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SUMMIT ON
GLOBAL CHEMICALS & PETROCHEMICALS
MANUFACTURING HUBS IN INDIA
11 - 12 November, 2019 | The Grand Hyatt, Mumbai

FICCI

SUMMIT ON
GLOBAL CHEMICALS & PETROCHEMICALS
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November 2019

PCPIR REJUVENATION STUDY

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PCPIR REJUVENATION STUDY

डी.वी. सदानंद गौडा
D.V.SADANANDA GOWDA

मंत्री
रासायन उर्वरक मंत्रालय
भारत सरकार, नई दिल्ली

Minister
Chemical & Fertilizer
GOVERNMENT OF INDIA, NEW DELHI

MESSAGE

The Indian Chemicals and Petrochemicals Industry is a vital component of the Indian economy and plays a catalytic role in accelerating the country's GDP. Growing at a robust pace over the years, it has huge potential, specially at a juncture when the global industry is steadily shifting its focus to Asian countries. We need to seize this opportunity to create world class chemical and petrochemical manufacturing hubs in India.

With the expectation of crossing $300 billion market in the next 6 years, the Indian Chemical and Petrochemicals Industry has a supportive role to play towards realizing the vision of Indian becoming a $5 trillion economy by 2025.

Organised by the department of Chemicals & Petrochemicals, jointly with the federation of Indian Chambers of Commerce and Industry (FICCI), this Global Summit is a great platform for the stakeholders to start working towards transforming India as a global petrochemicals manufacturing hub.

I am pleased to be a part of the Global Summit and wish it all the success.

(D.V.Sadananda Gowda)

November 2019

Camp Off. : 1st Floor, Podium Block, Dr.Ambedkar Road, Bengaluru - 560 001 Tel: 080-22866697 Fax 080-22866698
Off. Room No. 316-A, Shastri Bhawan, Dr.Rajendra Prasad Road, New Delhi-110 001, Tel : +91-11-23383559, 23386519, 23386364, Fax :+91-11-23384020

राज्य मंत्री
पोत परिवहन (स्वतंत्र प्रभार),
रसायन एवं उर्वरक
भारत सरकार

सत्यमेव जयते

Minister of State
Shipping (Independent Charge),
Chemicals and Fertilizers
Government of India

मनसुख मांडविया
MANSUKH MANDAVIYA

04th November, 2019

MESSAGE

Indian Chemical & Petrochemical Industry is critical and one of the driving engines of manufacturing sector. In this globalized world, Chemical & Petrochemical Industry plays a prominent role in the economic growth and covers almost every sphere of life.

To sustain the growth and momentum of the sector, Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIRs) were conceptualized which are envisaged to generate better efficiency by utilizing common infrastructure and support facilities.

Our focus is not just to be self-sufficient but to be at par with the global industrial market. Phenomena like accelerated globalization, business and changing pace of technology have brought sweeping changes and abundant opportunities for industries to grow.

I am delighted to be a part of this Global Summit which will be the first renewed initiative to showcase the strengths and opportunities in each PCPIRs to the global investing communities and work together with stakeholders to aid the growth of the PCPIRs and thereby contribute towards achieving the national vision of being $5 trillion economy by 2025.

I welcome all the delegates and wish the Summit a grand success.

(Mansukh Mandaviya)

पी. राघवेन्द्र राव
सचिव
P. RAGHAVENDRA RAO
Secretary

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

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कक्ष संख्या 501, 'ए' विंग, शास्त्री भवन
डॉ राजेन्द्र प्रसाद रोड़, नई दिल्ली – 110 001
Government of India
Ministry of Chemicals & Fertilizers
Department of Chemicals & Petrochemicals
Room No. 501, 'A' Wing, Shastri Bhavan
Dr. Rajendra Prasad Road, New Delhi - 110 001
Tel.: 23384196/ 23382467/Fax : 23387892
E-mail : sec.cpc@nic.in

MESSAGE

The Indian chemical & petrochemical industry is a critical part of the Indian economy and has made immense contributions to human life backed by a rich heritage of innovation. It has also played a significant role in the country's ongoing metamorphosis from an agrarian economy to an industrialized economy.

With investment in R&D, this industry is registering a significant growth in the knowledge sector, especially the specialty and fine chemicals segments. The opportunities and the potential of Indian market is well recognized globally, and we have become the preferred choice for most of the nations.

The Global Summit jointly organized by the Department of Chemicals & Petrochemicals and FICCI, is a great platform to discuss issues faced by the industry as well as to strategize in making it more vibrant, competitive and sustainable.

I am privileged to be a part of the Global Summit and look forward to useful insights by the stakeholders.

P. Raghavendra Rao

(P. Raghavendra Rao)

Federation of Indian Chambers of Commerce and Industry
Federation House
Tansen Marg
New Delhi 110001
T +91 11 23738760 (11 Lines)
F +91 11 23320717 - 23721504
E ficci@ficci.com
www.ficci.com
CIN: U99999DL 1956NPL002635

Mr. Prabh Das
Chairman-FICCI National Petrochemical Committee
Managing Director & CEO
HPCL-Mittal Energy Limited

Message

Indian Chemical and Petrochemical sector is a key pillar of the economy with profound impact on all aspects of our lives. The industry has witnessed healthy growth over the years and is billed to surpass $300 billion by 2025.

However, the massive potential of the sector is yet to be fully utilized. India's per capita consumption and penetration level of petrochemicals is lower than the global average, indicating significant headroom for growth.

Going forward, the **Summit on Global Chemicals & Petrochemicals Manufacturing Hubs in India**, jointly organized by the Chemicals and Petrochemicals, Government of India and FICCI, assumes immense significance. It is a great forum to deliberate pertinent issues related to the industry, showcase opportunities, exchange knowledge and network and ultimately lay the foundation for making Indian Chemical & Petrochemical Industry, the hub for both domestic and international markets.

My best wishes for a very successful summit.

Prabh Das

Federation of Indian Chambers of Commerce and Industry
Federation House
Tansen Marg
New Delhi 110001
T +91 11 23738760 (11 Lines)
F +91 11 23320714 / 23721504
E ficci@ficci.com
www.ficci.com
CIN: U99999DL 1956NPL002635

Mr. Deepak C Mehta
Chairman-FICCI National Chemical Committee
CMD, Deepak Nitrite Ltd

Message

Indian Chemical and Petrochemical industry occupies a pivotal position not just in the Indian economy but in meeting basic needs of the people and improving their quality of life. Driven by the vision of Hon'ble Prime Minister of India, Shri Narendra Modi in making India a $5 trillion economy through flagship initiatives like Make in India, Start Up India, Skill India and Digital India, the sector is making rapid progress and expected to become a significant global player.

I am glad to note that Department of Chemicals and Petrochemicals, Government of India and FICCI are jointly organizing the **Summit on Global Chemicals & Petrochemicals Manufacturing Hubs in India** which provides us with the opportunity to address current challenges and explore areas of growth in the industry.

This event will not only showcase unique investment opportunities in the sector but would also facilitate national and global stakeholders to deliberate and collaborate in driving this industry towards a more sustainable future.

Looking forward to meeting you all in Mumbai to make the **Summit on Global Chemicals & Petrochemicals Manufacturing Hubs in India** a grand success.

(Deepak C Mehta)

FOREWORD

S. S. Acharya
Managing Director
Mott MacDonald, India
ss.acharya@mottmac.com

Manoj Mehta
Head – Chemicals & Petrochemicals
FICCI
manoj.mehta@ficci.com

India is one of the most attractive investment destinations in the world, with several foreign funds attracted to the country by its political stability, a growing middle class and economic reforms. Currently ranked 63 in the World Bank's Doing Business 2020 report - up from 130 in 2016 - the Indian Government has a clear focus on ensuring doing business is straightforward and easy.

The 'Make in India' campaign is intended to boost domestic manufacturing and attract foreign investment through the development of industrial corridors and clusters. Clusters play a vital role in the success of the chemical and petrochemical industries due to cost-economics, shared resources and linkages. This has been amply demonstrated through thriving petrochemical hubs in Rotterdam, Jurong Island, the Houston Bay Port Area and the Dahej PCPIR.

In 2007, the Government of India unveiled its PCPIR policy with the intention of developing global scale industrial clusters, to benefit from co-siting, networking and the greater efficiencies that come through utilising common infrastructure and support services. The Dahej PCPIR in Gujarat has clearly been the frontrunner among PCPIRs, making use of the existing investor-friendly approach of the state government and developing port infrastructure. PCPIR authorities in Paradip and Visakhapatnam have prepared their draft master plan and are actively pursuing investments in these regions.

This paper gives an overview of the Indian chemicals and petrochemicals industry. Based on the current state of development of various PCPIRs in the country, potential investment avenues have been identified, and recommendations are based on the global best practices. We hope that this report will help policy makers to determine a successful growth path for PCPIRs and allow the industry to play an increasingly important role in India's quest to become a US$5trn economy.

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EXECUTIVE SUMMARY

Chemicals and Petrochemicals sector is one of the largest contributors to India GDP. India is the sixth largest producer of chemicals in the world and contributes 3.4% to the global chemical industry. However, per capita consumption of chemical products in India is low (1/10th of the global average). With increasing population, rising disposable income and a gradual shift towards middle class society, demand for chemical products is expected to increase over the next decade.

The Government of India adopted a policy in 2007 to set up Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR). Currently there are four identified regions - Dahej (Gujarat), Vishakhapatnam (Andhra Pradesh), Paradip (Odisha) and Cuddalore (Tamil Nadu). However, due to a wide range of issues (ranging from overall infrastructure development to project financing), attracting investment to Vizag, Paradip and Cuddalore has been relatively challenging in comparison to Dahej. Considering the overall scenario, the Government has now planned for policy interventions to rejuvenate investment in PCPIRs.

The chemicals market in India has grown at 3% over the last decade. Demand for most of products is set to increase in the near future, due to increasing requirement from downstream industries. India though continues to be a net importer for most of these chemicals. Thus, there exists a huge potential for investment in manufacturing units of bulk chemicals, petrochemicals, speciality chemicals and feedstock.

The current scenario of development at each PCPIR has been gauged by interactions with Government and private stakeholders and publicly available data during the course of this study. Infrastructure projects required by each PCPIR have been listed in the report. These projects need to be taken up on priority to improve the overall investment scenario of these clusters.

Operation model across successful petrochemical hubs from around the world (Jurong, Antwerp, Houston) have been looked at to understand key drivers for investment. Based on this, we have identified five key success factors to improve the investment attractiveness of the PCPIRs.

Success of PCPIRs will depend on proactive roles by the PCPIR management in proper conceptualisation and phasing of the PCPIR development and industry participation by way of investments in infrastructure and industry. The government shall act as a catalyst providing support in terms of fast track clearances, favourable duty regime and an overall business friendly environment. To give a fillip to PCPIRs, the government may also consider time bound exemptions, subsidies and incentives.

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1. INTRODUCTION

1.1 Indian Chemical and Petrochemical Industry

India's chemical industry is highly diversified and covers more than 80,000 commercial products. The Industry is backbone of various downstream industries such as automobiles, textile, paper, paints, FMCG and pharmaceuticals.

India is the sixth largest producer of chemicals in the world and contributes 3.4% to the global chemical industry. The total market size of chemical industry was US$ 163 Billion in FY 18 and is expected to reach US$ 304 Billion by 2025.

The current per capita consumption of chemical products in India is one-tenths of the global average which indicates that demand would grow considering various factors such as increasing population, rise in disposable income and the shift towards middle class society which would lead to rising demand for home and education.

The chemical industry is classified into five major segments:

- Bulk Chemicals: Bulk chemicals are group of chemicals which are made on large scale, these are further divided into organic, inorganic and alkali chemicals.
- Petrochemicals and Polymers: These are derived from various chemical compounds such as hydrocarbons which are derived from crude oil or natural gas.
- Specialty Chemicals: Specialty chemicals are high R&D, high value and low volume chemicals, these are derived from basic chemicals and are made for specific end use applications. Specialty chemicals can be further classified into:
    - Surfactants
    - Flavours and fragrances
    - Polymer additives
    - Textile chemicals
    - Colorants
    - Paints and coatings
    - Construction chemicals
    - Personal care chemicals
    - Water chemicals

- Fertilizers: Fertilizers are materials which provide nutrients for plant growth. Fertilizers can be organic/inorganic and natural/synthetic in nature. These can broadly be classified into: nitrogenous, phosphate, potassium and complex fertilizers.
- Agrochemicals: Chemicals which are used to protect crops against insects and pests are covered under this category. These broadly cover insecticides, fungicides, herbicides and bio-pesticides. They are used on irrigation water, seeds, soils and crops.

1.2 Overview of PCPIR Policy

The Petroleum, Chemicals and Petrochemicals Investment Region (PCPIR) Policy was announced by the Government of India (GoI) in April 2007. The policy envisaged the development of Global Scale Industrial Corridors in the petroleum, chemical and petrochemical sectors of the country in an integrated and environmentally friendly manner.

The Policy was targeted at establishment of high-class infrastructure, promoting competitive environment conducive to setting up new business units, attracting investments and providing a boost to production, exports and employment generation in the targeted sectors.

1.3 Objectives of the PCPIR Policy

The key objectives of the PCPIR Policy are listed below:

- Attract FDI and enhancement of growth rates and global competitiveness to raise regional and India's international standing in the petrochemical and related sectors
- Achieving synergies of value added manufacturing and R&D and reaping benefits of co-sitting, networking and greater efficiency using common infrastructure & support services
- Improvement of petrochemical industry image within India and of Indian products/services abroad
- Identification and removal of current obstacles (feedstock, regulatory architecture, tariff anomalies, export facilitation, infrastructure, logistics, skill development)
- Prioritization for resource allocation through policy framework and ensuring safe and sustainable operations
- Promote green chemistry, focus on speciality chemicals

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2. MARKET OVERVIEW

2.1 Introduction

For the purpose of this study, historical demand, growth in demand, imports and exports for the entire gamut of products in the chemicals and petrochemicals industry are considered. As there are numerous products under bulk chemicals and petrochemicals (including polymers), some of the products were identified, considering high historical demand, demand growth rate, imports and exports.

The following sections give an insight into the domestic market scenario for the five major chemicals and petrochemicals segments, feedstock and alternate feedstock.

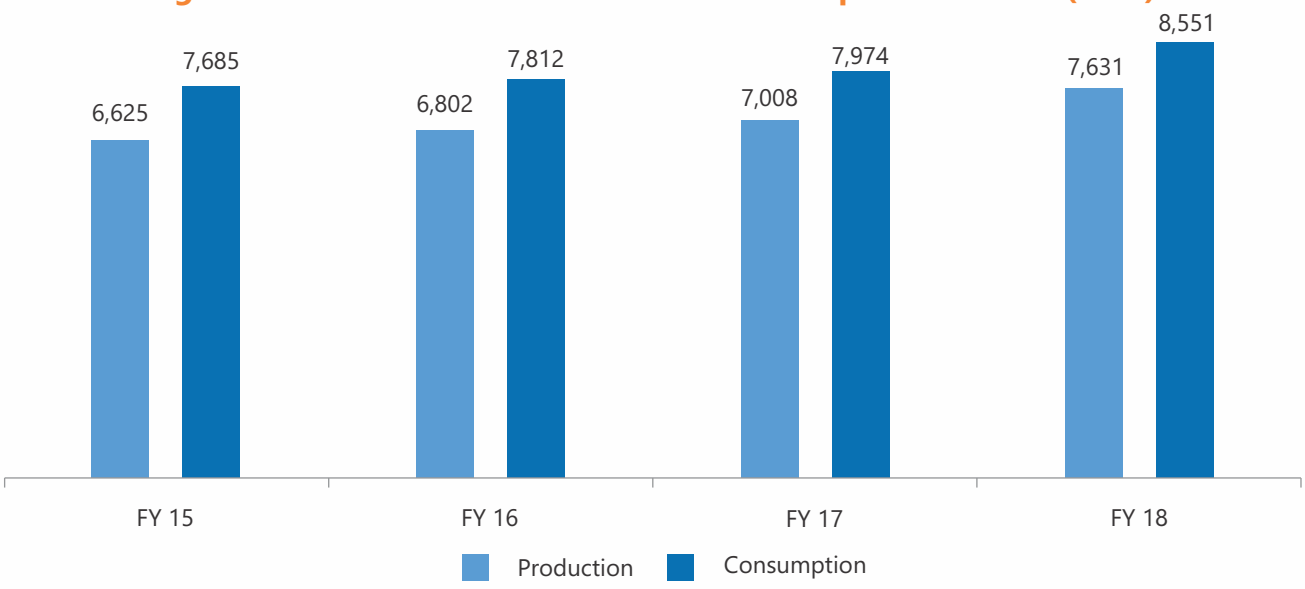
2.2 Bulk Chemicals

Bulk Chemicals are high volume and low value products; they are produced to cater to a vast range of downstream industries. These can majorly be classified into three classes, alkali, organic and inorganic.

2.2.1 Alkali Chemicals

Alkali chemicals have the largest market share in the domestic chemical industry accounting for 69% of the total production. Figure 1 illustrates the historical production consumption scenario in India.

Figure 1: Alkali chemicals Production-Consumption Scenario (TMT)



Source:MoCF

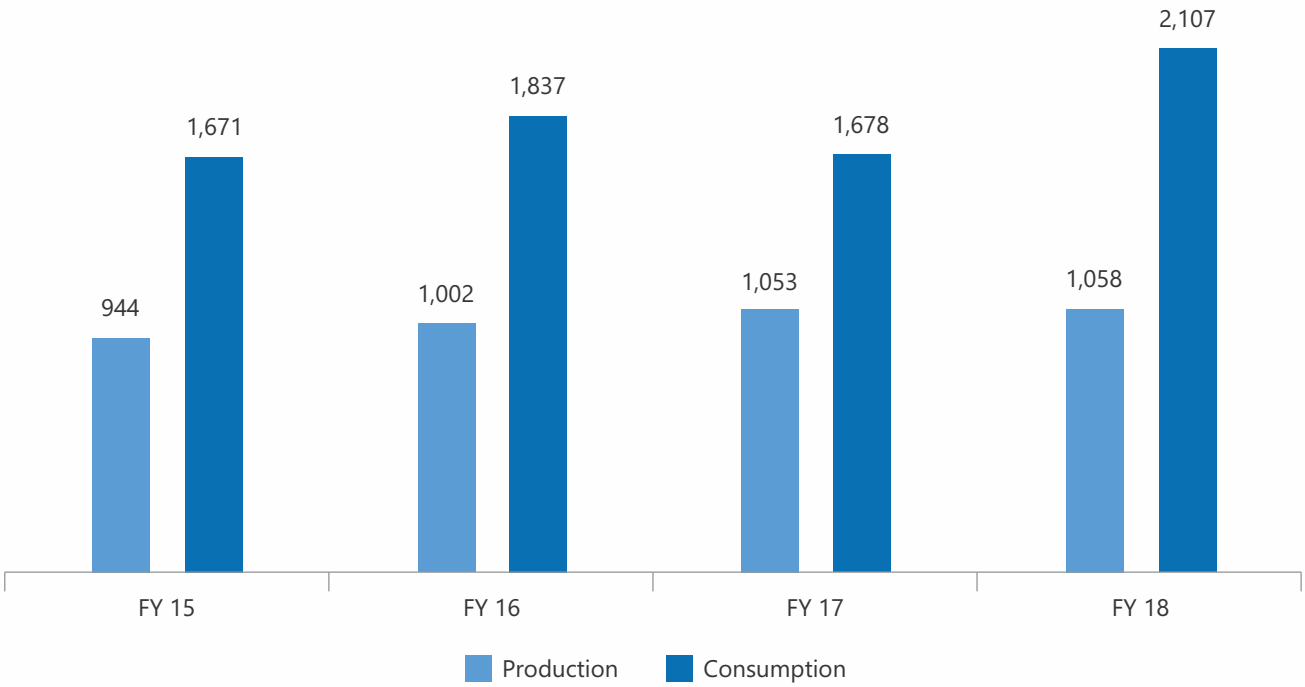
Market Scenario

- The overall gap in production and consumption of alkali chemicals has by and large remained constant from FY15-18 (1,059 TMT in FY15 and 919 TMT in FY18). There has been negligible capacity addition in India during this period
- Demand for alkali chemicals has grown steadily at 5% CAGR during this period (8,551 TMT in FY18). Soda Ash has the maximum demand among alkali chemicals (43% of total demand)
- India imports around 18% of its total demand for alkali chemicals
- Alkali chemicals demand is expected to grow at 13% CAGR from FY19-23. End-user industries such as textile and FMCG, which are the key demand drivers are expected to grow at a healthy rate of around 10% during this period

2.2.2 Inorganic Chemicals

Inorganic chemicals are the chemicals which are not carbon based and are of mineral origin, these chemicals are used as intermediates for downstream industries. Figure 2 illustrates the historical production-consumption scenario in India.

Figure 2: Inorganic Chemicals Production-Consumption scenario (TMT)



Source: MoCF

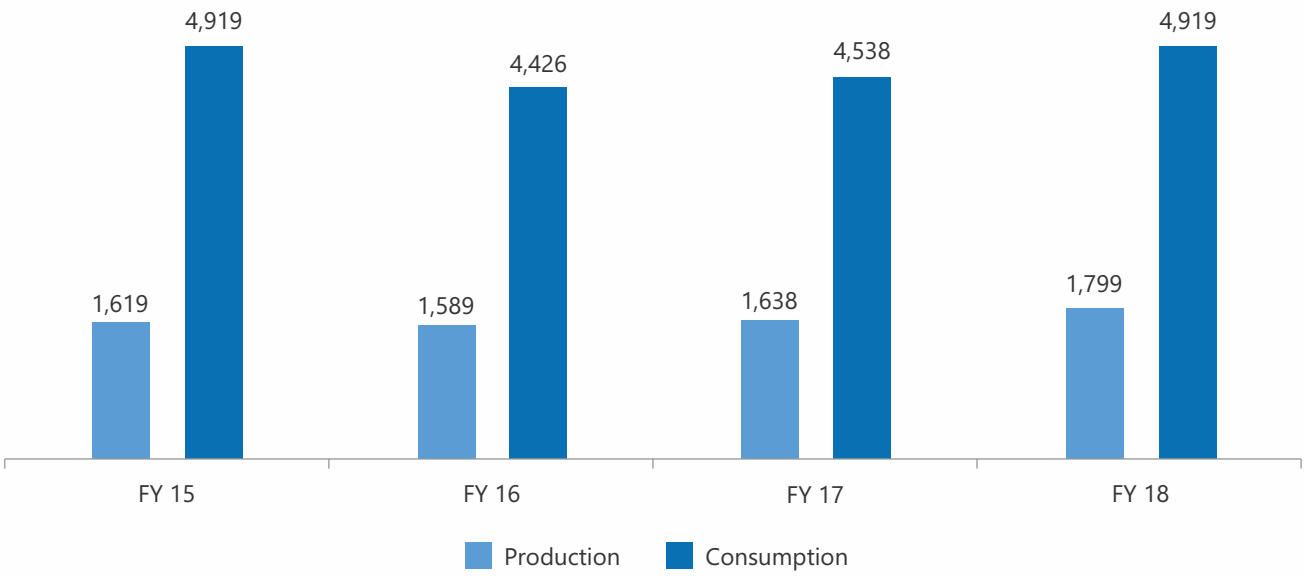
Market Scenario

- The gap between production and consumption of inorganic chemicals has progressively widened from FY 15 to FY 18 (726 TMT in FY15 and 1,048 TMT in FY18). This is primarily because of increased demand and very less capacity addition during this period
- Demand for inorganic chemicals has grown at 8% CAGR during FY15-FY18 (2,107 TMT in FY18). Calcium carbonate and carbon black constitute 76% of total domestic demand for inorganic chemicals
- India imports around 58% of its total demand for inorganic chemicals
- Demand for inorganic chemicals is expected to grow at 9% CAGR from FY19-23, with aluminium fluoride demand growing at 14%. Key drivers for demand will come from end-user industries like aluminium as its demand would rapidly grow in advent of increasing investments in power (growth of 5-6%), infrastructure (growth of 7-8%) and transport (growth of 6%) sectors. Investment in manufacturing facilities for inorganic chemicals will also help in reduction of imports

2.2.3 Organic Chemicals

Organic chemicals have a significantly large contribution to the Indian chemical industry. Acetic acid, phenol, acetone, methanol, formaldehyde, ethyl acetate are the chemicals which have high demand under this segment. Figure 3 illustrates the historical production consumption scenario in India.

Figure 3: Organic Chemicals Production-Consumption scenario (TMT)



Source: MoCF

Market Scenario

- The overall gap in production and consumption of organic chemicals has remained consistent FY15-18 (3,300 TMT in FY15 and 3,120 TMT in FY18)
- Demand for organic chemicals has grown at 5.4% CAGR during FY15-FY18 (4,91 TMT in FY18). Methanol and acetic acid constitute 76% of total domestic demand for organic chemicals
- India imports around 69% of its total demand for organic chemicals
- Demand for organic chemicals is expected to grow at 9% CAGR from FY19-23, with phenol demand growing at 11%. With India looking to reduce its import percentage for organic chemicals, there is potential for large investments in this segment

2.2.4 Conclusion

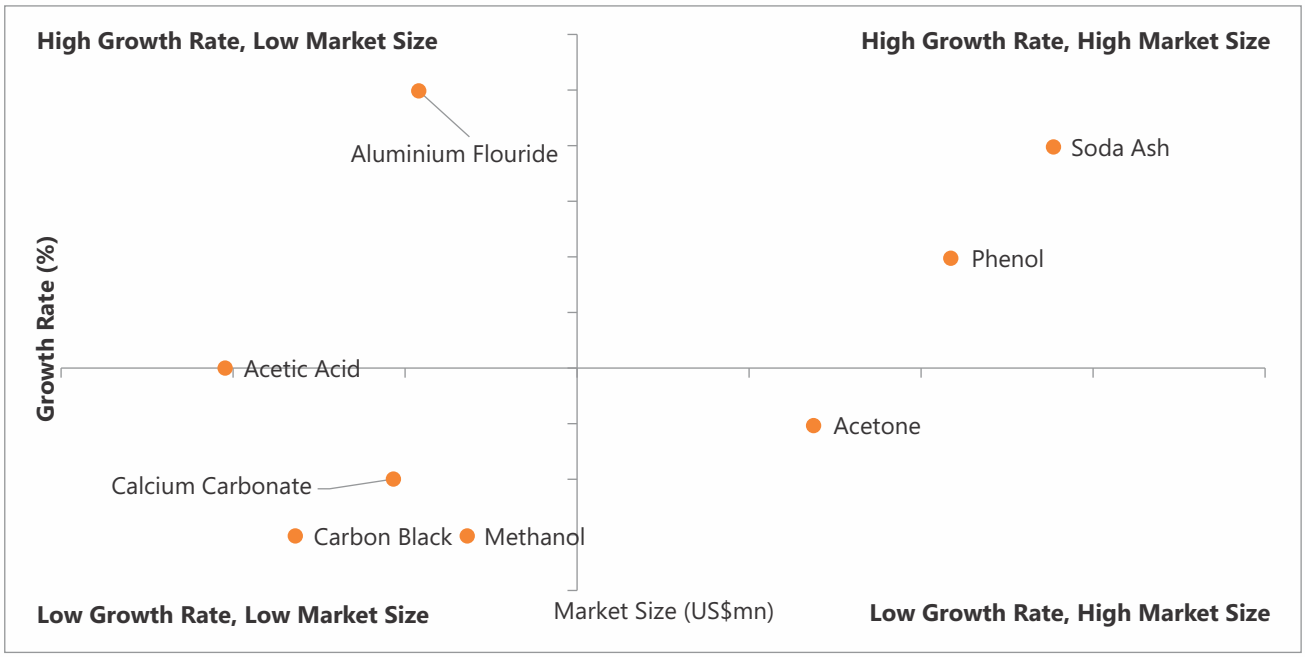
The estimated growth rate and future market size (FY23) for selected bulk chemicals is mentioned in Table 1.

Table 1: Estimated growth rate and Market Size – FY23

Product	Estimated Growth Rate	Expected Market Size (US$ mn)
Soda Ash	13%	1,252.11
Aluminium Fluoride	14%	288.00
Carbon Black	6%	567.86
Calcium Carbonate	7%	370.29
Acetic Acid	9%	1,131.43
Methanol	6%	972.14
Acetone	8%	481.83
Phenol	11%	512.40

Source: MM Analysis

Figure 4: Investment Potential – Bulk Chemicals



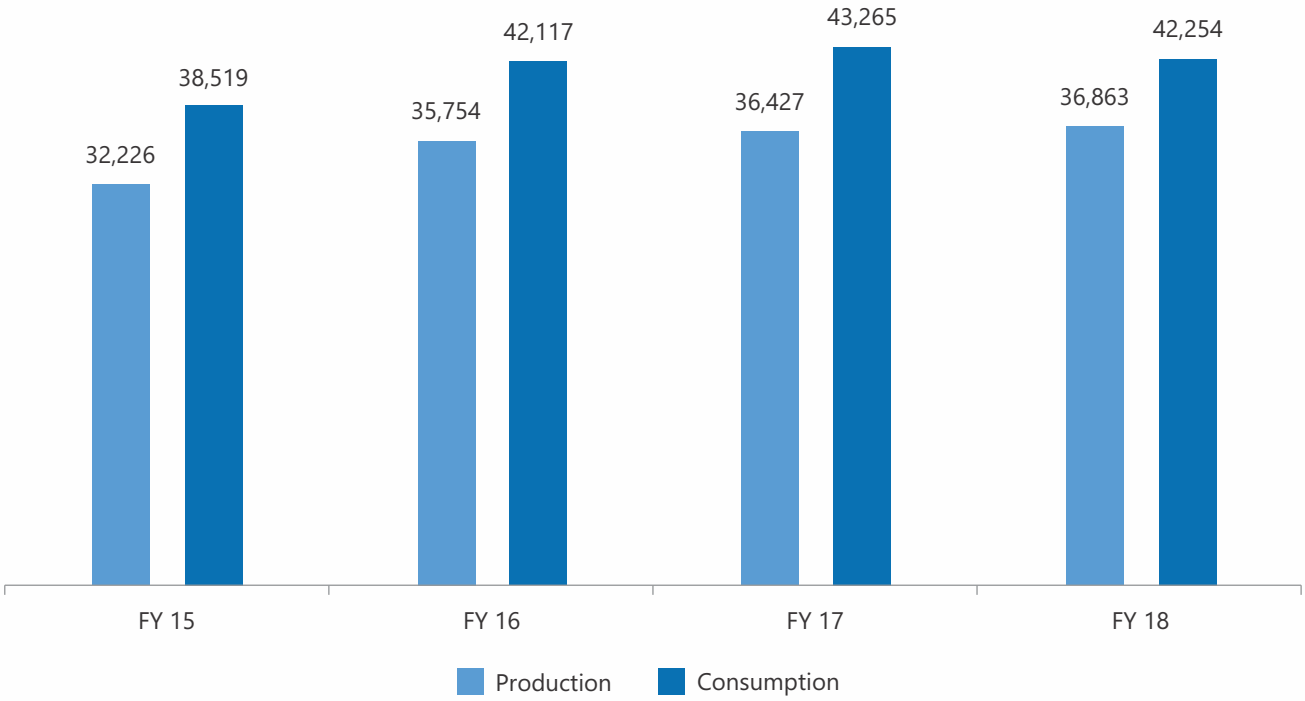
Source: MM Analysis

From Figure 4 it is evident that there exists excellent investment potential for bulk chemicals like soda ash and phenol (having high growth rate and high market size). There also lies a possibility of investment in chemicals like aluminium fluoride which have low market size, but high growth rates.

2.3 Petrochemicals

Petrochemicals also known as petroleum distillates are chemicals derived from petroleum and natural gas by refining. Some chemical compounds derived from petroleum are also obtained from other fossil fuels like coal or natural gas. Two most common classes of petrochemicals are olefins and aromatics, oil refineries produce olefins and aromatics by cracking of petroleum fractions, whereas chemical plants produce olefins by steam cracking of natural gas like ethane and propane, and aromatics are produced by catalytic reforming of naphtha. Figure 5 illustrates the historical production consumption scenario in India.

Figure 5: Petrochemical Production-Consumption scenario (TMT)



Source: MoCF

Market Scenario

- The overall gap in production and consumption of petrochemicals has remained consistent during FY15-18 (6,300 TMT in FY15 and 5,400 TMT in FY18)
- Demand for petrochemicals has grown at 5.4% CAGR during FY15-FY18 (42,254 TMT in FY18). 31% of this demand comes from polymers while 22% from olefins
- India imports around 11.2% of its total demand for petrochemicals. Most imports are for polymers which is around 37% of the total demand for that segment
- Petrochemicals demand is expected to grow at 7.5% CAGR from FY19-23, with polymer demand growing at 8%. Growth in end-user industries like packaging and textiles (growth of around 10%) will drive demand in this segment. Upcoming investments in plastic parks and automotive clusters will create huge demand for polymers and synthetic rubber

Conclusion

The estimated growth rate and future market size (FY23) for selected petrochemicals and polymers is mentioned in Table 2 and Table 3.

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Table 2: Estimated growth rate and Market Size – FY23: Petrochemicals

Product	Estimated Growth Rate	Expected Market Size (US$ mn)
Polyester Filament Yarn (PFY)	6%	4,096.93
Polyester Staple Fibre (PSF)	6%	1,822.92
EVA	6.80%	542.14
Butyl Rubber	8%	1,164.29
SBR	7%	859.29
PBR	5%	123.21
ABS	10%	698.21
MEG	6.14%	2,955.52
PTA	9.00%	5,147.12
Toluene	11%	678.25
Styrene	5%	1,430.00
Polyol	10%	947.14

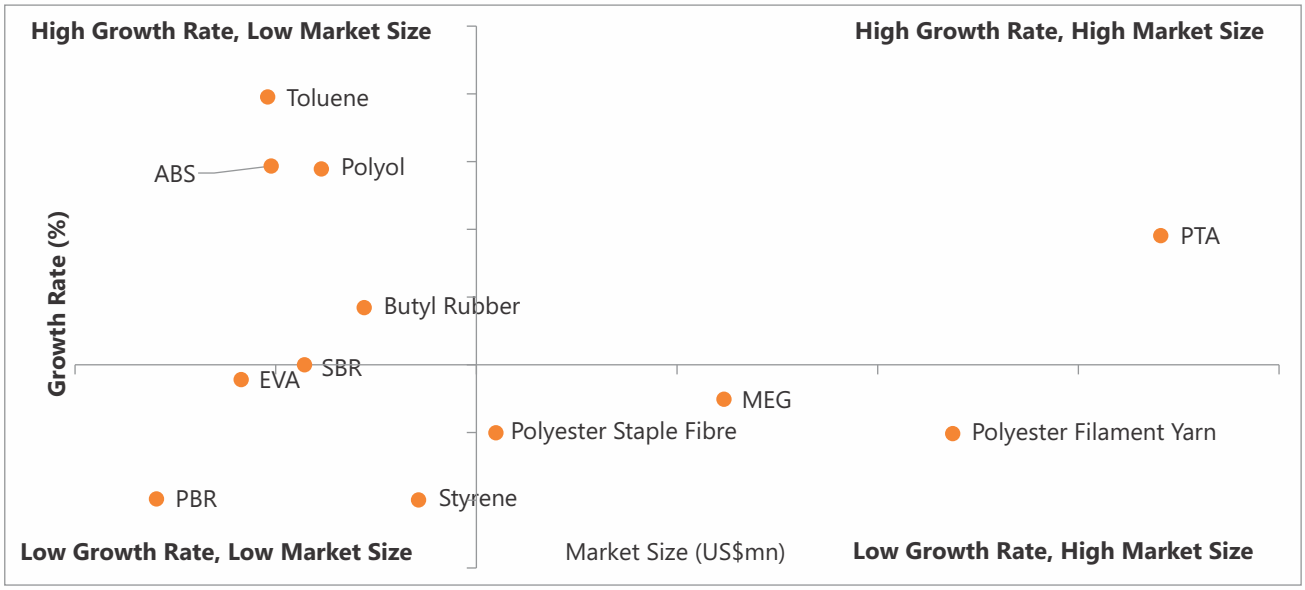
Source: MM Analysis

Table 3: Estimated growth rate and Market Size – FY23: Polymers

Polymers	Estimated Growth Rate	Expected Market Size (US$ mn)
PVC	8.20%	5,204.10
PS and EPS	5%	365.00
HDPE/LLDPE	9.40%	6,472.50
LDPE	6.40%	790.71
PP	10.50%	11,165.71

Source: MM Analysis

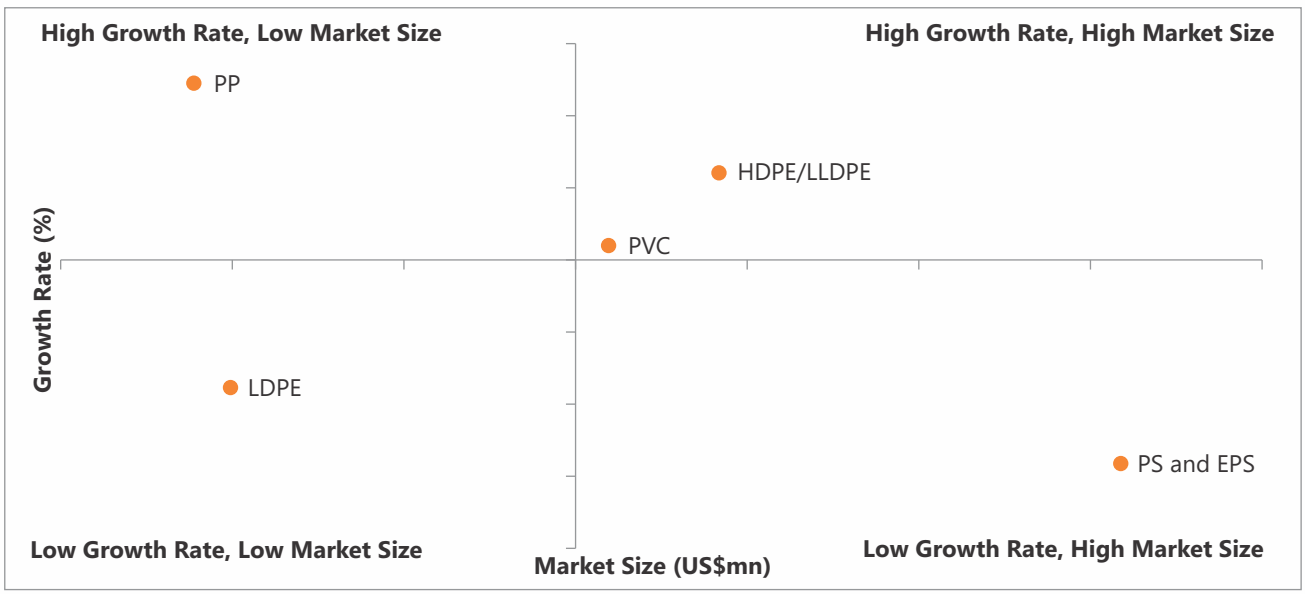
Figure 6: Investment Potential - Petrochemicals



Source: MM Analysis

Figure 6 indicates that there exists excellent investment potential for petrochemicals like PTA (having high growth rate and high market size). There also lies a possibility of investment in petrochemicals like PFY, MEG and PSF (critical input materials to the textile industry) which have low growth rates, but high market size. Investment may also be considered for petrochemical products like Toluene, Polyol and ABS having low market size but high growth rates.

Figure 7: Investment Potential – Polymers



Source: MM Analysis

Figure 7 illustrates that there exists excellent potential for investment in HDPE/LLDPE swing units, due to increasing demand from the plastic industry (packaging, plastic pipes).

2.4 Specialty Chemicals

Specialty chemicals are generally defined as chemicals which are high value and low volume chemicals, these chemicals are R&D intensive. Specialty chemicals are classified based on their applications.

The specialty chemicals considered under this study are:

- Surfactants
- Flavours and fragrances
- Polymer additives
- Textile chemicals
- Paints and coatings
- Colourants - Dyes and pigments
- Construction chemicals
- Personal care chemicals
- Water chemicals

Market Scenario

- Speciality chemicals constitute 22% of the total chemicals and petrochemicals market in India. As of FY18, the total market size is around US$ 35 billion
- The demand for speciality chemicals is expected to grow at 12% CAGR from FY19-22, driven by investments in end-user industries like personal care, food and beverage, textiles and packaging
- Speciality chemicals being high value products, future investments in India should also focus on the export market

Conclusion

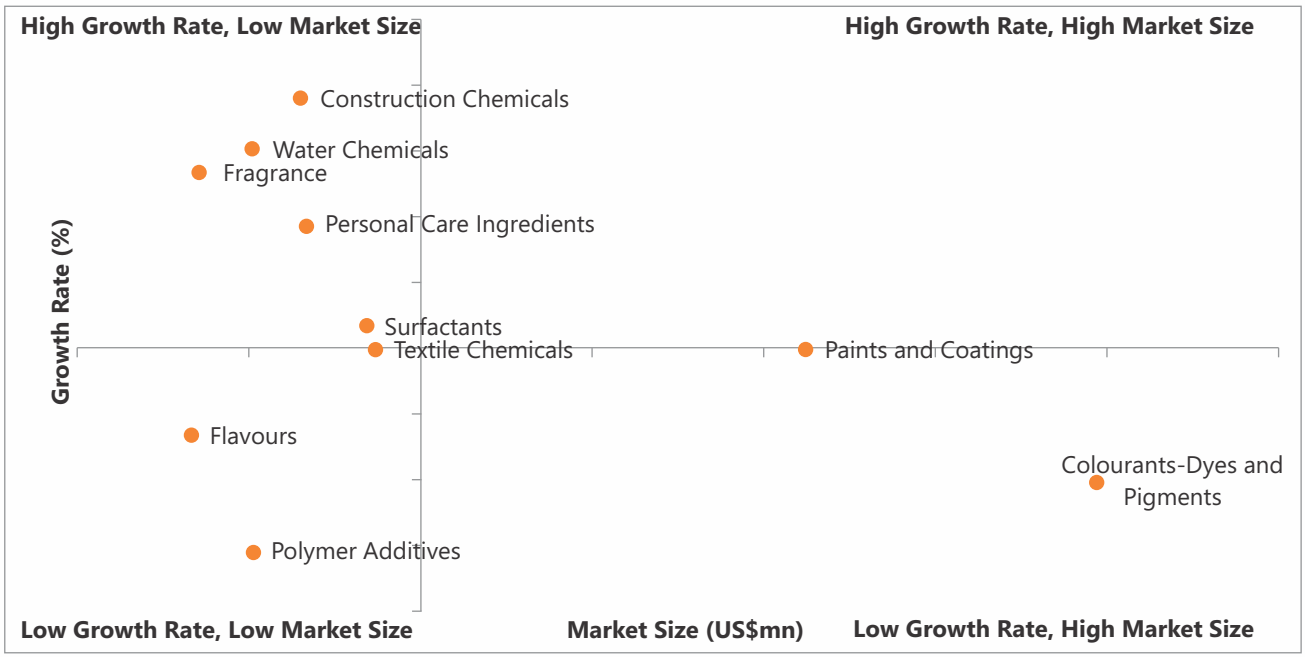
The end-user future demand for speciality chemicals along with the market size (FY23) is mentioned in Table 4.

Table 4: Speciality Chemicals End-User Market Demand and Market Size

Products	Estimated Growth Rate	Expected Market Size (US$ mn)
Surfactants	11.36%	2,742.86
Flavours	9.70%	714.29
Fragrance	13.80%	800.00
Polymer additives	7.95%	1,419.57
Textile chemicals	11.00%	2,857.14
Paints and coatings	11.00%	7,878.00
Colourants- Dyes and pigments	9.00%	11,857.14
Water chemicals	14.00%	1,426.00
Construction chemicals	14.80%	1,980.00
Personal care ingredients	12.90%	2,049.00

Source: MM Analysis

Figure 8: Investment Potential – Speciality Chemicals



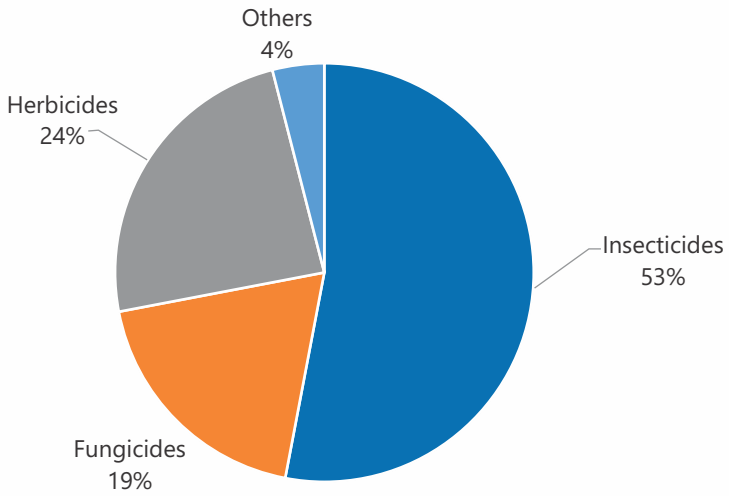
Source: MM Analysis

Figure 8 illustrates that investments in speciality chemicals would be driven by demand from end-user segments like paints and coatings and dyes and pigments industry. There exists excellent potential for investment in manufacturing units of speciality chemicals like Linear Alkyl Benzene (LAB). Potential for investment also lies in speciality chemicals having end user applications in construction, fragrance and personal care industry.

2.5 Agrochemicals

India is the fourth largest producer of agrochemicals globally after the United States, China and Japan. Agrochemicals (crop protection products/ pesticides) are broadly classified into five types, insecticides, herbicides, fungicides, bio-pesticides and others. Others comprise of rodenticides, plant growth regulators (PGR) and fumigants. The domestic market segmentation by type of pesticides is shown in Figure 9.

Figure 9: Domestic Market Segmentation by Type of Pesticides



Source: MoCF

Market Scenario

- India's current production capacity for pesticides as of FY19 stands at 292,000 MT. The production capacity has grown at 3.8% CAGR from FY15-19
- As of FY19, India's imports stand at 117,000 MT (growing at 5.15% CAGR from FY15-19), whereas exports stand at 461,000 MT (growing at 12.76% CAGR from FY15-19). India is thus a net exporter for agrochemicals
- Fungicides and herbicides are the leading segments in exports, having grown at 16.2% and 31.5% CAGR respectively from FY15-19

- Imports are dominated by insecticides and pesticides having grown at 1.5% CAGR and 14.07% CAGR respectively from FY15-19. More than 50% of India's imports come from China
- India's per hectare consumption of pesticides is among the lowest in the world (0.6 kg/ha) against 5-7 kg/ha in the UK and about 13 kg/ha in China. Low awareness levels among farmers regarding pesticides has resulted in lower per hectare pesticide consumption in India
- India's agrochemical market currently stands at US$ 2.9 billion
- The agrochemicals market in India is expected to grow at 8% CAGR, reaching US$ 3.7 billion in FY22 and US$ 4.7 billion and FY25

Conclusion

The outlook for the domestic pesticide market looks positive with a predicted growth rate of 8% CAGR over up to FY25. The dependency on agrochemicals will continue to increase, with farmers education. Key industry players like Nagarjuna Agrichem Limited and Agrico Organics have made significant investments during FY18 and FY19 to add to their capacities. Thus, with a growing export market and steadily increasing domestic demand, there lies significant potential for investments in the agrochemicals sector in India.

2.6 Fertilizers

Fertilizers are chemical products which provide nutrients for plant growth. They can be broadly classified as nitrogenous, phosphate, potassium and complex fertilizers. India is the 2nd largest consumer of fertilizers and also the 3rd largest producer of nitrogenous fertilizers.

Market Scenario

- India's current production capacity for fertilizers stands at 49.68 MMT. Over the last financial year, there has been significant capacity addition (1.7 MMT) in the private sector
- Total fertilizer production in India in FY19 was 45.37 MMT. Production increased at a CAGR of 4.63% from FY16-19
- Production of urea has hovered around 24.5 MMT from FY16-FY19. During this time Diammonium Phosphate (DAP) production grew by 7.34% from 3.8 MMT to 4.7 MMT
- Complex fertilizer production has remained stagnant around 8.4 MMT from FY16-19. This has been primarily due negligible capacity addition and poor utilisation rates
- India imports raw materials (Urea, DAP) required for fertilizer production. There are no reserves in the country for Potash, hence the entire demand of muriate of phosphate/potassium chloride (MOP) is met through imports

- Imports for urea and DAP have decreased from 8.5 to 6.5 MMT and 6.0 to 4.2 MMT respectively from FY16-18. This has been due to an increased thrust from the Government of India to end urea imports by 2022 and achieve self sufficiency
- Imports for MOP have grown at 10.5% CAGR from FY16-18
- The fertilizer demand in India is expected to reach 77.8 MMT by FY23, growing at a rate of 2.2% CAGR
- As of FY18, the Indian fertilizer market was around US$ 64 billion. The market is expected to grow at 13% CAGR from FY19-23 to around US$ 138 billion

Conclusion

The outlook for the fertilizer industry in India looks extremely positive. With the Government of India's push towards reducing imports of urea by 2022, there lies ample scope for investments in this sector.

2.7 Pharmaceuticals

Indian pharmaceutical industry has been playing a significant role in manufacturing various low cost and high-quality medicines for the global as well as the Indian market. India is the world's largest exporter of generic medicines, with 20% of the global market share. Chemicals that are used to manufacture pharmaceutical drugs (Active Pharmaceutical Ingredient [API]) are mostly imported.

Market Scenario

- India's total API production as of FY19 stands around US$ 14.17 billion. Production market is expected to grow at a CAGR of 9% reaching US$ 18.25 billion by FY22
- 60% of India's total API demand is imported. Around 85% of India's total imports are from China
- Most API production units in India run at 30%-40% utilisation rate, significantly lower when compared to China (around 70%). This is because most Indian pharmaceutical companies rely on imports for API supply

Conclusion

There exist immense opportunities in India for setting up API manufacturing units. Upcoming bulk drug parks in Andhra Pradesh and Gujarat will act as key drivers for greenfield investments. A large percentage of import of APIs which are of significant value (poly vinyl chloride, m-xylene, diammonium phosphate) can be substituted by enhancing domestic production capacities. However, support from the government is needed to ensure these plants reach optimal levels of utilisation.

2.8 Feedstock

2.8.1 Naphtha

Naphtha is a petroleum product derived from refining of crude oil/gas and is largely used as feed by industries for power generation or for conversion into olefins and aromatics to serve as building blocks for downstream industries.

Market Scenario

Naphtha is the major feedstock for the chemical and petrochemical industry which is used for production of urea, aromatics, olefins, propylene and ethylene. As of FY18, about 83% of the total naphtha demand came from petrochemical industry.

Demand for naphtha by petrochemical industries increased from 9,412 TMT in FY13 to 10,362 TMT in FY18 indicating growth in the domestic chemical and petrochemical sector over the period. The demand for naphtha in the country is expected to increase further with growth in chemical and petrochemical industry. Table 5 highlights the historical production and net exports for naphtha in India.

Table 5: Naphtha Production and Trade in India (in TMT)

Naphtha trade	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18
Production	19,018	18,505	17,391	17,861	19,946	20,006
Net Exports (in TMT)	6,885	7,302	5,974	4,185	5,950	6,801

Source: MoCF

Conclusion

India has surplus production of naphtha and is a net exporter. On the other hand, India is largely dependent on imports for petrochemical grade naphtha as most of the naphtha production in the country is not suitable for use for production of petrochemical building blocks and rather used as fuel by industries for power generation.

With growth in Indian chemical and petrochemical industry the demand for naphtha is expected to grow significantly in near future, driven by the demand of ethylene and propylene. Ethylene demand is expected to reach 25.5 MMTPA, while propylene demand is expected to increase to about 14.2 MMTPA by 2040.

To meet this feedstock demand, India would need investment in 20 cracker units by 2040. A small percentage of naphtha demand by downstream industries can be met in some parts of the country by

pooling of naphtha from crackers/ refineries operating at discrete locations. In addition, feedstock demand can also be met up to a large extend by adoption of alternate feedstock technologies.

2.8.2 Natural Gas

Market Scenario

The Government of India has planned to increase share of natural gas in its energy basket to 15% by 2030. With this vision in mind, there has been significant investment in developing transmission and distribution infrastructure for natural gas (development of city gas distribution network). This coupled with environmental friendly characteristics, reasonable prices and increased availability has led to significant increase in demand for natural gas in India over the past 4-5 years.

Power and fertilizer sector are the two biggest contributors to natural gas demand in India, accounting for more than 55% of natural gas consumption. More than 50% of total natural gas demand comes from Western India.

Conclusion

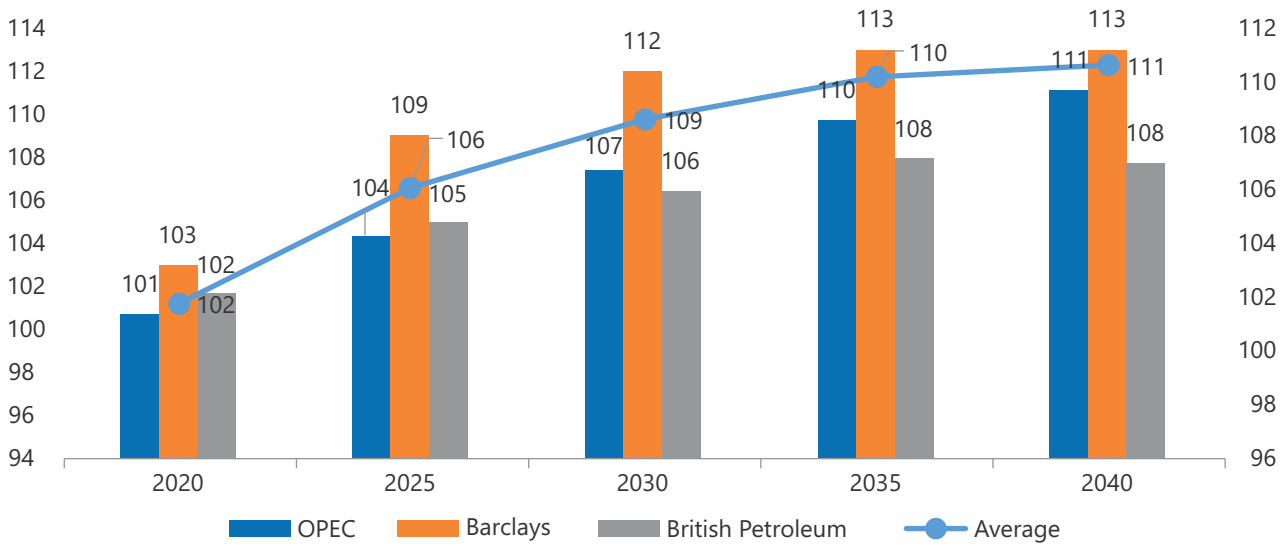
In future, natural gas demand will grow significantly at a CAGR of 6.8%, reaching 746 MMSCMD in FY30.

Power and Fertiliser sectors would continue to be the biggest consumers of natural gas till 2030 with power sector accounting for 47% and fertiliser sector 15% of the total demand.

2.8.3 Crude Oil

Market Scenario

Figure 10: Crude oil demand (mb/d)



Source: OPEC, Barclays and British Petroleum

Table 6: Oil Demand by product (mb/d)

Product	2017	2020	2025	2030	2035	2040	CAGR (2020-2030)	CAGR (2030-2040)
Ethane/LPG	11.2	12	12.7	13.5	14.1	14.4	1.18%	0.65%
Naphtha	6.3	6.7	7.1	7.6	8.1	8.6	1.27%	1.24%
Gasoline	25.5	26.6	27.9	28	27.9	27.8	0.51%	-0.07%
Light Products	43	45.2	47.7	49.1	50	50.8	0.83%	0.34%
Jet/Kerosene	7.2	7.7	8.4	8.8	9.4	9.8	1.34%	1.08%
Gasoil/Diesel	28.6	30.8	31.2	31.6	31.7	31.6	0.26%	0.00%
Middle Distillates	35.9	38.5	39.6	40.4	41.1	41.3	0.48%	0.22%
Residual Fuel	7.1	6.6	6.8	7.1	7.3	7.4	0.73%	0.41%
Other Products	11.2	11.6	11.8	12	12.1	12.2	0.34%	0.17%
Heavy Products	18.4	18.2	18.7	19.1	19.4	19.6	0.48%	0.26%
World	97.2	101.9	106	108.6	110.5	111.7	0.64%	0.28%

Source: OPEC Oil Report 2018

Conclusion

- India is projected to be the country with the fastest demand growth and will see the largest additional demand in the period to 2040
- Major demand over the projected period is expected to come from light products
- Within light products demand for ethane/LPG is set to increase by 3.3 MB/D between 2017 to 2040
- Commercial vehicles and trains are expected to continue to use fuels over the period despite electrification of vehicles
- Electrification of vehicles may take longer than predicted, hence more than 50% of the vehicles will continue to run on petrol/diesel by 2040
- Strong demand is expected to come from the petrochemical sectors

2.9 Alternate Feedstock

Foreseeing the increasing demand for naphtha in the country in coming years and keeping in view the capital-intensive nature of setting up of cracker unit, other feeds such as ethane, methanol can be

considered to cater to the feedstock demand in various parts of the country by use of appropriate technologies. Few of the alternative feedstock opportunities are detailed in the section below:

2.9.1 Ethane as Feed

Ethane can be a major feedstock for obtaining ethylene. Ethylene, one of the major feedstocks for production of polymers, can be obtained from steam cracking of ethane.

This technology has not been largely adopted in India with very few players such as Reliance currently operating plants based on ethane cracker. GAIL in JV with HPCL is planning to come up with an ethane feed-based cracker in Andhra Pradesh.

Use of ethane as feed poses certain challenges:

- India being short in ethane reserves, ethane feed for operation of such units would be largely import dependent. Also, operation with ethane require large infrastructure investments and facility development such as need for cryogenic ships and ethane carriers
- Other drawback of use of ethane for cracking is a lower yield because of the fact that as the feedstock changes from heavy to light the yield decreases

However, use of ethane as feed is quite popular in the United States. Discovery of large gas reserves in various parts of the world such as in the United states has led to popularity of ethane cracking for obtaining ethylene.

Abundance of natural gas/ shale reserves along with adoption of advanced techniques such as hydraulic fracturing has provided these countries with inexpensive and plentiful supplies of natural gas and NGLs, which are rich in ethane. Petrochemical manufacturers in the United States are largely investing in ethane cracking capacity.

Since use of ethane as feedstock can considerably reduce the cost and processing efforts, adoption of ethane as alternate feedstock can help substantially reduce the overall cost of feedstock production.

GAIL/ HPCL has plans for investment in ethane cracker. This presents a positive scenario for use of ethane as a potential feedstock in the country in coming years.

2.9.2 PDH

PDH - propane dehydrogenation process is a process of selective dehydrogenation of propane to obtain propylene. Historically, propylene has been produced as a by-product of petroleum refining or naphtha cracking for ethylene production. However, the PDH process is dedicated to purposeful production of propylene.

The PDH technology so far remains unexplored in India. Due to high propylene yield, investment in the technology is gaining traction in North America to cater to the propylene demand in the country.

The process provides with higher propylene outputs over other processes such as naphtha cracking and hence can be explored for catering to the increasing demand for the feedstock in the country.

At present, GAIL is planning to set up a PDH plant on the western coast of India (with Maharashtra being the location priority) at an investment of US$ 1.14 bn. The plant could serve as a major source of feedstock for petrochemical units operating in Dahej. The technology can further be adopted in other parts of the country with increasing demand for propylene-based products in the states of Madhya Pradesh, Odisha, Tamil Nadu and Assam with proposed plastic parks.

2.9.3 Coal to Olefin/ Methanol to Olefin (CTO/ MTO)

Coal has traditionally been a source of energy for various industries. It is the process of conversion of coal to olefins (building blocks for petrochemical industry). The entire process encompasses the following steps: Coal is first converted to synthesis gas, which is then converted to methanol, which is further converted to olefins for use by downstream industries.

The technology remains unexplored in the country as implementation of CTO technology in India may suffer due to inadequate/ reliable supplies and fluctuations in coal prices. However, for successful implementation of CTO technology, the government must make policies to allocate coal on large scale basis for chemicals to ensure sufficient feedstock supplies to the industries.

CTO/MTO in recent times has emerged as a popular technology for olefin production in various parts of the world like China. China having abundant coal reserves, about 20% of China's ethylene capacity and 17% of the propylene capacity driven by CTO process.

Indian coal has higher ash content (30% - 40%) as compared to South African, Australian and Indonesian coal (ash content of 8% - 10%). This limits the applicability of Indian grade coal, resulting in more imports. Blending and washing techniques are solutions to reducing ash content. However, washing only reduces ash content by 6% - 8%. Blending is a far more practical solution but increases costs.

Considering various advantages such as high yield of output, flexibility of variation of P:E ratio and low costs of project implementation, CTO/MTO can be explored as a potential feedstock for chemical and petrochemical industry over coming years, provided there is adequate provision for supply of coal for feedstock generation, a balance on energy and costs incurred and issues regarding sustainability of the process.

2.10 Circular Economy

2.10.1 Circular Economy in Chemical Industry

Recovering and recycling of building blocks and semi-finished products guarantee the possibility of exploring new businesses by reducing the environmental burdens due to extraction and refining of virgin materials.

2.10.2 Waste to Resource

- Five fundamental molecule circulating loops in chemical industry:
  - Substituting some portion of fossil feedstock with renewable feedstock such as bio-ethanol, lactic acid Bio C_2 etc.
  - Increased re-use of end user products – Develop designs to reuse partnerships with manufacturers
  - Mechanical recycling: Reusing existing materials without modifying the chemical bonds.
  - Chemical recycling: When molecules cannot be reused in their intact structure, chemical companies could modify the material molecular bond to recover hydrocarbon.
  - Energy recovery and carbon utilization: Involves recovering the energy contained in molecules by oxidizing hydrocarbons to CO_2, capturing it, then building new chemical feedstocks via a catalytic reaction.

Challenges: requires new assets for creating dense CO_2 sources and for re-synthesizing of carbons into hydrocarbons.

Infrastructure for end user reuse and mechanical recycling is available but there is room for expansion by using new emerging technologies.

Increased use of molecule circulating loops could reduce dependence on naphtha and gas-based feedstocks, however circulation of molecules requires large amounts of carbon neutral energy.

Another important point of discussion in the chemical sector is that circulation of molecules would lead to reduction in demand of some products, however but overall demand of chemicals is likely to grow due to the need of products that enable circularity in the downstream industry.

All this is expected to lead to increased demand for engineered polymers and specialty chemicals.

2.10.3 Concept of Mass Balance

In the mass balance approach, fossil resources are replaced by sustainable biomass already at the beginning of the production process. The applied share of renewable resources is then allocated to the new product.

One of the options is to break down complex, mixed and contaminated products into simpler chemicals to be used as virgin-grade feedstock for new products. An economical solution from an investment point of view is to plug these processes into the existing chemical infrastructure which has over US $2.5 trillion in investments worldwide. However, the recycled feedstock will not be physically separate from other raw materials in the chemical manufacturing process.

Mass balance is an approach which helps us trace the flow of materials through the complex value chains. The mass balance principle has been practiced by BASF for several years for biomass feedstock (Biomass Balance approach). In this approach, the fossil resources are replaced by sustainable biomass already at the beginning of the production process. In a third-party certified process, the applied share of renewable resources is then allocated to the new product. Based on this calculation, up to 100% of the fossil resources can be replaced by renewable raw materials. Using renewable raw materials helps to save fossil resources and may contribute to reducing greenhouse gas emissions.

BASF is piloting the use of recycled feedstock from plastic waste in its ChemCycling project. In chemical recycling, the long molecular chains of plastics are broken down into their basic building blocks by different technologies, e.g. pyrolysis. The oil derived from this thermochemical process can be used to produce new plastics, replacing fossil raw materials such as naphtha. Chemical recycling of plastics can help reduce the amount of plastic waste which ends up in landfill or is incinerated.

In order to enable circular economy in the industry, different chemical plants need to be linked to each other, either physically through pipelines, through rail or road network or water-based logistics chains.

This enables by-products from one chemical process to be used as input material for another downstream chemical plant which would increase the overall industry efficiency and is a good starting point to enable increased uses of recycled feedstock.

Example: Polyamides and polyesters can mostly be recycled without having to go through the process of breaking them down to a petrochemical feedstock first also these can be converted back to into their constituent monomers under favorable reaction conditions.

However, the same is not possible for PE and PP, these need to be broken down to molecular fragments and converted into a liquid mix of simple hydrocarbons.

To a chemical manufacturer a recycled feedstock is just another raw material that enters production, recycled and virgin feedstock can be co-fed which could be the start to circular economy, while being an enabler to other industries.

2.10.4 Recommendations for PCPIR

- Mechanical recycling plants could be setup in the PCPIR regions to facilitate recycling of end user materials which can be used as an input for other plants. Example: Ganesha Ecosphere, a Kanpur

based PET bottle scrap recycling company with annual capacity of 87,600 MT of recycled polyester staple Fibre

- Energy recovery and carbon utilization units to be set up in the regions to facilitate recycling of products like CO_2. Ex: SABIC has a facility to purify and utilize waste CO_2 from one plant and use it as a feedstock in others to produce urea and methanol coupled with purified CO_2 sales to food and beverage players and production of polymers from renewable feedstock
- Chemical recycling plants can be planned for the regions in the future as chemical recycling plants are energy intensive and the requirement for carbon neutral energy is high. With growing share of renewable in the energy mix, such carbon neutral energy is expected to be available in the future
- Bioethanol plants: Bioethanol can be used as a substitute for some portion of the feedstock used by chemical industries. Bioethanol can be used to produce ethene as a route for polyethene. Ethanol is also used as a chemical intermediate for glycol ethers. Ethanol also finds applications in manufacturing of cosmetics, pharmaceuticals, detergents, inks and coatings

3. DAHEJ PCPIR, GUJARAT

3.1 State Profile Overview

Gujarat is located at the west coast of India and has the longest coast line (1600 km) in the country. It has achieved the status of one of the principal industrialised states in India, being the leader in almost ten key sectors.

Economic Snapshot

Table 7: Gujarat's Contribution to the Indian Economy

Particulars	Gujarat
GSDP, Current price (2017-18)	US$ 173 Billion
GSDP growth rate, YoY (2017-18)	11.70%
Per capita income, Current price (2017-18)	US$ 2,333
Cumulative FDI inflows since April 2000 (US$ billion)	US$ 23.2 Billion
Exports (2017-18)	US$ 66.8 billion
Human Development Index	0.667

Source: IBEF, investindia.gov

Gujarat's GSDP in FY18 was US$ 173 billion with a 11.7% year on year growth rate. FDI inflows in Gujarat between April 2000 and March 2019 reached US$ 23.2 billion. The state's exports reached US$ 66.8 billion in FY19 contributing to a total of 22% to India's net exports. Gujarat's HDI stands at 0.667.

Table 8: Gujarat Demographics

Particulars	Gujarat
Population, Million	60.4
% of population in working age group	65%
Urbanisation Rate	43%
Female/Male Ratio	918/1000

Source: IBEF, investindia.gov

Gujarat is the 9th most populated state in India and is home to about 5% of the country's total population. About 65% of Gujarat's population is in the working age group.

Education

Table 9: Social Infrastructure - Education

Particulars	Gujarat
Literacy Rate	78.03%
Unemployment Rate (FY18)	4.8
Central Universities	1
State Universities	30
Private Universities	32
Industrial Training Institutes	368

Source: IBEF, investindia.gov

Gujarat has a literacy rate of 78.03% as per the Census, 2011. It is home to 368 industrial training institutes and over 60 universities. The state allotted a total of US$ 160 million in FY18 for Sarva Shiksha Abhiyan and the Mid-Day Meal schemes.

Physical Infrastructure

Table 10: Gujarat Physical Infrastructure

Particulars	Gujarat
No. of Major Airports	16
No. of Key Ports	5
Coastline Length (km)	1600
No. of SEZs	17
EODB Rank (2017)	5

Source: IBEF, investindia.gov

Gujarat has 16 major air ports including an international airport - Ahmedabad. It has the country's longest coastline of 1,600 km and has 5 key ports namely- Mundra, Kandla, Jafrabad, Pipavav and Hazira. As of FY19, the state had 17 operational SEZs across various sectors.

Key Industrial Sectors

- Chemicals and Petrochemicals: Gujarat is the hub of chemical industry in India, accounting for 62 percent of India's petrochemical production, 35 per cent of other chemicals production and 18 per cent of India's chemical exports
- Pharmaceuticals and Biotechnology: Gujarat is the leader in pharmaceutical manufacturing in India and accounts for 28% of country's exports. It has over 3,300 pharma manufacturing units
- Gems and Jewellery: Gujarat accounts for around 72 per cent of the world's share of processed diamonds and more than 80 per cent of diamonds processed in India. It also accounts for 95 per cent of diamonds exported from India
- Agro & Food Processing: Gujarat accounts for the largest share in the total investments in the food processing sector of India. The state has around 30,000 food processing units, 560 cold storages and the presence of 45 dairy plants
- Textile: Gujarat is the largest producer and exporter of cotton in India, producing 27% of the country's output. It is also the third largest producer of denim in the world. The state houses 18 textile clusters

3.2 Introduction to Dahej PCPIR

Dahej PCPIR is one of the four PCPIRs identified by GOI under the PCPIR policy 2007. It is located in Bharuch district of Gujarat, in proximity to the Delhi Mumbai Industrial Corridor. The region spreads over an area of 452.98 sq.km, housing industries operating in chemical, petrochemical, textile, automotive and various other sectors.

3.3 PCPIR Management Structure

Industries and Mines Department of Government of Gujarat is the Nodal Department of Gujarat Petroleum, Chemicals and Petrochemicals Special Investment Regional Development Authority. Gujarat Industrial Development Corporation (GIDC) is responsible for orderly establishment and organization of industries in industrial areas and industrial estates. Primarily responsibilities of GIDC include:

- Identification and acquisition and development of land suitable for industrial establishment
- Plotting and land allotment
- Provision of basic infrastructure in industrial area

Gujarat Petroleum, Chemicals and Petrochemicals Special Investment Regional Development Authority (GPCPSIRDA) was constituted under the GSIR Act, 2009 vide GoG Notification dated 18th September

2010. GPCPSIRDA is responsible for the ground level planning and execution, and performs all regulatory functions relating to the GPCPSIR.

Regional Development Authority (RDA) was constituted in 2010 by Industries and Mines Department of Government of Gujarat for monitoring and management of PCPIRs. RDA undertakes zoning related activities while the authority of issuing of NOC lies with GIDC.

However, no independent board has been formed to look into the management, planning and implementation of Dahej PCPIR.

3.4 Progress Status of PCPIR

3.4.1 Master Planning

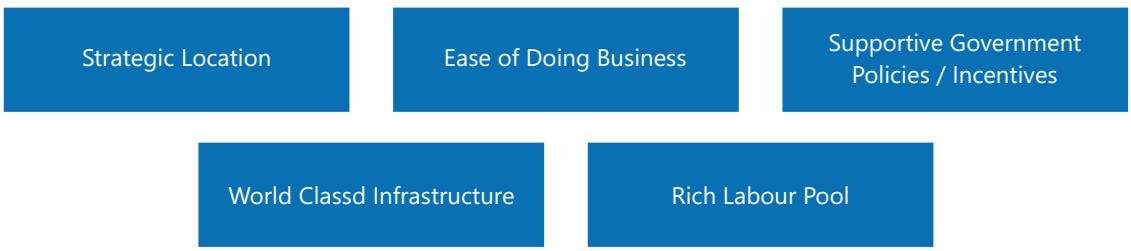
Final draft plan has been sanctioned by the apex authority under the provision of GSIR Act 2009 and GTP & UD Act 1976 in 2012.

3.4.2 Status of Approvals and Clearances

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has granted Environment and Coastal Region Zone (CRZ) clearance in 2017, for an area of 44,445.18 Ha (after excluding forest land of ~853.41 Ha) for development of Gujarat PCPIR.

Environmental clearance and costal region zone (CRZ) study has be completed and clearance received from MoEF&CC.

3.5 Key Investment Drivers



Strategic Location: Dahej being located on the western coast of the country is in proximity to OPEC and various oil major markets from across the globe. Ease of crude availability has been one of the major factors that contributed to industrial development along the western coast

Ease of Doing Business: Gujarat ranks fifth of all the states and UTs in the country in ease of doing business which indicates friendly policies, environment and protection for the firms investing in the region

Pre- Established Industries: Gujarat is hub for many petrochemical and petroleum refineries. Companies like Reliance and Indian Oil have already established their refineries and invested in the regions which now forms industrial base for further investments and expansion

World in Class Infrastructure: Dedicated infrastructure enables the region to take advantage of its location by providing reliable connectivity to markets. Presence of 12 ports in the state along with connectivity to Delhi Mumbai Industrial Corridor and Dedicated Freight Corridor boost industrial development in the region

Rich Labour Pool: Gujarat having educational institutes and training centres provides the region with sufficient skilled manpower in pace with the industrial development in the region

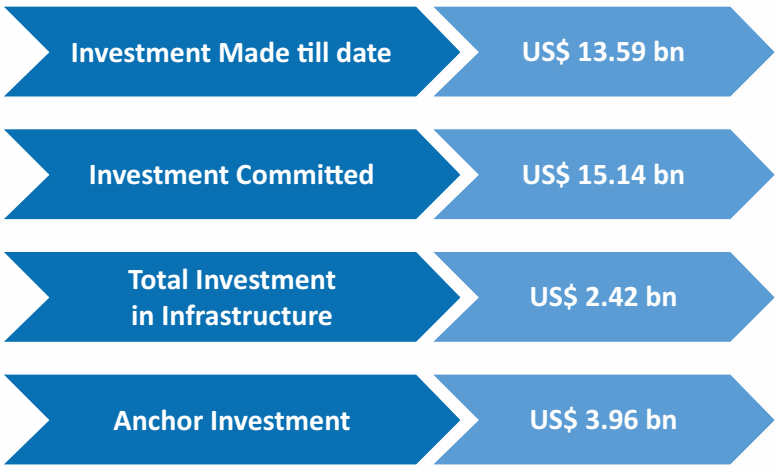
3.6 Investments

Dahej is a leading investment destination with excellent industrial base in diversified sectors like chemicals & petrochemicals, textiles, drugs & pharmaceuticals and ports & ship building. With the emergence of GPCPSIR, Dahej SEZ and vicinity to Delhi Mumbai Industrial Corridor (DMIC), it is expected to further fuel the industrial and economic growth of the district.

3.6.1 Major Investors and Investments

Dahej has been successful in attracting major investments into the PCPIR. Total investments of about US$ 13.6 bn have been made so far, with US$ 2.4 bn investment made for infrastructure development in the PCPIR region by the Gujarat Infrastructure Development Corporation (GIDC). Anchor investments include US$ 4.0 bn investment by OPaL.

Figure 11: Investment Summary



Source: MoCF, GIDC

Major investors in the region include Reliance, BASF, Aditya Birla, Welpun, GACL, Adani, SRF, GSPL, Torrent, Lanxess. Various projects by Nayara Energy, Godrej, Agrovet, Polyplastics, Thermax, Astral Pipes, Neogen Chemicals and few others are under implementation.

3.7 Infrastructure

3.7.1 Land use and availability

The PCPIR region in Dahej has a total geographical area of 452.98 sq.km with processing area of 230 sq. km (approx. 51% of the total area). The processing area includes industrial estates along with warehousing, oil terminals and ports.

Of the total processing area of 230 sq.km, about 133.7 sq. km area is acquired by the GIDC which comprises five Estates and one SEZ namely, Dahej Estate I, II, III, Vilayat, Sayakha and Dahej SEZ. About 70% of the processing area under GIDC has been allotted for industrial development.

Table 11 below lists land allotment area details for various industrial developments.

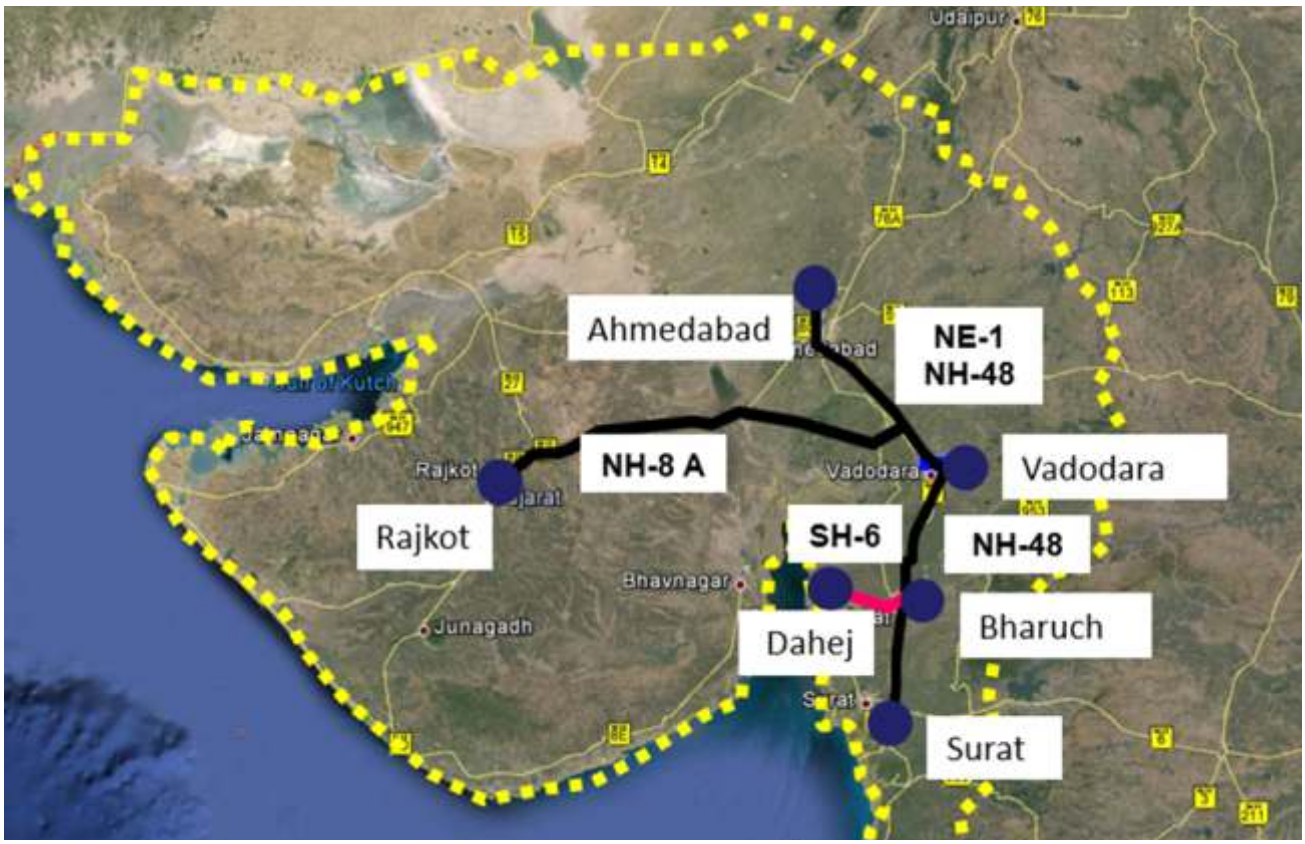
Table 11: Processing Land Utilization details

Location	Total Area (in Ha)	Allotted Area (in Ha)	Allotted area as % of total area
Dahej I	4,400	3,784	86%
Dahej II	3,105	2,206	71%
Dahej II	1,317	920	70%
Vilayat	1,028	915	89%
Sayakha	1,859	741	40%
Dahej SEZ	1,661	843	51%
	13,370	9,410	

Source: GIDC

3.7.2 Road Connectivity

Figure 12: Existing Road Connectivity



Source: GIDC

Existing:

- Major Road passing through PCPIR is State Highway No. 6 (Bharuch Dahej State Highway), which connects Dahej to Amod in the north and to Bharuch in the east
- The Six lane Dahej-Bharuch State Highway (SH6) connects the region to Delhi-Mumbai National Highway and National Expressway
- Other road links connecting GPCPSIR are NH-8, SH-6, SH-161, SH-64, SH-13

Proposed:

- Ahmedabad-Vadodara National Expressway is proposed to be extended to Mumbai, this will provide circular connectivity to the PCPIR
- Two escape routes of RoW 150 m and 120 m are proposed to provide safe exit in situation of contingency

DPR for the above road projects are ready and request for fund is already placed to the central government.

3.7.3 Rail Connectivity

Existing:

- Delhi – Mumbai Broad Gauge railway line connects the region to Delhi towards north via Vadodara and Ahmedabad and to Mumbai towards south
- Bharuch –Dahej rail line in proximity of 62 km

Proposed:

- Delhi-Mumbai Dedicated Freight Corridor (DFC) is proposed
- Bharuch-Dahej broad gauge line is proposed which would connect to the DFC at Dayadra Jn.

3.7.4 Airports

Existing:

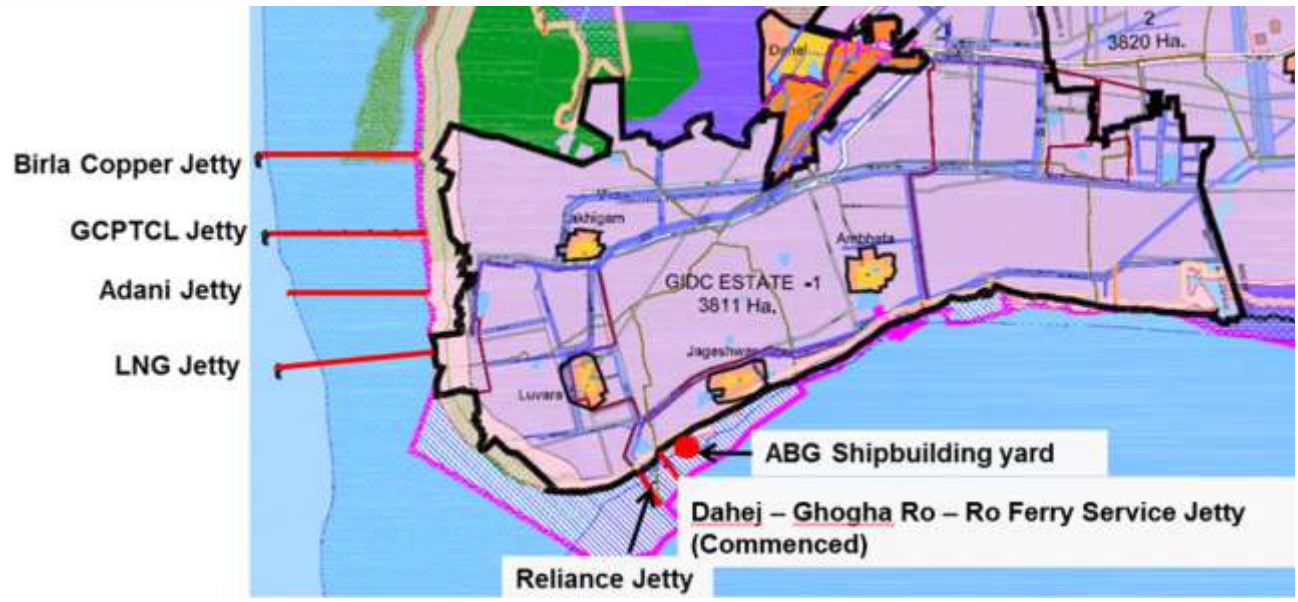
- International airport at Ahmedabad is about 200 km from Dahej
- Domestic airport at Vadodara in 90 km of the PCPIR region
- 85 km from Domestic Airport at Surat

Proposed:

- Greenfield airport is proposed for PCPIR
- Airstrip is proposed at Ankleshwar

3.7.5 Ports

Figure 13: Existing and Proposed Port Infrastructure



Source: GIDC

Various Port and Storage facilities:

- Adani Petronet Dahej Port Pvt Ltd (Dahej) - 11 MMTPA
- GCPTCL Liquid Chemical Terminal - 3.8 MMTPA
- LNG Petronet (Gas Terminal) - 10 MMTPA
- Reliance liquid fuel jetty – 2 MMTPA
- Birla Copper bulk cargo jetty - 5 MMTPA
- Dahej- Ghogha Ro-Ro Ferry Service Terminal
- Jetty for handling ODC (Over Dimensional cargo) in Joint Venture with Dahej SEZ Ltd is under development

Proposed:

- Jetty for handling various liquid and pressurized cargoes by GCPTCL up to capacity of 5 MMTPA
- Development of Marine Shipbuilding Park (MSP)

3.8 Utility and support facility

3.8.1 Utility Facility: Water sourcing and availability

Existing:

- GIDC currently supplies 25 MGD of raw water drawn from Narmada river to Angareshwar
- Drinking water in the region is supplied by GWSSB, primarily sourced from Narmada Canal
- 50 MGD of water supply is available from Miyagam Branch Canal (130 km) and 25 MGD water supply from Narmada River (60 km)
- The present water utilization in the region stands at 200MLD

Proposed:

- 100 MLD desalination plants (50*2 MLD) are under planning stage with EPC contract already awarded to M/s L & T JV Tecton by GIDC

3.8.2 Utility Facility: Power sourcing and availability

Existing:

- Four 220 KV sub-stations supply power to Dahej, Dahej SEZ, Rahiyad-Suva and Vilayat
- Eight 66 KV substations located at Dahej, Luna, Bhensali, Vadadala, Galenda, Jolwa Sambheti and Vilayat provide dedicated supplies in the respective regions
- 220 KV substation at Suva Dahej is operating under Gujarat Energy Transmission Corporation Limited (GETCO)
- 1200 MW gas-based power plant by Torrent Power Ltd. in Dahej SEZ

Proposed:

Though there is sufficient power supply in the region for existing industries to operate however considering the future requirement following projects are proposed

- One 440KV, two 220KV & ten 66KV substations within PCPIR area, to meet the increasing power demand

3.8.3 Other Support Facilities

Effluent Disposal: At present, a 90 MLD treated effluent disposal pipeline is available with diffuser into the deep sea, while additional 190 MLD effluent disposal line is under planning

CETPs: 40 MLD CETP is operational in Dahej with another 40 MLD plant ready for commissioning with infrastructure work already completed

Waste Treatment: TSDF of 1.4MMT facilitates disposal of hazardous solid waste. However, incinerators and waste heat recovery system are proposed to be installed to treat hazardous industrial waste

3.8.4 Social Infrastructure

Existing:

- There exists basic infrastructure such as internal roads and water supply facilities to about 10 villages in the region
- Modernized Pakhajan PHC Upgraded General Hospital for medical consultation and support
- Presence of 786 Industrial Training Institutes (ITI), 283 government institutes in the state
- Presence of premium institutes that provide required skills and qualifications in management, design, planning and chemicals & petrochemical technology

Proposed:

- Total area of about 118 sq. km has been reserved for town planning for development by RDA under 14 Town Planning schemes
- Area would comprise of residential, specific mix use, commercial, institutional and various utility facilities
- Portable water supply scheme is proposed to ensure sufficient water availability to support livelihood

3.9 Budget allocation for Infrastructure Development

Table 12 details the proposed and committed investments in various infrastructure projects in the PCPIR region.

Table 12: Investment in Infrastructure Development

Organization	Particulars	Cost (US$ Million)	Capacity/Length
R&B	Highway Up gradation	27.43	50 Km
	External Roads	10.14	
GMB	Ro –Ro Facility	87.86	30 Km
GCPTCL	Chemical port and storage terminal	130.00	3.8 MMTPA
GSPL	Gas distribution	62.71	
GIDC	Roads	94.14	244 Km
	Water Supply Schemes	158.71	50+25 MGD (Dahej & Saykha WS)
	Drainage	28.14	
	CETP Dahej	30.43	40 MLD
	CETP Saykha	30.57	40 MLD
	Effluent disposal pipeline	31.29	20 MGD
	Power	13.43	
	Other amenities	5.71	
Total (GIDC)		392.43	392.43
GTCO	Power	16.57	Four 220 KV sub-stations, Seven 66 KV sub stations, Three 33 KV
Adani Port (Dahej Port Pvt. Ltd)	Ports & Jetty	177.14	11 MMTPA
Petronet LNG		642.86	10 MMPTA
Birla Copper Jetty (DHIL)		35.14	5 MMTPA
IPCL (Reliance Jetty)		15.29	2 MMTPA
Bharuch Dahej Railway Company Ltd	Railways	49.86	62 Km
Torrent	Power	775.29	
Grand Total		2,422.7	2,422.71

Source: GSPSIR

Investments of US$ 2.43 bn are proposed for infrastructure development in Dahej. Proposed investments shall be funded in EPC, PPP and hybrid models, with US$ 0.73 bn investment through public funding and US$ 1.70 bn through private funding.

3.10 Feedstock

3.10.1 Anchor Tenant

ONGC Petro Additions Limited (Opal) is the anchor tenant in the PCPIR region of Gujarat and is the major source of feedstock for the downstream industries in the region.

OPaL has set up a grass root mega Petrochemical complex (spread across an area of 508 hectare) in the Dahej SEZ region under the PCPIR policy of the central government. The Petrochemical complex comprises of a dual feed cracker with a capacity to produce 1.9 million tons of products and for providing feedstock to the downstream industries.

DFCU unit cracks the petroleum gas (C2, C3 and C4) and naphtha feed to produce several chemical and petrochemical products namely ethylene, propylene, butadiene, benzene, pyrolysis gasoline and carbon black feedstock.

3.10.2 Feedstock for Petrochemical Complex

The complex has a total of eight furnaces, with flexibility of changing feedstock inputs (base design for 60% naphtha and 40% gases). This gives the company an advantage of switching between gas and naphtha during periods of high gas prices and vice versa. Considering the processing capacity of the petrochemical complex, feed requirements for operations are detailed in Table 13.

Table 13: Feedstock Requirement

Feedstock Requirement	
Gas requirement	
Cracking	~ 4 mmscmd
Power generation	~1.45 mmscmd
Naphtha requirement	1,500 KTA

Source: OPaL

Gas and Naphtha (blend of ARN and LAN) are the major feedstock for the petrochemical complex at Dahej. It is noted that total gas requirement is ~ 5 mmscmd while total naphtha requirement stands at 1,500 KTA for operation of the OPaL petrochemical cracker complex at Dahej.

3.10.3 Feedstock Sourcing

Olefins based petrochemical complex is based on gas and naphtha as feeds for operation.

Natural Gas

To cater to its gas requirements for various petrochemical complex operations, OPaL has direct gas supplies from the ONGC upstream extraction plant at Dahej via a 10 Km pipeline. The gas feed supplies from the 5 MMTPA extraction plant are as:

- Ethane: 465 KTPA
- Propane: 225.2 KPA
- Butane: 155 KTPA

ONGC has rights to extract the rich C2+ components from 5 MMTPA LNG supplied by Ras Gas,Qatar. In addition to cracking, OPaL also requires gas supply for operating gas based captive power plant (195 MW), which is the major source of power for the petrochemical complex. Though ONGC extraction plant is the major source for gas feed (C2/C3 gas and C4) for the OPaL petrochemical complex in Dahej, however supplies from the extraction plant are not sufficient to support petrochemical complex operations.

OPaL being part of Dahej SEZ, gas supplies to the unit are under the control GSPL (Co-developer transmission of gas in SEZ region). The tenant in the past had to face serious issues due to unavailability of feedstock which affected its operations and also led to delay in commissioning of the massive complex project causing financial loss to the company.

Due to mega nature of the complex project there was significant feedstock requirement against existing supplies and infrastructure. As gas supplies (through GSPL) fell short for operations of the petrochemical complex, OPaL faced issues in commissioning the project and requested for additional supplies in line with the cracker requirement, which was denied. After refusal for grant additional CT for gas by GSPL, OPaL had to obtain feedstock on delivery basis (at higher charges) from GSPCL, which increased the expenditure on feedstock.

Also, insufficient supplies of feedstock (gas) led to abrupt sudden shutdown of hydrocarbon plant causing financial loss and also delay in complex commissioning activities.

Facing such difficulties, OPaL has planned to import gas to compensate for shortfall of propane and to obtain more cheap and secured feed in use for the DFCU unit.

Naphtha

Naphtha for complex operation at Dahej is currently supplied by GCPTCL, primarily sourced from ONGC, Hazira through marine route. Naphtha supply to OPaL under GSPTCL at present stands at about 500-600 KTPA against requirement of 1,500 KTPA of naphtha. Considering the impact of inadequate feedstock supplies on complex operation and dependence on mode of transport of naphtha to support a mega-scale complex operation, a pipeline of capacity 1,547 KTPA from GCPTCL terminal is proposed and approved to ensure adequate naphtha supply to the complex.

3.10.4 Feedstock for Downstream industries

The petrochemical complex in integration with the ONGC upstream extraction plant operates as an integrated complex to produce various chemicals and petrochemicals that serve as major feedstock to the downstream industries. The complex being one of the largest in the country has huge capacities of ethylene (1,100 KTA) and propylene (400 KTA). The complex has a basic polymer unit producing polyethylene and polypropylene which serve as feed to various downstream industries. The complex also has processing units for benzene, butadiene, pygas and carbon black feedstock. Various processing capacities of cracker are listed in Table 14.

Table 14: OPaL Processing Capacities

Product	Capacity (in KTA)
Ethylene	1100
Propylene	400
HDPE/LLDPE	2X360
HDPE	340
PP	340
Benzene	115
Butadiene	150
Pygas	150
CBFS	70

Source: OPaL

The complex was commissioned in March 2017 and is currently operating at ~90% capacity, producing feedstock (such as ethylene, propylene, benzene, butadiene, CBFS and polymers) for use by various downstream industries in the region.

Ethylene and propylene serve as the major feedstock for polymers production such as polyethylene and polypropylene units, which further are processed by various downstream industries such as packaging, automobile and consumer goods industries. Benzene is the major feedstock for production of styrene which is further used in manufacturing of SBR.

3.10.5 Feedstock Availability for Downstream Industries

OPaL positions itself as a leading player in the Indian petrochemical industry's large petrochemical capacities, with commissioning of mega scale dual feed cracker, which is the largest in South Asia. The company has about 20% of PE and 7% PP domestic capacity share[1].

As part of the Dahej SEZ, OpaL has export obligations of 50 per cent of its production. Majority of OPaL's exports include about 100% of py-gas (via Hazira) and benzene (via Pipavav) and about 60% of butadiene (via Kandla).

Compliance to the SEZ export norms are obstructing the anchor unit from providing its supplies to the industries within the PCPIR. Restricted feedstock supplies from the anchor tenant are pushing related industries in the region towards imports.

[1]As of FY17, Source: ONGC Corporate presentation dated 5-6th Nov 2018

OPaL to Exit from SEZ

OPaL post experiencing feedstock supply constraints under SEZ, now has applied for exit from SEZ. This would also pave way for the tenant to explore opportunities in the domestic market. This will help the tenant to save 8.25% of customs duty on domestic sale of polymer products, thereby allowing it to improve its access to a high potential market such as polymers. This is also expected to address feedstock challenges for the downstream industries.

3.11 Employment

3.11.1 Employment Generation

Industrial, social and economic development in the region with emergence of the PCPIR has provided immense employment opportunities in various sectors.

Total of 160,000 employment has been generated thus far, which includes 45,000 direct employment by major companies in the region into manufacturing and core industrial activities however 135,000 indirect employment has been generated in various development and implementation activities.

3.11.2 Skill Development

Gujarat has presence of a large number of educational and training institutes which have been supporting industrial activities/ establishments in the region with skilled manpower. There are about 7 ITIs in the PCPIR within a radius of 30 km. Manpower being a crucial resource to drive the industrial growth, efforts are needed for ensuring availability of skilled human resource in future to keep up with the pace of industrial development in the region. Various skill up-gradation centres have already been set up by GIDC and private companies such as Essar, ABG Shipyard, L&T, with few more under implementation.

MOTT MACDONALD

4. VISAKHAPATNAM PCPIR, ANDHRA PRADESH

4.1 State Profile Overview

Andhra Pradesh (AP) is located in the southern peninsula of India. The state has a well-developed social, physical and industrial infrastructure and has good power, airport, IT and port connectivity. It ranks number one in India for ease of doing business.

Economic Snapshot

Table 15: AP's Contribution to the Indian Economy

Particulars	Andhra Pradesh
GSDP, Current price (2017-18)	USD 125.6 billion
GSDP growth rate, YoY (2017-18)	16%
Per capita income, Current price (2017-18)	USD 2233
Cumulative FDI inflows since April 2000 (US$ billion)	USD 18.7 billion
Exports (2017-18)	USD 14.1 billion
Human Development Index[2]	0.643

Source: IBEF, investindia.gov

FDI inflows in AP between April 2000 and March 2019 reached US$ 18.7 billion. The state's exports reached US$ 14.1 billion in FY19 contributing to a total of 4.3% to India's net exports. HDI stands at 0.643.

[2]Factors taken into consideration- 1) Life Expectancy, 2) Education, 3) Per Capita Income

Demographics

Table 16: Andhra Pradesh Demographics

Particulars	Andhra Pradesh
Population, Million (Census 2011)	49.4
% of population in working age group[3]	70%
Urbanisation Rate	29%
Female/Male Ratio	997/1000

Source: IBEF, investindia.gov

Andhra Pradesh is the 10th most populated state in India and is home to about 4.1% of the country's total population. About 70% of the population is in the working age group.

Education

Table 17: Social Infrastructure - Education

Particulars	Andhra Pradesh
Literacy Rate	67.40%
Unemployment Rate (FY18)	4.5
Central Universities	1
State Universities	21
Private Universities	3
Industrial Training Institutes	535

Source: Invest India

Andhra Pradesh has a literacy rate of 67.4% as per the Census 2011. It is home to more than 500 industrial training institutes. In the budget FY19, US$ 33.38 billion has been allocated for secondary education and US$ 437.91 million for higher education in the state.

[3]Working age group – 15-59 years

Physical Infrastructure

Table 18: Andhra Pradesh Physical Infrastructure

Particulars	Andhra Pradesh
No. of major airports	6
No. of key ports	4
Coastline Length (km)	974
No. of SEZs	19
EODB Rank (2017)	1

Source: IBEF, investindia.gov

Andhra Pradesh has 6 major airports including an international airport at Visakhapatnam. It has 4 key ports namely- Vishakhapatnam, Kakinada, Gangavaram and Krishnapatnam. As of FY19, the state had 19 operational SEZs across various sectors.

Key Industrial Sectors

- Biotechnology and Life Sciences: Andhra Pradesh is home to more than 200 pharmaceutical units and is among the top 3 states in pharmaceutical exports. Exports of pharmaceuticals from the state stood at US$ 1.41 billion in FY18
- Agriculture and Allied Industries: The presence of rich climatic and soil conditions make Andhra Pradesh a major agricultural belt. It ranks first in fish and shrimp production as well as in the area and production of fruits and spices
- Chemicals and Petrochemicals: Andhra Pradesh has huge oil & natural gas reserves. The production of major chemical and petrochemicals stood at 0.66 mn tonnes in 2017-18
- IT and Electronics: The state houses more than 20% of the electronic manufacturers in India. It has 3 dedicated SEZs to the IT sector and the government has also planned 20 electronics manufacturing clusters

4.2 Introduction

The Andhra Pradesh PCPIR is the largest PCPIR in the country spread over an area of about 640 Sq. Km between Visakhapatnam and Kakinada. The region is further divided into 3 zones namely Visakhapatnam Zone, Nakkapali Zone and Kakinada Zone, for efficient planning, development and management.

Figure 14: Zoning Structure of Visakhapatnam PCPIR

Source:VK PCPIR SDA

Zone I: Visakhapatnam Zone

- Zone I is spreads over an area of 334.51Sq. km in Visakhapatnam ideally positioned between the Gangavaram Port, airport and Visakhapatnam Port with NH16 (Golden quadrilateral on the north-west
- Major existing industries in the region include HPCL Visakh refinery, Coromandel Fertilizers Limited, NTPC Simhadri Power Plant and Andhra Petrochemicals Limited

Zone II: Nakkapali Zone

- Zone II extends over an area of about 158.20 Sq. km and is well connected by all modes of transportation with connectivity to NH16 in north (1 km), SRC trunk line (4 km), Visakhapatnam Port (70km), Gangavaram Port (62km)
- Hetero Drugs Pharma manufacturing SEZ is a major project under development in the region

Zone III: Kakinada Zone

- Zone III extends over an area of about 147.29 Sq. km in East Godavari district with Kakinada deep water port providing connectivity to foreign markets
- Major projects in the region include 7 power projects and 2 chemical and fertilizer plants
- The KG basin can serve as a source of feedstock (natural gas) for existing and proposed industries in the region

4.3 PCPIR Management Structure

- The PCPIR is currently under the management of Special Development Authority (SDA), formed under G.O. Ms. No, 373 in 2008, which is chaired by the Managing Director APIIC; however, no independent management board has been formed
- Roles and responsibilities of SDA include:

- Regulatory functions
- Conducting environmental impact study
- Preparation of master plan
- Monitoring land use

- The APIIC was designated as the nodal agency for promotion and implementation of PCPIR in Andhra Pradesh vide G.O. Rt. No. 457 of Industries and Commerce Department and is responsible for allotment and development of land

4.4 Progress Status of PCPIR

4.4.1 Master Planning

- The master planning for the Visakhapatnam PCPIR was taken up by the SDA in March 2011 and after discussion with various stakeholders, a draft master plan was published by August 2013
- A revised master plan has been prepared addressing the suggestions of an expert committee constituted for scrutiny of the master plan and is submitted to MA&UD dept, Govt. of A.P for approval
- Finalization of master plan is subjected to confirmation on anchor unit, its location, size and configuration

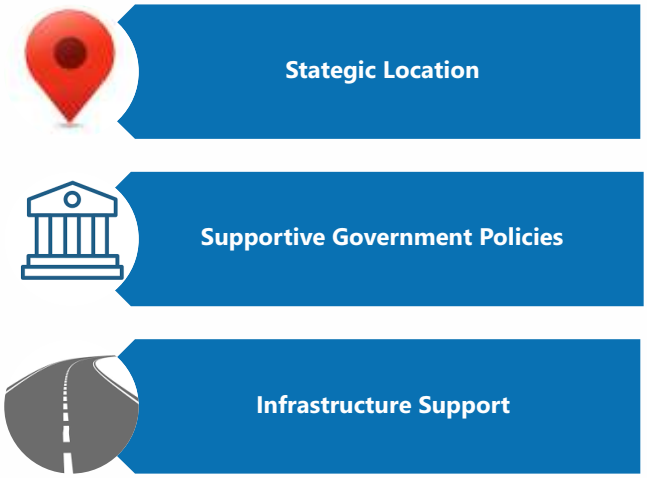
4.4.2 Status of Approvals and Clearances

- Environmental clearance and EIA studies have been completed and the draft EIA report has already been submitted
- Public hearing for the EIA study remains pending and shall be conducted post finalization of master plan
- Once the master plan is finalized, public hearing will be conducted and EIA report will be submitted to MoEF, GOI for obtaining environmental clearance

4.5 Key Success Factors

Figure 15 lists factors that potentially drive the development and investments in the VK PCPIR.

Figure 15: Key Factors that Drive the Investments in the VK PCPR



Source: MM Analysis

Strategic Location: Andhra Pradesh, located on the eastern coast of India, lies in proximity to petrochemical majors- ASEAN countries like Singapore, Malaysia, Thailand and others. Location of Andhra Pradesh puts it at an advantage of connectivity to high potential markets in east over industrial clusters operating in western part of the country.

Supportive Government Policies: Government policies have been supportive by providing industry friendly policies and incentives that help develop an ecosystem favourable for industrial development in the state. Implementation of single window clearance is one of the major policy decisions that would attract larger investments into the PCPIR region.

Infrastructure Support: Investment in infrastructure development such as PCPIR expressway would provide smooth connectivity to various markets both within and outside the delineated region. Development of Visakhapatnam Chennai Industrial Corridor would help boost the industrial development in the region by connecting it to other industrial regions, major cities and markets.

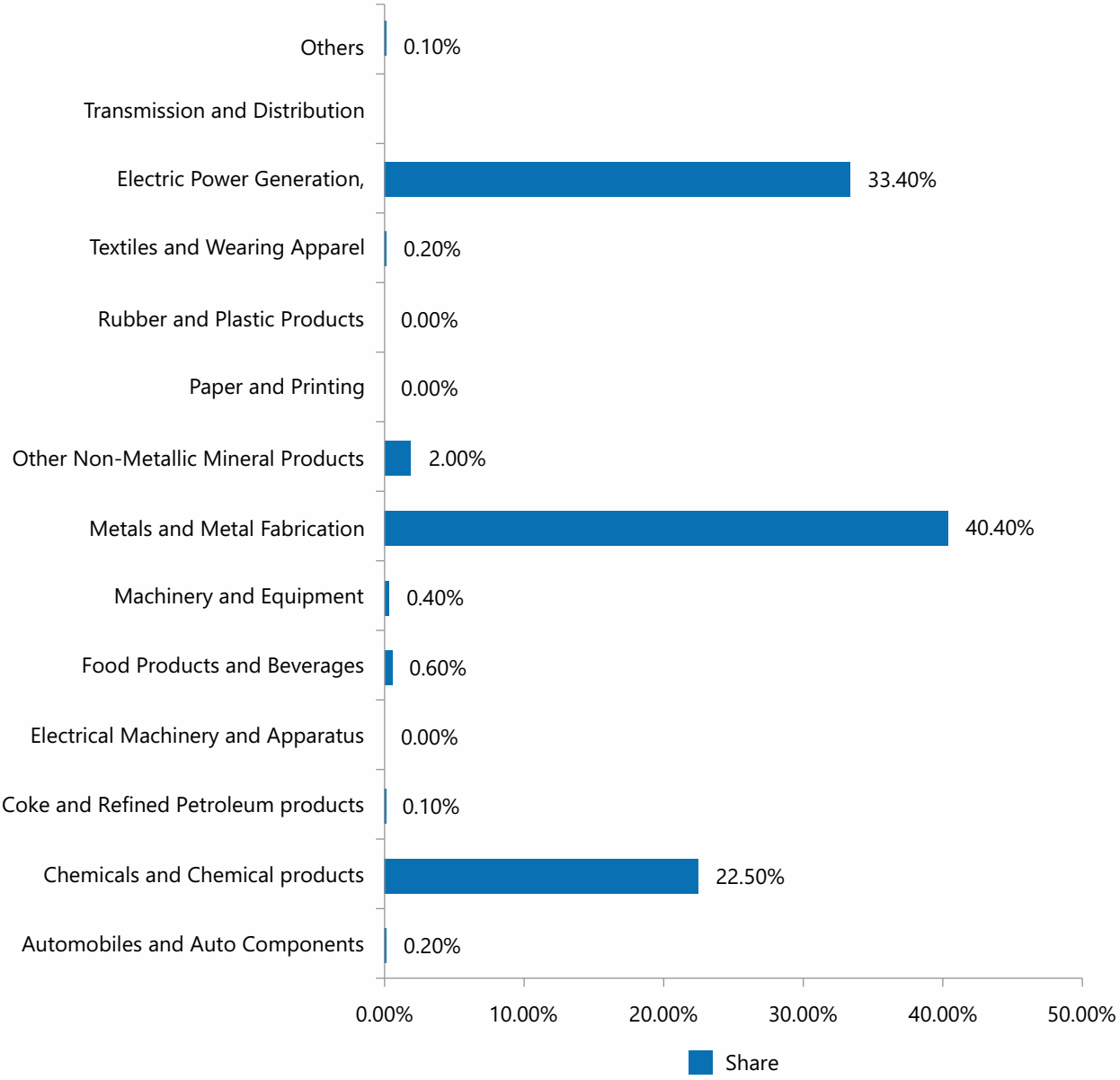
4.6 Investments

4.6.1 Major Investors and Investments

As of FY 19, committed and actual investments made so far amount to US$ 6.82 bn and US$ 1.98 bn respectively. JNPC, RINL, NTPC, HNPCL, Brandix, Hetero Drugs, Asian Paints have made major investments in the VK PCPIR region.

Figure 16 indicates the investments made in different industrial sectors in the PCPIR region.

Figure 16: Existing Industrial Profile Mix of VK PCPIR (% Share in Investment)



Source: VK-PCPIR SDA

Power generation, metal and metal equipment and, chemicals and allied products are the key sectors for investment in the region

The Visakhapatnam PCPIR region comprises of various industrial clusters, SEZs and industry majors. These are:

- Industrial clusters –JNPC Pharma City, Duppituru, Krishnapalem, Parawada Phase-I, Parawada Phase-II, Pudi, Thammavaram, Vakalpudi.

- SEZs – APSEZ at Atchutapuram, Brandix SEZ, Pharma SEZ (JNPC), Hetero Drugs Pharma SEZ, Kakinada SEZ
- Other major industries – Visakhapatnam Steel Plant (RINL), NTPC, Coromondel Industries Limited, Spectrum Power Plant (SPGL)

4.6.2 Investments Opportunities

Table 19 below indicates the existing industrial mix across different zones in the PCPIR along with the potential sectors for investment across these zones.

Table 19: Project Composition of the PCPIR

S. No.	Industrial Cluster	Ownership and Industrial Area Status	Existing Product Mix	Proposed Industrial Mix
Visakhapatnam PCPIR Zone				
1	RINL	RINL	Steel and Downstream Industries	Steel and Downstream Industries
2	NTPC and HNPCL	NTPC & HNPCL	Power Generation	Power Generation
3	JNPC	RAMKEY SEZ	Pharmaceuticals	Pharmaceuticals
4	AP SEZ	APIDC, GoAP SEZ	Petrochemical, Chemicals, Textiles, Engineering, Metal and Non-Metallic, Mixed Industries etc.	Petrochemical, Chemicals, Metal and Engineering, Textiles, Petroleum Refinery, Metal and Non Metallic, Mixed Industries etc.
5	AP SEZ Expansion Area, Pudi IC, Krishnapalem IC	GoAP SEZ	-	Mixed Industries, Metal and Engineering Industries, Chemical Industries
Nakkapalli PCPIR Zone				
5	Nakkapalli	APIDC, GoAP	Petrochemicals (HETERO SEZ)	Petrochemical, Chemicals, Textiles, Metals and Light Engineering, Food Processing, Mixed Industries.
6	Payakaraopeta	APIDC, GoAP	-	Food Processing, Light Engineering, Mixed and Non-Polluting Industries.
Kakinada PCPIR Zone				
7	Kakinada SEZ	Kakinada SEZ Pvt. Ltd SEZ	-	Petrochemical, Chemicals, Petroleum Refinery, Downstream Industries, Power Generation, Mixed Industries etc.
8	Other Industrial Clusters	SPCL, APIDC, Coromandel International Limited Pvt. Ltd.,	Chemicals, Food Processing, Fisheries	Chemicals, Food Processing, Fisheries, other Non-polluting industries.

Source: VK-PCPIR SDA

Kakinada- Potential for Development of Petrochemical Hub

Presence of dedicated infrastructure with upcoming anchor unit indicates a supportive ecosystem for development of petrochemical hub in the Kakinada region.

- Land availability: About 6,750 Ha of land remains available for allotment for industrial operations in the KSEZ with total of 9,120 Ha of allottable land available in the Kakinada region for establishment of petrochemical downstream industries. Land available is in form of developed plots with road, drainage, water supply, Water Treatment Plants (WTP), Sewage Treatment Plants (STP) and other similar facilities
- Anchor unit: Haldia PetroChemicals and HPCL in JV with GAIL with proposed investment in Kakinada would serve as the anchor unit with supply of required feedstock
- Dedicated Infrastructure: Development of PCPIR expressway will connect Kakinada to markets in and outside the PCPIR region. Development of VCIC would further improve the connectivity of the region and thereby boost the industrial development in Kakinada
- Port availability: The proposed GMR Port in the region with dedicated liquid cargo handling facility will provide the proposed petrochemical units/ industries with required access to global markets
- Water supply: 40 MGD of assured water supply from the Godavari perennial river
- Power supply: The proposed GMR power plants would be providing uninterrupted 800 MW supply for supporting industrial operations in the region
- Feed Availability: Discovery of K.G. Basin in the region can serve as a dedicated source of feed for petrochemical industries in the region, eliminating the import dependency

4.7 Infrastructure

4.7.1 Land Use and Availability

The Visakhapatnam PCPIR spreads over a total area of about 640 sq. km, geographically divided into 3 zones. Table 20 lists zone wise area. The total area is further divided into processing and non-processing area. As per the PCPIR norms, processing area includes industrial estates/area, SEZs, FTZs, EPZs, power plants, other large and mega industrial complexes and industrial R&D institutions and logistics facilities such as container terminals, truck terminals, logistic hubs and warehousing areas, service corridors and utilities.

Table 20: Land Area Details

S. No.	ZONES	Geographical Area (ha)
1	Visakhapatnam Zone	33,451
2	Nakkapalli Zone	15,820
3	Kakinada Zone	14,729
	Total Area	64,000

Source: VK PCPIR SDA

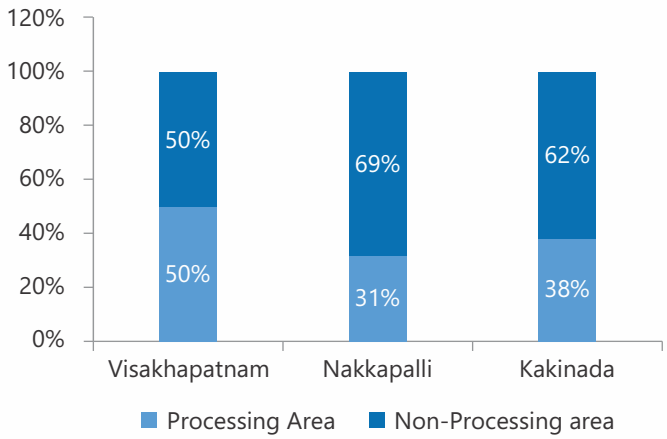
Processing Area

As per PCPIR Policy, total designated processing area within VK-PCPIR is 275.3 sq.km (~27500 Ha), accounting for 42.4% of total area. It includes 253.8 sq.km of manufacturing/industrial area (92%).

At present, APIIC has acquired over 76 sq km area of which 47 sq km has been allotted for industrial establishment.

Figure 17 details the zone wise distribution of total area into processing and non- processing area.

Figure 17: Zone wise Processing Area Distribution



Source: VK PCPIR SDA

It is noted that Visakhapatnam has the largest share of processing area (~50% of geographical area) of the all three zones.

Figure 18 details the total processing area along with area occupied, undergoing development and unoccupied area within each zone in the PCPIR region. The total acquired area indicates the extent of land developed and suitable for allocation for investments. The occupied area comprises of land area with existing and committed projects.

Figure 18: Land Area Status

Visakhapatnam Zone	Nakkapalli Zone	Kakinada Zone
• Total Processing Area: **16,617.97Ha**	• Total Processing Area: **5280.1 Ha**	• Total Processing Area: **5666.6 Ha**
• Occupied Area: **4989.7 Ha**	• Occupied Area: **60.1 Ha**	• Occupied Area: **435.7 Ha**
• Area Under Expansion/ to be Developed: **4173.17 Ha**	• Area Under Expansion/ to be Developed: **5055.5 Ha**	• Area Under Expansion/ to be Developed: **4683.6 Ha**
• Unoccupied Area: **2279.8 Ha**	• Unoccupied Area: **141.4 Ha**	• Unoccupied Area: **331.5 Ha**

Source: VK PCPIR SDA

Visakhapatnam Zone

- The Visakhapatnam Zone has the largest processing area of about 16,617.97 Ha of which 4,989.7 Ha has been acquired for investments while 4,173.17 Ha is under development and 2,279.8 Ha remains unoccupied
- Visakhapatnam Steel Plant (RINL), NTPC, HNPCL, JNPC, and APSEZ are the major existing industrial areas of the Processing Area in Visakhapatnam PCPIR Zone
- There is significant part of the industrial area/clusters of the Processing Area in Visakhapatnam PCPIR Zone, which is not yet built, but is committed for industrial and support infrastructure. Amongst these committed Processing Areas, JNPC and AP SEZ are comparatively lesser built areas. Approximately, 65.6% of JNPC and 90% of AP SEZ is yet to be built
- Land acquisition is under progress for expansion of approximately 10.58 sq.km of AP SEZ
- JNPC, in principle, caters to pharmaceutical industries and AP SEZ caters to mixed industrial activities. BRANDIX is one of major SEZs in AP SEZ dedicated for textiles industries. National Thermal Power Corporation (NTPC) and Hinduja National Power Corporation Limited (HNPCL) are the power generation companies

Kakinada Zone

- Kakinada PCPIR Zone is second most important zone where number of industrial activities with respect to power generation, chemical, and fisheries industry exist
- Parry Infrastructure, Spectrum Power Plant, Coromandel International Limited Fertilizers Ltd. are the major companies

- Kakinada SEZ is proposed for development of petroleum refinery and petrochemical-led industrial activities
- Kakinada SEZ forms an important part of the VK-PCPIR due to its ambitious plans for the refinery and petrochemical industries

Nakkapalli Zone

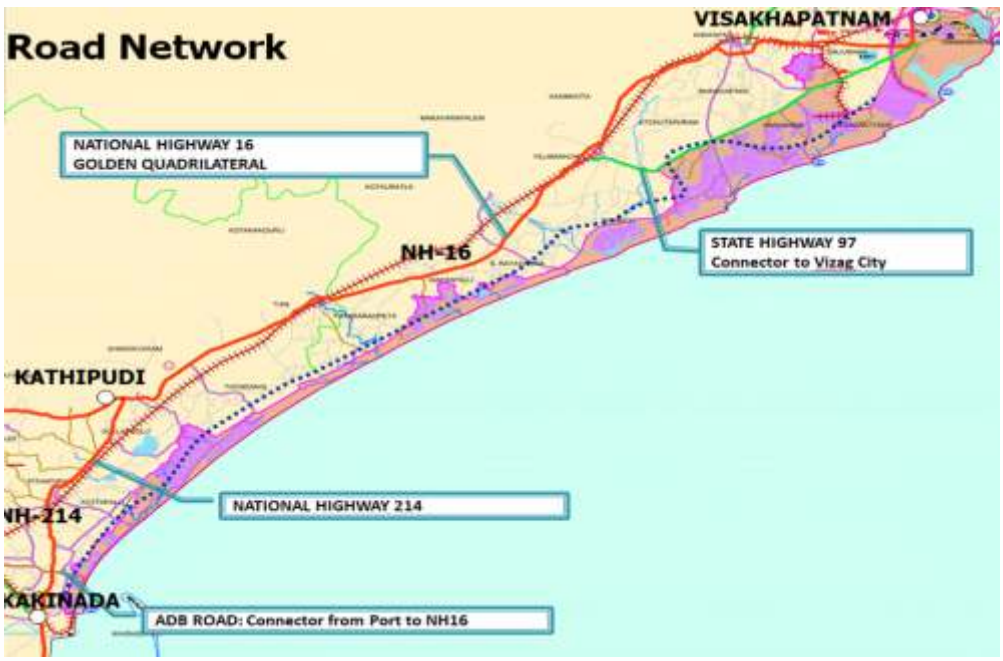
- In VK-PCPIR, Nakkapalli is least built in terms of its Processing Area. Currently, there exists only one major industrial area, i.e., HETERO SEZ. The approximately area of HETERO SEZ industrial area is 1.10 sq. km and is dedicated to pharmaceuticals
- Two large sites- Nakkapalli Industrial Cluster (23.54 sq. km) and Payakaraopeta Industrial Cluster (15.69 sq. km) have been identified as Processing Areas and land acquisition is under progress.
- A minor port is also proposed (as per the Master Plan) at Nakapalli Industrial Cluster. This cluster is part of the committed Processing Area in Nakkapalli PCPIR Zone. A total of 1.88 sq.km is reserved for the port

4.7.2 Road Connectivity

4.7.2.1 Existing Road Infrastructure

Vishakhapatnam PCPIR lies adjacent to NH16, connecting the region to Kolkata in north and Chennai in south.

Figure 19: Road Connectivity



Source:VK PCPIR SDA

Zone I: Visakhapatnam Region

- National Highway 214 and State Highway 97 for establishing hinterland connectivity of the industrial clusters to domestic markets
- Port connectivity corridor: 4 lane 12 Km corridor between Visakhapatnam port to NH16 (golden quadrilateral)
- Port connectivity corridor: 4 lane 3.8 Km corridor which would connect the upcoming Gangavaram port and NH16
- Industrial clusters connected to national highway through major district roads (MDRs)
- National highway 16 is under upgradation from existing 4 to 6 lane road. NH16 upgradation project is under M/s Transstroy

Zone II: Nakkapalli Region

- The industrial region lies in proximity of 1 Km from the golden quadrilateral

Zone III: Kakinada Region

- Hinterland connectivity via NH16 (golden quadrilateral) and NH 214
- Port connectivity corridor: Kakinada deep water port to NH16 via ADB road
- Hinterland connectivity via SH40 (Rajahmundry- Kakinada)

4.7.2.2 Proposed Road Infrastructure development

Figure 20: Proposed Road Infrastructure Development

Source:VK PCPIR SDA

Table 21 below details few of the road infrastructure development projects proposed or in implementation under various schemes.

Table 21: Proposed Road Infrastructure Development Projects

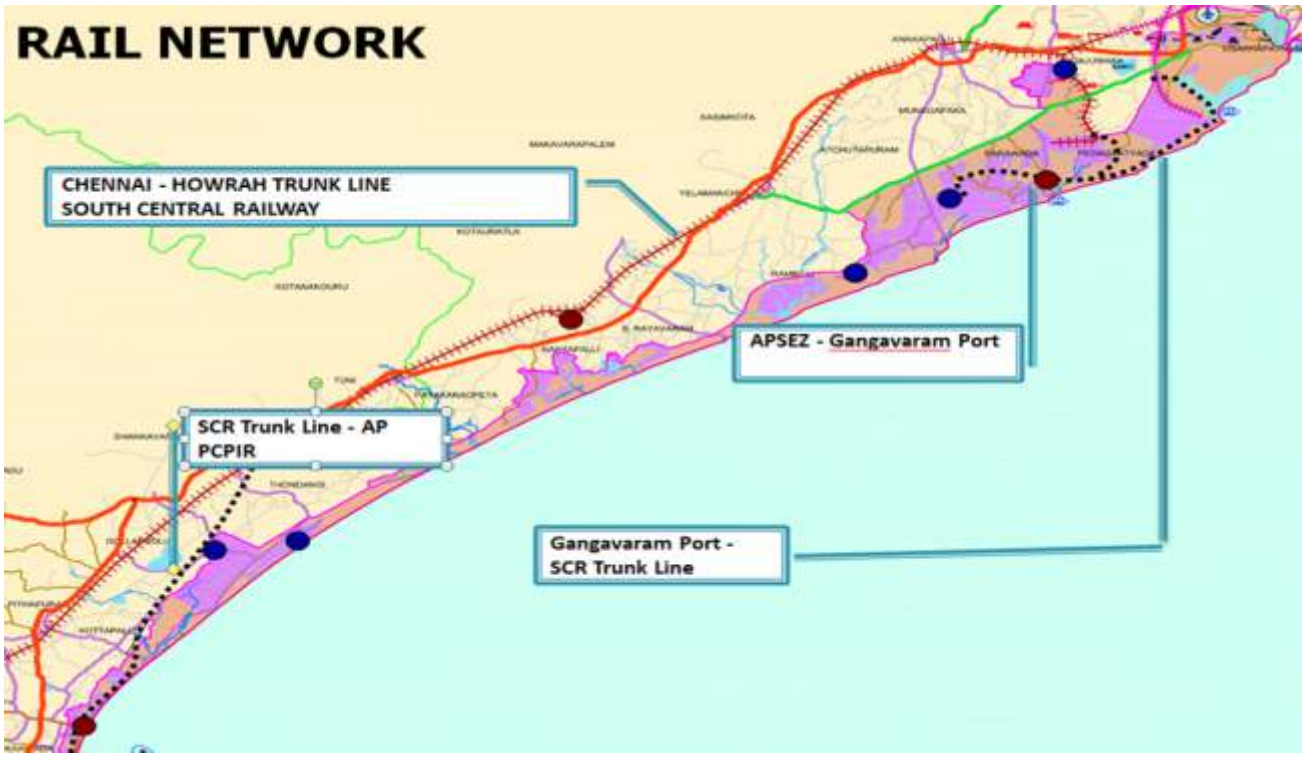
Proposals	Estimated cost (US$ mn)	Status
PCPIR Expressway: A 138 Kms 6 lane expressway from Gangavaram port to Kakinada Port	276.71	Proposed under master plan, shall be taken post finalization of master plan
SH97: Up gradation from 2 to 4 of 42Km SH from Yalamanchili to Gajuwaka	18.29	-
ADB Road: 51.07 Kms connecting Kakinada port to NH16 for 2 to 4 lane Up gradation	23.57	Taken up by APRDC under VCIC
NH 214 up gradation from 4 to 6 lane connecting Kathipudi to Kakinada	37.14	Work near Completion
NH 214 up gradation from 4 to 6 lane (later phase)	55.29	-
NH 214 paving	8.57	-
NH16 up gradation of Visakhapatnam to Rajahmundry stretch from 4 to 6 lanes	108.57	Under Planning
Other external road links	54.86	Anakapalli- Atchutapuram road proposed under VCIC
Total investment proposed	583.00	

Source: MM site visit

- Total investment of about USD 0.58 bn has been proposed in road infrastructure development in the Andhra Pradesh PCPIR region under various schemes
- Investments in road infrastructure would serve the existing and upcoming industries with improved connectivity to the raw material procurement sites and end user markets within the country and from ports, thereby reducing cost
- Development of road infrastructure would help improve the connectivity among various industrial regions/ clusters within the PCPIR region and outside

4.7.3 Rail Connectivity

Figure 21: Existing and Proposed Infrastructure projects



Source: VK PCPIR SDA

- There exists trunk rail infrastructure – South Central Railway (SCR) line that runs parallel to the AP PCPIR from Chennai to Bhubaneswar
- SCR provides connectivity from the APSEZ to Gangavaram Port i.e. Currently Gangavaram Port, Visakhapatnam Steel Plant, NTPC Power Plant at Parawada and Kakinada Port are connected by broad gauge national rail network
- Railways being the bulk cargo carrying mode, two rail network linkages connecting the major industrial clusters/SEZs have been proposed in the study area. It is proposed to develop broad gauge rail connectivity to AP SEZ, Kakinada SEZ, and HNPCL to improve logistic movement in the project area

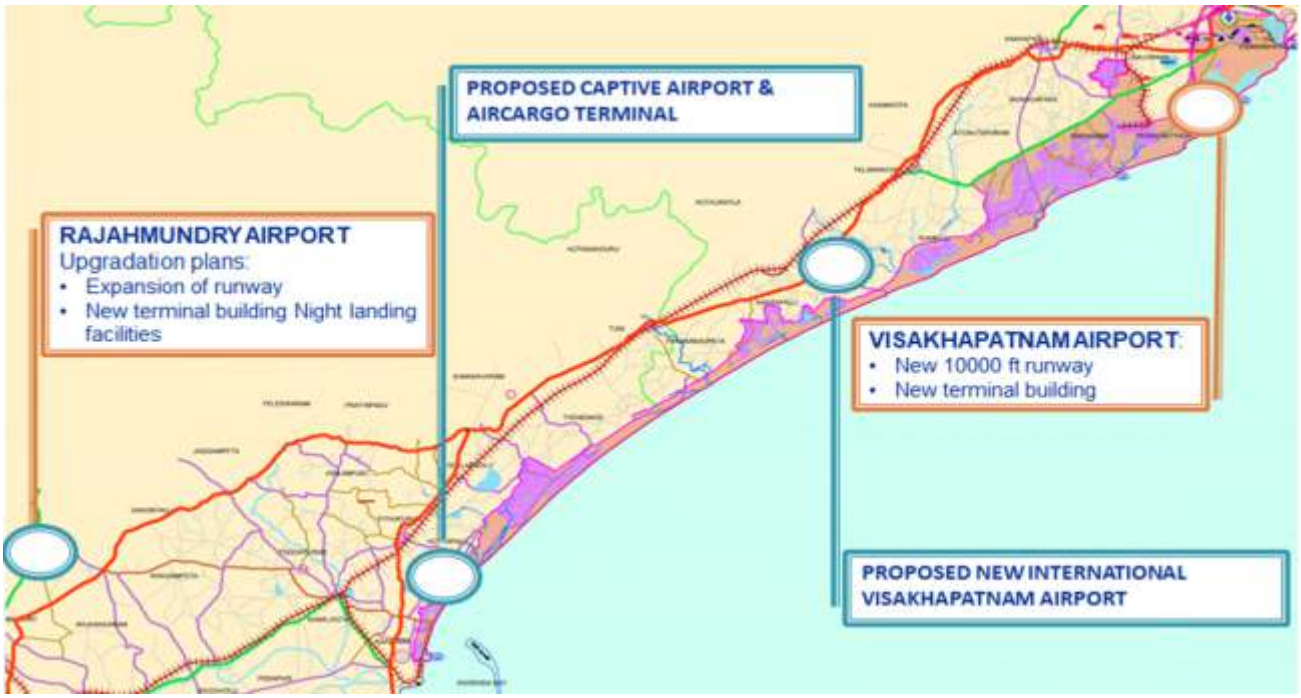
Table 22: Proposed Road Infrastructure Investments

Proposals	Estimated Cost (US$ mn)
Kakinada port to SCR via Kakinada SEZ	25.43
APSEZ to Gangavaram Port (26 Km)	14.57
Connectivity from APSEZ PCPIR to SCR trunk station	4.29
Rail Freighta stations with container freight stations, integrated container depots and warehouse Private Universities	100.00
Total	144.29

Source: VK PCPIR SDA

4.7.4 Airport

Figure 22: Existing and Proposed projects



Source: VK PCPIR SDA

- At present, there exist two airports in the AP PCPIR region namely Rajahmundry Airport and Visakhapatnam Airport. However, a greenfield airport is proposed in Visakhapatnam and a captive airport and terminal in Kakinada
- Other proposed projects include upgradation of existing airports

Table 23 details the proposed airport infrastructure developments in the region along with estimated cost.

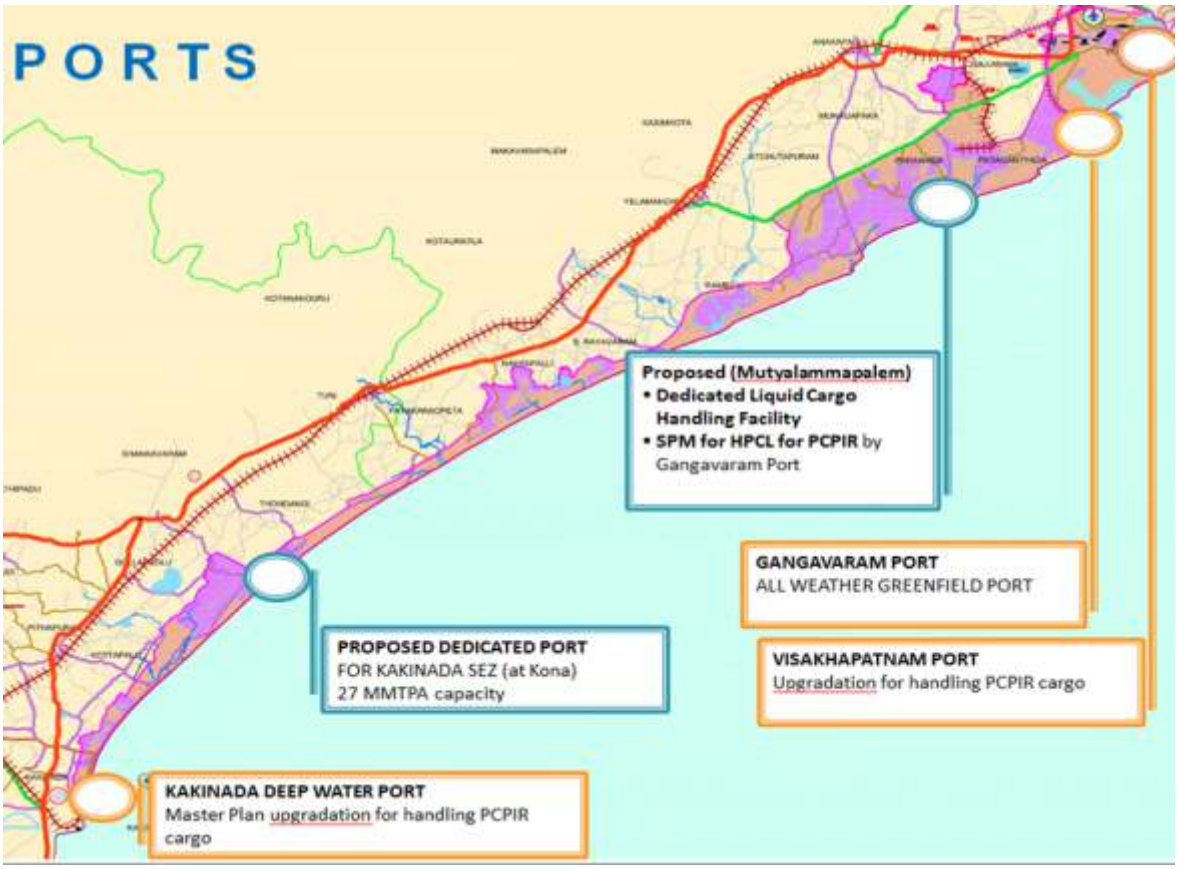
Table 23: Proposed Port Infrastructure Development Projects

Proposals	Estimated cost (US $)	Status
New Visakhapatnam International Airport	285.71	Proposed
Air Cargo complex and Airstrip at Kakinada	71.43	-
Upgradation of Rajahumdry Airport	17.14	Completed
Total	374.29	

Source: VK PCPIR SDA

4.7.5 Ports

Figure 23: Existing and Proposed ports



Source: VK PCPIR SDA

- Currently there are 3 major ports functioning in the VK PCPIR, namely Visakhapatnam Port, Gangavaram Port and Kakinada Deep Water Port
- Visakhapatnam Port is the major port with handling capacity 0.5 mn TEUs. Gangavaram Port is the deepest port with 21 mts of draft availability having the capacity to handle 200,000 DWT while Kakinada Deep Water Port and Anchorage Port has the capacity to handle 14 and 4 MT of cargo and with ship to ship transfer of crude oil facility

Table 24: Proposed Port Infrastructure Development Projects

Proposals	Estimated cost (US$ mn)
Upgradation of Visakhapatnam Port	278.57
Upgradation of Kakinada Deep water Port	235.71
Total	514.29

Source: VK-PCPIR SDA

In addition to upgradation of existing ports, under the draft master plan, greenfield port projects have been proposed. These include dedicated liquid cargo handling facility, SPM for HPCL refinery and dedicated port of capacity of about 27 MMTPA at Kakinada, to handle coal, general cargo, and liquid cargoes. Proposed port under GMR shall bring in added advantages for heavy manufacturing in process and discrete industries and support upcoming Haldia refinery/ petrochemicals complex.

Being strategically located on the Visakhapatnam Chennai Industrial Corridor, the port and industrial park together are expected to become the gateway to the East Coast of India.

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4.8 Utility and Support Facility

4.8.1 Utility facility: Water Sourcing and Availability

Figure 24: Existing Water Source

Source: VK PCPIR SDA

- At present, a 95 MLD water scheme is available to cater to the needs of APSEZ, Pharma City, Pharma SEZ and Brandix
- Water from ground or canals are currently the major sources of supply of water for industries in the region
- Presently, nearly 2000 to 3000 TMC of water is discharged into the sea every year from Godavari River which may be used to meet future water demand of the PCPIR
- The Yeleru Left Main Canal is the major source of water supply to GVMC, RINL, NTPC and APIIC industrial units
- 95 MLD water supply scheme is proposed under the VCIC to cater to the needs of Rambilli Cluster
- Another 39 MLD water supply scheme is proposed under VCIC to cater to the needs of developing Nakkapalli Cluster
- Dedicated supplies from Godavari River and Samalkota Canal can cater to the industrial needs of the Kakinada Cluster

- Supplies from the proposed Polavaram Canal (proposed under the draft master plan) can cater to the future water requirement of industrial regions in Visakhapatnam
- Considering the current and upcoming water supplies, there is no need for water desalination plant in the region

4.8.2 Utility: Power requirement and Availability

NTPC, NHPCL and SPGL are the major power projects operating in the region. Existing power facilities for supporting industrial operations across various industrial clusters/SEZs include:

- 220/132 KV substation for APSEZ
- 220/132 KV substation for Brandix SEZ
- 220/132 KV substation for Pharma SEZ
- 33/11 KV supply in KSEZ with 220/132 KV substation proposed under VCIC scheme

Various power projects proposed to meet the future power requirement include:

- 220/132 KV substation for Nakkapally Cluster under VCIC scheme
- 132 KV substation proposed in Rambilli Cluster under VCIC scheme

4.8.3 Social Infrastructure

- At present, about 3,472 Ha of land is under development of residential estate, which is further proposed to be extended as per the master plan with land already identified for residential township in all three zones
- Infrastructure for public utilities and facilities is being implemented in the region
- Development of knowledge hubs across all zones is proposed for skill development

4.9 Budget allocation for Infrastructure Funding

As per the PCPIR policy, infrastructure work is proposed to be taken up in three ways as:

- Public private partnership (PPP) mode with 20% VGF from GOI
- Govt. of A.P.
- Private

Table 25 details the proposed budget allocation structure for various infrastructure development projects in the PCPIR region.

These include development/ upgradation of road, rail, port, airport and other external infrastructure projects such as CETPs, ETPs, STPs, water and power supply schemes and various logistic and warehousing facilities.

Table 25: Investment in Infrastructure Development

	Govt. of A.P.	Govt. of India (20% VGF)	Private
Proposed Source of Funds (in US$ mn)	333.14	172.40	2,170.31

Source: VK PCPIR SDA

Total infrastructure project proposal for the VK PCPIR is estimated at US$ 2.68 bn, with the Government of India contributing US$ 172.4 mn through Viability Gap Funding (VGF).

4.10 Connectivity

- Major trunk infrastructure is already laid, while necessary expansions are at advanced stages of design and implementation
- VK-PCPIR contains three functional ports namely Visakhapatnam Port, Gangavaram Port and Kakinada Port which are among the leading ports of India. Road connectivity of VK-PCPIR is well established through NH 16 and NH 216 to the external hinterland. Railway connects the ports to the double lane broad gauge railway line connecting Chennai and Kolkata. There exist two functional airports in the vicinity of the VK PCPIR
- Proposed expressway would serve as the spine in connecting various industrial clusters and SEZs within the three zones together and to the market outside the PCPIR region
- Proposed GMR port in Kakinada shall be equipped with infrastructure sufficient to provide the proposed petrochemical units/ industries with required access to global markets

4.11 Feedstock

4.11.1 Anchor tenant

HPCL/ GAIL is the anchor tenant for the Visakhapatnam PCPIR. HPCL has setup a greenfield 15 MMTPA refinery and 1 MMTPA Olefins and Aromatics Complex aimed at providing feedstock to industries in the investment region. At present HPCL and GAIL have conducted pre-feasibility study for further expansion. There are ongoing discussion between Government of Andhra Pradesh and HPCL & GAIL on Viability Gap Funding and other support / incentives.

4.11.2 Feedstock availability

HPCL refinery in Visakhapatnam has an installed capacity of 8.33 MMTPA. The refinery is one of the first major industries of Visakhapatnam and first oil refinery on the East Coast

The tenant is dedicated for processing of a wide range of petroleum products, viz. LPG, MS, SKO, ATF, HSD, Bitumen and various grades of lubricants, specialties and greases as per BIS standard. HPCL has proposed refinery expansion to support demand creation from development of chemical and petrochemical industries in the region over coming years. Expansion as proposed by the tenant include:

- Refinery capacity: Expansion from 8.33 to15 MMTPA
- Hydrocracker unit (FCHCU) with a capacity of 3.053 MMTPA -as a part of the Visakh Refinery Modernization Project (VRMP)
- Olefins and Aromatics Complex proposed at APSEZ Visakhapatnam

4.11.3 Upcoming Anchor Projects

The two major upcoming anchor projects in AP PCPIR are:

- **HPCL/ GAIL**

HPCL in JV with GAIL has plans for a greenfield refinery project (1.5 MMTPA petrochemical complex) in Kakinada at an investment of US$ 4.29 bn; HPCL being the anchor to AP PCPIR, already has a refinery in operation in Visakhapatnam.

- **Haldia Petro-Chemicals**

Haldia Petrochemicals Ltd (HPL) proposes to setup a refinery in Kakinada SEZ at an investment of US$ 11.43 bn. The unit shall be processing about 4.5 MMTPA of fuel products and approx. 8.4 MMTPA of petrochemical products which include HDPE, MEG, PVC, styrene, benzene, phenol, acetone and polyol

Proposed anchor units will pave way for establishment of petrochemicals hub/ cluster in the region by provision of feedstock for downstream industries in the vicinity. The projects will help attract more investments into the Kakinada region as they provide immense opportunities for downstream industries to setup nearby.

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4.12 Employment

4.12.1 Employment Generation

Total of 1,18,675 employment has been generated so far including direct employment by major companies in the region into manufacturing and core industrial activities and indirect employments via engagement into various development and implementation activities.

Table 26 details the estimated employment opportunities expected in future.

Table 26: Proposed Employment Generation

Sector	Direct Employment	Indirect Employment
Petroleum	16,000	24,000
Petrochemicals	54,000	81,000
Chemicals and Fertilizers	52,000	78,000
Ancillary sector	192,000	348,000
Infrastructure-logistics, ports	211,000	106,000
Total	525,000	637,000

Source: VK-PCPIR SDA

4.12.2 Skill Development

To ensure availability of skilled human resource in future to support the industrial development in the region, knowledge hubs are proposed in each zone for provision of required training and skill upgradation.

5. PARADIP PCPIR, ODISHA

5.1 State Profile Overview

Odisha is located in the eastern region of India and the state's economy has shown significant growth in the recent past. It is a key state with regards to the minerals and metal-based industries.

Economic Snapshot

Table 27: Odisha's Contribution to the Indian Economy

Particulars	Odisha
GSDP, Current price (2017-18)	USD 63.9 billion
GSDP growth rate, YoY (2017-18)	10.3%
Per capita income, Current price (2017-18)	USD 1244
Cumulative FDI inflows since April 2000 (US$ billion)	USD 589 million
Exports (2017-18)	USD 6.3 billion
Human Development Index	0.597

Source: IBEF, investindia.gov

Odisha's GSDP in FY18 was USD 63.9 billion and FDI inflows into has reached US$ 589 million from April 2000 to March 2019. The state's exports reached USD 6.3 billion in FY19 contributing to a total of 1.9% to India's net exports. Odisha's HDI stands at 0.597.

Demographics

Table 28: Odisha Demographics

Particulars	Odisha
Population, Million	41.9
% of population in working age group	65%
Urbanisation Rate	17%
Female/Male Ratio	978/1,000

Source: IBEF, investindia.gov

Odisha is the 11th most populated state in India and is home to about 3.5% of the country's total population. About 65% of Odisha's population is in the working age group.

Education

Table 29: Social Infrastructure - Education

Particulars	Odisha
Literacy Rate	72.87%
Unemployment Rate (FY18)	7.1
Central Universities	1
State Universities	18
Private Universities	4
Industrial Training Institutes	100

Source: IBEF, investindia.gov

Odisha has a literacy rate of 72.87% as per the Census, 2011. It is home to 100 industrial training institutes and around 25 universities.

Physical Infrastructure

Table 30: Odisha Physical Infrastructure

Particulars	Odisha
No. of major airports	3
No. of key ports	3
Coastline Length (km)	485
No. of SEZs	5
EODB Rank (2017)	14

Source: IBEF, investindia.gov

Odisha has 3 major air ports including an international airport - Bhubaneswar. It has a coastline of 485 km and has 3 key ports namely- Paradip, Dhamra and Gopalpur. As of FY19, the state had 5 operational SEZs across various sectors.

Key Industrial Sectors

- Metals and Mining: Odisha is one of India's richest states in terms of mineral reserves. The state has produced US$ 579 million worth of mineral resources in FY17. It is considered as the aluminium capital of India
- Agriculture & Food Processing: Odisha has 10 agro-climatic zones and 8 major soil types favourable for the production a variety of crops. It is also the leading producer of horticulture crops in the country
- IT and Electronics: The IT sector in the state is dominated by over 300 SMEs which employ around 12,000 software professionals. The govt is considering a mega project in Bhubaneswar to attract ICT investments

5.2 Introduction

Paradip, located at about 115 Km from the state capital Bhubaneshwar is identified as one of the PCPIR regions by GOI as per the PCPIR Policy. The region spreads over an area of about 285 sq.km. at the junction of two districts namely Kendrapada and Jagatsinghpur.

5.3 PCPIR Management Structure

There is no independent board formed for management of the PCPIR, however, IDCO is notified as nodal agency for the Paradip PCPIR and is responsible for:

- Preparation of Master Plan
- Planning and implementation of schemes in the region
- Development of the PCPIR region

Paradip Investment Region Development Ltd (PIRDL) has been formed as a SPV for implementation of the PCPIR in Paradip. Under Odisha Development Authorities Act, 1982, PIRDL will be declared as "Special Planning Authority" for the PCPIR. IPICOL being the nodal agency of Government of Odisha for investment is responsible for marketing and promotion of the region. The body is making efforts for marketing the Paradip PCPIR.

5.4 Progress Status of PCPIR

There is no independent board formed for management of the PCPIR so far however, IDCO is notified as nodal agency for the Paradip PCPIR and is responsible for:

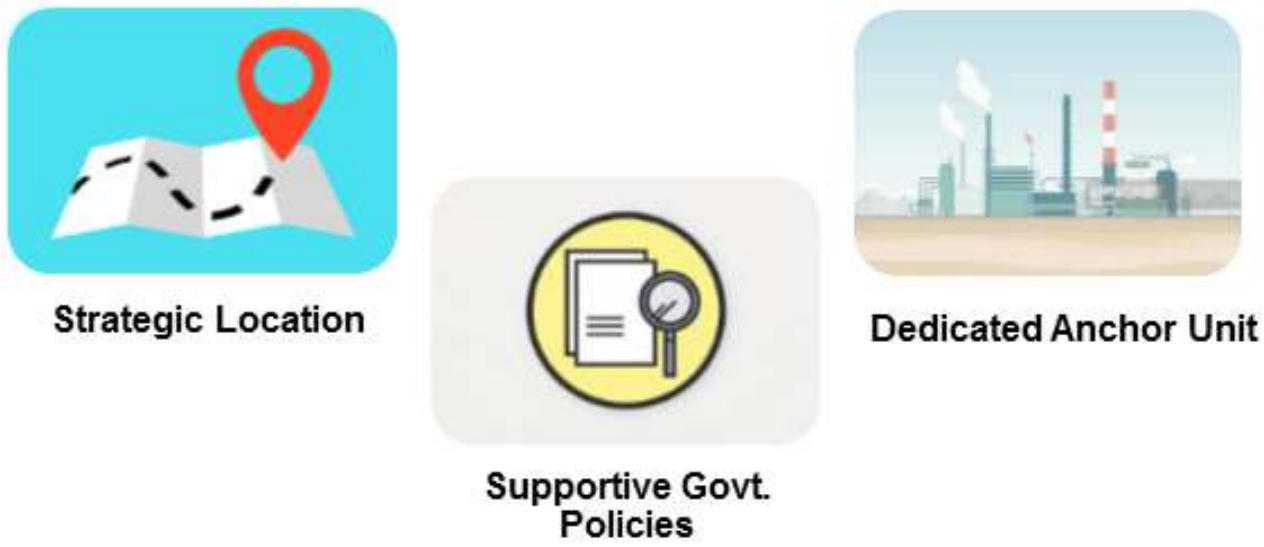
5.4.1 Master Planning

The Draft Master Plan for the Paradip PCPIR has been prepared by Odisha Industrial Infrastructure Development Corporation (IDCO) and shall be notified soon

5.4.2 Status of Approvals and Clearances

The Environmental Impact Assessment (EIA) study has been completed and public hearing is being planned for the same, post which environment clearance is expected.

5.5 Key Success Factors



Strategic Location: Odisha, located on the eastern coast of India lies in proximity to petrochemical majors ASEAN countries like Singapore, Malaysia, Thailand and others.

Supportive Govt. Policies: Government has been supportive for developments in Odisha by providing industry friendly policies and incentives that help develop an ecosystem favourable for industrial development in the state. Implementation of single window clearance is one of the major policy decisions that is expected to attract larger investments into the PCPIR region.

Dedicated Anchor Unit: IOCL Refinery at Paradip- the anchor unit has proposed expansion for supply of feedstock.

5.6 Investments

5.6.1 Major Investors and Investments

Investments worth US$ 6.43 bn have been made in Paradip, which include investment in industrial establishments and infrastructure development.

Table 31 lists various existing and upcoming investments in the region.

Table 31: Proposed and Existing Investments

Investment	Products	Capacity	Unit
Indian Farmers Fertilizer Cooperative Ltd (IFFCO)	Sulphuric Acid	2,310,000	MTPA
	Phosphoric Acid	875,000	MTPA
	DAP/NPK	1,920,000	MTPA
Paradip Phosphates Ltd	DAP	1,200,000	MT
	Phosphoric Acid	300,000	MT
	Sulfuric Acid	726,000	MT
Paradip Carbons Ltd	Calcination plant	125,000	TPA
Deepak Fertilizer & Petrochemicals	Ammonia	126	KTA
	Nitric Acid	376	KTA
	Technical Ammonium Nitrate (TAN) Prill	330	KTA
	Ammonium Nitrate Solution	376	KTA
	AN Melt	140	KTA
Plastic Park	Injection Moulding, Blow Moulding and Extrusion Moulding units		

Source: IDCO

IFFCO, Paradip Phosphates Ltd, Paradip Carbon Ltd and Deepak Fertilizers & Petrochemicals are few of the major investments made in the PCPIR region.

Plastic Park

Development of Plastic Park in Odisha is expected to attract numerous small and medium sized investments into the PCPIR with increasing demand for PP and PE derivates in various industries. The Plastic Park development is planned over an area of about 120 acres of which 21.18 acers has already been allotted to 9 PP based downstream units. Potential downstream investment projects for plastic park include industries based on PP Rafia, flexible packaging, compounding and injection moulding products.

The proposed plastic park will have feedstock linkage with the IOCL anchor unit. The plastic park is proposed to function on the cluster approach sharing common infrastructure and facilities.

5.6.2 Investment Opportunities

Odisha being a developing PCPIR region having sufficient land, external infrastructure and manpower, has the potential to cater to increasing demand of chemicals and petrochemicals. Various projects for investment in the high potential sectors like chemicals and petrochemical are detailed in Table 32.

The Paradip region is planned on Cluster based approach wherein different clusters have been proposed. Investments specific to these clusters is detailed below:

Table 32: Investment Opportunities

Industrial Area	Primary Product	Allied Industry	Downstream Industry
Industrial Area II : Downstream PE &PP Based	BOPP Film Unit	Flexible Film Packaging	
	Raffia Unit	Ropes, Strappings etc.	
	Injection Moulding Units	Furniture, Crates, Household Items, Battery Covers etc.	
	Geotextiles		
Industrial Area III : Methanol Based	Acetic Acid	Vinyl Acetate Monomer	PVA / Adhesive Unit
			PV(OH)
	Formaldehyde	Phenol Formaldehyde Resin	Bakelite/Switches, Particle Boards, Panels, Doors etc.
		Urea Formaldehyde Resin	Switches/ Other Electrical connectors etc.
		Melamine Formaldehyde Resin	Utensils
Industrial Area IV : MEG/DEG/TEG + PTA Based	PSF Unit	Textile Units	Readymade Garment Units, Upholstery, Blankets etc.
		Carpet Manufacturing	
	BOPET Film Unit	Zari, Strapping	
	Unsaturated Polyester Resins	Wind Mill Fan Blades, FRP Boats, Canopies, Helmets etc.	
		Coolants, Antifreeze, etc.	

Industrial Area	Primary Product	Allied Industry	Downstream Industry
Industrial Area V : Propylene / Benzene / N-Paraffin Based	Isopropyl Alcohol	Pharmaceuticals, Ink Manufacturing, Agrochemicals, etc.	
	Cumene-Phenol - Acetone-Bisphenol A-Polycarbonate	Phenol Formaldehyde Resin, Epoxy Resin	Bakelite/Switches, Particle Boards, Panels, Doors, FRP Products, Sheets, Jars etc.
	Acrylic Acid / Acrylates	Leather Binders, Textile Chemicals etc.	
		Polyacrylonitrile& its Sodium Salt - Super Absorbent Polymer	Water Treatment Chemicals, Diapers, Sanitary Tissues etc.
	Linear Alkyl Benzene	Detergent, LABSA, Liquid Detergents, Varnish oils etc.	
Industrial Area VI : Sulfur Based	Sulfuric Acid Unit	Battery Manufacturing	
		AOS Units	Detergent Production
			Cosmetics
			Soaps
		Sulfonation Units	Chemicals, Dyes etc.
	SSP Unit		
	DAP/NP-NPK Unit		
Industrial Area VII : Acrylonitrile/ Butadiene / Styrene Based	SAN - ABS Unit	Injection Moulding Units - Luggage, Stationery Items, Sheets, Automotive Components, Decorative Items etc.	
	NBR/SBR/PBR	Automobile Tyre Units	
		Non Tyre Rubber Units, Tyre Retreading, Hoses, Cycle Tyres, Rice Dehusking Rolls, Tubings, Gaskets, o-Rings etc.	
Industrial Area VIII : Miscellaneous Units	Linear Alpha Olefins	Alpha Olefin Sulfonates	Detergent Production

Source: IDCO

5.7 Infrastructure

Figure 25 highlights the external infrastructure connectivity of Paradip PCPIR to nearby markets and regions.

Figure 25: Existing and Proposed External Infrastructure

Source: IDCO

5.7.1 Land Use and Availability

The PCPIR region of Paradip spreads over an area of about 284.15 sq.km with processing area of 112.49 sq. km (approx.40% of the total area). The processing area includes industrial estates along with warehousing, oil terminals and ports.

About 61.98 Sq Km of the total processing area is developed and can be allotted for industrial operations, of which 29.28 Sq Km has already been allotted. Therefore, about 192.9 Sq Km of the area is available for greenfield developments in the PCPIR region, indicating sufficient land availability for future investments.

5.7.2 Road Connectivity

Existing:

- NH-5A connects Paradip to NH16 (Golden Quadrilateral)
- SH-12 connects the region to the city Cuttack

Proposed:

- Upgradation of NH-5A to 8 lane road
- Greenfield road from Paradip is proposed to connect to the state capital Bhubaneswar
- 451 kms long Coastal Highway is proposed connecting Gopalpur, Odisha to Digha, West Bengal that would passthrough Paradip, providing the it with reliable connectivity to various regions

5.7.3 Rail Connectivity

Existing:

- Paradip-Cuttack line is in operation
- Railway line connecting Paradip to Haridaspur is under construction

Proposed:

- A Railway line from Paradip is proposed which will connect it to Dhamra

5.7.4 Airports

Existing:

- Biju Patnaik International Airport in Bhubaneswar (115 kms) is the nearest airport to Paradip

Proposed:

- Greenfield airport is proposed in Paradip to cater to the increasing movement towards the region

5.7.5 Ports

Existing:

- Paradip Port: It is a deep draft, all-weather sea-port with handling capacity of about 277 MTPA
- Dhamra Port is another port in proximity of 120 Kms from Paradip. It is also a deep draft, all weather port with capacity of about 25MMTPA

Proposed:

- Paradip port is proposed for expansion to upto 325 MMT by 2020 with capacity to handle larger vessels of size of about 2,00,000 DWT

5.8 Utility and Support Facility

5.8.1 Utility Facility: Water sourcing and effluent treatment

Existing:

- At present, water is sourced from Mahanadi River

Proposed:

- Recycled water network for supply of 314 MLD of 536.7 MLD treated water supply from Mahanadi river
- Installation of 4 CETPs of total 137 MLD Capacity and 4STPs of total 178 MLD capacity is proposed in the region

5.8.2 Utility Facility: Power sourcing and availability

Existing:

- At present power is supplied by Odisha Power Transmission Corporation Ltd.

Proposed:

- 400 kV (proposed) & 220 kV (existing) Line from New Duburi
- 400/220 kV, 1500MVA Main Receiving Station in Paradip
- Additional 220/33 kV Grid Stations to be developed.

5.8.3 Social Infrastructure

- Development of two knowledge parks is proposed as per the master plan, where colleges, technical institutes and ITI/vocational training centres will be established to cater to the demand of skilled manpower in the region

5.9 Budget Allocation for Infrastructure Development

Investments are proposed in two phases. Table 33 below describes the phase wise proposed investment for different external infrastructure development.

Table 33: Phase wise Infrastructure Investment Split[1]

Description	Total Amount (US$ mn)	Phase-1 (US$ mn)	Phase-2 (US$ mn)
Transportation	696.57	236.96	391.40
External road network	868.95	-	-
Water Supply	188.92	98.12	90.80
Waste Water Management	115.47	60.93	54.53
Strom water Drainage & Flood Management	331.06	189.67	141.39
Solid Waste Management	9.56	5.83	141.39
Power Supply	291.33	169.26	122.07
Total	2,501.86	760.78	941.58

Source: IDCO

Total investment with fund allocation to different interest groups is given in Figure 26.

Figure 26: Fund Allocation for Infrastructure and Facilities Development

GOVT. OF INDIA

- Development of Odisha Coastal Corridor Up-gradation of NH-5A
- Up-gradation of NH-5A
- **US$ 0.62 bn**

GOVT. OF ODISHA

- Development Greenfield Bhubaneswar- Paradip Road
- Up-gradation of SH-12
- Public Transportation-BRT
- Greenfield Airport
- 400 KV double circuit line from New Duburi to Paradip
- **US$ 0.34 bn**

PPP

- Development of logistic hubs & truck terminal
- Water supply system
- Waste water management system
- **US$ 0.49 bn**

Private

- Improvement of existing road networks
- Junction Improvements
- Proposed Bridges, ROBs & RUBs
- Storm Water Drainage & Flood Management
- Solid waste management
- Power Supply Distribution network
- **US$ 1.03 bn**

Source: IDCO

[1]Phase-1: 2016-2026, Phase-2: 2026-2036

5.10 Feedstock

5.10.1 Anchor Tenant

IOCL is the anchor tenant in Paradip, the PCPIR region of Odisha and is the major source of feedstock for the downstream industries in the region. IOCL positions itself as a petroleum major with 32% of Domestic Refining Capacity and 43.9% total domestic petroleum market share.

The Paradip Refinery with processing capacity of about 15 MMTPA spreads over an area of about 3,345 acres.

5.10.2 Feedstock for Anchor Unit

Crude and natural gas are the major feedstock for the tenant unit to be converted to high value petroleum products or for use as fuel.

To ensure availability of adequate feedstock for efficient refinery operations, the tenant has made investment in elaborate infrastructure for pumping crude oil to the Paradip Refinery and for smooth, safe and efficient movement of the finished products. This includes a crude oil unloading facility at Paradip offshore with the first Single Point Mooring (SPM) facility on the east coast of India; a complex cross-country product pipeline network; a marketing terminal with truck loading bays and tank-wagon gantry; and an LPG terminal with facilities for road dispatch. One of the biggest product dispatch infrastructure of Paradip Refinery is the captive South Oil Jetty, the first-of-its-kind in India.

5.10.3 Feedstock Availability (Auto Fuel)

IOCL has setup a 15 MMTPA grassroots refinery in the region. The refinery is mainly configured to process high-sulphur and heavy crude oil to produce various auto fuels and petroleum products such as petrol and diesel of BS-IV and BS-VI quality, kerosene, aviation turbine fuel, propylene, sulphur, and petroleum coke. It is also designed to produce Euro-V premium quality motor spirit and other green auto fuel variants for export.

Apart from investments in petrochemicals, Paradip refinery is currently looking into opportunities in auto fuel with stringency in auto fuel norms and introduction of BS-VI rules. Being a potential caterer for BS VI fuel requirements in the country, IOCL foresee's great market opportunities in this sector over coming years.

5.10.4 Feedstock Availability

Potential polymer-based units proposed in the PCPIR region will require a steady supply of ethylene from the IOCL Refinery installed at Paradip. However, these efforts to attract downstream investors to the PCPIR (Petroleum, Chemicals & Petrochemicals Investment Region) has suffered due to constraints in ethylene supplies in the region by the tenant.

In addition to existing feedstock supply constrains in the region, IOCL's plans to use ethylene as a feed for its upcoming mono-ethylene glycol plant as part of its petrochemical complex would further constrain its ethylene supplies in the region. Considering the feed requirement for MEG unit, the tenant may not be in a position to spare ethylene for the downstream units as the entire quantity is expected to be consumed in the value addition process.

However, the tenant has expansion plans (from 15 to 25 MMTPA). The proposed expansion would play a crucial role to boost the development of petrochemical cluster in the PCPIR region by catering to the needs of various downstream industries in the plastic park; this include setting up of polymer and various petrochemical intermediate units such as PX/PTA and MEG, which would be crucial feedstock for the planned plastic park. The proposed capacities under expansion are listed in table below:

Table 34: IOCL - Capacities under Expansion

Product	Capacity (in KTA)
Polypropylene	680
PX/ PTA	1,200
MEG	357

Source: IOCL

Polypropylene Plant, Paradip: Catering to the Needs of Plastic Park

The polypropylene plant of about 680 KTA capacity is under implementation by IOCL in Paradip. The polypropylene plant is expected to supply propylene to plastic and packaging industries in the proposed plastic park under the scheme of Government of India and to cater to the plastic demand in the eastern region. The PP plant at Paradip shall be dedicated for production of homopolymer grades suitable for injection moulding, raffia, biaxially oriented PP, TQ film, fiber & filament and extrusion.

PX/PTA and MEG Plant: Catering to the demand of textile industries in East of India

PTA and MEG are petrochemical intermediates predominantly in the manufacturing of polyester staple fibre and filament yarn. IOCL has proposed investment in PTA and MEG to encourage development of downstream textile industries via provision of adequate and reliable feedstock supplies in the region.

5.10.5 Anchor Supplies in the Region

At present, the petroleum products of the refinery include 49.6% of middle distillates (SKO, ATF, Euro III HSD, Euro IV HSD, 31.5% of light distillates (LPG, Propylene, Euro III MS, Euro IV MS) and 19.9% of petcoke and sulphur.

The anchor supplies comprises of exports of finished petroleum products to Asia Pacific, Europe, USA, and to the demand centres in east India, north east and to some southern states like Andhra Pradesh and Telangana.

The tenant with plans to cater to the domestic demand is under the process of implementing a cross country pipeline network for supply of finished petroleum products across different parts of country.

The petroleum products from Paradip Refinery are majorly dispatched through product pipelines, constituting to about ~52% of total supplies in the county indicating access of dedicated pipeline infrastructure, while other modes of connectivity with end user market include road transport (~13%) & coastal movement (~35%).

5.11 Employment

5.11.1 Employment Generation

A total of 38,260 employment has been generated so far including direct employment by major companies in the region into manufacturing and core industrial activities and indirect employments via engagement into various development and implementation activities.

The development in the PCPIR with more investments anticipated in future, not only contribute to the economy, but also provide large employment opportunities. The Paradip PCPIR is expected to generate employment for about 0.37 million people by 2036.

5.11.2 Skill Development

At present the immediate region around Paradip PCPIR does not have sufficient technical institutes. However, CIPET is located in Bhubaneshwar which has also established its Plastics Product Evaluation Centre (PPEC) at Plastic Park in Paradip.

Development of two knowledge parks is proposed as per the master plan, where colleges, technical institutes and ITI/vocational training centers will be established to cater to the demand of skilled manpower in the region.

6. CUDDALORE PCPIR, TAMIL NADU

6.1 State Profile Overview

Located in the southernmost part of the country, Tamil Nadu is the fourth largest state in India. It ranks first among the states in terms of number of factories and industrial workers. The state has a varied manufacturing sector and is the leader among several industries.

Economic Snapshot

Table 35: Tamil Nadu's Contribution to the Indian Economy

Particulars	Tamil Nadu
GSDP, Current price (2017-18)	USD 229.7 Billion
GSDP growth rate, YoY (2017-18)	12.50%
Per capita income, Current price (2017-18)	USD 2284
Cumulative FDI inflows since April 2000 (US$ billion)	USD 30.7 Billion
Exports (2017-18)	USD 30.5 billion
Human Development Index	0.708

Source: IBEF, investindia.gov

Tamil Nadu's GSDP in FY18 was USD 229.7 billion with a 12.5% year on year growth rate. FDI inflows in Tamil Nadu between April 2000 and March 2019 reached US$ 30.7 billion. The state's exports reached USD 30.5 billion in FY19 contributing to a total of 9.3% to India's net exports. Tamil Nadu's HDI stands at 0.708.

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Demographics

Table 36: Tamil Nadu Demographics

Particulars	Tamil Nadu
Population, Million	72.2
% of population in working age group	68%
Urbanisation Rate	49%
Female/Male Ratio	996/100

Source: IBEF, investindia.gov

Tamil Nadu is the 6th most populated state in India and is home to about 6% of the country's total population. About 68% of Gujarat's population is in the working age group.

Education

Table 37: Social Infrastructure - Education

Particulars	Tamil Nadu
Literacy Rate	80.09%
Unemployment Rate (FY18)	7.8
Central Universities	2
State Universities	22
Private Universities	34
Industrial Training Institutes	560

Source: IBEF, investindia.gov

Tamil Nadu has a literacy rate of 80.09% as per the Census, 2011. It is home to 560 industrial training institutes and around 60 universities. In the budget FY19, US$ 3.99 billion is allocated for primary education.

Physical Infrastructure

Table 38: Tamil Nadu Physical Infrastructure

Particulars	Tamil Nadu
No. of major airports	6
No. of key ports	3
Coastline Length (km)	940
No. of SEZs	11
EODB Rank (2017)	15

Source: IBEF, investindia.gov

Tamil Nadu has 6 major air ports including an international airport - Chennai. It has a coastline of 940 km and has 3 key ports namely- Chennai, Ennore and VO Chidambaranar. As of FY19, the state had 11 operational SEZs across various sectors.

Key Industries

- Automobile and Auto-components: The state accounted for 45% of the total auto exports from India. It is also the export hub of passenger vehicles and the top tyre manufacturing state in the country
- Pharmaceuticals: Tamil Nadu is the 5th largest producer of pharmaceuticals in India and accounts for 10% of the total production of the country. It has dedicated SEZs and bio-pharmaceutical parks that offer facilities for pharmaceutical productions
- Textile: Tamil Nadu is known as the 'yarn bowl' of the country. It ranks 1st in apparel production and 2nd in textile production in India. It accounts for 41% of the country's cotton yarn production
- IT and Electronics: Tamil Nadu has emerged as a key destination for IT investments. The state has 22 approved IT parks and is the 4th largest software exporter from India
- Renewable Energy: The state has the highest renewable energy capacity in the country and ranks 10th globally in installed capacity of wind power

6.2 Introduction

The Government of India has identified a PCPIR in Tamil Nadu in 2017, to be developed over an area of 256 sq km across 45 villages in Cuddalore and Nagapattinam districts.

6.3 PCPIR Management Structure

- The PCPIR's management structure has not been formed
- Govt. of Tamil Nadu has sanctioned an in-principle approval for setting up -TN PCPIR Management Board

6.4 Progress Status of PCPIR

- The zoning plan is prepared and approved for an extent of 25,683 hectares comprising a processing area of 10,400 hectares and a non-processing area including agricultural space, roads and open area of 15,283 hectares
- Master plan, EIA study and the approval of Master plan is yet to be undertaken
- Liquidation process has been ordered by the NCLT against the proposed anchor tenant – Nagarjuna Oil Corporation Limited (NOCL)

6.5 Investments

- With regard to the PCPIR, CCEA approval was received for an investment of around US$ 2 bn, which includes investment of US$ 400 mn from the Central Govt. through budgetary support and VGF, US$ 125 mn from State Govt. fund and US$ 1.4 bn through private developer's investment
- The total envisaged investment in the PCPIR region is US$ 13.2 bn over a period of 10-15 years, including the anchor unit investment of US$ 3.8 bn
- Except for the anchor tenant (NOCL), no major investments have been made in the region

6.6 Infrastructure

Some of the major infrastructure developments proposed are:

- Doubling and electrification of Villupuram - Thiruvarur railway stretch
- Strengthening of the National Highway NH 45 A and widening it into a four lane highway
- Conversion of the State Highway- SH 10 to a National Highway

6.7 Utilities

6.7.1 Water

- Water demand is proposed to be met through a desalination plant (300 MLD)
- Common ETP is proposed to be setup under the PPP model, whereas the State Govt. will setup the STP

6.7.2 Power and Gas

- 1,200 MW power plant is currently in operation in the region
- Tamil Nadu Generation and Distribution Corporation (TANGEDCO) has been informed to meet the desired power requirement of the region
- Gas pipeline is proposed to be laid by IOCL, connecting the PCPIR region which is part of the network connecting Ennore – Nagapattinam pipeline. Currently, IOCL has completed the route survey

6.7.3 Education and Skill Development

- 1,200 MW power plant is currently in operation in the region
- Cuddalore and Nagapattinam districts in the PCPIR region have sufficient technical and industrial training institutes to impart the required technical skills and knowledge
- Skill development centres are also set up by the state government to meet the industry needs

6.8 Feedstock

Crude oil is the major feedstock for anchor unit. As the construction of anchor unit is stalled midway, refinery products & by-products required for downstream industries is not readily available. Since the region does not have adequate resources of crude oil & refinery products for use in industries, currently reliance is placed on imports. Port facility is available to procure feed stock.

6.9 Employment

The region has provided employment to over 13,950 people so far, across various sectors.

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7. INTERNATIONAL PETROCHEMICAL HUBS

7.1 Overview

There are multiple direct and indirect benefits that arise from setting up and developing a successful petrochemical hub. The advantage of the symbiotic ecosystem wherein raw material suppliers as well as manufacturers benefit from being present in the same investment attracting geographic periphery are multi-fold. Some of the successful petrochemical hubs are depicted in Figure 27.

Figure 27: Successful International Petrochemical Hubs

Source: MM Analysis

There is a growing deficit in petrochemicals supply vis-a-vis in India. By 2020, this gap is expected to reach 5.4 million MT. This provides a significant opportunity for investments in the domestic petrochemical sector.

To spur manufacturing in India, PCPIRs were conceptualised. However, several challenges have impeded growth in these regions:

- Lack of investment
- Infrastructure bottlenecks
- Land acquisition and related regulatory issues
- Limited planning

Globally three petrochemical hubs, Antwerp-Rotterdam-Rhine-Ruhr Area (ARRRA), Jurong Island and Bay Area Houston are recognised benchmarks for development of new clusters around the world. Key drivers and success factors for each of these hubs are mentioned subsequently.

Case Study 1: Petrochemical Hub - Port of Antwerp

The chemical industry in the Netherlands forms part of one of the strongest chemical clusters in the world - The Antwerp-Rotterdam-Rhine-Ruhr Area (ARRRA). This interconnected cluster is responsible for supply of a huge array of products to the competitive European manufacturing industry, for both domestic and export markets.

Key Drivers and Factors of Success

- Location advantage of being in Europe (a market which is central to all trading nations)
- State-of-art infrastructure offering a suite of logistics advantages and market penetration in the industrial and commercial heart of Europe.
- A highly integrated industrial environment with numerous partners - suppliers, contractors and customers - in the oil and chemical sector, with unrivalled connectivity throughout the process chain.
- Both Belgian and Flemish Governments have implemented several stimulating investment incentives ranging from tax-related schemes on to employment, training and R&D advantages.
- The greater Antwerp region hosts a diversified range of technical support services like EPC companies, process optimisation, process control, automation & instrumentation, maintenance, heavy lifting, health, safety & environment (HSE), quality control, storage and dispatching of all products, in all aspects.
- Presence of a large range of highly competent Belgian and international service providers, to deal with diverse financial, legal and taxation matters
- A skilled labour market as the Flemish region is renowned for its highly educated, multilingual and productive workforce.
- A smooth administrative handling of projects by the Antwerp Port Authority.
- Government has supported by providing funds and various tax and non tax related incentives for R&D, skill and technological development activities

Case Study 2: Petrochemical Complex- Jurong Island

Jurong island is a petrochemical complex built on artificially amalgamated islands. The island spreads over an area of more than 3,000 Ha and hosts more than 95 companies from the US, Europe and Asia. Today, Singapore is the third-largest oil refining centre in the world, the largest bunkering port and, one of the top 3 oil trading hubs in the world.

Key Drivers and Factors of Success

- **Location Advantage:** It had location advantage of being situated in the southeastern Asia, which is a high demand intensive region for products of chemicals and petrochemical origin. Singapore has been successful by targeting the right segments/ regions
- **Favourable Policies:** Law and policy framework in Singapore support trade and attract foreign investments into the country
- **Government Support:** The Government of Singapore has been supportive in development petrochemical hub through provision of various subsidies, investment in infrastructure and forming policies that promote such a project.

Further provisioning of tax benefits on industrial projects and cofounding various R&D, efficient resource utilization, innovation centric, training and skill development activities has spurred industrial activity in the region.

- **Industry Integration:** The integrative design and strong logistical capabilities have attracted large number of the major chemical manufacturers

Presence of large number of global chemical companies in Singapore served as an established industrial base for the development of the petrochemical complex.

- **Advanced Logistics:** Availability of reliable infrastructure and logistic facilities have been successful in attracting investment from across the globe

Logistically, Singapore's location is ideal to act as a regional hub for Southeast Asia's chemical industry. Lack of investment in markets such as Indonesia, Philippines, Vietnam and until recently Malaysia has allowed the Jurong Island cluster to establish a strong position, both in scale and competitiveness.

- **Technological Advancement:** Singapore being a centre for global excellence in technology has piloted Industrial Internet-of-Things (IIOT) solutions into their manufacturing processes, achieving great efficiencies. With the use of a tracker system to boost worker safety and efficiency, the company has started to save several man hours a year

Case Study 3: Petrochemical Complex- Port of Houston

Port of Houston the largest petrochemical complex in United States is situated in Houston, Texas. It a global leader in manufacturing petrochemicals, with the Houston Ship Channel recognized as the largest petrochemical complex in the U.S. It operates at major terminals along the Houston Ship Channel, with more than 150 private companies situated along Buffalo Bayou and Galveston Bay.

Key Drivers and Factors of Success

- **Location Advantage:** City of Texas, which has an evolved industrial cluster provided a strong base for development of a petrochemical complex
- **Strong Supply chain with modern logistic facilities:** Presence of well-managed strong supply chain and logistics has been crucial for sustainability and development of a logistic intensive petrochemical complex
- **Surplus of natural resources:** The petrochemical industry has a massive presence in Houston due to the energy industry, so Houston is directly reaping the benefits of cheap natural gas
- **Infrastructure:** Availability of proper infrastructure has helped attract larger investments
- **Abundance of skilled manpower:** Availability of skilled labour force had also been an important factor that supported development in the region
- **Government Support:** The government has supported the development of industrial hubs by provision of various tax relaxations and funding for infrastructure development, plant and equipment setup and skill development activities along with various tax benefits such as goods in transit and tax -free access to electricity
- In addition to above advantages the government offers subsidies for implementation of greener technology

7.2 Learning's

We have identified five key success factors to drive investments in a petrochemical hub:

Figure 28: Key Success Factors

Robust ecosystem with anchor company	Efficient logistics network	Policies, regulations and incentives	State of the art infrastructure and clearly defined operating model	Unambiguous ownership structure
• Anchor investor with large-scale investment • Supportig industries across value-chain • Presence of ancillary industries	• Proper connectivity to road, rail, port and airport • Well co-ordinated onsite logistics network	• Single window clearance • Financial incentives	• Shared pipeline infrastructure • Clearly defined operations processes	• Suitable partnership models • Well defined responsibilities

Source: MM Analysis

The subsequent sections illustrate examples from global petrochemical hubs, highlighting instances depicting these key success factors.

Robust Ecosystem with Anchor Company

Successful petrochemical hubs across the world have been driven by a handful of large-scale investors, termed as anchor investors. Anchor investors are typically industry leaders in their respective fields.

Anchor Investment - Shanghai Chemical Industrial Park

Shanghai Chemical Industrial Park (SCIP) lies in the north coast of Hangzou Bay with a total planning area of 29.40 sq. km. Anchor investments made in SCIP are depicted in Table 39. These investors are industry leaders in their respective fields.

Table 39: Anchor Investors

Investor	Project
SECCO (JV of BP with SPC and SINOPEC)	Ethylene cracker
Bayer	Integrated Chemicals
BASF (JV with Huntsman, GPCC, SHYG)	MDI/TDI
BASF	PTHF
Lucite	MMA

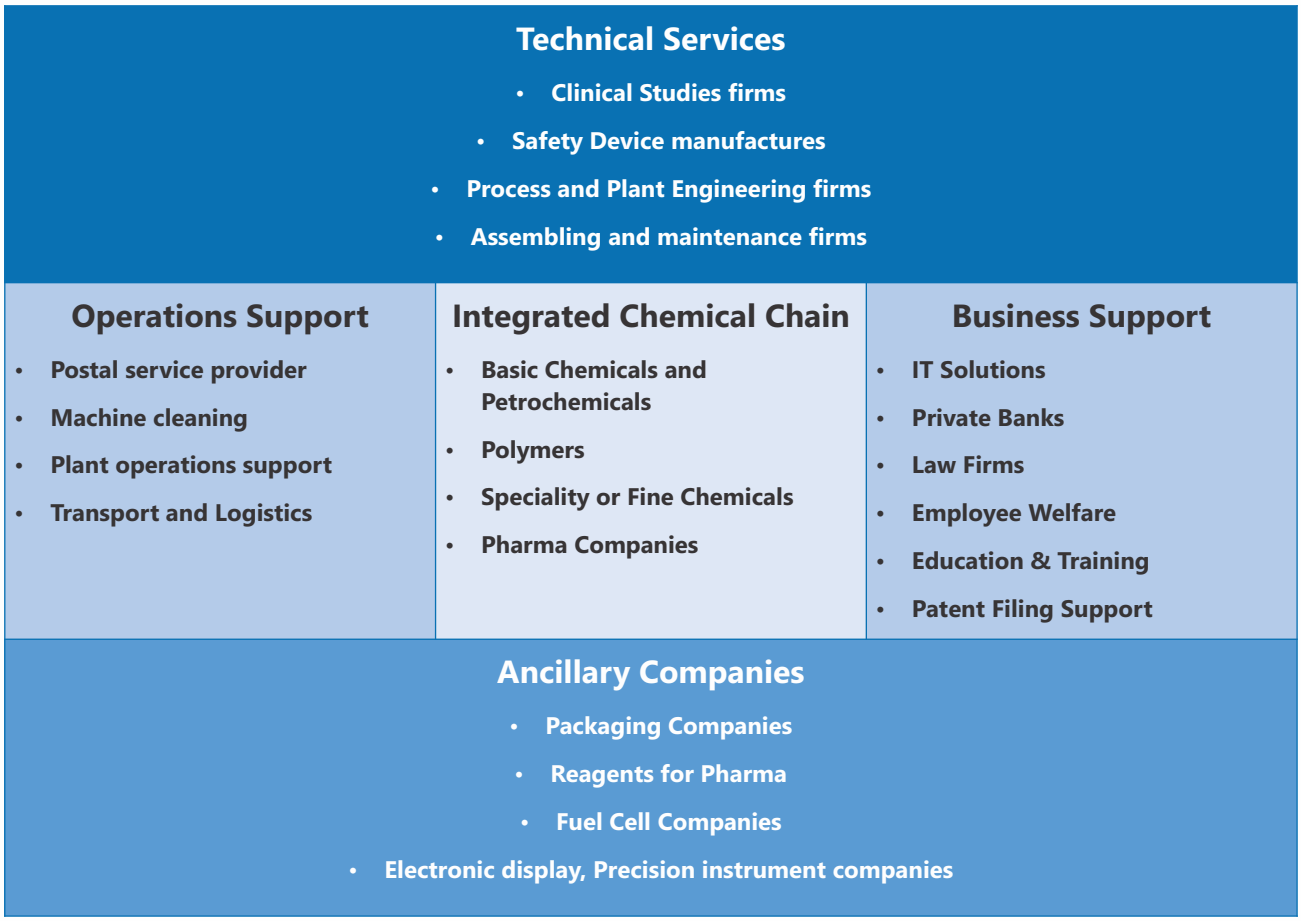
Source: SCIP Website

BP, Bayer and BASF act as anchor investors with a total initial investment of US$ 7 billon. Apart from this, investments to the tune of US$ 1.5 billion have been made in support industries and infrastructure. Anchor investors subsequently attracted investments from 5-6 large scale domestic and international players.

Integrated Chemical Value-Chain – Frankfurt Hoechst

Frankfurt Hoechst industrial park located in Frankfurt, Germany provides a robust ecosystem – integrated chemical chain, ancillary and support industries.

Figure 29: Integrated Chemical Chain at Frankfurt



Efficient Logistics Network

A high-quality logistics network is critical for efficient transportation for both incoming and outgoing material.

High quality logistics support - Frankfurt Hoechst

The Frankfurt Hoechst chemical hub has highly efficient and top-quality logistics infrastructure.

- **Tri-gateway model:** Optimal combination of road, rail and inland water transport
- **Excellent cargo handling:** The hub is capable of handling 40,000 TEUs/year
- **Loading facility for trucks and trains:** The hub provides loading facilities for trucks and a total of 6 tracks
- Storage and ware-housing

Policies, Regulations and Incentives

Policies and incentives are key drivers for any investment. Facilitation in regulatory clearances also add to investment attractiveness for any region.

Single Window Clearance - Shanghai Chemical Industrial Park

SCIP administrations centre provides single window access for all procedural requirements. Authorised by the Shanghai municipal committee SCIP admin centre liaisons with government and public bodies for clearances. It also collects income taxes on behalf of the government. It acts as a one-stop solution for all payments related to utilities and support services.

Some examples of tax rebates, incentives and subsidies support provided in successful petrochemical hubs is listed in Table 40.

Table 40: Rebates and Incentive Support

Petrochemical Hub	Tax rebate/incentives/subsidies
Antwerp	Financial Support • Support up to €100,000 for companies active in transportation • Support of up to €200,000 for start-ups • Subsidies are granted for basic industrial research and repayable loans for the development of new products and processes • SMEs receive special attention under various subsidy arrangements • Favourable tax policies such as Innovation Income Deduction • low interest rates • Capital bonuses to attract foreign investment Tax Benefits • Favourable tax policies such as Innovation Income Deduction: companies can deduct up to 85% of their net innovation income from the taxable base • Reduced tax rate for innovation income • Tax incentives for R&D activities Patent Income Deduction grandfathered • Companies are entitled to an 80% deduction of their gross patent income from the taxable base Tax exemption of regional subsidies • Subsidies granted by the Belgian Regional Institutions to support R&D are exempt from corporate tax

Petrochemical Hub	Tax rebate/incentives/subsidies
Jurong	Intellectual Property Development Incentive • Tax reduction by 5-10% after qualifying a percentage IP income Research Incentive Scheme for companies • 50% support on manpower cost • 30% support on Training cost • 30% support on licensing, royalties and technology acquisition Training grant for Company • 30% support on Training, skill development Productivity Grant • Co-funding to improve energy, water, land and labour efficiency Enterprise development Grant • up to 70% support on innovation and business capability upgradation
Houston	Texas Enterprise Fund • USD 1,000 to USD 10,000 per job creation Texas skill development Fund • Provision of job training , training cost USD 1,800 per trainee State Sales and Use Tax refund • Refund on investment for every job creation State Sales and Use Tax Exemptions • Tax exemption on machinery, equipment, natural gas and electricity Local Incentives • Property tax abatement: 50% abatement per year, upto 10 years • Goods in transit exemption • Freeport Exemption
Kaohsing	Tax Incentives • Duty free import of machinery and equipment, new materials, goods, fuel, semi products, samples and finished products • Zero commodity tax, value added tax and deed tax • Reduced business income tax (set to 10% of operating income)
Jubail	Financial Support • Land lease at low price • Loans for up to 75% support on investment • Loan repayment extension up to 20 years Tax Exemptions • Custom duty exemptions on imports of plant and machinery and raw material

State of the art Infrastructure and Clearly Defined Operating Model

Shared usage of common infrastructure facilities increases profitability of a firm.

Sharing of infrastructure - Jurong Island, Singapore

Companies on Jurong island are able to share marine facilities (jetties and berthing), waste treatment, warehousing, firefighting, medical and emergency response service, roads and drain infrastructure and service pipelines. Service pipelines are a form of common service corridor that runs around Jurong Island so that companies located at any part of the island can have easy access to the service corridor. By 'plugging in' to the service pipeline, companies can transfer raw materials, finished products and obtain utilities services seamlessly (SembCorp Utilities Terminals helps to control the flow to companies). 'Plug and play' capability is a key element of the Jurong Island's strategic advantage.

Unambiguous Ownership Structure

An important factor for success of any petrochemical hub is the ownership model under which it operates. Different type of promoters/owners include petrochemical and chemical companies, government industrial promotion bodies, infrastructure development companies and financial institutions. Some examples of ownership models that exist in successful hubs are mentioned below:

- **Public Ownership:** Kabinburi Industrial Park, Thailand.
- **Private Ownership:** Frankfurt Hoechst, Germany
- **Public Private Partnership:** WuXi Singapore Industrial Park, China

8. INVESTMENT POTENTIAL

8.1 Introduction

Investment attractiveness of a country depends on a wide variety of factors, like the state of the economy (reflected by GDP growth rate), market dynamics (demand-supply), trade scenario (import-export), policy environment, quality of infrastructure, skill and cost of manpower etc. We have benchmarked India with select South and East Asian countries (China, Thailand, Malaysia, Singapore and Indonesia hereafter referred to as "competing nations") considering the above-mentioned factors. This is depicted in Table 41 and Table 42. It should be noted that importance of these factors would vary with nature of business. All these factors may not be critical for attractiveness of a country to a particular type of business.

Table 41: Cost of Business

Sl. No.	Country	Cost of Labour (US$/hr.)	Cost of Capital (%)	Power (US$/kWh)	Corporate Tax Rate (%)
1	India	2.00	9.50%	0.08	25%
2	Malaysia	2.66	4.90%	0.06	24%
3	Indonesia	1.68	10.50%	0.10	25%
4	Singapore	24.16	5.30%	0.19	17%
5	Thailand	3.22	4.10%	0.12	20%
6	China	2.60	4.30%	0.08	25%

Source: US Bureau of Labour Statistics, World Bank (2018 data)

Table 42: Growth Rate, Infrastructure Profile and Ease of Doing Business

Country	GDP Growth Rate (%)	Infrastructure Profile (LPI Score)[1]	Ease of Doing Business[2]
India	7.0%	2.91	63
Malaysia	4.7%	3.15	12
Indonesia	5.2%	2.89	73
Singapore	3.1%	4.06	2
Thailand	4.1%	3.14	21
China	6.6%	3.75	31

Source: World Bank Data

[1]World Bank Logistics Performance Index 2018: Infrastructure score. Score is indicative of the quality of trade and transport infrastructure (ports, airports, railroads, roads and IT). Higher Logistics Performance Index score means better quality.

[2]The World Bank Doing Business 2020 report ranks countries on the basis of distance to frontier (DTF), a score that shows gap of an economy to the global best practice

Although India's GDP growth rate continues to be one of the highest in world, it lags behind competing nations in terms of quality of infrastructure, cost of business and ease of doing business.

8.2 Potential for Investment in PCPIRs

Multiple examples exist in India where industrial clusters have been successfully implemented. However, one should note that each of these clusters were much smaller than the overall area of a PCPIR (250 sq. km. or more). Development of an area of this magnitude requires longer gestation periods, and the role of the government and other key stakeholders evolve over time.

Table 43 represents the changing role of government and private players over a period of 7-10 years.

Table 43: Phase-wise Role of Government & Private Players

	Phase 1	Phase 2	Phase 3
Government	Appointment of consultants with prior experience of development of international chemical hubs for master planning	Based on the masterplan expand the PCPIR management organisation with executives trained in management of the region	Continue aggressive marketing
	Appointment of consultants for common ICT implementation	Aggressive marketing of PCPIR at international forums, with messages from top leadership	Focus on attracting investments in R&D, technology providers, plant and machinery suppliers
	Land acquisition of sizeable land parcel (preferably contiguous and not less than 10% of total notified area) in the PCPIR	Invite private participation for infrastructure development for utilities (power, water, gas), effluent treatment and disposal, port infrastructure upgradation, rail network augmentation and logistic parks	Constant engagement with the private participants, both industry and infrastructure to facilitate resolution of challenges
	Constitution of PCPIR authority and management with dedicated PCPIR responsibility, and with prior cluster management experience	Invite private participation for infrastructure development for industrial parks within the PCPIR	Facilitate the soft support infrastructure such as links between the communities, academia and industry
	Ensure development of external infrastructure till the periphery of the PCPIR	Secure sizable investments (10% of envisaged total investments)	Strengthen networks in the region by encouraging collaboration and cooperation among players in the cluster

	Phase 1	Phase 2	Phase 3
	Development of basic infrastructure (roads, drains, land development) in acquired area	Push investments by public enterprises into the region	Facilitate technical collaboration with best-in-class global chemical hubs
	Simplification of the administrative/ regulatory framework with assurance of timebound clearances. Close coordination with Ministry of Chemical and Fertilisers, Ministry of Commerce and Industries, Ministry of Petroleum and Natural Gas and Ministry of Environment, Forests and Climate Change	Establish centres of learning and excellence in consultation with the industry and build collaboration with global institutes of repute	Invite private participation for development of large-scale infrastructure such as airports, mass transport systems
		Promote technical education in the vicinity of the cluster through subsidised education at it is/ CIPET centres, to ensure steady supply of skilled personnel	Strategic alliances with developed nations should also focus on technology sharing
Private	Preparation of masterplan	Development of infrastructure in the processing area	Development of large-scale infrastructure such as airports, mass transport systems
	Preparation of common ICT platform for the PCPIRs, website with information pertaining to the economic/ industrial profile, market opportunity, legal/ regulatory framework, virtual reality walkthroughs of the region	Development of social infrastructure (residential, hospitals, hospitality, retail and other commercial) in the non-processing area up to standards which will attract talented labor pool from established chemical industries	Establishment of R&D centres by the industry
	Execution of infrastructure development activity as identified by the Government	Development of downstream industrial parks in the region	
		Development of units by the industry. Anchor tenants set up ecosystem for ancillary industries	
Timeframe	**18-24 months**	**24-36 months**	**48-60 months**
	TN	**AP/OD**	**GJ**

TN - Tamil Nadu, AP - Andhra Pradesh, OD - Odisha and GJ - Gujarat

Source: MM Analysis

The above framework is based on discussion with key industry stakeholders and maturity cycles for successful petrochemical hubs around the globe. It has been observed that an effective partnership between government and private stakeholders over the three phases results in the evolution of a developed self-reliant petrochemical cluster. Table 3 also illustrates the current level of development for each PCPIR.[3]

The sections below give an indication of potential investments for each PCPIR in terms of product and infrastructure.

Product Selection and Investment[4]

- For product selection we looked at domestic demand and import-export scenario for products under each chemical and petrochemical segment
- Current and proposed downstream industries in the hinterland of each PCPIR were also been considered while determining the investment potential
- The selected products were represented in the form of a matrix (hereafter referred to as "product selection matrix"), segregated according to four key segments: bulk chemicals, petrochemicals, speciality chemicals and feedstock
- Each of these products were then classified into two categories:
  - Strong Potential: Products which have immediate investment potential based on current downstream demand and high imports
  - Good Potential: Products with a potential for investment in the near future subject to upcoming downstream demand

Legend: Product Selection Matrix

	Strong Potential
	Good Potential

A compendium of projects mentioning the economic size of a unit for selected products along with indicative capital expenditure is detailed in Appendix B. This will give the reader an idea about the typical investment required for setting up different chemical and petrochemical manufacturing units

[3]AP – Andhra Pradesh, GJ – Gujarat, OD – Odisha, TN – Tamil Nadu

[4]Investment for TN PCPIR has been determined basis of secondary research as we did not receive any data on current status and proposed investments from the PCPIR management

Investment in Infrastructure

Proposed investment in infrastructure has been determined on the basis of discussions with PCPIR management and existing infrastructure scenario in each of the clusters.

8.2.1 Dahej PCPIR, Gujarat

The existing and upcoming downstream industries which lead to demand for chemical and petrochemical products is shown in Table 44.

Table 44: Existing and Upcoming Industries - Dahej

Existing	Upcoming
Food Processing	Electronics
Automobile and Auto-Components	
Chemicals	
Pharmaceutical and Bio-technology	
Textile and Garments	

Source: MM Analysis

The product selection matrix for Dahej is illustrated in Table 45.

Table 45: Product Selection Matrix - Dahej

Bulk Chemical	Petrochemicals	Speciality
Acetic Acid	PVC	Polyol
Carbon Black	Styrene	Linear Alkyl Benzene
Phenol	EVA	APIs
Acetone	Butyl Rubber	
Methanol	PP	

Source: MM Analysis

The potential investment in infrastructure development at Dahej PCPIR is mentioned in Table 46.

Table 46: Potential Infrastructure Investment (US$ mn) – Dahej

Particulars	Value (US$ mn)	Remarks
Area (SQKM)	453.00	
Internal Plot Development	-	
Solid Waste Management	28.57	
Power	828.57	400 KV double circuit overhead, 400/220 KV Substation 220/33 kV Grid Stati, 33 KV Distribution System, 66 Kv Sub Stations, Road Lighting Work and Area Lighting
Water Supply Sector	171.43	227 MLD, 113 MLD Effluent Disposal Pipeline 20 MGD
Effluent & Waste Water Sector (ETP/STP)	57.14	ETP - 2 Nos. 40 MLD
Drainage Sector	28.57	Drainage Plan for Road, Water harvesting structures and Internal sections
Flood Management	-	
Roads/ Transport	142.86	100-150 Km (2-4 Lane, 4-6 Lane)
Ferry	85.71	
Gas Distribution	71.43	
Chemical Storage	142.86	
Rail	57.14	
Airports	-	
Ports	914.29	Jetty Dahej- Ghogha Ro-Ro Ferry Service Jetty Handling
Logistics	-	
Total Project Cost	2,514.29	

Source: MM Analysis

8.2.2 Vishakhapatnam PCPIR, Andhra Pradesh

The existing and upcoming downstream industries which lead to demand for chemical and petrochemical products is shown in Table 47.

Table 47: Existing and Upcoming Industries - Vizag

Existing	Upcoming
Textile	Electronics
Power and Energy	Apparel city
Biotech and LifeScience	
Automotive	
Auto-Ancilliary	
polymers	
Chemicals	
Food Processing	

Source: MM Analysis

The product selection matrix for Vizag is illustrated in Table 48.

Table 48: Product Selection Matrix - Vizag

Bulk Chemicals	Petrochemicals	Speciality
Caustic Soda	MEG	Pharmaceuticals
Soda Ash	PTA	Pesticides
Aluminium Fluoride	Synthetic Fibres	Fertilizers
Methanol	PP	Flavours and Fragrances
Sodium Bicarbonate	PVC	Paints and coatings
Hydrogen Peroxide		

Source: MM Analysis

The potential investment in infrastructure development at Vizag PCPIR is mentioned in Table 49.

Table 49: Potential Infrastructure Investment (US$ mn) – Vizag

Particulars	Value (US$ mn)	Remarks
Area (SQKM)	640.00	
Internal Plot Development	-	
Solid Waste Management	157.14	229 Lakh MT to be Treated
Power	1,028.57	400 KV double circuit overhead, 400/220 KV Substation 220/33 kV Grid Station 33 KV Distribution System, 66 Kv Sub Stations Road Lighting Work and Area Lighting
Water Supply Sector	328.57	400 MLD
Effluent & Waste Water Sector (ETP/STP)	71.43	ETP - 100 MLD, STP 100 MLD
Drainage Sector	300.00	
Flood Management	-	
Roads/ Transport	757.14	426 Km road (2-4 Lane, 4-6 Lane development)
Ferry	-	
Gas Distribution	-	
Chemical Storage	-	
Rail	185.71	72 Km
Airports	485.71	2 Nos.
Ports	671.43	3 Major Ports
Logistics	100.00	
Total Project Cost	4,085.71	

8.2.3 Paradip PCPIR, Odisha

The existing and upcoming downstream industries which lead to demand for chemical and petrochemical products is shown in Table 50.

Table 50: Existing and Upcoming Industries - Paradip

Existing	Upcoming
Chemicals	Electronics
Food Processing	FMCG
Ancilliary - Metals	
Glass	
Paper	

Source: MM Analysis

The product selection matrix for Paradip is illustrated in Table 51.

Table 51: Product Selection Matrix - Paradip

Bulk Chemicals	Petrochemicals	Speciality	Feedstock
Acrylonitrile	PP	Pesticides	Ethylene
Methanol	PVC	LAB	Propylene
Ammonia	ABS	Dyes and Pigments	
	SAN	Polymer additives	
	HDPE		
	LDPE		
	PS and EPS		
	NBR		
	SBR		
	PBR		
	Styrene		
	Butadiene		
	MEG		
	PTA		

Source: MM Analysis

8.2.4 Cuddalore- Nagapattinam PCPIR, Tamil Nadu

The existing and upcoming downstream industries which lead to demand for chemical and petrochemical products is shown in Table 53.

Table 52: Potential Infrastructure Investment (US$ mn) – Paradip

Particulars	Value (US$ mn)	Remarks
Area (SQKM)	284.15	
Internal Plot Development	1,028.57	Internal Roads, Rail connectivity
Solid Waste Management	14.29	
Power	371.43	400 KV double circuit overhead, 400/220 KV Substation 220/33 kV Grid Stati 33 KV Distribution System, 66 Kv Sub Stations Road Lighting Work and Area Lighting
Water Supply Sector	257.14	537 MLD Water requirement WTP-1=141 MLD WTP-2 =134 MLD
Effluent & Waste Water Sector (ETP/STP)	200.00	4 CETPs of total 137 MLD Capacity & 4STPsoftotal 178MLDcapacity
Drainage Sector	185.71	Drainage Plan for Road, Water harvesting structures and Internal sections
Flood Management	200.00	
Roads/ Transport	728.57	For around 400 Km road length (2-4 Lane, 4-6 Lane development)
Ferry	-	
Gas Distribution	-	
Chemical Storage	-	
Rail	-	
Airports	42.86	1 Nos.
Ports	-	
Logistics	257.14	
Total Project Cost	3,300.00	

Source: MM Analysis

Table 53: Existing and Upcoming Industries - Cuddalore

Existing	Upcoming
Automotive	Electronics
Auto Components	
Aerospace	
Pharmaceuticals	
Textile	
Electronics	
Chemicals	
Polymers	
FMCG	

Source: MM Analysis

The product selection matrix for Cuddalore is illustrated in Table 54.

Table 54: Product Selection Matrix - Cuddalore

Bulk Chemicals	Petrochemicals	Speciality
Caustic Soda	PP	APIs
Soda Ash	ABS	Dyes and Pigments
Carbon Black	SAN	Pesticides
	Butyl Rubber	
	Styrene	
	PS and EPS	
	PVC	

Source: MM Analysis

The potential investment in infrastructure development at Cuddalore PCPIR is mentioned in Table 55.

Table 55: Potential Infrastructure Investment (US$ mn) – Cuddalore

Particulars	Value (US$ mn)	Remarks
Area (SQKM)	256.83	
Internal Plot Development	285.71	Upgradation of Internal roads
Solid Waste Management	57.14	For Tentative TSDF for hazardous waste - 1 MMT capacity
Power	657.14	400 KV double circuit overhead, 400/220 KV Substation 220/33 KV Grid Stati 33 KV Distribution System, 66 KV Sub Stations Road Lighting Work and Area Lighting
Water Supply Sector	214.29	WTP - 200 MLD
Effluent & Waste Water Sector (ETP/STP)	100.00	ETP - 100 MLD, STP 100 MLD
Drainage Sector	142.86	Drainage Plan for Road, Water harvesting structures and Internal sections
Flood Management	57.14	
Roads/ Transport	457.14	For around 300 Km road length (2-4 Lane, 4-6 Lane development)
Ferry	28.57	
Gas Distribution	28.57	
Chemical Storage	42.86	
Rail	71.43	30 Km
Airports	142.86	1-2 Nos.
Ports	485.71	Jetty Handling
Logistics	100.00	
Total Project Cost	2,857.14	

Source: MM Analysis

9. RECOMMENDATIONS

Government support

- **Dedicated management:** Appointment of full-time management board with CEOs heading each PCPIR and dedicated managerial/ technical teams to oversee the establishment and functioning, with government grant for functioning. At least one board member shall have prior experience of global chemical/ petrochemical clusters
- **Single window fast-track clearance:** Implementation of single window clearance in Odisha, Tamil Nadu and Gujarat for approvals/ clearances would speed up the process of newer establishments and development in the PCPIRs
- **Reduction in clearance timelines:** Timeline for EIA approval needs to be defined within a period of one month, as delays in approvals impede investments
- **Environment clearance:** EC shall be sought for the entire PCPIR (eg. Dahej PCPIR), so that industries need clearance only from the state/ local bodies and not from the MoEF&CC
- **Subsidy on land:** High cost of land (approx. US$ 40/ sqm) is one of the key factors obstructing newer investments in PCPIR regions. However large-scale investments have been attracted to various other parts of the country, where cheap land is available. The government may consider providing industrial land at subsidised rates to attract investors to these regions.
- **Incentives on electricity:** Electricity supplies to industries in PCPIR regions can be made at reduced taxes/ duties and, capital subsidies and/or simplified net-metering/ gross metering policy for solar power
- **Financial support:** Timely release of funds for infrastructure development (such as VGF)
- **Incentives and exemptions:** Tax incentives similar to those applicable in SEZs may be given in PCPIRs for a limited timeframe (10 years)
- **Extension in corporate tax relaxation timelines:** Since large investments in the chemicals and petrochemicals industry have long implementation periods (typically 5-7 years), the revised corporate tax scheme (proposing reduction to 17.25%), for new investments in PCPIRs may be extended.
- **Exemption from DDT:** New Exemption from dividend distribution tax for a period of 10 years may be considered for investments in chemical, petrochemical and allied industries in the PCPIR region.

Feedstock

- **Incentives and exemptions:** Availability of feedstock remains an issue, with anchor tenants not in a position to provide feedstock for downstream; hence incentives such as land subsidy, tax exemptions can be given for investments in anchor unit
- **Reserving feedstock:** Anchor units shall be contracted for mandatory supply of 20-30% of their production within the PCPIR region
- **Investment in alternate feedstock:** To meet the increasing demand for feedstock, opportunities in alternate feedstocks such as Ethane, PDH, CTO/ MTO should also be explored. Adoption of these technologies need promotion from government in terms of adequate fund assistance for research and development
- **Cracker investments:** Efforts need to be made by central and state government to attract cracker investments into existing/ proposed PCPIRs to be able to establish linkages across the petrochemical chain. Joint venture route with PSUs and private participation may be considered
- **Multiple anchor engagement:** Concept of multiple anchor units within a PCPIR can be considered. This would not only eliminate dependency of large number of industries on a single anchor tenant, but also facilitate operations of number of smaller integrated clusters within the PCPIR

Trade

- Revision in Custom duty:
  - Custom duty on high value products with significant imports, such as polymers and their downstream products should be increased to 10% from current 7.5%. This would help shift country's dependency from imports to domestic production
  - Custom duty on import of synthetic fibres should be raised from 5% to 10%. This would help curb increasing imports into the country and protect interest of domestic manufacturers
  - Custom duty on basic products and feedstock such as Naphtha, Styrene, VCM, Methanol, Polyvinyl Monomer should be reduced to zero. As this would improve accessibility to raw material and enable industry to produce value added chemicals and petrochemicals products from basic products
- Evaluation of the impact of FTAs and tariff rationalization: FTAs need to be carefully evaluated for tariff rationalization as trade largely affects the need for domestic petrochemical production. Cheaper imports may suppress the growth of domestic petrochemical industry
- Revision in antidumping/ safeguard duty: Antidumping and safeguard duties need to be revised time to time as per the current price standards for them to serve their purpose of protecting interest of domestic manufactures

Enabling Infrastructure:

- **Masterplan incorporating best international practices:** The master plan framework should be developed benchmarking with sustainable, legal, strategical and social standards adopted by various successful petrochemical hubs across the globe
- **Expert support:** Inputs from industry experts while developing the master plan shall help in placing the industries and facilities effectively such that it would increase operating efficiency, minimize logistic and transportation costs and also help in better utilisation of infrastructure
- **Basic infrastructure:** Basic infrastructure projects such as roads/ highways and utilities need to be accorded top priority, in order to make the PCPIRs investment-worthy destinations. This can be done by appointing private or state-owned developers for each region for infrastructure development and provision of facilities
- **Feedstock storage:** Feedstock import storage facilities need to be developed to provide feedstock reserves and to ensure uninterrupted feed supplies in the region
- **Pipeline infrastructure:** Dedicated pipeline infrastructure needs to be in place to ensure uninterrupted gas supply for operation of cracker units
- **Upgradation of port infrastructure:** There is need for upgradation of port infrastructure in Paradip and Vizag as sourcing crude directly at the eastern coast can pave way to establishment and development of industrial hubs in the region. Also, it would be economical over the existing practice of crude transportation from western coast via pipelines or road for use by industries
- **Co-siting and sharing:**
  - Provision for shared utilities will enable minimisation of cost of operations, and utilities can be used effectively by all the stakeholders
  - Contractor-Sub contractor models should be conceived with reference to models developed by Thailand and Vietnam
- **Service providers:** State government can put up these facilities through third parties or the entire utility blocks can be given to third parties to invest in the facilities and then operate the facilities. Jurong has utilised the same model, a third party has invested in these facilities and they operate and supply. Multiple service providers within the PCPIRs shall ensure competitive price
- **Social infrastructure:** Investment in development of social infrastructure is essential to attract and retain talent in PCPIRs. World-class townships are necessary to attract expatriates with niche skill sets to the regions

Investments

- Downstream SMEs: Apart from larger investments, small and micro industries (with land requirement of around 1-2 acre) such as formulating companies, plastic processing industries can be potential investors in PCPIRs (with infrastructure development in process, such as Paradip and Visakhapatnam), as they have minimum requirement for ETP and allied facilities
- **Broadening of scope for investments:** PCPIRs should encourage investments by allied industries (such as home care, textiles) in addition to investment by core chemical and petrochemical industries
- **Power infrastructure development:** Investment in power infrastructure in Paradip will be crucial to cater to the steam and power requirement by various small and medium units in the region

Foreign Investments:

- **Dedicated body:** Dedicated arm within the PCPIR team shall be responsible for scouting global investment.
- **Promotion:** Marketing efforts should be made to showcase investment potential of PCPIRs to global investors. This can be done by active participation in fairs, workshops and exhibitions held at international level and advocacy by the country's senior leadership. Houston presents a remarkable example of development via private agencies, where private agencies are hired by government for development and promotion of industrial regions
- **Global standards:** Adopting frameworks such as Eco-Industrial Parks[5] will give the PCPIRs an edge over other investments destinations

[5]An international framework for Eco-Industrial Parks, The World Bank Group

APPENDIX A

Table 56: CAPEX Estimations

Product	CAPEX (US$ Million)	Capacity (KTPA)	Building (US$ Million)	P&M (US$ Million)	MFA (US$ Million)	Prelim expenses (US$ Million)
Titanium dioxide	100	400	10	60	1	6
Cumene	50	139	5	50	4	4
Phenol/Acetone	200	171	20	150	15	12
Bisophenol-A	250	127	25	210	20	20
Polycarbonate	410	141	40	350	30	30
Propylene Glycol	150	53	15	130	12	11
Polyol	165	69	20	140	13	12
Epichlorohydrin	150	82	15	130	12	10
Carbon Black	15	12	1	10	1	1
Caustic Soda	180	99	44	110	1	4
Urea Fertilizer	1200	1270	120	900	84	96
Caustic Soda	100	119	12	0	2	1
Auto-Components (Injection Moulding Facility)	12	-	6	1	0.10	1
Polyester chips	6	35	1	4	0	0
PVC	86	170	8.57	64.27	5.99	6.85
MEG	536	357	53.6	402	37.52	42.88
LAB	41	42	4.1	30.75	2.87	3.28
SAN	20	34	2	15	1.4	1.6
Butyl Rubber	2000	120	200	1500	140	160
Epichlorohydrin	39	50	3.9	29.25	2.73	3.12
ABS	19	44	1.85	13.875	1.29	1.48
Acetic Acid	759	61	75.85	568.92	53.09	60.68

Product	CAPEX (US$ Million)	Capacity (KTPA)	Building (US$ Million)	P&M (US$ Million)	MFA (US$ Million)	Prelim expenses (US$ Million)
Polypropylene	450	680	45	337.5	31.5	36
Fertilizers (IPA)	160	100	16	120	11.2	12.8
Chloromethane (API - Pharmaceutical)	24	80	2.4	18	1.68	1.92
Polyurethane	828	500	82.8	621	57.96	66.24
Soda ash	149	11300	14.88	111.6	10.41	11.90
Sodium Bicarbonate	12	33000	1	9	1	0.96
Methanol	15	33	2	11.25	1	1.2
Aluminium Fluoride	77	30	8	57.75	5	6.16
Hydrogen Peroxide	10	30	1	7.5	1	0.8
Polystyrene	11	33	1	8.25	1	0.88
Expanded Polystyrene	12	33	1	9	1	0.96
Styrene Butadiene Rubber (SBR)	10	33	1	7.5	0.7	0.8
Poly Butadiene Rubber (PBR)	10	33	1	7.5	0.7	0.8
Dual feed cracker	4500	1100	450	3375	315	360
CPC Green and CPC Blue (Dyes and pigments)	12.14	4	1.21	9.10	0.84	0.97
Ammonia (Pesticides)	540	1600	54	405	37.8	43.2
Flavours and Fragrances (IFF Plant)	72	3600000	7.2	54	5.04	5.76
Decorative paint (Paints and coatings)	255	500,000 Kilo Litre	25.5	191.25	17.85	20.4

Source: MM Estimates

GLOSSARY

Table 57: Glossary

Abbreviations	Description
ABS	Acrylonitrile butadiene styrene
APIIC	Andhra Pradesh Industrial Infrastructure Corporation Ltd
ARRRA	Antwerp-Rotterdam-Rhine-Ruhr Area
ASEAN	Association of Southeast Asian Nations
CAGR	Compound Annual Growth Rate
CCEA	Cabinet Committee on Economic Affairs
CEPT	Common effluent treatment plant
CRZ	Coastal Region Zone
DMIC	Delhi–Mumbai Industrial Corridor
EIA	Environmental impact Assessment
FMCG	Fast Moving Consumer Goods
FY	Financial year
JNPC	Jawaharlal Nehru Pharma city
GIDC	Gujarat Industrial Development Corporation
GPCPSIR	Gujarat Petroleum, Chemical and Petrochemical Special Investment Region
GOI	Government of India
GSPC	Gujarat State Petroleum Corporation Ltd
HDPE	High-density polyethylene
HSE	Health, Safety & Environment
IDCO	Odisha Industrial Infrastructure Development Corporation
IFFCO	Indian Farmers Fertiliser Cooperative Indian Farmers Fertiliser Cooperative Limited

Abbreviations	Description
IOCL	Indian Oil Corporation Limited
ITI	Industrial Training Institute
IIOT	Industrial Internet-of-Things
KV	Kilo Volt
LAB	Linear Alkyl Benzene
LDPE	Low-density polyethylene
LPG	Liquefied petroleum gas
MEG	Mono Ethylene Glycol
MGD	Million gallons per day
MLD	Millions of litre per day
MM	Mott MacDonald
MMSCMD	Million Metric Standard Cubic Meter per Day
MMTPA	Million metric ton per annum
NCLT	National Company Law Tribunal
NH	National Highway
NTPC	National Thermal Power Corporation Limited
NBR	Nitrile rubber
OPaL	ONGC Petro additions Limited
OPEC	Organization of the Petroleum Exporting Countries
PBR	Poly Butadiene Rubber
PDH	Propane Dehydrogenation
PCPIR	Petroleum, chemical and petrochemical investment region
PFY	Polyester Filament Yarn
PGR	Plant Growth Regulation
PTA	Purified terephthalic acid

Abbreviations	Description
PP	Polypropylene
PPP	Public Private Partnership
PPEC	Plastics Product Evaluation Centre
PSF	Polyester Staple Fibre
PVC	Poly Vinyl Chloride
RDA	Regional Development Authority
TMT	Thousand Metric Ton
SABIC	Saudi Arabia - Al-Jubail - Saudi Basic Industries Corporation
SBR	Styrene Butadiene Rubber
SDA	Special Development Authority
SCIP	Shanghai Chemical Industrial Park
SEZ	Special Economic Zone
SH	State Highway
US	United States
VCIC	Vizag-Chennai Industrial Corridor
VK PCPIR	Visakhapatnam PCPIR
VRMP	Visakh Refinery Modernization Project

Authors of the Report

Sayan Shom
Lead Project Manager - Advisory India
Mott Macdonald, Lead Project Manager - Advisory India
Tel: +91-120 460 8221
E: sayan.shom@mottmac.com

Abhimanyu Mazumdar
Consultant, Advisory India,
Mott MacDoanld
Tel: +91-120 460 8127
E: abhimanyu.mazumdar@mottmac.com

Saumak Mitra
Assistant Director
Chemicals and Petrochemicals
FICCI Federation House,
1 Tansen Marg, New Delhi -110001
Tel: +91-11-2348 7473
E: saumak.mitra@ficci.com

Samidha Hasija
Research Associate
FICCI Federation House,
1 Tansen Marg, New Delhi -110001
Tel: +91-11-2348 7473
E: samidha.hasija@ficci.com

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Nachiket Basole, Senior Assistant Director
Mob.: +91-9867312834 / +91-9833312834
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Our engineers, project and programme managers have taken lead roles in the world's highest profile infrastructure and development projects. With Mott MacDonald, the advantages of size and stability that come from a US$2bn organisation are realised. Mott MacDonald employs over 16,000 people, delivering projects in Africa, Asia Pacific and Australasia, Europe, the Middle East, North and South America, and South Asia – 150 countries in all.

Being employee-owned Mott MacDonald is free to choose its engagements and focus on the issues that are important to its clients. Mott MacDonald insists on the highest standards of integrity. Mott MacDonald was the first consultancy firm to be certified to BS 10500, the UK's anti-bribery management standard, recognised as the most stringent in the world

FICCI

About FICCI

Established 90 years ago, FICCI is the largest and oldest apex business organization in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies.

A non-government, not-for-profit organization, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concerns of industry, reaching out to over 2,50,000 companies. FICCI serves its members from large (domestic and global companies) and MSME sectors as well as the public sector, drawing its strength from diverse regional chambers of commerce and industry.

The Chamber with its presence in 14 states and 10 countries provides a platform for networking and consensus-building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

FICCI

Industry's Voice for Policy Change