

Republic of India

Republic of India
Preparatory Survey on Raw Material Production
Business for Semiconductor Material Polyimide in
India (Overseas Investments and Loans) Phase 1
(Private Sector Investment Finance)
Final Report

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Japan International Cooperation Agency

Sojitz Corporation

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Table of Abbreviation

Abbreviations	Definition
BEIL	Bharuch Enviro Infrastructure Ltd
BOCW	Building and Other Construction Workers
CAPEX	Capital Expenditure
CHWTSDF	Common Hazardous Waste Treatment, Storage, and Disposal Facility
CONCOR	Container Corporation of India Ltd.
CTE	Consent to Establish
CTO	Consent to Operate
DCR	Development Control Regulations
DISH	Directorate of Industrial Safety & Health
EIA	Environmental Impact Assessment
FETP	Final Effluent Treatment Plants
GETCO	Gujarat Energy Transmission Corporation Limited
GGCL	Gujarat Gas Company Limited
GIDC	Gujarat Industrial Development Corporation
GPCB	Gujarat Pollution Control Board
GSPL	Gujarat State Petroleum Limited
ISBL	In Side Battery Limit
JIA	Jhagadia Industrial Association
MCC	Motor Control Center
MoEF	Ministry of Environmental and Forest
MSDS	Material Safety Data Sheet
NCT	Narmada Clean Tech
NOC	No Objection Certification
OPEX	Operating Expenditure
OSBL	Out Side Battery Limit
PCPIR	Petroleum, Chemicals and Petrochemicals Investment Region
PESCO	Petroleum and Explosives Safety Organization
SEIAA	State Environment Impact Assessment Authority
SHDP	State Highway Development Program
TIC	Total Installed Cost
TSDF	Treatment, Storage, and Disposal Facility

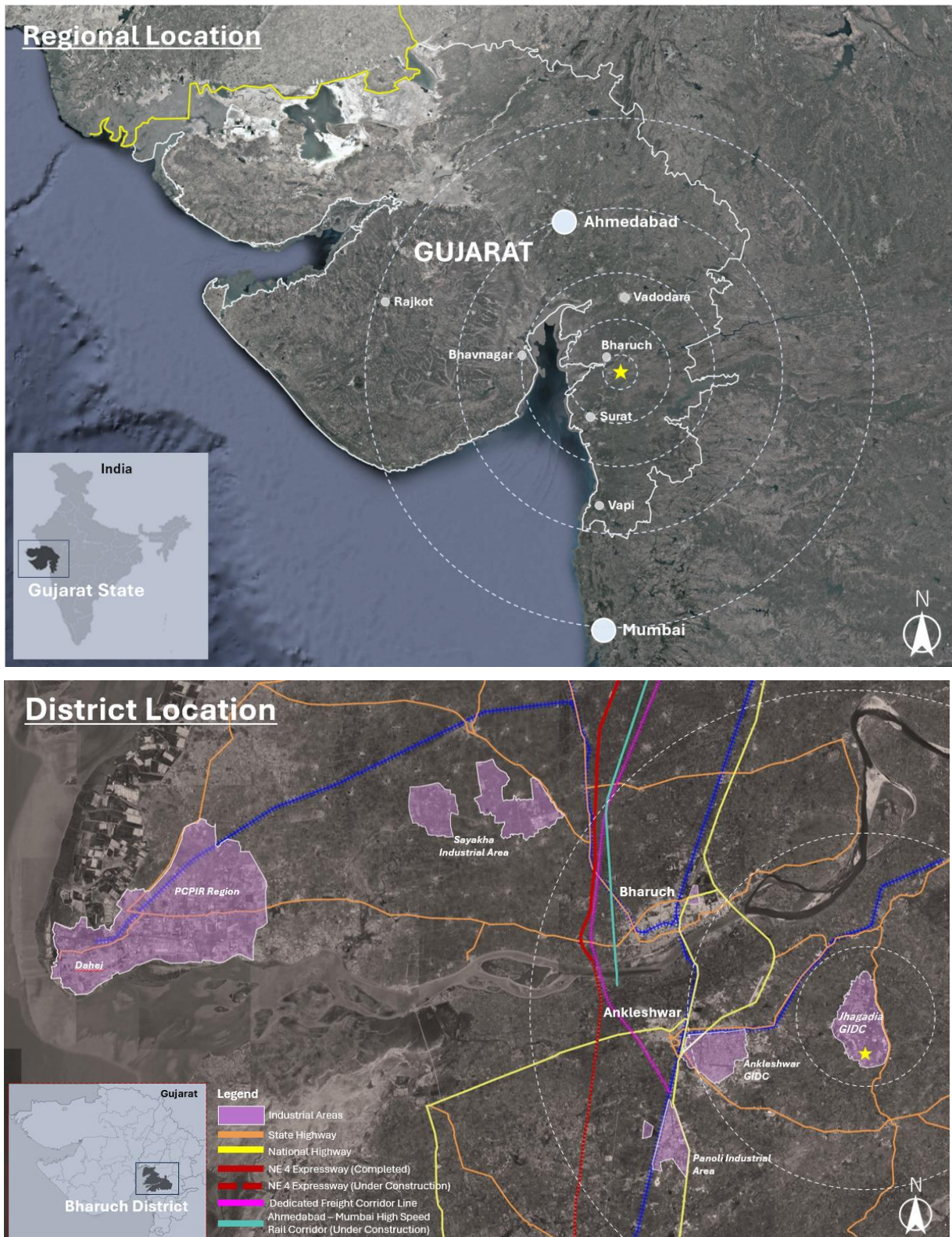
Abbreviations	Definition
ZLD	Zero Liquid Discharge

Currency rate in September 2024

1 INR= 1.72609 JPY,	1 JPY = 0.5793 INR
1 USD = 144.811 JPY,	1 JPY = 0.0069 USD
1 USD = 83.895 INR,	1 INR = 0.0119 USD

Source: JICA Website: JICA Settlement Rate

Project Location Map



Source: Edited by the Study Team based on Google Map

Summary

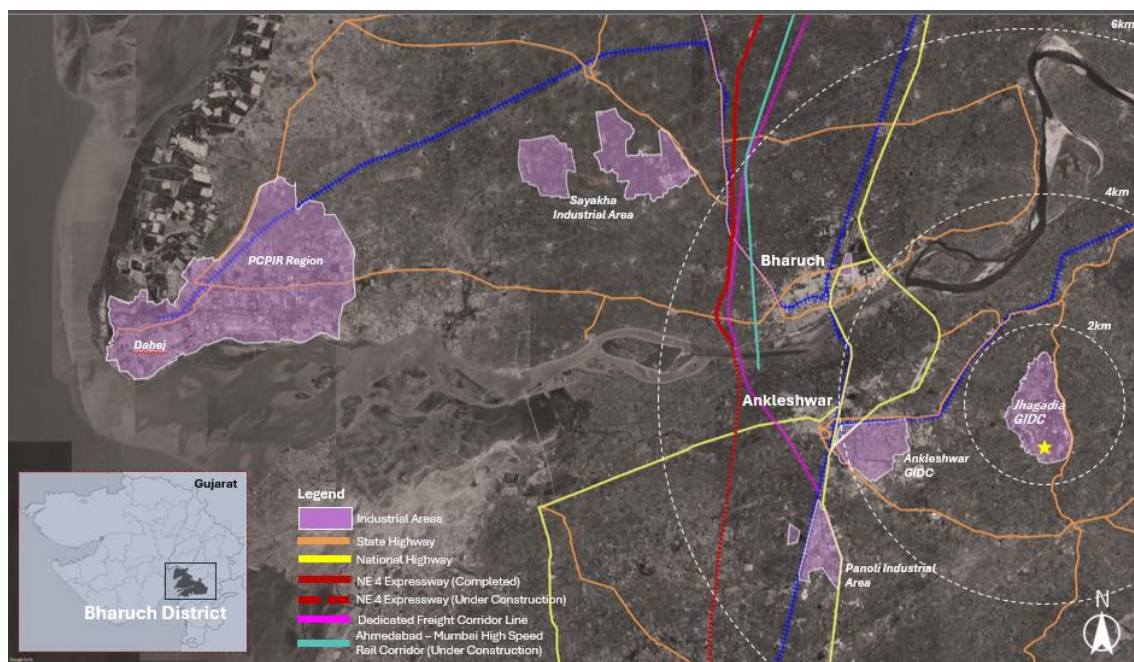
Chapter 1 Background of Study

1.1 Background of the Proposed Business

With the advancement of 5G/6G communication, ADAS, autonomous driving, and smart cities, semiconductor development is expected to progress, leading to an increase in the demand for semiconductor materials, including polyimide. A partner of Sojitz, has established manufacturing technology for polyimide raw materials and produces chemical products at its facility in Jhagadia, India, also supplying to Japan. This study aims to examine the necessary prerequisites for launching a polyimide monomer manufacturing business in India.

1.2 Study Area

The study area is the industrial city of Jhagadia, located in the southern part of the Bharuch district in Gujarat, India.



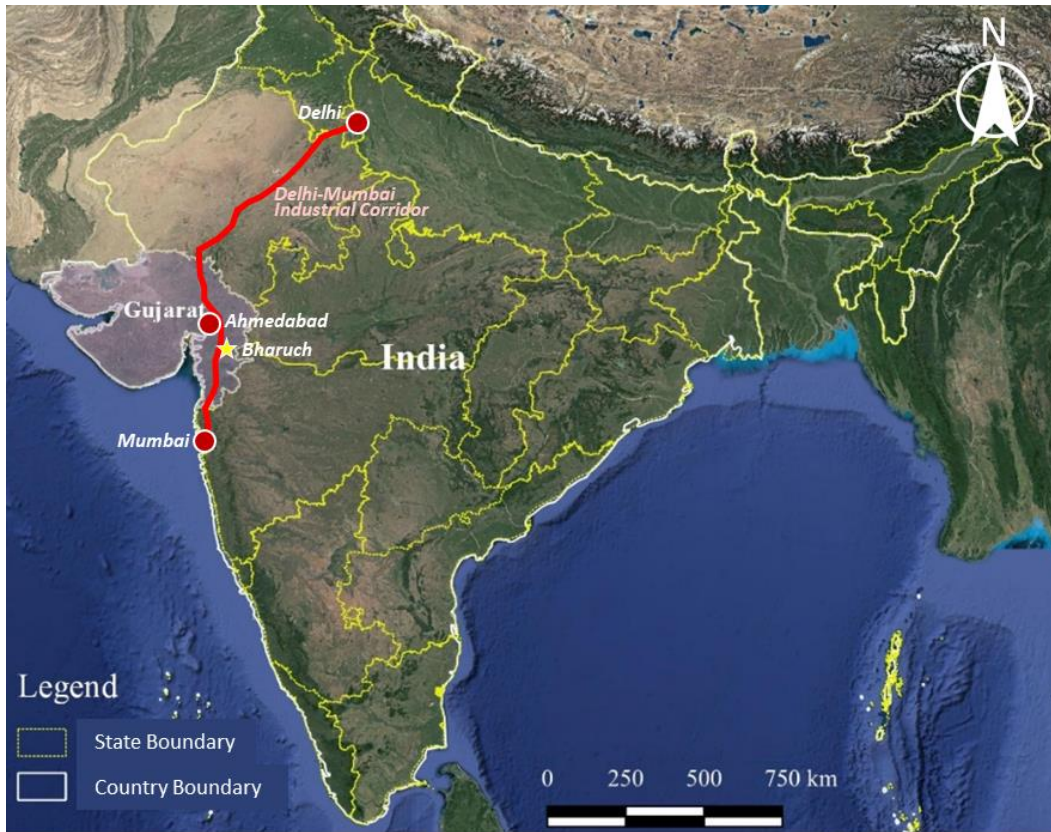
Source: Study Team

Figure 1 Regional and District Location of the Project Site

Chapter 2 Overview of the Bharuch District, Gujarat

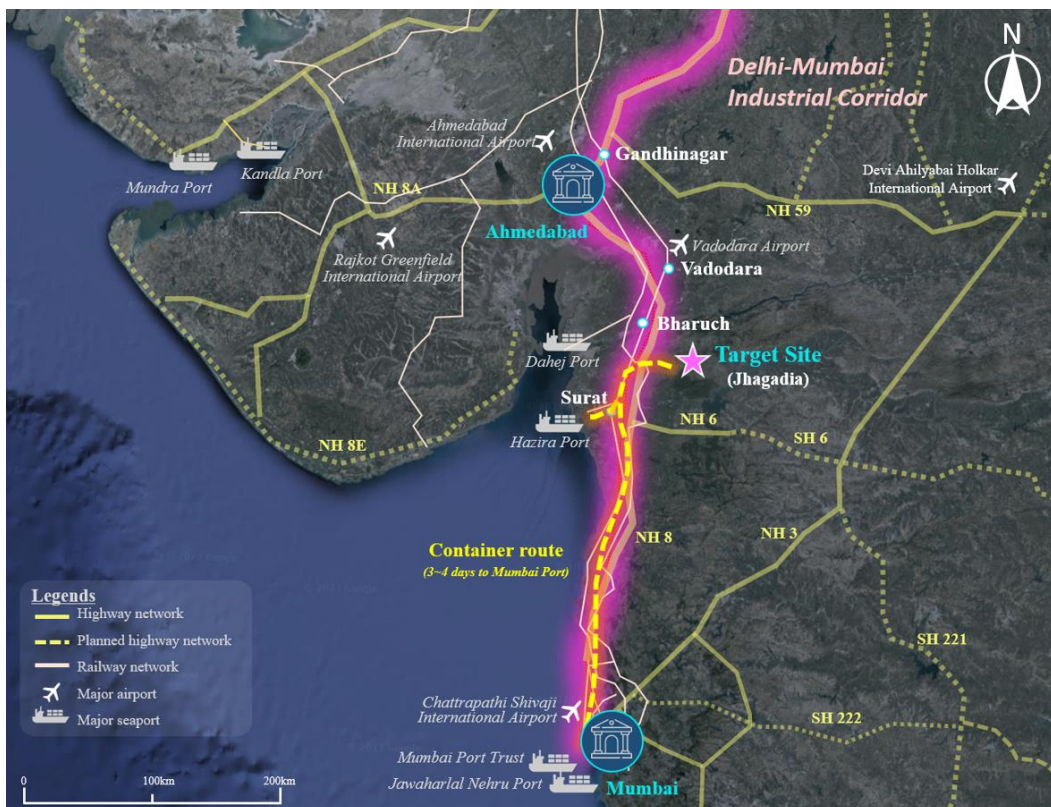
2.1 Gujarat State and the Logistics Infrastructure in the State

Gujarat is located in the northwest of India, with a 1,600 km coastline, and forms an important part of the Delhi-Mumbai Industrial Corridor (DMIC). The region has well-developed logistics infrastructure, including 42 ports, 17 domestic airports, 3 international airports, and over 100,000 km of road and rail networks, facilitating active trade both within and outside the region.



Source: Study Team

Figure 2 Location of Gujarat State in India



Source: Study Team

Figure 3 Overview of Regional Logistic Development

2.2 Industrial Development in Bharuch District, Gujarat

The Gujarat Industrial Development Corporation (GIDC) was established in 1962 and operates 168 industrial estates, with 106 estates currently under development. The state government has established SEZs in Kandla and Surat, a software technology park in Gandhinagar, an apparel park in Surat, and is developing a petrochemical complex in Dahej. GIDC contributes to industrial growth by providing land and infrastructure support. The Jhagadia Industrial Association (JIA) supports local businesses and collaborates with GIDC to promote industrial growth.

Chapter 3 Economic Condition and Market Analysis of India

3.1 Economic condition of India

According to the IMF, the GDP growth forecast for India is 7.0% in 2024, 6.5% in 2025, and 6.5% in 2026. In 2024, although net exports contributed negatively, growth was driven by increases in personal consumption and investment. From 2025 to 2026, the growth rate is expected to slow down as the demand recovery from Covid-19 levels off. On the other hand, despite facing temporary slowdowns and inflation challenges, the Indian economy is expected to accelerate its growth in the future due to increases in agricultural production and the recovery of government capital investment.

Chapter 4 Development of Jhagadia GIDC Industrial Estate

4.1 Development Status of the Industrial Estate

The Jhagadia GIDC Industrial Estate was developed by the Gujarat Industrial Development Corporation (GIDC) in 1993 and is part of one of India's largest industrial clusters, covering an area of 1,700 hectares. The study area is approximately 40 ha.

4.2 Infrastructure Development within the Industrial Estate

The main access route to the Jhagadia GIDC Industrial Estate is State Highway 165, connecting the eastern main gate and Jhagadia city, with heavy use by large trucks. The stormwater drainage system includes open drains and greenbelts, and during the site survey, puddles were observed, likely due to inadequate road maintenance.

Electricity supply is provided by two GETCO substations, with DGVCL supplying 11kV to the businesses within the estate. Water is sourced from the Narmada River at Rundh Village, about 30 km away, and is currently providing 65 MLD. An increase in treatment capacity to 120 MLD is proposed for the future.

Details of the utility connections for Target area are summarized in the table below based on the interviews.

Table 1 Details of Utility Connection to Target area

Items	Details of Utility Connection
Water Supply	<ul style="list-style-type: none"> Partner has obtained approval from GIDC for a water supply of 2,023 KLD. The necessary supply line and connection from the nearby water tank to Target area have been fully established. If Partner's water requirements exceed the approved amount, they must apply for an additional water supply permit and cover the cost of constructing the required connection to the water tank.

Power Supply	<ul style="list-style-type: none"> A dedicated 66 kV power transmission line from the GETCO substation is connected to serve Target area.
Gas Supply	<ul style="list-style-type: none"> A gas pipeline from GGSL is laid beneath the northern underground road of Target area and is planned to be connected to the zone.
Wastewater Treatment	<ul style="list-style-type: none"> Treated wastewater, after undergoing primary and secondary treatment at the onsite plant, will be connected via the GIDC pipeline to NCT's FETP.
Solid Waste Disposal	<ul style="list-style-type: none"> Waste produced will be transported to BEIL's disposal facilities by truck, with real-time monitoring via GPS.

Source: Study Team

Chapter 5 Production Plant Development in Target area

5.1 Summary of Operations and Management Characteristics

Target site is being developed for the manufacturing of new chemical products and is characterized by the following features:

Table 2 Summary of Operation and Management Characteristics

Main Characteristics	Details
Land Development and Earthwork	The earthwork balance within Target area is being managed effectively by utilizing excavated soil from foundation construction in each block as fill material for other areas within Target area.
Management by common facility	To systematically carry out production, shared facilities such as product storage tanks, Motor Control Center (MCC), electrical rooms, etc. are utilized.
Utility supply	<ol style="list-style-type: none"> Water Supply: Water is received from a single connection point within the GIDC water network. A flow meter is installed at the connection point to monitor the water supply. Power Supply: Three transformers (66kV/11kV) and electrical panels are planned within Target area. Power will be received via a 66kV cable from the substation located at the southwest of the site (110kV/66kV). Heat Supply: The boiler, which serves as the heat source, is a multi-fuel type, with gas being the primary fuel. Additional fuels, such as coal and biomass briquettes, are also expected to be used.
Transfer of material and utility	<ol style="list-style-type: none"> Overhead Pipe Rack: To ensure that ongoing construction activities do not interfere with the production processes of individual plants, overhead pipe racks are pre-installed. These racks facilitate smooth execution of future modifications, such as the addition of new pipelines. Above-Ground Fire Hydrant: The fire hydrant system is installed as an independent network, separate from the pipe rack system. The water storage tank for the fire hydrant system is also maintained independently from the potable water tank system.
Discharge of wastewater and stormwater	<ol style="list-style-type: none"> Effluent Treatment Plant (ETP): The types of industrial wastewater generated within Target area are clearly identified, enabling efficient operation of a shared ETP system. Sewage Treatment Plant (STP): Domestic wastewater is directed to the STP for appropriate treatment. Stormwater: Three reservoirs are planned within the zone. These will collect rainwater, which will be discharged into surrounding waterways after quality confirmation. Thus, Zero Liquid Discharge (ZLD) Policy does not apply.

Source: Study Team

Chapter 6 Market Analysis of Products

6.1 Polyimide (PI) Market

Polyimide (PI) is a polymer synthesized by polymerizing diamine and acid anhydride. It is used as varnish or film in electronic materials (such as smartphones and liquid crystals) and gas separation membranes. The demand for PI varnish in 2023 is 25,300 MT/year, and it is projected to grow at an annual rate of approximately 3% over the next five years, reaching 29,600 MT/year by 2028. About 70% of PI varnish is processed into film, while the remaining 30% is used as varnish. Varnish (excluding that used for film) is utilized in liquid crystal alignment films and OLEDs.

The demand for PI film in 2023 is 9,000 MT/year, and it is projected to grow at an annual rate of approximately 4% over the next five years, reaching 10,880 MT/year by 2028. (Note that the quantities of varnish and film do not match because the varnish quantity includes the solvent.) The film is used in applications such as graphite sheets and coverlay films.

Chapter 7 Technical Verification

7.1 Scale-Up Production by pilot plant

During the investigation period, scale-up production, which had been prototyped at the laboratory level, was carried out using a pilot plant. A key challenge during the scale-up was the stable management of metal content in the product. To promote technological improvements related to metal management, a Japanese precision chemical manufacturer, was appointed as a technical consultant.

Out of a total of 14 batches produced, 3 batches met the specifications. For the batches that did not meet the specifications, the metal content exceeded the customer's standard values, and the product color, which should be transparent according to the specifications, was slightly yellowish. These issues require further improvement.

Chapter 8 Business Plan

8.1 Verification of Business feasibility

Profitability is expected at the market price at the start of this business consideration, but at the current market price, the net profit for the current period is negative, indicating that profitability is not expected.

Chapter 9 Environmental and Social Considerations

9.1 Overview of Environmental and Social Considerations

This project falls under Schedule 5(f), Category "B" as per the 2006 EIA Notification and its amendments in India. The project obtained the Terms of Reference (ToR) from the Gujarat SEIAA through letter No. SIA/GJ/136909/2020 dated September 3, 2020. Additionally, based on the screening under the 2022 JICA Guidelines for Environmental and Social Considerations, this project is classified as Category B.

9.2 Consideration of Alternatives

Since the project is located within the GIDC industrial estate and benefits from its advantageous infrastructure (such as water and electricity supply, transportation access, and port facilities), alternative locations were not considered.

9.3 Scoping, Impact Assessment, and Mitigation Measures

Scoping was conducted through on-site interviews and the Environmental Impact Assessment (EIA). The EIA specifies the impact assessment and mitigation measures for this project. A detailed matrix is provided in the main text.

9.4 Monitoring Plan

Partner is required to establish a monitoring plan that includes third-party environmental monitoring (on a monthly/quarterly basis) for HCl, chlorine, HF, HBr, sulfur dioxide, nitrogen oxides, groundwater quality, and noise levels. Additionally, partner must submit semi-annual Environmental Clearance Condition Compliance Report on compliance with environmental permit conditions.

9.5 Implementation Framework

The project has already obtained Environmental Clearance (EC). The currently operating plant has secured both the Consent to Establish (CTE) and Consent to Operate (CTO) from the Gujarat Pollution Control Board (GPCB).

9.6 Consultations with Local Stakeholders

Since the project is located within an industrial estate, no special consultations are required.

9.7 Grievance Redress Mechanism

The existing partner facility has an established grievance redress process, which will also be applied to this project.

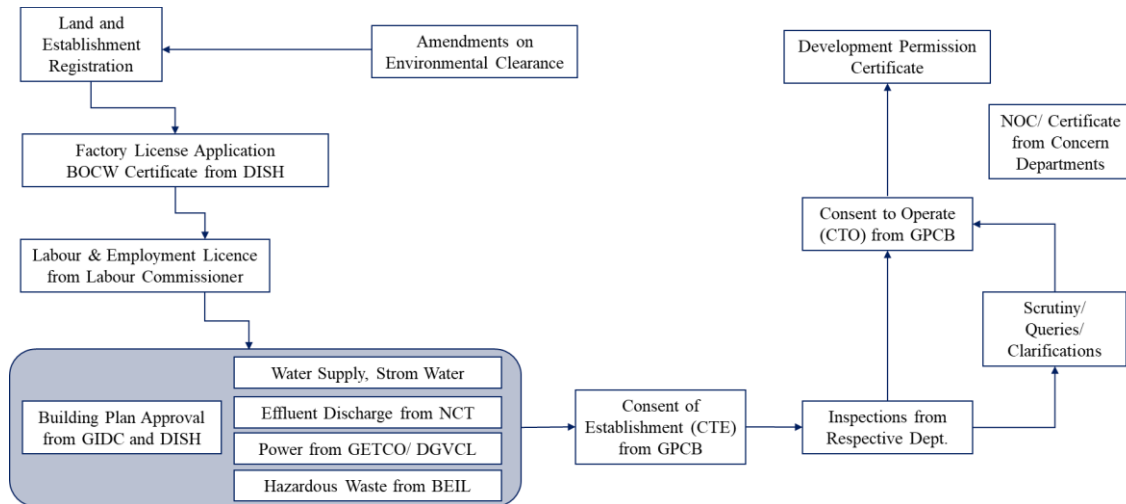
9.8 Land Acquisition and Resettlement

As the project will be implemented within an existing facility, no new land acquisition or resettlement is required.

Chapter 10 Legal Procedures and License Registration Process

10.1 General License and Registration Process

To establish an industrial area in a GIDC-approved industrial estate, investors must register with the Gujarat state government through the "Single Window Mechanism." The application must include information such as building plans, permits, investment details, and industry type. After submission, an NOC or approval will be received from the relevant authority. The responsible authorities will review the application within 7 days and notify any questions or required clarifications via mail or email. The application process steps are summarized in the flowchart.



Source: Study Team based on Discussions with GIDC, partner, JIA

Figure 6 General License and Registration Process

10.2 The Status of Legal Procedure for target zone

Partner has successfully completed the necessary legal procedures for target area. As a result, individual industrial units, such as the production plant to be developed by Sojitz within the allocated land parcel, are not required to undertake the same legal processes except for the Building Plan Approval.

Chapter11 Summary of the Feasibility Study

In general, since the production plant is being constructed within partner's premises, where a similar plant has already been developed and a pilot project successfully conducted, the associated risks are minimal.

Chapter 1. Project Outline

1.1 Background of Study

1.1.1 Background of the Proposed Business

The drive toward a 5G/6G communication society, along with advancements in Advanced Driver Assistance Systems (ADAS), autonomous driving, and smart city development, is creating significant momentum in semiconductor development and innovation. Consequently, the demand for semiconductor manufacturing materials, including Flexible Copper Clad Laminate (FCCL) and Flexible Printed Circuit (FPC), as well as the critical material polyimide, is expected to rise in the forthcoming years.

1.1.2 Development Status of the Proposed Business

The consideration is to establish a raw material manufacturing business for semiconductor-grade polyimide within the site already owned by the partner in Jhagadia, Gujarat.

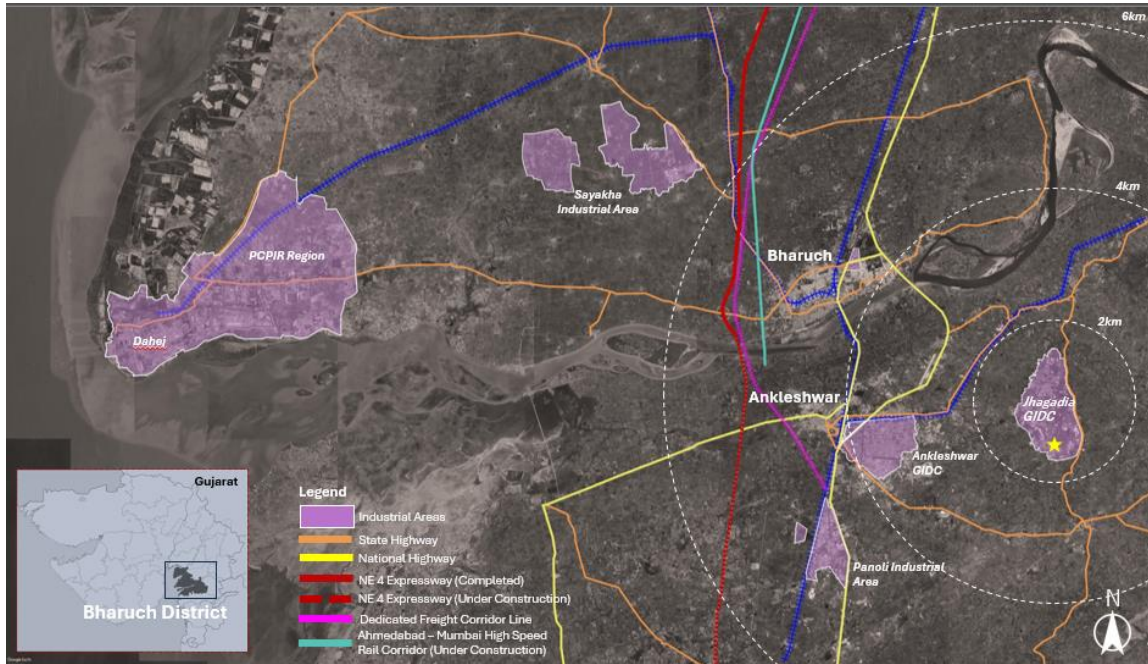
1.2 Aims

This study aims to investigate the prerequisites for establishing a polyimide monomer manufacturing business in India, with a specific focus on the following areas:

- **Basic Scheme of the Business:** This includes an analysis of the role and involvement of the proposing organization, as well as partner investigations.
- **Market Research:** Conducting a market analysis of semiconductor materials, including Flexible Copper Clad Laminate (FCCL), Copper Clad Laminate (CCL), polyimides, polyimide monomers, and the basic raw material
- **Initial Technical Due Diligence:** Assessing technical aspects related to metal management.
- **Organization of Necessary Permits and Licenses:** Identifying and organizing the necessary permits and licenses (such as manufacturing licenses) required for project implementation, while also confirming associated procedural methods.
- **Verification of Local Conditions:** Evaluating the natural conditions, socio-economic factors, and infrastructure status surrounding the proposed survey site.
- **Layout Plans:** Creating draft layout plans for the new factory and its associated infrastructure.
- **Preliminary Environmental and Social Impact Assessment:** Conducting an environmental and social impact assessment in accordance with the JICA Environmental and Social Considerations Guidelines (January 2022 version).
- **Investment and Cost Analysis:** Collecting information regarding the investment and associated costs necessary for tentative commercialization, which includes land costs, equipment costs, and labor costs (Director, sales staff, researchers, operators).
- **Financial Planning:** Based on the required investment and costs for commercialization, preparing a financial plan and cash flow analysis, along with conducting sensitivity analysis.
- **Additional Information Collection:** Gathering any other relevant information necessary for the success of the project.

1.3 Study Area

The study area is located in Jhagadia, an industrial town situated in the southern part of the Bharuch District of Gujarat, India.



Source: Edited by the Study Team based on Google Map.

Figure 1-1 Regional and District Location of the Project Site

1.4 Scope of the project and expected outcomes

The scope of work and expected outcomes of this study are as follows.

1.4.1 Scope of the Project

a. Basic Survey

- Outline of the basic scheme for the business, including the role and involvement of the proposing organization (including partner investigation).
- Market research on semiconductor materials, including Flexible Copper Clad Laminate (FCCL), Copper Clad Laminate (CCL), polyimides, polyimide monomers, and the basic raw material.
- Initial technical due diligence related to metal management.
- Organization of necessary permits and licenses (such as manufacturing licenses) required for project implementation, along with confirmation of associated procedural methods.

b. Site Survey

- Verification of natural conditions, socio-economic factors, and infrastructure status in the vicinity of the survey site.
- Collection of information regarding the investment and costs necessary for tentative commercialization, including land costs, equipment costs, and labor costs (Director, sales staff, researchers, operators).
- Gathering any additional information required for the project.

c. Planning

- Based on the required investment and costs for commercialization, preparation of a financial plan and cash flow, including conducting sensitivity analysis.
- Development of draft layout plans for the new factory and associated infrastructure.
- Preliminary environmental and social impact assessment in accordance with the JICA Environmental and Social Considerations Guidelines (January 2022 version).

1.4.2 Expected Outcomes

The following outcomes are anticipated upon the realization of the proposed business:

- The commencement of operations at the new factory is expected to create employment opportunities in the surrounding area.
- Through the implementation of this project, the acquisition of metal management technology for raw materials will be facilitated. This will likely lead to increased opportunities for the manufacturing and sale of electronic materials and components based on this technology, thereby contributing to the development of the Indian economy and further job creation.
- India has established manufacturing technologies for chemicals across various sectors, including pharmaceuticals and agrochemicals, thus playing a key role in the global materials supply chain. However, it lacks technologies for electronic materials, particularly in metal management, resulting in missed opportunities in this field. Recent developments include Foxconn's initiation of iPhone production in India and discussions for a joint venture in semiconductor manufacturing with local companies.¹ Furthermore, Tata Group is planning to enter the semiconductor manufacturing sector in the coming years, which aligns with the expected increase in demand for electronic materials within the country.² As a result, Indian chemical and materials manufacturers are looking to expand into the production of materials for electronic applications.

¹ <https://jp.reuters.com/article/vedanta-foxconn-gujarat-idJPKBN2QE00B/>

² <https://www.nikkei.com/article/DGKKZO66684770Z01C22A2MM8000/>

1.5 Methodology of the Study

1.5.1 Site Visit and Survey

The following outlines the details of the site visit and on-site activities conducted by the Study Team.

Table 1-1 Site visits conducted by Study Team

Date	Team	Purpose
September 2024	Sojitz - Nippon Koei	Offsite Survey and Environmental Survey
October 2024	Sojitz	Business Formation Survey
December 2024	Sojitz - Nippon Koei	Target Site Conditional Survey

Source: Study Team

1.5.2 Interview and Discussion

1.5.2.1 Interview with GIDC and JIA

Discussions were held between the Gujarat Industrial Development Corporation (GIDC) and Jhagadia Industries Association (JIA) officials and the Study Team, focusing primarily on infrastructure development in the Jhagadia Industrial area and social infrastructure.

1.5.2.2 Discussion with partner

An interview was conducted with the management of partner at the existing plant in target area of Jhagadia, focusing primarily on the current production and manufacturing operations at the site. This was followed by a site visit to the existing plant to assess the future requirements for the development of target area.

1.5.2.3 Interview with Japanese companies

Interviews were conducted with Asahi MODI, a Japanese company that has already established operations in the Jhagadia Industrial area, focusing primarily on their impressions of the site development, employees' origins, and related topics.

1.5.2.4 Interviews with other stakeholders

In addition, the Study Team conducted interviews with several parties, including water treatment agencies, Narmada Industries (Bharuch GIDC), logistics service providers in Ankleshwar, and GIDC Ankleshwar branch officers from adjacent estates.

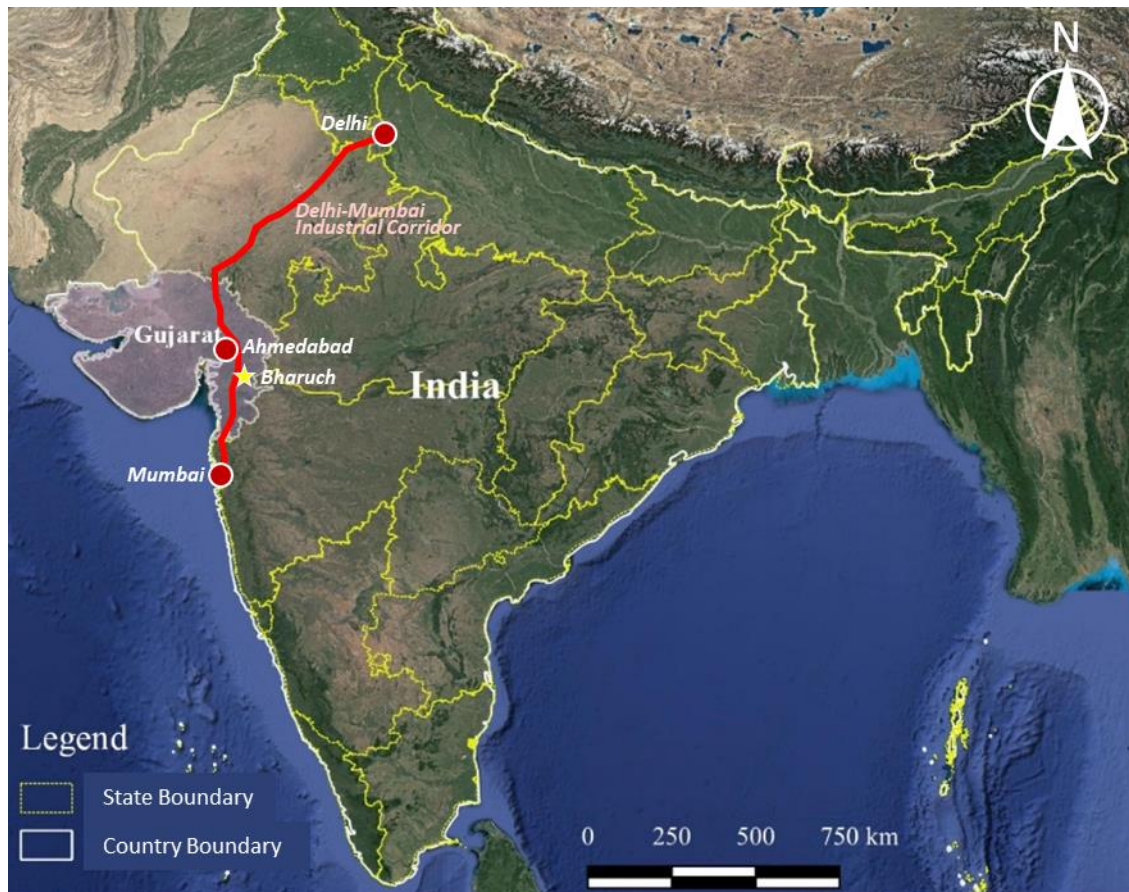
Chapter 2. Overview of the Bharuch District, Gujarat

2.1 Territory of Gujarat State and Bharuch District

2.1.1 Gujarat State

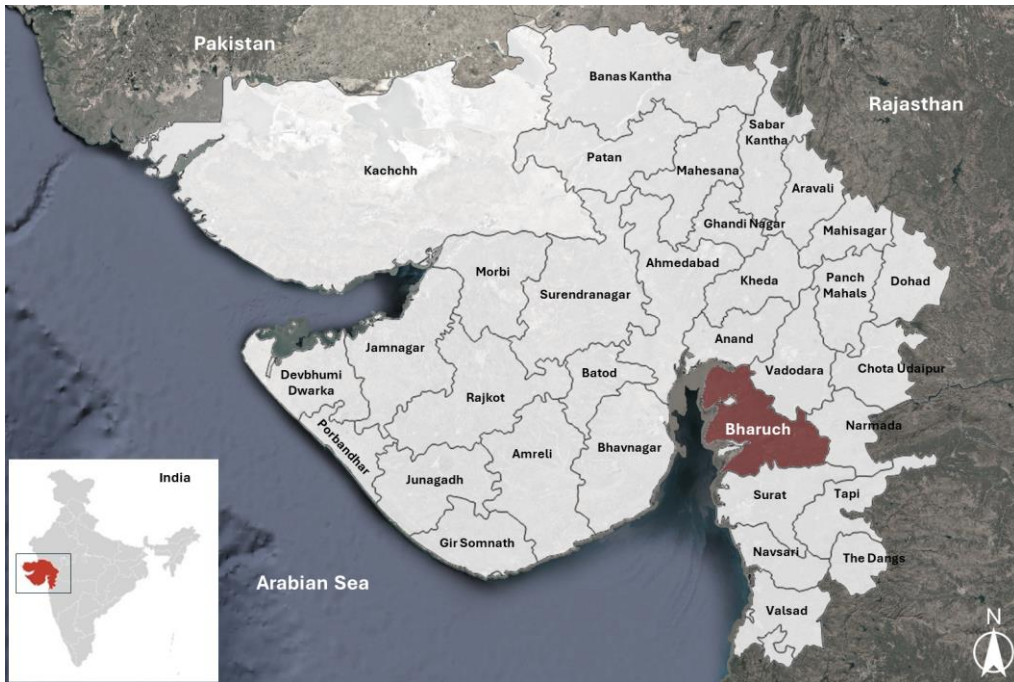
Gujarat, located in northwestern India, has the country's longest coastline of 1,600km. It is bordered by the Arabian Sea to the west, Pakistan to the northwest, and the Indian states of Rajasthan, Madhya Pradesh, and Maharashtra. Covering an area of 196,024km², Gujarat's landscape includes forests, plantation crops, grazing lands, and mining-industrial wastelands. As of July 1, 2024, the state's population is estimated at 72.65 million, with projections expecting it to reach 81.5 million by 2036.

The state is a crucial part of the Delhi-Mumbai Industrial Corridor (DMIC), serving as a key hub for industrial and economic development within the project.



Source: Edited by the Study Team based on Google Map Figure 2-1 Location of Gujarat State in India

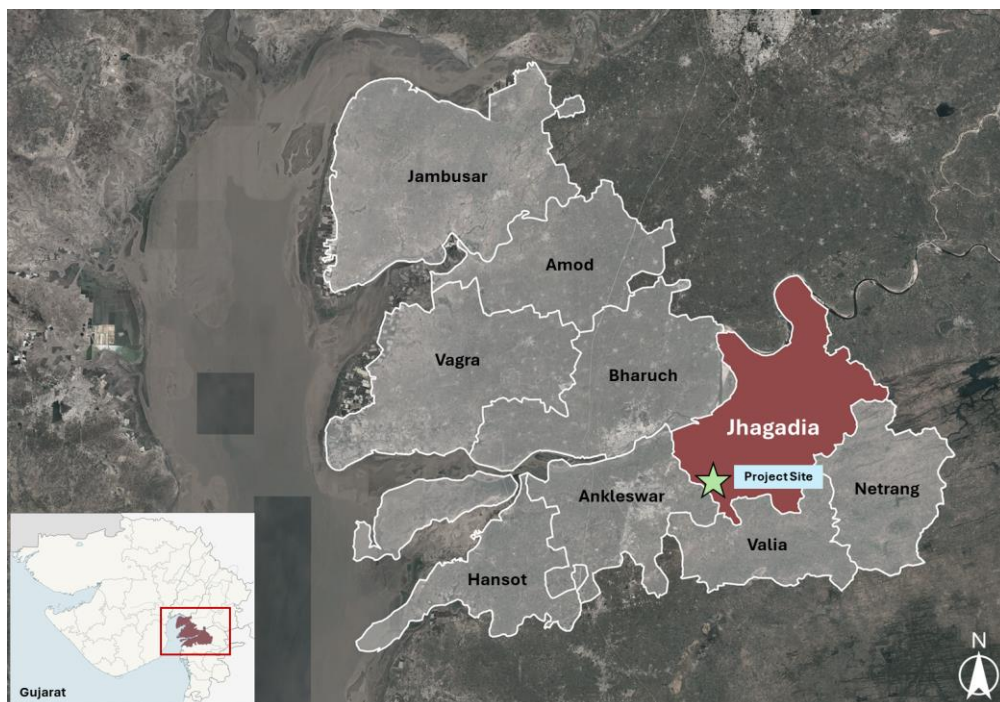
As shown in Figure 2-2, Gujarat consists of 33 districts which are further divided into 253 talukas. The capital city of the state is Gandhinagar, a planned city located on the banks of the Sabarmati River, about 23 km north of Ahmedabad, the largest city in the state.



Source: Edited by the Study Team based on Google Map Figure 2-2 Boundary and District Divisions in Gujarat State

2.1.2 Bharuch District

Bharuch district, located on the banks of the Narmada River in Gujarat State, is the second oldest city in India. Covering an area of 5,246km², it has a population of 1.6 million. The district includes the 9 talukas as shown in Figure 2-5. The city of Bharuch, the administrative headquarters, is historically significant as one of the world’s first seaports and a key trading center during the Maurya and Gupta empires. The target project area this time is located southeast of Bharuch.

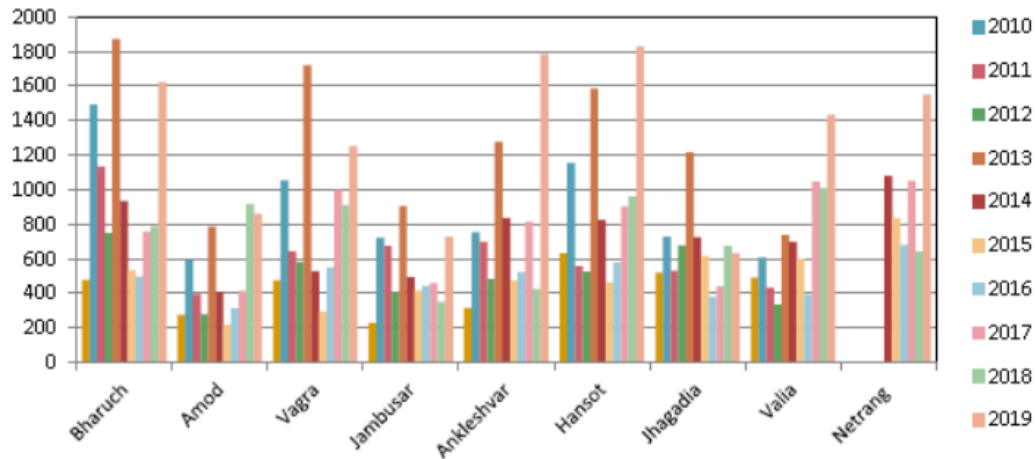


Source: Edited by the Study Team based on Google Map Figure 2-3 Administrative Map (Taluka division) in Bharuch District

2.2 Natural Condition

2.2.1 Climate

Bharuch has a mild, humid climate influenced by Arabian Sea monsoons, with a tropical savanna climate and annual rainfall between 750 mm and 800 mm. Summers (March to June) are hot, reaching up to 42°C, while the monsoon season (June to September) brings heavy rainfall and cooler temperatures around 32°C. Winter (December to February) sees minimum temperatures around 10.2°C. The region remains humid due to its coastal location, with predominantly black soil and alkaline soil in coastal areas. Average annual rainfall is around 640 mm, with local variations.

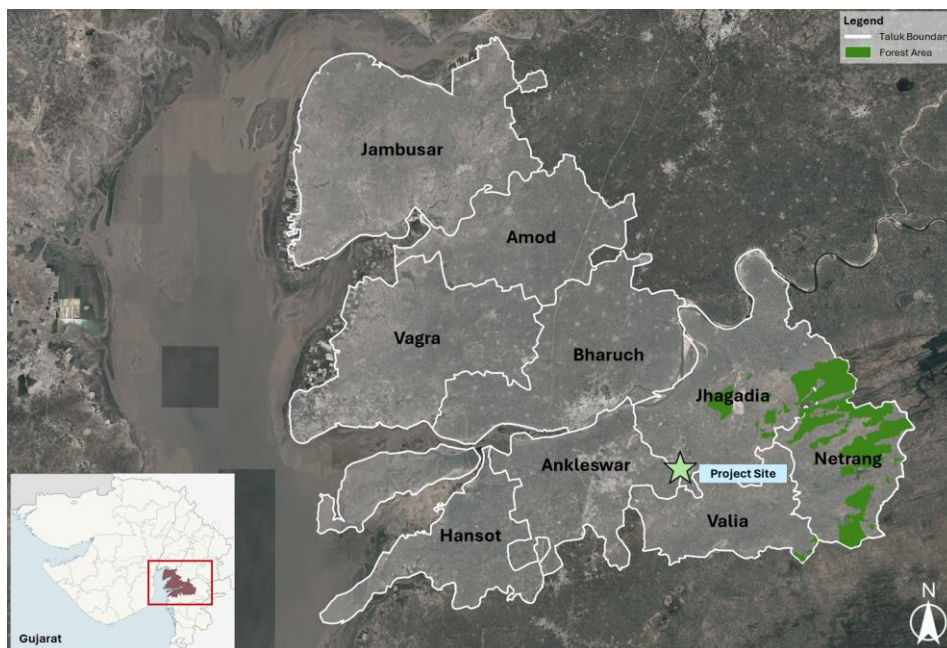


Source: Disaster Management Plan of Bharuch District 2022-2023

Figure 2-4 Rainfall Data in Bharuch District (2010~2019)

2.2.2 Geography

The district, located at an average altitude of 15 meters, is a port city on the banks of the Narmada River, with the Gulf of Khambhat to the west. Its diverse landscape includes riverbanks, plains, and proximity to the Arabian Sea.



Source: Study Team

Figure 2-5 Geography of Bharuch District

2.2.3 River and Hydrology

The Narmada River is the fifth longest river in India, flowing 1,312 km westward. It is the only river passing through Bharuch and is considered one of the five sacred rivers in Hinduism. The river forms the traditional boundary between northern and southern India and flows into the Arabian Sea through the Gulf of Khambhat, around 30 km west of Bharuch.



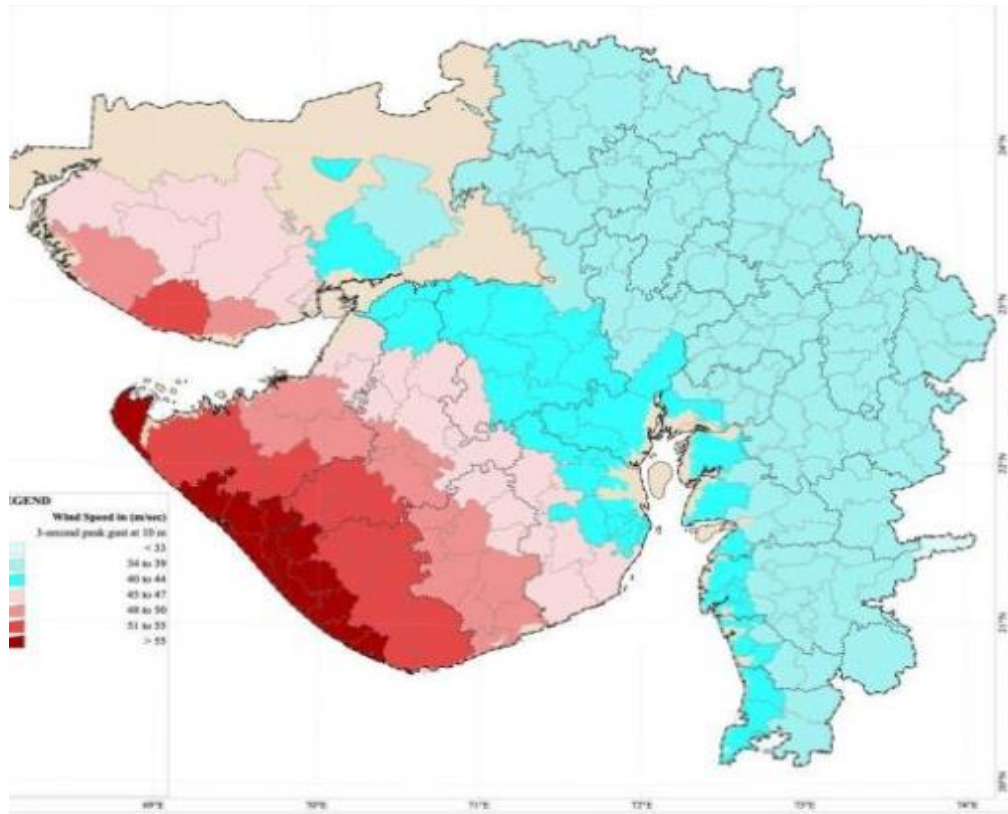
Source: Edited by the Study Team based on Google Map Figure 2-6 Rivers flowing in Gujarat State

2.2.4 Natural Disaster

2.2.4.1 Cyclone

Bharuch district faces a significant risk of cyclones, with a 62%, 68%, and 34% likelihood of occurrence in the months of October, November, and December, respectively. The district has experienced storm cyclones in October 1975, October 1993, and November 1996. These cyclones are characterized by high-velocity winds, often accompanied by heavy rainfall.

The vulnerability to cyclones is particularly high in the west-facing talukas of Hansot, Vagra, Amod, and Jambusar, which are situated closer to the Arabian Sea and are most susceptible to the impact of these storms due to their geographical location.



Source: Bharuch District Disaster Management Plan 2022-2023

Figure 2-7 Gujarat Cyclone Hazard Risk Zonation

2.2.4.2 Flood

Flooding is a significant natural disaster threat in Bharuch district, largely due to the presence of the Narmada, Dhadhar, and Kim rivers, as well as the collapse of various check dams such as Pingot on Tokarikhadi, Baldewa on Kaverikhadi in Valia and Netrang talukas, and Dholi on Madhumatikhadi in Jhagadia taluka. Flooding can occur due to heavy monsoon rains or cyclones.

Historically, Bharuch and Ankleshwar talukas have been severely affected by flooding, particularly from the Narmada River. In 1994, certain low-lying areas of Valia taluka were also impacted by flooding from the Kim River. These recurring floods pose a serious risk to the region, requiring ongoing preparedness and mitigation efforts.

2.3 Social Economy

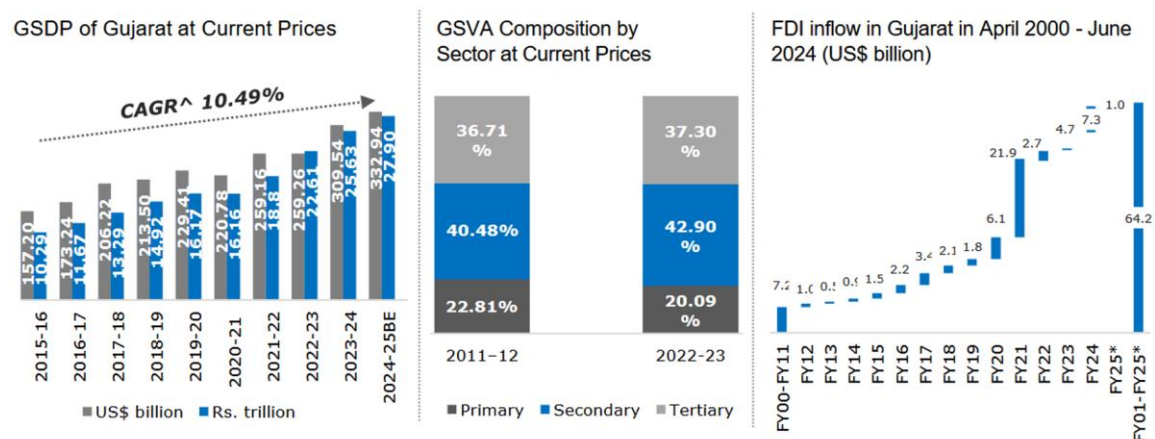
2.3.1 Social Economy Development in Gujarat State

Gujarat, one of India's most economically dynamic states, has made significant strides in socio-economic development over the past few decades. Known for its rich cultural heritage and vibrant industrial growth, the state has consistently focused on improving its economic and social infrastructure, contributing to a higher standard of living for its citizens.

2.3.1.1 Economic Growth and Industrial Development

Gujarat has emerged as one of the leading states in India in terms of industrial output. The state accounts for around 7.3% of India's GDP and approximately 20% of India's total exports. The state's industrial growth is primarily driven by sectors like manufacturing, petrochemicals, textiles, chemicals, and pharmaceuticals, with large industrial hubs in cities such as Ahmedabad, Surat, and Vadodara. Gujarat is also known for its contribution to India's GDP through its agriculture sector, contributing to 13.3% of the country's total agricultural output.

According to the State Economic Survey 2023, Gujarat's Gross State Domestic Product (GSDP) grew at a rate of 8.1% in the fiscal year 2022-23, higher than the national average of 7.0%. The state's focus on infrastructure development, ease of doing business, and industrial parks has contributed significantly to this growth.



Source: Ministry of Statistics and Programme Implementation, Directorate of Economics and Statistics, Department for Promotion of Industry and Internal Trade (DPIIT)

Figure 2-10 Economic Snapshot of Gujarat

2.3.1.2 Healthcare, Education, and Skill Development

Gujarat has made significant progress in healthcare, education, skill development, and social welfare, which are key drivers of its socio-economic growth. The state has over 30,000 primary health centers and 3,000 hospitals, improving healthcare access. The Infant Mortality Rate (IMR) has dropped from 52 per 1,000 live births in 2001 to 30 per 1,000 live births in 2020.

In education, Gujarat's literacy rate stands at 78.03%, with over 50,000 schools and 200 higher education institutions. Programs like Kanya Kelavani Yojana³ have boosted female education and enrollment. Skill development has been a priority, with 1.5 million youth trained through the Gujarat Skill Development Mission⁴, enhancing workforce capabilities. Gujarat has also reduced poverty, with the poverty rate declining from 31.6% in 2005 to 16.3% in 2019.

2.3.2 Economy and Industry Development in Bharuch District

2.3.2.1 Overview of Bharuch's Economy

Bharuch District is a significant contributor to Gujarat's economy, driven by a blend of industrial and agricultural sectors. Strategically located along the Narmada River and the Gulf of Khambhat, Bharuch is a hub for trade, connectivity, and industrial development. Historically a major trading port, its modern economy reflects a blend of traditional agriculture and advanced industries, making substantial contributions to Gujarat's Gross Domestic Product (GDP).

The industrial sector accounts for approximately 46% of the district's economic output, followed by agriculture at 19%, services at 27%, and other sectors at 8%.

2.3.2.2 Industrial Sector

The Gujarat Industrial Development Corporation (GIDC) has been instrumental in fostering industrial growth in Bharuch through strategically established industrial estates.

- **Ankleshwar Industrial Estate:** Among Asia's largest industrial clusters, Ankleshwar hosts over 1,000 units specializing in chemicals, pharmaceuticals, and engineering goods. This estate is a cornerstone of Gujarat's industrial output, significantly contributing to exports and employment generation.
- **Dahej Special Economic Zone (SEZ):** Dahej SEZ is a globally recognized petrochemical and chemical hub. With state-of-the-art infrastructure and proximity to Dahej Port, it attracts significant domestic and international investments. It facilitates exports of fertilizers, petrochemicals, and specialty polymers, accounting for a notable share of Gujarat's export revenue.
- **Jhagadia Industrial Estate:** Focused on large-scale manufacturing, Jhagadia specializes in chemicals, textiles, and paper production. It complements the region's industrial ecosystem by providing diversification and economic resilience.

2.3.2.3 Service Sector

Gujarat's service sector plays a pivotal role in the state's economic development, covering diverse segments such as trade, logistics, IT, financial services, real estate, and tourism.

- **Trade and Logistics:** With 42 operational ports and extensive connectivity, Gujarat serves as a critical hub for domestic and international commerce.

³ It is a girl child education promotion program led by the Gujarat state government, aimed at expanding educational opportunities for girls through financial support, free education, and scholarship programs for students. The program seeks to promote social and economic empowerment through education. ([Central and State sponsored schemes](#) - p46)

⁴ Established in February 2009, it serves as the central institution overseeing Gujarat's state-level skill development strategy, aimed at expanding employment opportunities. It is responsible for monitoring, coordinating, and evaluating skill training programs, identifying skill gaps, and analyzing employment outcomes to enhance the effectiveness of various schemes. Beyond merely providing skill training, it also focuses on securing employment opportunities and developing a workforce adaptable to changing market demands. (<https://skills.gujarat.gov.in/>)

- **Information Technology:** The IT/ITeS Policy 2022-2027 aims to create 1 million jobs, making Ahmedabad and Gandhinagar emerging technology hubs.
- **Tourism:** Over 38 million domestic and 0.8 million international tourists visit annually, drawn to attractions like Gir National Park and the Statue of Unity.
- **Financial Services:** GIFT City establishes Gujarat as a global financial hub for trade and international services.

2.3.2.4 Agriculture Sector

Despite its industrial dominance, Bharuch sustains a thriving agricultural sector, reflecting a balanced economic structure. Fertile lands along the Narmada River enable high-yield cultivation of vital crops.

- **Cotton:** As a primary cash crop, cotton supports the district's textile industry and strengthens its agro-industrial linkage.
- **Bananas:** Bharuch is one of Gujarat's leading producers of bananas, contributing significantly to the horticulture sector and export markets.
- **Pulses and Other Crops:** The cultivation of pulses and other staples forms a key part of the agricultural economy, catering to both local and state-level demand.

Modern irrigation systems and favourable climatic conditions ensure consistent productivity, with the agricultural sector contributing approximately 19% to the district's GDP. The symbiotic relationship between agriculture and industry underscores the district's economic resilience.

2.4 Demography

2.4.1 Population in Gujarat

As of July 1, 2024, Gujarat state's population is projected to be approximately 72.65 million, with an expected increase to 81.5 million by 2036. The sex ratio in 2024 is projected to be 110.59 males per 100 females, with 38.15 million males and 34.5 million females, resulting in a male surplus of 3.65 million.

2.4.2 Population in Bharuch District

As of 2024, Bharuch city is estimated to have a population of 237,000, with a metro population of 315,000. The last census in 2011 recorded a population of 169,007, with an urban/metropolitan population of 223,647. The 2021 census was postponed due to COVID-19, and current estimates are based on past growth trends.

Bharuch has a literacy rate of 87.27%, with 132,572 literates—70,654 males and 61,918 females. Male literacy stands at 90.76%, while female literacy is 83.60%. The sex ratio is 947 females per 1,000 males, with a child sex ratio of 907 girls per 1,000 boys.

Regarding race and religion, Bharuch city is diverse, with a population composed primarily of Hindus, followed by Muslims, Jains, and smaller communities from various other faiths. The city's demographic reflects Gujarat's broader cultural and religious diversity.

2.5 Logistics and Infrastructure Development Surrounding Gujarat

Gujarat's robust infrastructure, particularly in logistics, is a key driver of its industrial and economic growth. The state is home to 42 ports, including major ones like Dahej Port, which handles a significant portion of Gujarat's bulk exports, and Kandla and Mundra ports, which are among India's largest and handle a substantial share of the country's international trade. These ports, combined with a comprehensive road network of over 100,000 km and an efficient railway system, ensure smooth transportation and connectivity, bolstering trade across the region.

Gujarat's connectivity is further strengthened by 17 domestic airports and 3 international airports, facilitating air transport for both passengers and cargo. Key infrastructure projects, such as the Surat-Bharuch Expressway and the Dedicated Freight Corridor, are set to enhance regional connectivity and improve trade efficiency by reducing travel time and logistics costs.

2.5.1 Roadway

Gujarat's extensive and high-quality road network has been central to its growth as an industrial powerhouse. The state boasts a road network of approximately 104,564 km, including 18,447 km of State Highways, which account for 26% of the total—significantly higher than Maharashtra (18%) and Andhra Pradesh (13%). This robust connectivity supports economic growth, trade, and industrial development.

Key projects include the ongoing construction of the National Expressway-6, which will directly connect Bharuch to key regions, enhancing accessibility and reducing travel time. Bharuch strategically located along major routes like the DMIC, benefits from Gujarat's superior infrastructure, making it a vital hub for commerce and logistics.

With continued investments in urban and regional road development, Gujarat is setting benchmarks in connectivity and driving balanced economic growth across the state.

2.5.2 Railway

Gujarat's railway network plays a crucial role in enhancing regional and national connectivity, supporting both passenger and freight movement. The state is connected through major railway stations like Vadodara Junction, one of the busiest in India, and Bharuch, which lies along key railway corridors. The Western Dedicated Freight Corridor (WDFC), passing through Gujarat, is a significant project aimed at improving freight movement between Jawaharlal Nehru Port (JNPT) and Dadri. This corridor covers 565 km in Gujarat, with critical detours through cities like Bharuch, Vadodara, and Ahmedabad.

Gujarat is also set to benefit from ongoing infrastructure improvements, including the Pune-Mumbai-Ahmedabad high-speed rail corridor and several rail projects aimed at increasing capacity and reducing travel times. The state is investing heavily in 42 railway infrastructure projects, with 2,947 km of rail lines under development, including new lines, gauge conversions, and track doubling, at an estimated cost of \$3.7 billion USD.

2.5.3 Airway

Gujarat has a robust air infrastructure with 19 airports across the state, ensuring strong regional connectivity. Key airports include Ahmedabad, Vadodara, Surat, and Rajkot, all of which are well-connected to major cities. The Dholera greenfield airport and expansions of existing airports like Surat and Vadodara will further enhance the state's air connectivity. The state also has private-managed airports such as Mundra (Adani) and Mithapur (Tata).

The Gujarat State Government has signed agreements to develop 11 new greenfield airports and expand nine existing ones, including Surat, Vadodara, and Kandla. A proposed international airport at Dholera will boost connectivity, and seaplane terminals at Sabarmati Riverfront and Kevadia enhance regional access. While Bharuch itself is not a major airport hub, the expanding infrastructure in neighboring cities significantly improves air access for the district.

The specific demand for small airports at emerging Centres of Growth such as Special Investment Regions, ports, entertainment zones, Economic or industrial zones etc may arise in Gujarat State. There are emerging small new airports and airport development opportunities as below.

Table 2-1 List of Small New Airports

Location	Connectivity Requirement	Present Status
Ankleshwar	Delhi, Mumbai	Semi-finished airport in dormant stage. Civil Aviation Dept. GoG plans to lease the airfield to local industries association to complete balance work.
Mandvi	Mumbai, international locations	Airstrip with 5000 ft runway in operational stage. No Terminal building. Upgradation would be required.
Dwarka	Mumbai, Delhi International	No plans yet. Nearest airport is Porbandar, 150 km Requirement would depend on successful development of tourism in the area
Mundra	Delhi, Mumbai, International locations	The aerodrome with 1900 m airstrip already established by MPSEZ Ltd. Will expand if required.
Ambaji	Mumbai, Delhi, Ahmedabad	Civil Aviation Dept. plans to construct 7000 ft airstrip under PPP format

Source: GIDC

2.5.4 Waterway Port

Gujarat's waterway infrastructure, particularly in southeastern regions, plays a crucial role in trade and logistics. Dahej Port, located near Bharuch, is a key deep-sea multi-cargo port, handling around 30 million tons of cargo annually, including liquid chemicals, petroleum products, and automobiles. Hazira Port, also nearby, is a significant deep-sea port in the Delhi-Mumbai Industrial Corridor, facilitating multimodal transport and handling around 17.5 million tons of cargo annually. Both ports enhance Gujarat's connectivity for international trade, strengthening its position as a major logistics hub.

2.6 Industrial Park Development in Gujarat State and Bharuch District

2.6.1 Gujarat Industrial Development Corporation (GIDC)

The Gujarat Industrial Development Corporation (GIDC) is a key government agency responsible for promoting industrial growth and development in the state of Gujarat. Since its establishment in 1962, it has set up 168 industrial estates and another 106 are being developed in different parts of the state. The State Government has Special Economic Zones at Kandla and Surat and a software technology park at Gandhinagar. GIDC plans to set up an apparel park in Surat. Additionally, GIDC has developed an industrial park in Dahej, which includes a petrochemical complex with facilities like a private airstrip, effluent collection and disposal, a liquid chemical port and railway lines

GIDC plays a vital role in the state's industrial growth by developing essential infrastructure. Its primary functions include providing land and sheds for industries, as well as offering critical infrastructure support such as water supply, drainage systems, roads, stormwater drains, and street lighting.

2.6.2 Jhagadia Industries Association (JIA)

The Jhagadia Industries Association (JIA) represents industries in the Jhagadia region of Bharuch district, focusing on supporting industrial growth, advocating for policy reforms, and fostering collaboration among businesses. It works to address challenges related to infrastructure, regulations, and economic development.

In contrast, the GIDC is a government body responsible for developing and managing industrial estates, including the Jhagadia GIDC. While JIA represents the interests of local industries, GIDC focuses on providing industrial infrastructure and resources. Both entities work together to support the region's industrial growth.

Chapter 3. Economic Condition and Market Analysis of India

3.1 Economic Condition

According to the IMF's GDP growth forecast, India is expected to grow by 7.0% in 2024, 6.5% in 2025, and 6.5% in 2026. In 2024, although net exports contributed negatively, growth was driven by increases in personal consumption and investment. From 2025 to 2026, the growth rate is expected to slow down as the demand recovery from Covid-19 levels off.

The analysis suggests that high prices are causing a decline in demand, and controlling the inflation rate to 4% is seen as the key to sustainable economic growth. The Reserve Bank of India (RBI) has maintained the policy interest rate at 6.5% since April 2023. Although the inflation rate is showing a downward trend, there is still caution regarding price increases. The monetary policy meeting in October 2024 hinted at a shift to a neutral stance, indicating a willingness to cut rates if necessary.

In 2024, the Modi administration won the general election and is pursuing an all-encompassing foreign policy towards the West, China, and Russia. However, consideration for coalition partners is necessary, and policy decisions are expected to take time.

Despite temporary slowdowns and inflation challenges, the Indian economy is expected to accelerate growth in the future due to increased agricultural production and a recovery in government capital investment. The central bank is emphasizing inflation control and showing a cautious approach to monetary policy management.

3.2 Challenges of the Proposed Business and Mitigation Plans

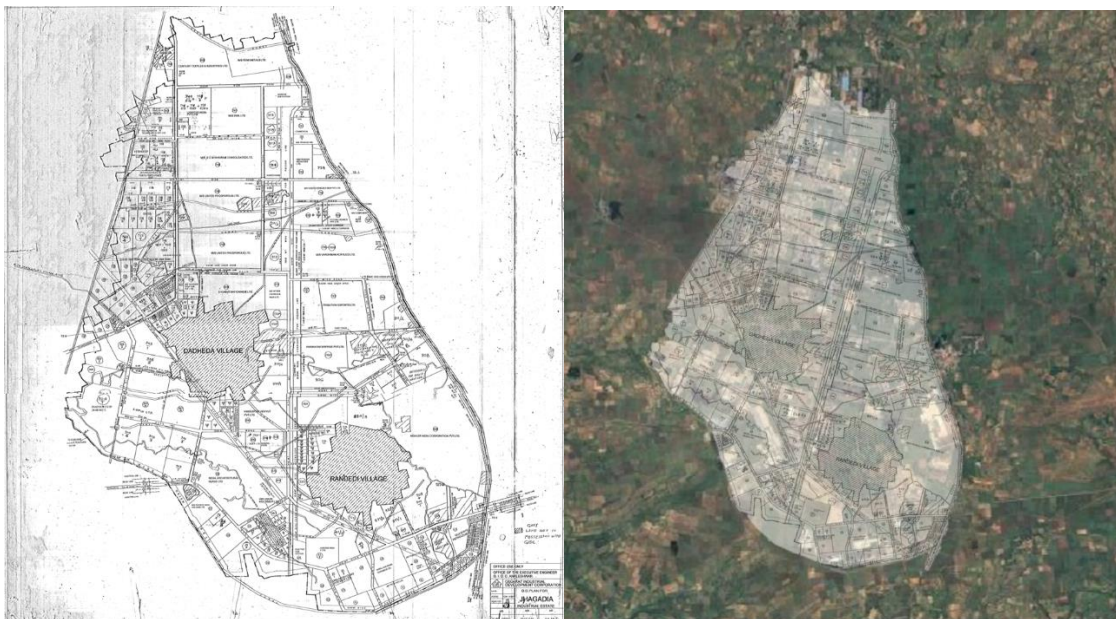
Since the end-use is in semiconductors, extremely stringent quality control is required, particularly in reducing and managing the metal content in the products. However, there are few examples of Indian companies successfully manufacturing chemical products for advanced semiconductor applications. As a countermeasure, a Japanese technical consulting firm with expertise in metal management will be engaged to provide advice on manufacturing process management to the partner company. This will help achieve the quality standards demanded by the market.

Chapter 4. Development of Jhagadia GIDC Industrial Estate

4.1 Overview of Jhagadia GIDC Industrial Estate

4.1.1 Current Development Condition of the Industrial Estate

The Jhagadia GIDC Industrial Estate (hereafter referred to as Jhagadia GIDC), developed and managed by GIDC in 1993, is recognized as one of the largest industrial clusters classified as part of the Mega Industrial Estate, covering an area of 1,700ha. It supports a diverse range of industries, including chemicals, pharmaceuticals, engineering, and textiles. Figure 4-1 shows the Detailed Development Plan of the estate.



Source: GIDC

Figure 4-1 Detailed Development Plan for Jhagadia GIDC

Within the Jhagadia GIDC, a total of 285 plots have been developed, with over 180 companies and industries currently operating within the GIDC. According to the GIDC Joint Committee Report 2021, approximately 1,300 ha of the total area have been allotted, corresponding to 275 out of the 285 plots. The remaining 10 plots have yet to be allocated. Among the 275 allotted plots, the status of 36 plots is currently under construction.

4.2 Geotechnical Condition

4.2.1 Abstract of Geotechnical Survey

In the review and analysis of ground data conducted in 2022, a total of 26 boreholes (BH) were drilled to a depth of 20.0 meters, and 8 trial pits were excavated.

4.2.2 Sub Surface Stratifications

The results of the subsurface stratification indicate that, on average, the soil up to a depth of 2 meters consists of blackish silty clay with high plasticity and very stiff consistency. Between depths of 2 meters and 20 meters, the strata are comprised of yellowish-grey silty clay, ranging from very stiff to hard consistency. The Standard Penetration Test (SPT) N values for this layer range from approximately 20 to over 10, which can be considered good for foundation design, as it indicates a relatively strong and compact soil layer.

4.2.3 Chemical Analysis and Environmental Conditions

The chemical analysis of the soil shows a mildly alkaline pH range of 8 to 9, which is generally suitable for construction but may require attention for specific materials sensitive to alkalinity. The sulphate content is low, between 0.010% and 0.020%, posing no significant risk to concrete durability. The chloride content ranges from 0.02% to 0.11%, which is not high but should be considered when designing concrete mixes, especially for structures exposed to moisture or corrosive environments. Overall, the soil conditions are relatively mild, with minor considerations for material selection and protection.

4.2.4 Foundation Capacity Analysis

The foundation capacity analysis provides recommendations for both shallow/open foundations and pile foundations. For shallow/open foundations, lightly loaded structures with foundation widths up to 1.5m should be placed at a depth of 750mm from the finished ground level (FGL), with a net safe bearing capacity not exceeding 7.5t/sqm. For pile foundations, when shallow foundations are not feasible, under-reamed pile foundations are recommended for lightly loaded structures, while bored cast-in-situ piles should be used for larger, more important structures. The load-carrying capacity of piles should be verified with load tests prior to execution. Overall, the recommendations ensure safe, stable foundations tailored to different structures, considering soil conditions, load requirements, and water table levels.

4.3 Development of Road and Transportation Facility

4.3.1 Road Network

The State Highway (SH165) currently serves as the primary access route connecting the main entrance of Jhagadia GIDC from the eastern side to the nearest urban center, Jhagadia. It is the most utilized route by heavy trucks due to its relatively wide structure, as illustrated in the surrounding road network map in Figure 4-2. However, portions of SH165 are in poor condition, with significant wear and damage caused by heavy truck traffic.

According to the JIA, the state government plans to construct a new access highway directly connecting to Jhagadia GIDC as part of the 6000 km State Highway Development Program (SHDP) aimed to address the need for upgrading and maintaining the region's core transportation network, thereby enhancing logistical efficiency.



Source: Study Team

Figure 4-2 Condition of SH165 at the Northern Portion (left) and Southern Portion (right)

Additionally, there are several access routes leading to Jhagadia GIDC from nearby urban centers such as Bharuch and Ankleshwar to the west, which pass through surrounding villages. These roads are cement concrete roads, developed under critical infrastructure projects through a collaborative effort involving the JIA, the Government of Gujarat (50% funding), the GIDC (25% funding), and member industries (25% equity contribution).



Source: Study Team

Figure 4-3 Condition of Access Roads from the Western Side of Jhagadia GIDC

4.3.2 Railway network

Unlike other industrial areas Jhagadia GIDC does not have a direct railway connection. The nearest railway station is Ankleshwar Junction, located approximately 10 km from the industrial estate. Ankleshwar Junction serves as a critical hub for freight movement, providing connectivity to major cities and ports, which facilitates the seamless transportation of finished goods and raw materials. Additionally, the area benefits from a Container Corporation of India (CONCOR) yard at Ankleshwar, which specializes in handling containerized cargo. The facility currently operates two railway lines daily and has a handling capacity of 2,000 TEU (Twenty-foot Equivalent Unit) containers. Currently, material transportation between the industrial estate and the Ankleshwar CONCOR Container Yard relies solely on trucking, highlighting the need for enhanced rail connectivity in the future. Bharuch Junction, situated approximately 15 km away, is another key rail hub, mainly serving as an intercity passenger terminal. Moreover, a railway line diverging from Ankleshwar towards Jhagadia is under consideration for future development. Once operational, this line is expected to support Jhagadia GIDC by facilitating both passenger and cargo movement.

4.3.3 Other Logistics Facilities

GIDC has established three truck parking areas within the industrial park. Currently, there are plans to enhance the site by installing facilities that include a cafeteria providing meals for drivers and cleaning staff, restrooms, and rest areas.

4.4 Development of Stormwater Drainage Facility and Channels

4.4.1 Stormwater Drainage

The industrial estate is equipped with a stormwater management system comprising open stormwater drains and green buffers along both sides, designed to mitigate flooding risks during heavy rainfall. During the site survey, rainwater stagnation was observed in flat areas, likely attributable to inadequate maintenance of road conditions.



Source: Study Team

Figure 4-4 Open Stormwater Drain (left) and Water Stagnation in Common Compound (right)

4.4.2 Discharge into Water Channel

Based on discussions with partner, GIDC, and JIA, stormwater discharge from each plot to the main drainage system will be closely monitored using CCTV cameras and pH meters to ensure compliance with environmental standards. The Pollution Control Board will oversee and verify adherence to these standards before the stormwater is ultimately discharged into the natural water

channel flowing through the area. As a result, the Zero Liquid Discharge (ZLD) policy is not applicable to this industrial estate.



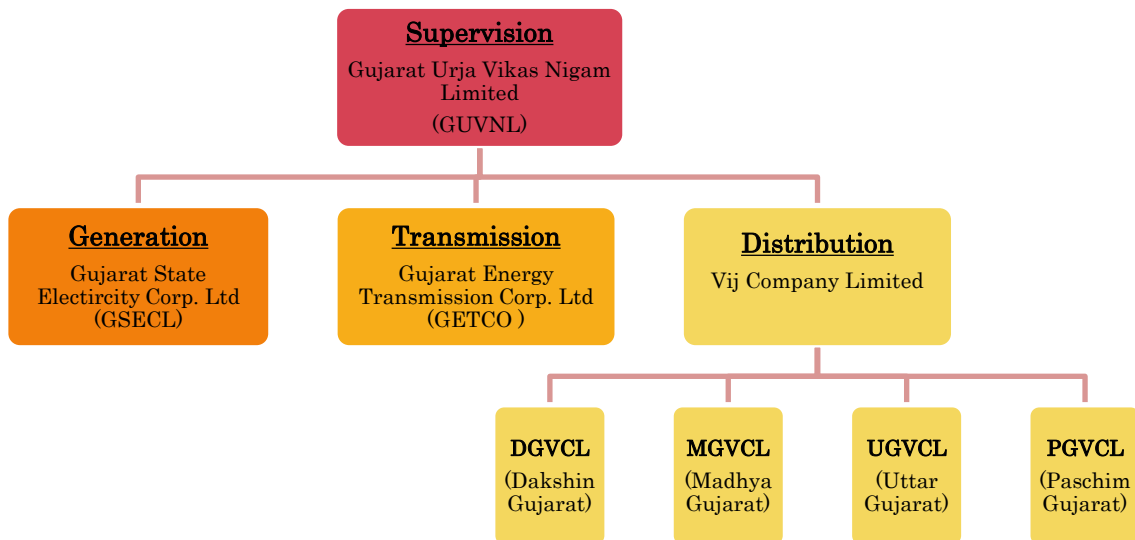
Source: Study Team

Figure 4-5 Discharge Point of Industrial Plot with Monitoring Device (left), Water Channel (right)

4.5 Development of Power Supply Facility

4.5.1 Power Generation and Transmission

Figure 4-6 illustrates the organizational structure of the parties involved in power provision in Gujarat. Gujarat Energy Transmission Corporation Ltd (GETCO) operates as an independent entity, functioning as the state transmission utility. GETCO is responsible for providing transmission licenses and managing the state load dispatch center. It transmits power generated across the state to the Jhagadia GIDC via an extensive network of 400kV, 220kV, 132kV, and 66kV transmission lines.



Source: Study Team

Figure 4-6 Stakeholders Involved in Power Provision Sector in Gujarat State

4.5.2 Power Substation and Distribution Lines

Currently, there are two substations operated by GETCO within the industrial park. Through these substations, 11kV power distribution is provided to the member companies within the park

4.6 Development of Water Supply Facility

4.6.1 Water Source

The water source for Jhagadia GIDC is located at Rundh village, approximately 30 km from the industrial estate. A raw water treatment facility at this location treats water from the Narmada River, with an installed capacity of 77 MLD. Currently, 65 MLD of treated water is being supplied through pumping from the river. To meet future demand, the Jhagadia Industrial Association (JIA) has proposed an increase in capacity to 120 MLD.

4.6.2 Water Distribution

The treated water is pumped to the Jhagadia GIDC sump through a 700mm concrete pipe, and a water supply distribution network is provided within the estate. Currently, there are eight locations with common overhead water tanks in Jhagadia GIDC, one of which is under construction. These tanks supply water to all industrial units within the estate based on their respective requirements.

4.7 Development of Wastewater Treatment Facility

4.7.1 Regional Centralized Treatment System

Individual industries within the Jhagadia GIDC discharge treated wastewater meeting the discharge standards established by the Gujarat State Pollution Control Board (GPCB) into the GIDC drainage network. The wastewater is then collected in five collection sumps/tanks located within the industrial estate and subsequently transferred to a centralized regional booster pumping station at Kantiajal. This pumping station also receives industrial effluent from other Final Effluent Treatment Plants (FETPs) serving industrial estates such as Ankleshwar and Panoli. The combined effluent is ultimately discharged into the deep sea through a marine outfall located 35 kilometers from the site.

4.7.2 Final Effluent Treatment Plan in Jhagadia GIDC

The Final Effluent Treatment Plant (FETP) in the industrial estate has been recently developed as part of the Narmada Clean Tech (NCT) project, with an investment of approximately 55 crore INR. The facility has a total treatment capacity of 35 MLD and is designed to handle effluent streams from various industries within the estate.

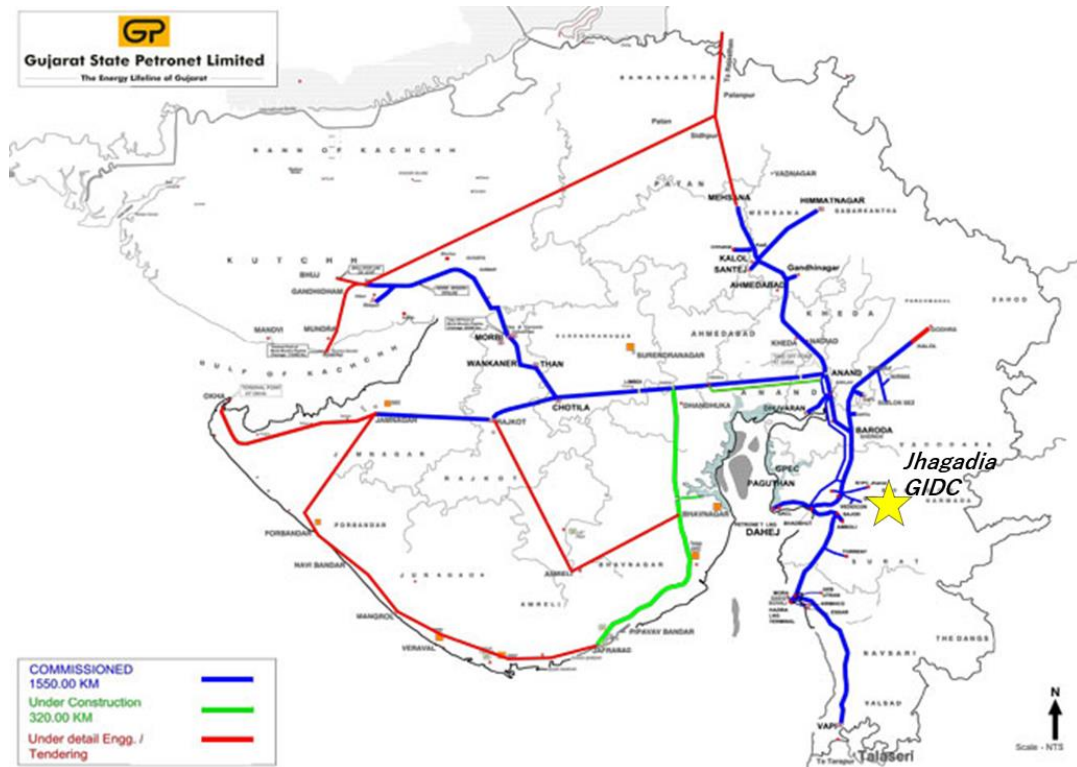
Industrial effluent meeting FETP compliance measures is discharged to the plant for further treatment. Currently, out of 120 industries in the estate, only 43 are connected to the FETP via pipelines for effluent discharge. Industries generating less than 50 KLPD of effluent transport their waste to the FETP using tankers, subject to approval by the GPCB. This system ensures effective management of effluent from industries of varying capacities within the estate.

4.8 Development of Other Infrastructure Facility

4.8.1 Gas Supply Facility

Gujarat Gas Company Limited (GGCL) is a prominent gas transmission and distribution company operating in the industrial hub of South Gujarat. With a pipeline network extending approximately 2,700 km, GGCL serves a customer base of 2.30 lakh. As shown in Figure 4-7, GGCL operates two major trunk pipelines: the Hazira-Surat pipeline and the Hazira-Ankleshwar pipeline. The latter, a 73 km trunk line running from Hazira to Ankleshwar, has been further extended to cover the Jhagadia region.

In Jhagadia GIDC, gas supply pipelines are laid underground and are connected directly to industrial customers, ensuring a reliable and efficient energy supply for operations within the industrial estate.



Source: Gujarat State Petronet Limited (GSPL)

Figure 4-7 Network Map of GSPL

4.8.2 Solid Waste Disposal

Integrated solid waste management, including hazardous waste in the region, is managed by Bharuch Enviro Infrastructure Ltd (BEIL), a dedicated Hazardous Waste Management Company. BEIL has established and operates a Common Hazardous Waste Treatment, Storage, and Disposal Facility (CHWTSDF) located in Ankleshwar, approximately 15 km from Jhagadia GIDC.

The facility handles various types of hazardous waste, including liquid, solid, semi-solid, and tarry waste, generated by over 1,800 industries in the region, including those within Jhagadia GIDC. Its services include secured landfill operations, hazardous waste treatment, stabilization and solidification processes, common incineration facilities, and advanced systems such as a multiple-effect evaporator (MEE) to ensure effective and compliant waste management.



Source: BEIL

Figure 4-8 Incineration Plant (left) and Landfill Site (right) in BEIL’s TSDF

4.8.3 Fire Management System

Currently, Jhagadia GIDC has two fire stations. However, the existing firefighting and allied facilities within the estate are inadequate. The local fire station is not well-equipped, with only one fire tender available, which limits its capacity to handle severe fire incidents or disasters involving fire and explosions.

In case of emergencies, additional support is mobilized from 18 fire tenders belonging to nearby industries within Jhagadia GIDC, as well as from neighboring industrial hubs like Ankleshwar and Bharuch. This supplementary assistance complements the in-house firefighting capabilities of individual units but highlights the need for significant improvements in firefighting infrastructure within the estate.

4.9 Offsite Utility Connection to target area

Although most of the utility connection pipelines from the target site are unclear, based on discussions during the interviews, the utility connections are detailed in Table 4-3

Table 4-1 Details of Utility Connection to target area

Items	Details of Utility Connection
Water Supply	<ul style="list-style-type: none"> • Partner has obtained approval from GIDC for a water supply of 2,023 KLD. • The necessary supply line and connection from the nearby water tank to Target area have been fully established. • If partner's water requirements exceed the approved amount, they must apply for an additional water supply permit and cover the cost of constructing the required connection to the water tank.
Power Supply	<ul style="list-style-type: none"> • A dedicated 66 kV power transmission line from the GETCO substation is connected to serve Target area.
Gas Supply	<ul style="list-style-type: none"> • A gas pipeline from GGCL is laid beneath the northern underground road of Target area and is planned to be connected to the zone.
Wastewater Treatment	<ul style="list-style-type: none"> • Treated wastewater, after undergoing primary and secondary treatment at the onsite plant, will be connected via the GIDC pipeline to NCT's FETP.
Solid Waste Disposal	<ul style="list-style-type: none"> • Waste produced will be transported to BEIL's disposal facilities by truck, with real-time monitoring via GPS.

Source: Study Team

Chapter 5. Production Plant Development in Target area

5.1 Overview of Target area

The history of parcel formation at the target site over the past 10 years is shown, indicating that the original farmland and water bodies have been altered due to local land development and infrastructure improvements..

5.1.1 Existing Development Conditions

5.1.1.1 Onsite Development

Figure 5-1 illustrates the chronology of plot formation in Target area over the past 10 years. The original plantation land and water bodies have been transformed through on-site land development and infrastructure modifications.

5.1.2 Summary of Operations and Management Characteristics

Target area is being developed for the manufacturing of new chemical products and is characterized by the following features:

Table 5-1 Summary of Operation and Management Characteristics

Main Characteristics	Details
Land Development and Earthwork	The earthwork balance within Target area is being managed effectively by utilizing excavated soil from foundation construction in each block as filling material for other areas within Target area.
Management by common facility	To systematically carry out production, shared facilities such as product storage tanks, Motor Control Center (MCC), electrical rooms, etc. are utilized.
Utility supply	<p>(4) Water Supply: Water is received from a single connection point within the GIDC water network. A flow meter is installed at the connection point to monitor the water supply.</p> <p>(5) Power Supply: Three transformers (66kV/11kV) and electrical panels are planned within Target area. Power will be received via a 66kV cable from the substation located at the southwest of the site (110kV/66kV).</p> <p>(6) Heat Supply: The boiler, which serves as the heat source, is a multi-fuel type, with gas being the primary fuel. Additional fuels, such as coal and biomass briquettes, are also expected to be used.</p>
Transfer of material and utility	<p>(3) Overhead Pipe Rack: To ensure that ongoing construction activities do not interfere with the production processes of individual plants, overhead pipe racks are pre-installed. These racks facilitate smooth execution of future modifications, such as the addition of new pipelines.</p> <p>(4) Above-Ground Fire Hydrant: The fire hydrant system is</p>

	<p>installed as an independent network, separate from the pipe rack system. The water storage tank for the fire hydrant system is also maintained independently from the potable water tank system.</p>
Discharge of wastewater and stormwater	<p>(4) Effluent Treatment Plant (ETP): The types of industrial wastewater generated within Target area are clearly identified, enabling efficient operation of a shared ETP system.</p> <p>(5) Sewage Treatment Plant (STP): Domestic wastewater is directed to the STP for appropriate treatment.</p> <p>(6) Stormwater: Three reservoirs are planned within the zone. These will collect rainwater, which will be discharged into surrounding waterways after quality confirmation. Thus, Zero Liquid Discharge (ZLD) Policy does not apply.</p>

Source: Study Team

5.2 Development Plan of the Target Production Plant

5.2.1 Demand Forecast

The establishment of the production plant will generally follow the process, which includes the development of the foundation, plant construction, onsite utility installation, and pipeline connection to the utility area. Estimating the production generation at 10 tons per day, the demand forecast of necessary utilities and waste production are outlined below.

Table 5-2 Demand and Waste Production Forecast for the Target Plant

Items	Demand or Waste Production Forecast
Water	300 m ³ /day
Sewage	25 kL considering 200 manpower
Coal	275 MT/day
Power	20,000 KW hr/day
Solid waste (Inorganic)	5 TPD
Residue for incineration	3 TPD

Source: Partner

5.3 Onsite Utility Connection Plan

5.3.1 Logistics Plan

Tankers that transport raw materials and final products utilize the internal roads, while utilities are connected via a pipe rack system.

Raw chemical materials will be stored centrally in the chemical tank farm before being delivered to each production plant. Similarly, storage tanks are available for the final production, where the output materials are stored.

5.3.2 Water Supply Plan

Water is sourced from GIDC's overhead water tank located offsite and connected to an onsite reservoir situated near the northern boundary. From the reservoir, the water flows to the pumping station tank and is then distributed to the production plant through internal water pipelines mounted on a pipe rack system.

5.3.3 Power Supply Plan

Power is sourced from the offsite 66kV substation operated by GETCO, located to the southwest of Target area. The power is then distributed to the onsite transformer in Target area, where it is stepped down to 11kV and further decentralized to three motor control centers (MCC) before being supplied to the target plant.)

5.3.4 Heat Supply Plan

The first steam boiler (50 TPH) is designed to operate using materials such as coal and biomass briquettes. The generated steam will be transmitted to the target plant through a pipe rack system.

5.3.5 Wastewater (Sewage and Effluent) Treatment Plan

The sewage and effluent generated from the target production plant will be transmitted to the onsite sewage treatment plant (STP) and effluent treatment plant (ETP). Treated water will be discharged through the northwest discharge point and sent to the NCT treatment plant for further treatment before being discharged to deep sea. Hazardous waste materials will be filtered and temporarily stored in a designated area adjacent to the treatment plants.

In Target area, the generated wastewater will undergo primary and secondary treatments onsite before being discharged and transported to the NCT treatment plant for further tertiary treatment.

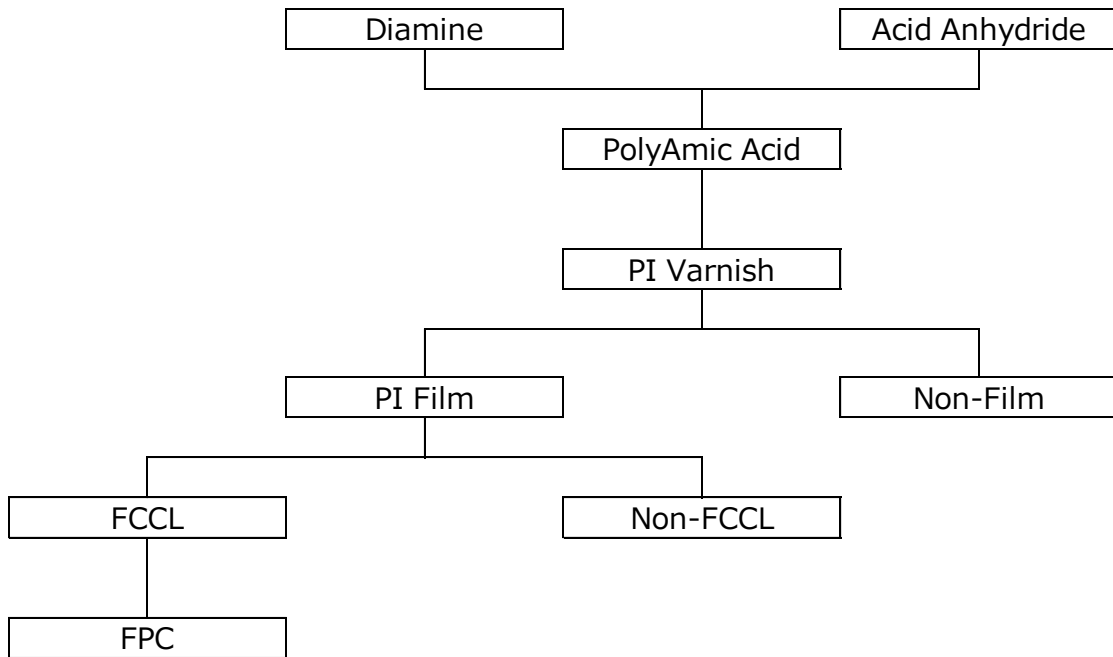
5.3.6 Stormwater Drainage Plan

Stormwater runoff from the surrounding area of the target plant will be directed out of Target area through the internal drainage network. The discharged stormwater will flow into the GIDC stormwater drainage system along the road, ultimately being released into the canal that runs through the industrial estate.

Chapter 6. Market Analysis of Products

6.1 Product Flow

Polyimide (PI) is a polymer synthesized by polymerizing diamine and anhydride. It is used either as varnish or film.



Source: Created by Study Team

Figure 6-1 Product Flow Diagram

Chapter 7. Technical Verification

7.1 Metal Management

Since target material is used in semiconductor, extremely stringent control of metal content in the product is required.

7.2 Improvement of Metal Management Technology

To promote improvements in metal management technology, we have engaged, a Japanese precision chemical manufacturer as a technical consultant.

7.3 Establishment of Manufacturing Process through Scale-Up Production

During the survey period, we conducted scale-up production of the target product, which had been prototyped at the laboratory level, using a pilot plant. A key challenge during the scale-up was the stable management of the metal content in the product. To promote technological improvements related to metal management, we engaged a Japanese precision chemical manufacturer as a technical consultant.

Out of the total 14 batches produced, 3 batches met the specifications. For the batches that did not meet the specifications, improvements are still needed in terms of the metal content exceeding the customer's standard values and the product's color, which should be transparent but is instead slightly yellowish.

Chapter 8. Business Plan

8.1 Business Structure

Partner and Sojitz will jointly invest to establish a Joint Venture (hereinafter referred to as JV).

8.2 Financial Analysis

At the market price at the start of this project evaluation, a profit was anticipated. However, at the current market price, the result is that the profit for this term is negative, and profitability cannot be expected.

Chapter 9. Environmental and Social Considerations

9.1 Project Summary

Sojitz and its partner are assessing the proposed business for several compelling reasons. Partner has already established a raw material manufacturing operation for semiconductor materials, specifically polyimide, at its existing facility in Jhagadia, Gujarat. This site is also involved in the production of various chemicals and supplies products to Japan.

The project falls under Schedule 5(f) Category–“B” as per EIA Notification 2006 and its amendment thereof. The project has obtained Terms of Reference (ToR) via letter no SIA/GJ/136909/2020 dated 03.09.2020 from SEIAA, Gujarat. In addition, according to screening under JICA Guidelines for Environmental and Social Considerations, 2022, the project is categorized as Category B.

9.2 Environmental and Social Consideration Systems/Organizations in Gujarat, India

9.2.1 EIA Notification 2006

The Environmental Impact Assessment (EIA) Notification 2006 in India is a key regulatory framework under the Environment Protection Act, 1986. It outlines the process for assessing and mitigating the environmental impacts of proposed industrial, infrastructural, and developmental projects. The notification mandates that certain categories of projects must obtain environmental clearance before construction or expansion.

Over the years, the notification has been revised several times to address emerging environmental challenges and streamline processes. The 2020 Draft EIA Notification proposed changes such as exemptions for some projects, reduced public consultation periods, and retrospective clearances, but faced widespread criticism for potentially diluting environmental protections. India's EIA framework is a cornerstone of environmental governance, requiring careful balancing of development needs with ecological sustainability.

9.2.2 List of Environmental Regulations

Regulations	Summary
The Water (Prevention and Control of Pollution) Act, 1974 and Rules, 1975	<ul style="list-style-type: none"> Regulates the prevention, control, and abatement of water pollution. Establishes pollution control boards at the central and state levels.
The Air (Prevention and Control of Pollution) Act, 1981 and Rules, 1982	<ul style="list-style-type: none"> Controls air pollution by regulating emissions from industrial and vehicular sources. Assigns regulatory authority to central and state pollution control boards.
The Noise Pollution (Regulation and Control) Rules, 2000	<ul style="list-style-type: none"> Set permissible noise levels for industrial, commercial, residential, and silence zones. Provides for noise mapping and control measures.
The Hazardous and Other Wastes (Management and Transboundary	<ul style="list-style-type: none"> Manages hazardous and transboundary waste movement.

Movement) Rules, 2016 and Amendments thereafter	<ul style="list-style-type: none"> Ensures environmentally sound disposal.
The Plastic Wastewater Management Rules, 2016 and Amendments thereafter	<ul style="list-style-type: none"> Regulates the use, collection, and recycling of plastic waste. Bans single-use plastics and emphasizes extended producer responsibility (EPR).
The Bio-Medical Waste Management Rules, 2016 and Amendments thereafter	<ul style="list-style-type: none"> Governs the segregation, handling, and disposal of bio-medical waste.
The Construction and Demolition Waste Management Rules, 2016	<ul style="list-style-type: none"> Promotes recycling of construction and demolition debris. Mandates waste management plans for large projects.
The E-Waste (Management) Rules, 2022	<ul style="list-style-type: none"> Regulates the collection, storage, recycling, and disposal of electronic waste. Introduces Extended Producer Responsibility (EPR).
The Battery Waste Management Rules, 2022	<ul style="list-style-type: none"> Ensures safe recycling and disposal of used batteries.
The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989	<ul style="list-style-type: none"> Regulates the handling of hazardous chemicals.
The Rules for the Manufacture, Use, Import, Export and storage of Hazardous Micro-Organism Genetically Engineered Organism Cell, 1989	<ul style="list-style-type: none"> Ensures biosafety in handling genetically modified organisms.
The Ozone Depleting Substance (Regulation and Control) Rules, 2000	<ul style="list-style-type: none"> Controls the production and use of substances that deplete the ozone layer.
Coastal Regulation Zone (CRZ) Notification, 2019	<ul style="list-style-type: none"> Protects coastal ecosystems and regulates activities along the coastline.
Utilization of Fly Ash – Notification of Direction, 1999	<ul style="list-style-type: none"> Promotes the use of fly ash in construction and other applications to reduce waste.
Eco-mark Resolution, 1991	<ul style="list-style-type: none"> Certifies eco-friendly products to promote environmental awareness.
The Public Liability Insurance Act, 1991	<ul style="list-style-type: none"> Requires industries to have insurance coverage for environmental accidents.
The Environmental Audit Scheme, 1996	<ul style="list-style-type: none"> Encourages self-regulation by requiring periodic environmental audits.

Source: Study Team

9.3 Examination of Alternatives

Site selection: The proposed project is located at GIDC notified industrial estate, Jhagadia.

Because the site is located within an industrial estate, the following benefits are available.

- Substantial Utility Supply- Water, Power & Gas
- Availability of chemical handling port in Dahej
- Strategic location
- Easy Connectivity by Rail, Air and Sea

In addition, the following factors within the study area (10 km) have also been considered.

- There is no National Park or Wildlife Sanctuary
- There are no metropolitan cities
- There are no ecologically sensitive areas.

For those reasons, an alternative site is not considered.

9.4 Scoping

According to interview and composed EIA. The following is the scoping matrix.

Table 9-1 Scoping matrix

Scoping Matrix				
Sector	Items	Assessment		explanation
		Before and during construction	During operation	
Pollution	Air pollution	✓	✓	<ul style="list-style-type: none"> · During Construction: there is a temporary negative impact on air quality due to the operation of construction vehicles/equipment. · During Operation: It estimates the increase the number of workers, and increase number of vehicles. It might cause the negative impact on air quality.
	Water quality	✓	✓	<ul style="list-style-type: none"> · During Construction: embankment work may be carried out when the plant is extended, which may cause turbidity. Possible muddy water emissions, in the case of base camp establishment, Possible pollution if waste is dumped in its present state. · During Operation: organic polluted water may be discharged from toilets, etc.
	Wastes	✓	✓	<ul style="list-style-type: none"> · During Construction: construction waste such as construction debris is expected to be generated. · During Operation: general waste and human waste will be generated from toilets, etc.
	Soil contamination	✓	✓	<ul style="list-style-type: none"> · During Construction: Minor soil contamination due to oil leakage from heavy machinery and transport vehicles. · During Operation: soil contamination surrounding areas due to oil leaks from related vehicles.
	Noise/Vibration	✓	✓	<ul style="list-style-type: none"> · During Construction: noise and vibration is expected to occur due to the operation of construction-related vehicles/equipment. · During Operation: noise is expected to occur due to the increase of plants.
	Ground subsidence	-	-	During Construction / Operation, the area is industrial area, and no ground subsidence.
Natural environment	Protected areas	-	-	· During Construction /Operation: there is no protected areas exist in and around the project area.
	Biodiversity	✓	✓	
	Hydrology	-	-	The area is inside industrial area. No need to think about hydrology
	Terrain/ Geology	-	-	The area is inside industrial area. There is no difficulties about terrain and geology.
Social Environment	Land acquisition and resettlement	-	-	· During Construction / Operation: Project site is within industrial area. No land acquisition and resettlement needed.
	Livelihoods	✓	✓	· During Construction/Operation : the possibilities of employment generation from surround area should be considereed
	Socially vulnerable	-	-	<ul style="list-style-type: none"> · During Construction: it has been confirmed that there are no socially vulnerable persons living in the project area. However, if there are vulnerable groups living in the surrounding area, there could be consequential or secondary impacts due to the construction work. · During Operation: No activities are envisaged that would have a negative impact on vulnerable group.
	Cultural heritage	-	-	· During Construction / Operation: The project site and its surroundings do not have any cultural heritage (tangible or intangible).
	Landscape	-	-	· During Construction / Operation: The project site located within industrial area, so there is no impact for landscape..
	Ethnic minorities/indigenous people	-	-	· During construction / Operation: it has been confirmed that there are no ethnic minorities or indigenous peoples living in the project area.
	Working environment (work safety)	✓	✓	<ul style="list-style-type: none"> · During Construction: the construction working environment must be ensured in accordance with relevant legislation. · During Operation: a suitable working environment for plant staff needs to be ensured in accordance with relevant legislation.
Health, safety and security of local communities	✓	✓	<ul style="list-style-type: none"> · During Construction: influx of construction workers may lead to the spread of STDs and infectious diseases. In addition, land changes due to cut and fill may create new habitats for mosquitoes. Traffic accidents may occur as construction vehicles use the road. · During Operation: It might increase the number of workers, and increase traffic. 	

Source: Study Team

9.5 Impact Assessment

The impact assessment has been done within EIA regarding the upcoming project. The following is the impact matrix.

Table 9-2 Impact matrix

Sector	Item	Impact Assessment during Scoping		Impact Assessment based on Survey Results		Evaluation
		Before and during construction	During Operation	Before and during Construction	During Operation	
Pollution	Air Pollution	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: There is the possibilities about dust generation from excavation activities, emission of HC, Co, Nox & PM from vehicular transportation, and spilage & leakage during transportation of solid, liquid and gaseous raw materials. During Operation: There is the possibilities about emission of HCl, Cl2, HF and HBr, fugitive emissions of solvents, emission of PN,SO2 and NOX from D.G, boiler, and furnaces / thermopack, and emission of HC & Co from vehicular transportation during operational phae.
	Water Quality	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: Sewage generation during construction phase During Operation: There are possibilities about wastewater generation from process, spillage and leakage of solvents/acids during manufacturing process, generation of waste water from cooling tower, DM water, softener, scrubber & boiler, generation of wastewater during floor washing, sowage generation, contamination of surface water, soi and biodiversity during storm water runoff, and consumotion of fresh water.
	Wastes	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: There are generation of debris from excavation activities, and generation of scraps from fabrication work. During Operation: Industrial and administrative processes generate various types of waste, including hazardous materials, plastic containers, MEE salt, used oil, fly ash, and sewage sludge from manufacturing and utilities. Additional waste includes discarded electronic devices, lead-acid batteries, biomedical items like bandages and gloves, and general office waste such as plastic bottles, wrappers, and paper products. These activities highlight the need for effective waste management to handle diverse waste streams responsibly.
	Soil Contamination	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: The removal of top soil during site clearance, and possibilities of spillage and leakage of raw materials or product during procurement of raw materials, During Operation: There are possibilities about spillage and leakage of raw material or product during procurement of raw materials, and contamination of surface/ground water, soil and biodiversity during stormwater runoff.
	Noise/vibration	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: There are disturbances to the habitat due to noise generation. During Operation: There are noise generation from D.G set
	Ground subsidence	-	-	N/A	N/A	The construction area is GIDC industrial area, there is no ground subsidence
Natural Environment	Protected Areas	-	-	N/A	N/A	
	Biodiversity	✓	✓	B-	B-	<ul style="list-style-type: none"> During Construction: Disturbance to Habitat due to noise generation During Operation: There are possibilities of deterioration of foliage due to coal dust and contamination of surface water, soil and biodiversity during stormwater runoff
	Hydorology	-	-	N/A	N/A	The project area is GIDC Industrial Estate, so hydrorology is not applicable.
	Terrain/geology	-	-	N/A	N/A	The project area is GIDC Industrial Estate, so terrain/geology is not applicable.
Social Environment	Land Acquisition and Resettlement	-	-	N/A	N/A	The project area is GIDC Industrial Estate, so no land acquisition and resettlement,
	Livelihood	✓	✓	B+	B+	There are possibilities to create employment oppotunities.
	Socially Vulnerable	-	-	N/A	N/A	Socially vulnerable people are not identified.
	Cultural Heritage	-	-	N/A	N/A	The project area is GIDC Industrial Estate, there is no cultural heritage to be protected.
	Landscape	-	-	N/A	N/A	The project area is GIDC Industrial Estate, not applicable about landscape.
	Ethnic minorities/indegenous people	-	-	N/A	N/A	The ethnic minorities and indigenous people are not identified surrounding project site.
	Working Environment (work safety)	✓	✓	B-	B-	Working environment and worker's safety should be properly protected.
Health Safety and security of local communities	✓	✓	B-	B-	The plant will be used hazard or toxic materials. These materials should be properly controlled.	

Source: Study Team

9.6 Mitigation Measures and Costs for Implementing Mitigation Measures

According to the above impact assessment, the following mitigation measures are proposed to be implemented.

Table 9-3 Mitigation measures

Before and During Construction			
Sector	Item	Expected Impact	Mitigation Measure
Pollution	Air Pollution	There is the possibilities about dust generation from excavation activities, emission of HC, Co, Nox & PM from vehicular transportation, and spillage & leakage during transportation of solid, liquid and gaseous raw materials.	<ul style="list-style-type: none"> Regular water sprinkling and dust mask will be provided Maintaining the speed limit of vehicle transporting construction materials Use of only PUC certified vehicles Materials will be transported in closed or covered trucks.
	Water Quality	Sewage generation during construction phase	Sewage will be treated in soak pit
	Wastes	There are generation of debris from excavation activities, and generation of scraps from fabrication work.	<ul style="list-style-type: none"> Debris will be reused in filling low lying area Scraps will be given to authorized vendors
	Soil Contamination	The removal of top soil during site clearance, and possibilities of spillage and leakage of raw materials or product during procurement of raw materials,	<ul style="list-style-type: none"> Top soil will be stacked separately and will be used for greenbelt development and filling lowlying area. Materials will be transported in covered trucks. Drivers will be trained to handle the spillages and leakages.
	Noise/vibration	There are disturbances to the habitat due to noise generation.	Use of properly certified, tested and calibrated equipments
Natural Environment	Biodiversity	Disturbance to Habitat due to noise generation	<ul style="list-style-type: none"> Greenbelt of 33.01% is already planned with the premises It will be ensure that no fauna or flora species are disturbed. Activities will be carried out during day time only.
Social Environment	Livelihood	Employment opportunities might be considered	<ul style="list-style-type: none"> The unskilled employment potential will be used for site cleaning during pre-construction phase. The skilled and unskilled employees/workers will working during construction phase for activities like excavation, site levelling
	Working Environment (work safety)	Working environment and worker safety should be maintained	Risk assessment studies regarding hazard identification and risk assessment and qualitative risk assessment was carried out for the various activities and hazardous chemical storage at the facility
	Health Safety and security of local communities	Health safety measure should be maintained	<ul style="list-style-type: none"> AIL will have well equipped occupational health center to cater any health related emergency situation. Qualified doctors and nurses will be available. All workers and employees will be provided safety gadgets

During Operation			
Sector	Item	Expected Impact	Mitigation Measure
Pollution	Air Pollution	There is the possibilities about emission of HCl, Cl ₂ , HF and HBr, fugitive emissions of solvents, emission of PN,SO ₂ and NOX from D.G, boiler, and furnaces / thermopack, and emission of HC & Co from vehicular transportation during operational phae.	<ul style="list-style-type: none"> Water/Caustic/Aq. HF/H₂O₂ scrubber will be provided to control the emission. Solvents will be recovered by installation of solvent recovery system and it will be reused into manufacturing process. ESP & Lime dosing will be provided to boiler, furnaces and thermopack. Adequate stack height will be provided to DG set. DG set will be used only during emergencies. Maintaining the speed limit of vehicle transporting materials. Use of covered vhecles with tarpaulin for transport of raw materials Use of only PUC certified vehicles Green Belt development will improve the aesthetic value of the project sites.
	Water Quality	There are possibilities about wastewater generation from process, spillage and leakage of solvents/acids during manufacturing process, generation of waste water from cooling tower, DM water, softener, scrubber & boiler, generation of wastewater during floor washing, sowage generation, contamination of surface water, soi and biodiversity during storm water runoff, and consumption of fresh water.	<ul style="list-style-type: none"> Wastewater from process will be treated in MEE + ATFD and ETP and partially recycled back via RO and partially discharge outside after treatment. Area will be paved to avoid the spillage/leakage leaching into GW Wastewater from utilities will be treated in RO, MEE + ATFD Wastewater from floor washing will be treated in ETP Sewage generated during operation phase will be treated in proposed STP and recycle for gardening
	Wastes	Industrial and administrative processes generate various types of waste, including hazardous materials, plastic containers, MEE salt, used oil, fly ash, and sewage sludge from manufacturing and utilities. Additional waste includes discarded electronic devices, lead-acid batteries, biomedical items like bandages and gloves, and general office waste such as plastic bottles, wrappers, and paper products. These activities highlight the need for effective waste management to handle diverse waste streams responsibly.	<ul style="list-style-type: none"> Discarded containers/Plastic waste/bags/drums/carboys will be given to authorized dealers/recyclers. Hazardous waste from manufacturing, utilities, ETP,MEE will be managed as Hazardous Waste Management Rules, 2016 E-waste will be handled as per E-waste (Management) Rules, 2016 (as ammended 2018) Batteries will be handled as per Batteries Waste Management Rules, 2020 Plastic Waste will be managed as per Plastic Waste Management Rules, 2016 (as ammended 2018) Bio-medical waste will be managed as per Biomedical Waste Management Rules, 2018 Sewage sludge will be used as manure Fly ash will be sold to brick and cement manufacturing industry
	Soil Contamination	There are possibilities about spillage and leakage of raw material or product during procurement of raw materials, and contamination of surface/groundd water, soil and biodiversity during stormwater runoff.	<ul style="list-style-type: none"> Materials will be transported in covered trucks. Drivers will be trained to handle the spillages and leakages. Separate storm water drains will be provided to avoid mixing of storm water with process area
	Noise/vibration	There are noise generation from D.G set	<ul style="list-style-type: none"> Acoustic enclosures would be provided. DG set will be used only during emergencies Adequate Greenbelt development
Natural Environment	Biodiversity	There are possibilities of deterioration of foliage due to coal dust and contamination of surface water, soil and biodiversity during stormwater runoff	<ul style="list-style-type: none"> Transportation of foliage's due to coal dust Contamination of surface water, soil and biodiversity during stormwater runoff
Social Environment	Livelihood	Employment opportunities might be considered	During operation phase, certain numbers of employees will be appointed on regular basis
	Working Environment (work safety)	Working environment and worker safety should be maintained.	<ul style="list-style-type: none"> Adequate number of flammable and toxic gas detectors near to pipelines, storage and surrounding area.
	Health Safety and security of local communities	Health safety measure should be maintained	<ul style="list-style-type: none"> Periodical medical check-up as per factory rules will be done for employees and contract workers, and health record will be maintained.

Source: Study Team

9.7 Monitoring Plan

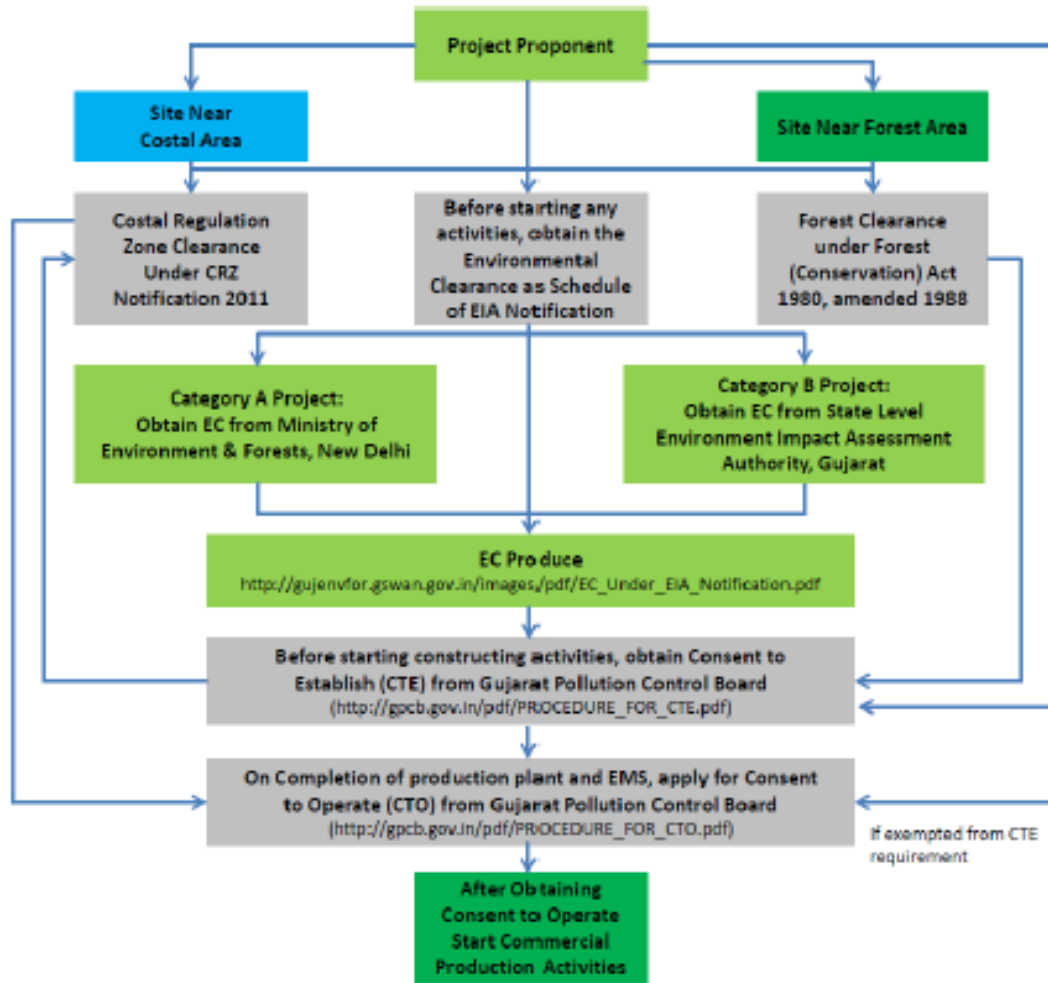
9.7.1 General Monitoring Plan

Partner will set a monitoring plan that includes monitoring of HCl, Chlorine, HF, HBr, Sulphur Dioxide and Oxides of Nitrogen, groundwater quality, noise monitoring by third-party environmental monitoring on a monthly/quarterly basis, and submission of half yearly Environmental Clearance Condition Compliance Report.

The detailed monitoring plan and procedures are mentioned in Chapter 6 and Chapter 10 of EIA document. The following records should be kept as per the requirements of schedules.

- Monthly and Annual Progress Reports
 - Immediately upon the completion of monitoring as per planned schedule, reports need to be prepared, and necessary documents shall be forwarded to the concerned person.
- Budgetary Provision for Environmental Monitoring and Management Cost
 - Project proponent has already initially allotted Capital and Recurring cost for the Environmental Monitoring and Management. It is detailed in Chapter 10 of EIA report.

9.8 Implementation System



Source: Handbook for Japanese Companies' Investments in Gujarat (2013), Matsuda & Partner

Figure 9-1 Implementation System

In the proposed project, already EC was issued and current operation plants have already acquired Consent to Establishment (CTE), and Consent to Operate (CTO) from GPCB.

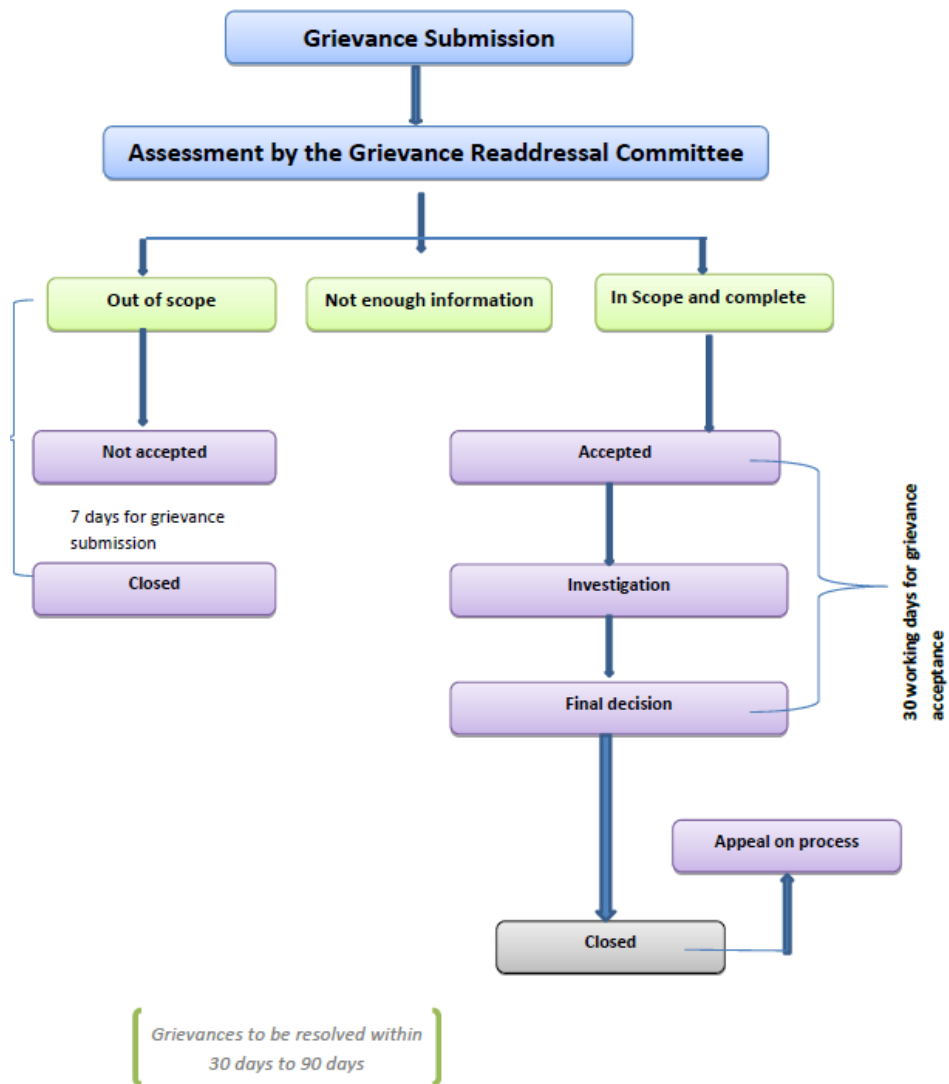
9.9 Consultation with Local Stakeholders

- Public Consultation

Public consultation is not applicable for the proposed project as the project site is located in GIDC Notified Industrial Estate of Jhagadia.

9.10 Grievance Redress Mechanism

Partner has already created Grievance Redress Mechanism as company policy, and the following process has been working in operated plants.



Source: partner

Figure 9-2 Grievance Redress Mechanism

9.11 Land Acquisition and Resettlement

The project site is within Jhagadia GIDC, and the facility will be set up within the existing facility of partner. No land acquisition and resettlement required.

Chapter 10. Legal Procedures and License Registration Process

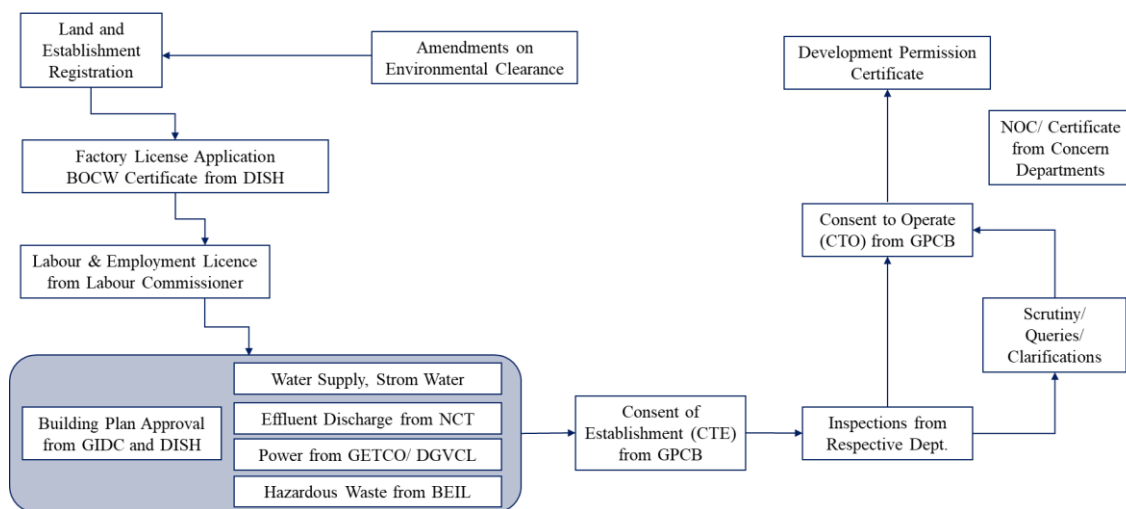
10.1 General Legal Procedures for Single Zone Development

10.1.1 General License and Registration Process

To establish an industrial zone within the GIDC Notified Industrial Park, investors or industrialists must register through the Single Window Mechanism available on the investor facilitation portal established by the Government of Gujarat.

The application should be completed with all necessary information, includes Building Plan, Factory License, investment details, type of industry etc. Upon submission, the application is forwarded to various line departments for No Objection Certification (NOC)/clearances. The competent authority will review the documents and raise any queries or clarifications within seven days of receiving the application, communicated via courier or email, whichever is received last.

The steps involved in the permission application process are outlined in the flow chart below, providing a clear overview of the procedural workflow.



Source: Study Team based on Discussions with GIDC, partner, JIA

Figure 10-1 General License and Registration Process

10.1.2 The Status of Legal Procedure for Target area

Partner has successfully completed the necessary legal procedures for the entirety of Target area. As a result, individual industrial units, such as the production plant to be developed by Sojitz within the allocated land parcel, are not required to undertake the same legal processes except for the Building Plan Approval.

10.2 Details of Each Legal Procedure

10.2.1 Land and Establishment registration

When setting up an industrial unit on leased land, both the lessee and lessor are required to execute and register a legally binding lease agreement with the local Sub-Registrar. This ensures that the land is properly zoned for industrial use and that any necessary approvals for land-use conversion, if required, are obtained. Additionally, establishment registration must be completed in accordance with the applicable laws. GIDC has leased Target area to Partner

10.2.2 Factory License & BOCW Certificate

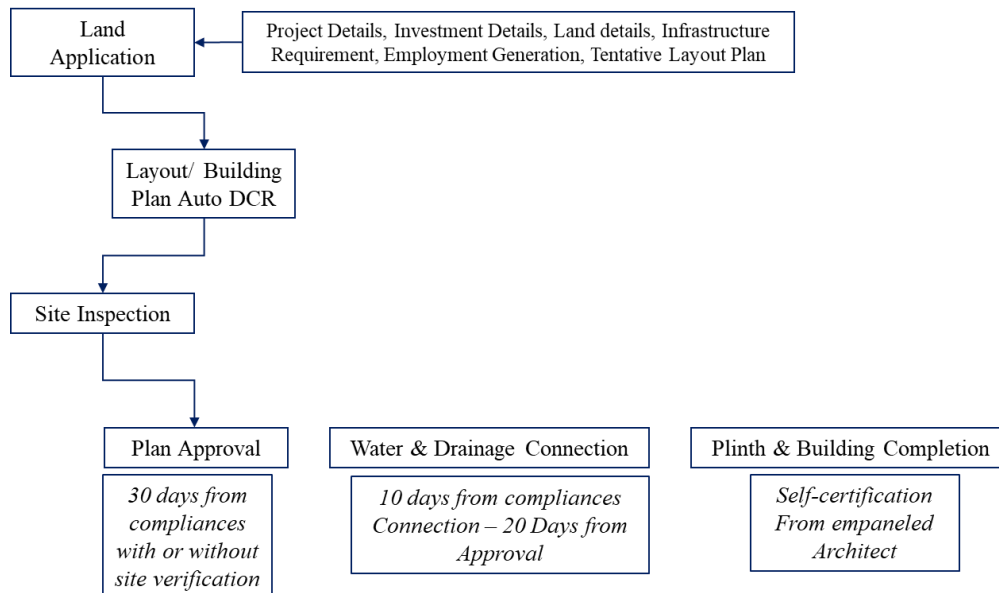
The Building and Other Construction Workers (BOCW) Certificate is issued by the Directorate of Industrial Safety & Health (DISH) to ensure compliance with the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. This certificate is mandatory for construction projects employing 10 or more workers.

To obtain the certificate, the lessee must register the establishment with DISH, provide details of the workers, pay the applicable fee, and ensure compliance with worker welfare provisions, including safety, health, and welfare measures. The certificate is crucial for legal operations and entitles workers to benefits under the Act.

10.2.3 Building Plan Approval from GIDC and DISH

Building Plan approval will be obtained from GIDC and DISH. During the planning and design phase of the industrial unit, the Industrial Development Control Regulation 1996 must be adhered to, in accordance with the GIDC Act 1962.

The flowchart below illustrates the process for obtaining Building Plan approval from various agencies during the pre-operational stage.



Source: Discussion with GIDC

Compliances refer to the Comprehensive General Development Control Regulations 2017 (Industrial Building Regulations) followed by GIDC.

Figure 10-2 Building Plan Approval Process Chart

Individual units proposed within Target area are still required to comply with the following procedures during both the pre-establishment and post-establishment phases.

Table 10-1 List of License/ Registration for establishment of Industrial Unit

Sr. No	Necessary License and Registration	Remarks
1	Environmental Clearance from Ministry of Environment and Forest – Partner has obtained environmental clearance for certain Industries. Amendments will be required for any other industrial categories that are not listed	Obtained
2	Labor license from Assistant Labor Commissioner office, Bharuch	To obtain
3	Building drawing approval from GIDC and DISH (No separate NOC/ approval from fire department)	To obtain
4	Factory License/ Building and Other Construction work certificate during construction from DISH	To obtain
5	Electricity/ Power Supply Connection approvals from GETCO (Gujarat Energy Transmission Corporation Limited) and Dakshin Gujarat Vij Company Limited	Obtained*
6	Water supply, Storm water, Septic tank approvals from GIDC	Obtained
7	Hazardous waste approval from Bharuch Enviro Infrastructure Ltd (BEIL)	To obtain
8	Effluent disposal approval from Narmada Clean Tech (NCT)	To obtain
9	CTE – Consent to Establishment – GPCB after getting EC from MoEF	To obtain
10	CTO – Consent to Operate from GPCB	To obtain
11	Professional tax registration from local panchayat	To obtain
12	Property tax registration by “Notified Area Authority	To obtain
13	Explosive Storage area Approval from PESO (Petroleum and Explosives Safety Organization), if required	To obtain

*If the overall requirement for Zone IV exceeds 66 KVA, then additional power shall be obtained from GETCO.
Source: Discussion with GIDC, Partner, JIA.

10.2.4 Consent of Establishment from GPCB

The Consent to Establish (CTE) from the Gujarat Pollution Control Board (GPCB) is a mandatory approval under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981 for setting up an industrial unit in a GIDC industrial area.

To obtain the CTE, the applicant must apply through the Xtended Green Node (XGN) portal of GPCB, providing details such as the project layout, manufacturing process, raw materials, pollution control measures, and proposed waste disposal methods. Supporting documents, including the land allotment letter from GIDC or the Lessee, site plan, environmental management plan, and NOC from relevant authorities, must also be submitted.

The CTE ensures that the proposed industry complies with environmental regulations before beginning construction or operations. The following checklist serves as a reference for preparing for the pre-establishment phase.

Table 10-2 Checklist for Consent to Establish

Sr. No	Items
1	Drawings/Maps (a) Site Plan (b) Key Plan (c) Detailed drawing with machine layout in third

	angle projection
2	Proof of ownership building or land (a) GIDC allotment letter (b) Letter of approval of construction by local authority (c) Sale deed (d) Lease deed (e) Form No. 7 / 12 of Gram Panchayat
3	Proof of Occupier (a) Partnership deed (b) Memorandum of Article of Association (c) Appointment letter of concerned administrative department Occupier for Government owned factories (d) Other documents.
4	Schedule VII (Notification of site) with MSDS for chemical factory
5	GPCB consent / NOC, List of raw material, finished goods Flow process chart
6	Annexure B for Chemical Industry PESO license/approval (if applicable)
7	Process description with parameter
8	Fire load calculation as per Rule 66 A
9	Details of firefighting equipment

Source: Study Team based on Discussion with JIA and Partner

10.2.5 Consent to Operate (CTO) from GPCB

After obtaining the CTE, industries are required to secure the CTO from the GPCB before commencing production. This ensures compliance with environmental regulations under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981.

The CTO application is submitted through the XGN portal, along with necessary documents such as a copy of the CTE, details of the pollution control measures implemented, Environmental Clearance (if applicable), waste management plans, and monitoring reports of treated emissions and effluents. GPCB will conduct an inspection of the facility to verify compliance before granting it to the CTO. The validity of the CTO depends on the industry category (e.g., Green, Orange, or Red) and must be periodically renewed to ensure continued compliance.

10.2.6 Development Permission Certificate by DISH

The Development Permission Certificate from the DISH is a required approval for industries planning to establish or expand operations. This certificate focuses on workplace safety, health measures, and the structural adequacy of the industrial premises.

To obtain the certificate, the applicant must submit detailed information, including building layout plans, site details, machinery specifications, and safety provisions, through the DISH portal or the respective state authority. The plans must comply with statutory requirements related to worker safety, emergency exits, ventilation, and firefighting systems. DISH conducts inspections and reviews the application before granting the certificate. This approval is crucial for ensuring that the industrial establishment meets legal safety and health standards during and after construction.

Chapter 11. Summary of the Feasibility Study

11.1 Conclusion

The following section provides a detailed summary of the feasibility study, addressing each topic with the identified issues and corresponding proposed recommendations.

11.1.1 Offsite Utility and Access Road

Issue As mentioned in Chapter 4, Jhagadia GIDC established over three decades ago, faces challenges associated with its maturity. These include deteriorating access roads from Bharuch and Ankleshwar, as well as aging offsite utility infrastructure, which may impact production reliability of the target plant.

Proposed Recommendation To mitigate these issues, it is recommended to formulate contingency plans for alternative utility sources in collaboration with Partner, the intermediate utility service provider for the target plant. Furthermore, regular engagement with the Jhagadia Industrial Association (JIA) is essential to advocate for consistent maintenance and infrastructure improvements. Collaborative efforts with local stakeholders will play a critical role in ensuring stable utility provision and enhancing the operational reliability of the target plant.

11.1.2 Operational Readiness of the Target Plant

Issue The operation of the target plant is dependent on the completion and functionality of critical onsite utilities and connection infrastructure, such as the pipe rack and connecting pipelines. These elements are essential for the seamless operation of the plant. However, there are significant challenges due to the complexity of the material and utility requirements. Additionally, key facilities, including the boiler and utility tanks, are still under construction. This raises concerns about potential delays in their readiness, which could misalign with the target plant's construction timeline.

Proposed Recommendation It is crucial to closely monitor and regularly follow up on the progress of onsite utility development with partner. Proactive engagement and consistent updates on progress will help address potential risks, ensuring the timely availability of the necessary utilities and infrastructure for the commencement of the plant's operations.

11.1.3 Environmental and Social Considerations

Issue Biodiversity

Proposed Recommendation Greenbelt of 33.01% should be ensured with premises. Construction activities will be carried out during daytime only.

Issue Livelihood

Proposed Recommendation Employment opportunities of surrounding area should be considered. As proposed EIA, the unskilled workers employment opportunities might be available for site cleaning during pre-construction phase. In addition, the skilled workers might be used for activities like excavation, and site leveling. Then, if available, a certain number of employees should be hired on a regular basis.

Issue Working Environment (Work Safety)

Proposed Recommendation Risk assessment should be done before carrying out activities. Then, all workers and employees need to be provided with safety equipment.

11.1.4 Quality Control, Including Metal Management

Issue Ensuring Quality Stability After the Construction of the Commercial Plant

Proposed Recommendation It is recommended to continue employing technical consultants in Japan who excel in metal management. By receiving advice on improvements as needed, it is necessary to achieve a reduction in metal content.

11.2 Analysis of Project Risks

In general, since the production plant is being constructed within partner's premises, where a similar plant has already been developed and a pilot project successfully conducted, the associated risks are minimal.

Annexure 1 List of Documents Required for Industrial Unit

List of Documents required while Industrial Units to set-up in the Notified Area

Sr No	Documents/ Licence/ Registration
1	Company registration Certificate (RoC)
2	PAN Registration
3	TAN Registration
4	Investment Facilitation Portal registration (IFP)
5	Application for Land registration Or Transfer order (Leasehold Land) /NA Order (Free hold Land)
6	Authority Letter/ Board resolution for sign the Documents
7	Land Possession & Receipt/Occupancy Certificate (For Lease hold Land)/ Title Deed (For free hold Land)
8	Land Agreement
9	Addition of Plot No. in GST registration or New GST registration
10	Lease deed
11	Site Survey/ Contour Survey
12	Amendment in DD Plan & Field Book
13	Industrial Entrepreneurs Memorandum (IEM)
14	Application for Environment Clearance (EC)
15	Water Assurance Letter
16	Drainage Assurance Letter
17	NOC for Hazardous Waste
18	CER / CSR Proposal & Approval (Depending on Project cost as declared)
19	EIA
20	Receipt of EC
21	CTE based on TOR
22	Proposed Plan Approval
23	Labour Registration
24	Professional Tax Registration (Principle & Contractor)
25	BoCW
26	Temporary Power connection
27	Proposed Plan for Class A, B & C (Petroleum)
28	Proposed Plan (SMPV)
29	Proposed Plan (Gas Cylinder)
30	RoU (Chlorine)
31	Noc- GETCO for Cl2 line
32	Noc- Gujarat Gas for Cl2 line
33	RoU (Hydrogen)
34	RoU (Steam)
35	PF Registration
36	WC Registration
37	PLI Policy
38	Registration of Employment Exchange
39	Boiler installation / Steam pipeline Plan Approval
40	Plan Approval

Sr No	Documents/ Licence/ Registration
41	Building Stability Certificate
42	Fire NOC
43	Drainage connection
44	NoC for Petroleum License (drum storage)
45	NoC for SMPV License
46	NoC for Gas Cylinder
47	Petroleum License (Class A,B,C)
48	Storage License SMPV
49	Gas Cylinder Storage & Handling
50	Acid / Poison License
51	Hazardous Waste Membership TSDF/ Incineration Agreement
52	Rule-9 Permission (part of CTO and green passbook)
53	Registration under Legal Metrology
54	Calibration certificate for Balance/ Tanks/ Weighing/ Filling Machine
55	Bio Medical Waste Authorization
56	SPCB Consent-to operate (CTO/CCA)
57	Factory Licence
58	GIDC/SEZ Plan Approval (As built)
59	Approved Single line diagram of electrical installation
60	Process/flue gas stack thickness report
61	Corrosive storage thickness test report by competent person
62	Lifting tools and tackles certificate by competent person
63	Hoist and lift certificate-by competent person
64	Pressure vessel/plant test certificate by competent person (visual/external inspection 6 month, Thickness test-1year, Hydraulic and internal test-every two year, if continuous plant every four year NDT with permission of FI)
65	Thermic fluid heater oil test report
66	Thermic fluid heater coil test report by competent person-68D
67	Process interlocks list and it's test report
68	Forklift registration
69	Fire insurance of the company
70	Bio Medical Waste Disposal
71	E- Waste (Electrical and electronic)
72	MA - I License
73	MA - II License
74	Very High Frequency (VHF) Approval, in case walkie talkie to be used

Sr No	Records/Documents for Audit
1	Occupier as per act at site- registration in DISH (Form-2 & 3)
2	DG capacity at site (it is mentioned in pt no 26)
3	Earthing record (not applied differently)
4	DG neutral record and it's connection

Sr No	Records/Documents for Audit
5	Transformer service record
6	Transformer capacity
7	Transformer body earthing record
8	Transformer Neutral record
9	Earthing record of all equipment
10	Lightning arresters and It's testing record
11	Non Haz.waste disposal
12	Process stack -flue gas analysis record
13	workplace monitoring record-Form-37
14	water balance of site
15	Fire hydrant design and approval from Insurance
16	Illumination study of plant and other area
17	Occupational Health center -and FMO on retainer basis
18	Ambulance van
19	Pre employment medical check up
20	Fitness record of Employee Form-33
21	Health register- Form-32
22	Special fitness certificate by certified surgeon-Form-20(Dangerous operation/Carcinogenic Comp)
23	Accident register(Form-29)
24	FI/Certifying surgeon inspection remarks compliance status
25	Accident record
26	Form no. 7
27	Fire extinguisher certificate from CCOE-for CO2(available)
28	HAZOP/QRA recommendation compliance report
29	HAZ area classification
30	Safety Report submission to DISH
31	On/Off site Emergency plan and submission to DISH
32	SHE policy signed by Occupier and display at site.
33	Waste Oil Disposal -CPCB authorised vendor
34	Used battery disposal or send to dealer (buy back)
35	Plastic waste
36	Cotton Waste