sector, the central government may provide guarantee funding to sustain the business at least till the private sector to collect the initial investment cost. Also, it can support the private sector to establish PPP model through assisting the operation in the initial phase. To make the user charge based business more efficiently, the government can also invest into the smart meter as common asset and deploy across the CBIC area for all the relevant service providers.

Implementing Agency: DIPP, Ministries in charge of each sector

Cross state business enhancement

To Establish interstate infrastructure

Issues that block the smooth interstate business, such as CST, stamp duty, interstate transportation system etc., have been addressed by the central government and dealt with by some approaches. Nevertheless, many of the companies still show their frustration regarding those issues by highlighting the slow progress in the remedial approaches and the insufficient information provided from the government on the progress.

To address this, it is crucial for central government to share the status of each project through online channel, and set PMU at the central level to monitor and coordinate the stakeholder to make sure the progress to be made along with the planned timeline.

Implementing Agency: Ministries in charge of each sector

To launch reform initiatives in regulation

The difference of regulation, business process, and business related law etc. are inevitable, but they are often the key blocker for the private sector to expand the business across the state. Many of the companies contend that a certain standard or unification of the process would help the smooth business operation, and would provide incentive for them to expand the business. Especially if the CBIC is addressed as the cross state industrial corridor, such support would enhance the attractiveness of the region to the investors.

The central government can provide support to them by firstly organizing the discussion committee to identify and share the key issues in current regulation/laws (especially Labour laws, environment related regulation); and then it can encourage the state governments to hold round table discussion with representatives on regular basis to share successful models and experiences to resolve the issues.

In order to effectively improve the investment environment of CBIC by taking the above mentioned measures, the Government could consider incentivizing investors and designating CBIC as a national "special region", which allows flexible arrangement of business/investment rules and regulations beyond the regular arrangements in the other regions of India. With the status, the issues which the central Government is in charge, such as most items on taxation, import/export procedures and environment assessment, are easier to be addressed.

Implementing Agency: DIPP, Ministries in charge of each sector

12.6.2. Investment Promotion Program

The above mentioned issues and recommendations would be considered to be dealt under the integrated programme focusing on urgent needs of debottlenecking in hard and soft infrastructure and improve investment environment.

JICA has set up a program loan for Tamil Nadu State which deals with existing infrastructure bottlenecks as well as policy issues. The similar initiatives would be necessary for further promotion of business environment in the region.

The program loan to Tamil Nadu Government is supposed to be the concessional loan of 13 billion yen (approximately Rs. 767 Crore) in 2015 under the JICA's program entitled "Sector Program Loan for Tamil Nadu Investment Promotion Program." The main purpose of the program is the improvement of investment environment in Tamil Nadu. The expected outcome consists of the following four components: 1) improvement of investment application process, 2) enhancement of land acquisition system, 3) promotion of capacity development for industrial workers, and 4) development of the Governmental mechanism on construction of link infrastructures, e.g., road, power and water, surrounding key industrial parks where foreign companies/investors are in operation. The fund will be disbursed in stages upon the result of annual joint monitoring by the Tamil Nadu Government and JICA for evaluating the degree of improvement in investment environment. Similar arrangement and funding support from JICA should be applicable for Karnataka and Andhra Pradesh.

Enhancement of the collaboration between Japan and India

Collaboration with Japan is crucial to shift the plan into implementation and bring about the tangible result to the CBIC states. However, despite the fact that the collaboration has been driven forward at the central level, it takes a while for the decision or order from the central to the field at the state level; sometimes the private sector cannot endure the time taken for the decision to be made and to take effect. It also applies to the bottom up case; the decision agreed at the state level often takes time to reach to the central level, resulting in the missing the opportunity for the private sectors.

As the recommendation to solve the issue, the multi-layer collaboration needs to be promoted; Japanese experts are to be assigned at the multi layers of the organization as the collaboration liaison for Japanese companies and India companies as well as governments.

At the central level, the key bottleneck for the Japanese companies is that they need to negotiate with various ministries in order to obtain approval and agree on conditions, which takes a large volume of men-hours. The expert can support and facilitate the process by handling the procedure likely to take place at the central level for the CBIC projects.

At the CBIC special unit level, coordination between CBIC as a region and state government is to be a key; as the state government may have the different priority in the projects which are not aligned with CBIC, the balance of those needs to be controlled as the situation changes. If such coordination is delegated to an each private company, it is likely to block their actual business operation and discourages them to conduct further investment. Some personnel assigned as a coordinator will help both of India and Japan to build the win-win relation.

And the expert at the state level also takes important role. It is often contended that the investors or industry experts find it hard to communicate with the state government since they do not have much relationship at each state level; however, it is also told that the network at the state level is indispensable for smooth business operation in all the states in India. The expert will support to build in tight collaborative relation between India and Japan, then maximize the benefit of the collaboration.

All those experts need to work closely, exchange information, monitor the situation, and collaborate with Government of India and Japan to conduct further approach, if required.

13. Way Forward

Following actions will be required by the State Government of Tamil Nadu as a next step.

Legal/Regulatory Framework

Basic legal/regulatory framework needs to be developed and enacted.

a) Declaration of Industrial Township of the proposed Ponneri node as aligned to Article 243Q and Tamil Nadu Industrial Township Area Development Authority Act

b) Review of samples of State Support Agreement (SSA) and Share Holder Agreement (SHA) (Draft Shared with GoTN) and starting a dialogue with DIPP to discuss and sign the agreements

- Need to identify the role and responsibilities of each stakeholder, i.e. NICDA, State, and private sector

Institutional Framework

Based on the legal/regulatory framework, details of roles and responsibilities among central and state governments, and private sectors, setting up necessary organizations and building organization structure, hiring appropriate human resource will be required.

a) Issue of Government Order for Establishment of Institutional Structure as agreed by GoTN

b) Setting up Development Authority which will assume the role of the municipal body for the node

c) Setting up a node development SPV

d) Developing a framework on the involvement of private sector to the node and infrastructure development

- Set up a strategy to have effective involvement of private sector
- Conduct market soundings with potential private developers
- Develop action plan and road map

e) Establishment of Program Management Unit within [TIDCO] as a transition unit to lead coordination with Central Govt and State Govt Agencies and facilitate the implementation of the role of State under SSA and SHA

Financial Framework

Since the node development includes the large area development and various infrastructure developments, an integrated financial strategy will be required.

a) Prioritizing node and infrastructure development projects

b) Development of a funding plan considering economic and financial implication of prioritized projects on competitiveness of the node

c) Identification of alternatives on funding source including own budget, funds from central government, donor support funding (a project specific loan, a budget support loan) etc.

d) Developing necessary monitoring mechanism of project progress

Operation

Following steps will be required for physical node development and improvement of soft infrastructure.

a) EIA (to be initiated by DIPP)

b) Land assessment of the node to identify the details of necessary land development work

c) Preparation for land acquisition plan for the part of land which is not owned by GoTN currently within Master Plan Area so as to avoid the higher acquisition price due to speculation

d) Identification and preparation of priority projects under State responsibility

e) Developing a framework to implement necessary steps in response to recommendation on investment environment improvement including assurance of infrastructure services, supply of skilled labour, streamlining of business process etc.

Appendix A. - Industrial Analysis

A.1. Central and State Scheme for Electronics Sector

Appendix 1: Central and State Scheme for Electronics Sector

Scheme	Policy	Incentive
Central Scheme	EMC(Electronics Manufacturing Clusters)	• 75% of the project cost (subject to the a ceiling of Rs.50 Crore) given to SPV formed for this purpose
	MIP-S (Modified Special Incentive Package Scheme)	• CPEX subsidy of 25% to Non-SEZ Units • Reimbursement of CVD for capital equipment for Non-SEZ Units • Reimbursement of central taxes and duties (custom duties, service tax, excise duty) for high technology and high capital investment units (such as semi-conductor units)
State Scheme	ESDM Policy 2014	• Reimbursement of 50% of the actual costs for filling a patent. • Reimbursement of 50% of actual cost incurred in export promotion activities (international marketing, sales promotion, trade show participation etc...) • Reimbursement of 20% of the actual R&D expenses • 10% capital subsidy or Rs. 5 crore for the first two Anchor Units in greenfield cluster • Reimbursement of 95% of Central Sales Tax for domestic sales outside Karnataka (inter-state sales),
	Millennium IT Policy 2000	• The lowest taxation; 0.25% on computers and computer peripherals , and 4% work contract tax on the annual maintenance contract on hardware • exempt from payment of entry tax and purchase tax on computer hardware, computer peripherals and other capital goods including captive power generation sets, during the implementation stage which can be extended up to five years from the date of commencement of implementation • Sales tax exemption for a period of 10 (ten) years or deferment for a period of 12 (twelve) years, subject to a ceiling of 200% (two hundred percent) of the value of fixed assets. • For IT industry with Captive power generation, total exemption from payment of electricity tax and total exemption from payment of sales tax on fuel used for captive power generation • Special incentives for Mega projects (the investment more than Rs.100 crore)

Source : EMC notification, ESDM Policy 2014, IT Millennium Policy

A.2. *Electronic Products under BIS registration*

The Department of Electronics and IT (DeitY) has issued the Electronics and Information Technology Goods (Requirements for Compulsory Registration) Order, 2012, bringing into force a scheme for mandatory regime of registration of 15 electronics products. Subsequently, another 15 products were added as per Notification dated 7th November, 2014.

Appendix 2: Electronics Products under BIS registration

Sl.No.	Product
1	Electronic Games (Video)
2	Laptop/Notebook/Tablets
3	Plasma /LCD /LED Televisions of screen size 32" & above
4	Optical Disc Players with built in amplifiers of input power 200W and above
5	Microwave Ovens
6	Visual Display Units , Video Monitors of screen size 32" & above
7	Printers, Plotters
8	Scanners
9	Wireless Keyboards
10	Telephone Answering Machines
11	Amplifiers with input power 2000W and above
12	Electronic Musical Systems with input power 200W and above
13	Electronic Clocks with Mains Powers
14	Set Top Box
15	Automatic Data Processing Machine
16	Power Adaptors for IT Equipment
17	Power Adaptors for Audio, Video & Similar Electronics Apparatus
18	UPS/Invertors of rating ≤ 5k VA
19	DC or AC Supplied Electronics Control gear for LED Modules
20	Sealed Secondary Cells / Batteries containing Alkaline or other non-acid Electrolytes for use in portable applications
21	Self-Ballasted LED Lamps for General Lighting Services
22	Fixed General Purpose LED Luminaries
23	Mobile Phones
24	Cash registers

Sl.No.	Product
25	Point for Sales Terminal
26	Copying Machines / Duplicators
27	Smart Card Readers
28	Mail Processing Machines/Postage Machines/Franking Machines
29	Passport Reader
30	Power Banks for use in portable applications

A.3. Central and State Scheme for Food Processing Sector

Appendix 3: Central and State Scheme for Food Processing Sector

Scheme	Policy	Incentive
Central Scheme	Mega Food Park Scheme	• A capital grant at the rate of 50 percent of the eligible project cost (excluding cost of land, preoperative expenses and margin money for working capital)
State Scheme	Integrated Agribusiness Development Policy 011	• Exemption from Stamp Duty for MSME, Large and Mega agro based industries and agri infrastructure • The exemption of stamp duty and concessional registration charges • 100% exemption from payment of Entry Tax on 'Plant and Machinery and Capital Goods' for an initial period of 3 years from the date of commencement of project implementation • For 100 % EoU, 100 % exemption from payment of ET on 'Plant & Machinery and Capital Goods' for an initial period of 5 years from the date of commencement of project implementation • Exemption of APMC cess / fees for MSME, Large and Mega agro based industries and agri infrastructure • One time capital subsidy up to 50% of the cost of effluent treatment plants (ETPs), subject to a ceiling of `100 lakhs by MSME, large and mega agro based industrial unit and `500 lakhs for common effluent treatment plant established as part of agri infrastructure facility • All new large and mega agro based industries established shall be offered interest free loan on VAT as prescribed

Appendix B. - Methodology for designing and evaluating railway connections to the proposed new manufacturing nodes

B.1. Methodology

B.1.1. Concept of Logistics Hubs and their operation

The connection of the proposed manufacturing nodes by rail, and to a lesser extent by road, is vitally dependent upon the efficient operation of centrally located intermodal transfer terminals, or Logistics Hubs, within each node. These Logistics Hubs, which are evaluated in detail in the Logistics section of the Draft Final Report, will facilitate the transfer of cargo between road and rail, as well as the handling, storage and, where necessary, customs clearance, of containerized and breakbulk cargo. They are also the only practical means by which rail can access each node. The same is not true of road transport which can access individual manufacturing establishments within the nodes, via a dense network of local roads which will be provided in each node. Thus, rail connections to the nodes are inextricably linked to the operation of Logistics Hubs and will to a large extent determine the component facilities and layouts of the latter.

B.1.2. Railway electric traction

Recent discussions between the CBIC Railway team and the Advisor (Infrastructure) to the Indian Railway Board confirmed that the Indian Railways has an expectation of serving each node by electric, rather than by diesel, traction.[57] This is because the Southern and South Central Railways have already electrified most of their networks and the South Western Railway is implementing plans for the rapid electrification of its network.

A major problem which arises in connection with the construction of Logistics Hubs is that the rail sidings for loading/unloading of cargo in the hubs cannot be equipped with overhead catenaries for electric traction. This is due to the potential interference of overhead lines with the operation of high lift cargo handling equipment, such as reach-stackers and top lifting forklifts. Further, en-route changes of traction from diesel to electric are not considered practical, since they will greatly impair rail efficiency and add to operating costs.

Therefore, it will be essential to construct reception sidings just outside the hub boundaries to allow electric locomotives to be repositioned at the rear of their trains and to push back complete train consists (of up to 700 metres in length) into the loading/unloading sidings within the hub. For this purpose, approximately the first 150 metres of track within the hub leading into the loading/unloading sidings would have to be overhead wired. In this way, electric locomotives will be able to enter loading/unloading sidings as far as the second pantograph on each unit, to couple to or uncouple from their trains and to move forward under electric power to the reception sidings.

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[57] Meeting between G Pillai, Adviser Infrastructure of the IR Board, and P Hodgkinson and D Vijayaraghavan of the CBIC Rail team in New Delhi. on 13 November 2014.

B.1.2.1. Types of traffic to be handled in Logistics Hubs

It is not considered practical to develop logistics hubs to handle any traffic other than containers or break-bulk. The traffic forecasts prepared by the CBIC Railway Team envisage that the outputs of the nodes will, with the exception of those dispatched to short haul destinations, be containerized. In the case of inputs, with the exception of liquid petrochemicals which will be fed into Ponneri and Krishnapatnam by pipeline, almost all inbound tonnage will be steel moved in break-bulk lots, either from the ports by road or from domestic steel plants by rail. [58]

The initial input/output analysis which was based on the land acreage forecasts of the PWC team envisaged that metal manufacturing would take place within all nodes. This is not considered to be realistic in view of the likelihood that it would require transport of coal or other bulk minerals by rail and the creation of large stockpiles of such materials within each node (and possibly hub). Accordingly, the Rail team has modified the forecast to allow only for inputs of manufactured metals for downstream manufacturing processes, such as auto component, machinery or medical equipment manufacture.

B.1.2.2. Management and financing of Logistics Hubs

It is assumed that Logistics Hubs will be constructed by the SPV companies established by the Government to act as landlords and developers of the nodes. It is likely that the management and operation of the hubs will be contracted out through a competitive bidding process, to logistics specialists who will be required, at minimum, to invest in and operate cargo handling equipment within the hub. It is possible that the hubs could be run along the lines of the CONCOR model, whereby the entirety of the investment in the hub (in the infrastructure, as well as in the cargo handling equipment) could be the responsibility of the hub operator. In this case, the operator would also invest in specialized container wagons, contract with the railways for the scheduling and haulage of trains, and recover costs through haulage charges on freight customers.

The role of Logistics Hub operators and SPV companies might therefore be clearly defined inside and outside the hub. *Inside the hub*, hub operators might be responsible for:

(i) Construction and maintenance of paving, roads, railway sidings, buildings and utilities; and

(ii) Acquisition, operation and maintenance of reach-stackers, top lifting forklifts, small forklifts in the CFS, racking systems and pallet movers.

Costs incurred in these activities, including the payment of land rent to the SPV company, would be offset by *handling charges* to be paid by freight customers.

Outside the hub, the SPV company might be responsible for:

(i) Construction and maintenance of electrified access lines (connecting to mainline) and reception sidings.

The cost of this investment would be recovered in the land rent chargeable to the hub operator, who in turn would pass this cost on to freight customers as part of the haulage charge.

Outside the hub also, the hub operator might be responsible for:

(i) Acquisition and maintenance of container wagons

(ii) Scheduling and managing the arrival and departure of container and steel trains

[58] Where steel is moved by road from the ports, it is assumed that it will by-pass Logistics Hub and be transported directly to factories.

(iii) Arranging with the Railways for the scheduling and haulage of container and steel trains

In the case of items (iv)-(vi), the hub operator would be required to contract with the Railway and would pay the IR haulage charge, which would be passed directly on to freight customers together with allowances for wagon investment and the payment of land rent to the SPV. In this sense, haulage charges made on freight customers would be revenue neutral, merely recovering costs incurred by the hub operator outside of the hub.

Such an arrangement would have the benefit of providing a clear demarcation between responsibility for infrastructure provision and maintenance *inside* the hub, which would be that of the hub operator and that *outside* of the hub which would be the responsibility of the SPV. In that sense, the responsibility of the SPV will be identical to the SPV's responsibility to provide other infrastructure, including roads, within the node.

With specific regard to the Ponneri Node, it is unclear at this stage whether the SPV would be required to contribute directly or indirectly to the cost of the Minjur-Ennore Port railway line from which the access line to Ponneri would take off. A direct contribution could be in the form of a share of the capital costs of the line, which is currently expected to be financed by Ennore Port (now renamed Kamarajar Port) and possibly Kattupalli Port (whose contribution would fund a siding to their port from the line).

There could also be an expectation of an indirect contribution from the Node via track access charges. While there is an agreement between Kamarajar Port Ltd and IR that no charge would be made for railway traffic to and from the port, there is no similar guarantee that other traffic (e.g. to Ponneri node) would not have to pay for operations on the Minjur – Ennore line.

This access charge would be paid by Indian Railways and transferred to the Hub Operator via the haulage charge. If this is likely to eventuate, it could threaten the viability of the node and should be strongly resisted.

In the light of the likely management and financing arrangements for the logistics hubs (as outlined above), it was decided that the financial appraisal should be undertaken *only in respect of the investment required inside the hub* and therefore to be borne directly by the hub operator. Investments in the railway facilities outside the hub are expected to be recovered from haulage charges made by the hub operator on freight customers.

It should be noted that in the case of steel traffic, rolling stock is supplied by the Railway and is paid for as part of the haulage charge which is also recovered from freight customers.

B.1.3. Modal share calculations based on input/output forecasts

Manufacturing inputs and outputs will be transported to and from the proposed nodes by road and rail, and in some limited cases, by pipeline. The input/output analysis on which the transport volumes are based was constructed from land area (acreage) forecasts by type of industry prepared by the PWC Regional Development team. This input/output analysis was prepared by the NK Urban/Industry Planning team. The methodology used to translate the acreage forecasts into input and output tonnages for each industry within each of the manufacturing nodes was described in the Industrial Forecasts section of this report.

It was assumed that the input and output volume forecasts prepared by the Urban/Industry Planning team will be indicative of the actual volumes of freight moving into and out of the nodes in each of the forecast years. However, it was found necessary to make some adjustments to the input/output forecasts because they allow for metal manufacturing from raw materials, which is considered to be beyond the scope of the nodes.

From the adjusted base, it was necessary to estimate the Origin/Destination distribution of the traffic, inclusive of the split of traffic between domestic ODs and the ports, and then to estimate the modal share of the traffic between each Origin and Destination. Ultimately, this information will be needed to estimate the proportion of total traffic arriving in or departing from the nodes by road and rail respectively.

B.1.3.1. Adjustment of input/output forecasts

The forecast of land area allocation by industry used as a basis for input/output tonnage forecasts was adjusted as follows:

(i) The allocation to "Metallurgy" was changed to Auto Components, Equipment and (where relevant) Medical Equipment manufacture, for the reasons given in Section 1.3 above;

(ii) Only the first two years of the acreage forecast were used to establish the starting input/output tonnages for all nodes and growth in subsequent years was assumed to be at BIS rate of 11.42% as identified in Interim Report 2.

The second of the above changes was made because the average rates of growth derived from the acreage forecasts were greater than 15% per year and thus would neither be realistic nor sustainable over the 20 year forecast timeframe.

The resulting adjusted forecasts of input/output tonnages are as follows:

Appendix 4: Input / Output Tonnage Forecasts (adjusted)

Node	Inputs (tonnes)				Outputs (tonnes)			
	2017/18	2023/24	2027/28	2032/33	2017/18	2023/24	2027/28	2032/33
Ponneri	627,783	1,078,017	1,851,149	3,178,756	538,046	923,922	1,586,541	2,724,376
Tumkur	417,070	716,184	1,229,817	2,111,818	378,213	649,459	1,115,238	1,915,065
Krishnapatnam	553,636	950,693	1,632,511	2,803,314	492,022	844,890	1,450,828	2,491,333

B.1.3.2. Origin/Destination estimates

Input/output tonnage estimates for each industry within each node were split by principal OD pairs in two ways.

First, the shares of input and output volumes originating in or bound for the ports were determined on the basis that:

(i) On average about 20-30 per cent of the output tonnages of the Ponneri and Tumakuru nodes and about 40 per cent of Krishnapatnam's output tonnages would comprise containerized exports bound for the ports[59];

(ii) All of the export container volume originating in the Ponneri and Krishnapatnam nodes would be transported by road to nearby ports, while the export container volume from Tumakuru would be split equally between Ennore and Krishnapatnam ports (with a major share of the volume being transported by rail);

(iii) Steel carried in break-bulk form would comprise the major share of input tonnage to all nodes.

(iv) In the case of Ponneri and Krishnapatnam, steel inputs would be split 50:50 between imports through the ports and steel from domestic sources (Salem for Ponneri and Bellary for Krishnapatnam), while all of Tumakuru's steel inputs would be sourced from Bellary.

Second, the 60-80% of output tonnage bound for domestic destinations was assumed to be split 60%:40% between long haul and short haul destinations respectively. New Delhi, being the focus of freight flows to northern India was assumed to account for some 60% of the long-haul tonnage.

[59] The share of exports in Krishnapatnam's output was expected to be relatively high owing to the assumed greater capacity of the port to attract mainline container vessel calls in future years.

B.1.3.3. Modal share estimates

In general, the modal share assumptions were as follows:

(i) For freight hauls in excess of 450 km, rail will have a 100% share;
(ii) For freight hauls of 300-450 km, the respective shares of rail and road will be 80%:20%; and
(iii) For freight hauls of less than 300 km, road will have a 100% share.

A comparison of road and rail charges for the haulage of containers in the Chennai-Bengaluru corridor was made as a basis for estimating the likely modal shares in this corridor of 330-350 km. The results of this analysis are given in Appendix 2 below. They indicate that if the inverse relationship between road and rail haulage rates is used to determine the relative modal shares, rail would have nearly an 80% share of the 20ft container volume carried in the westbound direction and a share of greater than 80% of the eastbound volume.

Significant service differences between road and rail could operate to limit the rail share. For example, if rail service delivery is at a lower level than that of road owing to the operational priority given to passenger traffic, rail could suffer a reduction in its modal share of container traffic in the corridor, notwithstanding its price advantage.

This was found to explain why rail had failed to penetrate the market for transport of new cars, despite the introduction of a new auto transport policy which involved investment in new multi-level car transporter wagons and a significant price advantage over road transport (see Interim Report 3).

While it is likely that IR will continue having to give operational priority to passenger traffic, it must be hoped that the proposed expansion of track capacity in certain critical line sections (as outlined in Interim Report 2) will compensate for any negative effects of such a policy on service delivery.

Appendix 5: Comparative analysis of charges for road and rail haulage of containers

1. Comparative distances

Route	Road distance (Km)	Rail distance (Km)
Harbour of Madras - Bengaluru (centre)	342	N/A
Harbour of Madras - Whitefield ICD	322	334

2. Comparative haulage charges

Route		Road		Rail		Ratio rail/road	Inverse ratio	Indicated modal shares	
		Rs.per container	Rs.per container-km	Rs.per container	Rs.per container-km			rail	road
Harbour of Madras - Whitefield	20ft loaded	36,000	111.80	10,200	30.54	0.27	3.66	78.5%	21.5%
	20ft empty	12,000	37.27	7,000	20.96	0.56	1.78	64.0%	36.0%
	40ft loaded	40,000	124.22	16,500	49.40	0.40	2.51	71.5%	28.5%
	40ft empty	18,000	55.90	13,000	38.92	0.70	1.44	59.0%	41.0%
Whitefield - Harbour of Madras	20ft loaded	36,000	111.80	6,800	20.36	0.18	5.49	84.6%	15.4%
	20ft empty	12,000	37.27	4,700	14.07	0.38	2.65	72.6%	27.4%
	40ft loaded	40,000	124.22	10,850	32.49	0.26	3.82	79.3%	20.7%
	40ft empty	18,000	55.90	8,600	25.75	0.46	2.17	68.5%	31.5%

Assumptions:
(1) Like for like comparison (haulage to/from Whitefield ICD by road vs. rail), on basis that road would have to call at Whitefield for customs inspection
(2) Road rates apply irrespective of direction of travel

The modal share assumptions listed above were used to determine rail modal shares of container and break-bulk traffic to and from each of the 3 proposed manufacturing nodes. The results of this analysis, as shown in Appendix .3, reflect the following assumptions:

(i) The rail share of container transport volume is highest for the Tumakuru node where the average haulage distance is significantly greater than 450 km and lowest for the Ponneri and Krishnapatnam nodes where local road hauls of containers between the nodes and the neighbouring ports predominate;

(ii) Steel haulage between Tumakuru and Bellary is 100% by rail, owing to the advantage that rail has with the operation of specialized steel carrying wagons marshalled into long unit trains, despite the haul distance being less than 300 km;

(iii) In the case of Ponneri and Krishnapatnam, steel haulage is split 50:50 between imports through the ports and domestically produced steel, with the result that their steel input volumes are shared equally between road and rail;

(iv) Food grains transported to Tumakuru and Krishnapatnam for food processing industries are likely to be sourced locally and hence will be transported 100% by road;

(v) Computer and defence products are likely to be transported entirely by road to local markets (or to airports) for further processing;

(vi) Since there is a large imbalance between inbound and outbound container flows (with outbound flows being much higher than inbound flows), it will be necessary to re-position empty containers from Ennore and Krishnapatnam ports. This will be done by road in the case of Ponneri and Krishnapatnam nodes and predominantly by rail in the case of Tumakuru;

Appendix 6: Ponneri node - Rail shares of container and break-bulk volume

Traffic category	2017/18	2022/23	2027/28	2032/33
Containers				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	18,448	31,679	54,398	93,411
- Empty Inbound (TEU)	26,892	46,178	79,296	1,36,165
Total	46,117	79,191	1,35,984	2,33,510
Containers - rail volume				
- Loaded inbound (TEU)	777	1,334	2,291	3,933
- Loaded outbound (TEU)	11,711	20,110	34,533	59,300
- Empty Inbound (TEU)	0	0	0	0
Total	12,488	21,444	36,824	63,233
Containers - rail share (%)				
- Loaded inbound (TEU)	100%	100%	100%	100%
- Loaded outbound (TEU)	63%	63%	63%	63%
- Empty Inbound (TEU)	0%	0%	0%	0%
Total	27%	27%	27%	27%
Breakbulk				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	2,19,125	3,76,278	6,46,136	11,09,533
Total	2,95,389	5,07,235	8,71,014	14,95,688
Breakbulk - rail volume				
- Inbound (tonnes)	76,263	1,30,958	2,24,878	3,86,156
- Outbound (tonnes)	0	0	0	0
Total	76,263	1,30,958	2,24,878	3,86,156
Breakbulk - rail share %				
- Inbound	100%	100%	100%	100%
- Outbound	0%	0%	0%	0%
Total	26%	26%	26%	26%
Petrochemicals - inbound pipeline (t)	4,63,993	7,96,759	13,68,179	23,49,410

Appendix 7: Tumakuru node - Rail shares of container and break-bulk volume

Traffic category	2017/18	2022/23	2027/28	2032/33
Containers				
- Loaded inbound (TEU)	3,679	6,317	10,848	18,628
- Loaded outbound (TEU)	17,779	30,529	52,424	90,021
- Empty Inbound (TEU)	14,100	24,212	41,576	71,393
Total	35,557	61,058	1,04,847	1,80,042
Containers - rail volume				
- Loaded inbound (TEU)	3,161	5,427	9,320	16,004
- Loaded outbound (TEU)	15,755	27,053	46,456	79,773
- Empty Inbound (TEU)	12,594	21,626	37,136	63,769
Total	31,509	54,107	92,911	1,59,545
Containers - rail share (%)				
- Loaded inbound (TEU)	86%	86%	86%	86%
- Loaded outbound (TEU)	89%	89%	89%	89%
- Empty Inbound (TEU)	89%	89%	89%	89%
Total	89%	89%	89%	89%
Breakbulk				
- Inbound (tonnes)	2,21,033	3,79,553	6,51,761	11,19,191
- Outbound (tonnes)	63,875	1,09,685	1,88,349	3,23,430
Total	2,84,908	4,89,238	8,40,110	14,42,620
Breakbulk - rail volume				
- Inbound (tonnes)	1,65,866	2,84,821	4,89,089	8,39,855
- Outbound (tonnes)	0	0	0	0
Total	1,65,866	2,84,821	4,89,089	8,39,855
Breakbulk - rail share %				
- Inbound	75%	75%	75%	75%
- Outbound	0%	0%	0%	0%
Total	58%	58%	58%	58%
Petrochemicals - inbound pipe+road	1,38,806	2,38,354	4,09,298	7,02,837

Appendix 8: Krishnapatnam node - Rail shares of container and break-bulk volume

Traffic category	2017/18	2022/23	2027/28	2032/33
Containers				
- Loaded inbound (TEU)	528	907	1,557	2,674
- Loaded outbound (TEU)	12,355	21,216	36,431	62,559
- Empty Inbound (TEU)	11,827	20,309	34,874	59,885
Total	24,710	42,431	72,862	1,25,118
Containers - rail volume				
- Loaded inbound (TEU)	528	907	1,557	2,674
- Loaded outbound (TEU)	6,211	10,665	18,314	31,449
- Empty Inbound(TEU)	0	0	0	0
Total	6,739	11,572	19,872	34,123
Containers - rail share (%)				
- Loaded inbound (TEU)	100%	100%	100%	100%
- Loaded outbound (TEU)	50%	50%	50%	50%
- Empty Inbound (TEU)	0%	0%	0%	0%
Total	27%	27%	27%	27%
Breakbulk				
- Inbound (tonnes)	4,68,967	8,05,300	13,82,845	23,74,594
- Outbound (tonnes)	1,90,649	3,27,378	5,62,167	9,65,341
Total	6,59,615	11,32,678	19,45,012	33,39,935
Breakbulk - rail volume				
- Inbound (tonnes)	92,192	1,58,310	2,71,847	4,66,810
- Outbound (tonnes)	0	0	0	0
Total	92,192	1,58,310	2,71,847	4,66,810
Breakbulk - rail share %				
- Inbound	20%	20%	20%	20%
- Outbound	0%	0%	0%	0%
Total	14%	14%	14%	14%
Petrochemicals - inbound pipeline	77,012	1,32,243	2,27,084	3,89,945

A high proportion of the outputs dispatched from the nodes, whether for export through the ports or for transport to domestic destinations, *will be containerized*. In general, only outputs transported by road to local markets will not be containerized.

Among the inputs, only steel, which is typically transported in break-bulk form, or liquid petrochemicals, which are mostly transported by pipeline, are not transported in containers.

The factors used in converting input/output tonnages to TEU volumes, where relevant, are as follows:

Appendix 9: Conversion factors for TEUs

Product	Tones per TEU
Medical Equipment	19
Auto Components	19
Electrical and other machinery	19
Processed Foods	16
Textiles and Apparel	14
Plastics and Pharmaceuticals	17

B.1.4. Principles for designing railway connections to the nodes

In all cases, railway connection will be via short electrified access lines (single track) linking central logistics hubs within each node to the nearest mainline. The principles adopted for railway operation are as follows:

(i) Separate fixed formation trains comprising 45 BLCA wagons for container traffic and 45 BFNS wagons for break-bulk steel traffic will operate between Logistics Hubs in the nodes and designated ODs without stopping except for technical purposes (e.g. crew and locomotive changes, fueling, sanding, etc);

(ii) A single 4,500 KW (6,035 HP) WAG9 electric locomotive, or equivalent, will be sufficient to haul both container and steel trains;

(iii) Full length trains will directly arrive in and depart from electrified 3 track reception sidings located just outside the hub boundaries;

(iv) On arrival in the reception sidings, mainline locomotives will uncouple and run around their trains, in order to push back into the non-electrified loading/unloading sidings within the hub, using the electrified approach tracks;

(v) After placing their trains, locomotives will return to the reception sidings. When unloading, re-loading and train inspection have been completed, locomotives will pull their trains out of the hub and depart directly for their ultimate destination;

(vi) Train inspection and brake testing will be carried out while trains are loading or unloading cargo.

Planning of the lengths of the reception and loading/unloading sidings is based on the following calculation of train length.

Appendix 10: Train Composition and Length

Train Type	Vehicle Type	No. in consist	Length over couplers (meters)	Overall length (metres)
Containers	WAG 9 electric loco	1	20.50	20.50
	BLCA container flat	45	14.63	658.13
	Brake van	1	15.00	15.00
	Total			693.63
Steel	WAG 9 electric loco	1	20.50	20.50
	BFNS steel wagon	45	14.72	662.22

Train Type	Vehicle Type	No. in consist	Length over couplers	Overall length
	Brake van	1	15.00	15.00
	Total			697.72

On this basis the length required between the turnout (switch) and the buffer stop in the loading/unloading sidings has been determined at 700 metres, while in the reception sidings the length will be 750 metres (to allow for some braking distance).

B.1.5. Principles for designing logistics hubs for the nodes

In each case, railway access to the node will be provided to a “Logistics Hub”, which will allow for the handling, storage and, where necessary, customs clearance, of containerized and break-bulk cargo (mainly steel).

The central feature of each node will be a set of tracks (three each for Tumakuru and Ponneri and two for Krishnapatnam) for the loading/unloading of containers and break-bulk cargo. *These tracks must allow for the receipt and dispatch of full length unit trains running between a single origin and a single destination, without being broken up or re-marshalled.* The length and traction type assumptions for the track layout within the hub are given in the preceding sections.

The steel and container handling areas will be separated by a chain link fence, and provided with their own security controlled entrances. In the Ponneri and Tumakuru hubs, a paved container yard would be provided on either side of the rail sidings to allow the discharge and loading of wagons by reach-stacker and heavy duty forklift equipment. In the case of Krishnapatnam a single container stacking area would be provided adjacent to the single container loading/unloading track. The tracks would be embedded in pavement to allow cargo handling equipment to work both sides of a train at the same time. In the case of both container and steel trains, handling equipment would work along a frontage of 600 metres.

The CY and steel storage areas are assumed to be dimensioned with lengths of 600 metres and 400 metres respectively. Their widths are determined by the projected cargo volume in the last year of the forecast period (2032/33). In the case of Ponneri and Krishnapatnam, the container stacks will be three TEU deep, while those in Tumakuru will be two TEU deep, giving widths of 18.3 m and 12.2 metres respectively. Roadways will be provided on either side of the rail sidings to allow direct transfer of containers and steel between wagons and road trailers or trucks.

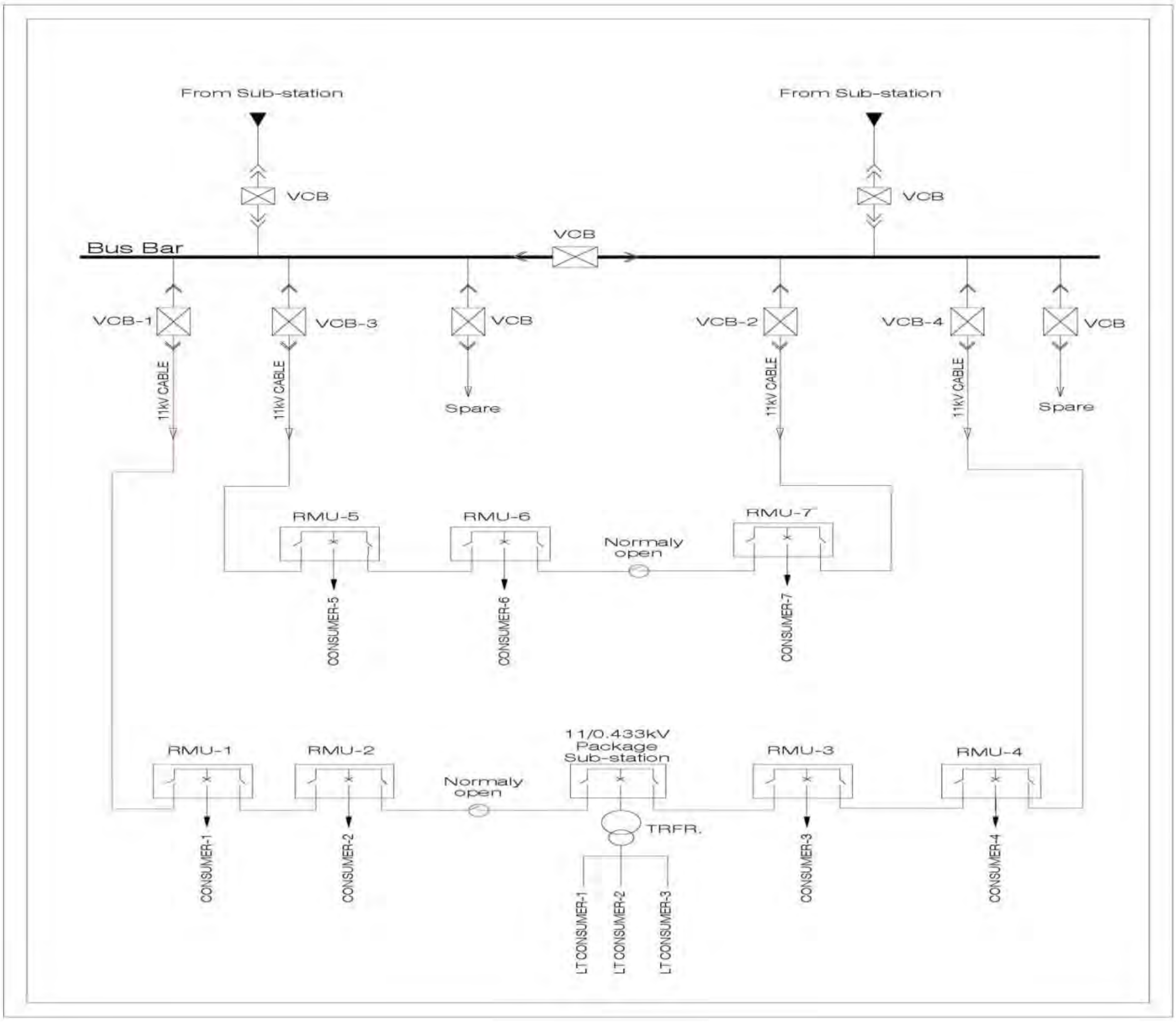
Other facilities to be provided within each hub include: a Container Freight station (CFS -for the stuffing/unstuffing and of containers and for customs inspection of container cargo); a long term warehouse for storage of cargo beyond the free period of 3 days; a two storey administration building with additional space for rental by service providers, such as freight forwarders; a trailer park; a workshop for the container repair and for the maintenance of cargo handling equipment; and gatehouses (for security at both entrances to the hub).

Owing to the need to accommodate long trains, the Logistics Hubs for all three nodes will have a long thin shape, which will allow additional area for future expansion.

Appendix C. - Power and Renewable

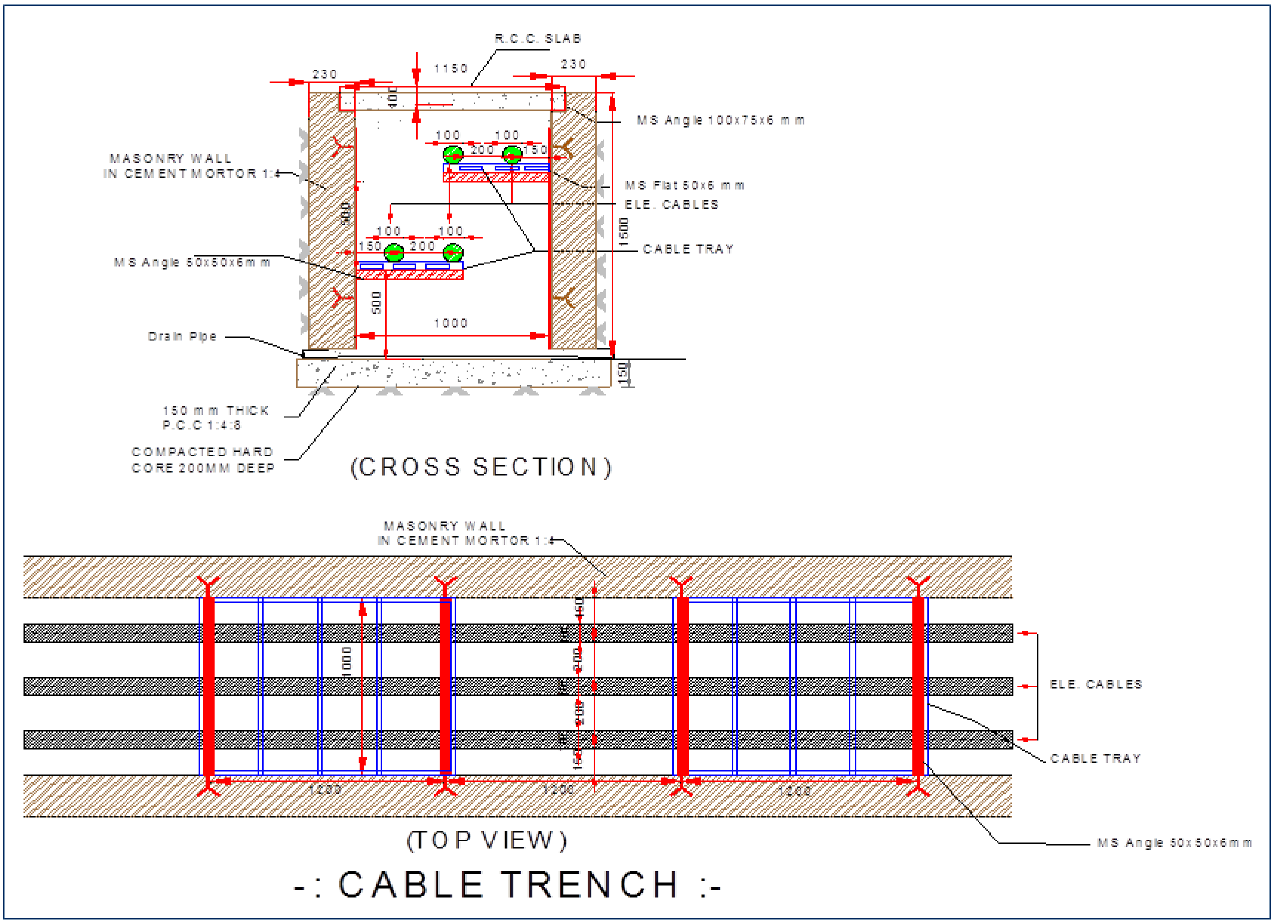
C.1. Single Line Diagram for underground distribution network

Appendix 11: Single Line Diagram for underground distribution network



B.2. Supporting design data on underground distribution system

Appendix 12: Supporting design data on underground distribution system



Proposed Masonry Cable trench on footpath (Cross section)

B.3. Benchmarking demand between SEZs

Appendix 13: Benchmarking demand between SEZs

Power Plant	Capacity (MW)	Area (Acres)	MW/Acres
Mundra SEZ	1300	44,478	0.029
Dahej SEZ	100	4,280	0.023
Kandla SEZ	900	23,408	0.038
Bhilai SEZ	230	4200	0.054
Ponneri	**759**	**21,795**	**0.034**
Krishnapatnam	301	5503	0.054
Tumkur	366	6138	0.059

B.4. Substation Design

New sub-station design philosophy

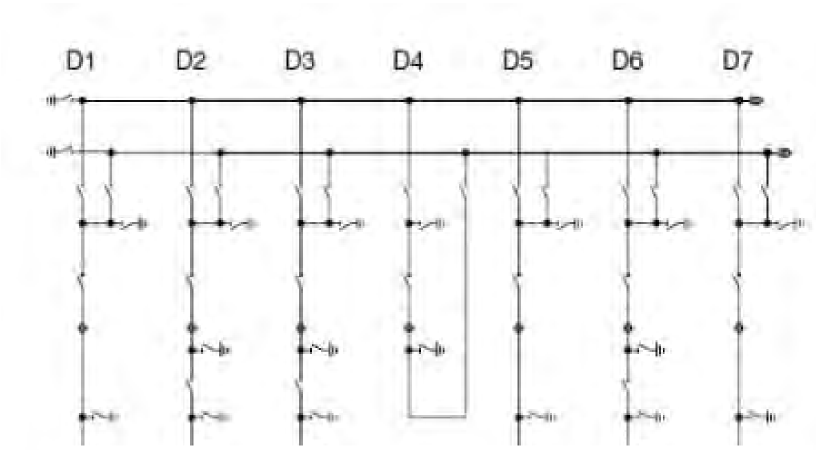
Appendix 14: Sample SLD for double busbar

In design of a new sub-station, previous learnings from the installations of sub stations need to be incorporated in the smart design. Typically in Indian conditions, we see Air insulated sub stations are used by distribution utilities. However, the conventional Air-insulated substation (AIS) design uses a large number of disconnectors in order to allow for maintenance and repair with a minimum of interruption. The occupied area of AIS is typically large and the maintenance demand of the open-air apparatus is relatively high, particularly in case of severe environmental conditions. Besides, switchgear, its subsystems and components are exposed to aging and wearing during the years of exploitation that leads to the increase in fault events over the years of service. The attempt in the new substation designs is to make them more compact and somewhat protected from the environmental impacts.

Also, the sensing and signal processing in existing substation designs is based on a number of individual sensors being placed in the switchyard and hard-wired directly to the control house. The individual monitoring, control and protection devices that are using those signals for their decision-making are located in the control house. This concept is not facilitating integration of data and signal processing across the substation.

Primary equipment design

The metal-enclosed gas-insulated switchgear inherently follows the criteria for new substation design and offers a higher reliability and flexibility than other solutions. Due to the gas enclosed design, GIS is the most suitable solution for indoor and underground substations. In outdoor and hybrid substations, the occupied area is tremendously reduced by using GIS technology.



Appendix 15: Installed Gas insulated substation: Torrent Power (Agra)

GIS configurations can be applied to any type of bus bar arrangements: single busbar, double busbar, single busbar with transfer bus, double busbar with double circuit breaker, one and a half circuit breaker scheme and ring busbar.

The GIS substation also is compact in design and reduces substation area tremendously (at least 70%) compared to the same AIS configuration. This fact allows GIS to become the choice of preference for indoor and underground substation. For a better appearance, an underground GIS substation can be designed with an aesthetic view that hides its presence

The compact and metal-enclosed design of GIS has prominent advantages and better performance than AIS. However, the high initial investment is a key obstacle in expanding the application of GIS. In remote or rural area, industrial areas or in developing countries, AIS is still the best choice. In places where the cost of land or cost of earthworks is high or where the sceneries cannot be disturbed by AIS, the solution is to use underground or indoor GIS.

Appendix 16: Use of IT in Substation: Torrent Power (Agra)

Regarding economics, initial capital investment is not enough to evaluate the overall substation project. Life Cycle Cost (LCC) should be considered, including primary hardware cost, maintenance cost, operation cost, outage cost and disposal costs.

The LCC comparison of AIS and GIS is as follows:

1. Primary hardware: For primary equipment, GIS is more expensive than AIS. However, the price of auxiliary equipment such as support, conductors, land, installation, control, protection and monitoring can lead to a cost difference between the two systems being small.

2. Maintenance: The failure rate of circuit breaker and disconnecting switch in GIS is one-fourth of that of AIS and one tenth in case of busbar, thus the maintenance cost of GIS is less than that of AIS over the lifetime.

3. Operation cost: The maintenance cost of GIS and AIS shall be equivalent. The cost for training in GIS is higher than in AIS.

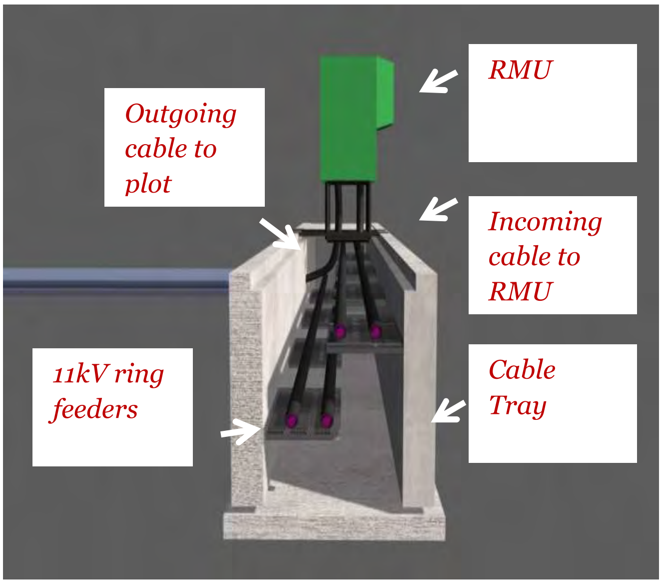
4. Outage cost: Since the failure rate of GIS is lower, the outage cost of AIS shall be greater.

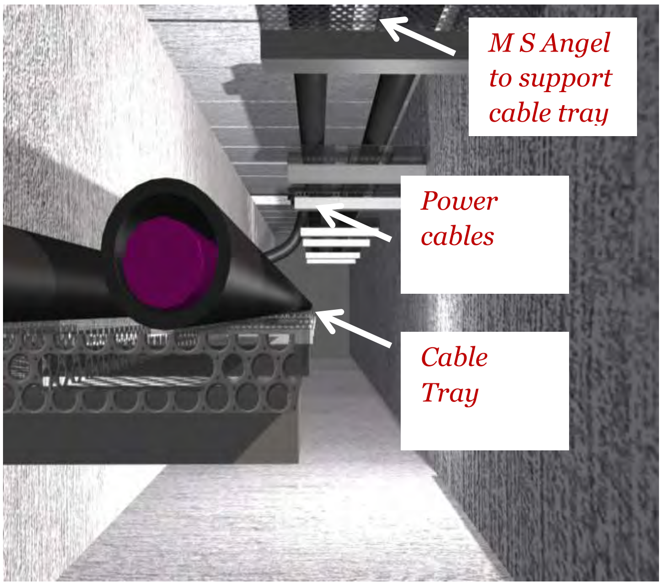
5. Disposal cost: The cost of decommissioning and disposal after use should be capitalized. The value of future expense must be taken into account.

Taking these considerations in mind, we propose installations of Gas insulated sub stations in the node for primary equipment design.

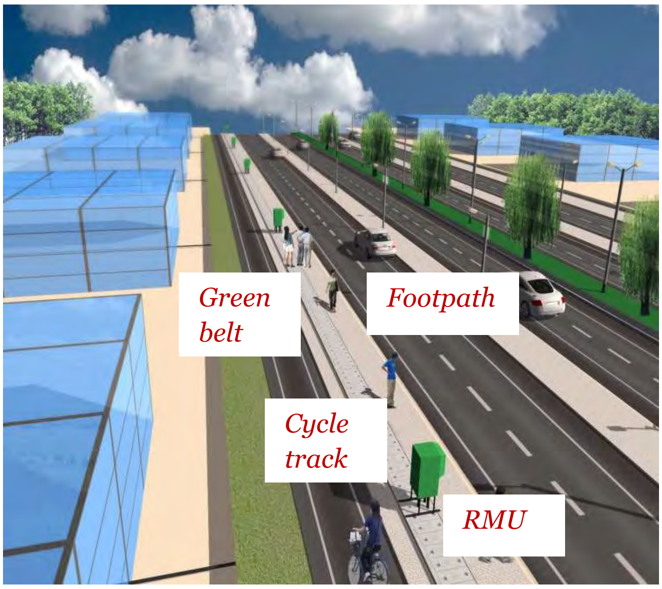
B.5. Underground Distribution Network Design

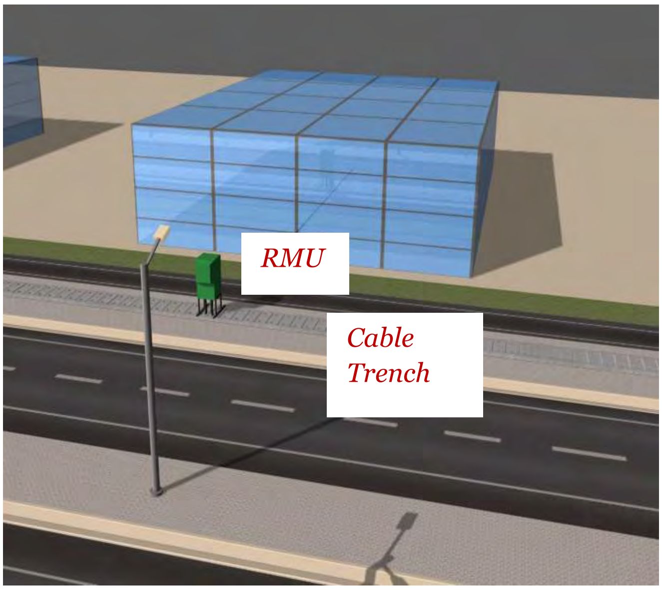
The illustrative diagrams illustrate the underground distribution network for the node.





Appendix 17: Underground 11kV feeders for node





Appendix 18: Underground feeders with RMU: Sample for illustration (Source: Naya Raipur Smart City Master Plan- PwC Analysis)

Appendix D. - Water Sector

D.1. Applicable Water Quality Standard

D.1.1. Indian Standard Specifications for Drinking Water

Appendix 19: Physical and Chemical Quality of Drinking Water

Si.No	Characteristics	Acceptable	Cause for Rejection
1	Turbidity (NTU)	1	10
2	Colour (units on Plantinum Cobalt scale)	5	25
3	Taste and Odour	Unobjectionable	Objectionable
4	pH	7.0 to 8.5	<6.5 or > 9.2
5	Total dissolved solids (mg/l)	500	2000
6	Total hardness (as CaCO3) (mg/l)	200	600
7	Chlorides (as Cl) (mg/l)	200	1000
8	Suiphates (as SO4) (mg/l)	200	400
9	Fluorides (as F) (mg/l)	1	1.5
10	Nitrates (as NO3) (mg/l)	45	45
11	Calcium (as Ca) (mg/l)	75	200
12	Magnesium (as Mg) (mg/l)	<30	`150
If there are 250 mg/l of sulphates, mg content can be increased to a mximum of 125mg/l with the reduction of sulphates at the rate of 1 unit per every 2.5 units of sulphates			
13	Iron (as Fe) (mg/l)	0.1	1
14	Manganese (as Mn) (mg/l)	0.05	0.5
15	Copper (as Cu) (mg/l)	0.05	1.5
16	Aluminium (as Al) (mg/I)	0.03	0.2
17	Alkalinity (mg/l)	200	600
18	Residual Chlorine (mg/I)	0.2	>1.0
19	Zinc (as Zn) (mg/I)	5	15
20	Phenolic compounds (as Phenol) (mg/l)	0.001	0.002
21	Anionic detergents (mg/l) (as MBAS)	0.2	1
22	Mineral Oil (mg/l)	0.01	0.03
	TOXIC MATERIALS		
23	Arsenic (as As) (mg/l)	0.01	0.05
24	Cadmium (as Cd) (mg/I)	0.01	0.01
25	Chromium (as hexavalent Ct)	0.05	0.05
26	Cyanides (as CN) (mg/l)	0.05	0.05
27	Lead (as Pb) (mg/l)	0.05	0.05
28	Selenium (as Se) (mg/l)	0.01	0.01
29	Mercury (total as Hg) (mg/l)	0.001	0.001
30	Polynuclear aromatic hydrocarbons (PAH) (µg/l0	0.2	0.2
31	Pesticides (total, mg/l)	Absent	Refer to WHO guidelines for drinking water quality Vol I. - 1993
RADIO ACTIVITY+			
32	Gross Alpha activity (Bq/l)	0.1	0.1
33	Gross Beta activity (Bq/l)	1	1

Appendix 20: Bacteriological Quality of Drinking Water

Organisms	Guidelines value
All Water intended for drinking	
E.coli or thermotolerant coliform bacteria	Must not be detectable in any 100-ml sample
Treated water entering the distribution system	
E.coli or theromotolerant coliform bacteria	Must not be detectable in any 100-ml sample
Total coliform bacteria	Must not be detectable in any 100-ml sample
Treated water in the distribution system	
E.coli or theromotolerant coliform bacteria	Must not be detectable in any 100-ml sample
Total coliform bacteria	Must not be detectable in any 100-ml sample. In case of large supplies, where sufficient samples are examined, must not be oresent in 95% of samples taken throughout any 12 month period.

D.1.2. Standard for Recycled Water and Facilities Criterion in Japan

Appendix 21: Standard for Recycled Water and Facilities Criterion in Japan

No	Characteristics	Standard Value for Touchable Water
1	E.coli	Not detactable
2	Turbidity	2
3	pH	5.8 - 8.6
4	Apparent Condition	Offenseless
5	Color	10
6	Odor	Offenseless
7	Residual Chlorine	Free residual chlorine: 0.1mg/L Combined residual chlorine: 0.4mg/L
8	Facility Criteria	It is necessary to install a coagulating sedimentation tank + a sand filter, or the facilities with as well or better treatment capabilities.

D.1.3. General Standard For Discharge Of Environmental Pollutants (Dischare to Inland Surface Water)

Appendix 22: B.1.3. General Standard For Discharge Of Environmental Pollutants

No.	Parameter	Standard Value
		Discharge to Inland surface water
1	Suspended solids (SS)	100 mg/L
2	Biochemical Oxygen demand (BOD)	30 mg/L
3	Chemical Oxygen Demand (COD)	250 mg/L
4	Total Nitrogen (T-N)	--
5	Ammonical nitrogen (as N)	50 mg/L
6	Total Kjeldahl Nitrogen (as NH_3)	100 mg/L
7	Free ammonia (as NH_3)	5 mg/L
8	Nitrate Nitrogen	10 mg/L
9	Dissolved Phosphates (as P)	5 mg/L
10	pH Value	5.5 to 9.0
11	Temperature	shall not exceed 5^{o}Cabove the receiving water temperature
12	Oil and grease	10 mg/L
13	Total residual chlorin	1 mg/L
14	Arsenic (as As)	0.2 mg/L
15	Mercury (as Hg)	0.01 mg/L
16	Lead (as Pb)	0.1 mg/L
17	Cadmium (as Cd)	2 mg/L
18	Hexavalent Chromium (as Cr^{+6})	0.1 mg/L
19	Total chromium (as Cr)	2 mg/L
20	Copper (as Cu)	3 mg/L
21	Zinc (As Zn.)	5 mg/L
22	Selenium (as Se)	0.05 mg/L
23	Nickel (as Ni)	3 mg/L
24	Cyanide (as CN)	0.2 mg/L
25	Fluoride (as F)	2 mg/L
26	Sulphide (as S)	2 mg/L
27	Phenoile compounds (as C_6H_5OH)	1 mg/L
28	Radioactive materials :	
	(a)Alpha emitter micro curie/ml.	10^{-7}
	(b)Beta emitter micro curie/ml.	10^{-6}
29	Bio-assay test	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn)	2 mg/L
31	Iron (as Fe)	3 mg/L
32	Vanadium (as V)	0.2 mg/L

D.2. Details of Cost Estimate

D.2.1. Ponneri

(1) Construction Cost

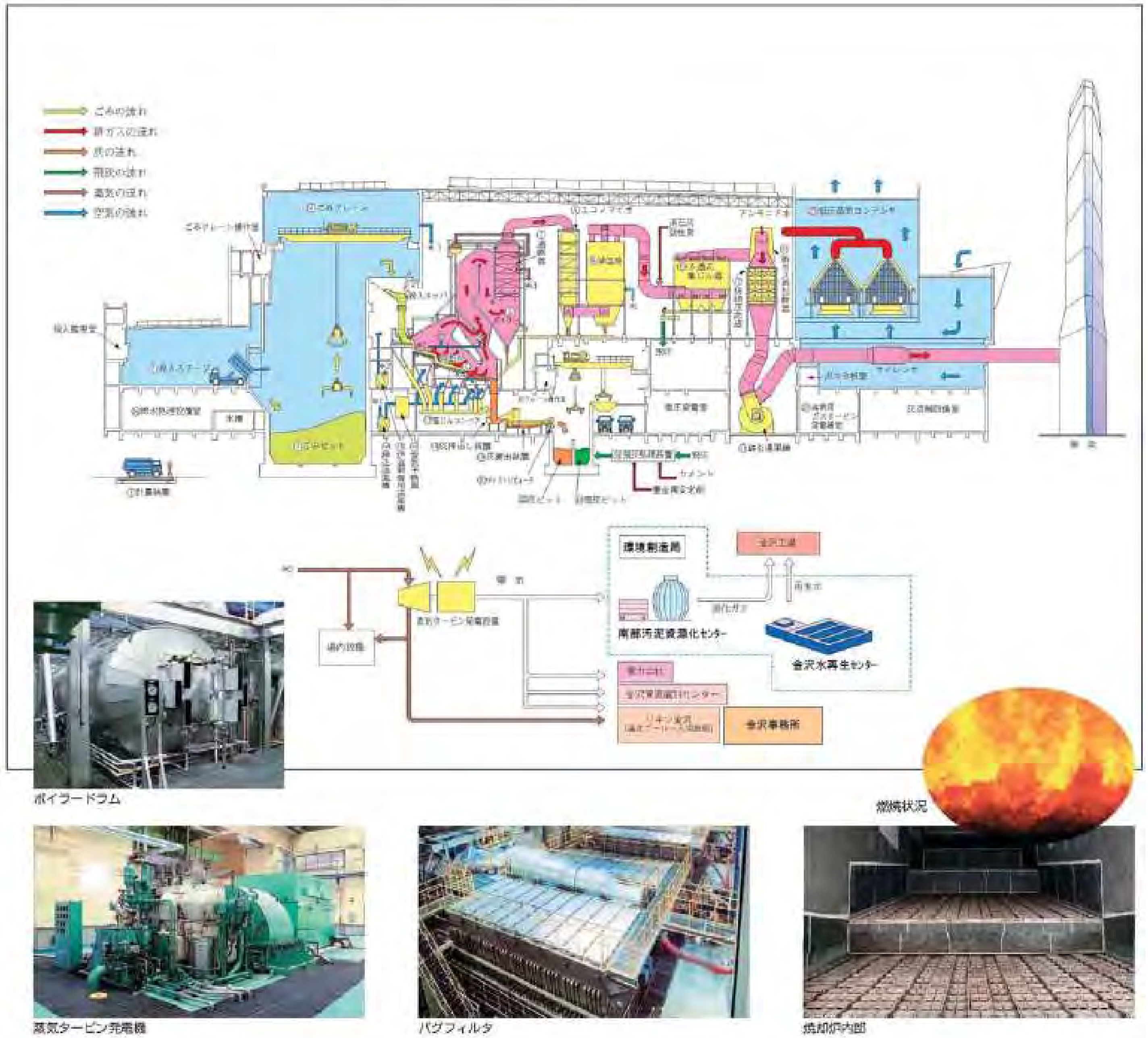
Item	Description		Unit	Unit Rate	Phase 1(2016-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
					Quantity	Cost	Quantity	Cost	Quantity	Cost	
				(INR)		(Million INR)		(Million INR)		(Million INR)	(Million INR)
WATER INFRASTRUCTURES											
1. Potable Water Supply Works	1) Raw Water Treatment System (from Kandaleru Reservoir)	a) Raw water pipe (DCIP, D=1,000mm)	m	83,678	50,000	4,184	0	0	0	0	4,184
	2) Water Treatment System	a) WTP	MLD	10,000,000	19.0	190	30.8	31	28.2	28	249
	3) Potable Water Transmission System	a) Reservoir	ML	7,000,000	9.5	67	15.4	108	14.1	99	273
		b) Pump station	kW	6,000,000	150	900	240	1,440	220	1,320	3,660
		c) Elevated tank	ML	30,000,000	2.00	60	3.20	96	2.95	89	245
		d) Transmission pipe (DIP, D=700mm)	m	45,602	0	0	3,750	171	0	0	171
		e) Transmission pipe (DIP, D=600mm)	m	37,154	0	0	1,980	74	7,430	276	350
		f) Transmission pipe (DIP, D=500mm)	m	27,164	2,600	71	1,500	41	0	0	111
		g) Transmission pipe (DIP, D=400mm)	m	19,061	0	0	0	0	11,130	212	212
		h) Transmission pipe (HDPE, D=300mm)	m	5,441	2,300	13	0	0	0	0	13
	4) Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	m	5,441	19,200	104	0	0	12,900	70	175
		b) Distribution pipe (HDPE, D=200mm)	m	2,054	41,800	86	42,600	88	79,700	164	337
		c) Distribution pipe (HDPE, D=150mm)	m	1,410	25,600	36	70,700	100	86,200	122	257
	Sub-total					**5,710**		**2,147**		**2,379**	**10,236**
2. Non-Potable Water Supply Works	1) Tertiary Treatment Plant	a) Tertiary treatment plant by RO process	MLD	14,000,000	20.9	293	34.5	483	96.5	1,351	2,127
	2) Non-Potable Water Transmission System	a) Reservoir	ML	7,000,000	10.5	74	17.5	123	48.0	336	532
		b) Pump station	kW	6,000,000	180	1,080	270	1,620	750	4,500	7,200
		c) Elevated tank	ML	30,000,000	2.75	83	3.60	108	8.50	255	446
		d) Transmission pipe (DIP, D=600mm)	m	37,154	0	0	3,000	111	7,500	279	390
		e) Transmission pipe (DIP, D=500mm)	m	27,164	1,450	39	3,500	95	2,000	54	189
		f) Transmission pipe (DIP, D=400mm)	m	19,061	2,500	48	0	0	10,500	200	248
		g) Transmission pipe (HDPE, D=300mm)	m	11,234	0	0	0	0	13,000	146	146
	3) Non-Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	m	5,441	19,200	104	0	0	12,900	70	175
		b) Distribution pipe (HDPE, D=200mm)	m	2,054	41,800	86	42,600	88	79,700	164	337
		c) Distribution pipe (HDPE, D=150mm)	m	1,410	25,600	36	70,700	100	86,200	122	257
	Sub-total					**1,842**		**2,727**		**7,477**	**12,046**
3. Domestic Sewerage System	1) Sewage Collection System	a) Sewer pipe (RC, D=700mm)	m	12,195	0	0	1,743	21	2,682	33	54
		b) Sewer pipe (RC, D=600mm)	m	7,992	0	0	2,905	23	4,470	36	59
		c) Sewer pipe (RC, D=500mm)	m	6,951	2,285	16	5,810	40	8,940	62	118
		d) Sewer pipe (RC, D=400mm)	m	4,827	9,140	44	11,620	56	17,880	86	187
		e) Sewer pipe (RC, D=300mm)	m	2,640	18,280	48	23,240	61	35,760	94	204
		f) Sewer pipe (RC, D=250mm)	m	1,998	61,695	123	70,882	142	109,068	218	483
		g) Intermediate pump stations	kW	300,000	45	14	125	38	180	54	105
	2) Sewage Treatment Plant	a) Final pump station	kW	2,000,000	20	40	45	90	45	90	220
		b) Sewage treatment plant	MLD	8,000,000	7.7	62	15.3	122	16.4	131	315
	Sub-total					**347**		**594**		**804**	**1,745**
4. Treated Sewage and Industrial Effluent Collection Works	1) Treated Sewage Transfer System from STP to TTP	a) Transfer pump station	kW	6,000,000	15	90	22	132	65	390	612
		b) Transfer pipe (DIP, D=1000mm)	m	83,678	0	0	0	0	200	17	17
		c) Transfer pipe (DIP, D=700mm)	m	45,602	0	0	200	9	0	0	9
		d) Transfer pipe (DIP, D=500mm)	m	27,164	200	5	0	0	0	0	5
	2) Treated Sewage Transfer from Nellore City to TTP	a) Treated sewage pump station	kW	6,000,000	0	0	0	0	90	540	540
		b) Transfer pipe (DIP, D=1000mm)	m	83,678	0	0	0	0	25,000	2,092	2,092
	3) Treated Effluent Collection and Transfer System	a) Sewer pipe (RC, D=1400mm)	m	40,149	0	0	0	0	894	36	36
		b) Sewer pipe (RC, D=1200mm)	m	32,436	0	0	0	0	2,682	87	87
		c) Sewer pipe (RC, D=1100mm)	m	26,574	0	0	0	0	4,470	119	119
		d) Sewer pipe (RC, D=1000mm)	m	18,603	0	0	1,743	32	6,258	116	149
		e) Sewer pipe (RC, D=900mm)	m	16,812	0	0	2,905	49	8,940	150	199
		f) Sewer pipe (RC, D=800mm)	m	14,580	1,371	20	5,810	85	13,410	196	300
		g) Sewer pipe (RC, D=700mm)	m	12,195	2,285	28	11,620	142	17,880	218	388
		h) Sewer pipe (RC, D=600mm)	m	7,992	9,140	73	17,430	139	22,350	179	391
		i) Sewer pipe (RC, D=500mm)	m	6,951	18,280	127	23,240	162	26,820	186	475
		j) Sewer pipe (RC, D=400mm)	m	4,827	22,850	110	29,050	140	35,760	173	423
		h) Sewer pipe (RC, D=300mm)	m	2,640	38,845	103	34,860	92	75,990	201	395
		k) Intermediate pump station	kW	300,000	100	30	230	69	700	210	309
		l) Final pump station	kW	2,000,000	50	100	75	150	175	350	600
		m) Effluent force main (DIP, D=1200mm)	m	120,494	0	0	0	0	200	24	24
		n) Effluent force main (DIP, D=900mm)	m	67,574	0	0	200	14	0	0	14
		o) Effluent force main (DIP, D=700mm)	m	45,602	200	9	0	0	0	0	9
	Sub-total					**695**		**1,214**		**5,283**	**7,193**
5. Drainage Works	1) Drainage System	a) Storm water drain	m	20,000	37,500	750	101,520	2,030	138,250	2,765	5,545
		b) Improvement of existing canal	m	12,000	8,510	102	0	0	0	0	102
		c) Improvement of bund of existing water body	m	0	0	0	0	0	0	0	0
		d) Outfall Structures	Nos	1,000,000	1	1	3	3	2	2	6
	Sub-total					**853**		**2,033**		**2,767**	**5,654**
TOTAL						**9,447**		**8,716**		**18,710**	**36,873**

(2) Operation and Maintenance Cost

Item	Description		Unit	Charges	Phase 1(2016-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
					Annual	Phase Total	Annual	Phase Total	Annual	Phase Total	
				(%)	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)	(million INR)
WATER INFRASTRUCTURES											
1. Potable Water Supply Works	1) Raw Water Treatment System (from Kandaleru Reservoir)	a) Raw water pipe (DCIP, D=1,000mm)	l.s.	5	209.2	1,046	209.2	1,046	209.2	2,092	4,184
	2) Water Treatment System	a) WTP	l.s.	5	4.8	24	10.3	51	11.7	117	193
	3) Potable Water Transmission System	a) Reservoir	l.s.	5	3.3	17	8.7	44	13.7	137	197
		b) Pump station	l.s.	10	45.0	225	162.0	810	300.0	3,000	4,035
		c) Elevated tank	l.s.	10	6.0	30	15.6	78	24.5	245	353
		d) Transmission pipe (DIP, D=700mm)	l.s.	3	0.0	0	5.1	26	5.1	51	77
		e) Transmission pipe (DIP, D=600mm)	l.s.	3	0.0	0	2.2	11	10.5	105	116
		f) Transmission pipe (DIP, D=500mm)	l.s.	3	2.1	11	3.3	17	3.3	33	61
		g) Transmission pipe (DIP, D=400mm)	l.s.	3	0.0	0	0.0	0	6.4	64	64
		h) Transmission pipe (HDPE, D=300mm)	l.s.	3	0.4	2	0.4	2	0.4	4	8
	4) Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	l.s.	3	3.1	16	3.1	16	5.2	52	84
		b) Distribution pipe (HDPE, D=200mm)	l.s.	3	2.6	13	5.2	26	10.1	101	140
		c) Distribution pipe (HDPE, D=150mm)	l.s.	3	1.1	5	4.1	20	7.7	77	103
	Sub-total				**277.6**	**1,387.8**	**429.2**	**2,146.2**	**607.8**	**6,078.1**	**9,612.1**
2. Non-Potable Water Supply Works	1) Tertiary Treatment Plant	a) Tertiary treatment plant by RO process	l.s.	20	29.3	146	106.8	534	290.2	2,902	3,583
	2) Non-Potable Water Transmission System	a) Reservoir	l.s.	5	3.7	18	9.8	49	26.6	266	333
		b) Pump station	l.s.	10	54.0	270	189.0	945	495.0	4,950	6,165
		c) Elevated tank	l.s.	10	8.3	41	19.1	95	44.6	446	582
		d) Transmission pipe (DIP, D=600mm)	l.s.	3	0.0	0	3.3	17	11.7	117	134
		e) Transmission pipe (DIP, D=500mm)	l.s.	3	1.2	6	4.0	20	5.7	57	83
		f) Transmission pipe (DIP, D=400mm)	l.s.	3	1.4	7	1.4	7	7.4	74	89
		g) Transmission pipe (HDPE, D=300mm)	l.s.	3	0.0	0	0.0	0	4.4	44	44
	3) Non-Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	l.s.	3	3.1	16	3.1	16	5.2	52	84
		b) Distribution pipe (HDPE, D=200mm)	l.s.	3	2.6	13	5.2	26	10.1	101	140
		c) Distribution pipe (HDPE, D=150mm)	l.s.	3	1.1	5.4	4.1	20	7.7	77	103
	Sub-total				**104.6**	**522.9**	**345.9**	**1,729.4**	**908.6**	**9,086.2**	**11,338.6**
3. Domestic Sewerage Works	1) Sewage Collection System	a) Sewer pipe (RC, D=700mm)	l.s.	5	0.0	0	1.1	5	2.7	27	32
		b) Sewer pipe (RC, D=600mm)	l.s.	5	0.0	0	1.2	6	2.9	29	35
		c) Sewer pipe (RC, D=500mm)	l.s.	5	0.8	4	2.8	14	5.9	59	77
		d) Sewer pipe (RC, D=400mm)	l.s.	5	2.2	11	5.0	25	9.3	93	129
		e) Sewer pipe (RC, D=300mm)	l.s.	5	2.4	12	5.5	27	10.2	102	141
		f) Sewer pipe (RC, D=250mm)	l.s.	5	6.2	31	13.2	66	24.1	241	338
		g) Intermediate pump stations	l.s.	5	0.3	2	1.6	8	3.9	39	49
	2) Sewage Treatment Plant	a) Final pump station	l.s.	5	1.0	5	4.3	21	8.8	88	114
		b) Sewage treatment plant	l.s.	5	1.5	8	6.1	31	12.5	125	163
	Sub-total				**14.5**	**72.3**	**40.8**	**203.9**	**80.4**	**803.6**	**1,079.8**
4. Treated Sewage and Effluent Collection and Transfer Works	1) Treated Sewage Transfer System from STP to TTP	a) Transfer pump station	l.s.	5	4.5	23	11.1	56	30.6	306	384
		b) Transfer pipe (DIP, D=1000mm)	l.s.	3	0.0	0	0.0	0	0.5	5	5
		c) Transfer pipe (DIP, D=700mm)	l.s.	3	0.0	0	0.3	1	0.3	3	4
		d) Transfer pipe (DIP, D=500mm)	l.s.	3	0.2	1	0.2	1	0.2	2	3
	2) Treated Sewage Transfer from Nellore City to TTP	a) Treated sewage pump station	l.s.	5	0.0	0	0.0	0	13.5	135	135
		b) Transfer pipe (DIP, D=1000mm)	l.s.	5	0.0	0	0.0	0	104.6	1,046	1,046
	3) Treated Effluent Collection and Transfer System	a) Sewer pipe (RC, D=1400mm)	l.s.	5	0.0	0	0.0	0	1.8	18	18
		b) Sewer pipe (RC, D=1200mm)	l.s.	5	0.0	0	0.0	0	4.3	43	43
		c) Sewer pipe (RC, D=1100mm)	l.s.	5	0.0	0	0.0	0	5.9	59	59
		d) Sewer pipe (RC, D=1000mm)	l.s.	5	0.0	0	1.6	8	7.4	74	83
		e) Sewer pipe (RC, D=900mm)	l.s.	5	0.0	0	2.4	12	10.0	100	112
		f) Sewer pipe (RC, D=800mm)	l.s.	5	1.0	5	5.2	26	15.0	150	181
		g) Sewer pipe (RC, D=700mm)	l.s.	5	1.4	7	8.5	42	19.4	194	243
		h) Sewer pipe (RC, D=600mm)	l.s.	5	3.7	18	10.6	53	19.5	195	267
		i) Sewer pipe (RC, D=500mm)	l.s.	5	6.4	32	14.4	72	23.8	238	341
		j) Sewer pipe (RC, D=400mm)	l.s.	5	5.5	28	12.5	63	21.2	212	302
		h) Sewer pipe (RC, D=300mm)	l.s.	5	5.1	26	9.7	49	19.8	198	272
		k) Intermediate pump station	l.s.	5	0.8	4	3.2	16	10.2	102	122
		l) Final pump station	l.s.	5	2.5	13	8.8	44	21.3	213	269
		m) Effluent force main (DIP, D=1200mm)	l.s.	3	0.0	0	0.0	0	0.7	7	7
		n) Effluent force main (DIP, D=900mm)	l.s.	3	0.0	0	0.4	2	0.4	4	6
		o) Effluent force main (DIP, D=700mm)	l.s.	3	0.3	1	0.3	1	0.3	3	5
	Sub-total				**26.6**	**132.8**	**77.7**	**388.7**	**174.8**	**1,748.0**	**2,269.5**
5. Drainage Works	1) Drainage System	a) Storm water drain	l.s.	5	37.5	188	139.0	695	277.3	2,773	3,655
		b) Improvement of existing canal	l.s.	5	5.1	26	5.1	26	5.1	51	102
		c) Improvement of bund of existing water body	l.s.	10	0.0	0	0.0	0	0.0	0	0
		d) Outfall Structures	l.s.	5	0.1	0	0.2	1	0.3	3	4
	Sub-total				**42.7**	**213**	**144**	**1,451**	**283**	**2,827**	**4,492**
TOTAL					**465.8**	**2,329.1**	**1,038.0**	**5,919.7**	**2,054.3**	**20,542.7**	**28,791.5**

Appendix E. -Solid Waste Management

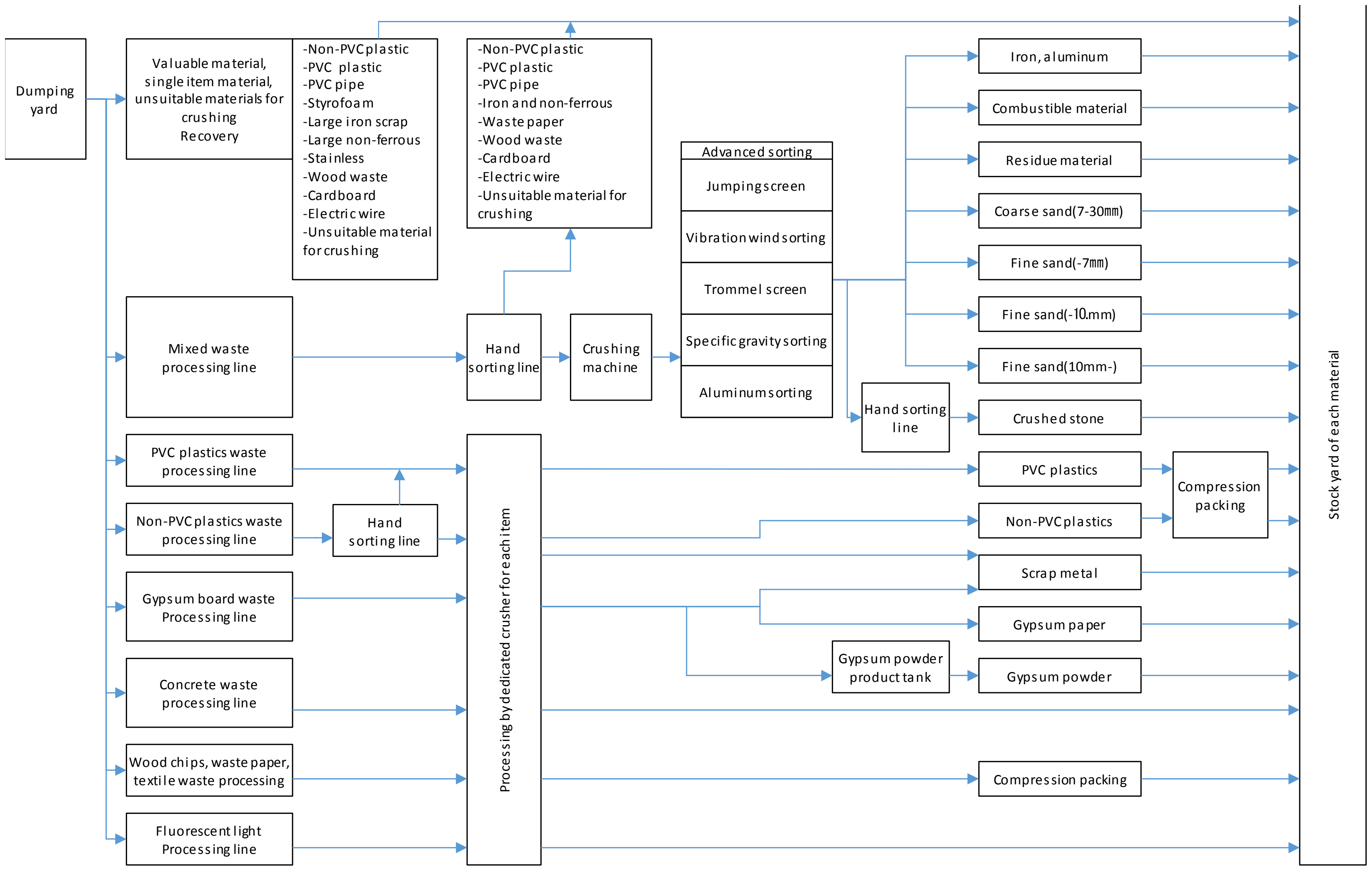
D.3. Cases of Waste to Energy (Incinerator) in Japan



Source: Brochure of Yokohama City.

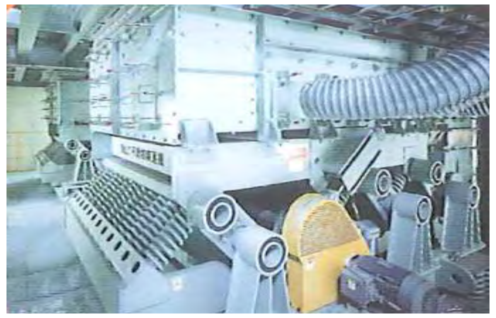
D.4. Cases of Processing Facility for Construction Waste in Japan

Construction waste in Japan: Specifically, concrete slabs, asphalt-concrete slabs, construction sludge, wood generated from construction works, waste plastic, glasses, concrete chips, ceramics, scrap metals, paper, fiber, rubber, and mixed items of these are defined as construction waste.



Trommel screen
-Sorting by the particle size and wind

Incombustible separation machine
-Sorting by crushed and reclaimed sand



Jumping screen
-Removing the moisture and dust by jumping

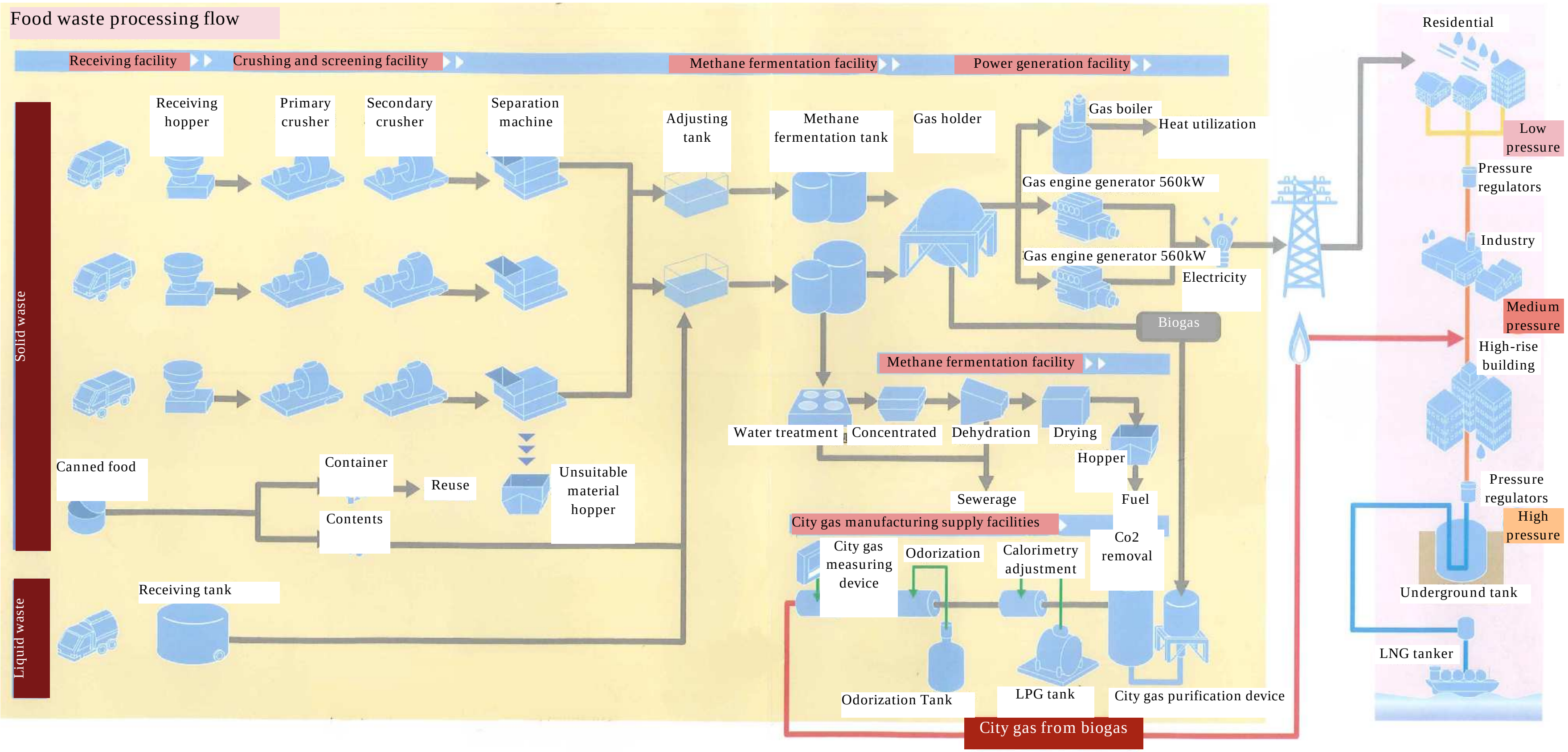
Specific gravity separator
- Sorting by the weight difference

Vibration & wind separator
-Sorting by vibration and wind

Magnetic separator
-Sorting by magnetic forces

Source: Brochure of Takatoshi Co.,Ltd.

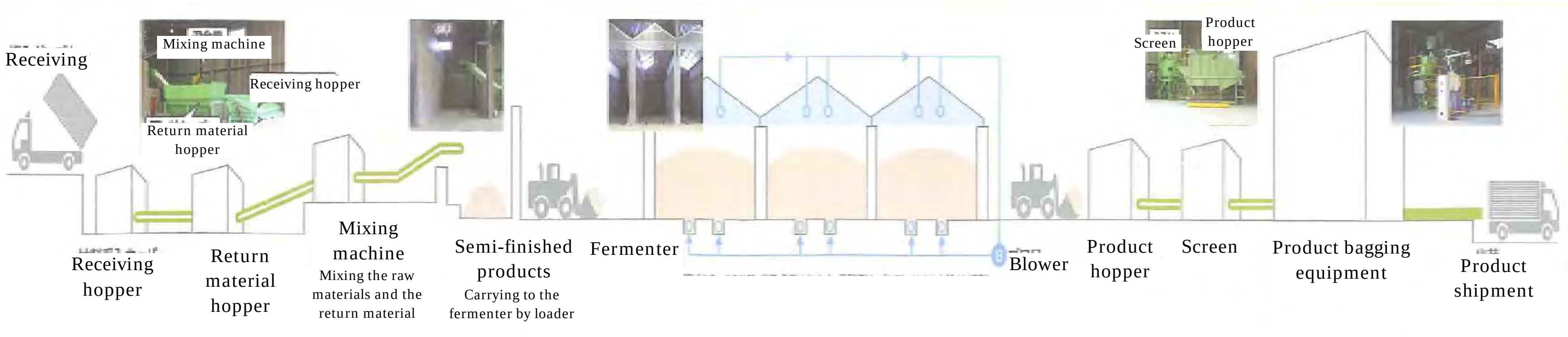
D.5. Appendix: Cases of Bio-methanation in Japan



This system has the following characteristics.
*High quality of fermentation is secured by crushing the food waste and removing the unsuitable materials at the sorting facility before the methane fermentation process.
*Supplying gas to the consumers by refining

Source: Brochure of BIOERNERGY Co.,Ltd.

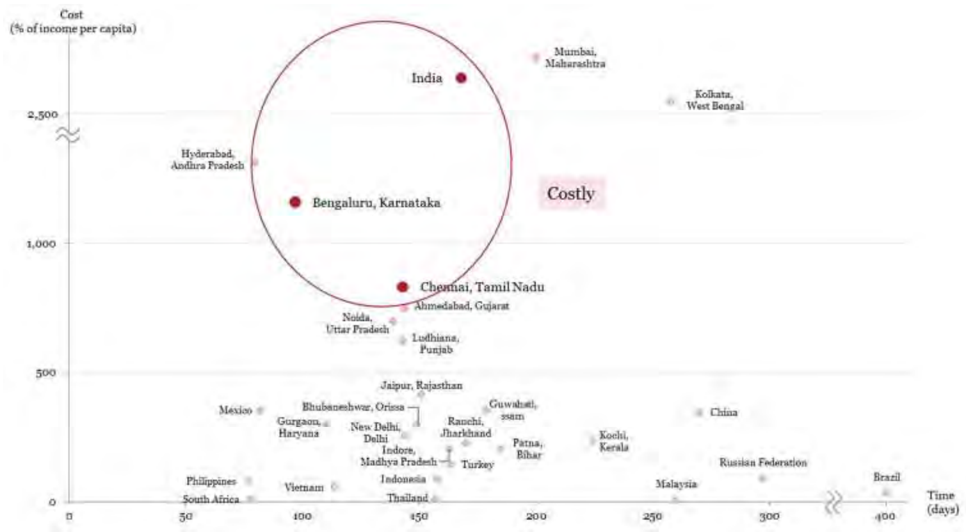
D.6. Appendix: Cases of Composting in Japan



The characteristics of this system is to control odor and water content by the "decompressed parallel fermentation technology" where the air suction is done from the upper part of the facility using a blower and exhaust gas is emitted from the lower part of the facility.

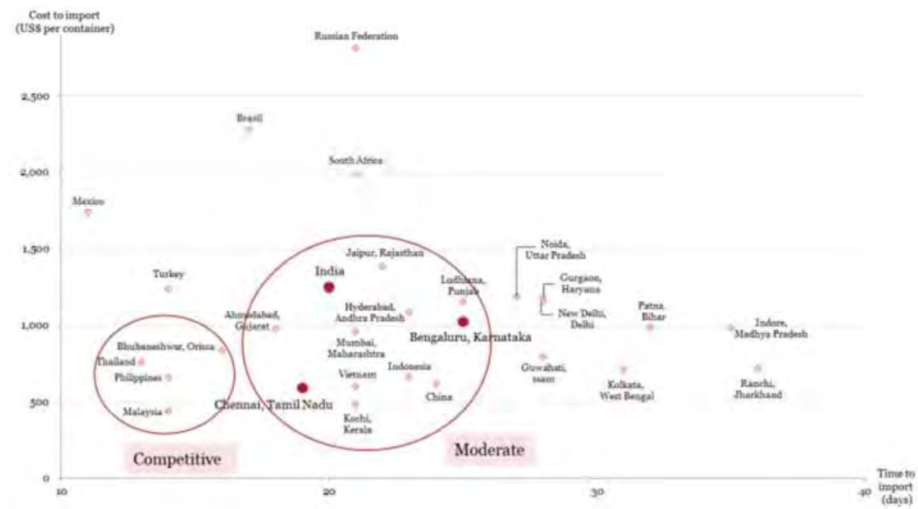
Appendix F. -Investment Environment

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 categorized 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.



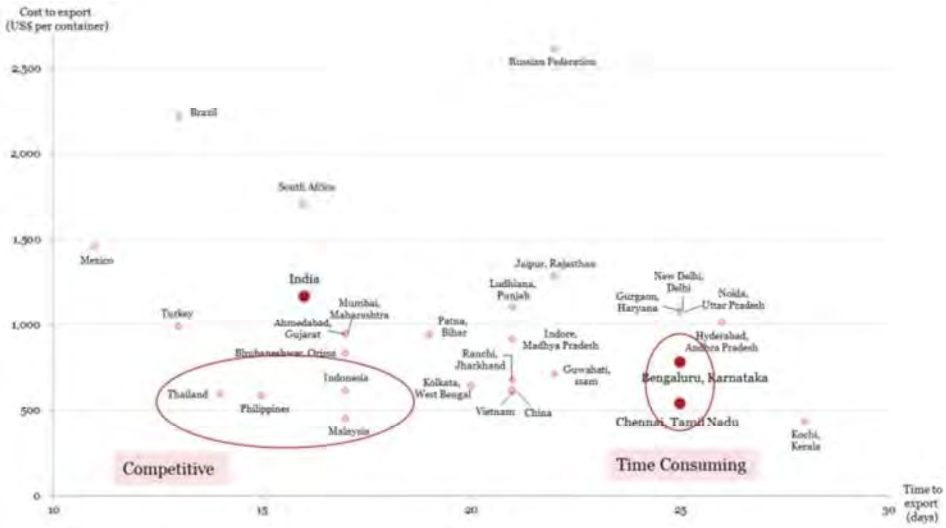
Appendix 23: **Dealing with Construction Permits**

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.



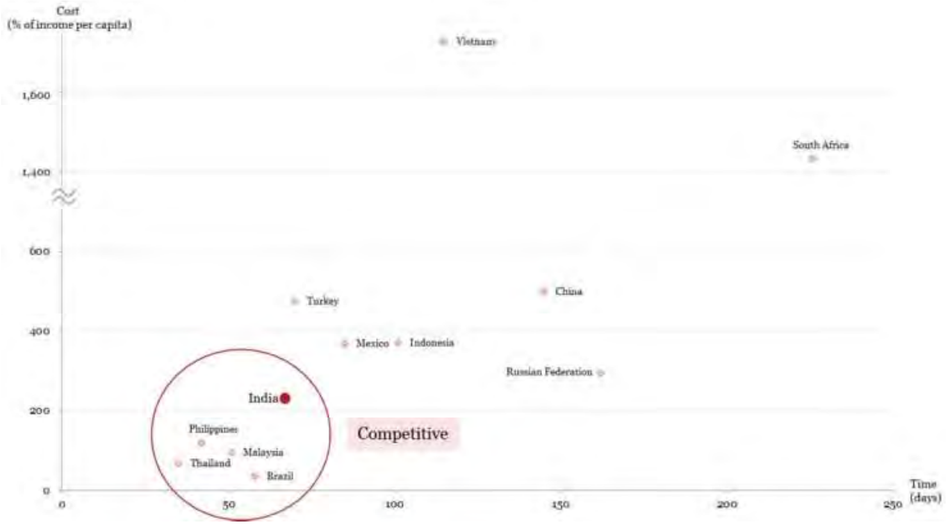
Appendix 24: Trading Across Borders - Import

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.



Appendix 25: Trading Across Borders – Export

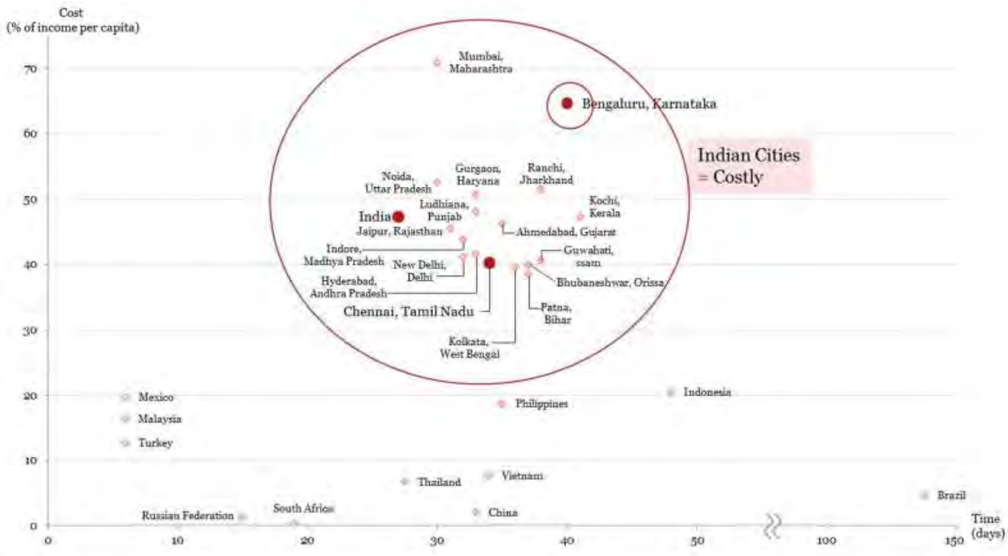
Also, the ease of getting electricity for users could be said as the strength of CBIC. However, it is only true for large scale companies in reality.



Appendix 26: Getting Electricity

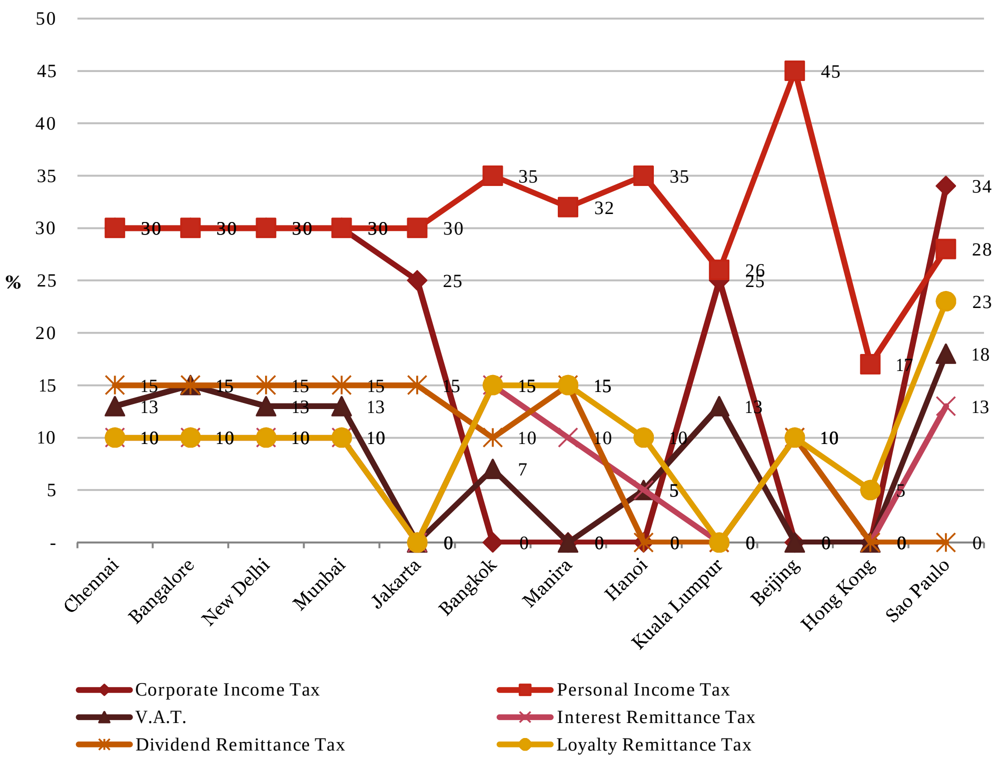
For the next, the analysis takes up the contents evaluated as weaknesses of CBIC, i.e., starting business, paying taxes and enforcing contract.

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.



Appendix 27: 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.



Source: JETRO

Appendix 28: Tax Rates (2013)

Here are other taxes the investors are levied in CBIC.

Appendix 29: 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.

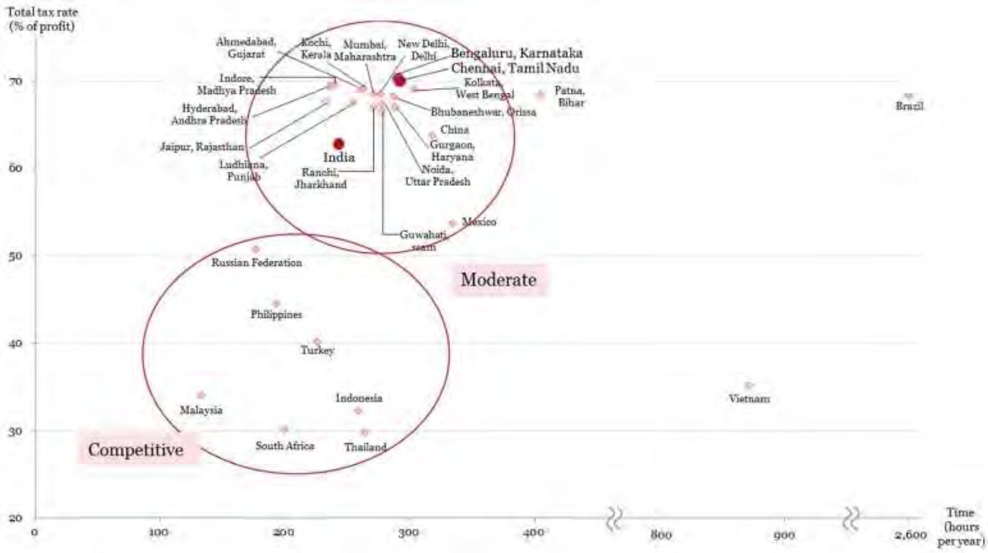
Appendix 30: Indirect Taxes

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.

Name	Rate	Description
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.
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.

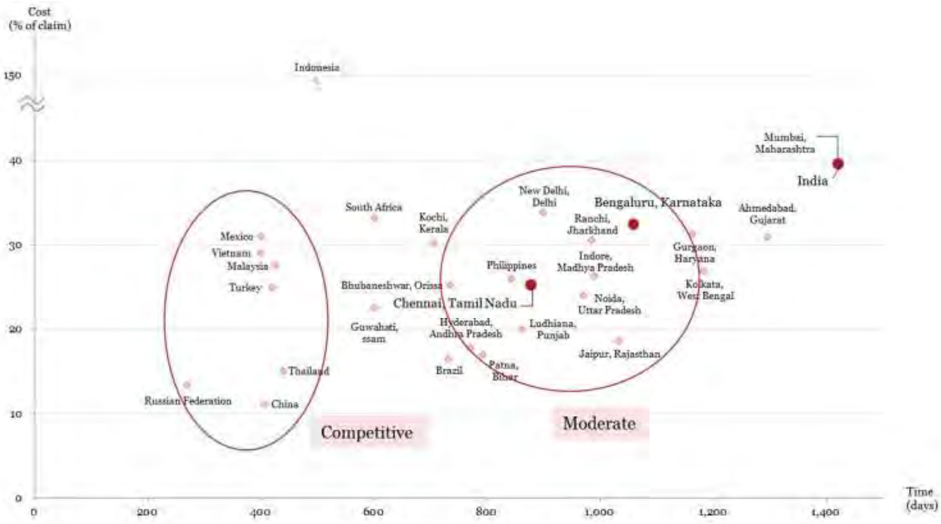
In addition to the tax rate, procedure of paying tax is troublesome and requires time for investors. For example, the time of paying tax per year in China is 9 times, but it is 68 times in Chennai. This means India has still been trapped in the short term and micro view on taxation that higher tax rate 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.



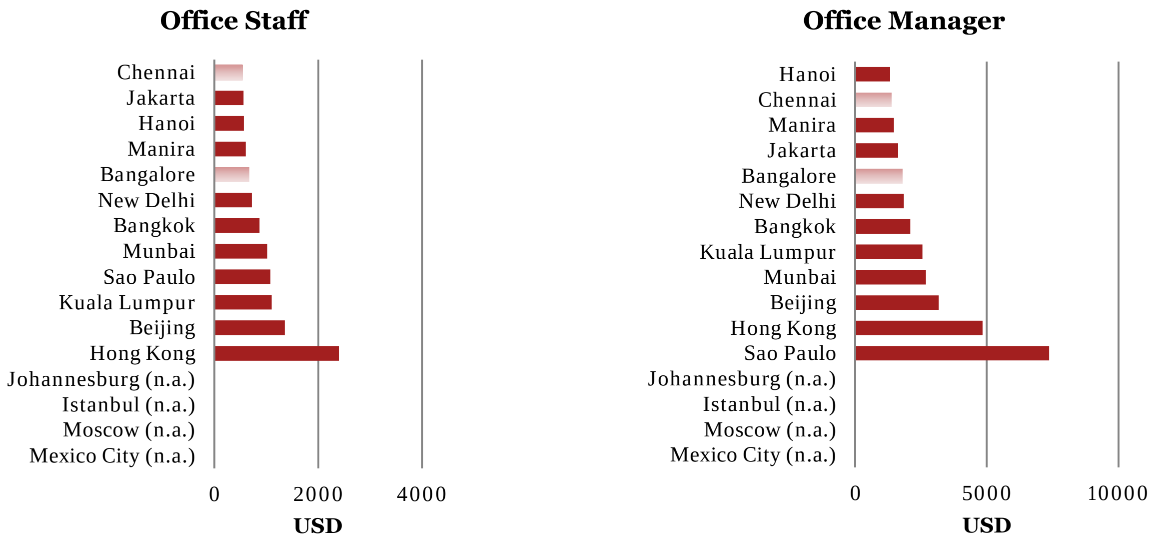
Appendix 31: Paying Taxes

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.



Appendix 32: Enforcing Contract

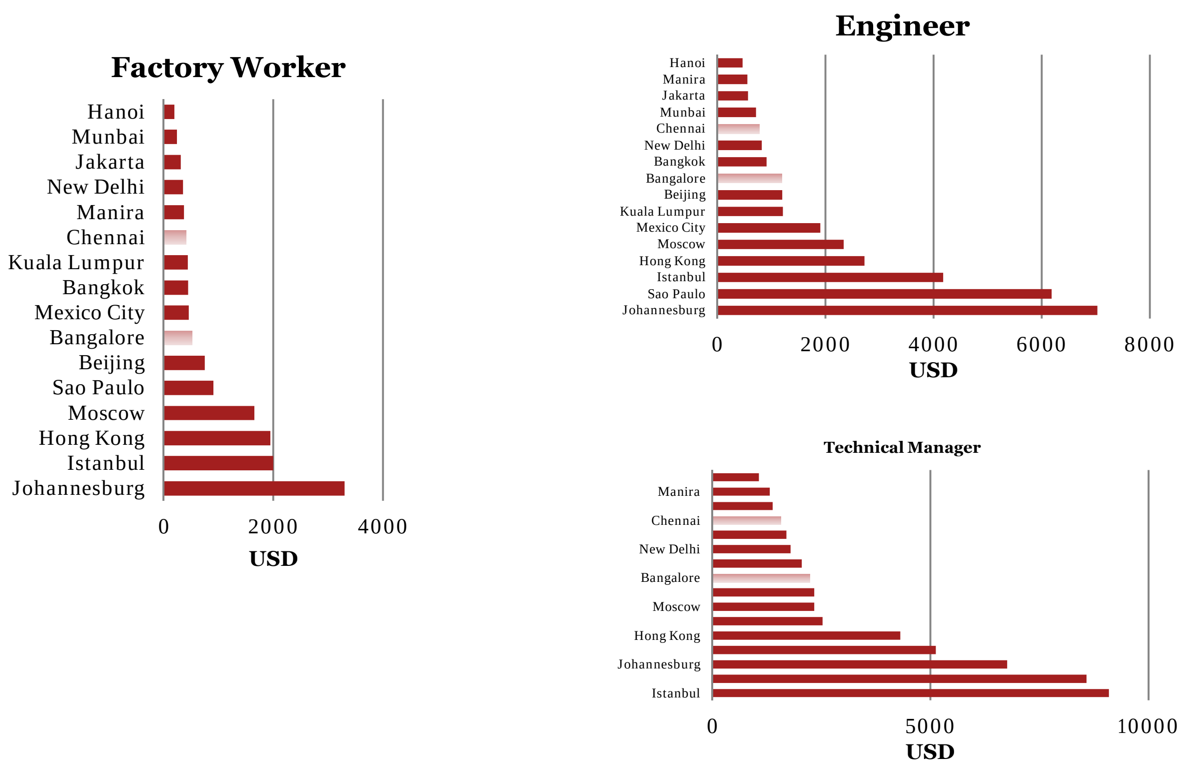
As for the average wages, the office workers' wages in 2 cities in CBIC are placed in the low level group. Given the level of education in those cities available for white collared persons, it can be said that high quality human resources are available at reasonable price in CBIC. In addition, in India, 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.



Source: JETRO

Appendix 33: 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.



Source: JETRO

Appendix 34: 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.

Appendix 35: Comparison of Ease of Doing Business

Parameter		Singapore [1st]*	Thailand [26th]*	Indonesia [114th]*	Vietnam [78th]*	India [142th]*			
						Best practice	KT/Bengaluru	TN/Chennai	AP/Hyderabad
①Starting a business	Cost (% of income per capita)	0.6	6.6	20.1	5.3	41.1	64.7	40.3	41.6
	Time (days)	2.5	26.5	52.5	34	32	40	34	33
②Dealing with construction permits	Cost (% of income per capita)	0.3	0.1	4.9	0.7	1,314.20	1,158.70	831.7	1,314.20
	Time (days)	26	113	202	114	80	97	143	80
③ Registering property	Cost (% of property value)	2.8	6.3	10.9	0.6	7.7	9.2	10.1	10.5
	Time (days)	4.5	2	25	57	26	28	48	37
④Paying Tax	**Payments (no. per year)**	5	22	65	32	59	59	68	78
	Time (hrs per year)	82	264	253.5	872	255	291	292	236
⑤Enforcing Contracts	Cost (% of claim)	25.8	15	118.1	29	17.8	32.5	25.3	17.8
	Time (days)	150	440	460	400	770	1,058	877	770
⑥Trading Across Borders	Cost to export (US$ per container)	460	595	585	610	833.9	783.5	540	1,011.60
	Time to export (days)	6	14	17	21	17	25	25	26
⑥Trading Across Border	**Cost to import (US$ per container)**	440	760	660	600	833.3	1,023.90	592.9	1,084.50
	Time to import (days)	4	13	26	21	16	25	19	23
⑦Closing Business	Cost (% of estate)	3	36	22	14.5	7	10	10	7
	Time (years)	0.8	2.7	2	5	7	7.3	6.5	7

Source: World Bank

Appendix G. Critical Projects

Projects Specific to Ponneri Node

No.	Name of the project	Sector	State	Entity	Term	Cost	Status
1	Northern Port Access Road for connectivity to Ennore Port	Ports	Tamil Nadu	CMD TIDCO Govt of Tamil Nadu	Long Term	Rs. 400 crore (Phase I)	FR/DPR Complete
2	Rail link to Ennore Port from the North of Minjur Railway station on the Chennai – Gudur line	Ports	Tamil Nadu	Kamarajar Port Ministry of Shipping Ministry of Railways	Long Term	Rs. 170 crores	FR/DPR in Progress
3	Ennore Port (Minjur) - Avadi/Tiruvallur Rail link	Ports	Tamil Nadu	Kamarajar Port, Ministry of Shipping TIDCO Indian Railways	Long Term	Rs. 350 crores	-
4	Rail link from Avadi to Guduvancherry via Sriperumbudur and Oragadam	Ports	Tamil Nadu	CMD TIDCO Govt of Tamil Nadu Ministry of Railways	Long Term	Rs. 1295.81 crore (Civil Engg cost and other - Rs. 839.41, Land - Rs. 456.40 crore)	FR/DPR in Progress

Projects common to the CBIC region which can potentially help Ponneri Node

No.	Name of the project	Sector	State	Entity	Term	Cost	Status
5	Greenfield Airport at Sriperumbudur	Airports	Tamil Nadu	Airports Authority of India & Transport Department, Govt. of Tamil Nadu	Govt of Tamil Nadu Ministry of Civil Aviation	Rs. 9,000 crores	FR/DPR Complete
6	Chennai Outer Ring Road – Phase I and Phase II	Urban Roads	Tamil Nadu	TNRDC	Short Term	Rs. 2,156 crores	Under Construction

No.	Name of the project	Sector	State	Entity	Term	Cost	Status
7	Peripheral Road from Mamallapuram to Ennore	Urban Roads	Tamil Nadu	Department of Highways & Minor Ports, Govt. of Tamil Nadu	Long Term	Rs. 3,726 crores (Construction) Rs. 5,331 crores (Land Acquisition)	FR/DPR Complete
8	Bengaluru– Chennai Expressway	Roads	Karnataka & Tamil Nadu	NHAI	Long Term	Rs. 6,783 crores	FR/DPR in Progress
9	Line upgradation of some sections along Chennai – Bengaluru route	Railways	Karnataka & Tamil Nadu	Ministry of Railways	Long Term	Rs. 516.9 crores	Under construction
10	Dedicated Freight Corridor between Chennai & Bengaluru	Railways	CBIC region	Dedicated Freight Corridor Corporation of India Limited (DFCCIL)	Long Term	Rs. 11,927 Crore	-

Appendix F Cost-Detail Break up

Appendix 36: Detailed Break up of cost

Item (All Costs in Rs. Crore - Escalated Prices)	Phase I	Phase II	Phase III	Total
	Upto FY 19	FY 20-24	FY 25 onwards	
Roads	**1,234**	**232**	**1,340**	**2,806**
Internal Road works	452	119	1,340	
Intersection works	7	1	0	
River Bridges Works	46	52	0	
Flyover Bridge Works	93	12	0	
Road Facilities	548	13	0	
Internal Public Transport Facilities Works	28	35	0	
External Road Works	0	0	0	
External Public Transport Facilities works	0	0	0	
Major River Bridge Works	60	0	0	
Flyover Bridge Works	0	0	0	
Railway	**96**	**1**	**19**	**116**
Logistics Hub	96	1	19	
Railway Access Line	0	0	0	
Container Wagon	0	0	0	
Water and Effluent Treatment Facilities	**432**	**458**	**5,285**	**6,175**
Potabe water supply works	36	48	1,413	
Non-Potable water supply works	203	186	1,626	
Domestic Sewerage works	47	36	476	
Treated Sewage and Industrial effluent collection works	88	70	998	
Drainage works	57	118	773	
Solid Waste Management	**3**	**51**	**335**	**389**
Hazardous waste infrastructure	0	47	192	
MSW infrastructure	3	4	143	
Power infrastructure cost	**68**	**391**	**2,475**	**2,933**
Generation Infrastructure	0	0	0	
Transmission Infrastructure	0	0	0	
Distribution Infrastructure	68	391	2,475	

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