Comprehensive Integrated Master Plan for Chennai Bengaluru Industrial Corridor Final Report

Tumakuru Industrial Node Development Plan

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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 a robust average rate of 7.3%, putting itself on the map of some of the best performing manufacturing economies. However it is still only 15% of Indian's overall GDP and hence assumes vast growth potential. The government has set a vision to grow India's manufacturing sector to contribute 25% to the nation's GDP from current 15% by the 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.

That India has large infrastructure gap, which impacts competitiveness of manufacturing in India, is well understood. Equally, the financing and institutional capacity constraints imply that rapid build-up across all areas is unrealistic. In this context, the Industrial Corridors can help prioritize industrial and infrastructure projects in a defined regional boundary to leverage agglomeration benefits. Thus, the foundation for developing successful models of development needs to be created.

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 the world class hub for attracting domestic and foreign investment in industries by providing world class infrastructure, required connectivity to the eastern ports, 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 Centre *"Be known as a global leading manufacturing centre 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

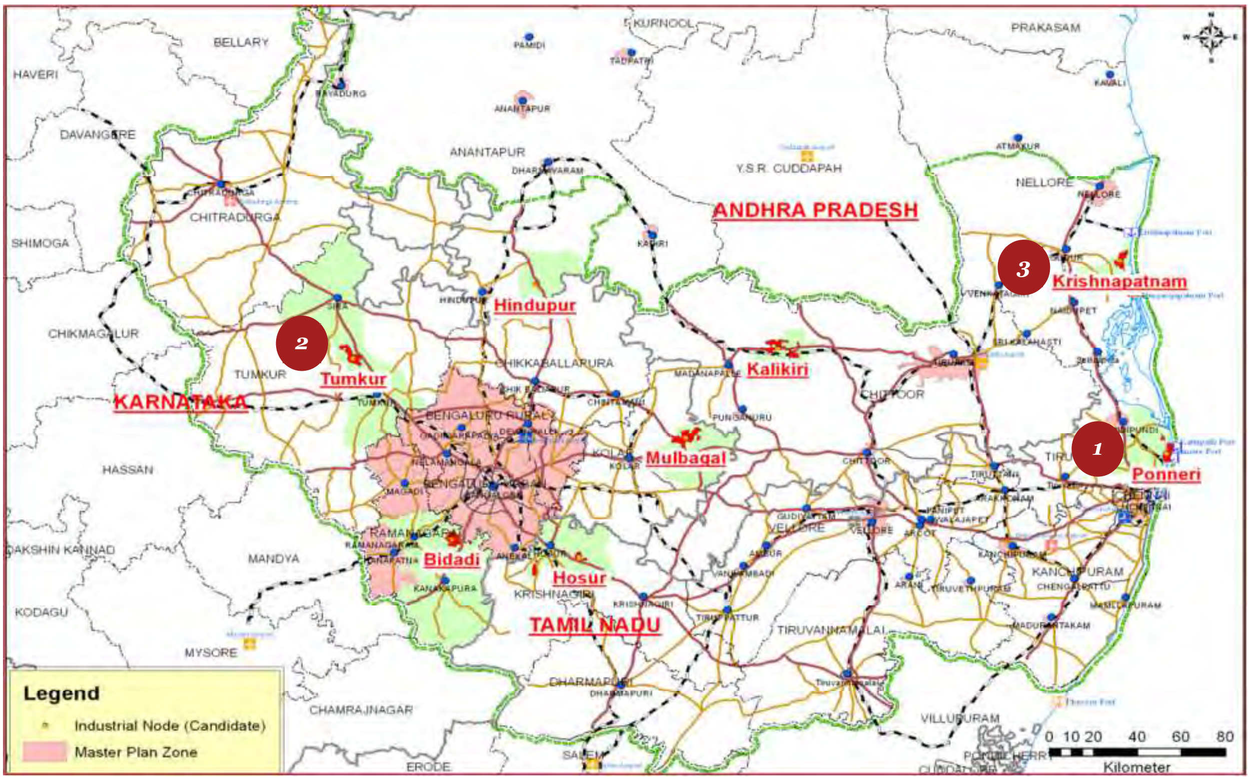


Figure 1.2 : Nodes selected for CBIC

Development of Industrial Node at Tumakuru

The JICA Perspective Plan for CBIC identified Vasanthanarasapura Industrial Area or Tumakuru NIMZ as a prospective industrial node for CBIC along with seven other nodes including Mulbagal and Bidadi in Karnataka. Tumakuru NIMZ is 90KM from the Tumakuru district centre and about 120 km from the Bengaluru International Airport. Tumakuru has the distinct advantage as the satellite town to Bengaluru. It has the potential to integrate with wider Bengaluru industrial and economic cluster which includes automobile and electronics industrial hubs such as Bidadi (Toyota Hub) and Narasapura etc.

Phase I- III of Tumakuru NIMZ is currently the brown-field industrial area which has been developed and operational. Phase IV- VI measuring around 10,000 acres is the green- field industrial development which will be undertaken under CBIC. KIADB is under the process of land acquisition for the green field area. New Industrial Park for Japanese companies will be planned at phase III of Tumakuru NIMZ. The development of Tumakuru Node and associated infrastructure will be beneficial for surrounding industrial activities including forthcoming Japanese Industrial Park.

Locational Advantages

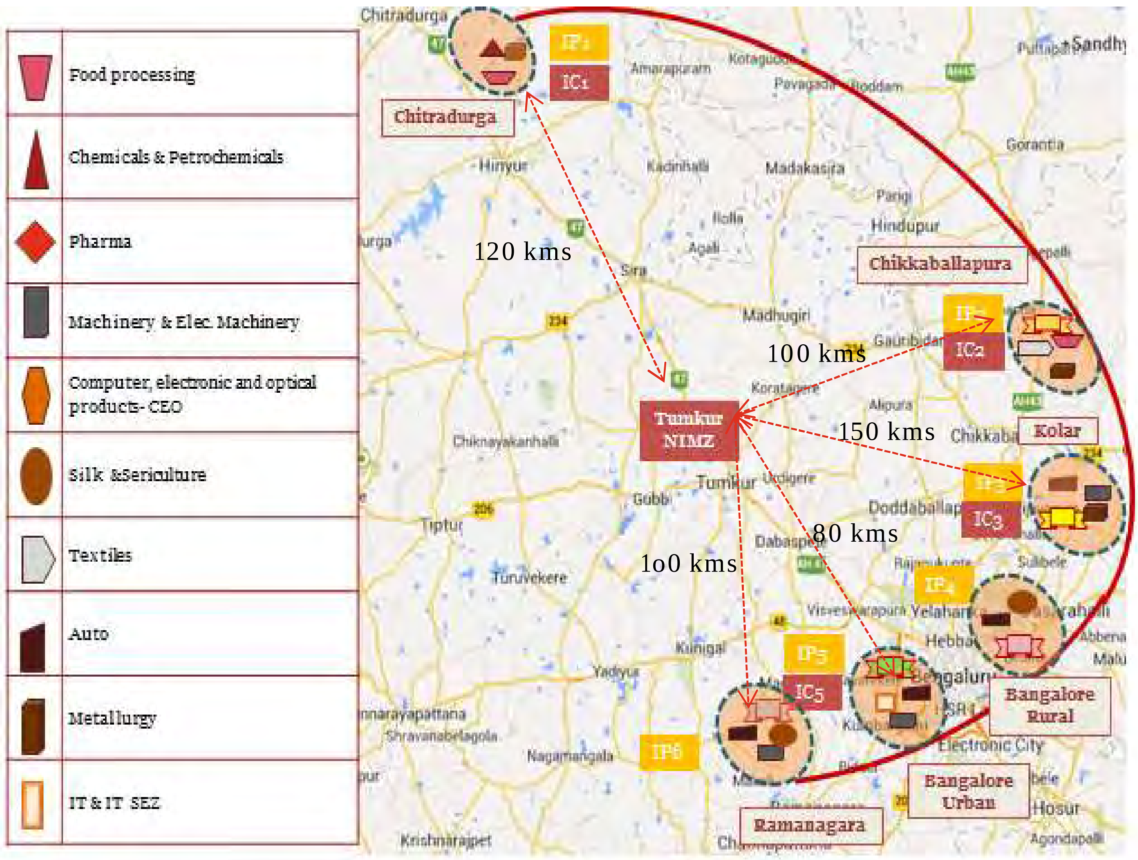
The proposed Tumakuru Node lies along either side of NH-4 which connects Mumbai to Chennai via Pune and Bengaluru. The site is located about 90km northwest of the centre of Bengaluru city, and 20km northwest of Tumakuru city, the headquarter of Tumakuru district. It is well connected to a number of regional ports with several alternatives including - 1) Chennai and Ennore, 2) Krishnapatnam, 3) Mangalore, and 4) Mumbai.

Table 1.1: Location advantage of Tumakuru Node

Particular	Description
Distance from Metropolitan/major city	80 km from city centre of Bengaluru 20 km from Tumakuru city 30 km from Sira city
Accessibility to trunk road network	NH-4 passes through the site
Accessibility to railway network	Currently, there is no direct railway access to the site; however a

Particular	Description
	new access line has been proposed through the node area by South Western Railway (Tumakuru – Davanagere new line).
Accessibility to major transport facilities (port, airport)	The node site is: 250 km east of Mangalore port. 360 km west of Ennore port. 350 km west of Krishnapatnam port. 100 km from Bengaluru International Airport
Major industrial locations in the surrounding area	Adjacent to Vasanthanarasapura industrial area (existing Tumakuru NIMZ area: 480 ha) 40km from Dabaspet industrial area (450 ha)

Source : JICA Study team



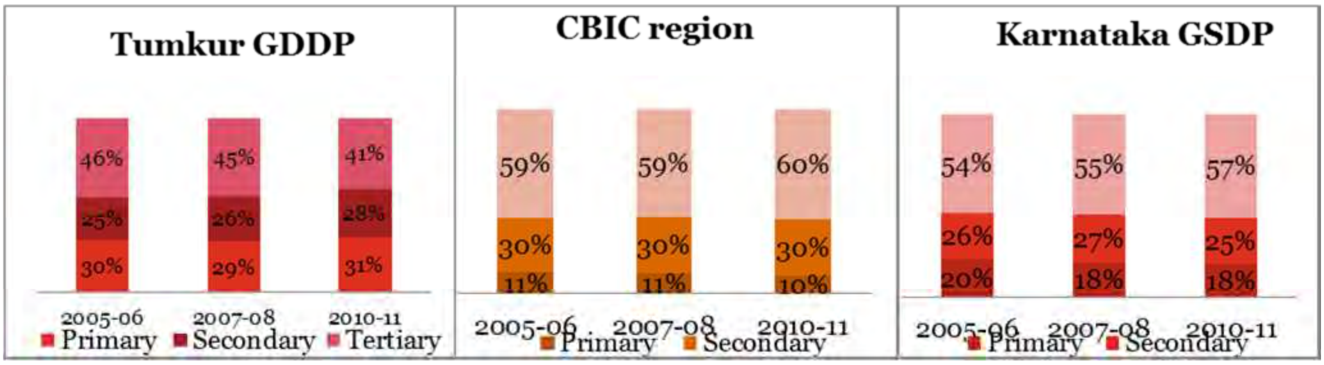
Source: MSME profiles of districts, PwC analysis

Figure 1.3: Industrial Parks in proximity to the node

Opportunity exists for transition of Tumakuru from low urbanization, primary sector & SME's intensive manufacturing to high- technology manufacturing district, leveraging upon proximity to technology and other industry players and skilled labor in mega urban centres such as Bengaluru.

Tumakuru district has low levels of urbanization at 22% (Census 2011) when compared to Karnataka state which stands at almost 40%. Employment profile of the district is characterized to be primary sector intensive. The share of primary sector in Tumakuru district GDDP at 31% (2010-11) is higher than that in CBIC region and Karnataka. The employment profile consists of two- thirds of employment engaged in agriculture and related activities.

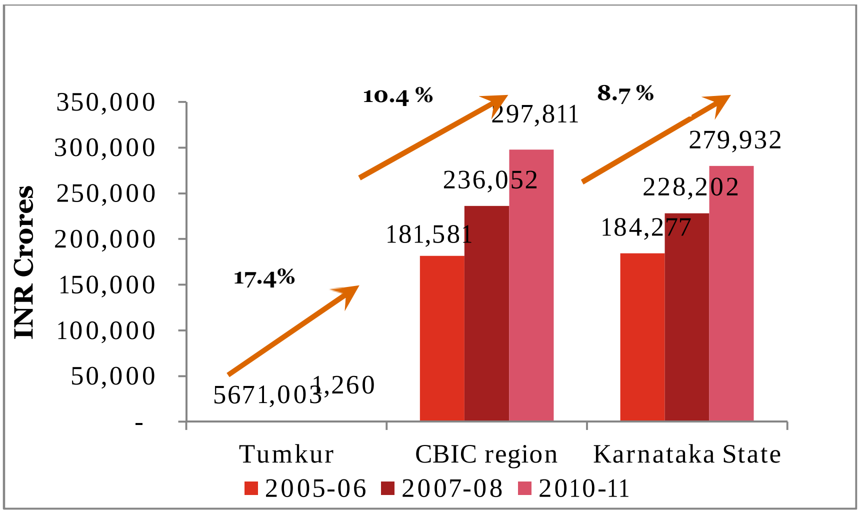
The per capita income is also low in Tumakuru district at INR 32,007 (2010-11) than Karnataka state and CBIC region.



Source: District income estimates, 2004-2005 to 2010 to 2011, Department of Economics and statistics

Figure 1.4: Share of primary, secondary & Tertiary sectors in Tumakuru district

Having said this, the district has a high literacy rate at 74% which is above the national average and at par with Karnataka State at 75%. In terms of GDP also, Tumakuru is recognized as a fast growing district within Karnataka with a CAGR of 17.4% (2005-11) in GDDP, double that of Karnataka State.



Source: District income estimate, 2004-2005 to 2010-2011, Dept. of Economic and statistics, GoK

Figure 1.5 Gross Domestic Product, constant price 2004-05

While the current manufacturing share in Industrial GDP at around 30% is much lower than the national average of 60%, opportunity exists in terms of industrial sprawl from already saturated urban centres such as Bengaluru, Chikkabellapura to Tumakuru.

Tumakuru has started attracting FDI with neighboring industrial hubs in and around Bengaluru.

Since prominent industrial areas of Bangalore Urban are saturating, nearby districts are becoming the preferred choice for investment. Maximum spillover of investment is seen in Bengaluru Rural and Ramanagara followed by Tumakuru and Chikaballapura.

Tumakuru recently has started attracting FDI in manufacturing. Out of a total of INR 1,700 Crores, 10% of industrial investment is via FDI[1] . Food Processing sector, Computers Electronics and Optical sector and Auto sector are highest contributors to FDI accounting for around 59%. Also, given that 13% of total upcoming investments in Tumakuru are in manufacturing, the Secondary sector is certainly set to pick- up.

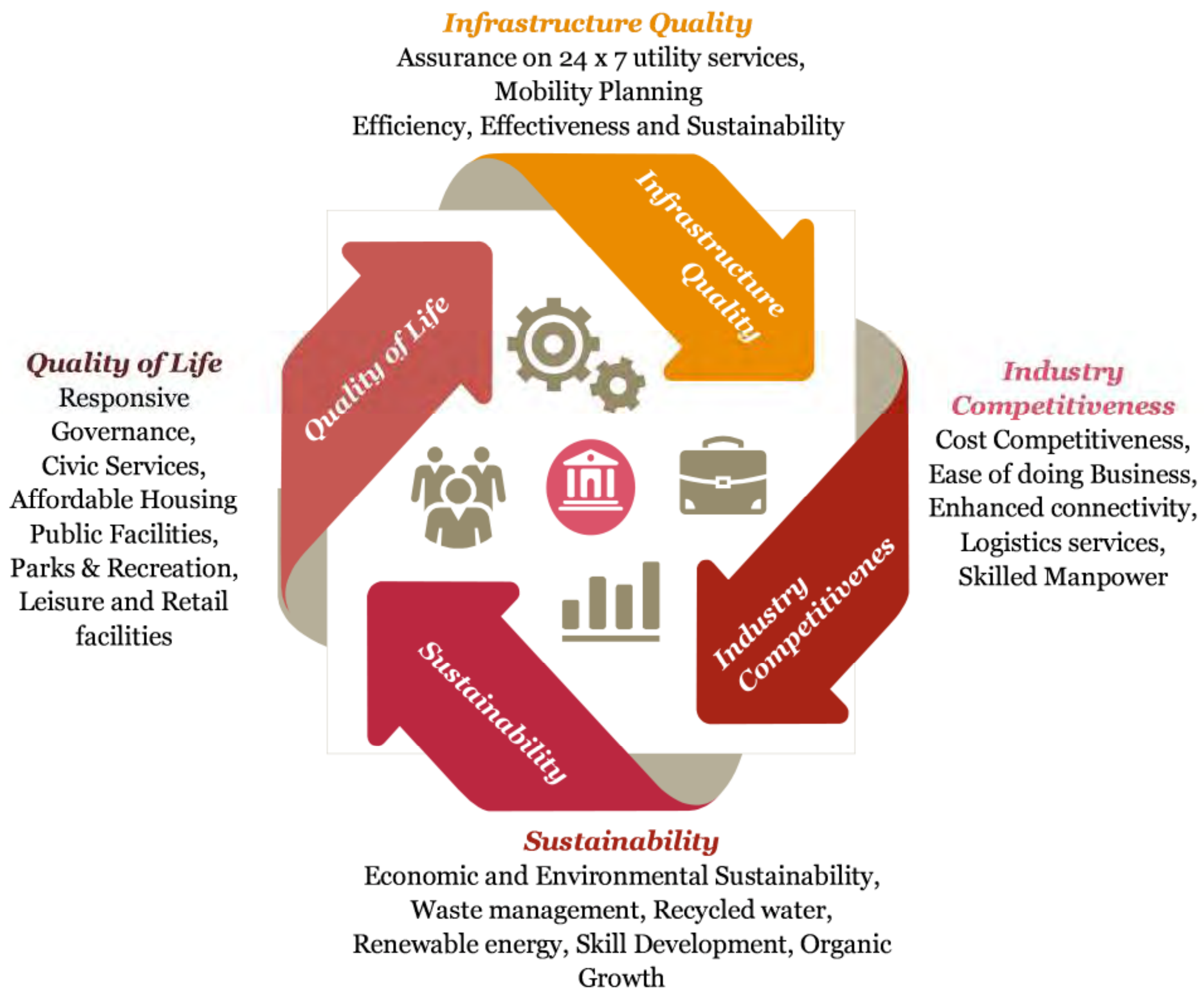
[1] Perspective Plan 2012-16

Vision for Tumakuru as Hub for Technology Sector

In the Master Plan's context, the Competitiveness of Node means comparative advantages, which enable the Node 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, inputs from state government and key requirements for industrial and urban growth, it is envisaged that the Tumakuru 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.



Planned Growth Strategy

The industrial node at Tumakuru 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.

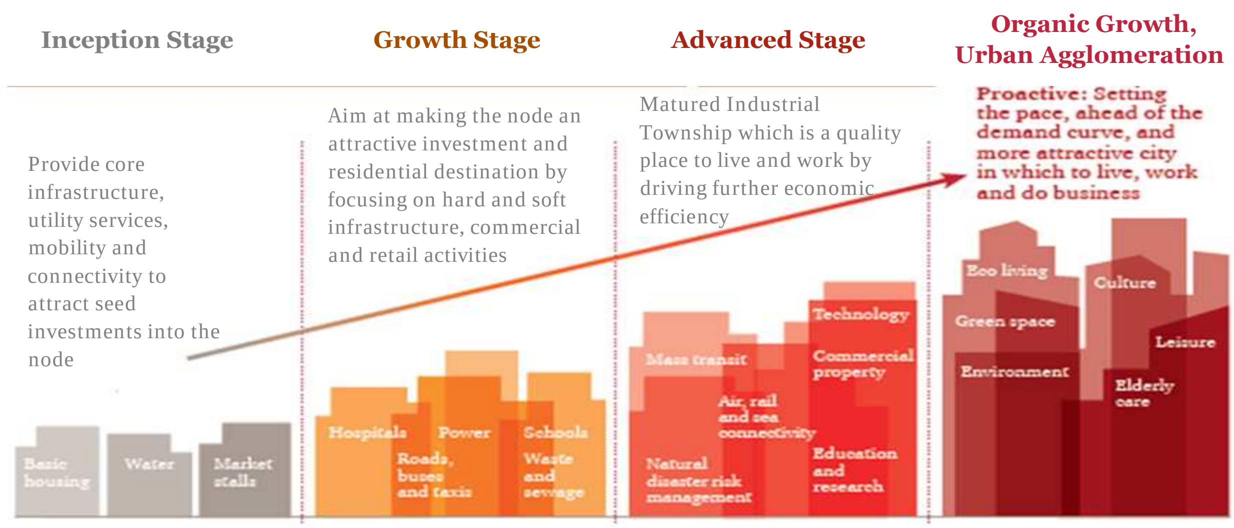
  In addition, the nodes will also start accommodating a proportion of workers within the nodes as Resident Workers. In this stage, the Node is trying to provide the basic infrastructure so as to be able to attract investors to take industrial land parcels and create a seed development. The land allocation 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 masterplan 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

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 Tumakuru node aims at a level of quality exceeding the above mentioned advanced industrial parks. The advantage of the Tumakuru 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 Bengaluru area is considerably high, the Tumakuru 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 Tumakuru Node.

Knowledge Park in the Node

A Knowledge park provides an environment for innovation and development 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 of the 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 Tumakuru. Traditional sectors have been identified based on historic investment and activity in the region. Potential sectors are those that are still in the nascent stages but have a promising future. Five traditional sectors and 5 potential sectors were finalized for Vasanthnarapura node. Based on analysis the sectors identified traditionally strong sectors for the node are:

Food processing	**Auto Components**	**Computer, Electronic & Optical (CEO) products**	**Textiles & Apperals**	**Pharma**

Potential sectors which are chosen for future development due to policy thrust and upcoming investment of these sectors in the CBIC region are highlighted below:

Electrical Machinery	**Machinery**	**Chemicals & Petrochemicals**	**Metallurgy**	**Aerospace**

The theme for Industrial development in Tumakuru node has been identified as a conscious migration from low- tech manufacturing to high technology engineering and electronics: While the Tumakuru NIMZ will leverage upon existing traditional industries in the region and continue to attract investments in these sectors, the idea is to slowly migrate to large scale investments with high output values.

This will require transition from low technology (textiles, basic consumer goods, simple mechanical devices) to high- technology manufacturing (automobiles, airplanes, complex electronics/ automation equipment etc). Aligned to the above theme, for the sake of detailed industrial analysis in the subsequent sections, we have conducted an in- depth assessment of the following sectors, to cover aspects such as sector growth in India, opportunities, viability drivers, and key challenges design implications to make the node nationally and internationally competitive for the sector.

Computer, electronic & optical products	**Auto and Auto Components**	**Food Processing**

Computer electronic & optical products (CEO)

Drivers for Growth

- **National level related:**
- Strong Government support & high growth of domestic market
- **Tumakuru Node related:**
- Proximity to developed cluster in Bengaluru
- Availability of skilled labour
- Strong support by State Government through IT Millenium Policy & Electronics System Design & manufacturing
- Tumakuru identified as part of Electronics Manufacturing cluster in South India, under M-SIP Central scheme making it cost- competitive.

Issues and challenges

- Cost disadvantage against domestic manufacturing vis- a-vis imported final product
- Difficulties in just- in- time supply due to lack of adequate infrastructure leading to high turn around time of for developing finished good

Key issues and recommendations specific to CEO development in Tumakuru Node are summarized as below.

Table 1.2: Summary of key recommendations for CEO sector

Components		Issues	Design Implication
Economic enhancers			
Connectivity	Road	• Some parts are precision parts and get damaged due to bad condition of road • Difficulty in just in time supply due to traffic congestion • Lack of ports connectivity to West coasts	• Chennai-Bengaluru Express Way needs to be monitored as a priority project. • Connectivity to New Mangalore Port needs to be improved. • Satellite Township Ring Road (Bengaluru) and Individual Town Ring Road needs to be monitored as a priority project
	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. • Tumakuru-Davanagere Railway line needs to be monitored as a priority project.
Power		• High tech manufacturing needs uninterrupted and assured power supply	• Power procurement plan needs to be developed to layout power distribution and transmission design and to identify the required interventions. • Adopt appropriate forecasting techniques. • A central control center to be established.
Logistic		• Need improved ports connectivity, road network and warehousing capabilities to build capacity	• Prioritize road and transport network development. • Invite logistics firms as synergistic and optional tenants to set-up base within the NIMZ.
Urban Transport		• inadequate public transportation to Tumakuru for commuting	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed. • Doubling of existing rail line between Bengaluru and Tumakuru may be beneficial for passenger transport.
Value enhancers			
R&D promotion		• Products need to match global trend	• Establish Government affiliated R&D center in proposed **Knowledge Park.** • GoK may promote R&D activities through incentives. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged.
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	• Formulate State Policy to Set up **Knowledge Park** inside the Node to provide Center of Excellence and to attract SMSE. • Establish testing facilities and certificate support center inside the **Knowledge Park**
Skilled labour for high-technology manufacturing		• Requires adequately trained manpower for hi-tech manufacturing	• Implement actions under KIPP to enhance skill availability • Formulate State Policy to Set up **Knowledge Park** inside the Node with foreign investment and partnerships.

Components	Issues	Design Implication
Administrative enhancers		
IPR regime	• Strong IPR protection is required to encourage R&D activities.	• Conduct seminars for private sectors to enhance awareness on Patent law and application process/requirement in India and to encourage IPR registration.
Quality control	• It is mandatory to obtain BIS certification to manufacture.	• Formulate State Policy to Set up **Knowledge Park** inside the Node to support obtaining certification.

Auto and Auto Components

Drivers for Growth

- **National level related:**
- Policy drivers such as Automotive Mission Plan
- Automobiles sector designated as priority sector
- Growth in consumer demand
- **Tumakuru Node related:**
- Presence of major OEM players , Tier I, Tier II suppliers forming the entire value chain of the industry in proximity of the node
- Good potential for export market if existing access to east & west port connectivity improved
- Good domestic sales market in major urban centres such as Bengaluru
- Proximity to R&D base in Bengaluru

Issues and challenges

- Lack of connectivity to New Mangalore port on west coast. Chennai port is congested.
- Unflexible labor laws to investors
- Low cost competitiveness due to expenses on taxes such as excise duty, high finance cost etc
- Low R&D base

a) Key design implication

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

Table 1.3: Summary of key recommendations for auto and auto components sector

Components		Issues	Design Implication
Economic enhancers			
Connectivity	Road	• Some parts are precision parts and get damaged due to bad condition of road, • Difficulty in just in time supply to OEMs • Lack of ports connectivity to West coasts	• Chennai-Bengaluru Express Way needs to be monitored as a priority project. • Connectivity issue of New Mangalore Port needs to be solved. • Satellite Township Ring Road (Bengaluru) and Individual Town Ring Road needs to be monitored as a priority project
	Rail	• Investors are still not comforted with any guaranteed delivery time for railway transport	• Dedicated Freight Corridor may be considered as a CBIC priority project. The operation of DFC needs to be

Components		Issues	Design Implication
			efficient with delivery ensured in time bound manner. • Tumakuru-Davanagere Railway line needs to be monitored as a priority project.
	Port	• Although there is a potential in export market in Africa and Europe, connectivity with west coast ports is not well established.	• Enhancement of minor ports on west coast • Connectivity to New Mangalore Ports needs to be improved.
Urban Transport		• Inadequate public transportation to Tumakuru for commuting	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed • Doubling of existing rail line between Bengaluru & Tumakuru to facilitate passenger transport
Value enhancers			
R&D promotion		• Products need to be renovated to match global trend	• Establish Government affiliated R&D center in proposed **Knowledge Park** • GoK may promote R&D activities through incentives. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged with appropriate industry and academic tie- ups.
Skill development		• The lack of skilled labour in certain technical field	• Implement actions under KIPP to enhance skill availability • Formulate State Policy to Set up **Knowledge Park** inside the Node with foreign investment and partnerships
Administrative enhancers			
Labour Issue		• Labour laws are not flexible	• GoK may consider relaxation of labour laws to ease labour union management and contract worker management
IPR regime		• Strong IPR protection is required to encourage R&D activities.	• Conduct seminars for private sectors to enhance awareness on Patent law and application process/requirement in India and to encourage IPR registration
Indirect Tax regime		• Complicated tax regime increase the cost of production	• GoK needs to be prepared for smooth transition to GST enforcement.

Food Processing

Drivers for Growth

- **National level related:**
- Increasing disposable incomes, changing eating habits
- Policy drivers- Central Mega Food Park Scheme, Agri export zones
- **Tumakuru Node related:**
- Established food cluster and major production centre of paddy, ragi, maize, cereals, pulses, etc
- Proximitic to organized retail marktes- Bengaluru & Mysuru
- GoK policy support- Mega food parks scheme

Issues and challenges

- Inadequate infrastructure facilities- cold storage, warehousing etc
- Lack of large players providing end- to- end aggregation, procurement, processing and retailing
- Inadequate food safety laws and quality standards
- Low productivity as a result of outdated machinery and technology

a) Key Design Implication

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

Table 1.4: Summary of key recommendations for food processing sector

Components	Issues	Design Implication
Economic enhancers		
Logistics	• Warehouses in Tumakuru region are running at full capacity. Most cold storage units in the state are non-functional due to low profitability as a result of rising power cost among other reasons	• GoK may consider providing finance and tax incentives and encourage PPP initiatives in providing common facilities such as cold chain infrastructure, ware housing etc. • Exemption from electricity duty may be considered.
Water	• Water supply shortage in Tumakuru district	• Quality water supply assurance from KIADB to food processing units is required, including following projects identified by JST. ✓ Yettinahole Water supply project ✓ Water diversion (94 MLD) from Hemavathy Canal • Provide incentives to companies to set up water treatment facilities such as STP, rain reservoir.
Environment	• 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 including common effluent treatment plant
Urban Transport	• Inadequate public transportation to Tumakuru for commuting.	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed • Doubling of rail line between Bengaluru and Tumakuru to facilitate passenger transport
Value enhancers		
Supply chain	• Inadequate and fragmented supply chain and logistic service	• Government should implement Agri logistic hubs (within the node if possible) to create efficient forward and backward linkages to attract small and medium

Components	Issues	Design Implication
		players The Agri- hub may contain the following facilities: o A product development centre/ Incubation centre o Warehouse for incoming and finished goods o Cold storage facility o Food testing / Quality control lab o R&D centre o Trading centre o Packaging centre o Dedicated parking for trucks
Manufacturing/ Processing Skills	• At present only unskilled labour is utilized in the processing units	• Food processing specific training centres can be proposed in **the Knowledge Park** to improve the value of the end product.
Value addition activity	• Since majority of industry consists of small units, it is difficult to access advanced technology and machinery. Lack of technology adaption causes low labour productivity and low value additions.	• GoK may consider additional financial scheme to encourage procurement of upgraded machinery, in addition to entry tax exemption (Integrated Agribusiness Development Policy 2011)
Administrative enhancers		
Quality Control	• The lack of adherence to international food standards and quality norms and outdated Indian standards	• GoK should promote awareness on quality standards and encourage to implement Standards such as ISO, HACCP etc
Ease of doing business	• Multiple departments (pollution related, food safety related, labour related) are to be approached for clearances	• Simplification of licensing system and reduction of the number of licenses is necessary. • Factories department may act as a single point of contact and take care of all industries required by any industrial unit.

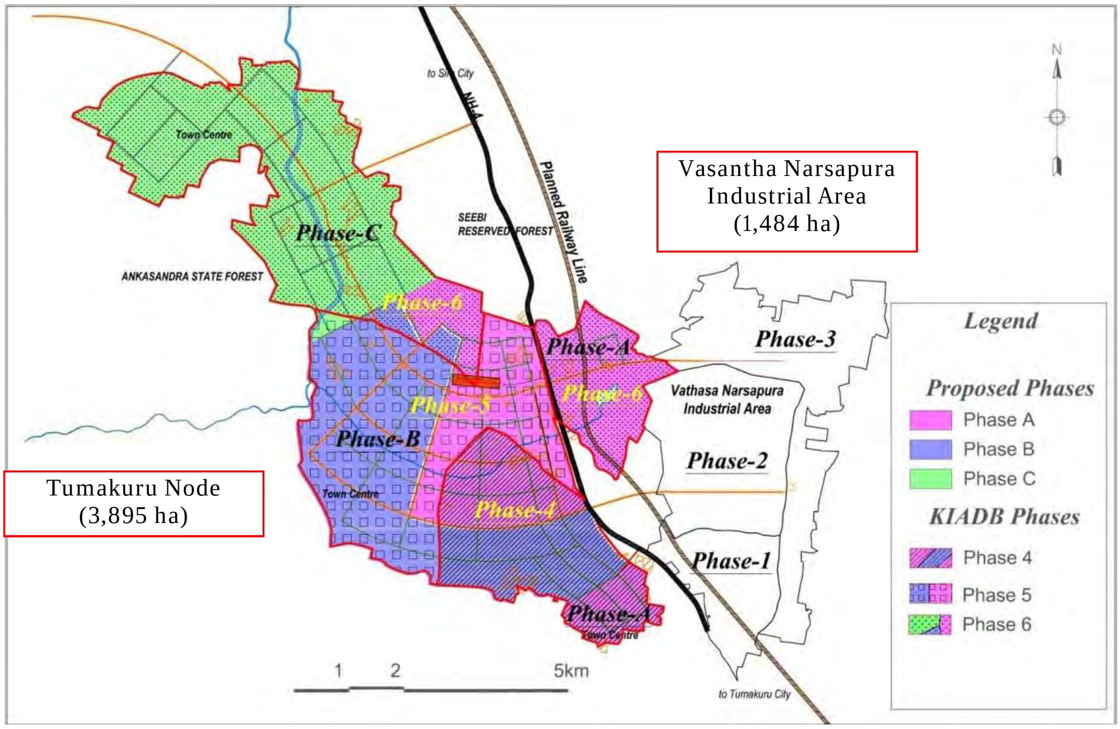
Land Use Plan

Delineation of the Node

The Tumakuru Node covers an area of 5,379 ha, of which 1,484 ha have already been developed by KIADB as the Vasanthanarasapura industrial area. The remaining 3,895 ha has been chosen for the preparation of development plans for the Tumakuru Node. The boundaries of the node area have been confirmed and finalised through discussion with KIADB and illustrated as the following figure. The node is adjacent to VasanthaNarsapura Industrial Area where is already in operational including the participation of a Japanese company and a New Industrial Park for Japanese companies to be planned.

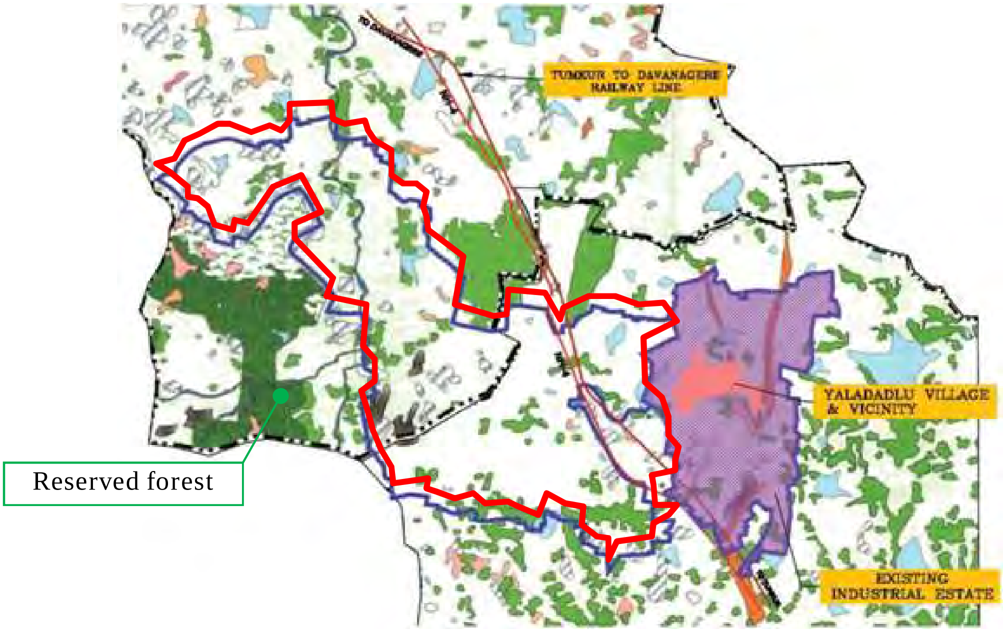
Current Land Use

Crop land and agriculture plantation are partially spread in phase A to C area (hatched area in the below Figure 6). As shown in Figure 1.7, reserved forest areas are found beyond the western edge of the node boundary; some of this area is utilized by the locals for tree plantations. The area has to be reserved from the development to keep buffer zone in line with related regulations.



Source: JICA Study Team

Figure 1.6: Node and Priority Area Boundaries of Tumakuru



Source: Tumkur NIMZ "Draft Techno-Economic Feasibility (TEF) Report cum Development Plan by KSIIDC

Figure 1.7: Current land use map of Tumakuru Node

Land Acquisition Status

The land for the existing industrial area (Vasanthanarasapura) has been acquired by KIADB already. However the new development area for Tumakuru Node has yet to be acquired. The land acquisition process for this area is currently at the notification stage. The land acquisition status as of July 2015 is summarised below:

Table 1.5 : Land Acquisition Status of Tumakuru Node of July 2015

Extent of Node Area	*(ha)*	*(Acre)*	*Acquisition Status*
Phase 1 to 3	*1,484*	*3,666*	*Acquired* *Brownfield Development*
Phase 4	*697*	*1,722*	*Final Notification issued. final compensation needs to be disbursed.*
Phase 5 & 6	*3,199*	*7,905*	*Acquisition process started. To be completed in 1-1.5 years*
Total	***5,379***	***13,293***	

Note: Figures in the table are approximate numbers. The field survey has to be done and confirm the exact figures for each land.
Source: Interviews to KIADB by JICA Study Team

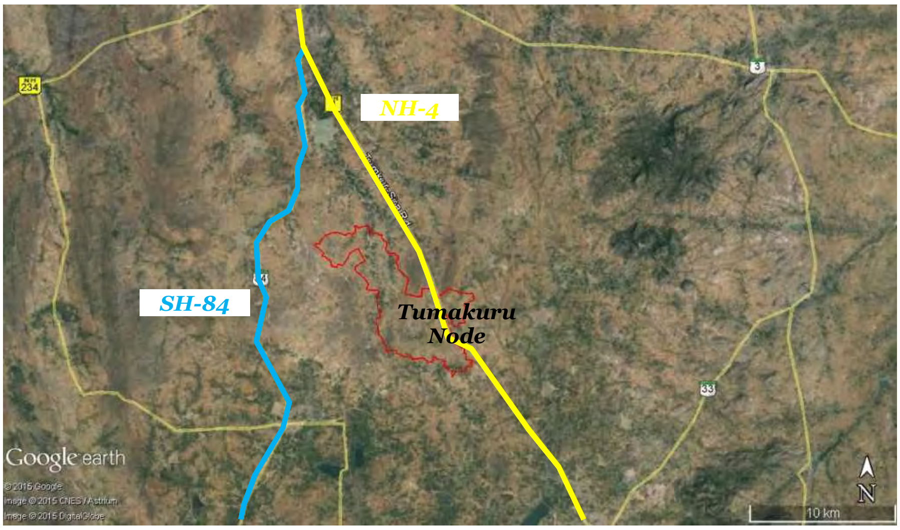
Review of Existing Development Plan

The points to be considered and proposals for the transportation and land use sectors are summarized below:

Table 1.6: Items to be considered in Existing Plan (KSIIDC Plan)

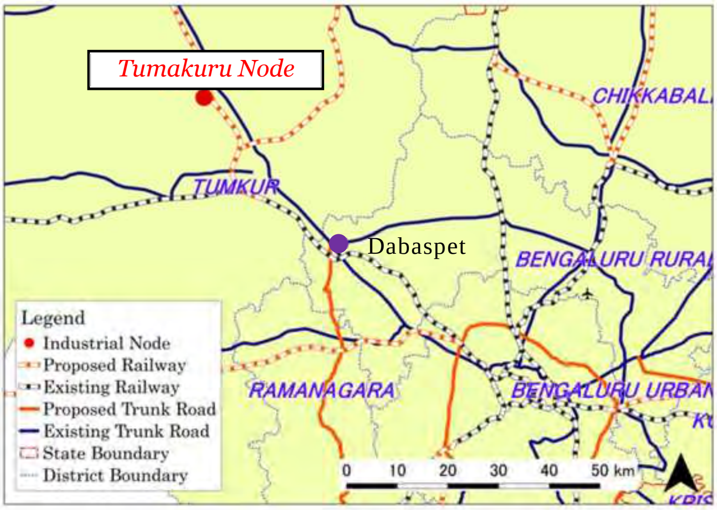
Bottlenecks	Proposal
Transportation	
• Rail access is planned on the eastern side of NH-5. Outputs from industrial plants in phases A to C have to cross over NH-5 to access the railway line	• Additional rail access has to be planned for the western side. In addition, a location for a logistics centre should be identified for integrated freight operations.
• No trunk road connection to the west (towards Mangalore port) is proposed	• Road connectivity to SH-84 which runs west has to be considered
• No public transport system is proposed	• A bus system is necessary to transport workers from the proposed railway station to individual factories
Land Use	
• Residential zones are planned for the western area only (away from the National Highway).	• The southern part of phase-A is close to the planned railway station and has big potential as a residential area. Some residential areas should be planned near NH-4.
• Reserved forests are located beyond the western boundary and need to be preserved	• Residential areas should be planned as a buffer between industrial zones and reserved forests. The rich green environment has to be utilised to make residential space more environmentally friendly.

Source: JICA Study Team



Source: Google Earth Pro

Figure 1.8 : Road Network Map of Tumakuru Node



Source: JICA Study Team

Figure 1.9 : Transportation Map of Tumakuru

Projected Industrial Land Demand

The target year for completion of the node development is assumed to be 2033. Taking into account appropriate development scales and after discussions with nodal agencies, JICA Study Team proposes to develop the node in three phases: Phase-A (2014-2019), Phase-B (2020-2024) and Phase-C (2025-2032). Based on industrial analysis for Tumakuru Node by JICA Study Team the estimated land demand of to achieve the growth scenario is shown in the following table;

Table 1.7: Estimation of Developable Area for Tumakuru Node

(unit: acre)					
		Phase-A	Phase-B	Phase-C	Total
Traditionally Strong Sector	Auto	378	1,009	2,271	3,658
	Pharmaceuticals	152	496	914	1,562
	Textile & Apparels	139	371	835	1,345
	Food Processing	72	193	434	699
	Computer, electronic and optical products	72	191	429	692
	(Sub-total)	**813**	**2,260**	**4,882**	**7,955**
Potential Sector	Metallurgy	49	131	294	474
	Electrical Machinery	49	131	294	474
	Machinery	49	131	294	474
	Chemicals & Petrochemicals	49	131	294	474
	Defence & Aerospace	49	131	294	474
	(Sub-total)	**245**	**653**	**1,468**	**2,366**
Total		**1,058**	**2,912**	**6,350**	**10,323**

Source: JICA Study Team

Projected Population

The future population of the node, consisting of the working population and residential population, was projected according to the land demand shown above. As a result, the working population is estimated to be as 498,365 people with a residential population of 280,000 people in the Tumakuru Node in 2033.

Table 1.8 : Population Framework

	2018	2023	2033
Working Population	21,739	86,791	498,365
Residential Population	93,333	186,667	280,000

Source: JICA Study Team

Land Use and Phasing Plan

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

Table 1.9: Proposed Area by Land Use in Tumakuru Node

No.	Item	Phase A	Phase B	Phase C	Remarks
1	Industrial Area	1,058 Acre	2,912 Acre	6,350 Acre	To be include open space (5%) based on Building Code of India P-15)
2	Existing Residential Area	110 Acre	65 Acre	66 Acre	Measure on the map of existing land use map
3	Residential Area (Including Commercial Facilities and Social Facilities)	517 Acre	517 Acre	517 Acre	Based on plan
4	Water bodies & Greenbelt	358 Acre	131 Acre	320 Acre	Measure on the map of existing land use map
5	Infrastructure (road, plant facilities etc.)	599 Acre	192 Acre	353 Acre	Based on plan

Source: JICA Study Team

In addition to the residential area above, the number 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 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 (Playground)

Infrastructure Development Plan

Overview

The figure below shows the infrastructure development plan for Tumakuru with the key features summarised below Table.

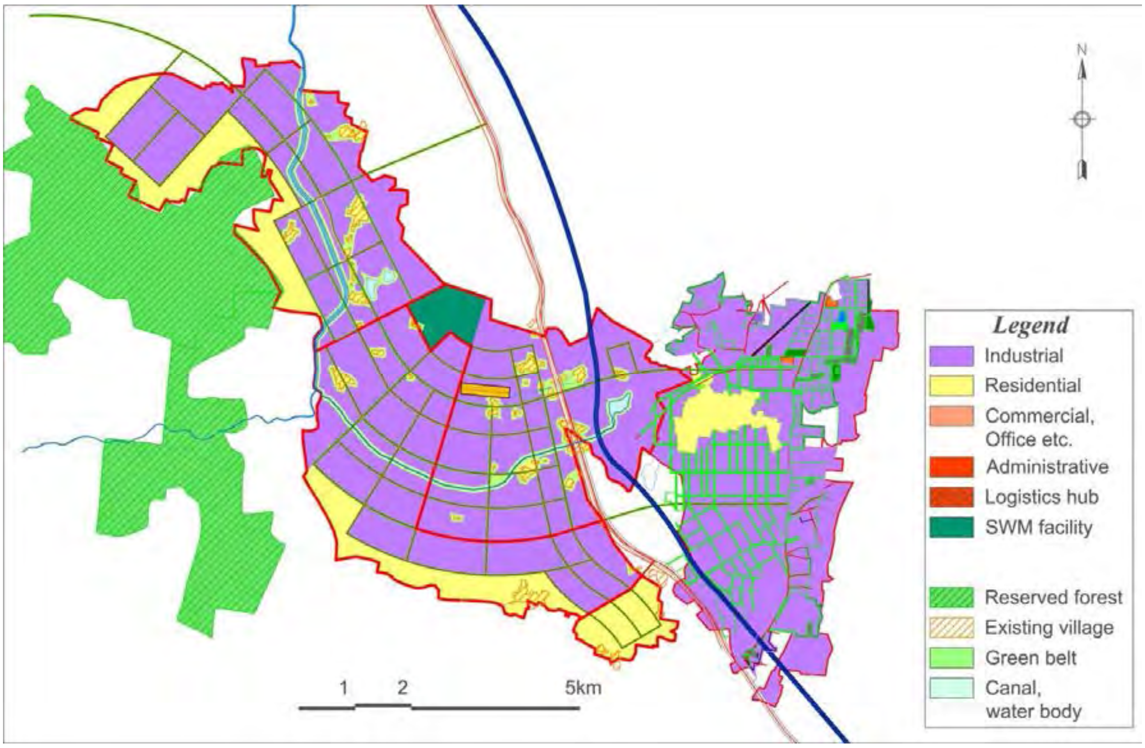


Figure 1.10: Infrastructure Development Plan

Table 1.10: Summary of Infrastructure Development Plan

Component	Key Features
Site Characteristics	Direct access to NH-4, elevated land with minimum flood risk
Land Use	Residential areas are planned along the NE and SW boundaries with a green buffer area.
Road	A new access road to NH-4 and Direct access to the existing industrial area
Railways	A logistic hub with rail access connecting to the planned Tumakuru- Davanagere main line
Water Supply	Water supply form Hemavathi Canal (100MLD) Recycled water provided from the STP in Tumakuru City is proposed to be used
Solid Waste Management	Regional waste treatment facility is planned inside the node area.
Power	Power supply from external power plant is planned. Prioritized distribution to the node is required.

Road

Current Situation

Major industrial linkage to/from Tumakuru node will be developed with Bengaluru, Chennai, Chennai Port, Ennore Port, Krishnapatnam Port, and Mangalore Port. Present lane numbers of corresponding roads to the linkage are four or six on linkages with Bengaluru, Chennai, Chennai Port. However, there are some sections which are given only two lanes on linkages with Krishnapatnam Port and Mangalore Port. There are few congested road sections on major industrial linkage to/from Tumakuru node based on volume capacity ratio at present condition. Traffic congestion basically occur on roads located in city area of Chennai and Bengaluru, while other roads are not congesting in present condition.

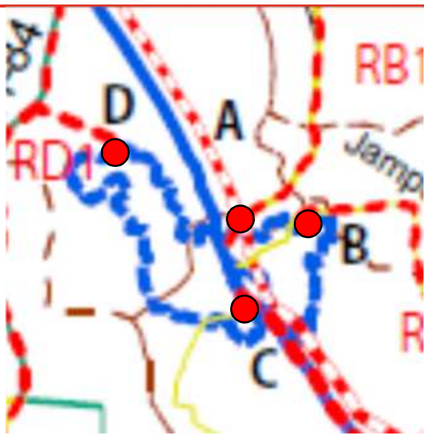
External roads near Tumakuru node are NH4, NH206, and SH84. NH4 pass through Tumakuru node and NH4 is main access road of Tumakuru node. SH84 passing through north to south is located near Tumakuru node and SH84 is possible to provide short access to NH206 from Tumakuru Node. Present road condition of NH4 and NH206 are fairy maintained. There is few damaged pavement sections on SH84, but level of the damage is not serious. As for internal road, road on developed area are given more than two lanes with adequate carriageway width for large vehicle. Current roads on undeveloped area are basically narrow and damaged especially at river section. Careful hydrological analysis is needed to design river crossing structures.

Demand Supply Analysis for External Node Infrastructures

Demand supply gaps of main access routes connecting to the four access points of Tumakuru node are estimated and introduction of railway is proposed to access route of access point C because V/C is 1.79, in long term under 8 lanes road capacity without introduction of public transport and development of more than 8 lanes road is not realistic. Double tracking from single track between Tumukuru and node is proposed in long term by this plan. Result of demand supply analysis for all access points are shown in Table 1.11.

Table 1.11: Result of Demand Supply Analysis by Access Points

Year		2019				2024				2034			
Access Points		A	B	C	D	A	B	C	D	A	B	C	D
Number of Lanes (Access Road)		6	4	6	2	6	4	6	4	6	4	8	6
Demand Supply Gap (V/C)	Roads	0.20	0.15	0.37	0.46	0.42	0.30	0.74	0.37	1.02	0.73	1.01	0.82
	Railway											0.89	



Source: JICA Study Team

Framework for Infrastructure Development for Node

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 as shown in Table below.

Table 1.12: Implementation Plan with Preliminary Cost

Item	Description	Phase 1 (2014-2018)					Phase 2 (2019-2023)					Phase 3 (2024-2033)									
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1. Internal Road Works	1) Primary Roads			6101	6101	3593										400	754	754			
	2) Secondary Roads				1755	1755				2080	3160								520	7090	
	3) Tertiary Roads				5950	7630		1838	1838	1838	4038							1475	1475	1475	2315
2. Intersection Works	1) At-Grade Intersection (signalized)				605	771				160	160									110	135
	2) Grade-separated intersection			1850	2125	2125															
3. River Bridge Works	1) On Primary Road			357	357	357															
	2) On Secondary Road						60	60						358	358	358	358				
	3) On Tertiary Road			110	110	110	55	55					529	529	529	529	529				
4. Flyover Bridge Works	1) On Primary Road																				
	2) On Secondary Road																				
	3) On Tertiary Road																				
5. Road Facilities	1) Street Light				833	1055				368	658									342	452
	2) Traffic Light				1040	1040					640										490
	3) Central Traffic Light Control System				300																
	4) Utilies Box			8520	8520	8520															
6. Internal Public Transport Facilities Works	1) Bus Terminal					1300					1300										2600
	2) Bus stop				165	165				135	135									190	190
	3) Bus Depot					800					800										1600
Grand Total (Internal Node)				16938	27861	29222	115	1952	1838	4580	10891		529	887	887	1287	1641	2229	1995	9207	7782
7. External Road Works	1) RB1				3870	6150				1740	2220								960	2700	3180
8. External Public Transport	1) Railway															2600	2600	2600	2600	2600	2600
Grand Total (External Node)					3870	6150				1740	2220					2600	2600	2600	3560	5300	5780
Grand Total (Internal and External Node)				16938	31731	35372	115	1952	1838	6320	13111		529	887	887	3887	4241	4829	5555	14507	13562

Source: JICA Study Team

Railway

Current Situation

The site is 20 km northwest of Tumakuru town, which is the nearest railway station. The Railways are building a new line from Tumakuru to Davanagere, due to be completed by 2018, which will pass through the node.

Demand Forecast

The demand forecast for Tumakuru 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 Tumakuru.

Table 1.13: Tumakuru 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)	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%

Source: JICA Study Team

Development Plan

The logistics hub is proposed in the node area at west of NH4, to be connected to the Tumakuru – Davanagere line via a bridge over NH4 and a wye junction. 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 3 km electrified line will therefore be supplemented by 2 receiving sidings (of 756m average length) on either side of the main line and is expected to cost Rs 24.03 Crores (US $ 4 Mn) in total.

The Tumakuru logistics hub itself will cover an area of 166,859 square metres, with 3 lines – one to receive steel and two to handle container traffic. It will also have a container freight station, warehouses, trailer parking and workshops as required. The hub will be developed in 2 phases at a total cost of Rs 91.9 Crores (US $ 15.3 Mn).

The capital costs and identified O&M costs for the Tumakuru logistics hub and railway access line over a 20 year operating period are given below.

Table 1.14: Tumakuru Railway Access Line and Logistics Hub - Cost Summary

Cost Details	Phase 1 2016 to 2026	Phase 2 2027 to 2037	Total
Railway Access Line and Wagons			
a) Capital Cost of Railway Access Line	24.03	-	24.03
b) Maintenance Cost of Railway Access Line	21.38	66.52	87.90
c) Capital Cost of Container Wagons	10.51	18.84	29.35
d) Maintenance Cost of Container Wagons	6.19	19.61	25.80
Logistics Hub			
e) Capital Cost of Logistics Hub	82.25	9.61	91.86
f) O & M Cost of Logistics Hub	44.02	74.60	118.62
Total	**188.38**	**189.18**	**377.56**

All Costs are in Rupees Crore.

Source: JICA Study Team

Water

Current Situation

There are no perineal water resources near to the Tumakuru Node. Also, Hemavathy canal is a seasonal flow water resources and it flows during monsoon period, when there is surplus water released from Gorur dam. The Tumakuru Node receives only 0.3 MLD of raw water from the industrial water supply scheme of KIADB at the 7 ML reservoir. At present, some of the industries in the brownfield development area are using the groundwater; however it was informed by the industries that they are not using the groundwater for drinking purposes. Considering the present situation of the groundwater in Tumakuru taluk, it is to be noted that groundwater is deeper and it cannot be treated as a reliable water resource for the industrial usage.

Existing drainage channels will be utilized in the development of the Node. Natural river and ponds will also be utilizaed for stormwater drain and retention. In order to ensure the flood prevention and preservation of the water bodies' funcitions, however, improvement works of the water bodies, which include bank protections by embankment, modification of the river's alighment, realignment of the ponds' shape and depth, etc., will be necessary.

Framework for Infrastructure Development

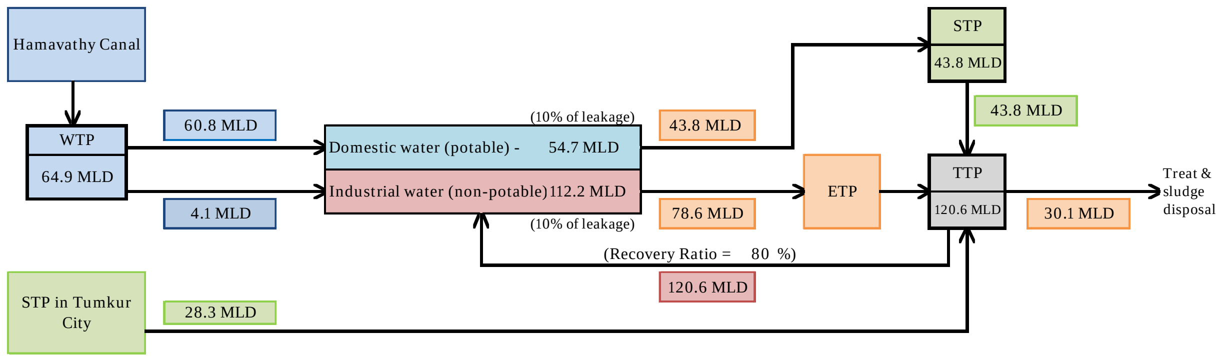
To realize sustainable development of the Tumakuru Node, stable water supply, good sanitary conditions, preservation of water environment and prevention of flood event are imperative. Development framework of water infrastructures including those for water supply, wastewater management and stormwater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

- 24 x 7 supply of water to 100% industries and households with direct water supply connection.
- 100% connection of industries and households to sewer network and 100% coverage of primary and secondary treatment of the sewage
- 100% coverage of road network with storm water drainage network
- Because of the very limited water resource, water recycling of the treated wastewater from the Tumakuru City and the NIMZ area

- Available surface water will be the water resource for the domestic water. Recycled water will be the water source for the industrial water.
- 100 MLD of surface water allocation by Government of Karnataka (GoK) State through Hemavathy canal will be considered for node development.

Water Balance

Based on the above-mentioned framework, the ultimate water balance of Tumakuru 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

Figure 1.11 : Water Balance in 2033

Development Plan

The capital costs and O&M costs for the three phases are summarized as below.

Table 1.15: Summary of Capital Cost and O&M Cost for Water Sector

No	Component	Phase-1 (2016-18)		Phase-2 (2019-23)		Phase-3 (2024-33)	
		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	6,392	334	1,260	384	968	443
2	Non-potable water supply system	1,943	105	2,525	337	4,973	749
3	Sewerage system	447	20	373	41	549	72
4	Treated sewage & effluent colletion system	701	28	645	81	2,224	210
5	Stormwater drainage system	1,020	51	1,425	122	1,266	187
Total		**10,504**	**538**	**6,228**	**965**	**9,979**	**1,661**

** All figures are in million INR*

Source: JICA Study Team

Solid Waste Management

Current Status

The only one regional TSDF (landfill) in Karnataka state is located at Dabespet, the linear distance of only around 40 km away from Tumakuru Node. The capacity of the landfill site is, however, estimated to be exceeded in 2023 in the CBIC area. And the total capacity of the existing common incineration facilities in Karnataka state is already insufficient to treat the volume of waste generated in the state.

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.

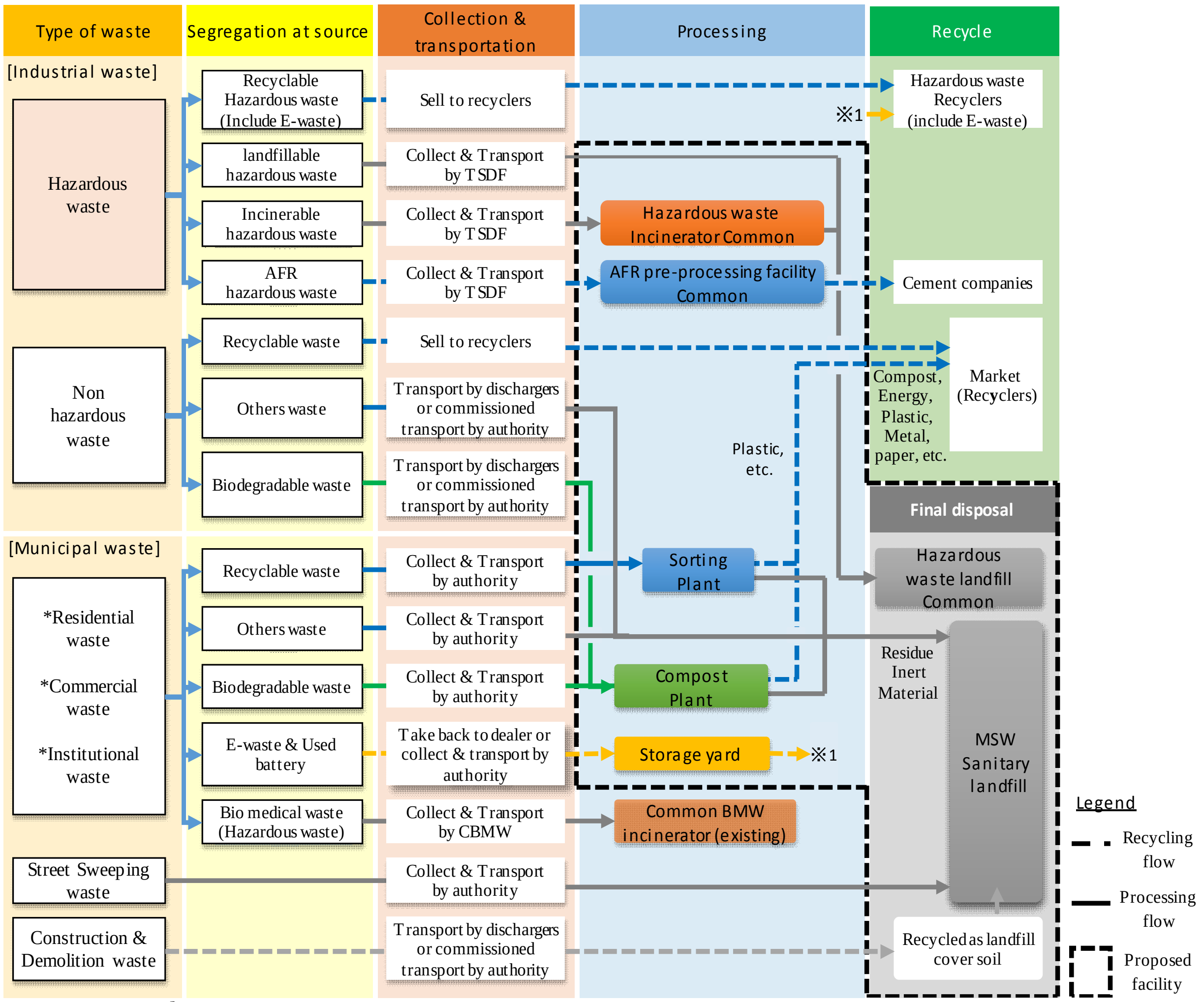
Table 1.16 Development concept, policy and program for solid waste management in the Node

Concept	Building the sustainable sound material-cycle society		
Development policy	1) Establishment of an appropriate waste management 2) Reduction in the volume of waste that goes into the final disposal through 3R promotion 3) Selection of environmentally and economically sustainable waste treatment system 4) Coordination with the stakeholders 5) Capacity development of institutions relevant to waste management 6) Integration of solid waste management facilities		
Development Program	Within the Node area		include the areas outside of a Node
	Hazardous waste management (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 development plan for hazardous waste management facilities - Development of a collection and transportation system - Development of a hazardous waste management treatment facilities	**■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	**■Program for development of common hazardous waste treatment facilities on the state level** -Devising a common hazardous waste treatment facilities development plan for the state **■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

Waste management plan for 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 1.12: 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 1.17: Summary of Capital Cost and O&M Cost for Solid waste management Sector

Cost: INR mil.

Item	Component	Phase 1(2014-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)	
		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) Hazardous waste incinerator	0	0	977	782	2,154	5,010
	2) Hazardous waste landfill	0	0	27	15	1,467	1,643
	3) AFR pre-processing facility	422	190	328	600	1,642	3,827
MSW infrastructure	1) Composting plant	20	6	34	29	79	145
	2) Sorting plant	13	9	20	43	42	194
	3) Sanitary landfill	10	2	43	23	188	205
	4) Stockyards for e-waste, etc.	8	-	8	-	8	-
	5) Collection vehicle	29	16	29	58	73	250
	6) Garage & workshop	8	-	8	-	17	-
soft component		Period	Phase Total	Period	Phase Total	Period	Phase Total
■Capacity development program for appropriate waste management & ■Program on 3R Promotion		2 years	86	1 year	43	3 years	128
■Program for development of common hazardous waste treatment facilities on the state level		1 year	54		0		0
■Institutional capacity development program for the authorizing organization ■Support program for the private industries		2 years	107	1 year	54	2 years	107

Source: JICA Study Team

Power

Power infrastructure planning for the node has been undertaken keeping in mind the overall objective of ensuring round the clock power for consumers at affordable rates while ensuring smart elements of the power network are integrated with other infrastructure networks.

Based on primary and secondary interactions with the key stakeholders and investors, it was found that reliable and quality power at affordable rates was one of the important considerations for any node investments. Corresponding to these needs, the characteristics of the power systems was designed. Redundancy of operations, maximum efficiency, operations via multiple IT systems etc. were found to be the key determinants of a successful design. This was integrated in our "Smart" approach for undertaking the design of the network.

Power Demand and Generation

The projected power demand expected in the node was compared with existing power infrastructure availability on ground to assess gaps for meeting the objective. It was found that from the distribution and transmission perspective additional capacities would be needed on ground for meeting the upcoming demand. To meet power demand at varying scenarios the node needs close to 208 MW in phase B (till FY 2024) which increases to 462 MW in phase C (till FY 2032).

When the available sources for meeting the gap is considered, only one sub stations (Madhugiri- 220kV) forms a viable source of power transmission into the node. Considering the load requirement at the node for ensuring robustness, two Main Receiving Sub Stations (MRSS – 220kV, 2X 150 MVA GIS based sub-station) have been planned for taking up the entire supply from the other transmission S/S outside the node. MRSS would be responsible for distribution of electricity within the node in the phase II. 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.

Distribution

On the distribution side, based on the load requirement around 11 sub stations of 20 MVA each have been planned for taking up the load in phase II. All these distribution sub-stations would be connected via 66kV lines to MRSS sub station and would have 11kV feeders (10 each) for consumer load. These are standard underground 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. It has been also estimated that the tentative tapping points, 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 1.18: Substation requirement in the node area

Characteristics	2016-19	2020-24	2025-32
Total demand expectation for system design (MW)	52.26	145.97	323.77
System design for 80% loading condition in the node	65.33	182.46	404.71
System power factor	0.80	0.80	0.80
Total installed capacity (MVA)	81.66	228.07	505.88
Capacity of each distribution sub- station (MVA)	20	20	323.77
Additional distribution sub-station requirement (Nos.)	4	7	14

Source: PwC Analysis

Procurement

From the generation perspective, in order to ensure robust availability of supply to consumers around 330 MW would be needed in phase C for the node. Considering the nature of electricity, it is not necessary that generation for the entire capacity needs to be within the node. Through regulatory norms provided, if transmission availability and commercials of the arrangement are assured, power can be procured from outside the node at delivery points of transmission sub stations. The same has also been estimated for the node. Around 80% of the power would be procured from the Southern Grid via Madhugiri 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 procured from outside the node is expected to be from conventional power stations. However, considering the regulatory provisions for open access 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 locates in Karnataka which is conducive to solar as well as wind energy. Hence, around 38 MW of solar and wind generation would be expected in phase II which will increase to 84 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).

Investment Requirement

Total investment requirement in transmission and distribution is estimated to be around INR 66,704 Lacs (without cost escalation) for the node in the all phases. For in node generation, the investment would be undertaken for specific industries which are looking to set up the capacities and for procured generation from outside the node, 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 only 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 1,00,770.3 Lacs (with cost escalations) for ensuring robust power supply till FY 2032.

Table 1.19: Additional Investment requirements (INR lakhs) [Inflation adjusted]

Characteristics	Phase A	Phase B	Phase C
Investment requirements	13,047	26,633	61,090

Operational Plan

The node 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. This provides the necessary stakeholder ownership for various activities. 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.

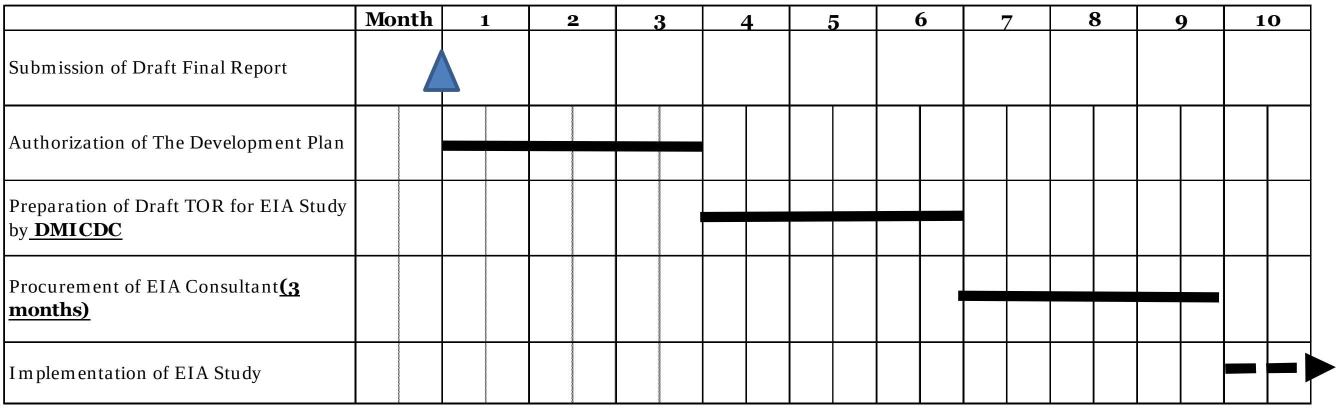
Environmental and Social Considerations

The development plans for the prioritized nodes have been prepared by the JICA Study Team(JST) in the Part B of the CBIC Study. According to the practices in DMIC, the Environmental Clearance (EC) for the development plans will have to be obtained from Ministry of Environment and Forests (MoEF), Govt. of India.

The JST conducted the initial environmental examination (IEE) level study on the development plans for the Nodes in the course of the technical assistance for CBIC study. The study was conducted based on the JICA

Guidelines. The environmental scoping in the course of IEE level study clarified several issues should be taken consideration in the TOR of EIA study. The JST prepared the proposed draft TOR for EIA study considering the matters for consideration resulting from the IEE level study. It is expected that the DMICDC will prepare the TOR referring the draft TOR for EIA study.

The expected schedule for EIA after establishment of development plan was proposed as shown in the below Table. The land acquisition of 3,897 ha of land, out of 5,382ha, has not been completed. 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.



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:

Table 1.20: Direct and Indrect benefits

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 ***199,347 jobs.***

Table 1.21: Direct potential employment of Tuumakuru Industrial Node

	Total direct employment
Traditionally strong sectors	***168, 140***
Auto	74,179
Pharmaceuticals	40,630
Textiles & Apparels	21,239
Food Processing	8,487
Computer, electronic and optical products	23,606
Potential sectors	***84,751***
Total	***199, 347***

Source: JICA Study Team for CBIC

b) Industrial investment

Industrial land is expected to attract tenants from various sectors identified for Tumakuru Industrial node as focus sectors. Total land for traditionally strong sectors with higher probability to get occupancy is 4,882 acres. Potential sectors are projected to occupy 1,468 acres of industrial land in Tumakuru IN. Together these tenants are expected to infuse Rs. 49,786 crores or USD 8,300 mn of investment in the node by the end of Phase 3.

Table 1.22: Industrial Investment

	Industrial Investment (Rs. Cr)
Traditionally strong sectors	**37,877**
Auto	18,926
Pharmaceuticals	9,898
Textiles & Apparels	2,084
Food Processing	1,618
Computer, electronic and optical products	5,350
Potential sectors	**11, 909**
Total	**49, 786**

Source: PwC projections

Indirect benefits

Direct employment results in investments and employment generation 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.

The total indirect employment generated due to the Tuamakuru Node development is expected to be 1.5 times the direct job creation equal to ***299,020 indirect jobs.*** It should be noted that the number of jobs created within Tumakuru would be a portion of above indirect employment creation due to integrated nature of economies in the region.

Table 1.23: Indirect Benefits and Impacts

Indirect Benefits	Impact
Indirect potential employment generation	Indirect employment in industrial node is expected to amount to 299,020.
Availability of quality industrial infrastructure	State-of-the-art industrial infrastructure facilities within the node along with its enhanced connectivity to the major logistics and trade hubs will create an economic boom in the sub-region
Enhanced mobility and alternate transportation	Enhanced mobility and connectivity with residential, retail and commercial activity will provide impetus to allied hinterland
Efficient and responsible infrastructure use	CBIC will make available affordable and accessible sustainable technologies in various areas, including manufacturing process, support services and habitant development.
Availability of work-life balance benefits	Holistic and inclusive development approach gives 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.

Permanent benefits

Permanent benefits include potential gross value added from various manufacturing activities across sectors identified as highly potential for Tumakuru Node as well as some relevant services. Total permanent employment adjusted to deadweight and displacement assumptions (net employment) till 2053 is anticipated to be 355,087 and total direct GVA contribution is expected to amount to USD 6,305 million.

Table 1.24: Permanent net employment to be generated in Tumakuru Industrial Node

Total permanent net employment	Nos
Direct permanent net employment	142,035
Indirect permanent net employment	213,052
Total permanent net employment	**355,087**

Table 1.25: Projected GVA benefits, Tumakuru Industrial Node

Total GVA	USD mn
Net additional direct GVA	2,522
Net additional indirect GVA	3,783
Total additional net GVA	**6,305**

Benefit-Cost Ratio

The industrial node is assumed as ongoing concern till 2053 for the purpose of NPV calculation. Total net present value of benefits is expected to be USD 1,355 million.

Table 1.26: Summary of Net Present Costs and Benefits, Tumakuru Industrial Node

Summary of costs and benefits	
Total projected costs, USD mn	1,355
Total projected benefits GVA, USD mn	6,305
Total net benefits, USD mn	**4,950**

Having calculated the net present value of projected costs and benefits till 2053, the project is estimated to have a **benefit-cost ratio of 2.8,** ignoring any optimism bias in the estimated costs and benefits.

Table 1.27: Benefits-Cost Ratio for Tumakuru Industrial Node Development

Full-term NPV	
NPV of projected costs USD mn	637
NPV of projected benefits USD mn	1,782
Benefit - Cost Ratio (BCR)	**2.8 x**

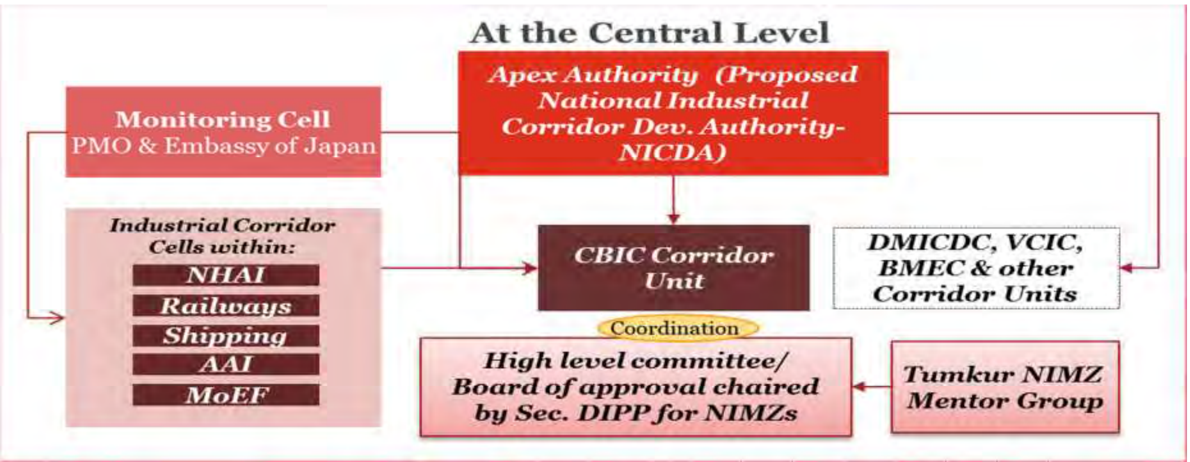
Thus, development of Tumakuru Node can be considered economically beneficial given the costs anticipated for development of this industrial node, without taking Optimism Bias under consideration.

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 KSIIDC, the institutional framework for Tumkur Node has been formulated.

Proposed Institutional structure for Tumakuru and CBIC in Karnataka

Taking into key considerations the key learnings for CBIC and suggestions from GoK, the following institutional structure has been proposed for Tumakuru 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 will be represented on the NICDA Board.
- **Industrial corridor units may be formed within key agencies such as NHAI, Railways, MoEF, Shipping etc for facilitation of critical external infrastructure projects. These units may report directly to PMO & CBIC Corridor unit at the central level and State Apex Committee at the state level**
- Monitoring cell comprising of PMU and Japan embassy to form the apex level monitoring body

Figure 1.13: Central level institutional structure for CBIC in Karnataka

The role of State Governments is critical at every stage of the node development starting with land acquisition, development of trunk infrastructure like power and water within the node, and executing critical external infrastructure projects for the success of the node. Given that it is the state government who will have to drive node and CBIC development in the state, strong commitment from the state is of utmost importance.

Requirements from the state wil include an empowered state level committee as a monitoring agency with high-profile representation from all relevant state departments. Other requirements include designated nodal agencies, in Tumakuru's case KSIIDC for Node development and Dept. of Industries & Commerce for external infrastructure development.

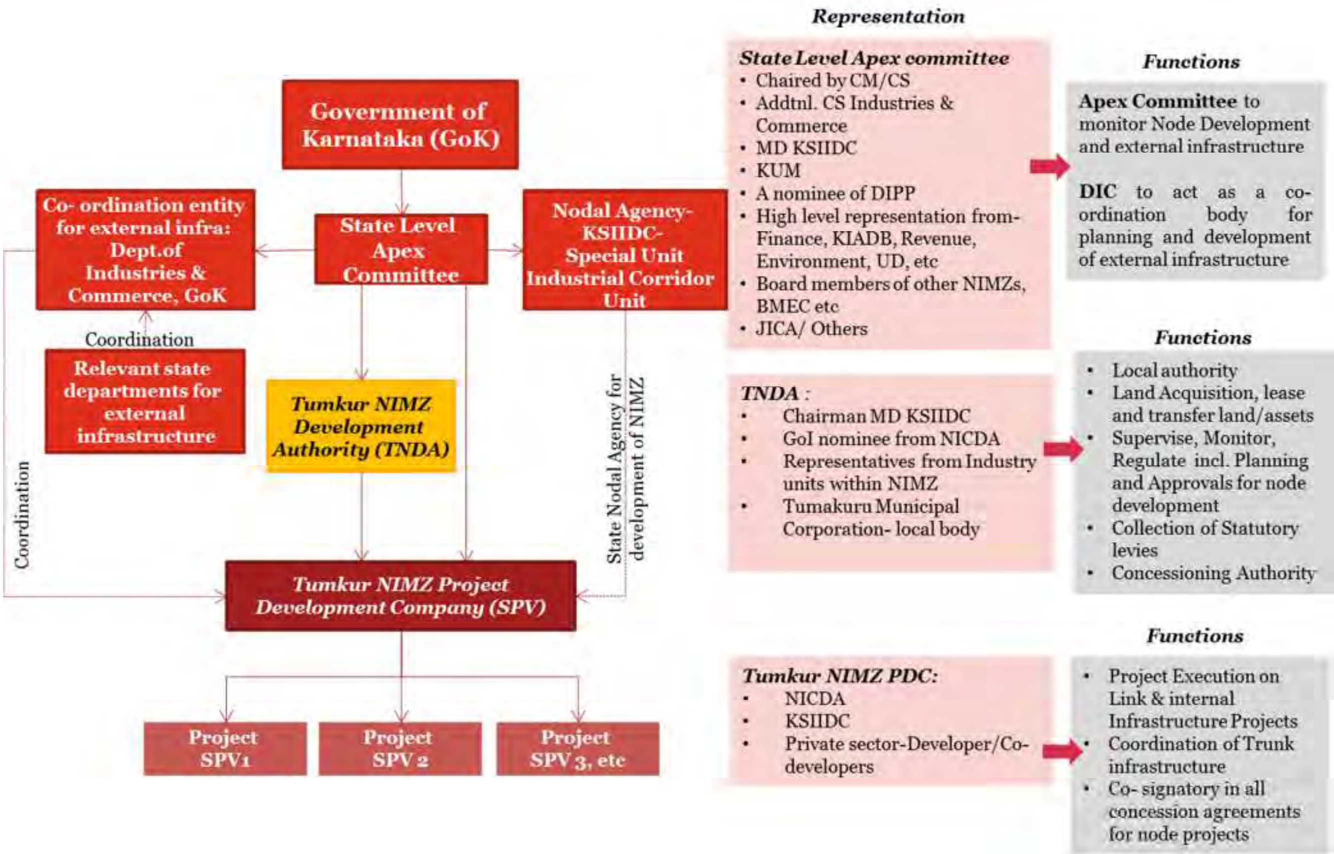


Figure 1.14: State level institutional structure for CBIC in Karnataka

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:

Two options for financing framework have been considered for CBIC development in Karnataka. First option is similar to current practice in DMIC and incorporates recommendations of NICDA.

- **All fund routing is through the Central Trust (Financing arm of NICDA).**

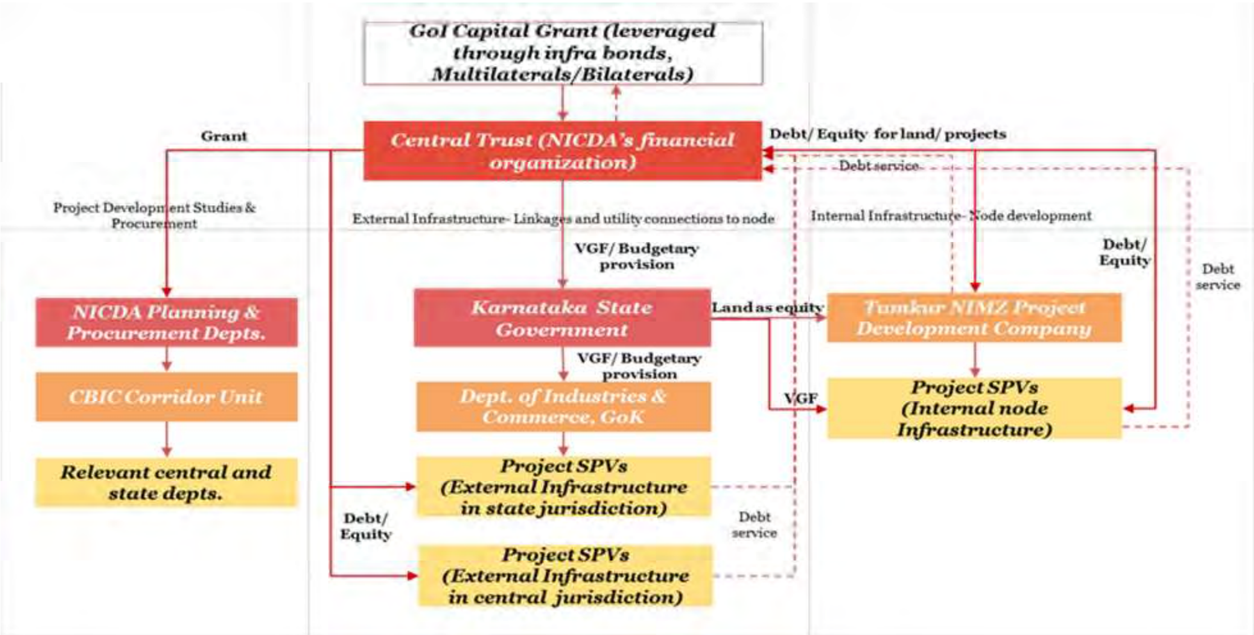


Figure 1.15: Option 1- Financing framework for CBIC in Karnataka

In the second option, it is proposed that JICA funding may be made available both at NICDA level (at centre), and JICA can directly fund the state through creation of Karnataka state infrastructure trust fund. This will enable faster fund routing from JICA directly to the state government.

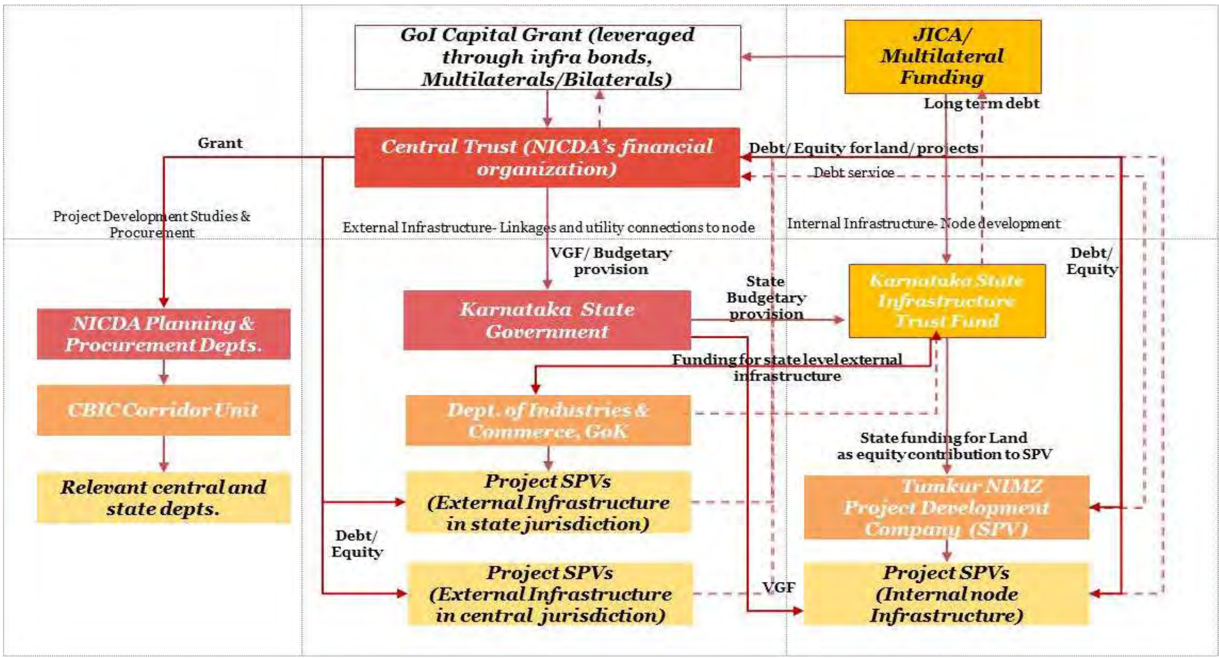


Figure 1.16: Option 2- Financing framework for CBIC in Karnataka

Financial Assessment and Plan

The financial model has been built for the master SPV which will be responsible for undertaking the development of the Tumakuru 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 1.28: Financial Model Option

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 Tumakuru Node have been arrived at using national and international benchmarks for unit costs.

Table 1.29: Cost components

Item	INR cr.	% share of TPC
Land acquisition cost	4,862	35%
Land development	693	5%
Roads	1,768	13%
Railway	140	1%
Water and Effluent Treatment Facilities	3,000	22%
Solid Waste Management	1,172	9%
Power infrastructure cost	959	7%
Contingency	773	6%
Interest During Construction	347	3%
Total	**13,713,716**	**100%**

Source: JICA study team

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

Table 1.30: Phase wise cost

Item	Phase A Upto FY 19	Phase B FY 20-24	Phase C FY 25 onwards
Land acquisition cost	4,862	0	0
Land development cost	52	163	478
Roads	864	290	614
Railway	68	9	63
Water and Effluent Treatment Facilities	806	608	1,586
Solid Waste Management	56	189	927
Power infrastructure cost	118	258	584
Contingency	197	152	425
Interest During Construction	138	90	119
Total	**7,162**	**1,759**	**4,795**

Both the above tables pertain 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 Tumakuru node:

Table 1.31: Financing Structure

	INR cr.	% contribution of TPC
Equity (Infusion into the SPV through land)	4862	35%
Debt (Land development & infrastructure cost)	5793	42%
Internal Accruals	3061	22%
	13,716	**100%**

Scenario Analysis for Project viability

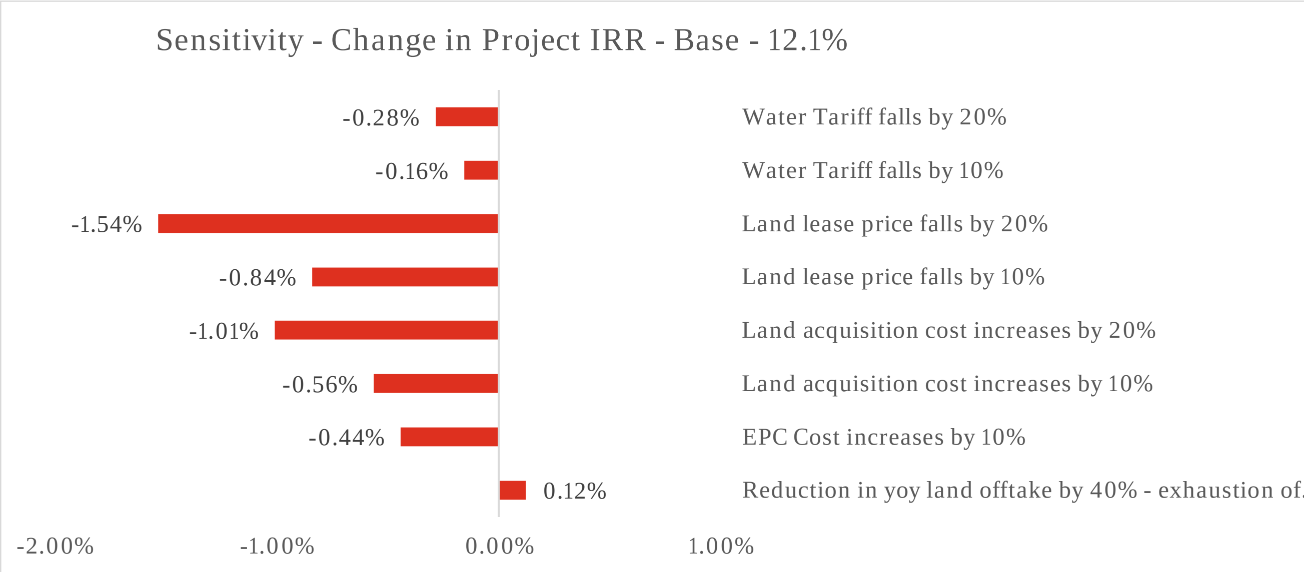
Under the current financing structure, and cost and revenue assumptions, the project IRR stands at 12.1% and Equity IRR at 13%. Other scenarios have been analysed to assess any improvement in project viability by altering key project parameters such as tariff etc and by unbundling entities for independent operations. The same have been presented below:

- **Land lease rentals**: Currently the ongoing lease rentals at Vasanthanarasapura NIMZ 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, etc are essentially non- saleable areas and form around 27% of total land area under proposed project. Thus the first scenario that has been considered, assumes loading of cost of non- saleable area over the ongoing lease rentals to recover land cost for non- saleable areas, i.e upfront lease rental of Rs. 1.52 cr/ acre as against ongoing rate of Rs. 1.20 cr/ acre

- **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.

- **Project cost:** This scenario considers altering project cost by increasing cost for individual project components. A case of change in land acquisition cost has been considered for the scenario analysis graph presented below

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



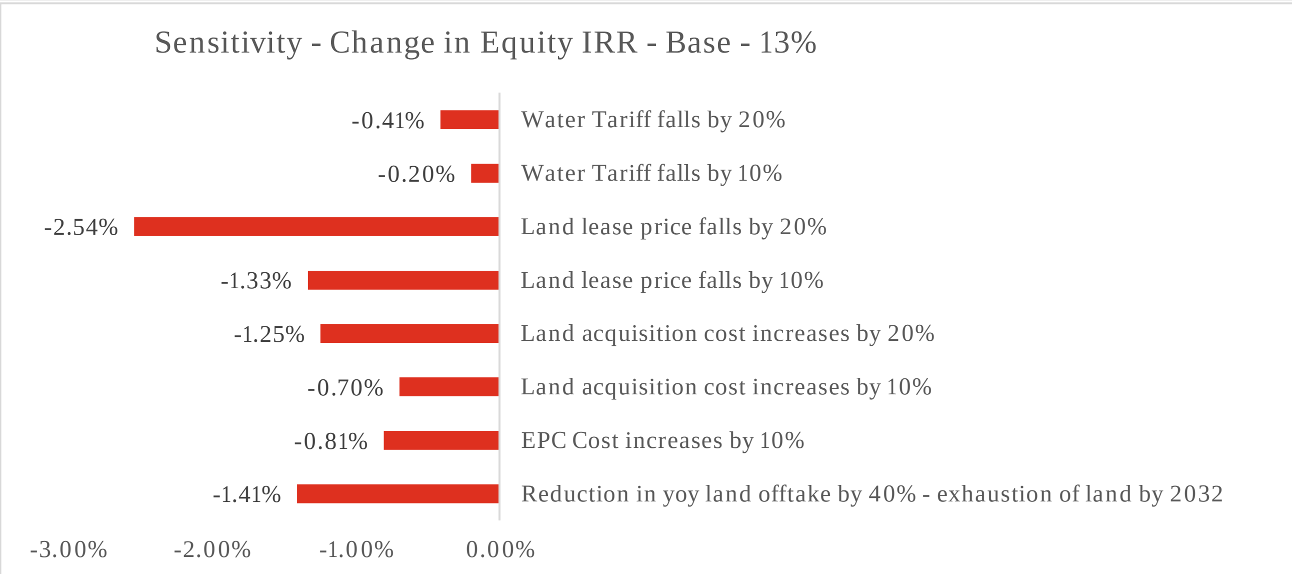


Figure 1.17: Scenario Analysis- Impact on Project and Equity IRR

As seen in the graph above, the Project and Equity IRR is sensitive to parameters related to land- Offtake and pricing. Any delay in land acquisition, may lead to substantial increase in land acquisition costs, impacting the projects viability. Also subdued demand will also substantially impact project viability. If the demand off-take reduces by 40% of projected demand, the Equity IRR reduces by 1.4% and time taken for absorption of land increases by 3 years.

Unbundling infrastructure components may be possible given the demand build- up for individual utilities is sufficient in later years. Based on current projections, only SWM, Rail & Power SPVs are analyzed to be viable as stand- alone SPVs. Other infra such as road and water are not viable as stand- alone SPV's and fall short of Equity IRR below market expectations (18%). Thus unbundling such components will require infusion of any additional Govt. grant/ sub- ordinate loan etc (if applicable). Elaborating this further, a graph has been presented below showing change in Equity IRR of the project by unbundling all individual infra components from the Master Developer.

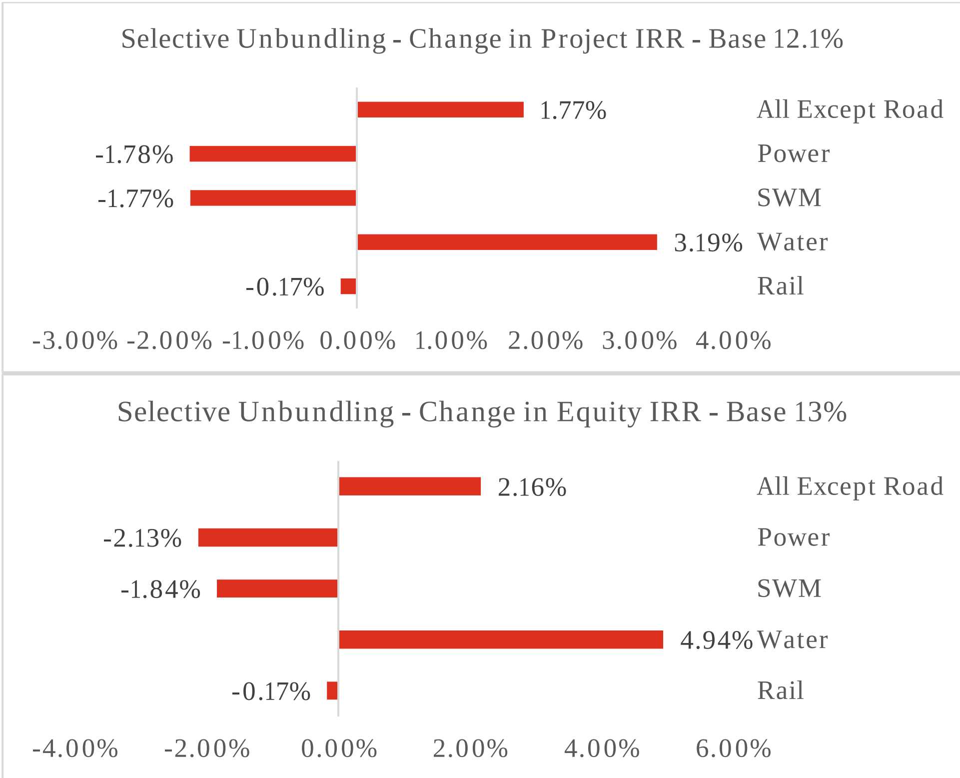


Figure 1.18: Impact on Project and Equity IRR by unbundling individual Infra Components

As seen, the Project and Equity IRR increases only by unbundling Water SPV and All SPV's except Road. Road has no revenue model, so it has to be retained with the Master Developer. It is not feasible to unbundle Water SPV, as the current water tariffs (in line with ongoing water tariff in Tumakuru) which have been adopted are sufficient to meet only water opex requirements. In order to be feasible as a stand- alone SPV, it may be required that the Government provide up- front grant and/ or increase water tariffs specific to NIMZ node such that the additional cost will be borne by the State Government such that citizens will not be overburdened.

Investment Environment Improvement

Recommendation to Karnataka Government

Karnataka is characterized by the highest number of the ITIs & ITC, but still need to improve in the other realms. The above analysis, especially, shows that Karnataka is behind the other states in Infrastructure and Industrial park readiness, where we strongly recommend the in-depth support from authority should be required to enhance investments to the State including manufacturing sectors.

Table 1.32: Recommendation for Karnataka

Perspectives	Details of the Recommendations
Infrastructure	• PMU to help collaborate with relevant State Governments and Central Government to 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	Implement actions under KIPP to make land related information available to investors • KIADB to set up dedicated unit to operate existing Kaigarika Bhoomi to include online application system, tracking system, helpline and monthly update mechanism in FY15/16. • Land pool policy to be introduced to increase land availability for investors. The Policy is targeted to be approved by FY 15/16, and operational guideline to be released in FY
Skill Development	1) Implement actions under KIPP • Revision of existing Skill Development Policy of the State and preparation of Draft Skill Development Policy 2015-20 comprising detailed road map of schemes, yearly target outcomes, and budgetary provisions in FY15/16. • Arrangement of an annual industry-government round table to continuously understand the skill demand with changing contexts. Foreign investors including Japanese investors may be invited as participants of the roundtable. • Introduce new curriculum to match up-to-date skill requirement. 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 3) Formulate comprehensive IP Strategy / Measures for the State • As Karnataka Industries Policy 2014-19 indicates, comprehensive IP Strategy / Measures for the State need to be formulated at priority basis to create IP creation, IP Protection, IP Commercialization and IP Enforcement.
Business Process	Implement actions under KIPP to improve the single window mechanism. • KUM to enhance exiting E-Udyami to include tracking system, helpline, information such as contact details of nodal officers, incentive schemes available, • KUM to appoint dedicated person for each investor to support project clearances and coordinate with line departments
Industrial park/Cluster	• Formulate the operational guideline on priority basis to encourage establishment of Industrial Parks by private investors, as Karnataka Industrial Policy 2014-19 indicates and establish the support mechanism inside the Industries Department. • Establish the standard to ensure the quality of infrastructure provided (water, power, waste management etc.)

Way Forward

The following activities need to be undertaken by the Government of Karnataka (GoK) for moving project towards implementation of Tumakuru Node.

Legal/Regulatory Framework

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

a) Declaration of Industrial Township of the proposed Tumakuru node as aligned to Article 243Q

b) Review of samples of State Support Agreement (SSA) and Share Holder Agreement (SHA) 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 GoK

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 additional 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 [KSIIDC or an appropriate organization] 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 GoK 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.

f) Confirmation of water supply to Tumakuru Node

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.

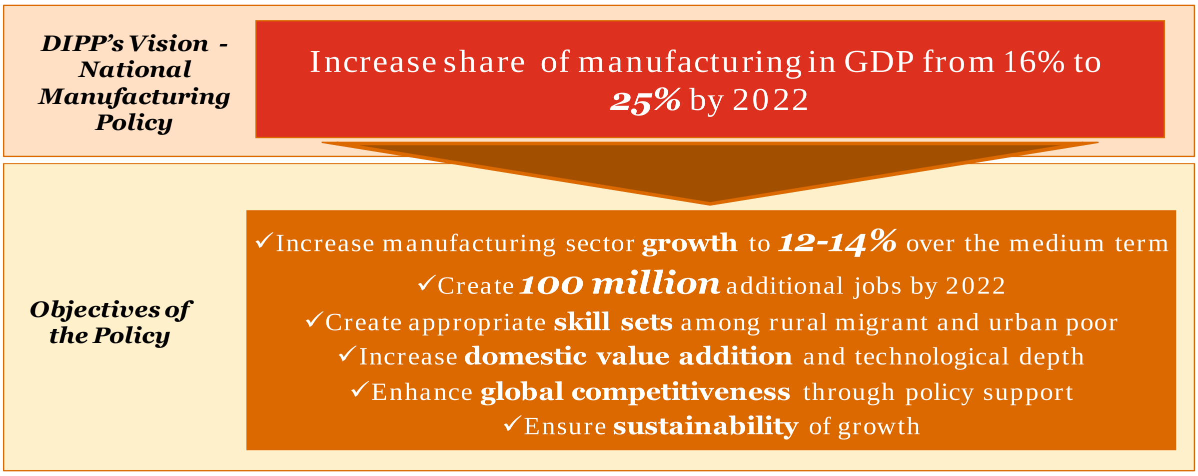
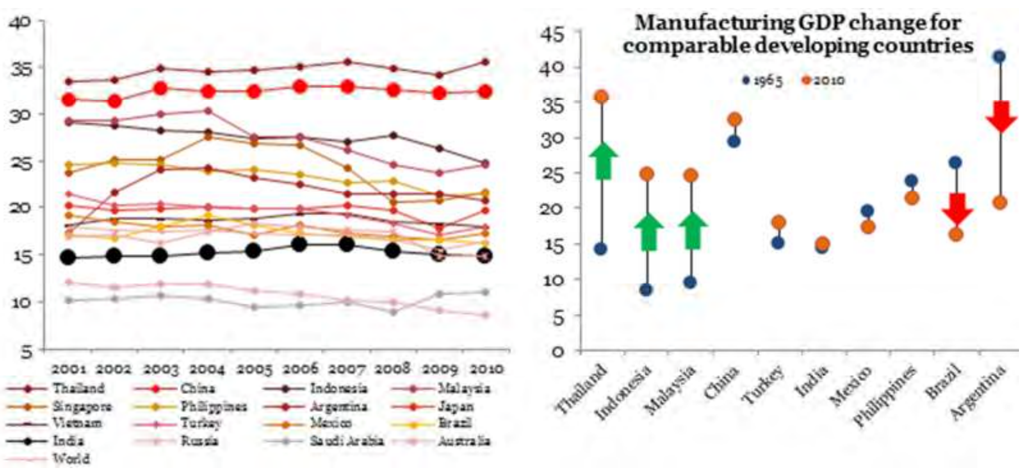


Figure 2.1: Vision and Objective of National Manufacturing Policy

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.



Source: World Bank Statistics

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[2]. Realisation of primary objectives of the policy, such as increasing manufacturing sector

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

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

Figure 2.3: Industrial Corridor Development Projects

In the state level in Karnataka, there is an opportunity for 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)

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, Tumakuru 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

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 about **91,000 sq. kms** (about 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:

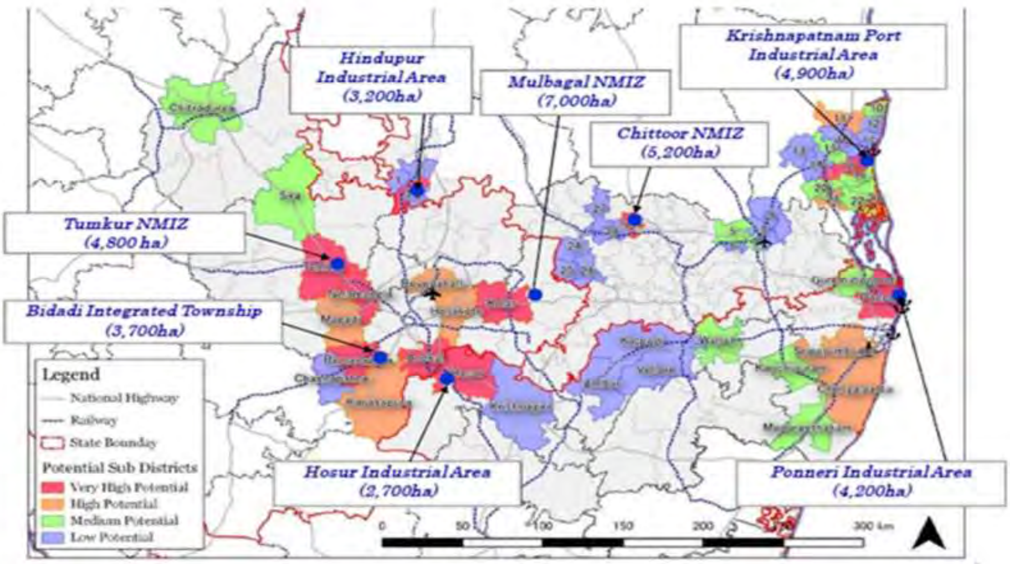
Category A: High priority regions with the potential to provide faster return on investments

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:

- Accessibility to regional trunk roads
- Existence of protected/restricted areas
- Government land availability and availability of proposed industrial development areas
- Water availability
- Assessment of urban planning strategy
- Existing and planned industrial areas
- Accessibility to major transport facilities (port and airport)
- 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.



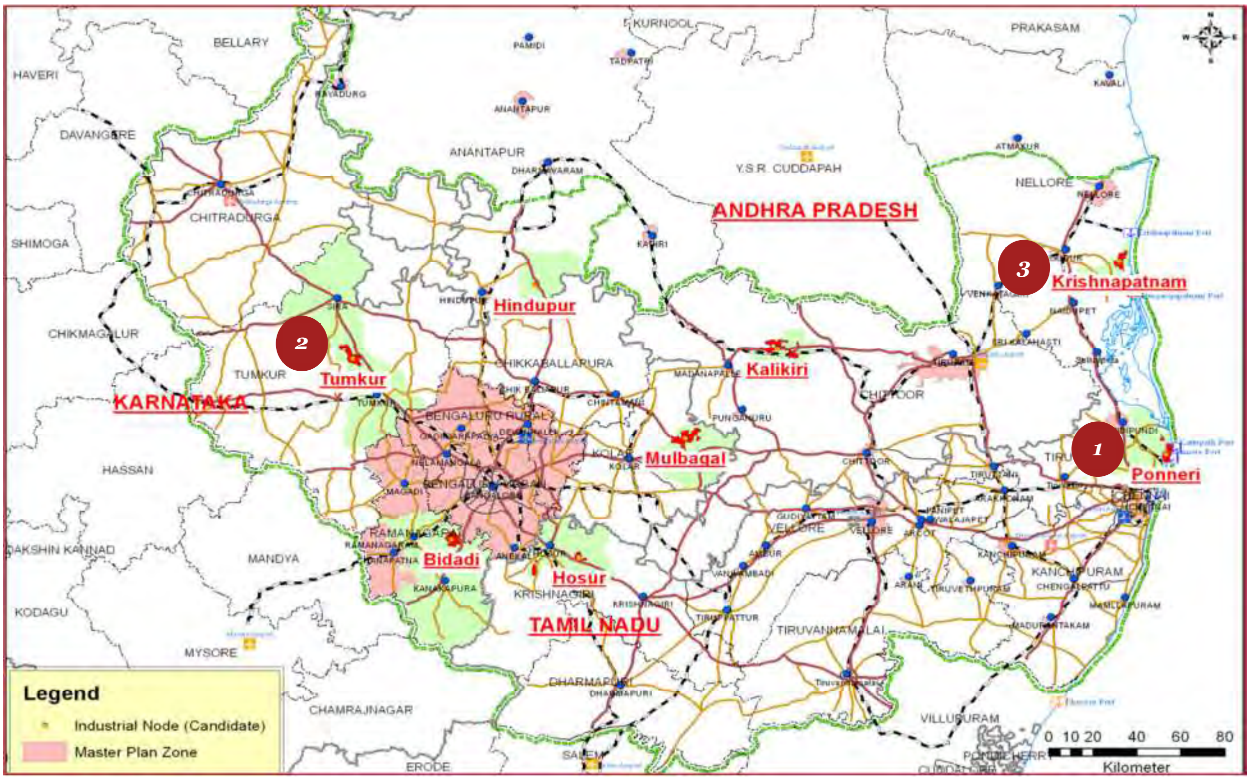


Figure 2.5: Nodes selected for CBIC including three nodes selected for Master plan development

Selection of Tumakuru node

Tumakuru NIMZ has the key advantage in terms of accessibility to the regional trunk road as well as access to NH-7, which stretches between Bengaluru and Chitradurga through Tumakuru NIMZ. This area has more government land than Bidadi, another potential area. In addition, the area has an existing industrial park (Vasantha Narasapura Phase1-3), and one Japanese consortium is planning to develop the factory in the area. The surrounding area is planned to expand with the Tumakuru NIMZ master plan. It is in the phase of notification for the land acquisition as of May 2014. In the view of short term development, this is the highest potential industrial node in Karnataka state.

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.

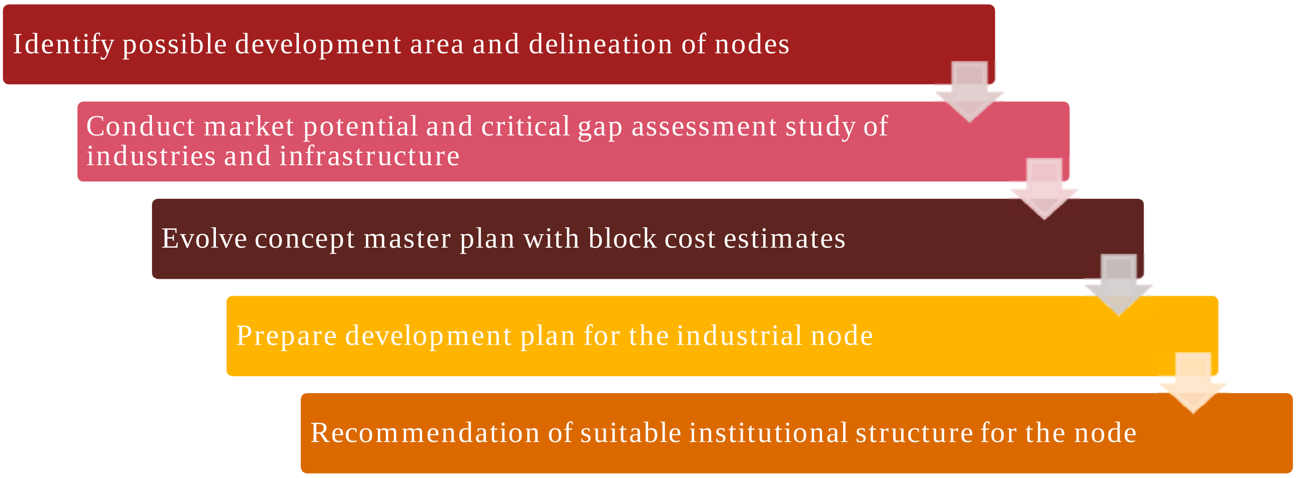


Figure 2.6: Study Framework

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 Approach for Infrastructure Development 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.

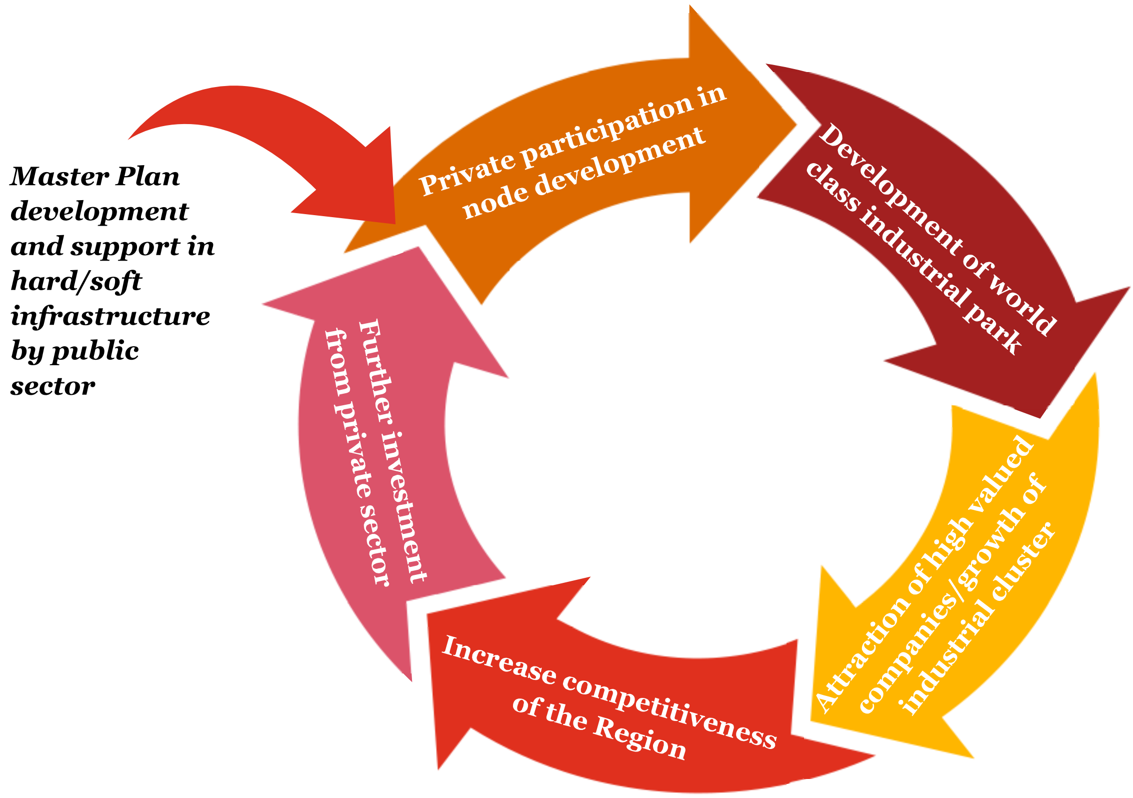


Figure 2.9: Public Private Partnership in Node Development

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 Centre *"Be known as a global leading manufacturing centre 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 Final Report

The Final Report 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 below.

- **Overview of Tumakuru District and Vision for the Node** including the socio-economic profile of the district

- **Analysis of Traditional and Potential Industrial Sectors for Tumakuru** 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 Tumakuru District and Node*

3.1 Regional Assessment of Tumakuru

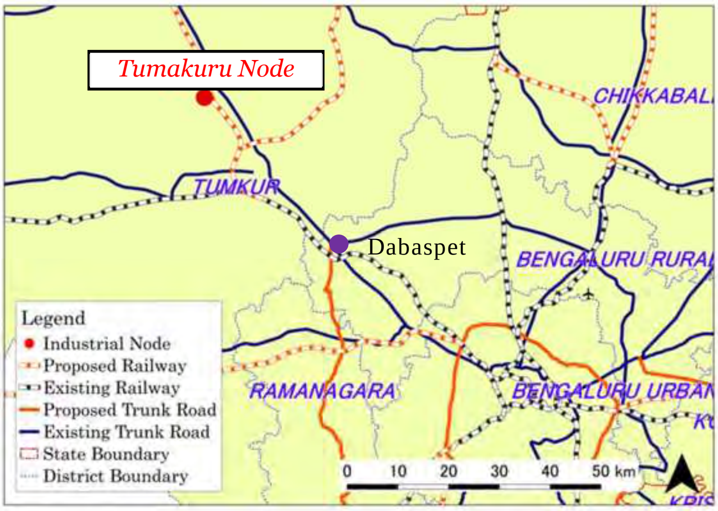
The proposed Tumakuru Node lies along either side of NH-4, which connects Mumbai to Chennai via Pune and Bengaluru. The site is located about 80km northwest of the center of Bengaluru city, and 20km northwest of Tumakuru city, the headquarters of Tumakuru district. The distance to ports from this node is a drawback compared to the other two nodes, but this area has several alternatives for importing and exporting materials and products - 1) Chennai and Ennore, 2) Krishnapatnam, 3) Mangalore, and 4) Mumbai.

There are some existing industrial areas located along NH-4. When considering industrial areas bigger than 100 ha, Vasanthanarasapura (the existing industrial area of Tumakuru NIMZ) and Dabaspet industrial areas are the nearest. Both areas have been developed mainly for Indian companies; only a few foreign companies have plans to develop factories in those areas so far. The overview of Tumakuru Node is summarised as below:

Table 3.1 : Overview of Tumakuru Node

Particular	Description
District/ State	Tumakuru district/ Karnataka state
Distance from Metropolitan/major city	80 km from city centre of Bengaluru 20 km from Tumakuru city 30 km from Sira city
Accessibility to trunk road network	NH-4 passes through the site
Accessibility to railway network	Currently, there is no direct railway access to the site; however a new access line has been proposed through the node area by South Western Railway (Tumakuru – Davanagere new line).
Accessibility to major transport facilities (port, airport)	The node site is: 250 km east of Mangalore port. 360 km west of Ennore port. 350 km west of Krishnapatnam port. 100 km from Bengaluru International Airport
Major industrial locations in the surrounding area	Adjacent to Vasanthanarasapura industrial area (existing Tumakuru NIMZ area: 480 ha) 40km from Dabaspet industrial area (450 ha)

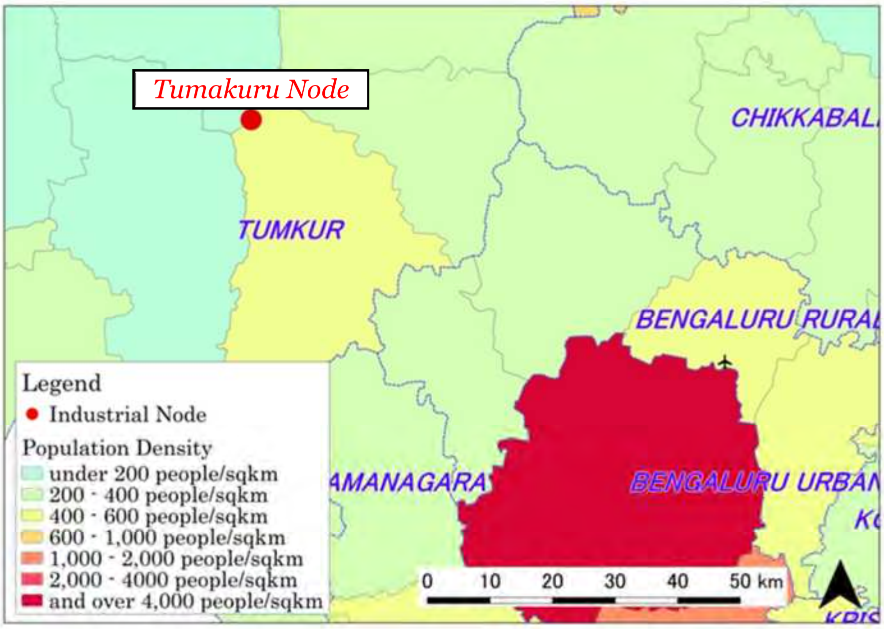
Source: JICA Study Team



Source: JICA Study Team

Figure 3.1: Infrastructure Map of Tumakuru

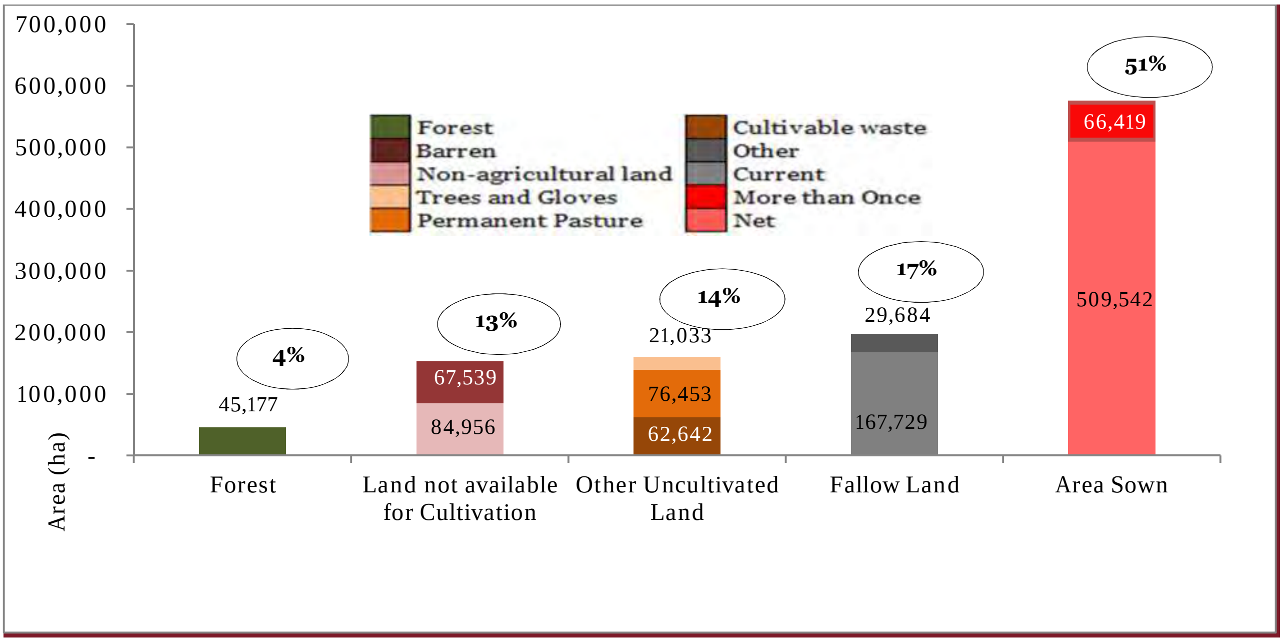
In the Bengaluru Metropolitan Area, the population is concentrated in the Bengaluru Urban district and its surrounding sub-districts. Northwest of Bengaluru, only Tumakuru sub-district has a relatively high population density, since the sub-district contains Tumakuru city itself (the district headquarters). The density of Tumakuru sub-district is 400-600 people/sq.km.



Source: JICA Study Team

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

The geographical area of Tumakuru is 1,064,755 hectares with around half of the land area under cultivation (indicated as the 'net sown area'). Only 4% of the total area is forest land. Uncultivable land forms 27% of the total and includes non-agricultural land, barren land, cultivable wasteland, land for trees & groves and permanent pasture. The proposed NIMZ land at Vasanthanarasapura of 12,500 acres (i.e. 50 sq. km or 5059 hectares) consists of fallow land or agricultural land without irrigation canals or perennial water resources.



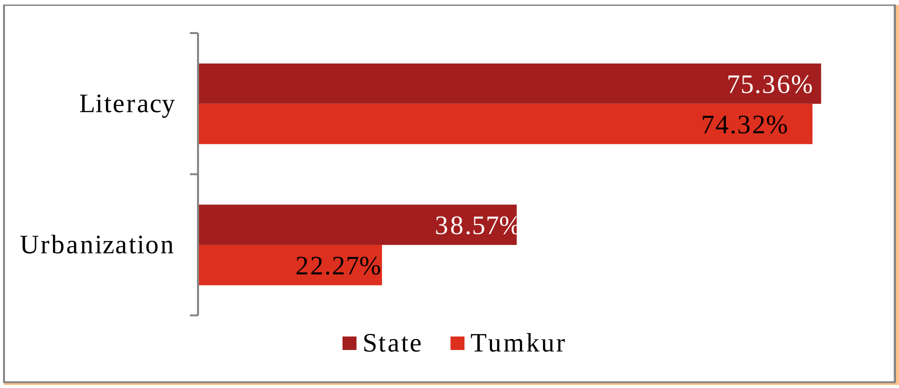
Source: Agriculture Contingency Plan for Tumakuru District, Go

Figure 3.3: Land Utilisation 2011-12 in Tumakuru District

3.2 Socio- economic profile of Tumakuru district

3.2.1 Vital Social Characteristics

Urbanization in Tumakuru district is lower than Karnataka State. Tumakuru district occupies an area of 10,597 km² and population of 2,681,449. Out of 10 talukas in the district, Tumakuru taluka has one-fifth of total population share followed by Sire (12%) and Gubbi & Madhugiri (10% each). Only about 22% of population lives in urban area. The urbanization is lower compared to 38% of State's urban population. Literacy rate for Tumakuru is 74.32% (*census 2011*). The average literacy rate of State and CBIC region are 75.36% and 78.27% respectively. However, even with comparative less urban population, the literacy rate at the node is at par with the State figures.



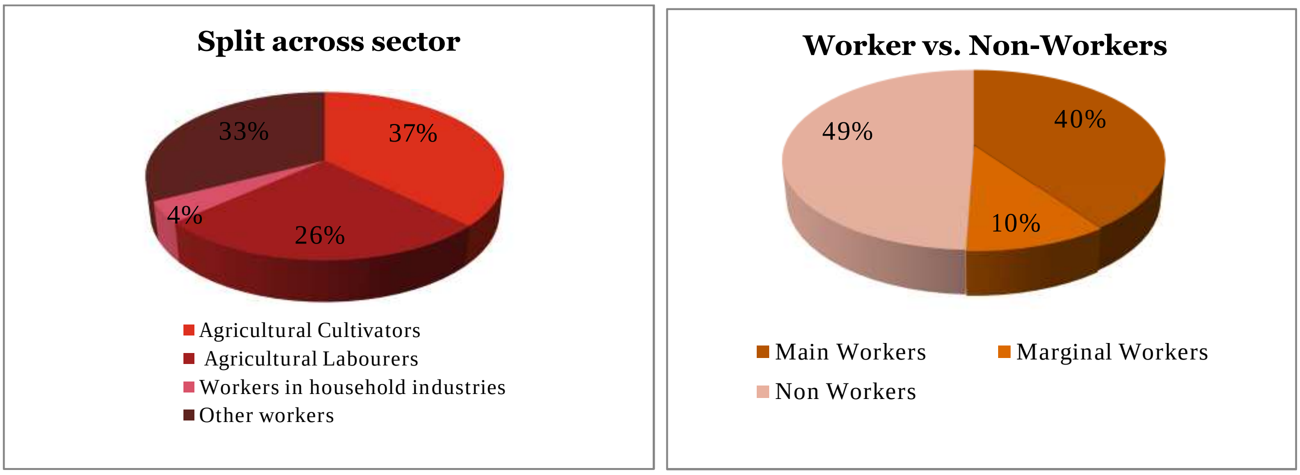
Source: Census 2001 and 2011, PwC Analysis

Figure 3.4: Literacy and urbanization for Tumakuru district, influence region & State

3.2.2 Employment

Two-third of employment is generated by agricultural related activities

- The total district population is 1,064,755 (Census 2011).
- The share of workers population involved in agriculture activities (agricultural cultivators and agricultural labourers) is highest at 60%.
- One –third of workers are involved in house-hold industries.
- This indicates majority of the population (~ 60%) is dependent upon agriculture related activities.



Source: 2011 census

Figure 3.5: Worker ratio in Tumakuru district

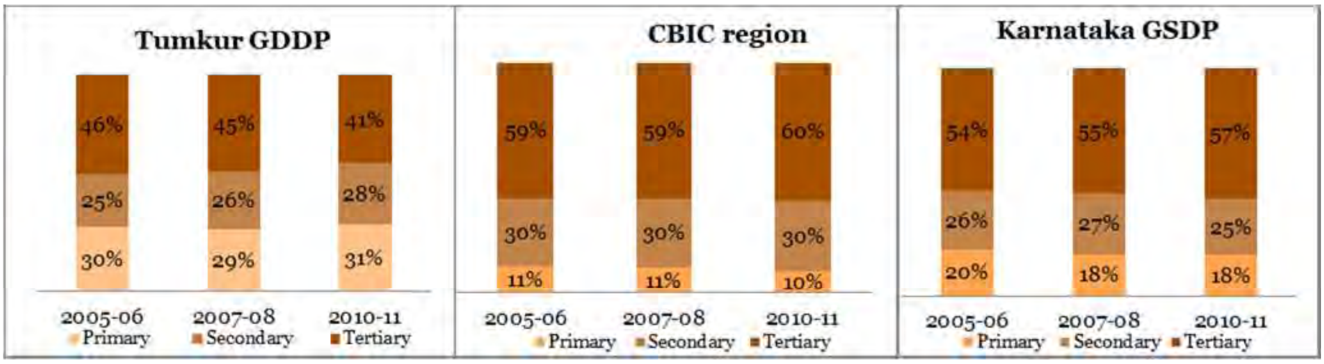
Only 50% of employable population has employment tenure of more than 6 months in a year. The employable population of Tumakuru node consists of 50% are main workers and 10% Marginal Workers.

Main Workers are those workers who had worked for the major part of the reference period i.e. 6 months or more. Marginal Workers are those workers who had not worked for the major part of the reference period i.e. less than 6 months. Non worker category constitutes 40% of employable population. A non-worker is a person who has not work at all during the reference period and includes students who did not participate in any economic activity (excludes infants or very elderly people).

This indicates that 50% of employable population is either not working due to full time employment opportunity or involvement in education related activities.

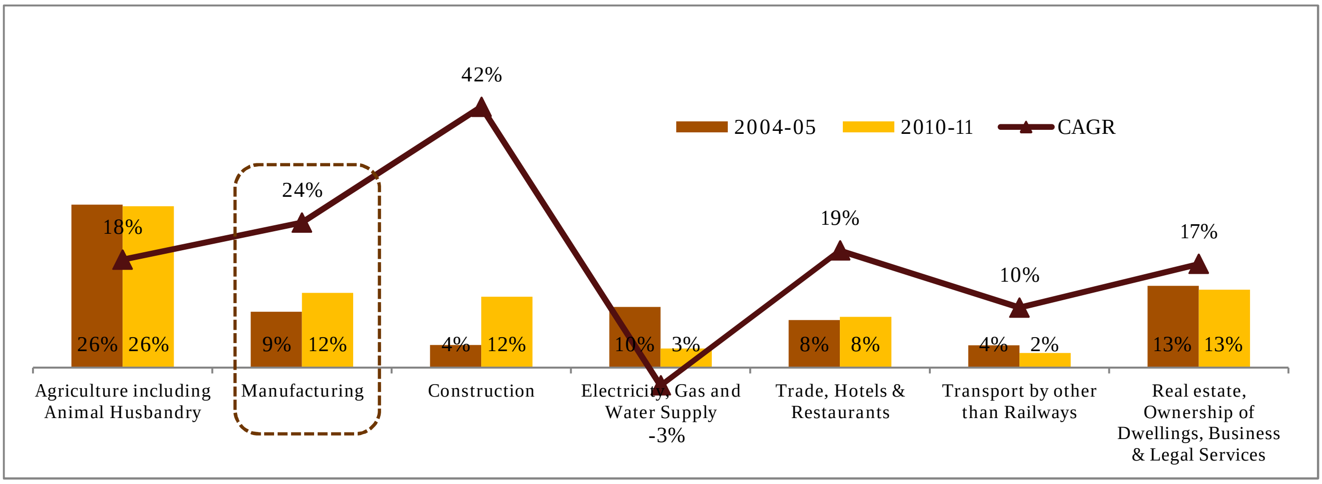
3.2.3 Gross District Domestic Product

Primary sector contributes to more than one-third of GDP by employing two-third of the employable population. At CBIC region the contribution to GDP is dominated by tertiary sector at 60%. Secondary sector has one-third share followed by primary sector that has minimum share of 10% in CBIC region. This mix has remained constant over the years for CBIC region. On the other hand the economy of Karnataka state shows the same trend and is dominated by tertiary sector segment with a GSDP share of 57% in 2010-11. This is followed by the secondary sector share at approximately 25% of GSDP and primary sector share of 18%. The sectorial contribution mix at the state level has remained more-or-less constant over past decade as observed in case of CBIC region. However Tumakuru district GDDP exhibits trends similar to Karnataka for secondary sector share state however primary sector share is much higher and hence reducing tertiary sector share in the district.



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

Figure 3.6: Share of primary, secondary & tertiary sectors in Tumakuru/CBIC/Karnataka



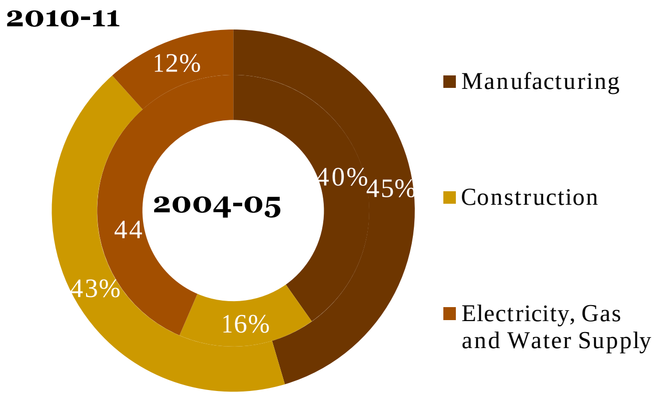
Source: District domestic product 2004-05 to 2010-11, Directorate of Economics and Statistics, GoK, PwC analysis

Figure 3.7: Major components of GDDP of Tumakuru district

Manufacturing Sector of Tumakuru District

Manufacturing is a modest player in secondary sector – 12% contribution to GDDP by 2010-11. Secondary sector of Tumakuru district contributed 28% to the district's GDP in 2010-11 and has grown from Rs. 1,424 crore to Rs, 2,590 crore at a CAGR of 10% between 2004-05 and 2010- 11.

Manufacturing and Construction both are dominating segments of secondary sector in Tumakuru. However where manufacturing has grown at CAGR of 24%, construction sector growth is whopping at CAGR 42% almost double of manufacturing. Manufacturing and Construction both segments are the third largest contributor to the district's GDP after Agriculture and Real Estate. Electricity, Gas and Water Supply has reduced its share from 10% in 2004-05 to 3% in 2010-11.

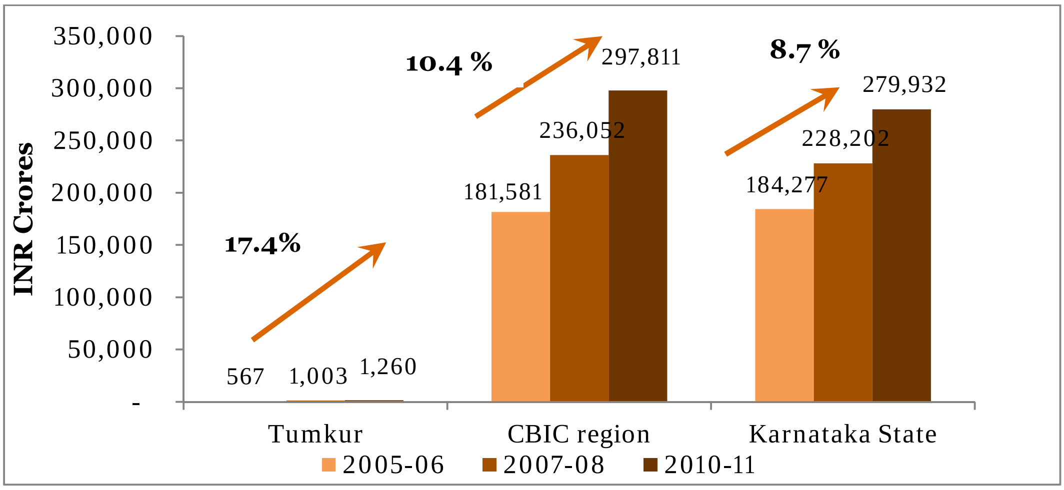


Source: District domestic product - Karnataka 2004-05 to 2010-11, Directorate of Economics and Statistics, GoK, PwC analysis

Figure 3.8: Composition of Secondary sector in Tumakuru district

In volume terms manufacturing has grown from Rs. 474 crore in 2004-05 to Rs. 169 crore in 2010-11. Tough its share has increased from 40% to 45% for the period of 7 years (2005-11) in secondary sector it is followed by construction that has increased from 16% to 43%. It is strikingly low comparing to the national level where manufacturing constitutes about 60% of industry GDP[3].

Pertaining to these factors manufacturing GDDP of Tumakuru district is growing at twice the growth rate of Karnataka State. The CBIC region comprises of three of highest Gross domestic product (GDP) contributing states in the country, together accounting for 1/5th of national GDP as well as industrial NDP. Karnataka's current share of manufacturing in GSDP is 17.86%. The state contributes to 5.5% of national GDP and is ranked 7th nationally at constant prices (2004-05). The GDP of Karnataka state and CBIC region have being growing at CAGR of 8.7% and 10.4% respectively (2005-06 to 2011-12). The contribution of Tumakuru district to the CBIC region of Karnataka have being at nominal rate of approximately 4%. The GDP of Tumakuru has grown from 567 Crore in 2004-05 to Rs. 1,260 Crore. With this Tumakuru has registered CAGR of 17.4% in GDDP and growth rate double of Karnataka State.



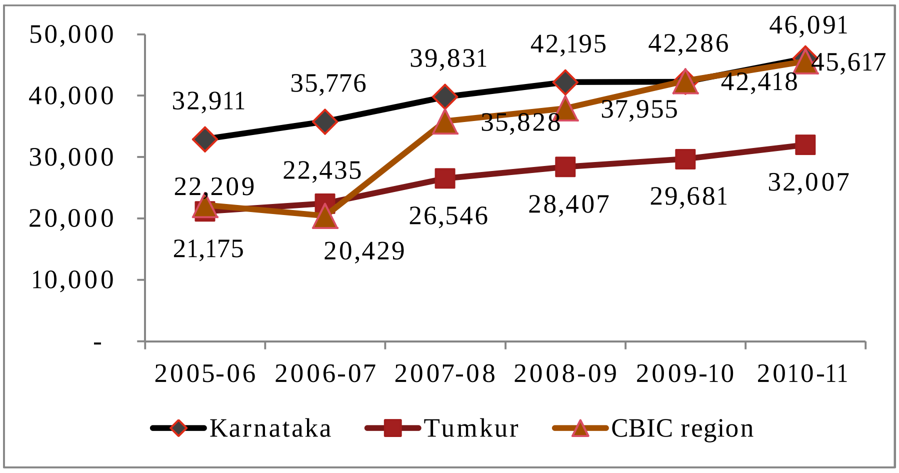
Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoK

Figure 3.9 : Gross Domestic Product, constant prices 2004-05

3.2.4 Per Capita Income

The per capita income at constant prices (2004-05) for Karnataka state is INR 46,091 that has grown at CAGR of 7% in last 5 years. The per capita income of Tumakuru district is much lesser at INR 32,007 (2010-11) but has grown at a CAGR of 9% during the same period more than Karnataka state CAGR. However, per capita income of Tumakuru is still lower than the Karnataka state and CBIC region.

3 Economic Survey 2013-14, Chapter 9 "Industrial performance", p. 162, http://www.indiabudget.nic.in/

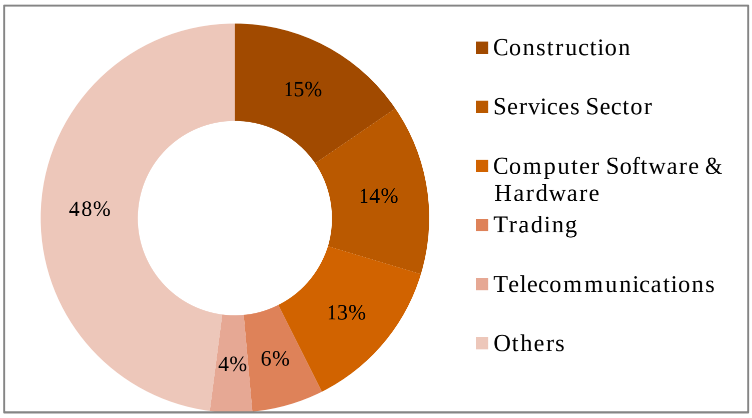


Source: District Income estimates, 2004-2005 to 2010-2011, Dept. of Economics and statistics, GoK

Figure 3.10 : Per capita income at constant prices (2004-05), INR

3.2.5 Foreign Direct Investment

Karnataka has received US$ 10.53 billion FDI Inflows from January, 2000 to December, 2012. With this percentage share of total FDI inflows of Karnataka is 5.59% and ranks Karnataka 3rd highest FDI receiving state.[4] The top five sectors in FDI equity inflows are Construction, Services Sector (Financial, Banking, Insurance, Non-Financial / Business, Outsourcing, R&D, Courier, Technology, Testing and Analysis), Computer Software & Hardware, Trading and Telecommunications. Construction dominates the inflow of FDI flowed by Service sector and Computer Software & Hardware. It is observed that manufacturing is not among the top sectors receiving FDI. Focus needs to be for attracting more foreign investors in manufacturing.



Source: DIPP Annual report 2012

Figure 3.11 top five sectors in FDI Karnataka

Details of top 25 FDI equity inflows received in Karnataka reveals that 4 deals are in manufacturing that forms 13% of total high ticket deals in the State. The manufacturing segments that received FDI are Chemicals & Petrochemical and non-metallic Minerals.

Table 3.2: FDI Inflows

Name of Indian Company	Name of Foreign investor	Item of Manufacture	Amount of FDI Inflows (INR crore)
Praxair India Ltd	Praxair Pacific Ltd (Mauritius)	manufacture of industrial gases	577

[4] http://dipp.nic.in/English/Publications/SIA_NewsLetter/AnnualReport2012/Chapter6.3.iii.pdf

Name of Indian Company	Name of Foreign investor	Item of Manufacture	Amount of FDI Inflows (INR crore)
Mysore Cements Ltd	CementruM I.B.V (Netherland)	Cement Lime and Plaster	359.10
Givaudan (India) Pvt. Ltd.,	Givaudan (India) Pvt. Ltd (Switzerland)	Chemical Products NEC	317.68
Continental Automotive Components	Continental Automotive GMBH (Germany)	Manufacture of Laboratory and Scientific Instruments N.E.C. (includes manufacture of non-optical mic	236.16
	Total manufacturing		**1,489.94**
	Total FDI (all sectors)		**11,149.38**

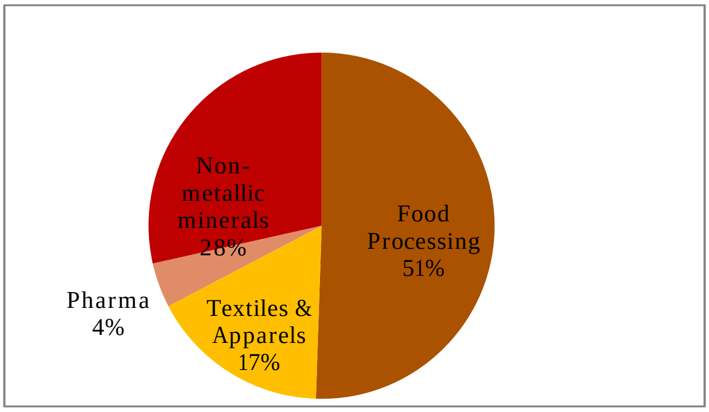
Source: PwC Analysis

Tumakuru recently has started attracting FDI in manufacturing. For Tumakuru district out of total INR 1,700 Crores industrial investment 10% is via FDI. The Food Processing, CEO and Auto are highest contributor to FDI from Tumakuru district accounting for 59%. Food processing has investment in gherkins and vegetable pickles. CEO has attracted investment in electronics component. There has been one Japanese investor in Tumakuru district in IT involved in software development.

Manufacturing in Tumakuru district is set to pick up – 13% of total upcoming investments are in manufacturing sector. 87% of total investments in upcoming projects in Tumakuru are in electricity generation, Mining and services-other than financial.

Manufacturing sector is gradually picking up – 13% of total investments in upcoming projects. Investment in manufacturing in district is dominated by food processing sector with share of 51%. This involves setting up of mega Food Park and a coconut technology park in the district.

Investments are also planned in Textiles in ready-made garments, non-metallic minerals sector with one unit of Ceramic floor and wall tiles and non-metallic minerals sector and herbal extract unit in pharma sector.



Source: Capex CMIE Database

Figure 3.12: Outstanding manufacturing in Tumakuru

FDI units in the district are Export oriented Units (EoU) and will drive future exports from the region. All the EoUs are multi-national companies. At Karnataka state level for exports Textiles & Apparels and Computer, electronic and optical products (includes Computer Software & BT) accounts for 75% of share. Karnataka's share in all India exports has increased nominally from 9.99% in 2002-03 to 11.71% in 2011-12. Karnataka exports have grown at CAGR 29% in same period compared to Indian export CAGR of 21%.

Name of Indian Company	Item of Manufacture
System Consultant Information India (P) Ltd	Software development
Wienerberger Berger Brick Industry Pvt,	Wire Cut Bricks
Mann & Hummel filter Pvt Ltd	Air Oil Separator, Oil filter, Air filter
CIPSA — RIC India Pvt. Ltd.	Printed Circuit Boards
Kern Liebers Pvt. Ltd	Springs
Reitzel India Pvt Ltd	Gherkin & other vegetable pickles
Indo Spanish Taste Foods Pvt. Ltd.	

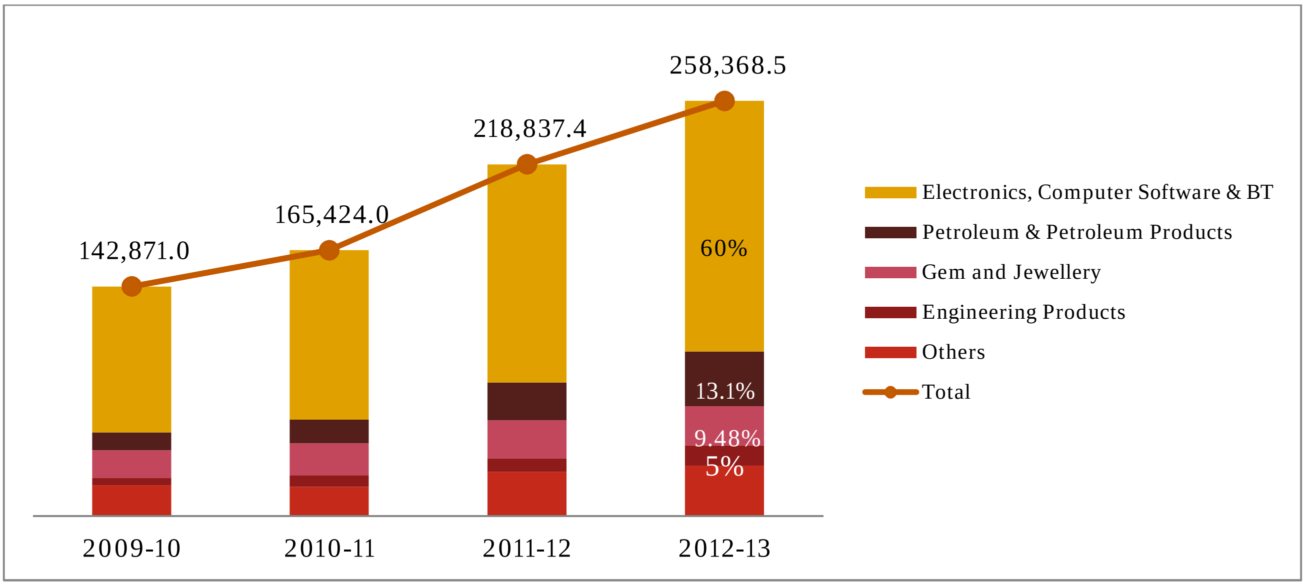
Source: PwC Analysis

Figure 3.13: List of Companies in EoUs

3.2.6 Export

Karnataka's export share in India increased from 11.71% in 2011-12to 12.67% in 2012-13. Also, the share of exports in GSDP which was 7.36 % in 1993-94, has grown to 48.4% in 2012-13.

Exports of electronics and computer software constitute the largest share in the State's exports. Its share was of the order of 60% in 2012-13 he exports of electronics and computer software from the State accounted for as much as 38 % of India's total exports. The other commodities which have substantial share in Karnataka's exports in 2012-13 are Petroleum and petroleum products (13.13%) and Gems & Jewelry (9.48%). These three commodities account for about 83% of Karnataka's exports. On the other hand, share of engineering products remained nominal, at 5% compared to other products.



Source: Economic Survey of Karnataka 2013-14

Figure 3.14 Karnataka Export Performance

Tumakuru district has low per capita income because 95% of the employment is in Micro and SSI sector and primarily dominated by household activities (repairing & services) that form one-fifth of total manufacturing

Manufacturing GDDP of Tumakuru district is growing at twice of the growth rate of Karnataka State, 17.4%.

3.3 Industrial Infrastructure profile

3.3.1 Existing Infrastructure Profile

Tumakuru district has around 840 acres of developed industrial infrastructure. Industrial development in the district started in 1981 when the Karnataka Industrial Areas Development Board (KIADB) promoted industries at Hirehalli. This was followed by industrial areas at Sathyamangala and subsequently at Antharasanahalli and Kunigal. As of now there are nine industrial areas and nine industrial estates in the district. Totalling around 844 acres, all the areas and estates were developed by KIADB. The outline of existing industrial areas and industrial estates are summarised as follows:

Table 3.3: Existing KIADB Industrial Areas in Tumakuru District

Sl.No.	Name of Industrial Area	Taluk	Extent Developed (Acre)	No. of Plots allotted
1	Antharasanahalli 1st Phase	Tumakuru	208.00	136
2	Antharasanahalli 2nd Phase	Tumakuru	256.00	142
3	Sathyamangala	Tumakuru	54.5	46
4	Hirehalli	Tumakuru	160.86	101
5	Kunigal 1st Phase	Kunigal	112.57	90
6	Kunigal 2st Phase	Kunigal	52.97	11

NOTE: Phases 1 to 3 of Vasanthanarasapura industrial area are excluded

Source: DIC, Tumakuru

Table 3.4: Existing KIADB Industrial Estates in Tumakuru District

Sl. No	Name of Industrial Estate	Taluk	No. of sheds and plots constructed
1	B.H. Road, Tumakuru	Tumakuru	Sheds – 32; Plots - 41
2	Antharasanahalli 2nd phase	Tumakuru	Sheds – 34; Plots - 153
3	Hirehalli	Tumakuru	Sheds - 20; Plots - 15
4	Yeliur,	Sira	Sheds – 0; Plots - 11
5	Sira	Sira	Sheds – 15; Plots - 13
6	Tiptur	Tiptur	Sheds – 20; Plots - 44
7	Kunigal	Kunigal	Sheds – 16; Plots - 30
8	Madhugiri	Madhugiri	Sheds – 14; Plots - 22
9	Pavagada	Pavagada	Sheds – 0; Plots - 97

Source: DIC, Tumakuru

3.3.2 Industrial Clusters

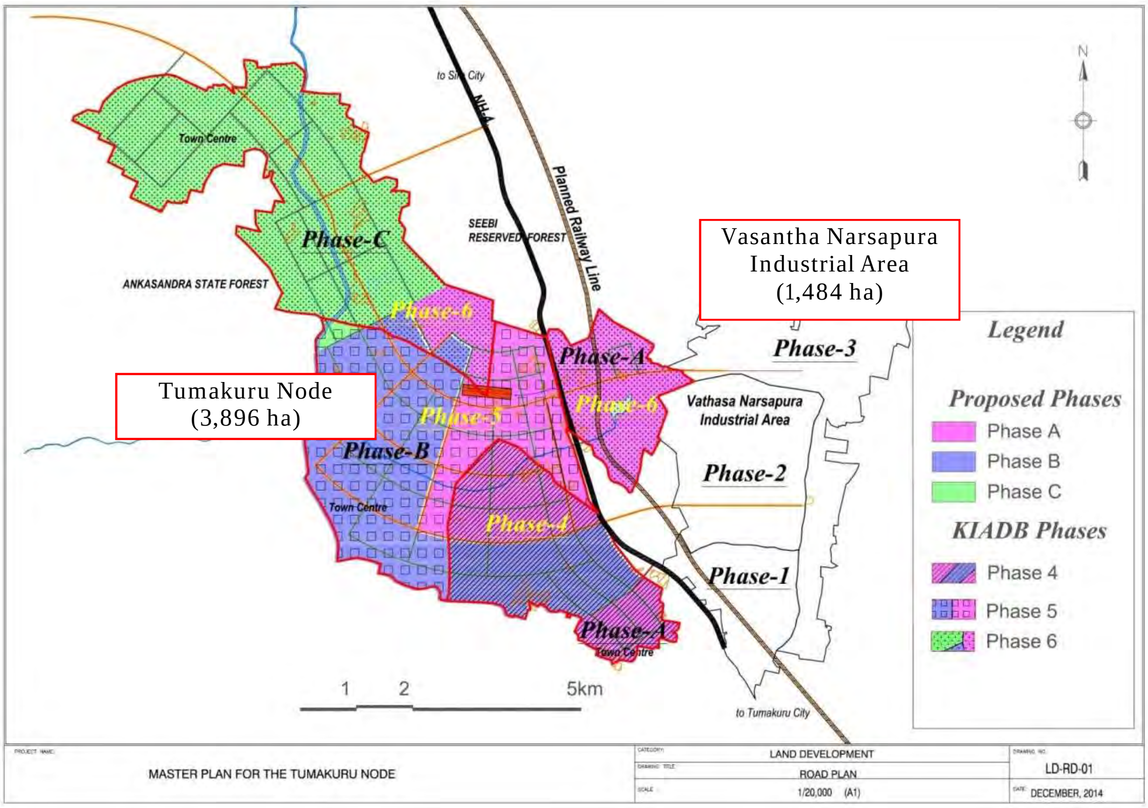
Node is surrounded by many industrial clusters in close proximity. Industrial clusters are located within 150 km radius and towards south-east of proposed Tumakuru NIMZ. This includes Bengaluru-Urban and rural in south, Chikkaballapura and Kolar in south-east and Ramanagar in south-west. Bengaluru Urban has largest share of upcoming clusters in IT and manufacturing sectors.

The details of Operational Industrial areas /clusters and Upcoming & Ongoing IPs/SEZs/ICs in each of the industrial district were presented in ITR3 report.

3.4 Overview of Tumakuru Node

3.4.1 Delineation of the Node

The Tumakuru NIMZ covers an area of 5,379 ha, of which 1,484 ha has already been developed by KIADB as the Vasanthanarasapura industrial area. The remaining 3,896 ha has been chosen for the preparation of development plans for the Tumakuru Node. The boundaries of the node area have been confirmed and finalised through discussion with KIADB and are illustrated below:



Source: JICA Study Team

Figure 3.15: Node and Priority Area Boundaries of Tumakuru

3.4.2 Topography

The locations of the three selected nodes in the CBIC region including Tumakuru are illustrated below:

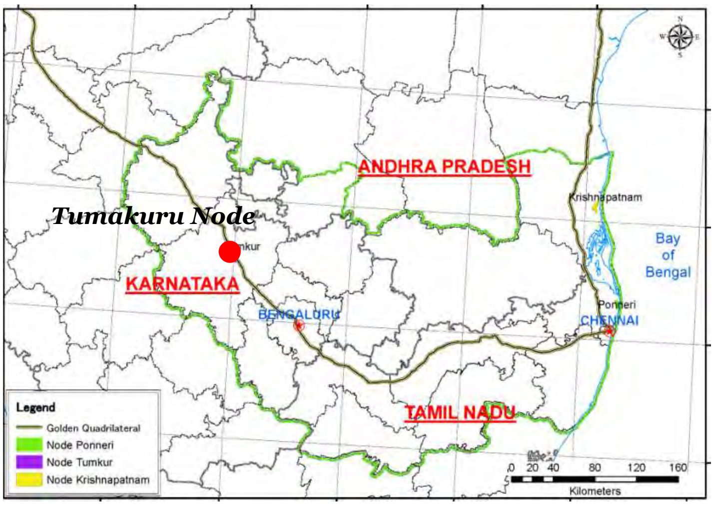
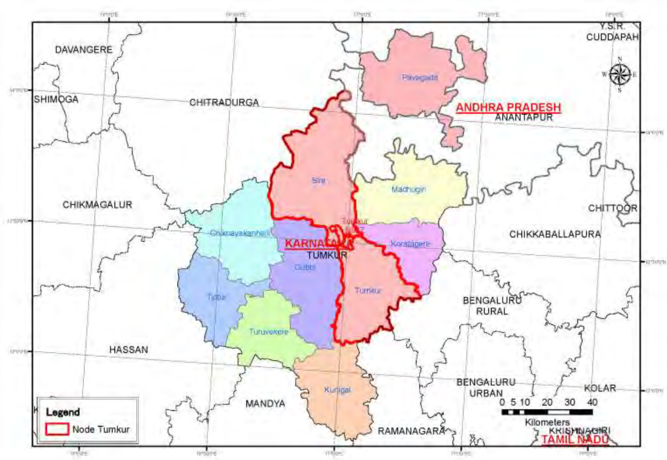
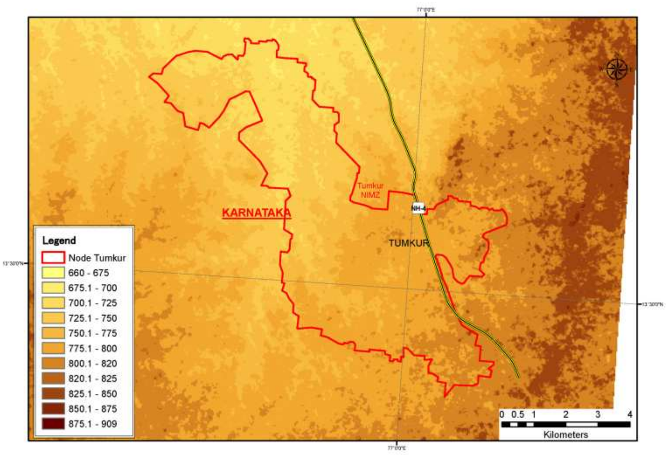


Figure 3.16 Location of Nodes

The total area of the node was defined according to the boundary of the greenfield area of the Tumakuru NIMZ after consultations with KIADB of the Karnataka state government. The proposed node site is located within Tumakuru and Sira taluks of Tumakuru district as shown in the following figure.





Source: Global Map

Source: ASTER GDEM (METI and NASA)

Figure 3.17 Location of Tumakuru & Sira Taluk

Figure 3.18 Geography of Tumakuru Node

Tumakuru district is a landlocked district bordered by Bengaluru Rural and Chikballapura districts to the east, Mandya and Ramanagara districts to the south, Hassan district to the west, Chitradurga district to the northwest and Ananthapur district of Andhra Pradesh to the northeast. The site lies along either side of NH 4 (Mumbai-Pune-Bengaluru-Chennai stretch of the Golden Quadrilateral), around 80km to the northwest of the state capital (as measured from the Outer Ring Road), and 20km to the northwest of Tumakuru city, the district headquarters. The site is located 10 km northwest of the Tumakuru Urban Development Authority (TUDA) boundary. The above figures indicate the location of the NIMZ site as well as its proximity to Bengaluru. This land area has a gentle slope and the approximate elevation is between 700-825m above sea level.

3.4.3 Natural conditions

The climate in the district is usually dry with the temperature ranging from 16-34°C and is almost uniform across the entire district except in the northern taluk of Pavagada. The year is broadly classified into four seasons - Dry season (January to February), followed by Hot Weather (March to May), the Southwest

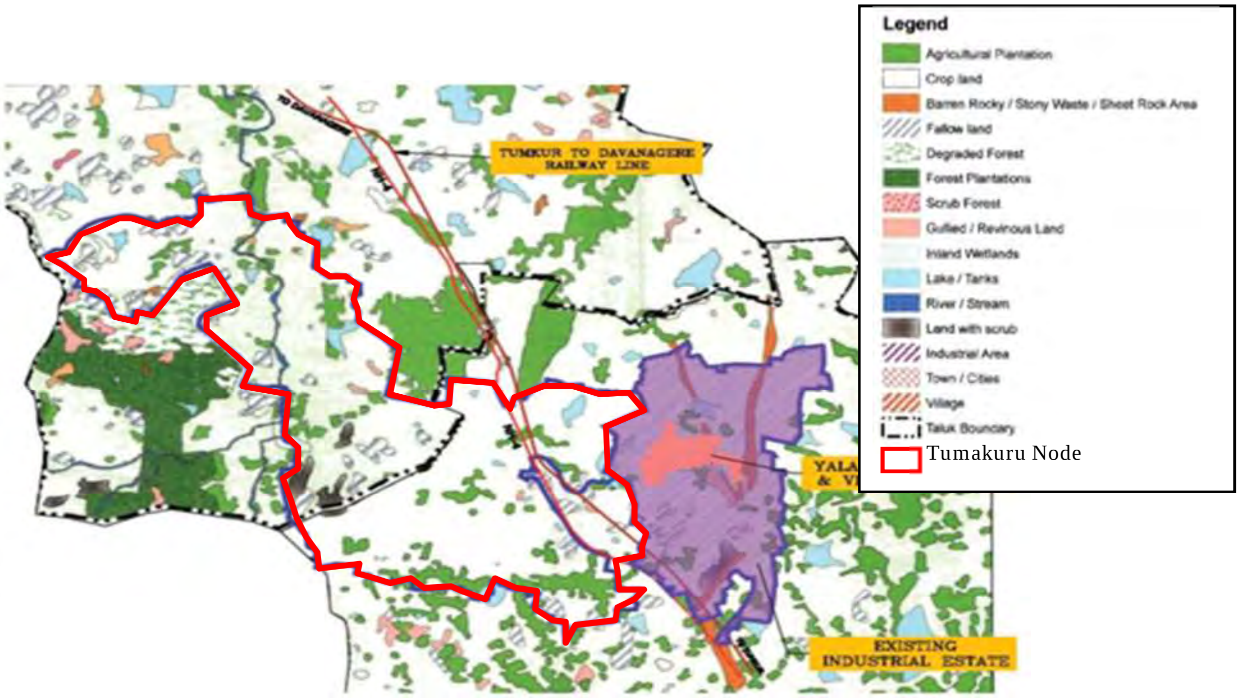
Monsoon season (June to September), and the Northeast Monsoon period (October to December). April is the hottest month with temperatures of 34°C and December is the coolest with temperatures of 16°C.

The district receives rainfall from both the Southwest and Northeast Monsoons. The average annual rainfall in the district as a whole is 613mm. The average annual rainfall is 795mm in Tumakuru taluk and 647 mm in Sira taluk. The rainfall graph indicates that rainfall is highest in the eastern parts of Tumakuru and reduces at Pavagada in the north. It gradually reduces towards Tiptur to the west, which records 769mm. On an average, the number of rainy days ranges between 32-35 days per year.

3.4.4 Current Distribution of Settlement and Social Facilities

Land Use

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



Source: Tumakuru NIMZ "Draft Techno-Economic Feasibility (TEF) Report cum Development Plan by KSIIDC

Figure 3.19 Current Land Use Map of Tumakuru Node

- Most of the southern area of Tumakuru Node is covered by crop land and agricultural plantations of coconuts, mangoes and bananas.
- According to the Draft Techno-Economic Feasibility (TEF) Report cum Development Plan of Tumakuru NIMZ, it is difficult to carry out double/triple cropping due to the limited water resources in the area.
- There is also fallow land across the node due to limited water resources. Therefore, it is judged that water resources and water supply are key issues in the area.
- Reserved forest areas are located beyond the western edge of the node boundary and a part of the area is utilised by local people for tree plantations.
- The main road that connects to the regional trunk road is less than 4m wide, although some sections have a smooth surface and have been paved with asphalt.
- A few small reservoirs are scattered across the area and are utilised for irrigation by local farmers. In addition, it is also common practice for some farmers to purchase water from water treatment plants nearby since no water distribution system has been developed for the area so far.

- According to the villagers, the bridge across the river was destroyed by a flood which occurred a few years ago.

Source: JICA Study Team

Figure 3.20 Sub-arterial Road in Gowdanahalli

Source: JICA Study Team

Figure 3.21 Small Reservoir in Gowdanahalli (Outside Node)

Source: JICA Study Team

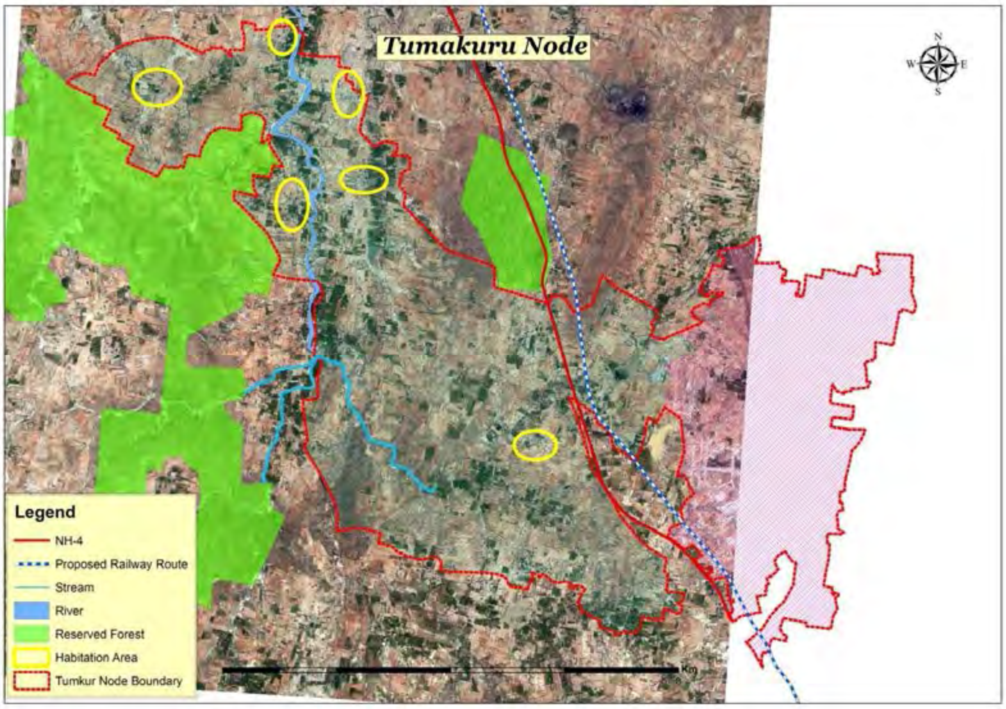
Figure 3.22 Cultivated Land in Thippanahalli

Source: JICA Study Team

Figure 3.23 Destroyed Bridge

Settlements

The location of existing settlements within the Node is illustrated in the following figure and findings are summarised below.



Source: JICA Study Team

Figure 3.24 Distribution of the Existing Settlements

- The river that runs through the node traverses a course from the Hemavathy reservoir towards Sira taluk. Within the node, four settlements are located along this river, which flows from south to north. During the field visit of the JICA Study Team, it was observed that the river was completely dry. The alignment of the river needs to be maintained as it is during and after industrial development since it is a natural drain.
- Agriculture, livestock and forestry are the main occupations of the villagers in the settlements.

Social Facilities

Most of the regional social facilities (health centres and higher education institutions like high schools, universities etc.) are located in Tumakuru city although there are a few social facilities in and around Tumakuru Node itself.

Others

Farmlands

Some settlements and hamlets are scattered across the area of Tumakuru Node. In addition, farm land is also present in some areas of the node. The local agricultural farmers cultivate commercial fruits such as coconuts, mangoes, bananas etc.

Source: Google Earth Pro, JICA Study Team

Figure 3.25: Farm Land Partially Spread in Tumakuru NIMZ Phase-4 to -6

Topography

As indicated in Figure 3.18 “Geography of Tumakuru Node”, the area is hilly and gradually slopes down from southeast to northwest. Based on analysis of the contours of the site, land levelling should be considered to promote development.

3.4.5 Land Acquisition Status

The land for the existing industrial area (Vasanthanarasapura) has been acquired by KIADB already. However the new development area for Tumakuru Node has yet to be acquired. The land acquisition process for this area is currently at the notification stage. The land acquisition status as of July 2015 is summarised below:

Table 3.5 : Land Acquisition Status of Tumakuru NIMZ of July 2015

Area	Area	Acquisition Status	Remarks
Vasanthanarasapura Industrial Area	*1,484 ha (3,666 Acre)*	Completed	According to NIMZ report, total area is indicated as 3,995.38 Acer.
Tumakuru Node	*3,896 ha (9,627 Acre)*	Preliminary notification was issued, and proposal for the issue of final notification was sent to the govt.	It may take around 1.5-1.75 years to complete acquisition at a minimum. The southern portion is estimated to be completed earlier than the northern portion. According to NIMZ report the area is indicated as 10,096Acer.
Total (Tumakuru NIMZ)	*5,379 ha (13,293 Acre)*	-	According to NIMZ report, the area is indicated as 10,096Acer.14,091.26Acer

Note: Figures in the table are approximate numbers. The field survey has to be done and confirm the exact figures for each land. *Source: Interviews to KIADB by JICA Study Team*

4 Node Development Vision

4.1 Analytical Framework for Development of Node Vision

As part of vision for development of Industrial corridors, it is envisaged that each of the industrial nodes should provide the incoming industries and companies a competitive edge when compared to similar industrial nodes domestically as well globally. It is recognised that global investors tend to zoom into their investment destination decision, firstly based on the country's macro environment, followed by careful consideration amongst regional and local options before deciding on the final investment location. In this regard, it is important to develop an appropriate vision for the development of the node based on its strengths and potential for attracting particular industries. This should be followed by structured building up of core competencies to enhance the regional, national and global competitiveness of the node.

The vision for Tumakuru Node was similarly developed through structured analysis of its strengths, weaknesses and the vision set out to develop the industrial node and future agglomeration of diversified economic, commercial and civic activities.

As a first step, a SWOT analysis was conducted based on existing and potential infrastructure and industries present in the region and the brownfield development at the node. In addition, since Tumakuru Node is identified as NIMZ under the Government, existing national and state policies on development of NIMZ were reviewed as the basis for the node development policy. Next, based on a Competitiveness Framework, target functions were identified as part of the identified Node Development Vision.

4.2 Potential as Industrial Hub for Technology Sector

Tumakuru's *Unique Selling Proposition* is its proximity to the Bengaluru industrial and commercial eco-system including established industrial clusters such as Bidadi and Narasapura and the electronic and IT services hub of the Bengaluru City.

Strategically placed at only 80kms away from the north of Bengaluru and 90km from the Kampegowda International airport, Tumakuru has major potential to develop as the ***Advanced Technology centric industrial hub north of Bengaluru***. The Tumakuru Industrial Node is proposed to be well connected with the industrial clusters around Bengaluru 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 Tumakuru 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: Development Potential of Tumakuru Node

	Advantages	Challenges
Internal	***Strength:*** • Strategically located on the outskirts of silicon valley of India – Bangalore • High occupancy of industrial plots and sheds in the district showing huge latent demand • Brownfield industrial area that would initiate further industrial impetus in the area • Existing food processing industry base, textile industry and auto, aerospace industry in the district and its vicinity with presence of players across the value- chain of these industrial sectors	***Weakness:*** • Lack of major surface water resource nearby and limited capacity of ground water resource • No port facility in the district since it is land locked and the connectivity to the nearest port, i.e., New Mangalore Port is a concern • Logistics facilities at the existing industrial areas are insufficient • Lack of adequate socio- cultural environment in Tumakuru city fabric to

	Advantages	Challenges
	• NH4 passing through the site is part of Golden Quadrilateral of India. NH 4links four of the 10 most populous Indian cities • Proposed Tumakuru-Davanagere Rail Line passing through the site would bring the NIMZ on the national rail map • Proximity to Dhabol –Bangalore Gas pipeline provides easy access to gas • Greenfield location rendering opportunity to coherently plan logistics facilities / multi modal logistics parks	attract foreign investors
External	***Opportunity:*** • Will create support industry market arising due to future saturation in Bangalore – Presents and opportunity of vendors / ancillaries for Bangalore based industries such as BEML, BHEL and HAL • Can absorb spill over market of Bengaluru and other industrial areas such as Dabaspet • Opportunity to enhance connectivity to the eastern region (NH 4 and NH 7) through planned ring road projects such as Peripheral Ring Road and Satellite Town Ring Road • Opportunity to enhance connectivity to Mangalore Port • Advantage to harness developments in nearby industrial locations such as Dabbaspet and other regions • Proposed Peninsular Region Industrial Corridor (PRIDe Corridor), with Tumakuru as one of its node, is expected to provide impetus to investments in the region	***Threat:*** • Other proposed NIMZs in the state and in neighboring states would be potential competition to Tumakuru NIMZ • Industrial areas, mega industrial projects/parks and SEZs located in and around Bangalore could act as a competition to the subject development • Delays in commissioning of ring roads around Bangalore and road improvement to Mangalore could result in delayed access to ports • Delay in land acquisition for the propose NIMZ project could result in losing investments to other industrial destinations within and outside the state

Source: KSIIDC Report and Study Team Analysis

4.2.2 View of Karnataka State Government

The study team has undertaken consultation meetings with the Karnataka State Government for developing the Master Plan. The following views for the Tumakuru node development have been adopted for the development of the Node Vision through these stakeholder consultations:

- Karnataka State Government suggested developing the Node vision in-line with the guiding principles of the NIMZ plans as shown above in the plan for the Tumakuru NIMZ.

- The guiding principles shown in the planning document shall be refined in order to provide stronger and clearer messages for potential investors.

- Tumakuru Node shall be the first green field smart city in India. It shall be a success model of smart city which could provide good materials of case studies for further developing the definition and concept of smart city best suitable for India.

- Food Processing shall be one of the priority industries in addition to the listed industries in the plan of the Tumakuru NIMS, i.e., Engineering Goods, Defense & Aerospace, Plastic, Textile & Apparels and Pharmacy.

- Tumakuru Node shall be the first industrial hub in Karnataka developed independently outside Bangalore. (Currently all major industrial parks in Karnataka except Tumakuru are contained in the Bangalore industrial cluster.)

- The development of Tumakuru Node should be led by the private companies which actually establish the production and business base in it.

4.3 Vision for Tumakuru – 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 Tumakuru 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.

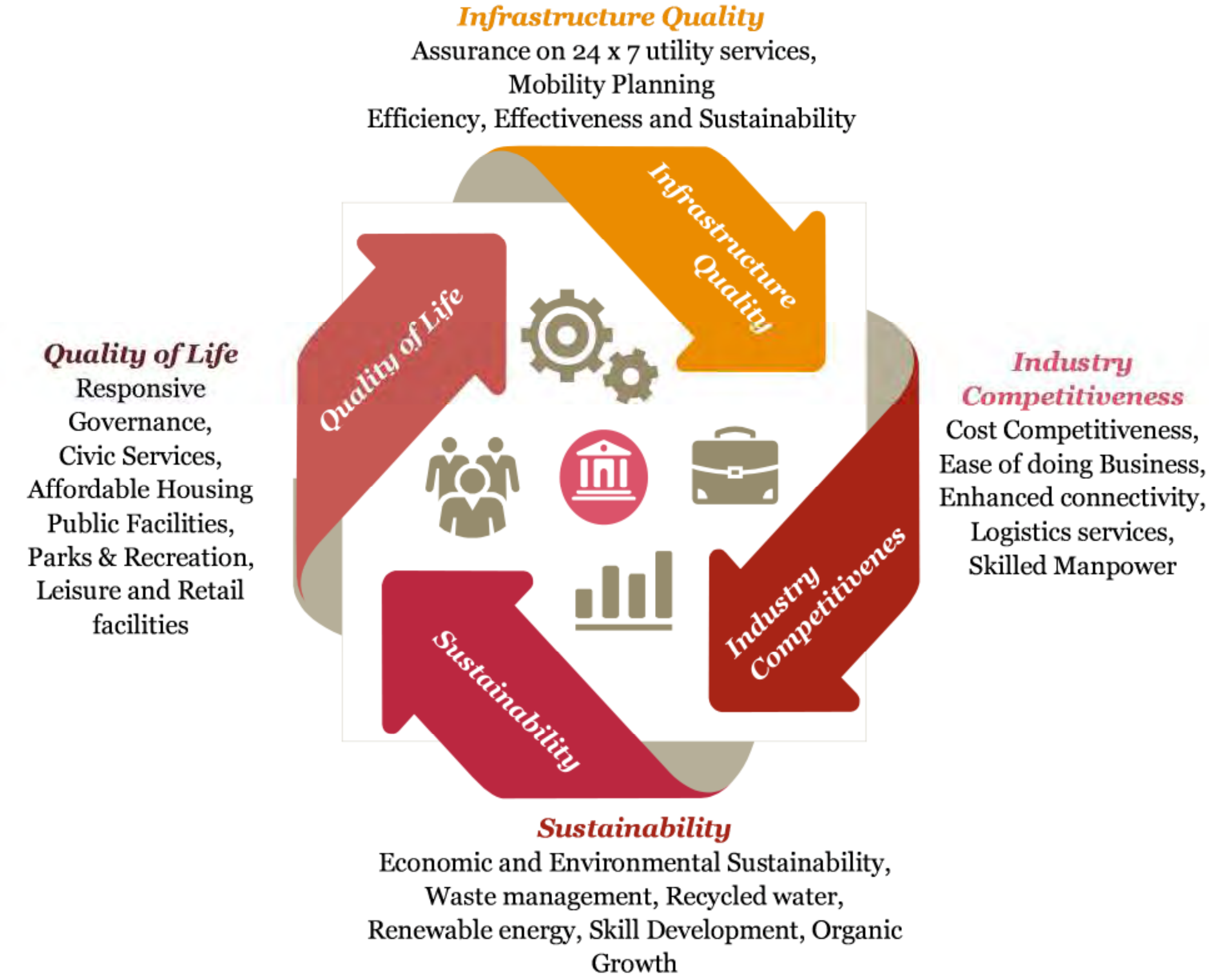


Figure 4.1 Vision for Tumakuru Node

4.3.1 Planned Growth Strategy

The industrial node at Tumakuru 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.

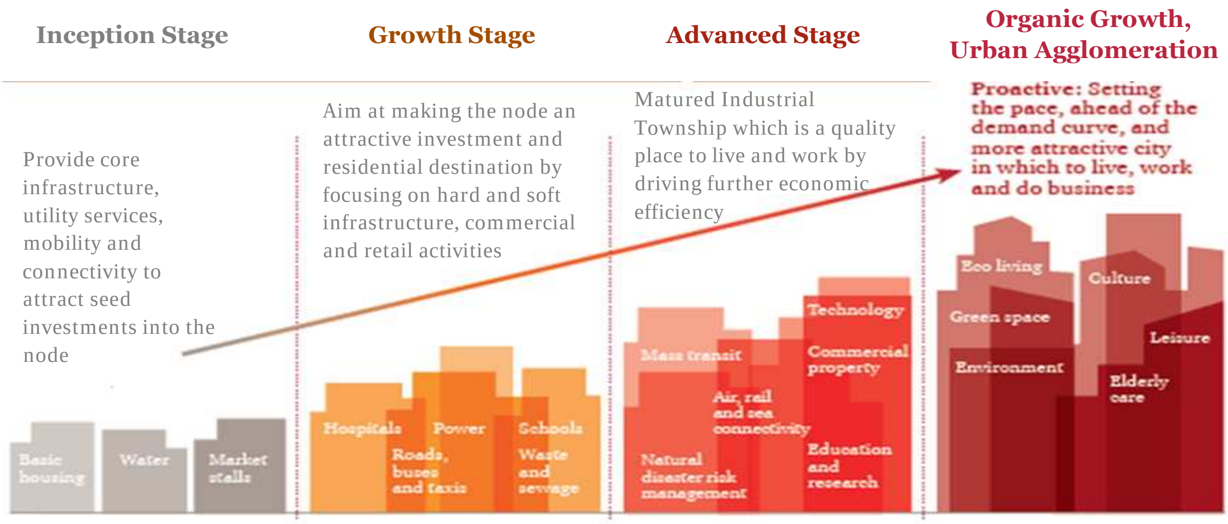
  In addition, the nodes will also start accommodating a proportion of workers within the nodes as Resident Workers. In this stage, the Node is trying to provide the basic infrastructure so as to be able to attract investors to take industrial land parcels and create a seed development. The land allocation 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 masterplan 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 Tumakuru node aims at a level of quality exceeding the above mentioned advanced industrial parks. The advantage of the Tumakuru 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 Bangalore area is considerably high, the Tumakuru 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 Tumakuru 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. The 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.

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 Tumakuru based on these four components is shown below-

Infrastructur

Strengths & Opportunities

- ✓ NH4 passing through a the Node is a part of Golden Quadrilateral of India, linking four of the 10 most populous cities in India.
- ✓ Proposed Tumakuru-Devanagere Rail Line passing through the Node

Challenges

- ✓ No port facility in the district
- ✓ Delay in road improvement to Mangalore Port

Business

Strengths & Opportunities

- ✓ Brownfield industrial area that would initiate further industrial impetus in the area
- ✓ Absorb spill over market of Bengaluru and create support industry base

Challenges

- ✓ Other industrial areas and SEZs etc. could be potential competition

Strengths & Opportunities

- ✓ Strategically located on the outskirts of Bengaluru.
- ✓ Access to R&D base and abundant skilled workforce in Bengaluru

Challenges

- ✓ Skill availability in Tumakuru needs to be improved

Human

Strengths & Opportunities

- ✓ Proximity to Dhobol-Bengaluru Gas pipeline provides easy access to gas
- ✓ Moderate climate to attract foreign investors as well as domestic investors

Challenges

- ✓ Lack of major surface water resource nearby
- ✓ Lack of Public transport between Bengaluru and Tumakuru

Livabilit

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.

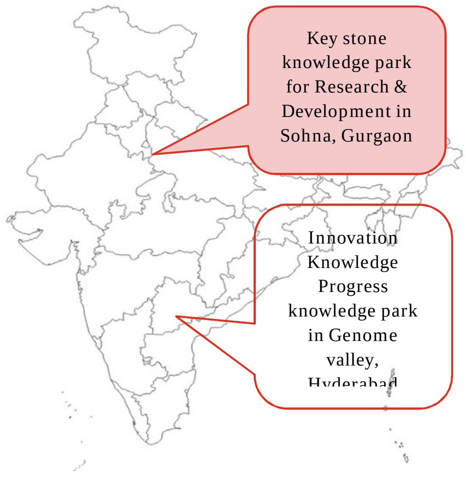
Tsukuba Science City, Japan
•***Area:*** 6,672 acres
•**Type of activities:** Electronics, Biotechnology, Mechatronics, New materials, Information engineering, Space development, Environmental science, Natural resources and energy, Earth sciences, Civil engineering and construction, Agriculture
•***Business 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

Knowledge Park in the World

Knowledge parks in India



Keystone Knowledge park [5] 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 upto BSL3 level. This is conceptualized to drive research and innovation oriented companies to North India. This is established with wee-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[6] 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.

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[5] http://www.keystonesez.com/
[6] http://www.ikpknowledgepark.com/

5 *Industrial Development Analysis*

5.1 *Proposed Industries Mix for Tumakuru Node*

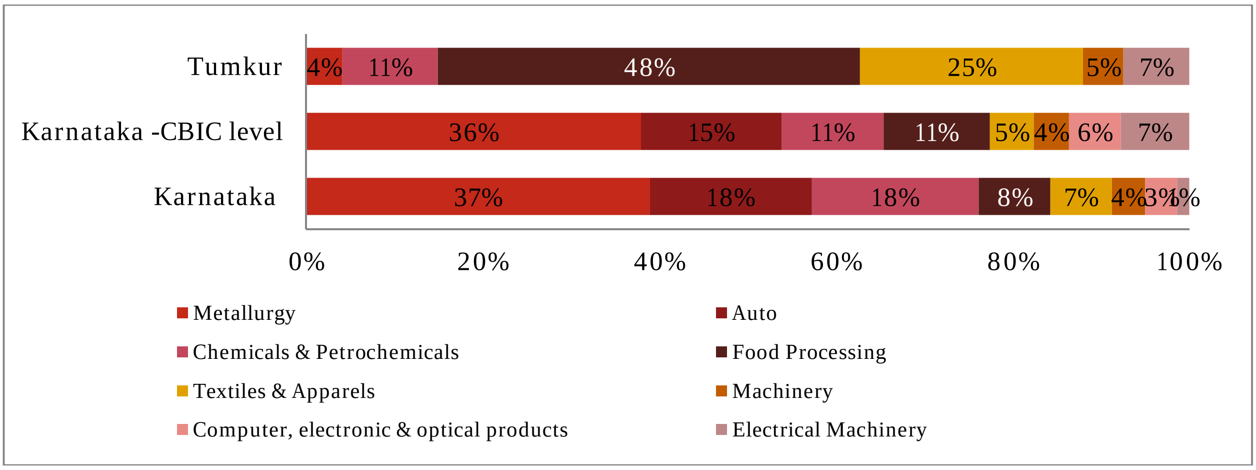
5.1.1 *Focus sectors selected for CBIC region*

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 I. 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**

Rationale for initial viable sectors for Tumakuru node

Sectors viable for the node were chosen based on existing industrial agglomeration and competitive advantage of the region based one analysis of manufacturing investment of Karnataka state, Karnataka CBIC districts and Tumakuru district and top industries were identified pertaining to the district. Based on such analysis, the top 5 industries which formed around 80% of total investment share were shortlisted as Traditional Industry Sectors for CBIC Karnataka Districts- Auto, Pharma, Textiles and Apparels, Food Processing, Computers Electronics and Optical Products, among the chosen 10 industry sectors for CBIC region as a whole. Among these sectors, existing leading sectors in Tumakuru include food processing (including beverages), Textiles & Apparels, Chemicals & Petrochemicals and Electrical Machinery as shown in the figure below:



Source: Capex CMIE database,PwC analysis

Figure 5.1: the manufacturing investment

By 'Traditional sectors', it indicated sectors which are traditionally present and will be promoted to gain competitiveness in the region. The remaining CBIC focus sectors fall under 'potential sectors,' which will be pursued to ensure emerging sectors are also attracted to the Node given that necessary Factors of Production will be put in place to encourage the same.

Selected Sectors for Tumakuru node

Five traditional sectors and 5 potential sectors were finalized for Vasanthnarapura node. Based on analysis the sectors identified traditionally strong sectors for the node are:

Food processing	**Auto Components**	**Computer, Electronic & Optical (CEO) products**	**Textiles & Apperals**	**Pharma**

Potential sectors which are anchored to future development due to policy thrust and upcoming investment of these sectors in the CBIC region are highlighted below:

Electrical Machinery	**Machinery**	**Chemicals & Petrochemicals**	**Metallurgy**	**Aerospace**

Defense and Aerospace though not one of the identified sectors as per Interim Report II is considered potential sector due to immense future potential. In Tumakuru district outstanding investment at sector stands at INR 499 Crores highest compared to any other sector.

Theme for Industrial Development

1 Urban areas in and around Bangalore are getting saturated. Lack of large tracts of planned industrial areas is pushing investments from Bengaluru Urban to Bengaluru Rural and other districts such as Kolar, Tumakuru etc. It is anticipated that such shift is only going to increase in the near future, given the rising cost of land in Bengaluru Rural. Tumakuru NIMZ offers around 10,000 acres of greenfield industrial land in close proximity to Bengaluru city, with an **existing eco- system of Industrial Units** comprising of Auto, Electrical Machinery & Electronics Units. Thus the envisaged planned development of the NIMZ with world- class industrial and logistics, residential, and social facilities will enable Tumakuru in becoming the preferred choice for investment.

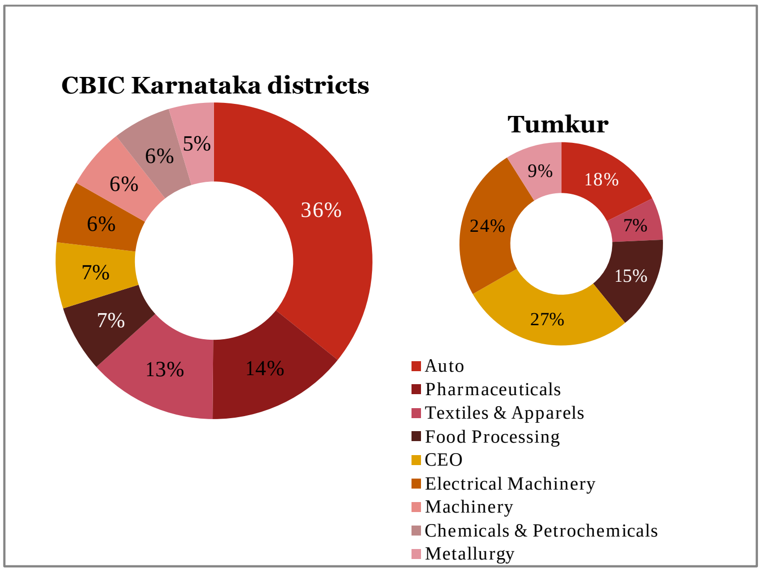


Figure 5.2 : Manufacturing investment

2 Among sectors identified, top three sectors in Tumakuru are electronics, electrical machinery, & auto and auto components, which account for around 70% of total district's manufacturing investment. Thus Tumakuru has potential to be developed as a "**High Technology Manufacturing Zone**"

Karnataka is part of the South Auto cluster with presence of major auto and auto components players, such as Toyota Kirloskar, Honda motorcycles & scooters, Hyundai, Nissan, etc. Given that Auto is a prominent sector in CBIC Karnataka district, and Tumakuru is part of the emerging Auto Cluster, it is expected to pick up as another Auto manufacturing destination.

3 Intrinsic USP's of Tumakuru Region will facilitate positioning of the Nodes as a "High Technology Manufacturing Zone". Tumakuru will be a beneficial recipient of investment spill- over from Bengaluru, by leveraging on **existing Factors of Production** in the region.

Figure 5.3: Factor of productions

- About 50% of MNC R&D centres in India are based in Bengaluru
- Around 400 of the Fortune Global 500 companies outsource their IT services to firms in Bengaluru
- The city houses 500000 IT professionals, or 1/3rd of the total IT professionals in the country
- Bengaluru is the 4th largest technological cluster in the world after Silicon Valley, Boston and London
- About 50% of the world's SEI CMM Level 5 certified companies are located in Bengaluru
- Ranks 4th in terms of tourists arrivals in India
- Moderate climate which attracts both domestic and foreign investors

4 Migration **from low- tech manufacturing segment to high technology engineering** and electronics investments: While it will be beneficial to capitalize upon existing traditional industry set-up on Food Processing and Textiles in the region, large scale investments with high output values will require a migration evolution from low tech (textiles, basic consumer goods, simple mechanical devices) to high- tech manufacturing (airplanes, complex electronics/ automation equipment, automobiles etc.). Such **transition as a candidate for high- tech manufacturing is envisaged for Tumakuru**.

Karnataka has been among the fore- runner states to promote the Aerospace sector aligned to India's "Make in India" campaign for this sector. It is the first state in the country to announce an Aviation Policy with specific incentives and policy decisions to promote investments in this sector. Tumakuru can leverage upon its proximity to HAL and Bengaluru. The presence of global R&D giants and private aviation organizations such as BAE Systems, Boeing, Rolls Royce, Honeywell, Snecma, GE, EADS and Boeing in and around Bengaluru will provide the necessary back-end linkages for Tumakuru for attracting investments in the aerospace segment. Tumakuru has equal advantages when compared to existing Bengaluru International Aerospace Park (BIAP), in terms of distance to port, good road connectivity, skill labour availability.

Aligned to the above theme, for the sake of detailed industrial analysis in the subsequent sections, we have conducted an in- depth assessment of the following sectors, to cover aspects such as sector growth in India, opportunities, viability drivers, and key challenges design implications to make the node nationally and internationally competitive for the sector.

Computer, electronic & optical products

Auto and Auto Components

Food Processing

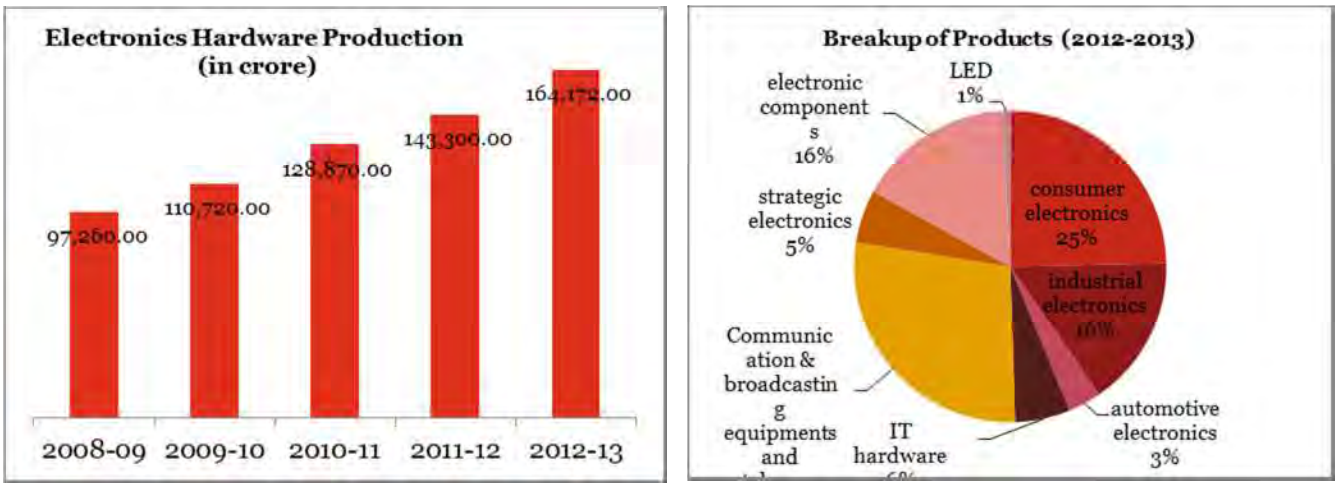
5.2 Planning Development of Industry Sectors

5.2.1 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[7]. 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%[8] between 2008 and 2011. With 5 out of top 10 countries, Asia dominates the electronics market[9]. 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 fueled 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 growth and going by current estimates, the demand for electronics in the country is projected to be USD400 billion by 2020[10].

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

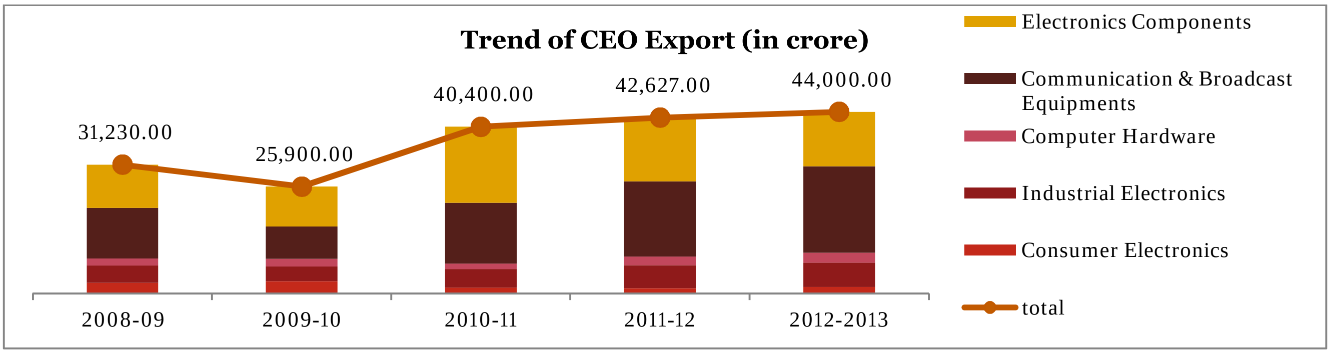


Source: ESC

Figure 5.4: Electronics Hardware production

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%.

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 5.5 Trend of CEO Export (in crore)

Indian CEO Exports expected to increase from USD 4 billion to USD 80 million by 2020[11]. 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%).[12]

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.

[11] DEITY – National Electronics Policy 2012
[12] ESC

National level related

Strong Govenrment support

- Tumakuru as well as Bengaluru have been notified as Brownfield EMC (Electronics Manufacturing Cluster) for the purpose of M-SIP scheme (Modified Special Incentive Package Scheme) under Central Scheme. These incentives help to overcome cost disadvantages. Details of incentives are listed in Annexure.

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 in Bengaluru as well as other locations from Tumakuru Node

- *Consumer Electronics* would be predominantly driven by digitization, higher disposable income, availability of financing, affordable products, retail chains are the future growth drivers for the segment. Growth in household spending would have spin off effects in Telecommunications and IT Hardware as well.

- *Communication and Broadcast Equipment (CBE)* would be mainly driven by future increasing mobile penetration, entry-level mobile phones and an increasing rural subscriber base/mobile penetration to B and C circles with mobile connections. Further, increasing number of wire line and wireless broadband (Broadband Wireless Access/WiMax as well as demand for Consumer Premises Equipment and Fibre to the Home are likely to drive demand in the long term.

- *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

- *Strategic Electronics* would be driven by growth of defense sector. Defense and aerospace is one of the key sectors in Karnataka. Tumakuru has equal advantages when compared to existing Bengaluru International Aerospace Park (BIAP), in terms of distance to port, good road connectivity, skill labour availability.

Tumakuru level related

Karnataka is already positioned as a leader in the IT/ ITeS sector in India. More than a third of India's Software export is from Karnataka. Karnataka has also witnessed a fast growth in the hardware sector- Number of hardware companies has increased from 27 in 2001-02 to 76 in 2008-09, while exports from hardware have risen from US$ 78 million to US$ 823 million over the same period[13]. The state is the 2nd largest exporter of

[13] Sector profile, GIM

Electronics Hardware[14], and 3rd in Electronics & IT hardware production[15], with bulk of these companies concentrated in and around Bengaluru. Given the mature eco- system, the CEO sector has been selected as one of the focus industry sectors for detailed assessment for Tumakuru Node. Below are growth drivers for Electronics manufacturing in Tumakuru:

Developed cluster	Availabilty of skilled labour	Strong support by State Government

1) Developed cluster

Tumakuru is located 80km from city center of Bengaluru, which houses more than 2000 IT companies and approximately 750 MNCs such as Wipro, Infosys. HP etc. While investments in the sector are primarily being driven towards North Bengaluru Region, high land price and poor connectivity (crowded roads), and lack of adequate public transport system may prove a deterrent. Tumakuru can leverage upon its proximity to Bengaluru, and given an equal advantage in terms of skilled labour pool, can work upon improving other facilitating factors such as proper housing and civic amenities, extension of Bangalore Metro to the NIMZ etc.

2) Availability of skilled labour

Abundant workforce and supply base available in catchment. There are institutions and research centers dedicated to Electronics in Bangalore, such as Center for Electronics Design and Technology Electronics and Radar Development Establishment (LRDE).

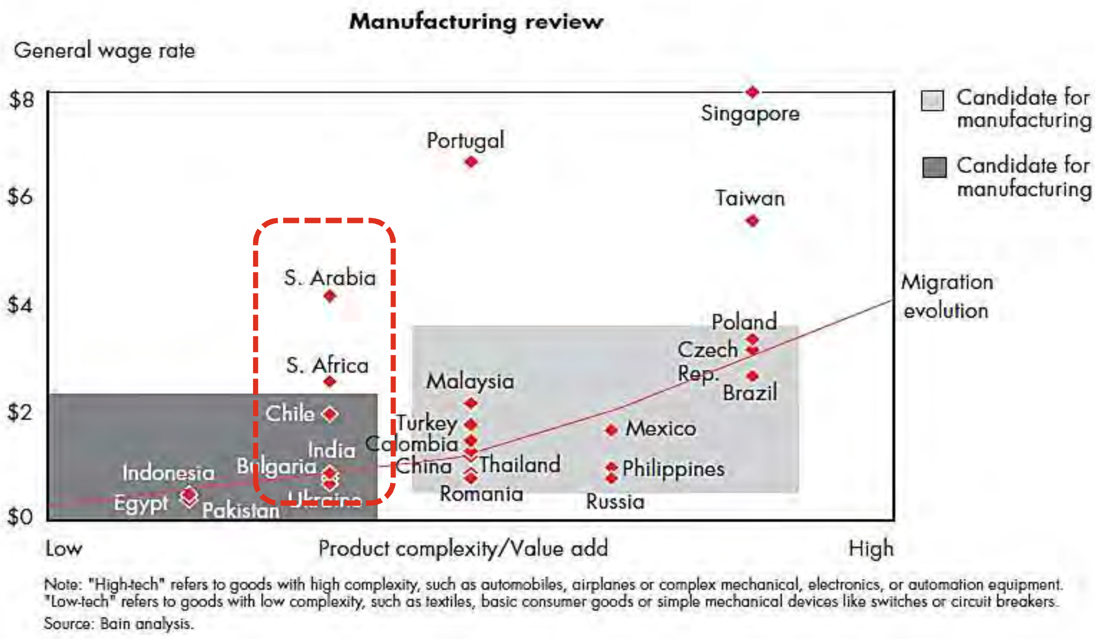
3) Strong Support by State Government

GoK has already taken policy initiatives to support Electronics sector in Karnataka. GoK formed IT millennium Policy 2000, and ESDM Policy 2014 to provide various incentives with investors.

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 billion16. 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.

[14] GIM
[15] productivity & competitiveness of Indian Manufacturing : IT Hardware & Electronics
[16] INDIAN ESDM MARKET - ANALYSIS OF OPPORTUNITY AND GROWTH PLAN, An IESA - Frost & Sullivan Report

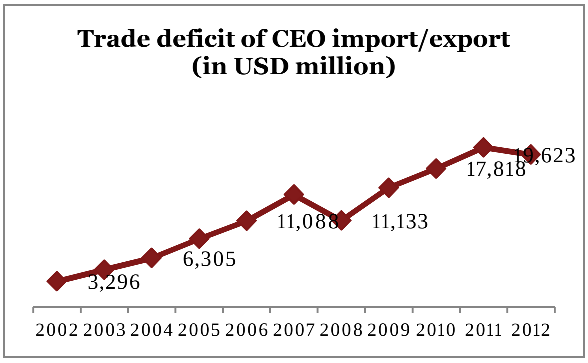


Source: Making move to low -cost countries, Bain & Company, 2005

Figure 5.6 Manufacturing review

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.



Source: ASI

Figure 5.7: Trade deficit of CEO import/export

Cost disadvantage against import of final profucts

Difficulties in just-in-time supply

1) Cost disadvantage against import of final products

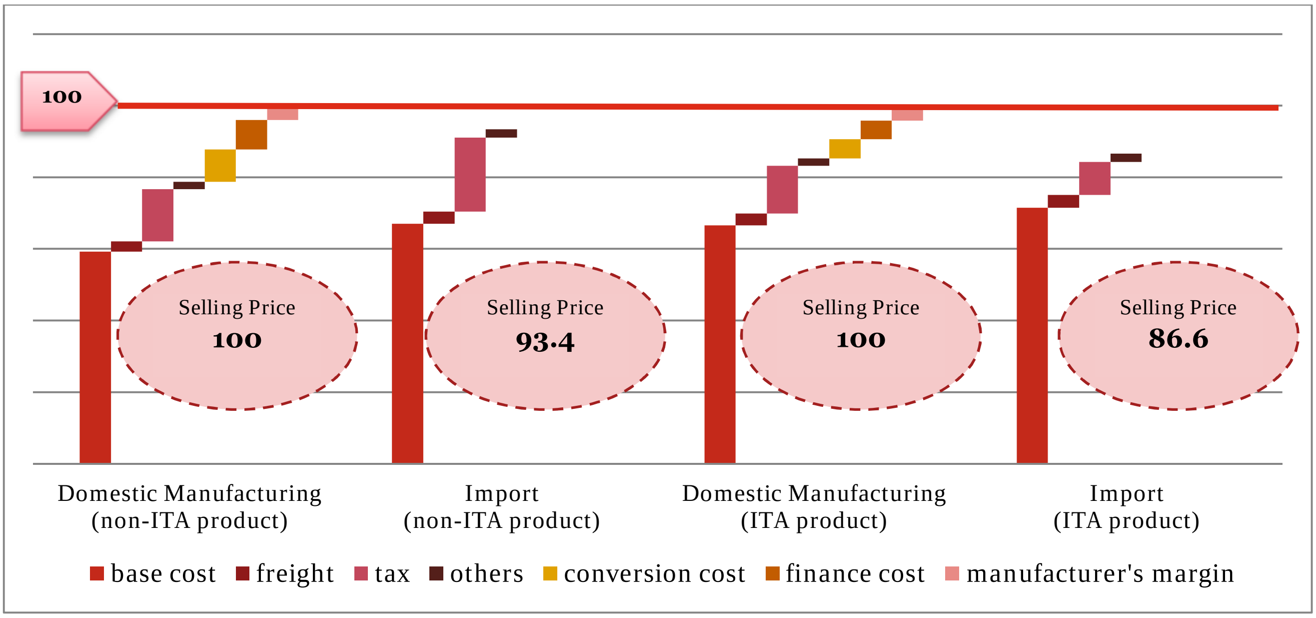
Infrastructure disabilities cause cost disadvantages in terms of manufacturing in India. Impact of disabilities on cost structure is show in the table below. Major disability factors arise from lack of eco-system for component supply base, low labour productivity and higher power costs in India.

Table 5.1: Impact of Disabilities of 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.)
Raw Material Freight Costs	3	1.2	High finance cost due to high interest rate for the purpose of raw material inventory cost
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**

Note: Assume power costs contribute to 5% of overall costs. Assume other overhead costs are same between India and China
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 5.8: Comparison of cost of production – Domestic manufacturing vs import

2) 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.

Specifically, CEO products are one of the key products transported by air for both export and import. Due to the criticality of 'just in supply' of the sector and nature of products being vulnerable to damage, air transportation is preferable for CEO sector. However, airports in the region witness much higher dwell time for import and export than international standard. The Chennai Airport takes an average of more than 4 days for import cargo clearance, and 2 days for import, compared to 6 hours for export and 4.5 hours for import in Singapore. The problems are the limited air capacity and the lack of sufficient infrastructure facilities (such as truck docking bays) at the airports, as well as issues related to operational perforce (customs and documentation procedures).

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

Figure 5.9: Impact of Delay in Supply

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

Figure 5.10: Components of Cluster development

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

1) 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.

2) 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.

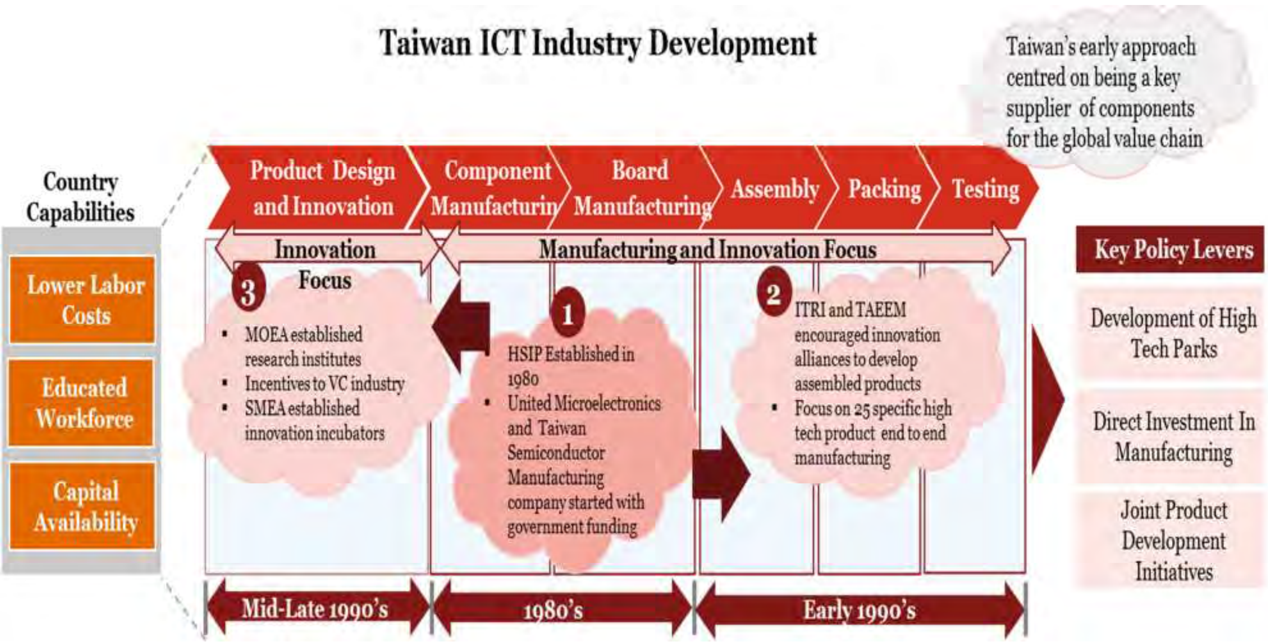


Figure 5.11: Taiwan ICT Industry Development

3) 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 Design Implication

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Tumakuru emerges as a top destination CEO sector 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	• Technological readiness and upgradation • Researc h and development • Cluster development	• IPR enforcment • Techonolgoy infrastrucure

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

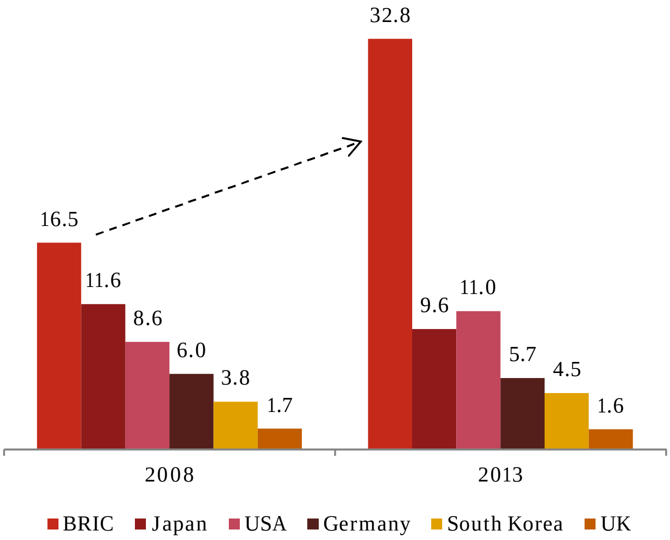
Table 5.12: Key recommendation for the CEO sector

Components		Issues	Design Implication
Economic enhancers			
Connectivity	Road	• Some parts are precision parts. Since bad condition of road, package cost is high to protect products, otherwise they get damaged. • Suppliers often fail to deliver parts or final products just in time, due to high idle time on port and roads • Although there is a potential growth export market, port connectivity and quality of port is sufficient enough to handle automobile export activities. • Some of critical auto parts are being imported.	• Chennai-Bengaluru Express Way should be considered as a CBIC priority project to enhance connectivity to Chennai Port with regular monitoring mechanism for update on status of works. • Connectivity issue of New Mangalore Port needs to be solved at the priority basis and utilization needs to be improved to promote export from West coast. Ports on West coasts will create accessibility to export market in Africa and Europe. • Satellite Township Ring Road (Bengaluru) and Individual Town Ring Road should be considered as a CBIC priority project to ease congestion in Bengaluru Area.
	Rail	• Rail transport mitigates the risk of damage. However, currently there is no guaranteed delivery time by Indian Railways.	• Dedicated Freight Corridor may be considered as a CBIC priority project to enhance connectivity to Chennai Ports for import and export purpose. The operation of DFC needs to be efficient with delivery ensured in time bound manner. • Tumakuru – Davanagere railway line may be considered as a CBIC priority project to connect to Davanagere via Chitradurga.
Power		• High tech manufacturing needs uninterrupted and assured power supply as equipment is very sensitive to fluctuations (4-5% of scrap in terms of value generated due to power cuts) • Power supply is in-consistent and in short supply. • Current cost of power to industry does not provide any distinct manufacturing advantages	• Power procurement plan needs to be developed to layout power distribution and transmission design and to identify the required interventions. • Sensors and energy meters to be installed across various medium and low voltage network in the Node to adopt appropriate forecasting techniques. • A central control centre to be established, 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.
Logistic		• Need improved ports, road network and warehousing capabilities to build capacity for future (China, spends 9% of GDP into public works compared to 4% in India)	• Prioritize road and transport network development in areas marked for clusters catering to electronics and telecom manufacturing • Invite logistics firms as synergistic and optional tenants to set-up base within NIMZ
Urban Transport		• Inadequate public transport between Bengaluru & Tumakuru.	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed for easy commuting for employees from Bengaluru City to Tumakuru. Investors can

Components	Issues	Design Implication
		consider Bengaluru City as a recruitment base and access to a large pool of talent in Bangalore City. • Doubling of existing rail line between Bengaluru and Tumakuru may beneficial for passenger transport
Value enhancers		
R&D promotion	• Products need to be renovated to match global trend shifting toward efficient and more eco-friendly vehicles. However, since the sector remains unorganized, latest technology is not implemented.	• Establish Government affiliated R&D centre in proposed **Knowledge Park** • GoK may promote R&D activities through incentives. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged
Cluster development/Technology infrastructure	• Landed cost for raw material procurement due to absence of component supply base. • Requires good primary and secondary component supplier base • Need centralized testing and certification agencies • Good to have additional support services like prototyping, shared infrastructure etc.	• Formulate State Policy to Set up **Knowledge Park** inside the Node to provide Centre of Excellence and to attract SMSE ✓ Training Facilities and Skill development centre ✓ New Product Development Centre ✓ Centre for quality standards Control, improvement, monitoring ✓ Ingenious Equipment & Material Testing facilities ✓ Quality testing labs to ensure export quality of the products etc.
Skill labour for high technology manufacturing	• Requires adequately trained manpower to meet basic manufacturing and plant management needs • Currently low cost yet skilled labour for hi-tech manufacturing is in short supply; can be augmented	• Implement actions under KIPP to enhance skill availability ✓ Revision of existing Skill Development Policy of the State and preparation of Draft Skill Development Policy 2015-20 comprising detailed road map of schemes, yearly target outcomes, and budgetary provisions in FY15/16. ✓ Arrangement of an annual industry-government round table to continuously understand the skill demand with changing contexts. Foreign investors including Japanese investors may be invited as participants of the roundtable. ✓ Introduce new curriculum to match up-to-date skill requirement. • Formulate State Policy to Set up **knowledge Park** inside the Node ✓ incentive industries to participate in the Training and Placement of workforce to promote private investment and partnership • National Skill Development program may be re- aligned to include and promote training provided directly by the employer through some grant provision by the government. For eg. Siemens India has a training center in Bengaluru, which is well equipped with modern facilities to conduct trainings for fresh Siemens GTE (Graduate Trainee Engineers) & also extended to the College/University students to be trained in advance areas of Electricals & Automation.

Components	Issues	Design Implication
Administrative enhancers		
IPR regime	• Strong IPR protection is required to encourage R&D activities. However, Legal framework of IPR is weak, and not willing to transfer the technology	• Conduct seminars for private sectors to enhance awareness on Patent law and application process/requirement in India and to encourage IPR registration.
Quality control	• It is mandatory to obtain BIS certification to manufacture, store, sell and import prescribed 30 electronic and information goods, and additional components.	• Formulate State Policy to Set up **Knowledge Park** inside the Node ✓ provide Indigenous support facilities such as Equipment Testing, Quality Control to promote innovative product development • Good to have certification agency for promotion and awareness creation of BIS regulation.

5.2.2 Auto and Auto Components



Source: Auto facts

Figure 5.13 Top Contributors to the Automobile Production (in Million Units)

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[17].

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[18].

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.**

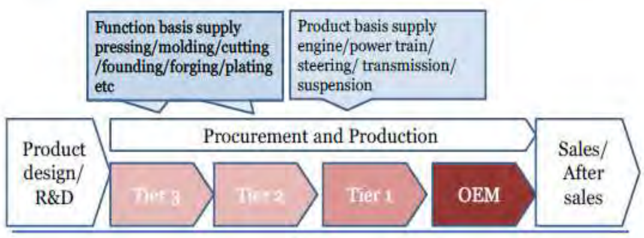


Figure 5.14 Value chain in Auto Sector

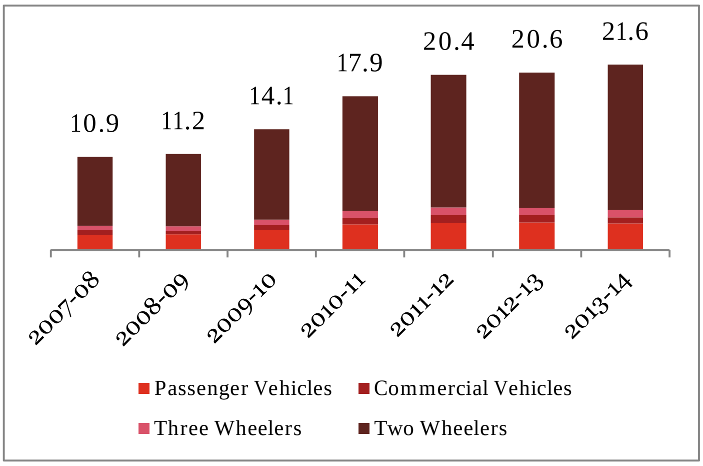
The Automobile Industry has a distinguished place in the Indian manufacturing sector. India contributes around 3-4% to the total global production of passenger cars and commercial vehicles. In contrast to the global economic slowdown, Indian automobile industry has registered a steady growth rate in 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%[19].

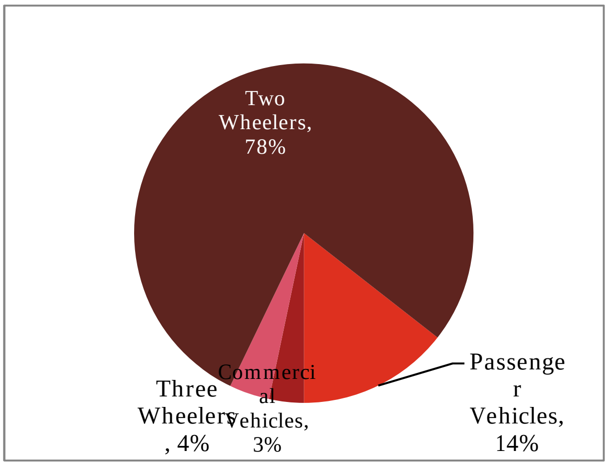
Indian Original Equipment Manufacturers (OEM) (e.g. Tata/Mahindra/Ashok Leyland/Hindustan Motors), provide all of the functions starting from Tier 3 to assembly are present in India. There are cases when they import components from outside India, but their basic tendency is to use domestic components. 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

[17] PwC Report on Automobile economic Outlook and employment situation
[18] Auto facts
[19] SIAM

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 5.15: Production trend of Vehicles in India (In million)

Figure 5.16: 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.

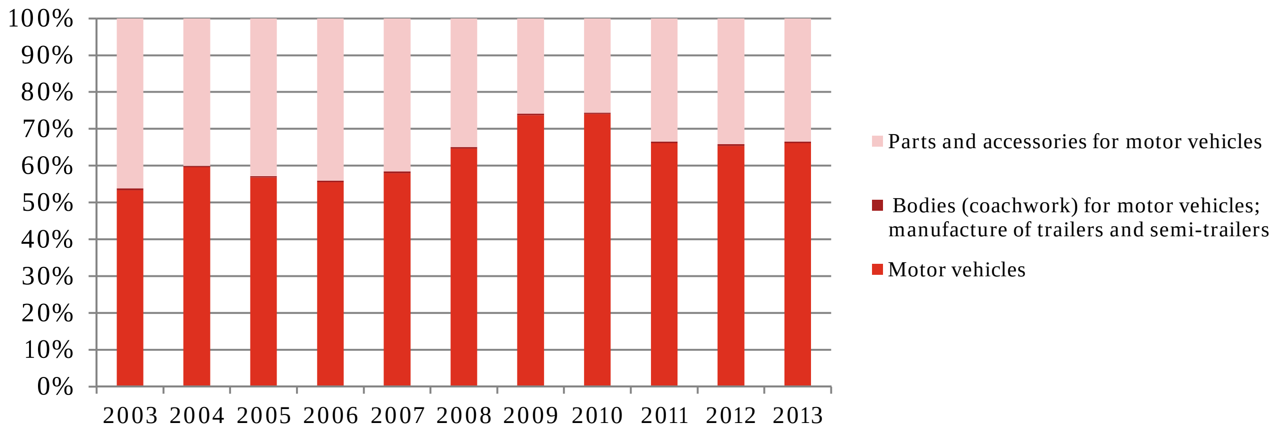
Export of auto and auto components is also witnessing robust growth with 28% of CAGR growth from 2002 to 2012. 68% of export is motor vehicles and 29% is parts and accessories. India has improved its share of exports from 0.21% in 2003 to 1.03% in 2013 (rank 31 to 22). Consistency is maintained in the exports of top two 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)*[20]	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 5.17 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 5.18 Dynamics of Indian Export

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

Viability Driver for Future Investment

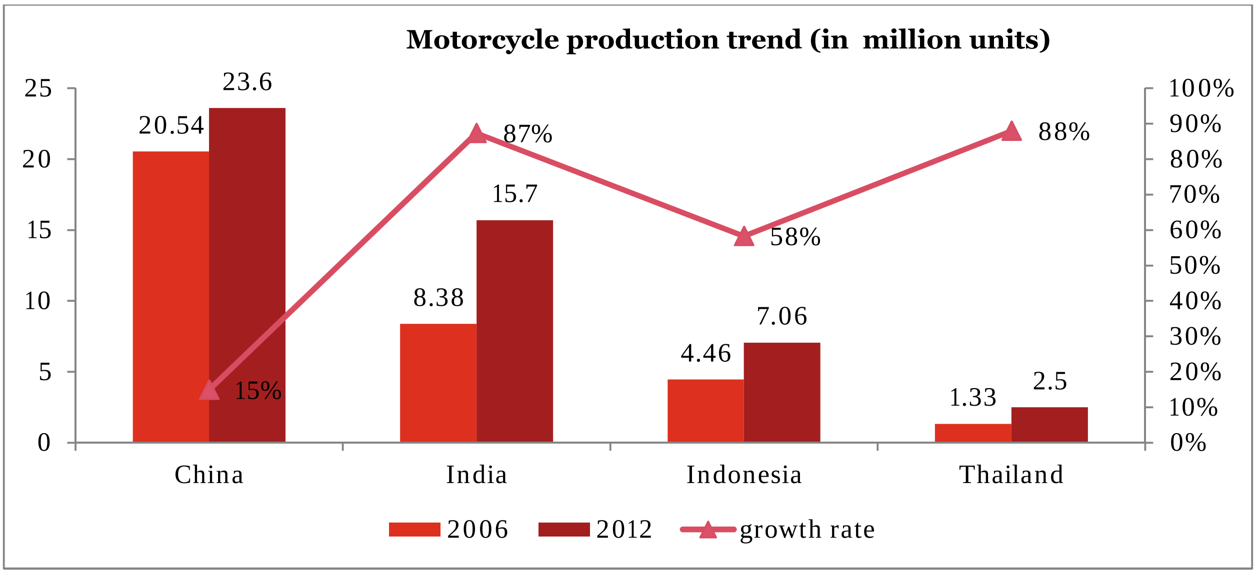
1. National level related

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.

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 productons, and the second largets produccer after China globally.

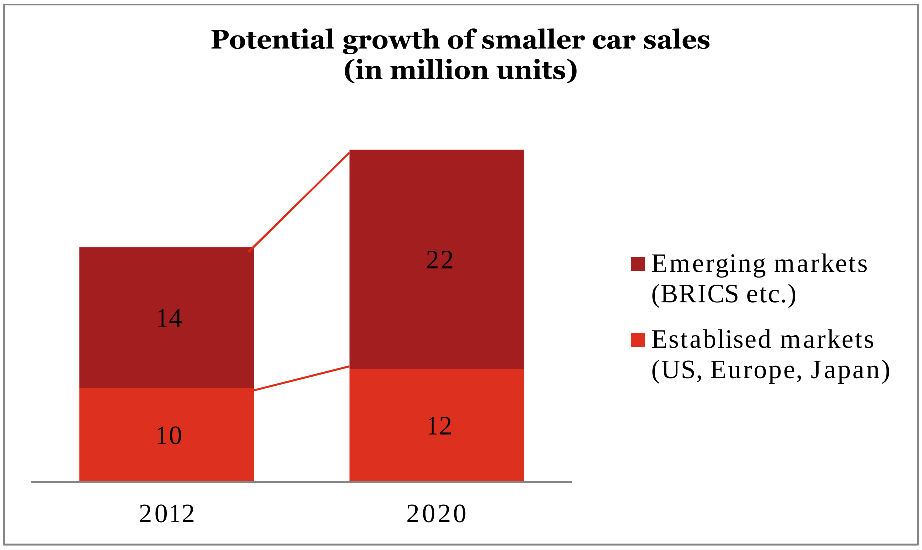


Source: Trends in Motorcycle fleets worldwide, PwC analysis

Figure 5.19 Motorcycle production trend

Potential global demand for smaller car

- Customer's purchase behaviour is shifting globally toward efficient and eco-friendly vehicles. Both emerging and established market have 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, Tumakuru is strategically located where manufactures can enter export market through both ports on West coast to access Europe or African market as well as East coast to access Asian market.



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

Figure 5.20 Potential growth of smaller car sales

2. Tumakuru level related

Karnataka is a part of South Auto cluster where major auto and auto components players, such as Toyota Kirloskar, Honda motorcycles & scooters, Hyundai, Nissan, India Yamaha motors, are concentrated. Further, Tier 1& 2 forming approximately 80% of output and employment, and accessories unit cater to major share of investment at 65% in Karnataka. At present major players of auto and auto components sector are dominated in Bengaluru. However, Bengaluru is being saturated due to land supply. Further, Tumakuru node has presence of Tier 2 and 3 units that are into manufacture of parts and accessories. These are export oriented units or suppliers to auto companies in nearby area of Bengaluru Urban and rural. Tumakuru, located 80km from city center of Bengaluru can be the next destination for auto components sector. Below are growth driver of auto components sector on Tumakuru.

Presence of majoir OEM players, Tier-I,Tier-II suppliers	Connectivity to ports	Sales market	Availability of large tracts of industrial land	Proximity to R&D base

1) Presence of major OEM, Tier-I, Tier-II players

Karnataka is a part of South auto cluster which is located at Hoskote in Bangalore Rural, Bidadi in Ramanagar and at Dharwad. There are leading OEM companies located such as Toyota, Volvo for four wheelers, and Honda motor cycles & Scooters for two wheelers. Honda Motorcycles & Scooters set up an additional plant in

Narasapura, and have witnessed a fast growth from 2012-13 to 2013-14. Domestic sales increased at 34% and exports increased at 20.9%. There is large demand of components for two wheelers.

Not only major OEM players, there are abundant Tier-I and Tier-II players in Karnataka, such as DENSO, Aisin Seiki, BOSCH, APEX auto, Faurecia. There is large demand of components for these players.

2) Connectivity to ports

As discussed, there is a big potential in export market, and connectivity to ports are critical factors. Tumakuru has access to three ports both West side (Mangalore Port) and East Ports (Chennai, Ennore Port and Krishnapatnum Port) via NH and SH. Further, ICD in Bangalore is easily accessible. Improved connectivity to Mangalore Port is extremely crucial to improve export market potential for Tumakuru for the Auto sector. Further projects such as Dedicated Freight corridor between Bengaluru & Chennai (with spur to Tumakuru NIMZ) will enable smoother and faster transport of heavy auto and auto parts from the logistics hub within the NIMZ to Chennai Port directly.

3) Sales market

Bengaluru has the highest number of registered vehicles in 2011 among major cities in India. Tumakuru is strategically located having access to big car markets on West Coast States, such as Gujarat and Maharashtra as well as east coast states such as Tamil Nadu and Andhra Pradesh having higher spending propensity towards purchase of automobiles. (Gujarat and Maharashtra have 1^{st} and 2^{nd} highest number of registered vehicles)

4) Availability of large tracts of Industrial Land

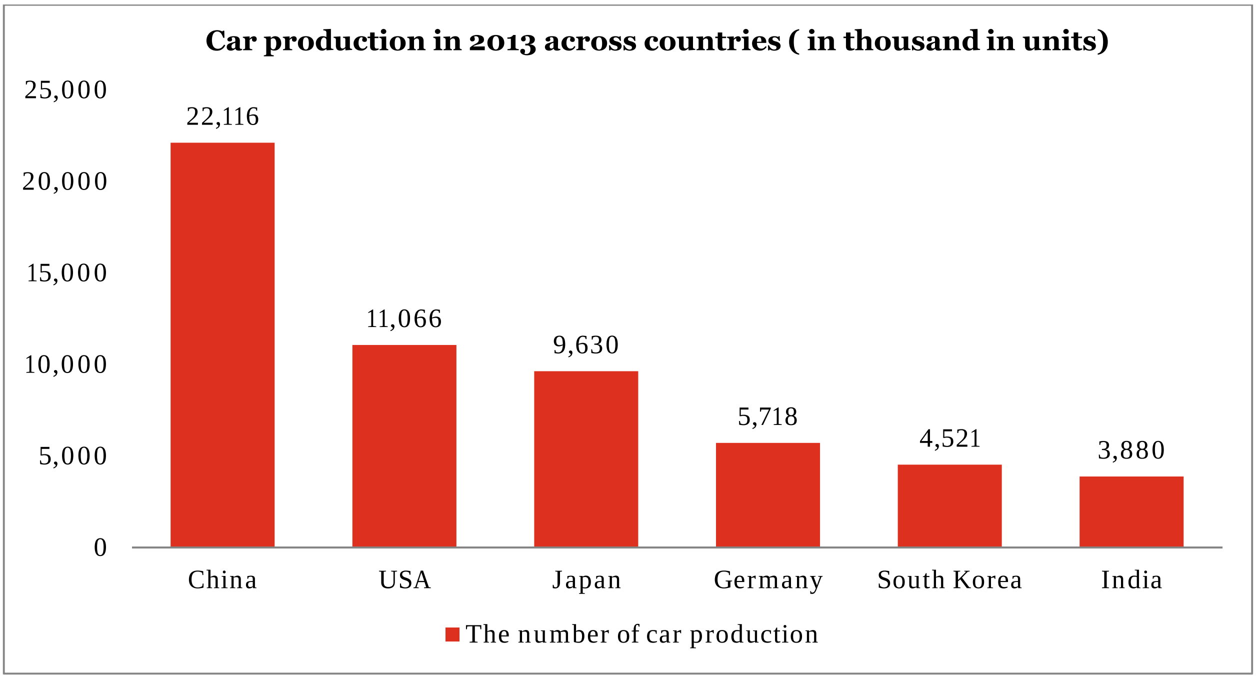
Phase IV- VI of Tumakuru NIMZ is around 10,096 acres of greenfield industrial area. Given that auto manufacturing hubs require larger industrial plots (the Toyota Factory is Bidadi is spread over around 3,000 acres), and there is acute shortage of such large tracts of industrial land in and around Bengaluru, Tumakuru has an intrinsic advantage of attracting auto sector manufacturers given the existing developed cluster for the sector, and other advantages elaborated above.

5) Proximity to R&D base

About 50% of MNC R&D centres in India are based in Bengaluru. The sector may utilize the skill force and facilities for R&D activities for the sector.

Key Challenges and Issues

Despite the robust growth of auto and auto components sector in India, however, annual car production in China is almost 7 times of the number in India, as seen in the graph below.



Source : OICA, PwC Analysis

Figure 5.21 The number of Car production

Growth of auto component industry is directly linked to the growth of automobile industry. More than 65% auto component is sold to the OEMs21. 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 exported22. 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[23].

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[24].

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 cent25. 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

[21] Automotive Mission Plan 2006-2016
[22] Overview of Indian automotive component Industry, Tata strategic group management
[23] INDIAN AUTO COMPONENTS INDUSTRY: RIDING THE TIDE
[24] *Automotive Mission Plan 2006-2016*
[25] Volkswagen website

lack of export 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.

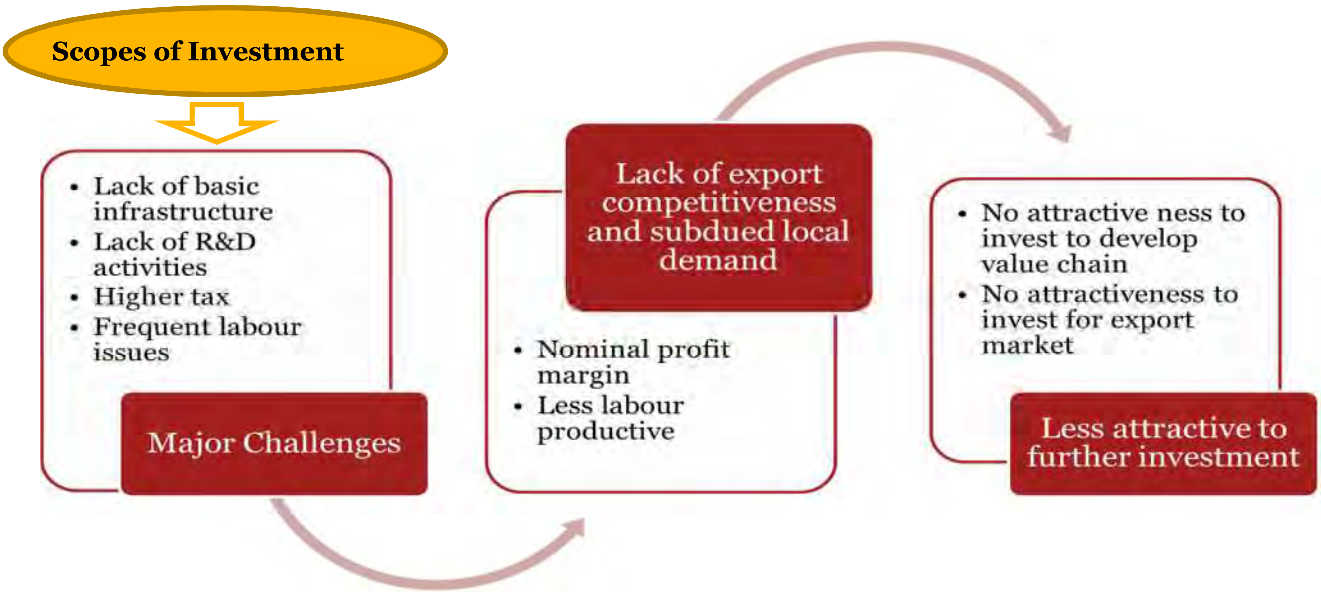


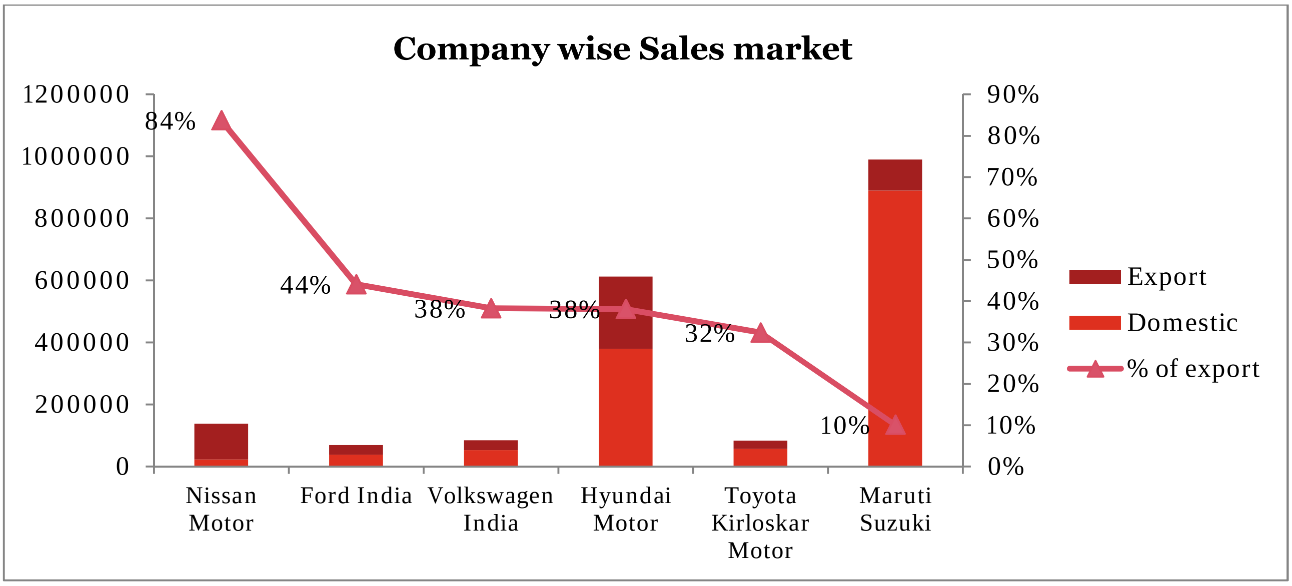
Figure 5.22 Major challenges in Auto Sector

1) 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, and 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[26].

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



Source : PwC Analysis, ,SIAM

Figure 5.23: Company wise Sales market in 2013-14 (in unit number)

Improvement of railway facility and operation may require to promote rail transport and export for auto and auto component sector. Toyota Kirloskar Motor(KTM) is a leading auto manufacturing company in Karnataka. Export accounts for 32% of total sales, however the production amount is lower side compared to other major auto companies. At the same time KTM is utilizing only about half of the current capacity with 310,000 units per year. Despite of the proximity to the Bengaluru – Mysore railway line, all dispatches from the Toyota Plant in Bidadi are by road transport with two reasons. One is that the loading facilities at the station were found to be unsatisfactory – in particular the siding was too short to accommodate sufficient wagons to take the desired loading. Secondly, the South Western Railway, being required to give operational priority to passenger trains, was consistently unable to guarantee delivery times[27].

As the table blow 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.

[27] Appendix 2, ITR 2

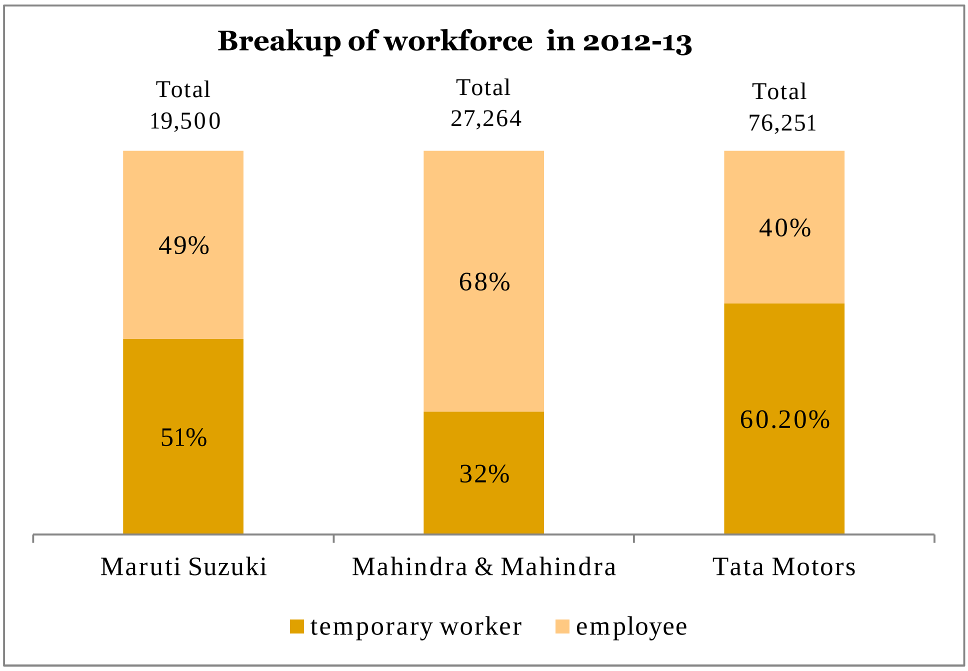
Table 5.2 Commodity wise traffic

(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

2) 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.



Source : PERMANENT PROBLEMS OF TEMPORARY WORKERS IN AUTOMOBILE INDUSTRY

Figure 5.24: Breakup of workforce in 2012-13

Many auto sectors raised the labour related issues because current labour laws are too favourable 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),

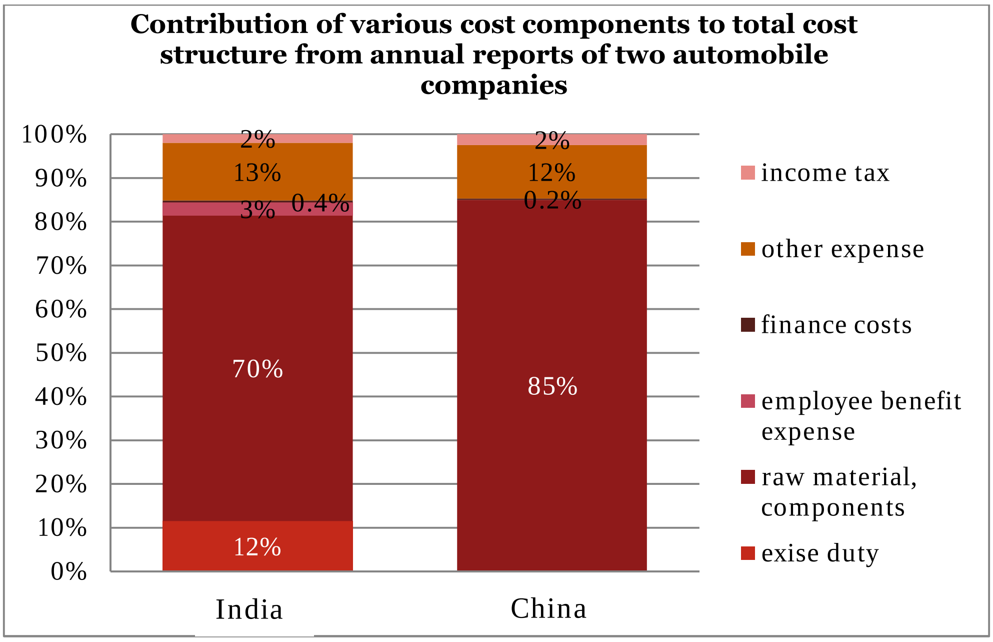
d) raise minimum membership from 15% to at least 30% of the total workforce in order for a labor union to be recognized.

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

International Benchmarking against Global Competition

1) 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- set by passing on to the end users thereby increasing the overall cost for the manufacturer, reducing their cost- competitiveness in the global market.

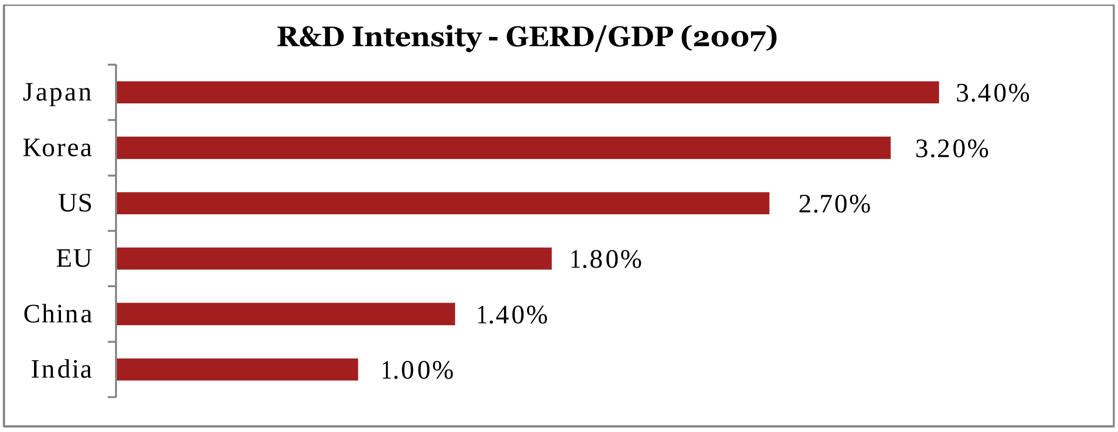


Source: Annual reports 2013-14 of two leading automobile companies in India and China, PwC Analysis

Figure 5.25 Comparison of cost structure of Auto companies in India & China

2) 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.



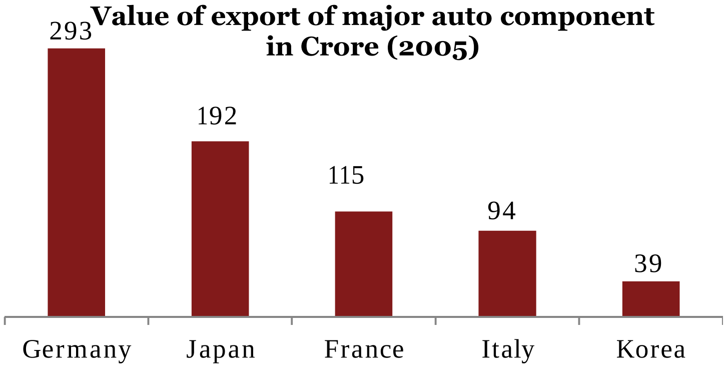
Source: Benchmarking analysis report, European Assessment of Global Publicly Funded Automotive Research

Figure 5.26R&D Intensity

Case Studies – Success factors in selected leading countries

GERMANY

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 5.27: 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

1) 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.

2) Supplier contribution for technical advances

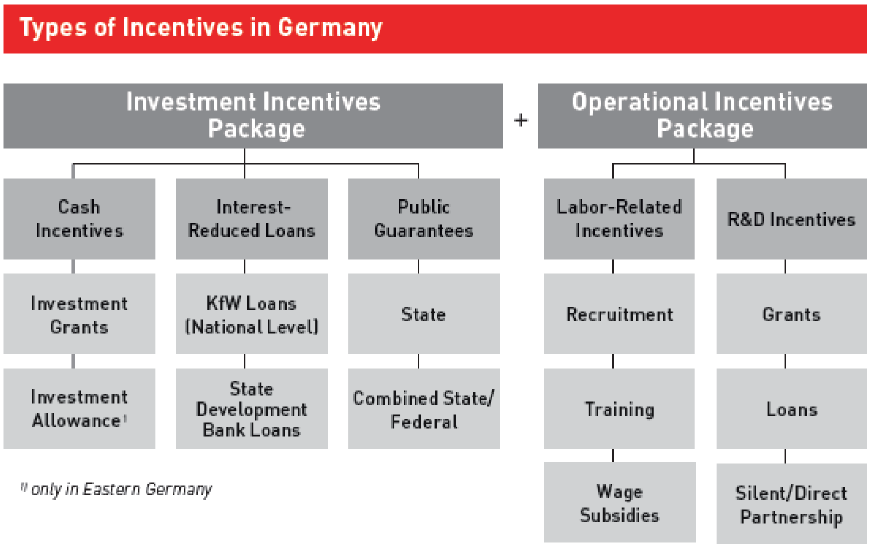
Technological advances are increasingly taking place on the side of suppliers. OEMs accordingly differentiate themselves in terms of brand reputation and service. While suppliers themselves renovate products through R&D activities, OEMs can focus on marketing to build long-term brand relationship.

3) 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.

4) Comprehensive financial assistance

There are various means of financial assistance through various instruments available in Germany to fit the needs of investors across sectors. 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

Figure 5.28: Type of Incentives in Germany

Table 5.3: Key learning

Key factors	Challenges in Tumakuru	Learning
Paradigm shift of the OEM business model	India based car manufacturers have expertise on smaller car production.	Ports connectivity and quality need to be improved to promote export.
Supplier contribution for technical advantage Strong focus on R&D activities	The majority of manufactures in Tumakuru are small players and do not have capacity for R&D activity. Therefore, OEMs or Tier-I companies need to train them to meet their requirement.	Strong Government support by incentives on R&D may be required to encourage R&D activities further.
Comprehensive financial assistance	The sectors investors are facing issues in recruitment and training of workers, and labour union management.	Labour related incentive may be considered.

Key Design Implication

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Tumakuru emerges as a top destination auto and auto components 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	• Technological readiness and upgradation • Researc h and development • Value addition • Skill Development	• Labour law reform • Tax regime • IPR enforcement

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

Table 5.4 Key recommendation for Auto and auto components sector

Components		Issues	Design Implication
Economic enhancers			
Connectivity	Road	• Many auto parts are precision parts. Given 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, due to high idle time on roads • Although there is a potential growth export market, port connectivity and quality of port is sufficient enough to handle automobile export activities. • Some of critical auto parts are being imported.	• Chennai-Bengaluru Express Way should be considered as a CBIC priority project to enhance connectivity to Chennai Port with regular monitoring mechanism for update on status of works. • Connectivity issue of New Mangalore Port needs to be solved at the priority basis and utilization needs to be improved to promote export from West coast. Ports on West coasts will create accessibility to export market in Africa and Europe. • Satellite Township Ring Road (Bengaluru) and Individual Town Ring Road should be considered as a CBIC priority project to ease congestion in Bengaluru Area.
	Rail	• Government of India has taken an initiative to promote rail transport by introducing “Automobile Freight Train Operator” (AFTO) scheme. However, investors are still not comforted with any guaranteed delivery time.	• Dedicated Freight Corridor may be considered as a CBIC priority project to enhance connectivity to Chennai Ports for import and export purpose. The operation of DFC needs to be efficient with delivery ensured in time bound manner. • Tumakuru – Davanagere railway line may be considered as a CBIC priority project to connect to Davanagere via Chitradurga..
	Port	• Although there is a potential in export market in Africa and Europe, the minor ports on West coast are not fully utilized	• Enhancement other Minor ports (Karwal Port, Tadri Port etc) may be necessary to provide additional access to export market
Urban Transport		• Employees in Bengaluru city need to use their own vehicles, due to inadequate public transportation.	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed for easy commuting for employees from Bengaluru City to Tumakuru. Investors can consider Bengaluru City as a recruitment base and access to a large pool of talent in Bangalore City. • Doubling of existing railway line between Bengaluru and Tumakuru to facilitate passenger transport
Value enhancers			
R&D promotion		• Products need to be renovated to match global trend shifting toward efficient and more eco-friendly vehicles. However, since the sector remains unorganized,	• Establish Government affiliated R&D centre in proposed **Knowledge Park** • GoK may promote R&D activities through incentives. • Industry-Academia Collaboration on Innovative R&D needs to be encouraged

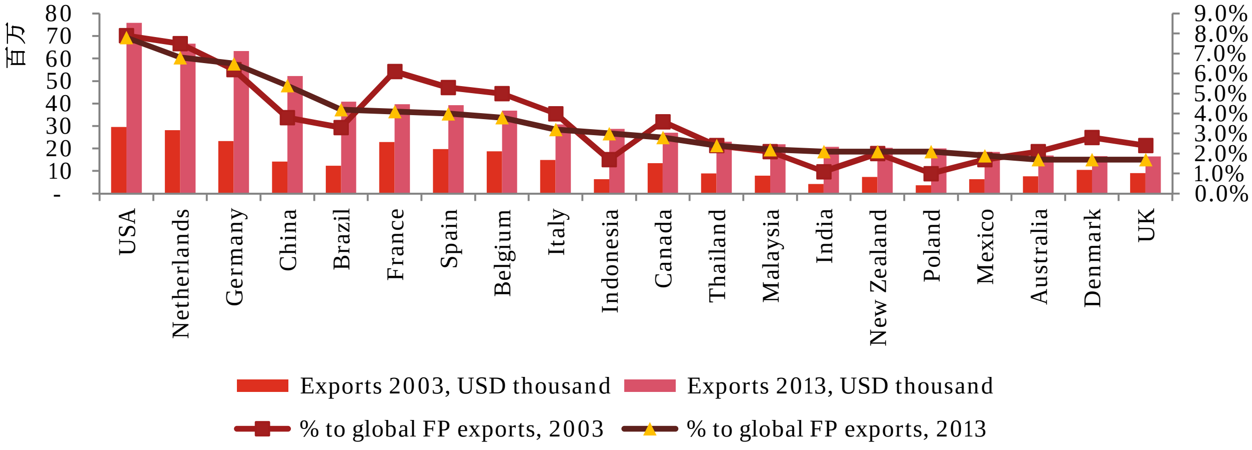
Components	Issues	Design Implication
	latest technology is not implemented.	• GoK has proposed setting up of an Aviation University. On similar lines, funding may be proposed to develop a top- class Auto sector R&D institute with tie- ups with IISC, Bengaluru etc.
Skill development	• The lack of skilled labour in certain technical field, the investors need to train workers from the basic requirement. • The skill is too conventional and does not match the industry requirement,	• Implement actions under KIPP to enhance skill availability ✓ Revision of existing Skill Development Policy of the State and preparation of Draft Skill Development Policy 2015-20 comprising detailed road map of schemes, yearly target outcomes, and budgetary provisions in FY15/16. ✓ Arrangement of an annual industry-government round table to continuously understand the skill demand with changing contexts. Foreign investors including Japanese investors may be invited as participants of the roundtable. ✓ Introduce new curriculum to match up-to-date skill requirement. • Formulate State Policy to Set up **knowledge Park** inside the Node ✓ incentive industries to participate in the Training and Placement of workforce to promote private investment and partnership • National Skill Development program may be re- aligned to include and promote training provided directly by the employer through some grant provision by the government. For eg. Siemens India has a training centre in Bengaluru, which is well equipped with modern facilities to conduct trainings for fresh Siemens GTE (Graduate Trainee Engineers) & also extended to the College/University students to be trained in advance areas of Electricals & Automation
Administrative enhancers		
Labour issue	• Approx 40% is contract workers. Labour productivity is less due to instability of contract workers. • Labour laws are too favourable to workers and not flexible. Industries frequently face labour union issues.	• GoK may consider relaxation of labour laws to ease labour union and contract worker management, in line with other pro- active states such as Rajasthan • GoK may consider introducing incentives to industries for recruitment, training
IPR regime	• 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.	• Conduct seminars for private sectors to enhance awareness on Patent law and application process/requirement in India and to encourage IPR registration
Indirect Tax regime	• Complicated tax regime increase the cost of production	• GST is expected to be implemented. GoK needs to be prepared for smooth transition to GST enforcement. Training on GST operation for tax officers need to be programed and conducted.

5.2.3 Food Processing

The global Food Processing industry was estimated to be USD 3,200 billion in the year 2010[28]. The US and EU and together account for over 60% share of the global food processing industry. In the Asian region Japan is the largest food processing market.

Top 2o exporting countries in food processing sector contribute about 70% to total exports of the sector globally. In terms of value of exports in 2013, USA, France and Netherlands are the top three exporting countries. **5 Asian countries are present in the top 20 list; China ranks the 4th, followed by Thailand at 10th and Indonesia at 12th positions. India secured the 14th position in the list of top exporting countries in 2013**[29].

Top exporting countries based on value of exports, 2003 vs 2013



Source: Trade statistics for international business development, International Trade Centre, intracen.org, PwC analysis

Figure 5.29: Top exporting countries based on value of exports

Across all regions, the major sub-sectors on the basis of demand are Meat, Poultry, Fruits and Vegetables and Sugar. These sub-sectors contribute to more than 70% of the demand of Food Processing sector. The major regions that contribute to more than 60% of the global retail sales of processed foods are United States and the European Union. Currently, around 58% of produced food is consumed by developing countries. This is expected to increase to over 70% by 2050 supported by the fact that over 35% of the world's population currently lives in China and India. Over the past 10 years (between 2003 and 2013) there have been insignificant changes in terms of top exporters, across major food processing sub-sectors.

India has improved its position on the global food processing exports arena by from 1.1% to 2.1% share in total food processing exports (22nd to 14th rank). Improvement in export volumes has been remarkable in meat and edible meat offal (from 23rd rank in 2003 it secures 8th rank globally) fish, crustaceans, mollusks, aquatic invertebrates (from 12th to 4th rank), animal vegetable fats and oils, cleavage products (from 47th to 17th rank). However, some in large segments of food processing, such as meat, fish and seafood preparations, dairy products, cereal, floor, starch, milk preparations, etc., it still lags behind, thought these sub-sectors are among the highest in terms of value added.

[28] *Gyan Research and Analytics Pvt. Ltd, 2012*
[29] Trade statistics for international business development, International Trade Centre, intracen.org

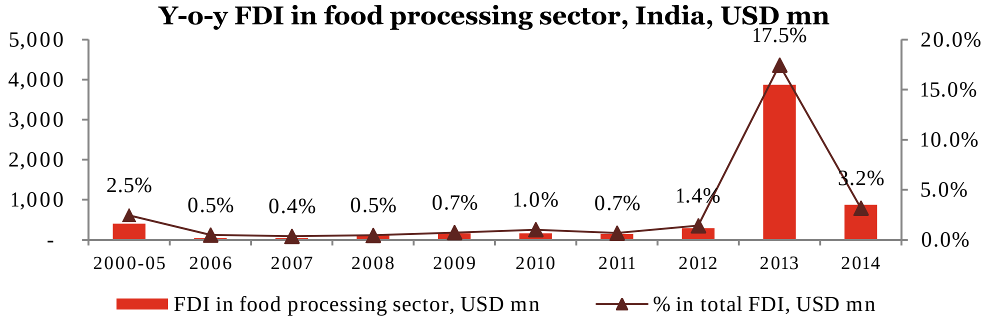
Table 5.5: Trade competitiveness ranking, 2003 vs 2013, Food processing[30]

Rank	Meat and Edible Meat Offal	Fish, Crustaceans, Molluscs, Aquatic Invertebrates	Meat, Fish and Seafood Preparations	Dairy products, Eggs, Honey and Animal Products	Animal Vegetable Fats and Oils, Cleavage Products	Cereal, Flour, Starch, Milk Preparations and Products	Vegetable, Fruit, Nut etc Food preparations	Miscellaneous Edible Preparations
1	USA (1)	China (2)	China (1)	Germany (1)	Indonesia (2)	Germany (1)	China (2)	USA (1)
2	Brazil (3)	Norway (1)	Thailand (2)	N. Zealand (4)	Malaysia (1)	Italy (2)	USA (4)	Germany (2)
3	Germany (7)	USA (3)	Germany (3)	Netherlands (2)	Netherlands (6)	France (3)	Netherlands (1)	Netherlands (3)
4	Netherlands (2)	**India (12)**	USA (4)	France (3)	Argentina (3)	Netherlands (8)	Belgium (6)	France (4)
5	Australia (5)	Viet Nam (5)	Netherlands (6)	USA (13)	Spain (5)	USA (5)	Italy (3)	China (13)
India	**8 (23)**	**4 (12)**	**43 (44)**	**21 (39)**	**17 (47)**	**28 (38)**	**25 (38)**	**28 (32)**

Source: Trade statistics for international business development, International Trade Centre, intracen.org, PwC analysis

Food processing industry is one of the largest industries in India and is estimated to be worth USD 121 billion in 2012 and accounts for 32% of country's total food market31. With a huge agriculture sector, abundant livestock, and cost competitiveness, India is fast emerging as a sourcing hub for processed food. Around 90% of the output of food processing sector is contributed by four sub-sectors - vegetable oil, grain mill and starch, dairy and other food products. Output of the sector has increased from over USD 62 billion in 2008-09 to over USD 90 billion in 2010-1132 and is expected to grow at a CAGR of ~10% till 201533. Food processing industry in India is increasingly seen as a potential source for driving the rural economy as it brings about synergy between the consumer, industry and agriculture. A well-developed food processing industry is expected to increase farm gate prices, reduce wastages, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings.

Between January 2000 and November 2014, foreign direct investment in food processing sector in India stood at USD 6.1 billion. The FDI spike has been registered in 2013 having marked the entry of several large foreign players such as Nestle, Coca Cola, Hersheys, Mc Cormick, etc.



Source: Fact sheet on foreign direct investment (FDI), DIPP

Figure 5.30: FDI in food processing sector, India

[30] Numbers in brackets represents rank in 2003
[31] *D&B Research*
[32] *Annual Survey of Industries (Conversion 1USD = 60 Rupees)*
[33] *D&B Research*

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

Table 5.6: Sub-sector wise projected growth rates – Food processing sector

Segment	Growth rate
Marine	4%
Fruits and vegetables	6%
Vegetable oil	5%
Dairy	8%
Grain mill and starch[34]	10%

Source: D&B Research, ASSOCHAM, Feedback consulting

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

Some of the other key measures undertaken by the Government include: amendment of the Agriculture Produce Marketing Committee Act, rationalization of food laws, implementation of the National Horticulture mission etc. The government has also outlined a plan to address the low scale of processing activity in the country by setting up the mega food parks, with integrated facilities for procurement, processing, storage and transport. To promote private sector activity and invite foreign investments in the sector the Government allows 100% FDI in the food processing & cold chain infrastructure.

Despite of continual efforts and initiatives by the Government to provide the required stimulus to the food processing sector, processing activity is still at a nascent stage in India with low penetration. At the same time, though India is a key producer of food products, having an adequate production base for inputs, productivity levels are very low in the country.

[34] *Average growth rate of food processing sector*

Viability drivers for future investments

There is number of growth drivers fueling the processed food sector in India and Tumakuru

1. **National level related**

Increasing disposable incomes, rapid urbanisation and changing eating habits

- Increasing demand for functional food coupled with awareness about healthy/nutritional foods has increased spending on health foods. Further, changing lifestyles has resulted in willingness to pay premium prices for quality products

Policy drivers

- Government of India has been promoting the concept of Mega Food Parks and is anticipated to set up 50 such parks across the country by the end of 12th Five Year Plan, to attract FDIs
- Low entry barriers
- Various tax incentives and policy initiatives taken by the government to increase the share of India processed food industry in the global market has encouraged entrepreneurs to set up food processing units, specially export oriented units
- Sops to private sector participation; 100 per cent FDI under automatic route
- Agri Export Zones have been set up; under the government's Vision 2015 plan, mega food parks to be established
- Approval of National Mission on Food Processing
- Launch of Infrastructure Development scheme to increase investments in food processing infrastructure

Availability of resources

- India has numerous advantages like availability of abundant raw materials, the second largest arable land in the world, low labour costs
- Diverse agro-climatic conditions making it suitable for practicing different crops

India emerging as a procurement hub

- India is gradually emerging as a procurement hub for agri related produce. There has been a gradual but significant improvement in product and packaging quality over a period of time, which has infused greater confidence in the importing nations for Indian products

2. **Tumakuru level related**

Food processing is one of the most prominent sectors in Tumakuru district in particular. 48% of district's investment is dominated by food processing sector. Highest investments are in Vegetable oil, grain mill & starch and gherkins. Segments within food processing have shown tremendous CAGR over last decade compared to other sectors. Processing and preserving of fruit and vegetables is a leading segment with 20% export share from India followed by grain mill products, starches and starch Product at 4% in 2012. Output-wise vegetable and animal oils and fats, dairy products, grain mill products and starch products form 70% of share at India level. The Central Government as well as GoK offer schemes for financial support to develop food processing sector in Tumakuru.

Established Food Cluster	High input base of raw materials	Government support	Sales Market

1) Established food cluster

There are four existing food parks in Karnataka in Malur(Kolar), Navanagar (Bagalkot), Hiriyur (Chitraduruga), Jewargi(Gulbarga). Further, India Food Park (Rs. 1000 crore, 22,000 tonne capacity, spread over 110 acres) is being implemented in Vasanthanarasapura IA as one of the 10 Mega Food Parks to be established in the country as part of Central Mega Food Parks Scheme.

2) High inputs base of raw materials

Availability of raw materials is crucial for food processing industry. Tumakuru district is primary sector intensive with 30% contribution of GDDP (2010-11), as compared to 18% in State. It is a major production center of commercial crops- groundnut, areca nut and other major crops such as Paddy, Ragi, Maize, Cereals & minor millets and pulses.

3) Sales Market

Organized retail markets such as Bengaluru & Mysore are easily accessible from Tumakuru. That the primary catchment (Bangalore, Mysore) is within 200 kms radius is relevant especially with respect to transport of perishable produce.

4) Government Support

GoK formed Integrated Agribusiness Development Policy 2011 to achieve sustainable growth in the field of agriculture and allied sector, various incentives and relaxation are proposed as part of the Policy benefitting the food processing sector as well as agriculture sector. Further Mega Food Park Scheme is applied to Tumakuru under Central Scheme.

Key challenges and issues

While India remains a top producer of food, production yield levels are among the lowest amongst the BRIC countries. Even though India is the largest producer of several agricultural commodities, there are high levels of losses in the supply chain. A study conducted by the Central Institute of Post-Harvest Engineering and Technology (CIPHET) in 2010 put the losses in the range of 0.8% to 18% and attributed them to several factors including non-availability of facilities for aggregation, packaging, storage, transportation, and cold chain and low level of processing of agricultural produce.[35] A number of challenges/issues exist, hampering the growth of the food processing sector across the value chain in the country:

[35] Economic Survey 2013-14, Agriculture and Food Management, Chapter 8, p. 152, http://indiabudget.nic.in/es2013-14/echap-08.pdf

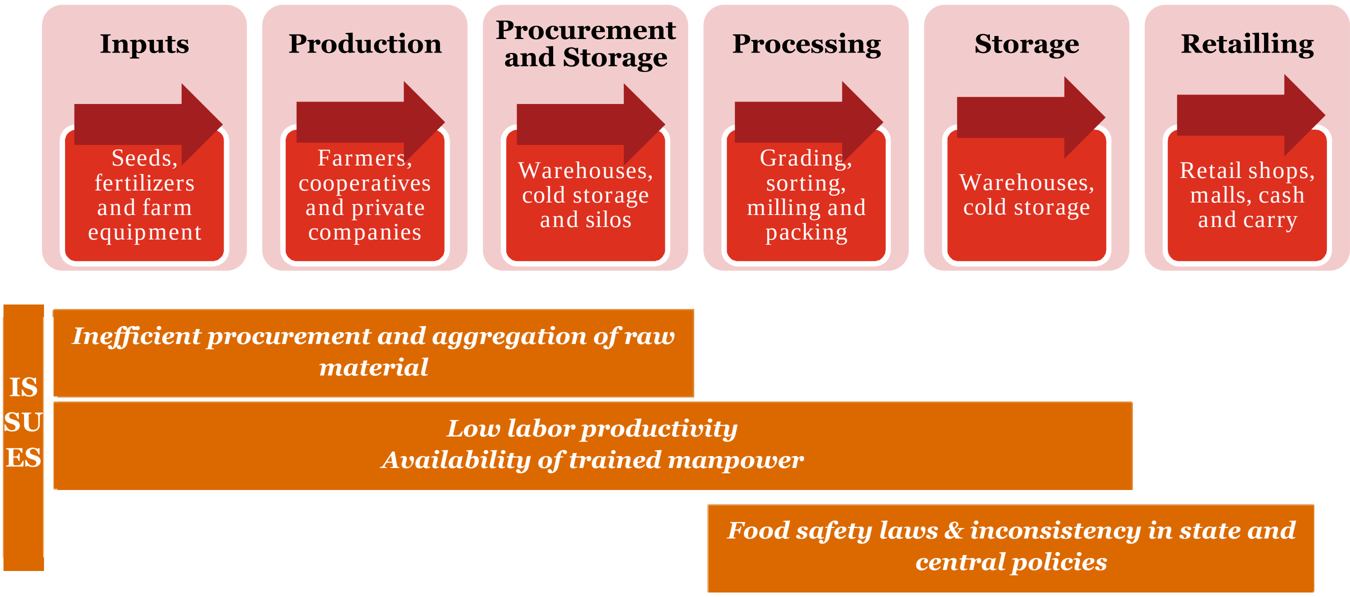


Figure 5.31: Value chain in food processing sector

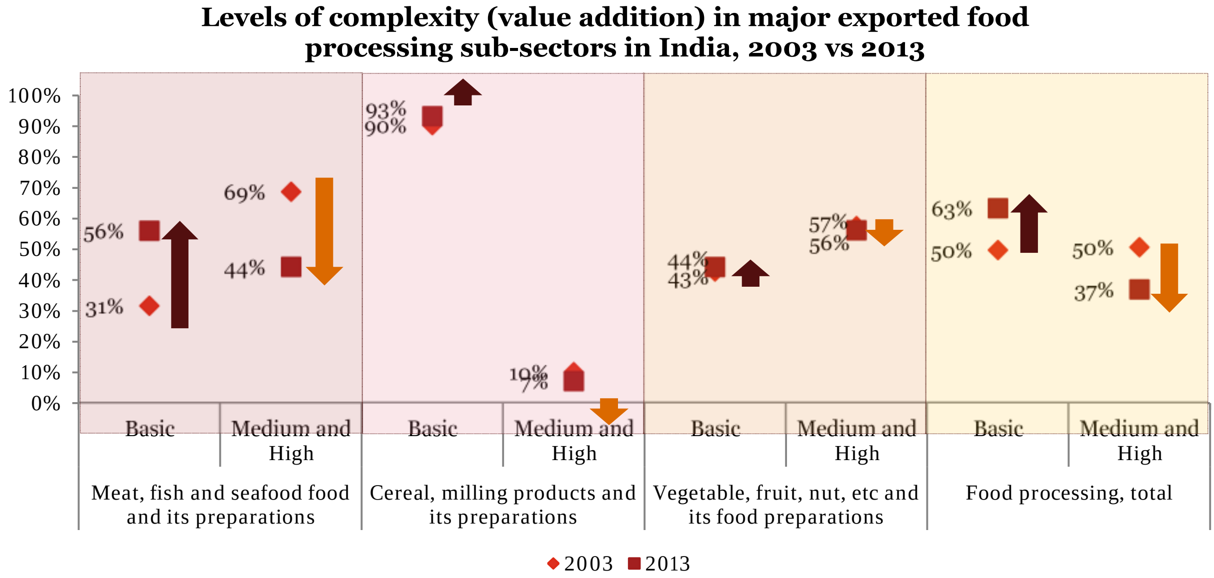
Indian food processing sector has one of the lowest levels of processing activities vis-a-vis other countries.

Table 5.7: Percentage of food processed in India vis-a-vis in developed countries - 2010

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

Source: Emerging Markets Insight

This is reflected in the exports basket of the country which is low in high-value added items.



Source: International Trade Centre (intracen.org), PwC analysis

Figure 5.32: Constitution of food processing exports basket in India, 2003 vs 2013

There is substantial increase in exports of low value added, basic products, from 50% in 2003 to 63% in total food exports. It was mostly on account of increase of low value added exports of meat, fish and seafood product group. Also the dominant share of low value added exports in cereal, milling products and its preparations increased from 90% in 2003 to 93% in 2013.

Below the consultant details and summarizes the issues and challenges of the food processing sector:

Inadequate infrastructure facilities	Inefficient procurement and aggregation of raw material	Food safety laws and Inconsistency in central and state policies	Productivity levels and availability of trained manpower

1) Inadequate Infrastructure Facilities

Inadequate support infrastructure which is the biggest bottleneck in expanding the food processing sector, in terms of both investment and exports includes: long and fragmented supply chain, inadequate cold storage and warehousing facilities, road, and rail and port infrastructure. Lack of modern logistics infrastructure such as logistics parks, integrated cold chain solutions, last mile connectivity, dependence on road over rail, customized transportation, technology adoption (barcoding, RFIDs) and government support via incentivizing private public partnerships are some of the gaps that exist in supply chain & logistics sector in India.

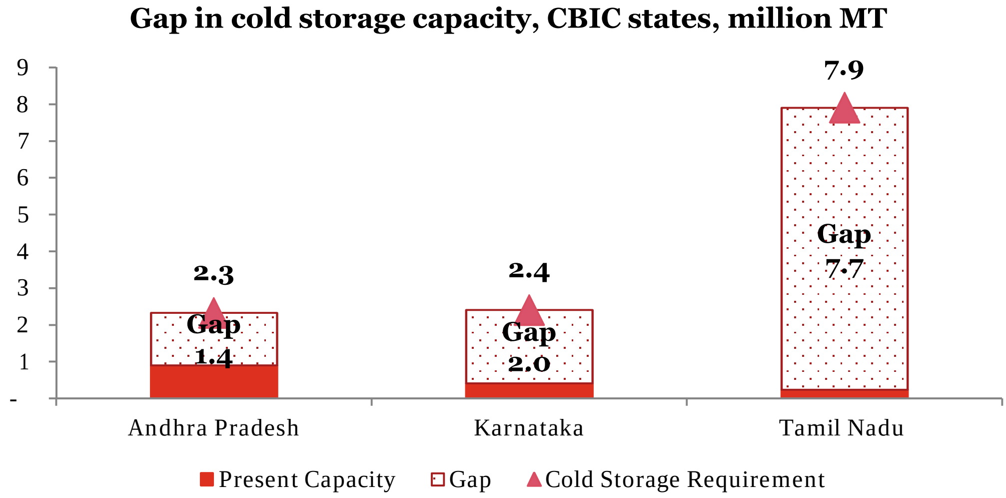
Status of current regulated markets by Agricultural Produce Market Committees (APMC) is discouraging in terms of infrastructure facilities. Gaps in Marketing Infrastructure:

- Cold Storage units exist only in 9% of markets
- Grading facilities exist in less than 1/3rd of markets
- Scientific storage is only 30 per cent of the required capacity
- Only 11 States have taken initiative under NHM in establishing cold storages and eight states have established 51 apni mandis, there is virtually no progress in the setting up of wholesale markets except in Kerala
- Lack of cleaning, grading, electronic weighing and quality certification facilities[36].

Cold Storage & Warehousing:

According to government estimates, India has 6,300 cold storage facilities (only around 10% in the domain of co- operative/ public sector), with a combined capacity of 30.11 million metric tons that can store less than 11% of what is produced, bulk of which are utilized for a single commodity, such as potatoes. As seen in the chart below, CBIC states have a gap of around 11 million MT in cold storage capacity.

[36] Report of the working group on agricultural marketing infrastructure, secondary agriculture and policy required for internal and external trade, for the 12 Five year Plan 2012-17



Source: National Spot Exchange (NSE) and DMI

Figure 5.33: Gap in cold storage capacity, 2010, CBIC states, million MT

- A major barrier to cold chain implementation in India is cost. The operating cost for Indian cold chain storage units are double those of the Western countries (US$ 60 per cubic meter compared to less than US$ 30 in the Western countries). And, a major cost contributor is energy expenses which account for 28% of total expenses in India ass against 10% in Western countries.

- Coupled with cost, are other issues such as lack of backward & forward linkages to supplement cold chain such that commodities which are transported and stored in the cold chain have enough market value to absorb the added cost

- Because of fragmented backward linkages (processor with farmers), the cold chain industry in India is still seen by investors as high on capital, low on volume and requiring a long payback period for the investment

- The warehousing capacity available in India is about 108.75 million MTs, and is projected short by at-least 30% required during the 12th Five Year Plan period.

2) Inefficient procurement and aggregation of raw material

Agriculture in India is characterized by highly fragmented land holdings. Fragmented and dispersed nature of crop production leads to lack of predictability of supply and homogeneity in quality required for large- scale food processors. Agricultural trade is characterized by a long supply chain with multiple market intermediary participation.

Identifying the current challenge, Govt. of India has introduced the concepts of Terminal Markets[37] and Contract Farming[38]. However, until recently, very few states have made reforms at state level in the APMC Act to enact these concepts.

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[37] Terminal markets operate on a hub and spoke model where the markets form the hubs, and are linked to different collection centres (spokes) that are located close to the production centres. It serves as an assembly, processing and trading place for agricultural commodities.

[38] Contract Farming is an agreement between the food processor (contractor), typically a large organized player, and the farmer, whereby the farmer is contracted to plant the contractor's crop on his land and deliver a quantum of produce, based upon anticipated yield and contracted acreage at a pre-agreed price. The food processor provides inputs in terms of technology and training to the farmer, to improve the yield and quality of the produce.

3) Food safety laws and inconsistency in state and central policies

The Indian food regulations comprise various food policies that have been enacted at different points of time, and are under the ambit of various ministries of government of India. Historically they were introduced to complement and supplement each other in achieving total food sufficiency, safety and quality. The result is that the food sector in India is governed by a number of different statutes rather than a single comprehensive enactment. This incremental approach has led to incoherence and inconsistency in the food sector regulatory scenario. In addition the multiplicity of ministries and administering authorities at both the central and state level has resulted in a complex regulatory system that is not well integrated adding an additional burden on the food industry.

Currently processors need to comply with numerous laws and enforcement agencies at the State level. Multiplicity of legislations has led to conflicting approach, lack of coordination and administrative delays.

On the export front the biggest hurdle for growth in export has been the mismatch in quality between what is produced in India and what is required in the importing countries.

There is lack of adoption of practices such as traceability and certification, which, if followed, could substantially increase trust in Indian food products. Also certain Indian food standards are dated and require revision to improve the quality of Indian processed foods, e.g.- the Meat Food Products Order, 1973 (MFPO) is rarely applicable to the current industry.

Another challenge is the multiple tax regimes. Commission charges, market fee(varies generally between 0.50% to 2.00%), octroi/ entry tax imposed by certain states, sales tax, weighing charges, labour charges for handling ,loading and unloading, though varying from state to state and commodity to commodity is estimated to be approximately more than 12% of the total value of produce marketed . Also the 12% excise duty on packaging material for food processing industry is high considering that packaging material constitutes a significant proportion of the cost of the processed foods (50-55% in case of packaged juices, 35-40% for jams and potato chips). In contrast, several countries like Ireland, UK etc. provide a differential treatment to food products and do not levy any taxes on these segments. In Germany, the overall tax burden on corporates has reduced below 30% and corporate income tax is only 15% on all corporate taxable incomes as against above 30% in India. Such competitive tax regime has facilitated huge foreign investments in the country.

4) Low labour productivity

Another critical issue in India hampering food processing industry is low labour productivity. Indian food processing industry is mainly constrained due to lack of productivity augmenting technologies, low capacity utilization of plant, low level of processing technology, over staffed operations and poor management of seasonal variations. Compared to other countries labour productivity in the food processing sector in India in 2012 was USD 10,1o3, which is twice lower than in China and almost three times lower than in Brazil.[39]

Most of the food processing units in India are small scale and their inability to scale up has often resulted in inefficiencies in operations. Small scale units find it capital intensive to invest in critical areas of efficiency such as state of art technology and manufacturing equipment, trained manpower, quality and certification systems, marketing & promotion.

5) Lack of adequate trained manpower

Many positive developments in the food processing sector have also resulted in the apprehension about the emerging skill shortages due to mismatch between the demand for specific skills and available supply. In fact, of late, shortage of skilled, semi-skilled and unskilled workers has emerged as a critical factor impacting the competitiveness of Indian food industry. At each level in the value chain, there are strong deficiencies in technical knowhow and support.

Apart from the above major challenges hampering the growth of sector include constraints in raw material production, taxation, access to credit, processing plants with obsolete technologies, lack of applied research etc.

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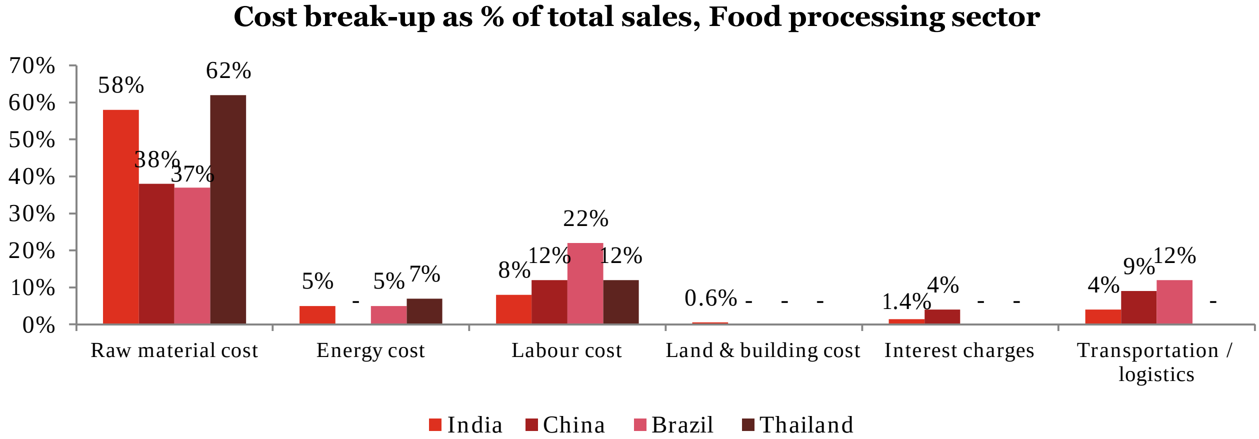
[39] Agro-Industries for Development, UNIDO

Benchmarking Against International Competition

The consultant has studied various parameters that are critical to achieve competitiveness in the manufacturing sector along with the progression of India vis-à-vis competing countries on the competitiveness protocol. The consultant presents the results of the benchmarking exercise below:

1) Cost Structure

Cost structure encompasses all the expenses that a firm must take into account when manufacturing and 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.)



Source: www.enterprisesurveys.org, The World Bank

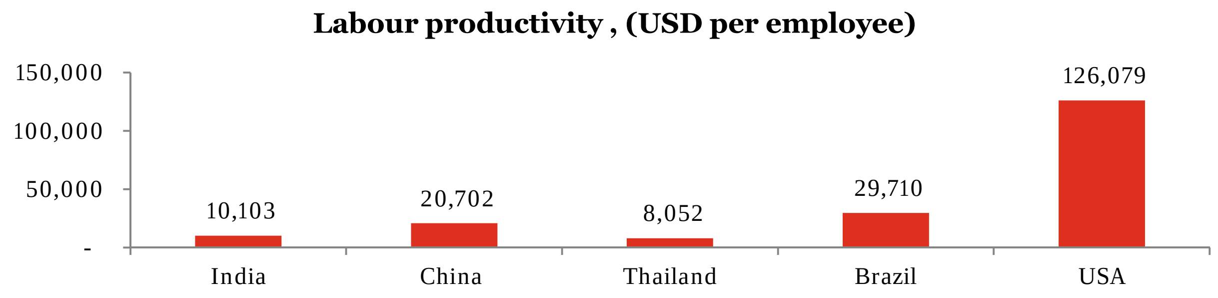
Figure 5.34: Cost structure – food processing sector

India has very high raw material costs though slightly better than Thailand but lagging behind China and Brazil by a huge margin. Energy costs in India which are affected more by government action than by market forces are almost at par with the competing countries.

There is lack of raw-material standardization in Indian food processing industry. Very few units have developed linkages with the farmer to get assured supply of the required standard of raw material. There is the need to not only develop linkages with the raw material supplier but also ensuring complete post harvesting infrastructure necessary to keep the produce in a standardized form which is cost efficient for the industry. As a result, raw-materials for fruits and vegetable processing like pulps, dried vegetables etc. are imported. Most of the firms who are engaged in exports of processed food rely on imports for their critical raw-material. For meat & poultry industry as well, there is lack of standardization of inputs.

2) Productivity

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



Source: UNIDO

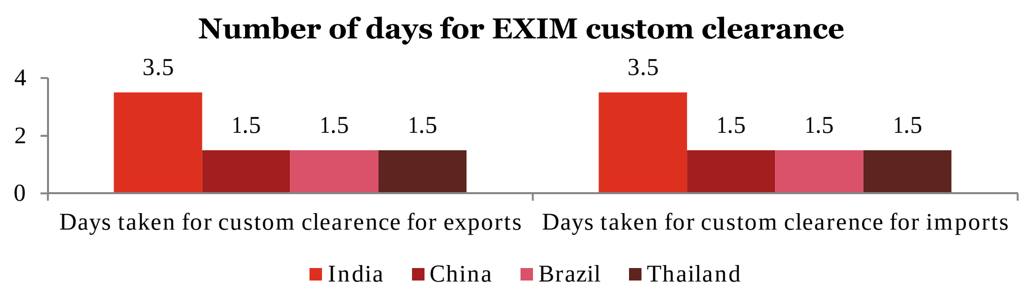
Figure 5.35: Comparison of Labour productivity for export- oriented fish & seafood sector

Higher labour productivity of competing countries is one of the sources of competitive advantage over India, as shown in the figure above. India has slight advantage over Thailand in terms of labour productivity in fish and seafood segment, while China emerges as a leader having labour productivity more than double against competing countries (both in fish and seafood and fruits and vegetables sub-sectors. China has a huge labour force as compared to India but manages to have very high gross value added.

The primary reason is lack of processing in all the food segments in India due to which overall value addition is minimized. Another reason is lack of technology available for food processing. There is limited availability of food processing machinery, most of which has to be imported. Food processing sector, being dominated by MSMEs; very few of these firms are able to afford imported machinery and hence reliance is on manual processing.

3) 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 reach to the target market. Countries which are able to achieve faster turnaround time and have quicker time to market will enjoy competitive advantage in the market.



Source: Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013], http://dsir.csir.res.in/webdsir/#files/reports/isr1/food_processing.html

Figure 5.36: Process time taken for production and reaching to market

India stands at clear point of disadvantage as compared to competing countries (China, Brazil & Thailand) because of higher process time as depicted in the figure above.

While overall process time is almost same in all the countries, time to market for Indian companies especially in export markets is higher primarily because of longer time taken for both custom clearances for exports of finished goods and import of raw materials in India. This disadvantage implies that, the delivery of imported raw material/ machinery to the factory is delayed which could delay the entire production process. Further, delay in custom clearance of exports means that the delivery to the overseas market is delayed by a fair margin which means delivery with tight schedules would have to suffer and markets would look for other supplier countries for such kind of products.

Key Design Implications

Based on the previous reports and discussions above, the top issues and implications for the node design that need to be resolved to ensure Tumakuru emerges 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 value chain management
- Technological readiness and upgradation
- Value addition

Administrative enhancers

- Regulatory and policy support for quality control

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

Table 5.8 Key recommendation for food processing sector

Components	Issues	Design Implication
Economic enhancers		
Logistics	• Warehouses in Tumakuru region are running at full capacity and require immediate capacity augmentation (Government provided warehousing) • Most cold storage units in the state are non-functional due to low profitability as a result of rising power costs, low occupancy given seasonality of crops, high cost of establishment of multi- crop stage facility by SME's etc. Currently only 1 cold storage of 1500 MT capacity operational in Tumakuru	• To encourage investment in cold chain infrastructure, government may consider providing finance and tax incentives for construction of modern automated warehouses and cold chains. Similar incentives may be considered for construction of food parks, Warehouses, Integrated cold chains, Modernized Abattoir etc, under public-private partnership. • Exemption from electricity duty may be considered. • It may also be considered that GoK develops common facilities such as cold- storage, warehousing, packaging units etc to serve a cluster of MSMEs in the food processing sector, as it may not be viable for them to develop by themselves such capital intensive facilities owing to their scale and profitability
Water	• Water supply shortage in Tumakuru district- 0.1 to 0.15 MLD of water being supplied by KIADB indusial water supply scheme, many brownfield industries utilising ground water (uninterrupted water supply reqd. for identified sub- sectors for Tumakuru)	• Quality water supply assurance from KIADB to food processing units is required, including following projects identified by JICA team ✓ Yettinahole Water supply project ✓ Water diversion (94 MLD) from Hemavathy Canal • Provide subsidy to companies to set up water treatment facilities such as STP, rain reservoir etc.
Environment	• 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
Urban Transport	• Employees in Bengaluru city need to use their own vehicles, due to inadequate public transportation.	• Extension of Bengaluru metro or other Urban transport (BRTS etc) may be proposed for easy commuting for employees from Bengaluru City to Tumakuru. Investors can consider Bengaluru City as a recruitment base and access to a large pool of talent in Bangalore City. • Doubling of railway line between Bengaluru and Tumakuru to facilitate passenger transport
Value enhancers		

Components	Issues	Design Implication
Supply chain	• Inadequate and fragmented supply chain and logistic service prevents linkages of farmers to the market, depriving them of the opportunities offered by the emerging retail boom.	• GoK should implement the proposed Agri logistic hub with efficient operation to create backward and forward linkage, including export promotion support to attract SMSE players The Agri hub may contain following facilities; - A product development centre/ Incubation centre - Warehouse for incoming and finished goods - Cold storage facility - Food testing / Quality control lab - R&D centre - Trading centre - Packaging centre - Dedicated parking for trucks
Manufacturing/ Processing Skills	• At present only unskilled labour is utilized in the processing units given the nature of job and lack of processing capacities of raw food products • Processing of the raw food articles can help improve the overall value of the product but this will require skilled labour	• Processing can improve the value of the end product and fetch better prices for the food articles in the international market. Investment in training and skilled labour will help achieving the above • Food processing specific training centres can be proposed to be setup for training existing employees • Better synergy between existing colleges/ universities in this sector, industry and Govt. run training centres under NSDC
Value addition activity	• Since majority of industry consists of small units, it is difficult to access advanced technology and machinery. Lack of technology adaption causes low labour productivity and low value additions.	• GoK may consider additional financial scheme to encourage procurement of upgraded machinery, in addition to entry tax exemption (under Integrated Agribusiness Development Policy 2011)
Administrative enhancers		
Quality Control	• The lack of adherence to international food standards and quality norms restricts imports of processed food • The existing Indian standards are outdated and not harmonized with international standards. • Lack of in-house quality control and testing facilities in conformity with the international standards. This is proving to be critical bottleneck in exports of products	• GoK should promote awareness on quality standards needs to be created through seminars, newsletters and training programmes • Food Processing units should be encouraged to implement Standards such as ISO, HACCP etc

Components	Issues	Design Implication
Ease of doing business	• Multiple departments (pollution related, food safety related, labour related) are to be approached for clearances by an industrial unit. Labor issues are also being dealt by different departments • Lengthy process of custom duty clearances taking almost 3-4 days for imports and exports	• Implement actions under KIPP to improve the single window mechanism. ✓ KUM to enhance exiting E-Udyami to include tracking system, helpline, information such as contact details of nodal officers, incentive schemes available, ✓ KUM to appoint dedicated person for each investor to support project clearances and coordinate with line departments

5.3 Implementation of recommendations

In order to build a comprehensive eco- system for the success of proposed industries within the NIMZ, 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 NIMZ guidelines, such as the following:

- 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

6 *Land Use Plan*

6.1 Review of Existing Development Plan

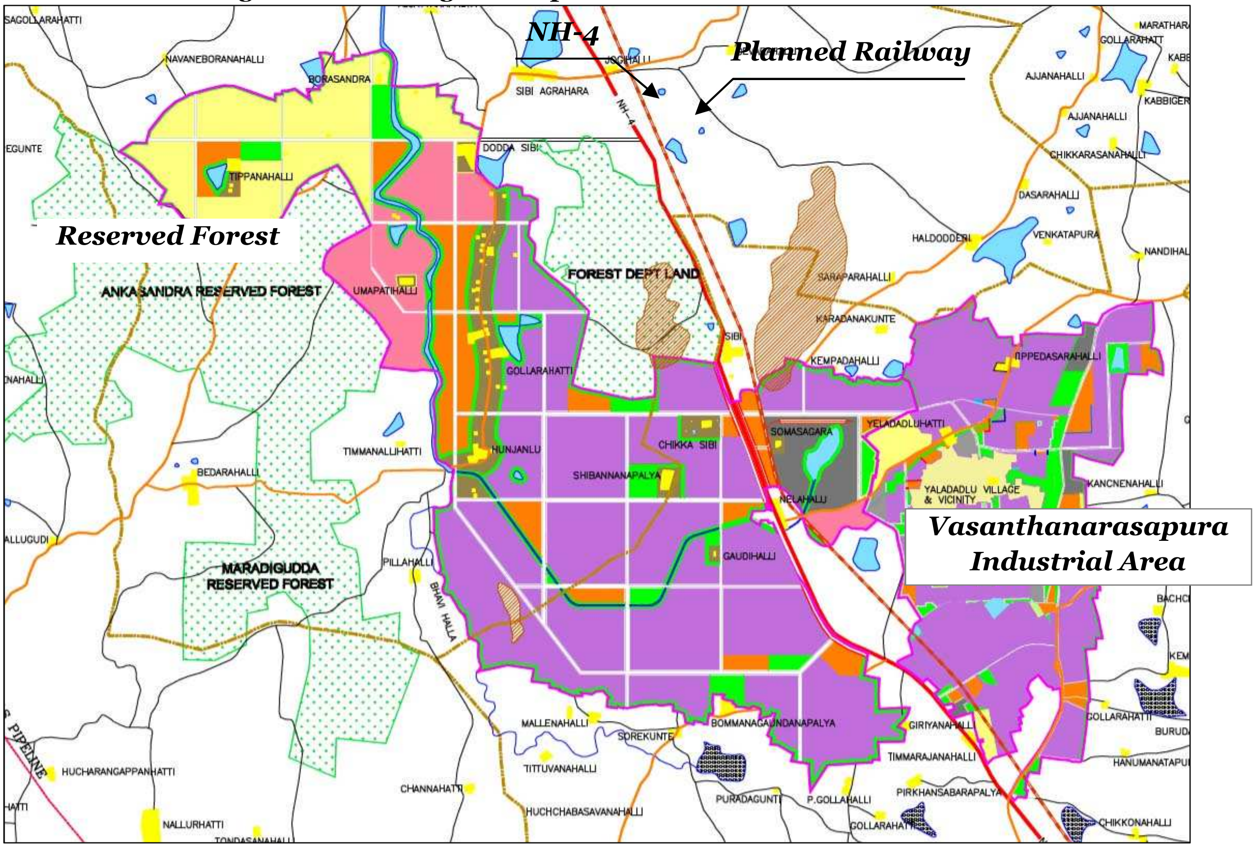
As previously described, the master plan for Tumakuru NIMZ was prepared by KSIIDC. The master plan proposed an inner road network and identified expected industries. The area distribution of expected industries is summarised in the following table and figure:

Table 6.1: Proposed Industrial Area in Techno-Economic Feasibility Report

Industry	Area		Ratio
Engineering Goods	275 ha	680 Acre	30 %
Electronic & Telecom Hardware	223 ha	550 Acre	24 %
Defence & Aerospace	172 ha	424 Acre	19 %
Textile & Clothing	102 ha	252 Acre	11 %
Pharmaceuticals	82 ha	202 Acre	9 %
Plastic & Plastic Products	68 ha	168 Acre	7 %
Total	921 ha	2,276 Acre	100 %

Source: NIMZ Draft Techno-Economic Feasibility Report cum Development Plan by KSIIDC

Figure 6.1 Existing Development Plan for Tumakuru NIMZ



Source: NIMZ Draft Techno-Economic Feasibility Report cum Development Plan by KSIIDC

Further to the existing plan, the following points should also be considered in terms of transportation and land use in order to make the node attractive for foreign investors.

Table 6.2: Items to be considered in Existing Plan

Observation in the Existing Plan	Proposed Revision
Transportation	
• Railway access is planned in the eastern side from NH-4. Outputs from industrial plants in the western side have to cross over NH-4 road to access the railway line.	• Additional railway access has to be planned for the western side to connect to a logistics hub for integrated freight operations. The location for this hub should be identified within the industrial area.
• No trunk road connection to the west (toward Mangalore port) is proposed.	• Road connectivity to SH-84 should be considered.
• No public transport system is proposed.	• A bus system is necessary to transport workers from the proposed railway station to individual factories.
Land Use	
• Residential zones are planned in the western area only (away from the National Highway).	• The southern part of the node is close to the planned railway station and has big potential as a residential area. Some residential areas should be planned near NH-4 considering accessibility to the road.
• Reserved forests are located beyond the western boundary and need to be conserved.	• Residential areas with a buffer zone between industrial zones and reserved forests should be planned. The rich green environment should be utilised for promoting residential developments within environmentally friendly areas.

Source: JICA Study Team

In addition to the items mentioned above, water availability in this area is also important for the development in Tumakuru Node, since currently there is no water treatment facility, reservoir and river. Taking the availability of water into consideration, the feasibility of water consuming industries such as textiles & clothing should be re-considered – existing plans proposed that 11% of the Tumakuru NIMZ area would be occupied by those industries.

6.1.1 Existing Infrastructure Projects

Overview

NH-4, passing through Tumakuru Node in the north-south direction, has already been widened to six-lanes. The development of the new Tumakuru – Davanagere railway line, which will run alongside NH4 and include a station within the node, has also been planned. The existing Vasanthanarasapura industrial area will be developed in three phases from Phase-1 to -3, for which the land acquisition has already been completed by KIADB.

Existing Plan for Vasanthanarasapura Industrial Area

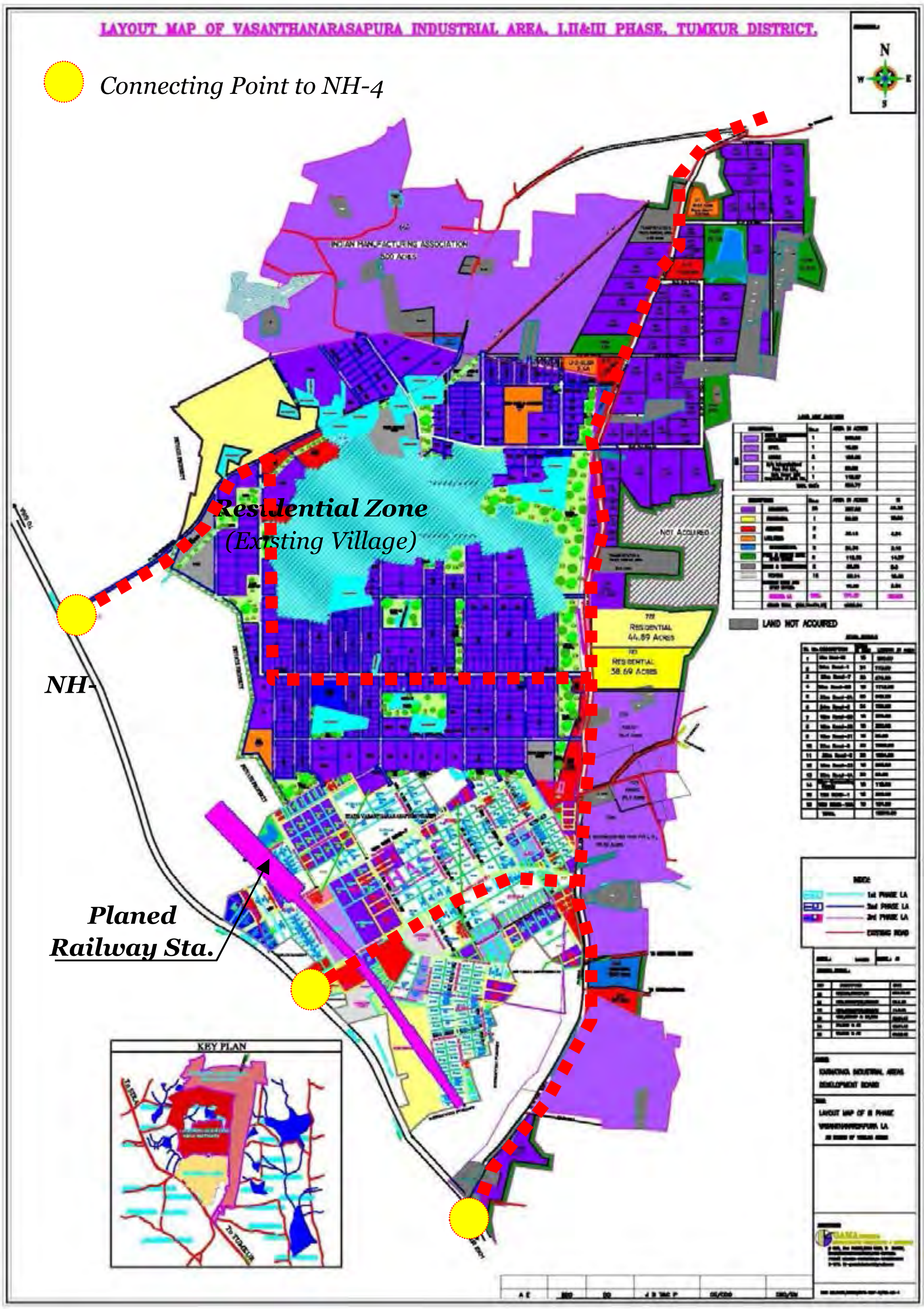
A layout plan for the Vasanthanarasapura industrial area, located on the east side of NH-4, was formulated by KIADB. Some factories of Indian engineering companies and a mega food park have been constructed or are being constructed in this area, according to DPR of Vasanthanarasapura industrial park.

Table 6.3: Land Use of Vasanthanarasapura Industrial Area

No.	Description	Number	Area (Acre)	Ratio (%)
1.	Industrial - Plots	66	358	46
2.	Residential	-	84	11
3.	Amenities & Utilities	5	38	5
4.	Commercial	3	24	3
5.	Parks, Buffer Zones & Open Spaces.	8	112	15
6.	Transportation & Truck Parking.	2	39	5
7.	Roads	16	97	13
8.	Existing Road & Open Spaces	-	20	3
	TOTAL OF GENERAL I.A.		771	100
	GRAND TOTAL (826.77 + 771.27)=		1,598	

Source: KIADB

As illustrated below, connectivity to NH-4 from the east side is planned at three points, although a direct connection to and from the west side of Tumakuru NIMZ wasn't included in the plan.



Source: KIADB

Figure 6.2 Existing/ Proposed Industrial Units in Tumakuru Node

6.2 Development Framework

6.2.1 Land for Infrastructure Development

The target year for completion of the node development is 2033. Taking into account appropriate development scales and after discussions with nodal agencies, JICA Study Team proposes to develop the node in three phases: Phase-A (2016-2019), Phase-B (2020-2024) and Phase-C (2025-2032).

Based on industrial analysis for Tumakuru Node by JICA Study Team, the major future industries are to be traditionally strong industries including “Auto”, “Pharmaceuticals”, “Textile & Apparels”, “Food Processing”, “Computer, electronic and optical products”, and other potential industries. The estimated land demand of those industries was examined and following scenario was considered to be the effective scenario for necessary infrastructure development.

Table 6.4: Land for Infrastructure Development on Tumakuru Node

	Phase A	Phase B	Phase C	Total
Industrial area	1,058	1,854	3,438	**6,350**
Residential area	517	517	517	**1,552**
Existing settlement	110	65	66	**240**
Infrastructure(road & plant)	599	192	353	**1,144**
Water body, green area & others	358	131	320	**809**
Total	**2,643**	**2,759**	**4,694**	**10,096**

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 5.2.1 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 area should be developed in each phase (taking into account the availability of domestic water), with a plan for a final total of280, 000 residents to live in the Node.
- 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 498,365 people with a residential population of 280,000 people in the Tumakuru Node in 2033.

Table 6.5: Population Framework

	Phase A	Phase B	Phase C
Working Population	21,739	86,791	498,365
Residential Population	93,333	186,667	280,000

Source: JICA Study Team

6.3 Land Use Plan

6.3.1 Spatial Development Concept

As shown in Section 5.1, a layout plan for Tumakuru NIMZ including Tumakuru Node was formulated by KIADB. Taking this plan into consideration, JICA Study Team has prepared a new layout plan for Tumakuru Node according to the following development concepts.

1. Road Network

- NH-4 is the main outer trunk road, and will provide logistical connections from/to the external area.
- Connectivity with Mangalore Port will be improved by the new connection to SH-84 from Tumakuru Node. In addition, traffic conditions will be further improved by connecting NH-4 to SH-84 through the node.
- The roads illustrated in red colour in the following figure will be developed as the main inner trunk roads (The roads "1" and "2" will connect Tumakuru Node with Vasanthanarasapura industrial area. The road "3" will connect the northern area of Tumakuru Node with NH-4 and the road "4" will connect Tumakuru Node with SH-84）.
- The intersections of NH-4 and inner trunk roads will be developed as grade separated crossings (in the case of T-shaped intersections, side roads should be designed to connect to the main roads).
- Road alignments will follow natural contour lines as much as possible so that the requirements for excavation and filling will be minimised.

2. Logistics

- The logistics sector (i.e. transport of freight) will be served by developing a new railway access line from the node to connect to the proposed Tumakuru – Davanagere Line.

3. Grid Pattern for the Developable Area

- The whole area will be framed in a grid pattern of roads forming large blocks of 500m-1km size.
- Needful green area will be designed to keep Node area through development of open space with certain ratio in each grid and street trees along the main/sub road.

4. Residential Area Development

- Residential area is proposed along the south-west of node boundary. Extent of residential area is equally distributed in all three phases to ensure a uniform growth. These residential areas are planned based on the following factors.

- *Away from Polluting industries* - Residential area is planned along the boundary to improve the ambience of residence as the rich greenery landscape is naturally present along the node boundary. If it's centrally located, it means the area is surrounded by polluting industries, and cannot provide environmental-friendly area for the residents.

- *Safety* – Container goods will pass frequently through primary industrial area, to avoid conflicts between these freight traffic and domestic traffic; residential areas are planned away from the industrial zone. For this reason, internal bus network system is proposed as shown in Clause 6.1.4.2, instead of "walk to work" concept.

- *Wind Direction* –As the wind predominantly flows from SW to NE and SE to NW, residential areas is planned in the windward region which will ensure fresh air.

- *Reserve Forest* – Proposed residential area in phase 3 will act as a buffer zone between industries and residential area.

- *Cluster Development* - Residential areas are grouped along the node boundary to avoid haphazard development. Cluster development will provide easy access to social facilities such as schools, health centres, commercials, open space etc.

- Economic Development – This group development will reduce the cost of physical infrastructure facilities and increase the value of market price in comparison with scattered development.

- Clustered residential zone will improve the socio-economic activities rather than scattered or haphazard development.

• Residential areas will be developed in Tumakuru Node to support 280,000 people by 2033. Although the current domestic water availability is limited to about 50,000 residents, water for the additional 230,000 residents will be allocated from Tumakuru Urban area in the medium and long-term. Therefore, the scale of residential area is designed for 280,000 residents in total).

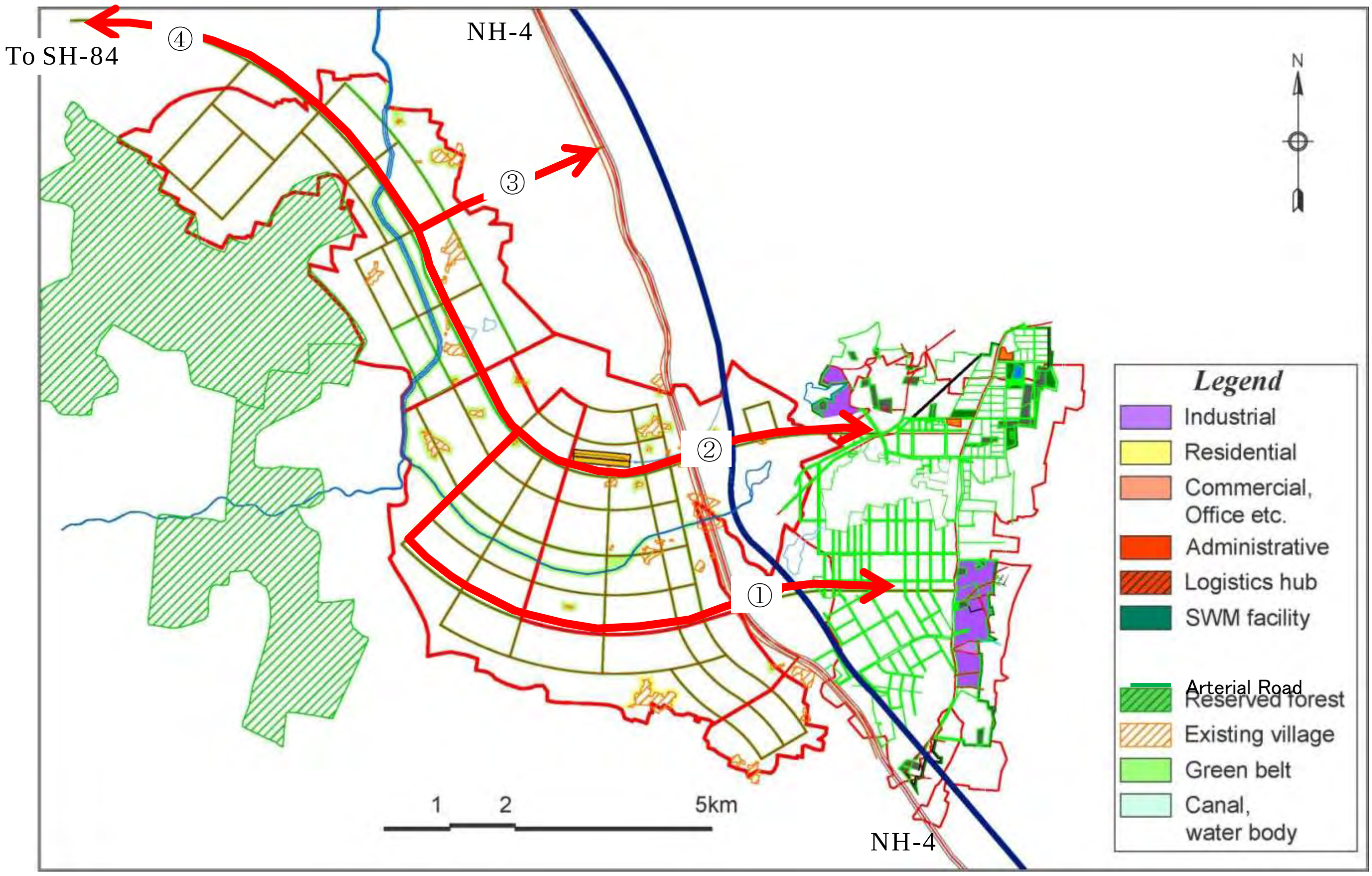
5. Environmental Reservation

• The river with the greenly buffer zone will be conserved.

• New rainwater reservoir and wastewater treatment facilities will be developed in an integrated and consistent manner.

• A reserved forest is located on the western area of Tumakuru Node. The appropriate buffer zone should be allocated around the forest area as per existing guidelines (URDPFI Guidelines 2014, Ministry of Urban Development). The establishment of residential areas alongside the reserved forest area and other green spaces will help realise both the goal of environmental conservation and the requirement of a green environment for residential areas.

Highly hydrophilic parkland with a clean and green environment will be designed by allocation of 100m wide buffer zone along the stream in Tumakuru Node.



Source: JICA Study Team

Figure 6.3: Road Network Concept of Tumakuru Node

6.3.2 Land Use and Phasing Plan

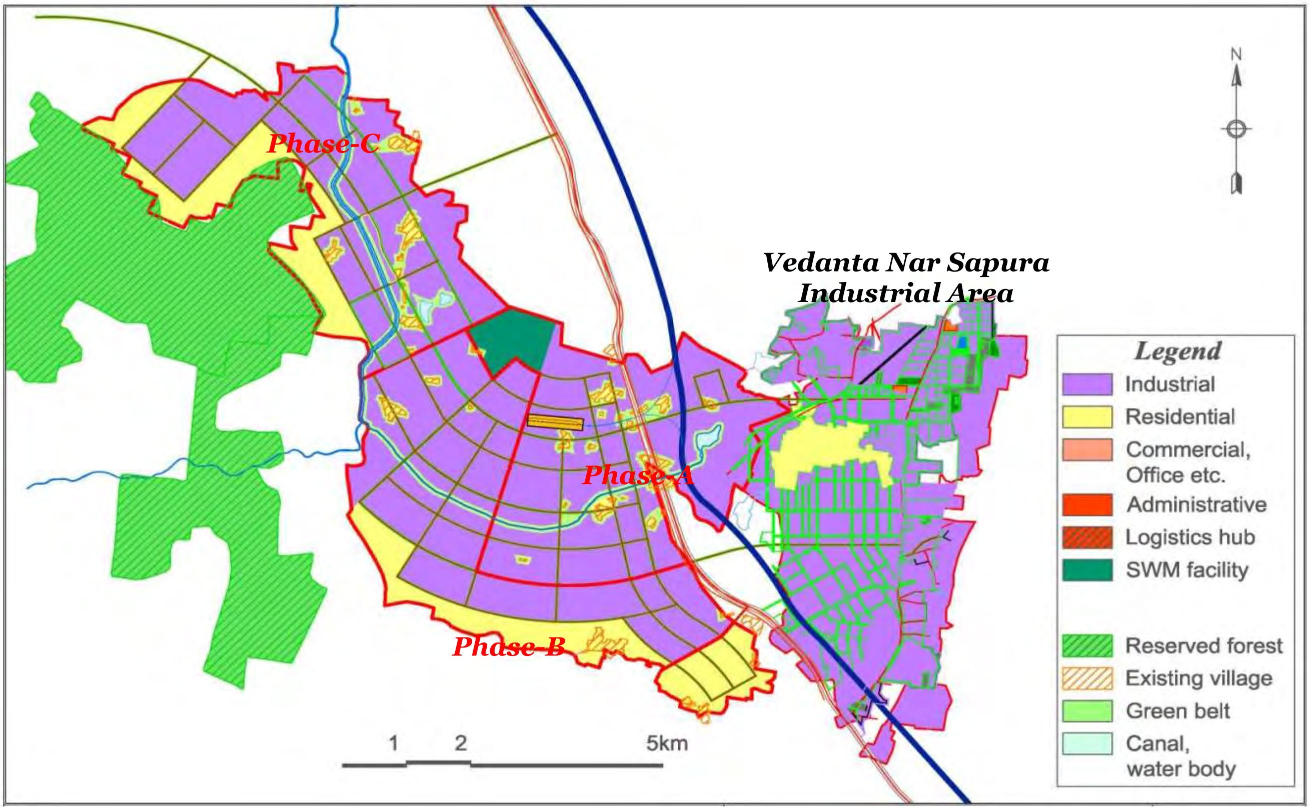
Based on the development framework and the development concept above, the required area for each land use category is estimated as shown in the following table.

Table 6.6: Proposed Area by Land Use in Tumakuru Node

No.	Item	Area		Remarks
1	Industrial Area	2,570.0ha	6,350Acre	5% of open space should be included
2	Existing Residential Area	97.3ha	240Acre	
3	Residential Area (Including Commercial Facilities and Social Facilities)	614.2ha	1,518Acre	
4	River & Buffer Zone	324.5ha	802Acre	
5	Solid Waste Management Facilities	72.3ha	179Acre	
6	Logistic Hub (Railway)	16.7ha	41Acre	
7	Arterial Road	390.7ha	965Acre	
	Total	4,086.0 ha	10,096Acre	

Source: JICA Study Team

Considering accessability to NH-4 and topographic conditions, the following phased developments are proposed.



Source: JICA Study Team

Figure 6.4: Phasing Plan

6.4 Development Plan for Residential Area

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

Table 6.7: Specification of Housing Building

Item		Amount
Planed Population		280,000 persons
Household Member	➢ National Family health survey (NFHS) 2007	4.6 persons/family
Number of families (2033)	➢ Population /4.6 (HM)	60,870 families
Specification of residence	➢ Land per one housing	39 m²
	➢ Total floor area per one housing	372 m²
	➢ Total floor area of all housing unit	1,115 m²
	➢ Number of housings	2,536
	➢ Total residential area	2,693,986 m²
	➢ Open space (15%)	400,000 m²
	➢ Internal main road (10%)	309,800 m²
Total		**3,407,900 m²**

Source: JICA Study Team

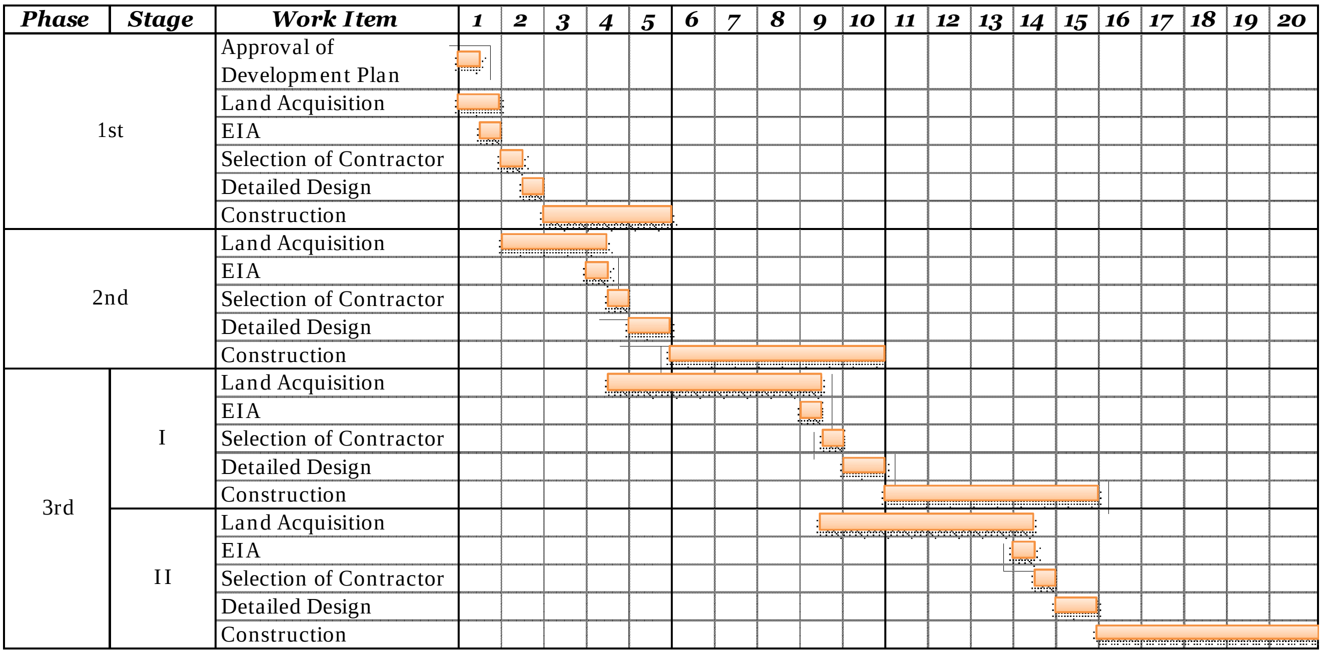
In addition to the residential area above, the number and required area for necessary public facilities (e.g. educational facilities, health centers, offices, civic center etc.) are estimated based on the residential population and "National Building Code of India". The estimated results indicate that the minimum requirement is a total of 180 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 (Playground)

6.5 Implementation Plan (Development Schedule)

Tumakuru 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 proposed phasing plan and identified work items and volumes.

Table 6.8: Implementation Plan (in year)



Source: JICA Study Team

6.6 Cost Estimate

6.6.1 Land Development

Land development for Tumakuru Node will require only land grading works and will not require any additional soil to be obtained from outside the node, since the node is located in an elevated area. It means the land development cost will be relatively low compared to areas of low elevation. The total land development cost is estimated as **INR 3,985 million and** the cost in each phase are shown below.

Table 6.9: Cost Estimate of Land Development (Tumakuru Node)

Item	Description		Unit	Unit Rate	Phase 1(2014-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
					Quantity	Cost	Quantity	Cost	Quantity	Cost	
				(INR)		(INR Lakh)		(INR Lakh)		(INR Lakh)	(INR Lakh)
LAND DEVELOPMENT WORKS											
Land Development Works	Excavation	1m per 1 sq.m on half of site	cu.m	120	2,140,787	2,569	3,757,506	4,509	6,956,546	8,348	15,426
	Soil Transportation & Embankment	1m per 1 sq.m on half of site	cu.m	190	2,140,787	4,067	3,757,506	7,139	6,956,546	13,217	24,424
Total					4,281,574	6,636	7,515,012	11,648	13,913,092	21,565	39,850

Source: JICA Study Team

6.6.2 Housing Development

Based on the proposed plan for housing development, total development cost including construction of housing buildings, pavements and open space is estimated as **INR 34,517 million**. The details are shown as below:

Table 6.10: Cost Estimate for Housing Development Plan

Item	Description	Unit	Unit Rate	Phase 1(2014-2019)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
				Quantity	Cost	Quantity	Cost	Quantity	Cost	
			(INR)		(INR Lakh)		(INR Lakh)		(INR Lakh)	(INR Lakh)
Cost of Housing Area Construction										
Residential Area Development	Housing	sq.m	12,163	942,895	114,689	942,895	114,689	942,895	114,689	344,066
	Open Space	sq.m	63	583,721	369	583,721	369	583,721	369	1,108
Total				1,526,616	115,058	1,526,616	115,058	1,526,616	115,058	345,174

Source: JICA Study Team

6.6.3 Public Facility Development

Based on the proposed plan for public facilities, total development cost including construction of hospital, commercial centres, sport ground, schools, and fire station is estimated as **INR 14,098 million**. The details are shown below:

Table 6.11: Cost Estimate for Public Facilities Development Plan

Item	Description	Unit	Unit Rate	Phase 1(2014-2019)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
				Quantity	Cost	Quantity	Cost	Quantity	Cost	
			(INR)		(INR Lakh)		(INR Lakh)		(INR Lakh)	(INR Lakh)
Cost of Public Facilities Construction										
Public Facilities	Construction of Public Facilities	sq.m	12,163	385,402	46,878	385,402	46,878	385,402	46,878	140,635
	Open Space	sq.m	63	186,667	118	186,667	118	186,667	118	354
Total				572,069	46,996	572,069	46,996	572,069	46,996	140,989

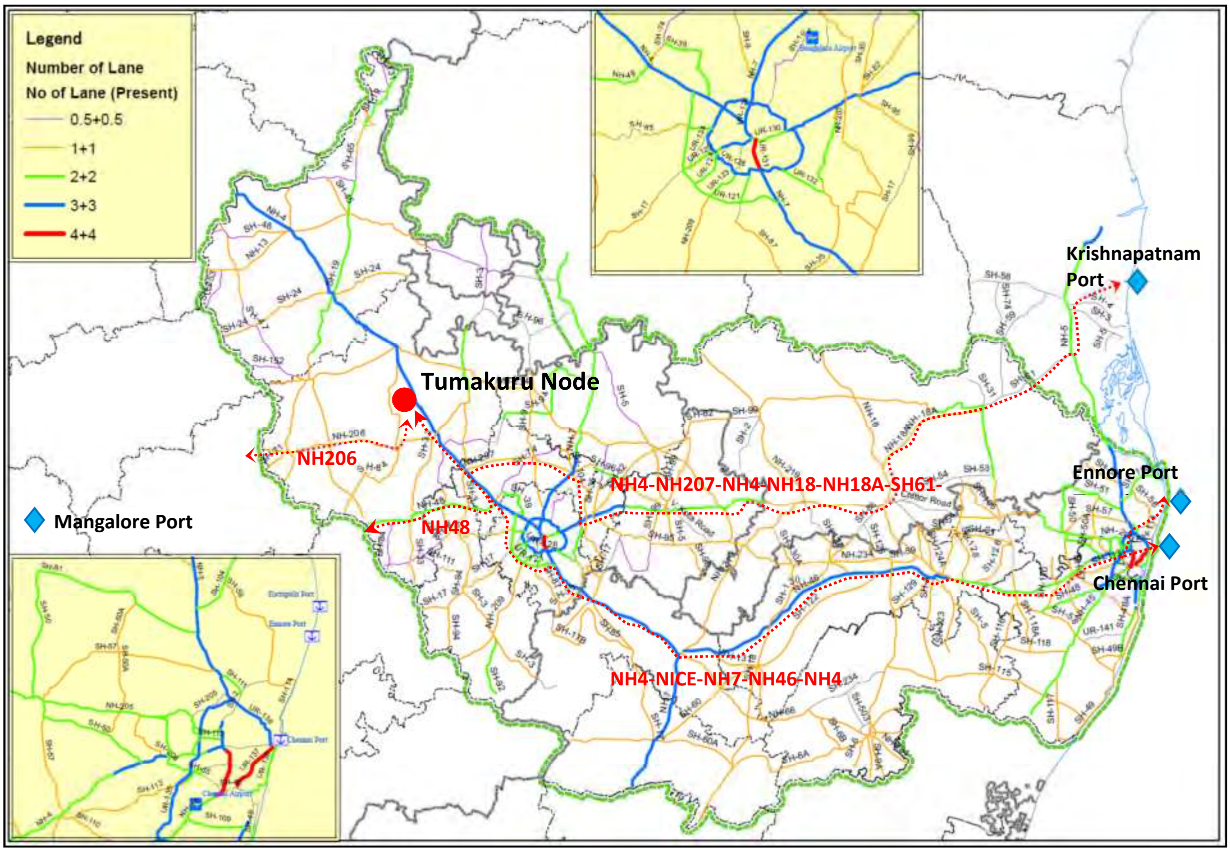
Source: JICA Study Team

7 Infrastructure Development Plan

7.1 Roads & Public Transport

7.1.1 Sector Overview

Major industrial linkage to/from Tumakuru node will be developed with Bengaluru, Chennai, Chennai Port, Ennore Port, Krishnapatnam Port, and Mangalore Port and corresponding roads to the linkages are delineated as shown in Figure below. Present roads have four or six lanes on linkages with Bengaluru, Chennai, and Chennai Port. However, there are some sections which are given only two lanes on linkages with Krishnapatnam Port and Mangalore Port.



Source: JICA Study Team

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

Linear distances from Tumakuru nodes to major destinations which are related to industrial activities of Tumakuru nodes are summarized in Table below.

Table 7.1: Distance from Nodes

From	Tumakuru Node			
To /Linear Distance(km)	Bengaluru	86	Ennore Port	352
	Chennai	354	Krishnapatnam Port	343
	Tumakuru	19	Mangalore Port	250
	Chennai Port	359		

Source: JICA Study Team

Land demands and population demands of Tumakuru Node in three phases are forecasted by the JICA Study Team as shown in Table 6.4 and Table 6.5, respectively.

"Development of NIMZ at Tumakuru, Karnataka, and Techno-Economic Feasibility Report cum Development Plan" (F/S) was prepared by KSIIDC. In the F/S, development of three intercity roads of NH48, NH206, and SH71 are proposed. These development projects aim to connect external linkage with Mangalore Port. The F/S also propose internal road network with two type of road width (60m, 45m) and crossing structures on NH4. Planning concept of road hierarchy and level of road density are not clearly mentioned in the F/S.

Development issues are selected with consideration of development vision discussed in Chapter 5.3 and envisioned future road and traffic conditions of Tumakuru 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.)

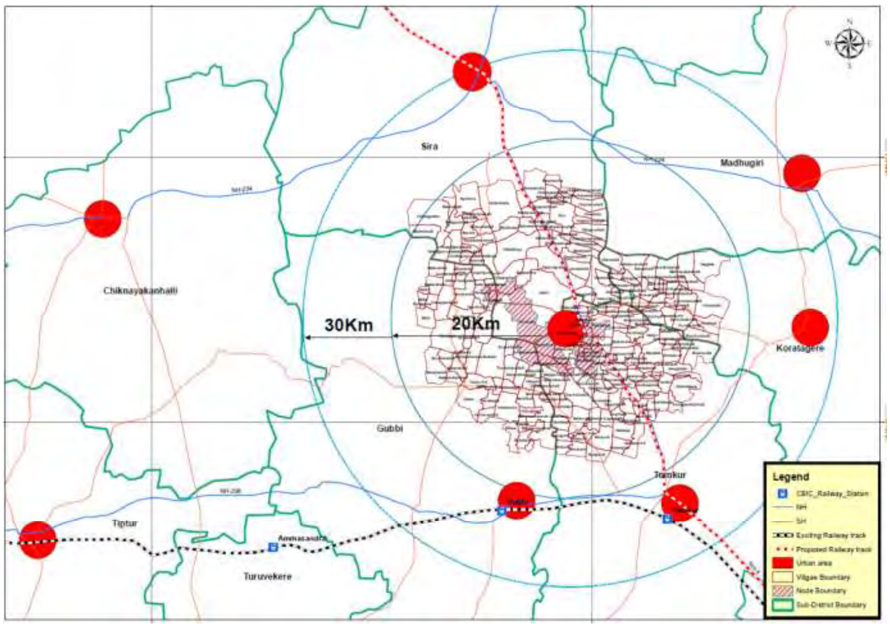
⑦ Estimation of peak hour pcu traffic volume by traffic mode and access points

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 neighboring sub-district in considering of urbanization trend and population frame of sub-districts. Sub-district within about 50km from node center is selected for the distribution. Urbanization trend and the distribution result to sub-district are shown in Figure 7.3 and Table 7.2, respectively.



Source: JICA Study Team

Figure 7.3: Envisaged Direction of Urbanization

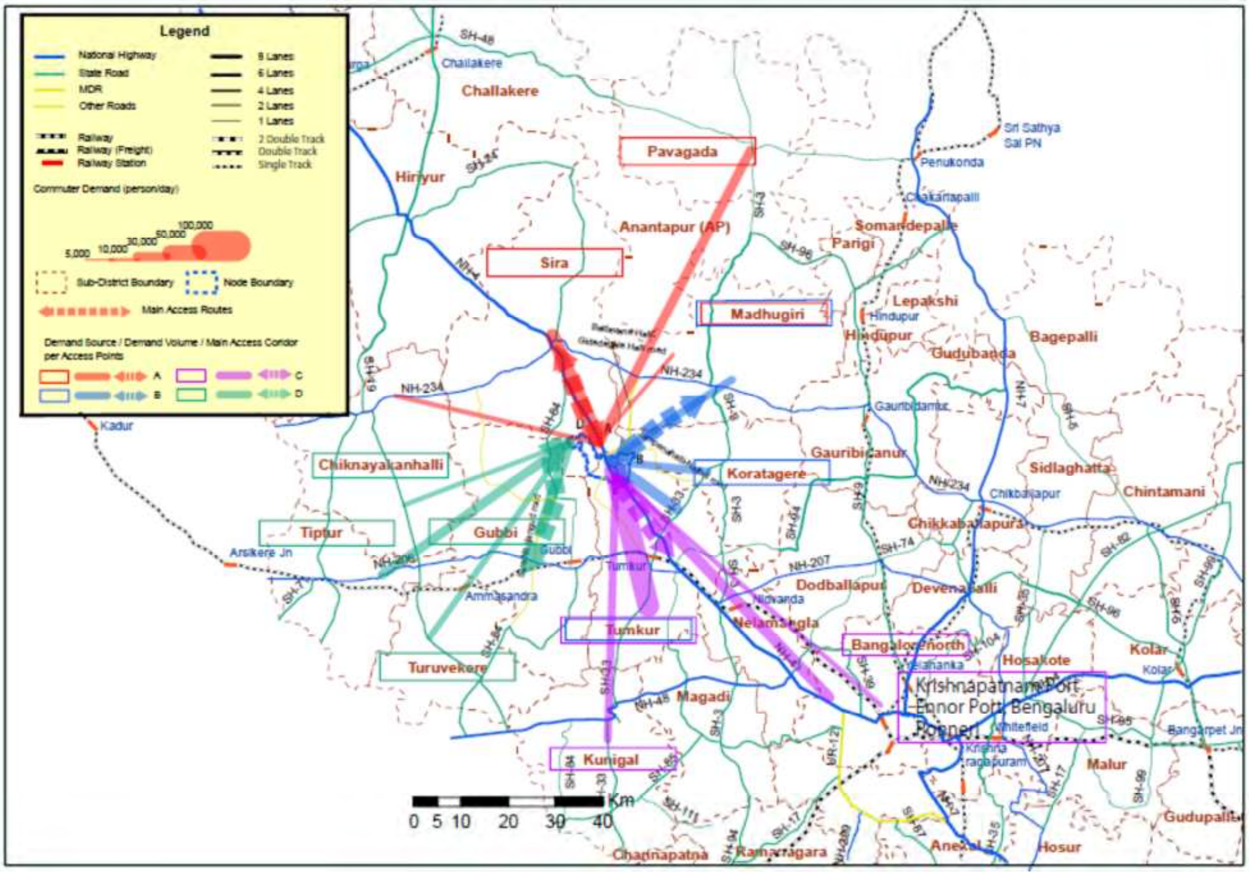
Table 7.2: Distribution of Node Employee to Vicinal Sub-Districts

Item			**Unit**	**Year**		
				2019	2024	2034
Area	Residential		Acre	517	1,035	1,552
	Whole		Acre	1,576	3,947	7,902
Population	Residential		person	93,333	186,667	280,000
	Employee (Res.)		person	41,067	82,133	123,200
	Employee (Non-Res.)	**Sub-Districts**				
		Tumakuru	person	17,600	44,084	88,264
		Sira	person	7,515	18,824	37,688
		Gubbi	person	6,085	15,241	30,515
		Madhugiri	person	5,988	14,998	30,029
		Koratagere	person	4,024	10,080	20,182
		Chiknayakanhalli	person	4,776	11,962	23,950
		Pavagada	person	5,333	13,359	26,747
		Tiptur	person	5,188	12,995	26,017
		Turuvekere	person	3,467	8,683	17,385
		Kunigal	person	4,485	11,234	22,491
		Bengaluru	person	10,348	25,920	51,896
	Employee total		person	115,874	269,513	498,365

Source: JICA Study Team

② Identification of Node Access Points

Four node access points (A to D) are identified based on sub-districts which are distributed node commuter, existing roads and rail, and land use plan in node as shown in Figure below. Colored solid lines express commuter volume between sub-district and node. Colored dotted line shows access route from sub-districts to access points.



Source: JICA Study Team

Figure 7.4: Identification of Node Access Point

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

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

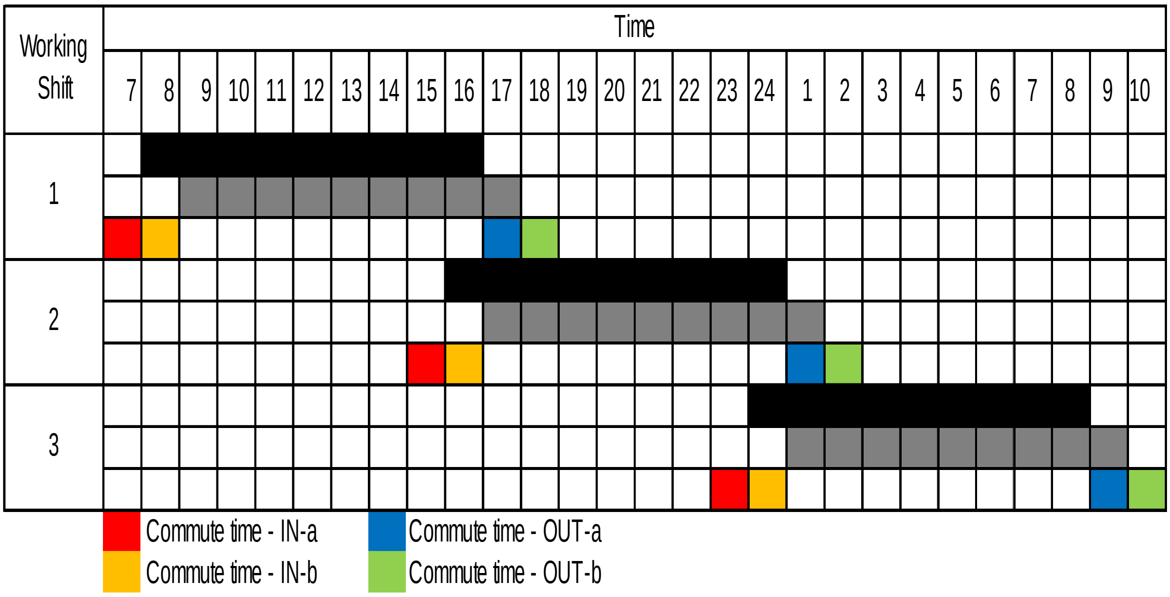
Table 7.3: Grouping of Node Employee by Access Points

Sub-District	Year											
	2019				2024				2034			
	A	B	C	D	A	B	C	D	A	B	C	D
Tumakuru		5,867	11,733			14,695	29,389			29,421	58,843	
Sira	7,515				18,824				37,688			
Gubbi				6,085				15,241				30,515
Madhugiri	1,996	3,992			4,999	9,999			10,010	20,019		
Koratagere		4,024				10,080				20,182		
Chiknayakanhalli	2,388			2,388	5,981			5,981	11,975			11,975
Pavagada	5,333				13,359				26,747			
Tiptur				5,188				12,995				26,017
Turuvekere				3,467				8,683				17,385
Kunigal			4,485				11,234				22,491	
Bengaluru			10,348				25,920				51,896	
Total	17,232	13,882	26,566	17,127	43,163	34,773	66,543	42,900	86,420	69,622	133,230	85,893
	74,807				187,380				375,165			

Source: JICA Study Team

④ *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 7.5. 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 7.5: Proposed Work Time Zones

Table 7.4: Number of Node Employee in Peak Hour

Year											
2019				2024				2034			
A	B	C	D	A	B	C	D	A	B	C	D
2,872	2,314	4,428	2,854	7,194	5,796	11,090	7,150	14,403	11,604	22,205	14,316

Source: JICA Study Team

⑤ 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.

⑥ 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 below.

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

⑦ 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 7.6: 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 6.2.4 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 6.2.4 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 below.

Table 7.6: Annual Cargo Volume by Access Point

Categories	Origin / Destination	Access Point	Year			
			2019	2024	2029	2034
INBOUND CONTAINER	Ponneri	C	518	890	1,528	2,624
OUTBOUND CONTAINER	Ennor Port	C	625	1,073	1,843	3,165
	K. Port	C	625	1,073	1,843	3,165
	Chennai	C	774	1,329	2,282	3,918
EMPTY CONTAINER	Bengaluru	C	1,506	2,586	4,440	7,624
INBOUND BULK	Local	C	55,167	94,732	162,671	279,336
	Bengaluru	C	138,806	238,354	409,298	702,837
OUTBOUND BULK	Local	C	56,535	97,082	166,707	286,265
	Bengaluru Airport	C	7,340	12,604	21,643	37,164

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 the table below.

Table 7.7: Peak Hour Cargo Volume by Access Point

Categories	Unit	Year											
		2019				2024				2034			
		A	B	C	D	A	B	C	D	A	B	C	D
Container	TEU/hour	0	0	2	0	0	0	3	0	0	0	8	0
Bulk	ton/hour	0	0	50	0	0	0	85	0	0	0	251	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 the table below.

Table 7.8: Traffic Parameters

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

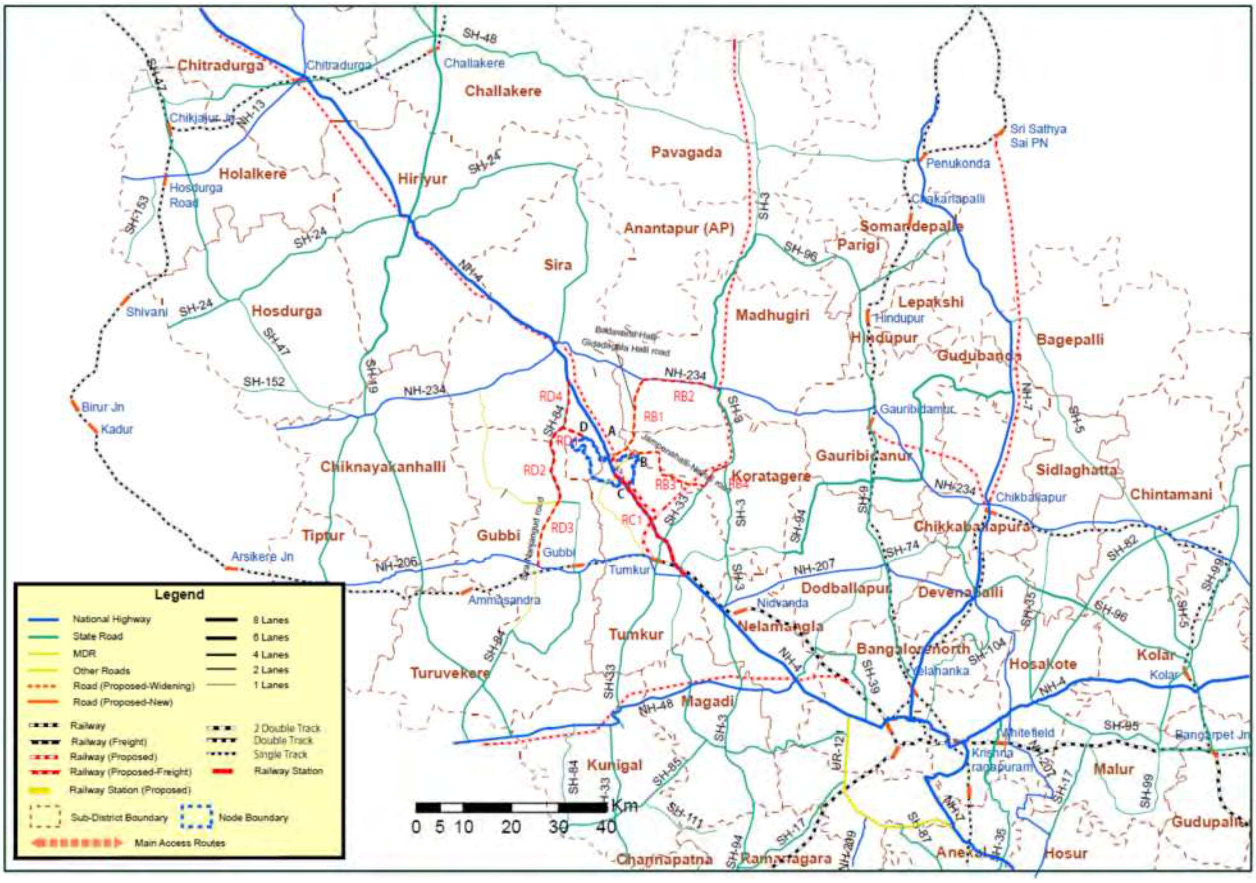
Source: JICA study team

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 point.

- **Assumed Access Infrastructure to Node**

Main access roads connecting between the node and sub-districts which provide node commuters and access points are selected from existing roads with proposed new roads as shown in Figure below. RB1 to RB4 are access route for access point B, RC1 is access route for access point C, and RD1 to RD4 are access route for access point D.



Source: JICA Study Team

Figure 7.7: Access Roads to Tumakuru Node by Access Points

Road capacity of the main access roads is estimated as shown in the table below. Following link capacity (DSV – LOS-B) of 1, 2, and 4 (Dual-2 - 2x2), 6 (Dual-3 - 2x3), and 8 (Dual-4 - 2x4) lanes road facilities are considered for assessing the traffic on a link/section:

- T1 – 1,800 PCUs
- T2 – 17,500 PCUs
- T4 – 45,000 PCUs
- T6 – 60,000 PCUs
- T8 – 85,000 PCUs

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 50% for access point A and C, 25% for access point B and D 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	6	60,000
B	RB1	Existing	2	17,500
	RB2	Existing	2	17,500
	RB3	Existing	1	1,800
	RB4	Existing	2	17,500
C	RC1	Existing	6	60,000
D	RD1	Proposed	-	
	RD2	Existing	2	45,000
	RD3	Existing	2	17,500
	RD4	Existing	2	17,500

Source: JICA study team

Railway capacity of main access route is set as shown in the table below. As for the share of passenger traffic which is not related to node on public transport is assumed to be 25% in consideration of node location on public transport network.

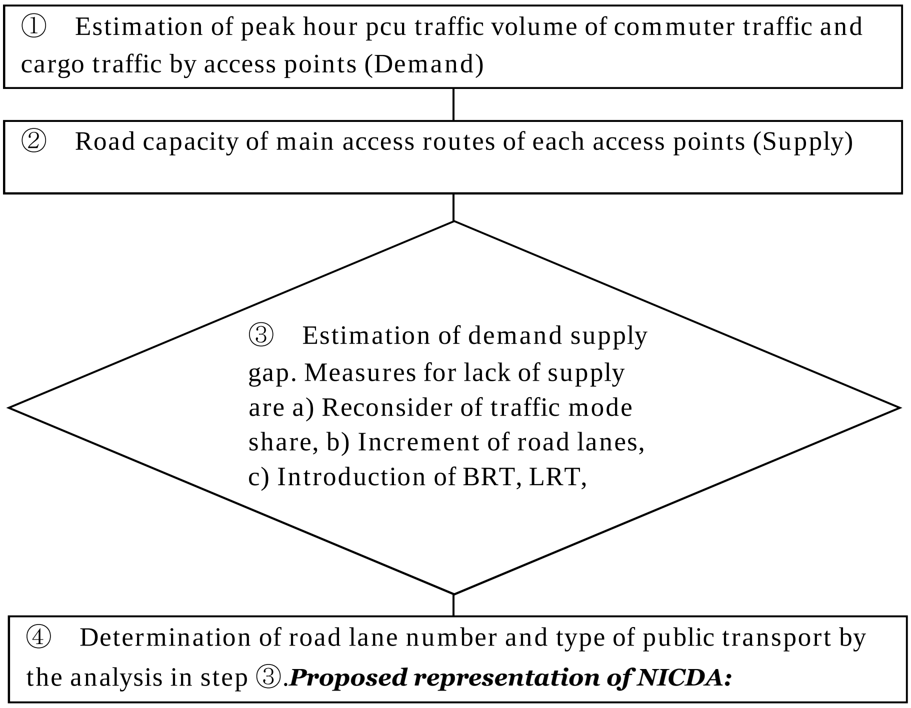
Table 7.10: Capacity and Cost of Public Transport

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 analyzed in accordance with the work flow shown in Figure 7.8.



Source: JICA Study Team

Figure 7.8: 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 for main access routes which do not satisfy demand as noted in Figure 7.8. As a result, introduction of railway is proposed as an access route to access point C. Although its V/C is estimated to be 1.79 in long term under 8 lanes road capacity without introduction of public transport, development of more than 8 lanes road is not realistic. Commuter demand of public transport at access point C is 6,661 pcd/hour, and this demand is possible to be accommodated by railway in accordance with Table 7.10. Double tracking from a single track between Tumakuru and the node is proposed in the long term by this plan. 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	2019 A	2019 B	2019 C	2019 D	2024 A	2024 B	2024 C	2024 D	2034 A	2034 B	2034 C	2034 D
1	Modal Share														
	M/C	%		20	20	20	20	10	10	10	10	20	20	15	20
	Car	%		20	20	20	20	20	20	20	20	20	20	15	30
	Bus	%		60	60	60	60	70	70	70	70	60	60	40	50
	Railway	%		0	0	0	0	0	0	0	0	0	0	30	0
2	Converted Commuter Traffic Volume														
	M/C	pcu/hour		239	193	369	238	300	241	462	298	1,200	967	1,388	1,193
	Car	pcu/hour		287	231	443	285	719	580	1,109	715	1,440	1,160	1,665	2,147
	Bus	pcu/hour		86	69	133	86	252	203	388	250	432	348	444	358
	Railway	train/hour	2000 commuter /train	0	0	0	0	0	0	0	0	0	0	3	0
3	Converted Cargo Traffic Volume														
	Trailer	pcu/hour		0	0	7	0	0	0	12	0	0	0	35	0
	Truck	pcu/hour		0	0	149	0	0	0	255	0	0	0	753	0
4	Number of Lanes														
	Road			6	4	6	2	6	4	6	4	6	4	8	6
5	Capacity														
	Road	pcu/day	One direction	60,000	45,000	60,000	17,500	60,000	45,000	60,000	45,000	85,000	45,000	85,000	60,000
	Road	pcu/hour	peak ratio: 0.1	6,000	4,500	6,000	1,750	6,000	4,500	6,000	4,500	8,500	4,500	8,500	6,000
	Road	pcu/hour	Occupancy ratio: 0.5(A,C) 0.25(B,D)	3,000	3,375	3,000	1,313	3,000	3,375	3,000	3,375	4,250	3,375	4,250	4,500
	Railway	train/hour		0	0	0	0	0	0	0	0	0	0	5	0
	Railway	train/hour	Occupancy	0	0	0	0	0	0	0	0	0	0	4	0

No.	Mode	Unit	Remarks	Year											
				2019				2024				2034			
				A	B	C	D	A	B	C	D	A	B	C	D
			ratio: 0.25												
6	Demand Supply Gap (V/C)														
	Roads			0.20	0.15	0.37	0.46	0.42	0.30	0.74	0.37	1.02	0.73	1.01	0.82
	Railway			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00

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.

- *<u>Efficient and Stable Infrastructure</u>*
- *One Stop Service*
- *Quick and Easy Trouble Shooting*
- *Special Incentives*
-

Energy conservation and environmental conservation have been common global issues of development and technical innovation, especially IT technology, advanced eco-friendly technologies have been introduced into development. Concept of "Smart 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 smart city development in Transport sector is also proposed in Table 7.13.

Table 7.12: Three Pronged Approach of Smart 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 Smart 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 Tumakuru Node are about 11km and about 11km, respectively. 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 a station of public transport are important issues 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 of 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 known as an effective method of 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 and between industrial zone and logistic centre, 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 no 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 non-motorized vehicle and pedestrian traffic as well as roadside no 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.

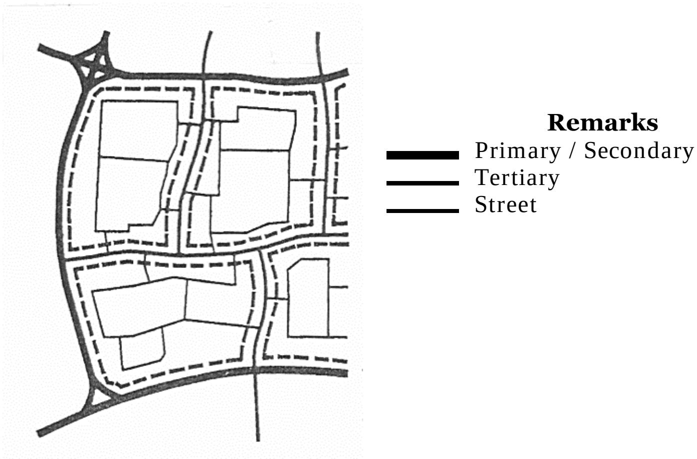
Table 7.14: Example of Target Road Density in Urban Area

Land Use	Target Road Density (km/km²)
Residential	4
Commercial	6
Semi-Industrial	2
Industrial	1

Source: Ministry of Construction, Japan.

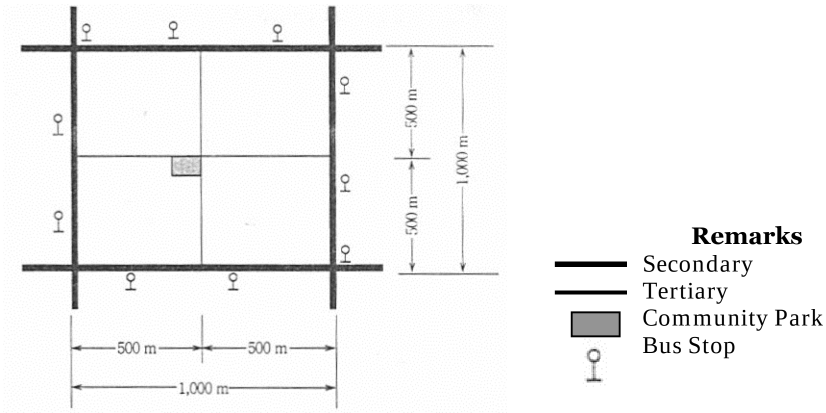
- ## Road Network by Grid Pattern

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 7.9 shows basic concept for establishment of road network pattern with kind of road hierarchy. Hence area which is surrounded by the road is formed as a community block; scale and shape of the block are considered on the road network establishment.



Source: JICA Study Team

Figure 7.9: Industrial and Urban Road Hierarchy

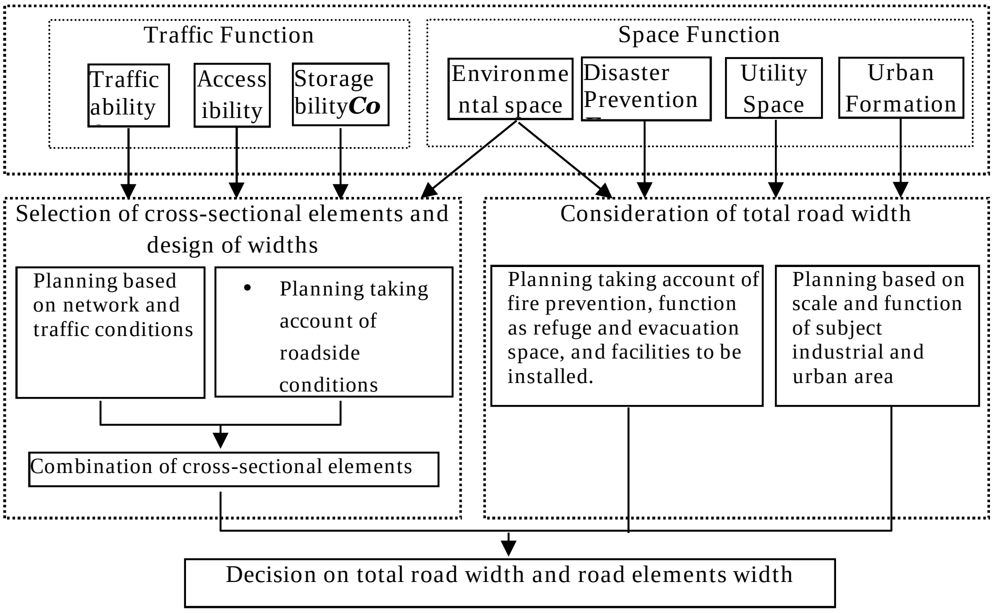


Source: JICA Study Team

Figure 7.10: 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 7.11: 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 comfortableness 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.

Planted Strip: A planted strip is a part of a sidewalk, providing aesthetic elements and serving as a 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 the table below 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, grade 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 70 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.

Table 7.16: Integrated Traffic Control System

Source: Okinawa Prefectural Police HP

- ## 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 install 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

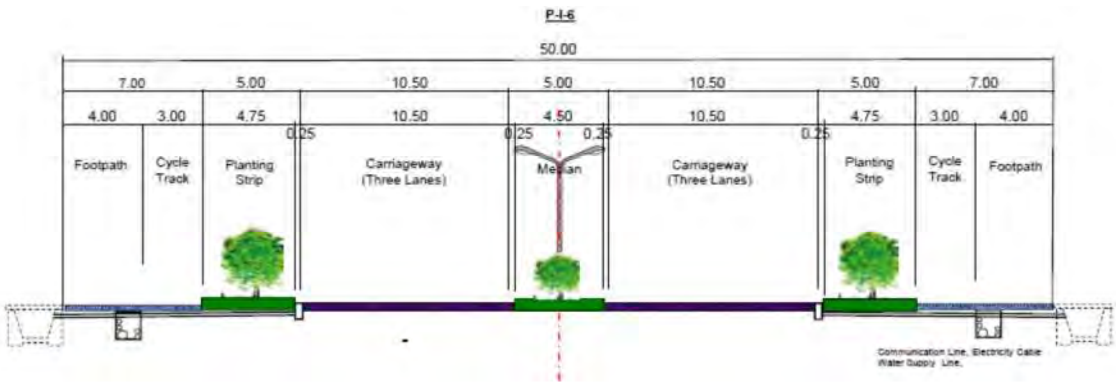
Proposed elements of typical cross sections in this plan are shown in Table 7.17 and Figure 7.12 to Figure 7.29. Figure 7.13, Figure 7.16, and Figure 7.19 show typical cross sections of primary road in a transitional period. Transitional typical cross sections aim to secure land for widening and efficient 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 7.17: Elements of Proposed Typical Cross Sections

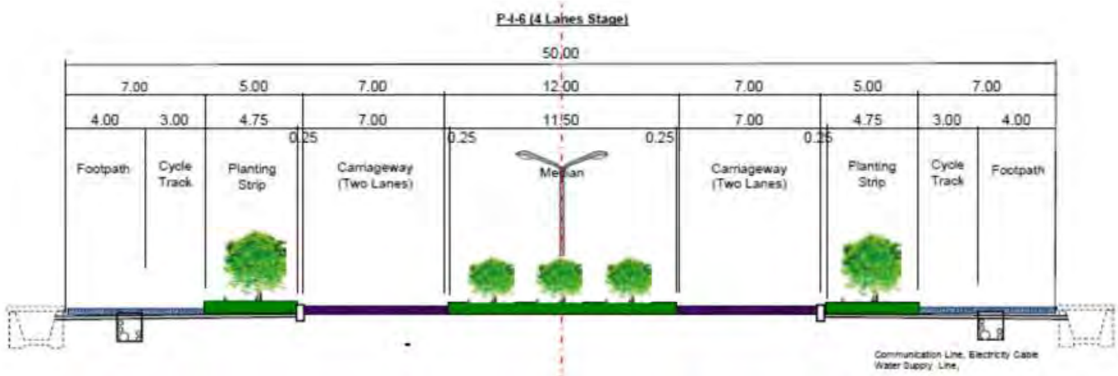
Classification	Type	Earthwork Section																	
		Foot Path	Planting Strip	Parking	Cycle Track	Service Road	Marginal Strip	Planting Strip	traveled way	median	traveled way	Planting Strip	Marginal Strip	Service Road	Cycle Track	Parking	Planting Strip	Foot Path	Total
Primary	P-I-6	4.00	0.00	0.00	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



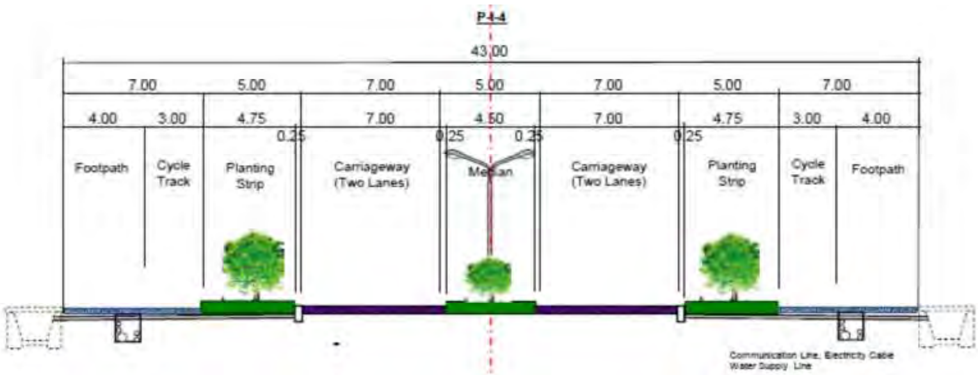
Source: JICA Study Team

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



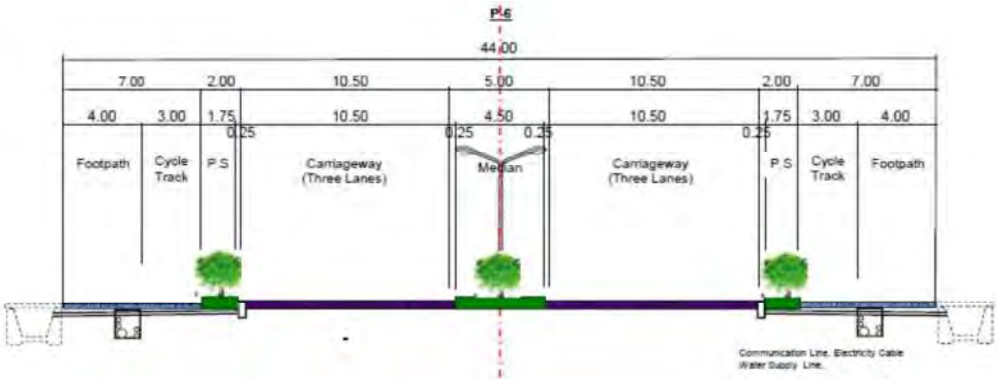
Source: JICA Study Team

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



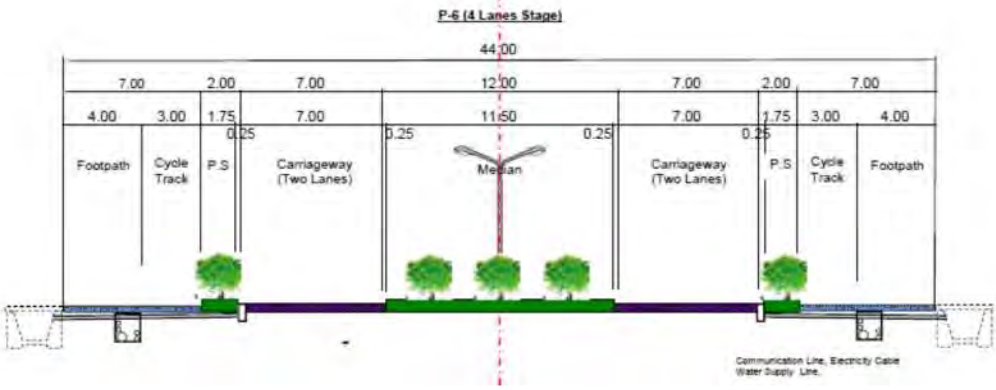
Source: JICA Study Team

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



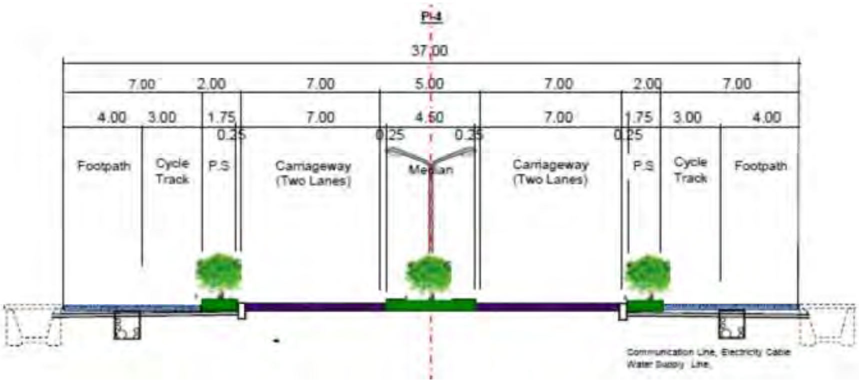
Source: JICA Study Team

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



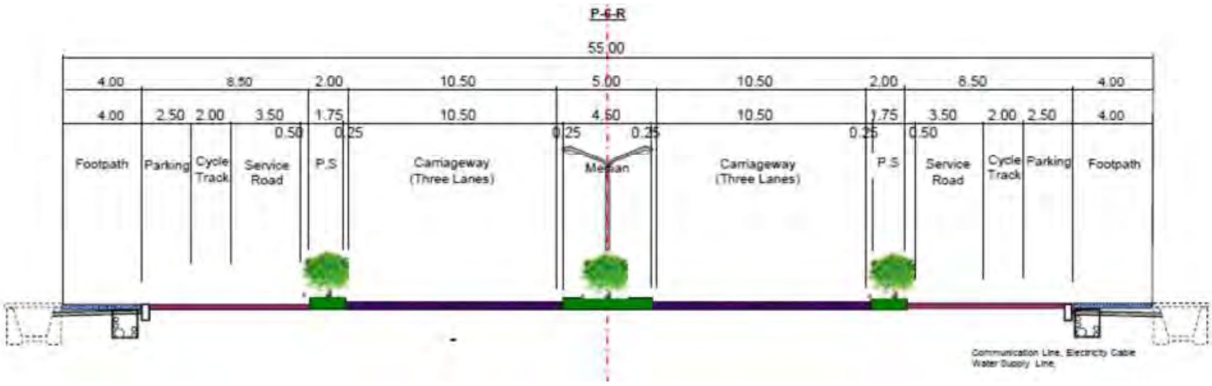
Source: JICA Study Team

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



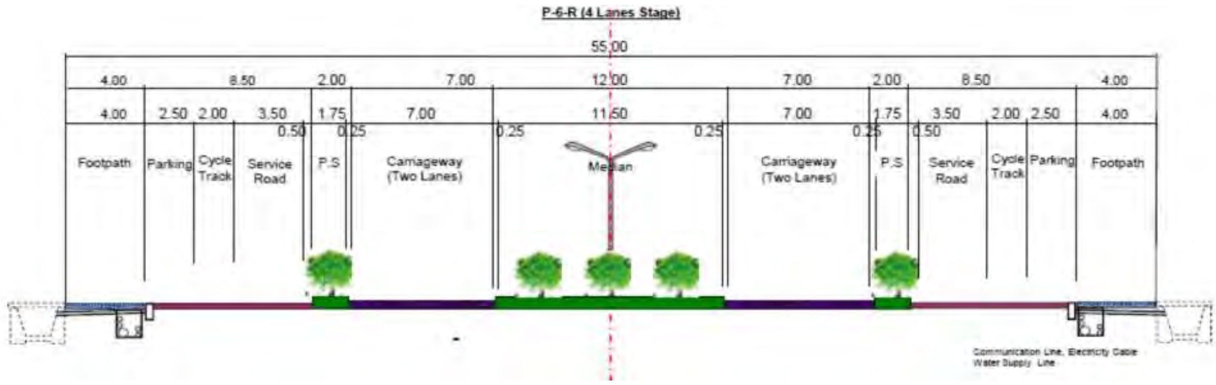
Source: JICA Study Team

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



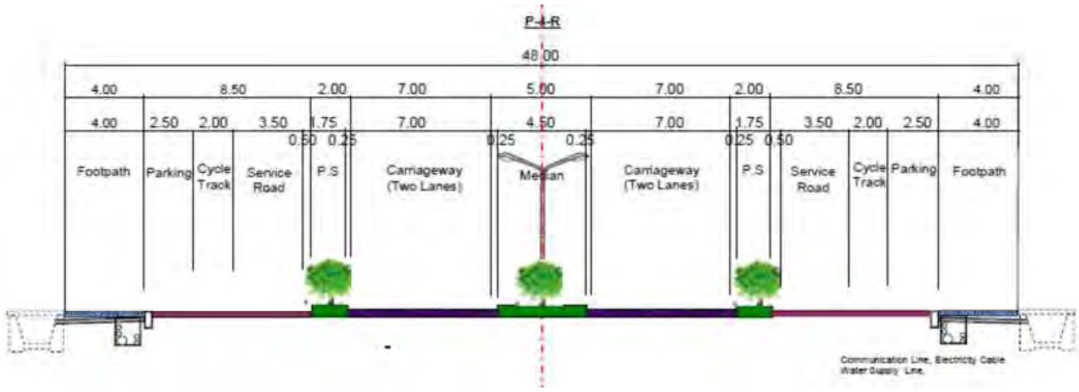
Source: JICA Study Team

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



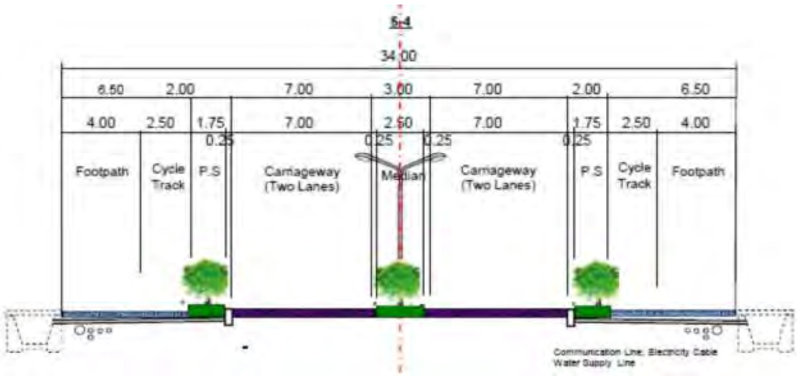
Source: JICA Study Team

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



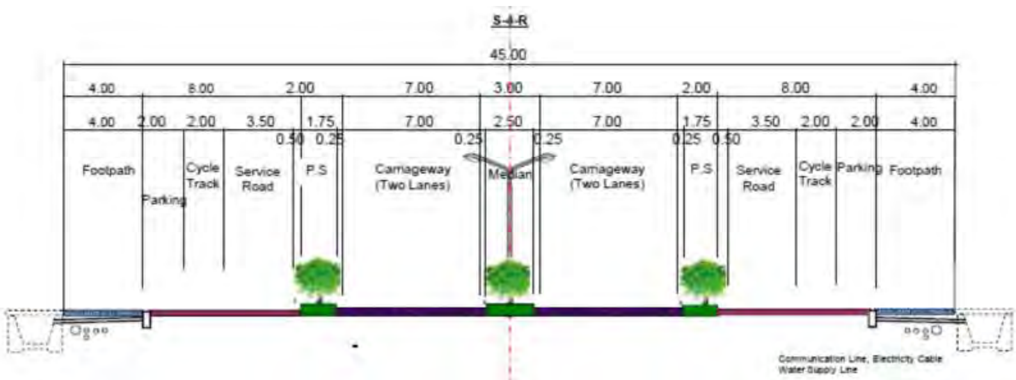
Source: JICA Study Team

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



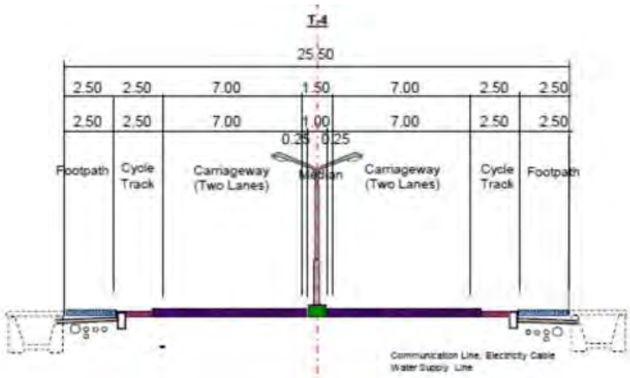
Source: *JICA Study Team*

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



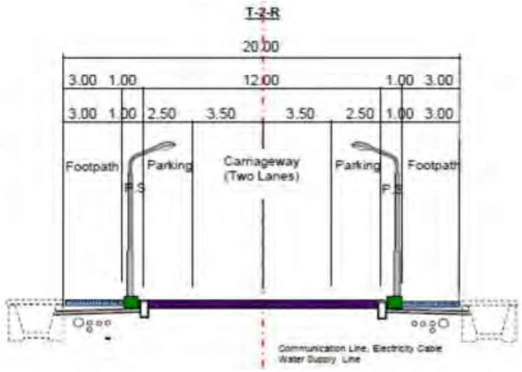
Source: *JICA Study Team*

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



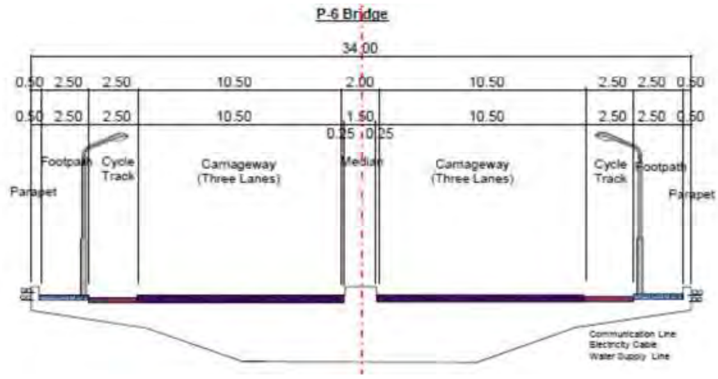
Source: *JICA Study Team*

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



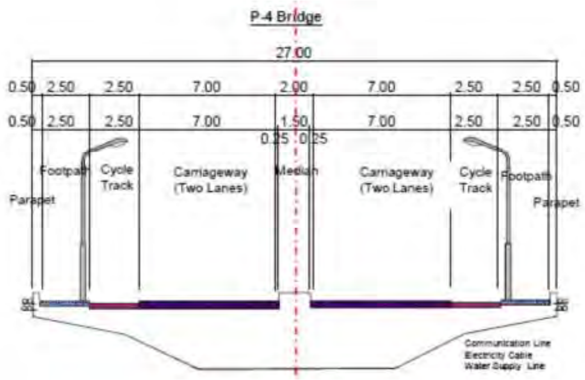
Source: *JICA Study Team*

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



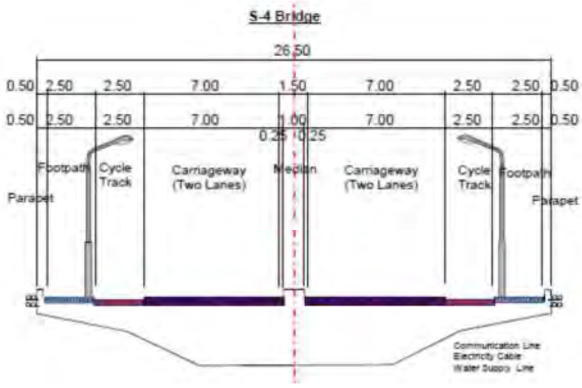
Source: *JICA Study Team*

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



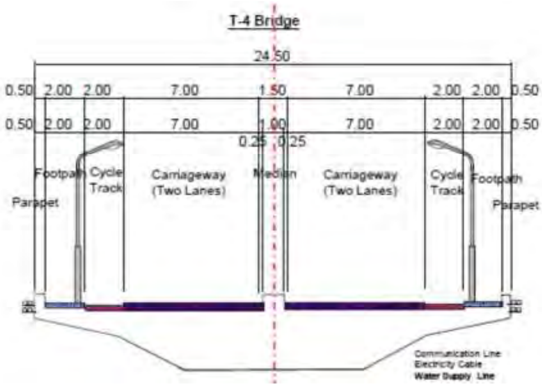
Source: *JICA Study Team*

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



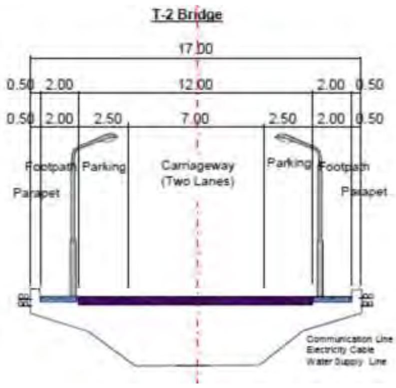
Source: *JICA Study Team*

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

<u>Bus System</u>

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 5,000m2.

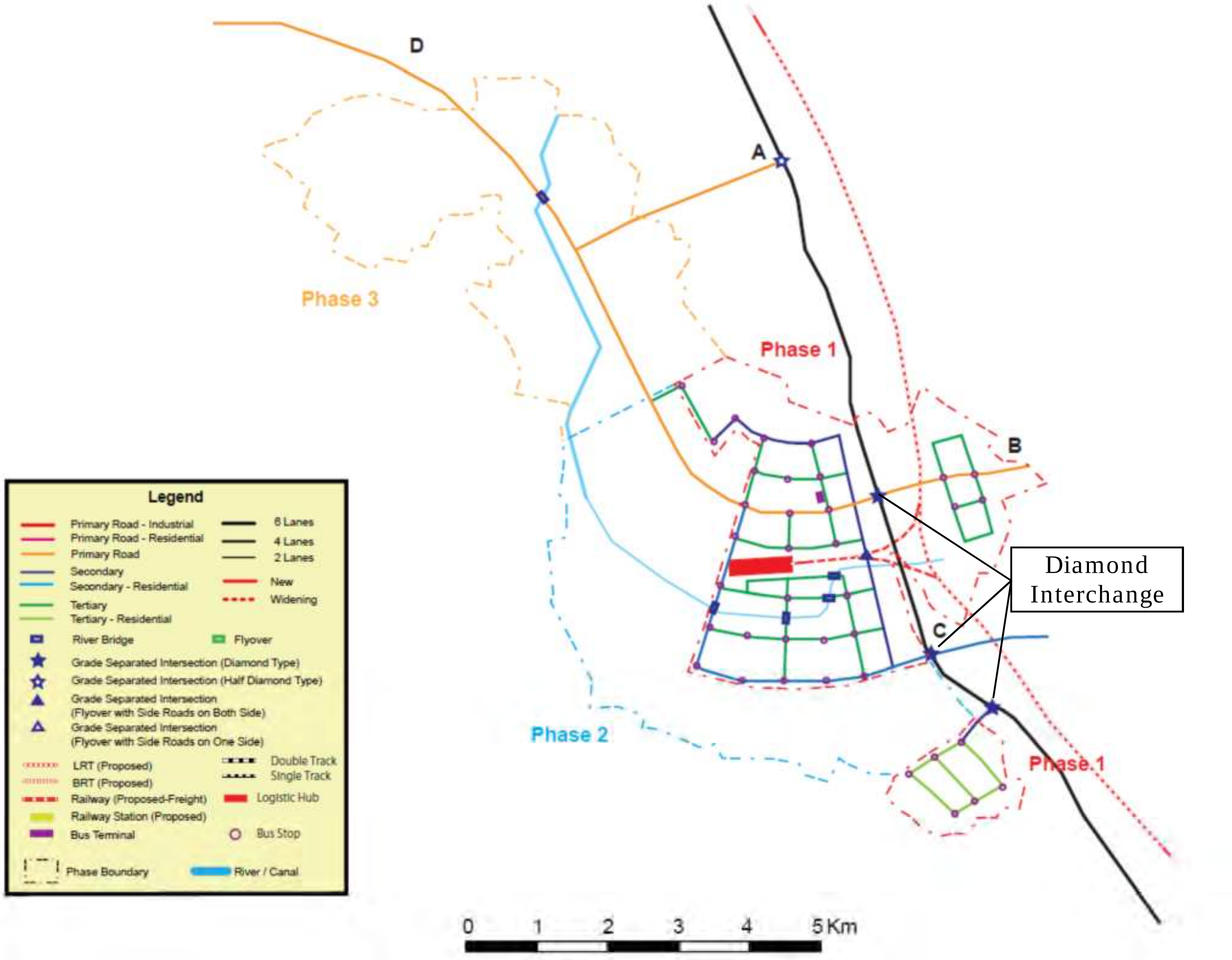
Bus Depot: Bus depot consists of vehicle related facilities and management facilities, and total area is 10,000m2.

Bus Stop: Type of bus stop is bus bay type and pavement area is 125m2.

7.1.5 Development Plan

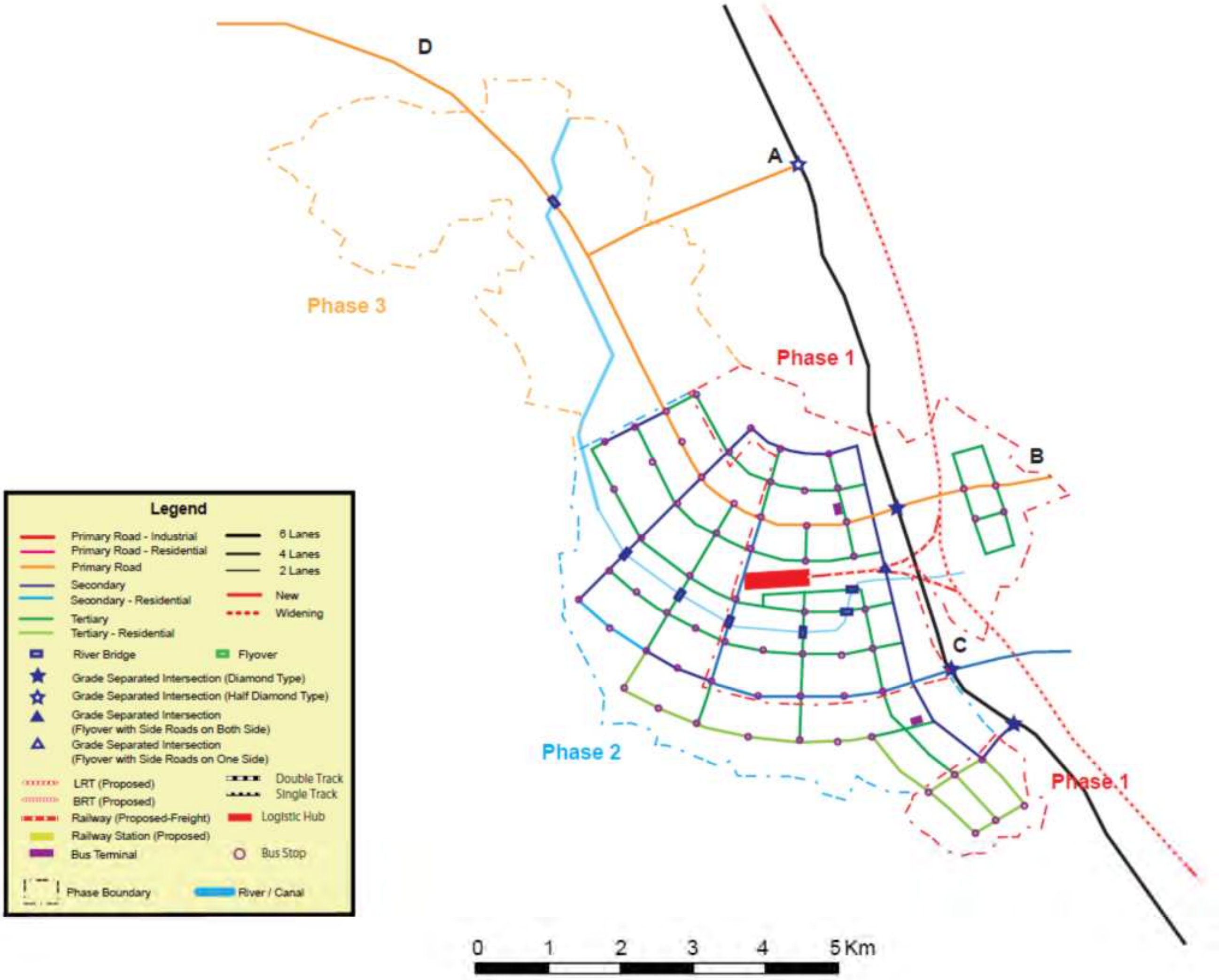
Internal Node Development

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



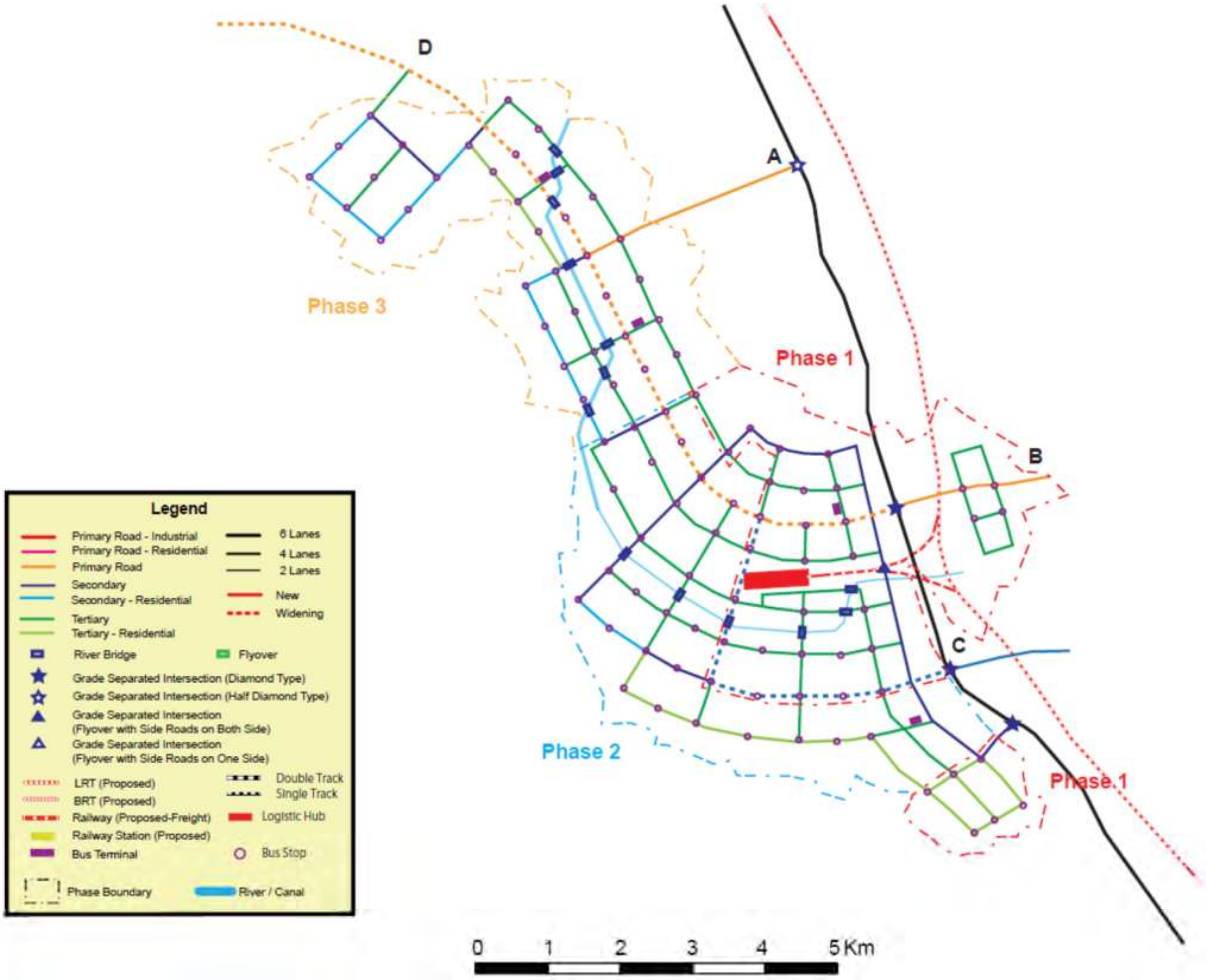
Source: JICA Study Team

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



Source: JICA Study Team

Figure 7.31: Road and Public Transport Facilities Development Plan in Internal Tumakuru Node (Phase B)

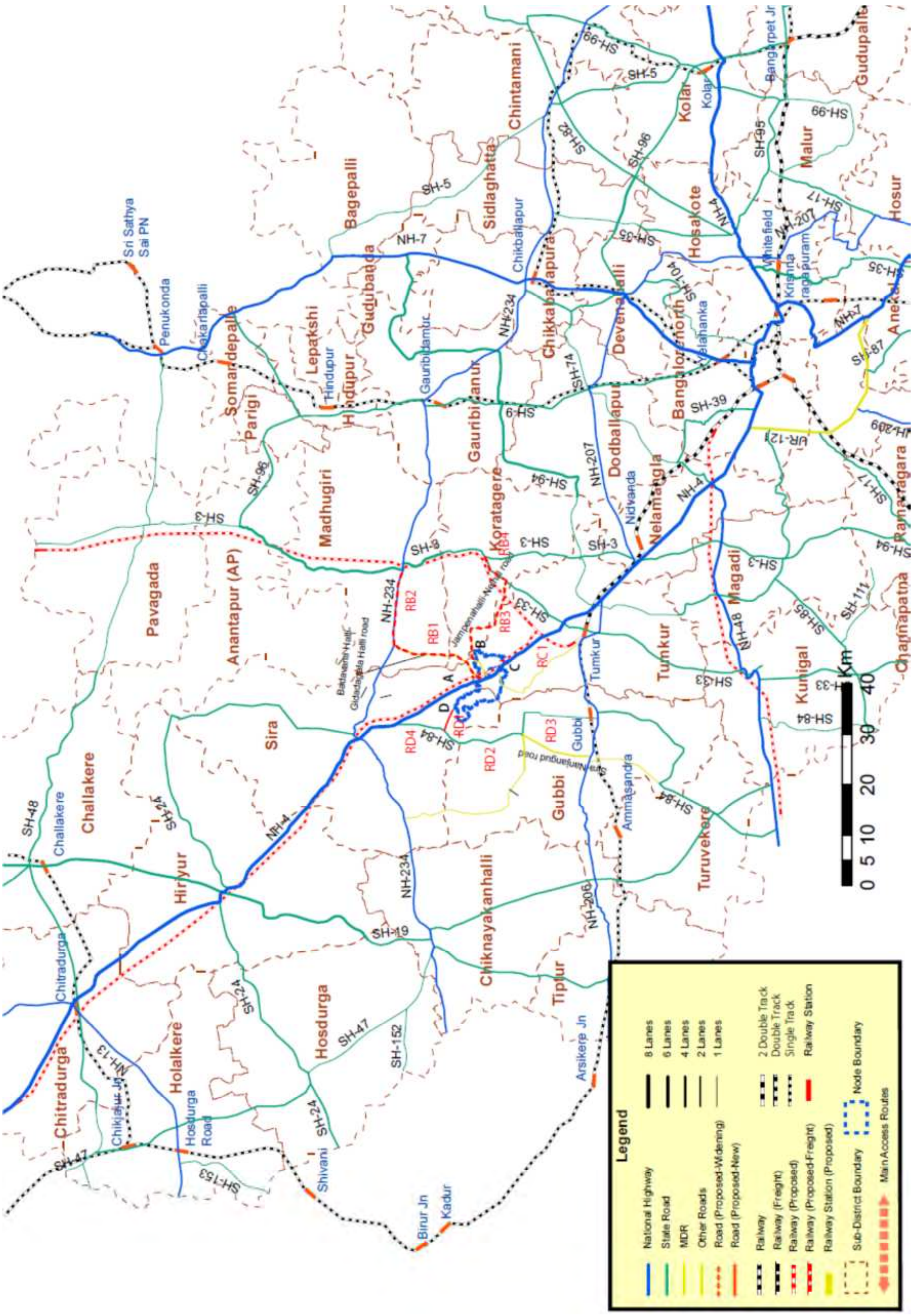


Source: JICA Study Team

Figure 7.32: Road and Public Transport Facilities Development Plan in Internal Tumakuru Node (Phase C)

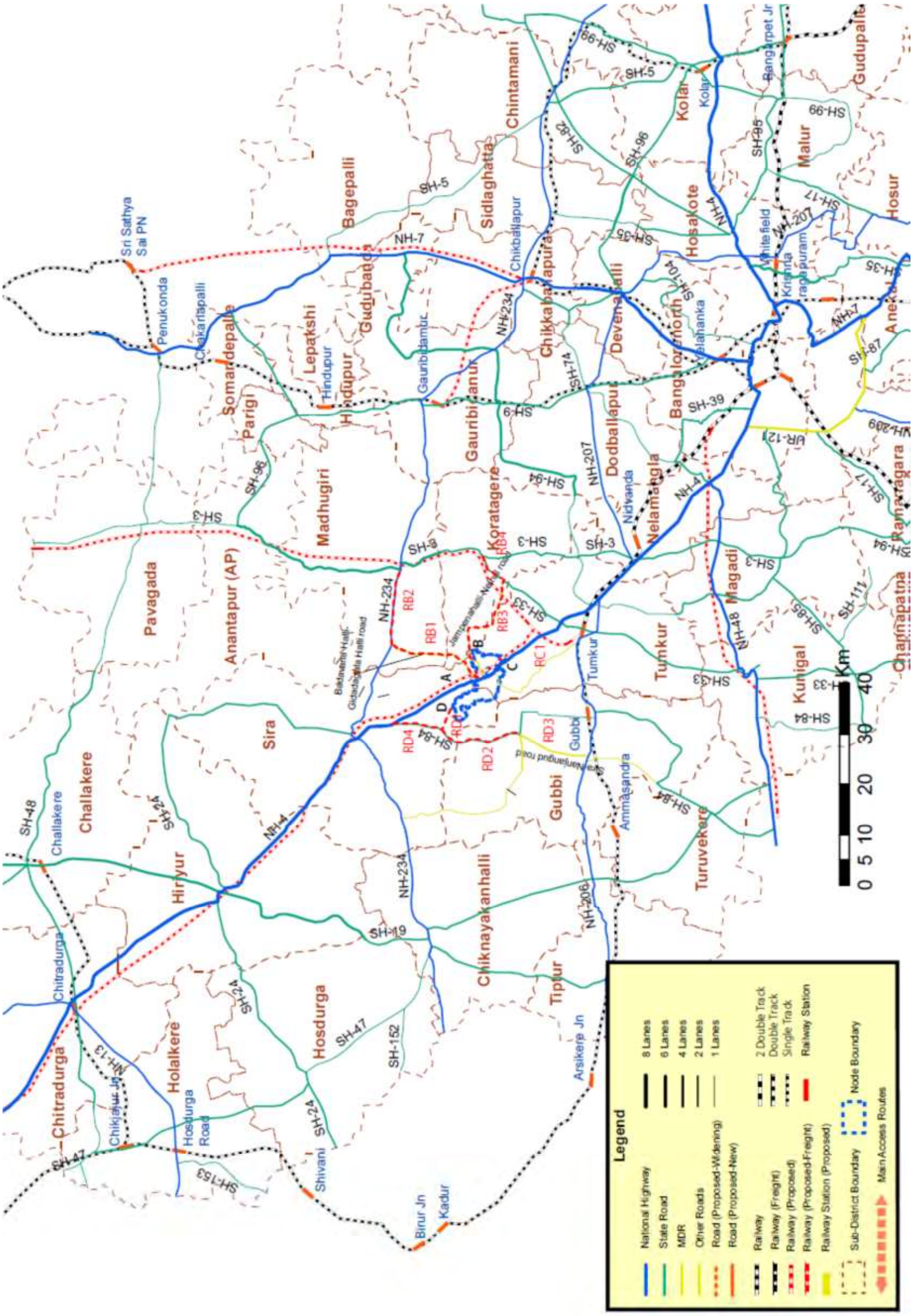
External Node Development

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 Figure 7.34 to Figure 7.36. As enhancement of the connection to Mangalore port, the connection to NH 206 through SH84 is keen to provide smooth road network.



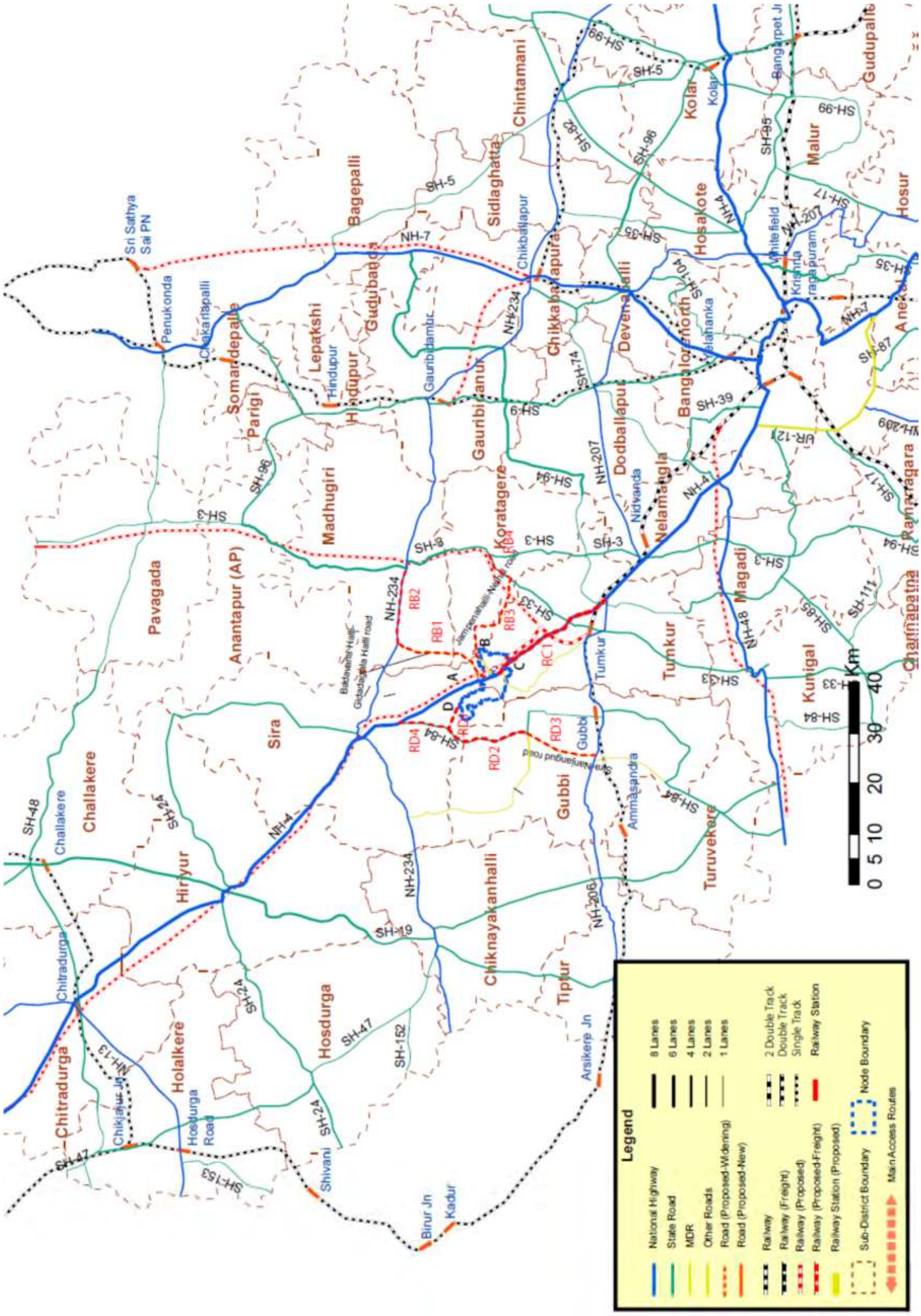
Source: JICA Study Team

Figure 7.33: Road and Public Transport Facilities Development Plan in External Tumakuru Node (Phase A)



Source: JICA Study Team

Figure 7.34: Road and Public Transport Facilities Development Plan in External Tumakuru Node (Phase B)



Source: JICA Study Team

Figure 7.35: Road and Public Transport Facilities Development Plan in External Tumakuru Node (Phase C)

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 7.18. Annual investment expenditure and total investment cost in each phase are also shown in the Table.

Table 7.18: Implementation Plan for Internal Node

Item	Description		Phase 1 (2014-2018)					Phase 2 (2019-2023)					Phase 3 (2024-2033)									
			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1. Internal Road Works	1) Primary Roads	a) 6 Lanes from 4 Lanes (ROW=44m)															400	400	400			
		b) 4 Lanes (ROW=37m)			3,593	3,593	3,593															
		c) Type-Industrial 6 Lanes from 4 Lanes (ROW=50m)																354	354			
		d) Type-Industrial 4 Lanes (ROW=43m)			2,508	2,508																
		e) Type-Residential 6 Lanes from 4 Lanes (ROW=55m)																				
		f) Type-Residential 4 Lanes (ROW=48m)																				
	2) Secondary Roads	a) 4 Lanes (ROW=34m)				1,755	1,755				2,080	2,080								520	520	
		b) Type-Residential 4 Lanes (ROW=45m)										1,080									6,570	
	3) Tertiary Roads	a) 4 Lanes (ROW=25.5m)				5,950	5,950		1,838	1,838	1,838	1,838							1,475	1,475	1,475	1,475
		b) Type-Residential 2 Lanes (ROW=20m)					1,680					2,200										840
2. Intersection Works	1) At-Grade Intersection (signalized)	a) Cross Type (6*4)				360	360															
		b) Cross Type (6*2)																				
		c) Cross Type (4*4)				125	125				100	100										25
		d) Cross Type (4*2)					36															
		e) Cross Type (2*2)																				
		f) T-Type (6*4)					108															
		g) T-Type (6*2)																				
		h) T-Type (4*4)				120	120				60	60									110	110
		i) T-Type (4*2)					14															
		j) T-Type (2*2)					8															
	2) Grade-separated intersection	a) Diamond Type			1,850	1,850	1,850															
		b) Half Diamond Type																				
		c) Flyover with side roads on both sideType				275	275															
		d) Flyover with side roads on one side Type																				
		e) Flyover with side road on one side Type																				
3. River Bridge Works	1) On Primary Road	a) 6 Lanes (W=34m)			357	357	357															
		b) 4 Lanes (W=27m)																				
	2) On Secondary Road	4 Lanes (W=26.5m)						60	60						358	358	358	358				
	3) On Tertiary Road	a) 4 Lanes (W=24.5m)			110	110	110	55	55					529	529	529	529	529				
		b) 2 Lanes (W=17m)																				
4. Flyover Bridge Works	1) On Primary Road	a) 6 Lanes (W=34m)																				
		b) 4 Lanes (W=27m)																				
	2) On Secondary Road	4 Lanes (W=26.5m)																				
	3) On Tertiary Road	a) 4 Lanes (W=24.5m)																				
		b) 2 Lanes (W=17m)																				
5. Road Facilities	1) Street Light	a) Dual bulb Type (High-pressure sodium lamp)				833	833				368	368									342	342
		b) Single bulb Type (High-pressure sodium lamp)					222					290										111
	2) Traffic Light	1) Cross Type Intersection				700	700					400										50
		2) T-Type Intersection				340	340					240										440
	3) Central Traffic Light Control System					300																
	4) Utilies Box	h: 1.5m w: 1.5m, both sides of road, Primary Road only			8,520	8,520	8,520															
6. Internal Public Transport Facilities Works	1) Bus Terminal	10 Busbays with 5,000m2					1,300					1,300										2,600
	2) Bus stop	Bus bay type (A=125m2) x both side				165	165				135	135									190	190
	3) Bus Depot	10,000m2					800					800										1,600
Annual Total (INR Lakh)			0	0	16,938	27,861	29,222	115	1,952	1,838	4,580	10,891	0	529	887	887	1,287	1,641	2,229	1,995	9,207	7,782
Phase Total (INR Lakh)			74,021					19,376					26,444									

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 Table 7.19. Annual investment expenditure and total investment cost in each phase are also shown in the Table.

Table 7.19: Implementation Plan for External Node

Item	Description		Phase 1 (2014-2018)					Phase 2 (2019-2023)					Phase 3 (2024-2033)									
			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
7. External Road Works	1) RB1	P1: Widening 2L-4L, P2: -, P3: -				1,200	1,200															
	2) RB2	P1: Widening 2L-4L, P2: -, P3: -				960	960															
	3) RB3	P1: Widening 1L-4L, P2: -, P3: -				1,710	1,710															
	4) RB4	P1: Widening 2L-4L, P2: -, P3: -					840															
	5) RC1	P1: -, P2: -, P3: Widening 6L-8L																		960	960	960
	6) RD1	P1: New 2L, P2: Widening 2L-4L, P3: Widening 4L-6L					1,440					480										480
	7) RD2	P1: -, P2: Widening 2L-4L, P3: Widening 4L-6L									840	840									840	840
	8) RD3	P1: -, P2: -, P3: Widening 2L-4L																			900	900
	9) RD4	P1: -, P2: Widening 2L-4L, P3: -									900	900										
8. External Public Transport Facilities Works	1) Railway	Double tracking from single track (Tumkur - Node)															2600	2600	2600	2600	2600	2600
9. Major River Bridge Works																						
10. Flyover Bridge Works																						
Annual Total (INR Lakh)			0	0	0	3,870	6,150	0	0	0	1,740	2,220	0	0	0	0	2,600	2,600	2,600	3,560	5,300	5,780
Phase Total (INR Lakh)			10,020					3,960					22,440									

Source: JICA Study Team

7.1.7 Cost Estimate

Based on proposed internal and external node development plans and identified projects, broad cost estimate is carried out for internal and external node development plans as shown in Table 7.20.

Table 7.20: Cost Estimate for Internal and External Node Infrastructures

Item	Description		Unit	Unit Rate	Phase 1(2014-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2023)		Total
					Quantity	Cost	Quantity	Cost	Quantity	Cost	
				(INR Lakh)		(INR Lakh)		(INR Lakh)		(INR Lakh)	(INR Lakh)
ROAD AND PUBLIC TRANSPORT WORKS											
1. Internal Road Works	1) Primary Roads	a) 6 Lanes from 4 Lanes (ROW=44m)	km	120	0.0	0	0.0	0	10.0	1,200	1,200
		b) 4 Lanes (ROW=37m)	km	700	15.4	10,780	0.0	0	0.0	0	10,780
		c) Type-Industrial 6 Lanes from 4 Lanes (ROW=50m)	km	120	0.0	0	0.0	0	5.9	708	708
		d) Type-Industrial 4 Lanes (ROW=43m)	km	850	5.9	5,015	0.0	0	0.0	0	5,015
		e) Type-Residential 6 Lanes from 4 Lanes (ROW=55m)	km	120	0.0	0	0.0	0	0.0	0	0
		f) Type-Residential 4 Lanes (ROW=48m)	km	950	0.0	0	0.0	0	0.0	0	0
	2) Secondary Roads	a) 4 Lanes (ROW=34m)	km	650	5.4	3,510	6.4	4,160	1.6	1,040	8,710
		b) Type-Residential 4 Lanes (ROW=45m)	km	900	0.0	0	1.2	1,080	7.3	6,570	7,650
	3) Tertiary Roads	a) 4 Lanes (ROW=25.5m)	km	500	23.8	11,900	14.7	7,350	11.8	5,900	25,150
		b) Type-Residential 2 Lanes (ROW=20m)	km	400	4.2	1,680	5.5	2,200	2.1	840	4,720
Total					55	32,885	27.8	14,790	38.7	16,258	63,933
2. Intersection Works	1) At-Grade Intersection (signalized)	a) Cross Type (6*4)	Location	45	16	720	0	0	0	0	720
		b) Cross Type (6*2)	Location	35	0	0	0	0	0	0	0
		c) Cross Type (4*4)	Location	25	10	250	8	200	1	25	475
		d) Cross Type (4*2)	Location	18	2	36	0	0	0	0	36
		e) Cross Type (2*2)	Location	10	0	0	0	0	0	0	0
		f) T-Type (6*4)	Location	36	3	108	0	0	0	0	108
		g) T-Type (6*2)	Location	28	0	0	0	0	0	0	0
		h) T-Type (4*4)	Location	20	12	240	6	120	11	220	580
		i) T-Type (4*2)	Location	14	1	14	0	0	0	0	14
		j) T-Type (2*2)	Location	8	1	8	0	0	0	0	8
	2) Grade-separated intersection	a) Diamond Type	Location	1,850	3	5,550	0	0	0	0	5,550
		b) Half Diamond Type	Location	1,480	0	0	0	0	0	0	0
		c) Flyover with side roads on both sideType	Location	550	1	550	0	0	0	0	550
		d) Flyover with side roads on one side Type	Location	500	0	0	0	0	0	0	0
		e) Flyover with side road on one side Type	Location	480	0	0	0	0	0	0	0
Total						7,476		320		245	8,041
3. River Bridge Works	1) On Primary Road	a) 6 Lanes (W=34m)	sq.m	0.45	2,380	1,071	0	0	0	0	1,071
		b) 4 Lanes (W=27m)	sq.m	0.45	0	0	0	0	0	0	0
	2) On Secondary Road	4 Lanes (W=26.5m)	sq.m	0.45	0	0	265	119	3,180	1,431	1,550
	3) On Tertiary Road	a) 4 Lanes (W=24.5m)	sq.m	0.45	735	331	245	110	5,880	2,646	3,087
		b) 2 Lanes (W=17m)	sq.m	0.45	0	0	0	0	0	0	0
Total						1,402		230		4,077	5,708
4. Flyover Bridge Works	1) On Primary Road	a) 6 Lanes (W=34m)	sq.m	0.4	0	0	0	0	0	0	0
		b) 4 Lanes (W=27m)	sq.m	0.4	0	0	0	0	0	0	0
	2) On Secondary Road	4 Lanes (W=26.5m)	sq.m	0.4	0	0	0	0	0	0	0
	3) On Tertiary Road	a) 4 Lanes (W=24.5m)	sq.m	0.4	0	0	0	0	0	0	0
		b) 2 Lanes (W=17m)	sq.m	0.4	0	0	0	0	0	0	0
Total						0		0		0	0
5. Road Facilities	1) Street Light	a) Dual bulb Type (High-pressure sodium lamp)	pole	1	1,667	1,667	736	736	683	683	3,086
		b) Single bulb Type (High-pressure sodium lamp)	pole	0.8	277	222	363	290	139	111	623
	2) Traffic Light	1) Cross Type Intersection	Location	50	28	1,400	8	400	1	50	1,850
		2) T-Type Intersection	Location	40	17	680	6	240	11	440	1,360
	3) Central Traffic Light Control System		l.s	300	1	300	0	0	0	0	300
	4) Utilies Box	h: 1.5mx w: 1.5m, both sides of road, Primary Road on	km	1200	21	25,560	0	0	0	0	25,560
Total						29,828		1,666		1,284	32,779
6. Internal Public Transport Facilities Works	1) Bus Terminal	10 Busbays with 5,000m2	Location	1300	1	1,300	1	1,300	2	2,600	5,200
	2) Bus stop	Bus bay type (A=125m2) x both side	Location	10	33	330	27	270	38	380	980
	3) Bus Depot	10,000m2	Location	800	1	800	1	800	2	1,600	3,200
Total						2,430		2,370		4,580	9,380
Grand Total (Internal Node)						74,021		19,376		26,444	119,841
7. External Road Works	1) New Construction	a) 6 Lanes	km	780	0	0	0	0	0	0	0
		b) 4 Lanes	km	600	0	0	0	0	0	0	0
		c) 2 Lanes	km	360	4	1,440	0	0	0	0	1,440
	2) Widening	a) 6 Lanes to 8 Lanes	km	120	0	0	0	0	24	2,880	2,880
		b) 4 Lanes to 6 Lanes	km	120	0	0	0	0	18	2,160	2,160
		c) 2 Lanes to 6 Lanes	km	240	0	0	0	0	0	0	0
		d) 2 Lanes to 4 Lanes	km	120	43	5,160	33	3,960	15	1,800	10,920
		e) 1 Lanes to 4 Lanes	km	180	19	3,420	0	0	0	0	3,420
Total					66	10,020	33	3,960	57	6,840	20,820
8. External Public Transport Facilities Works	1) Railway	Double tracking from single track (Tumkur - Node)	km	600	0	0	0	0	26	15,600	15,600
Total						0		0		15,600	15,600
9. Major River Bridge Works			sq.m	0.45	0	0	0	0	0	0	0
Total						0		0		0	0
10. Flyover Bridge Works			sq.m	0.4	0	0	0	0	0	0	0
Total						0		0		0	0
Grand Total (External Node)						10,020		3,960		22,440	36,420
Grand Total (Internal and External Node)						84,041		23,336		48,884	156,261

Note:
- Internal road work costing is done for road portion only above the formation level
- Road work cost includes cost of sub base, base, surface courses, median, culverts, minor bridges, drainage, footpath, marking, planting zone, utilities box etc.

Source: JICA Study Team

Maintenance cost for annual and phase period is estimated as shown in Table 7.21.

Table 7.21: Operation Cost Estimate for Internal Node Infrastructures

Item	Description		Unit	Charges	Phase 1(2014-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2023)		Total
					Annual	Phase Total	Annual	Phase Total	(INR Cr.)	Phase Total	
				(%)	(INR Lakh)	(INR Lakh)	(INR Lakh)	(INR Lakh)	(INR Lakh)	(INR Lakh)	(INR Lakh)
ROAD AND PUBLIC TRANSPORT WORKS											
1. Internal Road Works	1) Primary Roads	Routine maintenance (pot hole repair every year), periodic maintenance (overlay each 5 years)	l.s.	1.0	158	790	158	790	177	885	2,465
	2) Secondary Roads		l.s.	1.0	35	176	88	438	164	818	1,431
	3) Tertiary Roads		l.s.	1.0	136	679	231	1,157	299	1,494	3,329
2. Road Facilities	1) Street Light		l.s.	5.0	94	472	146	729	185	927	2,128
	2) Traffic Light		l.s.	2.5	52	260	68	340	80	401	1,001
	3) Central Traffic Controll Center		l.s.	5.0	15	75	15	75	15	75	225
Total					490	2,451	705	3,527	920	4,600	10,579

Source: JICA Study Team

7.2 Railways

7.2.1 Sector Overview

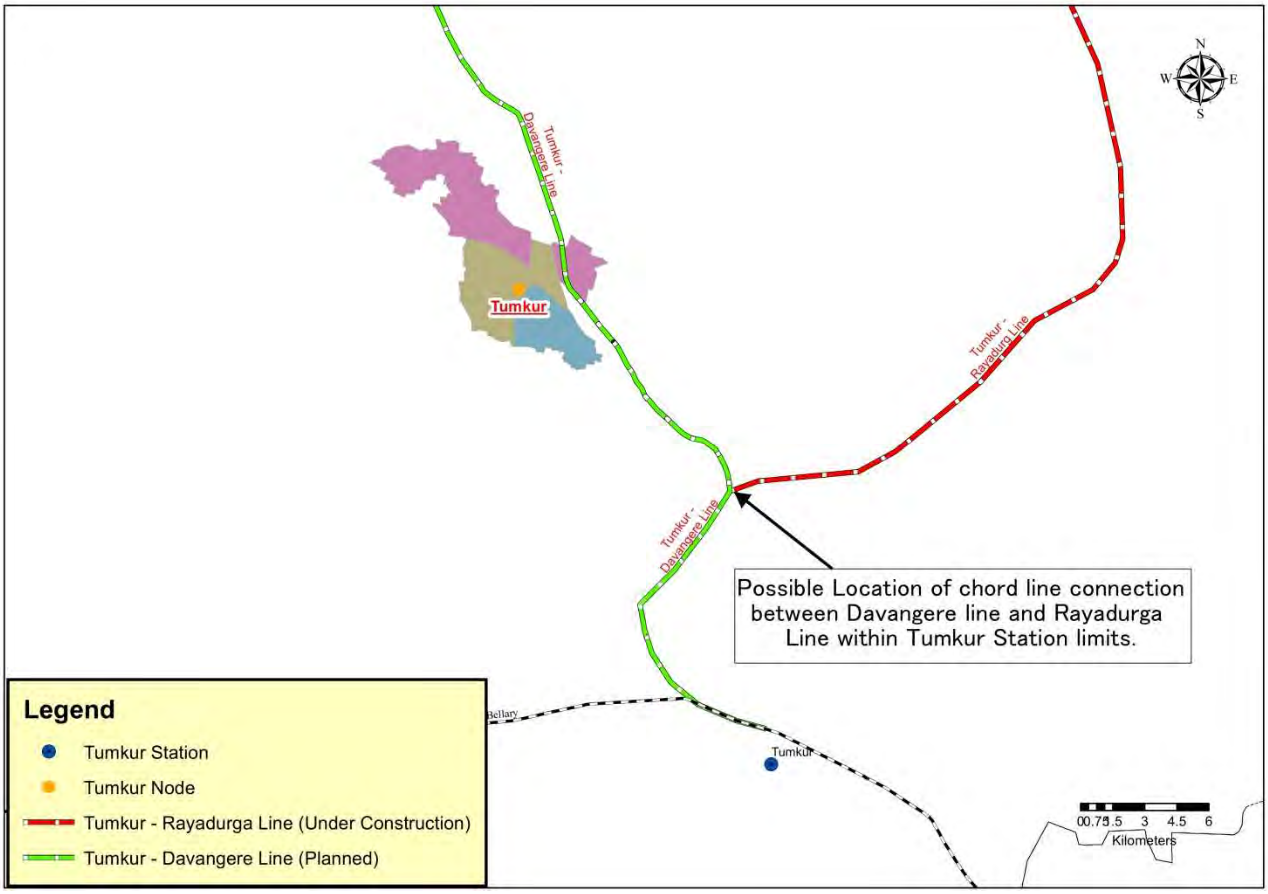
The connection of the proposed manufacturing nodes to the railway network will be essential for their commercial viability and competitiveness. Such connections can only be achieved through the development of multimodal transfer terminals, or “Logistics Hubs” within the nodes.

These Logistics Hubs, which are evaluated in detail in the Logistics section (Section 7.3) 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 Tumakuru node, the objective will be to connect the node to the existing railway network via an access line which would separate from a new line to be constructed between Davanagere and Tumakuru. This new line has been sanctioned for construction by Southwest Railways as a single track non-electrified line, at a cost estimated in 2011/12 prices at INR 1,836.58 Crore. Although its alignment has been fixed, land acquisition has yet to commence and it is now uncertain if construction can proceed before 2017/18.

The Tumakuru-Davanagere line will provide a direct connection between Bengaluru and Chitradurga, thereby avoiding the circuitous, and congested, rail route via Arsikere Junction and Birur. Via the new line, the Tumakuru node will in future have the benefit of a shortened rail access to Bellary (near the location of the steel plant at Toranagallu) and Mumbai. The distance from the node to Rayadurga, via the new line will be 217 km, as compared with 232 km via an alternative rail route now under development between Tumakuru and Rayadurga.

The potential advantage of the alternative route is that land acquisition has already started on its northern section through Andhra Pradesh, with the possibility that its construction could proceed in advance of the Tumakuru-Davanagere line. Provision of a link between the two new lines, perhaps as a chord line within the Tumakuru yard, could shorten the distance between the node and Rayadurga via the alternative route. To take advantage of the alternative, priority should be given to construction of the first 20 km of the Tumakuru-Davanagere line which would link it to the node.



Source: JICA Study team

Figure 7.36 Possible Connection between Davanagere and Rayadurga New Lines

The Tumakuru-Davanagere mainline will be separated from the node by National Highway 4 as its alignment runs on the eastern side of the highway. A plan for a rail crossing over this highway is outlined in Section 7.2.3 below.

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 B 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, Tumakuru 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 in the table below.

Table 7.22: Tumakuru 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

Source: JICA Study team

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. The average railway traffic density at Tumakuru is projected at 4 trains in and 4 trains out per day, suggesting a high probability that two trains could occupy the sidings at the same time. Based on the train specifications in Table 7.22, the length of the 2 siding tracks between turnouts (switches) will be 754 and 758 metres, which will accommodate the train lengths plus some allowance for braking. The 2 sidings are of nominally different lengths as they are located on a very mild curve.

7.2.3 Features of rail nodal access design at Tumakuru

The access line connecting the logistics hub at Tumakuru with the new Tumakuru-Davanagere line will be designed as a "wye" junction, which would permit trains to access the hub from either direction, without the need to reverse. It is proposed that the line will cross NH 4 on a bridge adjacent to an existing pedestrian bridge which crosses the highway where it passes through a cutting near the village of Nelahalu – see figures below. After the bridge, the two arms of the "wye" branch out to meet the Tumakuru – Davanagere line. *Source: JICA*

Study team

Figure 7.38: Tumakuru Node – Existing pedestrian bridge

Source: JICA Study team

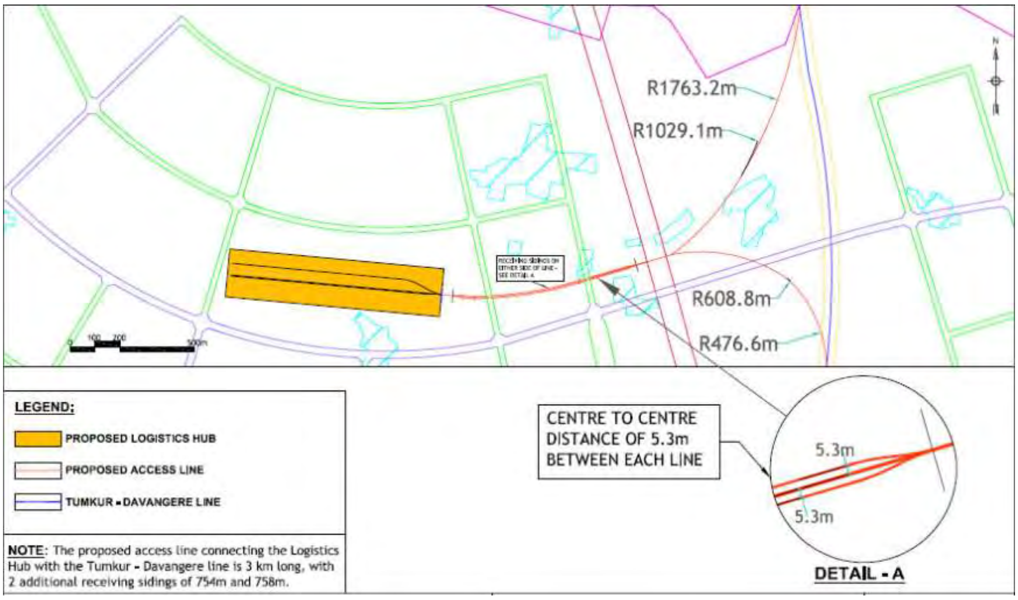
Figure 7.37: Tumakuru Node – NH4 crossing site

The two arms of the “wye” will have a combined length of 2 km. From the junction of these arms to the boundary of the logistics hub, the overall track length, comprising the running line plus 2 sidings, will be 2.5 km, giving an overall track length of 4.5 km from the junction with the mainline to the hub boundary.

Although it is not proposed to construct Tumakuru-Davanagere as an electrified line, it will be necessary to provide overhead wiring on the access line and reception sidings in order to prepare for electric traction on the mainline. *In the meantime, the strategy should be to negotiate with IR to advance plans for construction of Tumakuru-Davanagere (and possibly also Tumakuru-Rayadurga) as an electrified line.*

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 477 meters.

The layout of the access line, showing its relationship to the logistics hub and the reception sidings is given in the figure below. A recent inspection of the site of the node revealed no particular difficulties for construction of the access line.



Source: JICA Study team

Figure 7.39: Tumakuru Node – Layout of proposed rail access line and reception sidings

7.2.4 Demand forecast

The demand forecast for Tumakuru as in the case of the other two nodes, was based on input/output forecasts prepared by the Industry Planning team. The table below presents the forecasts of the rail modal volume and share used as a basis for scaling the rail facilities at Tumakuru.

Table 7.23: Tumakuru 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)	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				

Traffic category	2017/18	2022/23	2027/28	2032/33
- 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

Source: JICA Study team

Owing to the potential to transport raw plastic inputs in containers from Ponneri as well as containerized cotton from Nagpur a better balance between loaded inbound and outbound container flows will be achieved in Tumakuru than is the case at nodes located near ports.

A key feature of these forecasts is that rail is expected to carry a dominant share (nearly 90%) of container volumes to and from Tumakuru, clearly a result of the predominance of long haul outbound container flows to domestic destinations.

Rail will also have the major share of the re-positioning of empty containers to the node from Ennore and Krishnapatnam ports.

Rail will transport (in break bulk form) 100% of the steel input tonnage to the node, all from Bellary.

Realization of the above forecast TEU and break-bulk tonnage volumes for rail will translate, on average, to three inbound and three outbound container trains, and one inbound and one outbound steel train, per day.

7.2.5 Cost estimate

Connection of Tumakuru node to the rail network will require construction of an electrified access line (running from the yet to be constructed Tumakuru-Davanagere mainline) with reception sidings for an overall length of 5.2 track km.

The unit construction cost of single electrified line, equipped with automatic block signaling, was estimated at INR 53 million per km. This cost was derived from the quoted costs of recent new line construction projects.

Since it will be necessary for the line to cross NH 4 on a bridge, the unit construction cost of the track on this bridge is likely to be substantially higher than that applicable to the remainder of the access line. In the absence of any definitive information on bridge unit construction costs, it was assumed in this case that they would be double the above unit rate. The overall cost at current prices of the access line and reception sidings would therefore be INR 240.33 million, as shown in Table 7.24 below.

Table 7.24 Tumakuru Node - Capital Cost for construction of Access Lines

Access Line		Totals
Length of Arm 1 (km)	1.13	
Length of Arm 2 (km)	0.94	2.81
Length of main access line	0.84	
Unit construction cost (million Rs/km)	53.00	
Total cost (million Rs)		**149.08**
Length of Bridge (km)	0.10	0.10
Est. unit construction cost (million Rs/km)	106.00	
Total cost (million Rs)		**11.11**
Total cost access line plus bridges		**160.19**
Reception sidings		
Length (km)	1.51	
Unit construction cost (million Rs/km)	53.00	
Total cost (million Rs)		**80.14**
TOTAL		
Length (km) (excluding length of bridge)	4.43	
Unit construction cost (million Rs/km)		
Total cost (million Rs)		**240.33**

Source: JICA Study team

7.2.6 Development plan

Construction of the access track should be completed in time to allow trains to run to and from the Tumakuru node in early 2018, coinciding with the scheduled commencement of manufacturing activity. It should be possible to carry out the construction works within the two year period 2015/16-2016/17.

As indicated in Annexure B 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 Table 7.25 and Table 7.26 below.

Table 7.25 Tumakuru 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)*	0.0106	0.0062	0.0036	0.0021
Access track maintenance (Rs. per ntk)*	0.0339	0.0326	0.0320	0.0316
Container wagon investment (Rs. per ntk)	0.0186	0.0177	0.0178	0.0176
Container wagon maintenance (Rs. per ntk)	0.0110	0.0104	0.0105	0.0103
Total charge (Rs. per ntk)	**1.0941**	**1.0870**	**1.0839**	**1.0816**
Sources: (1) MOR Statistical Statements				
(2) Consultant's Train Cost Model				
* Calculated across total ntk generated by the node (containers plus steel)				

Source: JICA Study team

Table 7.26 Tumakuru 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)*	0.0106	0.0062	0.0036	0.0021
Access track maintenance (Rs. per ntk)*	0.0339	0.0326	0.0320	0.0316
Total charge (Rs. per ntk)	**1.2346**	**1.2288**	**1.2256**	**1.2237**
Sources: (1) MOR Statistical Statements				
(2) Consultant's Train Cost Model				
* Calculated across total ntk generated by the node (containers plus steel)				

Source: JICA Study team

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.

7.2.7 Critical success factors

The construction of at least the first 20 km of the proposed Tumakuru-Davanagere (from Tumakuru to the node) will be essential to allow the development of a rail access to the Tumakuru node. The capital cost of this project, if the line is constructed as a single track electrified line, would be about INR 1,060 million (INR Crore 106).

In addition it is likely to be necessary to construct a link between the Tumakuru-Davanagere and Tumakuru-Rayadurga lines – ideally within the Tumakuru station limits.

If the development of the Tumakuru node is likely to generate additional passenger traffic for the Tumakuru-Davanagere line, it is highly possible that the capacity of the new line will be saturated by the end of the forecast period (2032/33). Since the line is to be single track, its train capacity would be 15 in each direction, or 30 in total, per day. It is possible that some 10 trains per day (20 in total) could divert from the existing Bengaluru-Rayadurga mainline via Arsikere Junction and Birur. The node can be expected to generate about 8 freight trains per day in both directions; hence the available capacity of the line will have been fully absorbed by 2032/33.

It will be particularly important that the workforce forecasts and related daily passenger number be critically reviewed, in the light of the possibility of developing feeder bus services to accommodate this demand. Alternatively, this DFR should contain recommendations for track doubling of the new line, at least between Tumakuru and Chitradurga.

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 center 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 Tumakuru 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 Tumakuru, 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 5 high stacking of empty containers, the required number of ground-slots was calculated as 357 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. In the Tumakuru hub, the container stacks will be 2 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 the 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 Table 7.27 below.

Table 7.27 Tumakuru Logistics Hub - Throughput

Category	2017/18	2022/23	2027/28	2032/33
Loaded inbound (TEU)	3679	6317	10848	18628
Empty inbound (TEU)	14100	24212	41576	71393
Loaded outbound (TEU)	17779	30529	52424	90021
Empty outbound (TEU)				
Total (TEU)	35557	61058	104847	180042
CFS t/put (40% of loaded container volume)-TEU	8583	14739	25309	43460
Breakbulk handling in CFS - inbound tonnes	22893	39311	67504	115916
Breakbulk handling in CFS - outbound tonnes	125735	215910	370756	636654
Steel handling in CY -tonnes	165866	284821	489089	839855
Sub-total (Tonnes)	314493	540042	927349	1592424
Overtime storage volume in CFS and steel yard (5% of total tonnage)	15725	27002	46367	79621
Other L.T. storage volume (20% of CFS volume)	29726	51044	87652	150514
Reefer storage volume (50% of L.T.storage volume)	14863	25522	43826	75257

Source: JICA Study Team

In particular, it was assumed that:

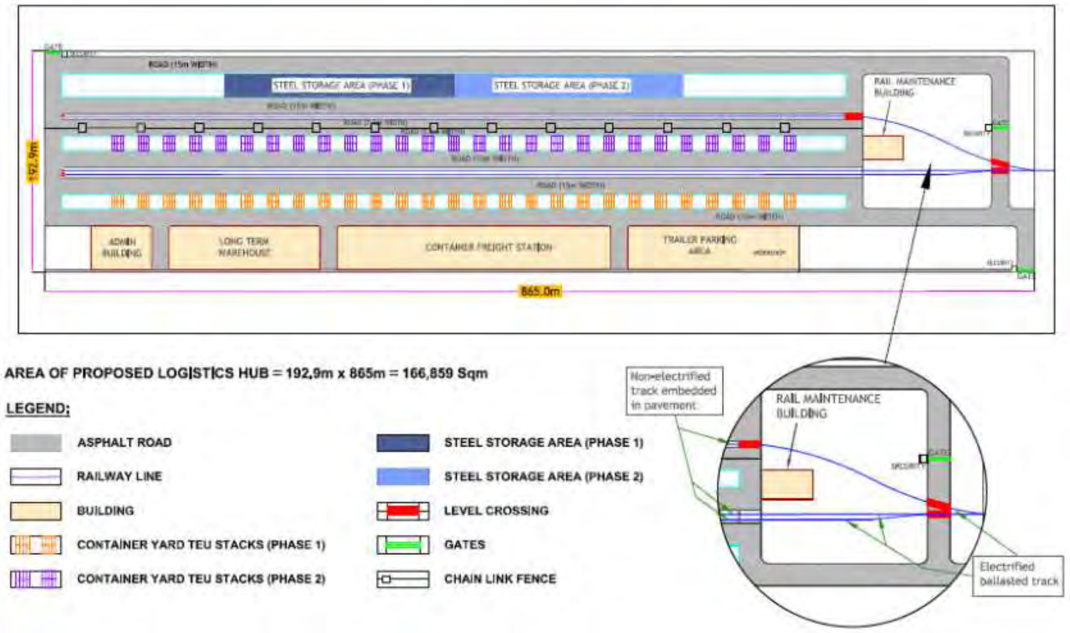
- 40% of the CY throughput of loaded TEU will be stuffed or unstuffed in the CFS;
- Long term storage volume (Cubic metres) will represent about 20% of total break-bulk volume handled in the CFS;
- Reefer storage volume will represent half of the Long Term storage volume.

7.3.4 Features of Tumakuru logistics hub design

The proposed layout of the Tumakuru logistics hub is given in the figure below. The design assumptions and specifications are indicated in Table 7.28 below.

Table 7.28 Tumakuru 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)		9,086
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		72,567
Not utilised		37,840
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%



Source: JICA Study team

Figure 7.40: Tumakuru 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 in the table below.

Table 7.29: Tumakuru 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	87,787	2,047.51	179.74	11,320	2,047.51	23.18	99,107	2,047.51	202.92
Railway sidings (a)			104.32			50.06	-		154.39
- paved area	6,300	4,000	25.20	3150	4,000	12.60	9,450	4,000	37.80
- length embedded	1,400	450,00,000	63.00	700.00	450,00,000	31.50	2,100	450,00,000	94.50
- length electrified plus ballasted	304	530,00,000	16.12	112.50	530,00,000	5.96	417	530,00,000	22.09
Buildings									
- Admin Building	2,000	19,625.41	39.25				2,000	19,625.41	39.25
- CFS	9,086	13,083.61	118.88				9,086	13,083.61	118.88
- L.T. warehouse	5,000	21,587.95	107.94				5,000	21,587.95	107.94
Security/gatehouse	300	13,083.61	3.93				300	13,083.61	3.93
Workshop	1,500	18,317.05	27.48				1,500	18,317.05	27.48
Railway maint.store	700	18,317.05	12.82				700	18,317.05	12.82
Sub-total (Buildings)			310.29			-			310.29
Utilities			37.38			4.61			41.99
Sub-total (Bldgs and Infra)			631.74			77.85			709.59
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	7	1.01	7.09	8	1.01	8.10	15	1.01	15.19
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	11	0.04	0.40	14	0.04	0.51	25	0.04	0.91
Conveyors			6.34						6.34
Racking system			0.88						0.88
Sub-total			136.99			11.99			148.98
Misc.fixed assets									
Consultancy fee (3%)			23.06			2.70			25.76
Contingency (4%)			30.75			3.59			34.34
Total			***822.54***			***96.12***			***918.66***

Sources for costs

1) *Ministry of Railways (Adviser Infrastructure) 13/11/2014*
2) *Cost of Hyster TIL reachstacker from CONCOR 03/07/2014*
3) *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 A, 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 B, 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 Table 7.30.

Table 7.30 Tumakuru 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	315.87	0.00	315.87	9.48	12.63	22.11	337.98
2016/17	315.87	130.35	446.22	13.39	17.85	31.24	477.46
2017/18	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2018/19	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2019/20	0.00	2.03	2.03	0.06	0.08	0.14	2.17
2020/21	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2021/22	0.00	3.41	3.41	0.10	0.14	0.24	3.65
2022/23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023/24	0.00	1.05	1.05	0.03	0.04	0.07	1.12
2024/25	0.00	0.04	0.04	0.00	0.00	0.00	0.04
2025/26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2026/27	77.85	3.18	81.03	2.43	3.24	5.67	86.70
2027/28	0.00	1.09	1.09	0.03	0.04	0.08	1.16
2028/29	0.00	4.46	4.46	0.13	0.18	0.31	4.77
2029/30	0.00	1.09	1.09	0.03	0.04	0.08	1.16
2030/31	0.00	0.07	0.07	0.00	0.00	0.01	0.08
2031/32	0.00	2.10	2.10	0.06	0.08	0.15	2.25
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	**709.59**	**148.98**	**858.56**	**25.76**	**34.34**	**60.10**	**918.66**

(cyan)	Phase 1
(yellow)	Phase 2

Source: JICA Study team

(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 Table 7.31 and Table 7.32 respectively.

Table 7.31 Tumakuru 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	111	15.43	29	13.61	29.04
2019/20	111	15.43	29	13.61	29.04
2020/21	120	16.68	31	14.55	31.23
2021/22	120	16.68	31	14.55	31.23
2022/23	126	17.51	33	15.49	33.00
2023/24	126	17.51	33	15.49	33.00
2024/25	135	18.76	35	16.43	35.19
2025/26	135	18.76	35	16.43	35.19
2026/27	135	18.76	35	16.43	35.19
2027/28	153	21.26	39	18.31	39.57
2028/29	162	22.51	42	19.72	42.23
2029/30	177	24.60	45	21.13	45.72
2030/31	186	25.85	48	22.53	48.38
2031/32	186	25.85	48	22.53	48.38
2032/33	195	27.10	50	23.47	50.57
2033/34	195	27.10	50	23.47	50.57
2034/35	195	27.10	50	23.47	50.57
2035/36	195	27.10	50	23.47	50.57
2036/37	195	27.10	50	23.47	50.57
TOTAL		426.51		371.82	798.34
Unit Wages Cost (per annum), Rs.			1,38,975		
Unit Salaries Cost (p.a.), Rs.			4,69,473		

Source: JICA Study team

Table 7.32 Tumakuru 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	631.74	6.32	130.35	2.61
2018/19	631.74	6.32	130.39	2.61
2019/20	631.74	6.32	130.43	2.61
2020/21	631.74	6.32	132.45	2.65
2021/22	631.74	6.32	132.49	2.65
2022/23	631.74	6.32	135.90	2.72
2023/24	631.74	6.32	135.90	2.72
2024/25	631.74	6.32	136.95	2.74
2025/26	631.74	6.32	136.99	2.74
2026/27	631.74	6.32	136.99	2.74
2027/28	709.59	7.10	140.17	2.80
2028/29	709.59	7.10	141.26	2.83
2029/30	709.59	7.10	145.72	2.91
2030/31	709.59	7.10	146.80	2.94
2031/32	709.59	7.10	146.88	2.94
2032/33	709.59	7.10	148.98	2.98
2033/34	709.59	7.10	148.98	2.98
2034/35	709.59	7.10	148.98	2.98
2035/36	709.59	7.10	148.98	2.98
2036/37	709.59	7.10	148.98	2.98
TOTAL		134.13		56.09
R&M cost % of cum. inv.-fixed assets			1.0%	
R&M cost % of cum. inv.-equip.			2.0%	

Source: JICA Study team

(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/unstuffing (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 resulting revenue flows are given in Table 7.33 below.

Table 7.33 Tumakuru 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	35557	56891	28.45	8583	12.87	314493	36.79	15725	5.52	2.15	3750	11.33	500	1.89	99.00
2018/19	40657	65052	32.53	9814	14.72	359603	42.07	17980	6.31	2.46	3750	11.33	600	2.27	111.68
2019/20	45757	73212	36.61	11045	16.57	404713	47.35	20236	7.10	2.77	3750	11.33	700	2.64	124.36
2020/21	50858	81372	40.69	12276	18.41	449822	52.62	22491	7.89	3.07	3750	11.33	800	3.02	137.05
2021/22	55958	89532	44.77	13507	20.26	494932	57.90	24747	8.69	3.38	3750	11.33	900	3.40	149.73
2022/23	61058	97693	48.85	14739	22.11	540042	63.18	27002	9.48	3.69	3750	11.33	1000	3.78	162.41
2023/24	69816	111705	55.85	16853	25.28	617503	72.24	30875	10.84	4.22	3750	11.33	1100	4.16	183.91
2024/25	78574	125718	62.86	18967	28.45	694965	81.30	34748	12.20	4.75	3750	11.33	1200	4.53	205.42
2025/26	87332	139731	69.87	21081	31.62	772426	90.36	38621	13.55	5.28	3750	11.33	1300	4.91	226.93
2026/27	96090	153743	76.87	23195	34.79	849887	99.42	42494	14.91	5.81	3750	11.33	1400	5.29	248.43
2027/28	104847	167756	83.88	25309	37.96	927349	108.49	46367	16.27	6.34	3750	11.33	1500	5.67	269.94
2028/29	119886	191818	95.91	28939	43.41	1060364	124.05	53018	18.61	7.25	3750	11.33	1560	5.89	306.44
2029/30	134925	215880	107.94	32569	48.85	1193379	139.61	59669	20.94	8.15	3750	11.33	1620	6.12	342.95
2030/31	149964	239943	119.97	36199	54.30	1326394	155.17	66320	23.28	9.06	3750	11.33	1680	6.35	379.46
2031/32	165003	264005	132.00	39829	59.74	1459409	170.73	72970	25.61	9.97	3750	11.33	1740	6.57	415.97
2032/33	180042	288067	144.03	43460	65.19	1592424	186.29	79621	27.94	10.88	3750	11.33	1800	6.80	452.47
2033/34	180042	288067	144.03	43460	65.19	1592424	186.29	79621	27.94	10.88	3750	11.33	1800	6.80	452.47
2034/35	180042	288067	144.03	43460	65.19	1592424	186.29	79621	27.94	10.88	3750	11.33	1800	6.80	452.47
2035/36	180042	288067	144.03	43460	65.19	1592424	186.29	79621	27.94	10.88	3750	11.33	1800	6.80	452.47
2036/37	180042	288067	144.03	43460	65.19	1592424	186.29	79621	27.94	10.88	3750	11.33	1800	6.80	452.47
Total (20 years)			1757.19		795.30		2272.73		340.91	132.76		226.66		100.49	5626.04

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 Table 7.34, indicates a healthy surplus of revenue over costs for the Tumakuru Hub.

Table 7.34 Tumakuru 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	6.32	2.61	7.59	45.56	99.00	53.44
2018/19	15.43	13.61	6.32	2.61	7.59	45.56	111.68	66.12
2019/20	15.43	13.61	6.32	2.61	7.59	45.56	124.36	78.80
2020/21	16.68	14.55	6.32	2.65	8.04	48.24	137.05	88.81
2021/22	16.68	14.55	6.32	2.65	8.04	48.24	149.73	101.49
2022/23	17.51	15.49	6.32	2.72	8.41	50.45	162.41	111.96
2023/24	17.51	15.49	6.32	2.72	8.41	50.45	183.91	133.47
2024/25	18.76	16.43	6.32	2.74	8.85	53.10	205.42	152.32
2025/26	18.76	16.43	6.32	2.74	8.85	53.10	226.93	173.83
2026/27	18.76	16.43	6.32	2.74	8.85	53.10	248.43	195.33
2027/28	21.26	18.31	7.10	2.80	9.89	59.37	269.94	210.57
2028/29	22.51	19.72	7.10	2.83	10.43	62.58	306.44	243.86
2029/30	24.60	21.13	7.10	2.91	11.15	66.88	342.95	276.07
2030/31	25.85	22.53	7.10	2.94	11.68	70.10	379.46	309.36
2031/32	25.85	22.53	7.10	2.94	11.68	70.10	415.97	345.86
2032/33	27.10	23.47	7.10	2.98	12.13	72.78	452.47	379.69
2033/34	27.10	23.47	7.10	2.98	12.13	72.78	452.47	379.69
2034/35	27.10	23.47	7.10	2.98	12.13	72.78	452.47	379.69
2035/36	27.10	23.47	7.10	2.98	12.13	72.78	452.47	379.69
2036/37	27.10	23.47	7.10	2.98	12.13	72.78	452.47	379.69
TOTAL (20 YEARS)	426.51	371.82	134.13	56.09	197.71	1186.27	5626.04	4439.77
Admin overhead rate		20%						

Source: JICA Study team

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.918.66 million could be provided via equity funds and/or project loans.

7.4 Power & Renewable Energy

7.4.1 Sector Overview

The historical trend of power requirement in the three states – Karnataka, Andhra Pradesh and Tamil Nadu was analyzed. 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 CBIC region, 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 analyzed to estimate the supply of power in short term in three states. Demand and supply gap was analyzed with focus on capacity addition plans to assess the power position of the states.

Table 7.35: 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

Source: PwC Analysis

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. Karnataka's state transmission utility, KPTCL added 31,539 km of transmission lines in FY 13 and proposes to add a similar quantum in the short term.

BESCOM has prepared a perspective plan for capital investments totaling to Rs.2932.00 Crores for the period from 2013-14 to 2017-18 Year on year. It has formulated the target for AT&C loss reduction based on the several recommendations and has under taken every effort to achieve the laid targets. BESCOM has initiated a programme for replacing all Electro mechanical meters by Electro Static Meters the reduce AT & C Loss. Metering DTC's in rural areas (Non – RAPDRP areas) as per KERC directives for energy Auditing predominantly feeding to IP sets. Smart meters are being introduced which are supplier and consumer friendly. HT installations above 500 KVA having 3Ph 3 wire metering are proposed for replacing with 3Ph 4 wire for enabling accurate unbalance load recording there by reduction in AT&C Loss. It is also working on improvement of power supply through the following schemes[40]:-

- Implementation of NJY(Niranthara Jyothi Yojane)
- Restructured Accelerated Power Development & Reform Programme (RAPDRP) works & Distribution Automation System (DAS)
- Providing Ariel Bunched Cables (ABC works)

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

[40] bescom.org/wp-content/uploads/2013/01/Chapter5-Capex__.docx
bescom.org/wp-content/uploads/2013/01/Business-plan.docx

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):*

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 Section 2 (Design Philosophy), 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 7.36: 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.

Source: JICA Study Team

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 outcomers from the RMU are being fed into the consumer transformers for consumption. Please refer to the Appendix 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 7.37: 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%**

Source: PwC Analysis

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 A, phase B and Phase C power demand estimate for the node.

Table 7.38: Power demand estimates for various years, PwC analysis

Category	FY 2017	FY 2019	FY 2022	FY 2025	FY 2028	FY 2031	FY 2032
Industrial (MW)	18.03	54.10	108.20	162.30	216.40	270.50	288.53
Residential (MW)	2.86	9.73	23.44	42.35	68.02	102.42	116.24
Others (MW)	3.61	10.83	21.66	32.49	43.31	54.14	57.75
Total expected demand (MW)	24.51	74.66	153.30	237.14	327.73	427.06	462.52

Category	FY 2017	FY 2019	FY 2022	FY 2025	FY 2028	FY 2031	FY 2032
Diversity Factor (DF)*	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Maximum demand (MD)	17.16	52.26	107.31	166.00	229.41	298.94	323.77

Source: PwC Analysis

From the estimates in phase A around 75 MW of demand is expected in the node. However, in phase B 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 C 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 7.39: Gap assessment for the node

Category	FY 2016	FY 2019	FY 2022	FY 2025	FY 2028	FY 2031	FY 2032
Maximum demand (MD)	17.16	52.26	107.31	166.00	229.41	298.94	323.77
Total available capacity as per existing infrastructure (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Usable capacity for the node	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Demand for which system needs to be designed (MW)	17.16	52.26	107.31	166.00	229.41	298.94	323.77

Source: PwC Analysis

In phase B it would be required power infrastructure to cater to the demand of almost 145 MW. This will increase to 323 MW in phase C.

Table 7.40: Scenarios for design gap (MW)

Category	Total Demand (MW)	Maximum gap for system design (MW)
Phase A (2019)	74.66	52.26
Phase B (2024)	208.52	145.97
Phase C (2032)	462.52	323.77

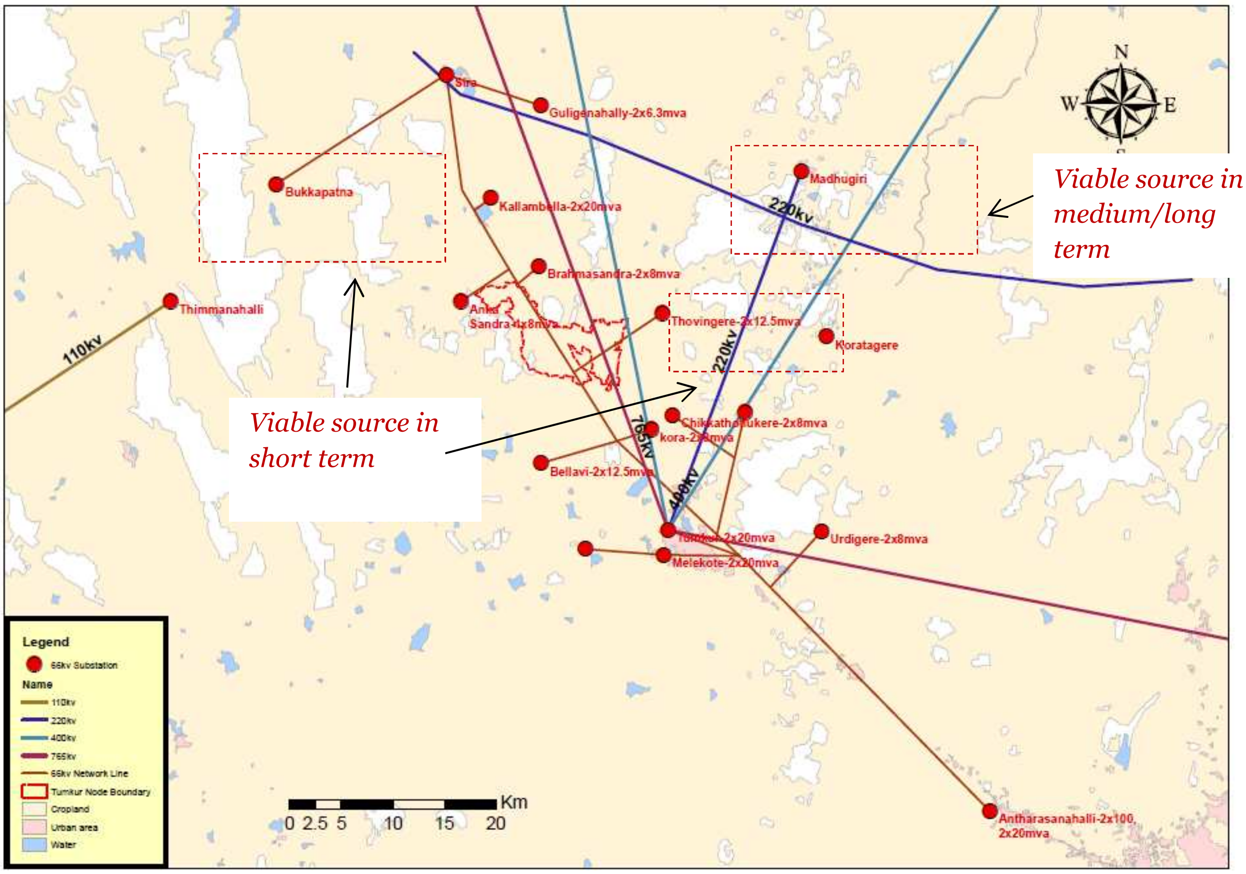
Source: PwC Analysis

Considering the philosophy for design, it would be required to have varying strategies for meeting existing and upcoming demand. In phase A considering that the expected demand is close to 75 MW, this can be met by present system of the utilities with marginal outside additions. However, in phase B and C, 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

Considering technical considerations (length of 11kV feeders), only one substation (Madhugiri- 220kV 2x 150 MVA S/S) forms a viable source of power for the node. Madhugiri S/S is expected to meet the bulk of existing requirements of the node.



Source: JICA Study Team

Figure 7.41: Existing power infrastructure for node

However, assessing the current loading of the sub-station (Madhugiri- 220kV 2x 150 MVA)[41], it is noted that only 18% of the S/S is available currently for the node demand.

Table7.41: Available capacity for the node

Name of the substation	PTR Capacity (MVA)	Peak Loading (MVA)	Available Capacity (MVA)	Available Capacity (MW)
Madhugiri- 220kV 2x 150 MVA	2 X 150 MVA	232.5[42]	67.5	54

Source: PwC Analysis

This would be insufficient for the phase B demand and hence would need up gradation from the transmission utility. This would be critical in the phase II plan for meeting power demand in the node. Also, it would be required to have 220kV line from Madhugiri S/S to the node for operationalizing the transfer of electricity.

[41] http://www.kptcl.com/Tr%20line%20details110%20-%2066%20kV.xls

[42] 1MW = 0.8MVA

Hence, in the phase I, supply would be met by existing distribution infrastructure. In phase B, extension of the transmission infrastructure at Madhugiri -220kV would be required for meeting the demand of the node.

However, the transmission utility should ensure that the timelines of the project can be met and adequate arrangements can be made for allocation of capacity 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 66kV/11kV with capacities varying from 2x10 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 7.42: Distribution sub-station requirement (Nos.)

Characteristics	2016-19	2020-24	2025-32
Total demand expectation for system design (MW)	52.26	145.97	323.77
System design for 80% loading condition in the node	65.33	182.46	404.71
System power factor	0.80	0.80	0.80
Total installed capacity (MVA)	81.66	228.07	505.88
Capacity of each distribution sub-station (MVA)	20	20	323.77
Additional distribution sub-station requirement (Nos.)	4	7	14

Source: PwC Analysis

Also, considering the high demand coming in the region, we also propose installation of a Main Receiving Sub Stations (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.

Table7.43: Transmission sub-station requirement (Nos.)

Characteristics	2016-19	2020-24	2025-32
Total installed capacity (MVA)	81.66	228.07	505.88
Current Transmission Capacity with augmentation of Madhugiri S/S (MVA)	67.5	67.5	67.5
Proposed addition in transmission capacity (MVA)	0	300	600
Key characteristics of transmission S/S	2 X 150 MVA, 220/ 66 kV Gas Insulated Sub-station for the region		

Source: PwC Analysis

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 or would be fed from a new designed transmission sub-station outside the node.

Location and tapping points

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 for any 11kV line should not exceed 5-10 km in length. Similar is the consideration in case of LT level line which cannot exceed more than 500 meters to enable technical losses reduction for the state. This dictates the location of the sub stations to be near the consumption point.

For the purpose of the designing, each sub-station should be able to handle 20 MVA load from upcoming demand. These sub stations are located 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.

Based on the locations of the sub stations, input/output line interconnections would be based on available spare capacity for the node in the existing transmission network. This would also vary by timeline. Key elements are as below:-

1) In the phase A, the input flow would be from the AnkaSandra, Thovingere, BrahmaSandra S/S s220 kV S/S into the proposed sub-stations S-1 to S4 for fulfilling phase I demand of the node.
2) In the phase B, the 220kV feeder from Madhugiri S/S would feed the Main Receiving Sub Station (MRSS) in the node which in turn would feed 66/11kV sub stations (S1 to S11).
3) In the phase C, the 220kV feeder from Madhugiri S/S would feed the Main Receiving Sub Stations (MRSS) in the node which in turn would feed 66/11kV sub stations (S1 to S25) as well as any new planned substation.

The following is proposed to be the input-output characteristics of the feeders from S/S in the node:-

Table7.44: Line characteristics (I/O configurations)

Sub Station	Input	Output
AnkaSandra, Thovingere, BrahmaSandra (220kV , 2X 150 MVA transmission S/S)	AnkaSandra, Thovingere, BrahmaSandra S/S, 220kV DC/SC Line	MRSS bay (220kV S/C Line)
Main Receiving Sub Stations (MRSS) within the node	Madhugiri S/S- 220kV	Distribution S/S (S1 to S5) – 66kV
Sub-Stations (1-25)	MRSS Bay (66kV) AnkaSandra, Thovingere, BrahmaSandra (220kV , 2X 150 MVA transmission S/S)	10 X 11kV feeder for consumers

Source: PwC Analysis

The following section describes the interconnections diagrammatically for reference. The subsequent pictorials show indicative locations of the proposed substations across the short (phase A), medium (phase B) and long term (phase C) in line with the proposed demand growth.

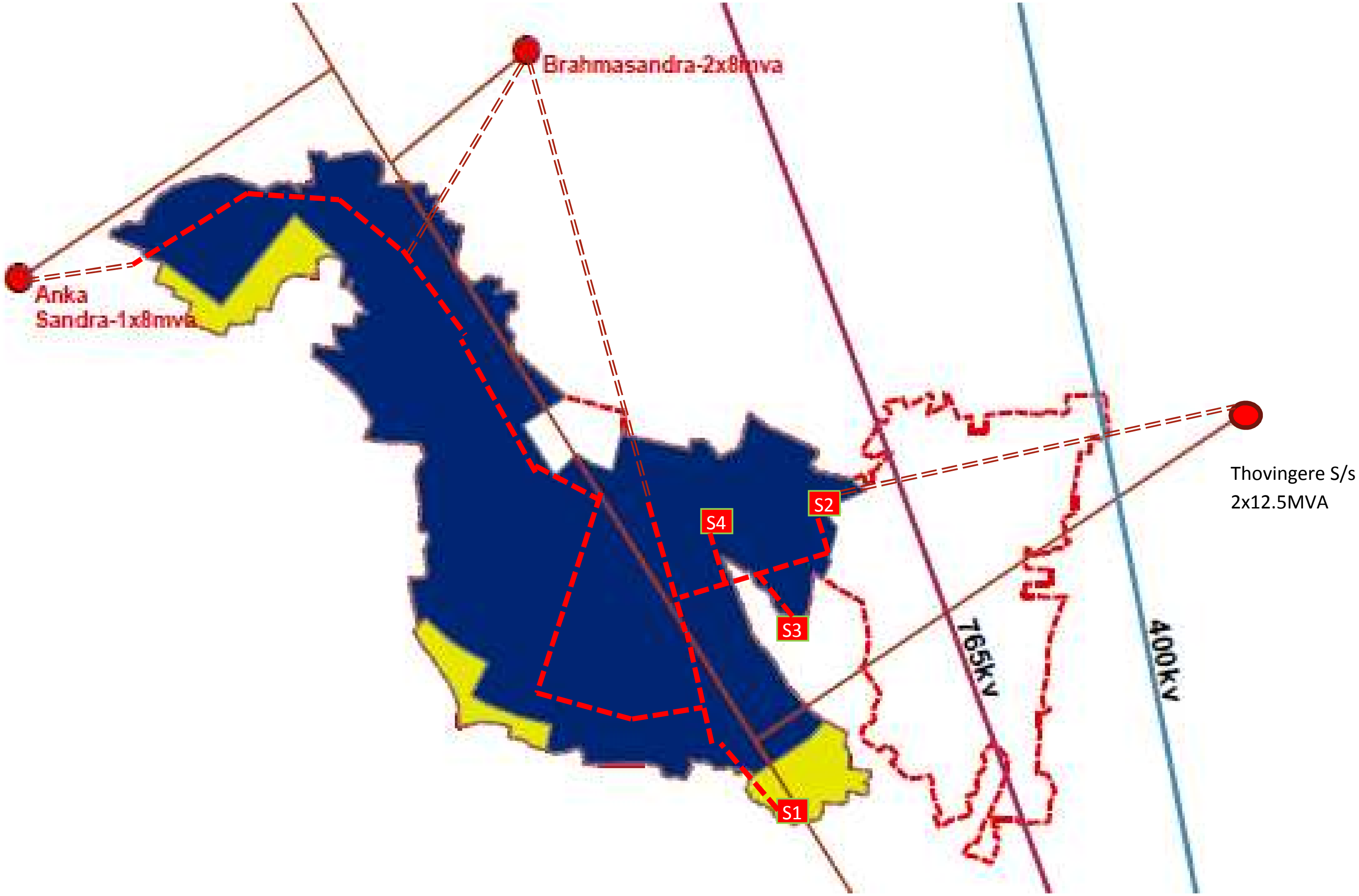


Figure 7.42: Sub-station locations for Phase A

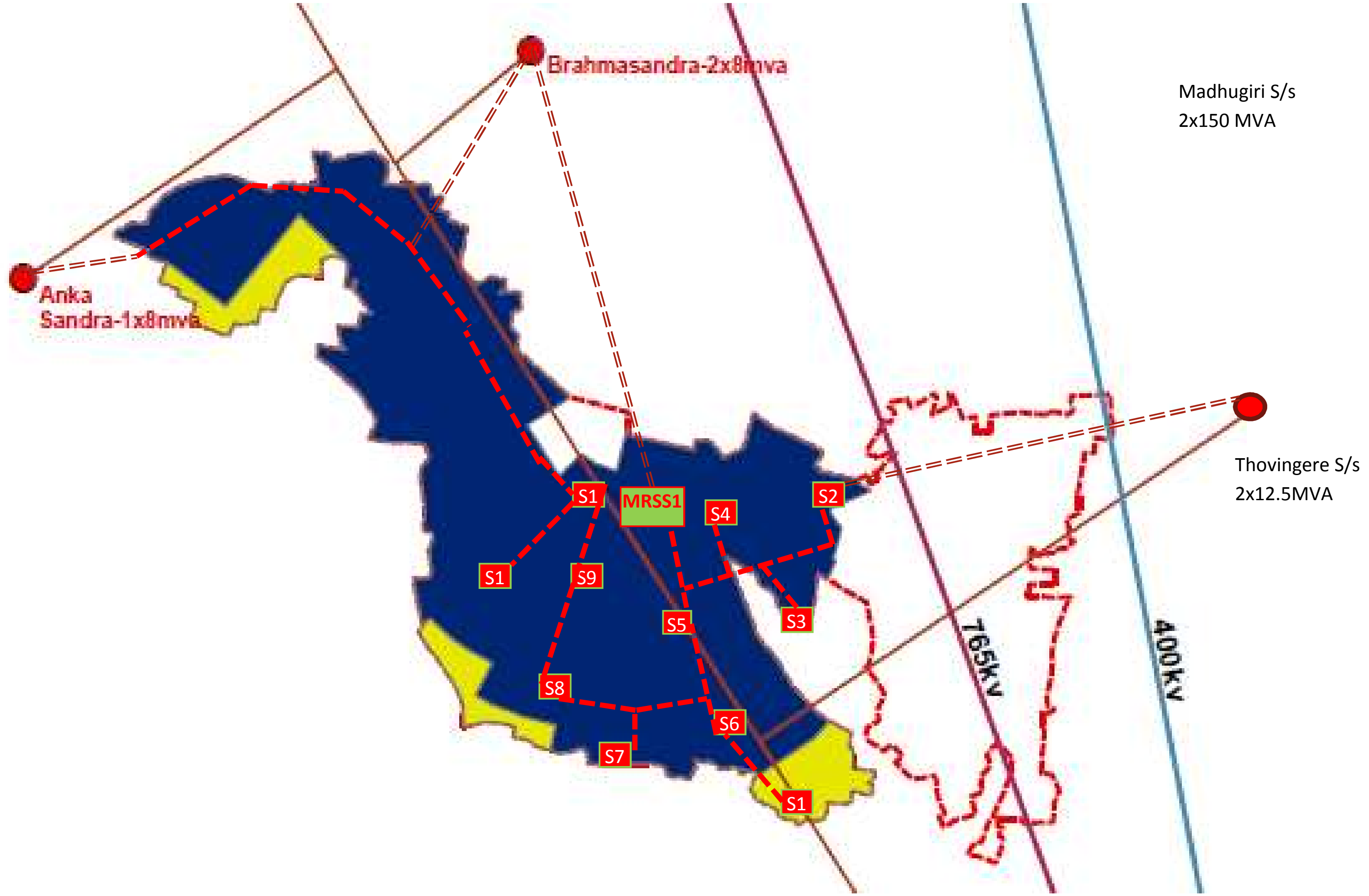


Figure 7.43: Sub-station locations for Phase B

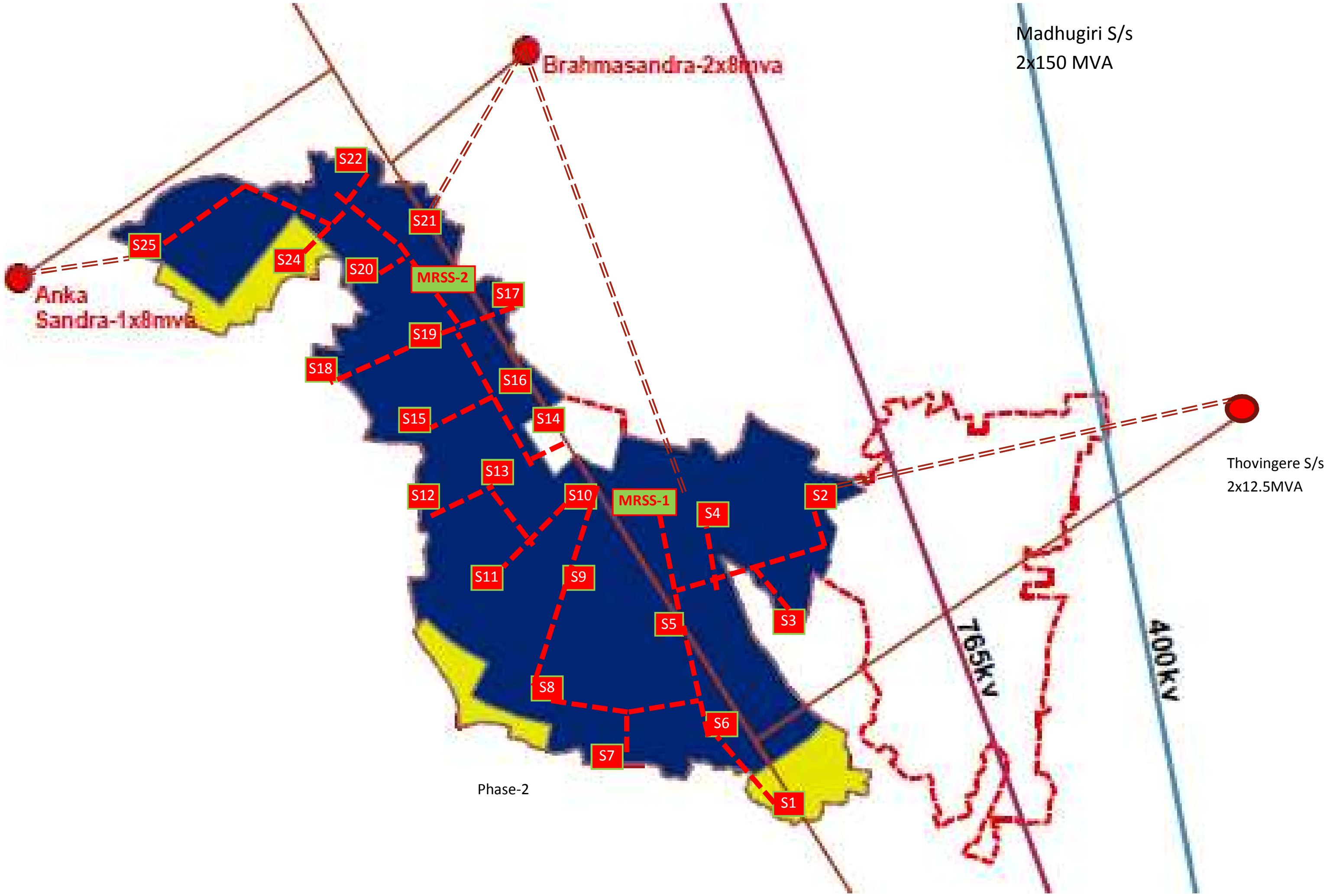


Figure 7.44: Sub-station locations for Phase III

The figures above show 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 C we will have 14 more sub stations coming up in the area. The locations of these stations would be dependent upon the demand growth post the phase B. Hence, it would not be possible to ascertain with certainty the locations of these 14 sub stations in the present assessment. However tentative locations are proposed in this report.

Land requirement

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 7.45: Standard land requirement for sub-stations

Characteristics	Area requirement (Sq. Mts.)
Distribution sub-station (66/11kV) – 1 X 20 MVA	2020
Transmission receiving sub-station- 2x150MVA, 220/66kV GIS Based sub-station	24,280

Source: PwC Analysis

As per the sub –station requirement, we see that the land requirement for distribution and transmission infrastructure would be as follows:-

Table7.46: Land requirement for sub stations

Characteristics	2016-19 (Sq. Mts.)	2020-24 (Sq. Mts.)	2025-32 (Sq. Mts.)
Distribution infrastructure	8,080	22,220	50,500
Transmission infrastructure	0	24,280	48,560
Incremental land requirement from distribution and transmission perspective	8,080	38,420	52,560
Cumulative land requirement	8,080	46,500	99,060

Source: PwC Analysis

In the phase A we would need close to 8,080 Sq. mt. of area for the distribution infrastructure. This would increase to close to 46,500 Sq. mt. of area for distribution and transmission infrastructure in the phase B and stabilize to 99,060 Sq. mt. in the phase C.

1. *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

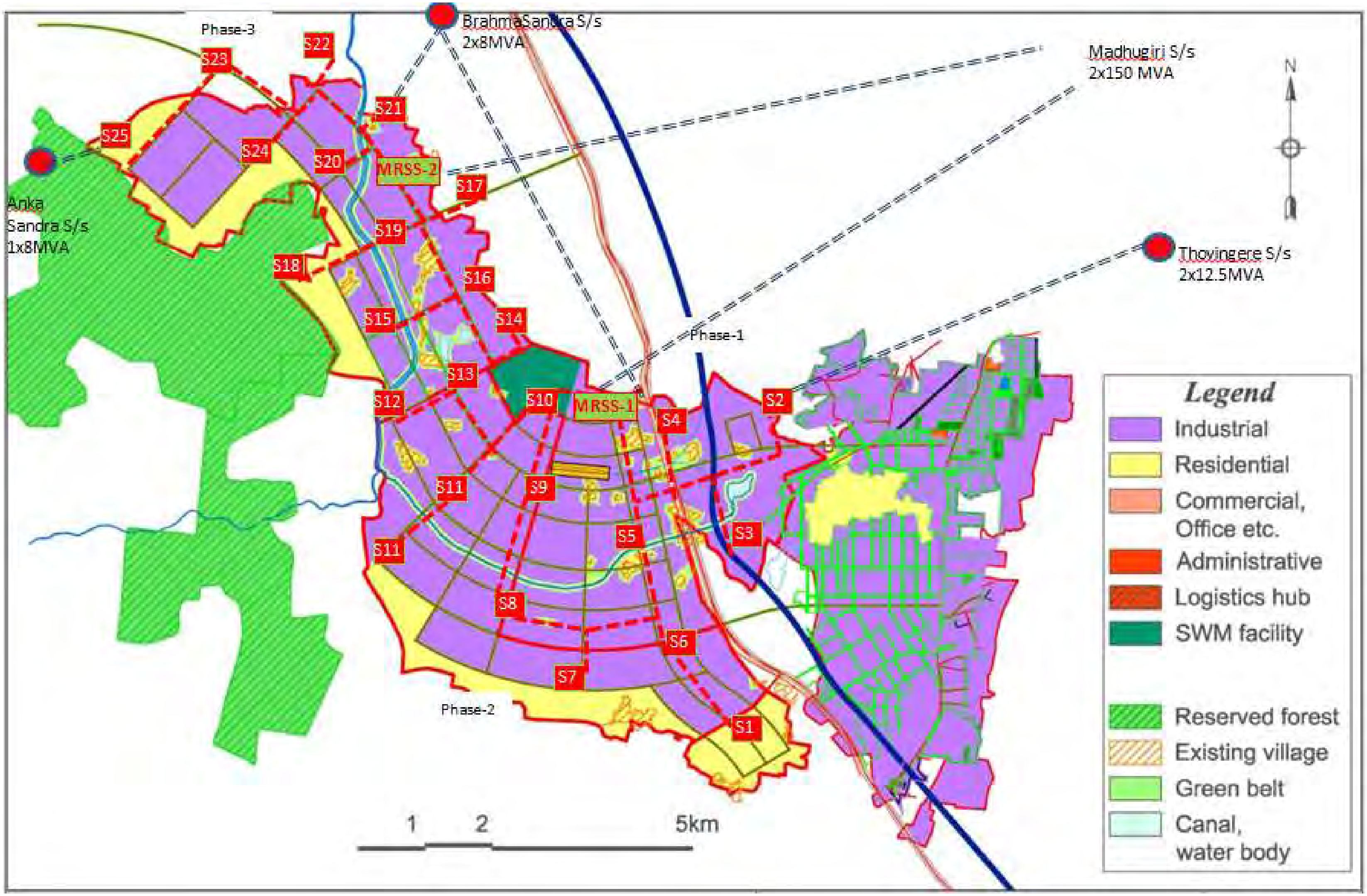


Figure 7.45: Proposed distribution network for the node superimposed on master plan for roads

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 Andhra Pradesh 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

At the present node doesn't have any planned conventional power projects coming up in the phase B/C. There would be in node captive renewable generation that consumers install in industries/homes. However, there are 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.

Table7.47: Renewable energy source: Expected capacity addition (MW)

Category	Total Demand (MW)	Maximum Installed Capacity from Renewable Energy Sources (MW)*
Phase A(2019)	74.66	13.53
Phase B (2024)	208.52	37.78
Phase C (2032)	462.52	83.81

Source: PwC Analysis

* *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 Madhugiri (220kV, 2X150 MVA) is 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 B/C, 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 7.48: Gap analysis for the node area.

Scenario	Total Demand (MW)	Supply (MW)	Gap (MW)
FY 2016	42,548	50,680	(8,132)
FY 2022	64,324	-	13,644
FY 2032	147,948	-	97,268

Source: PwC Analysis

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.

Some upcoming power plants which are viable sources of power for the node:-

- **Bidadi**: The Karnataka government has approved the proposal of Karnataka Power Corporation Limited (KPCL), the state-owned power generator, to procure liquefied natural gas (LNG) for the first block of its proposed 700 Mw Bidadi Combined Cycle Power Plant (BCCP). Its estimated cost is USD 700 million.

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 KPTCL.

2) Allowance of open access to the node at transmission level to ensure the procurement for adequate power for the node. Managed by KPTCL

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 B/C.

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 Discoms supply capacities subject to the Discoms 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 smart 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 Discoms licensee area, is almost similar across all regions owing to the Discoms 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 7.49: 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

Comparison parameters	*Distribution Franchisee*	PPP Model	Utility based procurement
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

Source: PwC Analysis

Table 7.50: 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 7.51: Contribution and benefits to Consumers, Discom and IBF

	Contribution	Benefits
Consumers	• Growth in consumption	• Improvement in services • Good quality 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

Source: PwC Analysis

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

"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

(* In case of Tumakuru, [Name of the Utility] is BESCOM)

7.4.8 Risk perspective for the plan

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.[43]

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.

[43] http://www.tutorialspoint.com/management_concepts/project_risk_categories.htm

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

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 smart 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 A elements and costs

Table 7.52: Elements and costs for Phase A

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
B	66kV Incoming Overhead line				
i	From 66kV Thovingere S/s to Proposed Substation (S2)	10	KM	33	330
ii	From 66kV Brahamsandra S/s to Proposed Substation (S4)	10	KM	33	330

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
C	66 kV Underground Feeders from MRSS and interconnections between 66/11kV Substations				
	Installation of 66 KV grade suitable for 66 KV earthed system linked polyethylene (XLPE) armoured Copper conductor cable in existing masonry cable trench on M.S. cable trays for Substation inter connection				
i	Substation S2 to S3	8	KM	56	448
ii	Substation S3 to S4	8	KM	56	448
iii	Substation S4 to S1	8	KM	56	448
	For S/s interconnection	16	KM	56	896
D	66/11kV Substation with following specifications	4	Nos.	600	2,400
i	2x10MVA Power Transformer				
ii	5 Numbers 66kV Breaker Panels, Compatible to SCADA				
iii	11 Numbers, 11kV indoor breaker panels, compatible to SCADA				
iv	Substation building and Substation SCADA automation				
E	11kV Distribution system				
i.	Installation of XLPE(E) 11KV insulated Aluminum 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	128	Km	38	4,864
F	Cable trench for Cable laying	100	Km	5	500
	Total				**10,664**

Source: PwC Analysis

In phase A and total cost of INR 10,664 lacs (Present Value) would be required.

Phase B elements and costs

Table 7.53: Elements and costs for Phase B

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
A	Main Receiving Substation				
	2x150MVA, 220/66kV GIS Based Substation	1	Nos.	9,000	9,000
B	220kV Incoming Overhead line				
i	220kV Incoming line to Main Receiving Substation (MRSS)	30	KM	58	1,748

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
C	66 kV Underground Feeders from MRSS and interconnections between 66/11kV Substations				
	Installation of 66 KV grade suitable for 66 KV earthed system linked polyethylene (XLPE) armoured Copper conductor cable in existing masonry cable trench on M.S. cable trays for Substation inter connection				
i	MRSS to 66/11kV Substations (S1 to S11)	88	KM	56	4,928
	For S/s interconnection	28	KM	56	1,568
D	66/11kV Substation with following specifications	7	Nos.	600	4,200
i	2x10MVA Power Transformer				
ii	5 Numbers 66kV Breaker Panels, Compatible to SCADA				
iii	11 Numbers, 11kV indoor breaker panels, compatible to SCADA				
iv	Substation building and Substation SCADA automation				
E	11kV Distribution system				
i.	Installation of XLPE(E) 11KV insulated Aluminum 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	224	Km	38	8,512
F	Cable trench for Cable laying	200	Km	5	1,000
	Total				**20,208**

Source: PwC Analysis

In phase B and total cost of INR 20,208 lacs (Present Value) would be required.

Phase C elements and costs

Table 7.54: Elements and costs for Phase C

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
A	Main Receiving Substation				
	2x150MVA, 220/66kV GIS Based Substation	1	Nos.	9,000	9,000
B	220kV Incoming Overhead line				
i	220kV Incoming line to Main Receiving Substation (MRSS)	30	KM	58	1,748
B	66kV Incoming Overhead line				
i	From 66kV Ankadandra S/s to Proposed Substation (S25)	10	KM	33	330
ii	From 66kV Brahmasandra S/s to Proposed Substation	10	KM	33	330

S.No.	Description	Quantity	Unit	Rate (Lacs)	Amount (Lacs)
	(S21)				
C	66 kV Underground Feeders from MRSS and interconnections between 66/11kV Substations				
	Installation of 66 KV grade suitable for 66 KV earthed system linked polyethylene (XLPE) armoured Copper conductor cable in existing masonry cable trench on M.S. cable trays for Substation inter connection				
i	MRSS to 66/11kV Substations (S12 to S25)	112	KM	56	6,272
	For S/s interconnection	56	KM	56	3,136
D	66/11kV Substation with following specifications	14	Nos.	600	8,400
i	2x10MVA Power Transformer				
ii	5 Numbers 66kV Breaker Panels, Compatible to SCADA				
iii	11 Numbers, 11kV indoor breaker panels, compatible to SCADA				
iv	Substation building and Substation SCADA automation				
E	11kV Distribution system				
i.	Installation of XLPE(E) 11KV insulated Aluminum 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	448	Km	38	17,024
F	Cable trench for Cable laying	200	Km	5	1,000
	Total				**35,832**

Source: PwC Analysis

In phase C and total cost of INR 35,832 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%[44] the average for the year 2010-14, till 2020 post which it is marginalized to 4%.

Table 7.55: Capital cost escalation (in INR lacs)

	Phase A	Phase B	Phase C
Capital cost	10,664	20,208	35,832
Capital cost with escalation	13,047	26,633	61,090

Source: PwC Analysis

[44] http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG/countries

Operation and Maintenance (O&M) cost varies for distribution companies. For estimation of O&M cost, ratio of Tangible Assets for BESCOM for the year 2013 and the corresponding R&M cost for the distribution for 2013 has been considered which stands at 3.8%. The O&M cost for Phase A; B and C are expected to be in the same ratios. [45]

Table 7.56: O&M cost and net cash outflow (in INR lacs)

	2013	Phase A	Phase B	Phase C
Fixed Assets/Cumulative capital cost with escalation	3,22,341	13,047	26,633	61,090
O&M cost	149	12	66	267
Total		13,059	26,699	61,357

Source: PwC Analysis

Net Cash outflow for Phase A would be INR 13,059 Lacs, for phase B would be INR 26,699 Lacs, for phase C would be INR 61,357 Lacs.

[45] *BESCOM Balance sheet and P&L account dt. 31st March 2013* (http://bescom.org/wp-content/uploads/2014/02/Annual-Accounts-2012-13.pdf)

7.5 Water

7.5.1 Sector Overview

Tumakuru Node is located in water-stressed area. In urban areas of Tumakuru and Sira Sub-Districts, where the node is located, the existing water supply systems does not satisfy the target unit water provision set by the national standard. Combined unit water supply amount in Tumakuru City and Sira City around is only 83 litter per day per capita (lpcd), while the target value is 135 lpcd. Major water resources for domestic use in Tumakuru City is a reservoir located 8 km from the city. However, the reservor's water is originated from the Gorur Dam which is located as far as 240 km from the city. This suggests absence of availabe water resource to meet the urban water demand. In rural areas around the node, domestic water resources are groundwater but the water table is reported to be deteriorated because of over exploiration. Industries in and around Tumakuru City are heavily relying on groundwater from their private wells. Total explitation of groundwater in the Tumakuru District for industrial purposes is 480.9 MLD, while the industrial water from surface water is only 0.7 MLD.

Wastewater management is not fully developed in the Tumakuru District. Only one sewage treatment plnat (STP) exists in the Tumakuru City but there is no other STP in the other areas including the surrounding areas of Tumakuru Node. As for the drainage system, the area around the node does not have flood prone area generally, because of the low annual rainfall and the undulating topograhic conditions which are advantageous in smooth drain of the stormwater.

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 Tumakuru Node.

i) Forecast of domestic water demand, industrial water demand, sewage generation and stormwater discharge in the node

ii) Determination of water resource balance to satisfy the domestic and industrial water demands

iii) 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

iv) Preparation of implementation plan to develop the water infrastructures

v) 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 Tumakuru 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 stormwater 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

Tumakuru Node will be developed by three phases which are the short term (by 2018), the middle term (by 2023) and the long term (by 2033). Accordingly, the estimation of water demand and sewage generation will target at the years 2018, 2023 and 2033.

Relevant Technical Standards

The development plan of each infrastructure is based on the follwoing technical standard.

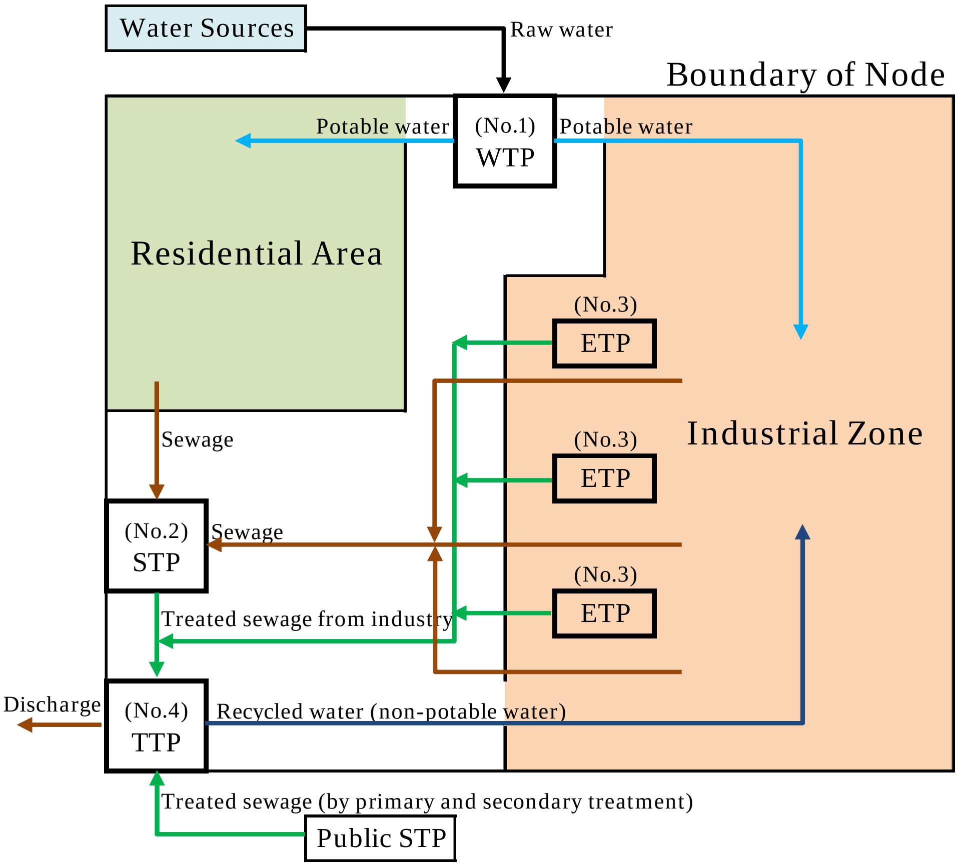
Table 7.57: Applicable Technical Standards for Water Infrastructure Plans

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 the figure below presents functions of the water treatment facilities in the node and the table below 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 7.58: Applicable Water Quality Standards for the Water Treatment 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 7.48), 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 Annex D.

7.5.4 Demand Forecast

The domestic water demand, the industrial water demand, the sewage generation and the stormwater discharge of Tumakuru Node are projected in order to estimate the requuired capacitiy and scale of each infrastructure.

Domestic Water Demand

The domestic water demand for the residential area is estimated with the follwoing formula:

(Domestic water demand for residential area) = (Target per capita water consumption) x (Target residential population)

Based on the Manual on Water Supply and Treatment prepared Ministry of Urban Development, the target unit water consumption is classified into three levels as described in the table below.

Table 7.59: Target Per Capita Water Supply Level

No.	Classification of towns / cities	Recommended Maximum Water Supply Level (LPCD)
1	Towns provided with piped water supply but without sewerage system	70
2	Cities provided with piped water supply where sewerage system is existing/contemplated	135
3	Metropolitan and Mega cities provided with piped water supply where sewerage system is existing/contemplated	150

Source: Manual on Water Supply and Treatment prepared Ministry of Urban Development

The proposed node will not be the Metropolitan or Mega city, however, both water supply system and sewerage system will be developed in the node, thus the node can be classified to the category No.2 and the target unit water consumption of the node is 135LPCD.

In addition, 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 above, in addition, water demand should consider water loss or water leakage, which is allowed up to 15% by the manual. In this study, water leakage is assumed at 10% of the total water demand. Including the water leakage, domestic water demand for the residential area and the industrial zone are estimated as shown in the table below.

Table 7.60: Domestic Water Demand of Tumakuru Node

Supply Destination	Unit Water Consumption (LPCD)	Year 2018		Year 2023		Year 2033	
		Population	Water Demand (MLD)	Population	Water Demand (MLD)	Population	Water Demand (MLD)
Residential People Excluding Employees	135	52,266	7.1	104,534	14.1	156,800	21.2
Employees from the inside of Node	135	41,067	5.5	82,133	11.1	123,200	16.6
Employees from the Outside of Node	45	74,807	3.4	187,380	8.4	375,165	16.9
Total			**16.0**		**33.6**		**54.7**
Including Water Loss			**17.8**		**37.3**		**60.8**

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 the international 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 Tumakuru Node is estimated as described in Table below.

Table 7.61: Industrial Water Demand of Tumakuru Node

Industrial Sector	Unit Industrial Water Demand	Year 2018		Year 2023		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	49	1.9	131	5.1	294	11.6
Medical Equipment	0.0043	0	0.0	0	0.0	0	0.0
Food Processing	0.0139	72	1.0	193	2.7	434	6.0
Textiles & Apparels	0.0312	139	4.3	371	11.6	835	26.0
Electrical Machinery	0.0029	49	0.1	131	0.4	294	0.9
Machinery	0.0025	49	0.1	131	0.3	294	0.7
Chemicals & Petrochemicals	0.0755	49	3.7	131	9.9	294	22.2
Pharmaceuticals	0.0043	152	0.7	496	2.1	914	3.9
Auto	0.0145	378	5.5	1,009	14.6	2,271	32.9
Computer, electronic and optical products	0.0087	72	0.6	191	1.7	429	3.7
Defence & Aerospace	0.0145	49	0.7	131	1.9	294	4.3
Total		**1,058**	**18.7**	**2,912**	**50.3**	**6,350**	**112.2**
Including Water Loss			**20.8**		**55.9**		**124.7**

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 consumption. Therefore, the sewage generation of Tumakuru Node is calculated as presented in Table 7.62.

Table 7.62: Sewage Generation of Tumakuru Node

Generation Source	Sewage Generation (MLD)		
	Year 2018	Year 2023	Year 2033
Residential People Excluding Employees	5.7	11.3	17.0
Employees from the inside of Node	4.4	8.9	13.3
Employees from the Outside of Node	2.7	6.7	13.5
Total	**12.8**	**26.9**	**43.8**

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 Tumakuru 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 7.48. Industrial effluent volume in the node is estimated as 70% of the industrial water consumption as presented in Table below for each phase.

Table 7.63: Industrial Effluent Generation of Tumakuru Node

Industrial Effluent	Effluent Generation (MLD)		
	Year 2018	Year 2023	Year 2033
Industrial Effluent	**13.1**	**35.2**	**112.2**

Source: JICA Study Team

Stormwater Discharge

(1) Stormwater 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 stormwater 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 7.64: 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	61-75
	- Low Density	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.

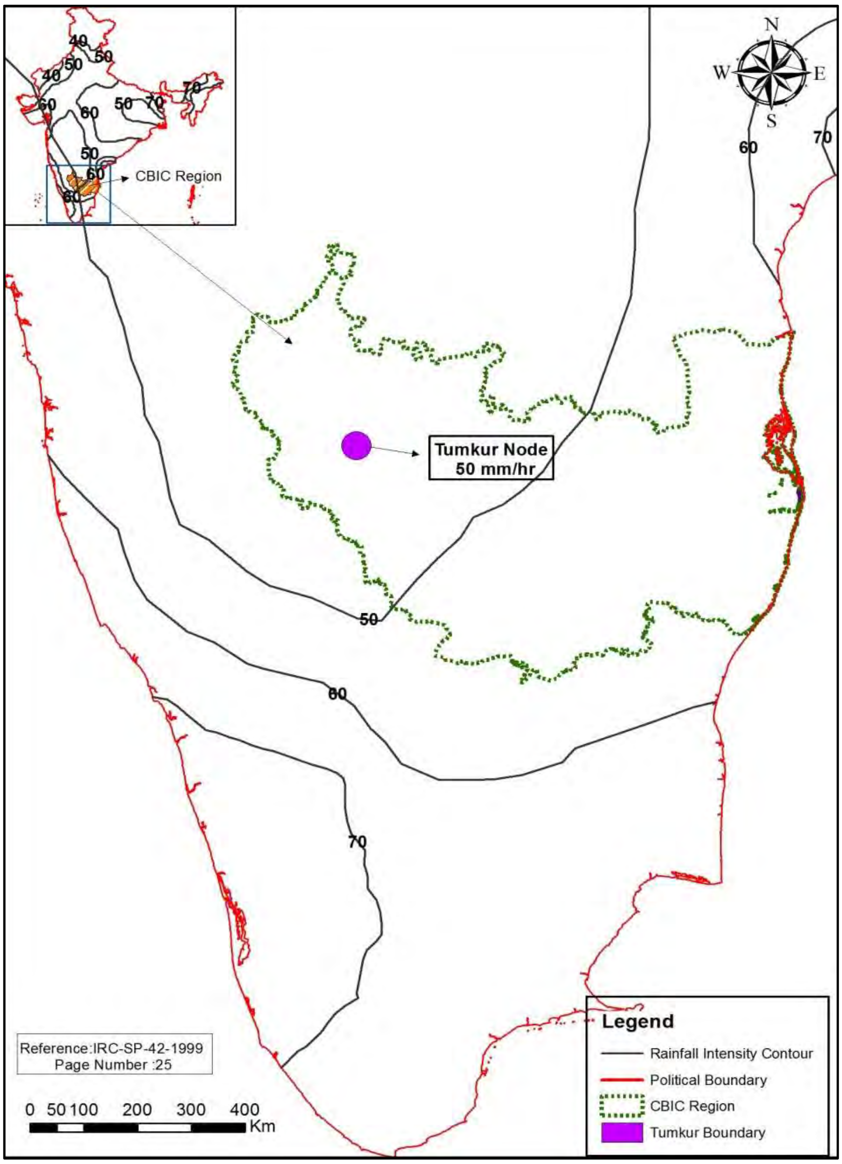
Source: *World Health Organization Publications on "Surface Water Drainage for low Income Communities" & Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) guidelines for "Standards / Requirements for SWD"*

(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.



Source: JICA Study Team

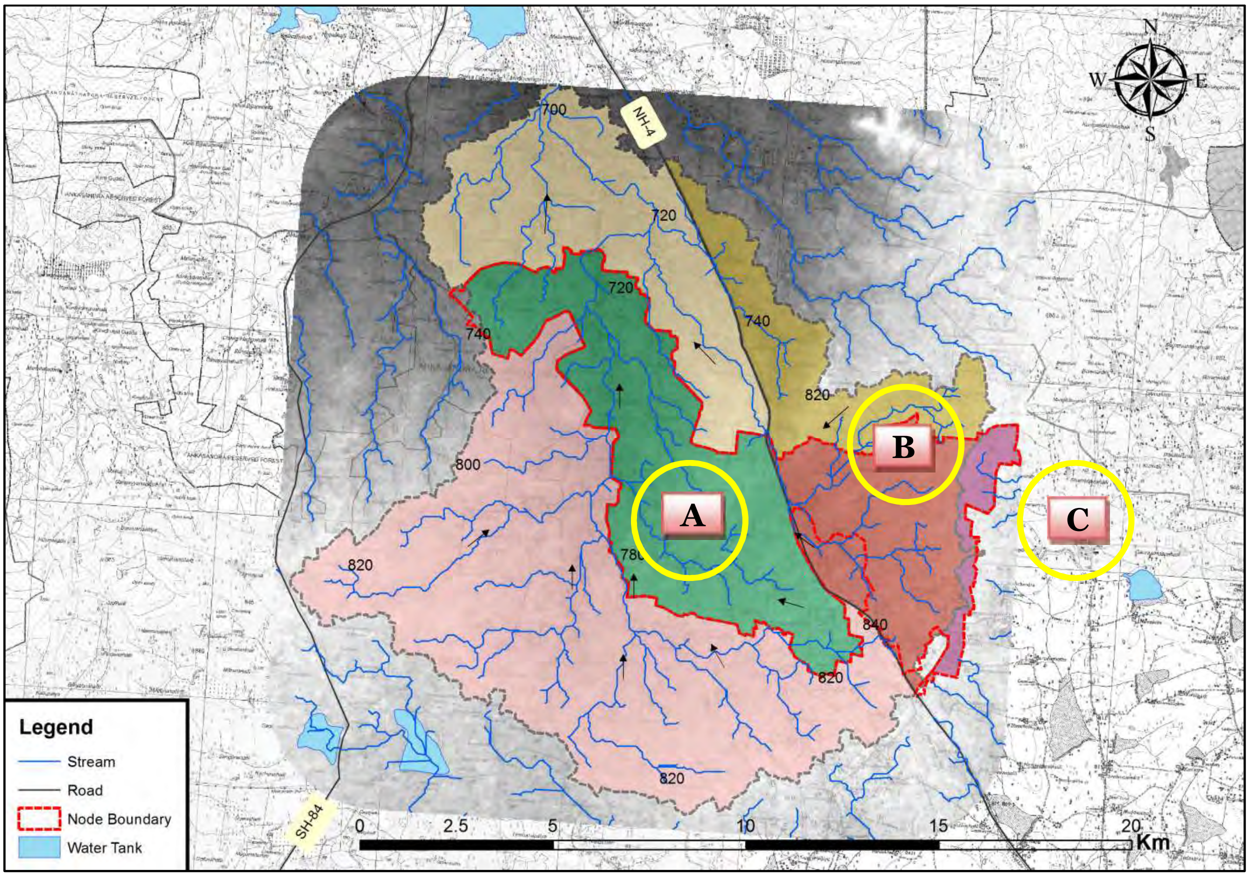
Figure 7.48: Rainfall in one hour as per IRC-42

From the figure above, the rainfall for one hour contours plotted, the intensity of rainfall for Tumakuru node is considered as 50mm/hr and the same value adopted for computing storm water discharge through rational formula.

(5) Drainage Basin Plan

The drainage basin plan for the catchment area for Tumakuru Node contributing to the storm run-off into the node presented in the Figure 7.48. Tumakuru Node is divided into two parts by National Highway (NH-4) from Begaluru to Chennai, as it being the ridge line. Drainage basin map for the node is prepared based on elevation data shown in the Figure 7.48 from the satellite image of Tumakuru node area. Tumakuru Node is divided into three drainage basins viz. A, B & C. Drainage basin “A” will flow from South to North and ultimately disposes to Hamavathy River towards Northern side of Node. Drainage basin, “B” flows from South-East to North and ultimately disposes to the Hamavathy River on Northern side of the node. Also, the basin “C” is smaller catchment among three and it flows from West to East and dispose to the water body on Eastern side of Drainage basin “C”. The drainage basins “A” contributes on the western portion of the node &

“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: Tumakuru Node Drainage Basin Plan

(6) Total Stormwater Discharge

Storm Water Discharge is computed using rational formula. Tumakuru node development area is divided into 8 sub-zones, C-I, C-II, C-III, C-IV, C-V, C-VI, C-VII & C-VIII based on the topography and the disposal of storm discharge. Summary of the storm water discharge in the collection network is presented in the Table 6.65.

Table 7.65: Summary of the Storm Water Discharge in each zone

Sl.No	Zone	catchment area (ha)	storm discharge (cum/s)
1.	C-I	600.15	50.01
2.	C-II	440.63	36.72
3.	C-III	251.96	21.00
4.	C-IV	823.51	68.63
5.	C-V	453.32	37.78
6.	C-VI	714.72	59.56
7.	C-VII	622.21	51.85
8.	C-VIII	205.34	17.11

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 7.5.2, based on the result of collection of relevant information, the candidate water sources for both potable water and non-potable water in Tumakuru Node are listed in Table below.

Table 7.66: Potential Water Sources for Tumakuru Node

Water source	Possible water use		Capacity	
	Potable	**Non-potable (Industrial)**		
Hamavathy Canal	✓	✓	100 MLD	Water reallocation to Tumakuru NIMZ
Rain water reservoir	✓	✓	3 MLD	to be developed in the node
Bugandahalli Reservoir	✓	✓	-	No allocation to the node so far
Secondary treated sewage at the existing STP in Tumakuru City		✓	24.5 MLD	Actual sewage volume in 2013: 16 MLD
Secondary treated sewage at the future STP in Tumakuru City		✓	28.29 MLD	2nd phase of the STP above (Planned completion: 2017)

Source: JICA Study Team

As for the Hamavathy Canal, the Government of Karnataka expressed in the Study's review meeting with DIPP that the government would allocate 100 MLD of water to Tumakuru NIMZ. It is re-allocation of water from Gorur Dam and will include additional water transmission facilities such as pumping facilities and additional water pipes or channels. The re-allocation is under approval process of the state government. Necessary projects to construct the addoitional facilities need to start from preparation of DPRs. If the Government of Karnataka compelete the approval procedure of the water re-allocation smoothely, the projects will possibly finish by the year 2018. However, it should be noted that 100 MLD will be allocated to the entire area of Tumakuru NIMZ instead of the Tumakuru Node. Tumakuru Node needs to share the water of 100 MLD with the existing industrial areas in the NIMZ. Also, it is to be noted that Water resources officials of Tumakuru have informed that they will suggest the intake location, upon receiving the official gezette for allocation of 100 MLD by GoK.

In addition, rainwater will be a possible water resource in the Tumakuru Node where the existing water resrouce is limited. It is an anlternative water resource in case the water from Hamavathy Canal is not available at early stage of the node's operation. Assuming the development area planned by 2018, possible water amount avaiable in the node is preliminary estimated in Table below. Available volume will be 3.0 MLD.

Table 7.67: Preliminary Estimation of Possible Rain Water Amount Available in the Tumakuru Node in 2018

	a	b	c	d	e	f	g1	g2	h
	Total area of rainwater reservoirs	Catchment	Annaul rainfall	Runoff coeffiient	Annaul flow into the reservoirs	Evaporation rate	Available water amount		Water depth of the reservoirs
	(ha)	(ha)	(mm/year)		(m^3/year)	(mm/day)	(m^3/year)	(MLD)	(m)
Case 1	15	680	400	0.6	1,632,000	10.0	1,084,500	**3.0**	5.4
Case 2	20	680	400	0.6	1,632,000	10.0	902,000	**2.5**	4.1
Case 3	25	680	400	0.6	1,632,000	10.0	719,500	**2.0**	3.3
Remarks		70% of the developed areas	Min. rainfall in the district since 2001: 417	*1	(b x 10^4) x (c/1000) x d	*2	e - (a x 10000 x f x 365/1000)	g1/365	(e/2) / (a x 10000) *3 *4

*1: Runoff coefficient of industrial zone & residential area with narrow green spaces is applied which is based on the Japanese guideline of planning and design of sewerage facilities.

*2: Evaporation rate is estimated from the following empiric formula. --> L=C(Pw-Pa)A

L: evaporation amount, C: coefficient, Pw: saturated steam pressure at the target temperature,

Pa: steam pressure at the target temperature and humidity, A: surface area of reservoir

*3: Water depth is estimated assuming a half-year amount should be retained in the reservoir because the dry season is six month (half a year).

*4: Water depth of reservoir will be 3 to 6m with consideration for the ease of construction works of underground structures.

Source: JICA Study Team

Bugadhanahlli Reservoir supplies frashwater for potable water to Tumakuru City. At present, there is no plan to allocate the reservoir's water to Tumakuru NIMZ or the Tumakuru Node. However, if there is not sufficient amount of freshwater for the people who live in or work in Tumakuru NIMZ, the reservoir will be one of the alternative water resources to NIMZ. According to the Water Resrouces Department of Karnataka State Government,water allocation to Bugadhanahlli Reservoirs is 1.1246 TMC (87 MLD). On the other hand, domestic water demand in Tumakuru City is estimated at 73.3 MLD in 2031 according to the DPR on Improvement Project to Tumakuru Water Supply in November 2013 by KUWS&DB. Therefore, about 14 MLD of freshwater in Bugadanahalli Reservoir may be available for Tumakuru NIMZ in 2031. This reservoir is expected as one of the alternative water resources in case the water from Hamavathy Channel is not available for a shrt term.

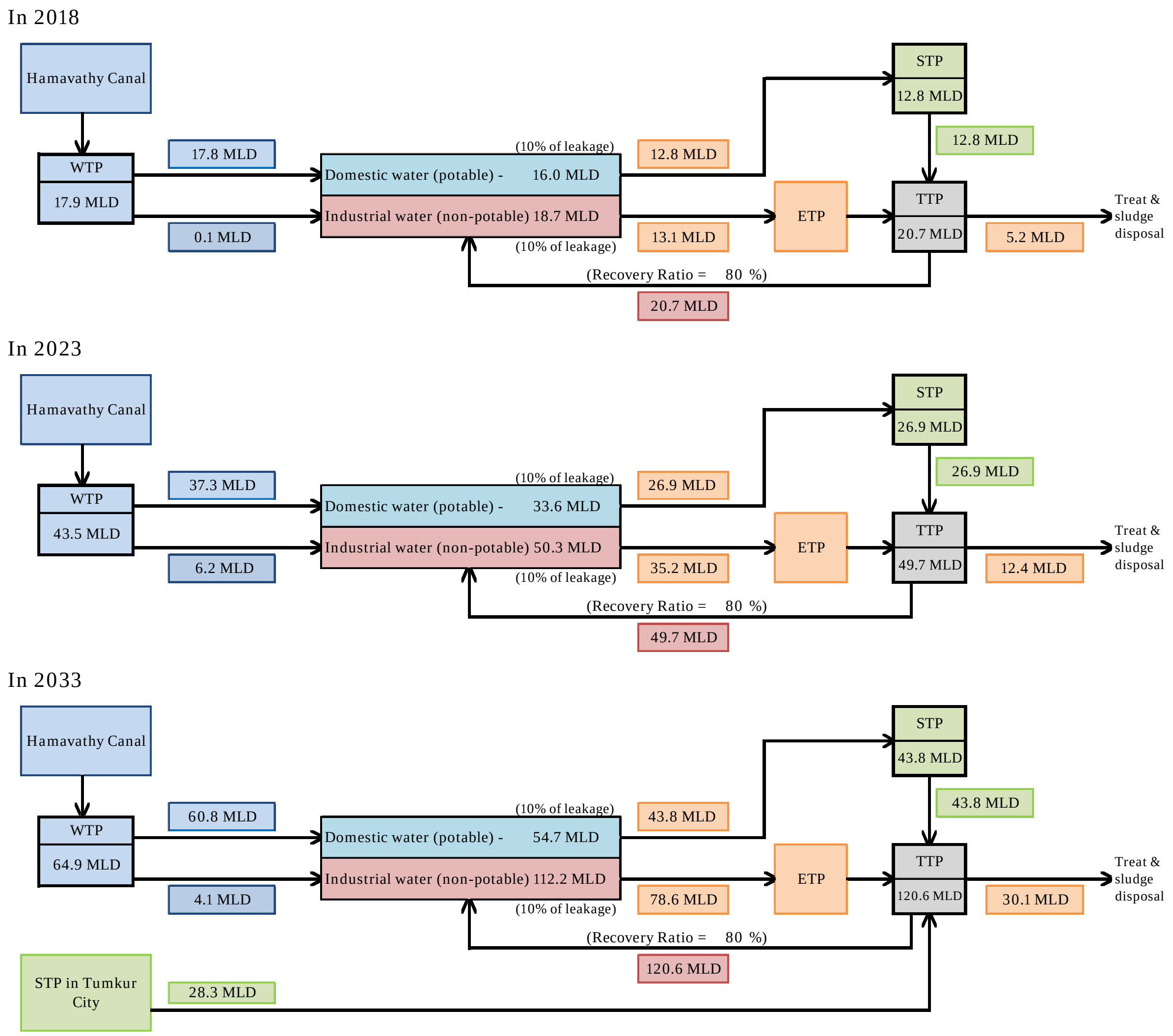
Treated sewage from STP in Tumakuru City is also a potential water resource for Tumakuru Node. The existing STP in Tumakuru City has a capacity of 24.5 MLD and expansion of the STP by an additional capacity of 28.29 MLD is planned. Sewage treatment method in the existing STP is aerated lagoon, while the additional portion of the STP is planned as sequencing batch reactor (SBR). Treated sewage from the existing STP will be around 50 mg/L in BOD but the additional STP by SBR will achieve better water quality of less than 20 mg/L in BOD constantly. After completion of the expansion of the STP, therefore, utilization of the treated water from the expanded portion should be prioritized more than that from the existing portion of the STP. It is noted that KIADB has a similar plan to supply secondary treated sewage from the existing STP in Tumakuru city to the existing industrial area in Tumakuru NIMZ according to DPR of the treated sewage transfer project.

For recycle of the treated sewage including treated sewage in the node and that from Tumakuru City, the node will have a tertiary treatment plant (TTP) by reverse osmosis (RO) process. 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.

Combining the possible water sources above, water balance of Tumakuru Node is proposed in Figure 7.51. Expected water supply amount of the water sources by water use is summarized in Table 7.68. Locations of the water sources are presented in Figure 7.53.

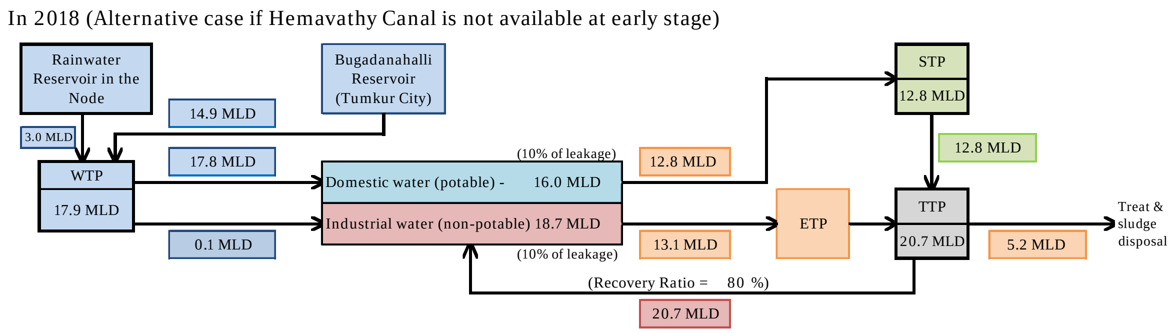
The proposed water balance is based on the following considerations:

- Water allocation from Hamavathy Canal and necessary construction works to transmit the water to Tumakuru NIMZ are assumed to be completed by 2018.
- Fresh water from Hamavaty Canal will be used preferentially to the treated sewage from the STP in Tumakuru City. Hence recycle of the treated sewage from the STP in Tumakuru City will start from 2033.
- Because of the higher treated water quality, utilization of treated sewage from the STP in Tumakuru City is limited to that from the expanded unit of the STP by SBR process. If much water is necessary from the STP, treated sewage from the existing unit (24.5 MLD at maximum) can be additionally used.
- Ultimate water use from Hamavathy Canal is 64.9 MLD in 2033. It is assumed that the surplus (about 30 MLD) will be used in the existing industrial areas of Tumakuru NIMZ (eastern part of the NIMZ).
- In case that Hamavathy Canal is not available for Tumakuru Node by 2018, utilization of the other water sources, which are rainwater and Bugadhanahlli Reservoir, is necessary. Water balance in such a case is illustrated in Figure 7.52.



Source: JICA Study Team

Figure 7.50: Water Balance of Tumakuru Node



Source: JICA Study Team

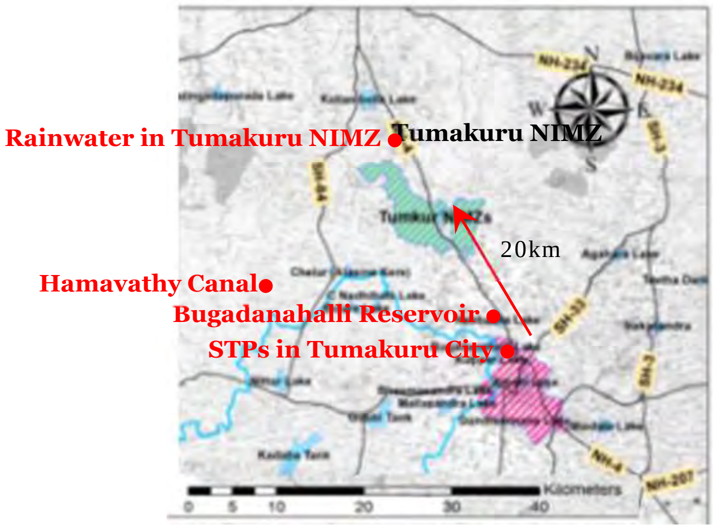
Figure 7.51: Water Balance of Tumakuru Node in 2018 (Alternative Case if water from Hamavathy Canal is not available by 2018)

Table 7.68: Supply Amount of Water Sources for Tumakuru Node by Phase

Use	Water Source	Supply Amount (MLD)			
		Year 2018		Year 2023	Year 2033
		Basic case	Alternative case*		
Domestic use	Hamavathy Canal	17.8	0.0	37.3	60.8
	Rainwater Reservoir in the node	-	3.0	-	-
	Bugadhanahlli Reservoir	-	14.9	-	-
Industrial process	Hamavathy Canal	0.1	0.0	6.2	4.1
	Treated sewage of STP in Tumakuru City	0.0	0.0	0.0	28.3

*In case that water from Hamavathy Canal is not available in the node (2018)

Source: JICA Study Team



Source: JICA Study Team

Figure 7.52: Location of Water Sources of Tumakuru Node

Water Treatment Technologies & Processes

(1) Selection of Water Treatment Processes

In Tumakuru Node, the following treatment plants are required to be developed newly.

1) Water Treatment Plant (WTP) to receive the rainwater in Tumakuru NIMZ, treat it appropriately and supply the potable water to both the residential area and the industrial zone

2) Sewage Treatment Plant (STP) to receive the domestic sewage from the residential area and the industrial zone and treat them primarily and secondarily

3) Tertiary Treatment Plant (TTP) to receive the secondary treated sewage from the STPs and treat it tertiarily in order to recycle the sewage for industrial processes

In order to meet the required water quality explained in subsection 6.5.3.3, the Study proposes the water treatment processes to the different types of the teratment plants above as presented in Table below.

Table 7.69: Selected Water Treatment Processes for Tumakuru Node

Water source	Treatment Process	Remarks
Water Treatment Plant (WTP)	Rapid sand filtration process	Flocculation, coagulation, sedimentation and filtration
Sewage Treatment Plant (STP)	Conventional activated sludge process	Sedimentation and biological treatment
Tertiary Treatment Plant (TTP)	Reverse osmosis (RO) process	Flocculation, coagulation, sedimentation, UF, and RO

Source: JICA Study Team

Rapid sand filtration process, which will be applied to WTP in the node, is a very common treatment process for drinking water suppy purpose in the world. WTP of the rapid sand filtration process consists of grit chamber, chemical mixing tank, flocculation tank, sedimentation tank, rapid sand filtration tank and chlorine implantation tank.

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 Reverse Osmosis (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 touch 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 Tumakuru Node for the following reasons:

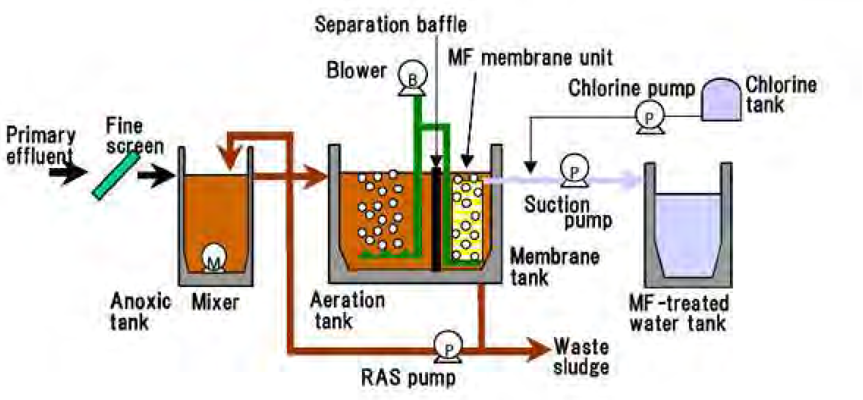
- In order to ensure the maximum utilization of water resources in the node, water recycle system in the node should be controlled by the node operator comprehensively. For that reasons and achieve lower unit prices by enhancing the scale merit, the water recycle system should attract the industries 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 24 billion INR even for Phase A. 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 below. 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 7.53: System configuration of MBR

2) High Efficiency RO (HERO)

This technology is one of the RO processes 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

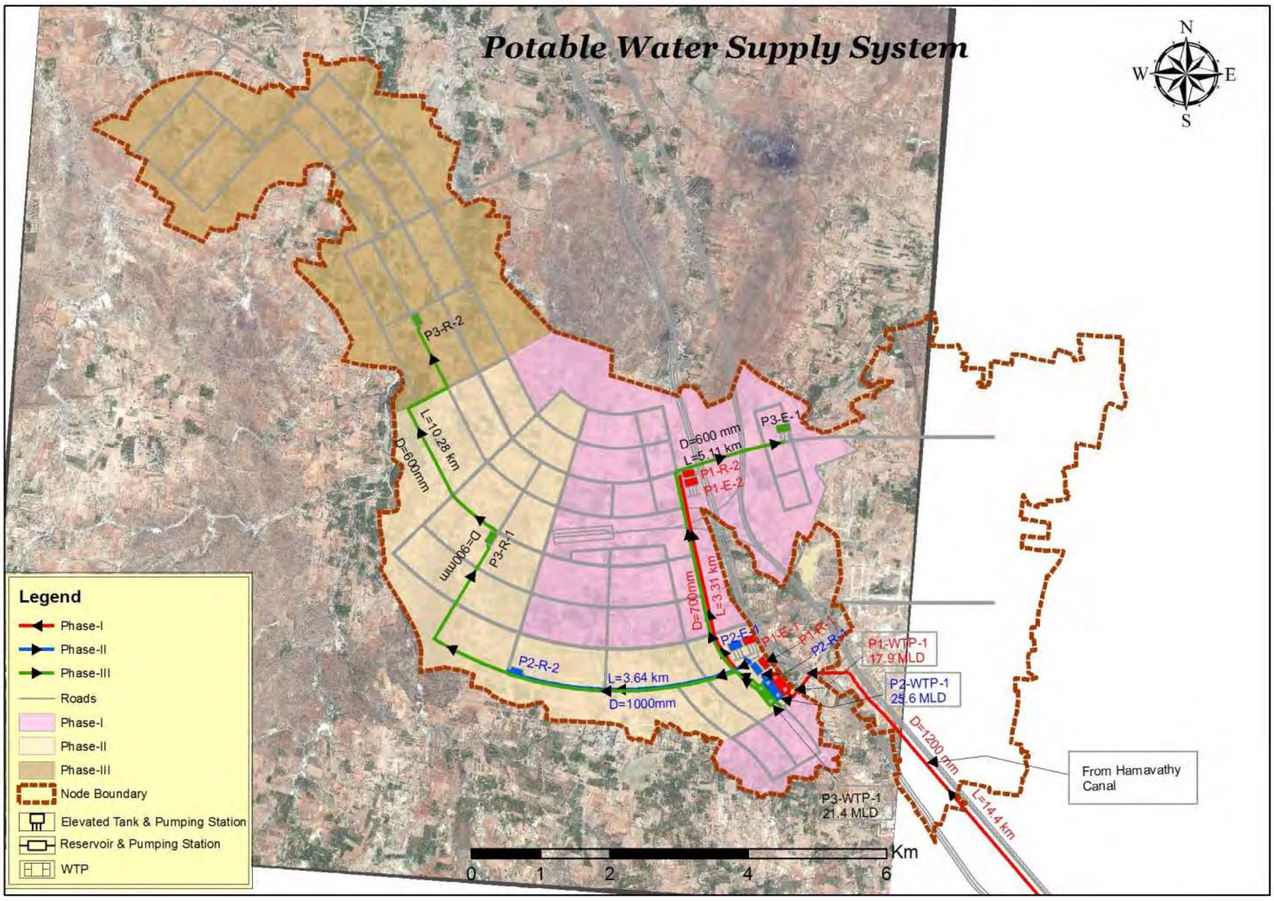
(1) Layout Plan and System Outlines

Layout plan of potable water supply system for Tunkur Node is illustrated in Figure 7.55 and outlines of the major facilities in the system are presented in Table 7.70.

Water treatment plant (WTP) will be located near the entrance gate of the Phase A residential area at the south-eastern end of the node area which is the most strategic point to receive the raw water from Hamavathy Channel. Also, this location is the most advantageous point in the node for water distribution because of its highest elevation. Necessary land area for the WTP for pahse 1 to 3 will be 2.4 ha. Reservoirs, pumping stations and elevated tanks to be constructed in the same premises as the WTP will be 1ha. Totally, about 3.5 ha will need to be secured for water supply facilities near the south-eastern entrance for the residential area.

Water transmission and distribution system in the node will basically have independent system for each development phase. Exceptionally water transmission line to the western Phase C area will be extended from that for Phase B at the reservoir P2-R-2. Reservoirs, pumping stations and elevated tanks for the area around the WTP will be located in the same premises as the WTP, while the other facilities will be located at the isolated locations.

Because of the advantageous location of the WTP, potable water from the WTP will be distributed by gravity via the reservoirs P2-R-2, P3-R-1 and P3-R-3, which distribute the water to most area of the phases 2 and 3.



Source: JICA Study Team

Figure 7.54: Layout Plan of Potable Water Supply System

Table 7.70: Outlines of the Potable Water Supply Facilities

Facility	Outlines/Capacity			Remarks
	Phase A	Phase B	Phase C	
Raw water conveyance system	DIP*1, D=1,200 mm L=14.4 km Pump motor output: 600 kW in total	-	-	From Hamavathy Channel
Water Treatment Plant (WTP)	17.9 MLD	25.6 MLD	21.4 MLD	Rapid sand filter
Reservoir	5.5 ML 3.5 ML	6.5 ML x 2	5.5 ML x 2	
Pumping station	2 locations	1 location	1 location	
Elevated Tank	1.5 ML 1.0 ML	1.75 ML	0.5 ML	Height: 15 to 25 m
Water transmission pipeline	DIP*1 D=700 mm L= 3.03 km	DIP*1 D=1000 mm L=4.24 km	DIP*1 D=600 - 900 mm L=10.46 km	
Water distribution pipeline	HDPE*2 D=150-300 mm 96.0 km	HDPE*2 D=150-200 mm 53.80 km	HDPE*2 D=150-300 mm 85.60 km	

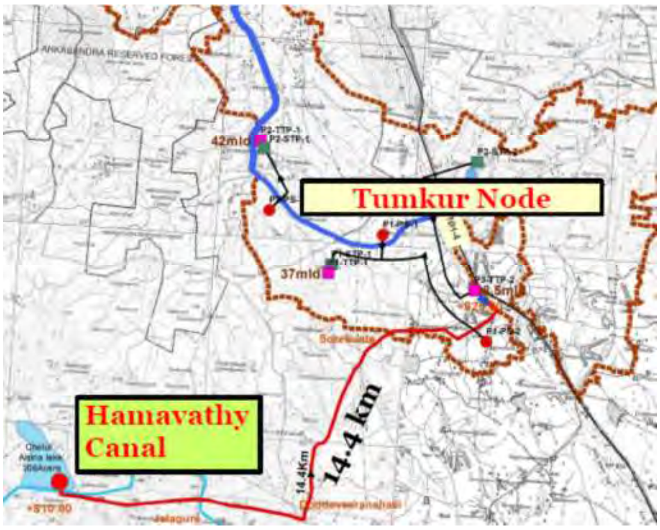
*1: DIP: Ductile iron pipe

*2: HDPE: High density polyethylene pipe

Source: JICA Study Team

(2) Plan of Raw Water Conveyance Pipeline

In order to receive freshwater from Hamavathy Channel, 14.4 km of water conveyance pipeline will be constructed as illustrated in Figure 7.56. Elevation of water intake point from the Hamavathy Channel is about +810, while the elevation of the WTP in the node is about +825. The raw water will be transfered to the node with a pumping station to be constructed near the water intake. From preliminary assumption that the velocity will be about 1.0 m/s, diameter of the raw water pipe is calculated as below:



Source: JICA Study Team

Figure 7.55: Layout of Raw Water Conveyance Pipeline from Hamavathy Channel to Tumakuru Node

$D = (4a/\pi)^{1/2}$, $a = Q/v$,

Where,

D: Diameter of pipe (m)

a: Cross-section area of pipe (m^2)

Q: Design sewage flow (m^3/s) = 100 MLD = 1.1.6 m^3/s

v: Velocity of sewage flow (m/s) (Assumption: 1.0 m/s)

Based on the above formula, the diameter of the water conveyance pipeline is estimated 1.2m. By Hazen-Williams formula and the difference in the elevations of the water intale and the node, in addition, necessary total pump head for the raw water conveyance will be about 30 m. Motor output of the raw water pump will be approximately 600 kW.

(3) Plan of Water Treatment Plant

The ultimate capacity of the water treatment plant in the node will be 79.3 MLD, which will be develped by three phases. The first phase will be 24.5 MLD by 2018 and the additionaly capacities in the second and third phases will be 33.6 MLD by 2023 and 21.2 MLD by 2033 as presented by the water balance in Figure 7.71.

(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 Tumakuru 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 CPHEEC'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

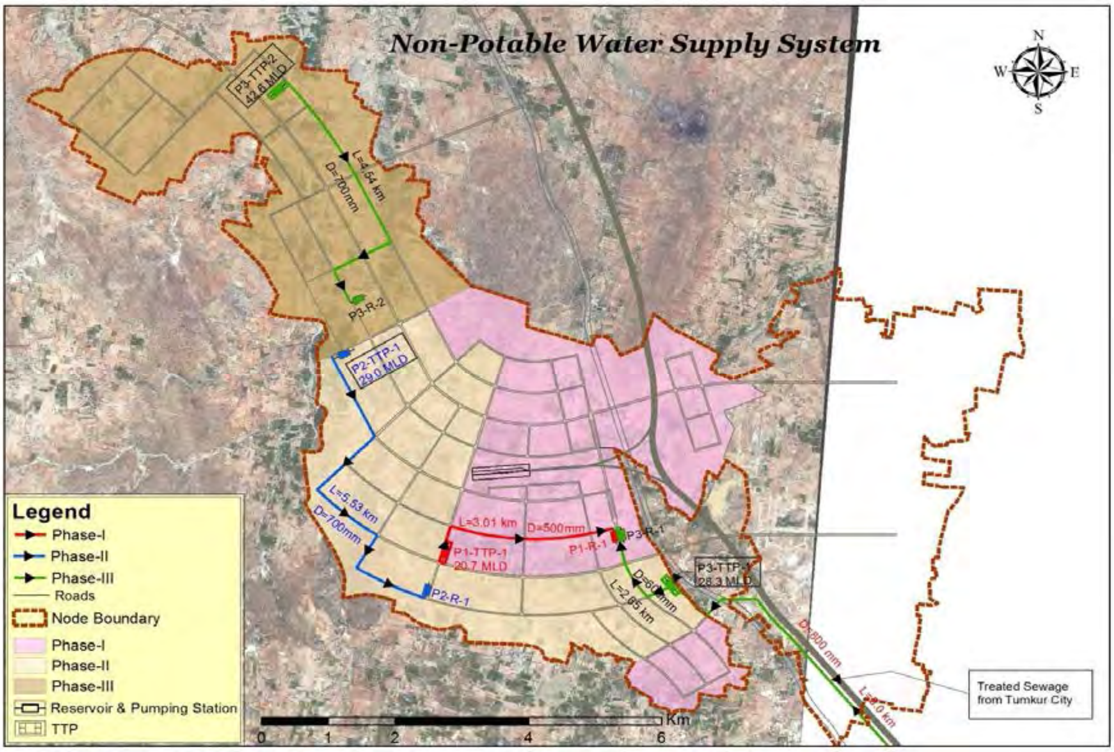
(1) Layout Plan and System Outlines

Non-potable water supply system will supply recycled water for industrial purposes. Layout plan of the non-potable water supply system for Tumakuru node is illustrated in Figure 7.57 and outlines of the major facilities in the system are presented in Table 7.71.

The non-potable water supply system in the node will have four tertiary treatment plants (TTPs), of which two TTPs are for Phase A and 2 respectively and the other two TTPs are for Phase C. One TTP will be constructed in each phase to recycle the treated sewage from the STP nearby. In Phase C, additionally, the other TTP will be constructed, which will receive the treated sewage from the STP in Tumakuru City.

TTPs to receive the treated sewage from the STPs in the node will be located at the lowest point in the development area for each phase. This location of the TTP will enable integrated operation and maintenance of the STP and TTP for each phase. The TTP to receive the treated sewage from the STP in Tumakuru City will be located at the sout-eastern end of the node.

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. The non-potable water produced in the TTPs will be pumped up to reservoirs which will be located at high elevations. The reservoirs will basicaly distribute the non-potable water by gravity to their distribution areas. To some high elevation areas, pumping stations to be constructed beside the reservoirs will distribute the non-potable water.



Source: JICA Study Team

Figure 7.56: Layout Plan of Non-Potable Water Supply System

Table 7.71: Outlines of the Non-Potable Water Supply Facilities

Facility	Outlines/Capacity			Remarks
	Phase A	Phase B	Phase C	
Tertiary Treatment Plant (TTP)	20.7 MLD	29.0 MLD	42.6 MLD 28.3 MLD	UF + RO
Reservoir	10.0 ML	14.5 ML	14.0 ML 21.0 ML	
Pumping station	1 location	1 location	2 locations	
Water transmission pipeline	DIP*1 D=500 mm L= 3.01 km	DIP*1 D=700 mm L=5.53 km	DIP*1 D=700 mm L=4.54 km	
Water distribution pipeline	HDPE*2 D=150-300 mm L=96.0 km	HDPE*2 D=150-200 mm L=53.8 km	HDPE*2 D=150-300 mm L=85.6 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)

As shown in Table 7.70, Tumakuru Node will have four TTPs. All phases will have one TTPs to receive treated sewage from the STPs in the node, respectively. In addition, Phase C will have the other TTP, which will receive treated sewage from the STP in Tumakuru City. Treatment process of the TTPs is RO process, which will have pre-treatment system of UF.

(3) Plan of Water Treatment and Distribution Facilities

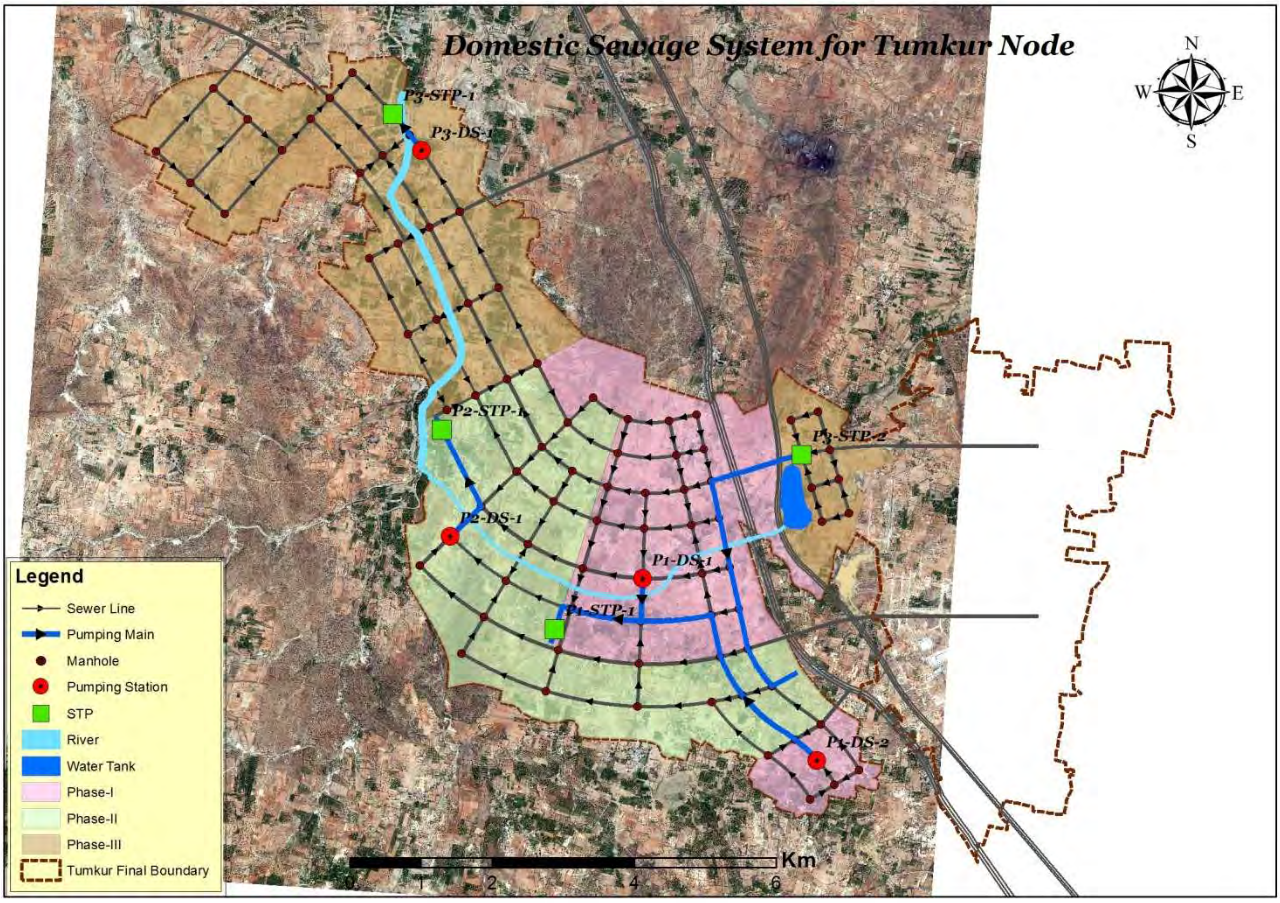
Water transmission and distribution facilities which include reservoris, water transmission pipes and water distribution pipes are planned by the same conditions and methodologies as the potable water supply system.

Plan of Sewerage System

(1) Layout Plan and System Outlines

Layout plan of sewerage system for Tumakuru node is illustrated in Figure 7.58 and outlines of the major facilities in the system are presented in Table 7.72.

Tumakuru Node will have independent sewerage system for each phase. Phases 1 and 2 will have one sewerage system respectively. On the other hand, Phase C will have two independent systems, one of which will cover the main western part of the Phase C area and the other will cover the eastern isolated area. STPs will be located at the lowest point in the development area for each phase, where the TTPs will also be located. Treated sewage from the STPs will be transfered to the TTPs nearby for recycle.This location of the STP will enable integrated operation and maintenance of the STP and TTP for each phase.



Source: JICA Study Team

Figure 7.57: Layout Plan of Sewerage System

Table 7.72: Outlines of the Sewerage Facilities

Facility	Outlines/Capacity			Remarks
	Phase A	**Phase B**	**Phase C**	
Sewage Treatment Plant (STP)	12.8 MLD	14.1 MLD	12.9 MLD 4.0 MLD	Conventional activated sludge process
Lift pump station	2 location	1 location	1 location	
Sewer pipe	RC Pipe* D=250–700mm L=100.20 km	RC Pipe* D=250–800mm L=55.60 km	RC Pipe* D=250–900mm L=86.60 km	

*: RC: Reinforced concrete pipe

Source: JICA Study Team

(2) Plan of Sewage Treatment Plant

As shown in Table 7.72, Tumakuru Node will have four STPs. Treatment process of all STPs is conventional activated sludge method. Treated sewage will be transfered to the TTPS to be recycled for industrial purposes.

(3) 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)

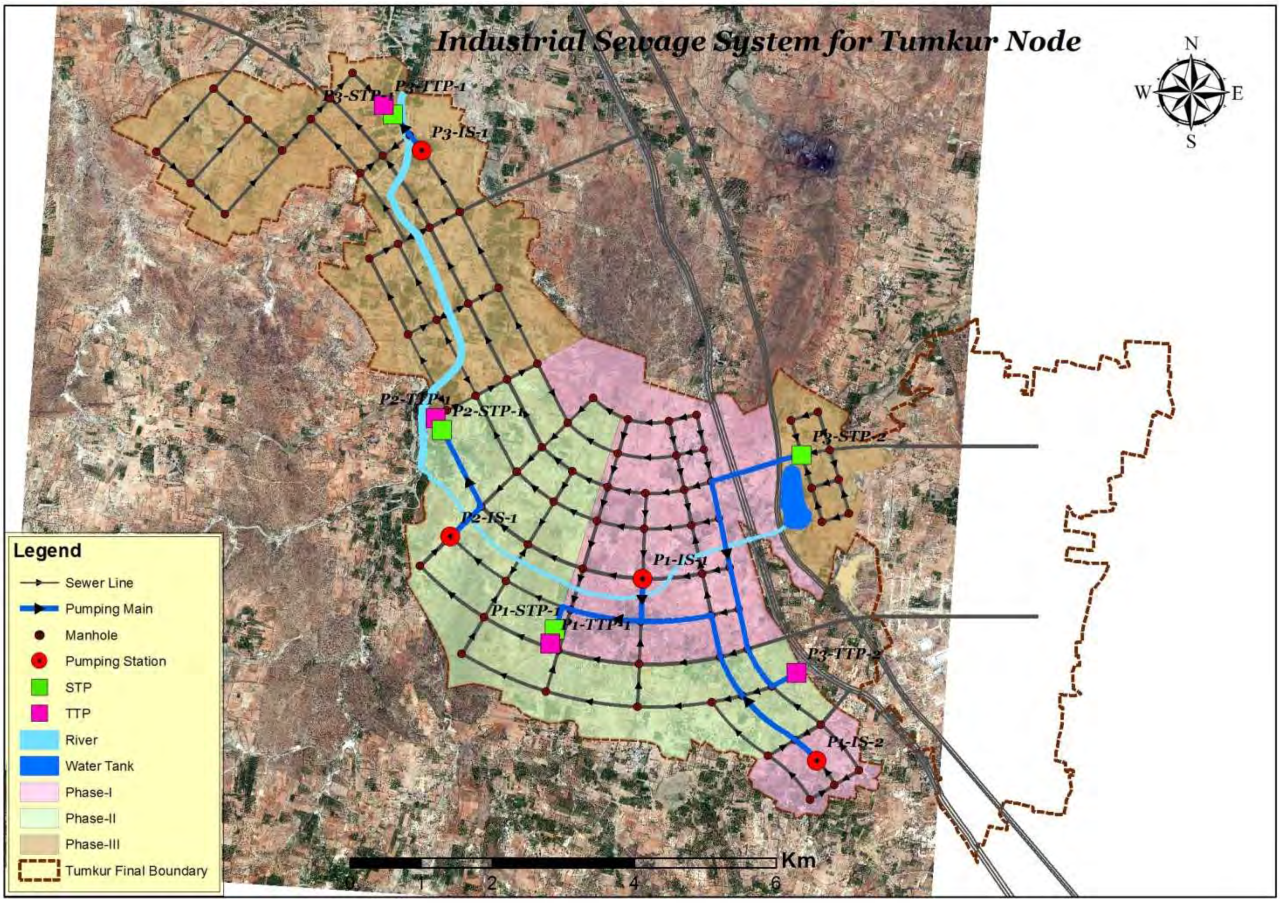
D: Diameter of pipe (m)

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 and transfer 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 Tumakuru node is illustrated in Figure 7.59 and outlines of the major facilities in the system are presented in Table 7.73. 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 7.58: Layout Plan of Industrial Effluent Collection System

Table 7.73: Outlines of Industrial Effluent Collection Facilities

Facility	Outlines/Capacity			Remarks
	Phase A	**Phase B**	**Phase C**	
Lift pump station	2 location	3 location	5 Location	-
Sewer pipe	RC Pipe* D=300–700mm L=100.20 km	RC Pipe* D=300–900mm L=55.60 km	RC Pipe* D=300–1100mm L=86.60 km	-

*: 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 Stormwater Drainage System

(1) Layout Plan and System Outlines

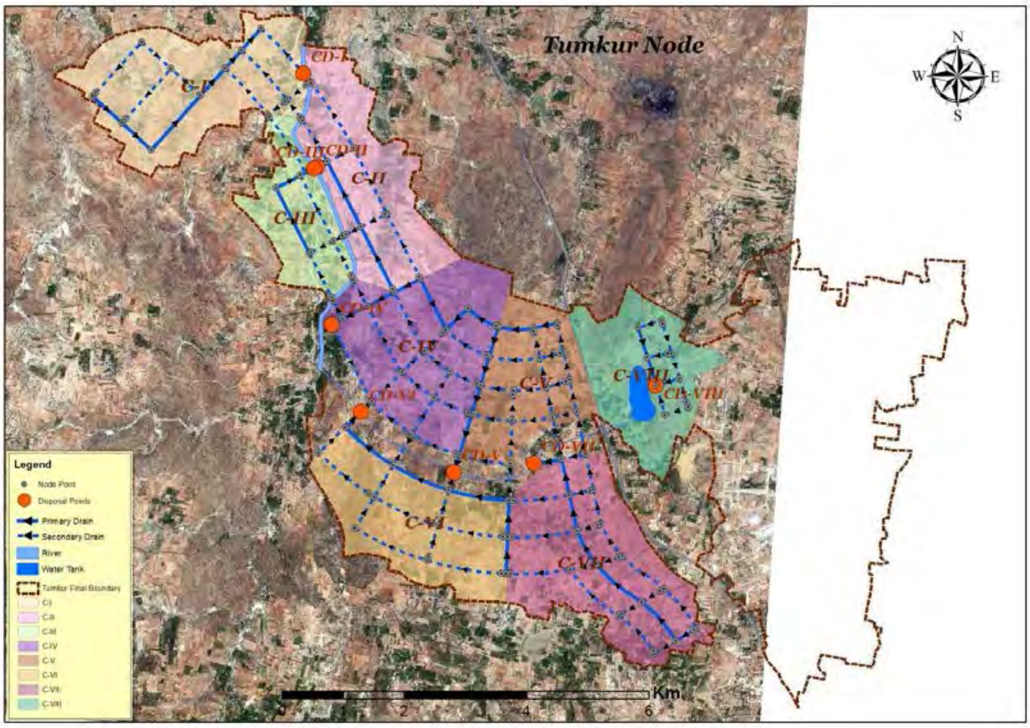
Stormwater diranage system is to drain the storm run-off from Tumakuru node during rainfall and manage the storm water entering into the node area and from other areas in the catchment. Layout plan of the stormwater drainage system for Tumakuru node is illustrated in Figure 7.60 and its phase-wise development plan is presented in Figure 7.61. System outlines are given in Table 7.74 and dimensions and length of drainage facilities are summarized in Table 7.75.

The proposed storm water in the node the node is divided into 8 drainage zones which are C-I, C-II, C-III, C-IV, C-V & C-VI. These zones will ultimately dispose stormwater to Hamavathy canal, with their respective disposal points denoted from CD-I to CD-VIII.

The storm water collection network length for Zone C-I is 24.92 km, C-II is 15.74 km, C-III is 11.90 km, C-IV is 32.38 km, C-V is 24.40 km, C-VI is 25.88 km, C-VII is 32.28 km and the length of network for C-VIII is 9.20 Km aligned on both sides of the road. The disposal points for all the zones from CD-I to CD-VIII are shown in the Figure 7.57 and suitable Outfall structures are to be constructed at disposal points.

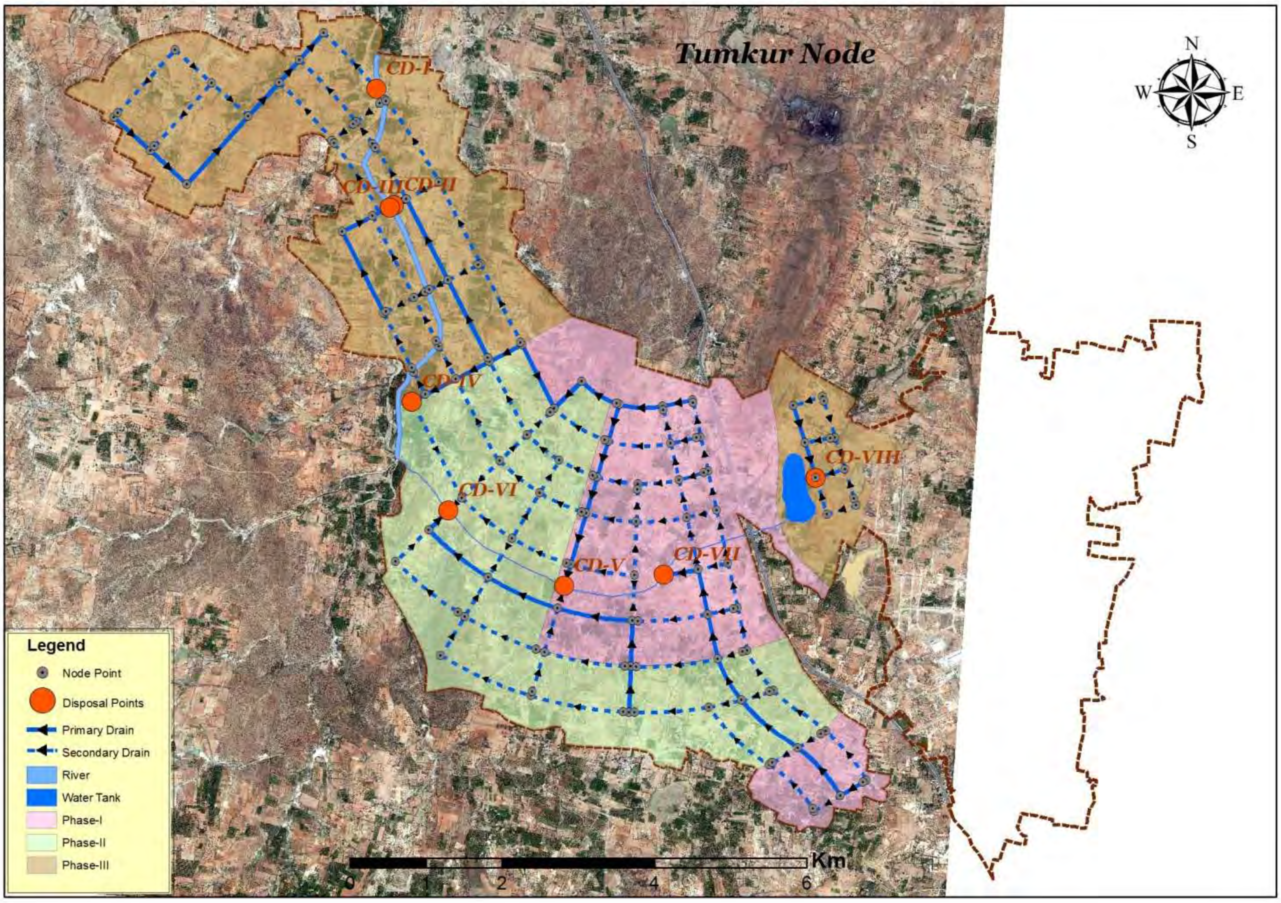
It is to be noted that the existing Hamavathy canal is to be improved to carry the run-off due to node development in order to ensure the safe conveyance of the storm discharge without creating any backflow or flooding. Also, it is necessary to develop the bunds of the canal with green belt along the canal on both sides to avoid erosion of soil during storm.

Existing water body on Eastern side of node will be used as disposal for the run-off collected in zone C-VIII and it is envisaged to improve this water body, which can be utilized for raw water storage reservoir upon requirement.



Source: JICA Study Team

Figure 7.59: Layout Plan of Stormwater Drainage System



Source: JICA Study Team

Figure 7.60: Phase Development Plan for Stormwater Drainage System

Table 7.74: Outlines of the Stormwater Drainage System

Sl.No	Zone	catchment area (ha)	storm discharge (cum/s)	Length of network (m)	Name of Disposal	Disposal
1.	C-I	600.15	50.01	24.92	CD-I	Hamavathy canal
2.	C-II	440.63	36.72	15.74	CD-II	
3.	C-III	251.96	21.00	11.90	CD-III	
4.	C-IV	823.51	68.63	32.38	CD-IV	
5.	C-V	453.32	37.78	24.40	CD-V	Canal
6.	C-VI	714.72	59.56	25.88	CD-VI	Canal
7.	C-VII	622.21	51.85	32.28	CD-VII	Canal
8.	C-VIII	205.34	17.11	9.20	CD-VIII	Water body
	Total	**4111.84**	**342.66**	**176.70**		

Source: JICA Study Team

Table 7.75: Sizes of Stormwater Drains

Size of the Drain (m x m)	Length (km)
1.00 x 1.00	70.57
1.50 x 1.00	16.91
1.00 x 1.25	4.74
1.50 x 1.25	13.08
2.00 x 1.25	10.34
2.50 x 1.25	4.67
1.50 x 1.50	7.20
2.50 x 1.50	13.92
3.00 x 1.50	5.15
3.50 x 1.50	1.30
3.00 x 1.75	3.31
3.50 x 1.75	4.85
3.50 x 2.00	0.96
4.00 x 2.00	2.49
5.00 x 2.00	4.10
5.50 x 2.00	1.20
6.50 x 2.00	0.80
4.50 x 2.25	1.00
5.50 x 2.25	1.20
5.00 x 2.50	1.45
6.00 x 2.50	3.22
6.50 x 2.50	0.96
7.00 x 2.50	2.38
8.50 x 2.75	0.90
Total	**176.70**

Source: JICA Study Team

(2) Plan of Stormwater Drainage Facilities

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 7.74, 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 industries in the node, all infrastructures should be constructed to be in time for the operation of each phase.

7.5.7 Cost Estimate

Summary of cost estimate of the construction and operation and maintenance (O&M) are presented in Tables below. Also, the details of cost estimate of the construction and O&M are presented in AnnexD. 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 7.76: Construction Cost of Water Infrastructures

Item	Phase 1(2016-2018)	Phase 2 (2019-2023)	Phase 3 (2024-2033)	Total
	Cost	Cost	Cost	
	(Million INR)	(Million INR)	(Million INR)	(Million INR)
1. Potable Water Supply Works	6,392	1,260	968	8,620
2. Non-Potable Water Supply Works	1,943	2,525	4,973	9,442
3. Domestic Sewerage Works	447	373	549	1,368
4. Treated Sewage and Industrial Effluent Collection Works	701	645	2,224	3,569
5. Drainage Works	1,020	1,425	1,266	3,712
TOTAL	10,504	6,228	9,979	26,711

Source: JICA Study Team

Table 7.77: 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	334	1,669	384	1,921	443	4,433	8,023
2. Non-Potable Water Supply Works	105	526	337	1,685	749	7,488	9,699
3. Domestic Sewerage Works	20	99	41	204	72	720	1,023
4. Treated Sewage and Industrial Effluent Collection Works	28	174	81	403	210	2,101	2,677
5. Drainage Works	51	255	122	611	187	1,870	2,736
TOTAL	538	2,722	965	4,824	1,661	16,611	24,157

Source: JICA Study Team

7.6 Solid Waste Management

7.6.1 Sector Overview

In the surrounding area of Tumakuru NIMZ, there is a common TSDF (landfill) in Dabespet located at around 40 km away from the Node area. There are five common incineration facilities in CBIC area. With the future economic development in Karnataka, the landfill amount will be over the landfill capacity after around 10 years. The capacity of the common incineration facilities is already insufficient to treat all incinerable hazardous waste.

Municipal solid waste management services are provided in Tumakuru and Sira municipalities around Tumakuru Node. No services are available in the rural areas including the Tumakuru NIMZ area. With the recent economic development, however, deteriorating environmental sanitation due to increasing waste becomes anxious level in the two cities. The both cities will prepare their plans for promoting appropriate waste management including recycling and upgrading of waste management facilities. As for the rural areas, according to Zilla Panchayat office administering villages, collection and recycling of waste by Gram Panchayat will be planned at the highly populated area.

NIMBY problems with the local inhabitants either for municipal solid waste or hazardous waste treatment facilities is prevailing and become constraints to construct necessary waste management facilities. To minimize the environmental impact by the waste management facilities and to obtain agreements with the local inhabitants, promotion of waste reduction through 3R will be an important policy measure.

The waste generators of hazardous waste are responsible for its management, either by its own or by contracting with authorized common hazardous waste treatment storage and disposal facilities (TSDF). According to the hazardous waste rule 2008, the treatment and disposal of hazardous waste should be made in the state in principle. The state government, waste generators and their associations, and waste treatment organizations, either individually or cooperatively, have their responsibilities to secure necessary land for establishing TSDF in the state. The state government has his responsibility to select the site of common TSDF.

In this section, the following items are studied in order to develop the infrastructures related to solid waste management sector which will support the industrial activities and local residents in the Node.

- Future prediction of the amount of MSW and the industrial solid waste.
- Preparation of development plan of the solid waste management system in the Node
- Preparation of the implementation plan to develop the infrastructures
- Preliminary cost estimation of infrastructures

7.6.2 Framework for Infrastructure Development

Appropriate solid waste management is an essential part to secure quality of life and sanitation in the Node area and therefore to achieve sustainable node development. The framework of infrastructure development which is based on the solid waste management facility in Tumakuru Node and surrounding node is shown below.

1. Hazardous waste management infrastructure

- Dabespet common TSDF (landfill) is located at only 40 km away from Tumakuru NIMZ. However, the capacity of the landfill site will be insufficient in 2023 in the CBIC area. A new common hazardous waste TSDF (landfill) for CBIC area shall be constructed in the Node area. Each waste generator shall transport and treat their waste.

- There are the common incineration facilities nearby, but the treatment capacity is not sufficient to cover the entire CBIC Node area. A new common incineration facility for CBIC area shall be constructed and used for the treatment of incinerable hazardous waste.

- Promoting recycling is essential to reduce environmental burden and the amount of waste for incineration and the landfill. Furthermore, construction of new incineration and landfilling facilities will be difficult due to the NIMBY issue. Therefore, a common AFR pre-processing facility for CBIC area shall be constructed in the Node for recycling cement kilns and waste reduction. The AFR facility shall be used for the suitable items for AFR in municipal waste as well as hazardous waste.

- Recycling of recyclable hazardous waste shall be promoted between individual site operators and recyclers with their trade contracts.

It should be noted that, any common TSDF should be developed in accordance with the plan of common TSDF which covers the entire state with the considerations of the economy of scale and efficiency of treatment as well as the presence of NIMBY issues,. With the future projection discussed earlier, it is expected that the remaining life expectancy of the current landfill becomes shorter than the current forecast. In addition, any common TSDF for hazardous waste should be operated by the private sector, and the facility should be developed so as to be able to receive the waste generated outside of the Node area. It is therefore assumed that common hazardous waste facilities for CBIC area are developed as part of the project.

2. Municipal solid waste infrastructure

- As for municipal solid waste, near Tumakuru Node, Tumakuru and Sira municipalities provide municipal solid waste management service. It is considered that impacts on environmental sanitation are concerned in Tumakuru and Sira municipalities. Each municipality plans to prepare the plan to implement appropriate waste management and to improve waste management facilities including recycling. However both municipalise is not planning to receive waste from outside of their own administrative areas.

- On the other hand, other rural areas including Tumakuru NIMZ do not provide municipal solid waste management services. According to Zira Pachayat office which manages the rural area of Gran Panchayat, waste treatment project including waste collection and recycling will be implemented in highly populated areas in Gran Panchayat in the future.

For this reason, waste management facilities for municipal solid waste in Tumakuru NIMZ shall be established within the node area.

7.6.3 Design Conditions

Design conditions of infrastracures related to solid waste management sector are presented below.

Development Phases of Proposed Node

Tumakuru Node will be developed under three phases, and the target year of the first phase is 2018, the second phase is 2023 and the third phase is 2033. Accordingly, the solid waste generation is estimated at the years 2018, 2023 and 2033. Figures for other years between them are calculated by dividing the target figures proportionally by the number of years.

Population Forecast

The target resident population and employed population of Tumakuru Node in each target year are forecasted as described in the table below.

Table 7.78: Population Forecast of Tumakuru Node

Year	2018	2023	2033
Resident Population	93,333	186,667	280,000
Employed Population	21,739	86,791	498,365

Source: JICA Study Team

Forecast of Industrial Land demand

The land demand of each industrial sector in Tumakuru Node is proposed at Table 6.4. 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 output.

Table 7.79: Proposed land demand of Each Industrial Sector in Tumakuru Node

Industrial Sector	Land demand (Acre)		
	Year 2018	Year 2023	Year 2033
Auto	378	1,009	2,271
Pharmaceuticals	152	496	914
Textiles & Apparels	139	371	835
Food Processing	72	193	434
Computer, electronic and optical products	72	191	429
Metallurgy	49	131	294
Electrical Machinery	49	131	294
Machinery	49	131	294
Chemicals & Petrochemicals	49	131	294
Defense & Aerospace	49	131	294
Total	1,058	2,912	6,350

Source: JICA Study Team

Relevant Technical Standards

The development plan of each facility is based on the following technical standard.

Table 7.80: 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 and Handling) 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 solid waste generated in Tumakuru Node is projected in order to estimate the required capacity of each facility. The types of solid waste for planning which include industrial waste and municipal solid waste are described below. In the Phase A study, the focus was given to the hazardous waste with high potential impact.

Non-hazardous waste generated from each industry is also included in the forecast here to evaluate the Node development more specifically.

Table 7.81: Type of the target waste for planning

Type	Type of waste
Industrial solid waste	Hazardous waste： landfillable waste, incinerable waste, Recyclable waste, and waste treated by AFR
	Non-hazardous waste
Municipal solid waste	Residential waste, commercial waste, Institutional waste, Street sweeping waste

Source: JICA study team

Industrial Hazardous Waste Demand forecast

As mentioned before, a common TSDF for hazardous waste generated by industrial activities is to be developed. For the estimation of hazardous waste generation, the figures presented in the phase A study are used herein.

Table 7.82: Industrial hazardous waste generated in CIBC area

	Year	2018	2023	2033
Incinerable hazardous waste	TPY	14,383	25,974	83,240
Landfillable hazardous waste	TPY	0	47,000	156,243
AFR hazardous waste	TPY	56,001	99,513	317,320

Source: JICA Study Team

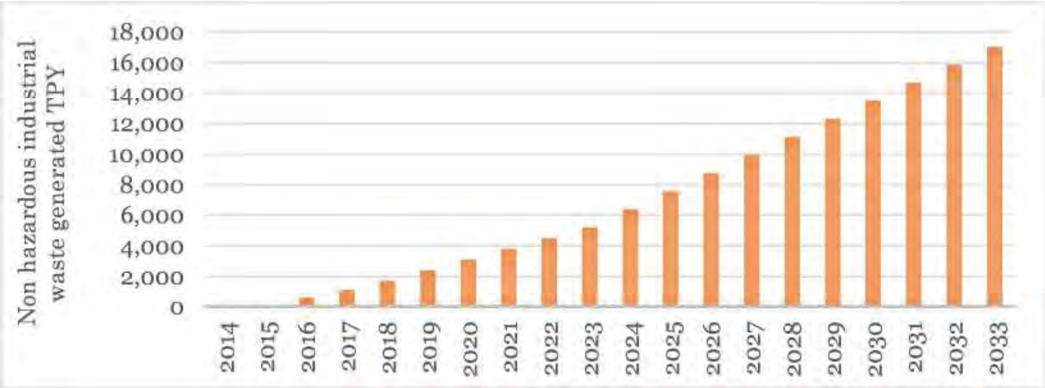
Industrial non-hazardous waste demand

There is no publicly available data on non-hazardous waste generated from each industry. According to the interview made by the JICA study team, a number of items are being recycled. Estimations were made herein for the items which recycling is supposed to be from desirable level behind such as plants and animal residues, animal waste in solid form, glasses, concrete slabs, ceramics, and debris. It is calculated by using the amount of waste generated per output by industry type in Japan, presented in Annex E. In addition, food residue from canteens of industry is discharged. It is calculated as 0.05kg/employee/day according to the interview made by JICA study team. Estimated amount of non-hazardous waste from the industry of the node is shown in the table below.

Table 7.83: Non-hazardous waste generated in the Tumakuru Node

	Year	2018	2023	2033
Number of employees		21,739	86,791	498,365
Canteen waste	TPD	1.1	4.3	24.9
Plants & animal residues, animal solid residue	TPD	2.6	7.0	15.5
glasses, concrete slabs, ceramics, and debris	TPD	1.0	2.9	6.3
Total	TPD	4.7	14.2	46.7

Source: JICA study team



Source: JICA study team

Figure 7.61: Estimates of Non-hazardous waste

Municipal Solid Waste Demand

Municipal solid waste demand is calculated based on the total estimate for residential waste which is the product of population projection by amount of waste generated per capita per day. The estimate for the total household is then divided by the ratio of waste by type (for commercial, institution, and street cleaning).

3. waste type, characteristics, and waste kg/capita/day for household, commercial, office, street cleaning waste

The estimate, presented in the following table, was made with reference to the Draft MSW collection and Transport DPR for Tumakuru devised by the Neighbouring City of Tumakuru Municipal Corporation in 2014.

Table 7.84: Date of waste generation based on generators in Tumakuru Municipal Corporation

	Waste generator	Total waste t/day	Generation ratio %	population	kg/capita/day
1	Residential waste	78.91	65.2%	305,822	0.258
2	Commercial waste, institutional waste	31.72	26.2%	-	-
3	Street cleaning waste	10.39	8.6%	-	-
	Total	121.03	100.0%	-	-

Source : Calculated by JICA study team based on the Draft MSW collection and Transport DPR for Tumakuru 2014.

Table 7.85: Details of qualitative analysis of MSW at Tumakuru municipality

	Waste type	%
1	Plastic material	12.2%
2	Paper	8.7%
3	cloth piece	10.3%
4	food waste	20.4%
5	Stones	6.7%
6	Glass pieces	0.2%
7	wood pieces	1.9%
8	Metal pieces	0.4%
9	Grass and leaves	20.6%
10	Silt and moisture	18.5%

Source: calculated by JICA study team based on the Draft MSW collection and Transport DPR for Tumakuru may 2014

4. 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 of Indian and Asian municipalities shown in the table below. The figures for other years until the year 2033 refer the figure of 0.258kg/capita/day for the year 2014 in Tumakuru Municipal Corporation as the base.

Table 7.86: 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 unit that was set, was calculated by the following equation. The amount of commercial waste, institutional waste and street cleaning waste was calculated by using of amount of residential waste and the ratio of each waste type generated in Tumakuru municipality.

The amount of Residential waste generated = Residential waste generated per capita per day × population of each year

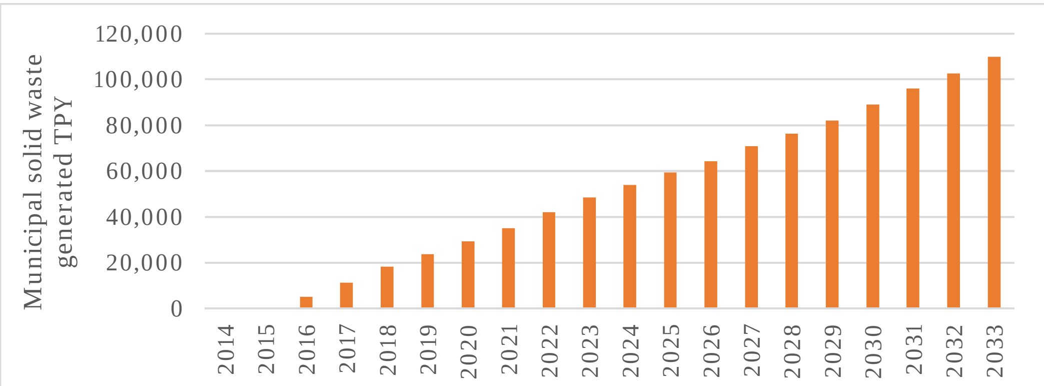
5. Future demand of municipal solid waste

Future prediction of amount municipal solid waste generated for each residential, commercial, institutional and street cleaning is presented in Table below.

Table 7.87: Future prediction of Municipal solid waste generation in the Node

	year	2018	2023	2033
Resident population		93,333	186,667	280,000
waste generated per capita per day	kg/capita/day	0.3510	0.4673	0.7
Residential waste	TPD	33	87	196
Commercial, institutional waste	TPD	13	35	79
Street cleaning waste	TPD	4	11	26
Total	TPD	50	133	301

Source : JICA study team



Source : JICA study team

Figure 7.62: Estimates of Municipal solid waste

7.6.5 Development Plan

Appropriate solid waste management is essential for securing the safe and hygienic living environment as well as for the environmentally low-impact and sustainable development of the Node. To maximize the effectiveness and efficiency of the solid waste management, it is important to consider the entire process of waste management, from generation to the final disposal, and to develop the system including infrastructure development, soft component and institution integrally.

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.
- For hazardous waste, a common TSDF for CBIC area operated by a private company or PPP mode is to be developed as mentioned earlier.

Development concept and development policy

Various concepts and measures necessary for the solid waste management in the Node development, including the concept of a smart city which is the vision for the Node urban development, are evaluated. As a result, the following concept and policies for the solid waste management are described.

Table 7.88: 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 smart 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 the 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 through 3R promotion at each stage of waste management, namely generation, discarding, collection, treatment, and the 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 the 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	To execute the above mentioned policies, capacity of institutions, controlling authorities as well as individuals in each relevant to waste management shall

Items	Outline
waste management	be strengthened.
6) Integration of solid 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 developmental policy mentioned above, the following programs are presented, as the development program on waste management, with the activities which shall be conducted by responsible parties.

Table 7.89: Development concept and policy in the node

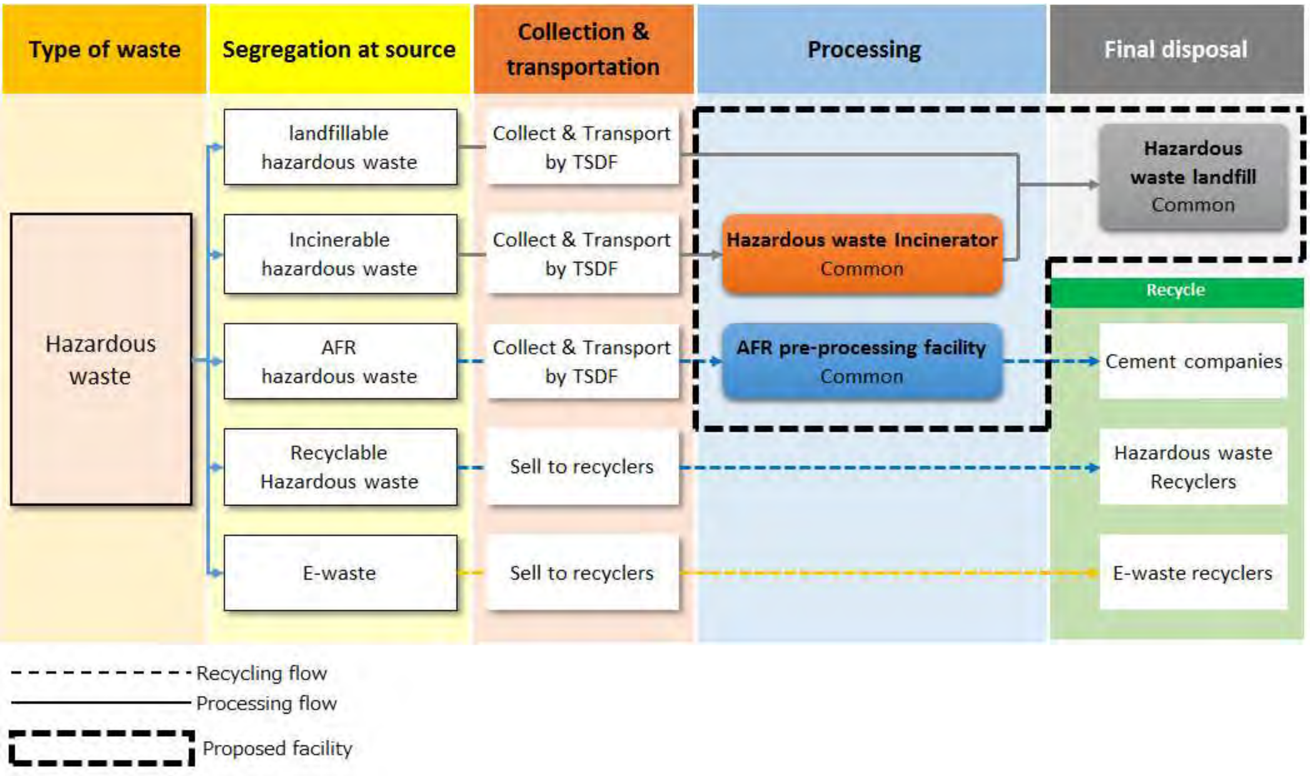
Concept	Building the sustainable sound material-cycle society		
Development policy	1) Establishment of an appropriate waste management 2) Reduction in the volume of waste that goes into the final disposal through 3R promotion 3) Selection of environmentally and economically sustainable waste treatment system 4) Coordination with the stakeholders 5) Capacity development of institutions relevant to waste management 6) Integration of solid waste management facilities		
Development Program	Within the Node area		include the areas outside of a Node
	Hazardous waste management (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 development plan for hazardous waste management facilities - Development of a collection and transportation system - Development of a hazardous waste management treatment facilities	**■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	**■Program for development of common hazardous waste treatment facilities on the state level** -Devising a common hazardous waste treatment facilities development plan for the state **■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 infrastructures for CBIC area shall be developed, as shown in the flow below. Hazardous waste management shall be done, in the process flow shown below in which waste are sorted according to its segregation classification and are treated under the responsibility of the waste generator. Upon developing the common hazardous waste management facilities, development of common hazardous waste facility plan is required for each phase by private or PPP.

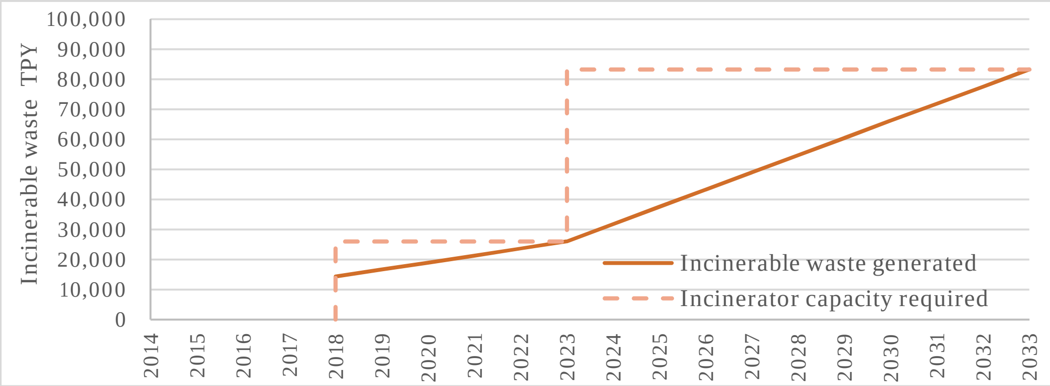


Source: JICA Study team

Figure 7.63: Hazardous waste treatment system

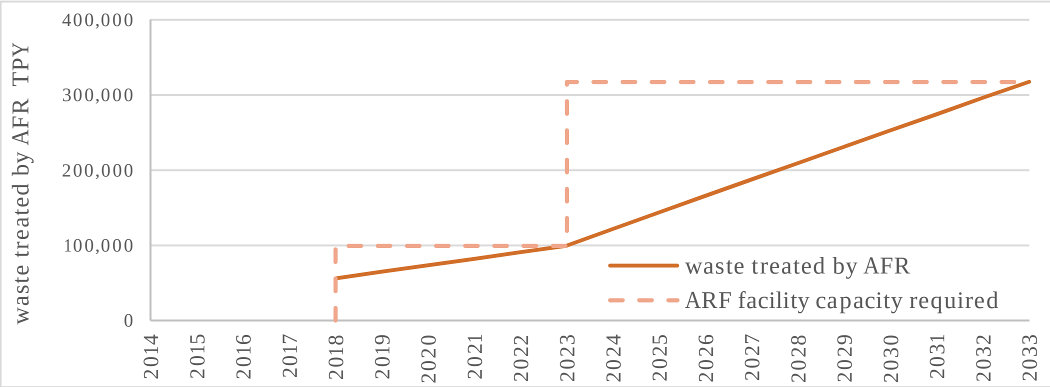
- Capacity of Each Infrastructure

For the before mentioned hazardous waste treatment system, the facility scale for each phase is calculated from the volume of waste generated. The results are indicated below.



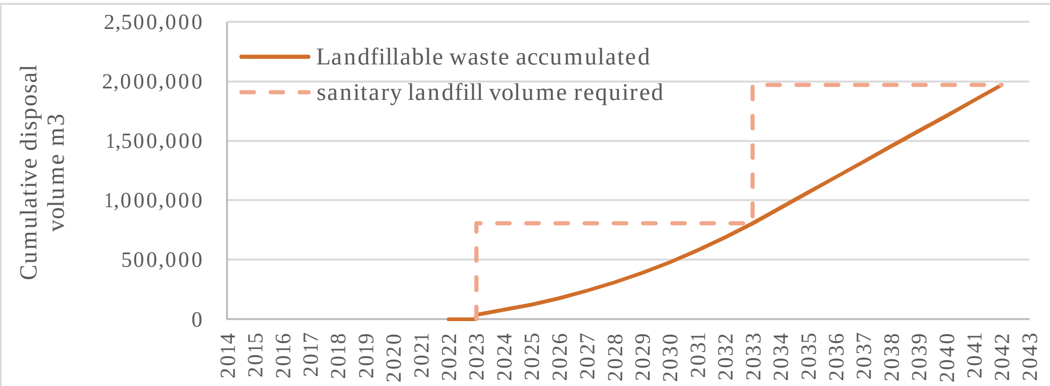
Source: JICA study team

Figure 7.64: Capacity of hazardous waste incineration facility



Source: JICA study team

Figure 7.65: capacity of AFR pre-processing facility



Source: JICA study team

Figure 7.66: Capacity of hazardous waste sanitary landfill

Table 7.90: Facilities capacity of each phase

Capacity of infrastructure		2016-2018	2019-2023	2024-2033	Total	Note
hazardous waste incineration facility	TPD	0	81	179	260	Operation rate is set as 88%
AFR pre-processing facility	TPD	160	124	622	907	Operation rate is set as 96%
hazardous waste sanitary landfill	m^3	0	56,400	1,012,477	3,046,164 (by 2042)	The ratio of landfill capacity used for cover soil is set as 20% Service life is calculated as 20 years.

Source: JICA study team

Municipal solid waste management

Municipal solid waste processing facility development program

To reduce the environmental impact, appropriate waste management system which would minimize the environmental impact through the entire process of waste management from its generation, collection and transportation, treatment to final disposal shall be aimed at in the development. For the appropriate waste management, infrastructure plays an important role. Waste management system at each stage of collection, treatment and disposal is summarised below. Upon the selection of those systems, 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 were considered.

- Development of collection and transportation system

Collection and transportation is starting point for the appropriate waste management by which waste are taken away from the living environment of the people safely and without delay, as well as illegal dumping is prevented. In order to implement efficient and economic collection and transportation, collection system shall be planned systematically. In the medium to long term, maintenance for the collection vehicles and equipment should be conducted periodically and these must be repaired and/or renewed, if necessary.

Collection of the waste segregated into wet and dry waste at source is conducted or planned in many areas in India. This method of collection has a great benefit for the entire solid waste management by the reasons mentioned below and therefore collection system of the waste segregated at source should be applied as standard.

- 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.

However, the current wet waste is including wastes such as wet paper or cloth. In the case of introducing the compost or biomethanization, etc., it is anticipated to contain incorrect wastes. Therefore, "Wet waste" is recommended to be revised and categorised as "Biodegradable waste" from the view of thorough separation. Also, “Dry waste" currently includes recyclable paper and plastic etc. It shall change the classification divided into "Recyclable waste" and "Others waste".

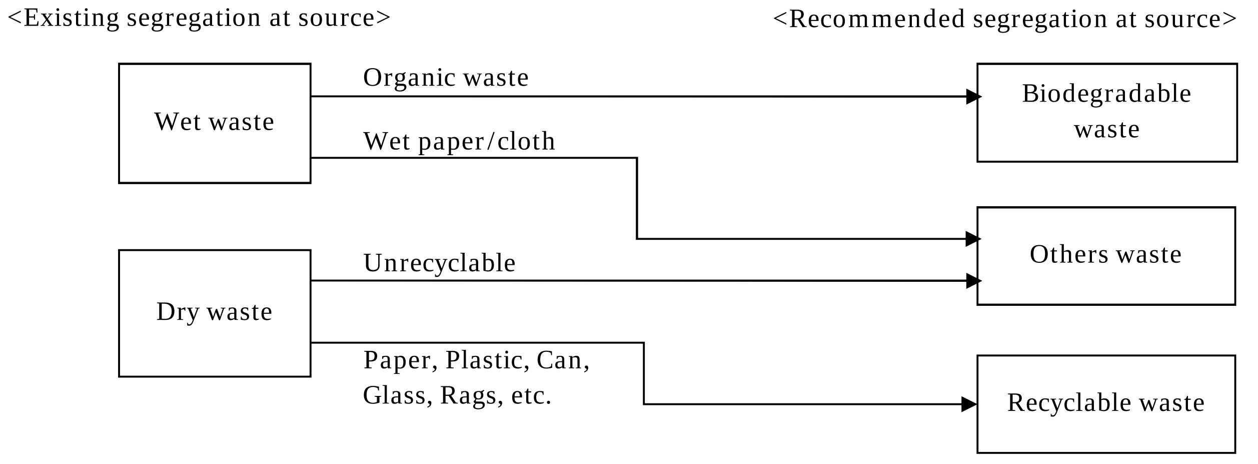


Figure 7.67: Segregation at source

In addition, non-hazardous waste generated from the private business activities shall be transported to the intermediate treatment facilities under their own responsibility. The reasons are 1) the characteristics and amount of those wastes of household, 2) the businesses are mandated to carry out its own waste management. For those who do not have transportation system of their waste, waste management companies shall provide collection and transportation services at reasonable prices.

Collection vehicles and machineries required are calculated based on the conditions mentioned below.

- Door to door collection by 5ton (10 ㎥) compactor truck for the residential houses within the Node, as these houses is newly built and accessible by the collection vehicles.
- Bulk specific gravity of 0.5t/㎥ and loading ratio of 96% are set
- Frequency of collection services are set as 3times/week for Biodegradable waste, 2times/week for each "others waste" and "recyclable waste".
- Collection trips are set as 3 trips per day.
- 2 collection areas
- Collection of non-hazardous waste from industries/businesses are outsourced to waste management companies

Table 7.91: Collection vehicle required

Type of collection vehicle	2018	2023	2033
Compactor vehicle	10	20	45
Number purchase vehicle of each phase	10	10	25

Source: JICA study team

- Development of intermediate facilities

The following intermediate treatment technologies for process of municipal solid waste in the Node area could be considered. The intermediate treatment technologies have some characteristics. It shall be selected according to the future economic and social condition.

With regards to RDF, residues after waste sorting for the mixed waste collection are used as fuel in the cement kilns in India. Sorted plastic waste with high calorific values is targeted for RDF. However, those plastics are segregated at source and are recycled as AFR in this plan. And it is necessary to consider the demand for RDF products outside of the Node. Therefore, RDF is excluded from this plan.

Table 7.92: Option of municipal solid waste intermediate treatment technology

	Merit	Demerit	remark
Compost	• Reducing waste amount by using organic waste • Relatively small initial 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
Bio methanation	• Reducing waste amount by using organic waste • Recapturing of biogas as renewable energy • Increasing experiences in India	• Large initial investment and running cost • High skills required for operation • Availability of the demand for the sludge	• Not many examples available with large-scale facility
Waste to Energy (Incinerator)	• Effective for public health • Reducing waste amount • Possible power generation in the cases 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, composting facility is considered as processing facility.

- Reduction in the volume of waste that goes into the final disposal through 3R promotion (basic policy)

- Obtaining separated organic waste by introduction segregation at source

- Both of the cost of development and maintenance are least costly. Selection of environmentally and economically sustainable treatment system(basic policy)

- Technology with low water demand is needed as there are constraints in water supply in Tumakuru Node.

- There is a vast green belt within the Node, and products from composting plant can be used in those areas. In addition, a vast agricultural land in the surrounding area can also be a potential user.

- According to the demand forecast of waste, the capacity of the facility is less than 300t/day and is considered unsuitable for Waste to Energy system.

※The waste to energy plant (incinerator) is operating in many municipalities in Japan. For recycling of incineration ashes, the guidelines for recycling such as the elution standard of the heavy metals, Usage, Quality specifications, etc. by ash melting and cement kiln has been established, and incineration ash is recycled. The processing flow is shown in Annex E. For the following reasons, the use of waste to energy plant in the node is difficult.

- Waste to energy plant can be selected from the scale over about 300t / day. According to interviews from Japanese manufacturers, power generation is possible even with 100t / day of capacity. However, the amount of power generation can only cover the running the WTE plant and not enough to sell the electricity generated to make profit.

- The amount of incinerable municipal solid waste for Tumakuru Node for 2033 is estimated as 206t / day.

- It is possible to build a large facility by incinerating Municipal solid waste mixed with hazardous waste, but that requires management of the homogenizing the quality of waste, making the operation process more complex. In addition, it also requires to consult the state government whether mixed incineration is possible or otherwise.

- In addition, no standard exists for the recycling of incineration ashes in India yet. Currently, the incineration ash should be treated as hazardous waste.

Moreover, sorting plant for segregation of recyclable shall be established to reduce the volume of waste that goes into the final disposal. The final residues will be taken to the final disposal site for landfilling. As for plastics, recycling shall be conducted at AFR pre-processing facilities and/or at the plastic recyclers. In addition, recyclables among the non-hazardous waste generated from industrial activities shall be sold to recyclers by each business entity, and the residues shall be treated as municipal solid waste.

- Development of a Sanitary landfill

A landfill site has the functions to separate the residues from the natural environment through recycling and intermediate treatment processes, to dispose it in a sanitary manner, and therefore to prevent environmental impact. A sanitary landfill site in accordance with the facility development guidelines in India shall be established.

- Other

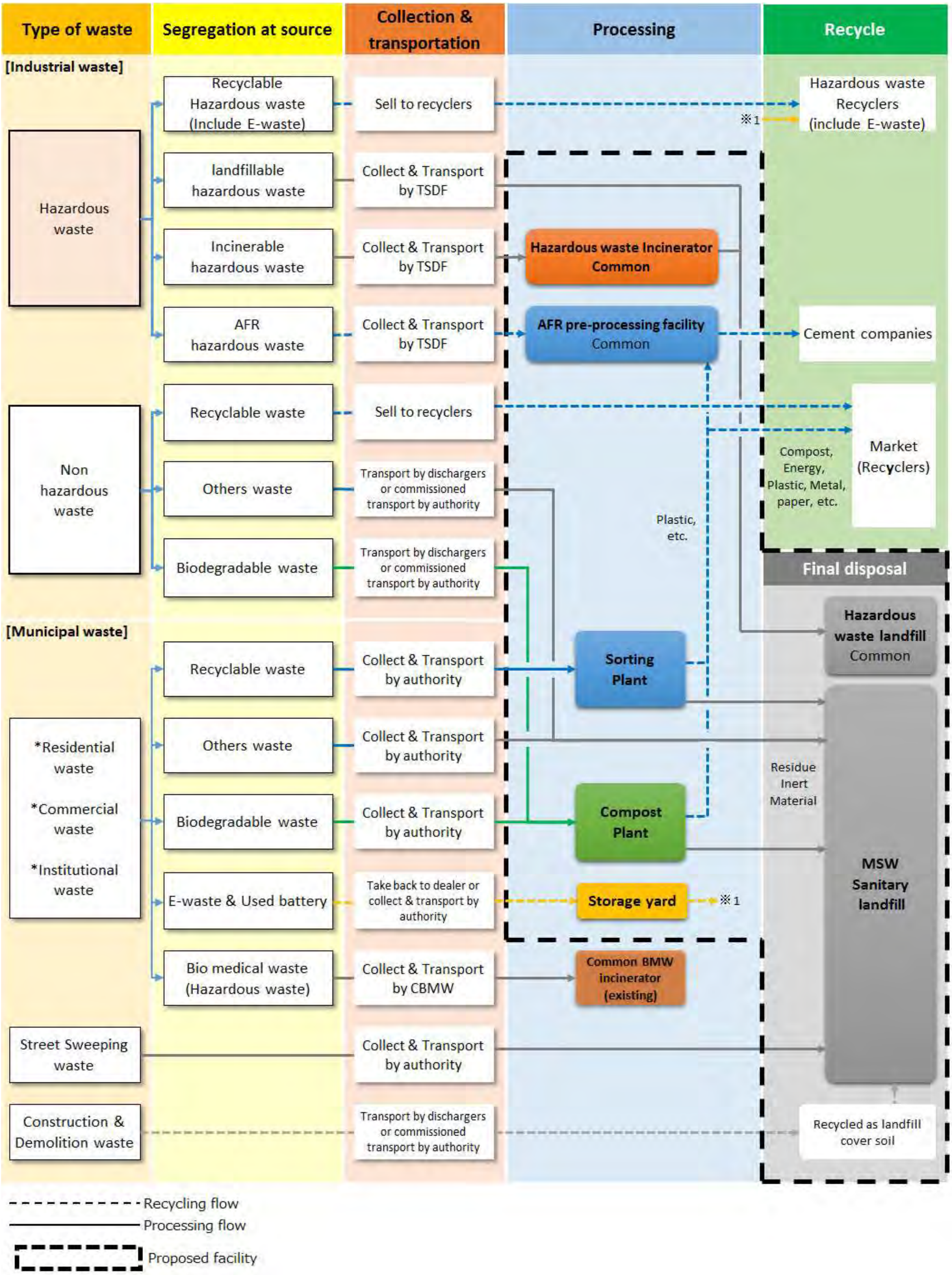
- Construction and demolition waste

  Construction and demolition waste typically include concrete, plaster, metals, and woods. These are usually heavy and bulky. Construction waste is not treated by the municipality and these wastes are discarded and scattered around low-lying land, street, and near the waste collection containers. The amount of those is expected to increase more due to the economic growth in the future.

As a countermeasure for this situation, discarding of construction waste at the waste collection point for municipal solid waste shall be prohibited, and the waste generator shall take these wastes to the landfill by themselves or by contracting waste management company. A storage area for these construction wastes shall be allocated within the landfill site, and these are used as cover soil for the landfill site or as construction materials. (Establishment of a recycling plant for construction waste might be possible in case the price of virgin materials become higher than the recycled materials. the case in Japan is shown in Annex E.) In addition, imposing of a landfilling charge shall be given considerations.

- Compostable waste from Street cleaning shall be composted, whereas others are landfilled.
- E-waste shall be stored at a temporary storage yard, and then it shall be taken to the E-waste recyclers.
- In principle, used batteries shall be taken to the sales agent for a take-back system. The used batteries collected shall be stored at a temporary storage yard, and then it shall be taken to the battery recyclers.
- Medical waste shall be directly taken to the common medical waste treatment facility located within the area by the waste generators.

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

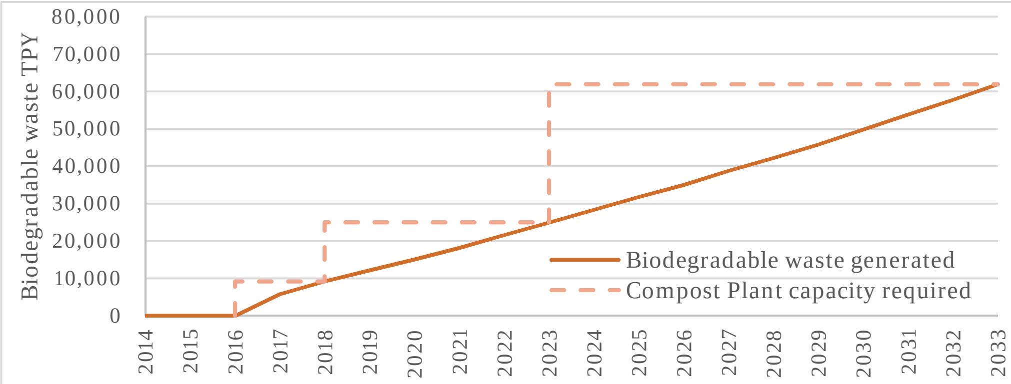


Source: JICA study team

Figure 7.68 Solid waste management in the Node

- Capacity of Each Infrastructure

For the before mentioned municipal solid waste treatment system, the facility scale for each phase is calculated from the amount of waste generation. The results are shown below.

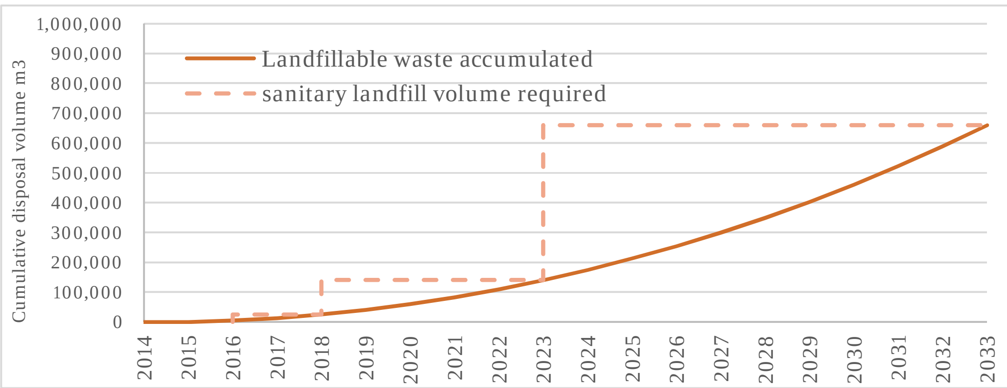


Source: JICA study team

Figure 7.69 Composting plant

Source: JICA study team

Figure 7.70 Capacity of sorting plant



Source: JICA study team

Figure 7.71 Capacity of sanitary landfill

Table 7.72 Capacity of each facility

Facility		2016-2018	2019-2023	2024-2033	Total	Note
Compost plant	TPD	30	51	119	200	Operation rate is set as 86%
Sorting plant	TPD	19	31	63	113	Operation rate is set as 86%
Sanitary landfill	m3	25,222	107,231	468,457	600,910	The ratio of landfill capacity used for cover soil is set as 20%

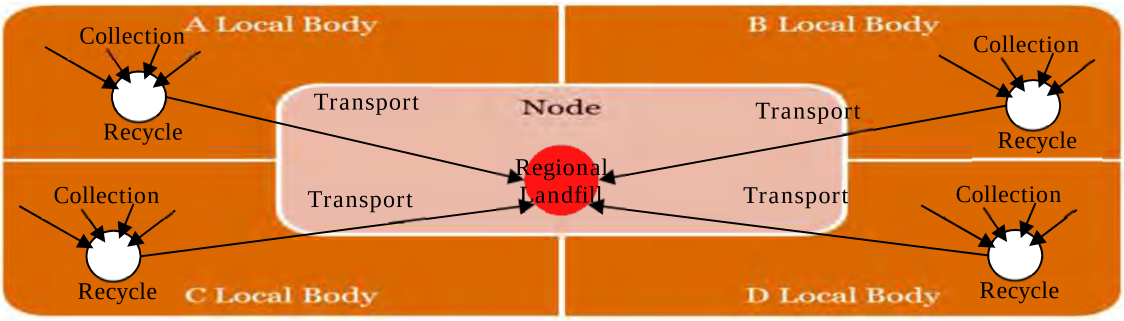
Source: JICA study team

- Development of master plan for municipal solid waste management

To develop the municipal waste treatment facilities, municipal solid waste management plan shall be needed for each phase by 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, located outside of the Node area, will require careful consideration. In addition, the master plan shall be reviewed every 5 years depending on the industrial development and the population increase in the Node.

– Waste treatment in the local body areas, outside of the Node area

It will be developed outside the Node area. The surrounding area which includes a part of the Node area (Gram Panchayat) shall prepare solid waste treatment facility in the Node area any waste generated outside the Node area such as the villages shall be treated at the waste management facilities in the Node area. It is therefore necessary that surrounding administrative authorities be included in the planning of municipal solid waste management. In this case, it is recommended that Gram Panchyat shall prepare their action plans for the waste management including collection and recycling. The residues (non-recyclables) transported from Gram Panchyat shall be transported and disposed at the landfill site in the Node are in Figure below.



Source: JICA study team

Figure 7.73 Image of municipal solid waste management

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 for capacity development of the individuals and institutions are important.

- Strengthening the capacity in operation of solid waste management

Capacity development of individuals and institutions in various aspects, such as below, are necessary to achieve appropriate waste management.

– Capacity to create the action plans on municipal solid waste management
– Capacity in public communication on collection by sorting and its improvement
– Capacity in planning and coordination for awareness raising program

- 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 the sustainable sound material-cycle society.

Program for 3R Promotion

To minimize the environmental impact from waste management and to establish the sustainable sound material-cycle society, reduction of waste that goes into the final disposal by controlling the generation of waste and promotion of recycling are considered to be the most important issues. This leads to reduction of the cost required for development and maintenance of facility of waste management as well as to the prolonged life of the final landfill site. Therefore, the priority should be put, in the order with higher priority, on 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 the waste reduction in the private sector is important, and the private companies shall aim to reduce its waste by practicing activities toward the resource based production activities.

- Awareness rising activities on 3R

To achieve establishment of the sustainable sound material-cycle society, the role of awareness rising through education, etc. is important. For the 3R promotion including the reduction of waste at source, obtaining understanding and cooperation among the local residents and private companies as sources of waste generation is considered to have the primary importance. It is targeted that the residents and the companies act on their own with 3R on mind, and to realize this “knowing” and “thinking” is an integral part. Therefore, planning and implementing the awareness raising programs, including the enhancement of the currently undergoing programs done by local communities such as ITC and NGOs, in the local community shall be promoted more actively. Upon conducting environmental education, the before mentioned awareness raising focal point should be effectively used 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 these activities on 3R further, development, promotion and networking of these markets shall be promoted. It is recommended to invite recycling industries to the same location as the waste treatment facility to be built by the project.

- Promotion of cooperation with NGOs and recyclers

The improvement in the quality of life by economic development, the amount and the characteristics of waste varies. Without understanding in and cooperation to the waste management by the stakeholders such as citizens and private companies, the generators of waste, the establishment of the 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 awareness rising on 3R and other environmental issues targeting the citizens and corporations shall be established as 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 a second-hand markets and flea market.

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 program not just in the Node area but also in the area outside of the Node. It is the responsibility of the state government to select the land for development of waste management facilities as well as implementation of appropriate municipal solid waste management and monitoring of the related facilities. The programs for project of the state government in executing its responsibilities are outlined below.

Program for development of common hazardous waste treatment facilities on the state level

With the economic development, it is expected that the volume of hazardous waste is to increase in the future. For the sustainable development, it is important to implement appropriate waste management. Therefore a common hazardous waste treatment facilities development plan for the state including the outside of the CBIC area shall be developed by the initiative of the state government.

Institutional capacity development program for the authorizing organization (state government, etc.)

Appropriate solid waste management is indispensable to secure safe and clean living environment and to establish a sustainable sound material-cycle society. Current inappropriate treatment must be removed. For this, capacity development of the state government staff in monitoring and authorizing management practices of the citizens and private companies has the primal importance.

- Strengthening the management capacity in controlling illegal dumping, inappropriate temporary storage, and treatment

There are some cases of inappropriate practices regarding both hazardous waste and municipal solid waste at present. By the development of appropriate waste treatment and disposal practices of illegal dumping and/or inappropriate temporary storage of waste should be removed. For this to be realized, 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) is also promoted along with the capacity development of administrative staff (state PCB).

- Support environmental technology program for the private industries

To promote zero emissions of waste through the use of waste among the industries as resources, a support should be provided on information on the latest recycling technologies and dialogue exchange among the companies. Technical support for development of cleaner production with low environmental impacts shall also be provided for the establishment of the sustainable sound material-cycle society.

7.6.6 Implementation plan to develop the infrastructures

Each capacity of infrastructure development at each target year is shown below.

Table 7.74 each capacity of the infrastructure development at each target year

Infrastructure			by 2016	by 2018	by 2023	Total
Hazardous waste facilities	Hazardous Waste incinerator	TPD	0	81	179	260
		ha	0.00	1.95	4.29	6.24
	AFR pre-processing facility	TPD	160	124	622	907
		ha	3.67	2.85	14.26	20.78
	Hazardous Waste landfill	m3	0	56,400	3,046,164	3,102,564
		ha	0.00	0.52	28.48	29.00
MSW facilities	Composting Plant	TPD	30	51	119	200
		ha	0.60	1.10	2.40	4.10
	Sorting Plant	TPD	19	31	63	113
		ha	0.30	0.50	1.00	1.80
	Sanitary Landfill	m3	22,222	107,231	468,457	600,910
		ha	0.50	2.14	9.35	12.00
	Collection vehicle Garage & workshop	Unit	10	10	25	45
		ha	0.11	0.10	0.22	0.43
	Stockyards for e-waste, etc.					
		ha	0.11	0.11	0.11	0.32
	Space for future recycling industrial facilities					
		ha	0.32	0.79	2.62	3.73
Total		ha	5.61	10.16	62.64	78.41

**A space for future recycling industrial facilities is calculated as 20% of the total space of MSW facilities.*
Source: JICA Study team

7.6.7 Preliminary cost estimation of infrastructures

The cost estimation for the infrastructure is indicated below.

Table 7.75 Preliminary cost estimation of infrastructures

1. Capital Cost

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 (INR mil.)
Hazardous waste infrastructure	1) Hazardous waste incinerator	includes infrastructure & Equipment	TPD	12.04	0.0	0.0	81.2	977.1	179.0	2,154.3	3,131.5
	2) Hazardous waste landfill	includes infrastructure (roads, water drainage, electricity) & Equipment(JCB, bulldozer, weighbridge, etc.)	1000m^3	0.48	0.0	0.0	56.4	27.2	3,046.2	1,466.8	1,494.0
	3) AFR pre-processing facility	includes infrastructure & Equipment	TPD	2.64	160.0	422.2	124.3	328.0	622.3	1,641.9	2,392.1
MSW infrastructure	1) Composting plant	includes infrastructure & Equipment	TPD	0.66	30.0	19.8	51.0	33.7	119.0	78.6	132.2
	2) Sorting plant	includes infrastructure & Equipment	TPD	0.66	19.0	12.6	31.0	20.5	63.0	41.6	74.7
	3) Sanitary landfill	includes infrastructure (roads, water drainage, electricity) & Equipment(JCB, bulldozer, weighbridge, etc.)	1000m^3	0.40	25.2	10.1	107.2	43.1	468.5	188.4	241.6
	4) Stockyards for e-waste, etc.		ha	77.00	0.1	8.3	0.1	8.3	0.1	8.3	24.9
	5) Collection vehicle		vehicle	2.94	10.0	29.4	10.0	29.4	25.0	73.5	132.3
	6) Collection vehicle garage & workshop		ha	77.00	0.1	8.3	0.1	7.9	0.2	17.1	33.3

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	1) Hazardous waste incinerator	Routine maintenance (repair every year), periodic maintenance (each 5 years)	l.s.	15%	0.00	0.00	146.57	781.71	469.72	5,010.34	5,792.05
	2) Hazardous waste landfill		l.s.	10%	0.00	0.00	2.72	14.94	149.40	1,643.38	1,658.32
	3) AFR pre-processing facility		l.s.	15%	63.32	189.97	112.52	600.13	358.81	3,827.32	4,617.42
MSW infrastructure	1) Composting plant		l.s.	10%	1.98	5.95	5.35	29.44	13.22	145.37	180.76
	2) Sorting plant		l.s.	25%	3.14	9.42	8.26	42.95	18.67	194.14	246.50
	3) Sanitary landfill		l.s.	7%	0.76	2.27	3.98	22.55	18.05	204.65	229.48
	4) Collection vehicle		l.s.	25%	7.21	21.64	14.42	75.06	32.45	337.76	434.46

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 (INR mil.)
■Capacity development program for appropriate waste management & ■Program on 3R Promotion	2years	86	1years	43	3years	128	257
■Program for development of common hazardous waste treatment facilities on the state level	1years	53		0		0	53
■Institutional capacity development program for the authorizing organization (state government, etc.) & ■Support program for the private industries	2years	107	1years	53	2years	107	267

Source: JICA study team

Table 7.76 Indicators of industry waste in Japan

Type of industry		Plants & animal residues, and	animal solid residues	glasses, concrete slabs, ceramics	Debris
				1.871	JPY/INR
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
Defense	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 Impact 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 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, both permanent and temporary aspects of the benefits to be realized were considered.

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.

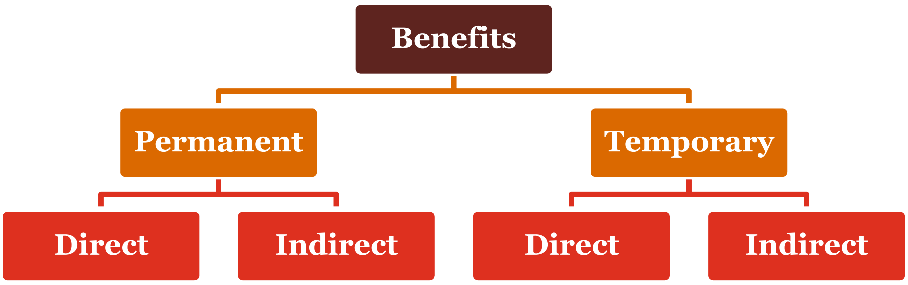


Figure 8.1: Benefits

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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.[46][47]

Table 8.1: GDP growth ratio

India's GDP projection	1980-99	2000-12	2013-20	2021-30
Real GDP growth, % p.a.	5.6%	6.9%	6.3%	6.9%
Ratio		1.23	0.91	1.10

Source: JICA Study Team

GVA per capita

[46] Standard Chartered - The Super Cycle lives: EM growth is the key (November 2013)
[47] Ratio beyond 2031 has been assumed to be 1.0 (PwC)

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[48]	Employment, India, 2009[49]	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**

Source: JICA Study Team

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[50]
Permanent multiplier (manufacturing)	1.5x[51]

Source: JICA Study Team

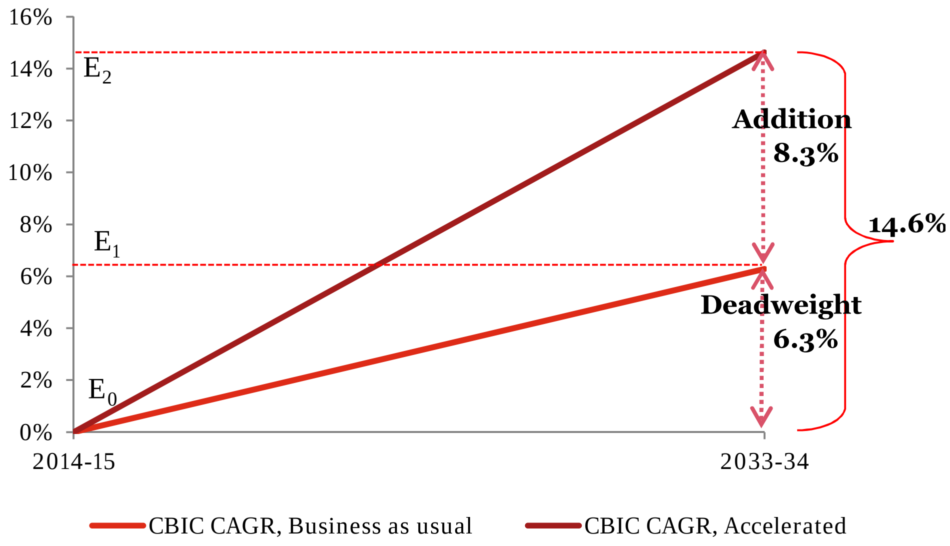
Deadweight and displacement assumptions

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:

- 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.

[48] http://unstats.un.org/unsd/snaama/selCountry.asp
[49] Planning commission data tables, Table 62, http://planningcommission.nic.in/data/datatable/index.php?data=datatab
[50] Planning commission, REPORT OF THE WORKING GROUP ON CONSTRUCTION FOR THE 11TH FIVE YEAR PLAN (2007-2012), planningcommission.nic.in/aboutus/committee/.../wg11_constrn.pdf
[51] Interim Report 3 projections



Source: JICA Study Team

Figure 8.2: Deadweight assessment[52]

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.[53] The following ready reckoner[54] 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%**
High	A high level of displacement is expected to arise	75%
Total displacement	All of the activity generated will be displaced	100%

Source: JICA Study Team

Given the brown-field development nature of Tumakuru medium displacement effects are anticipated.

[52] Adapted from Additionally and Economic Impact Assessment Guidance Note, A Summary Guide to Assessing the Additional Benefit, or Additionally, of an Economic Development Project of Programme, November 2008, by Dr. Alastair H. McPherson, Scottish Enterprise, p. 7
[53] Same as above, p. 10.
[54] Same as above, p. 11

8.3 Key Economic Benefits

Some of the key benefits that would be expected include:

Table 8.5: Direct benefits and Indirect benefits

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

Source: JICA Study Team

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 C, the total number of employment opportunities will be 199,347.

Table 8.6: Direct potential employment of Tumakuru Industrial Node

	Total direct employment
Traditionally strong sectors	***168, 140***
Auto	74,179
Pharmaceuticals	40,630
Textiles & Apparels	21,239
Food Processing	8,487
Computer, electronic and optical products	23,606
Potential sectors	***84,751***
Total	***199, 347***

Source: JST Projection

Developed land in industrial node

Total developable land in industrial node is 7,902 acres. The major saleable elements of this land will be industrial land – 6,350 acres and residential and commercial land – 1,552 acres. Population projected to reside in industrial node is 280,000 people by the end of Phase C.

Table 8.7: Land demand, acres

	Developable land, acres
Traditionally strong sectors	**4,882**
Auto	2,271
Pharma	914
Textiles and Apparels	835
Food Processing	434
Computer, electronic and optical products	429
Potential sectors	***1,468***
Total industrial area	**6,350**
Residential area	**1,552**
Total developable land	**7,902**

Source: JST projections

Industrial investment

Industrial land is expected to attract tenants from various sectors identified for Tumakuru Industrial node as focus sectors. Total land for traditionally strong sectors with higher probability to get occupancy is 4,882 acres. Potential sectors are projected to occupy 1,468 acres of industrial land in Tumakuru IN. Together these tenants are expected to infuse Rs. 49,786 crores or USD 8,300 mn of investment in the node by the end of Phase C.

Table 8.8: Industrial Investment

	Industrial Investment (Rs. Cr)
Traditionally strong sectors	**37,877**
Auto	18,926
Pharmaceuticals	9,898
Textiles & Apparels	2,084
Food Processing	1,618
Computer, electronic and optical products	5,350
Potential sectors	**11, 909**
Total	**49, 786**

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 299,020.

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.

8.4 Detailed cost-benefit analysis for all nodes

8.4.1 Temporary benefits

Temporary benefits include potential gross value added from construction activity as a result of development of proposed Tumakuru industrial node. Total temporary employment is anticipated to be 43,178 and total temporary GVA is expected to amount to USD 1,401 million. Total direct temporary employment is expected to be 15,421 and corresponding indirect employment is projected to amount to 27,757.

Table 8.9: Temporary employment to be generated in Tumakuru Industrial Node

Total temporary employment	Phase A	Phase B	Phase C
Direct temporary employment	6,014	3,501	5,906
Indirect temporary employment	10,825	6,302	10,630
Total temporary employment	**16,839**	**9,803**	**16,536**

Source: JICA Study Team

Table 8.10: Total temporary impact in monetary terms, Tumakuru Industrial Node

	Phase A	Phase B	Phase C
Direct temporary impacts – Construction expenditure (Phased), USD mn	331	247	649
Indirect GVA impacts USD mn	46	35	93
Total temporary impacts, USD mn	**377**	**282**	**742**

Source: JICA Study Team

8.4.2 Permanent benefits

Permanent benefits include potential gross value added from various manufacturing activities across sectors identified as highly potential for Tumakuru IN as well as some relevant services. Total permanent employment adjusted to deadweight and displacement assumptions (net employment) till 2053 is anticipated to be 355,087 and total direct GVA contribution is expected to amount to USD 6,305 million.

Table 8.11: Permanent net employment to be generated in Tumakuru Industrial Node

Total permanent net employment	Nos
Direct permanent net employment	142,035
Indirect permanent net employment	213,052
Total permanent net employment	**355,087**

Source: JICA Study Team

Table 8.12: Projected GVA benefits, Tumakuru Industrial Node

Total GVA	USD mn
Net additional direct GVA	2,522
Net additional indirect GVA	3,783
Total additional net GVA	**6,305**

Source: JICA Study Team

8.5 Benefit-cost ratio

The industrial node is assumed as ongoing concern till 2053 for the purpose of NPV calculation. Total net present value of benefits is expected to be USD 1,355 million.

Table 8.13: Summary of Net Present Costs and Benefits, Tumakuru Industrial Node

Summary of costs and benefits	
Total projected costs, USD mn	1,355
Total projected benefits GVA, USD mn	6,305
Total net benefits, USD mn	**4,950**

Source: PwC Analysis

Having calculated the net present value of projected costs and benefits till 2053, the project is estimated to have a **benefit-cost ratio of 2.8** ignoring any optimism bias in the estimated costs and benefits.

Table 8.14: Benefits-Cost Ratio for Tumakuru Industrial Node Development

Full-term NPV	
NPV of projected costs USD mn	637
NPV of projected benefits USD mn	1,782
Benefit - Cost Ratio (BCR)	**2.8 x**

Source: JICA Study team

Thus, development of Tumakuru Industrial Node can be considered economically beneficial given the costs anticipated for development of this industrial node.

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 Tumakuru 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: Finical model option

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 is 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: Timeline

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 Tumakuru 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.

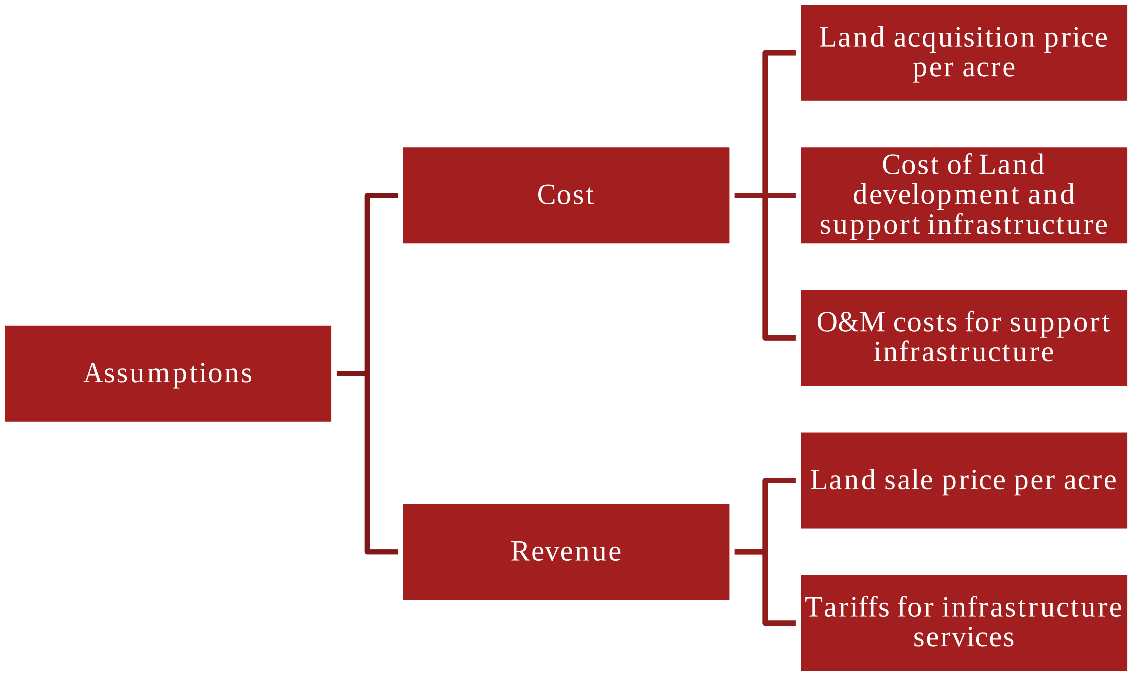


Figure 9.1: Cost and revenue assumptions

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: Cost of land development

Particulars	Rs. Crore
Land acquisition price per acre	0.60
Land development cost per acre (total cost over 35 yrs inc. inflation)	0.07
Total Cost of developed land per acre (total cost over 35 yrs inc. inflation)	1.20
Selling price of land per acre	1.20 in FY 16, escalated by 10% y-o-y

Source: JICA Study team

9.2 Project cost

Based on detailed technical assessment and master planning, cost estimates for developing Tumakuru Industrial Node have been arrived at using national and international benchmarks for unit costs. 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. It includes 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 total project cost (TPC) for development of land and infrastructure facilities over 10, 096 acres of Phase IV- V- VI of Vasanthanarasapura, is estimated around **INR 13,717 crores** (TPC inc. inflation and Interest during Construction (IDC)). The project cost break- up is as elaborated below. Bulk of the cost, around 50% of TPC is towards land acquisition and development. Among infrastructure components, Water and Effluent Treatment Facilities cost is highest at around 44% of total infrastructure cost.

Table 9.4: The project cost breakup

Item	INR cr.	% share of TPC
Land acquisition and land development		
Land acquisition cost	4,862	35%
Land development	693	5%
Infrastructure		
Roads	1,768	13%
Railway	140	1%
Water and Effluent Treatment Facilities	3,000	22%
Solid Waste Management	1,172	9%
Power infrastructure cost	959	7%
Others		
Contingency	773	6%
Interest During Construction	347	3%
Total	**13,716**	**100%**

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.

9.2.1 *Key capital cost assumptions*

Considering the scenario of master developer undertaking the responsibility for land and all infrastructures, the following are the key financing assumptions for the purpose of the financial model.

Financing structure:

Aligned to the DMIC model, it has been assumed that the Master Developer SPV will be constituted with center 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 Tumakuru node:

Table 9.5: Financial Structure

	INR cr.	% contribution of TPC
Equity (Infusion into the SPV through land)	4862	35%
Debt (Land development & infrastructure cost)	5793	42%
Internal Accruals	3061	22%
	13,716	**100%**

Source: JICA Study Team

The Commercial loan is assumed to be borrowed for a door to door tenor of 14 years with a moratorium of 3 years.

Phase- wise project costing (capital cost):

Initial construction period of 1 year has been assumed in April 2016, with commencement of partial operations in March 2018. For estimation of infrastructure capacity, land development has been assumed in a linear fashion over a 16 year time period (time- period required for exhaustion of land based on projected demand off-take). 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. Based on such assessment, phase- wise costing for infrastructure requirements is as follows:

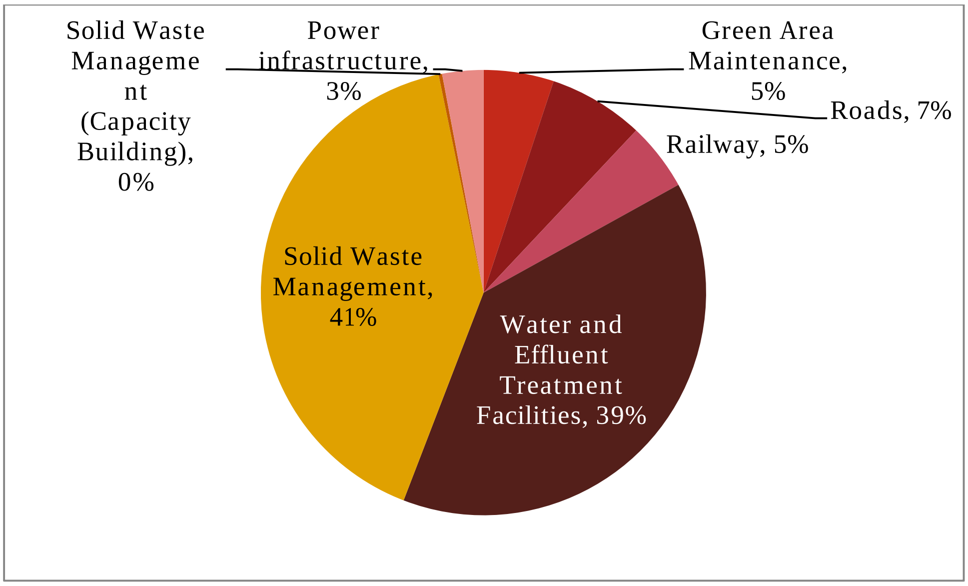
Table 9.6: Phase-wise project costing (capital cost)

Item	Phase A Upto FY 19	Phase B FY 20-24	Phase C FY 25 onwards
Land acquisition cost	4,862	0	0
Land development cost	52	163	478
Roads	864	290	614
Railway	68	9	63
Water and Effluent Treatment Facilities	806	608	1,586
Solid Waste Management	56	189	927
Power infrastructure cost	118	258	584
Contingency	197	152	425
Interest During Construction	138	90	119
Total	**7,162**	**1,759**	**4,795**

Source: JICA Study Team

9.3 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 breakup of O&M costs for Tumakuru Node under the current scenario of Master SPV managing all infrastructure components of the node.



Source: JICA study Team

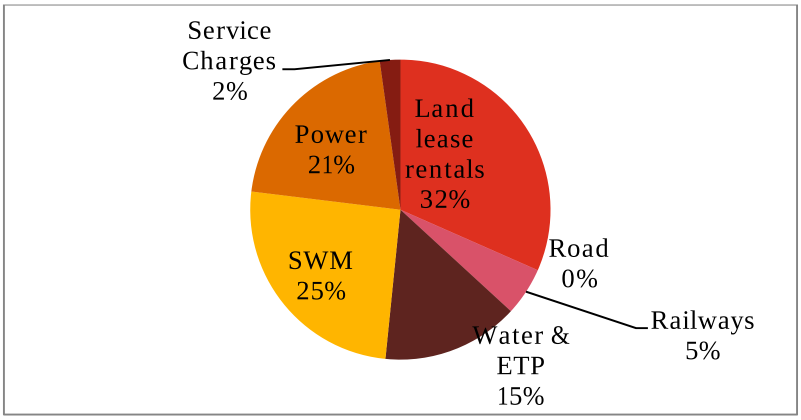
Figure 9.2: O&M cost split for Tumakuru Node

From the above chart, it may be observed that the solid waste management system accounts for maximum O&M at 41%. It may be noted that the JICA study team has proposed Incineration Facility for Hazardous waste in Tumakuru. The facility shall cater to industrial areas in and around Tumakuru in the CBIC Karnataka districts. Given the high power consumption for operating such a facility, maximum O&M cost is estimated for the SWM system. 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 Water and Effluent Treatment facilities, Railways & Roads. Maintenance of Green area has been assumed at 5% of the total revenues.

9.4 Revenues

Revenue streams envisaged for the project include land lease upfront lease rentals (99 yr lease based on prevailing practice in Vasanthanarasapura Industrial Area Phase I- III of KIADB), 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 total O&M costs, for provision of utilities. A y-o-y escalation of 5% has been assumed.

Land lease rentals form 30% of total revenues. Revenue estimations are based on ongoing market rates for land lease rates in Vasanthanarasapura, and user charges for utilities in the area.



Source: JICA Study Team

Figure 9.3: % share of revenue streams for Tumakuru Node

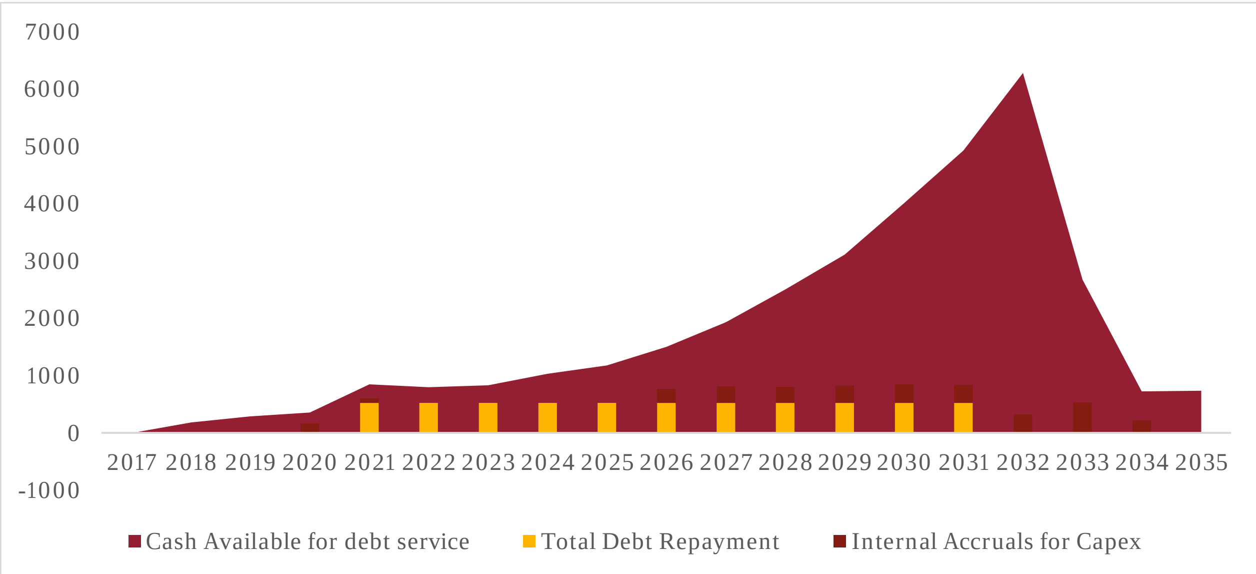
Key revenue assumptions:

Item	Rate
Land lease rental	Rs. 1.2 cr/ acre, escalated 10% y-o-y
Water Tariff o **Potable** o **Non potable**	o Rs. 10/ KL o Rs. 26/ KL (Revenue estimation has been done in a manner such that total revenues are able to recover the O&M costs over the 35 year project period. While rate of potable water has been kept consistent with ongoing market rates, non- potable water tariffs which are currently Rs. 20/ KL, have been adjusted in the above fashion)
Power	Consumer tariff on Rs. 0.93 per unit (kwh)
SWM	Revenue estimation has been done in a manner such that total revenues are able to recover the O&M costs over the 35 year project period. Break even Tariffs considered for revenue estimation for each Category - Rs per tonne: o MSW: Rs. 1189 o Nonhazardous waste: Rs. 1057 o Land fillable hazardous waste: Rs. 2318 o Incinerable hazardous waste: Rs. 11977 o Hazardous waste treated by AFR: 24

Item	Rate
	These rates are similar to the rates being charged for waste management for each category in industrial areas such as Dindigu, Andhra Pradesh.
Railways	Various sources such as handling at container yard, Warehousing, Cold Storage, Office rentals etc. Tariff estimation based on current Indian Railway & CONCOR rates.

Source: JICA Study Team

Revenues have been based on the above assumptions, and as seen in the chart below are sufficient for meeting opex and debt service obligations.



Source: JICA Study Team

Figure 9.4: Cash available vs. Debt service obligation (INR cr)

9.5 Scenario Analysis for Project viability

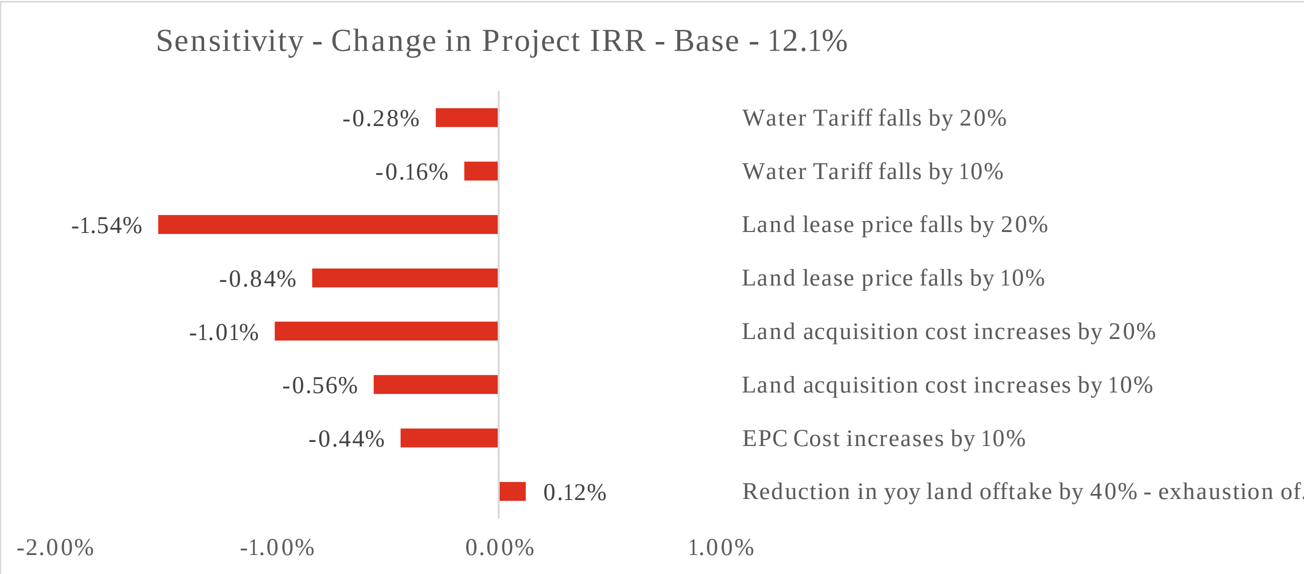
Under the current financing structure, and cost and revenue assumptions, the **project IRR stands at 12.1% and Equity IRR at 13%**. Other scenarios have been analyzed to assess any improvement in project viability by altering key project parameters such as tariff etc and by unbundling entities for independent operations. The same have been presented below:

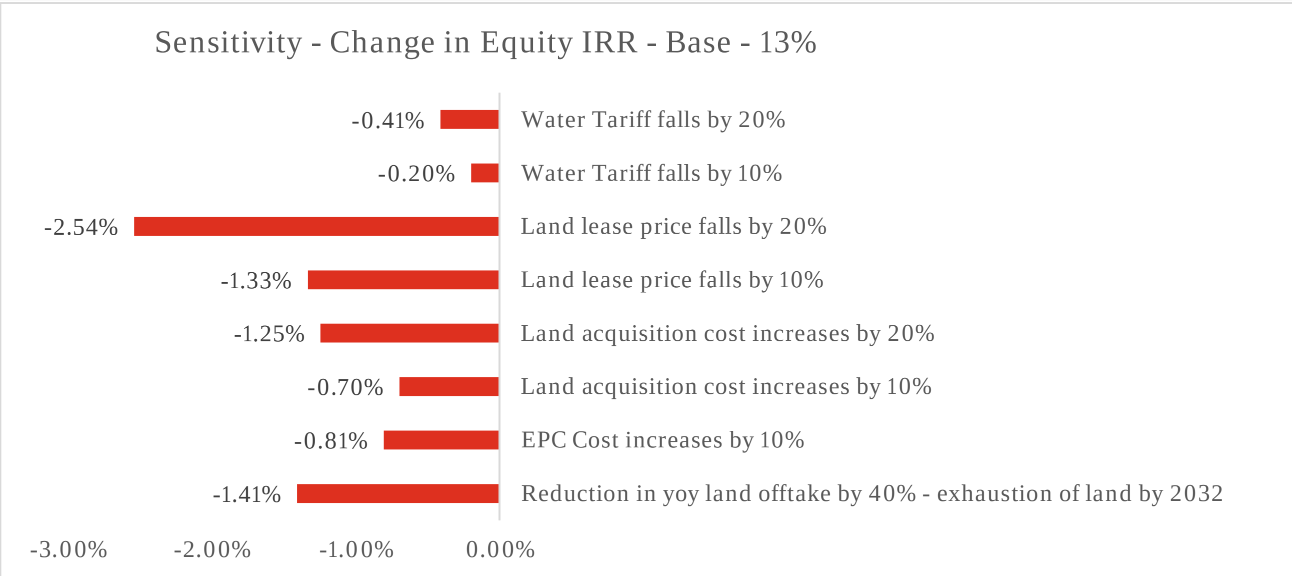
- **Land lease rentals**: Currently the ongoing lease rentals at Vasanthanarasapura NIMZ have been assumed with a 10% y-o-y escalation. It is to be noted that the Master Developer can sell land only to the extent of total area under industrial and residential land- use. Other areas such as road, green space, etc are essentially non- saleable areas and form around 27% of total land area under proposed project. The model assumes sale value of land at the ongoing rate of Rs. 1.20 cr/ acre escalating at 10% per annum but not less than the prevailing price of acquisition in that particular year

- **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.

- **Project cost:** This scenario considers altering project cost by increasing cost for individual project components. A case of change in land acquisition cost has been considered for the scenario analysis graph presented below

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





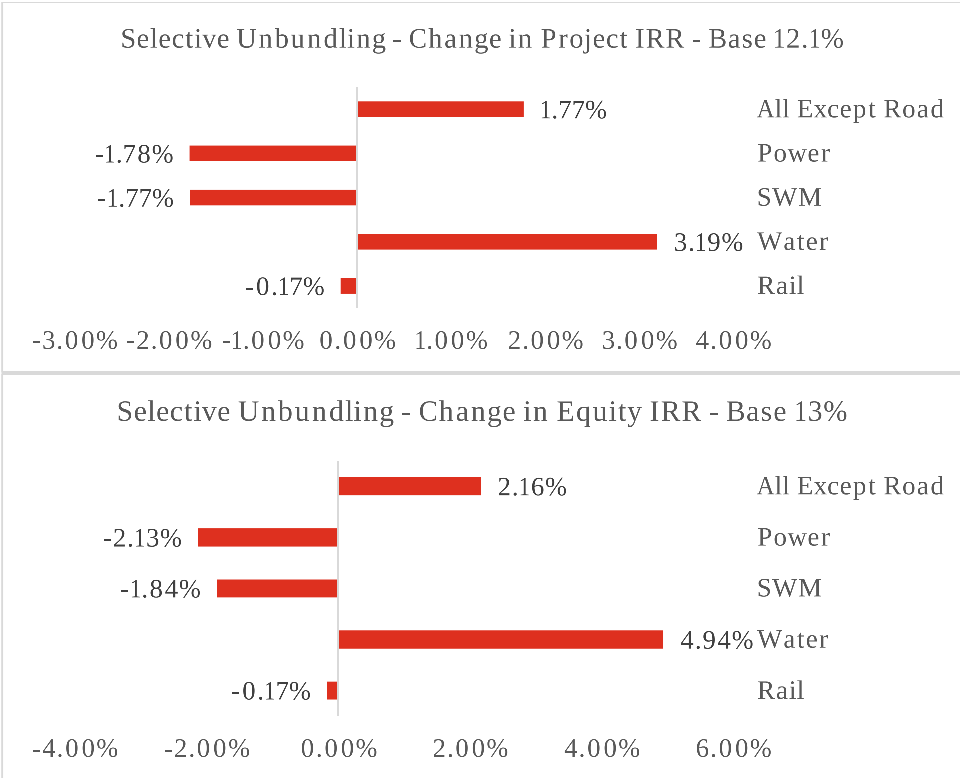
Source: JICA Study Team

Figure 9.5: Scenario Analysis- Impact on Equity IRR

As seen in the graph above, the Project and Equity IRR are sensitive to parameters related to land- Offtake and pricing. Any delay in land acquisition, may lead to substantial increase in land acquisition costs, impacting the projects viability. Also subdued demand will also substantially impact project viability. If the demand off-take reduces by 40% of projected demand, the Equity IRR reduces by 1.4% and time taken for absorption of land increases by 3 years.

Unbundling infrastructure components may be possible given the demand build- up for individual utilities is sufficient in later years. Based on current projections, only SWM, Rail & Power SPVs are analyzed to be viable as stand- alone SPVs. Other infra such as road and water are not viable as stand- alone SPV's and fall short of

Equity IRR below market expectations (18%). Thus unbundling such components will require infusion of any additional Govt. grant/ sub- ordinate loan etc (if applicable). Elaborating this further, a graph has been presented below showing change in Equity IRR of the project by unbundling all individual infra components from the Master Developer.



Source: JICA study Team

Figure 9.6: Impact on Equity IRR by unbundling individual Infra Components

As seen, the Project and Equity IRR increases only by unbundling Water SPV and All SPV's except Road. Road has no revenue model, so it has to be retained with the Master Developer. It is not feasible to unbundle Water SPV, as the current water tariffs (in line with ongoing water tariff in Tumakuru) which have been adopted are sufficient to meet only water opex requirements. In order to be feasible as a stand- alone SPV, it may be required that the Government provide up- front grant and/ or increase water tariffs specific to NIMZ node such that the additional cost will be borne by the State Government such that citizens will not be overburdened.

10 *Environmental and Social Considerations for Node Development Plan*

10.1Necessary 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.

10.2 Framework for EIA Studies for the Prioritized Node Developments

Source: JICA Study Team

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 prepared 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.

10.3 Initial Environmental Examination (IEE) Study

10.3.1 Objectives and Methodologies

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.

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

10.3.2 Outline of the Node

Topography

This land area has a gentle slope and the approximate elevation is between 700 and 825 meters above sea level.

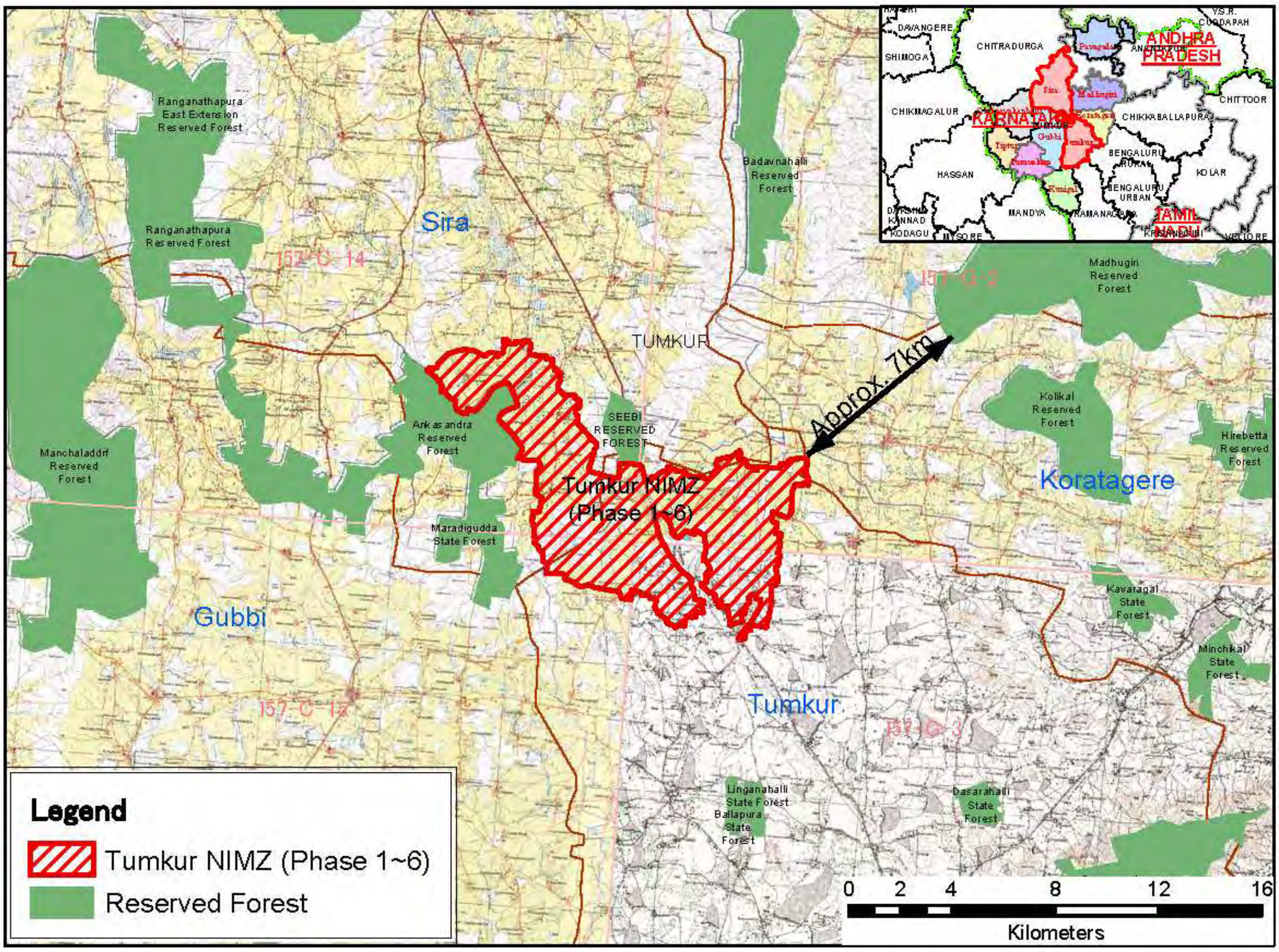
Climate

The climate in the Tumakuru district is usually dry with the temperature ranging from 16-34°C and is almost uniform across the entire district except in the northern taluk of Pavagada. The year may broadly be classified into four seasons - Dry Season (January to February), followed by Hot Weather (March to May), the Southwest Monsoon season (June to September) and the Northeast Monsoon period (October to December).

The district receives rainfall from both the Southwest and Northeast Monsoons. The average annual rainfall in the district as a whole is 613 mm. The average annual rainfall is 795 mm in Tumakuru taluk and 647 mm in Sira taluk. The rainfall graph indicates that rainfall is highest in eastern parts of Tumakuru and abruptly reduces at Pavagada in the north. On an average, the number of rainy days ranges between 32-35 days.

Sensitive Area

The development area doesn’t contain any environmental sensitive area such as reserved forest as shown in the below Figure 10.2.



Source: JICA Study Team

Figure 10.2: Location of Sensitive Area

Land use

The current land use pattern and distribution of settlements are as follows:

- Most of the area included in phase 4 of the Tumakuru National Investment Manufacturing Zone (NIMZ) is covered by crop land and agricultural plantations where coconuts, mangoes and bananas are grown.
- According to the Draft TEF report (Draft Techno-Economic Feasibility Report cum Development Plan) of Tumakuru NIMZ, double/triple cropping is difficult due to the limited water resources in this area.
- There is also fallow land at places across the node; it is observed that the water supply is one of the most critical issues in this area.
- Reserved forest areas are found beyond the western edge of the node boundary; some of this area is utilized by the locals for tree plantations.
- The main road that connects the area to the regional trunk road is less than 4m wide. However, some sections of it have a smooth surface, having been paved with asphalt.
- A few small reservoirs are scattered across the site and they are utilized for irrigation purposes by local farmers. In addition, some farmers purchase water from water treatment plants nearby. However no water distribution system has been developed for the area so far.

- Discussions with the villagers have indicated the bridge across the river was destroyed by a flood which occurred a few years ago.

- Four settlements are located along the river that passes through the node, running from south to north. The river runs from the Hemavathy reservoir towards Sira taluk, cutting across Phases 4, 5 and 6 of the NIMZ. During the field visit of the JICA Study Team, the river was noted to be fully dry. The alignment of the river has to be maintained since it is a natural drain.

- Agriculture, livestock and forestry are the main occupations of the villagers in the area.

- Some settlements and hamlets are scattered across the land designated for the phases 4 to 6Tumakuru of NIMZ. Additionally farm land is also present across the node. The local agricultural farmers are cultivating commercial fruits such as coconuts, mangoes, bananas etc.

Land Acquisition Status(as of November 2014)

The land acquisition status for Tumakuru Node is as shown in the Table 10.1. The acquisition of 3,897 ha of land, out of 5,382ha, has not been completed.

Table 10.1: Land Acquisition Status of Tumakuru

Phase	Area		Land Acquisition Status
	acre	ha	
1st	782	317	Acquired
2nd	1,242	503	Acquired
3rd	1,642	665	Acquired
Sub-total	3,666	1,485	
4th	1,722	697	Yet to be acquired
5th	3,174	1,285	Yet to be acquired
6th	4,732	1,915	Yet to be acquired
Sub-total	9,628	3,897	
Total	***13,294***	***5,382***	

Source: JICA Study Team

The general view of the site is shown in the Figure 10.3.

Source: JICA Study Team

Figure 10.3: General View of Tumakuru Node

10.3.3 Development Plan

The contents of the development plan for Tumakuru Node are as shown in the Table 10.2.

Table 10.2: Project Component (Tumakuru)

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) ● Railway Double tracking (Tumakuru – Sira) ● External Roads (Widening, New)
Railway	● Single track access line from proposed Tumakuru-Davanagere mainline line (distance approx. 3 km) crossing Highway 4 via two over bridges ● Three track arrival/departure yard outside the Logistics Hub, to permit re-positioning of locomotive and push-back into hub. ● Access line will initially be non-electrified but designed for ready later conversion
Logistics	The logistics Hub, containing: ● Separated paved loading/unloading yards for containers and steel ● Non electrified Railway loading/unloading tracks 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
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. ● Rain Water Harvesting system from storm water

Sector	Contents of Construction
Solid Waste Management	(Municipality waste) ● Compost treatment plant ● Sorting plant ● Sanitary landfill
	(Hazardous solid waste) ● Incinerator ● Sanitary landfill ● Plant for Alternative Fuels and Raw Materials(AFR)

Source: JICA Study Team

10.3.4 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	A	-	● There is a possibility to occur involuntarily resettlement due to land acquisition (approx.3, 900ha). ● 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.
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 people living in the node, 150,000 in the future and 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 Reserved Forest adjacent to the site might be affected during construction and operation stages.
Natural Environment	19	Meteorology	-	-	
Natural Environment	20	Landscape	-	B	● The provision of comfortable living condition to people living in the site is necessary. The number of the people is supposed to be

	No	Likely Impacts	Rating		Description
			Pre-construction / Construction	Operation	
					approx. 150,000 in the future.
	21	Global Warming	-	-	
Pollution	22	Air Pollution	A	A	● The increasing of number of vehicle at surrounding of the site during construction and future might cause air pollution.
	23	Water Pollution	-	A	● The water pollution in the river might cause due to establishment of factories and housing areas ● There is a possibility of natural disaster such as flood caused by seasonal storm.
	24	Soil Contamination	-	-	
	25	Waste	—	A	● The solid waste will be generated due to establishment of factories and housing areas.
	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

10.3.5 Conclusions

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 ● Provision of amenity for living environment

Item	Matters for Consideration
Natural Environment	● Appropriate conservation of Reserved Forest found adjacent to the project site ● Appropriate water supply considering poor condition in terms of water resource in the site ● Appropriate sewage treatment for water quality control of the river in the project site ● Countermeasures for natural disaster such as flood caused by seasonal storm
Pollution Control	● Countermeasures 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

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

- Physical Environment
- Secondary information on topography, geology and hydrology of the area will be collected within 15 km radius of the site.
- Climate
- Temperature, rainfall, wind direction, wind speed, relative humidity
- 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, landuse, 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 Leq hourly, leq day and leq 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 Landuse, 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

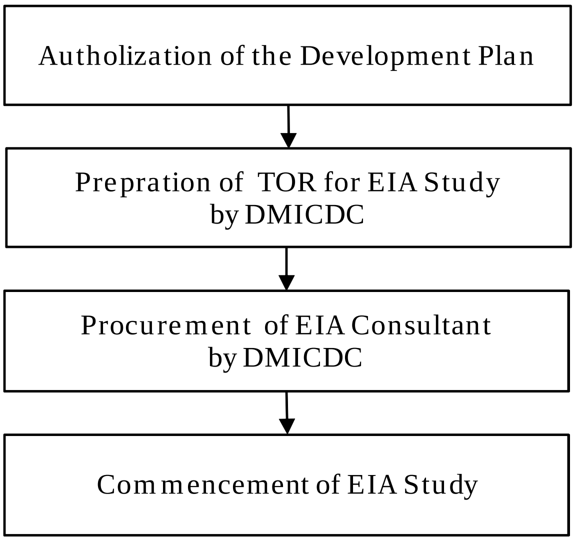
- Occupational health and safety Measures
- Requirements for green belt and landscaping
- Traffic Management plan

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.

10.4 Recommended Action and Schedule

The Environmental Impact Assessment (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 and Table below.



Source: JICA Study Team

Figure 10.4: 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

11 ***Institutional & Financing Framework***

Realisation of primary objectives of the National Manufacturing Policy[55] (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[56] and 16 NIMZs[57] 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

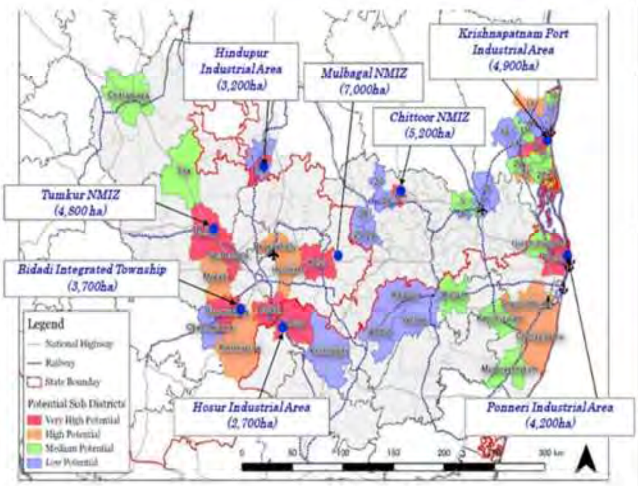


Figure 11.1: 8 industrial nodes selected along CBIC

State	Planned Area	Area Sq. km
Tamil Nadu	Ponneri Industrial Area	42
	Hosur Industrial Area	27
Karnataka	Bidadi Integrated Township	37
	Tumakuru NIMZ	48
	Mulbagal NIMZ	70
Andhra Pradesh	Hindupur Industrial Area	32
	Chittoor NIMZ	52
	Krishnapatnam Industrial Area	49

- 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

[55] 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
[56] DMIC, CBIC, BMEC, VCIC, AKIC
[57] 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) Tumakuru 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 funding					✔	✔	✔	✔	✔	✔	✔			✔
Industry Associations				✔								✔	✔	✔
Private Sector					✔	✔	✔	✔	✔	✔	✔			

Source: JICA Study Team

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 Tumakuru node and CBIC development.

11.1 Approach

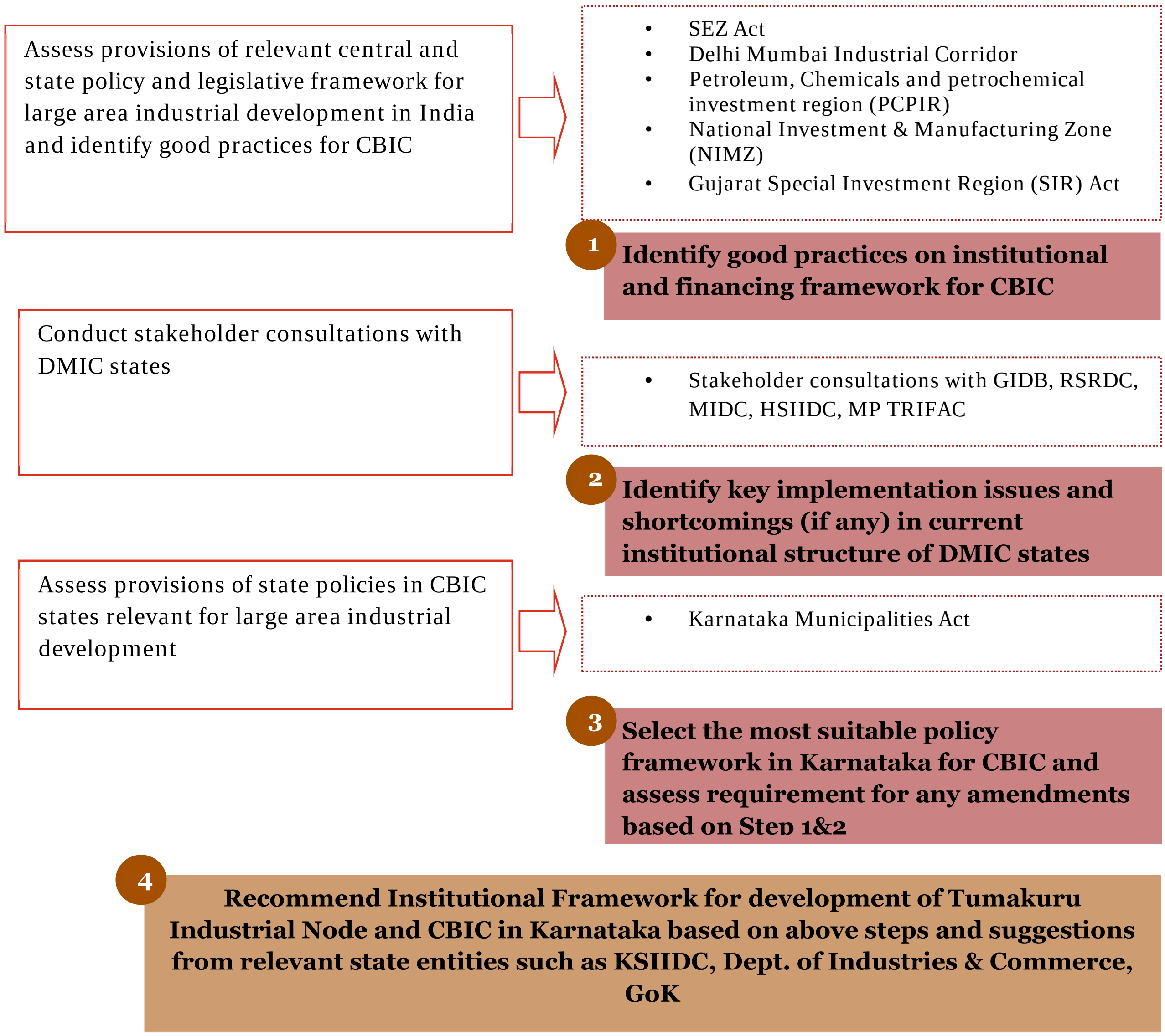


Figure 11.2: Approach towards formation of institutional framework

11.2 Administrative and Implementation Framework

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:

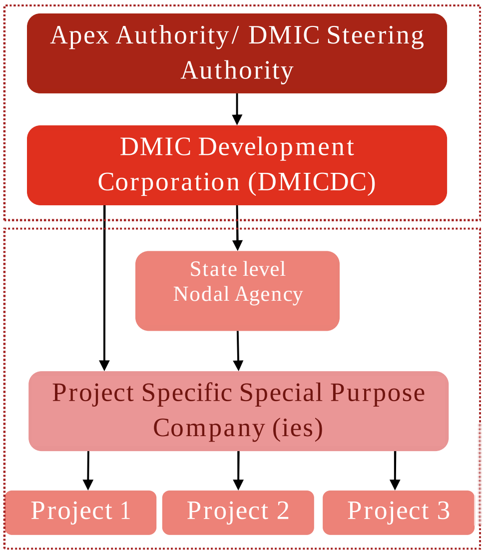
- **Constitution of SEZ authority**, a body corporate chaired by a Development Commissioner (of IAS rank), and comprising representation from Central/ State government, the developer and other nominated members empowered to acquire land, prepare master- plan, guidelines for land- use, FAR etc for the 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[58], 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.

11.2.1 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.

[58] 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



- Headed by the Finance Minister; Minister for Commerce & Industry, other cabinet ministers, and chief ministers of 6 states as members- Responsible for overall project supervision, monitoring and commissioning of projects, policy framework, fast- tracking clearances & approvals
- Incorporated as an SPV, Project Development Partner or Knowledge Partner to all SPVs and State Government agencies; Current shareholding pattern - DIPP (49%), IL & FS (41%), IDFC (10%); Responsible for project advisory services, Master Development Plan for DMIC, project prioritization and allocation to Central/ State Governments, raise financing instruments etc
- Responsible for co-ordination between the DMICDC, various state government entities and the project implementing agencies/ SPV; Node formed as an Industrial Township under Article 243 Q(1)(c) of the Constitution with composition of the Node SPV comprising of 49%- DMIC Trust and 51%- state
- Project SPVs for both central and state govt. sponsored projects (ports, railways, air, road, industrial, utilities)Both node and project SPVs are responsible for obtaining approvals & clearances, commissioning and monitoring of project implementation, arranging finance etc

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 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 existing in 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.**

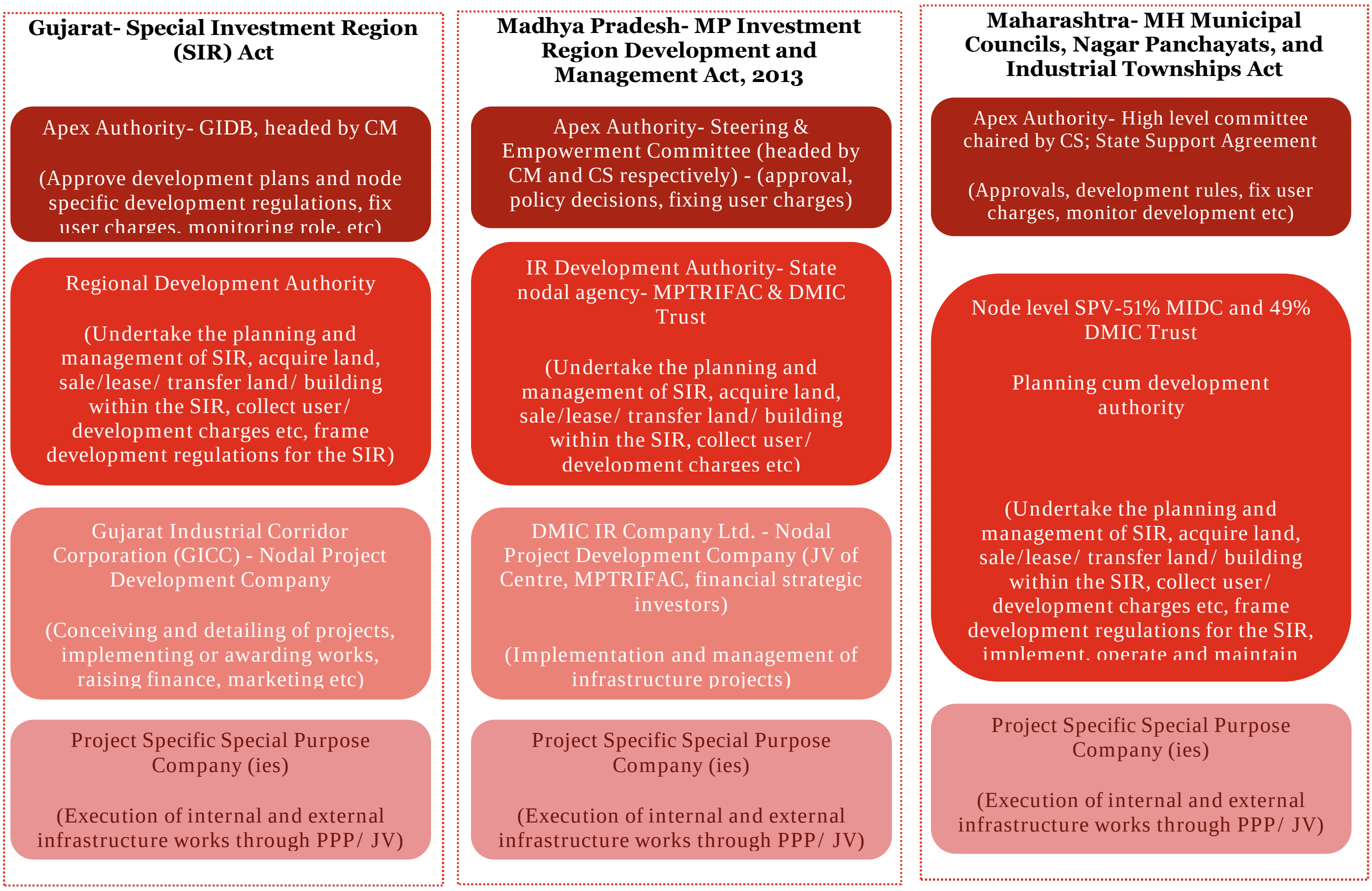


Figure 11.4: DMIC Implementation Framework across select states

Financing framework

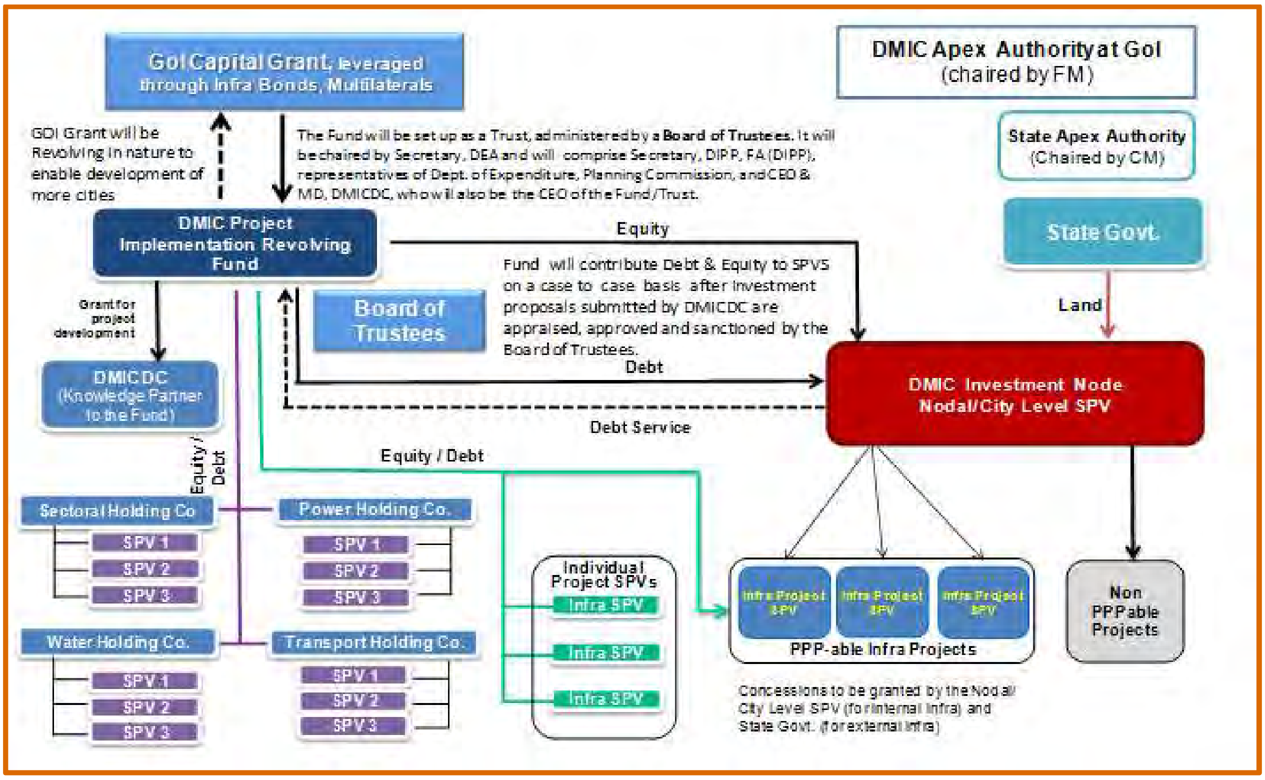
A "DMIC Project Implementation Fund" has been established as a Trust with an inter-ministerial Board of Trustees headed by Secretary, DEA. Central Government will provide a grant-in-aid of Rs 17,500 crore to the Fund/Trust over the next 5 years beginning 2011-12, for the development of the 6 industrial 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[59] of the Ministry of Finance or the Trust as the case may be.



Source: DMICDC

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.

1. Implementation Framework under PCPIR & NIMZ

At the Central Level, other large area industrial developments proposed are NIMZs and PCPIRs. NIMZ's are an important instrumentality of achieving the objectives laid down under the National Manufacturing Policy. Proposed to be set up in a minimum area of 50 sq. kms, an NIMZ is envisaged as an integrated industrial township with state of the art infrastructure. The ideology behind PCPIR is to develop an investment region with an area of around 250 square kilometres (5 times the size of an NIMZ) specifically for the establishment of manufacturing facilities for domestic and export led production in petroleum, chemicals & petrochemicals industry, along with associated services and infrastructure.

Both mandate similar project implementation frameworks with robust centre/ state representation. It is envisaged that while the Central/State Government (based on project jurisdiction) will be responsible for all external infrastructure, and wherever necessary will provide support in the form of viability gap funding, budgetary provisions, credit enhancements for other forms of financing etc for creation of these linkages. All internal infrastructures are to be provided by Developer/ co- developers.

[59] SIPP and CEO, DMICDC will be members of PPPAC to appraise and fast- track PPP projects in the DMIC region

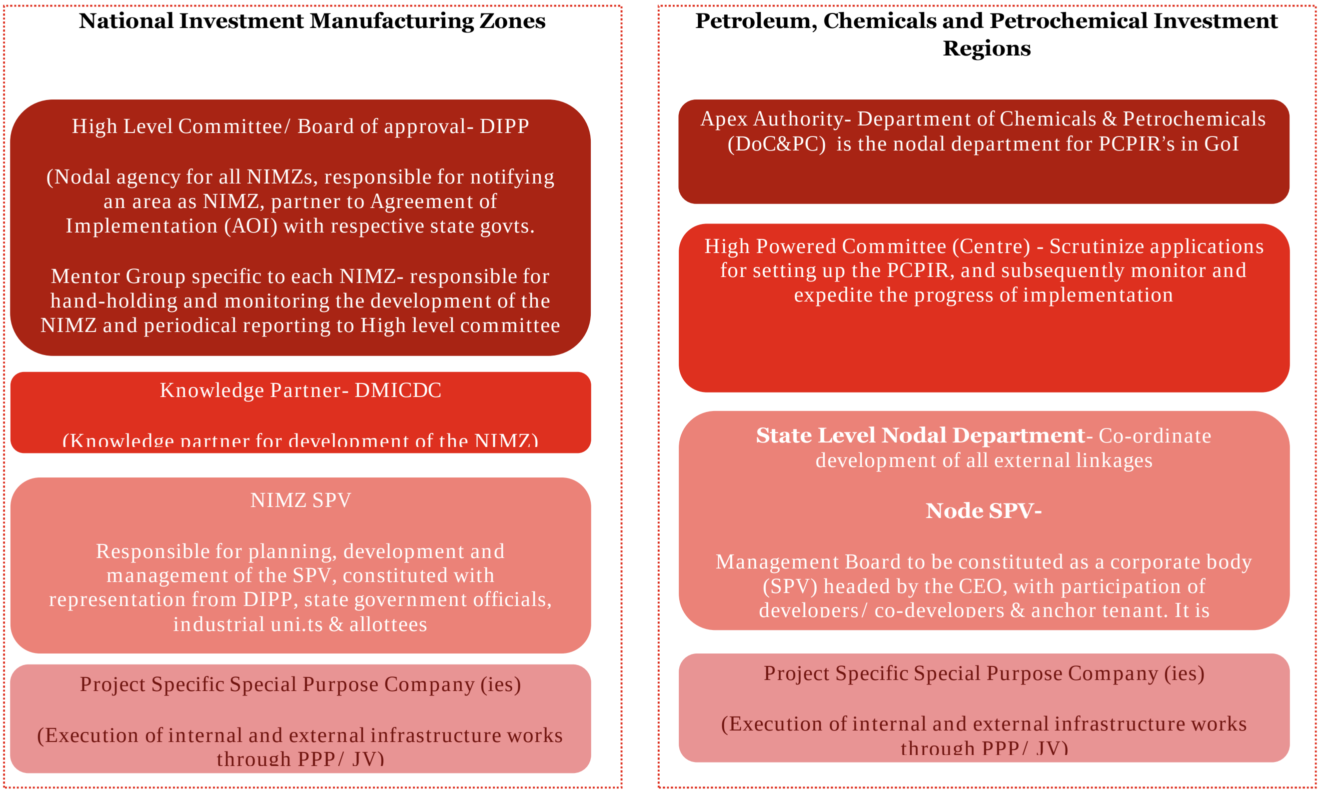


Figure 11.6: Implementation framework for PCPIR & NIMZ

2. 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 an 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.

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.

11.3 Key Learnings from Stakeholder Consultations

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: Stakeholder consultations with DMIC states

Issue	Remarks	Good Practice
Land acquisition	No transparency in valuation of land, resistance towards land acquisition due to poor compensation, no means of land monetisation by the land owner as a result of proposed development	• Gujarat mechanism of land pooling through Town Planning scheme • Customised 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	• 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 prioritisation of external infra 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 Result Framework Document with agency responsible and timelines for 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 for the node	• Industrial corridor cell maybe proposed in key central agencies such as NHAI, Shipping, Railway Board etc to plan, implement and operate projects 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 prioritised 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

Issue	Remarks	Good Practice
		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 monetisation 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

11.4 Successful Operational Examples - JUSCO & GIFT

GIFT city

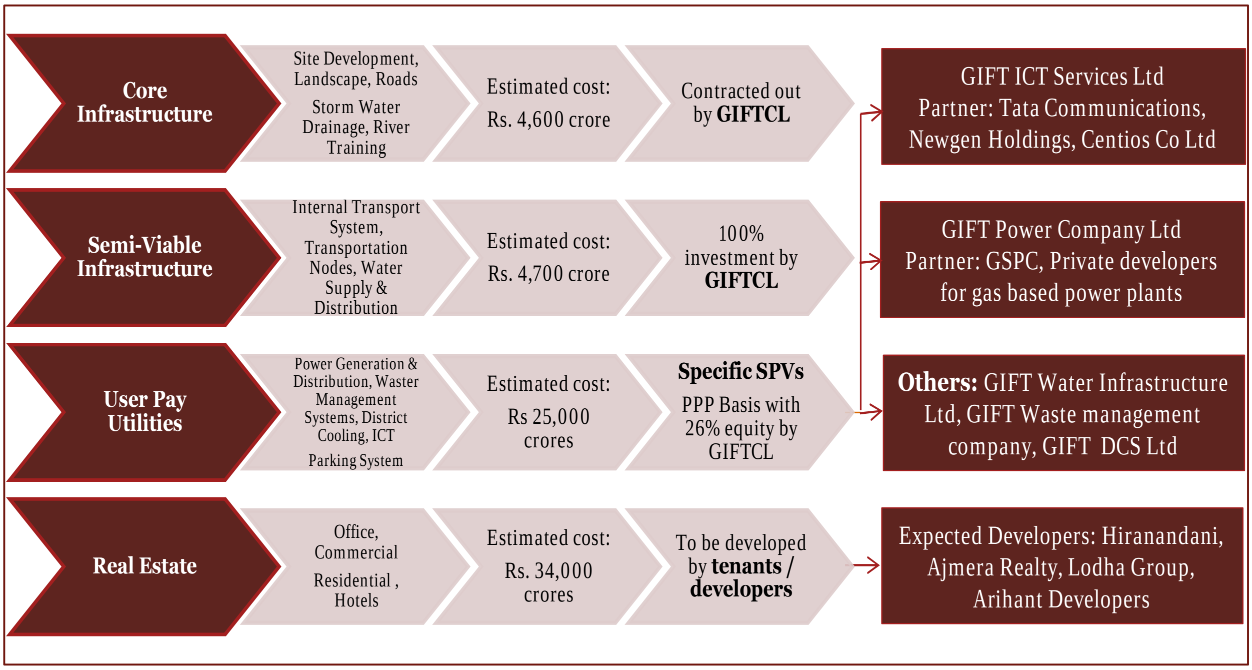
Gujarat International Finance Tec-City is planned as a financial central business district for the global financial services sector with the state of the art connectivity, infrastructure and transport access. GIFTCL is a Public Limited Company with IL&FS and GUDC both holding 50% each of the share capital 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 as the Single-Window Area Development Authority.

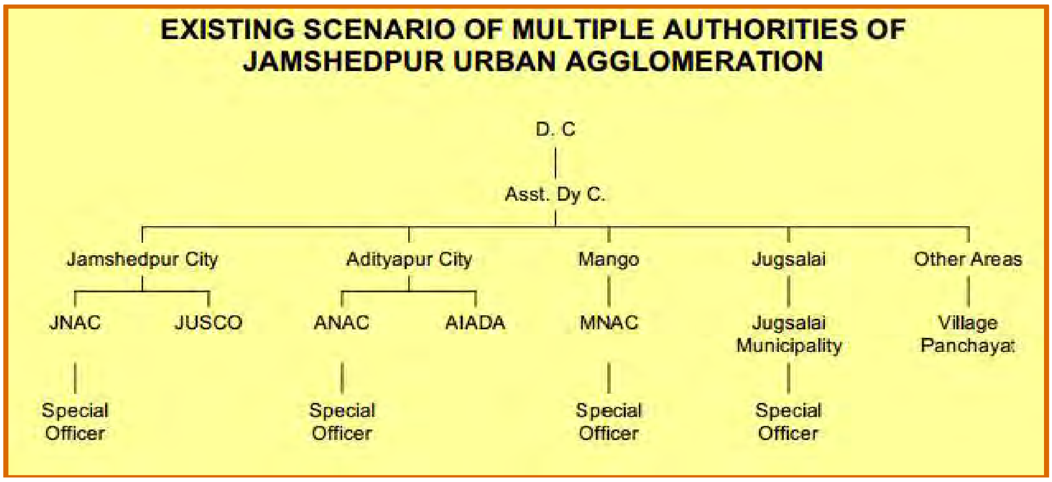


Source: GIFT/PwC Analysis

Figure 11.7: GIFT Structure

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:



Source: Jamshedpur City Development Plan

Figure 11.8: Existing Scenario of multiple authorities of Jamshedpur urban agglomeration

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.

Summary of key learnings

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 KSIIDC, the institutional framework for Tumakuru 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 co-ordinated planning of all industrial corridors. Apex Authority to be sufficiently empowered with high level representation from Finance Minister, other relevant cabinet ministers, 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

- **Corridor Units within relevant line departments:** Industrial corridor units within critical departments such as NHAI/ Railways/Shipping/ MoEF will be critical in delivering and fast- tracking of external infrastructure projects

- **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 Leve**l: 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.

The models of several industrial parks are summarized in Table 11.3.

11.5 Proposed Institutional Framework

11.5.1 Relevant Legislative Framework

In order to formulate the institutional structure for Tumakuru industrial node under CBIC, it is important to understand the relevant legislative framework in Karnataka which allows for such development. In this context, the suitability of 4 relevant state acts was assessed, namely:

- Karnataka Municipalities Act;
- Karnataka Industrial Areas Development Act;
- IT Investment Region (ITIR) Act; and
- Karnataka Town and Country Planning Act

An assessment of provisions of the above acts reveals that **the Karnataka Municipalities Act is most suitable for development of Tumakuru Node**. A suitability matrix for selection of legislative framework for CBIC development in Karnataka has been presented below.

Table 11.3: Suitability matrix for selection of legislative framework for CBIC in Karnataka

Provisions of the acts	Karnataka Municipalities Act	Karnataka Industrial Areas Development Act	IT Investment Region (ITIR) Act	Karnataka Town and Country Planning Act
Declaration as industrial area or township/ investment region/ special area	Yes	Yes	Yes	No
Special planning authority	Yes	Yes[60]	Yes	Yes[61]
Node	Industrial Township Area/ (similar to Article 243 Q)	Industrial estate/ area	Investment Region	Special planning area
Minimum area of delineated area	As per census planning area classifications	Smaller areas (less than 3,000 acres or 12 sq. kms)	40 sq. kms	As per census planning area classifications
Area Authority	Industrial Township Authority	KIADB	Management Board	Special area planning authority
Functions	All municipal functions	Node planning, develop and sell/ lease land, provide basic internal infrastructure within the node	Node planning, develop and sell/ lease land, provide all internal infrastructure within the node	All municipal functions
Funds	• Grants, loans, advance from Govt. • Taxes, levies, tolls, rents etc • Money received from the disposal of land, buildings property	Sale/ land lease; maintenance charges	User charges for infrastructure facilities, sale/ lease of land/ property	• Grants, loans, advance from Govt. • Taxes, levies, tolls, rents • Money received from the disposal of land, buildings property

[60] Karnataka Industrial Area Development Board (KIADB)
[61] Hampi World Heritage Area Management Authority

Source: PwC Analysis

11.5.2 Key considerations

- Tumakuru industrial node has been notified as an NIMZ by the state govt. and DIPP. Thus all regulations and guidelines for NIMZs are applicable for Tumakuru industrial node.
- The delineated area currently has existing village settlements under the jurisdiction of 7 Gram Panchayats[62]. Based on discussions with KSIIDC 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.

    - It is proposed that the node be declared as an Industrial Township by the state government aligned to Article 243 Q as per the NIMZ guidelines, and a separate Tumakuru Industrial Area Authority be formed which will assume the role of the municipal body for the node. Thus in accordance with the provisions of Article 243 Q and Karnataka Municipalities Act, the existing Gram Panchayats will cease to exist upon formation of such Tumakuru Industrial Area Authority.

[62] Gram Pachayats within the Node:
- o Tumakuru Taluk: Nelhalu, Kestur, Sorekute, Thimmarajanahalli
- o Sira Taluk: Seebi, Seebi aorahar, Chinnenahalli

Table 11.4: Model comparison

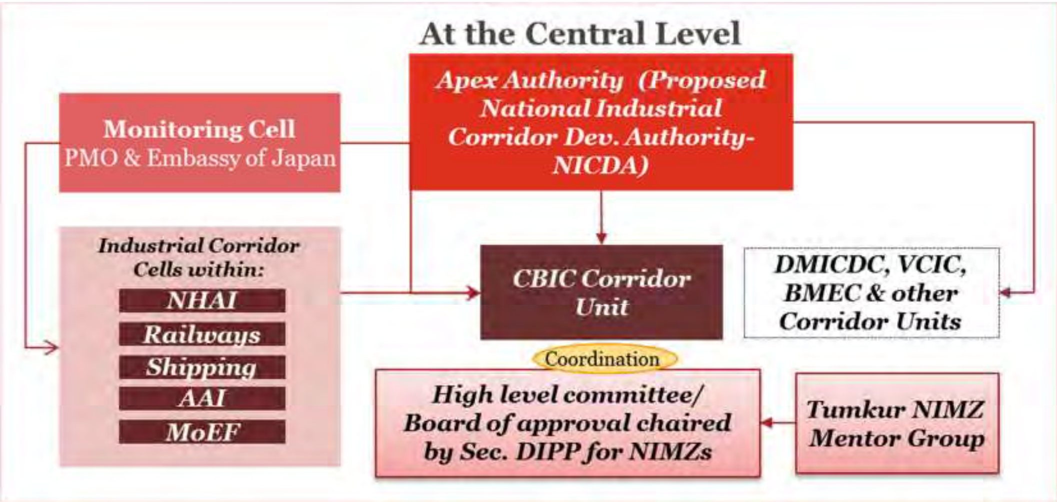
	GIFT City	JUSCO	Sri city	Dahej SEZ	Mahindra World City SEZ (Jaipur)
Land area (acres)	886	15,814.70	7000+	4279.86	3000
private sector equity	No JV: Gujarat International Finance Tec-City Company Limited' (GIFTCL), between Gujarat Urban Development Company Limited (GUDC) and Infrastructure Leasing & Financial 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

11.5.3 Proposed Institutional Structure

Taking into key considerations the key learnings for CBIC and suggestions from GoK, the following institutional structure has been proposed for Tumakuru 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.
- **Industrial corridor units may be formed within key agencies such as NHAI, Railways, MoEF, Shipping etc for facilitation of critical external infrastructure projects. These units may report directly to PMO & CBIC corridor unit at the Central level and State Apex Committee at the State level.**
- Monitoring cell comprising of PMO and Japan embassy to form the apex level monitoring body

Figure 11.9: Institutional structure for CBIC in Karnataka

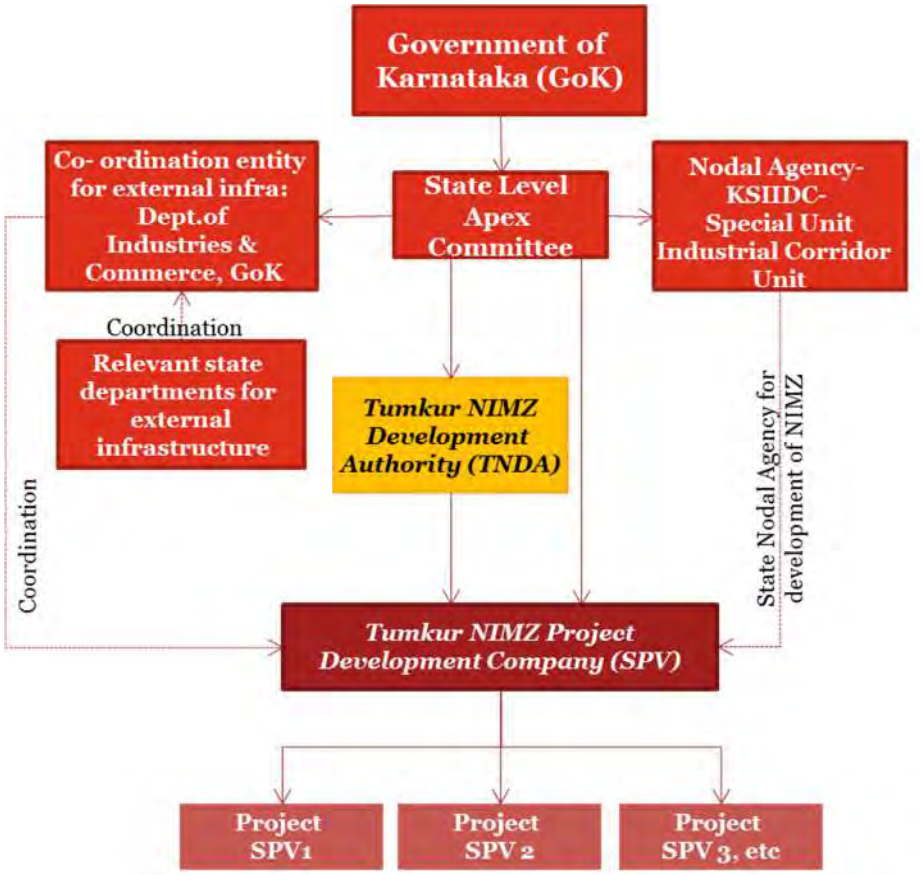


Figure 11.10: State level Institutional Structure for CBIC in Karnataka

• Key features of the proposed institutional structure

1. 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. The high level committee for NIMZs chaired by DIPP will notify, hand- hold and monitor the progress of Tumakuru NIMZ.

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 finance depts. and chief minister's offices*

2. 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 the High level NIMZ committee to periodically update progress of CBIC development, fast- track approvals and clearances within state jurisdiction and resolve any planning/ implementation issues.

Proposed representation of State Level Apex Committee:

- *Chaired by Chief Minister/ Chief Secretary*
- *Additional Chief Secretary, Commerce & Industries Department*
- *MD KSIIDC*
- *Karnataka Udyog Mitra (for investment promotion)*
- *A nominee of GoI (DIPP)*
- *High level representation from state departments-*
  - *Finance*
  - *KIADB/ Land and Revenue*
  - *Environment*
  - *Urban Dev. Dept./ Town Planning Dept.,*
- *Board members of mega industrial projects in state NIMZs, BMEC etc*
- *JICA/ other multi- lateral agencies*

3. Co-ordination entity for external infrastructure

Based on discussions with GoK, Department of Industries and Commerce has been identified as the nodal agency for co-ordinating implementation of all external infrastructures for CBIC in Karnataka. The department is instrumental for project clearance and monitoring through Single Window and High level committees through the nodal agency Karnataka Udyog Mitra (KUM).

Under the existing organisation set-up of the department, a new cell for Industrial Corridors may be set up headed by a Joint Director.

4. Capacity building

The state nodal agency may be suitably capacitated by creation of a special Industrial Corridor Cell by passing of requisite GO and

Proposed experts for Industrial Corridor cell in KSIIDC:

- o Subject matters experts in the field of industrial and urban planning
- o Project management office (PMO- external consultants)
- o Financial advisor
- o Liaison officer

5. Node Autonomy & private sector participation

In order to facilitate private sector participation, it was felt necessary to segregate the planning and development functions amongst two bodies, such that Government retains all statutory functions such as framing of development regulations, approvals, NOCs, collection of taxes, provision of statutory services such as low income group housing, police, low cost health and education etc. Accordingly, a Tumakuru NIMZ Development Authority may be created.

Proposed composition of Tumakuru NIMZ Development Authority

- o Chairman – MD KSIIDC
- o GoI nominee from NICDA
- o Representatives from Industry units within NIMZ/ other allottees
- o Tumakuru Municipal Corporation- Local Authority representative

For the development function a separate SPV may be created, Tumakuru NIMZ Project Development Company (Master Developer) which may contain private sector participation and be responsible for implementation and operation of the node. The suggested composition for Tumakuru NIMZ PDC is based on indicative guidelines proposed by NICDA.

Proposed composition of Tumakuru NIMZ Project Development Company:

- o KSIIDC-majority shareholding in SPV, share in equity based on valuation of land brought in by KSIIDC/ GoK for the Tumakuru NIMZ
- o NICDA-GoI's equity contribution (upto 49%)
- o Developer/ co- developers/ financial institutions-Equity contribution of private sector upto 49%
- o Private sector may either participate through equity infusion in the Tumakuru NIMZ PDC (Master Developer SPV) or through sub- SPV's for provision of viable services within the node through the PPP route

6. Technology Collaboration & Knowledge Transfer:

Participation of JICA (and other relevant multi- lateral agencies) has been proposed both at the Central Level (Monitoring Cell) and the State Level (Apex committee) to facilitate knowledge transfer and technology collaboration in newer areas such as Smart City concepts, Green Buildings, Zero Waste Discharge etc. Apart from training in technical skills, soft skill improvement program may also be undertaken. Involvement of JICA 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 made a detailed presentation to GoK in December 2014 about the proposed Institutional Structure and some observations were made. Based on that JST has revised the structure and the same has been mentioned here in this report.

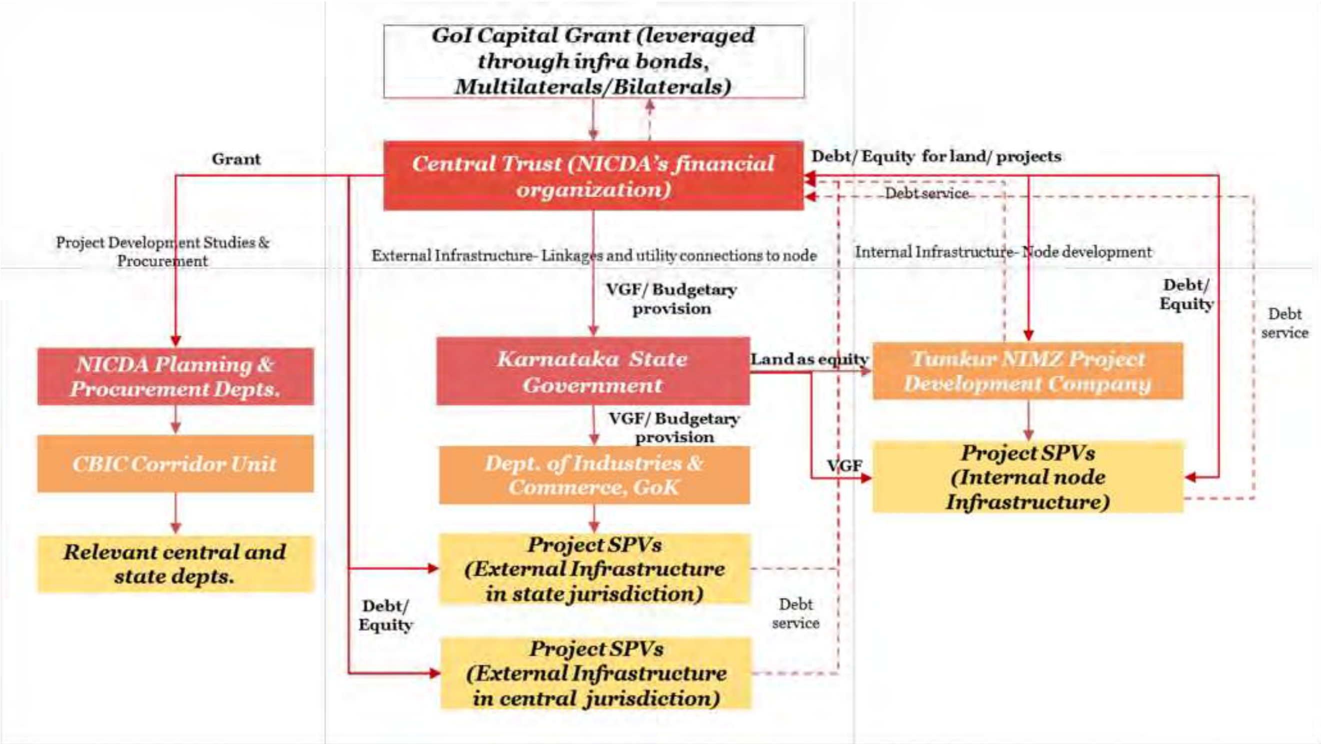
- **Detailed Roles & Responsibility Framework for key stakeholders for development of Node**

Table 11.5: Roles and responsibilities framework for key stakeholders for development of Tumakuru NIMZ and CBIC in Karnataka

Key Task	Responsibility
Land Delineation for the Node & Project Development Studies	KSIIDC is responsible for conducting pre- feasibility assessment for the node, and delineating appropriate land parcel for development
Land Acquisition	KIADB is responsible for all land acquisition and R&R activities
Approval & notification as NIMZ	Upon submission of proposal by KSIIDC, the NIMZ High level committee at the Central Level is responsible for notification of delineated area for NIMZ development
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 Tumakuru NIMZ 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 Tumakuru 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 Dept. of Industries and Commerce has been proposed as nodal agency for co-ordination & monitoring of external infrastructure. Monitoring such project status shall be conducted by the State level apex committee and the NIMZ High Level Committee & Central Monitoring Cell
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

11.5.4 *Financing Framework*

Two options for financing framework have been considered for CBIC development in Karnataka. 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.



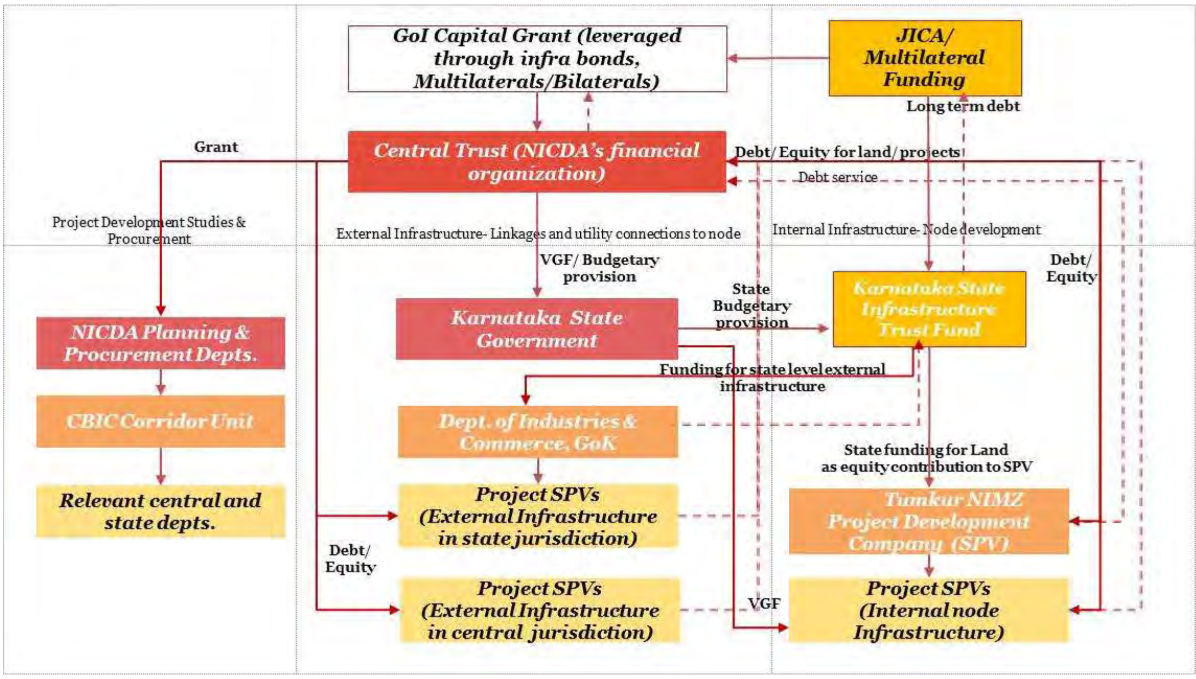
Source: PwC Analysis

Figure 11.11: Option 1- Financing framework for CBIC in Karnataka

- **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 Dept. of Industries & Commerce, GoK, from where it may be routed to relevant state departments (VGF/ Budgetary provisions). Again, NICDA may also choose to directly invest into project SPVs (both internal & external infrastructure) in the form of Debt/ Equity.
- For the development of the node, GoK's equity contribution in the Tumakuru NIMZ PDC, is in the form of land, NICDA's contribution may be in the form of Debt/ Equity, equity share capped at 49%, private sector equity contribution also to be capped at 49%.



Source: PwC Analysis

Figure 11.12Figure 11.13: Option 2- Financing framework for CBIC in Karnataka

In the second option, it is proposed that JICA funding may be made available both at NICDA level (at centre), and JICA can directly fund the state through creation of Karnataka state infrastructure trust fund. This will enable faster fund routing from JICA directly to the state government.

An initial round of discussions has been held with Karnataka State Government regarding the institutional and financing framework for Tumakuru Node and CBIC development in Karnataka. Based on further consultations with DIPP and GoK such framework will be finalised and presented in the Final Feasibility Report

12 *Investment Environment Improvement*

12.1 Background

The strengths and weaknesses of CBIC states were reviewed to assess their potential as global investment destinations in comparison with the rival countries/regions as well as investors' view on the ground. Recommendations were thus identified with the CBIC states to enhance the investment environment.

The quantitative analysis of Indian states and cities, as well as the global competitors, reveals the position of the CBIC states in the investment dynamism. This step is followed by the qualitative analysis of the comparative advantages/disadvantages of CBIC through feedback from consultation meetings. The analysis has been done in order to clarify the bottlenecks being faced by Japanese companies already operating in CBIC on the ground.

Based on the analysis, we have adopted five key perspectives which include infrastructure, land acquisition/building approvals, skill development, business process, and industrial park/cluster, to conduct benchmarking study across CBIC states and the states which follow best practices to highlight the areas of improvement. We have also done international benchmarking against South East Asia to indicate additional approaches for improvement.

The private sector feedback, from the in-depth interview with the companies who are facing hurdles in doing business in India, is analysed to specify further area of improvement for the CBIC state to become the key destination of the investment.

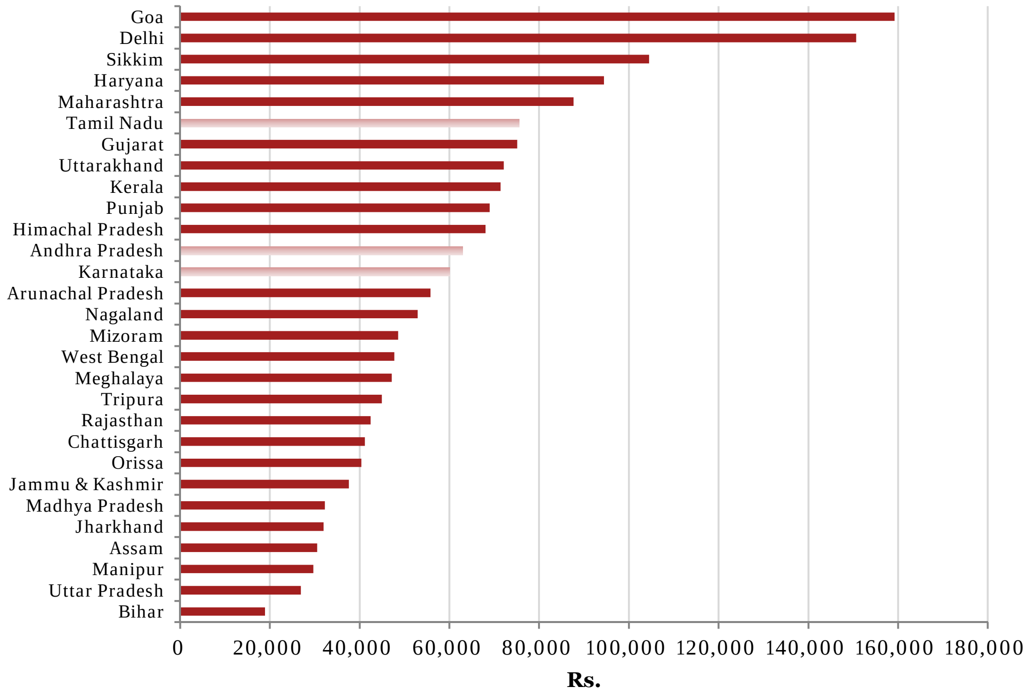
The focus of our recommendation from now on is primarily on the five perspectives where the states have a strong role to play. Although we conducted benchmarking against international competitors, the primary focus would be on best practices from the Indian states and also the feedback from the private sector to make sure that our recommendations 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 states as Tamil Nadu, Karnataka and Andhra Pradesh States at the state level, and Chennai and Bangalore at the city level.

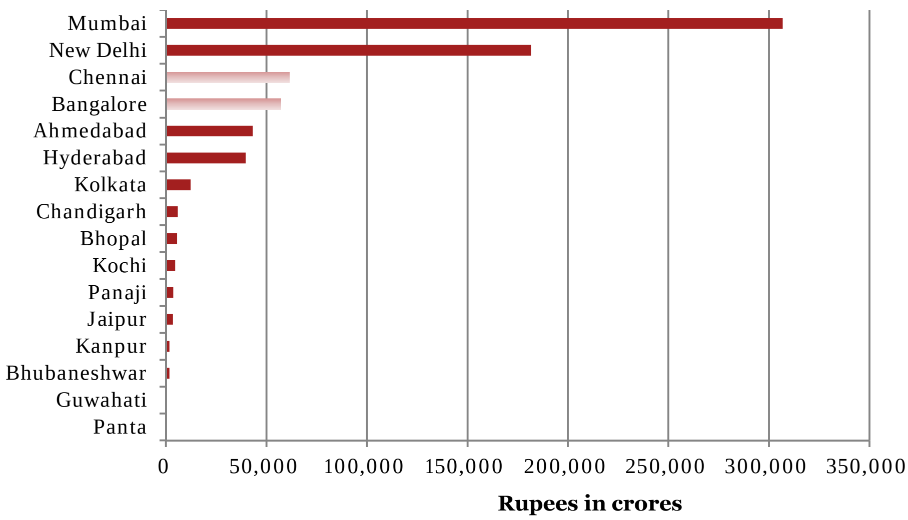
At first, state wise per capita GDP is compared in order to purchasing power of people in the market. Out of all the states, Goa and Delhi have performed better in this regard. It tends to be high in the states with major cities, and low in the states with large rural areas. The three states in CBIC are included in the high score group. CBIC can be said as one of the promising markets in India, which consists of people who possess a certain purchasing power.



Source: Economic Survey of Karnataka 2012-13

Figure 12.1: Per Capita Income at Current Prices (2010-11)

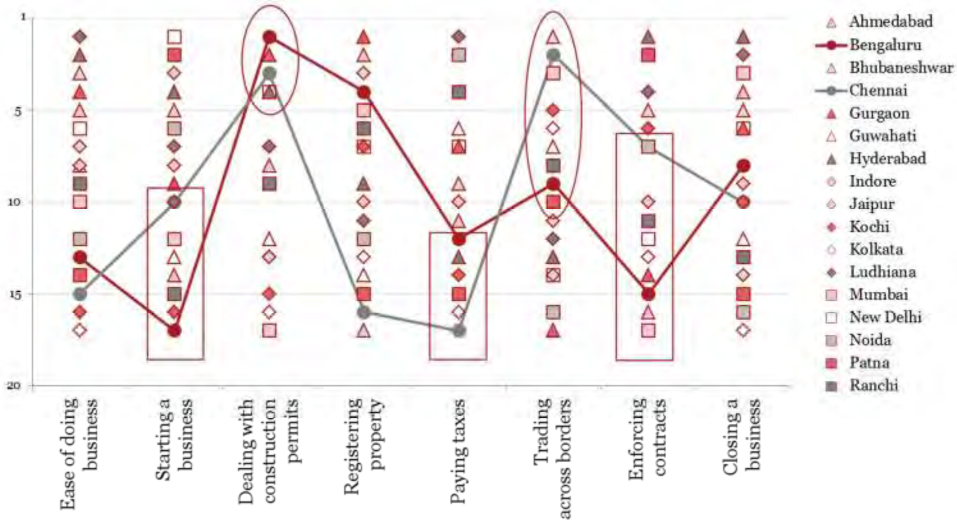
As to FDI inflow, currently lagging far behind from two major cities in DMIC region, the figure below shows outstanding performance of Mumbai and New Delhi. . Chennai and Bangalore rank third and fourth respectively. However, Mumbai is attracting approximately five times as much FDI as Chennai and Bangalore.



Source : GOI - FACT SHEET ON FDI
From APRIL, 2000 to NOVMBER, 2013

Figure 12.2: Received FDI Equity (April 2000 - November 2013)

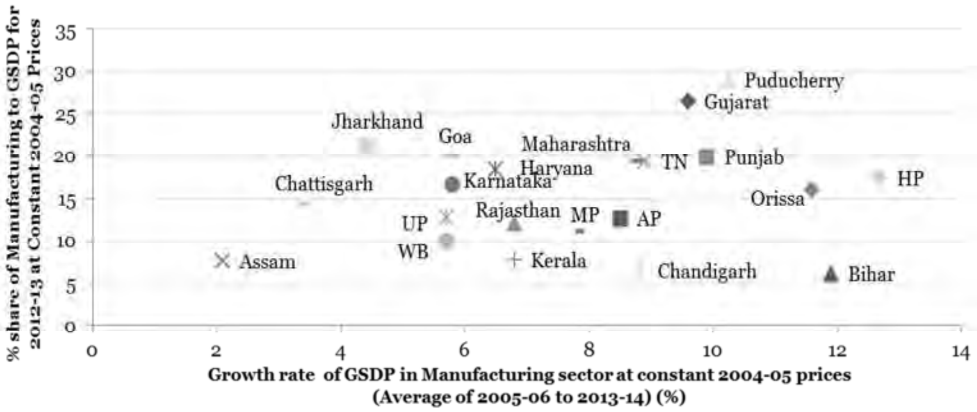
According to the investment climate survey of World Bank for the 17 major cities in India, the two cities in CBIC are ranked the lowest in terms of ease of doing business. Chennai which rank 15th is inferior to other cities with respect to of registering property and paying taxes. While Bengaluru which ranks 13th is inferior 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 While both the cities rank highly 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)

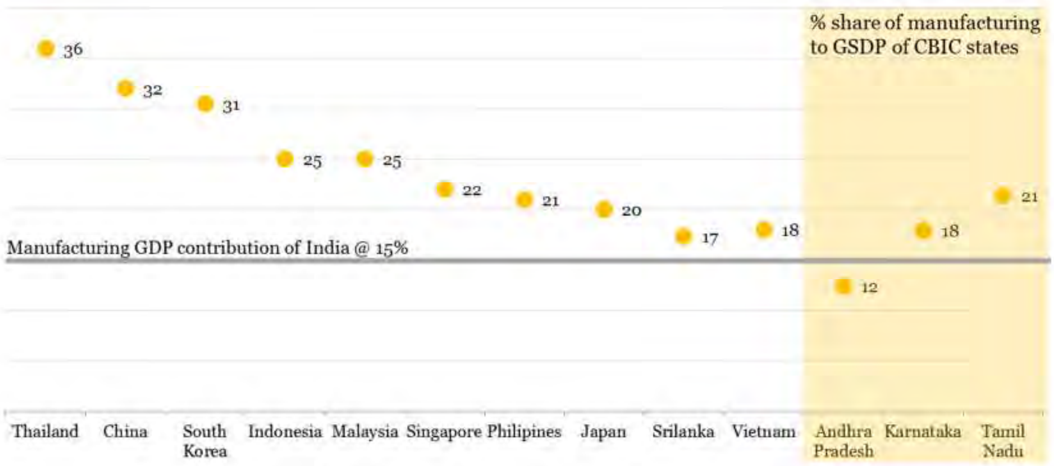
In addition, the manufacturing industry maturity of DMIC states such as Gujarat, Maharashtra, Punjab and Himachal Pradesh, and non- DMIC states such as Orissa and Puducherry, rank higher than the India average .While Tamil Nadu tops the CBIC region, Tamil Nadu is ranked in the top level, there are scope of growth in Andhra Pradesh and.



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 GDP. The contribution of the manufacturing industry to GSDP in all the Indian states is lower than that of South East Asia countries, highlighting the necessity of further investment in manufacturing sectors.



Source: Council on Competitiveness

Figure 12.5: International comparison of manufacturing GDP contribution (2010) (%)

12.2.2 Qualitative analysis

Consultation meetings with the foreign companies which have already presence in the CBIC region have been conducted to identify 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 discussion with stakeholders, major advantages attracting foreign companies/investors to the CBIC region are as follows.

Formulation of Large Scale Industrial Clusters and High Technical Potential

The best advantage for foreign companies/investors with regard to CBIC development is the future possibility of enhancing the global competitiveness through effective industrial clusters. Due to the presence of domestic manufacturing as well as inflow of foreign investments, industrial clusters in the CBIC region are rapidly growing in these years. In addition, suppliers of parts and materials as well as skilled labours necessary for the industries' production activities have already been available to some extent, thanks to existing eco system around the prominent industries in CBIC region such as the automobile sector. Furthermore, core cities, Bengaluru and Chennai, located close to key industrial parks and provide relatively finer living condition than the other regions in India.

Access to Entire Indian Domestic Market(Good road connectivity with other major cities)

CBIC is located along the Golden Quadrilateral Highways which enable manufacturers to deliver their products not only within CBIC, but also to major cities all over India. The accessibility to entire Indian market makes CBIC production base for foreign manufacturing companies.

Potential domestic market and abundant workforce

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. In addition to this tremendous market size, abundant workers are another factor attracting foreign investors.

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.

Location advantage for Potential Global/Regional Hub - Accessibility to Eastern and Western 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 advantage which offers easy access to export markets. Furthermore, CBIC holds one domestic and two international airports in the region. With The accessibility to the export markets CBIC may become a hub of their global and/or regional value chains in their long term strategy.

Low Labor Cost

Labour cost in India is competitive compared to other middle income countries, where the average wage increases severely. For example, the minimum wage in the Jakarta city in Indonesia has increased by 44% from last year. The average wages is rapidly increasing in Viet Nam, Malaysia and Thailand in recent years. The increase in wages leads to increase in whole production costs which would affect foreign manufacturers operating in those regions.

Proactive Investment Promotion by the Government

In recent decades, the Indian government had embarked on liberalizing the regulatory framework, particularly as regards foreign investment, through the Statement on Industrial Policy of 1991. Since then, the regulatory environment in terms of foreign investment has been consistently eased to make it increasingly investor-friendly. Moreover, both Central and State Governments are proactively approaching foreign investors to establish partnership.

CBIC's Major Difficulties Alienating Potential Foreign Companies & Investors

At the outset, it is important step for investors to identify investment location. There are some critical factors to be considered by investors to measure competitiveness of the locations such as i) cost competitiveness, ii) availability of external and internal infrastructure iii) availability of training institutes, iv) availability of land and skilled human resources, (v) nature of existing industrial cluster etc. .

The CBIC region is regarded as the promising investment destination. However, there is still scope of improvement to make CBIC region more attractive and business friendly. The key issues highlighted during the consultation meetings are listed below.

Infrastructure Bottlenecks

Lack of infrastructure is one of the major bottlenecks inside and outside the industrial areas. mid and long term road planning, construction of access roads to main roads and major ports, establishment of management system for freight railway and loading points, and improvement of overall operation of major ports may be the immediate requirement to address infrastructure bottlenecks. Similarly, 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 would lead to abrupt stoppage in production lines and production of a large number of defective products. "

- “In order to avoid this situation, the companies need to introduce privately-owned electrical power facilities, but the burden would be significant as this would require large investments and the electricity cost would become twice.”

2) Port

- “The cost of usage of some ports is over five times the international prices. Further revision of port charge is necessary.”
- “The number of gates through which the trucks can enter the port for receipt and delivery of materials are very limited. A security check is conducted at the gate one by one, and the line of trucks stretches 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.”
- “Port operation is an issue at ports, especially at Chennai Port. Due to lack of organized and integrated regulation or guidelines, rules of mandatory submitting documents and licences for clearance are often changed suddenly by orders of clearance officers at the port. Also, there are number 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 in Singapore.”

3) Road

- “In some areas of CBIC, the roads connectivity to industrial parks is yet to be constructed and become hurdle in the smooth distribution of parts and materials from the assembler to the supplier. Logistics activities between affiliated companies are highly inefficient. ”
- “The delay in the construction of an access road to main ports, the gateway to CBIC, is impeding business operations in the entire CBIC region. Large traffic jams caused by the delay leads to the late arrival of cargos and also lead times cannot be estimated accurately. . “

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.”

Insufficient land acquisition and building approval process

Land availability and getting 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. . The scarcity of land and lack of transparency in allotment process are the major problems related to the land acquisition.

Key feedback from the foreign companies

1) Land acquisition

- ”The responsibility of resolving land acquisition issues in industrial park lies entirely with the private companies”
- “Within one or two years, expansion may be considered. But all issues in the investment approval process would be a hindrance to make a decision on new investment, even though they are confident in the increase in demand along with the market growth.”

2) Land allotment

- “The criteria of land allotment and its process are not clear and transparent. Therefore land is sometimes allotted through personal relationship with the land authorities.”

3) Land information

- “Information on the industrial parks is not in the publicly available and difficult to access. For potential investors unless they have connections with the Government officials.”
- “Expansion of a plant is a very tedious process due to lack of land availability and information on the same. The Government should take initiatives to improve the land related information to investors.”

Low availability of the skill development system

India is known for its high-quality labour pool when compared with other emerging markets as each state has implemented various approaches to enhance the labour quality. Nevertheless, the growth in demand has overcome the supply and hence many of the business entities suffer from the shortage in skilled labour. Also, the need to incorporate initiatives to promote gender equality into the skill development may be required.

Key feedback from the foreign companies

1) Skilled Labour

- "Quality of skilled labour is very poor and hence they need training. But the companies do not have the capability to train them except for big companies like Toyota. Hence the quality of the training imparted 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 the institutes to purchase machines for training such as a turner or a CNC machine. "
- "Although the government is taking actions like establishing training institutes, skilled labour availability is low. People do not show interest in getting themselves trained in various skills."
- "White collar professionals prefer Bangalore to Tumakuru. It is difficult to retain them."

2) Labour law

- "Labour laws are extremely in favour of workers, which makes it hard for employers to take suitable actions in certain situations. Employers do not have any liberty to lay off any worker, even though; his/her performance is not satisfactory."

3) Labour union

- "There are union issues. The issues are numerous mainly because of interface of villagers from surrounding areas. Union issues cause shut downs of plants."

Business Process

Investors have raised concerns regarding the considerable amount of time and investment that goes into negotiating with line ministries to get permits for starting the business. Although many states set up Single window agency to facilitate the business process, many foreign companies have shown less satisfaction for that service. In the end, the companies need to make multiple visits to various ministries and go through various processes 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 that will require assessment by a specialist as needed. In many cases, this process takes 3-4 months on an average."

- "Application process and instructions on submission of required documents were clear. However, Single window clearance system was not efficient and not practical at all. The clearance certificate is not considered seriously and one has to go behind each department to obtain utilities and approvals."

2) MSMEs

- "Although the states give MSMEs the preferential treatment with incentives and subsidy, it takes more time for MSMEs' to obtain approvals than major companies. The requirement and difficulties MSMEs face should be considered."

Lack of Readiness of Industrial Parks

The quality of the industrial parks in the CBIC region is far from the international standard. Due to the low quality, the foreign manufacturers who have newly invested in CBIC are facing serious problems such as shortage of water, lack of stable power supply, delays in planned road construction and deferral of the Government permission. There are cases in which 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, investors have to negotiate with each line ministry though it is highly ambiguous and time-consuming process. This happens partly because many of the industrial parks in CBIC are still under public operation, while it is common for private developers to develop and operate industrial parks in the world. .

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 the necessary infrastructure such as water, electricity, drainage facilities and surrounding roads. An agreement on the construction of infrastructure between the tenant and the Governmental corporations managing the industrial park was not actualized in many cases in the past."

2) Access Roads from Industrial Parks to Main Roads

- "Main roads and industrial parks are not effectively/adequately connected with each other in the CBIC region. The damaged and unpaved access roads add to the traffic jams and restrict the free movement of vehicles. Although some trunk roads are constructed or expanded, the lead time between industrial parks and ports would still be longer without the effective access roads to industrial parks."

3) Roads inside Industrial park

- "The quality of internal road within industrial parks is not sufficient enough especially for carrying heavy loads. The responsibility of construction of roads within the industrial parks lies with the state's public development corporation. However, in many cases, the progress is slow."

4) Regulations

- "According to the current Indian environmental standards, 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 a complete cluster in the CBIC region. "

12.3 Analytical framework

Through the consultation and interviews with private sectors and from secondary research, a range of issues as well as measures taken by the states have been identified. Based on the results, we have adopted five perspectives, which are strongly advocated by the private sectors, as the key factors to improve the investment environment. These perspectives are "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 blackouts during the operation time; to avert the risk we purchased self-generating units, which has significantly increased the costs" • "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 hinderance for the business development". Without the clear system and procedure in the acquisition, we cannot take the risk of investment. • "For the city development, the authority needs to take a 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 standards from the foreign companies" • "The labor law is so complicated that the labor management is difficult"
D. Business process	• "We plan to build a power plant, but the registration process takes so much time and requires a significant amount of man power" • "Each state has different business process; even in one state, we had a tough time to understand and reach 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 building a automotive hub. Other states 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 sectors

With these five perspectives, we conducted/performed three-dimensional /studies to identify the issues related to the investment environment improvement, and come up with the suggestions for the CBIC states;

1. **Benchmarking among CBIC States and best practices in India**
2. **Analysis of the South East Asia**
3. **Feedback from foreign private sectors**

As for the benchmarking within India, we compared the CBIC states with the state with best practices in India to identify the gaps in CBIC states s as well as the key initiatives taken by the best practice state. For the second dimension, we have also applied the five perspective analysis to the regional competitors, such as Singapore, Thai, Indonesia, and Vietnam mainly to identify suggestions/recommendations for the policy. The private sector feedback is also analyzed to build recommendations. The requests from the foreign companies sometimes lack feasibility or practicability in India context, but it undoubtedly provides insights for CBIC to be a top destination for investments.

12.4 Analysis

12.4.1 Benchmarking among CBIC states and best practices 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 recommendations. 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.

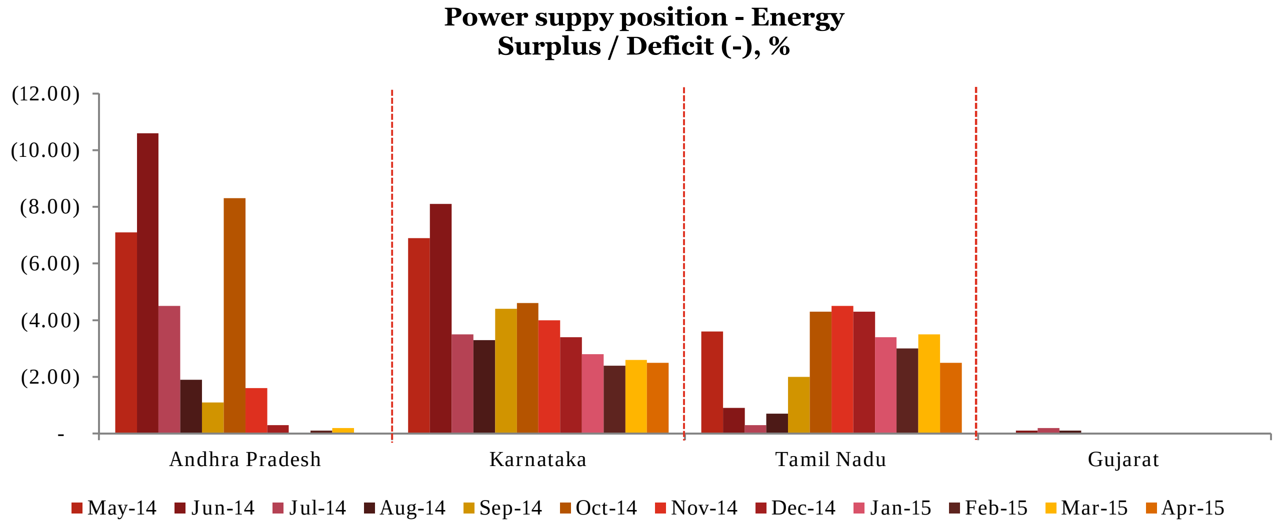
Power

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

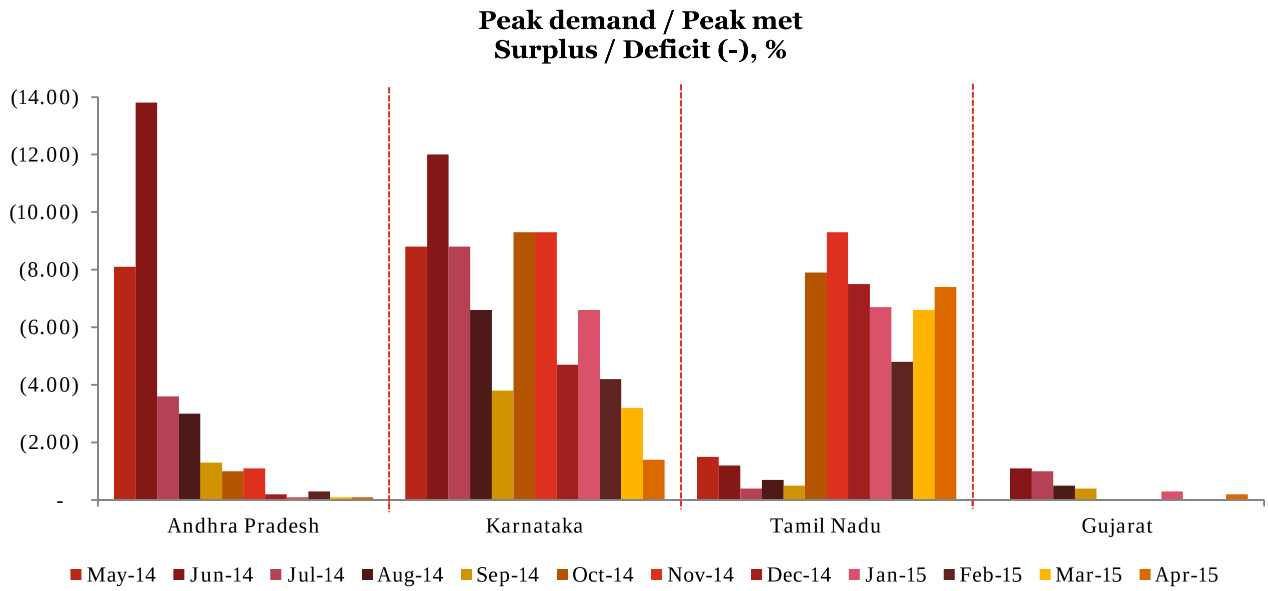
<u>Availability and Tariff</u>

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

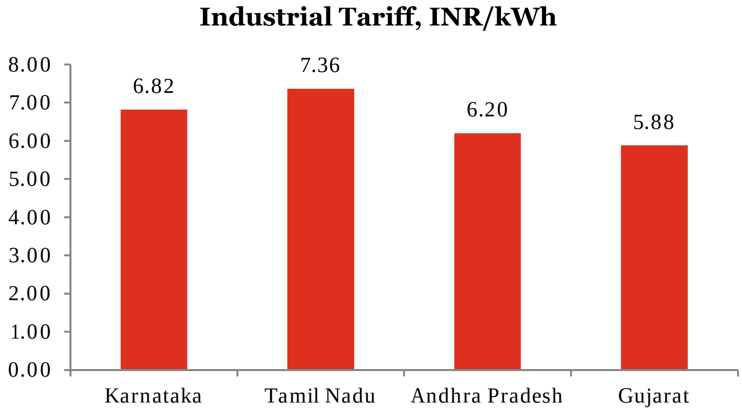
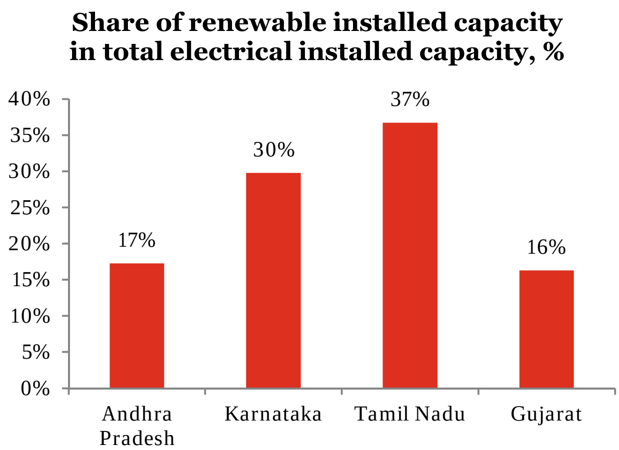


Figure 12.9: Industrial electricity tariff, 2014-15

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.



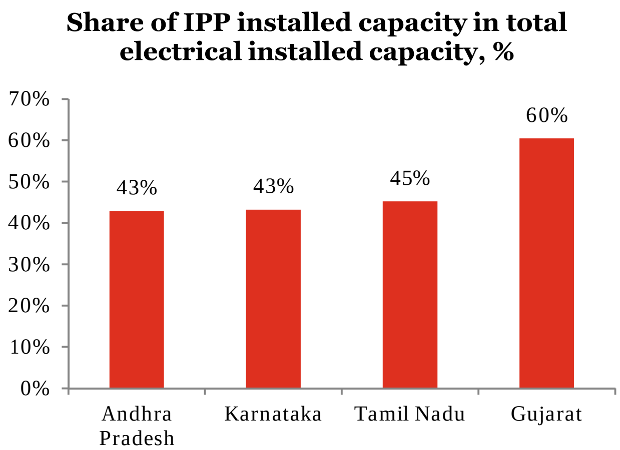


Figure 12.10 IPPs installed capacities

Figure 12.11 Renewable energy installed capacities

Port

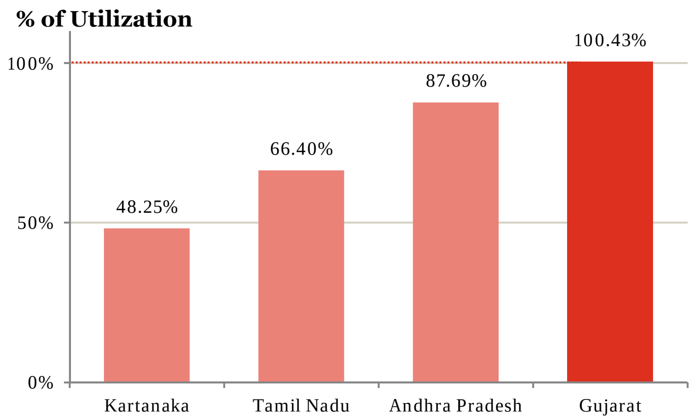
The smooth port operations lead to the increase of trading volume and then development of industry in the area. We utilize two key perspectives, utilization and non-major port policy to delve into the CBIC states' performance.

1) 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 of having two Major Ports, New Mangalore & Karwar, is characterized by low utilization.

According to ease of doing business, from World Bank, all CBIC states take a lot of time in trading across borders compared to best practices in India and South East Asian countries.

From private sectors, especially at Chennai port, logistics problems occur frequently due to lack of organized and integrated regulations or guidelines. Also, some foreign countries are feeling that the human cost and time for port clearance in CBIC region takes ten times as much as that of Singapore, indicating that there is scope of improvement in operation.



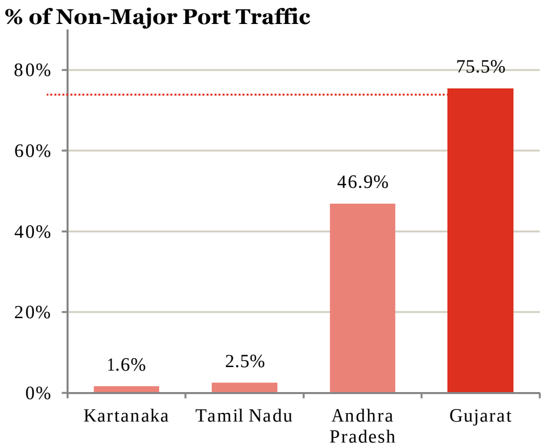
Source: Basic Port Statistic of India (2012-2013)

Figure 12.12: Port Utilization of a Major Port in each state

2) Non-Major Port

The traffic at the Non-major ports varies from state to state. In Gujarat and Andhra Pradesh, port operations are directed by the private sectors while in other states it's not the case Gujarat established Non-Major Port Policy and Schemes, which are being enforced by 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 losses in foreign exchange, Gujarat set the policy to decongest the b existing major ports on the Western Coast. The policy aims at providing efficient facilities and services and supports the country's domestic and international trade.

Other states are lagging behind and still have the government agency as the principal operator in all the ports. In Karnataka, traffic at Non-Major ports both in Karnataka and Tamil Nadu is significantly lower than Gujarat and Andhra Pradesh. These States may have to focus on how to utilize Non-Major Port more efficiently to handle the increasing cargo volume.



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 (No., Mill Tons)	237.04	399.55	159.04	193.62
Non-Major Port (No., Mill Tons)	110.61	150.93	1251.81	41287.82
Traffic (Mill 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 has been compared through two key parameters; how much time takes for land acquisition process and whether the land acquisition policy is explicitly established. As for the time to take for land acquisition, we have done three quantitative analysis to compare the land acquisition system in CBIC States and best practice states; duration of land allocation, land conversion and approval for the building plan. For the latter, we examine the policy of each state and highlight the difference

1) <u>Duration for Land allocation, Land Conversion, and Approval for the building plan</u>

The time taken for the allocation of the land for the industry varies depending on the state. In Madhya Pradesh, it takes only 90 days. Andhra Pradesh has promoted computerization & integration of all land records and it has 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 agricultural land to land for industrial use. 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 successfully simplified the process to 90 days under the APIIC's guidance. However, in Karnataka, though land acquisition process is established, the process takes longer time than other states.

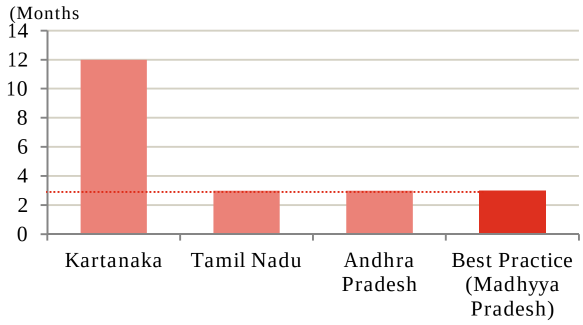


Figure 12.14: Duration for Land allocation

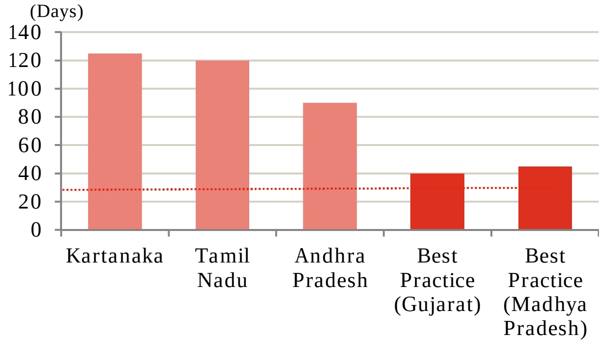
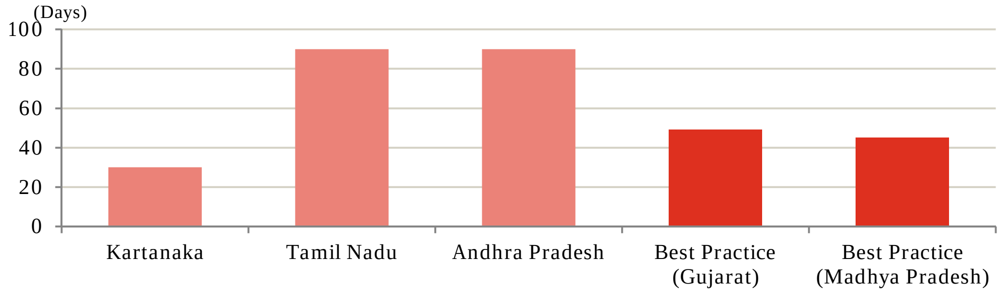


Figure 12.15: Duration for Land conversion

Source: Survey on business regulatory environment for manufacturing, FICCI report, DIPP web sit

As for approval for the building plan**, 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

2) <u>Land acquisition Policy</u>

All the CBIC states have established the land acquisition policy along with the designated authority, such as KIADB, SIPCOT and APIIC to support the land acquisition.

However, Gujarat differentiates itself from the other states by providing more comprehensive support to the land related process through various initiatives; scientific determination of market price through tie–ups with academic institutions, extensive information on land such as availability of land, gas, power, distance from port/airport etc through online portal 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, the land bank is available but only information on vacant plots is available in public domain and no clear picture of land acquisition status. Also, in Karnataka, enough information on the land is not available for the investors Therefore they need to approach KAIDB to get the information and select the locations out of options KIADB gives. Although KIADB has developed Land Portal, Kaigarika Bhoomi, it is not regularly updated, not providing up-to-date information. There is no land pool system operating. In Tamil Nadu, land related information is still not easily accessible.

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 speedily; 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 sit

Skill Development

According to the feedbacks from private sectors, a lot of enterprises have not been satisfied with the infrastructure of skill availability, and requested for the re-building of the policies on skill development. Skill development can be measured based on three levels; availability of skilled labours, gender related initiatives and R&D. With regard to availability of skilled labours, the number of higher education institutions and vocational training infrastructure are counted, and as for gender-related initiatives and enterprises, the policy for gender support and the policy for R&D promotion have been compared respectively.

1) Availability of skilled labours

Each state has taken the initiatives for skill development and established institutes with various curriculums. In terms of the number of such institutes, it is difficult to compare the status among the states considering the differences in population, and land availability.

In Gujarat, as a best practice State, Gujarat skill development mission has driven the skill development through various channels such as establishment of anchor institution, extension of training system 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 training. However, skilled labour is still not enough because sector specific training institutions still do not meet industry's requirement because curriculum are not up-to dated. In Karnataka the skilled labour is not sufficient due to the inadequate out dated curriculum in training institutes. Private sectors in Tamil Nadu stated that the number of vocational facilities is quite high but they still do not 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 Education and Vocational Training institutes

		Karnataka	Tamil Nadu	Andhra Pradesh	Gujarat
Higher Educational Institution	Polytechnics	289	351	263	-
	Engineering	187	491	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

Industry policies of All CBIC propose the support 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 clauses of the Industrial Employment (Standing Orders) Act, 1946 (Central Act 20 of 1946) , the policy provides flexibility in employment conditions including flexible working hours for women and in hiring women as contract labours

Research & Development

Technology is a key element for the increase in competitiveness and acceleration of innovation. All CBIC states encourage enterprises to conduct Research & Development in Technology by providing subsidies and incentives. However, Gujarat, as a best practice state, 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

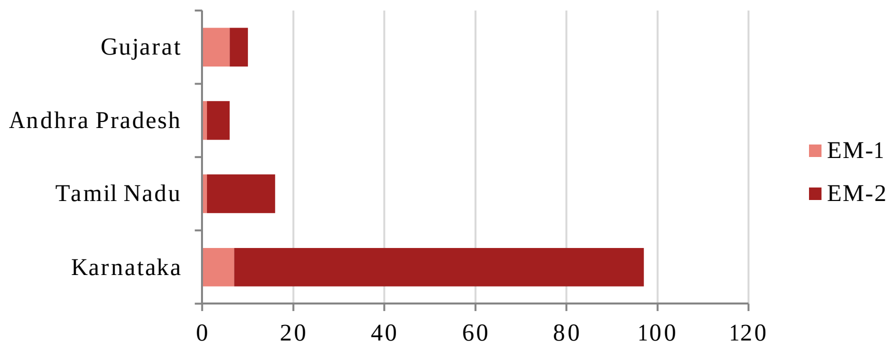
Business Process

In India, the business process has been reputed as complicated and it is taking a considerable time. Because of the state government efforts, there has been a 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 State, application of Single Window Mechanism is investors. The registration process and single window mechanism are compared with best practices.

Registration Process

This section deals with the time and effectiveness of the process for Entrepreneur's Memorandum (EM). Andhra Pradesh and Gujarat take short time for the approval. It is to be noted that Gujarat has an online monitoring system for entrepreneurs to follow up status, and help them take actions if there are any delays

On the 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 enforced and not practical. In Tamil Nadu also, it still takes time in investment application process because investors find it difficult 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 have introduced 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 hands-on support to business owners. IFP also provides various services, information dissemination, facilitating and monitoring investment proposals, and supports business owners 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. SIPC provides information online on doing business. 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. In Karnataka, KUM has been appointed as a nodal agency for Single window system. However, 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 to establish industrial hubs. Some states are adopting good practices through the collaboration of public and private sector, but others still have areas to be improved in terms of operation and policy. Roles of Authority, operational scheme, and adoption of Green Practices were analyzed.

Roles of Authority

Development of Industrial park/cluster is assisted and implemented by state governments. Gujarat Industrial Development Corporation (GIDC) has promoted private sectors to invest in development of industrial parks/clusters in operation. On the other hand, All CBIC states have Government organizations 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 formulated to provide incentives, such as new textile policy, mineral policy, grape processing and wine policy etc
- KIADB provides information on land availability online.

Tamil Nadu

- SIPCOT has been instrumental in promoting the formation of cluster
- identified special industrial estates for automobile companies
- utilize the single window system to attract the investment
- provide fiscal incentives such as tax exemptions and reduction
- SIPCOT provides information on land availability online.

Andhra Pradesh

- APIIC has promoted development of industry and industrial area.
- The government has established "industrial infrastructure upgradation 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 development of industrial parks/clusters

Operational Scheme

In addition to forming industrial clusters and developing infrastructures, operation and maintenance are critical factors to attract investors 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 / as per respective Act. Gujarat Policy also mentions incentive of 50% of total expenditure limited to Rs.200 million is dedicated to development of Core Infrastructure within the industrial park. Also the Policy 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 the maintenance of industrial parks. The Andhra Pradesh Panchayat Raj (APPR) Act is authorized to collect property tax/revenues with a condition that 35%/50% of the amount to be spent on maintenance of industrial parks. On the other hand, Tamil Nadu Industrial Policy encourages maintenance of industrial parks. However, there are still issues in the lack of maintenance and insufficient infrastructure. In Karnataka there is no mechanism to allocate funds for the maintenance, causing lack of internal roads in industrial areas. 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. Notably, Gujarat and Karnataka announced Zero Discharge policy and intend to install more environmental friendly equipment, system and standards with a wide range of incentives for 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 performed to identify the areas of improvement on the above five perspectives. ASEAN countries are attracting more foreign investment than India, due to the attractive business environment in terms of ease of doing business, well-developed infrastructure and adequate living standards. Singapore is awarded as the best country in the world from the viewpoint of "Ease of doing business", published by World Bank in 2014. Thailand, Vietnam and Indonesia are ranked 26th, 78th and 114th、 respectively. Given that India is ranked 142nd in doing business, the comparisons with those international competitors are expected to provide insights for the Indian states to improve investment environment.

Infrastructure

Benchmarking is performed on "Power", "Port" and "Road".

Power

In ASEAN countries, a stable power supply is achieved by private sector participation, utilization of advanced technologies and high awareness of energy saving with a strong initiative.

Parameters

- Power Generation & Distribution
- Power Capacity and Demand
- Renewable Energy
- Electricity Tariff

1) <u>Power Generation & Distribution</u>

Power supply and distribution system has/had been developed by the public authority appointed by the government to secure power supply. In Singapore, initially power supply system was developed by Public Utility Board (PUB), and then power generation and distribution were managed by Tease Holdings, a government institution. Currently 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 installation of energy efficient appliances with financial support and enhanced awareness on energy saving.

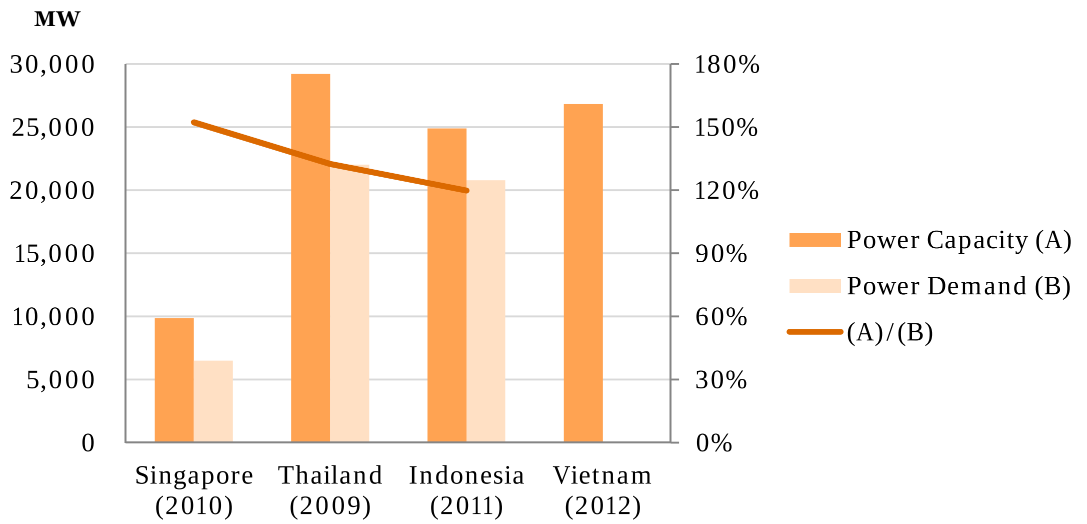
Table 12.8: Power Generation and Distribution

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

2) <u>Power Capacity & Demand</u>

Singapore has an enough capacity to provide stable power supply during peak hours. Thailand and Indonesia also provide relatively stable power supply. Especially the gap between demand and supply of Indonesia appears to be small.

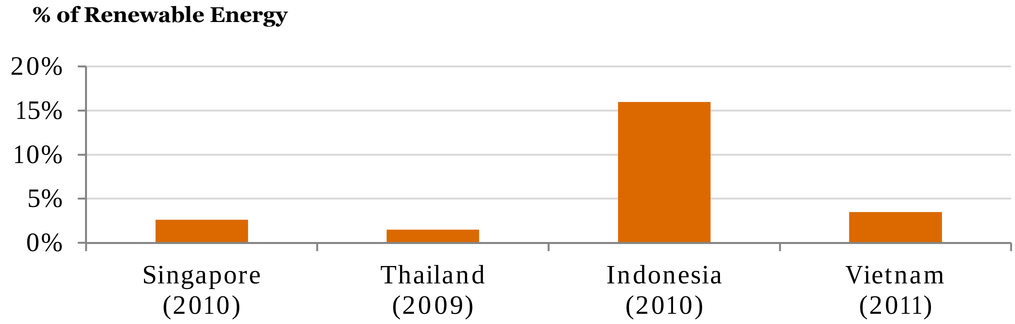


Source: JETRO, EGAT, PLN

Figure 12.19: Power Capacity and Demand (MW)

3) <u>Renewable Energy</u>

Each country promotes to introduce renewable energy as an alternative, environment friendly energy source. Especially, Indonesia is one of the countries that have the most geothermal resources in the world. Indonesia has a plan to expand the capacity of such power plants by utilizing geothermal and water resources. Singapore promotes business of clean energy like solar as a strategy. It also expects 7,000 job creations and SGD 1.7 billion GDP by 2015.

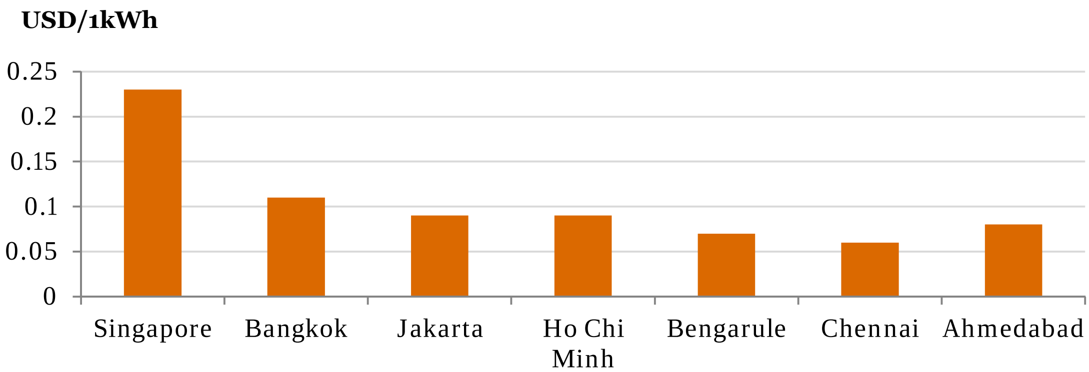


Source: JETRO, JBIC

Figure 12.20: Ratio of renewable energy

4) <u>Electricity Tariff</u>

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 a business in counties like Singapore. On the contrary, India keeps the tariff lower level than other international competitors.



Source: JETRO (2013)

Figure 12.21: Electricity Tariff

Port

It is crucial that ports should be developed and operated by the authority with a strong initiative. Each country has the authority and it has been running the ports smoothly.

Parameter

- Port Authority
- Traffic of Cargo Container

1) Port Authority

Singapore is located in the heart of Southeast Asia and is connected to six hundred ports in over one hundred twenty countries with daily sailings. (Ports in Singapore have been expanded as a trading hub 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 and implemented various activities such as operation and maintenance, water & raw materials supply, collection of garbage and delivery. In Thailand and Vietnam, the Act prescribes the guideline for port development and operation.

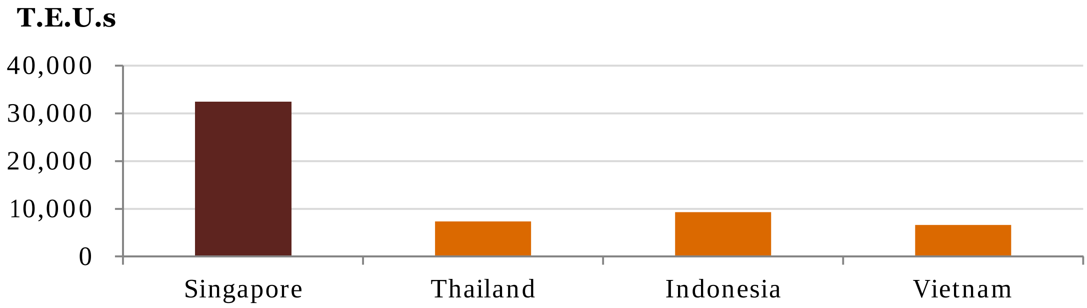
Table 12.9: Port Authority

	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. Palauan 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

2) 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 developed roads and related facilities and achieved high ratio of surfaced road.

Parameter

- Authority of Road Development
- Surfaced Road

1) <u>Authority of Road Development</u>

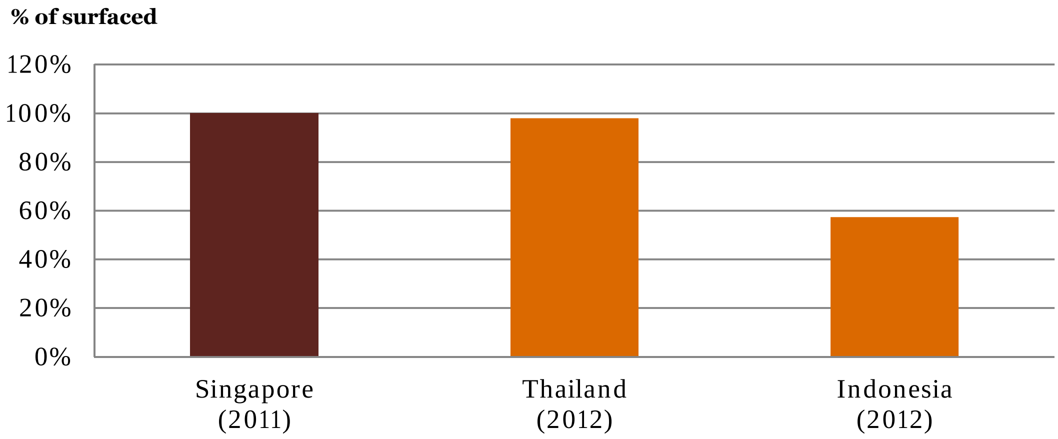
In Singapore, Land Transport Authority (LTA) has not only developed the structured roads but also committed to ensuring the safety of motorists and commuters. In Thailand also, under the Ministry of Transport (MOT), the government administrations such as Department of Highways, Department of Rural Roads and state enterprises have developed roads 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 Highways 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 achieved over 98%, whereas Indonesia has room to improve the road condition.



Source: World Bank, JBIC

Figure 12.23: Ratio of surfaced road

Land Acquisition/building approval

In Southeast Asia, acquisition of land for industrial use is smoother than that in India with authority based on the coherent and transparent policy with sufficient support.

Parameter

- Policy
- Support System

1) Policy

For industrial use, in Thailand, Industrial Estate Authority of Thailand (IEAT) is responsible for the land acquisition and land allotment to foreign investors. According to Constitution, fair compensation shall be paid to land owners affected by the land acquisition. In Singapore, since land is limited, 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)
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,

2) 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 starts. Also, IEAT specifies clearly/precisely 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) provides "On-door integrated service", although the actual implementation is still a challenge.

Skill Development

As one of the best practices in ASEAN countries, a special curriculum is built in partnership with high academic institutions as well as the private sectors who potentially hire those laborers.

Parameters

- Policy
- Skill Development Infrastructure

1) Policy

Each country has a policy/plan to promote skill development in order to enhance the competitiveness of the industry. In Singapore, the Ministry of Trade and Industry launched Strategic Economic Plan in order to enhance skills and the Ministry of Manpower and the institute under it, 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 purposes but also international purpose.

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

2) Skill Development Infrastructure

Skill Development Infrastructure such as Institute of Technological Education (ITE) and training centers play an important role in skill development. Singapore Government has made a lot of investments on vocational training and education via 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 in collaboration with higher educational institutes and private sectors.

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.

Source: JDI, JETRO, JBIC, JTC, IEAT,

Business Process

One of key factors of Business Process is that collaboration of line departments/organizations along with transparent process in time bound manner. One line system and accessibility of information are also important to enhance ease of business process.   .

The detailed comparison of ASEAN countries and CBIC states on the business process in terms of cost and time are described in the Appendix, but the time boundary is regulated by laws in ASEAN countries.

Parameter

- Single Window Mechanism

1) Single Window Mechanism

Single Window Mechanism is a critical factor for foreign investors to start business smoothly. In Singapore, Enterprise One Portal offers a single point of contact and wide range of information with government assistance. The Portal was awarded as Enterprise Challenge (TEC) Public Service Innovation (2006). Economic Development Board (EDB) also supports inviting 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 granting permissions, of which belongs to some Ministries. Moreover, IEAT established Information Center and Consultation Center and also provides E-service; application form and tracking system. Investment Coordinating Board (BKPM) in Indonesia also provides similar services to foreign investors. .

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 practices among ASEAN countries, guidance on the industrial park/cluster and Corporate Governance are well developed and detailed to operate industrial park/cluster efficiently.

Parameter

- Institutes for Development of Industrial Parks
- Maintenance of Industrial Park

1) <u>Institutes for Development of Industrial Parks</u>

JTC Corporation in Singapore has well developed corporate governance system in order to operate industrial parks smoothly. It focuses on three aspects: enhancing the knowledge and capabilities; increasing land productivity; and expanding its innovation capacity.

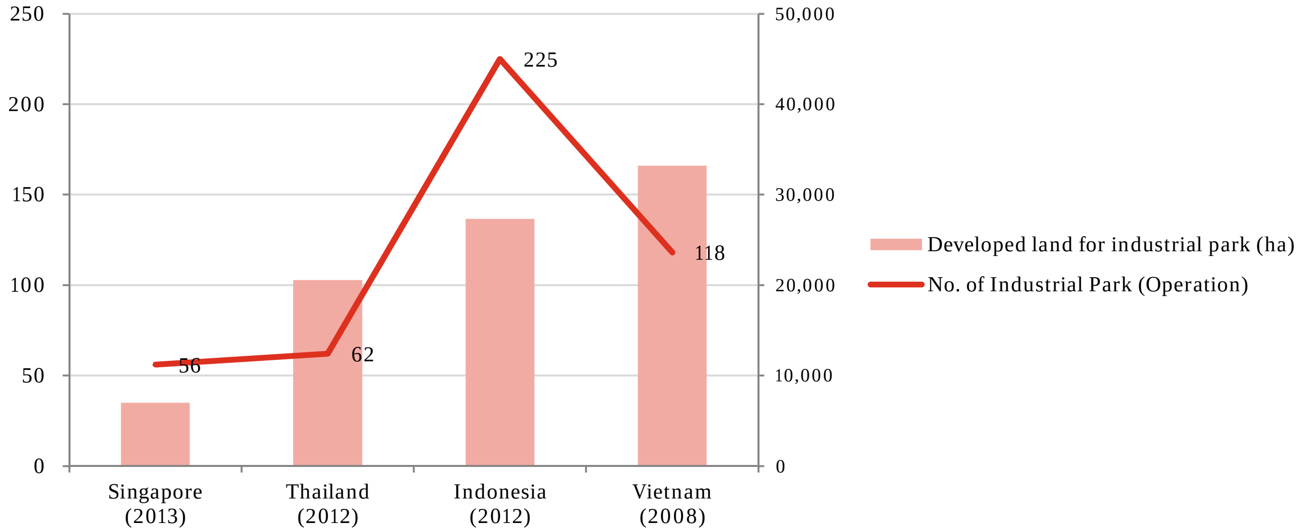
In Thailand, BOI and IEAT established the detail guidelines on the procedures.

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 depicts the number of Industrial Parks under operation and area of the developed land for industrial parks in Singapore, Thailand, Indonesia and Vietnam.



Source: JDI, ASEAN-JAPAN Centre

Figure 12.24: The No. and area of Industrial Parks

2) Maintenance of Industrial Park

With respect to operation and maintenance of industrial parks, detailed guidelines and strong 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 through green technologies. In Thailand, IEAT committee takes responsibility to carry 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

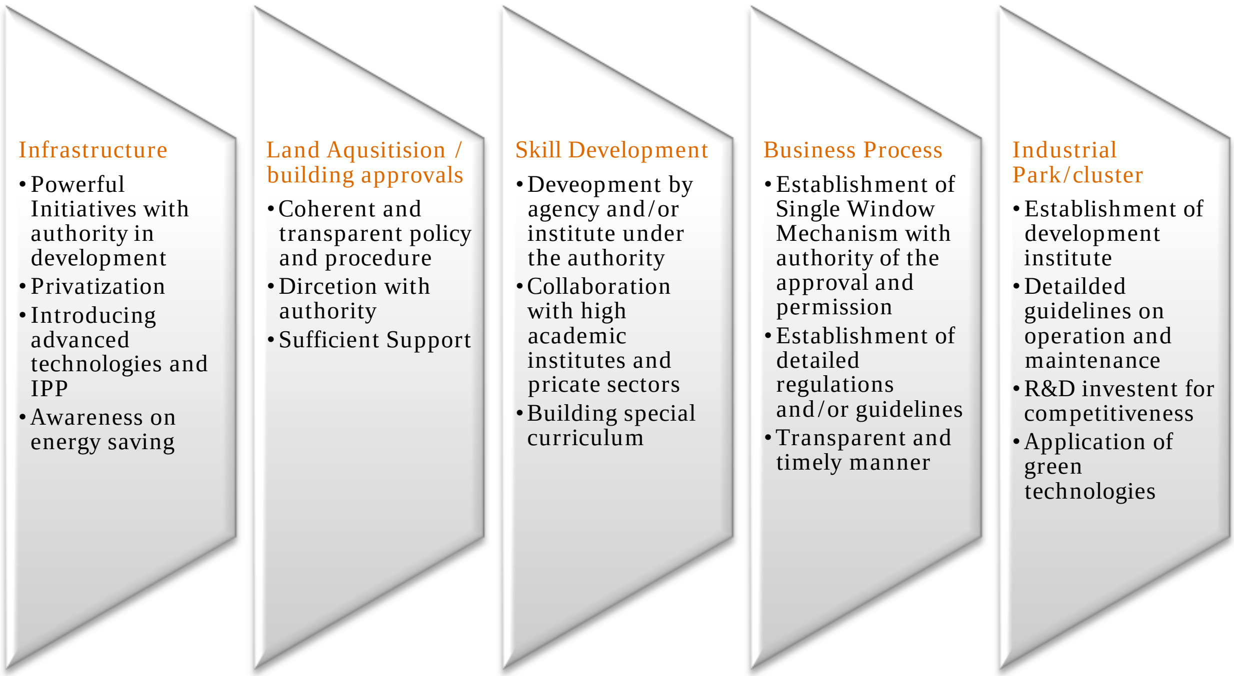


Figure 12.25: Summary of Key Implications

12.4.3 Feedback from the foreign private sector

Foreign companies provided feedbacks on the key hindrance to their further investment in India based on the five perspectives in this chapter. They, however, also provided additional feedbacks on the investment environment; State Government initiatives will be required to address the issues raised in feedback. Some of them will require cross states approaches.

Feedback for all the states

Low profitability

Most of the Japanese foreign companies describe the Indian market as “exhaustively cost competitive.” Many of them feel the values of higher quality are underestimated by the Indian consumers.

Especially in many of the India infrastructure projects, the project is divided into small pieces for bidding and fall into price competition; as the result, the project size tends to small, hence less flexible and less profitable, making the foreign companies hesitant to bring in investment.

Also another concern related to the profitability is the price ceiling set by the authority; the fixed price for the utility is not high enough to recover costs. Since it is difficult to make profit, it is hard to expand the business or even continue business. Many of the energy related companies request the flexible price policy at least during the initial phase, but currently such options are not admitted in any state.

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. Observing that the China’s rapid growth shows slowdown, global investors currently started considering the possibility that the expected future growth of emerging economy could have been overestimated. Under this situation, small and medium scale foreign companies, mainly essential-parts suppliers for manufacturing, are holding the decision for further investment in CBIC.

Also, the unexpected change in India's political landscape adds further uncertainty in the business environment. India is known for its drastic changes in the industry policy on the change of political parties in power. The change in policies often impact incentives expected to be given to investors. Hence it appears too risky for the foreign companies to invest significantly even with the support from the current policies

Feeble infrastructure for Tier 2 players

Tier 1 enterprises are often provided 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 suppliers are not provided with the minimum level of the support even though the parts/equipment are critical for Tier I manufacturers. It is reported that the one of the Tier 2 suppliers suffers from 7 hours blackout per day; this may hinder them from operating in India. This will affect Tier 1 players' manufacturing operation.

Weak foundation for Intellectual property

Intellectual property rights (IPR) are crucial for foreign companies which have full-fledged operations in India including R&D. Many foreign companies complained about the weak IPR regulatory framework in India, including slow registration process, complicated application and approval steps, and the lack of transparency in the standards for screening.

Indian 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 IPR regime, and also plan to increase the number of staff in the Patent office in order to speed up the pending application clearance. With these efforts, the number of the intellectual property rights applied by the foreign companies has increased sharply in many industries, especially in automobile and telecommunications.

However, in spite of these measures, many foreign companies still have concerns over the IPR policy in India and prefer R&D investment outside India... In order to attract further R&D investments in India, the current approaches need to be driven forward.

Unstandardized business process

Business processes are very complicated and require a significant amount of man-hours to comprehend even at the state level. However, the issue is that all the states have different methods in the business registration / application / approval / clearance processes in India and require the companies to re-learn the entire process if they intend to expand their business. It leads to significant losses in time and investment. It has now become a major hindrance for the foreign companies.

Burdensome tax system

India is characterized by high tax rates. Indirect tax such as CST is burden on the private sector. For example CST is imposed on the cross state transaction. This increases the cost of the products, and impact on the price competitiveness In addition to the cost tough competition faced by the foreign companies against the local companies; tax related cost is another burden for investors.

Also, another issue related to the tax is the frequent changes in the tax policy. Many of the private sector companies request the stability in the tax system; the unexpected change in the tax system has often caused anxiety in the private sector, then deterring them from further investments.

12.5 Recommendations to improve investment environment

12.5.1 Recommendations for Karnataka

The above analysis shows that the each CBIC state has both strengths and weaknesses in the investment environment and has adopted various approaches to enhance it. Although the analysis shows that there are some common issues, the approach to address these issues may differ from State to State.

The above analysis, especially, shows that Karnataka is behind the other states in Infrastructure and Industrial park readiness, where we strongly recommend in-depth support from authority in order to enhance investments to the state including in manufacturing sector. Recommendations for Karnataka are summarized in the table blow to improve the investment environment based on the five perspectives we employed in the analysis.

Recommendation for Karnataka

Table 12.17: Recommendation for Karnataka

Perspectives	Details of the Recommendations
Infrastructure	• PMU to help collaborate with relevant State Governments and Central Government to 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	Implement actions under KIPP to make land related information available to investors • KIADB to set up dedicated unit to operate existing Kaigarika Bhoomi to include online application system, tracking system, helpline and monthly update mechanism in FY15/16. • Land pool policy to be introduced to increase land availability for investors. The Policy is targeted to be approved by FY 15/16, and operational guideline to be released in FY
Skill Development	1) Implement actions under KIPP • Revision of existing Skill Development Policy of the State and preparation of Draft Skill Development Policy 2015-20 comprising detailed road map of schemes, yearly target outcomes, and budgetary provisions in FY15/16. • Arrangement of an annual industry-government round table to continuously understand the skill demand with changing contexts. Foreign investors including Japanese investors may be invited as participants of the roundtable. • Introduce new curriculum to match up-to-date skill requirement. 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 3) Formulate comprehensive IP Strategy / Measures for the State • As Karnataka Industries Policy 2014-19 indicates, comprehensive IP Strategy / Measures for the State need to be formulated at priority basis to create IP creation, IP Protection, IP Commercialization and IP Enforcement.
Business Process	Implement actions under KIPP to improve the single window mechanism. • KUM to enhance exiting E-Udyami to include tracking system, helpline, information such as contact details of nodal officers, incentive schemes available, • KUM to appoint dedicated person for each investor to support project clearances and coordinate with line departments
Industrial park/Cluster	• Formulate the operational guideline on priority basis to encourage establishment of Industrial Parks by private investors, as Karnataka Industrial Policy 2014-19 indicates and establish the support mechanism inside the Industries Department.

Perspectives	Details of the Recommendations
	• Establish the standard to ensure the quality of infrastructure provided (water, power, waste management etc.)

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.

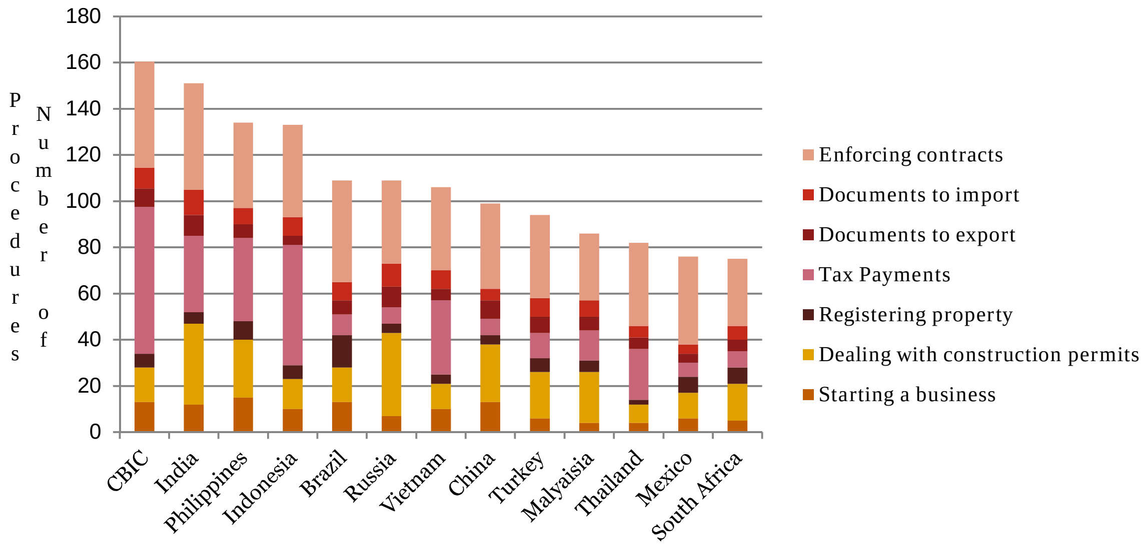
The recommendation for the central government, thus, is three steps: i) to develop the framework/guidelines for development of industrial parks with safety and environmental standards; ii) to test the above standards in specific industrial parks with governmental initiative and adjust the framework/guidelines 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, and 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 for Node Development*

The following activities need to be undertaken by the Government of Karnataka (GoK) for moving project towards implementation of Tumakuru Node.

13.1 Legal/Regulatory Framework

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

a) Declaration of Industrial Township of the proposed Tumakuru node as aligned to Article 243Q

b) Review of samples of State Support Agreement (SSA) and Share Holder Agreement (SHA) 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

13.2 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 GoK

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 additional 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 [KSIIDC or an appropriate organization] as a transition unit to lead coordination with Central Got and State Got Agencies and facilitate the implementation of the role of State under SSA and SHA

13.3 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

13.4 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 GoK 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.

f) Confirmation of water supply to Tumakuru Node

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
25	Point for Sales Terminal

Sl.No.	Product
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.[63] 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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[63] 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. [64]

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

[64] 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[65];

(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.

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;

[65] 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.

(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
	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. - Energy and Renewables

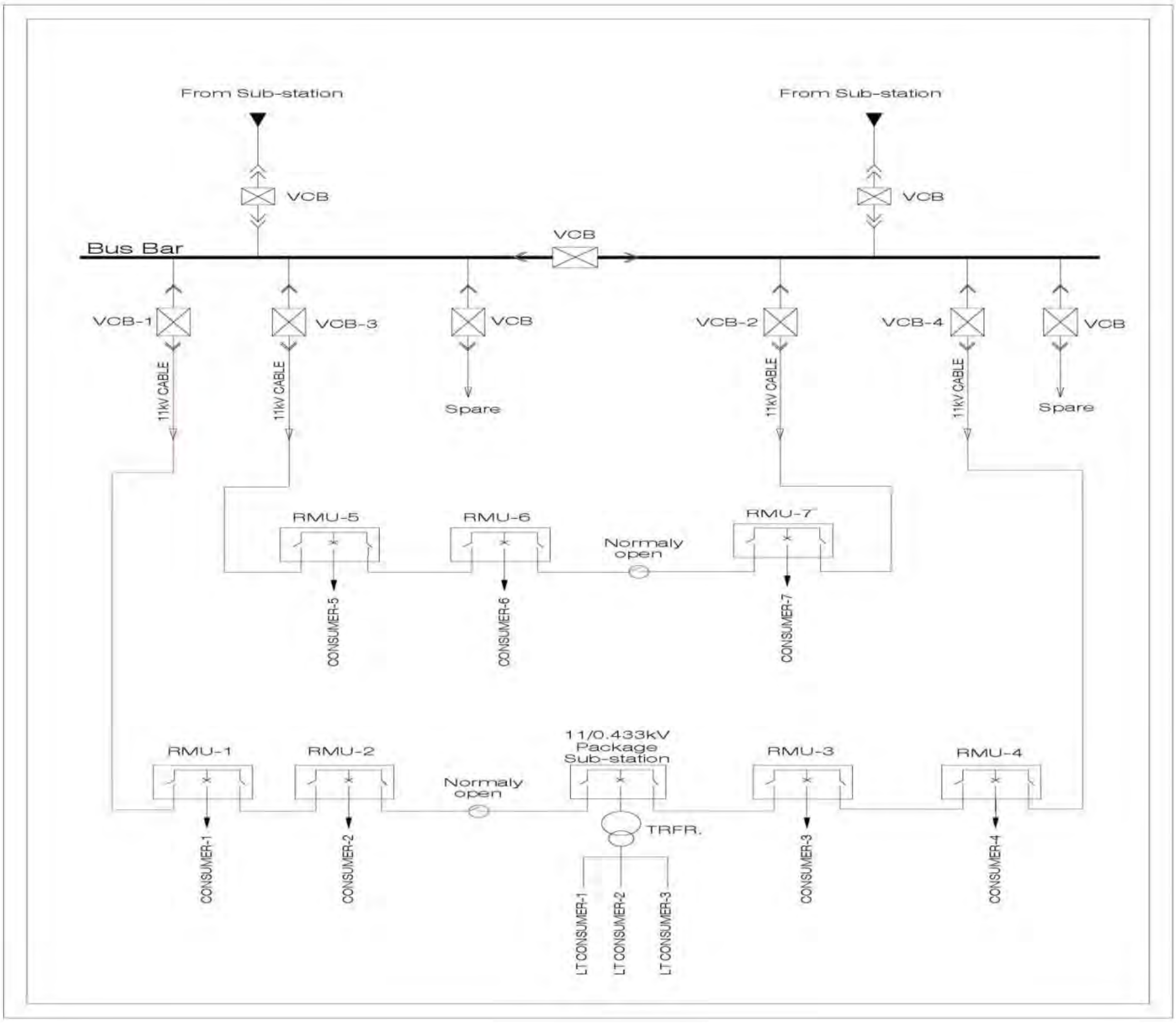
C.1. Key assumptions

In order to channelize the study we have made few assumptions which are based on industry standards and norms. Some of the assumptions utilized in the demand forecast model are specified below:

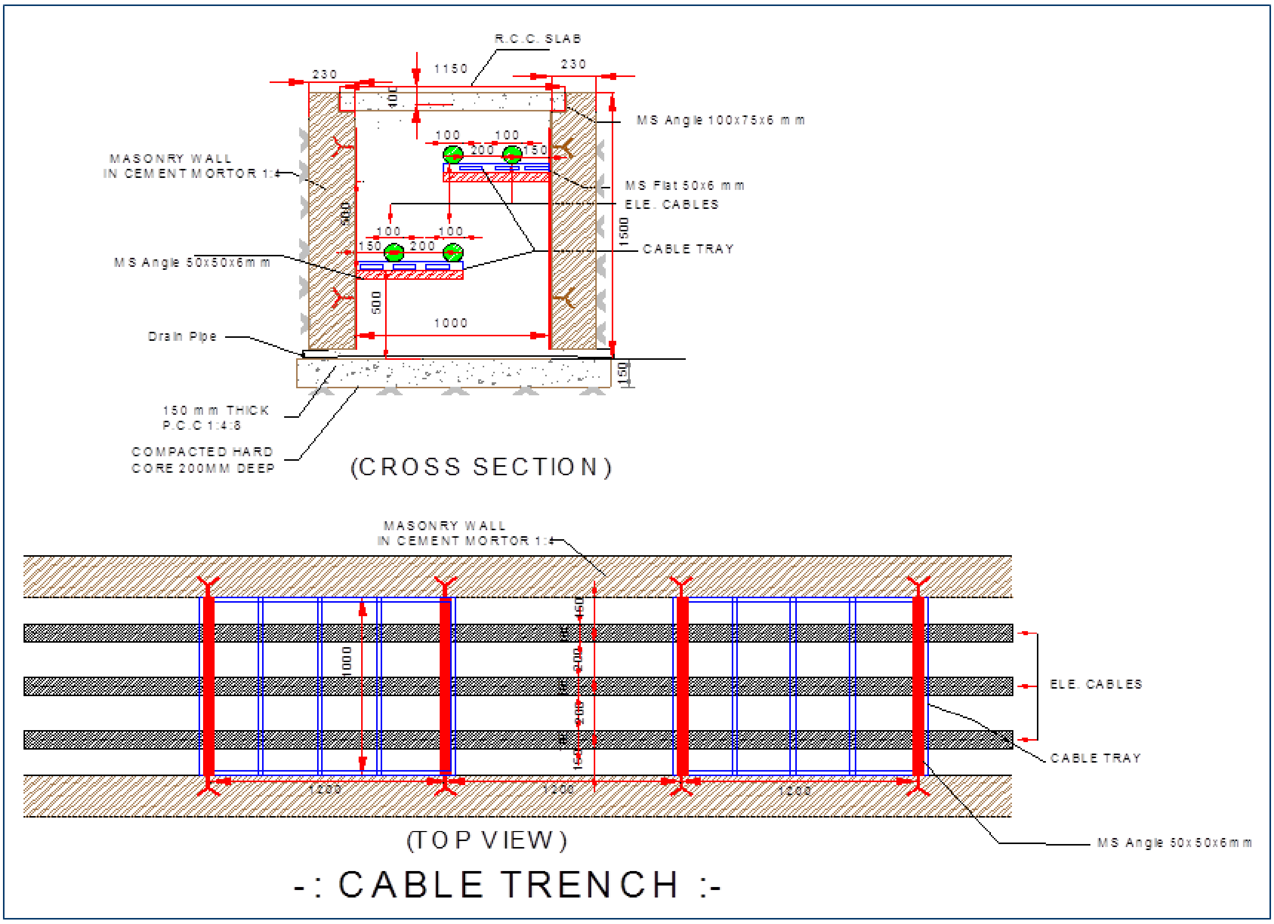
Appendix 11: Key assumptions in demand estimation and their sources

Factor	Estimated value	Data source
Load factor	0.66	Industry standards
Conversion factor for Sq km to Acre	247.11	Standard
Industrial Growth in Karnataka	8%	Ministry of Commerce & Industry
Direct to Indirect Employment factor	1.50	PwC research
Employment to population conversion factor	0.44	PwC research
Population growth rate of Karnataka after 10years	1.47%	Office of the Registrar General & Census Commissioner, India
Average per capita consumption growth rate	6.40%	PwC research

C.2. Single Line Diagram for underground distribution network



C.3. Supporting design data on underground distribution system



Proposed Masonry Cable trench on footpath (Cross section)

C.4. 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
Pooneri	759	21,795	0.034
Krishnapatnam	301	5503	0.054
Tumakuru	**366**	**6138**	**0.059**

C.5. Substation Design

New sub-station design philosophy

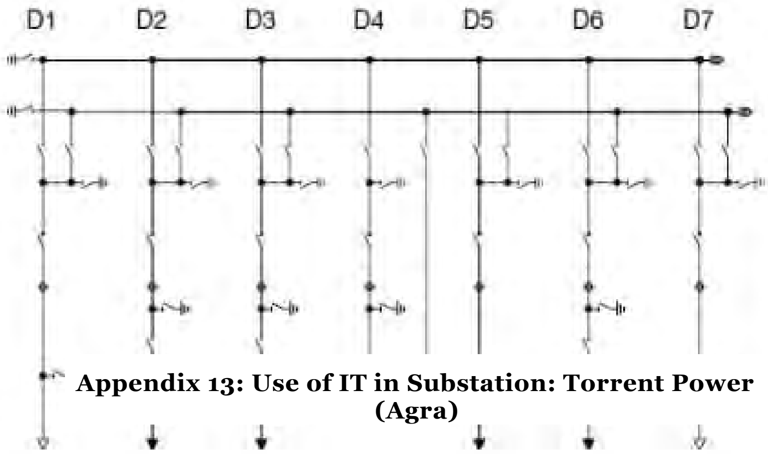
In design of a new sub-station, previous learnings from the installations of sub stations need to be incorporated in the smart design. Typically in Indian conditions, we see Air insulated sub stations are used by distribution utilities. However, the conventional Air-insulated substation (AIS) design 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 12:Sample SLD for double busbar



Appendix 13: Use of IT in 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.

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.

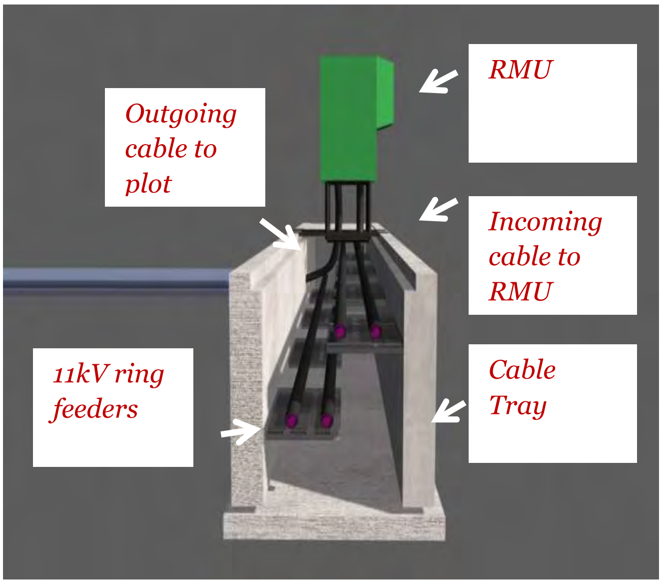
4. Outage cost: Since the failure rate of GIS is lower, the outage cost of AIS shall be greater.

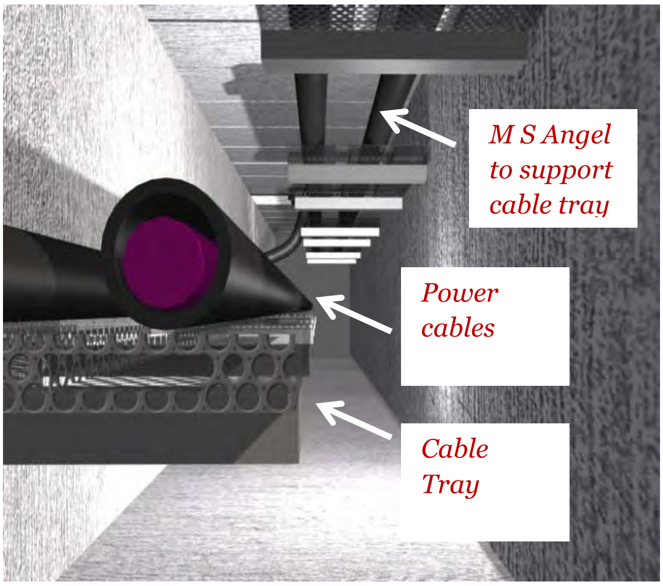
5. Disposal cost: The cost of decommissioning and disposal after use should be capitalized. The value of future expense must be taken into account.

Taking these considerations in mind, we propose installations of Gas insulated sub stations in the node for primary equipment design.

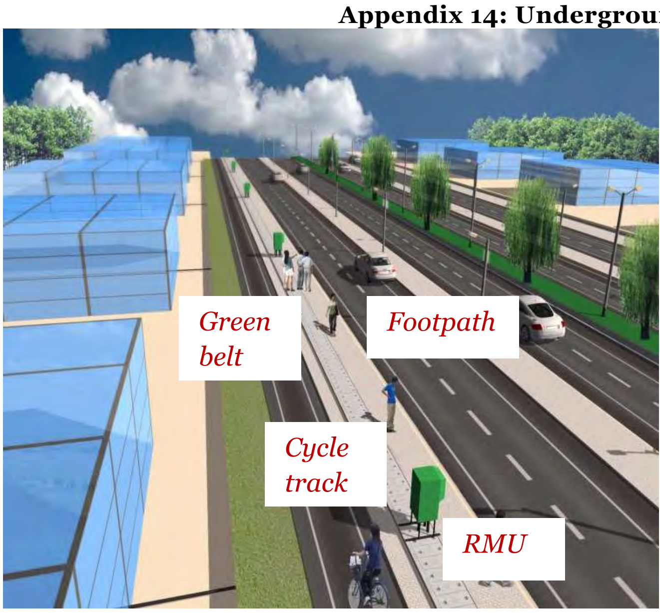
C.6. Underground Distribution Network Design

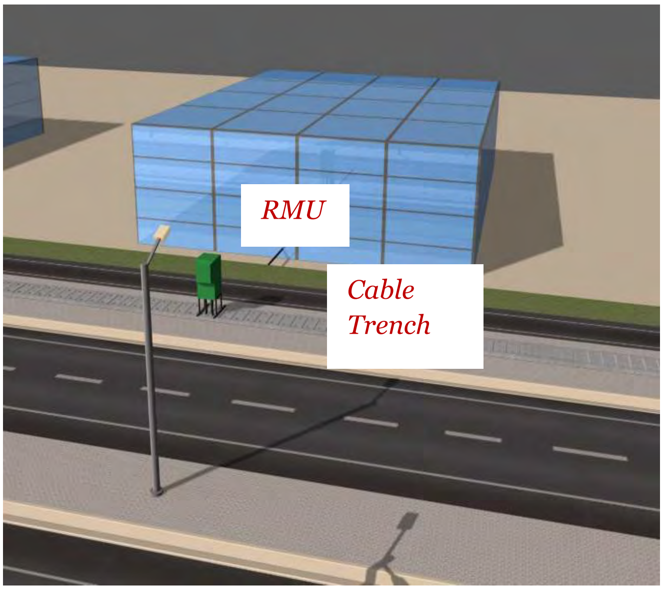
The illustrative diagrams illustrate the underground distribution network for the node.





Appendix 14: Underground 11kV feeders for node





C.7. Frequently used terms in Energy & Renewables

Abbreviation	Description
Acre	Area unit used in the imperial and U.S. customary systems
AIS	Air Insulated Substation
APGENCO	Andhra Pradesh Generation Company Limited
APSPDCL	Andhra Pradesh South Power Distribution Company Limited
APTRANSCO	Transmission Corporation of Andhra Pradesh Limited
BAU	Business As Usual scenario
BESCOM	Bangalore Electricity Supply Company Limited
CEA	Central Electricity Authority
CIL	Coal India Limited
EHT	Extra High Tension
EPS	Electric Power Survey
ERC	Electricity Regulatory Commission
HT	High Tension
GAIL	Gas Authority of India Limited
GIS	Gas Insulated Substation
INR	Indian Rupees
KPTCL	Karnataka Power Transmission Corporation Limited
kV	Kilo volts
kWh	Kilowatt hour
LGBR	Load Generation Balance Report
LOA	Letter of Award
LT	Low Tension
MCL	Mahanadi Coalfields Limited
MT	Metric Tonne
MTPA	Metric Tonne per annum
MVA	Mega Volt Ampere
MW	Mega Watt
MWh	Mega Watt Hour
MUs	Million kilowatt hours
PF	Power Factor
PTR	Power Transformer
RES	Renewable Energy System
SEZ	Special Economic Zone
S/S	Sub Station
TPS	Thermal Power Station
UG	Under ground
USD	United States Dollar

Appendix D. - Water Sector

D.1. Applicable Water Quality Standard

D.1.1. Indian Standard Specifications for Drinking Water

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

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 15: A.1.1. 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

Appendix 16: General Standard for Discharge of Environmental Polutants

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. Tumakuru

(1) Construction Cost

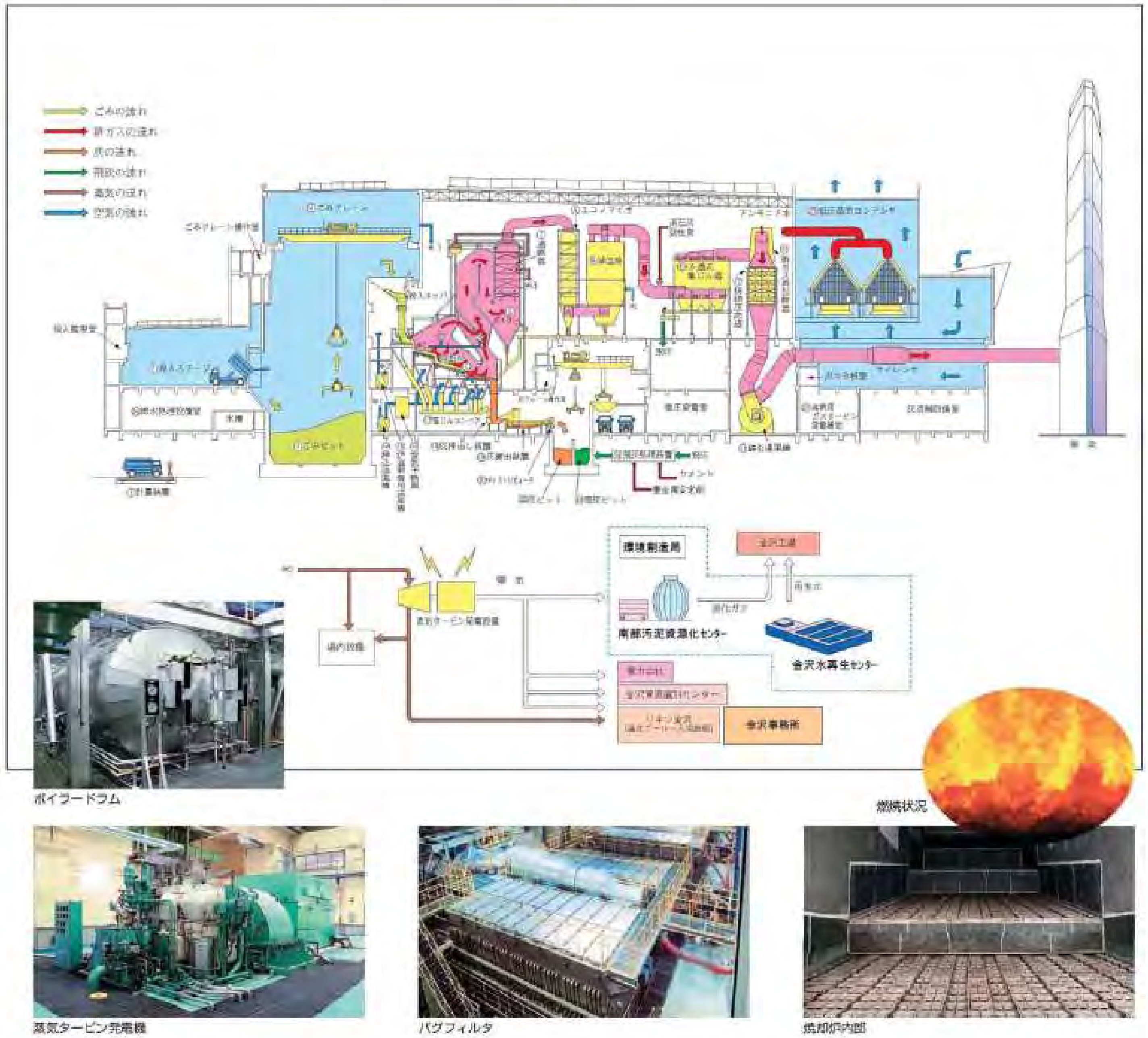
Item	Description		Unit	Unit Rate	Phase 1(2016-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2033)		Total
					Quantity	Cost	Quantity	Cost	Quantity	Cost	
				(INR)		(Million INR)		(Million INR)		(Million INR)	(Million INR)
WATER INFRASTRUCTURES											
1. Potable Water Supply Works	1) Raw Water Conveyance System (from Hamavathy Channel)	a) Raw water pipe (DIP, D=1,200mm)	m	120,494	14,400	1,735	0	0	0	0	1,735
		b) Pum station	kW	6,000,000	600	3,600	0	0	0	0	3,600
	2) Water Treatment System	a) WTP	MLD	10,000,000	17.9	179	25.6	256	21.4	214	649
	3) Potable Water Transmission System	a) Reservoir	ML	7,000,000	9.0	63	13.0	91	11.0	77	231
		b) Pump station	kW	6,000,000	60	360	70	420	10	60	840
		c) Elevated tank	ML	30,000,000	2.50	75	1.75	53	0.50	15	143
		d) Transmission pipe (DIP, D=1000mm)	m	83,678	0	0	4,240	355	0	0	355
		e) Transmission pipe (DIP, D=900mm)	m	67,574	0	0	0	0	2,750	186	186
		f) Transmission pipe (DIP, D=700mm)	m	45,602	3,030	138	0	0	0	0	138
		g) Transmission pipe (DIP, D=600mm)	m	27,164	0	0	0	0	7,710	209	209
	4) Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	m	5,441	21,300	116	0	0	15,900	87	202
		b) Distribution pipe (HDPE, D=200mm)	m	2,054	32,100	66	15,200	31	33,700	69	166
		c) Distribution pipe (HDPE, D=150mm)	m	1,410	42,600	60	38,600	54	36,000	51	165
	Sub-total					**6,392**		**1,260**		**968**	**8,620**
2. Non-Potable Water Supply Works	1) Tertiary Treatment Plant	a) Tertiary treatment plant by RO process	MLD	14,000,000	20.7	290	29.0	406	69.7	976	1,672
	2) Non-Potable Water Transmission System	a) Reservoir	ML	7,000,000	10.0	70	14.5	102	35.0	245	417
		b) Pump station	kW	6,000,000	210	1,260	280	1,680	540	3,240	6,180
		c) Transmission pipe (DIP, D=700mm)	m	45,602	0	0	5,530	252	4,540	207	459
		d) Transmission pipe (DIP, D=600mm)	m	37,154	0	0	0	0	2,650	98	98
		e) Transmission pipe (DIP, D=500mm)	m	27,164	3,010	82	0	0	0	0	82
	3) Non-Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	m	5,441	21,300	116	0	0	15,900	87	202
		b) Distribution pipe (HDPE, D=200mm)	m	2,054	32,100	66	15,200	31	33,700	69	166
		c) Distribution pipe (HDPE, D=150mm)	m	1,410	42,600	60	38,600	54	36,000	51	165
	Sub-total					**1,943**		**2,525**		**4,973**	**9,442**
3. Domestic Sewerage Works	1) Sewage Collection System	a) Sewer pipe (RC, D=900mm)	m	16,812	0	0	0	0	1,299	22	22
		b) Sewer pipe (RC, D=800mm)	m	14,580	0	0	834	12	1,299	19	31
		c) Sewer pipe (RC, D=700mm)	m	12,195	2,505	31	1,390	17	2,165	26	74
		d) Sewer pipe (RC, D=600mm)	m	7,992	2,505	20	1,390	11	2,165	17	48
		e) Sewer pipe (RC, D=500mm)	m	6,951	5,010	35	2,780	19	4,330	30	84
		f) Sewer pipe (RC, D=400mm)	m	4,827	5,010	24	2,780	13	4,330	21	59
		g) Sewer pipe (RC, D=300mm)	m	2,640	20,040	53	11,120	29	17,320	46	128
		h) Sewer pipe (RC, D=250mm)	m	1,998	65,130	130	35,306	71	53,692	107	308
		i) Intermediate pump stations	kW	300,000	40	12	90	27	150	45	84
	2) Sewage Treatment Plant	a) Final pump station	kW	2,000,000	20	40	30	60	40	80	180
		b) Sewage treatment plant	MLD	8,000,000	12.8	102	14.1	113	16.9	135	350
	Sub-total					**447**		**373**		**549**	**1,368**
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	20	120	25	150	50	300	570
		b) Transfer pipe (DIP, D=1200mm)	m	120,494	0	0	0	0	200	24	24
		c) Transfer pipe (DIP, D=900mm)	m	67,574	0	0	200	14	0	0	14
		d) Transfer pipe (DIP, D=700mm)	m	45,602	200	9	0	0	0	0	9
	2) Treated Sewage Transfer from Tumkur City to TTP	a) Treated sewage pump station	kW	6,000,000	0	0	0	0	150	900	900
		b) Transfer pipe (DIP, D=800mm)	m	56,308	0	0	0	0	5,000	282	282
	3) Treated Effluent Collection and Transfer System	a) Sewer pipe (RC, D=1100mm)	m	26,574	0	0	0	0	866	23	23
		b) Sewer pipe (RC, D=1000mm)	m	18,603	0	0	0	0	866	16	16
		c) Sewer pipe (RC, D=900mm)	m	16,812	0	0	556	9	1,299	22	31
		d) Sewer pipe (RC, D=800mm)	m	14,580	0	0	834	12	1,299	19	31
		e) Sewer pipe (RC, D=700mm)	m	12,195	2,505	31	1,390	17	2,165	26	74
		f) Sewer pipe (RC, D=600mm)	m	7,992	5,010	40	2,780	22	4,330	35	97
		g) Sewer pipe (RC, D=500mm)	m	6,951	10,020	70	5,560	39	8,660	60	168
		h) Sewer pipe (RC, D=400mm)	m	4,827	20,040	97	11,120	54	17,320	84	234
		i) Sewer pipe (RC, D=300mm)	m	2,640	62,625	165	33,360	88	50,661	134	387
		j) Intermediate pump station	kW	300,000	75	23	100	30	125	38	90
		k) Final pump station	kW	2,000,000	70	140	100	200	125	250	590
		l) Effluent force main (DIP, D=1200mm)	m	120,494	0	0	0	0	100	12	12
		m) Effluent force main (DIP, D=1100mm)	m	101,248	0	0	100	10	0	0	10
		n) Efflunet force main (DIP, D=900mm)	m	67,574	100	7	0	0	0	0	7
	Sub-total					**701**		**645**		**2,224**	**3,569**
5. Drainage Works	1) Drainage System	a) Storm water drain	m	20,000	43,780	876	71,160	1,423	61,760	1,235	3,534
		b) Improvement of existing canal	m	12,000	11,890	143	0	0	0	0	143
		c) Improvement of bund of existing water bo	m	12,000	0	0	0	0	2,270	27	27
		d) Outfall Structures	Nos	1,000,000	2	2	2	2	4	4	8
	Sub-total					**1,020**		**1,425**		**1,266**	**3,712**
TOTAL						**10,504**		**6,228**		**9,979**	**26,711**

(2) Operation and Maintenance Cost

Item	Description		Unit	Charges	Phase 1(2014-2018)		Phase 2 (2019-2023)		Phase 3 (2024-2023)		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 Conveyance System (from Hamavathy Channel)	a) Raw water pipe (DIP, D=1,200mm)	l.s.	5	86.8	434	86.8	434	86.8	868	1,735
		b) Pum station	l.s.	5	180.0	900	180.0	900	180.0	1,800	3,600
	2) Water Treatment System	a) WTP	l.s.	5	9.0	45	15.4	77	27.1	271	393
	3) Potable Water Transmission System	a) Reservoir	l.s.	5	3.2	16	7.7	39	11.6	116	170
		b) Pump station	l.s.	10	36.0	180	57.0	285	81.0	810	1,275
		c) Elevated tank	l.s.	10	7.5	38	12.8	64	14.3	143	244
		d) Transmission pipe (DIP, D=1000mm)	l.s.	3	0.0	0	10.6	53	10.6	106	160
		e) Transmission pipe (DIP, D=900mm)	l.s.	3	0.0	0	0.0	0	5.6	56	56
		f) Transmission pipe (DIP, D=700mm)	l.s.	3	4.1	21	4.1	21	4.1	41	83
		g) Transmission pipe (DIP, D=600mm)	l.s.	3	0.0	0	0.0	0	6.3	63	63
	4) Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	l.s.	3	3.5	17	3.5	17	6.1	61	95
		b) Distribution pipe (HDPE, D=200mm)	l.s.	3	2.0	10	2.9	15	5.0	50	74
		c) Distribution pipe (HDPE, D=150mm)	l.s.	3	1.8	9	3.4	17	5.0	50	76
	Sub-total				**333.8**	**1,668.8**	**384.2**	**1,920.9**	**443.3**	**4,433.2**	**8,022.9**
2. Non-Potable Water Supply Works	1) Tertiary Treatment Plant	a) Tertiary treatment plant by RO process	l.s.	20	29.0	145	98.6	493	236.7	2,367	3,005
	2) Non-Potable Water Transmission System	a) Reservoir	l.s.	5	3.5	18	8.6	43	20.8	208	269
		b) Pump station	l.s.	10	63.0	315	210.0	1,050	456.0	4,560	5,925
		c) Transmission pipe (DIP, D=700mm)	l.s.	3	0.0	0	7.6	38	13.8	138	176
		d) Transmission pipe (DIP, D=600mm)	l.s.	3	0.0	0	0.0	0	3.0	30	30
		e) Transmission pipe (DIP, D=500mm)	l.s.	3	2.5	12	2.5	12	2.5	25	49
	3) Non-Potable Water Distribution System	a) Distribution pipe (HDPE, D=300mm)	l.s.	3	3.5	17	3.5	17	6.1	61	95
		b) Distribution pipe (HDPE, D=200mm)	l.s.	3	2.0	10	2.9	15	5.0	50	74
		c) Distribution pipe (HDPE, D=150mm)	l.s.	3	1.8	9.0	3.4	17	5.0	50	76
	Sub-total				**105.2**	**525.9**	**337.0**	**1,684.9**	**748.8**	**7,487.7**	**9,698.5**
3. Domestic Sewerage System	1) Sewage Collection System	a) Sewer pipe (RC, D=900mm)	l.s.	5	0.0	0	0.0	0	1.1	11	11
		b) Sewer pipe (RC, D=800mm)	l.s.	5	0.0	0	0.6	3	1.6	16	19
		c) Sewer pipe (RC, D=700mm)	l.s.	5	1.5	8	2.4	12	3.7	37	56
		d) Sewer pipe (RC, D=600mm)	l.s.	5	1.0	5	1.6	8	2.4	24	37
		e) Sewer pipe (RC, D=500mm)	l.s.	5	1.7	9	2.7	14	4.2	42	64
		f) Sewer pipe (RC, D=400mm)	l.s.	5	1.2	6	1.9	9	2.9	29	45
		g) Sewer pipe (RC, D=300mm)	l.s.	5	2.6	13	4.1	21	6.4	64	98
		h) Sewer pipe (RC, D=250mm)	l.s.	5	6.5	33	10.0	50	15.4	154	237
		g) Intermediate pump stations	l.s.	10	0.6	3	2.6	13	6.2	62	77
	2) Sewage Treatment Plant	a) Final pump station	l.s.	10	2.0	10	7.0	35	14.0	140	185
		b) Sewage treatment plant	l.s.	5	2.6	13	7.9	40	14.1	141	194
	Sub-total				**19.8**	**99.0**	**40.8**	**203.8**	**72.0**	**719.9**	**1,022.6**
4. Treated Sewage and Effluent Collection and Transfer Works	1) Treated Sewage Transfer System from STP to TTP	a) Transfer pump station	l.s.	10	6.0	30	19.5	98	42.0	420	548
		b) Transfer pipe (DIP, D=1200mm)	l.s.	3	0.0	0	0.0	0	0.7	7	7
		c) Transfer pipe (DIP, D=900mm)	l.s.	3	0.0	0	0.4	2	0.4	4	6
		d) Transfer pipe (DIP, D=700mm)	l.s.	3	0.3	1	0.3	1	0.3	3	5
	2) Treated Sewage Transfer from Tumkur City to TTP	a) Treated sewage pump station	l.s.	10	0.0	0	0.0	0	45.0	450	450
		b) Transfer pipe (DIP, D=800mm)	l.s.	5	0.0	0	0.0	0	14.1	141	141
	3) Treated Effluent Collection and Transfer System	a) Sewer pipe (RC, D=1100mm)	l.s.	5	0.0	0	0.0	0	1.2	12	12
		b) Sewer pipe (RC, D=1000mm)	l.s.	5	0.0	0	0.0	0	0.8	8	8
		c) Sewer pipe (RC, D=900mm)	l.s.	5	0.0	0	0.5	2	1.6	16	18
		d) Sewer pipe (RC, D=800mm)	l.s.	5	0.0	0	0.6	3	1.6	16	19
		e) Sewer pipe (RC, D=700mm)	l.s.	5	1.5	8	2.4	12	3.7	37	56
		f) Sewer pipe (RC, D=600mm)	l.s.	5	2.0	10	3.1	16	4.8	48	74
		g) Sewer pipe (RC, D=500mm)	l.s.	5	3.5	17	5.4	27	8.4	84	129
		h) Sewer pipe (RC, D=400mm)	l.s.	5	4.8	24	7.5	38	11.7	117	179
		i) Sewer pipe (RC, D=300mm)	l.s.	5	8.3	41	12.7	63	19.4	194	298
		k) Intermediate pump station	l.s.	10	1.1	6	3.8	19	7.1	71	96
		l) Final pump station	l.s.	10	7.0	35	24.0	120	46.5	465	620
		m) Effluent force main (DIP, D=1200mm)	l.s.	3	0.0	0	0.0	0	0.4	4	4
		n) Effluent force main (DIP, D=1100mm)	l.s.	3	0.0	0	0.3	2	0.3	3	5
		o) Efflunet force main (DIP, D=900mm)	l.s.	3	0.2	1	0.2	1	0.2	2	4
	Sub-total				**28.4**	**173.6**	**80.6**	**403.0**	**210.1**	**2,100.6**	**2,677.2**
5. Drainage Works	1) Drainage System	a) Storm water drain	l.s.	5	43.8	219	114.9	575	176.7	1,767	2,561
		b) Improvement of existing canal	l.s.	5	7.1	36	7.1	36	7.1	71	143
		c) Improvement of bund of existing water bo	l.s.	10	0.0	0	0.0	0	2.7	27	27
		d) Outfall Structures	l.s.	5	0.1	1	0.2	1	0.4	4	6
	Sub-total				**51.0**	**255**	**122**	**611**	**187**	**1,870**	**2,736**
TOTAL					**538.2**	**2,722.3**	**964.8**	**4,824.0**	**1,661.1**	**16,611.0**	**24,157.3**

Appendix E. - Solid Waste Management

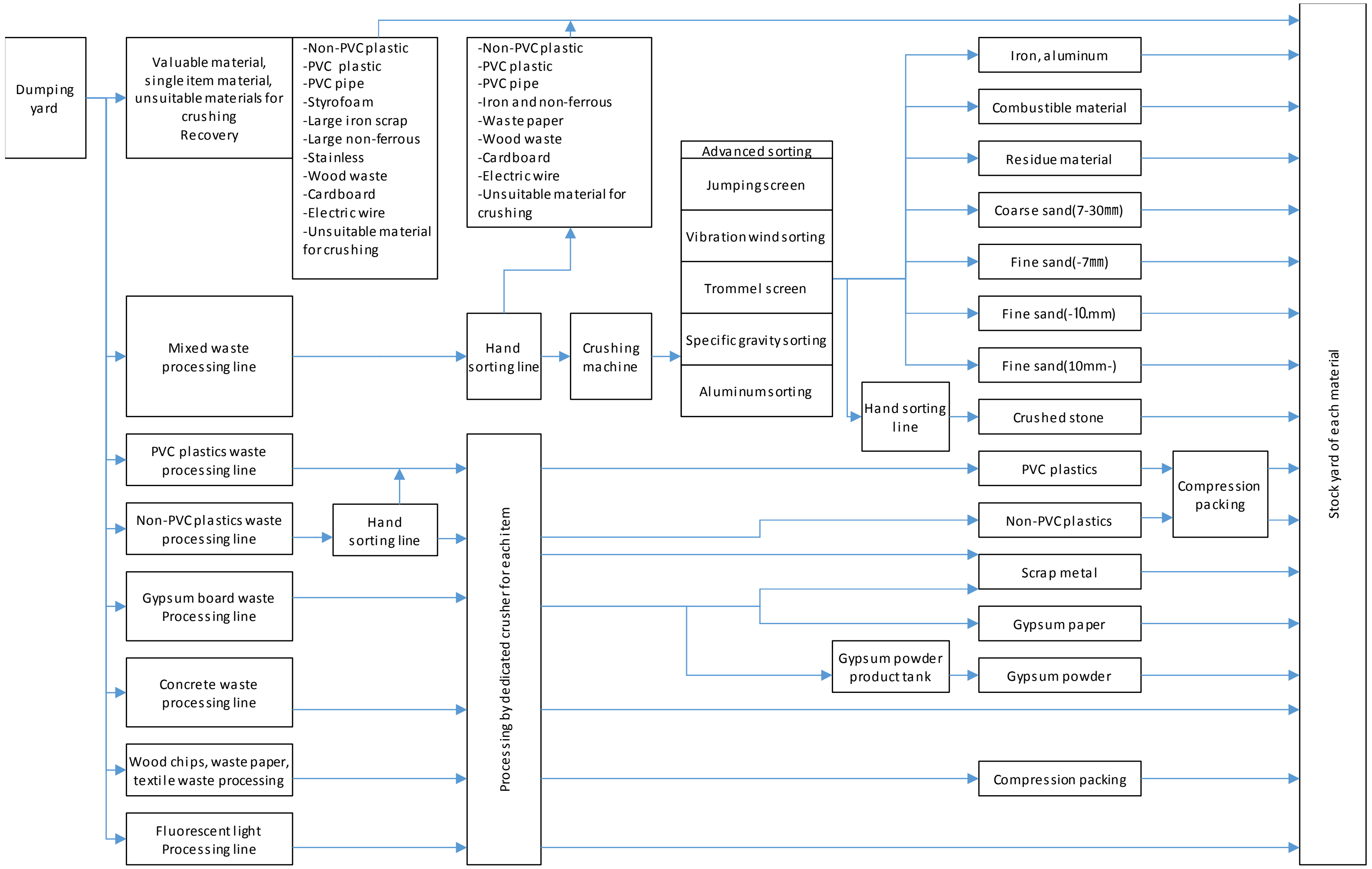
E.1. Cases of Waste to Energy (Incinerator) in Japan



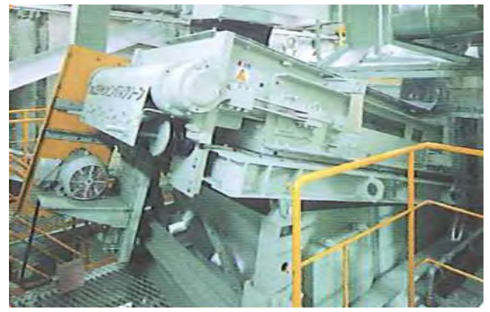
Source: Brochure of Yokohama City.

E.2. 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

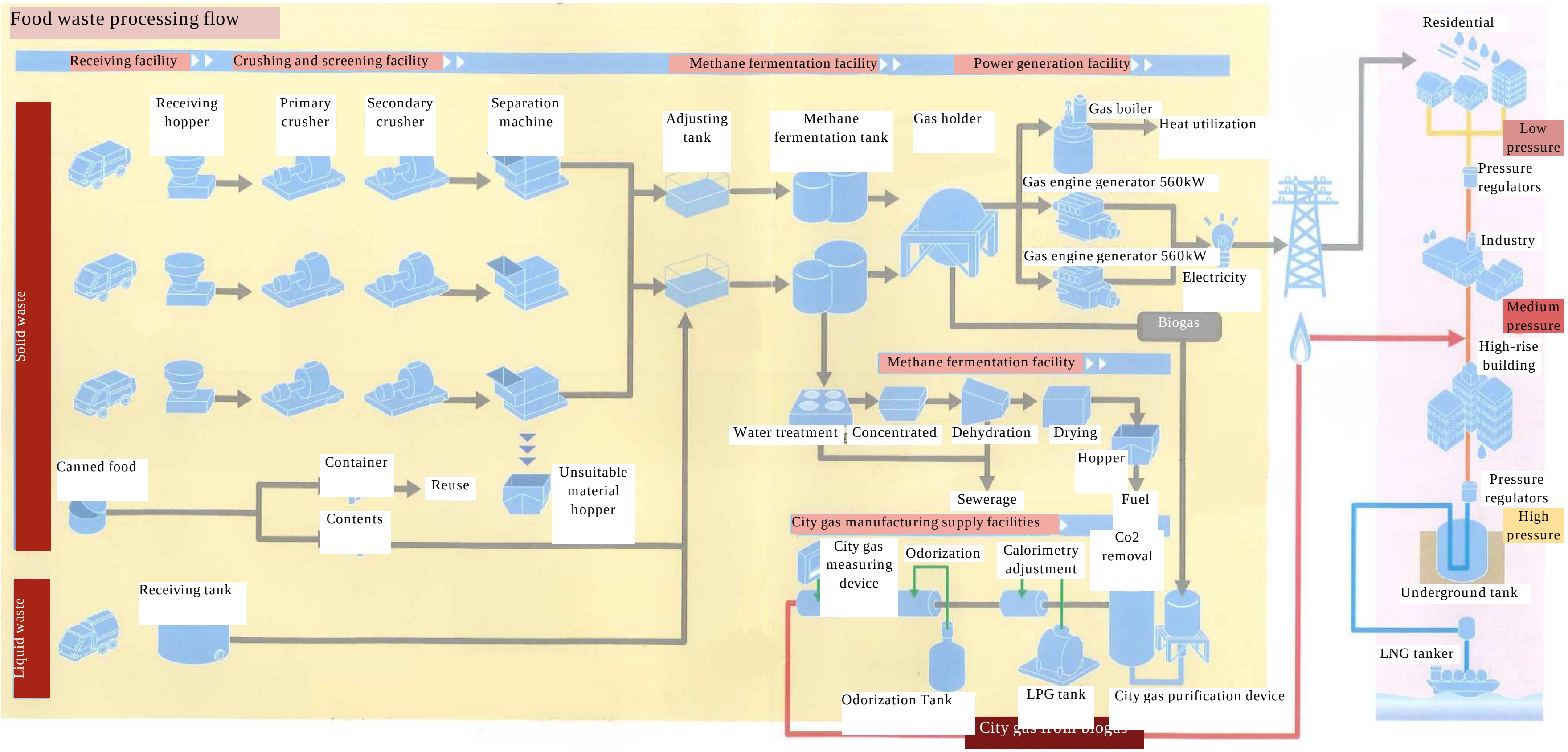

Specific gravity separator
- Sorting by the weight difference


Vibration & wind separator
-Sorting by vibration and wind


Magnetic separator
-Sorting by magnetic forces

Source: Brochure of Takatoshi Co.,Ltd.

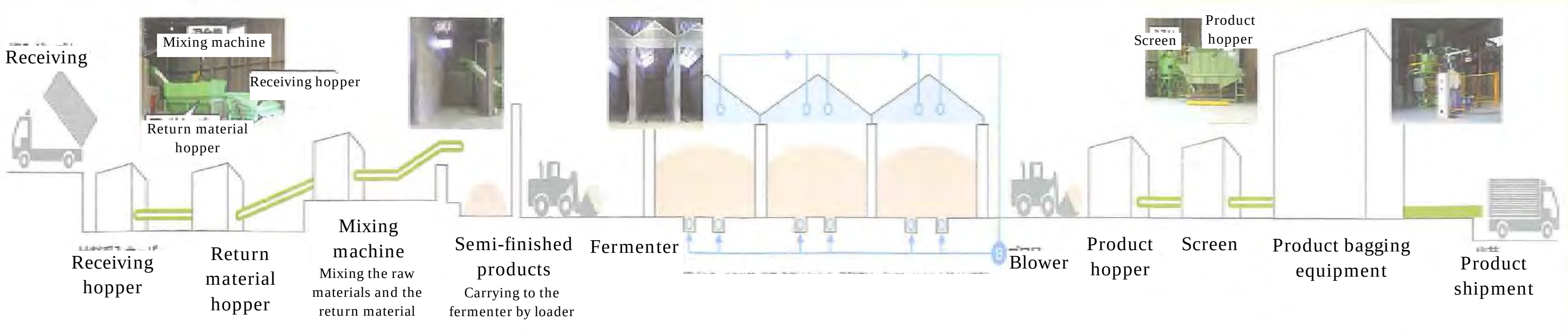
E.3. Appendix: Cases of Bio-methanation in Japan



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.

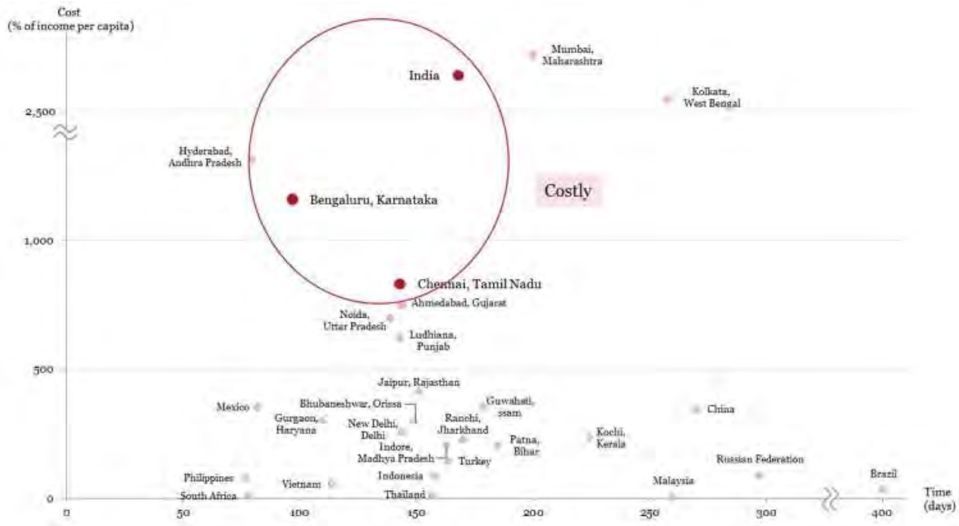
E.4. Appendix: Cases of Composting in Japan



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.

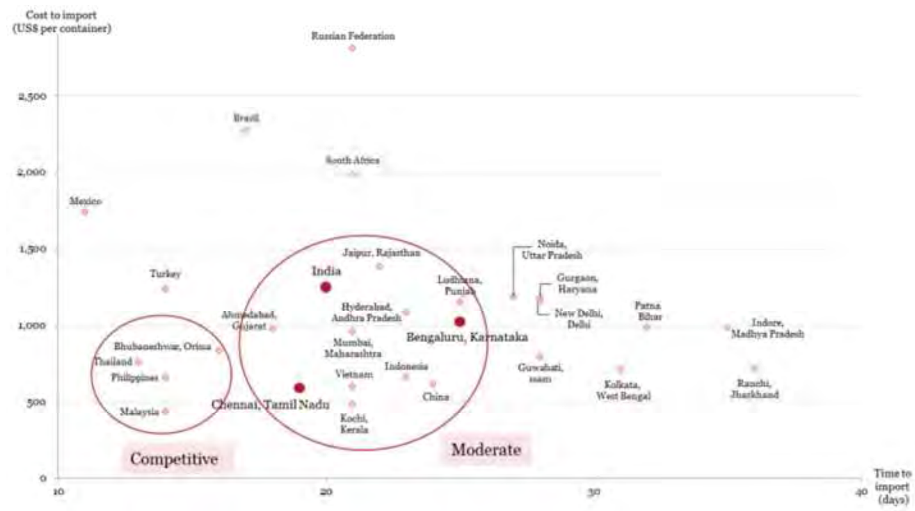
Appendix F. - Investment Environment

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



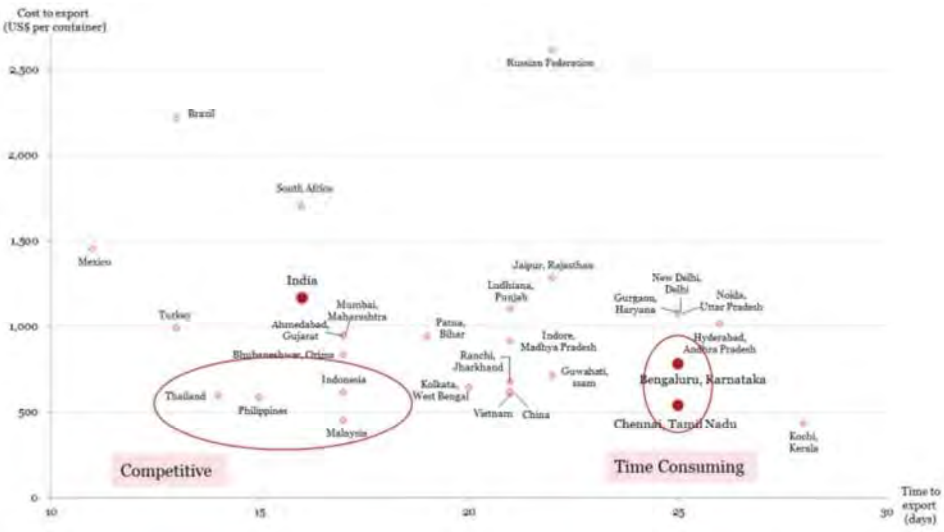
Appendix 17: Dealing with Construction Permits

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.



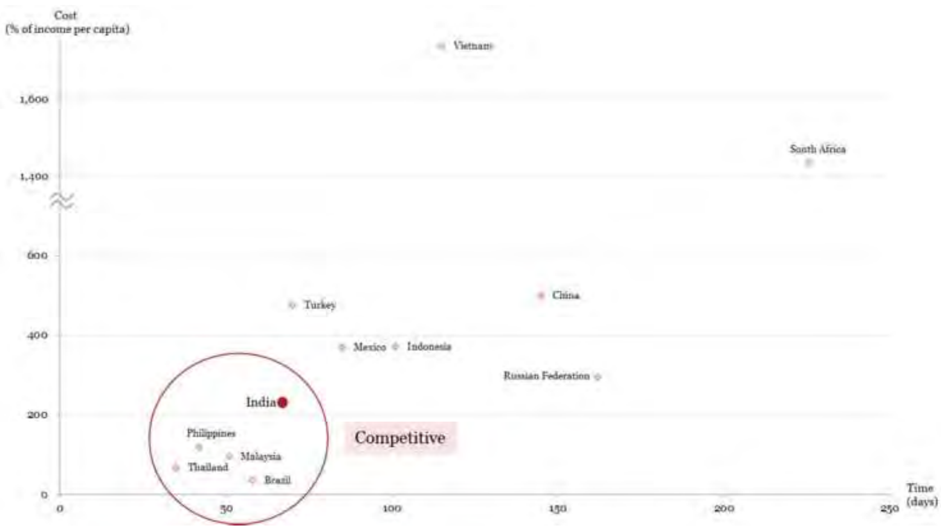
Appendix 18: Trading Across Borders - Import

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 19: 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.

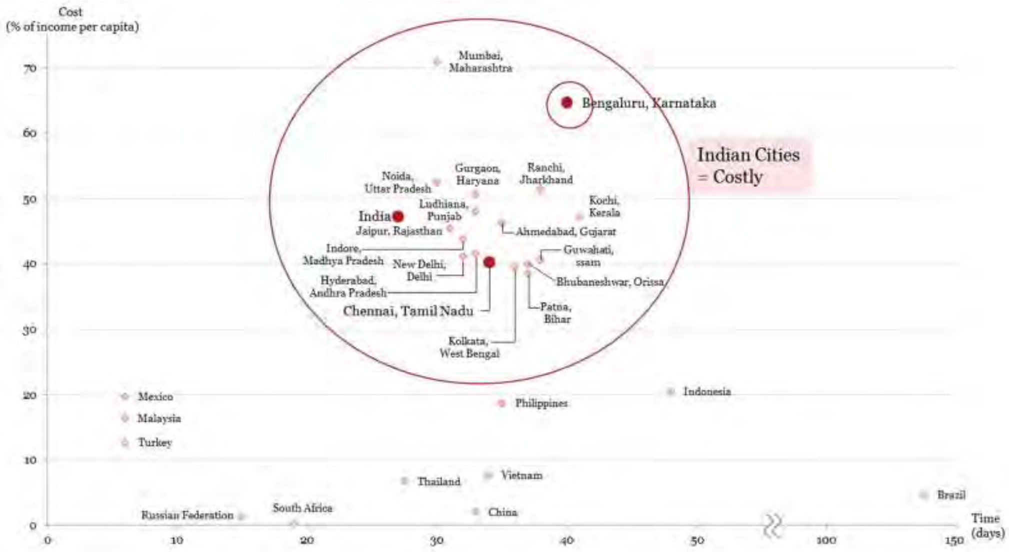


Appendix 20: Getting Electricity

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

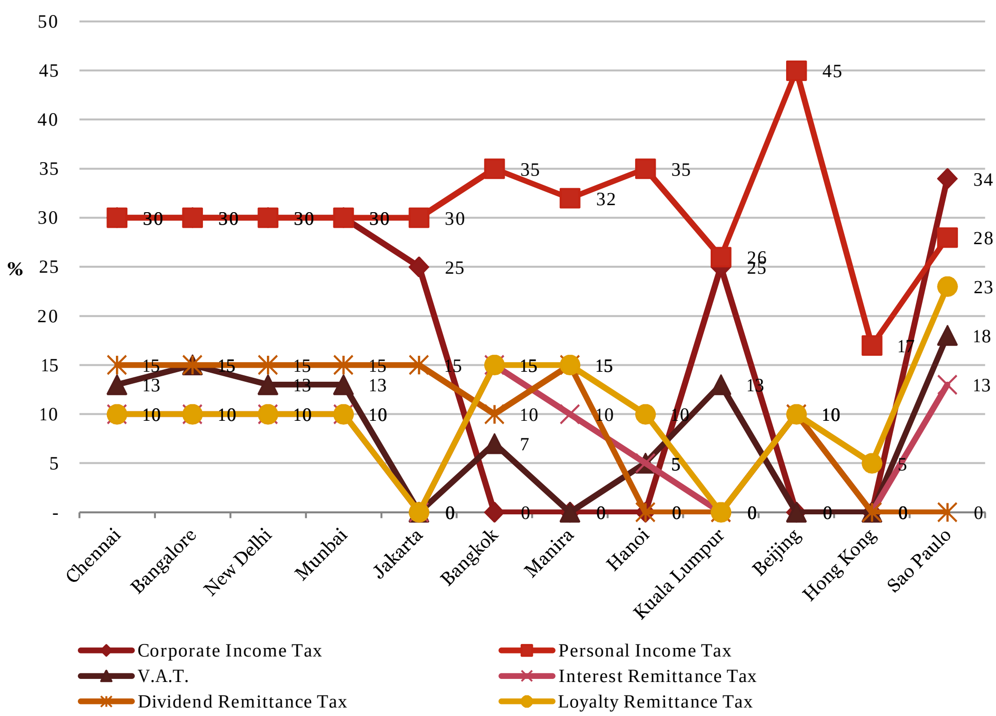
India requires high cost for investors when they start a business. The environment in Bengaluru is outstandingly expensive following to the most expensive city of Mumbai. On the other hand, the other countries, e.g., China, South Africa, Thailand, Vietnam and Russia, require much lower cost than India.

Appendix 21: 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.

Appendix 22: Tax Rates (2013)



Source: JETRO

Here are other taxes the investors are levied in CBIC.

Appendix 23: 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.

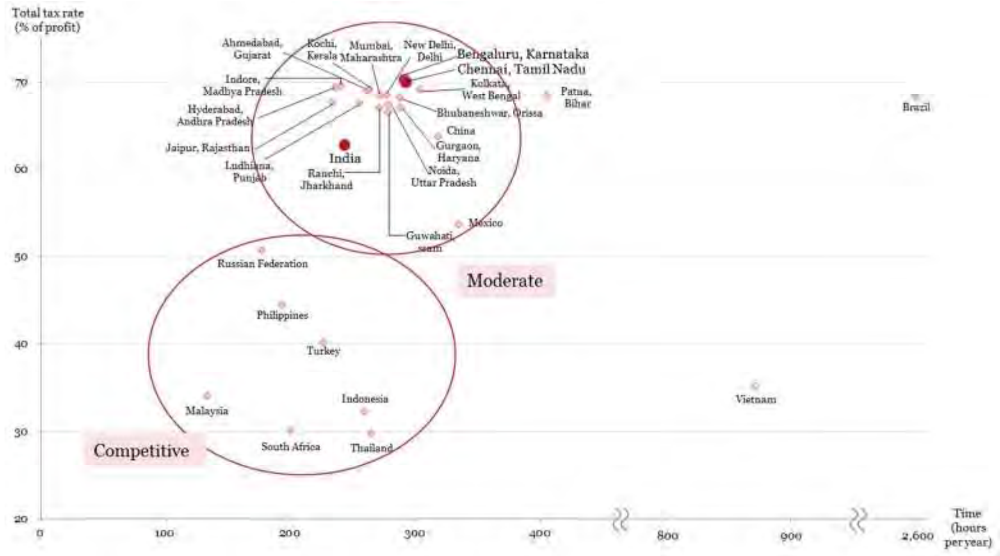
Appendix 24: Indirect Taxes

Name	Rate	Description
Basic Customs Duty (BCD)	0-10%	The rate of customs duty applicable to a product to be imported or exported depends on its classification under the Customs Tariff Act, 1975. Education cess at 2% and secondary and higher education cess at 1% are also levied on the aggregate customs duties. Additional duty of customs at 4% is charged in addition to the above duties on imports, subject to certain exceptions. ADC is calculated on the aggregate of the assessable value of imported goods, the total customs duties (i.e. BCD and CVD) and the applicable EC and SHEC Basic customs duty (BCD) is the basic component of customs duty levied at the effective rate notified under the First Schedule to the CTA and applied to the landed value of the goods (i.e. the CIF value of the goods plus landing charges at 1%) The peak rate of BCD is currently set at 10% for all goods other than agricultural and other specified products. However, the government has the power to exempt specific goods, wholly or in part, from the levy of custom duties. In addition, preferential or concessional rates of duty are available under various bilateral and multilateral trade agreements that India has entered into with other countries.
Countervailing Duty (CVD)	12%	It is charged in lieu of, the excise duty applicable on like goods manufactured in India. CVD is calculated on the landed value of goods and the applicable BCD. However, the CVD on specific consumer goods intended for retail sale is calculated on the basis of the maximum retail price (MRP) printed on their packs after allowing specified abatements.

Name	Rate	Description
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.

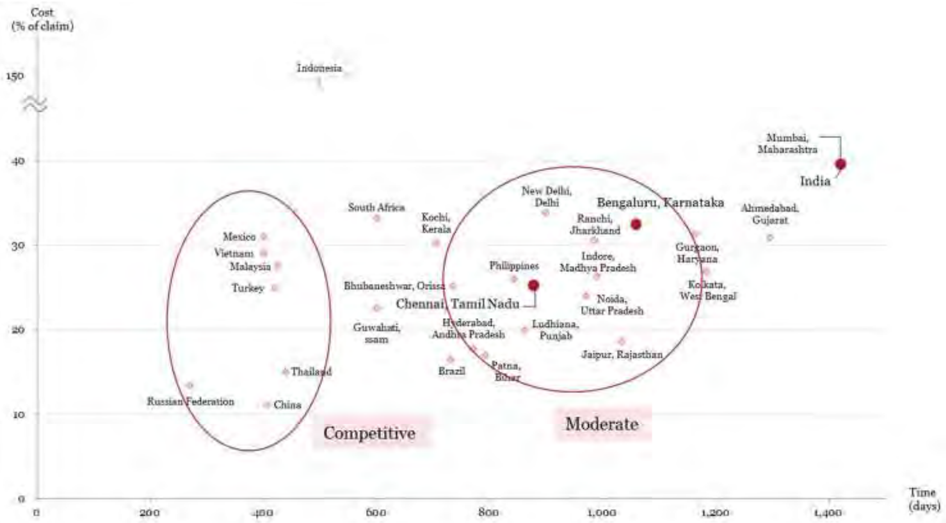
In addition to the tax rate, procedure of paying tax is troublesome and requires time for investors. For example, the time of paying tax per year in China is 9 times, but it is 68 times in Chennai. This means India has still been trapped in the short term and micro view on taxation that higher tax rate 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.



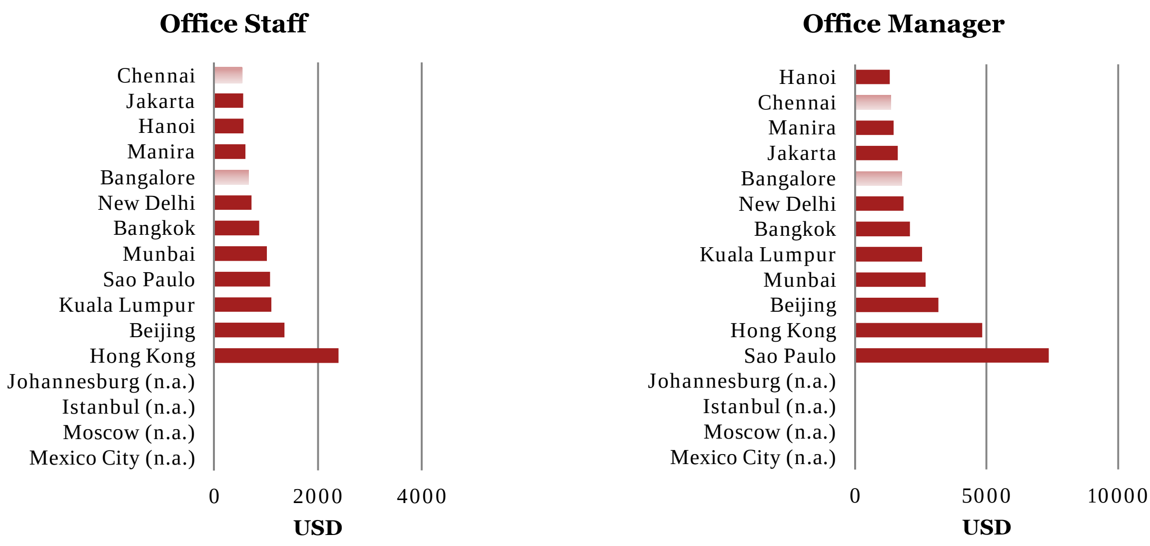
Appendix 25: Paying Taxes

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 26: Enforcing Contract

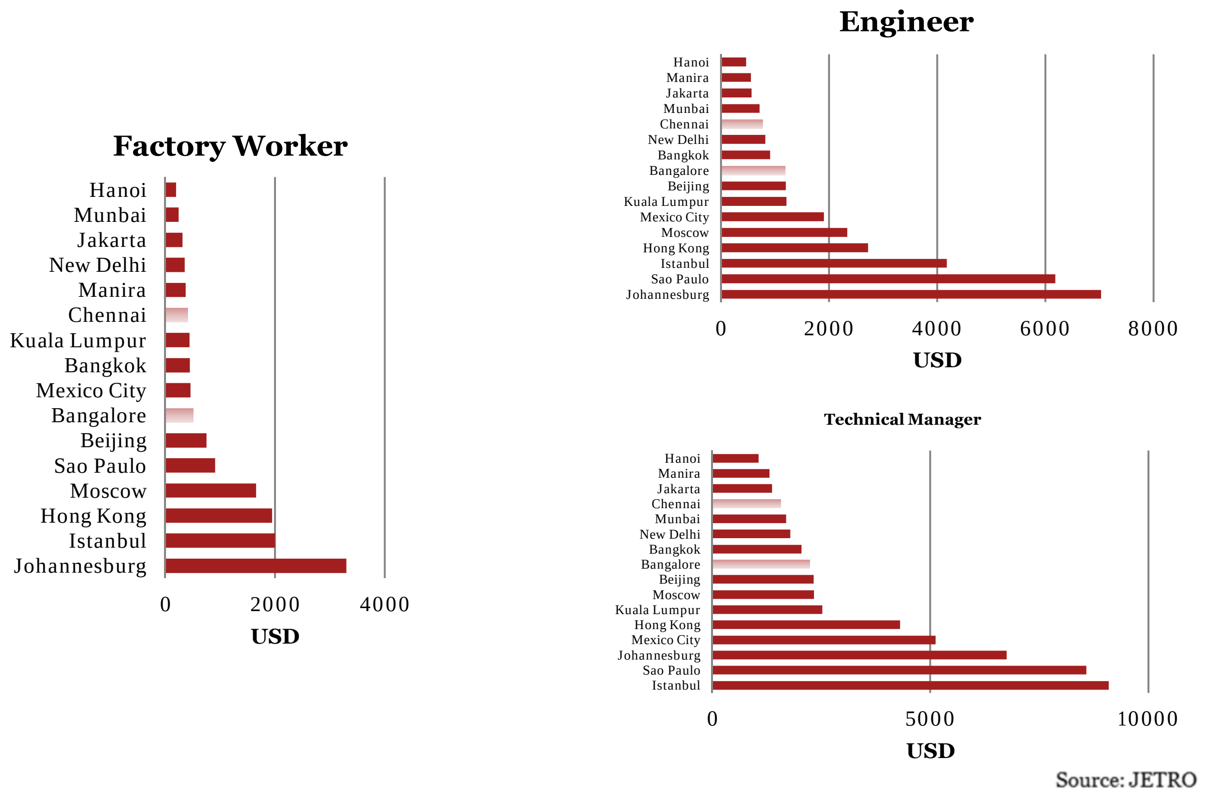
As for the average wages, the office workers' wages in 2 cities in CBIC are placed in the low level group. Given the level of education in those cities available for white collared persons, it can be said that high quality human resources are available at reasonable price in CBIC. In addition, in India, 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 27: 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.



Appendix 28: 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 29: 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

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