Comprehensive Integrated Master Plan for Chennai Bengaluru Industrial Corridor Final Report

Krishnapatnam Industrial Node Development Plan

October 2015

Japan International Cooperation Agency

PricewaterhouseCoopers Co., Ltd.

Nippon Koei Co., Ltd.

4R
JR
15-050

Table of Contents

List of Figures

List of Tables

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

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

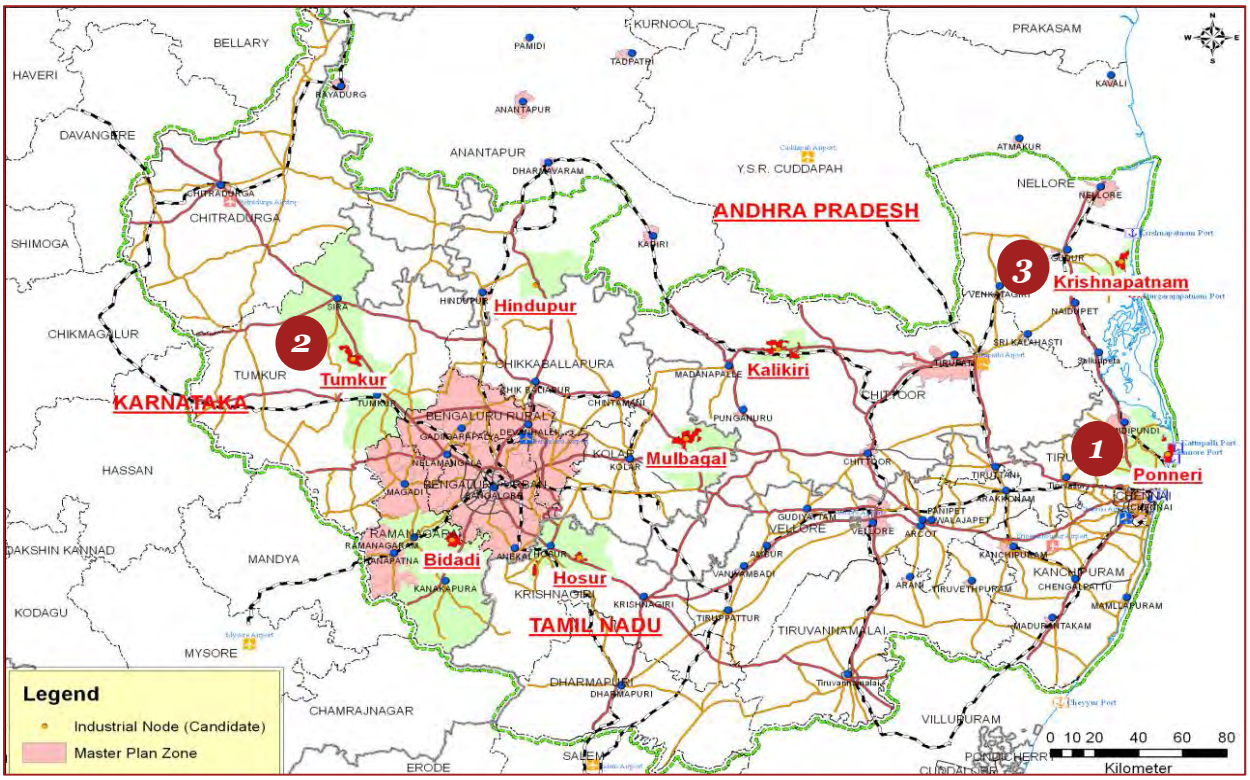


Figure 1.2: Nodes selected for CBIC

a. Development of Industrial Node at Krishnapatnam

Selection of Krishnapatnam Node

The JICA Perspective Plan for CBIC identified Krishnapatnam SEZ area as a prospective industrial node for CBIC along with seven other nodes in Tamil Nadu, Karnataka and Andhra Pradesh – including Hindupur and Kalikiri in Andhra Pradesh. This planned area is located in south of Krishnapatnam port as industrial development of about 12,000 acres, and KPCL (Krishnapatnam Port Company Ltd.) had earlier planned the layout plan for this area. Additionally, KPCL has plans to develop plant facilities (power plant, water treatment plant and waste water plant) near this area, and it is expected to provide stable operational environment for the factories in the future. A trunk road network (access road from NH-5) and railway connectivity have already been developed by KPCL. As the proposed node is near the port, it will also enjoy significant benefit from the port for industrial purposes.

Locational Advantages

KPT IN offers location advantage predominantly due to its proximity to rapidly expanding Krishnapatnam port

Krishnapatnam Industrial Node is Greenfield development where Krishnapatnam Infra-tech Private Limited (KPIL) had earlier planned development of Krishnapatnam SEZ. The access from NH-5 is currently a 4-lane road; however Krishnapatnam Port Company Ltd (KPCL) is planning to widen this to 6-lanes to satisfy future road demand.

Additionally, Naidupeta SEZ and Sri City are also located along NH-5. These areas, along with the proposed node and the cluster of developments around the urban core of Nellore city are expected to contribute to the further development of the south of Nellore District.

Table 1.1: Overview of the Krishnapatnam Area

Particular	Description
District/ State	• Nellore district/ Andhra Pradesh state
Distance from Metropolitan/major city	• 170 km from Chennai city centre along NH-5 and the access road to Krishnapatnam port • 40 km from Nellore city
Accessibility to trunk road network	• 20 km from NH-5, however no direct access from the national highway (only via Krishnapatnam Port)
Accessibility to railway network	• Railway access connects Krishnapatnam port to the mainline; however no railway access to the node area so far
Accessibility to major transport facilities (port, airport)	• 10 km from Krishnapatnam port • 90 km from Tirupati airport
Major industrial locations in the surrounding area	• 80 km from the proposed SEZ at Naidupeta on NH-5 • 130 km from Sri City on NH-5

Source: JICA Study Team

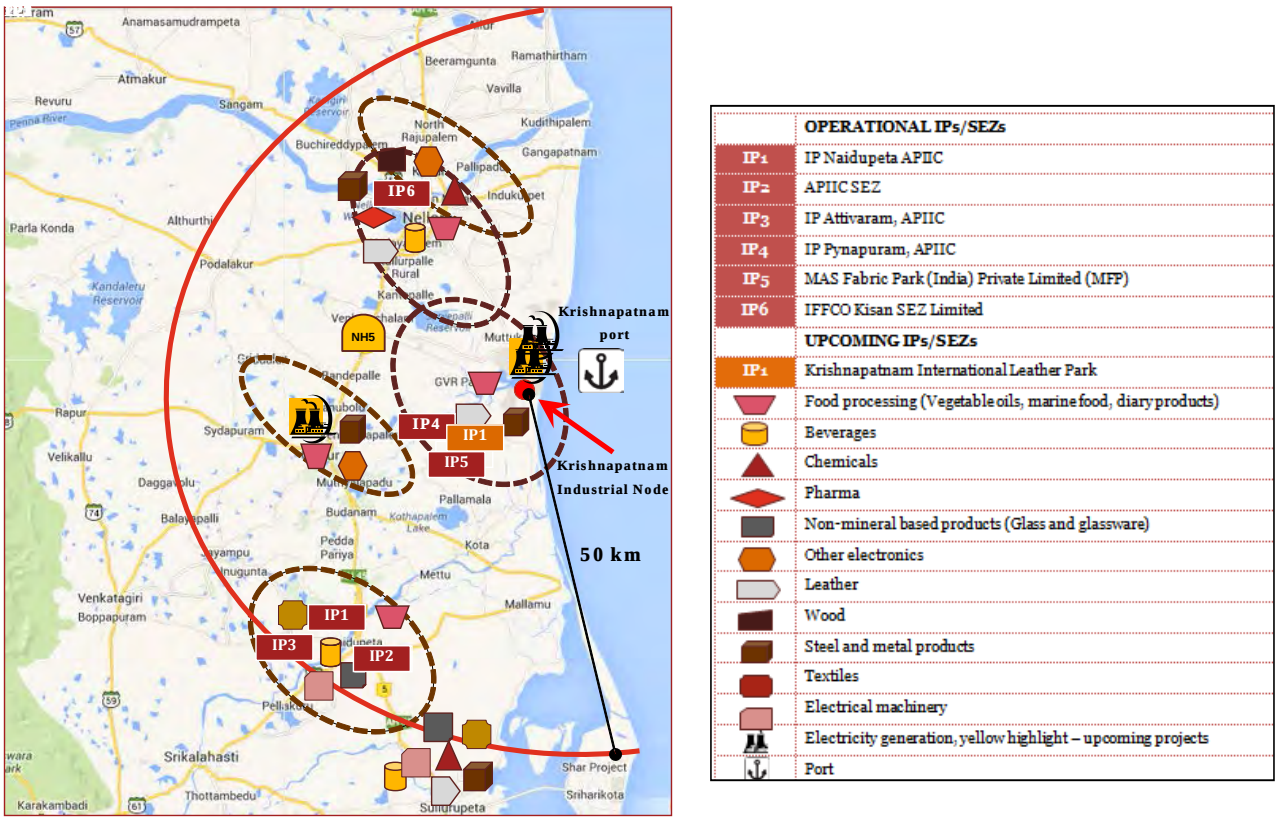


Figure 1.3: Industrial hubs in proximity to the Krishnapatnam Industrial Node

Source: MSME profiles of districts, CAPEX database, PwC analysis

Opportunity exists for transition of Krishnapatnam IN from low urbanization, primary sector and low value added non-engineering manufacturing to a hub of resource driven industries supporting exports and imports activities in the area.

Analysis of social profile of Nellore district reveals that it is lower than state and national average on urbanization levels. Majority of population in Nellore district is engaged in agricultural sector.

Nellore's economic analysis reveals that tertiary (53%) and primary (27%) sectors lead the economy of the district. Secondary sector contributes 20% to the district's GDP. However, it is driven by construction sector and manufacturing sector has small role to play with **only 6% contribution to GDDP by 2010-11**. Among major economic segments its growth rate was also one of the lowest, which influenced performance of Nellore district compared to growth of AP state and India as a whole.

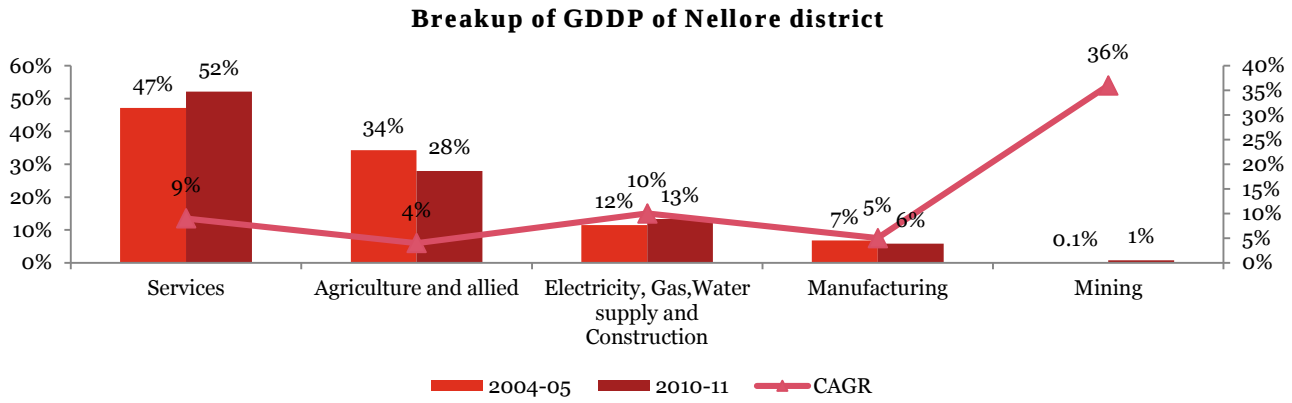
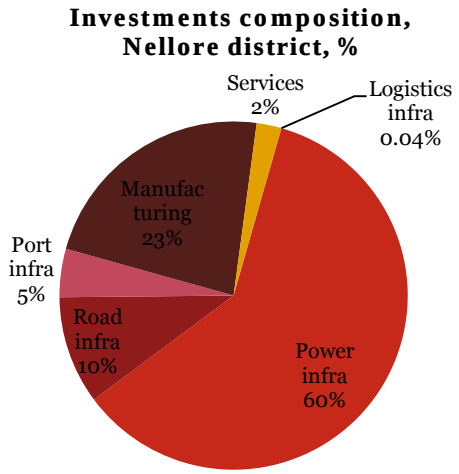


Figure 1.4: Major components of GDDP of Nellore district

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

Majority of employees are engaged in low value adding non-engineering sectors: 82% of employment in registered sector in Nellore district is concentrated in 3 sectors: leather (35%), food processing (31%), basic metals (16%). These sectors are characterized by low value addition in their final output. Number of employees engaged in in engineering sectors is very low.



Source: CAPEX database

Figure 1.5: Investment composition, Nellore district, %

However, analysis of the investments trends over the past decade suggests that Nellore district has accelerated infrastructure development to set the ground for manufacturing investments growth. Share of cumulative investments in Nellore district has grown from 10% in 2003-08 to 16% in 2009-15 in total investments in Nellore and districts in proximity.[1]

Infrastructure sectors have lion's share in total Nellore investments over the past 12 years – 75%.

Nellore district is coming up as the next manufacturing destination after neighboring locations get saturated.

[1] AP – Prakasam, Chittoor, Nellore, Y.S.R., Tamil Nadu – Chennai, Kancheepuram, Thiruvallur, Vellore

Many industrial parks exist in the district but saturated; existing industrial parks around the proposed node will offer supply chain advantages for certain industries

Total area of industrial parks in Nellore district is to the tune of ~ 15,000 acres, out of which only 15% is vacant. Proposed node is in close proximity to the existing industrial cluster naturally formed around Krishnapatnam port. In 50 km radius from the node there are several industrial clusters that have naturally formed the corridor along national highway NH5. Area around the port also hosts number of operational and upcoming power projects.

Major areas of industries concentration in 50 km radius from proposed node are Nellore, Gudur, Naidupeta and Sulurpeta. Food processing, metallurgy, chemicals, pharma and leather industries are located around Nellore city; Gudur predominantly hosts food processing and metallurgy units; Naidupeta is prominent industrial area with food processing, textiles, electrical machinery and some glassware units. Sulurpeta is another large industrial cluster which hosts textile, metallurgy, electrical machinery, chemicals, leather and non-mineral based industries. Area around Krishnapatnam port has several food processing units (edible oil refineries), metallurgy and leather units.

Vision for Krishnapatnam Industrial Node as an Industrial Hub for Resource-driven Industries

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 Krishnapatnam Industrial Node should have the following characteristics to build Node Competitiveness:

Industry Competitiveness

- Technological Advancement, Cost Competitiveness, Ease of doing business, Enhanced Connectivity, Logistics Services, Skilled Manpower

Infrastructure Quality

- Assurance on utility services (24 x 7), Mobility and Connectivity, Efficiency, Effectiveness and Sustainability of all infrastructure services

Sustainability

- Environmental Sustainability, Economic Sustainability, Waste management, Water Management and Recycling, Renewable Energy, Skill Development, Organic Growth

Quality of Life

- Responsive Governance, Civic Services, Affordable, Public Facilities, Parks & Recreation facilities, Leisure and Retail facilities

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

Quality of Life
Responsive
Governance,
Civic Services,
Affordable Housing
Public Facilities,
Parks & Recreation,
Leisure and Retail
facilities

Industry Competitiveness
Cost Competitiveness,
Ease of doing Business,
Enhanced connectivity,
Logistics services,
Skilled Manpower

Sustainability
Economic and Environmental Sustainability,
Waste management, Recycled water,
Renewable energy, Skill Development, Organic
Growth

Planned Growth Strategy

The industrial development at Krishnapatnam 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.

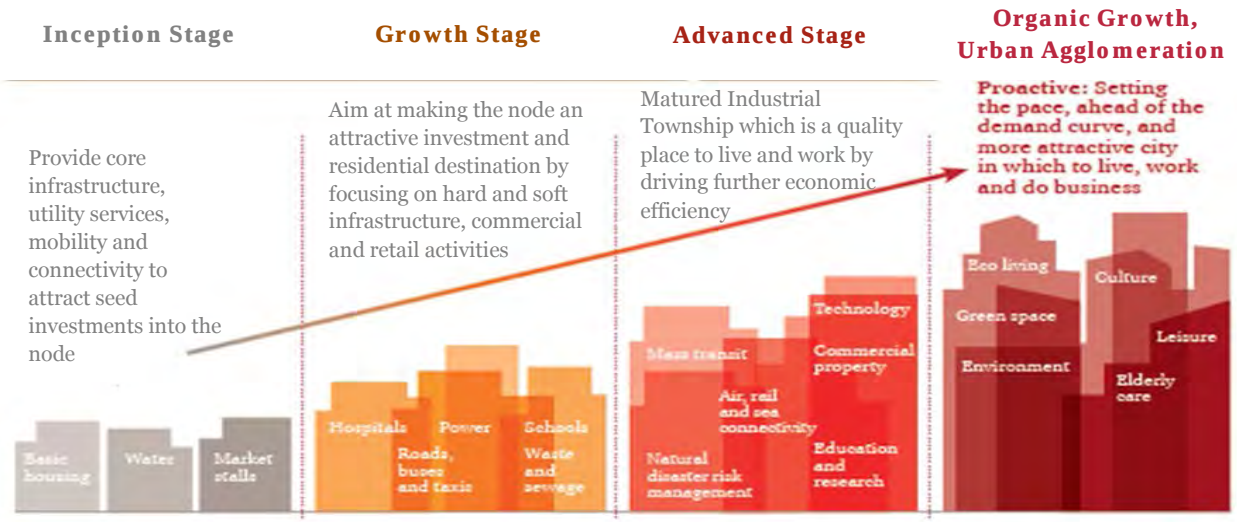
- **Second phase**, i.e. the ***Growth Stage***, after accumulation of set of core tenants, the node infrastructure should be enhanced by building soft infra such as healthcare, primary and secondary education, enhanced transport connectivity within a city and to surrounding areas. In addition, the

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 Krishnapatnam Industrial Node aims at a level of quality exceeding the above mentioned advanced industrial parks. The advantage of the Krishnapatnam Industrial Node is the hard and soft infrastructure which is supposed to be provided by the Government based on the CBIC Master Plan. Apart from that, the private participation in Krishnapatnam Industrial node will be expected not to bring equity (in the form of land) alone, but enhance the node attractiveness by involving its managerial expertise and capabilities to run the node after

it is set to operation. 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 port area is considerably high, the Krishnapatnam Industrial 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 Krishnapatnam Industrial Node.

Knowledge Park in the Node region

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

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

Industrial Development Vision

In-depth analysis has been carried out to select sectors viable for KPT IN and assess their market potential

Focus sectors for KPT IN were chosen based on industrial base and existing Factors of Productions (FoPs) coupled with stakeholder interactions and availability / requirement for FoPs pertaining to each of the CBIC focus sectors.

Based on above, 6 (six) sectors were identified as traditionally present in Nellore district. There are also several sectors that hold a very high potential for the CBIC region. In case of Nellore, the sectors mentioned below may be considered as **highly potential for KPT IN;** however, the availability of FoPs may not be favorable to accommodate all of them. Given the nature of the industries in the proximity to the node, FoPs available, Automobiles and Machinery sectors hold higher probability to gain prominence in the KPT IN.

Traditional sectors	*Potential sectors*
Food processing	*Automobiles*
Metallurgy	*Machinery*
Electrical equipment	*Electronics*
Chemicals and petrochemicals	*Medical equipment*
Textiles	
Pharma	

The theme for Industrial development in Krishnapatnam Industrial Node has been identified as a conscious migration from low value added non-engineering manufacturing to higher value added food processing segments and engineering sectors. While the Krishnapatnam IN will leverage upon existing traditional industries in the region and continue to attract investments in these sectors (food processing, metallurgy, electrical machinery), the idea is to slowly migrate to large scale investments with high output values.

This will require transition from low technology (food processing sub-sectors with low processing complexity, leather, textiles, etc.) to higher value added segments in food processing, engineering manufacturing (electrical machinery, automobiles).

Aligned to the above theme, for the sake of detailed industrial analysis in the subsequent sections, the consultant has 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.

Food processing | **Metallurgy** | **Electrical machinery**

Food processing sector

Drivers for growth	Issues and Challenges
•**National Level** •Increasing disposable incomes, rapid urbanisation and changing eating habits •Policy drivers •Availability of resources •Emergence of India as procurement hub •**KPT IN related** •High input base of raw material •Well established food processing sector in the district •Government support •Favorable location for exports	•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

Key recommendations for the development of the sector in Krishnapatnam Industrial Node are summarized below:

Components	Issues	Design Implication
Economic enhancers		
Connectivity	• Lack of last mile connectivity • Access road from Krishnapatnam port to Node area is an unpaved single lane road • Connectivity to the node from the highway is a single lane road	• Access road to Krishnapatnam and connectivity to NH-5 has to be improved. Widening activity is proposed • Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • A grid type road network to be followed • Three north-south trunk roads and east-west trunk roads each are planned
Water	• Water shortages in the Nellore district are persistent especially due to monsoon failures • Availability of water to the production (units located in government industrial parks are facing this issue)	• Creation of water management facilities • Maintenance of creeks/water sources, creation of canals, etc. • Quality water supply assurance by the node development and management authorities is required. The following arrangement has been proposed for the node: o Allocation of 1 TMC of water from Kandaleru

Components	Issues	Design Implication
	• Salinity of ground water due to proximity to the seaside • *Marine food specific:* – High tide affects water quality & salinity severely affects the growth of shrimps – Ineffective maintenance of canals doesn't allow water from the sea to come inside and mix with fresh river waters	Reservoir for immediate industrial needs by GoAP o Proposed to supply 0.5 TMC out of this 1 TMC water to the Krishnapatnam node through the newly-developed distinct pipeline. If this proposal is approved, 39 MLD (0.5 TMC/year) by Krishnapatnam Water Supply Company (KPWSC) • Treated sewage from the STPs can be a reliable potential water resource for industrial water in Krishnapatnam Node • A desalination plant has been identified by the food processing units as one of the utmost requirements for the area. • Drainage system may require a pumping system because the node area is wide flat land
Environment	• Development of port, other industries disrupts production • Lack of drainage for common water for the industries	• Careful planning of new industries is required as the segment is highly sensitive to water contamination • Introduction of green principles in manufacturing is to be promoted • Common effluent treatment plant can be developed by the government for similar industries within the district
Power	• For certain segments of food processing sector power cost is around 10-20% variable cost • Stakeholders are of the opinion that power tariffs are high in the region	• In medium term, power tariff subsidies for food processing industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries is required.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• Introduction of logistics hub in the node
Storage facilities	• Manufacturing capacities of processing units have increased, but storage facilities are inadequate	• Government can develop cold storage facilities in close vicinity of the markets and end consumers • To encourage investment in cold chain infrastructure, government may consider providing incentive 5 years for construction of modern automated warehouses and cold chains.
Value enhancers		
R&D facilities	• International practice suggests availability of R&D facilities for new product development within industrial park • *Marine related:* The initial component of the value chain is imported; R&D facilities for breeding SFP breeders are not available	• R&D laboratories can be proposed to serve the product development requirement of this industrial node as well as other food processing units within CBIC/country • *Marine food related:* Though almost the entire value chain is present in the country, it would be beneficial to develop indigenous capabilities for breeding SPF species
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	• 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

Components	Issues	Design Implication
	food products • Processing of the raw food articles can help improve the overall value of the product but this will require skilled labour	• Training centre can be proposed to be setup for training existing employees
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.	• Government of Andhra Pradesh may consider additional financial scheme to encourage procurement of upgraded machinery • Development of research center/center of excellence for value addition in food processing sector can be proposed in KPT IN. The center can explore tie ups with various organizations and research institutions abroad to emerge as a hub for new product development. It will help catering to the requirement of new products development higher on value addition • **New Product Development Center** Development of research center for value addition in food processing sector can be proposed in KPT IN. The center can explore tie ups with various organizations and research institutions abroad to emerge as a hub for new product development. It will help catering to the requirement of new products development higher on value addition
Administrative enhancers		
Ease of doing business	• 65 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	• Simplification of licensing system and reduction of the number of licenses is necessary. • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all industries required by any industrial unit.
Policy and regulatory framework	• Existing policies to facilitate food processing sector in Andhra Pradesh have expired this year • Power related: no adequate mechanisms for the companies buying power from open access	• Provide policy extension/introduce new policies/schemes for the sector • In case of power holiday for entire day, companies that should be given incentives to trade power for the whole day and get compensated. mechanisms for companies which buy power from open access should be established
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.	• GoAP 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

Metallurgy sector

Drivers for growth	Issues and Challenges
• **National Level** • Increased consumption intensity • Increase in demand for exports (demand for finished products is growing faster than any other segment along the value chain) • **KPT IN related** • High input base of raw material • Well established Metallurgy sector in the district • Proximity to port – favorable location for exports	• Poor supply • COnnectivity • High cost of capital • Low level of value addition

Key recommendations for the development of the sector in Krishnapatnam Industrial Node are summarized below:

Components	Issues	Design Implication
Economic enhancers		
Power	• Stakeholders are of the opinion that power tariffs are high in the region	• In medium term, power tariff subsidies for metallurgy industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries.

Components		Issues	Design Implication
Connectivity	**Road**	• Connectivity to domestic bauxite and alumina sources to be enhanced • Access road from Krishnapatnam port to Node area is an unpaved 1-lane road. It is limited to local residents and few heavy vehicles	• Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • A grid type road network will be followed • Three north-south trunk roads and east-west trunk roads each are planned • Access road to Krishnapatnam and connectivity to NH-5 has to be improved • Further allocation of Bauxite mines to companies setting up alumina and aluminum industries in Nellore region
	Railway	• There is no rail connectivity to the node at present • Nearest rail head is Venkatachalam located 25 (approx.) km away from the node	• Rail access to the Node area is proposed i.e., o 13.7 km spur line from the port access line, with the expectation to have considerable spare capacity o 55.7 km link from the port access line that would pass through the node (and the logistics hub itself) continue further south to connect Chennai – Nellore main line at Naidupeta
Value enhancers			
Development of new sub-sectors of metallurgy in the node		• Large food-processing and textile industries in the corridor may give rise to packaging requirements in aluminium in Nellore district and KPT IN in particular.	• Further allocation of Bauxite mines to companies setting up alumina and aluminum industries in Nellore region • In aluminum subsector, Nellore district is closest to bauxite sources. KPT IN also will have access to Krishnapatnam port. Further leases to Bauxite mining may be allocated to only those companies who intend to set up alumina and primary aluminum production units in the corridor.
Palletization		• There are limited reserves of high-grade Iron-ore lumps in the region. However, iron-ore fines are available and are currently exported in high quantities due to non-availability of pellet units to treat and use fines.	• Palletization can help to an extent in better usage of iron-ores fines and can also help ramp up export revenue by moving up the value chain.

Components	Issues	Design Implication
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • Government led initiatives inform of Knowledge Transfer Partnership, where students get more industry exposure, can play a key role in creating the right institute-industry linkages **Center of excellence** Creation of the **center** can be proposed in KPT node to enable the technology linkages, create industry-academia connect in the metallurgy sector, attract leading international research institutions to open research labs in the node. The center can cater to the requirement of the entire CBIC region and beyond and facilitate technology upgradation in metallurgy sector. Apart from the above, the center can also include: • One of the major issues of the sector is low productivity. One of the wings of the center can become a **training facility** for retraining and redevelopment of the labor force • **Quality testing laboratory** can become another element of the partnership center to work upon improvement of inferior quality of goods persistent in the sector at the moment.
Administrative enhancers		
Policy	• Policy level support is lacking to the metallurgy sector in India and Andhra Pradesh in particular • The sector is guided by the national level policies, where the draft National Steel Policy 2012 is yet to come out in concrete form • Andhra Pradesh does not have any specific policy dedicated to the metallurgy sector	• A dedicated committee may be appointed comprising members from all stakeholder agencies • Government of AP should propose a dedicated policy for the sector, which may increase the attractiveness of the sector along in the state as well as in the CBIC districts – Nellore, in particular

Electrical machinery sector

Drivers for growth	Issues and Challenges
•**National Level** •Growing power sector •Accelerated infrastructure expansion and growing urbanization •Growing telecom Industry •Farm mechanization •Increasing FDI •Nuclear capacity addition •**KPT IN related** •Availability of MSME base (Engineering) •Locational advantage – proximity to port	•Import oriented trade •Availability of raw materials •Infrastructural constraints (transporation of ODCs over NHAI bridges) •Uninterrupted power supply •Availability of indigenous testing facilities

Key recommendations for the development of the sector in Krishnapatnam Industrial Node are summarized below:

Components		Issues	Design Implication
Economic enhancers			
Connectivity	**Rail**	• Nearest rail head is Venkatachalam located 25 (approx.) km away from the node • There is no rail connectivity to the node at present • Rail connectivity is necessary to transport over dimensional consignments (ODC) and avoid problems in transporting heavy and ODC >98 MT on NHAI bridges. • Availability of rail sidings as a last mile connectivity to the main rail network is also essential	• Creation of rail network connectivity as necessary requirement to transport ODC cargoes • Rail access to the Node area is proposed i.e., – 13.7 km spur line from the port access line, with the expectation to have considerable spare capacity – 55.7 km link from the port access line that would pass through the node (and the logistics hub itself) continue further south to connect Chennai – Nellore main line at Naidupeta
	Road	• Availability of port infrastructure is essential FoP for the electrical machinery units • The segments dependent on electrical steel require proximity to ports as their raw material is imported	• Ensure seamless connectivity to port • Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • Access road to Krishnapatnam and connectivity to NH-5 has to be improved • It is also important to promote the vision of the GoI to boost country's share in electrical machinery exports

Components	Issues	Design Implication
Power supply	• Electricity rates are a point of concern of various stakeholders	• In medium term, power tariff subsidies for engineering industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries.
Value enhancers		
Availability of indigenous testing facilities	• Inadequate electrical equipment testing facilities in the country • Local players do not have enough capital to set up testing facilities as the investment required is huge.	• Facilitate setting up of indigenous testing and calibrating facility for equipment testing in the node, which can become a testing facility center for the state as well as neighboring states
Availability of Critical Raw Materials	• Constrained availability of certain critical raw materials such as Cold Rolled Grain Oriented (CRGO)/ Cold Rolled Non-Grain Oriented (CRNGO) Steel, Amorphous Steel etc. and volatility	• In the long run government should promote and ensure setting up units manufacturing CRGO and CRNGO electrical steel in the country to remove dependency on raw material imports
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • Government led initiatives inform of Knowledge Transfer Partnership, where students get more industry exposure, can play a key role in creating the right institute-industry linkages
Administrative enhancers		
BIS certification guidelines	• Electrical industry is largely dependent on imported electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported from very few suppliers worldwide (only 14 mills are operating worldwide). Out of 14 only 3 mills are BIS certified; currently it is mandatory to obtain BIS certification for all the suppliers.	• Any delay in the registration of foreign suppliers with BIS leads to supply constraints to domestic industry • BIS certifications guidelines to be modified to avoid delays in registration of foreign suppliers

Components	Issues	Design Implication
Technology upgradation and modernization	• Current level of technology adopted in the sector is not up to the world standards leading to low productivity and high process time • The sector is known for large number of MSMEs involved as vendor base for large units • Access to technology is limited for MSMEs and sighted as one of the constraints by sector stakeholders in Nellore district	• Under existing STI Policy 2013 assistance to MSMEs in installing modern machinery should be extended – funding solutions to MSME units at competitive rates encourage technology upgradation and modernization • Modifications to the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery manufacturers are to be introduced

Other Industries

Glass, ceramics and building materials-Nellore district hosts sizable base of ceramic, glass and leather units. Mineral based and building material industries in MSME structure of Nellore district secure the second position (more than 15%) after food and agro based industries in terms of employment and the third position (~ 13%) in terms of investments.
Glass sector has substantial potential for the node as it is one of the support industries for anticipated automobile sector. Building materials and ceramics hold equal potential due to upcoming construction activities both for industrial and residential units. Proximity to port provides opportunities for export oriented units in this sector to explore potential destinations overseas.

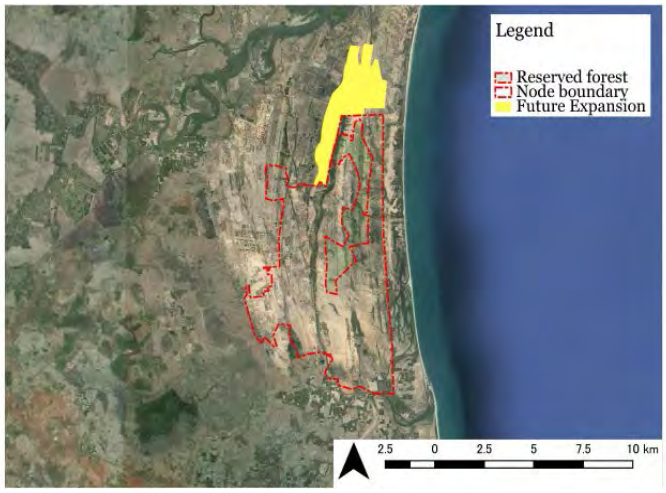
Leather sector is one of the prominent sectors in the manufacturing structure of Nellore district. As per ASI, it contributes 6% of total manufacturing output of the district and employs the largest number of people (2010-11).

Krishnapatnam International leather complex is coming up in Nellore district with unique solution for waste management. It is planned to be located a kilometer away from the Bay of Bengal into which the treated effluents can be disposed. Private contractors are being encouraged to build, own and operate an effluent treatment plant. Water source is planned from desalination plant budgeted in Rs.313 crore. The project received environmental clearance and the amount of Rs. 125 crore is expected from DIPP shortly along with Rs. 50 core from GoAP. The location of the complex in immediate proximity/within the KPT node will create potential for leather units to become a part of the proposed facility.

Land Use Plan

Delineation of the Node

In addition to the area covered by Phase 1 and Phase 2 of the former proposed Krishnapatnam SEZ, additional 1,567 Acre of land have additionally been identified as a part of the node in Krishnapatnam. As a result, an area of 5,654 ha (13,971 acres) was finalized for the node. There are some other land parcels to be acquired by APIIC in the surrounding area. However, the most of them are not suitable for development as part of the node since they are smaller and non-contiguous with the node area. But APIIC land parcel (1,332 Acre) in the north shown as yellow color in the figure below is identified as future expansion area for the Krishnapatnam Node.



Source: JICA Study Team

Figure 1.6: Node Boundary of Krishnapatnam

Table 1.2: Breakdown of Node Area

	Area	
	(Acre)	(ha)
Phase-1	5,501	2,226
Phase-2	8,470	3,428
Total	***13,971***	***5,654***

Source: APIIC, JICA Study Team

Current Land Use

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

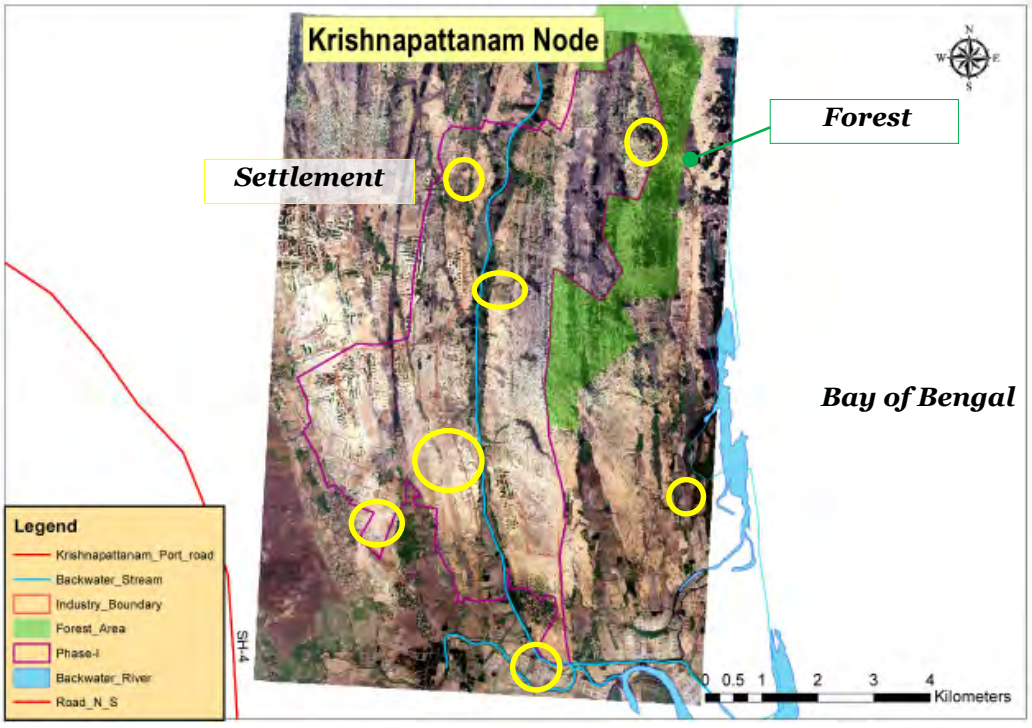


Figure 1.7: Distribution of Settlements in Krishnapatnam Node

Source: JICA Study Team

- Most of the land within the Krishnapatnam node area is vacant. However, a few settlements are scattered inside of the area (See yellow circles in above figure). The area of the existing settlements inside Node is roughly measured as 243 Acre on the satellite image. R&R plan is needed to be prepared during DPR stage.
- Reserved forest is spread in north part of the Node, and the area has to be protected from any developments. In addition, a small stream cuts across the site in a north-south direction. In view of the need for environmental conservation, this alignment should be unchanged.
- Since this area is located along the coastline, the topsoil is sandy.

Land Acquisition Status

For the areas covered by phase 1 of the Krishnapatnam SEZ, 90% of the land has already been acquired by APIIC and allocated to Krishnapatnam Port Infra-Tech Limited (KPIL). However the land acquisition for phase 2 is still in progress. In addition, 1332 acres of new land in the north (Thamminapatnam village) is planned to include as future expansion area through discussion with APIIC.

The land acquisition status of the Krishnapatnam Node as of June 2015 is summarised below:

Table 1.3: Land Acquisition Status of Krishnapatnam Node as of June 2015

Node		Area	Govt. Land	Pvt. Land	Acquisition Status	Remarks
Krishnapatnam Node	**Total**	**5,654 ha (13,971 Acre)**	**656 ha (1,620 Acre)**	**4,998 ha (12,350 Acre)**		
	Phase-1	2,226 ha (5,501 Acre)	312 ha (770 Acre)	1,914 ha (4,730 Acre)	Completed	312 ha are owned by APIIC and 1,914 ha has been handed over to KPIL.
	Phase 2	3,428 ha (8,470 Acre)	344 ha (850 Acre)	3,084 ha (7,620 Acre)	Under acquisition	The concessionaire or APIIC is in the process of land acquisition.
Node		**Area**	**Govt. Land**	**Pvt. Land**	**Acquisition Status**	**Remarks**
Krishnapatnam Node	**Total**	**5,654 ha (13,971 Acre)**	**656 ha (1,620 Acre)**	**4,998 ha (12,350 Acre)**		
	Phase-1	2,226 ha (5,501 Acre)	312 ha (770 Acre)	1,914 ha (4,730 Acre)	Completed	312 ha are owned by APIIC and 1,914 ha has been handed over to KPIL.
	Phase 2	3,428 ha (8,470 Acre)	344 ha (850 Acre)	3,084 ha (7,620 Acre)	Under acquisition	The concessionaire or APIIC is in the process of land acquisition.

Note: Figures in the table are approximate numbers. The field survey has to be done and confirm the exact figures for each land.

Source: JICA Study Team

Consideration of Linkage among Node and other Key Developments

Nellore city is the highest populated city near the node which has a potential to provide skilled and unskilled labours to industrial areas nearby. In addition to Krishnapatnam Node, Sri City and proposed Naidupeta SEZ located along NH-5 are expected to be developed as a core of urban development /industrial development, and therefore the cluster developments have to be linked together to enhance the future growth of this area. The concept of cluster developments in the Nellore area is illustrated below:

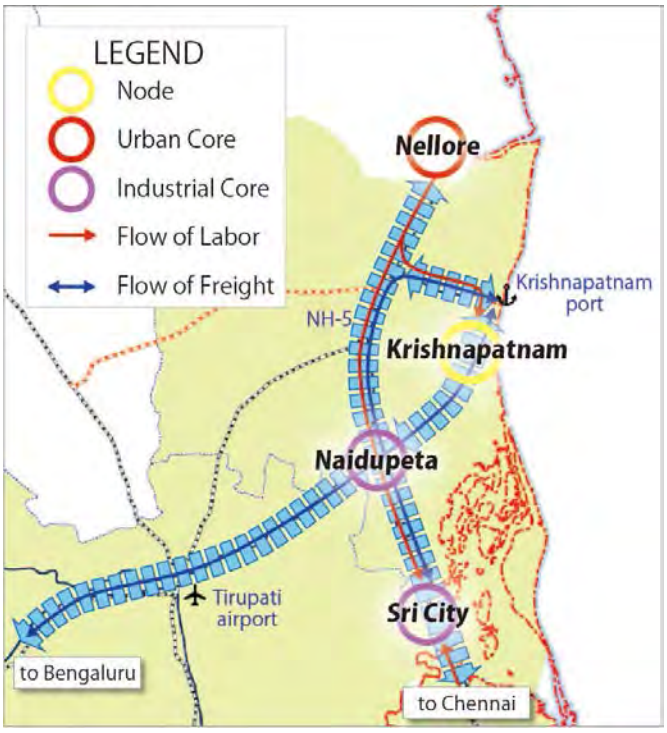


Figure 1.8: Enhancement of Connectivity among Surrounding Cores

Source: JICA Study Team

As shown in the above figure, the access road from Naidupet to Krishnapatnam node will be proposed from which will reduce the freight distance and time as well. This will also ensure good connectivity to Bengaluru.

Review of Existing Development Plan

The points for consideration and proposals for the transportation and land use sectors are summarised below:

Table 1.4: Items to be considered in the Existing Plan (Krishnapatnam)

Item should be considered	Proposal
Transportation	
• Access road from Krishnapatnam port to Node area is an unpaved 1-lane road.	• Access road to Krishnapatnam and connectivity to NH-5 has to be improved
• No public transport system is proposed	• A bus system is necessary to transport workers from the nearest railway station to individual factories
Land Use	
• Nellore city, which is expected to be the main source of labour, is 40km from the Node.	• Residential complexes for middle/low income workers should be built to ensure stable manpower within the node.

Source: JICA Study Team

Projected Industrial Land Demand

The target year for completion of the node's development is 2033. Taking into account appropriate development scales and after discussion with nodal agencies, JICA Study Team proposes to develop the node in three phases: Phase-1 (2014-2018), Phase-2 (2019-2023) and Phase-3 (2024-2033).

The estimated land demand of those industries used to achieve the growth scenario is shown in the following table:

Table 1.5: Estimation of Developable area for Krishnapatnam Industrial Node

(unit: acre)

Sectors		Phase-1 (2014-2018)	Phase-2 (2019-2023)	Phase-3 (2024-2033)
Traditionally Strong Sectors	Metallurgy	234	587	1,402
	Food Processing	424	1,063	2,540
	Textiles & Apparels	76	190	453
	Electrical Machinery	212	532	1,270
	Chemicals & Petrochemicals	83	207	494
	Pharma	12	29	69
	(Sub-total)	**1,040**	**2,606**	**6,228**
Potential Sectors	Medical Equipment	65	163	389
	Machinery	65	163	389
	Auto	65	163	389
	Computer, electronic and optical products	65	163	389
	(Sub-total)	**260**	**652**	**1,557**
Total		**1,300**	**3,258**	**7,785**

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. As a result, the working population will be 582,700 people with a residential population of 200,000 people in the Krishnapatnam Node in 2032.

Table 1.6: Population Framework

	Phase-1	Phase-2	Phase-3
Working Population	97,336	243,849	582,706
Residential Population	33,408	83,695	200,000

Source: JICA Study Team

Land Use and Phasing Plan

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

Table 1.7: Proposed Area by Land Use in Krishnapatnam Node

(Acre)

	Phase-1	Phase-2	Phase-3	Total
Industrial area	1,300	1,957	4,527	**7,785**
Residential area	284	428	987	**1,699**
Existing settlement	164	94	261	**519**
Infrastructure(road & plant)	770	643	1095	**2,508**
Water body, green area and others	91	570	799	**1,460**
Total	**2,609**	**3,692**	**7,669**	**13,971**

Source: JICA Study Team

Infrastructure Development Plan

Overview

The table below shows the infrastructure development plan for Krishnapatnam IN with the key features highlighted in the subsequent figure:

Table 1.8: Summary of Infrastructure Development Plan

Component	Key features
Site characteristics	10 KM south of Krishnapatnam port The eastern edge of Phase-3 is adjacent to the coastline. Hence, the area has low elevation and is sandy
Land use	Residential areas planned around existing settlements
Road	Access road to Krishnapatnam port Connectivity to NH-5 are proposed
Railway	New rail access line connecting port line to the node's logistics hub
Water supply	To be sourced from Kandarelu reservoir Recycled water from Nellore STP
Solid Waste Management	Regional waste treatment facility proposed
Power	No in-node generation High priority of dispatch from existing generation plant

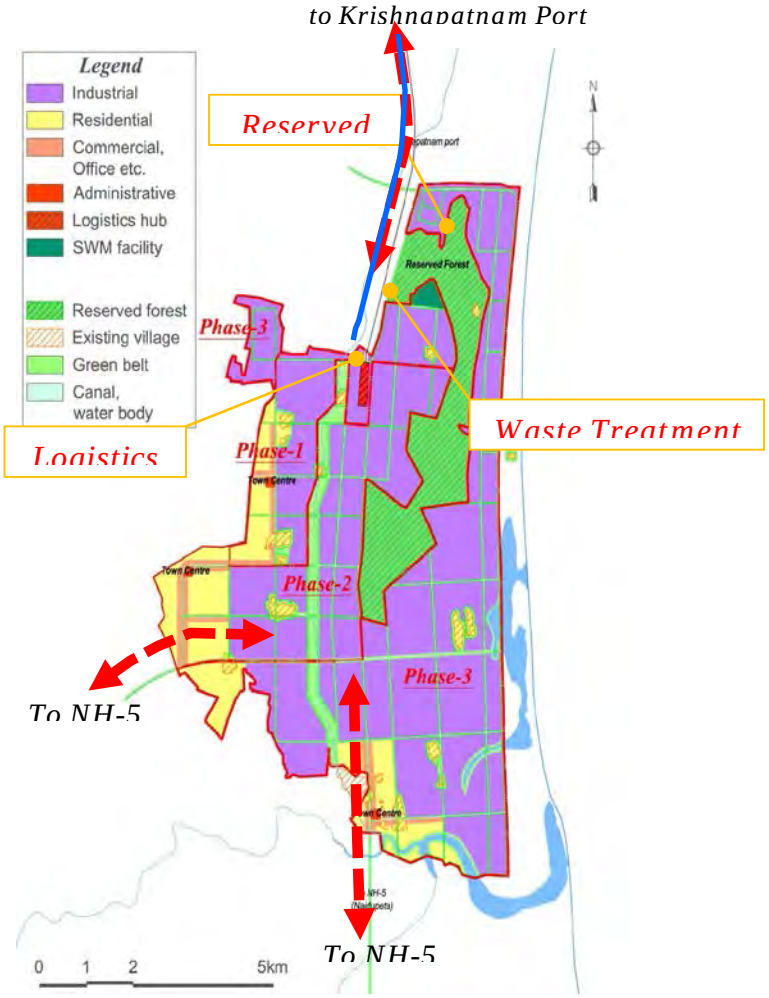


Figure 1.9: Infrastructure Development Plan for Krishnapatnam Industrial Node

Source: JICA Study Team

Road

Current Situation

Major industrial linkage to/from Krishnapatnam node will be developed with Bengaluru, Chennai, Vijayawada, Guntur, Nellore, Chennai Port, Ennore Port, and Sri City. Present lane numbers of corresponding roads to the linkages are four or six on linkages with Chennai, Vijayawada, Guntur, Sri City, Chennai Port, and Ennore Port. However, there are some sections which are given only two lanes on linkages with Bengaluru. There is almost no congested road sections on major industrial linkage to/from Krishnapatnam node based on volume capacity ratio at present condition.

External roads near Krishnapatnam node are NH5 and Krishnapatnam Port road. Krishnapatnam Port Road via NH5 is current main access road of Krishnapatnam node. Present road condition of NH5 and Krishnapatnam Port Road are fairy maintained. As for internal road, some road sections are being constructed with two lanes. Existing roads on undeveloped area are basically narrow and damaged.

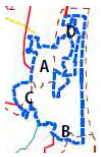
Krishnapatnam Port Company Limited proposed accesses from south (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km. Dimension of the development area is that north-south distance of about 11km and east-west distance of about 2-4km. Road Network pattern is grid type and three north-south trunk roads three east-west trunk roads are planned.

Demand Supply Analysis for External Node Infrastructures

Demand supply gaps of main access routes connecting to the four access points of Krishnapatnam node are estimated and introduction of LRT is proposed for access route of access point D because V/C is 1.91 in long term under 8 lanes road capacity without introduction of public transport and development of more than 8 lanes road is not realistic. Result of demand supply analysis for all access points are shown in Table 1.9.

Table 1.9: 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)		2	2	2	4	2	4	2	4	4	8	4	8
Demand Supply Gap (V/C)	Roads	0.35	0.58	0.36	0.38	0.88	0.55	0.89	0.90	0.90	0.97	0.92	0.91
	LRT												0.60



Source: JICA Study Team

Framework for Infrastructure Development for Node Development

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

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

Development Plan

Based on proposed internal and external node development plans and identified projects, implementation plan with preliminary cost estimate for internal and external node developments are proposed as shown in table below:

Table 1.10: Implementation Plan with Preliminary Cost Estimate for Internal and External Node Development Plans

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			5175	6945	3655										516	516	516			
	2) Secondary Roads				6203	2243				8590	5980							5428	5428	5428	5428
	3) Tertiary Roads				2600	4520		4238	4238	5398	4238						4310	4310	4310	4310	4310
2. Intersection Works	1) At-Grade Intersection (signalized)				569	320				220	220									453	453
	2) Grade-separated intersection			3257	3257	2517															
3. River Bridge Works	1) On Primary Road			2142	2142	2142															
	2) On Secondary Road			835	835	835	626	626	626	626							626	626	626	626	
	3) On Tertiary Road						1158	1158	1158	1158											
4. Flyover Bridge Works	1) On Primary Road																				
	2) On Secondary Road			212	212	212															
	3) On Tertiary Road																				
5. Road Facilities	1) Street Light				675	928			607	607	760										2525
	2) Traffic Light				810	810					880									905	905
	3) Central Traffic Light Control System				300																
	4) Utilies Box			7680	7680	7680															
6. Internal Public Transport Facilities Works	1) Bus Terminal					1300					2600										2600
	2) Bus stop			137	137	137				260	260							500			500
	3) Bus Depot					800					1600										1600
	4) LRT													15000	15000	15000	15000	15000	15000	15000	15000
Grand Total (Internal Node)				19437	32363	28098	1784	6021	6628	16858	16538			15000	15000	15516	20452	26380	25364	26721	33320
7. External Road Works	1) RA1			8548	9246	12513			1280	1280	1280								4768	7762	9418
8. External Public Transport Facilities Works	1) Railway																				
	2) LRT													36250	36250	36250	36250	36250	36250	36250	36250
9. Major River Bridge Works	1) Road Bridge			10965	10965	10965															
	2) LRT Bridge													900	900	900	900				
Grand Total (External Node)				19513	20211	23478			1280	1280	1280			37150	37150	37150	37150	36250	41018	44012	45668
Grand Total (Internal and External Node)				38950	52574	51576	1784	6021	7908	18138	17818			52150	52150	52666	57602	62630	66382	70733	78988

Source: JICA Study Team

Railway

Current Situation

The site is 9 km south of Krishnapatnam Port, which has an existing fully electrified double line with automatic signaling that connects to the Chennai – Nellore main line at Venkatachalam. There is also a full-fledged rail yard at the Port. As the Port is likely to serve as a gateway for EXIM traffic, all rail traffic generated at this node will be domestic traffic only.

Demand Forecast

The demand forecast for Krishnapatnam 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 Krishnapatnam.

Table 1.11: Krishnapatnam Node – Forecast Rail share of container and break bulk freight 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

Source: JICA Study Team

Development Plan

The logistics hub is proposed near the northern edge of the node and will be connected to the existing port line via a 15 km electrified line. Since hubs cannot be electrified for overhead traction (as it would obstruct loading), there will be receiving sidings outside each hub to allow for electric locomotives to run around and push trains into the hub. The proposed line therefore includes a main line of 13.5 km and 2 receiving sidings of 752 m each.

The line is expected to cost Rs. 79.5 Crores (USD 13.25 mn).

The Krishnapatnam logistics hub itself will cover an area of 151,375 square metres and will have 2 lines – one to receive steel and one to handle container traffic. It will also have a container freight station, warehouses, trailer parking and workshops as required. It will be developed in 2 phases at a total cost of Rs. 64.2 crores (USD 10.7 mn).

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

Table 1.12: Krishnapatnam Railway Access Line and Logistics Hub - Cost Summary

Cost Details (Rs. Crore)	Phase-1	Phase-2	Total
	2016 to 2026	2027 to 2037	
Railway Access Line and Wagons			
a) Capital Cost of Railway Access Line	79.52	-	79.52
b) Maintenance Cost of Railway Access Line	16.39	40.02	56.41
c) Capital Cost of Container Wagons	5.65	9.25	14.90
d) Maintenance Cost of Container Wagons	3.85	11.17	15.02
Logistics Hub			
e) Capital Cost of Logistics Hub	60.93	3.26	64.19
f) O & M Cost of Logistics Hub	33.08	53.36	86.44
Total	**199.42**	**117.06**	**316.48**

Source: JICA Study Team

Water

Current Situation

At the 50 km upstream of Penna River from Nellore City, there is Somasila Dam which is planned to be a stable water resource of Nellore City in the future. Also, there is Kandaleru Reservoir at about 50km west of Krishnapatnam Node, which can supply enough irrigational water and domestic water of Gudur City. Both Somasila Dam and Kandaleru Reservoir are stable water resources for the existing irrigation activity and domestic water supply schemes.

Even though the ground water classification status is “safe” for Chillakur & Kota taluks / mandals in Nellore district, where the Krishnapatnam Node is situated, it will be ideal to limit the ground water usage for the sustainable development of the node and the surrounding areas.

Framework for Infrastructure Development

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

- 24x7 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.
- Because of the very limited surface water resource and ground water resource around Krishnapatnam Node, water recycling of the treated wastewater from the Nellore City and the Node area will be introduced.
- 78 MLD of surface water from Kandaleru Reservoirs which is located at abut 50km west of Krishnapatnam Node will be allocated and utilized for domestic and industrial purpose.

Water Balance

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

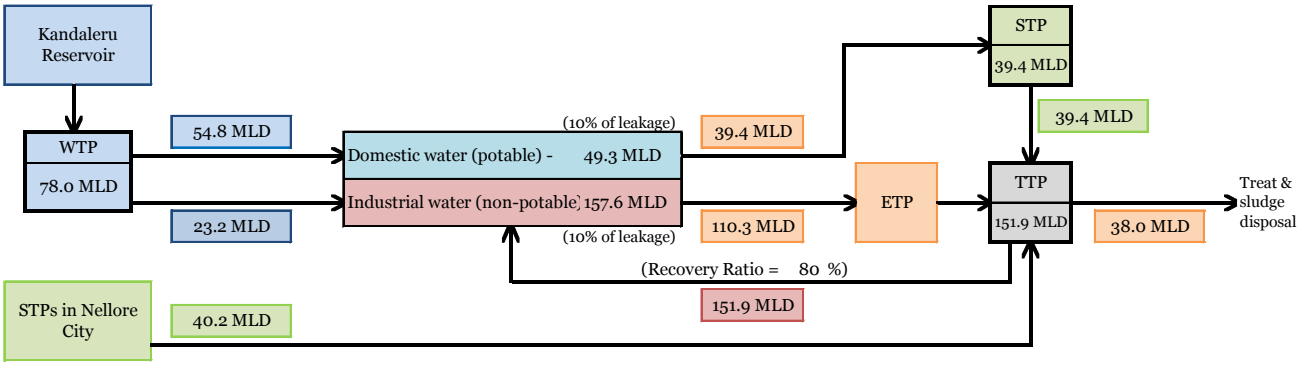


Figure 1.10: Water Balance for the Phase 3

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

Source: JICA Study Team

Development Plan

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

Table 1.13: 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	5,710	278	2,147	429	2,379	608
2	Non-potable water supply system	1,842	105	2,727	346	7,477	909
3	Sewerage system	347	14	594	41	804	80
4	Treated sewage & effluent colletion system	695	27	1,214	78	5,283	175
5	Stormwater drainage system	853	43	2,033	144	2,767	283
Total		**9,447**	**466**	**8,716**	**1,038**	**18,710**	**2,054**

** All figures are in million INR*

Source: JICA Study Team

Solid Waste Management

Current Situation

The only one regional TSDF (landfill and incinerator) in Andhra Pradesh is located at Pharma city, the linear distance of around 500 km away from Krishnapatnam Node, and it's located outside of CBIC area. The amount of hazardous waste for incineration in the Node is estimated so few that construction of a new incineration facility would be not effective.

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

<table>
<tr><th>Concept</th><th colspan="3">Building a sustainable sound material-cycle society</th></tr>
<tr><td>Development Policy</td><td colspan="3">1) Establishment of appropriate waste management
2) Reduction in the volume of waste that goes into final disposal through 3R promotion
3) Selection of an environmentally and economically sustainable treatment system
4) Coordination among the stakeholders
5) Capacity development for institutions relevant to waste management
6) Integration of solid waste management facilities</td></tr>
<tr><td rowspan="2">Development program</td><td colspan="2">Within the Node area</td><td>Include the outside of the Node</td></tr>
<tr><td>Hazardous waste management
(Private or PPP)</td><td>Municipal solid waste management
(including non-hazardous industrial waste)
(Developer)</td><td>Waste management
(state government)</td></tr>
<tr><td></td><td>■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</td><td>■Municipal solid waste management facility development program
- Development of a municipal solid waste management plan
- Development of a collection and transportation system
- Development of municipal solid waste treatment facility
■Capacity development program for appropriate waste management
- Strengthening capacity in operation of solid waste management
■Program on 3R Promotion
- Awareness rising on 3R activities
- Development and promotion of markets for reused and recycled products
- Promotion of cooperation with NGOs and recyclers
- Development of a focal point for awareness rising</td><td>■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 authorising 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 private companies, as well as for cooperation among the private businesses</td></tr>
</table>

Source: JICA study team

Solid waste management in the Node

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

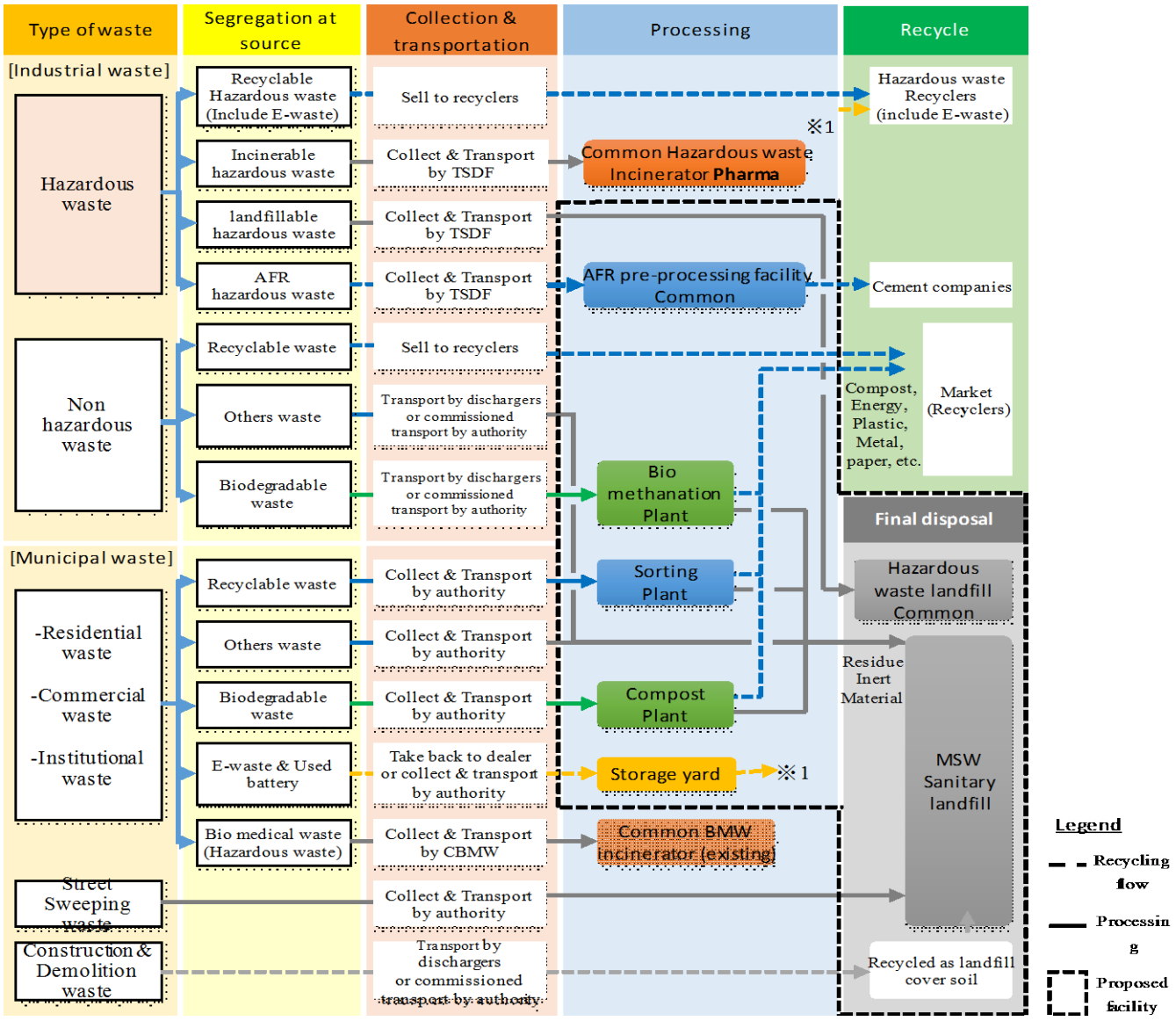


Figure 1.11: Solid waste management in the Nodefor the Phase 3

Source: JICA Study Team

Development Plan

The capital costs and O&M costs for the three phases are summarized in Table 1.15.

Table 1.15: 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 landfill	24	7	58	45	297	418
	2) AFR pre-processing facility	150	68	101	201	554	1,288
MSW infrastructure	1) Composting plant	9	3	20	16	83	124
	2) Biomethanation plant	42	19	62	83	143	394
	3) Sorting plant	3	2	8	15	30	108
	4) Sanitary landfill	6	1	28	14	169	172
	5) Stockyards for e-waste, etc.	8		8		8	
	6) Collection vehicle	21	12	26	45	88	236
	7) Garage & workshop	7		7		21	
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	129
■Program for development of common hazardous waste treatment facilities on the state level		1 year	54				
■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 the "Smart" approach for undertaking the actual design of the network.

Power Demand and Generation

The upcoming power demand expected in the node has been compared with existing power infrastructure availability on ground to assess gaps for meeting the objective. The consultant found that from the distribution and transmission perspective additional capacities would be needed on ground for meeting the upcoming demand. We see that for meeting the demand at varying scenarios the node needs close to 233 MW in phase II which increases to 540 MW in phase III.

When the consultant considered the available sources for meeting the gap, only two sub stations (Chendodu- 132kV, 2X150 MVA and the proposed Nidiguntapalem- 132 kV, 2X150 MVA) form a viable source of power transmission into the node. Chendodu has close to 60 MVA available for the node transmission. In case adequate generation is available, this S/S can provide enough supply for Phase I demand of the node. In the Phase II also, this can partially meet the demand. As per the plans of transmission utility, the second sub-station (Nidiguntapalem) will be available in the phase II for supply to the node. Post the availability of the second sub-station, the region would have enough transmission capacity for meeting the phase III demand as well.

Considering the load requirement at the node for ensuring robustness, two Main Receiving Sub Stations (MRSS – 132kV, 2X 150 MVA sub-station) has 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 and phase III. 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 34 sub stations of 16 MVA each have been planned for taking up the load by phase III. All these distribution sub-stations would be connected via 33 kV lines to MRSS sub station and would have 11kV feeders 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. We have also estimated the tentative tapping points as well as total land requirement for MRSS as well as distribution sub stations. Benchmarking of the design has also been undertaken with similar initiatives by private players for improving distribution network performance e.g. NDPL in Delhi, Torrent Power in Agra, Power grid in Vishakhapatnam etc. This is important for assessing the practicality of the design on ground.

Table 1.16: Substation requirement in the node area

Characteristics	2016-19	2020-24	2025-32
Total demand expectation for system design (MW)	59.33	163.36	351.56
System design for 80% loading condition in the node	74.16	204.20	439.45
System power factor	0.80	0.80	0.80
Total installed capacity (MVA)	92.70	255.24	549.31
Capacity of each distribution sub- station (MVA)	16	16	16
Additional distribution sub-station requirement (Nos.)	6	10	18

Procurement

From the generation perspective, in order to ensure robust availability of supply to consumers around 550 MW would be needed in the phase III 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 we have transmission availability and commercials of the arrangement make sense, power can easily be procured from outside the node at delivery points of transmission sub stations. The same has also been estimated for the node. Around 80% of the power would be procured from the Southern Grid via Chendodu and Nidiguntapalem sub-stations. 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 has been assessed to fall in a region in AP which is conducive to solar as well as wind energy. Hence, around 42 MW of solar and wind generation would be expected in phase II which will increase to 98 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 Rs. 1,31,594 lakh (with cost escalation) for the node all three 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.

Table 1.17: Additional Investment requirements (Rs. lakhs) [Inflation adjusted]

Characteristics	2016-19	2020-24	2025-32
Investment requirements	13,656	41,232	76,706

The node operational plan for the Node 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

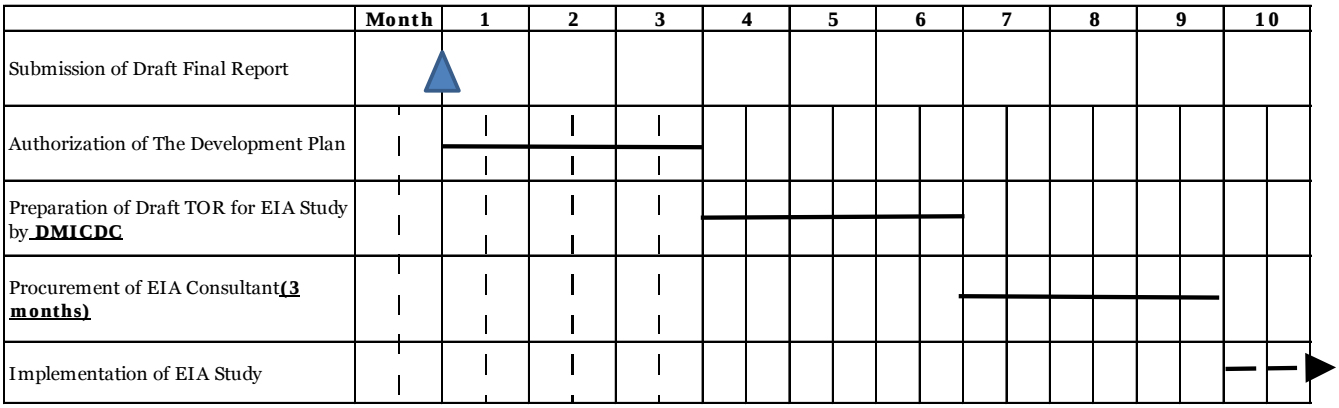
The development plans for the prioritized nodes have been preparing by the JICA Study Team (JST) in the Part B of the CBIC Study. According to the practices in DMIC, the Environmental Clearance (EC) for the development plans will have to be obtained from Ministry of Environment and Forests (MoEF), Govt.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

The 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 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 2,577 ha of land, out of 4,801 ha, 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. It is highly recommended to monitor the progress of land acquisition progress carefully.



Economic Cost Benefit Assessment

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 1.18: Direct 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

Direct Benefits

Direct potential employment generation by sector

Employment generated in proposed industrial nodes will comprise of direct and indirect employment opportunities. Direct employment refers to employment directly related to the production of products or services across sectors identified as focus sectors in each industrial node. By the end of phase 3, the total number of employment opportunities will be 233,082.

Table 1.19: Direct potential employment of Krishnapatnam Industrial Node

	Total direct employment
Traditionally strong sectors	***148,331***
Metallurgy	14,304
Food Processing	49,712
Textiles & Apparels	33,234
Electrical Machinery	37,888
Chemicals & Petrochemicals	11,830
Pharma	1,363
Potential sectors	***84,751***
Total	**233,082**

Source: JICA Study Team for CBIC

Industrial investment

Industrial land is expected to attract tenants from various sectors identified for Krishnapatnam Industrial Node as focus sectors. Total land for traditionally strong sectors with higher probability to get occupancy is **6,228** acres. Potential sectors are projected to occupy 1,557 acres of industrial land in Krishnapatnam IN. Together these tenants are expected to infuse Rs. 50,596 crore (USD 8,433 million) of investment in the by the end of projected period.

Table 1.20: Industrial Investment in Krishnapatnam Industrial Node

	Industrial Investment, Rs. crore
Traditionally strong sectors	***34,935***
Metallurgy	9,673
Food Processing	9,477
Textiles & Apparels	3,261
Electrical Machinery	7,746
Chemicals & Petrochemicals	4,447
Pharma	332
Potential sectors	15,661
Total	**50,596**

Source: PwC projections

Indirect benefits

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.

The total indirect employment generated due to the Krishnapatnam Industrial Node development is expected to be 1.5 times the direct job creation equal to **349,623 indirect jobs**. The number of jobs created within Krishnapatnam Industrial Node would be a portion of above indirect employment creation due to integrated nature of economies in the region.

Indirect benefits	Impact
Indirect potential employment generation	Indirect employment in industrial node is expected to amount to 349,623
Availability of quality industrial infrastructure	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	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	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

Summary of cost-benefit analysis for Krishnapatnam IN

Permanent benefits include potential gross value added from various manufacturing activities across sectors identified as highly potential for Krishnapatnam IN as well as some relevant services. Total permanent

employment adjusted to deadweight and displacement assumptions (net employment) till 2052 is anticipated to be 249,107 and total direct GVA contribution is expected to amount to USD 46,331 million.

Table 1.21: Permanent net employment to be generated in Krishnapatnam Industrial Node

Total permanent net employment	Nos
Direct permanent net employment	99,643
Indirect permanent net employment	149,464
Total permanent net employment	**249,107**

Table 1.22: Projected GVA benefits, Krishnapatnam Industrial Node

Total GVA	USD mn
Net additional direct GVA	1,981
Net additional indirect GVA	2,971
Total additional net GVA	**4,951**

Benefit-cost ratio

The industrial node is assumed as ongoing concern till 2052 for the purpose of NPV calculation. Total net present value of benefits is expected to be USD 1,206 million. The summary of costs and benefits is given in the table below.

Table 1.23: Summary of Net Present Costs and Benefits, Krishnapatnam Industrial Node

Summary of costs and benefits	
Total projected costs, USD mn	1,645
Total projected benefits GVA, USD mn	4,951
Total net benefits, USD mn	**3.3073,362**

Having calculated the net present value of projected costs and benefits till 2052, the project is estimated to have a benefit-cost ratio of 1.6 ignoring any optimism bias in the estimated costs and benefits.

Table 1.24: Benefits-Cost Ratio for Krishnapatnam Industrial Node Development

Full-term NPV	
NPV of projected costs USD mn	759
NPV of projected benefits USD mn	1,206
Benefit - Cost Ratio (BCR)	**1.6x**

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

Financial Planning and Assessment

The financial model has been built for the master SPV which will be responsible for undertaking the development of the Krishnapatnam 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 1.25: Financial model options

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

Table 1.26: Capital cost components

Item	Rs. crore	% share of TPC
Land acquisition cost	7648	41%
Land development	795	4%
Roads	2845	15%
Railway	112	1%
Water and Effluent Treatment Facilities	4760	25%
Solid Waste Management	288	2%
Power infrastructure cost	1316	7%
Contingency (7% of cost excl. land)	506	3%
Interest During Construction	484	3%
Total	**18753**	**100%**

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

Table 1.27: Phase wise capital cost components

Item	Phase I Upto FY 19	Phase II FY 20-24	Phase III FY 25 onwards
Land acquisition cost	7,648	0	0
Land development cost	90	165	540
Roads	886	669	1,290
Railway	80	5	27
Water and Effluent Treatment Facilities	837	843	3,080
Solid Waste Management	28	39	220
Power infrastructure cost	137	412	767

Contingency	103	107	296
Interest During Construction	138	143	203
Total	**9,946**	**2,383**	**6,423**

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 Krishnapatnam Industrial Node:

Table 1.28: Financing Structure

Financing component	Rs. crore	% contribution of TPC
Equity (Infusion into proposed SPV through land))	8404	45%
Debt (Land development & infrastructure cost)	8064	43%
Internal Accruals	2285	12%
Total	**18753**	

Scenario Analysis for Project Viability

Under the current financing structure, and cost and revenue assumptions, the project IRR stands at 7.5% and Equity IRR at 6.35%. Other scenarios of unbundling entities for independent operation have been assumed

1. **Land lease rentals:** Currently the ongoing lease rentals at Krishnapatnam have been assumed with a 10% y-o-y escalation. It is to be noted that the Master Developer can sell land only to the extent of total area under industrial and residential land- use. Other areas such as road, green space, water body etc are essentially non- saleable areas and form around 18% of total land area under proposed project.

2. **Land acquisition price** falls by 10% and 20%: The impact on Equity IRR was assessed for this scenario and presented in the chart below.

3. **Fall in land sale** price by 10% and 20%

4. **Fall in water tariffs** for both industrial and potable water by 10% and 20%. This scenario has been assumed as water tariffs are a sensitive issue.

5. **Land absorption** in KPT Industrial Node is extended to 5 more years (Till March 2038).

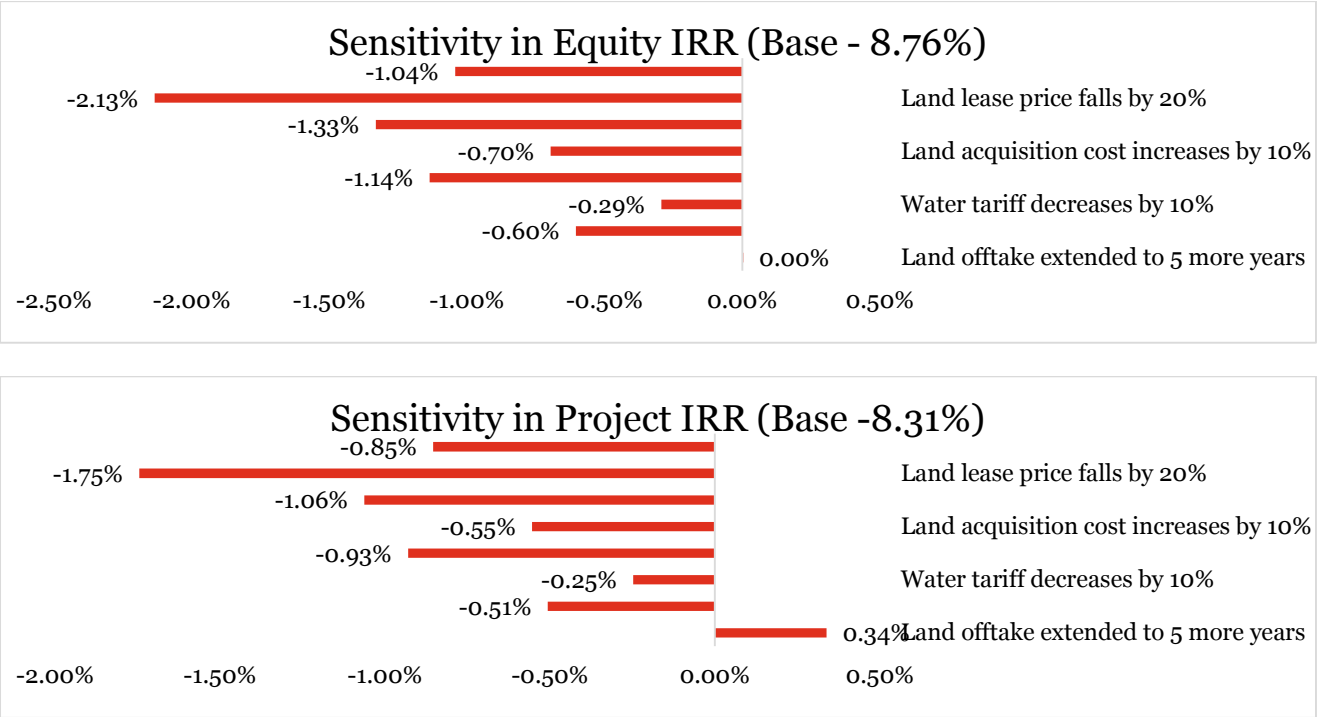


Figure 1.12: Sensitivity Analysis – Master SPV

The above sensitivity analysis has been performed for the scenario of the Master SPV managing the entire infrastructure without unbundling of SPV. From the above, it may be observed that the financial model is most sensitive to the EPC cost fluctuations, land acquisition price and the land sale price.

The scenario pertaining to unbundling of roads is not envisaged as there is no revenue model for the road utility. Hence, under all circumstances, it should be assumed that the road utility is to be vested with the master SPV.

The other sensitivity analysis has been performed by assuming unbundling of individual infrastructure services through separate SPV's from the Master SPV (assumed that each time sensitivity analysis is performed only one utility is unbundled and the others remain with the Master SPV).

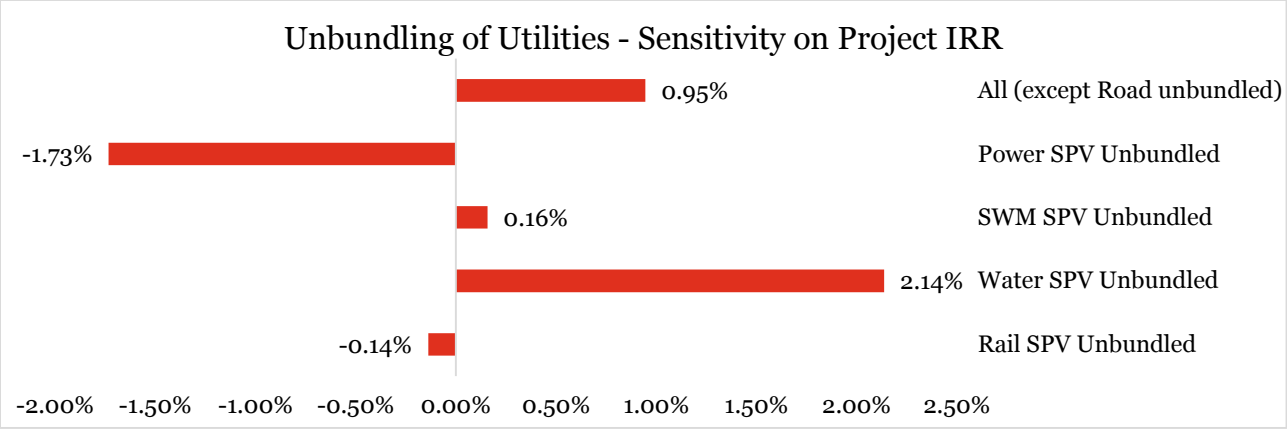


Figure 1.13: Sensitivity Analysis – unbundling of utilities

From the above, it may be observed that the unbundling of all utilities (except road) results in an increase in project IRR from 8.31% to 9.26%. The highest impact is in case of unbundling of water SPV or Power SPV, followed by rail SPV.

Unbundling infrastructure components may be possible given the fact that the demand build-up for individual utilities is sufficient in later years. Based on current projections, only SWM and power SPVs are analyzed to be viable as standalone SPVs. Other infra such as rail, road and water are not viable as standalone SPVs and fall

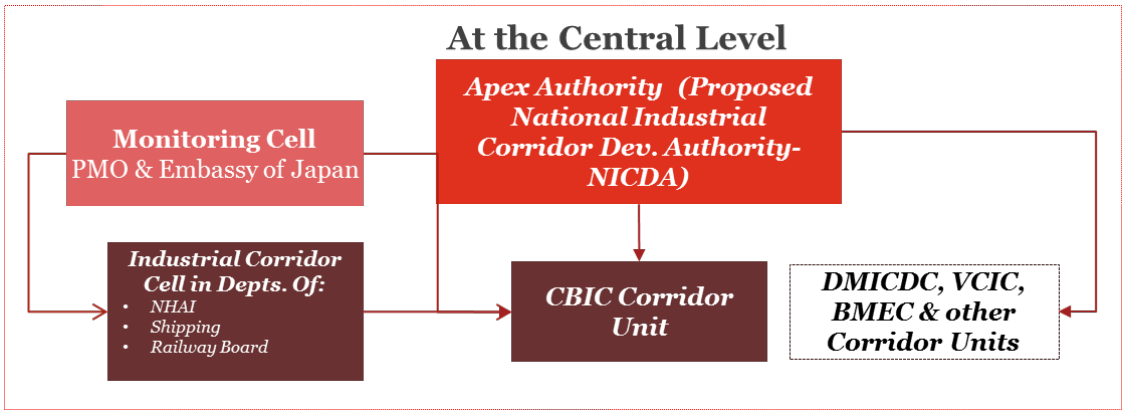
short of Equity IRR below market expectations (18%). Thus unbundling such components will require infusion of any additional government grant/ sub-ordinate loan etc (if applicable)

.*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 AP state government departments such as Dept. of Industries, Commerce & Export Promotion, Municipal Administration & Urban Development, the institutional framework for Krishnapatnam Node has been formulated.

Proposed Institutional structure for development of Krishnapatnam Node and CBIC in Andhra Pradesh

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



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

Figure 1.14: Central level institutional structure for CBIC in Andhra Pradesh

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.

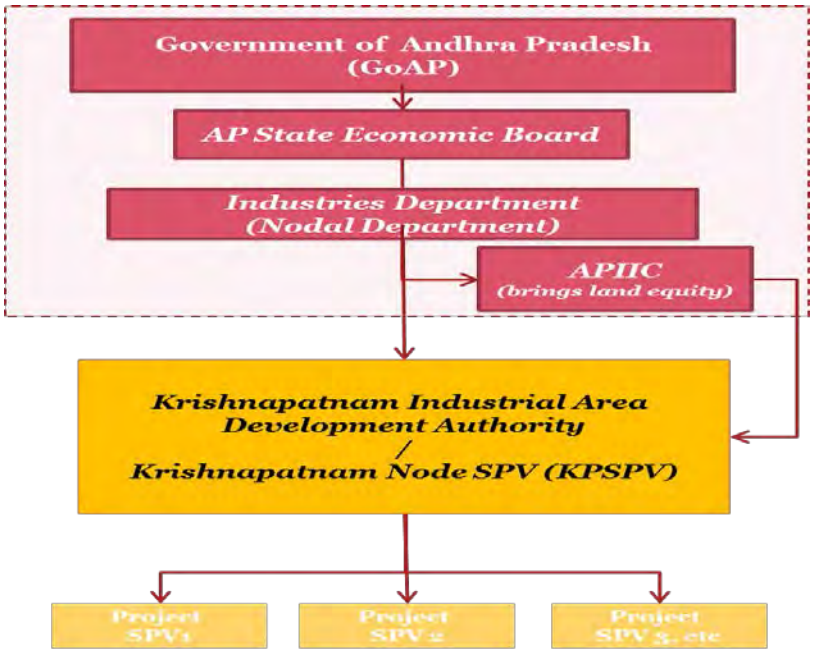


Figure 1.15: State level institutional structure for CBIC in Andhra Pradesh

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 Andhra Pradesh. First option is similar to current practice in DMIC and incorporates recommendations of NICDA.

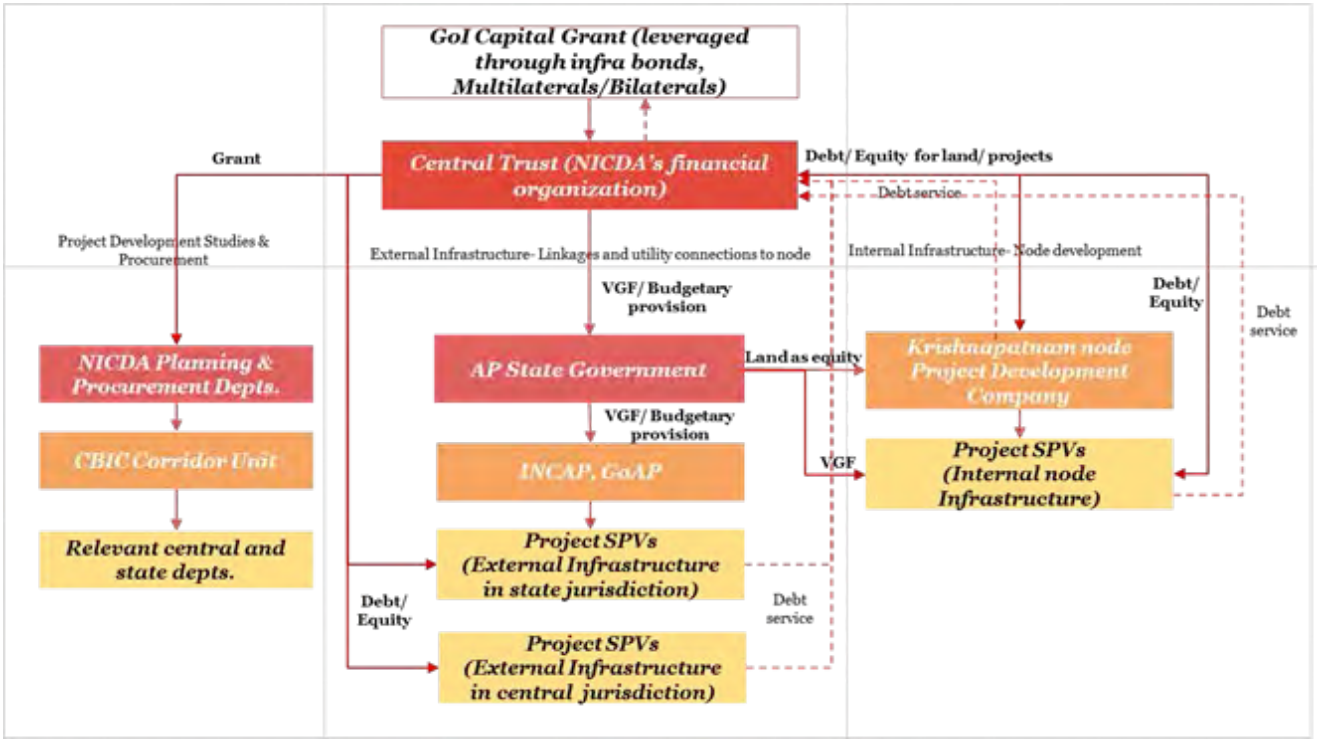


Figure 1.16: Option 1- Financing framework for CBIC in Andhra Pradesh

The second option incorporates alternate suggestions provided during stakeholder consultations with DMIC states and JICA. In the second option, it is proposed that JICA funding may be made available both at central level and state level. JICA can directly fund the state through creation of Andhra Pradesh state infrastructure trust fund or budget support allocation, such as a program loan.

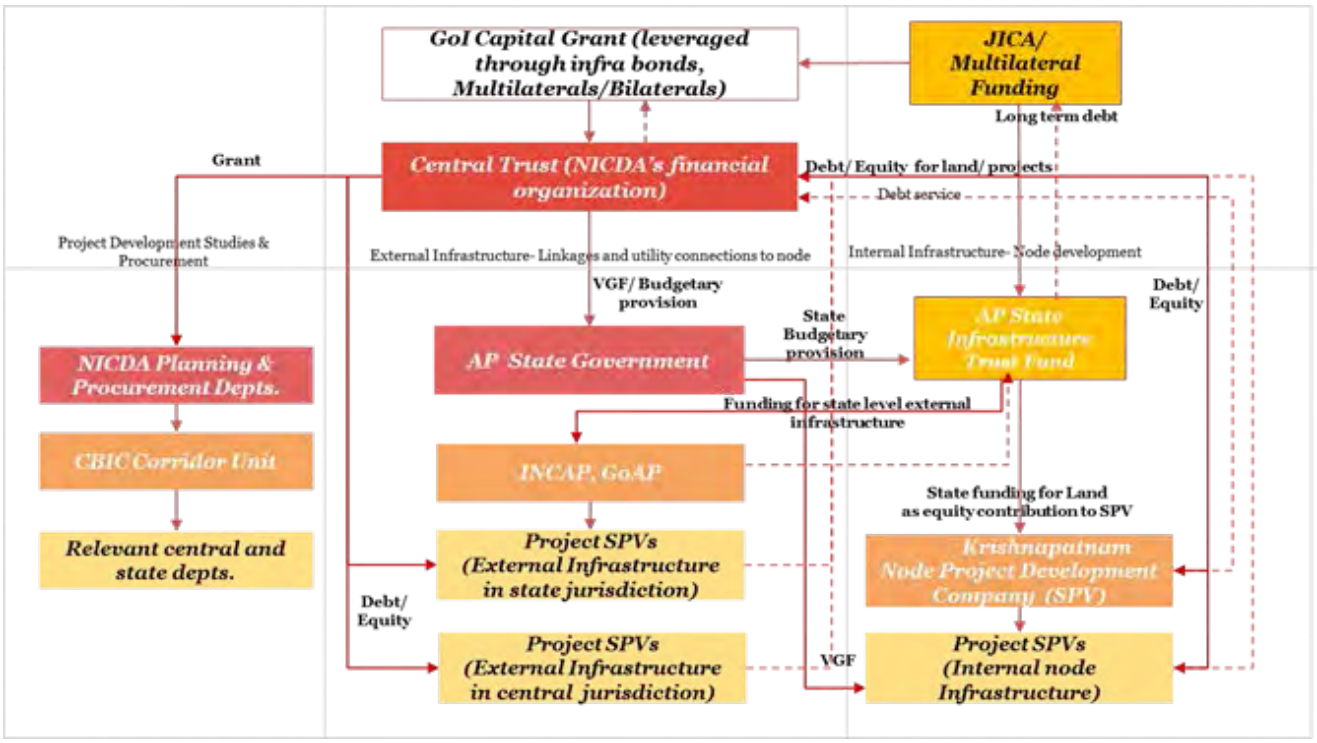


Figure 1.17: Option 2- Financing framework for CBIC in Andhra Pradesh

Investment Environment Improvement

Recommendation for Andhra Pradesh Government

Andhra Pradesh has enhanced the investment environment through various policies and ranked high among the India states. However, the states still need to take policy –related action to improve the environments, especially in order to enhance the power supply capacity which is still behind the other states.

Table 1.29: Recommendation for Andhra Pradesh

Perspectives	Detail of the Recommendations
Infrastructure	· Promote systems like installation of smart metering systems and smart grid systems · Spread power saving awareness and set measures to achieve the purpose · Ensure rolling out road improvement/new road construction projects in order to connect proposed nodes to the main highways and ensure seamless connectivity. This will help taking forward the nodes development at higher speed
Land Acquisition/Building approval	· Expand the information provided through the online system, such as the price, detailed description of the land, development status etc. · Enhance the usability of the online land information system by developing key factors, such as interface, functions, support process, software and tools · Promote the system to increase awareness across the states and boost the usage ratio · Establish submission manual for building plans to mitigate construction approval process
Skill Development	· Collaborate with private sector and higher educational institute to enhance the curriculum, especially to develop sector specific curriculum, which can be fully utilized right after the course completion to increase number of qualified workforce · Vocational training institutes in collaboration with private educational group and industry should be also proposed, since the majority of employment is expected to be skilled (engineering, management graduates) and also semi-skilled. · Collaboration between a private institution, government and industrial units should be in line with newly introduced Industrial Development Policy of AP 2015-20)
Business Process	· Further empower the authority of the mechanism to be more comprehensive and govern the process over the various department as one agency · Increase the functions of the transparent system to help investors monitor and track the application status online and assure single window mechanism until the approval and during the operational stage (not only at the application stage but also during the following up stage) · Develop skills to deal with IT and computer for implementation of the single window system
Industrial park/Cluster	· Establish detailed industrial park guideline on the key factors such as base infrastructure, environment standard, minimum level operation standard, and maintenance operation based on the private sectors' needs and strengthen its enforcement with empowered authority institutionally and financially with self- governance system. · Create an annual plan on the budget and for cluster's sustainable development · Collaborate with the private sector to develop higher level of infrastructure service that can meet the demand of the foreign companies · Provide customized fiscal incentives for primary industrial sectors · Fiscal incentives can be proposed for MSMEs, which are primarily in the engineering sector. This will help building the necessary vendor base in the node where major output is expected to come from engineering sector. Such sectors as electrical machinery, machinery, automobiles require presence of large vendor base in the immediate proximity. Hence, such incentives can be proposed.

Way forward

The following activities need to be undertaken by the Government of Andhra Pradesh (GoAP) for moving project towards implementation of Krishnapatnam Node.

Legal/Regulatory Framework

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

a) Declaration of Industrial Township of the proposed Krishnapatnam 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 GoAP

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

c) KPIL representation in node development SPV needs to be decided

d) Setting up a node development SPV

e) 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

f) Establishment of Program Management Unit within [APIIC 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 GoAP currently within Master Plan Area so as to avoid the higher acquisition price due to speculation

d) Identification and preparation of priority projects under State responsibility

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

•

2 Introduction

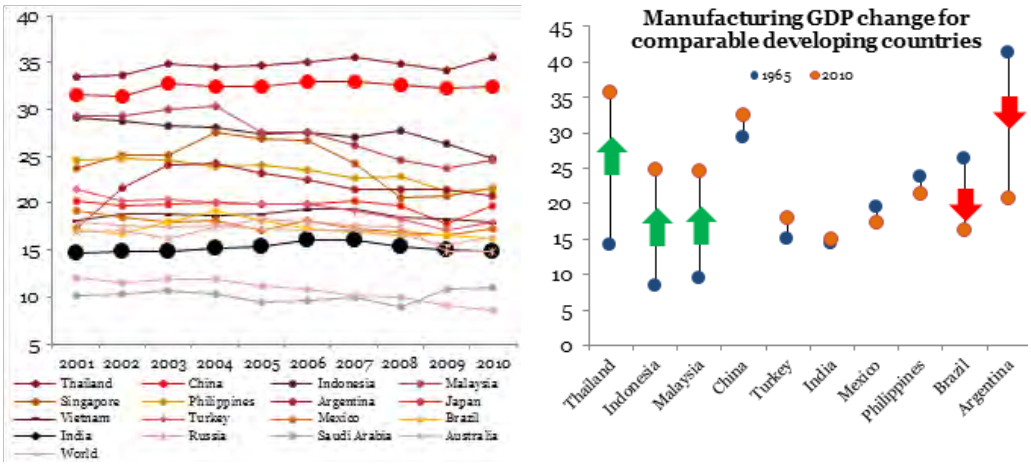
2.1 Context of Industrial Corridors for Sustainable Growth

The need to raise the global competitiveness of the Indian manufacturing sector is imperative for the country's long term-growth. Government of India (GoI) envisages manufacturing sector is key economic driver which contributes to its GDP growth and creation of additional employment opportunities. In the past 10 years, Indian manufacturing has grown at an average rate of 7.3%.

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 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:

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

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.

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 km, the CBIC covers an area of about **91,000 sq. km** (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. km, 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:

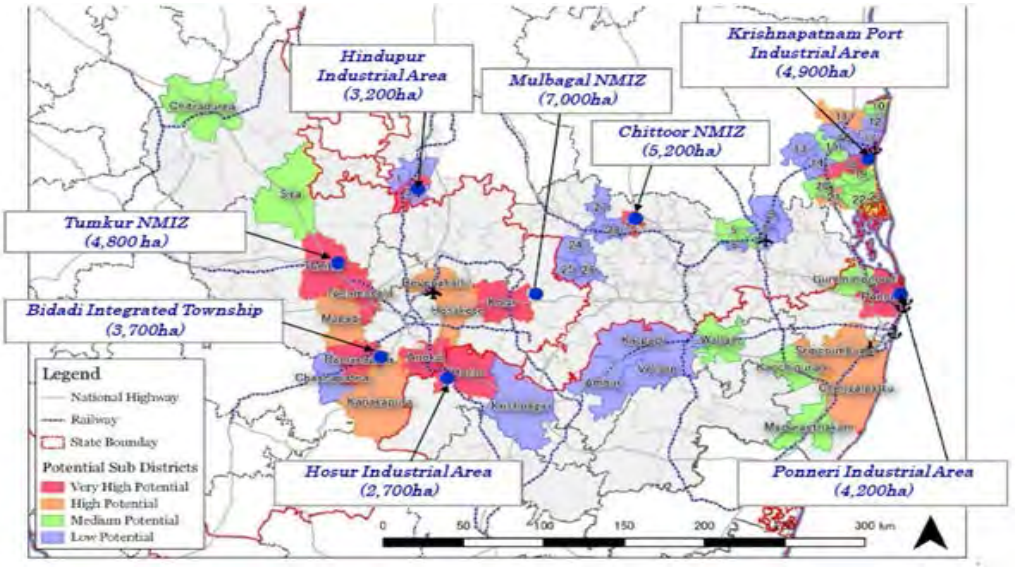
Category A: High priority regions with the potential to provide faster return on investments

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.



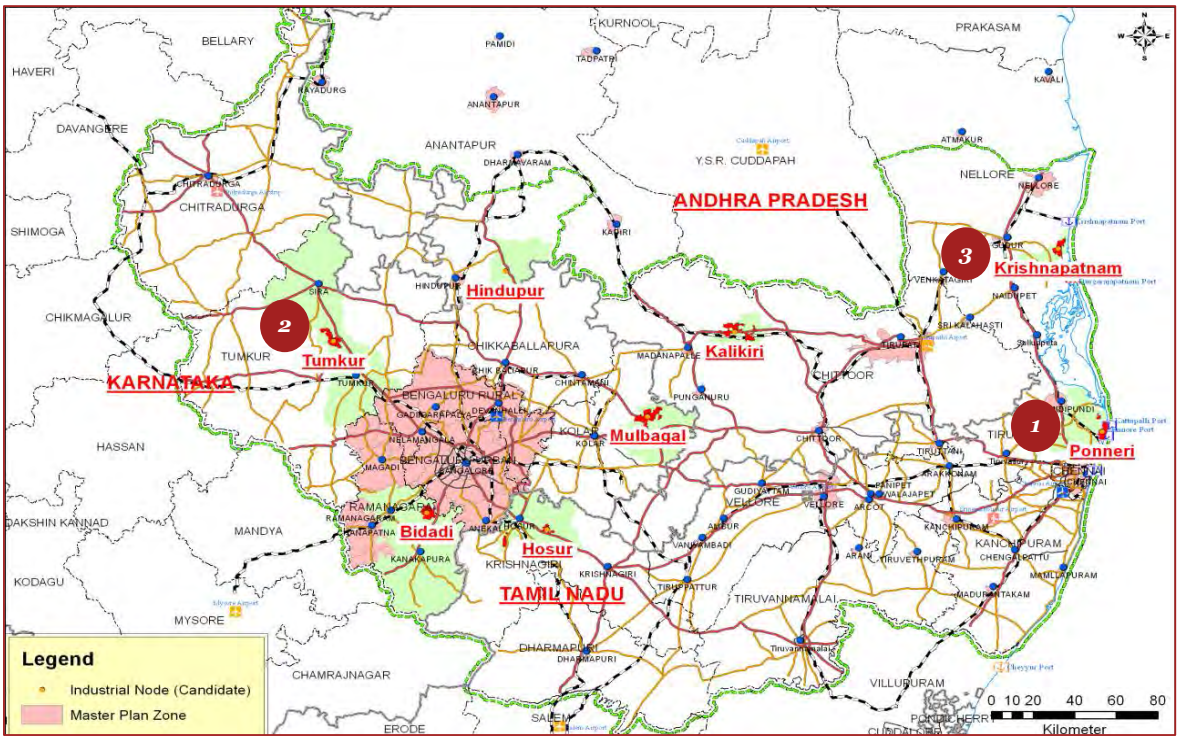


Figure 2.5: Nodes selected for CBIC including three nodes selected for Master plan development

Selection of Krishnapatnam Node

Krishnapatnam Industrial Node (KPT IN) is located in the south of Nellore District and has been identified as a high development potential area since it is close to Krishnapatnam port. A trunk road network (access road from NH-5) and railway connectivity have already been developed by Krishnapatnam Port Company limited. As the proposed node is near the port, it will also enjoy significant benefit from the port for industrial purposes. Additionally, KPCT has plans to develop plant facilities (power plant, water treatment plant and waste water plant) near this area, and it is expected to provide stable operational environment for the factories in the future.

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.

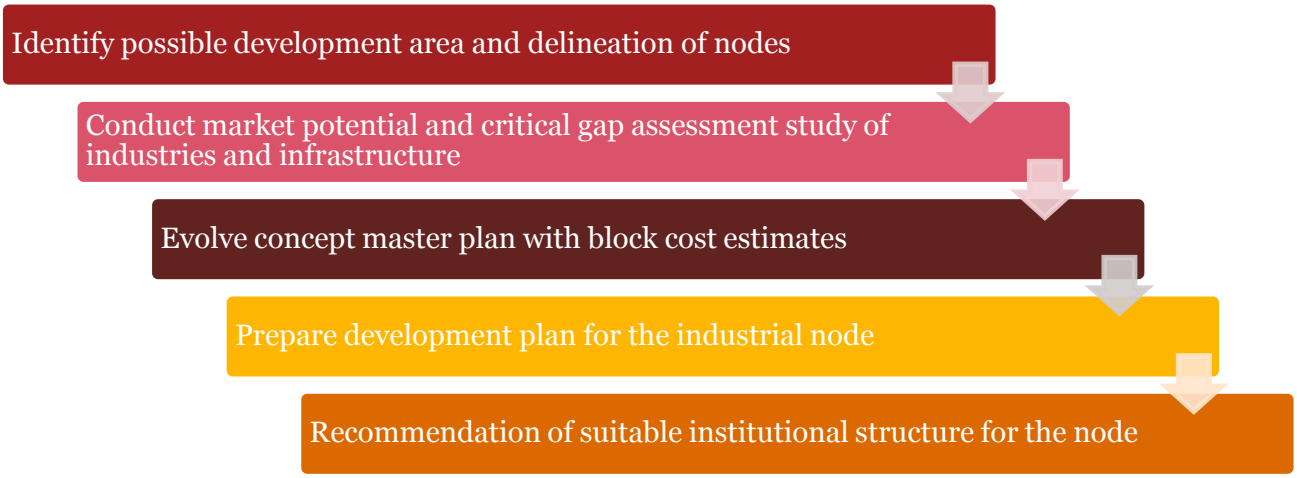


Figure 2.6: Study Framework

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.

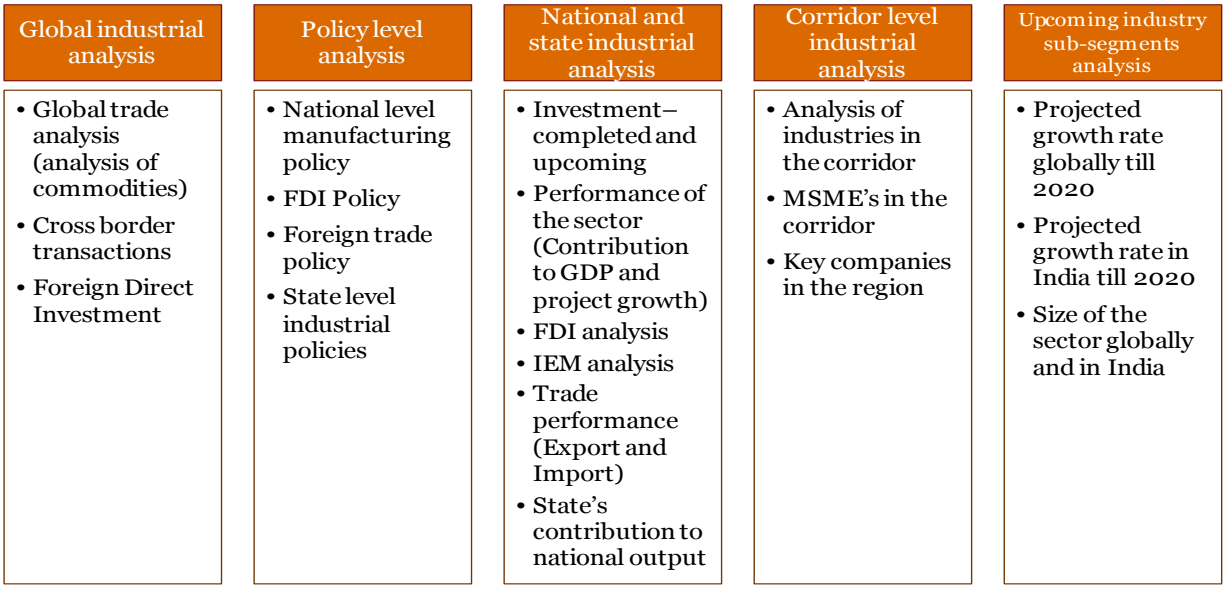


Figure 2.7: Parameters used for short-listing of potential sector in the corridor

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.

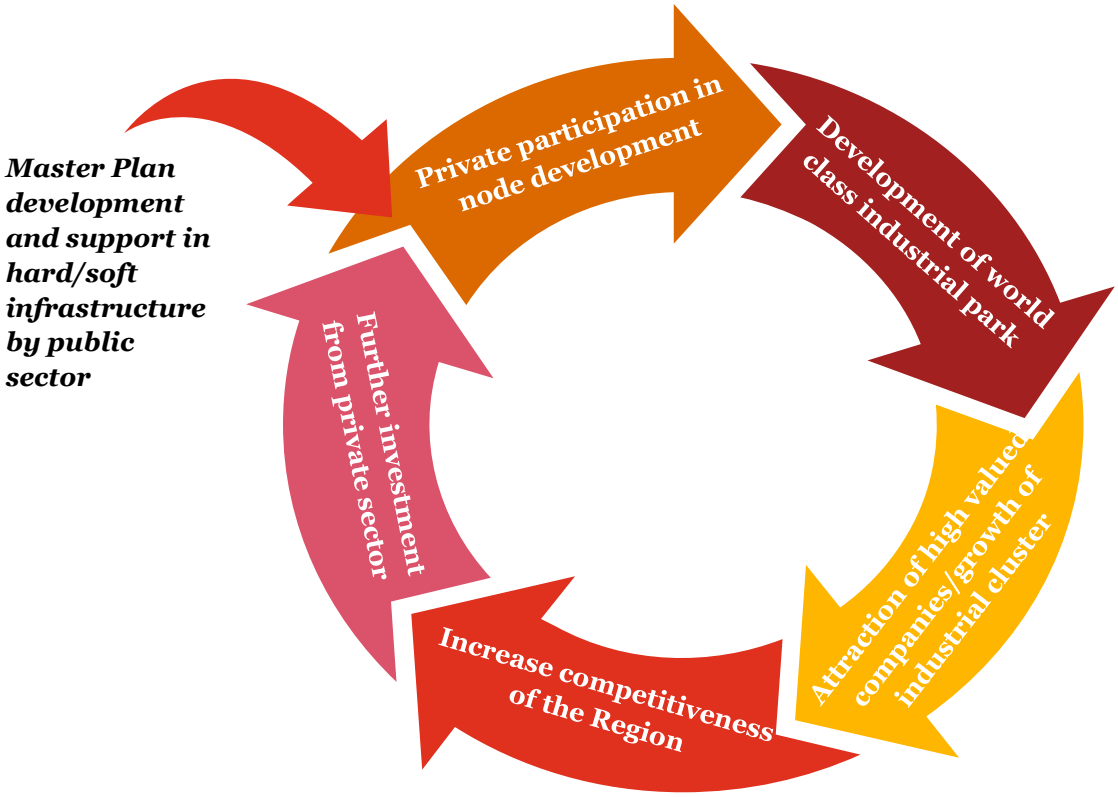


Figure 2.9: Public Private Partnership in Node Development

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

2.6 *Coverage of Final Report*

Final Report (FR) covers the critical gap assessment between industry development scenario and infrastructure and block cost estimates along with concept master plan and development plan of each node. Suitable institutional framework for the development of CBIC region will be analyzed and discussed.The main contents of the final report are summarized in the table below.

- **Overview of Nellore District and Vision for the Node** including the socio-economic profile of the district
- **Analysis of Traditional and Potential Industrial Sectors for Krishnapatnam** 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.

3 Overview of Nellore District and Krishnapatnam Industrial Node

3.1 Regional Assessment of Krishnapatnam Area

Krishnapatnam node (KPT IN) is located in the south of Nellore District and has been identified as an area with high development potential since it is close to Krishnapatnam port. Trunk road access from NH-5 and railway connectivity for the port have already been developed by Krishnapatnam Port Company limited; industries developed at the proposed node will enjoy significant benefits from the port and the transport infrastructure.

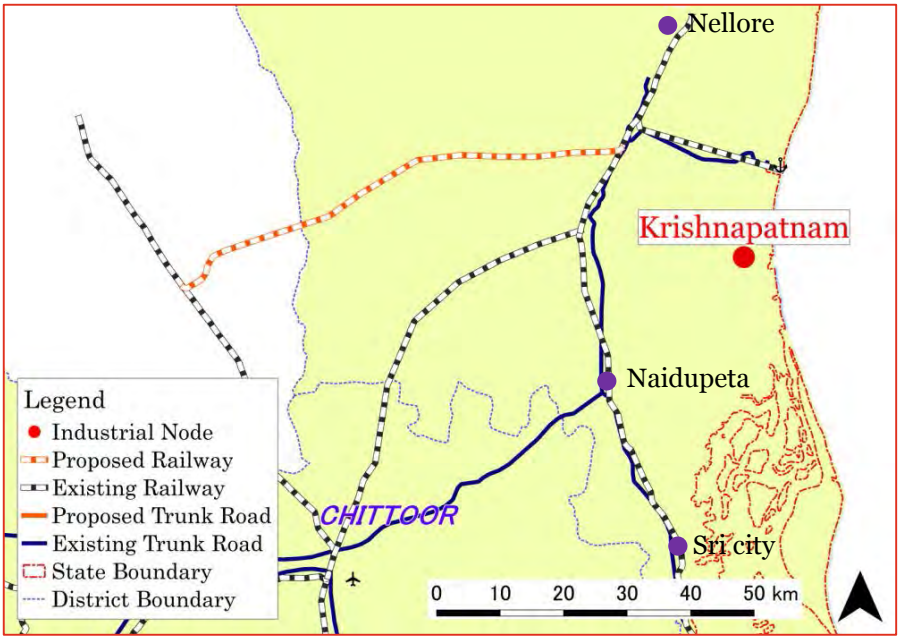
The access from NH-5 is currently a 4-lane road; however Krishnapatnam Port Company Ltd (KPCL) is planning to widen this to 6-lanes to satisfy future road demand.

Additionally, Naidupeta SEZ and Sri City are also located along NH-5. These areas, along with the proposed node and the cluster of developments around the urban core of Nellore city are expected to contribute to the further development of the south of Nellore District.

Table 3.1: Overview of the Krishnapatnam Area

Particular	Description
District/ State	• Nellore district/ Andhra Pradesh state
Distance from Metropolitan/major city	• 170 km from Chennai city centre along NH-5 and the access road to Krishnapatnam port • 40 km from Nellore city
Accessibility to trunk road network	• 20 km from NH-5, however no direct access from the national highway (only via Krishnapatnam Port) • 90 km from Tirupati airport
Accessibility to railway network	• Railway access connects Krishnapatnam port to the mainline; however no railway access to the node area so far
Accessibility to major transport facilities (port, airport)	• 10 km from Krishnapatnam port
Major industrial locations in the surrounding area	• 80 km from the proposed SEZ at Naidupeta on NH-5 • 130 km from Sri City on NH-5

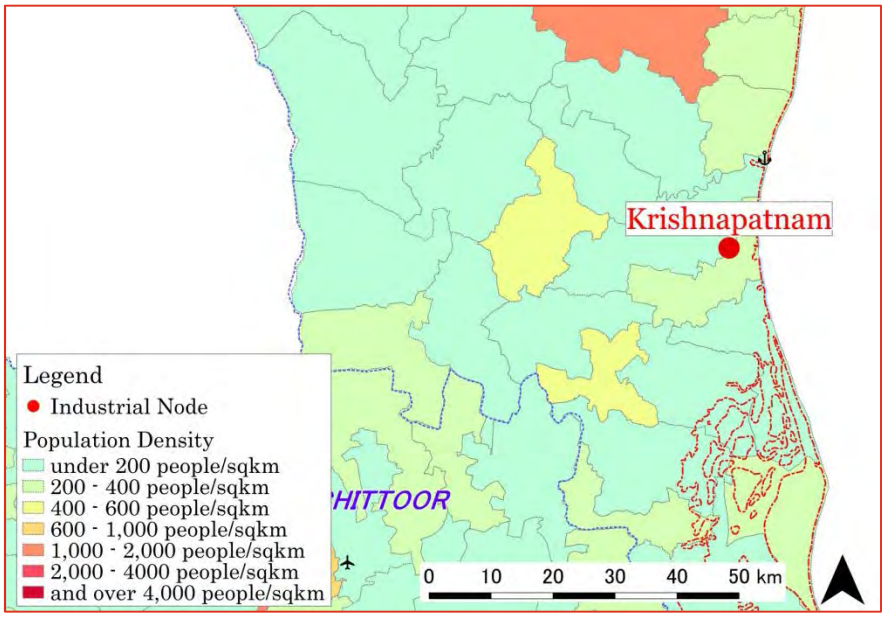
Source: JICA Study Team



Source: JICA Study Team

Figure 3.1: Infrastructure map of Krishnapatnam

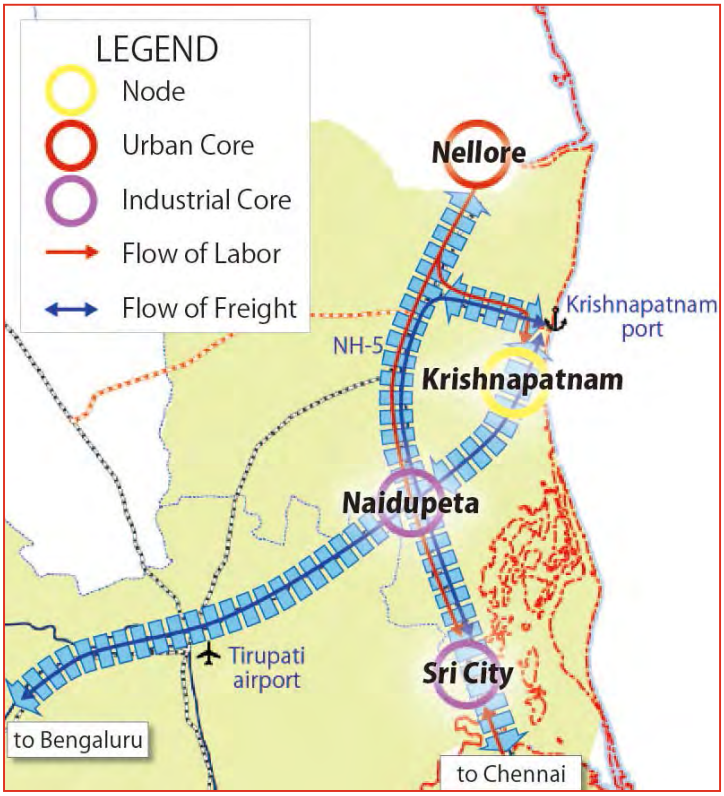
Most of the sub-districts in the south of Nellore District have a low population density (less than 200 people /sq.km). Only Nellore sub-district, which includes the district capital Nellore, has a density higher than 1,000 people /sq.km. The node area is 40 km away from Nellore.



Source: JICA Study Team

Figure 3.2: Population density in 2013 of Krishnapatnam and the surrounding area

As mentioned above, Nellore city is the most populous city near the node which has the potential to provide skilled and unskilled labour to industrial areas nearby. In addition to Krishnapatnam Node, Sri City and the proposed Naidupeta SEZ, also located along NH-5, are expected to be developed as a core of urban/industrial development, and therefore these cluster developments have to be linked together to enhance the future growth of this area. The concept of cluster developments in the Nellore area is illustrated below:



Source: JICA Study Team

Figure 3.3: Cluster development of South Nellore

As shown in the above figure, an access road from Naidupeta to Krishnapatnam node will be proposed. This will reduce distance and time for freight movements and will also improve connectivity to Bengaluru.

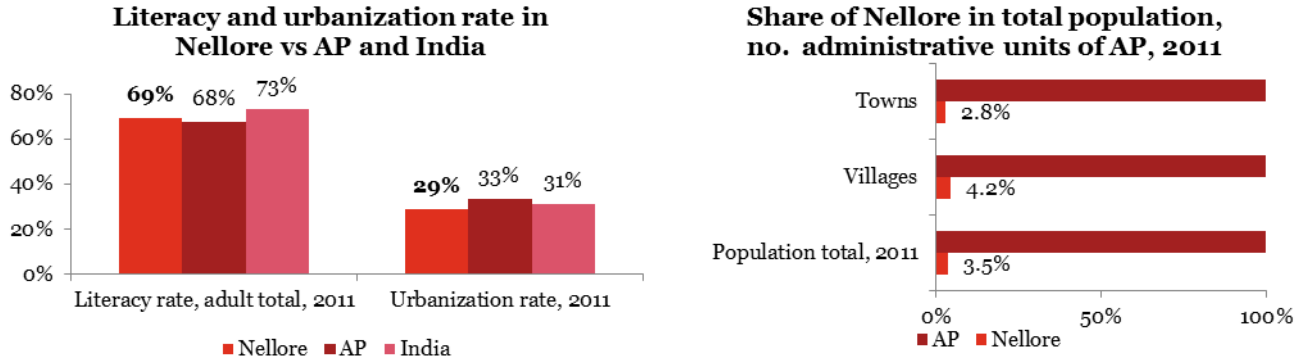
In this section economic and social profile of the adjourning areas of the Node and the Node (Nellore district with focus on 50-100 km radius from the Node) will be analyzed. The section will also cover major industrial hubs/clusters and status of industrial infrastructure at the state level and located in adjoining areas to KPT IN.

3.2 *Socio-Economic Profile of Nellore District*

3.2.1 *Vital Social Characteristics*

Nellore district is lower than state and national average on urbanization levels. Population of Nellore district is 2,966,082 as per Census 2011 data, out of which 1,493,254 (50.3%) are males and 1,472,828 (49.7%) are females. Its share in total population of Andhra Pradesh[3] is 3.5%. Density of population is relatively low – 227 persons per sq. km – if compared with Andhra Pradesh (308 persons per sq. km) and India (382 persons per sq. km).

Literacy rate in the district is higher than in overall Andhra Pradesh, but below national average. Nellore district is not urbanized; its urbanization level is lower than AP's average and event below national average level. Number of towns is about 3% of total towns in Andhra Pradesh, villages amount to more than 4% of total villages in the state.



Source: Census 2011, Statistical abstract of Andhra Pradesh, 2012, DES, GoAP, PwC analysis

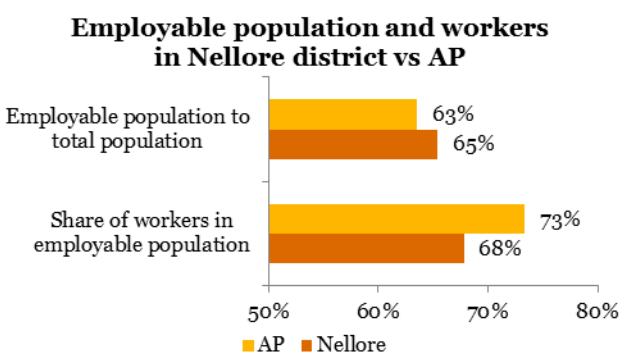
Figure 3.4: Demographic profile of Nellore district

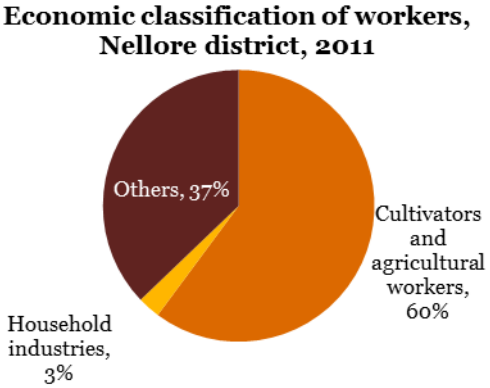
3.2.2 *Employment*

Majority of population is engaged in agricultural sector; need to increase employment opportunities in manufacturing sector Employable population (15-59 years) in Nellore district was 1,939,521 in 2011, which is 4% of total employable population of Andhra Pradesh.

Share of employable population in total population in Nellore district is 65%, higher than the same in Andhra Pradesh. However, share of workers in total employable population in Nellore district is lower (68%) than in Andhra Pradesh (73%).

[3] Andhra Pradesh before bifurcation is considered for population related analysis

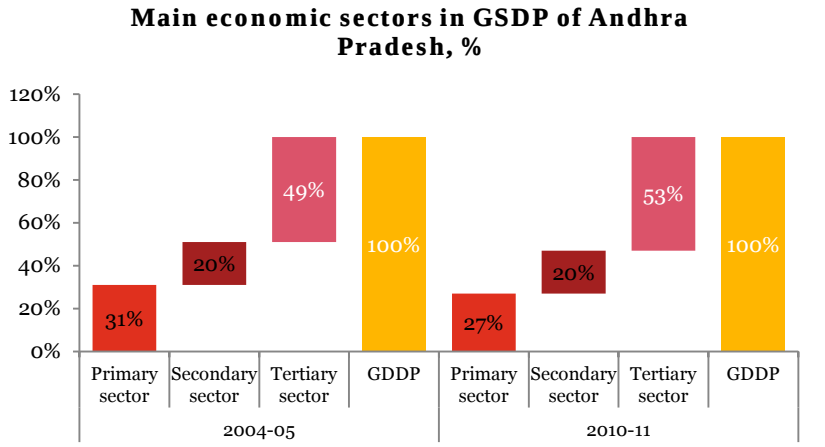




Source: Census 2011, Statistical abstract of Andhra Pradesh, 2012, DES, GoAP, PwC analysis

Figure 3.5: Employable population and distribution of workers across main categories

3.2.3 *Gross District Domestic Product*



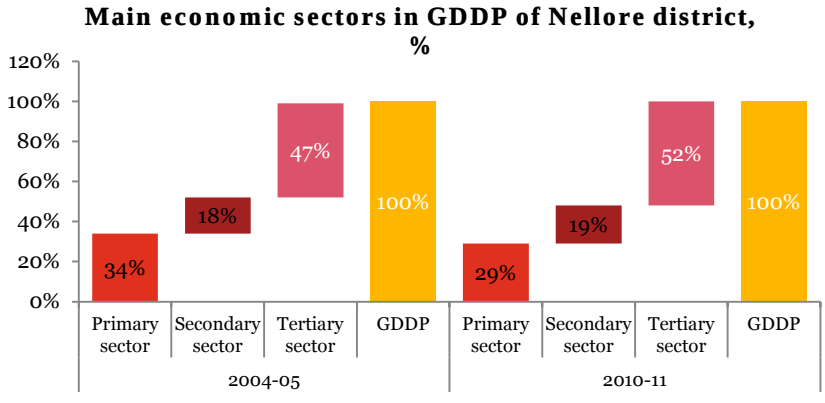


Figure 3.6: GDP composition in Andhra Pradesh and Nellore district, %

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

Structurally, GDP composition of Nellore District and Andhra Pradesh are similar. It is observed that in share of the share of primary sector in AP decreased by 3-4%; at the same time share of tertiary sector in total GSDP registered increase – 53%.

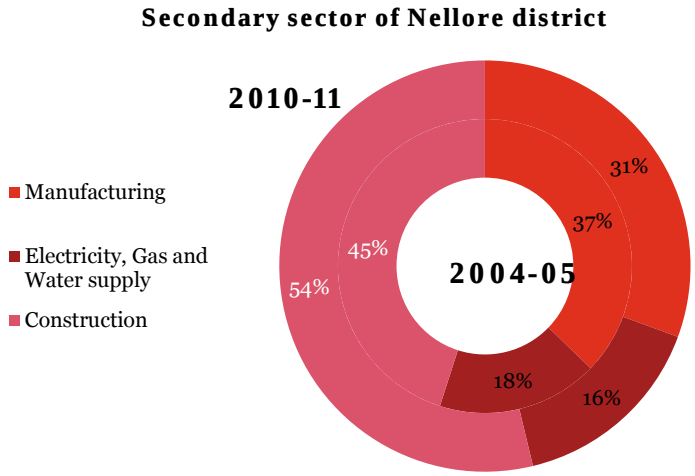
Secondary sector remained without change at the state level.

Primary sector in Nellore district has shrunk by 5% points between 2004-05 and 2010-11. However, in relative terms it is larger contributor to GDDP than primary sector of entire influence region of KPT IN and AP itself. Tertiary sector in Nellore district is almost at par with influence region and Andhra Pradesh.

Given strong agrarian background, industrial base is yet to gain momentum in Nellore district. There was marginal improvement by 1% point between 2004-05 and 2010-11, however, secondary sector is still not even at par with the one of influence region or state. Tertiary sector is well represented and has grown at par with state and influence region as a whole.

Secondary sector of Nellore district is dominated by construction; manufacturing share has contracted.

Secondary sector of Nellore district contributed 19% to the district's GDP in 2010-11 and has grown from Rs. 1,395 crore to Rs, 2,216 crore at a CAGR of 8% between 2004-05 and 2010-11.



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

Figure 3.7: Composition of secondary sector in Nellore district

Construction is a dominating segment of the secondary sector in Nellore, which has grown at 11% CAGR between 2004-05 and 2010-11. It has also increased its share by 9% points for the same period form 45% in 2004-05 to 54% in 2010-11.

Manufacturing segment is the second largest contributor to the district's GDP. However, its performance has not demonstrated remarkable results during the period under review.

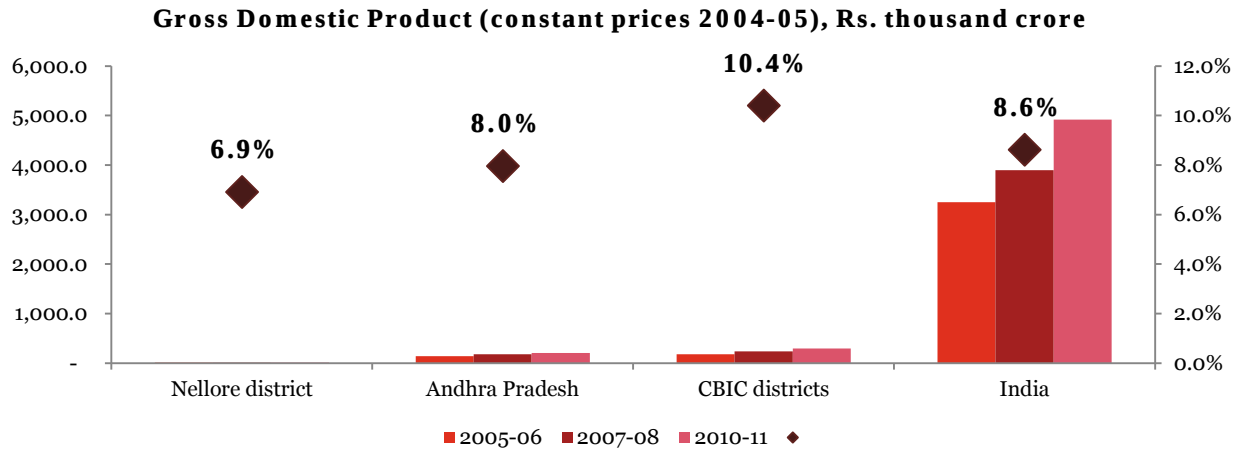
In volume terms the segment has grown from Rs. 520 crore in 2004-05 to Rs. 678 crore in 2010-11 and registered a CAGR of 5%. Its share in the secondary sector of district's GDP has contracted from 37% to 31% for the period of 7 years (2005-11). It is strikingly low comparing to the national level where manufacturing constitutes about 60% of industry GDP[4]

Manufacturing sector of Nellore district

Gross domestic product of Nellore has grown from 8.3 thousand crore in 2005-06 to Rs. 11.6 in 2010-11 thousand crore at a CAGR of 6.9%. It is below CAGR registered by the state of Andhra Pradesh[5], combined GDDPs of CBIC districts and Indian GDP. Manufacturing segment is the second largest contributor to the district's GDP. However, its performance has not demonstrated remarkable results during the period under review. In volume terms the segment has grown from Rs. 520 crore in 2004-05 to Rs. 678 crore in 2010-11 and registered a CAGR of 5%. It share in the secondary sector of district's GDP has contracted from 37% to 31% for the period of 7 years (2005-11).

Manufacturing sector contribution to the district's GDP consists of output from registered and unregistered industries. The consultant observed that split between registered and unregistered manufacturing has remained relatively unchanged over the 7 years (2005-11). Registered units have recorded growth at a CAGR of 4%, whereas output of unregistered units has grown at a CAGR of 5%. The dynamics of the manufacturing sector is represented in the graph below:

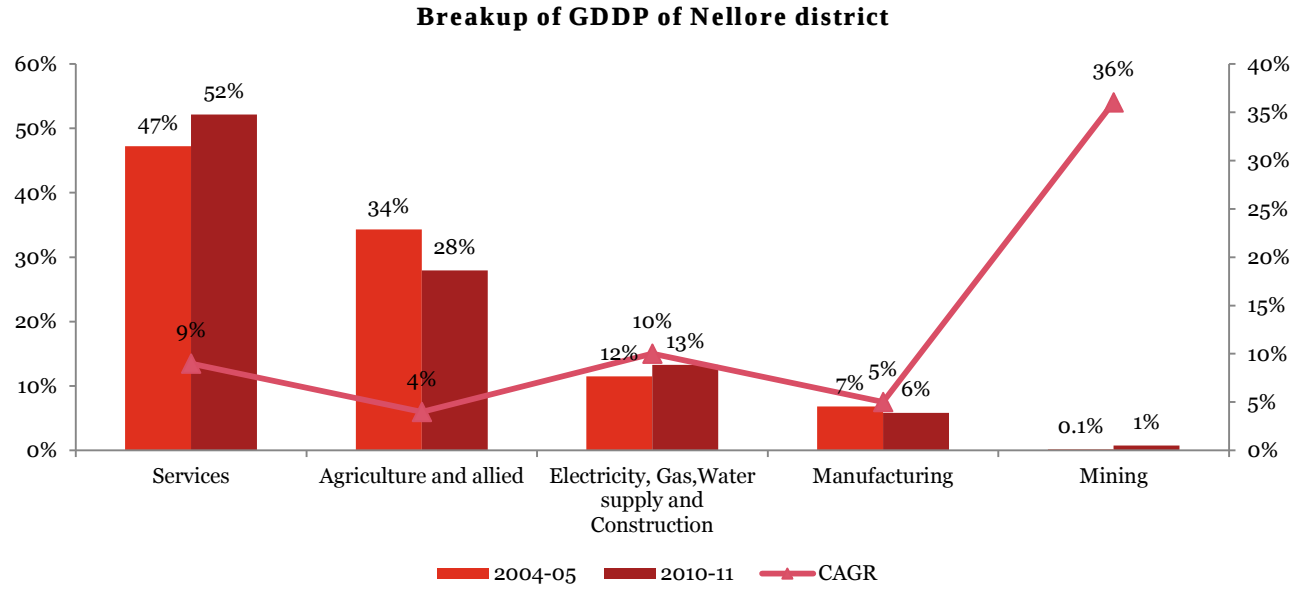
[4] Economic Survey 2013-14, Chapter 9 "Industrial performance", p. 162, http://www.indiabudget.nic.in/
[5] Andhra Pradesh from this section onwards, if not mentioned otherwise, means the recently formed state of Andhra Pradesh, consisting of 13 districts.



Source: District domestic product - AP 2004-05 to 2010-11, Directorate of Economics and Statistics, GoAP

Figure 3.8: GDP at constant 2004-05 prices, Nellore district vs CBIC districts, Andhra Pradesh and India

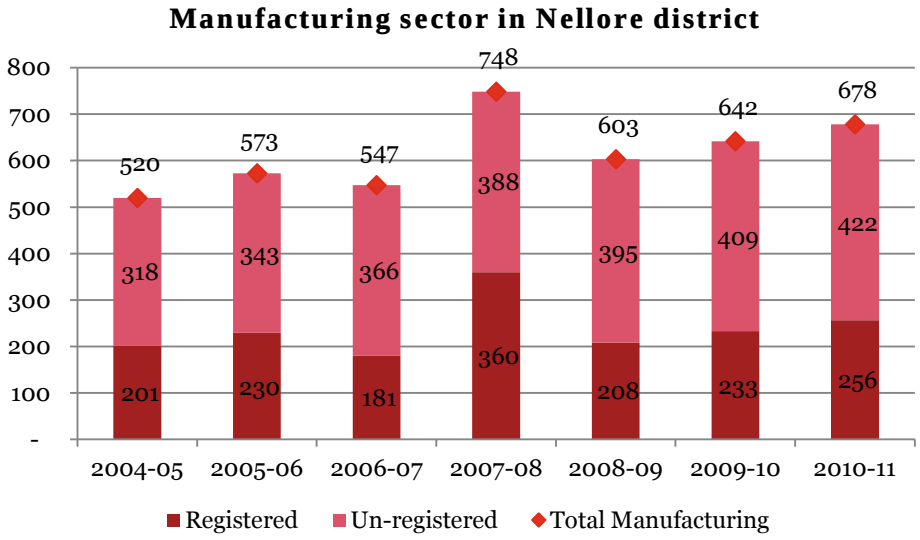
Analysis of large segments of GDP of Nellore district reveals that Manufacturing is a very modest player – only 6% contribution to GDDP by 2010-11. Among major economic segments its growth rate was also one of the lowest, which influenced outpaced performance of Nellore district compared to growth of AP state and India as a whole.



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

Figure 3.9: Major components of GDDP of Nellore district

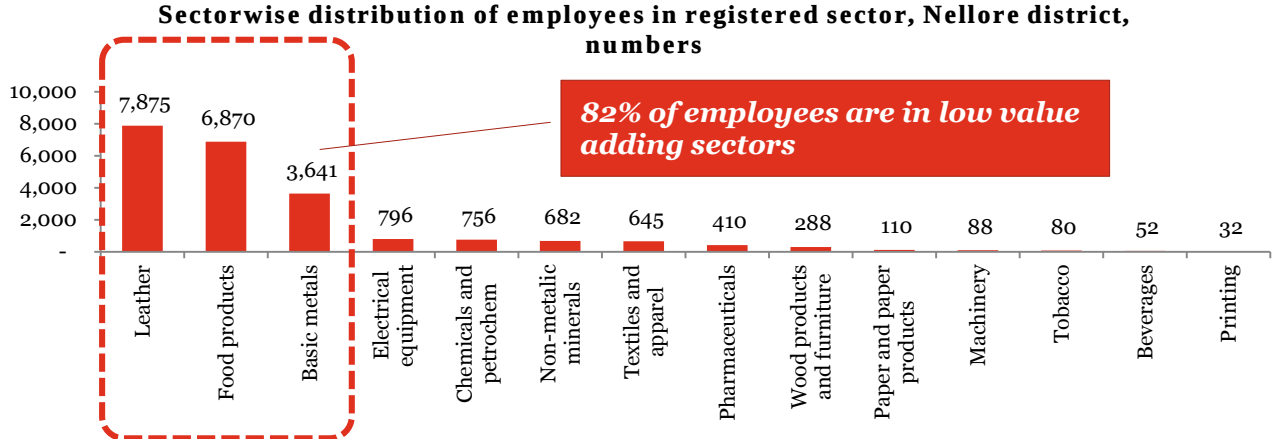
The total manufacturing output of Nellore is around Rs, 678 crore out of which only Rs. 250 crore of output comes from registered manufacturing units.



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

Figure 3.10: Composition of manufacturing sector of Nellore district

Majority of employees are engaged in low value adding non-engineering sectors. 82% of employment in registered sector in Nellore district is concentrated in 3 sectors: leather (35%), food processing (31%), basic metals (16%). These sectors are characterised by low value addition in their final output. Number of employees engaged in in engineering sectors is very low.

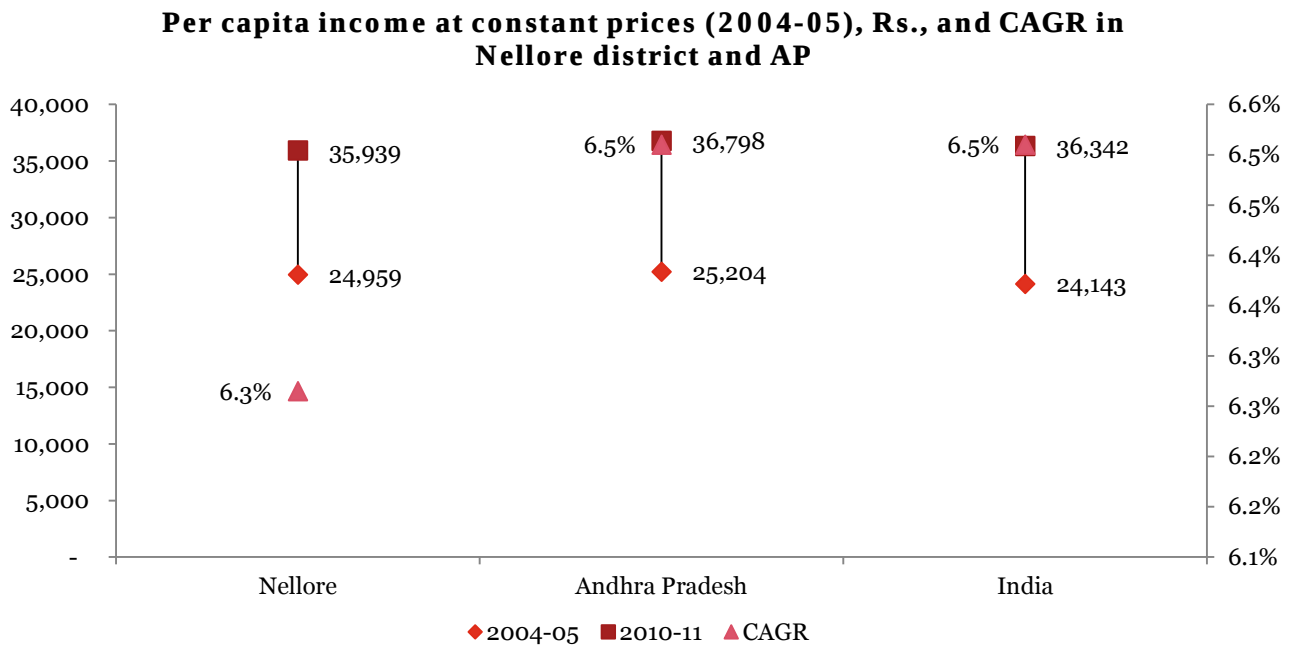


Source: ASI, Nellore district, 2010-11

Figure 3.11: Distribution of employees in registered sector

3.2.4 *Per Capita Income*

Per capita income in Nellore district has increased from Rs. 24,959 in 2004-05 to Rs. 35,939 in 2010-11 and has grown at a CAGR of 6.3%.

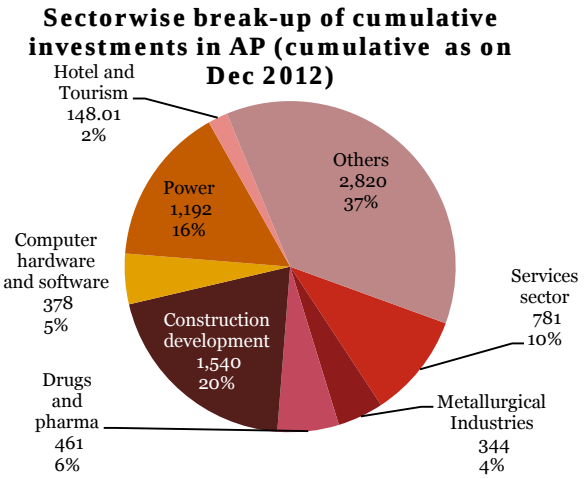


Source: District domestic product - AP 2004-05 to 2010-11, Directorate of Economics and Statistics, GoAP, PwC analysis

Figure 3.12: Per capita income of Nellore district vs Andhra Pradesh and India

Per capita income of Nellore district is below of per capita income of Andhra Pradesh and national estimates both in terms of actual amount and growth percentage. It is on account of large primary sector and underdeveloped manufacturing sector, engagement of majority of registered employees in low value adding segments of manufacturing sector.

3.2.5 *Foreign Direct Investment*



Break-up of FDI inflows (cumulative as on December 2012) reveals that Andhra Pradesh received the highest inflow in construction and power project (36% of total cumulative FDI inflows of the state). Power sector in Andhra Pradesh alone received more than 15% of the national cumulative FDI in power projects.

Other sectors that are prominent FDI recipients are services sector (10%), drugs and pharma (6%), computer hardware and software (5%) and metallurgical industries (4%).

Nellore has strong base of metallurgy and construction linked companies; and this can be leveraged for attracting FDI in future

Source: SIA NEWSLETTER - ANNUAL ISSUE, 2012, DIPP

Figure 3.13: Cumulative FDI in AP sector wise

79% of total investments in upcoming projects in Nellore are in electricity generation and shipping transport infrastructure services.

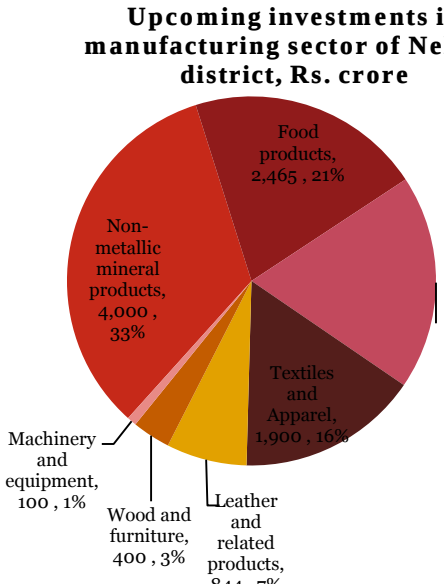


Figure 3.14: Upcoming investment in manufacturing sector, Nellore district

Manufacturing sector is gradually picking up – 12% of total investments in upcoming projects in Nellore are across various manufacturing sectors.

56% of upcoming projects across manufacturing sectors in Nellore district are distributed among 4 sectors identified as highly potential for CBIC region.

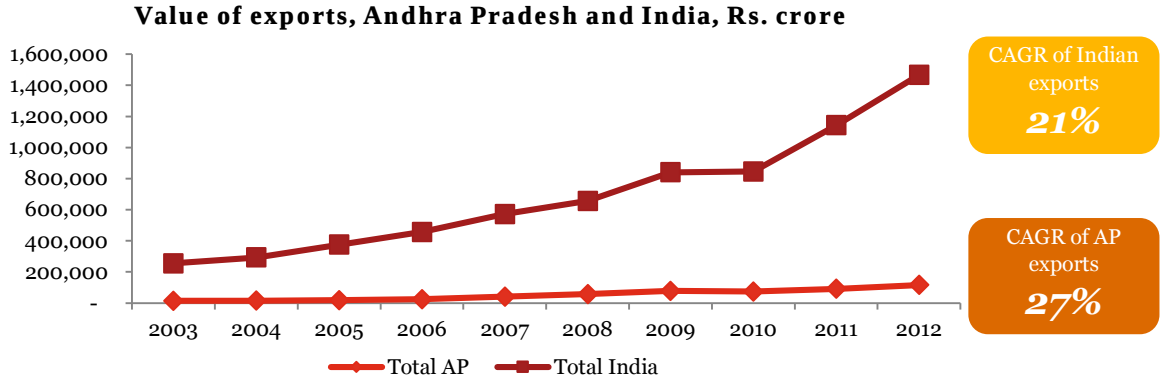
Non-metallic mineral products are witnessing highest amount of upcoming investment due to single large glassware manufacturing project.

In food processing sector major projects are announced in the following segments: dairy products, processed foods (soft drinks) and coffee. Chemicals and petrochemicals projects are coming up in fertilizers and plastics segments of the sector. Upcoming projects in textiles and apparels sector are represented by readymade garments segment.

3.2.6 *Exports*

Growth of export volumes from Andhra Pradesh has been steady and higher than national average. Andhra Pradesh has been showing remarkable performance as export destination. Its exports have grown about9x from Rs. 14 thousand crore in 2003 to Rs. 116 thousand crore in 2012. The state has improved its share in national exports from 5% in 2003 to 8% in 2012.

AP exports have grown at a 27% CAGR for the past 10 years having surpassed the India growth in exports – CAGR of 21% - for the same period.



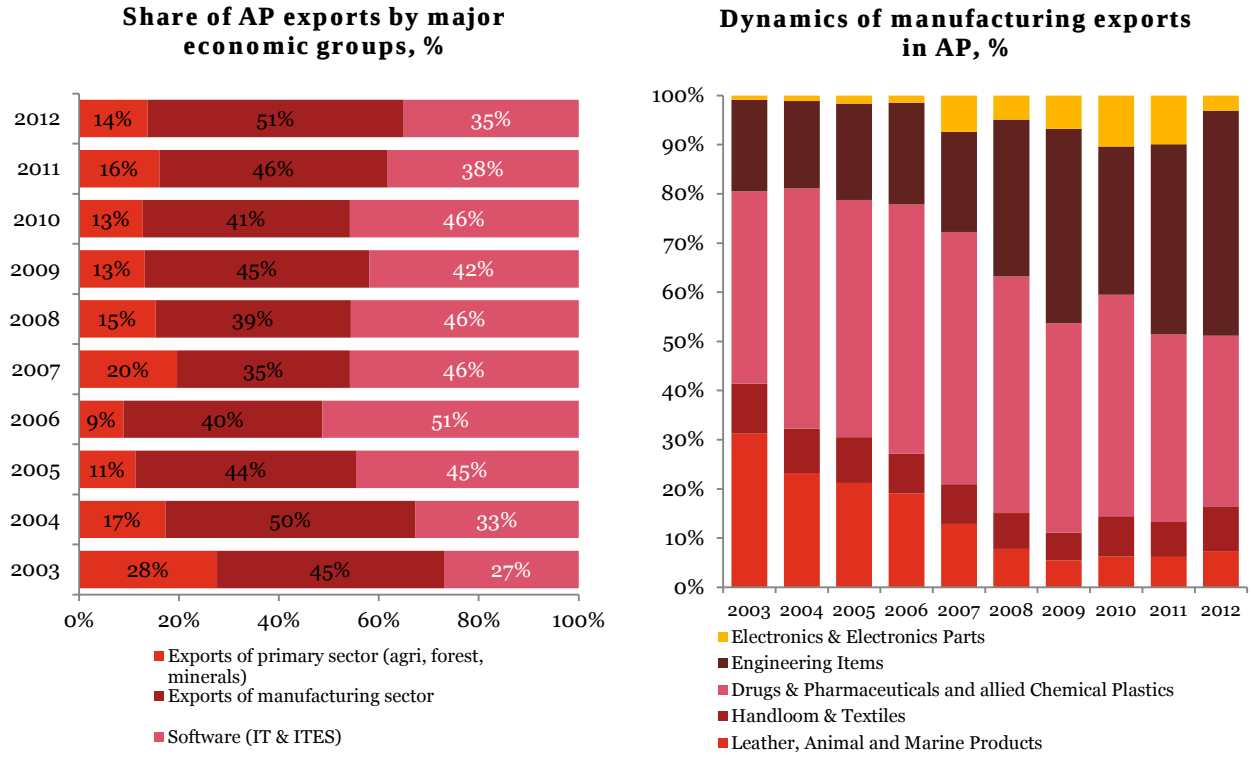
Source: Socio-economic survey AP, 2012-13, Economic survey of India, 2013-14

Figure 3.15: Value of exports in AP and India

Structurally exports of Andhra Pradesh have undergone remarkable change over the past decade. Share of software exports in total export basket of AP reduced from 51% in 2006 to 35% in 2012. Share of primary sector exports, usually low on value addition, reduced by half, from 28% in 2003 to 14% in 2012.

On the other hand, manufacturing sector has increased its presence in AP exports, having increased its share from 45% in 2003 to 51% in 2012. 80% of exported manufacturing goods include engineering items (46%), drugs and pharmaceuticals (35%).

Composition of manufacturing exports has undergone changes as well. In 2003 pharma was the leading sector with 39% share in total manufacturing exports, followed by leather, animal and marine products (31%) and engineering items (19%). One decade later 80% of exported manufacturing goods include engineering items (46%), drugs and pharmaceuticals (35%).



Source: Socio-economic survey AP, 2012-13

Figure 3.16: AP exports by major economic groups and dynamics of manufacturing sector exports in AP

Nellore district has low per capita income as majority of employable population is engaged in low value added non-engineering sectors, primarily agriculture, food processing and basic metals

Manufacturing in Nellore district is set to pick up – 12% of total upcoming investments are in manufacturing sector

3.3 *Industrial Infrastructure Profile*

3.3.1 *Existing Industrial Infrastructure*

Although a number of industrial parks and industrial estates exist in Nellore district, most of them are saturated, by both foreign and local factories. Industrial infrastructure in Nellore district is developed by

Andhra Pradesh Industrial Infrastructure Corporation Limited (APIIC), or by private developers with APIIC's assistance via PPP schemes.

APIIC is a government organisation whose objective is to provide industrial infrastructure for the development of industrial areas. Previously developed industrial areas have ranged from 15 acres to 2500 acres. The Corporation has a presence in each and every mandal of Nellore district. These industrial areas have approved layouts equipped with internal roads, water and power supply facilities.

Table 3.2: Industrial park details, Nellore district

Name of park	Total extent/allotable land, acres	Vacant plots, acres	Ownership
IP Naidupeta	1,601	698	APIIC
IP Pynampuram	1,826	324	APIIC
IP Attivaram	406	219	APIIC
Krishnapatnam International Leather Park	314 (412)		PPP
IP Ankulapatur (SBQ Steels)	152		
IP Mambattu	980	218	APIIC
Sri City	7,156	692	Private developer
IP Tada	98.5	-	APIIC

Source: APIIC, DIC Nellore district, official websites of selected parks

Andhra Pradesh hosts 115 SEZs at various stages of development. Out of these 115 SEZs, 8 are located in Nellore district. The details of those SEZs are as follows:

Table 3.3: SEZ details in Nellore district by Developer

Name of Developer	Type of SEZ	Location	Total extent, acres	Vacant plots, acres	Status	Role of GoAP	Employment potential
APIIC Ltd.	Multi Product	Dwarakapuram, Pallepalem, Menkuru, Konetrajupalem & Palluchuru(V), Naidupeta (M)	2,550	368	Operational	APIIC	3,000
Bharatiya International SEZ	Leather Product	TADA (M)	250	-	Operational	APIIC Joint venture	
APACHE SEZ Development India Pvt. Ltd.	Footwear	TADA (M)	257	-	Operational	Assisted by APIIC	15,000
MAS Fabric Park (India) Pvt. Ltd.	Textile and Apparel	Chintavaram (V), Chilakur (M)	583	-	Operational	Assisted by APIIC	30,000
Krishnapatnam Infratech Pvt. Ltd. SEZ (Phase I)[6]	**Multi Product**	**Chillakur, Kota(M)**	**11,864**	**Under plan**	**Formally approved**	**Assisted by APIIC**	
Indian Farmers Fertilisers Co-operation Ltd. (IFFCO)	Multi Product	Naidupeta	2,527		Operational	Private developer	5,000
Mambattu SEZ	Multi Product	Sulurpeta	564	-		APIIC	10,000

[6] Area of proposed KPT IN

Name of Developer	Type of SEZ	Location	Total extent, acres	Vacant plots, acres	Status	Role of GoAP	Employment potential
South Coast Infrastructure Development Co. of Andhra Pradesh Private Limited (SCIDCAP)	Building material	NH-5 between Prakasam and Nellore District	292	N/A	In principal approval	Private developer	

Source: APIIC, DIC Nellore district, official websites of selected SEZs, Nellore.com

3.3.2 *Industrial Cluster*

Existing industrial parks around the proposed node may provide supply chain advantages for certain industries, since the node is located close to the industrial cluster that has formed around Krishnapatnam port. Also, there are several industrial clusters along NH5 within 50 km of the node. The area around the port also hosts a number of operational and upcoming power projects. Major industrial zones in the vicinity include the following:

The main industries around the **city of Nellore** are food processing and beverages, pharma, chemicals and petrochemicals, steel and metal products, wood, leather, etc.

Areas **North and North-east of Nellore** host aquaculture units, hatcheries, ponds for shrimp cultivation and related processing units.

The **Gudur** area has food processing units, steel and metal products and electronics.

Naidupeta is a large agglomeration of industrial units; APIIC estates and an SEZ are located there as well. Industries including food processing and beverages, textiles, electrical machinery and non-mineral based products are located there.

The **area around Krishnapatnam port** has food processing, steel and metal products and a sizable leather cluster with the upcoming Krishnapatnam International Leather Park.

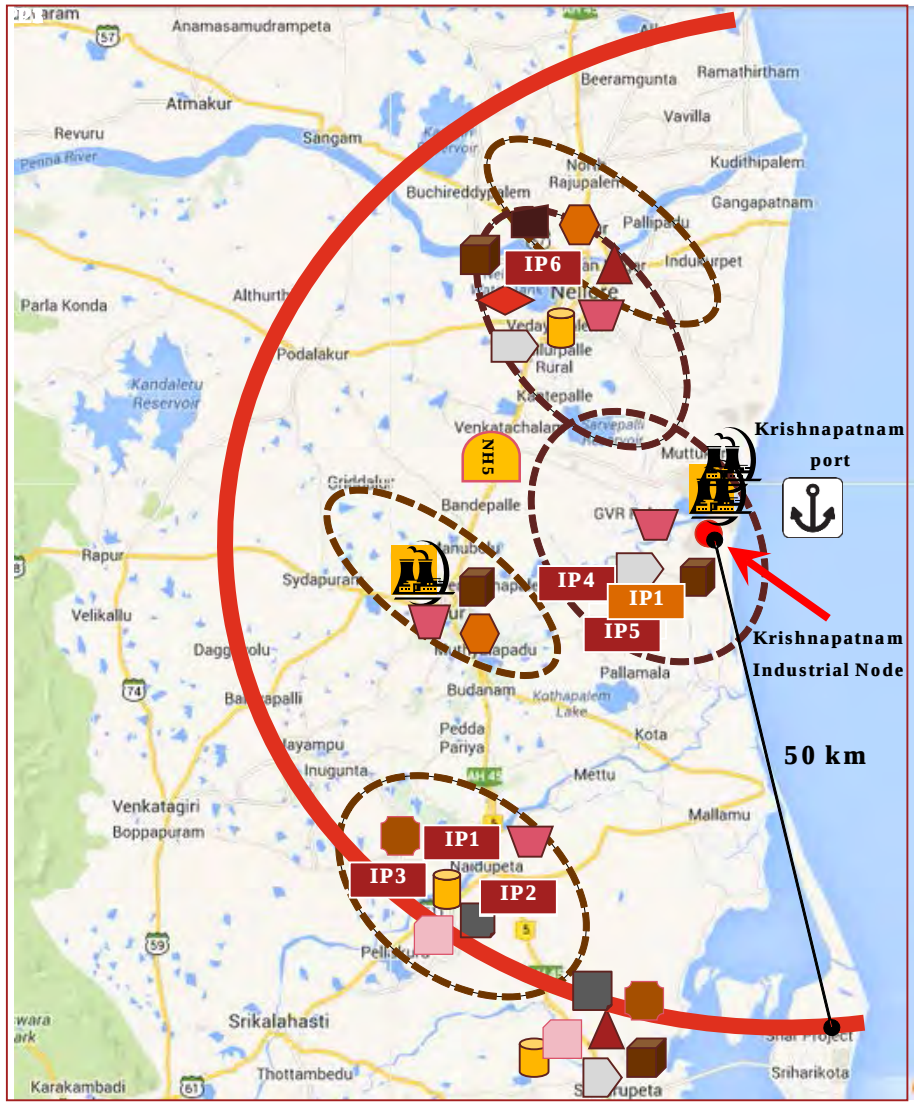
Sulurpeta is another prominent industrial area (which is beyond 50km from the node) hosting textiles, steel and metal products, electrical machinery, chemical and petrochemicals, leather industries etc.

Most industrial areas are currently operational with limited vacant space. The details are shown below:

Table 3.4: Vacant land of SEZ in Nellore district

Industrial park/SEZ	Total extent, acres	Vacant land, acres
Operational		
IP Naidupeta APIIC	1,601	698
APIIC SEZ	2,550	368
IP Attivaram, APIIC	406	219
IP Pynapuram, APIIC	1,826	324
MAS Fabric Park (India) Private Limited (MFP)	583	-
IFFCO Kisan SEZ Limited	2,527	
Upcoming		
Krishnapatnam International Leather Park	314 (412)	

Source: APIIC, DIC Nellore district, official websites of selec ted SEZs, Nellore.com



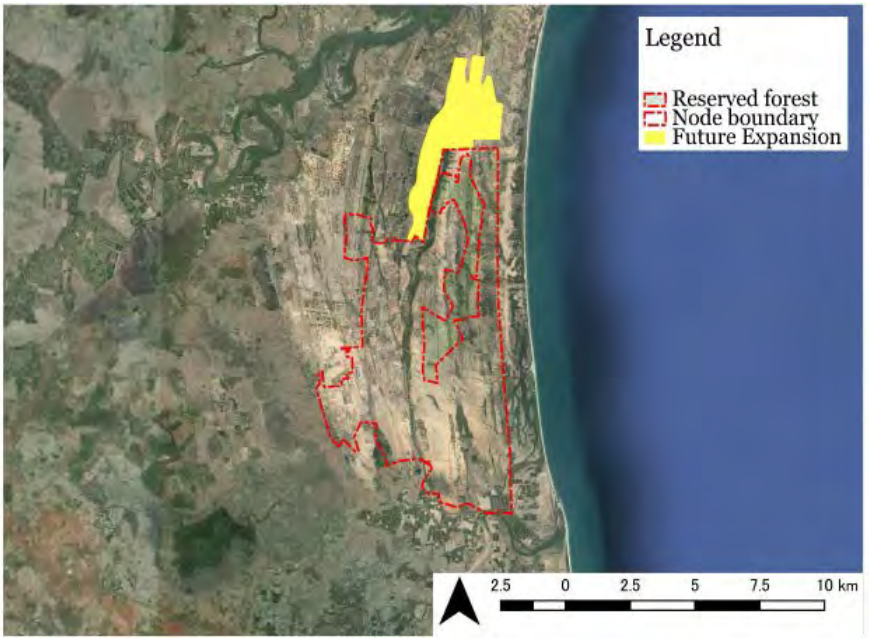
	OPERATIONAL IPs/SEZs
IP1	IP Naidupeta APIIC
IP2	APIIC SEZ
IP3	IP Attivaram, APIIC
IP4	IP Pynapuram, APIIC
IP5	MAS Fabric Park (India) Private Limited (MFP)
IP6	IFFCO Kisan SEZ Limited
	UPCOMING IPs/SEZs
IP1	Krishnapatnam International Leather Park
	Food processing (Vegetable oils, marine food, diary products)
	Beverages
	Chemicals
	Pharma
	Non-mineral based products (Glass and glassware)
	Other electronics
	Leather
	Wood
	Steel and metal products
	Textiles
	Electrical machinery
	Electricity generation, yellow highlight – upcoming projects
	Port

Figure 3.17: Industrial Hubs in proximity to Krishnapatnam Industrial Node

3.4 *Overview of the Krishnapatnam Industrial Node*

3.4.1 *Delineation of the Node*

In addition to the area covered by Phase 1 and Phase 2 of the proposed Krishnapatnam SEZ, additional 1,567 Acre of land in the south have additionally been identified as a part of the node in Krishnapatnam. As a result, an area of 5,654 ha (13,971 acres) was finalized for the node. There are some other land parcels to be acquired by APIIC in the surrounding area. However the most of them are not suitable for development as part of the node since they are smaller and non-contiguous with the node area. But APIIC land parcel(1,332 Acre) in the north shown as yellow color in the figure below is identified as future expansion area for the Krishnapatnam Node.



Source: JICA Study Team

Figure 3.18: Node Boundary of Krishnapatnam

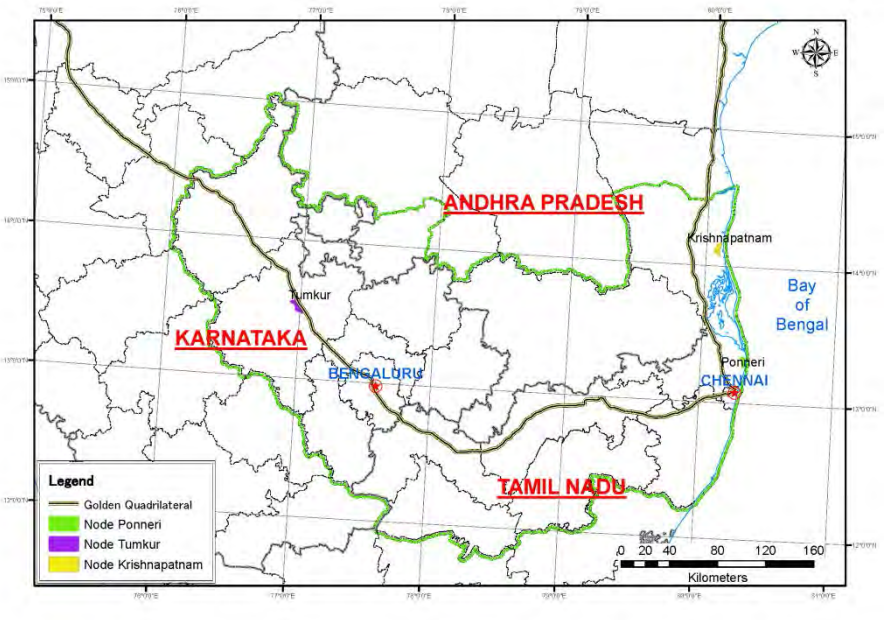
Table 3.5: Breakdown of Node Area

	Area	
	(Acre)	(ha)
Phase-1	5,501	2,226
Phase-2	8,470	3,428
Total	***13,971***	***5,654***

Source: APIIC, JICA Study Team

3.4.2 *Topography*

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



Source: Global Map

Figure 3.19: Location of Nodes

The Krishnapatnam node was defined based on the boundary of the proposed Krishnapatnam SEZ (Phase I & II). The SEZ is located within Kota and Chillakur mandals of Nellore district in the southeast of Andhra Pradesh state. Nellore district is bordered by Prakasam district to the north, Y.S.R. district to the west, and Chittoor district to the southwest as shown in the following figure.

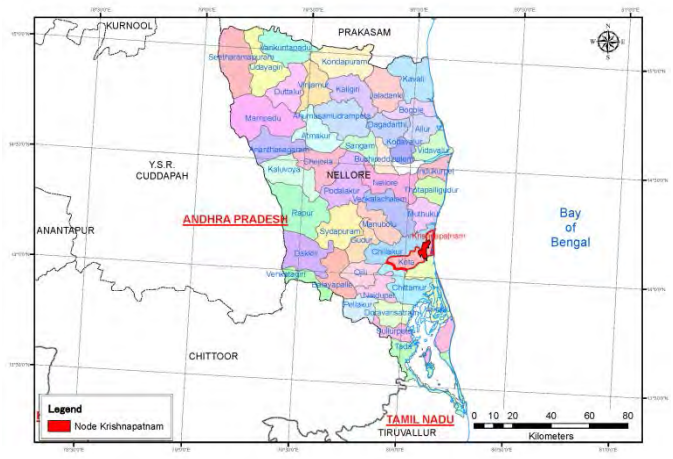


Figure 3.20: Location of Nellore District

Source: Global Map

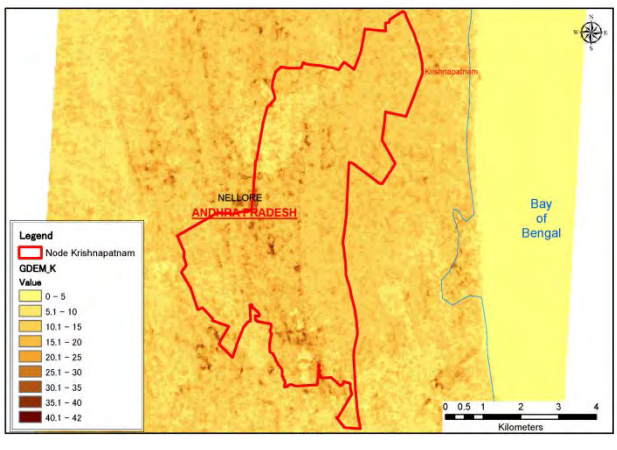


Figure 3.21: Geography of Krishnapatnam SEZ

Note: only phase-1 area is shown
Source: ASTER GDEM(METI and NASA)

The node is located approximately 30 km from Nellore city and about 10 km south of Krishnapatnam port. The node area runs parallel to the coastline of the Bay of Bengal. Most of the area is flat and the elevation varies from 10 to 20 meters above sea level.

3.4.3 *Natural conditions*

The climatic seasons are classified as follows: Winter – January and February, Summer – March to May, Southwest Monsoon – June to September and Northeast Monsoon – October to December.

The climate of Nellore is a typical tropical maritime climate, with warm and humid summers as well as mild winters. April and May are the hottest months and the hot conditions generally last till the end of June, while December, January and February are the coolest months. As Krishnapatnam is near the Bay of Bengal, the sea breeze contributes to moderation of climate both in winter and summer. The maximum temperature is 36-46°C during summer and the minimum temperature is 23-25°C during winter.

The humidity level is high due to its proximity to the coast. Nellore does not receive much rainfall during the Southwest Monsoon season, although rainfall occurs between the months of October and December. The rainfall ranges from 700–1,000 mm and about 60 percent of the annual rainfall will occur during that season. Cyclones are common in Nellore during the Southwest Monsoon period and accordingly cause floods at places across the area. It is noted that Nellore has both drought and flood risks depending on the seasons.

3.4.4 *Current Land Use / Distribution of Settlement and Social Facilities*

Land Use & Settlement

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

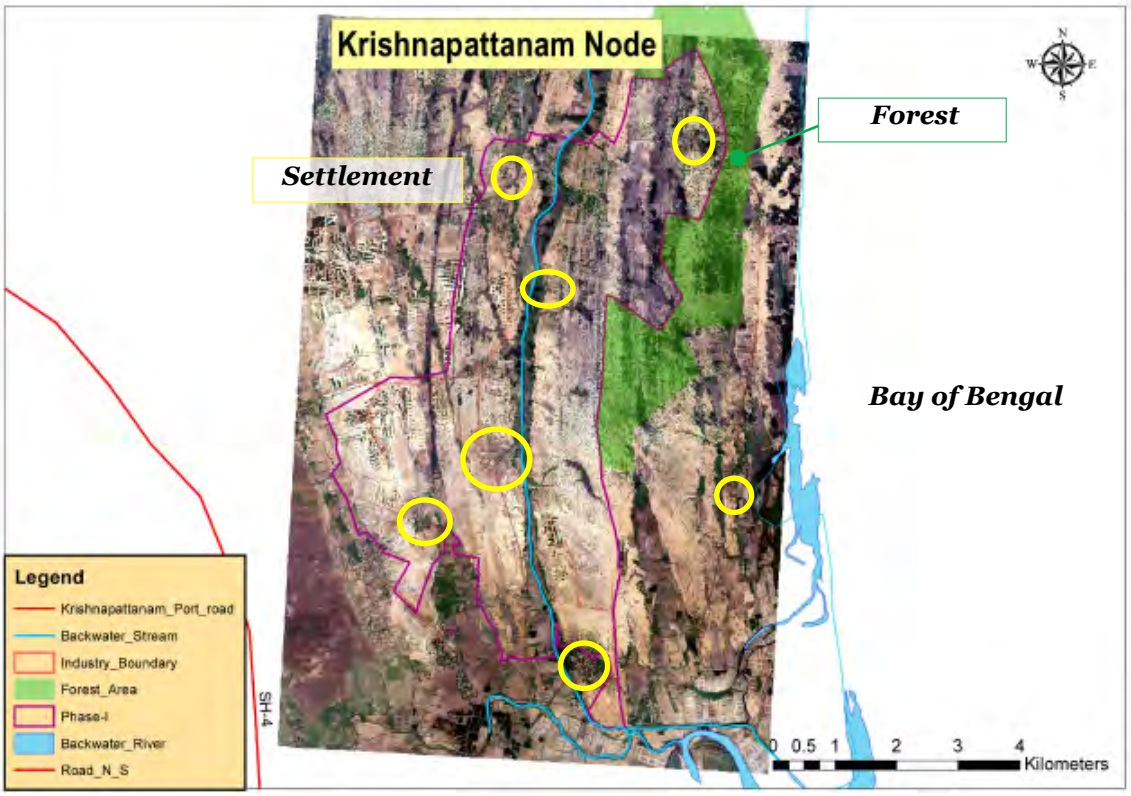


Figure 3.22: Distribution of Settlements in Krishnapatnam Node

Source: JICA Study Team

Most of the land within the Krishnapatnam node area is vacant. However, a few settlements are located and scattered inside of the area. (See yellow circles in above figure) The area of the existing settlements inside Node is roughly measured as 243 Acre on the satellite image. R&R plan is needed to be prepared during DPR stage.

A small canal crosses the site in a north-south direction. Taking into account the need to conserve the natural environment, the alignment should be unchanged. Reserved forest is spread in north part of the Node, and the area has to be protected from any developments.

Since this area is located along the coastline, the topsoil is sandy as shown in following photo.

Figure 3.23: Reservoir nearby Node Area

Figure 3.24: Surface of Node Area

Figure 3.25: Existing Access Road

Figure 3.26: : Subbase of the Access Road

Source: JICA Study Team

Social Facilities

While there is no health centre in the node area, there is one community school that is being constructed by Krishnapatnam Port Company limited.

3.4.5 *Land Acquisition Status*

For the areas covered by phase 1 of the Krishnapatnam SEZ, 90% of the land has already been acquired by APIIC and allocated to Krishnapatnam Port Infra-Tech Limited (KPIL). However the land acquisition for phase 2 is still in progress. In addition, 1332 acres of new land in the north (Thamminapatnam village) is planned to include as future expansion area through discussion with APIIC.

The land acquisition status of the Krishnapatnam Node as of June 2015 is summarised below:

Table 3.6: Land Acquisition Status of Krishnapatnam Node as of June 2015

Node		Area	Govt. Land	Pvt. Land	Acquisition Status	Remarks
Krishnapatnam Node	**Total**	**5,654 ha (13,971 Acre)**	**656 ha (1,620 Acre)**	**4,998 ha (12,350 Acre)**		
	Phase-1	2,226 ha (5,501 Acre)	312 ha (770 Acre)	1,914 ha (4,730 Acre)	Completed	312 ha are owned by APIIC and 1,914 ha has been handed over to KPIL.
	Phase 2	3,428 ha (8,470 Acre)	344 ha (850 Acre)	3,084 ha (7,620 Acre)	Under acquisition	The concessionaire or APIIC is in the process of land acquisition.

Source: JICA Study Team

Note: Figures in the table are approximate numbers. The field survey has to be done and confirm the exact figures for each land.

4 Node Development Vision – Krishnapatnam

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 Krishnapatnam Industrial 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. Based on a Competitiveness Framework, target functions were identified as part of the identified Node Development Vision.

4.2 Potential as an Industrial Hub for Resource-driven Industries

Krishnapatnam Industrial Node's Unique Selling Proposition is its proximity to the Krishnapatnam Port, established connectivity to NH-5 and good rail connectivity at Krishnapatnam port. It is a greenfield location which provides flexibility to plan adequate logistical facilities.

Strategically located in 140 km of Chennai and only 10 km away from Krishnapatnam port, the node is has high potential to develop as a hub for resource-driven industries servicing both exports and import. It can facilitate development of port-based industries as well.

The node is aimed at becoming a new center of economic activity of Nellore district given its potential for employment generation, which will support improvement of socio-economic profile for the area as well as the Nellore district.

4.2.1 SWOT Analysis

The following matrix summarizes current strategic positioning of Krishnapatnam Industrial Node with analysis of the strength, weakness, opportunity and threat. It is useful for evaluating development potential of the region which could lead to the future vision, direction and strategy for the further development.

The analysis is based on the survey result shown in the subsequent chapters on existing condition in each sector, i.e., land use, infrastructure and industry.

Table 4.1: SWOT Analysis for Krishnapatnam Node

	Strengths	*Areas for improvement*
Internal	***Strength:*** • Proximity to Krishnapatnam Port • No confirmed disputes on land acquisition, and relation with local residents due to CSR activities • Connectivity to NH5 as a part of GQ Highway • Flat land suitable for road and building construction • Good railway connectivity at Krishnapatnam port • Presence of development plan and capable private developer • Broad area enabling strategic allocation of waste management facilities • Benefits as Special Economic Zone • Small environment influence due to distance from main road and no protected forestry area • Availability of potential water resources from Kandaleru reservoir, recycling plant of Nellore city, and desalination plant • Greenfield location which provides flexibility to plan adequate logistical facilities and multimodal parks	***Weakness:*** • Distance form highly populated area, i.e., Chennai (140km) and Bangalore (310 km) • Existence of sensitive areas, i.e., agricultural land and local villages • Unavailability of ground water due to high level of salinity concentration • Lack of appropriate logistical facilities and good connectivity • Weak access to the internal area (Only an access road to port is not enough at peak time of traffic congestion.) • Lack of disposal facilities and monitoring capacity for waste occurred from the Krishnapatnam node in the future • Limited usage of land along the coastal area (Phase II) • Possibility of salt and wind damage
External	***Opportunity:*** • Growing interest of potential investors to the Krishnapatnam node due to overall policy direction of Andhra Pradesh Government to enforce the investment environment • Growing interest of foreign investors to India due to expectation to initiatives of new regime and prime minister • Existence of solid waste management plan for Krishnapatnam Port • Recent momentum of 3R in the region	***Threat:*** • Change of land law in 2013, which may cause delay of land acquisition to planned area due to the increased compensation to local people • Possibility of cost elevation for land acquisition due to the master planning • Uncertainty in current master plan which extends resident and commercial areas to a coastal line • Necessity of disaster mitigation measures

Source: JICA Study Team

4.2.2 *View of Andhra Pradesh State Government*

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

The Krishnapatnam Node shall:

- Attract foreign investors through establishing best investment environment among other industrial parks at east coast area of CBIC including the Chennai region.
- Provide the best business environment for foreign investors through maximizing advantage as the closest industrial park to Krishnapatnam port.
- Solve the issue of solid waste management currently most of the major Indian cities are facing.
- Show a success model of smart city beyond the current broad definition in India, so that the Government can study and develop the most suitable concept for India.
- Become a major manufacturing city led by private sector in India, especially one or two globally major companies

4.3 *Vision for Krishnapatnam – 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 Krishnapatnam Industrial Node should have the following characteristics to build Node Competitiveness:

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

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

Quality of Life
Responsive Governance,
Civic Services,
Affordable Housing
Public Facilities,
Parks & Recreation,
Leisure and Retail facilities

Industry Competitiveness
Cost Competitiveness,
Ease of doing Business,
Enhanced connectivity,
Logistics services,
Skilled Manpower

Sustainability
Economic and Environmental Sustainability,
Waste management, Recycled water,
Renewable energy, Skill Development, Organic Growth

4.3.1 *Planned Growth Strategy*

The industrial development at Krishnapatnam 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.

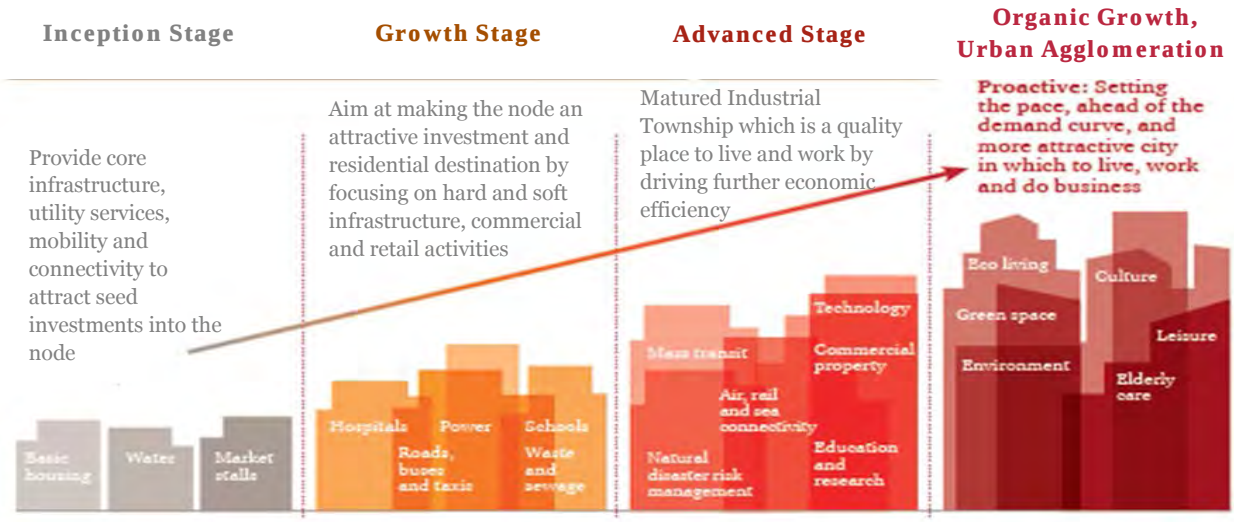
  In addition, the nodes will also start accommodating a proportion of workers within the nodes as Resident Workers. In this stage, the Node is trying to provide the basic infrastructure so as to be able to attract investors to take industrial land parcels and create a seed development. The land allocation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

4.3.3 *Knowledge Park in the node region*

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

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

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

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

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

Positioning of Krishnapatnam based on these four components is shown below:

Infrastructure

Strengths & Opportunities

- ✓ Proximity to Krishnapatnam Port
- ✓ Connectivity to NH 5 as a part of GQ highway
- ✓ Existing solid waste management plan for Krishnapatnam port
- ✓ Green field plan-flexibility to plan adequate logistical facilities and multimodal parks

Challenges

- ✓ Weak access to internal areas
- ✓ Distance form highly populated area, i.e., Chennai (140km) and Bangalore (310 km)

Business Environment

Strengths & Opportunities

- ✓ Growing interest of potential investors to the Krishnapatnam node due to overall policy direction of Andhra Pradesh Government to enforce the investment environment
- ✓ Growing interest of foreign investors to India due to expectation to initiatives of new regime and prime minister

Challenges

- ✓ Change of land law in 2013, which may cause delay of land acquisition to planned area due to the increased compensation to local people

Strengths & Opportunities

- ✓ Andhra Pradesh has more than 50 prestigious and central and state R&D laboratories
- ✓ Strong base for engineering colleges

Challenges

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

Strengths & Opportunities

- ✓ Availability of Potential water resources from Kandaleru reservoir, recycling plant in Nellore city and desalination plant
- ✓ Existing solid waste management plan for Krishnapatnam port
- ✓ Flat land suitable for road, building and amenities construction

Challenges

- ✓ Possibility of cost elevation for land acquisition due to the master planning

Human Capital

Livability

Successful Science and Technology parks in the World

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

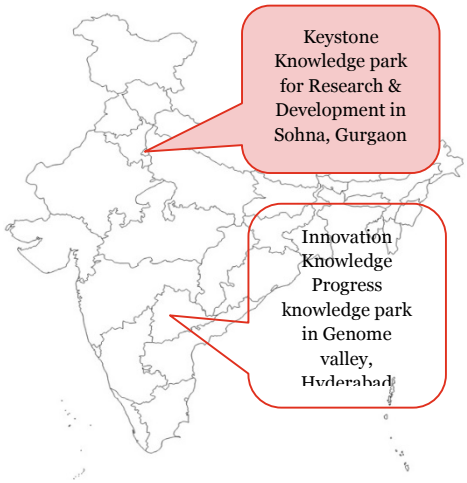
Berlin Adlershof, Germany
•**Area:** 1,038 acres
•**Type of activities:** Photonics and Optics, Renewable Energies and Photovoltaics, Microsystems and Materials, IT and Media, Biotechnology and Environment Analytics
•***Business Environment:*** Successful model of how public subsidies can stimulate sustainable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

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

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

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

Knowledge parks in India



Keystone Knowledge park [7] 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 well-versed amenities. Keystone Central is LEED Gold rated, enabling tenants to optimize their operational costs while demonstrating their commitment to sustainability. It is associated with private funding. This attracts industries from pharmaceutical, biotechnology, petrochemicals, new materials, crop protection, Agri Biotech labs, chemicals, Nanotechnology sectors along with plug and play office space. Key stone SEZ is well connected to this park.

Innovation Knowledge Progress (IKP) knowledge park [8] 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.

[7] http://www.keystonesez.com/
[8] http://www.ikpknowledgepark.com/

5 Industrial Development Analysis

5.1 Proposed Industries Mix for Krishnapatnam Industrial Node

5.1.1 Focus sectors selected for CBIC region

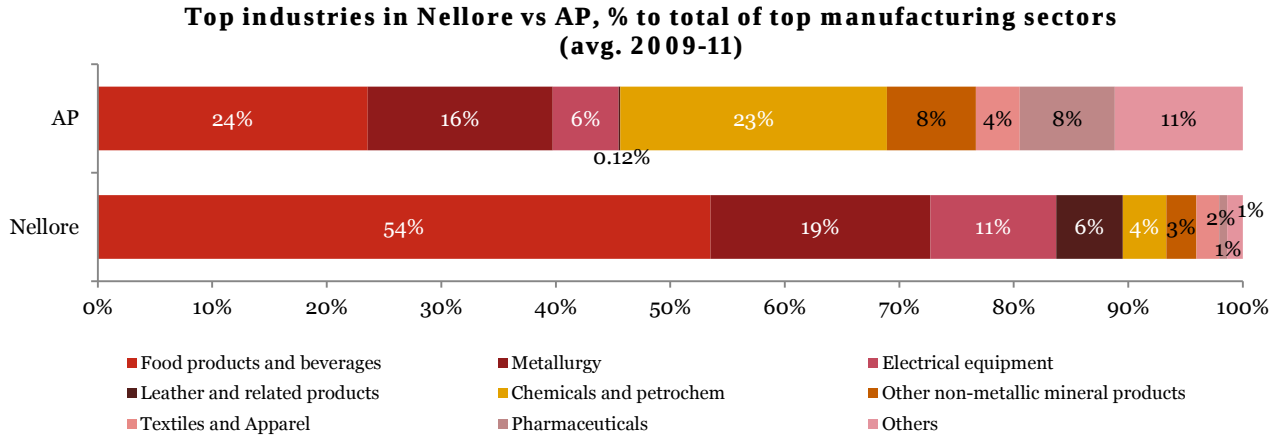
Initial study identified focus sectors for CBIC region. In depth analysis for identifying potential industries for the corridor was undertaken as a part of Interim Report 1 under Part A of this study. As per the analysis undertaken, the following manufacturing sectors are the key drivers of industrial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

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

Figure 5.1: Sectors shortlisted as potential sectors for the corridor

Rationale for initial viable sectors for KPT node

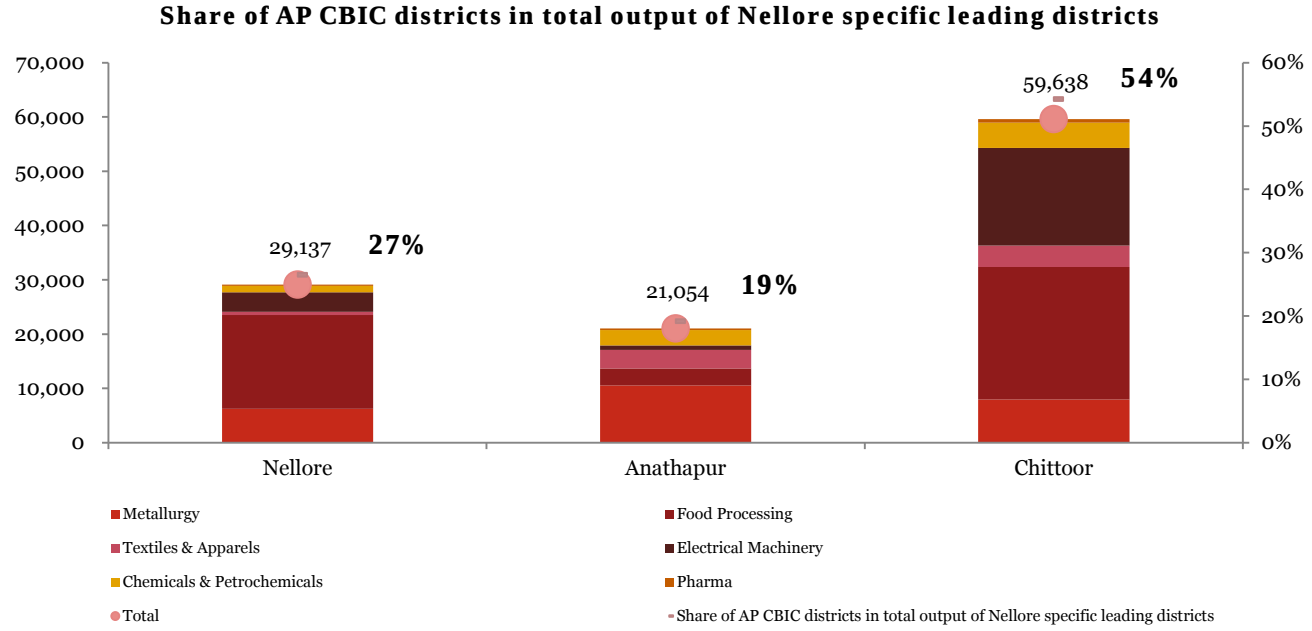
Viable sectors for KPT IN were chosen based on industrial based and existing FoPs. The consultant has analysed the manufacturing output of Nellore district and arrived at the top industries pertaining to the district. The leading sector is food processing (including beverages), followed by metallurgy and allied industries, electrical machinery and leather sectors. Food processing sector of Nellore in percentage terms is more than double of the same of Andhra Pradesh. It is also the largest contributor to the district's output of manufacturing sector. Share of each of the top sectors in Nellore and AP, is given in the figure below:



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

Figure 5.2: Top sectors in Nellore district vs AP

The consultant has selected sectors in Nellore district that form a part of focus sectors for entire CBIC region. Further, he has also analysed output of similar industries in other two CBIC districts of Andhra Pradesh to arrive at the total output in these 3 districts. Average share of leading sectors for Nellore district was calculated to understand prominence of contribution of Nellore district to the total output of similar sectors of other AP CBIC districts.



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

Figure 5.3: Share of AP CBIC districts in total output of Nellore specific leading districts

The consultant also assumed that basis of industrial development will be formed by the sectors traditionally present in Nellore district for which the district offers certain factors of production and which also form a part of CBIC region focus sectors. The remaining CBIC focus sectors fall under the category of "highly potential". Since they are proposed to be promoted for development in the CBIC region as a whole, it is assumed that with time the necessary FoPs will be created for them and it may be expected that select segments of these sectors may come to KPT IN.

Share of traditional sectors is assumed to be 80%, potential – 20%.

Selected Sectors for KPT node

6 traditional sectors and 4 highly potential sectors were finalised for KPT node. Based on analysis of industrial base in Nellore district, the consultant suggests that the following sectors, **traditionally present in Nellore**, are to be considered as focus sectors for KPT IN.

There are also several sectors that hold a very high potential for the CBIC region. In case of Nellore, the sectors mentioned below may be considered as **highly potential for KPT IN;** however, the availability of FoPs may not be favorable to accommodate all of them. Given the nature of the industries in the proximity to the node, FoPs available, Automobiles and Machinery sectors hold higher probability to gain prominence in the KPT IN.

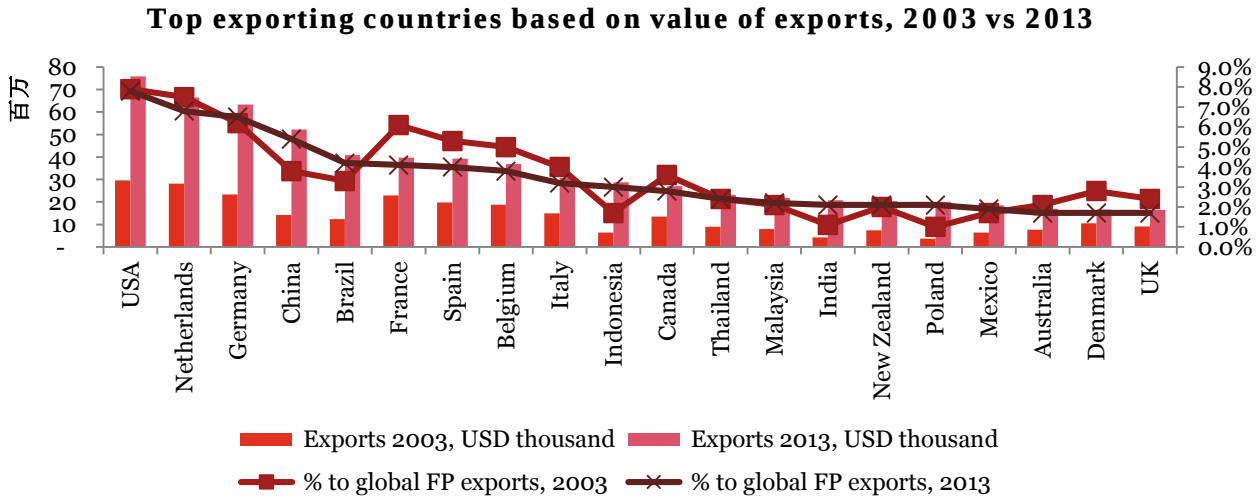
5.2 *Planning development of industry sectors for KPT Industrial node*

5.2.1 *Food processing*

Sector performance

The global Food Processing industry was estimated to be USD 3,200 billion in the year 2010[9]. 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 20 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[10].



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

Figure 5.4: 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

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

edible meat offal (from 23rd rank in 2003 it secures 8th rank globally) fish, crustaceans, molluscs, aquatic invertebrates (from 12th to 4th rank), animal vegetable fats and oils, cleavege 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.

Table 5.1: Trade competitiveness ranking, 2003 vs 2013, Food processing[11]

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, Cleavege 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

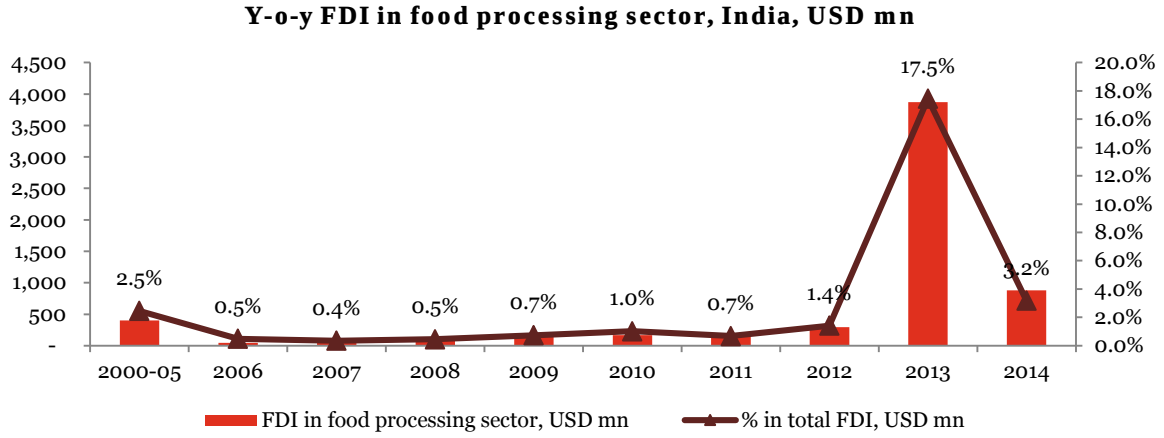
Food processing industry is one of the largest industries in India and is estimated to be worth USD 121 billion in 2012 and accounts for 32% of country's total food market[12]. With a huge agriculture sector, abundant livestock, and cost competitiveness, India is fast emerging as a sourcing hub for processed food.

Around 90% of the output of food processing sector is contributed by four sub-sectors - vegetable oil, grain mill and starch, dairy and other food products. Output of the sector has increased from over USD 62 billion in 2008-09 to over USD 90 billion in 2010-11[13] and is expected to grow at a CAGR of about10% till 2015[14].

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, Hershey's, McCormick, etc.

[11] Numbers in brackets represents rank in 2003
[12] *D&B Research*
[13] *Annual Survey of Industries (Conversion 1USD = 60 Rupees)*
[14] *D&B Research*



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

Figure 5.5: FDI in food processing sector, India

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

Table 5.2: 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[15]	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.

Viability drivers for future investments

There is number of growth drivers fuelling the processed food sector in India and Nellore.

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

(i) 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

(ii) KPT IN level related

Nellore district, and KPT, in particular, has certain drivers that make food processing as one of the most prominent sectors for this site:

High input base of raw material	Well established food processing sector in the district	Government support	Favorable location for exports

- **High input base of raw material**

Nellore district is primary sector intensive. Primary sector contributes 29% to GDDP (2010-11) and slightly higher than state's average – 27%.

Rich agricultural produce create favourable scenario for such resource based industries development in Nellore as food processing. Agriculture is the main occupation of the people of the district. Rice is the staple food of the people and paddy is the principal food crop followed by bajra, jowar and ragi crops. Tobacco, groundnut, chillies, sesamum, sugarcane are also mainly cultivated.

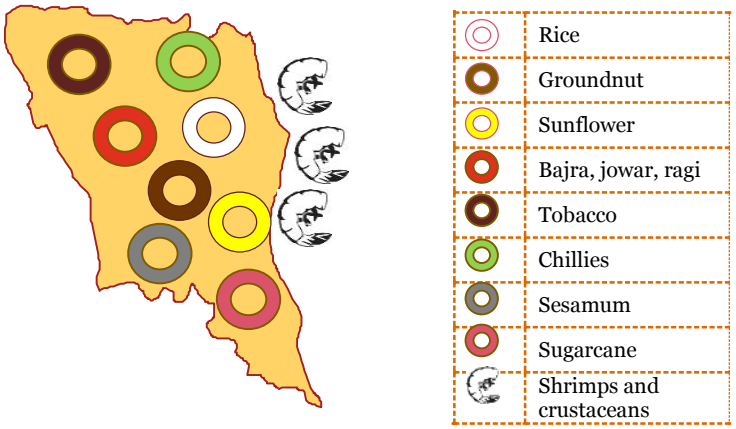


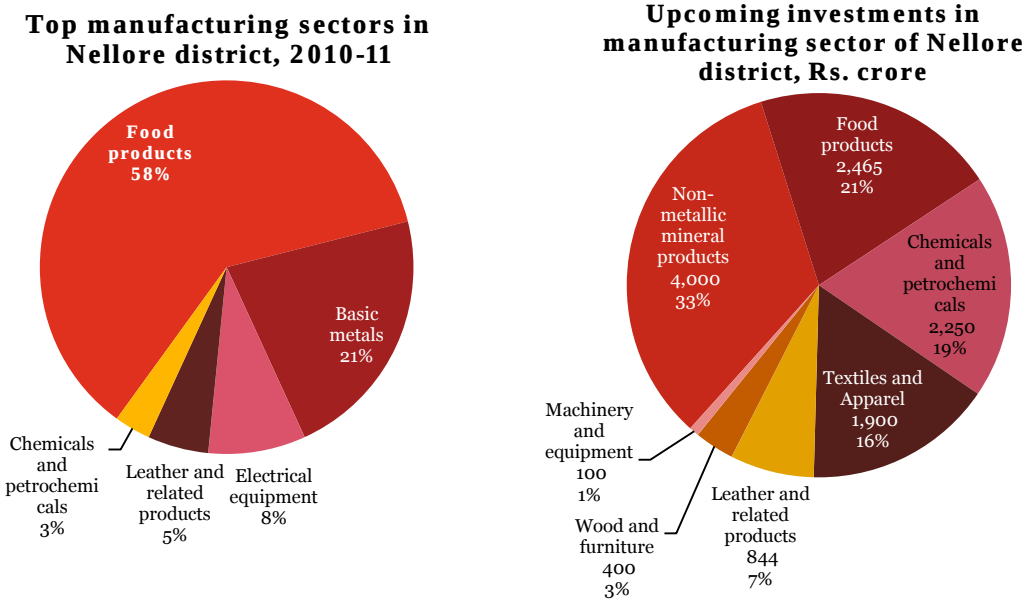
Figure 5.6: Natural resources in Nellore district – agriculture, aquaculture

Nellore district has a long coast line with shrimps and crustaceans under cultivation. Fish is also available in plenty and good number of aqua processing plants, feed mills and ice plants exist in the district.

- **Well established food processing sector in the district**

Food processing sector in Nellore district is the largest contributor to district's manufacturing output – 58%.

Upcoming projects are 21% of total announced investments in food processing sector in Nellore district. Major investments are announced in the following segments: dairy products, processed foods (soft drinks) and coffee.



Source: ASI 2010-11, Capex database

Figure 5.7: Manufacturing sectors of Nellore district and upcoming investments

- **Government support**

Food processing has been announced as one of the thrust sectors for Andhra Pradesh under Industrial Investment Promotion Policy 2010-2015 with special focus on MSMEs

To give a special focus on Food Processing industry the state of Andhra Pradesh has announced Food Processing Policy of Andhra Pradesh 2010-15. Units of horticulture, agriculture, animal husbandry, fisheries, agro food processing industries, allied industries are beneficiaries of the incentives announced under this policy

The Food Parks sanctioned under Mega Food Park scheme of Government of India would be considered for Tailor-made benefits on case to case basis.

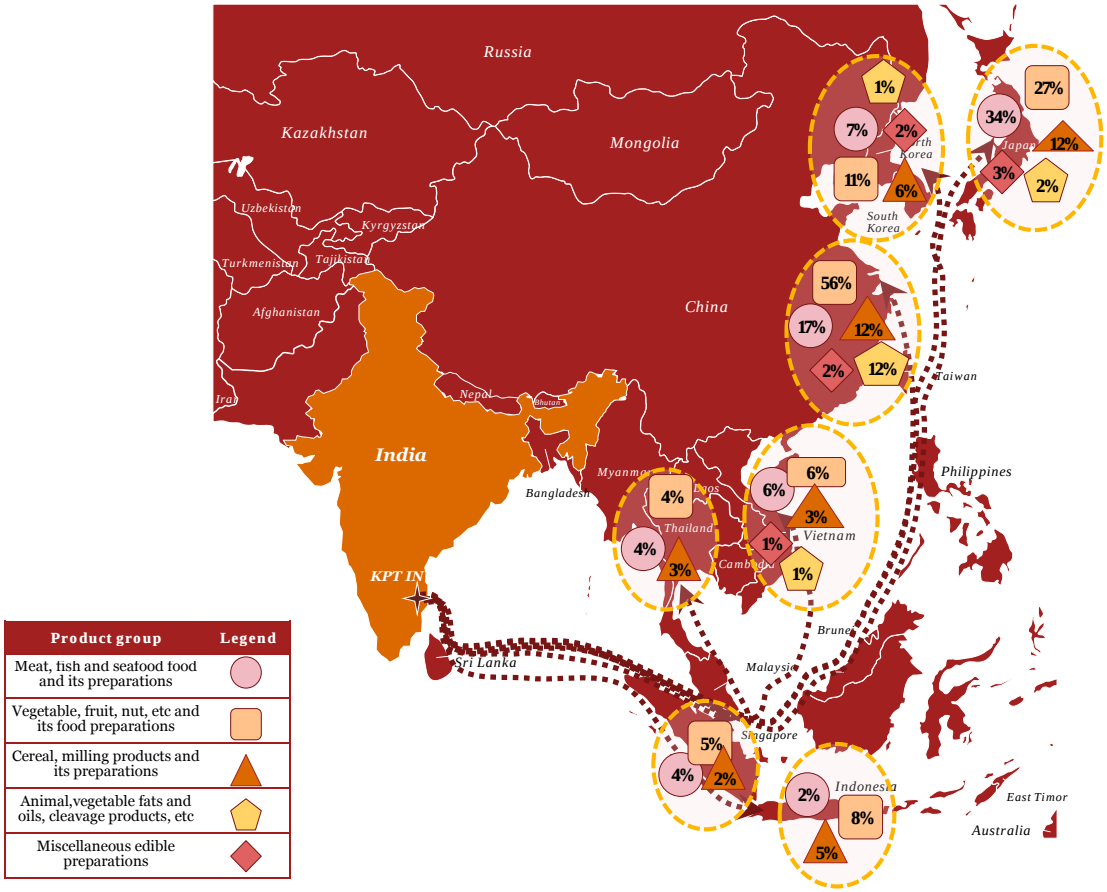
- **Proximity to port – favorable location for exports**

KPT IN is favorably located in immediate vicinity to the Krishnapatnam port. The export oriented units in food processing sector can leverage proximity to the markets of the leading processed food importing countries. The distance to the ports of the some top food processing products importing nations varies from 8.0 days to 22.0 days.

KPT port	Port in potential importing country	Average distance by sea route, days
Krishnapatnam port	Port of Shanghai, China	19.3
	Port of Tokyo, Japan	23.8
	Port of Chinae, South Korea	21.6
	Port of Hanoi, Vietnam	15.3
	Bongkot Terminal, Thailand	10.2
	Jurong Port, Singapore	8.0
	Anyer Terminal, Indonesia	9.5

Source: ports.com

The figure below depicts the proximity of the node to the leading importing countries of various product groups in food processing sector.



Source: intracen.org, ports.com, PwC analysis

Figure 5.8: Share of world imports in food processing product groups of top importing countries in the Southeast Asia; proximity from KPT port

For example, Japan is the largest importer of meat, fish and seafood products in the world. The top exporter contributes 26% to total exports in this product group, whereas India has only 2% share.

Assuming unconstrained scenario, the consultant has taken an example Japan and analyzed India's exports position in food processing sector exports to this country vs top two exporting nations.

Table 5.3: Share of top exporting countries vs India to Japan in food processing sector

Food processing sub-sector	Exporter - Top 1 % of total FP imports to Japan		Exporter – Top 2 % of total FP imports to Japan		India % of total FP imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
Meat and edible meat offal	US	32%	Australia	18%	0%	60.3	13.6	23.8
Fish, crustaceans, molluscs, aquatic invertebrates nes	Chile	11%	US	11%	4%	67.2	60.3	23.8
Dairy products, eggs, honey, edible animal product nes	Australia	23%	New Zealand	22%	1%	13.6	28.2	23.8
Edible vegetables and certain roots and tubers	China	58%	US	11%	0%	3.2	60.3	23.8
Edible fruit, nuts, peel of citrus fruit, melons	US	33%	Philippines	30%	2%	60.3	7.1	23.8
Coffee, tea, mate and	Brazil	22%	Colombia	13%	3%	59.8	66.2	23.8

Food processing sub-sector	Exporter - Top 1 % of total FP imports to Japan		Exporter – Top 2 % of total FP imports to Japan		India % of total FP imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
spices								
Cereals	US	67%	Canada	11%	0%	60.3	62.2	23.8
Milling products, malt, starches, inulin, wheat gluten	Canada	19%	Australia	12%	0%	62.2	13.6	23.8
Oil seed, oleagic fruits, grain, seed, fruit, etc, nes	US	34%	Canada	29%	0%	60.3	62.2	23.8
Animal, vegetable fats and oils, cleavage products, etc	Malaysia	38%	Italy	11%	3%	9.9	41.9	23.8
Meat, fish and seafood food preparations nes	China	44%	Thailand	29%	0%	3.2	13.7	23.8
Sugars and sugar confectionery	Thailand	38%	Australia	19%	0%	13.7	13.6	23.8
Cocoa and cocoa preparations	Singapore	22%	Malaysia	13%	0%	14.3	9.9	23.8
Cereal, flour, starch, milk preparations and products	China	21%	Singapore	15%	0%	3.2	14.3	23.8
Vegetable, fruit, nut, etc food preparations	China	43%	US	18%	1%	3.2	60.3	23.8
Miscellaneous edible preparations	US	17%	Thailand	12%	1%	60.3	13.7	23.8

Source: intracen.org, ports.com, PwC analysis

It is evident that India's share in food processing exports to Japan is quite modest; in spite of it having locational advantage in 12 product groups out of 16.

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.[16]

There is number of challenges/issues hampering the growth of the food processing sector across the value chain across the country:

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

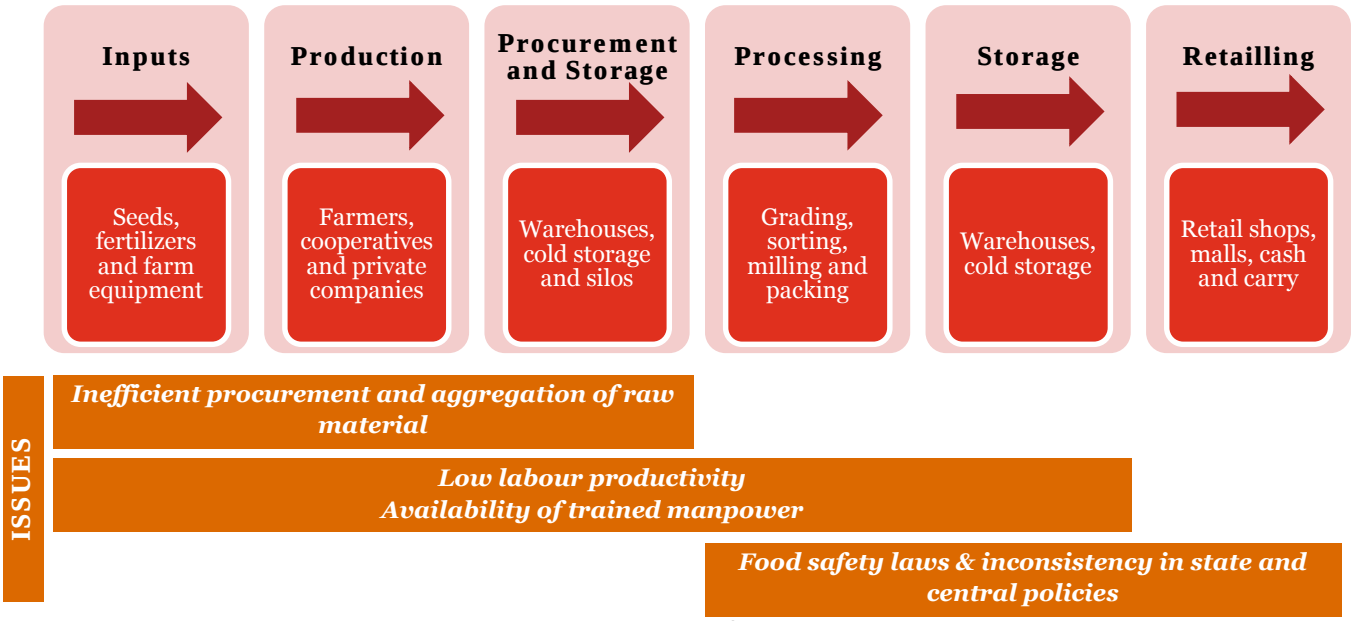


Figure 5.9: Value chain in food processing sector

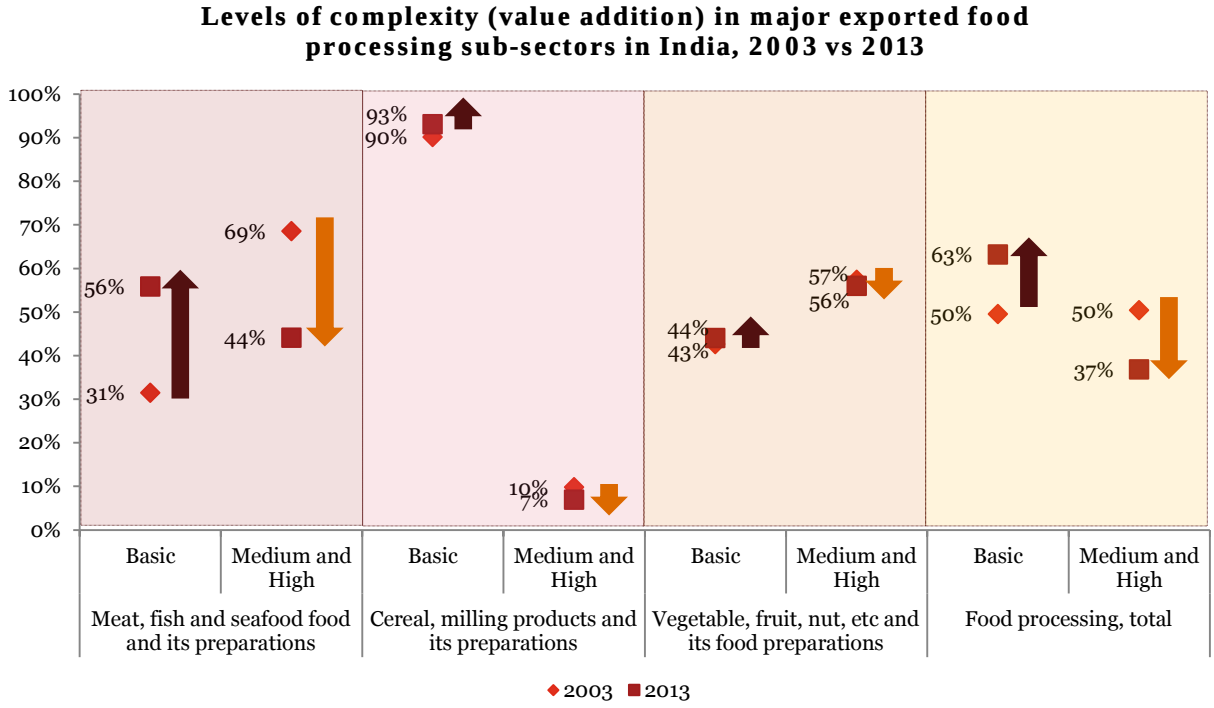
Indian food processing sector has one of the lowest levels of processing activities vis-a-vis other countries.

Table 5.4: 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 5.10: Constitution of food processing exports basket in India – level of processing complexity (value addition), 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**

The 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, 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.

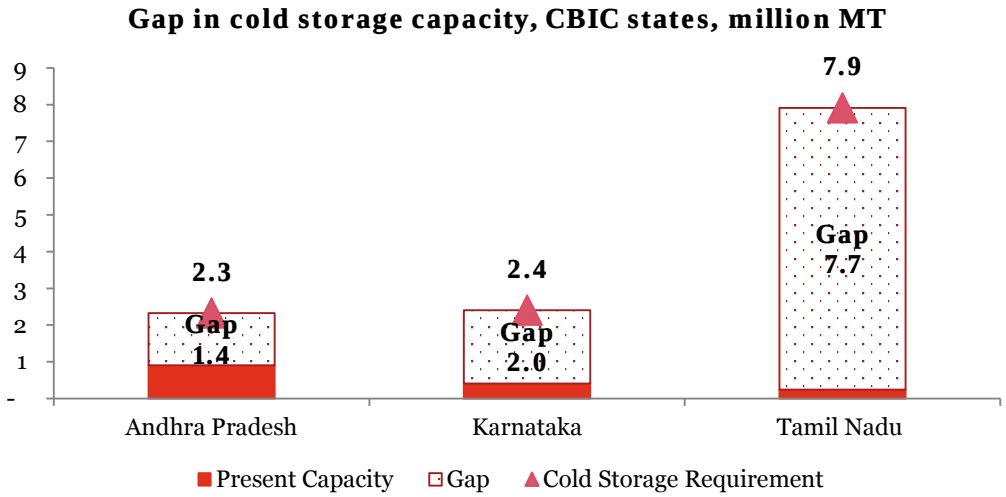
Status of current regulated markets by Agricultural Produce Market Committees (APMC) is discouraging in terms of infrastructure facilities. Gaps in Marketing Infrastructure:

- 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[17].

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.



Source: National Spot Exchange (NSE) and DMI

Figure 5.11: 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.

- **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[18] and Contract Farming[19]. However, until recently, very few states have made reforms at state level in the APMC Act

[17] 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

to enact these concepts. Private sector is also reluctant about participation in such reforms due to excessive politics involved in procurement and operations of such facilities.

- **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.

- **Low labour productivity**

Another critical issue in India hampering food processing industry is low labour productivity. The level and structure of the Indian food processing industry reflects that food production 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 10,103, which is twice lower than in China and almost three times lower than in Brazil.[20]

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.

---

[18] 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.

[19] 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.

[20] Agro-Industries for Development, UNIDO

- **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.

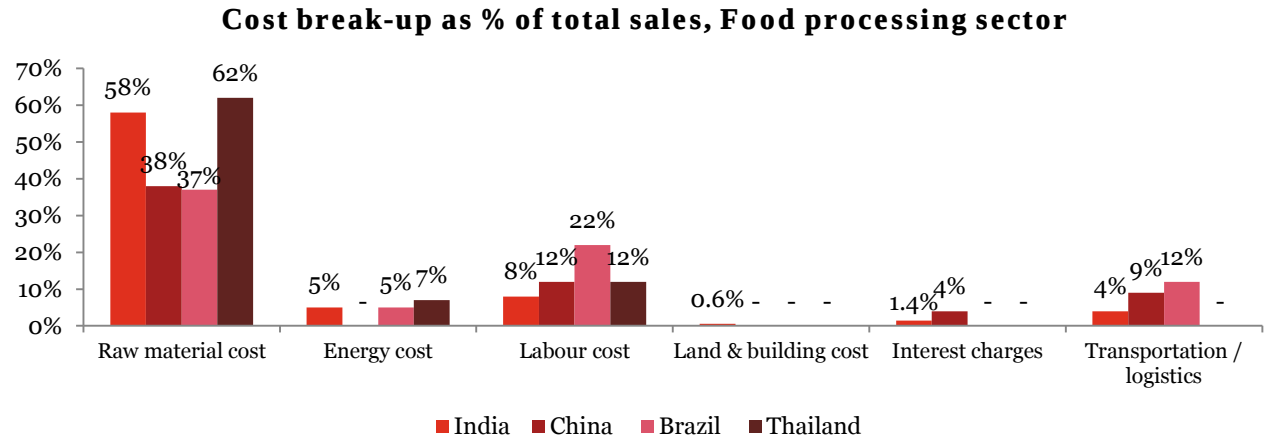
Apart from the above major challenges hampering the growth of sector include constraints in raw material production, taxation, access to credit, processing plants with obsolete technologies, lack of applied research etc.

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:

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

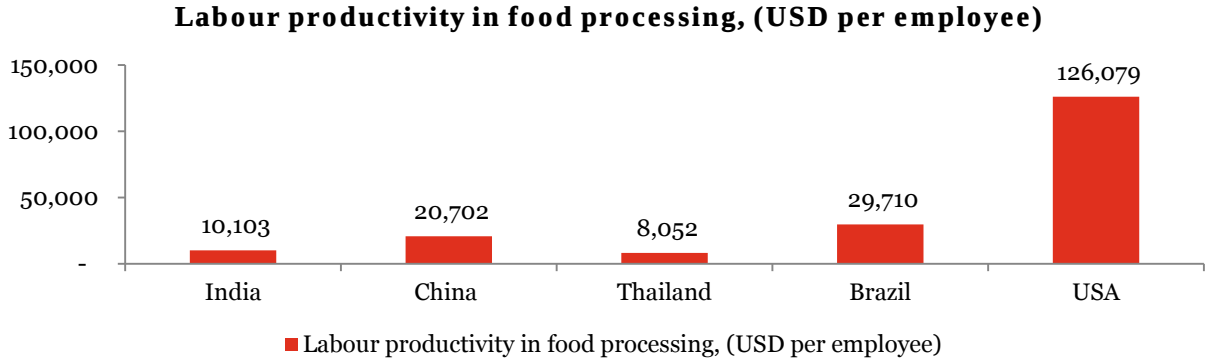
Figure 5.12: Cost structure – food processing sector

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.

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 5.13: Labour productivity for food processing (fish & seafood) sector

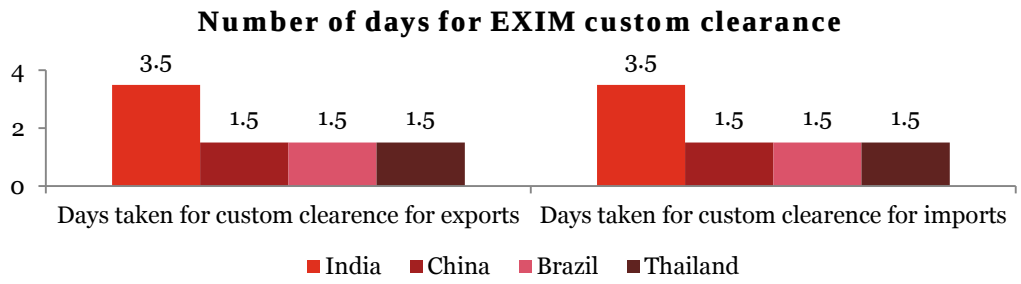
Higher labour productivity of competing countries is one of the sources of competitive advantage over India, as shown in the figure above.

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.

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 5.14: 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.

India's disadvantage implies that, the delivery of imported raw material 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.

Case studies – Success factors in select leading countries in food processing

NETHERLANDS

The Netherlands is the world's second largest exporter of agricultural products, after the USA. Together with the USA and France, the Netherlands is one of the world's three leading producers of vegetables and fruit. It supplies a quarter of the vegetables that are exported from Europe. The agri-business is one of the driving forces behind the Dutch economy.

At the same time, it poses challenges to the environment. In recent decades, farms became larger in scale and production became more intensive. As a result, fertilizers and manure made more impact on the countryside.

Farming had to become more sustainable, the Dutch government said. Today, the Dutch agricultural sector is strongly focused on sustainability: it is a source of healthy, safe food that is produced with respect for the landscape and the environment.[21]

Key success factors of food processing sector in Netherlands

- Expertise, infrastructureand logistics are all on an extremely high level in the Netherlands
- Continually investing in the renewal of agricultural production chains
- Farmers and growers are full partners in the agricultural production chain
- Substantial ivestments in environmental protection and implemented improvements in animal welfare

MALAYSIA

Malaysia is one of the leading countries in term of food processing sector. The food-processing sector account for about 10% of Malaysia's manufacturing output.

[21] http://www.hollandtrade.com/sector-information/agriculture-and-food/?bstnum=4909

Processed foods are all over the world. Especially, Malaysia is the world's largest exporter and the second world's largest producer of palm oil in the world.

Malaysia and Indonesia account for more than 85 % of the world palm oil output and about 93% of global exports of palm oil[22].

Key success factors of food processing sector in Malaysia

Support for services sector including logistics

Quality control encouragement

Strong marketing support

Dedicated R&D facilities

- **Support for Integrated Logistic Service**
  Given that the need to ensure that the service providers subscribe to industry practices such as "just-in-time" and to point deliveries The Government has introduced the ILS incentive in 2002 to encourage logistics service providers to consolidate or integrate their activities and become Third Party Logistics Service Providers (3PLs). As at 31 December 2007, a total of 20 companies have been granted the Integrated Logistics Services (ILS) incentives[23].

- **Quality Control encouragement**
  Food manufacturers are certified by the internationally recognized MS ISO 9001:2000 Certification of Quality Systems in terms of production, installation and servicing. SIRIM QAS, a wholly-owned subsidiary of SIRIM Bhd., acts as a leading certification, inspection and testing body in Malaysia. For the purpose of health certification, MOH is putting continuous efforts in upgrading of laboratories in the MOH and Department of Chemistry with sophisticated and advanced instrumentation.

- **Storing Marketing Support**
  Marketing support is provided by agencies such as the Malaysia External Trade Development Corporation (MATRADE) and FAMA (Federal Agricultural Marketing Authority) through their wide network of local and international offices.

- **Dedicated R&D facilities**
  The Malaysian Agricultural Research and Development Institute (MARDI) focuses on the development of value-added products, with some of its research projects ready for commercialization. In addition, there are research institute for food processing including product specific research institutes, The Malaysian Agricultural Research and Development Institute (MARDI), The Malaysian Palm Oil Board (MPOB), Malaysian Cocoa Board (MCB), The Forest Research Institute of Malaysia (FRIM), The Fisheries Research Institute (FRI).

[22] Food Industry in Malaysia
[23] OCCUPATIONAL STRUCTURE Integrated Logistics Services Industry

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 Krishnapatnam emerges as a top destination for food processing can be broadly classified around the three main areas:

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

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

Table 5.5: Key design implications for food processing sector

Components	Issues	Design Implication
Economic enhancers		
Connectivity	• Lack of last mile connectivity • Access road from Krishnapatnam port to Node area is an unpaved single lane road • Connectivity to the node from the highway is a single lane road	• Access road to Krishnapatnam and connectivity to NH-5 has to be improved. Krishnapatnam port trust has acquired land across the highway and widening activity is proposed • Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • A grid type road network will be followed • Three north-south trunk roads and east-west trunk roads each are planned
Water	• Water shortages in the Nellore district are persistent especially due to monsoon failures • Availability of water to the production (units located in government industrial parks are facing this issue) • Salinity of ground water due to proximity to the seaside • *Marine food specific:* – High tide affects water quality & salinity	• Creation of water management facilities • Maintenance of creeks/water sources, creation of canals, etc. • Quality water supply assurance by the node development and management authorities is required. The following arrangement has been proposed for the node: o APIIC has requested for the allocation water of 1.5 TMC from Kandaleru reservoir through letter vide CE-I/APIIC/CBIC/08/2015-16 dated 23-05-2015 o Krishnapatnam Water Supply Company (KPWSC) has proposed to supply 0.5 TMC out of this 1 TMC water to the Krishnapatnam node through the newly-developed distinct pipeline. If this proposal is approved, 39 MLD (0.5 TMC/year) of water would be allocated to the Krishnapatnam Node, thus water will be in abundance

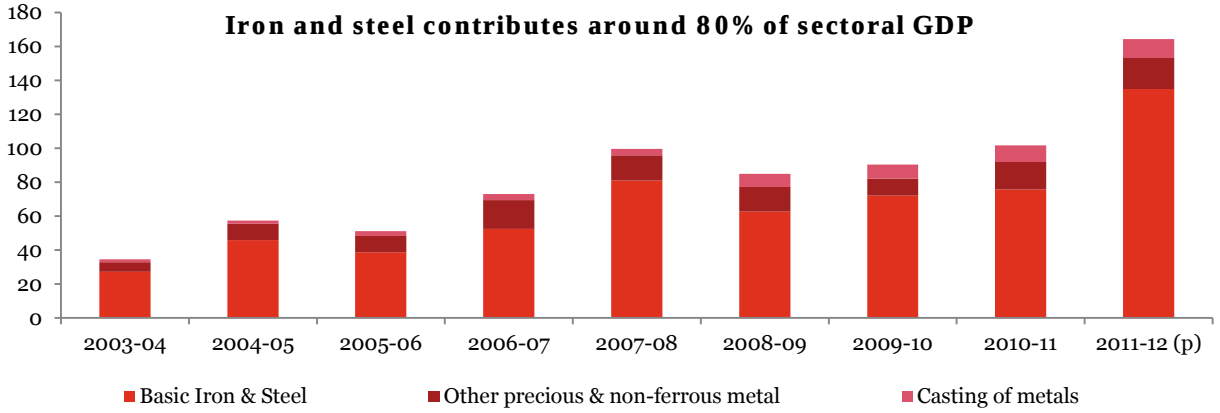
Components	Issues	Design Implication
	– severely affects the growth of shrimps – Ineffective maintenance of canals doesn't allow water from the sea to come inside and mix with fresh river waters	• It is expensive to convey the treated sewage from Nellore City to Krishnapatnam Node given 35 km distance. However, treated sewage from the STPs can be a reliable potential water resource for industrial water in Krishnapatnam Node • A desalination plant has been identified by the food processing units as one of the utmost requirements for the area. Desalination plant would be considered if the planned water supply project and the recycling system cannot satisfy the future water demand in the node • Drainage system may require a pumping system because the node area is wide flat land
Environment	• Development of port, other industries disrupts production • Lack of drainage for common water for the industries	• Careful planning of new industries is required as the segment is highly sensitive to water contamination • Introduction of green principles in manufacturing is to be promoted • Common effluent treatment plant can be developed by the government for similar industries within the district
Power	• For certain segments of food processing sector power cost is around 10-20% variable cost • Stakeholders are of the opinion that power tariffs are high in the region	• In medium term, power tariff subsidies for food processing industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries is required.
Logistics facilities	• Existing units experience issues with availability of trucks and tankers in vicinity	• Introduction of logistics hub in the node should facilitate
Storage facilities	• Manufacturing capacities of processing units have increased, but storage facilities are inadequate	• Support to units to create additional cold storage facilities is expected • Government can develop cold storage facilities in close vicinity of the markets and end consumers • To encourage investment in cold chain infrastructure, government may consider providing incentive 5 years for construction of modern automated warehouses and cold chains.
Value enhancers		
R&D facilities	• International practice suggests availability of R&D facilities for new product development within industrial park • *Marine related:* The initial component of the value chain is imported; R&D facilities for breeding SFP breeders are not available	• R&D laboratories can be proposed to serve the product development requirement of this industrial node as well as other food processing units within CBIC/country • *Marine food related:* Though almost the entire value chain is present in the country, it would be beneficial to develop indigenous capabilities for breeding SPF species
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	• 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 • Training centre can be proposed to be setup for training existing employees

Components	Issues	Design Implication
	this will require skilled labour	
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.	• Government of Andhra Pradesh may consider additional financial scheme to encourage procurement of upgraded machinery • Development of research center/center of excellence for value addition in food processing sector can be proposed in KPT IN. The center can explore tie ups with various organizations and research institutions abroad to emerge as a hub for new product development. It will help catering to the requirement of new products development higher on value addition • **New Product Development Center** Development of research center for value addition in food processing sector can be proposed in KPT IN. The center can explore tie ups with various organizations and research institutions abroad to emerge as a hub for new product development. It will help catering to the requirement of new products development higher on value addition
Administrative enhancers		
Ease of doing business	• 65 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	• Simplification of licensing system and reduction of the number of licenses is necessary. • Duplicating licenses is to be removed. Single window system is to be promoted. • In the opinion of existing units in the area, Factories department may act as a single point of contact and take care of all industries required by any industrial unit.
Policy and regulatory framework	• Existing policies to facilitate food processing sector in Andhra Pradesh have expired this year • Power related: no adequate mechanisms for the companies buying power from open access	• Provide policy extension/introduce new policies/schemes for the sector • In case of power holiday for entire day, companies that should be given incentives to trade power for the whole day and get compensated. mechanisms for companies which buy power from open access should be established
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	• GoAP 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

5.2.2 *Metallurgy*

Sector performance

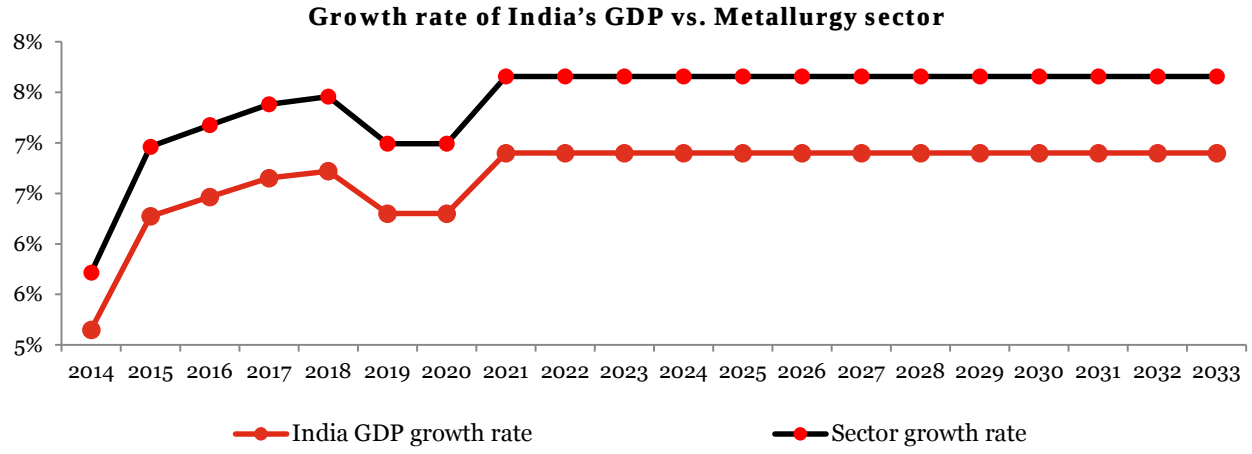
In 2012, Indian metallurgy sector registered an output of around US$ 140 billion[24] and contributed to around 2% of the national GDP[25]. In terms of sub-sectoral contribution, Iron and Steel industry contributes to around 80% of the sectoral GDP. At constant prices, the sector has registered growth of around 14% CAGR between 2003-04 and 2011-12. The high growth rate has been primarily driven by Iron and steel industry, which grew at 14.6% during the period.



Source: Annual survey of Industries, PwC Analysis

Figure 5.15: Contribution of sub-sectors to metallurgy sector GDP

However, between 2011-12 and 2013-14, India registered a slow growth rate in manufacturing sector as a whole, with 2.7%, 1% growth rates in successive periods from 2012-13 to 2013-14. In line with national GDP and manufacturing GDP, the growth rates during these two years are expected to be around 1%. Going forward, the national demand for the sector is expected to grow between 6-8%[26].



Source: ASI data, PwC analysis, Rajya Sabha replies

Figure 5.16: Growth rate of India's GDP vs. Metallurgy sector

Globally, metallurgy sector comprising iron & steel, aluminium, copper, nickel, lead, zinc, tin, silver and other basic metals, provides key inputs for a number of industries in the manufacturing sector. In 2012, at around US$ 855 billion, metallurgical sector constituted around 5% of global trade. The sectoral demand also drives the

[24] *Exchange rate of 60 Rs = 1 US$*
[25] *Annual survey of industries data, MOSPI and PwC Analysis*
[26] *Based on long term India GDP projections by IMF and Standard chartered, and sectoral elasticity co-eff to GDP as indicated by Working group on Iron and Steel,2012*

primary mining sector, which contributed about US$ 757 Billion (around 4%) to global trade during the same period.

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

Comparing the world competitive rankings of exporting countries between 2003 to 2013, China has taken a major leap in iron and steel exports, copper and articles and aluminum and articles, improving its position from Rank 17 to Rank 1, Rank 13 to Rank 5 and Rank 6 to Rank 1 respectively between 2003 and 2013. India on the other hand is not part of the top five exporting countries but has majorly improved its position in iron and steel (from rank 22 in 2003 to rank 12 in 2013), articles of iron and steel (from rank 20 to rank 10), nickels and articles thereof (from rank 33 in 2003 to rank 16 in 2013), aluminum and articles (from rank 42 in 2003 to rank 23 in 2013), lead and articles (from rank 48 in 2003 to rank 9 in 2013) and zinc and articles (from rank 40 in 2003 to rank 10 in 2013).

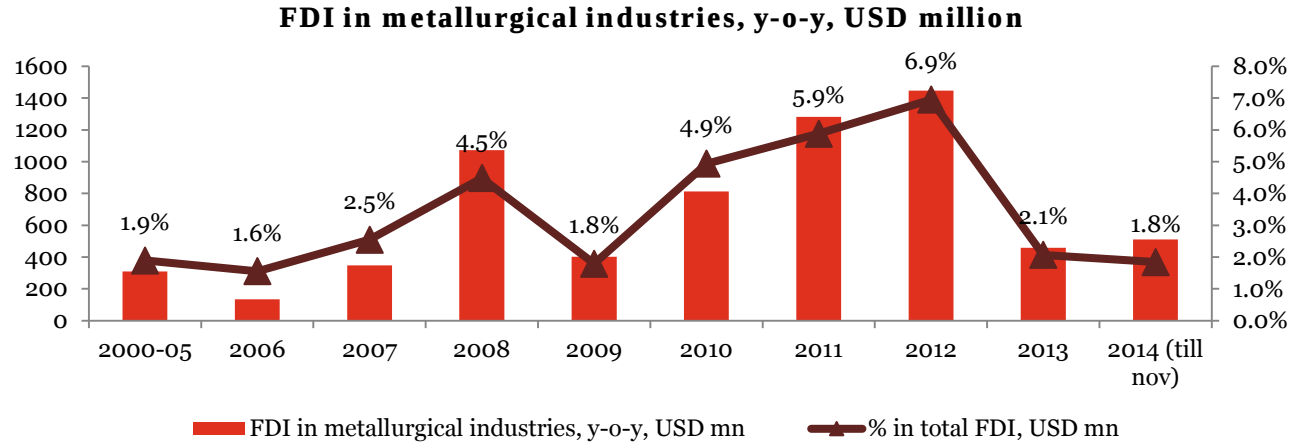
Table 5.6: Trade competitiveness ranking, 2003 vs 2013, Metallurgy[27]

Rank	Iron and Steel	Articles of Iron and Steel	Copper and articles	Nickels and articles	Aluminium and articles	Lead and articles	Zinc and articles	Tin and articles	Other base metals, cermets, articles
1	China (17)	China (2)	Chile (1)	Canada (2)	China (6)	Australia (2)	Canada (1)	Indonesia (1)	China (2)
2	Japan (1)	Germany (1)	Germany (2)	Russia (1)	Germany (1)	Canada (5)	Korea (6)	Malaysia (5)	USA (1)
3	Germany (2)	USA (4)	USA (3)	USA (5)	USA (3)	Germany (3)	Belgium (8)	Singapore (2)	Germany (4)
4	Korea (6)	Italy (3)	Japan (4)	UK (6)	Canada (2)	UK (6)	Australia (6)	Thailand (8)	Japan (3)
5	Russia (5)	Japan (6)	China (13)	Norway (3)	Russia (4)	Korea (12)	Netherlands (5)	Bolivia (7)	Russia (5)
India	**12 (22)**	**10 (20)**	**18 (23)**	**16 (33)**	**23 (42)**	**9 (48)**	**10 (40)**	**16 (22)**	**33 (42)**

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

Cumulative total FDI inflow in India during January 2000 to November 2014 is USD 237.3billion. Out of this total FDI inflow in the metallurgy industries during January 2000 to November 2014 is USD 8.3 billion which is 3.5% of the total FDI inflow. The highest growth was registered during 2011 and 2012 at an annual rate of 5.9% and 6.9% respectively.

[27] Numbers in brackets represents rank in 2003



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

Figure 5.17: FDI in metallurgical sector, India

Metallurgy sector is expected to be a key sector which may contribute to CBIC's success in terms of attracting investments to the corridor. The corridor states of Karnataka, Tamil Nadu and Andhra Pradesh, together contribute to about17% of the metallurgy sector output of India. Within the states, these districts have traditionally accounted for about12% of the total metallurgy sector investment in these 3 states. CBIC region has presence of end-use industries for metallurgy sector like automobiles, defence, construction, etc which are likely to act as demand pullers for the Metallurgy industry in the state. Within the corridor however, the presence of key metallurgy industries is weak currently. S

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

Viability drivers for future investments

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

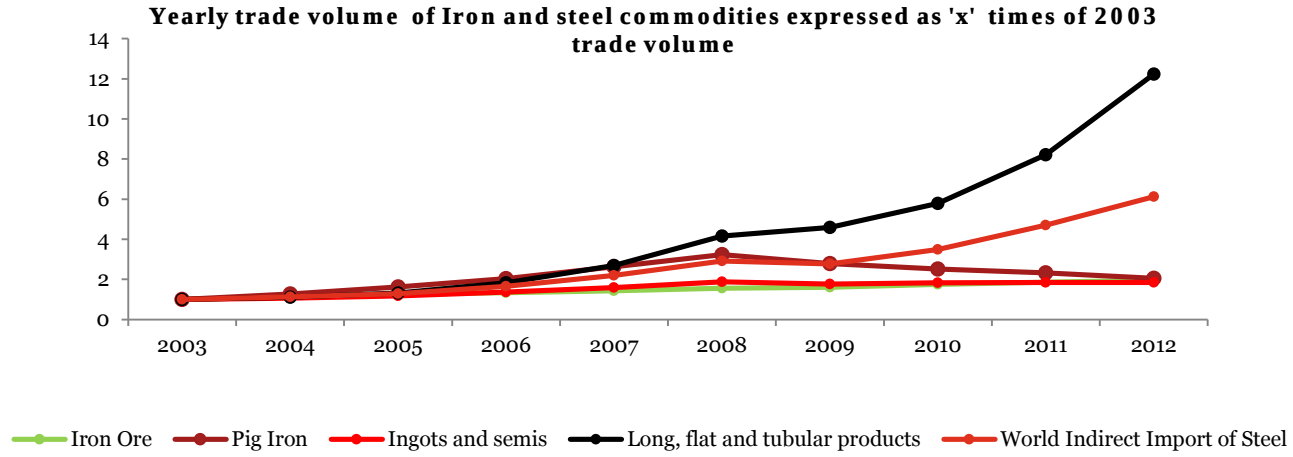
(i) National level related

- ***Increased consumption intensity***

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

- ***Increase in demand for exports***

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



ource: World Steel Organisation, PwC analysis

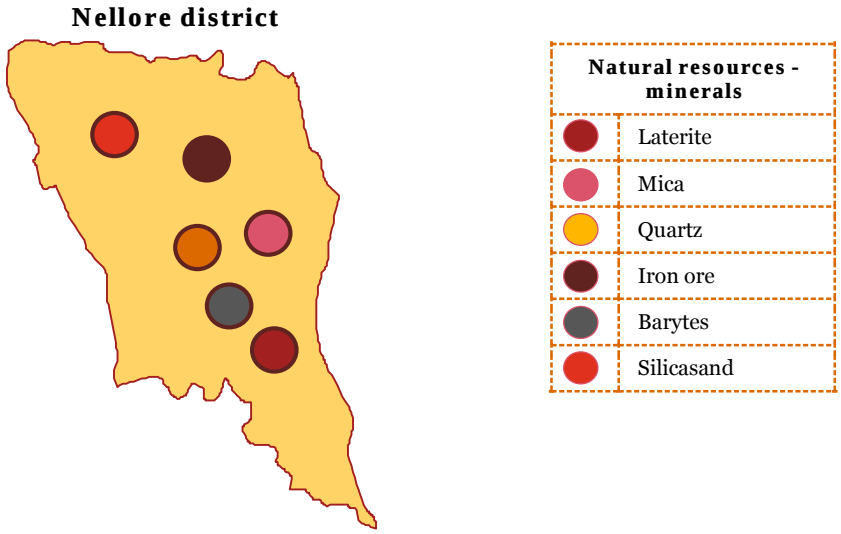
Figure 5.18: Growth in trade of iron and steel commodities

The government has also provided strong policy level support to the sector to ensure higher investment and growth of the sector:

(i) FDI up to 100% is permitted under the Automatic Route to explore and exploit all non-fuel and non-atomic minerals and process all metals as well as for metallurgy
(ii) Government of India is encouraging private ownership for steel operations and other high priority industry
(iii) Profits of companies producing specified metals are given tax concession under the Income Tax Act
(iv) Government of India significantly reduced the duty payable on finished steel products and has streamlined the associated approval process

(ii) KPT IN level related

- **High input base of raw material**



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

Figure 5.19: Natural resources of Nellore district

Nellore district has a rich mineral base and an industrial setup for metallurgy products. Major minerals available in the district include Mica, Quartz, Feldspar, Iron Ore and Barytes. Other major constituents are Silica Sand and Latarite occurring in major parts of the district.

- **Well established Metallurgy sector in the district**

Mining and Metallurgy sector as part of the primary sector is the smallest contributor to the district's GDP. However, it has rapidly grown over the 7 years of present analysis (2005-2011) at 41% CAGR. In 2010-11, 21% of the manufacturing share was of the basic metals sector.

- **Proximity to port – favorable location for exports**

KPT IN is favorably located in immediate vicinity to the Krishnapatnam port. The export oriented units in metallurgy sector can leverage proximity to the markets of the leading metallurgy importing countries. The distance to the ports of the some top metallurgy products importing nations varies from 8.0 days to 22.0 days.

Top manufacturing sectors in Nellore district, 2010-11

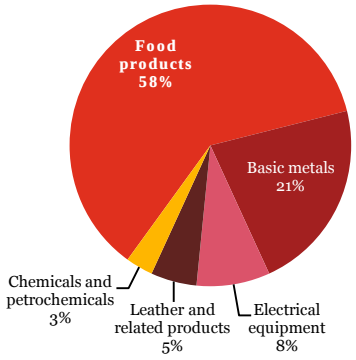
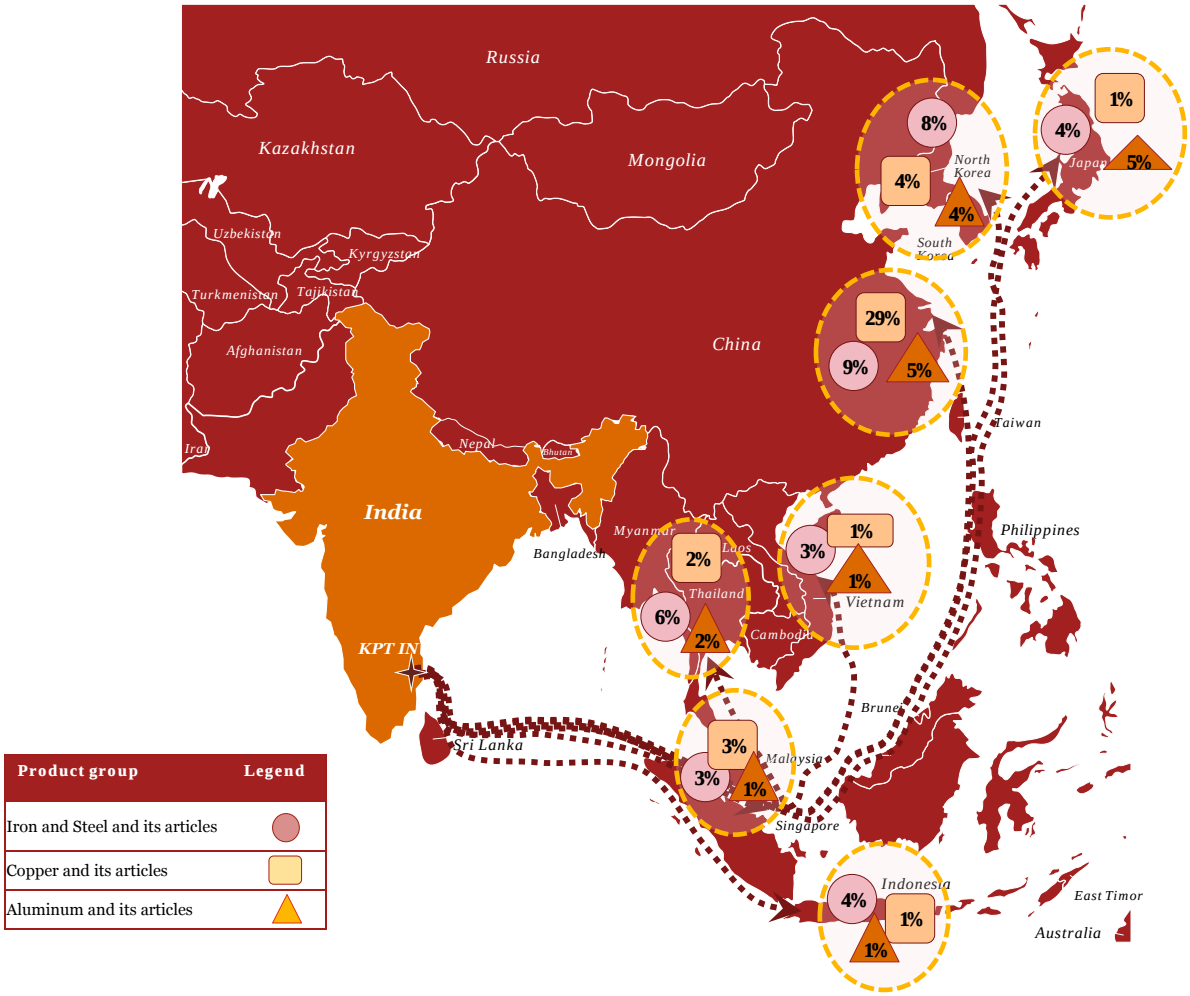


Figure 5.20: Manufacturing sectors of Nellore district, 2010-11

KPT port	Port in potential importing country	Distance, days
Krishnapatnam port	Port of Shanghai, China	19.3
	Port of Tokyo, Japan	23.8
	Port of Chinae, South Korea	21.6
	Port of Hanoi, Vietnam	15.3
	Bongkot Terminal, Thailand	10.2
	Jurong Port, Singapore	8.0
	Anyer Terminal, Indonesia	9.5

The figure below depicts the proximity of the node to the leading importing countries of various product groups in metallurgy sector and the size of opportunity present for the Node.



Source: intracen.org, ports.com, PwC analysis

Figure 5.21: Share of world imports in metallurgy product groups of top importing countries in the Southeast Asia; proximity from KPT port

For example, China is the major importer of metallurgy sector products in the world. The top exporter contributes 17% to total exports in this segment, whereas India has only 2.5% share.

Assuming unconstrained scenario, the consultant has taken an example of China and analyzed India's position in metallurgy sector exports to this country vs top two exporting nations.

Table 5.7: Share of top exporting countries vs India to China in metallurgy sector

Food processing sub-sector	Exporter - Top 1 % of total FP imports to China		Exporter – Top 2 % of total FP imports to China		India % of total Metallurgy imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
Iron and Steel	Japan	38%	Korea	19%	2%	10.6	7.6	19.3
Articles of iron or steel	Japan	23%	Germany	19%	1%	10.6	47.3	19.3
Copper and articles thereof	Chile	20%	Japan	8%	4%	47.3	10.6	19.3
Nickel and articles thereof	Russia	27%	Australia	17%	0%	15.7	23.1	19.3
Aluminum and articles thereof	USA	20%	Korea	12%	1%	78.7	7.6	19.3

Food processing sub-sector	Exporter - Top 1 % of total FP imports to China		Exporter – Top 2 % of total FP imports to China		India % of total Metallurgy imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
Lead and articles thereof	Canada	17%	Vietnam	14%	0%	56	2.8	19.3
Zinc and articles thereof	Australia	23%	Kazakhstan	16%	4%	23.1	NA	19.3
Tin and articles thereof	Indonesia	30%	Bolivia	14%	0%	9.6	55.8	19.3
Other base metals, cermets, articles thereof	Congo	31%	USA	14%	0%	42.8	78.7	19.3

Source: intracen.org, ports.com, PwC analysis

It is evident that India's share in metallurgy exports to China is quite modest; in spite of it having locational advantage in 7 product groups out of 9. However, only three products can be considered viable for exports as the remaining constitute insignificant share in total metallurgy export basket from India.

Key challenges and issues

Power supply

Metallurgy is a power intensive industry and about 16-18% of the production cost is dedicate to power. In Nellore district, as we understand from manufacturers, the availability of power is the major issue. They observe almost 40% power cuts as well as peak hour restriction (6-10 PM). If the operations are interrupted, the furnace takes about 2 hours to start which affects the overall efficiency of the plant.

Poor connectivity

The inadequacy of infrastructure is related to the absence of proper transportation and logistics facilities. The railway connectivity in most key mining states is poor and it has inadequate capacity for volumes to be transported which adds to the overall supply chain cost. Significant initiatives are required from Indian Railways through private participation to address the anticipated logistics requirement of the mining and manufacturing industries, the risk foreseen is too significant in magnitude to hamper the growth of industry.

High cost of capital

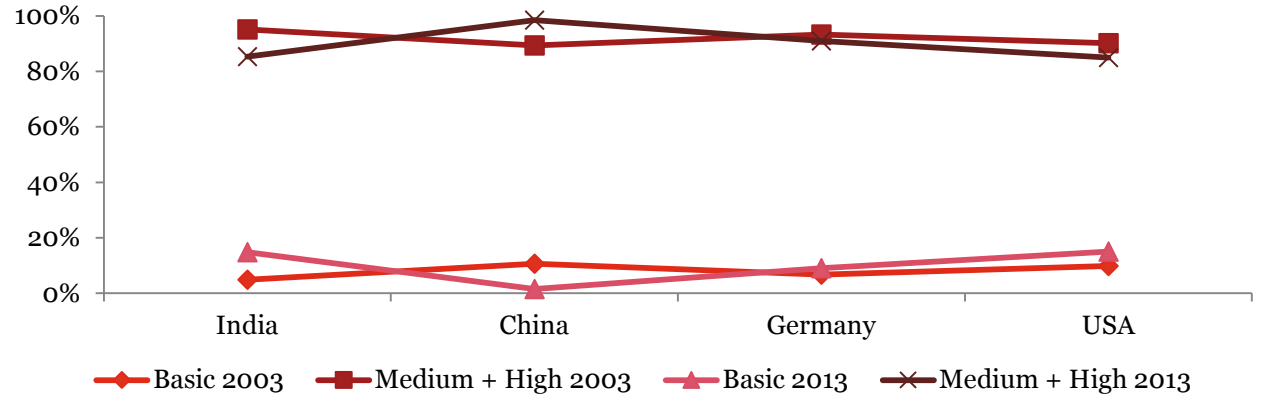
A substantial amount of working capital is required by metallurgy machine manufacturer as the cycle time is long, running sometimes into a few years. The Indian Capital Goods industry suffers a major disadvantage on interest rates when compared with foreign manufacturers. This in itself adds to the cost of Indian Capital, making them non-competitive against imports by at least 10%.

In addition, foreign manufacturers are offered deferred LC payments of 1-2 years placing Indian manufacturers at a major disadvantage. While foreign companies can raise working capital loans at 2-4 % interest on LCs, Indian companies do not get such LCs from buyers, and raising finance even at 14-16% becomes difficult.

Low level of value addition

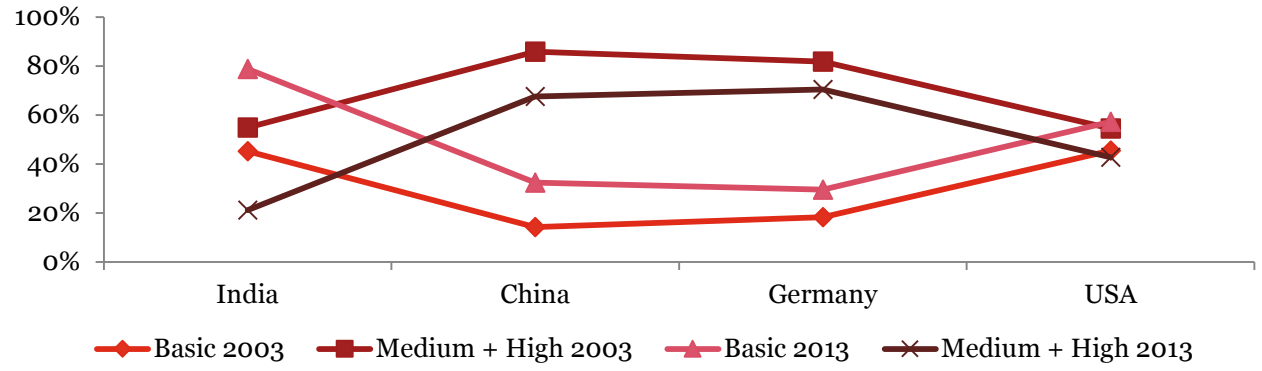
Value addition in metallurgy products is still low in India when compared to other major exporting countries in the world. 94% of total exports in metallurgy from India are from iron and steel and its articles, copper and its articles and aluminum and its articles. When metallurgy products complexity levels (value addition) of the Indian export are compared with the one of the world top three exporting countries, viz. China, Germany and USA, there is a high percentage of products in the basic level of product complexity category being exported

from India in copper and aluminum products while iron and steel and its articles have a higher percentage of products in medium and high level of complexity category.



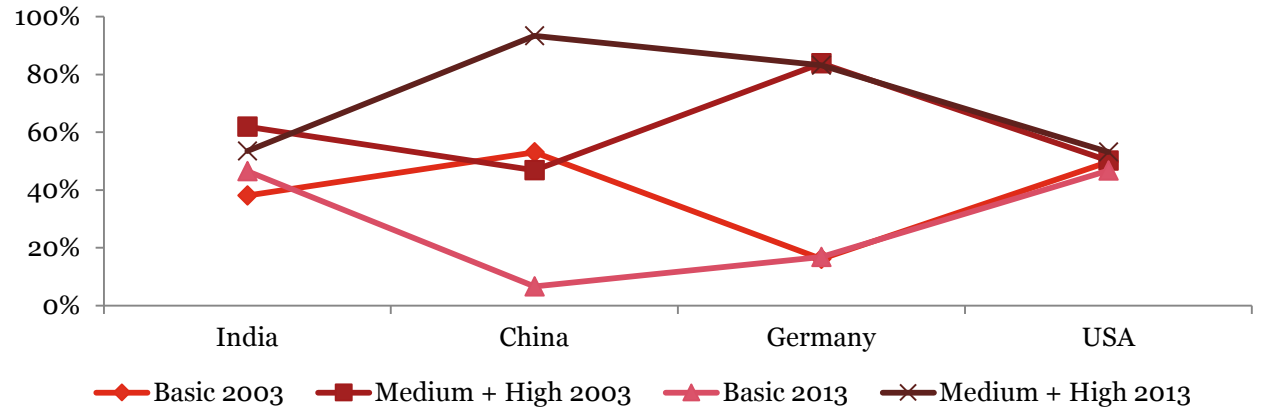
Source: International Trade Centre (intracen.org), PwC analysis

Figure 5.22: Constitution of iron, steel and its articles in export basket of India vs. top exporting countries – Level of processing complexity (value addition)



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

Figure 5.23: Constitution of copper and its articles in export basket of India vs. top exporting countries – Level of processing complexity (value addition)



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

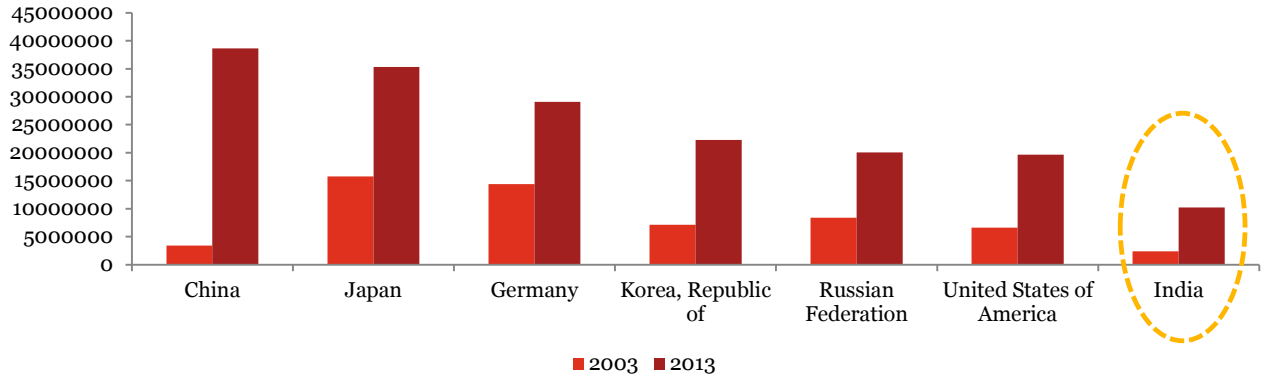
Figure 5.24: Constitution of aluminum and its articles in export basket of India vs. top exporting countries – Level of processing complexity (value addition)

Other issues that are affecting the growth of the sector are:

- Lack of Research & Development, design and new / expansion of existing manufacturing capabilities.
- Skill gaps and shortage of skilled manpower for manufacturing sector and R&D.
- Hesitance on part of customers to use machinery manufactured on the basis of indigenously developed technology.

Benchmarking against International Competition

Globally, the mining and metals sector has a $1.5 trillion annual value (June 2013)[28]. For many years, it grew more or less in step with global GDP. Starting with the turn of the millennium, the sector and demand for commodities started to grow significantly faster than global GDP. The main reason for that was the takeoff of the Chinese economy, particularly infrastructure and manufacturing. Currently, between 40% and 60% of every mineral that gets dug up anywhere in the world ends up in China. So the slowdown in China's economic growth now has caused softening of the sector worldwide.



Source: www.intracen.org – International Trade Centre

Figure 5.25 Change in the value of exports of iron and steel products between 2003 and 2013 among top exporting countries in the world

China has gone from being roughly 15% of global steel production and consumption at the turn of the millennium to close to 50% today. That's particularly important because, unlike coal, when it comes to raw materials, China lacks the necessary quality and size of iron ore reserves. The reserves are in Australia, Brazil, and to a lesser extent, India and South Africa.

Case studies – Success factors in select leading metallurgy manufacturing countries

CHINA

Technological innovation

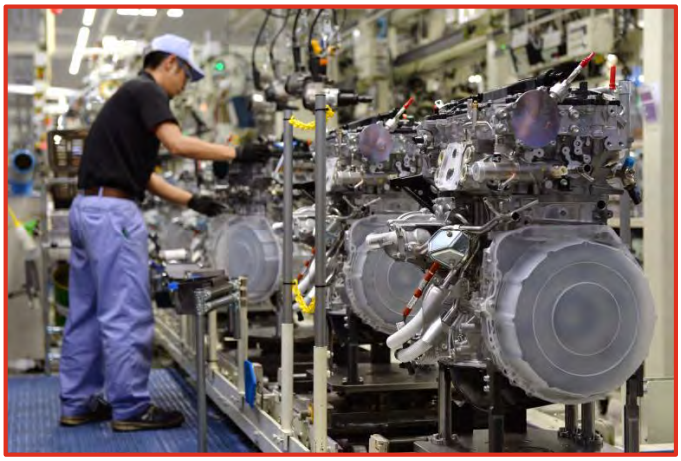
In recent years, the technological innovation system of iron and steel industry of China has been developing rapidly. Research institutions have been set up by the companies in the sector to sustain competition. As a result, the industry's capability of technological innovation has been enhanced, and many technological achievements have been made.

[28] As per article published by Yale school of management, US

Cost leadership

As mentioned above, China is a frontrunner in the iron and steel industry and now it has developed a cost leadership through the use of technology. China achieves the cost advantage through innovations and using better technology to process steel. China also invests a lot in research and development activities to achieve higher efficiency.

JAPAN



Production joint ventures

Japanese industries adopted the philosophy of long-term investment (Global alliances, FDI, capex, R&D, and service) with numerous strategic production giants across the world especially in fast growing Asian markets, such as Thailand, Indonesia, China and Malaysia and capitalized on two key facts:

a) rapidly increasing consumption of steel products, and
b) lack of a local producer or insufficient local capacity to meet demand

High Value Added Products

Japanese mills have developed a number of specialty steel products and have increased focus on these buy increasing production and exports. Examples include:

- ✓ Wear-resistant rails
- ✓ Black chromate-free electrogalvanized steel sheets
- ✓ High quality alloy oil pipe
- ✓ Special steel wire rods and bars
- ✓ Stainless Steel

The proportion of products supplied in high value added product group (such as products such as High tensile strength steels, IF steels and alloy tool steels, etc. mostly used for automotive) to the world has increased from 76% in 2005 to 83% in 2011 led by expansion of the Japanese auto makers in emerging economies mainly in Asia[29].

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 Krishnapatnam receives interest from metallurgy units can be broadly classified around the three main areas:

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

[29] www.jsic.files.wordpress.com "The Japanese Steel Industry In The Global Steel Market'

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

Table 5.8: Key design implications for metallurgy sector

Components		Issues	Design Implication
Economic enhancers			
Power		• Stakeholders are of the opinion that power tariffs are high in the region	• In medium term, power tariff subsidies for metallurgy industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries.
Connectivity	**Road**	• Connectivity to domestic bauxite and alumina sources to be enhanced • Access road from Krishnapatnam port to Node area is an unpaved 1-lane road. It is limited to local residents and few heavy vehicles	• Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • A grid type road network will be followed • Three north-south trunk roads and east-west trunk roads each are planned • Access road to Krishnapatnam and connectivity to NH-5 has to be improved • Further allocation of Bauxite mines to companies setting up alumina and aluminum industries in Nellore region
	Railway	• There is no rail connectivity to the node at present • Nearest rail head is Venkatachalam located 25 (approx.) km away from the node	• Rail access to the Node area is proposed i.e., o 13.7 km spur line from the port access line, with the expectation to have considerable spare capacity o 55.7 km link from the port access line that would pass through the node (and the logistics hub itself) continue further south to connect Chennai – Nellore main line at Naidupeta
Value enhancers			

Components	Issues	Design Implication
Development of new sub-sectors of metallurgy in the node	• Large food-processing and textile industries in the corridor may give rise to packaging requirements in aluminium in Nellore district and KPT IN in particular.	• Further allocation of Bauxite mines to companies setting up alumina and aluminium industries in Nellore region • In aluminium subsector, Nellore district is closest to bauxite sources. KPT IN also will have access to Krishnapatnam port. Further leases to Bauxite mining may be allocated to only those companies who intend to set up alumina and primary aluminium production units in the corridor.
Pelletization	• There are limited reserves of high-grade Iron-ore lumps in the region. However, iron-ore fines are available and are currently exported in high quantities due to non-availability of pellet units to treat and use fines.	• Pelletization can help to an extent in better usage of iron-ores fines and can also help ramp up export revenue by moving up the value chain.

Components	Issues	Design Implication
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • Government led initiatives inform of Knowledge Transfer Partnership, where students get more industry exposure, can play a key role in creating the right institute-industry linkages **Center of excellence** Creation of the **center** can be proposed in KPT node to enable the technology linkages, create industry-academia connect in the metallurgy sector, attract leading international research institutions to open research labs in the node. The center can cater to the requirement of the entire CBIC region and beyond and facilitate technology upgradation in metallurgy sector. Apart from the above, the center can also include: • One of the major issues of the sector is low productivity. One of the wings of the center can become a **training facility** for retraining and redevelopment of the labor force • **Quality testing laboratory** can become another element of the partnership center to work upon improvement of inferior quality of goods persistent in the sector at the moment.
Administrative enhancers		
Policy	• Policy level support is lacking to the metallurgy sector in India and Andhra Pradesh in particular • The sector is guided by the national level policies, where the draft National Steel Policy 2012 is yet to come out in concrete form • Andhra Pradesh does not have any specific policy dedicated to the metallurgy sector	• A dedicated committee may be appointed comprising members from all stakeholder agencies • Government of AP should propose a dedicated policy for the sector, which may increase the attractiveness of the sector along in the state as well as in the CBIC districts – Nellore, in particular

5.2.3 *Electrical Machinery*

Sector performance

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

Global trade in electrical equipment products accounts for about **4% of the total global trade**. Global exports reached USD 688 billion in 2013, with China being the leading exporter of electrical equipment – 20% share, followed by Germany, USA and Japan.

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

Figure 5.26: Top exporting countries based on value of exports

Analysis of global electrical machinery exports reveals that India's share is very modest and didn't significantly improve over the past decade: from 0.3% to 0.9% share in global exports of electrical machinery in 2003 and 2013 respectively.

The consultant analyzed India's position in electrical machinery exports having taken into consideration top 7 product groups that constitute above 70% of global electrical machinery exports. The country is not in top 20 for most of the product groups, except one (Part suitable for use solely / with boards, panels, etc.). However, India's exports rank has improved 5 out of 7 top exported product groups.

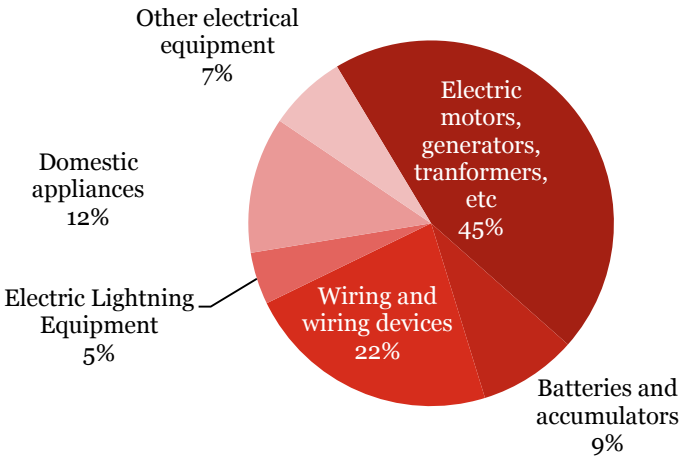
Table 5.9: Trade competitiveness ranking, 2003 vs 2013, Food processing[30]

Rank	Insulated wire/cable	Electric transformer, static converter	Electrical app for switchg not exceedg 1000 volt	Board & panels, equipped with two/more switches, fuses	Electric motors and generators (excl. generating sets)	Electrical machinery and app having individual function, nes	Part suitable for use solely / with boards, panels, etc.	Electric accumu-lators
1	China (4)	China (1)	Germany (1)	Germany (1)	China (2)	China (7)	Germany (1)	China (2)
2	Mexico (1)	Germany (3)	China (7)	China (12)	Germany (1)	Korea (18)	USA (2)	Korea (7)
3	USA (2)	USA (4)	USA (2)	USA (4)	USA (4)	USA (2)	Korea (18)	USA (6)
4	Germany (3)	Japan (6)	Japan (3)	Mexico (3)	Mexico (3)	Germany (3)	China (9)	Japan (1)
5	Romania (16)	Mexico (5)	France (4)	Japan (2)	Japan (5)	Japan (1)	Japan (3)	Germany (4)
India	**34 (49)**	**21 (31)**	**25 (39)**	**27 (50)**	**23 (34)**	**32 (37)**	**15 (38)**	**27 (30)**

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

The Indian electrical machinery sector output grew at 23% CAGR between 2008-09 and 2010-11 and reached USD 33 billion (Rs. 198,395 crore) by 2010-11[31]. Its share in total national manufacturing output amounted to 4%. Exports of electrical machinery for the corresponding period were USD 3.5 billion (Rs. 20,742 crore) and contributed around 2% to the total exports of goods from India.[32] There are four major sub-sectors that contribute 88% of the sector's output in India. They include electric motors, generators and transformers, batteries and accumulators, wiring and wiring devices and domestic appliances.

Electrical machinery 3-year average output (2009-11), India



Source: ASI

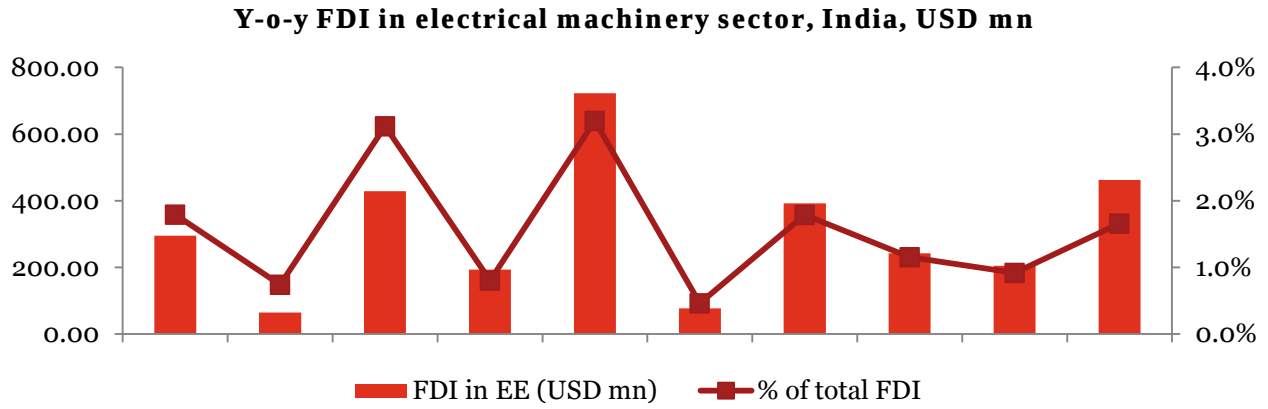
Figure 5.27: Composition of electrical machinery output, India

There is a strong demand for electrical machinery in the domestic market with gradual reduction of reliance on imports; however, India's exports performance has not been very strong.

[30] Numbers in brackets represents rank in 2003
[31] *Annual Survey of Industries*
[32] *International Trade Center*

According to the Department of Heavy Industries projections, overall growth of the sector is forecast around 13-14% till 2022.

Between January 2000 and November 2014, foreign direct investment in electrical machinery sector in India stood at USD 3.08 billion. Key players like Mitsubishi, Hitachi, Alstom and Toshiba have entered the Indian market mostly through JV route.



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

Figure 5.28: FDI in electrical machinery sector, India

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

Given the high growth trajectory of the sectors and huge domestic market potential and strong performance of the sectors in the districts under corridor's influence, electrical machinery sector is poised to emerge as key sectors which may contribute to CBIC's success in terms of attracting investments to the corridor. In Nellore district Sri City along the border of Andhra Pradesh and Tamil Nadu is one of the examples in attracting investments in electrical machinery sector.

Viability drivers for future investments

The growth drivers for the electrical machinery sectors are as highlighted below:

(i) National level related

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

Growing power sector

Capacity addition plans of Government for Indian power sector is the key growth driver for the sector. Total installed capacity as on January 2015, including renewable energy sources of the country is 259 GW. By the end of 12th and 13th Five Year Plans it is envisaged to add 89 GW and 94 GW of installed capacities respectively.

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

Accelerated infrastructure expansion and growing urbanization

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

Growing telecom industry

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

Increasing FDI

The Government of India has allowed a 100% FDI in the electrical machinery sector. The FDI in the electrical machinery sector has grown at a CAGR of 28% from 2006 to 2014. Cumulative FDI (2000-2014 (till November)) in electrical machinery sector amounted to USD 3.08 billion with FDI of USD 462 million added in 2014 alone.

Nuclear capacity addition

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

(ii) KPT IN level related

- **Availability of MSME base (Engineering)**

One of the most important FoPs for electrical machinery sector to establish a new unit is availability of ancillary base in the area. In case of Krishnapatnam Industrial Node, engineering MSME units are the second largest group of MSMEs present in Nellore district (12% in terms of number and 17% in terms of investment); hence, may serve as an ancillary base for the interested large tenants in electrical machinery sector.

- **Locational advantage – proximity to port**
  - **Proximity to ports – proximity to imports**

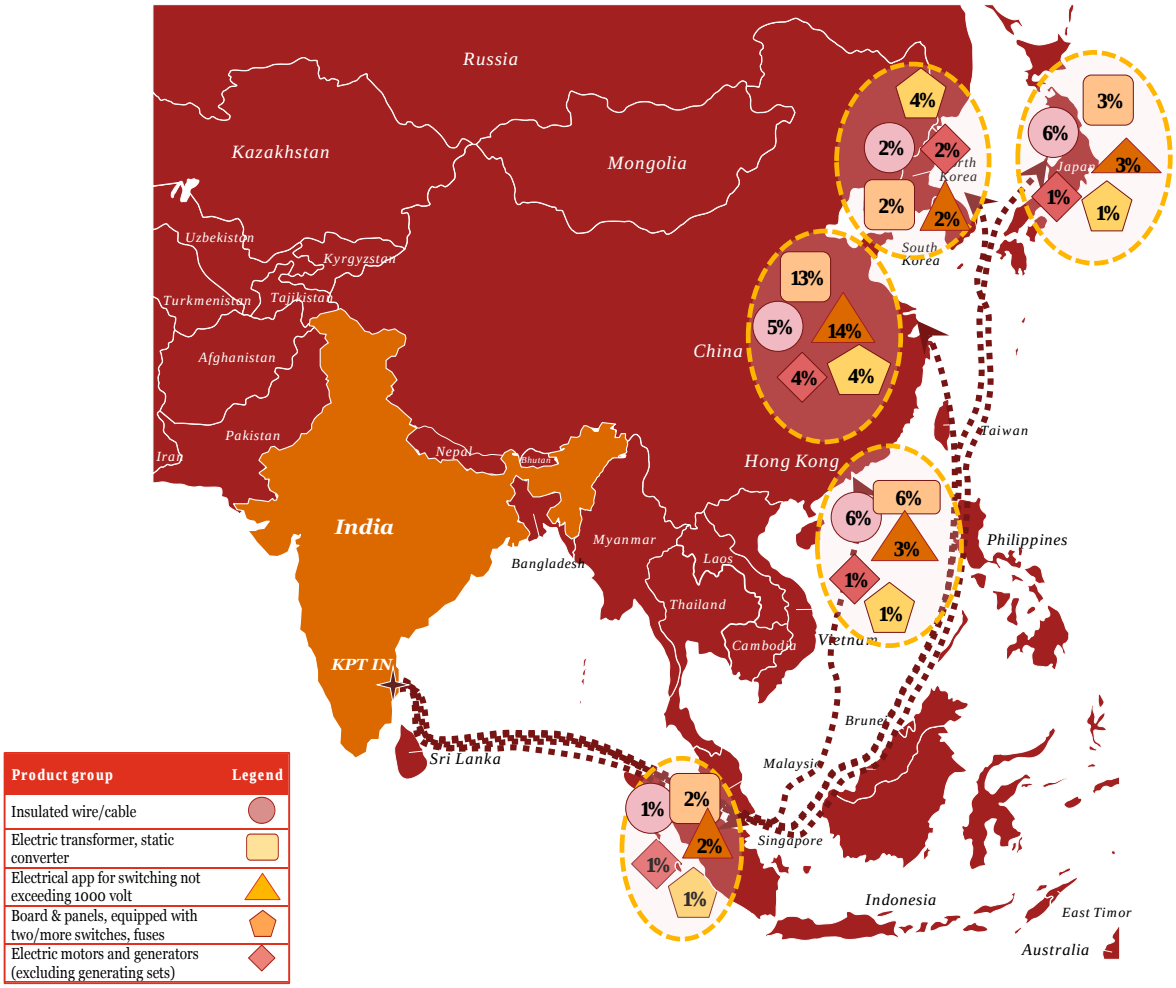
The segments dependent on electrical steel require proximity to ports as their raw material is imported; hence, location of KPT IN in immediate proximity to KPT port will become at attractive proposition for the electrical machinery units dependent on raw material imports.

  - **Favorable location for exports**

KPT IN is favorably located in immediate vicinity to the Krishnapatnam port. The export oriented units in electrical machinery sector can leverage proximity to the markets of the leading electrical machinery importing countries. The distance to the ports of the some top electrical machinery products importing nations varies from 8.0 days to 22.4 days.

KPT port	Port in potential importing country	Distance, days
Krishnapatnam port	Port of Shanghai, China	19.3
	Port of Tokyo, Japan	23.8
	Port of Chinae, South Korea	21.6
	Jurong Port, Singapore	8.0
	Port of Hong Kong, Hong Kong	15.7

The figure below depicts the proximity of the node to the leading importing countries of various product groups in electrical machinery sector and share of imports to the global imports in electrical machinery sector. (For calculation, we have taken top five product groups which form 57% of total world exports).



Source: intracen.org, ports.com, PwC analysis

Figure 5.29: Share of world imports in electrical machinery product groups of top importing countries in the Southeast Asia; proximity from KPT port

For example, China is a major importer of electrical machinery products in the world. The top exporter contributes 18% to total exports in electrical machinery, whereas India has only 1.8% share.

Assuming unconstrained scenario, the consultant has taken an example of China and analyzed India's position in electrical machinery sector exports to this country vs top two exporting nations.

Table 5.10: Share of top exporting countries vs India to China in electrical machinery sector

Food processing sub-sector	Exporter - Top 1 % of total FP imports to China		Exporter – Top 2 % of total FP imports to China		India % of total Metallurgy imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
Insulated wire/cable	Korea	11%	Japan	11%	0.2%	2.3	3.2	19.3
Electric transformer, static converter	Japan	14%	USA	9%	0.4%	3.2	85.8	19.3
Electrical app for switching not exceeding 1000 volt	Japan	26%	Korea	11%	0.3%	3.2	2.3	19.3

Food processing sub-sector	Exporter - Top 1 % of total FP imports to China		Exporter – Top 2 % of total FP imports to China		India % of total Metallurgy imports to Japan	Time to reach from Top 1, days	Time to reach from Top 2, days	Time to reach from India, days
Board & panels, equipped with two/more switches, fuses	Japan	18%	USA	10%	0.3%	3.2	85.8	19.3
Electric motors and generators (excluding generating sets)	Germany	17%	Japan	15%	0.5%	50.8	3.2	19.3

Source: intracen.org, ports.com, PwC analysis

It is evident that India's share in electrical machinery exports to China is quite modest; in spite of it having locational advantage in 3 product groups out of 5. Entering KPT IN will provide locational advantage for the export oriented units of electrical machinery sector. German companies in the sector having existing JV / looking for JV partner to establish base in India, can be approached as potential tenants for the node.

Focus on export oriented units of electrical machinery sector is in line with the vision of the government of India to boost country's share in electrical machinery exports

Key challenges and issues

Import oriented trade

While exports and imports of electrical machinery in India have grown at a CAGR of 19% and 18% respectively between 2001 and 2013. Share of electrical machinery exports as a percentage of total national trade in electrical machinery is about 37%. It is low as compared to global exports of electrical machinery and it is around 49% of total global trade in this product segment. Share of electrical machinery exports of China in total electrical machinery trade has increased from 51% in 2001 to 66% in 2013.

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

Availability of raw materials

Constrained availability of certain critical raw materials such as Cold Rolled Grain Oriented (CRGO)/ Cold Rolled Non-Grain Oriented (CRNGO) Steel, Amorphous Steel etc. and volatility in raw material prices is hurting domestic industry.

Electrical industry is largely dependent on imported CRGO/ CRNGO electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported by domestic manufactures from very few suppliers worldwide (only 14 mills are operating worldwide). Out of 14 only 3 mills are BIS certified; currently it is mandatory to obtain BIS certification for all the suppliers. Any delay in the registration of foreign suppliers with BIS leads to supply constraints to domestic industry.

Infrastructural constraints

The sector players face issues in transporting heavy and over dimensional consignments (ODC) >98 MT on NHAI bridges. As per procedure, various zonal railways are involved to give clearance for the movement of such ODCs. This leads to delay in projects, as highlighted by electrical machinery manufacturers of Nellore district. Congestion at ports further delays delivery.

Uninterrupted power supply

Power shortages are prevalent in many of the Indian states, including Andhra Pradesh and Nellore district in particular. Electricity rates are another point of concern of various stakeholders in Nellore district.

Availability of indigenous testing facilities

The electrical equipment testing facilities available in India are quite inadequate. Vendors have to send their equipment to foreign countries for testing which is time-consuming and expensive.

The process results in increased prices and directly affects the end-users. Moreover, the local players do not have enough capital to set up testing facilities as the investment required is huge.

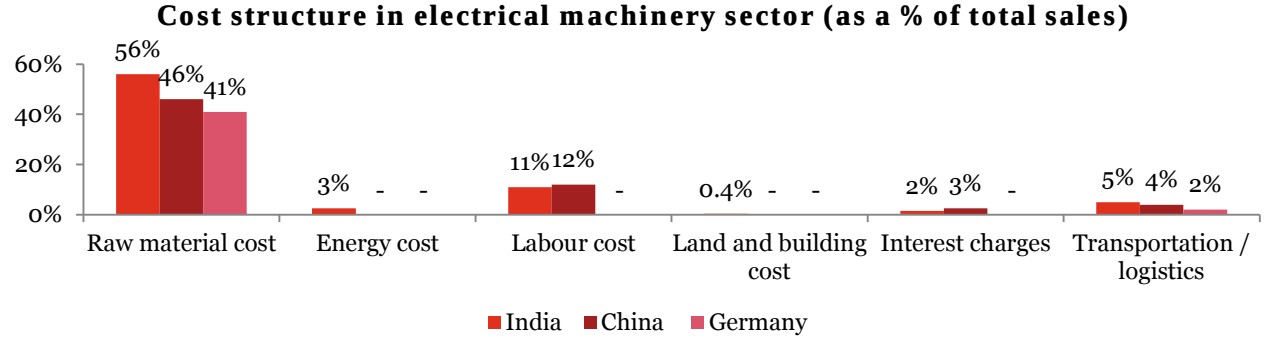
Benchmarking Against International Competition

As per the "Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive" by Dun & Bradstreet, there are various stages of competence protocol to ascertain competitiveness level of any given sector. Most of the Indian firms are still in the Stage 1 (initial) of the competence protocol and targeting basic conveniences & cleaning up of operations to achieve competitiveness in capital goods. Raw-materials and labour productivity are the key issues highlighted by the Indian firms. Some of the aspects in Stage 1 like energy conservation, clean & safe working environment, etc. are still to be looked up as measures for competitiveness.

Amongst the competing countries, China has already crossed the first stage managing basic clean-up of operations by managing backward linkages effectively and setting up component and raw-material industries supplying to Chinese firms at very competitive rates. Italy and Germany counterparts have already crossed the second stage and focus is on total improvement in systems & business processes by achieving total quality enrichment and enhanced value addition.[33]

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: "Capital goods: Productivity and Efficiency Benchmarking", Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013]

Figure 5.30: Cost breakup (as a % of total sales) in India vs leading manufacturers of electrical machinery

[33] "Capital goods: Productivity and Efficiency Benchmarking", Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013]

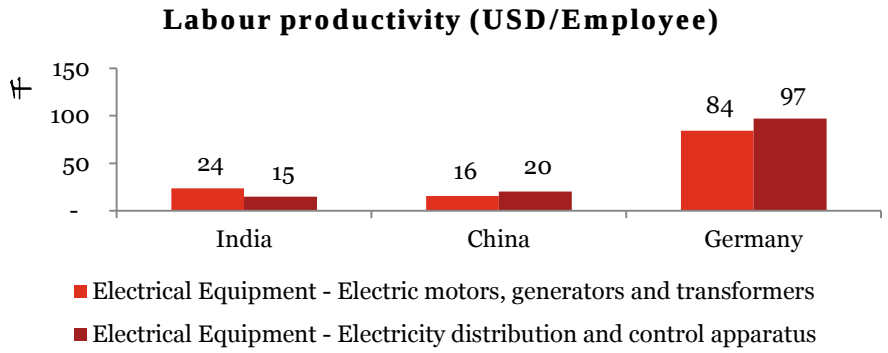
Margins can be improved either by increasing sales prices, or by reducing costs. As prices in real terms for many of the industry's staple products have eroded over many years, the focus has long been on reducing costs. Competing countries' (China and Germany) competitive advantage vis-à-vis India in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

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

As can be inferred from the comparisons drawn above that raw material costs need to be reduced to make India's cost structure in electrical machinery sector competitive as compared to leading countries in the sector.

Productivity

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



Source: "Capital goods: Productivity and Efficiency Benchmarking", Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013]

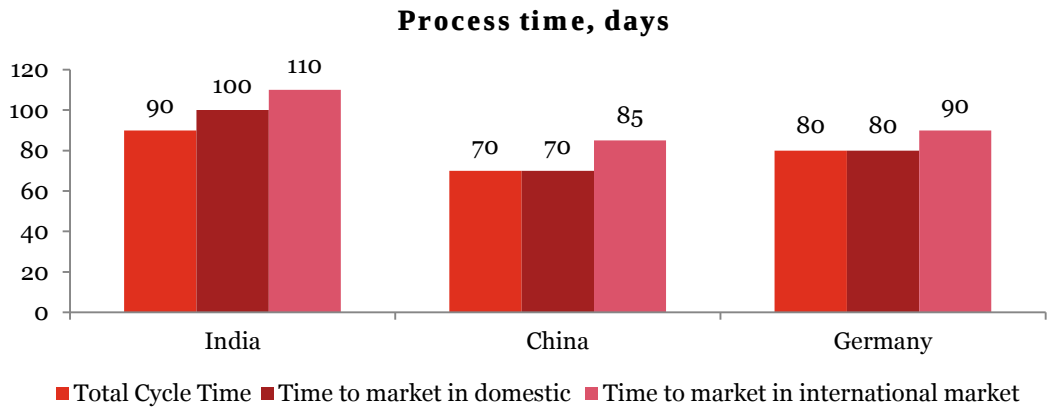
Figure 5.31: Labour productivity in India and leading electrical machinery manufacturing countries

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

India has comparative advantage over China in labour productivity for electrical motors, generators and transformers manufacturing, while the latter has slight advantage in electricity distribution and control apparatus. Germany emerges as a clear leader in both the categories having labour productivity four times higher than both China and India. This is due use of the latest technology and smart manufacturing which help Germany create higher gross value added products with lesser involvement of workforce.

Process Time

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



Source: "Capital goods: Productivity and Efficiency Benchmarking", Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013]

Figure 5.32: Process time in electrical machinery sector for India and leading electrical machinery manufacturing countries, days

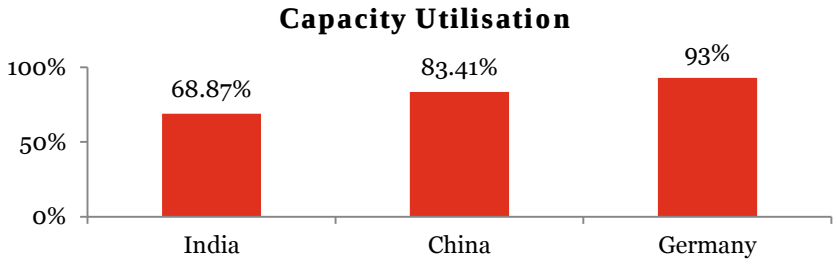
India stands at clear point of disadvantage as compared to competing countries (China, Italy and Germany) because of higher process time as depicted in the above figure.

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

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

Capacity utilization

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



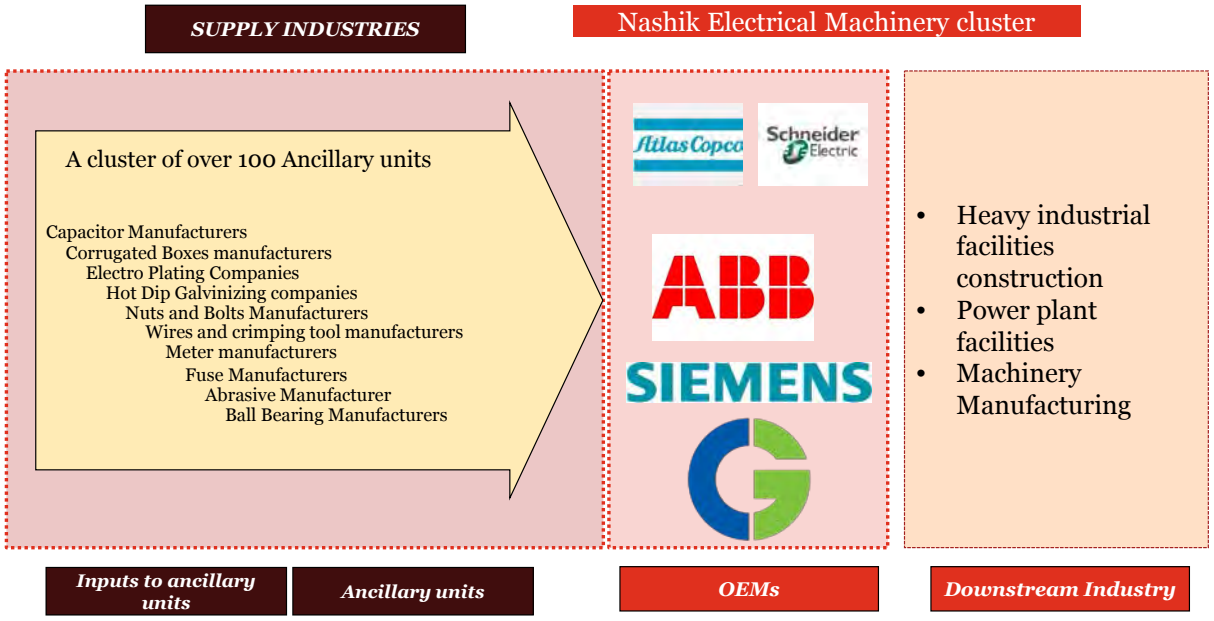
Source: "Capital goods: Productivity and Efficiency Benchmarking", Study on Innovative Interventions required in Manufacturing Sectors to make them Globally Competitive, Dun & Bradstreet Information Services India Private Limited, Mumbai [2013]

Figure 5.33: Capacity utilization in electrical machinery sector for India and leading electrical machinery manufacturing countries

India's disadvantage as compared to top competing countries (China and Germany) in capacity utilization is shown in the figure above.

Case study – Nashik Electrical Machinery Cluster

Electrical machinery is a sector where final products are majorly assembled and require sizable ancillary base industries in vicinity. Nashik electrical machinery cluster is one such example. Many OEM players have been attracted to a cluster on account of presence of large number of ancillary base industries.



Source: PwC

Figure 5.34: Electrical machinery cluster in Nashik

In case of Krishnapatnam IN, engineering MSME units are the second largest group of MSMEs present in Nellore district (12% in terms of number and 17% in terms of investment); hence, may serve as an ancillary base for the interested large tenants in electrical machinery sector.

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 Krishnapatnam receives interest from electrical machinery units can be broadly classified around the three main areas:

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

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

Table 5.11: Key design implications for electrical machinery sector

Components		Issues	Design Implication
Economic enhancers			
Connectivity	**Rail**	• Nearest rail head is Venkatachalam located 25 (approx.) km away from the node • There is no rail connectivity to the node at present • Rail connectivity is necessary to transport over dimensional consignments (ODC) and avoid problems in transporting heavy and ODC >98 MT on NHAI bridges. • Availability of rail sidings as a last mile connectivity to the main rail network is also essential	• Creation of rail network connectivity as necessary requirement to transport ODC cargoes • Rail access to the Node area is proposed i.e., – 13.7 km spur line from the port access line, with the expectation to have considerable spare capacity – 55.7 km link from the port access line that would pass through the node (and the logistics hub itself) continue further south to connect Chennai – Nellore main line at Naidupeta
	Road	• Availability of port infrastructure is essential FoP for the electrical machinery units • The segments dependent on electrical steel require proximity to ports as their raw material is imported	• Ensure seamless connectivity to port • Access to South (6 lane road) running from Naidupet (NH 5) via Kota and new industrial park to Krishnapatnam Port with length of about 50 km are proposed • Access road to Krishnapatnam and connectivity to NH-5 has to be improved • It is also important to promote the vision of the GoI to boost country's share in electrical machinery exports
Power supply		• Electricity rates are a point of concern of various stakeholders	• In medium term, power tariff subsidies for engineering industries in the corridor (for example, for the first 10 years of operation) can be considered. • After bifurcation of Andhra Pradesh into Andhra and Telangana, AP is a power surplus state. Stakeholders of Nellore district noted improvement of power supply scenario compared to the situation 1-1.5 years back. Further, regular vigilance on demand and supply of power on par with the growth in industries.
Value enhancers			
Availability of indigenous testing facilities		• Inadequate electrical equipment testing facilities in the country • Local players do not have enough capital to set up testing facilities as the investment required is huge.	• Facilitate setting up of indigenous testing and calibrating facility for equipment testing in the node, which can become a testing facility centre for the state as well as neighbouring states

Components	Issues	Design Implication
Availability of Critical Raw Materials	• Constrained availability of certain critical raw materials such as Cold Rolled Grain Oriented (CRGO)/ Cold Rolled Non-Grain Oriented (CRNGO) Steel, Amorphous Steel etc. and volatility	• In the long run government should promote and ensure setting up units manufacturing CRGO and CRNGO electrical steel in the country to remove dependency on raw material imports
Technology linkages, research and development initiatives	• Outdated technology, lack of research and development activities in the sector	• State and central government should focus on initiatives to establish technological linkages internationally with countries like Japan and investing in R&D can help in procuring cost effective technologies for modernizing – A world class research center • Government led initiatives inform of Knowledge Transfer Partnership, where students get more industry exposure, can play a key role in creating the right institute-industry linkages
Administrative enhancers		
BIS certification guidelines	• Electrical industry is largely dependent on imported electrical grade steel due to very limited manufacturing capacities within India. CRGO and Boiler quality plates are presently imported from very few suppliers worldwide (only 14 mills are operating worldwide). Out of 14 only 3 mills are BIS certified; currently it is mandatory to obtain BIS certification for all the suppliers.	• Any delay in the registration of foreign suppliers with BIS leads to supply constraints to domestic industry • BIS certifications guidelines to be modified to avoid delays in registration of foreign suppliers
Technology upgradation and modernization	• Current level of technology adopted in the sector is not up to the world standards leading to low productivity and high process time • The sector is known for large number of MSMEs involved as vendor base for large units • Access to technology is limited for MSMEs and sighted as one of the constraints by sector stakeholders in Nellore district	• Under existing STI Policy 2013 assistance to MSMEs in installing modern machinery should be extended – funding solutions to MSME units at competitive rates encourage technology upgradation and modernization • Modifications to the existing procurement policies by PSUs/utilities to facilitate technology absorption by electrical machinery manufacturers are to be introduced

5.2.4 *Other industries*

Glass, ceramics and building materials

Granular, Glassy, Semi-glassy and Massive Quartz/Quratzites deposits occur extensively in southern part of Andhra Pradesh. Nellore district is one amongst them. Quartz finds usage in Ferro-Alloys, Ceramic and Glass Industries. Presently Quartz is being mined from Ranga Reddy, Mahabubnagar, Medak, Kurnool & Nellore districts and exported from Chennai port to various countries[34]. Depending on the quality of the mineral, scope exists for setting up industrial units for the manufacture of Glass, Silicon Carbide, Fibreglass, Silica Gel, Quartz Wool, Ceramic Glass, Silicon Wafers and Refractories.

Nellore district hosts sizable base of ceramic, glass and leather units. Mineral based and building material industries in MSME structure of Nellore district secure the second position (more than 15%) after food and agro based industries in terms of employment and the third position (~ 13%) in terms of investments.

Glass sector has substantial potential for the node as it is one of the support industries for anticipated automobile sector. Building materials and ceramics hold equal potential due to upcoming construction activities both for industrial and residential units. Proximity to port provides opportunities for export oriented units in this sector to explore potential destinations overseas.

Leather industries

Leather sector is one of the prominent sectors in the manufacturing structure of Nellore district. As per ASI, it contributes 6% of total manufacturing output of the district and employs the largest number of people (2010-11).

Krishnapatnam International leather complex is coming up in Nellore district with unique solution for waste management. It is planned to be located a kilometer away from the Bay of Bengal into which the treated effluents can be disposed. Private contractors are being encouraged to built, own and operate an effluent treatment plant. Water source is planned from desalination plant budgeted in Rs.313 crore. The project received environmental clearance and the amount of Rs. 125 crore is expected from DIPP shortly along with Rs. 50 core from GoAP. The location of the complex in immediate proximity/within the KPT node will create potential for leather units to become a part of the proposed facility.

5.3 *Implementation of recommendations*

In order to build a comprehensive eco-system for the success of proposed industries within the node, 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 schemes or worked out based on existing precedents in relevant sectors:

5.3.1 *Food Processing*

The Scheme of Research & Development in Processed Food Sector[35] can be utilized to creation of this center.

[34] Department of mines and geology, Andhra Pradesh

[35] http://www.mofpi.nic.in/H_Dwld.aspx?KYEwmOL+HGpVvrjs+CYNME2/tuH1AhSoew1yuW4ovCA1fRgaNSPkXg==

ELIGIBLE INSTITUTIONS

All Universities, IITs, Central/State Government Institutions, Public Funded Organisations, R&D laboratories and CSIR recognized R&D units in private sector

ELIGIBLE PURPOSES

Ministry supports research proposals preferably of applied nature with commercial value resulting in development of innovative products, processes and manufacturing practices, which lead to development of food processing industry in the country.

FUNDING PATTERN

Government organizations: 100% of cost of equipment, consumables and expenditure.

Institutional Charges equal to 10% of project cost subject to maximum of Rs. 3 lakh for non-academic institutions and Rs. 5 Lakh for academic institutions.

For Private organizations / universities / institutions, grant is given to the tune of 50% of equipment cost.

The SPV can tie up with some leading eligible institutions (both government and private) and work out the structure of the center on PPP mode.

5.3.2 *Metallurgy*

Collaboration between the KPT SPV, government / private institution and the central/state government can be proposed to establish the center of excellence. The case study of the similar establishment between IIT Bombay and the central government which sponsored the project is presented below.

The SPV can contribute the infrastructure related components, academic institution can bring in R&D personnel and faculties, funding requirement can be made by government. In case of private institution additional funds can be envisaged.

For the quality testing laboratory:

Existing **private testing laboratories** can be approached by the developer with the following proposition:

- The developer provides necessary building and infrastructure facilities. The testing unit brings in the required testing equipment and personnel. User charges can be proportionally distributed between the KPT SPV and the testing facility.

In case of **government testing facility**, the possibility of support from the state government can be explored to expand the capacity of the existing unit and preference of locating this facility can be given to KPT Industrial node.

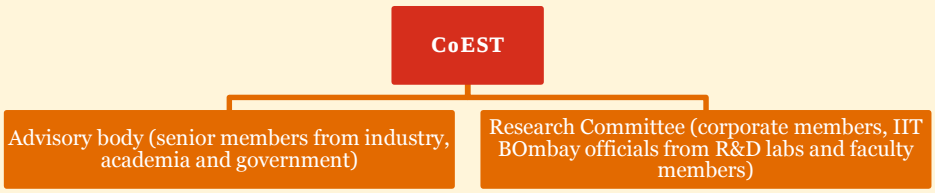
CASE IN HAND

Centre of Excellence in Steel Technology at IIT Bombay (CoEST)

Indian Institute of Technology Bombay (IIT Bombay) has established a Centre of Excellence in Steel Technology (CoEST) in its premises, inaugurated on 25th July, 2014. The center is sponsored by the Ministry of Steel.

Focus of the center: creation of high quality manpower for the steel industry and R&D on steel technology.

Organizational structure of CoEST



As per the model of CoEST, industries are invited to join CoEST as Corporate Members at a reasonable membership fee and avail membership benefits. The benefits of being a Corporate Member include prioritising and deciding R&D and other activities of the Centre; priority access to Centre facilities (at discounted charges); participation in training programmes organized by the Centre and consultancy services at discounted rates in alloy development; manufacturing process optimization, Corrosion and Protection, Tool design, Material and Process Selection etc

IIT Bombay will provide the infrastructure/building for the proposed Center – a new building about 3000 sq. m.

Source: http://www.iitbombay.org/iitb_dean_acr/august-2014-newsletter/Centre%20of%20Excellence%20in%20Steel%20Technology%20inaugurated%20at%20IIT%20Bombay.pdf

5.3.3 *Electrical Machinery*

Existing **private testing units** can be approached by the developer with the following proposition:

- The developer provides necessary building and infrastructure facilities. The testing unit brings in the required testing equipment and personnel. User charges can be proportionally distributed between the KPT SPV and the testing facility.
- In case of **government testing facility**, the possibility of support from the state government can be explored to expand the capacity of the existing unit and preference of locating this facility can be given to KPT Industrial node.

6 Land Use Plan

6.1 *Review of Existing Development Plan*

The master plan for Krishnapatnam Node was formulated by KIPL（Krishnapatnam Infratech Private Limited) and the layout plan is illustrated in the following figure. As per that plan, “coal & coke industries”, “light engineering”, “carbon black industries”, “auto mobile industries” and “food agro industries” were the main industries to be developed, along with an area for logistics, in the phase-1 area of Krishnapatnam Node. In addition to industrial development, plots for residential and commercial use were also planned to promote the “Walk to Work” concept.

Source: Krishnapatnam Port Company Limited MP

Figure 6.1: Existing Master Plan of Krishnapatnam Port

Further to the existing plan, the following points on transportation and land use should be considered to improve the attractiveness of the area for foreign investors.

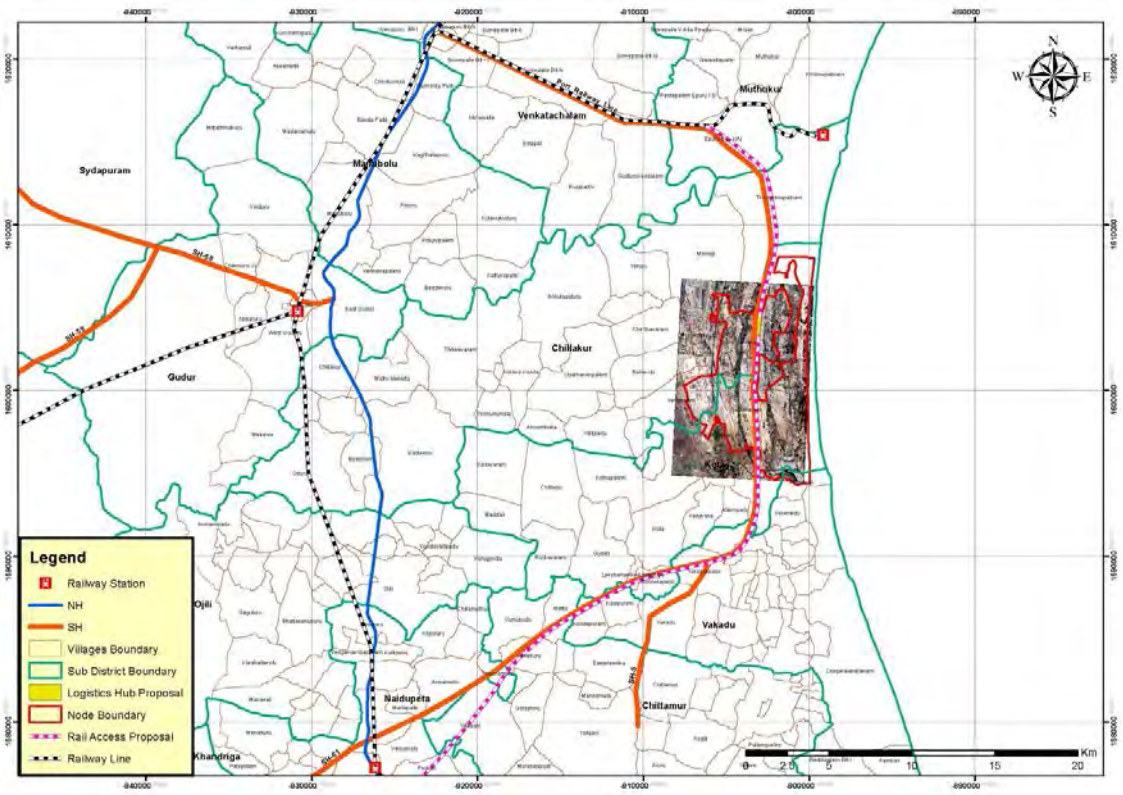
Table 6.1: Items to be considered in the existing plan (Krishnapatnam)

Observation in the Existing Plan	Proposed Revision
Transportation	
• Access road from Krishnapatnam port to Node area is an unpaved 1-lane road.	• Access road to Krishnapatnam and connectivity to NH-5 has to be improved
• No public transport system is proposed	• A bus system is necessary to transport workers from the nearest railway station to individual factories
Land Use	
• Nellore city, which is expected to be the main source of labour, is 40km from the Node.	• Residential complexes for middle/low income workers should be built to ensure availability of manpower within the node.

Source: JICA Study Team

6.1.1 *Existing Infrastructure Projects*

As of Dec 2014, these are no large scale infrastructure projects proposed in Krishnapatnam Node or the surrounding areas. However, KPIL is planning to develop an access road and railway from the south of Krishnapatnam Node to NH-5 to improve connectivity towards Bengaluru. This road will enhance the connectivity of the node in conjunction with other projects such as developing the access road from Krishnapatnam port to the Node, building a loop road network inside the Node and improving NH-5 between Naidupeta and the junction of the port access road.



Source: JICA Study Team

Figure 6.2: Road Connectivity of Krishnapatnam Node

Table 6.2Existing Infrastructure Projects in Krishnapatnam Node

Category	Project Name	Specification	Remarks
Road	Naidupeta-Krishnapatnam Port Access Road (Tentative Name)	Naidupeta (NH 5) via Durgarajapatnam and new industrial park to Krishnapatnam Port	Proposed by Krishnapatnam Port Company Limited
Railway	Naidupeta-Krishnapatnam Port Railway (Tentative Name)	55.72 km	Proposed by Krishnapatnam Port Company Limited

Source: JICA Study Team

6.2 *Development Framework*

6.2.1 *Land for Infrastructure Development*

The target year for completion of the node's development is 2033. Taking into account appropriate development scales and after discussion with nodal agencies, JICA Study Team proposes to develop the node in three phases: Phase-1 (2014-2018), Phase-2 (2019-2023) and Phase-3 (2024-2033).

Based on industrial analysis for Krishnapatnam Node by JICA Study Team, major future industries are likely to be from traditionally strong sectors including "Metallurgy", "Food Processing", "Textile & Apparels", "Electrical Machinery", "Chemical & Petrochemicals", "Pharma" and other potential industries. The estimated land demand of those industries was examined and the following scenario was assumed to be the effective scenario for necessary infrastructure development.

Table 6.3: Land for Infrastructure Development on Krishnapatnam Node

(unit: acre)

		Phase-1 (2014-2018)	Phase-2 (2019-2023)	Phase-3 (2024-2033)
Traditionally Strong Sectors	Metallurgy	234	587	1,402
	Food Processing	424	1,063	2,540
	Textiles & Apparels	76	190	453
	Electrical Machinery	212	532	1,270
	Chemicals & Petrochemicals	83	207	494
	Pharma	12	29	69
	(Sub-total)	**1,041**	**2,608**	**6,159**
Potential Sectors	Medical Equipment	65	163	389
	Machinery	65	163	389
	Auto	65	163	389
	Computer, electronic and optical products - CMIE	65	163	389
	(Sub-total)	**260**	**652**	**1,556**
Total		**1,300**	**3,258**	**7,785**

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, with a plan for a final total of 200,000 residents to live in Krishnapatnam 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 582,700 people with a residential population of 200,000 people in the Krishnapatnam Node in 2033.

Table 6.4: Population Framework

	Phase-1	Phase-2	Phase-3
Working Population	101,720	243,848	582,706
Residential Population	33,408	93,695	200,000

Source: JICA Study Team

6.3 *Land Use Plan*

6.3.1 *Spatial Development Concept*

As described in Section 5.1, a layout plan for Krishnapatnam Node has been formulated by KPIL. Taking this plan into consideration, JICA Study Team prepared a new layout plan for Krishnapatnam Node according to the following development concepts.

[Road Network]

b. The main road which connects to Krishnapatnam port and NH-5 passes through the centre of the node in a north-south direction (shown as a blue line in the figure on right).
c. Diamond junctions are proposed at 2 major intersections in the south of Node to ensure a smooth and efficient flow of traffic.

[Logistics]

d. The logistics sector (i.e. transport of freight) will be served by developing a new railway access line to Krishnapatnam Node from the existing Krishnapatnam port railway line.
e. A logistics hub is planned in the north of Node along the main road.

[Grid Pattern for the Developable Area]

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

[Residential Area Development]

g. Residential area will not be surrounded by industrial areas but will rather be located at three places, centre of the node, and the northern area. The residential area in each phase should be located at different places.
h. Residential areas will be developed in the Node to support 200,000 people by 2033. The residential area will be divided into three phases, with a projected population of 33,000 people in phase-1, 50,000 people in phase-2 and 117,000 people in phase-3.
i. Residential area and resort development on the beach side is proposed in Phase-3 area. But flood and tsunami prevention is required for the area.

[Environmental Reservation]

j. The canal will be maintained, along with a buffer zone.
k. The northern part of the Node is adjacent to a reserved forest. The appropriate buffer zone should be allocated around the forest area as per existing guidelines (URDPFI Guidelines 2014, Ministry of Urban Development).

l. Highly hydrophilic parkland with a clean and green environment will be designed by maintaining a 100m wide buffer zone along the canal within Krishnapatnam Node.
m. Land development is required to prevent flooding due to cyclones or high tides. For this reason, a road dyke is to be adopted for the development of the main road.

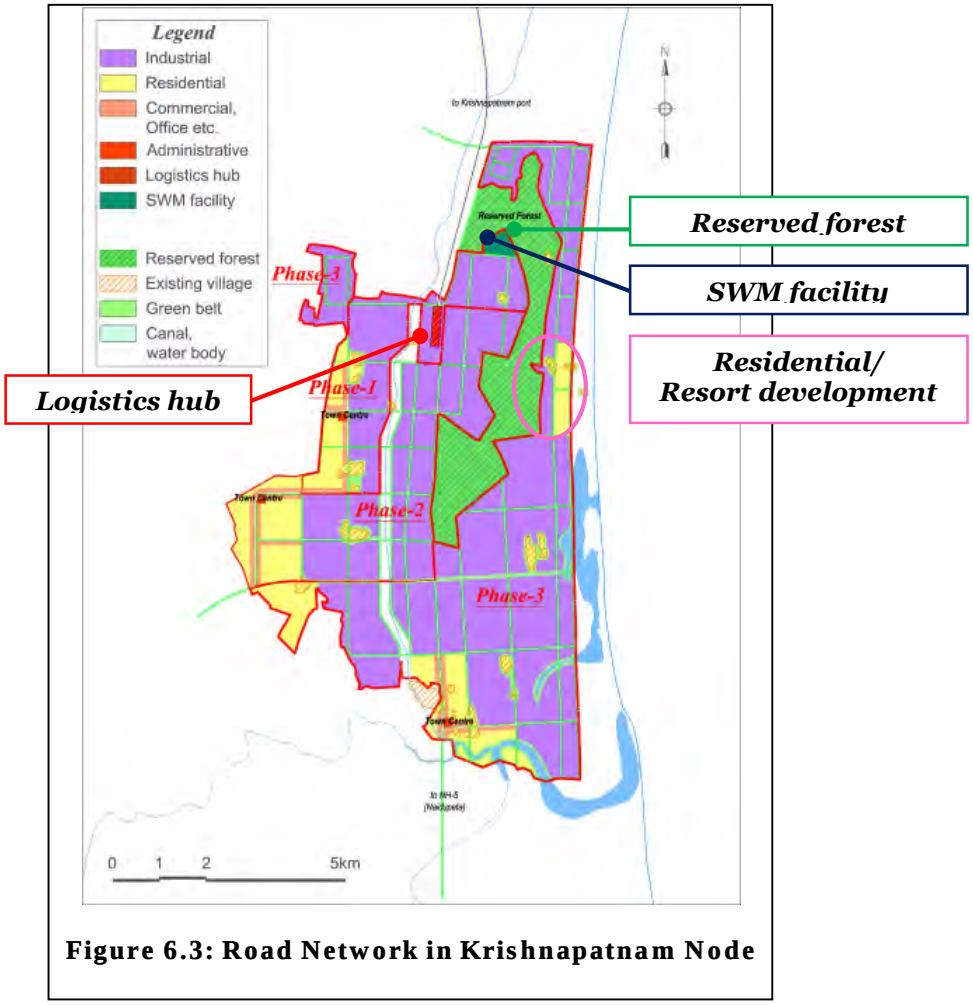


Figure 6.3: Road Network in Krishnapatnam Node

Source: JICA Study Team

6.3.2 *Land Use and Phasing Plan*

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

Table 6.5: Proposed Area by Land Use in Krishnapatnam Node

(Acre)

	Phase-1	Phase-2	Phase-3	Total
Industrial area	1,300	1,957	4,527	**7,785**
Residential area	284	428	987	**1,699**
Existing settlement	164	94	261	**519**
Infrastructure(road & plant)	770	643	1095	**2,508**
Water body, green area and others	91	570	799	**1,460**
Total	**2,609**	**3,692**	**7,669**	**13,971**

Source: JICA Study Team

Considering the land acquisition status and accessibility to Krishnapatnam port, the following phased developments are proposed.

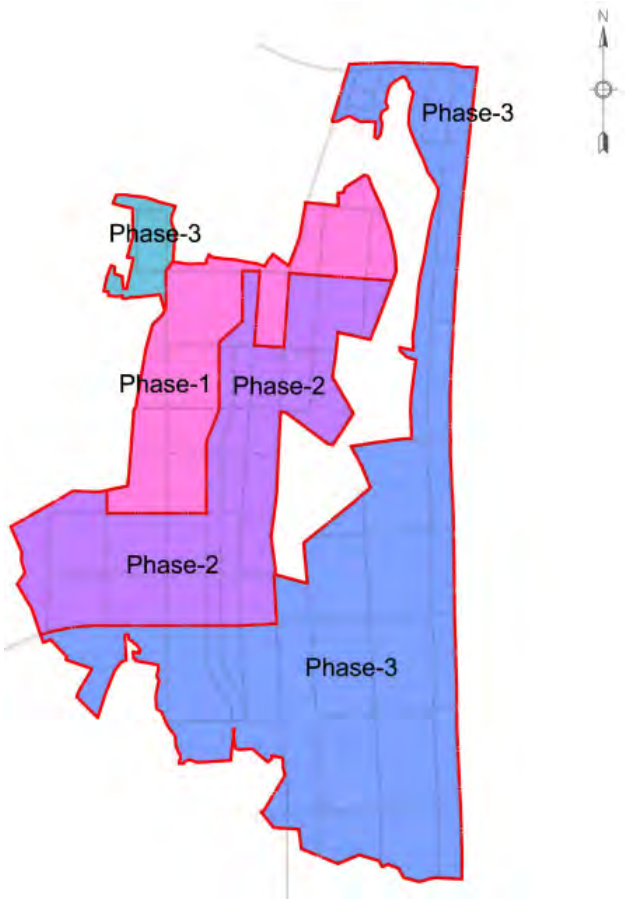


Figure 6.4: Phasing Plan

Source: JICA Study Team

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 6.6: Specification of Housing Building

	Content	Amount
Planed Population	➢ Residential area is planned along the boundary on the western side and southern side	200,000 (persons)
Household Member	➢ National Family health survey (NFHS) 2007	3.9(persons/family)
Number of families (2033)	➢ (Population of Krishnapatnam)/3.9 (HM)	51,282(a) (families)
Specification of residence	➢ Plot area of one house	38.82 (m^2)
	➢ 8 units form one floor of house	310.56 (m^2)
	➢ Common space per one floor	61.21 (m^2)
	➢ Area of one floor (coverage)	371.77 (m^2)
	➢ Area of three floors	1,115.31 (m^2)
	➢ Number of buildings =51,282(a) / 8(per floor)*3(three floors)	2,137 (building)
	➢ Area volume (one building) Coverage = 35%,Floor volume = 100% (National Building Code of India 9.6.2 Table 4 No. iv)	1,062.2 (m^2)
	➢ Total area volume	2,269,658.12 (m^2)
		226.97 (ha)
	➢ Open Space (15%)	34.00 (ha)
	➢ District Road (10%)	26.10ha
Total		287.11 (ha)

Source: JICA Study Team

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

6.5 *Implementation Plan (Development Schedule)*

Krishnapatnam 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 6.7: Implementation Plan

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

Source: JICA Study Team

6.6 *Cost Estimate*

Land Development

This cost estimation is based on the presumption that land development at Krishnapatnam Node will require only land grading works without requiring additional soil from outside the node, since the elevation of Krishnapatnam Node is higher than the designed ground level of Krishnapatnam port (3.5m above sea level). It means the land development costs will be relatively low. The total land development cost is estimated as **INR 48,834 Lakh** and the cost for each phase is shown below.

Table 6.8: Cost Estimate of Land Development (Krishnapatnam 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	2,631,366	3,158	3,960,810	4,753	9,160,617	10,993	18,903
	Soil Transportation & Embankment	1m per 1 sq.m on half of site	cu.m	190	2,631,366	5,000	3,960,810	7,526	9,160,617	17,405	29,930
Total					5,262,732	8,157	7,921,620	12,279	18,321,234	28,398	48,834

Source: JICA Study Team

Flood analysis is recommended to identify the risk of disasters in this area and to prepare a disaster prevention plan.

Housing Development

Based on the proposed plan of housing development, total development cost including construction of housing buildings, pavement and open space is estimated as **INR 291,186 Lakh**. The details are shown as below:

Table 6.9: Cost Estimate for Housing Development Plan (Krishnapatnam Node)

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	794,380	96,624	794,380	96,624	794,380	96,624	289,872
	Open Space	sq.m	63	692,246	438	692,246	438	692,246	438	1,314
Total				1,486,626	97,062	1,486,626	97,062	1,486,626	97,062	291,186

Source: JICA Study Team

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 **97,113 Lakh INR**. The details are shown as below:

Table 6.10: Cost Estimate for Public Facilities Development Plan (Krishnapatnam Node)

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	265,441	32,287	265,441	32,287	265,441	32,287	96,860
	Transportation & Embankment	sq.m	63	133,333	84	133,333	84	133,333	84	253
Total				398,774	32,371	398,774	32,371	398,774	32,371	97,113

Source: JICA Study Team