Cluster Profile Report
Ankleshwar Chemical Cluster

Prepared for:
Small Industries Development Bank of India (SIDBI)

SIDBI
भारतीय लघु उद्योग विकास बैंक
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Ankleshwar Environmental Preservation Society	AEPS
Ankleshwar Industries Association	AIA
Ankleshwar Research & Analytical Infrastructure Ltd	ARAIL
Bank of Baroda	BOB
Bureau of Energy Efficiency	BEE
Common Facility Centre	CFC
Dakshin Gujarat Vij Company Ltd	DGVCL
Delhi Mumbai Industrial Corridor	DMIC
Detailed Project Report	DPR
Disaster Prevention and Management Centre	DPMC
District Industries Centre	DIC
Energy Efficiency	EE
Export-Import Bank of India	EXIM
Financial Institute	FI
Gas Authority of India Ltd	GAIL
Global Environmental Facility	GEF
Government of India	GoI
Gujarat Gas Company Ltd	GGCL
Gujarat Industrial Development Corporation	GIDC
Gujarat Pollution Control Board	GPCB
Gujarat State Petronet Ltd	GSPL
High Tension	HT
Industrial Infrastructure Upgradation Scheme	IIUS
Industrial Training Institutes	ITI
International Standards Organization	ISO
Local Service Provider	LSP
Low Tension	LT
Micro Small and Medium Enterprises	MSME
Million Tonnes	MT
Ministry of Environment and Forests	MoEF
Multinational Corporations	MNC
Narmada Cleantech Ltd	NCTL
Panoli Enviro Technology Ltd	PETL
Panoli Industries Association	PIA
Piped Natural Gas	PNG
Small Industries Development Bank of India	SIDBI
Special Economic Zone	SEZ
Standard Cubic Metre	SCM
Strengths Weaknesses Opportunities and Threats	SWOT
The Energy and Resources Institute	TERI
Tonnes of Oil Equivalent	toe
United States Dollar	USD
World Bank	WB

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The study team is thankful to the officials of Ankleshwar Industries Association (AIA) and Panoli Industries Association (PIA) for showing keen interest in the study and providing their wholehearted support and cooperation for the preparation of this cluster profile report. We would like to extend our special thanks to Mr Vipul Gajera, President, AIA and Mr B S Patel, President, PIA.

Last, but not the least, interactions and deliberations with cluster coordinating agencies, industry associations, cluster coordination committee members, Micro Small and Medium Enterprise entrepreneurs, technology providers, and who were directly or indirectly involved throughout the study were exemplary and the whole experience was a rewarding one for TERI.

TERI Team

Certificate of Originality

This is to certify that this report is an original work of TERI. The study was jointly carried out by experts from TERI, New Delhi and the field-based team stationed in the cluster. The teams held detailed discussions and collected data from numerous industry stakeholders, which included MSME entrepreneurs, senior plant engineers, industries associations, local energy distribution companies, key local bodies, local service providers, suppliers, fabricators, experts, testing labs, effluent treatment plants, academic institutes/ITIs, and banks/FIs. In addition to this, the team reviewed secondary literature available in the cluster. The cluster profile is an end product of both first hand interactions/data and secondary literature in the cluster. Appropriate references have been indicated in places where TERI has utilized secondary sources of data and information.

Executive Summary

The chemical industry is an important contributor to the national economy with an estimated size of $30 billion. Ankleshwar is one of the most prominent MSME chemical clusters in the country. The cluster in Ankleshwar is spread over an area of 1,600 hectares and has a close proximity to the National Highway 8 (NH 8) and Delhi–Mumbai Railway Line. Attractive margins in the chemical industry coupled with capital subsidies and tax holidays offered by GIDC during 1970s led to the basic industrial development in Ankleshwar and Panoli. The setting up of large industries like Glaxo, Pfizer, Sterlite, Cadila, and Sun Pharma in this region provided a major boost to rapid industrialization in the cluster. There are close to 1,200 MSME units in the Ankleshwar cluster, out of which 600 are chemical units, which manufacture various types of chemicals, like dyes, pigments, insecticides, specialty chemicals, petrochemicals, pharmaceuticals, and paints. The Ankleshwar chemical cluster mainly caters to the demands of various large pharmaceutical enterprises based in Ankleshwar and large textile manufacturers based in Surat.

The industries in the cluster have formed associations based on their geographic location. These associations address various issues related to the redress of grievances and development of local industries.

In order to obtain a holistic view of the cluster and understand the key energy related cluster dynamics, a study was undertaken in the cluster between June and July. One-to-one meetings were held with about 50 industry representatives. In addition, detailed discussions were also carried out with industry associations, energy suppliers, opinion leaders, and key stakeholders in the cluster. This helped in understanding their roles, type of activities undertaken, and strengths and weaknesses of the cluster.

There are several support institutions working in the cluster and assisting chemical industries on different aspects, such as technological know-how, pollution control and effluent treatment, raw materials, fabrication, financing, testing and training, research and development, redress of grievances, and knowledge dissemination. The Ankleshwar Industries Association (AIA) is the apex organization of the cluster. The industry associations of Ankleshwar and Panoli have set up common effluent treatment plants in collaboration with the government departments. Furthermore, there are government bodies, which operate along with academic institutes and local service providers/suppliers in the cluster. There are also several banks/financial institutes in the cluster, but investments focussing only on energy–efficiency projects are presently low in the cluster. A map showing the link among various stakeholders within the cluster has been prepared.

The manufacturing process of chemical industries involves various processes, such as dissolving, filtration, purification, and drying. Majority of the equipment used by the chemical units like reaction vessels and heating systems are conventionally designed and no efforts have been made by local fabricators to improve the fundamental design of the equipment.

Energy accounts for a sizeable portion (about 7%–15%) of manufacturing costs of the chemical units of Ankleshwar. These units use both thermal and electrical forms of energy to fuel their processes. Total annual energy consumption of chemical manufacturing units in Ankleshwar is estimated at about 408,423 tonnes of oil equivalent (382 million SCM of natural gas and 960 million units of electricity) as per the data gathered from various sources for 2010–11.

Today, the chemical industries of Ankleshwar face a number of challenges especially to control their affluent discharge and pollution. They also face challenges due to the increasing cost of energy and raw materials. The units, now, need to become more efficient to maintain a decent profit margin and keep their manufacturing costs under control and for this, should adopt energy–efficient and clean technologies in their processes.

1.0 About the Project

1.1 Project Overview

The World Bank (WB), with support from the Global Environmental Facility (GEF), has designed the Micro Small and Medium Enterprise Energy Efficiency (MSME EE) project as part of the GEF Programmatic Framework project for Energy Efficiency in India. The objective of this project is *"to increase demand for energy–efficiency investments in target micro small and medium enterprise clusters and to build their capacity to access commercial finance."* This project is to be co-implemented by Small Industries Development Bank of India (SIDBI) and Bureau of Energy Efficiency (BEE).

1.2 Project Objectives

The objectives of this project are:

a) To create increased demand for EE investments by adopting a cluster approach to facilitate the development of customized EE products and financing solutions in five targeted industry clusters, and to build the capacity of identified apex organizations to assist the MSME units in identifying additional EE projects in the future, thereby, aiding in widespread replication.

b) To raise the quality of EE investment proposals from a technical and commercial perspective, and thus to increase the capacity of both project developers and Bank Loan Officers/Branch Managers to help shrink the gap between project identification and successful delivery of commercial finance.

c) To expand the uses of existing guarantee mechanisms for better risk management by banks to catalyse additional commercial finance for energy-efficiency.

d) To establish a monitoring and evaluation system for the targeted clusters.

The GEF implementing agency for this project is the World Bank (WB) and the executing agencies are Small Industries Development Bank of India (SIDBI) and the Bureau of Energy Efficiency (BEE). The five targeted MSME clusters covered under this project and the indicative information are given below:

Table 1.2: Five targeted MSME clusters covered under the project and the indicative information

S. No.	Cluster	Main Fuel
1	Kolhapur (Foundry)	Coke
2	Pune (Forging)	Furnace Oil
3	Tirunelveli (Limekiln)	Charcoal
4	Ankleshwar (Chemical)	Gas/Electricity
5	Faridabad (Mixed)	Electricity/oil

1.3 Major Components of the Project

The project comprises the following major components:

1) Activities to build capacity and awareness
   a) Marketing and outreach effort to clusters and capacity building at industry associations.
   b) Training of energy auditors/energy professionals.
   c) Specialized support to financial intermediaries.
   d) Unit-level support to MSMEs in accessing finance.
   e) Vendor outreach, enlistment and support, and engagement of a Regional Energy Efficiency Centre of Excellence for specialized technical capacity building activities in the area of furnace optimization.

2) Activities to increase investment in Energy Efficiency (EE)
   a) Energy efficiency project development support.
   b) Performance linked grants for demonstration of efficient technologies.

3) Programme knowledge management and sharing

2.0 Cluster Scenario

2.1 Introduction

The chemical sector contributes significantly to the Indian economy. The size of the Indian chemical industry is estimated at $30 billion. The production volumes in the chemical industry have positioned India as the third–largest producer in Asia next to China and Japan, and the 12th largest in the world. The industry, comprising both small and large scale units (including MNCs) produces several ranges of products and by-products, ranging from plastics and petrochemicals to cosmetics and toiletries. The chemical industry accounts for about 13% in the manufacturing output, 5% in the total exports of the country, and contributes about 20% in the national revenue through various taxes and duties. According to a sector study conducted on the Indian chemical industry by Export-Import Bank of India (EXIM Bank) between the years 2005 and 2006, the total annual production of basic chemicals and petrochemicals stood at 16 million metric tonnes and petrochemical intermediaries stood at 10 million metric tonnes.

Chemicals are used across many industry sectors in India as major raw materials. Some of these sectors and sub-sectors are listed in Figure 2.1[1]:

Fig. 2.1: End-user segments of Indian chemical industry

[1]*Source: Report of the task force on Chemical Industry, Government of India, February 2002.*

2.2 Industry Statistics

The state of Gujarat is a major contributor in the production of basic chemicals as well as petrochemicals with 54% and 59% as compared to the production in other parts of India, respectively. Also chemicals/petrochemicals and pharmaceutical sectors contribute about 60% in the entire manufacturing output of Gujarat. Other major Indian states producing various chemicals include Maharashtra, Tamil Nadu, and Uttar Pradesh. About 50% of the total chemical production in Gujarat is contributed by industries in Ankleshwar making it the most significant chemical cluster of Gujarat and India.

2.3 Overview of Ankleshwar Chemical Cluster

2.3.1 Geographical Location

Ankleshwar is an industrial town located in the Bharuch district of Gujarat. The population of the town is approximately 150,000 most of which is directly or indirectly related to the chemical industry. The Ankleshwar Industrial Estate was set up by the Gujarat Industrial Development Corporation (GIDC) in the 1970s. The industrial estate, which is spread over an area of 1,600 hectares has close proximity to National Highway 8 (NH 8) and Delhi–Mumbai Railway Line. The industrial estate has more than 1,200 industries manufacturing diverse range of chemicals, pesticides, pharmaceuticals, bulk drugs, petroleum products, engineering, textiles, plastics, rubber, and packaging. Of these 1,200 units more than 600 are MSME units manufacturing various types of chemicals, like dyes, pigments, insecticides, specialty chemicals, petrochemicals, pharmaceuticals, and paints.

Table 2.3.1: Ankleshwar at a glance

S. No.	Particulars	Information
1.	Geographical information	21.6 °N 73 °E
2.	Geographical area (Hectare)	1574.34
3.	Average annual rainfall (Bharuch)	600 mm
4.	Average temperature	40 °C (Summer), 32 °C (Monsoon), 23 °C (Winter)
5.	Population (Bharuch District)	1,550,822
6.	Literacy (Bharuch)	83.03 %

Panoli, a town located at a distance of 7 km from Ankleshwar has another major industrial estate set up by GIDC. It is spread over 1,100 hectares, is a hub of chemical manufacturing enterprises, and is located on the NH 8 and Delhi–Mumbai Railway Line. This industrial estate houses more than 300 units of which 120 are MSMEs manufacturing various chemicals like dyes, pesticides, pharmaceuticals, bulk drugs, petroleum products, and so on.

2.3.2 History and Evolution of Ankleshwar Chemical Cluster

Setting up chemical manufacturing units in Ankleshwar was an easy decision for Gujaratis, who are well-known for their entrepreneurship zeal and enthusiasm. The proximity of this place to the sea (a location called Ambakhadi) offered a ready place to absorb the effluents discharged from these units. Attractive margins in the chemical industry coupled with capital subsidies and tax holidays offered by GIDC during the 1980s led to rapid industrialization in Ankleshwar and Panoli. Proximity to NH 8 and the Delhi–Mumbai railway line offered fast and economical modes of transportation of the products.

Surat, a major city located about 70 km from Ankleshwar witnessed setting up of many textile units. This led to a staggering increase in the demand for major raw materials like dyes and pigments and provided an impetus to the growth of numerous dye and pigment manufacturing units in Ankleshwar.

The cluster received a major boost through the setting up of various large scale pharmaceutical industries like Glaxo, Pfizer, Sterlite, Cadila, and Sun Pharma. This led to the establishment of many MSMEs in the form of their ancillaries. After some years the growth of pigment industries started declining in Ankleshwar. During the same time, the Japanese government ordered for the closure of pigment industries in Japan. This increased the demand of pigments from Ankleshwar and provided a much-needed stimulus for the growth of pigment manufacturing units in Ankleshwar. The growth was propelled by the establishment of gas infrastructure in the industrial estate.

2.3.3 Inventorization of Units

The chemical units in Ankleshwar chemical cluster can be classified on the basis of scale of the units and the types of products manufactured.

Classification based upon product categories

Most of the units in the cluster manufacture dyes and pigments evident from Figure 2.3.3a.

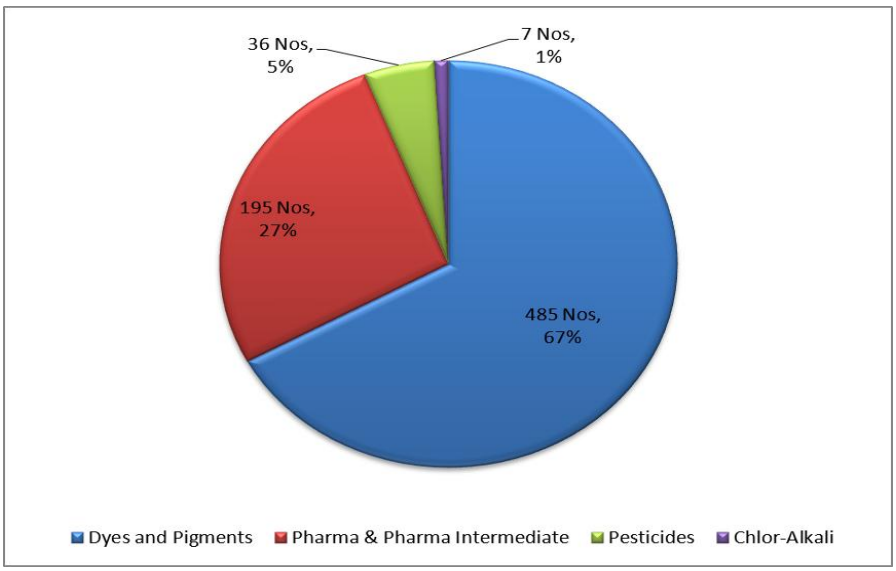


Fig. 2.3.3a: Classification based upon product categories

Source: Association directory

Classification based upon size of units

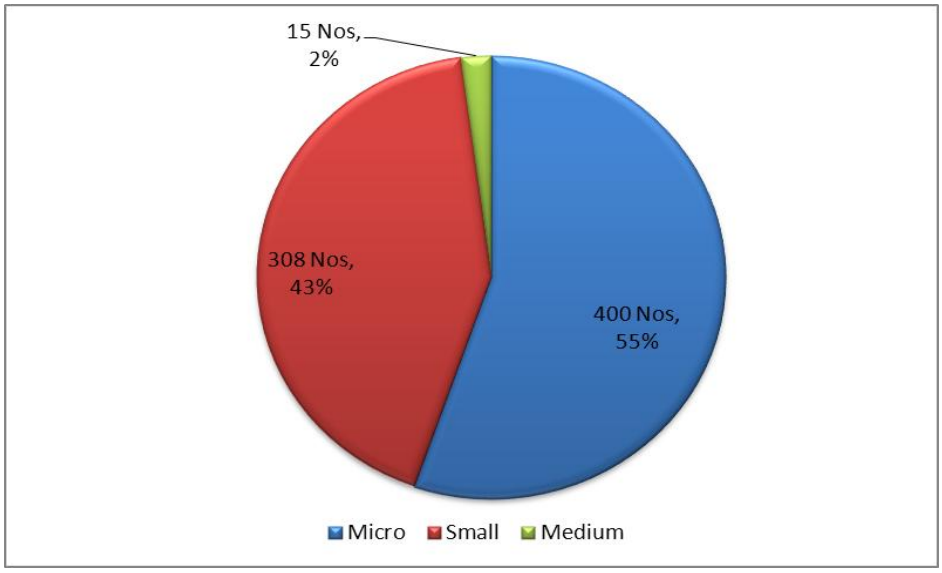


Fig. 2.3.3b: Classification based upon size of units

Ankleshwar chemical cluster houses a number of large scale and MSME units, which manufacture various types of chemical products. Some leading large scale industries and multinational companies like Cadila Healthcare Ltd, United Phosphorous Ltd, Asian Paints, Zandu Chemicals Ltd, Sun Pharma, Pfizer, Glaxo Pharma, Atul Paints, Synchem Chemicals, and so on, have their plants in Ankleshwar. These industries procure a variety of basic chemicals from MSMEs of Ankleshwar.

There are a number of chemical manufacturing industries among MSMEs, which not only have the highest turnover, production, and employment, but also command good reputation in the cluster as they have been in the market for a long time. Some of these are Meghmani Organics Ltd, Neelkanth Organics, Shree Ganesh Pigments, Parikh Chemicals, Sahyog Chemicals, and so on.

2.3.4 Raw Material usage in Cluster

A lot of basic chemicals are used as raw materials to manufacture major chemical products like dyes and dye intermediates, pigments, pesticides, petrochemicals, and so on. These basic chemicals used as raw materials are classified according to a variety of features: their chemical composition (organic and inorganic), their origin (mineral, vegetative, and animal), and their state of aggregation (solid, liquid, and gaseous).

Mineral raw materials are divided into ore (metallic), non-metallic, and combustible (organic). Ore minerals primarily comprise metal oxides and sulphides (Cu_2S, CuS, Fe_2O_3, Fe_3O_4, ZnS, and so on). It also includes SiO_2, Al_2O_3, CaO, and MgO.

Non-metallic mineral raw materials used are diverse in their chemical composition and are used either in their natural state (sand, clay, asbestos, and mica) or are delivered for chemical processing (chloride, phosphates, sulphates, carbonates, and aluminasilicates). Vegetative and animal raw materials include wood, cotton, oils

and fats, milk, hides, and wool. They are processed either into food products (food raw materials) or into products for domestic and industrial use. Cheap and easily available raw materials, such as water and air are also widely used by the chemical industries.

Majority of these raw materials are sourced locally. Most of the micro and small scale units in the cluster manufacture basic chemicals (intermediary products), which are used as raw materials by many medium and large scale units of the cluster. There are about 40 to 50 micro and small chemical units, which process basic chemicals to produce the raw material of required concentration for other chemical industries.

2.3.5 Products Manufactured

Chemical industries in Ankleshwar manufacture diverse range of products like dyes and dye intermediates, pigments, pesticides/insecticides, petrochemicals, agrochemicals, chlor-alkali, pharmaceuticals, paints, and so on. Some of the major categories of chemicals can be seen in Table 2.3.5 below:

Table 2.3.5: Chemical products manufactured in Ankleshwar

Category	Chemicals produced
Dyes and Pigments	Azo dyes, acid direct dyes, basic dyes, fats colour bases, oil-based dyes, whitening agents, organic pigment colours, pigment emulsion, food colours
Pesticides	Various pesticides and insecticides registered under the Insecticide Act, 1968
Petrochemicals	Synthetic fibres, fibre intermediates, polymer, performance plastics
Organic chemicals	Acetic acid, Acetone, Acetic anhydride, phenol, methanol, nitrobenzene, citric acid, chloromethane, aniline
Inorganic chemicals	Aluminium fluoride, calcium carbide, carbon black, potassium/sodium chlorate, titanium dioxide, and red phosphorous
Alkali	Soda ash, caustic soda, liquid chlorine

2.3.6 Technological Upgrades undertaken by Units in the Recent Past

Chemical units in Ankleshwar are finding it hard to obtain necessary clearances for expansion of their plants from the pollution control board due to their critically polluting nature. This has made it difficult for units to adopt new technologies; however, some of the units have adopted the following technologies in the recent past:

- Replacement of non-IBR type boiler with the IBR type boiler by medium sized units
- Fuel switch: From firewood to natural gas for steam generation and hot air
- Replacement of horizontal agitator with vertical agitator in reaction vessels
- Replacement of ice-based chilling system with electrical chiller machine in process cooling and refrigeration
- Adoption of spray drier in place of tray drier
- Adoption of advanced effluent treatment plant with closed loop water recycle, which has zero discharge
- Adoption of energy-efficient lighting

2.3.7 Current Market Scenario

The chemical units of Ankleshwar finds customers in both domestic and international markets. Large quantities of chemicals like dyes, agri-chemicals, pharmaceuticals, and so on, are consumed by large enterprises in the domestic markets. Most of the micro units located in Ankleshwar sell their produce to large pharmaceutical and agri-chemical industries located in Ankleshwar itself. Apart from the domestic market many units, which have acquired international quality and environment certifications are exporting speciality chemicals, inorganic chemicals, pigments, and so on, to various European countries, parts of North America, Australia, Singapore, Taiwan, Thailand, Africa, Bangladesh, and so on.

The chemical industries are under tremendous pressure due to intense competition in both national as well as international markets, weak R&D pipelines, increasing time-to-market of novel products, and fewer approvals by policy regulators. In order to explore the new markets, some development agencies have already started analysing opportunities in regions like Association of Southeast Asian Nations (ASEAN), Africa, Commonwealth of Independent State (CIS), and Latin American countries. Further, the present cyclical recessionary trends in the markets are also adding to the emerging downturn of the market scenario. In such a situation, it is becoming increasingly difficult for the units to maintain their profit margins.

2.3.8 Cluster Level Turnover, Profitability and Employment

The Ankleshwar industrial estate is considered to be the largest industrial cluster in India. The annual turnover of chemical industries in Ankleshwar exceeds Rs 10,000 crore. The cluster generates employment for about 2 lakh people out of which 80% are locals and the rest are from other states of India[2].

The chemical units' production capacities vary greatly from 100 tonnes to 1,000 tonnes per annum across all product categories. The turnover of the units also varies significantly, from Rs 2 crore to Rs 10 crore. There is a vast disparity in the prices of various chemicals manufactured in the cluster. Due to the absence of any authentic information regarding the production capacities and turnover of various product categories in the units of Ankleshwar, it is difficult to provide estimates of category-wise production and turnover. Further, discussions with various key stakeholders indicated that the profitability of individual units/ cluster were not available in public domain.

2.3.9 Social and Environmental Aspects in the Cluster

A major concern of the chemical units of Ankleshwar is to control their effluent discharge and pollution. The Ankleshwar chemical cluster was declared as 'critically polluted' among other 42 clusters in India by Ministry of Environment and Forest (MoEF),GoI. MoEF has induced the cluster units to invest in technologies for their effluent treatment. It keeps a check on the pollution levels of Ankleshwar and operates through GPCB. Due to the critically polluted state, GPCB has not been granting clearances to some companies for expansion of their production or to run some of their existing facilities. Chemical units in Ankleshwar have invested more than Rs 300 crore to reduce the pollution caused by them, and to make the cluster

[2] Business Standard, 10 Aug 2011;*'Ankleshwar aims to get rid of critically polluted status'*

pollution free. Hence, most of the initiatives carried on by the local bodies in Ankleshwar focus on dealing with pollution and environmental issues of the region. The industries association of Ankleshwar and Panoli have taken numerous initiatives to deal with the wastewater woes of the region.

2.3.10 Current Initiatives by Local Bodies

The major initiatives led by the industries association in collaboration with leading government agencies (mainly GIDC and GPCB) in Ankleshwar include:

- Setting up of Ankleshwar Industrial Development Society and Ankleshwar Environmental Preservation Society to keep a check on pollution emission levels of the units.
- Enviro Technology Ltd—a Common Effluent Treatment Plant was established jointly by GIDC and industry associations of Ankleshwar and Panoli. The plant was set up with a project cost of Rs 167 crore and has a treatment capacity of 75,000 m^3 of wastewater per day.
- Erection of common incinerator of 2.5 MT per hour.
- Closed pipeline conveyance with a capacity of 60 million litres per day from FETP to deep sea.
- Setting up of Disaster Prevention Management Centre (DPMC) to conduct programmes on Industrial Safety and Environment Protection.
- Ankleshwar Research & Analytical Infrastructure Ltd established in the premises of GIDC.
- AEPS ecology centre was established in 2009.
- Attractive green belt and plant ecology centre for research work is also established.
- Centre of Excellence has been set up in collaboration with Cadila Pharma for various training and testing services.

3.0 Major Cluster Actors

The primary stakeholders in the cluster are the chemical manufacturing units. The other stakeholders include various government agencies, industry associations, regulatory bodies, research and academic institutions, and testing and training institutes. These cluster actors provide innumerable kinds of services to the cluster units, such as redress of grievances, regulatory and advisory services, energy and raw materials supply, technological know-how and supply of technology, effluent treatment and pollution control, and testing and training services.

Some of these major cluster actors along with the services provided by them in the cluster have been elaborated below.

3.1 Industries Associations

There are two major industry associations active in the industrial estates of Ankleshwar and Panoli:

3.1.1 Ankleshwar Industries Association (AIA)

Ankleshwar Industries Association has been playing a key role in accelerating the growth in the Ankleshwar GIDC estate. AIA are proud of their over 1,200 member units, which stand out from other state-based industries associations because of its achievements in diversified areas. The major achievements of AIA include setting up of a Common Effluent Treatment Plant—Narmada Cleantech Ltd (NCTL) in association with GIDC/other industry associations for the treatment and safe disposal of industrial effluents, also the Effluent Conveyance Pipeline project for safe disposal of effluents into the sea through a 55-km-long pipeline, and also set up the Disaster Prevention and Management Centre (DPMC) for tackling and controlling safety hazards. Several other activities conducted by AIA include:

- Redress of grievances faced by the member industries
- Infrastructural development of estate through member's participation
- Providing guidelines to MSME members to fulfil various legal requirements and green belt development
- Activities related to environmental preservation and pollution control
- Disaster prevention and management
- Creating awareness among surrounding population about various issues

To carry out the above mentioned activities in an efficient manner, AIA promoted Ankleshwar Industrial Development Society and Ankleshwar Environmental Preservation Society along with Enviro Technology Ltd, Bharuch Enviro Infrastructure Ltd, and Narmada Clean Tech Ltd.

It is mandatory for each chemical MSME unit of Ankleshwar to get their effluent treated through NCTL, and to avail services of NCTL, it is mandatory for each one of them to become a member of AIA. As a result, almost all MSME chemical manufacturing units of Ankleshwar have now become members of the AIA. The association is headed by Mr Vipul V Gajera who is its current President. The association has state-of-art infrastructural facilities and has rented out space to banks and government agencies.

Table 3.1.1: Contact details of Ankleshwar Industries Association

Contact Person	Mr Vipul Gajera (President)
Address	618/619, GIDC Industrial Estate, Ankleshwar- 393002. District Bharuch (Gujarat)
Email	info@aiaindia.co.in

3.1.2 Panoli Industries Association (PIA)

Panoli Industries Association is the body responsible for safeguarding the interests of units in Paoli industrial estate. It has about 225 members out of which 120 are chemical manufacturing units. The major achievement of PIA was the setting up of a Common Effluent Treatment Plant—Panoli Enviro Technology Ltd (PETL) in Panoli. This was set up as a subsidiary of NCTL. All MSME chemical units are members of PETL and PIA. The association was instrumental in helping Panoli attain a status of the only industrial estate with completely "Controlled Discharge" of effluents in Gujarat. It also conducts various other activities in line with the activities of AIA. The association is headed by Mr B S Patel who is the current President and is highly proactive in handling the affairs of the association.

Table 3.1.2: Contact details of Panoli Industries Association

Contact Person	Mr B S Patel (President)
Address	L-913/10, GIDC Estate Panoli - 394116. District Bharuch (Gujarat)
Email	piapanoli@yahoo.com

3.2 Government Bodies associated with MSMEs in the Cluster

The government agencies in the cluster are providing developmental, regulatory, and policy services to the chemical units of Ankleshwar. A brief about these agencies is given below.

3.2.1 Gujarat Industrial Development Corporation (GIDC)

Gujarat Industrial Development Association (GIDC), an agency under the Government of Gujarat, has set up the industrial estates of Ankleshwar and Panoli. GIDC had offered tax holidays and capital subsidies of up to 25% to the entrepreneurs who are willing to set up units in Ankleshwar and Panoli. GIDC also owns 51% stake in Narmada Cleantech Ltd and manages its day-to-day operations. Its major task is to provide land to units for expansion by development of new industrial estates.

3.2.2 District Industries Centre (DIC)

The industrial estates of Ankleshwar and Panoli fall under the jurisdiction of District Industries Centre (DIC), Bharuch. DIC primarily provides services like registration of units, providing them with EM number, and maintaining the production and turnover records of the units.

3.2.3 Gujarat Pollution Control Board (GPCB)

Gujarat Pollution Control Board (GPCB) performs the tasks related to protecting the environment and preventing and controlling water pollution in Ankleshwar. GPCB has been entrusted with the central acts and relevant rules for pollution control as notified thereof from time to time. It has a regional office in Ankleshwar. This office ensures strict compliance of the chemical units to pollution control and effluent discharge norms. The units in Ankleshwar have to get their expansion plans approved by GPCB. This board is a major stakeholder in the Ankleshwar cluster as it also reports to the Ministry of Environment and Forests (MoEF) about the status of activities undertaken by the units to control their effluent discharge.

3.2.4 Ministry of Environment and Forests, Government of India

The Ankleshwar chemical cluster was declared as critically polluted amongst the other 42 clusters in India by the Ministry of Environment and Forests (MoEF), Government of India. MoEF has induced the cluster units to invest in technologies for their effluent treatment. It keeps a check on the pollution levels of Ankleshwar and operates through GPCB. Due to the critically polluted status, GPCB has not been granting clearances to some companies for the expansion of their production or to run some of their existing facilities. More than 300 crores has been invested by chemical units in Ankleshwar to reduce their pollution, and to bring out the cluster from the critically polluted area.

3.3 Technical, Academic, and R&D Institutions

Ankleshwar has good public and private testing labs situated inside the GIDC estate. The major research and testing lab, Ankleshwar Research and Analytical Infrastructure Ltd (ARAIL) is a private research lab situated inside the premises of GPCB. ARAIL offers a range of testing and R&D facilities to the chemical units of Ankleshwar, like competitive and precise analytical services, process technologies, and synthesis of new chemical entities, innovation on existing process, and so on.

The major engineering colleges and technical institutes supplying technical workforce to the cluster are situated in Bharuch. Some of the major engineering, technical, and polytechnic institutes offering a variety of courses in chemical engineering and chemical industry technologies are Sri Sadvidya Mandal's Institute of Technology, Valia Institute of Technology, Government Engineering College, and KJ Polytechnic. There are also several other Industrial Training Institutes (ITIs) in Bharuch district offering various industrial training courses, like Chemical Plant Operator, Laboratory Attendant/Chemist, Process Attendant, and ETP operator.

3.4 Service/Technology Providers

3.4.1 Effluent treatment and pollution control service providers

Narmada Clean Tech Ltd (NCTL)

NCTL, a subsidiary company of Gujarat Industrial Development Corporation, is jointly promoted by industries associations of Ankleshwar, Jhagadia, and Panoli industrial estates. It was set up to honour the directives given by the High Court.

The primary activity of NCTL is to receive the industrial effluents from Ankleshwar, Jhagadia, and Panoli industrial estates and to polish it at the Final Effluent Treatment Plant (FETP) to match the marine standards and then flow it deep into the sea. The Managing Director of GIDC is also the Chairman of NCTL. NCTL is presently is being managed by GIDC, who owns 51% stake in the company and the industries associations hold 49% share. It is mandatory for the MSME chemical units of Ankleshwar to get their effluents treated at NCTL. All the units in Ankleshwar have underground pipes for direct effluent discharge to NCTL. Spread over 300,000 square metres, this FETP has a treatment capacity of 75,000 m^3 per day using conventional biological treatment.

Panoli Enviro Technology Ltd (PETL)

Panoli Enviro Technology Ltd (PETL) is a sister concern of NCTL. This is also a Common Effluent Treatment Plant that provides wastewater treatment services to the MSME chemical units of Panoli. Wastewater is collected from these units in trucks and sent to FETP after primary, secondary, and tertiary treatment. The President of Panoli Industries Association (PIA) is one of the directors of PETL.

Ankleshwar Environmental Preservation Society (AEPS)

AEPS was set up by Ankleshwar Industry Association for better execution of its activities related to pollution control. The society is running a post-graduate diploma courses in environment management for last four years. AEPS is also running an environment monitoring laboratory to check samples of water, air, and solid waste collected from various industries. AEPS is facilitating the MSMEs of Ankleshwar to acquire ISO 14000 by hand holding them to comply with its strict environmental standards.

3.4.2 Technology Providers

Other major cluster stakeholders include a number of local technical experts, technology providers, and fabricators who fabricate equipment, like steam boilers, thermic fluid heaters, hot air generators, centrifuge, press filters, dryers, and reaction vessels, and so on. These fabricators offer complete fabrication and installation facilities to the local units. Figure 3.4.2 shows the relationship between various cluster level stakeholders.

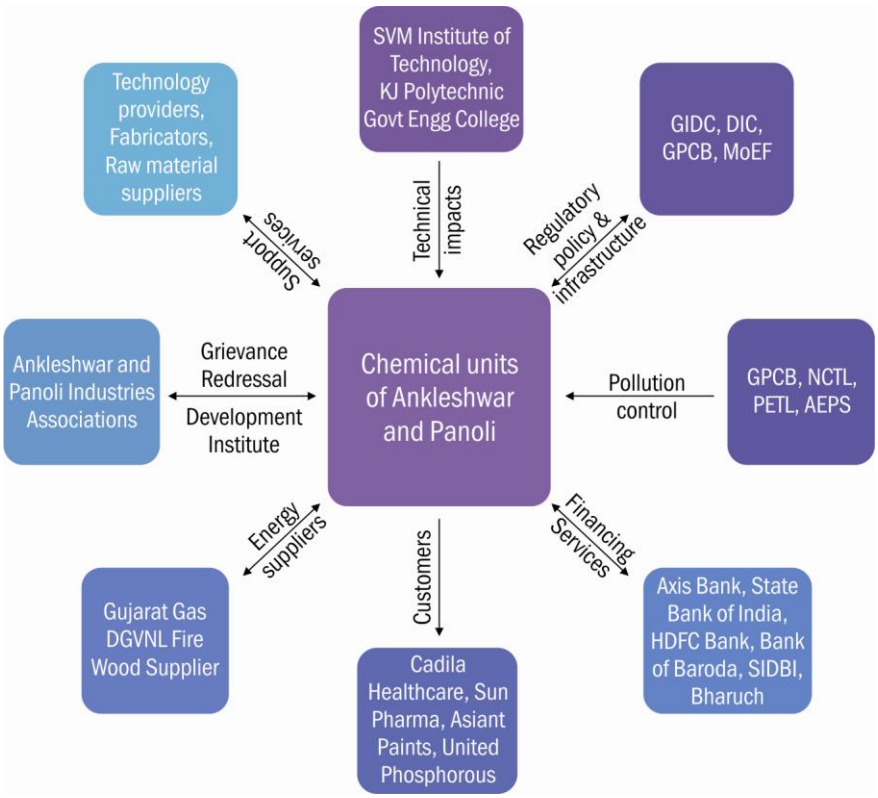


Fig.3.4.2: Relationship between major clusters actors

3.5 Financial Institutions

3.5.1 Lead Bank

The Bank of Baroda (BOB) is the lead bank in the Bharuch district with 5 branches.

3.5.2 Nationalized and Commercial Banks

There are about 25 nationalized, commercial, and cooperative banks operating in the cluster. Some of the key banks in this category include State Bank of India (SBI) and associate banks, Axis Bank, Vijaya Bank, Punjab National Bank, ICICI Bank, HDFC Bank, Dena Bank, and so on. Most of these banks are assisting in expansion and infrastructural upgrade of the units.

3.5.3 Financial Institutions

SIDBI is serving the Ankleshwar industries through its Baroda branch.

4.0 Technology Used and Production Process

4.1 Sector Technologies/Equipment

A variety of chemical products are being manufactured by MSME units in Ankleshwar cluster, like dyes, pigments, paints, agro-chemicals, and pharmaceutical products, however, the process equipment or technologies used in the manufacturing of these chemicals, are quite similar. Process equipment of a typical chemical manufacturing plant include:

- Steam boilers
- Thermic fluid heaters
- Reaction vessels
- Hot air generators
- Centrifuge
- Press filter
- Air compressors
- Dryers
- Circulation pumps
- Chilling system
- Electric motors

A brief description about the equipment is given below:

- **Steam boilers:** IBR and Non-IBR boilers are used in clusters for steam generation. Natural gas and firewood are the major fuels used to generate steam using the equipment. This steam is primarily used for jacket heating and direct insertion into the reactor. The size and capacity of these boilers varies from one unit to another. The capacities in terms of steam generated per hour range from 300 kg to 3 tonnes. Steam generation/utilization pressure and temperature varies according to the process requirement in the cluster. Steam generation pressure ranges from 7 kg/cm^2 to 10 kg/cm^2 and utilization pressure ranges from 6 kg/cm^2 to 4 kg/cm^2.

- **Thermic fluid heaters:** Thermic fluid heaters are widely used in the cluster for indirect heating viz., dryer and jacket heating. Natural gas is used for firing in the thermic fluid heaters. Heating capacity of these heaters varies according to the requirements of the process, ranging from 1 lakh kcal per hour to 4 lakh kcal per hour. Oil temperature in the thermic fluid heater varies from 180 °C to 200 °C.

- **Reaction vessels:** Reaction vessels, made from stainless steel are used for dissolving materials from the chemical units. These vessels are of different capacities depending upon the size and scale of the unit. The capacities range from 1 kilolitre to 10 kilolitre.

- **Hot air generators:** Hot air generators are used to generate hot air for the dryer. The hot air (150 °C to 200 °C) from the generators is pushed into the dryer chamber using fans. The hot air removes the moisture from the

materials placed inside the dryer. The fuel used for firing is natural gas. The heating capacity of the hot air generators used in the cluster range from 1 lakh kcal per hour to 2 lakh kcal per hour.

- **Centrifuge:** The intermediate product, which can be liquid or the suspended solid particles, is separated from the slurry using centrifuge. The centrifuge works using the sedimentation principle, where the centripetal acceleration causes denser substances to separate along the radial direction. Different basket size of centrifuge like 36 inch, 24 inch, and 48 inch are installed by the units in the cluster.

- **Press filter**: In the filter press, separation of solid part and liquid chemicals is done through pressing of the content in filter plates using hydraulic press. During this process solid intermediate is separated out from the liquid part. The separation occurs in chambers formed between the recessed faces of plates, which are clamped together in a rugged steel frame. Compressed air (in the pressure range of 5–7kg/cm^2) is used to remove interstitial water from pores in the filter cake. When the desired residual moisture content has been achieved, the filter is opened and the cake is removed. The filter press reduces the moisture content by 50% to 60%.

- **Air compressors:** Air compressors are used to produce compressed air in the range of 5 kg/cm^2 to 7 kg/cm^2. Compressed air has wide application across the industry. Conventional reciprocating compressors are used by most of the chemical units in the cluster. Some of the progressive units have also installed screw compressors.

- **Dryers:** Dryers are used for evaporating the liquids from the solids. A moisture-laden product is introduced into the dry chamber and is heated to a required temperature to drive off liquid from the product. A wide range of dryers are used in the cluster, such as tray dryer, fluidized bed dryer, rotary vacuum dryer, and spin flash dryer. Steam boilers, thermic fluid heaters, and hot air generator are used to achieve the desired temperature inside the dryer.

- **Circulation pumps**: Circulation pumps of different capacities are used for the boiler feed water circulation, oil circulation in thermic fluid heater, cooling water circulation, chilled water circulation, and process water circulation.

- **Chilling system**: A chiller plant normally consists of evaporator pumps, compressor, condenser pumps, and cooling towers. Centrifugal and reciprocating chillers are used in the cluster for jacket cooling. The cooling capacity of these chillers varies from 5 TR to 50 TR. Some units also use ice blocks for cooling.

- **Electric motors:** Various small and high-rating electric motors are used in almost all applications of the chemical units of Ankleshwar. Most of these motors are used in equipment like agitator, pumps, fans, centrifuge, dryer among other applications.

4.2 Present Technology Status

Literature review and consultation with primary cluster stakeholders like industrial associations, equipment suppliers, local service providers, and plant personnel provided following insight into the current technology status of the cluster:

- Reaction vessel, the primary equipment of the chemical process, is readily available in various sizes. Most of these reaction vessels operating at low to medium temperature are fabricated locally, whereas the vessels for higher parameters are sourced from outside the cluster. Majority of the reaction vessels are conventionally designed and no efforts have been made by local fabricators to improve the fundamental design of these equipment.
- Majority of agitator systems used for stirring the chemicals in reaction vessels are of horizontal type, which are inefficient and thus result in loss of energy during transmission. Vertical agitator system, which is an efficient substitute of horizontal system are also readily available in the cluster and need to be promoted amongst the units.
- BR and Non-BR boilers, hot air generators, and thermic fluid heater (thermopac) used in the cluster vary depending upon the plant's size. Most of the units in the cluster are using locally fabricated heating systems, which are inefficient as they do not have pre-installed waste heat recovery mechanisms.
- Most of the electric motors used in equipment like agitator system, centrifuge, and circulation pumps, and other systems are of standard make. This is due to lack of awareness about energy-efficient motors.
- Drying is the slowest sub-process of the chemical plant, and which requires the tray/spin flash dryers to operate continuously for 30 to 36 hours. Majority of the dryers used in the cluster are of old/traditional design and have low efficiency.
- Chilling systems, which are generally used in the medium size plants to substitute ice, are locally fabricated and are inefficient as compared to the latest available options.
- Transmission of intermediary product is mostly done manually in small units, which is increasing the dependence upon scarce human resources.

There exists a significant scope to encourage the cluster units towards adoption of energy-efficient technologies.

4.3 Manufacturing Process

The manufacturing process of the chemical industries varies depending on the type of products being manufactured by them. The manufacturing process of a typical chemical manufacturing unit along with the utilities and the energy sources is shown in Figure 4.3.

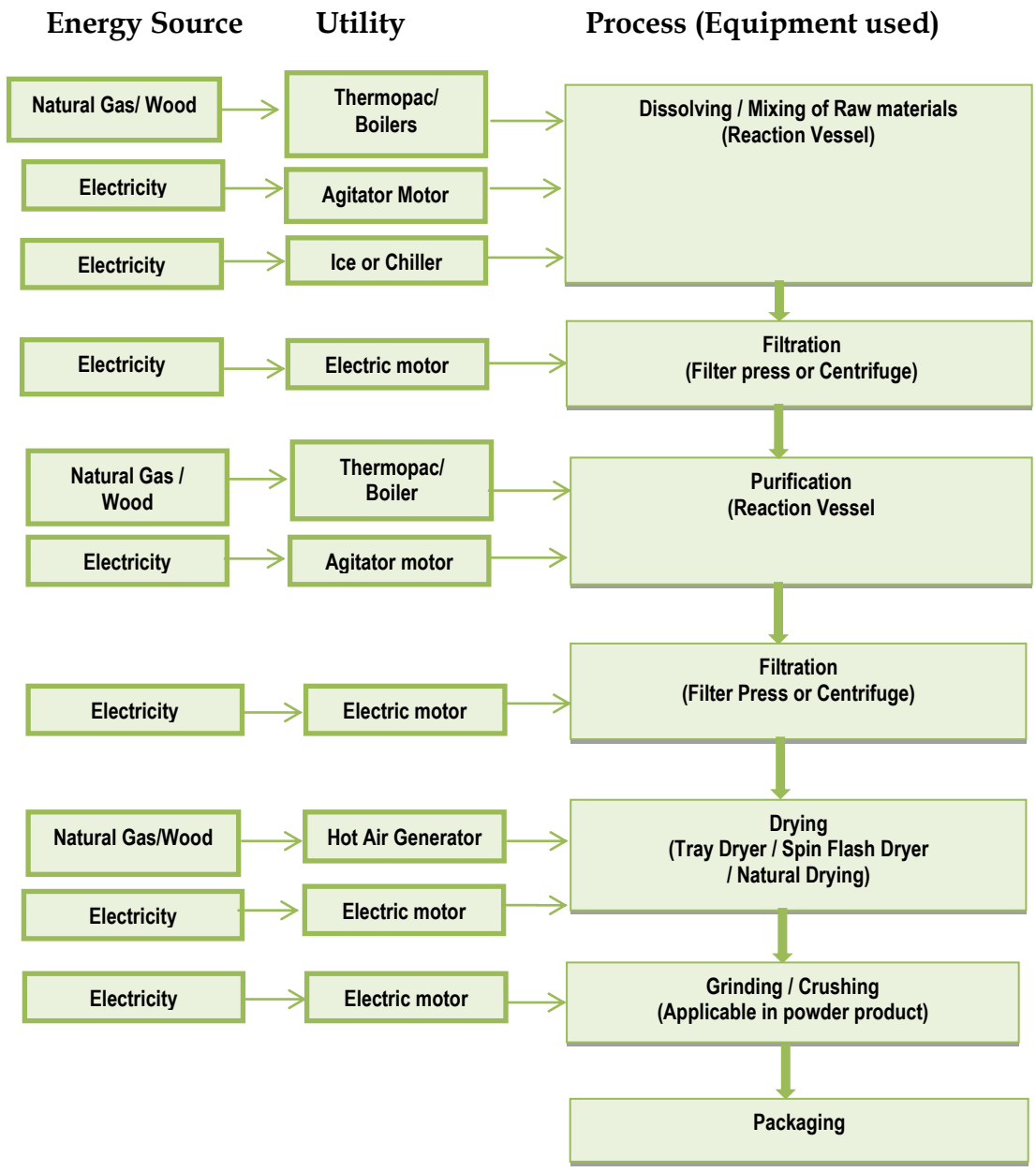


Fig. 4.3: Process flow diagram of typical chemical manufacturing unit

The production of various chemicals passes through the following stages:

Dissolving/Mixing: In the first step, raw materials in desired proportion by weights are poured into a reaction vessel. Then the mixture is continuously stirred and the temperature is increased or decreased as per the specific product requirement through jacket heating or jacket cooling. Process time of this step depends upon the specific milestone of the process, such as achieving certain temperature range or concentration of intermediate product. This process requires both thermal energy as well as electric energy. Generally, heat is supplied to this process through natural gas or wood based thermic fluid heater/boiler. Electricity is utilized in the process for continuously stirring of mixture.

Primary filtration in Centrifuge: In this process, the intermediate product, which can be liquid or suspended solid particles, is separated from the slurry. Filtration is generally done using centrifuge or filter press. The centrifuge works using the sedimentation principle, where the centripetal acceleration causes denser substances to separate along the radial direction, whereas, in the filter press separation of solid part and liquid chemicals is done through pressing of the content in filter plates using hydraulic press. During this process solid intermediate is separated out from the liquid part. This process usually takes 1–2 hours. This process requires electric energy to run the electric motors.

Purification: In this process, the basic properties of the intermediate product are improved or modified as per the requirement of the final product. For example, if the intermediate product is alkaline in nature, in order to neutralize it, sulphuric acid is added during the process and certain temperature parameters are maintained. In this process, temperature of the mixture is maintained using jacket cooling/heating and it is continuously stirred using the agitator system. This process requires both thermal energy as well as electric energy. Generally, heat is supplied to this process through natural gas-or wood-based thermic fluid heater/boiler. Electricity is utilized in the process for continuously stirring of mixture.

Secondary filtration: In this process, the intermediate product, which can be liquid or the suspended solid particles, is separated from the slurry. Filtration is generally done using centrifuge or filter press. This process also takes 1–2 hours like primary filtration and also requires electric energy to run the electric motors.

Drying: This process is generally applicable for organic chemical product where final state of the product is powder. In this process, the cakes received from filtration process are loaded into tray/spin flash dryers. In the dryer, cakes of the chemical are dried through moisture removal using hot air. This is the most time consuming step of the chemical manufacturing process and normally takes 20–36 hours per batch. Hot air is used for drying the cake in the dryer, and is supplied by natural gas or wood-fired hot air generator.

Grinding/Crushing (Pulverization): Granules/blocks of dried products are transferred to the pulverizer for crushing it to the required size particles of the final product. Electric motor drives the process, which takes about 3–5 hours for pulverizing one batch of the final product.

Packaging: In this step, the final product, the chemical, in the form of powder or liquid is packaged properly for dispatch.

5.0 Estimated Energy Consumption Pattern and Saving Potential

5.1 Energy Profile of the Ankleshwar Chemical Cluster

Energy accounts for a sizeable portion of manufacturing costs of the chemical units of Ankleshwar. The energy costs are 5%–7% of the manufacturing costs for inorganic chemicals and about 12%–15% for dyes and chemicals. The extent of energy consumption in these units depends upon the products manufactured and processes employed. Reduction in energy consumption can play a significant role in increasing the profitability of the chemical units of Ankleshwar.

5.2 Fuel types, Specifications, Sources, and Applicable Tariff

These units use both thermal and electrical forms of energy to fuel their processes. The various sources of energy include:

- Piped Natural Gas
- Electricity
- Firewood
- LDO, HSD (used rarely, only for DG sets)
- Coal (in few units)

Details about various sources of energy, the processes for which they are used, their suppliers, usage charges, and annual consumption are elaborated below.

5.2.1 Thermal Energy

Thermal energy in the form of steam/hot air is utilized to attain the process parameters of chemical reaction and for treatment/processing/drying of the final products. The energy sources utilized in the cluster for supplying thermal energy are Piped Natural Gas (PNG) and firewood. These thermal sources of energy are used to operate utilities like steam boiler, thermic fluid heater, hot air generator, and other heating utilities. The basic details of thermal energy sources used in the cluster are given below.

Table 5.2.1: Sources of Thermal Energy

Source	Calorific Value	Unit	Cost#	Unit	Supplier
Natural Gas	8500	kCal/SCM	31.94 (Quota price) 41.48 (Over quota limit)	Rs./SCM*	Gujarat Gas Company Ltd
Firewood	3200	kCal/kg	4	Rs./kg	Local suppliers (Unorganized)

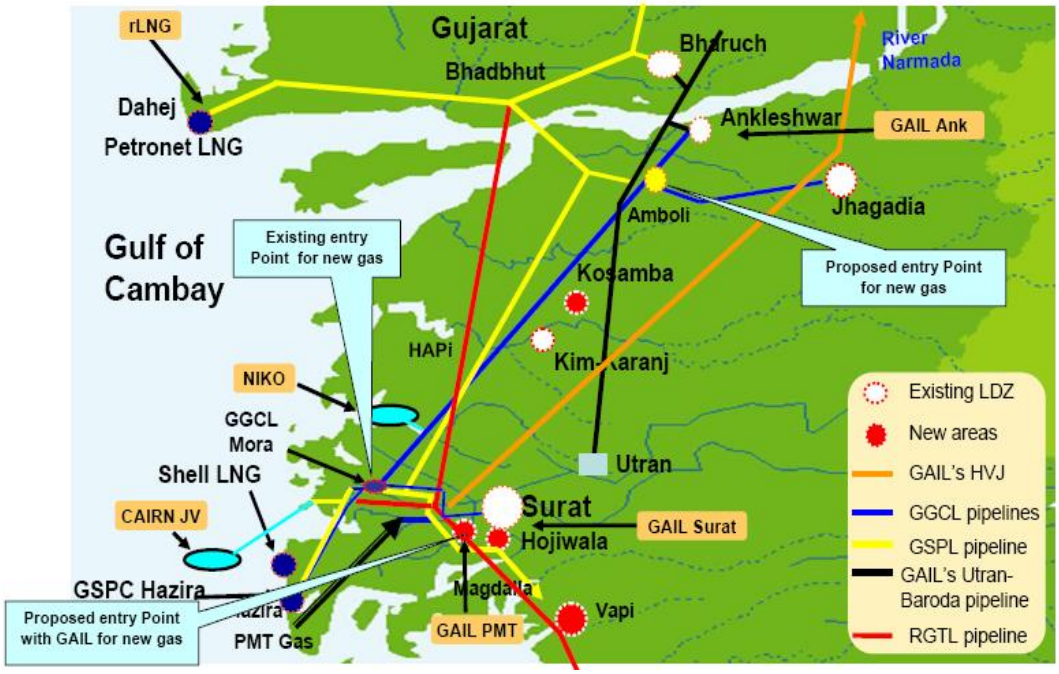
**Standard cubic metre*

#Applicable taxes and duties are extra

5.2.2 Piped Natural Gas

Currently, Gujarat has the most developed pipeline network in the country and is the only state in the country where the gas pipeline network is being operated by more than one player viz., Gas Authority of India Ltd (GAIL), Gujarat State Petronet Ltd (GSPL), and Gujarat Gas Company Ltd (GGCL). GSPL was promoted as the nodal agency by the Government of Gujarat to set up a gas-grid in Gujarat operating on common carriage basis.

GGCL is a gas transmission and distribution company operating in the industrial hub of South Gujarat. It distributes gas to domestic, commercial, and industrial consumers in Ankleshwar, Surat, and Bharuch. GGCL has a 2,700-km-long pipeline and serves about 2.30 lakh customers. It is obtaining gas from GAIL, GSPC as well as Cairn Energy. A 73-km trunk pipeline distributes gas from the gas fields of Hazira and Dahej to distribution network in Ankleshwar as is shown in the figure below:



Source- GGCL

The annual consumption of natural gas by chemicals (including dyes and intermediate, pesticides, and pharmaceutical) manufacturing units of Ankleshwar was about 382 million SCM in the year 2010–11, which is about 38% of the total gas consumed by industries in Gujarat. Classification of natural gas consumption among various types of chemical industries is shown in Table 5.2.2.

Table 5.2.2: Classification of PNG consumption among various chemical industries

S. No.	Product Type	Number of units	PNG quantity used (mmscm)	% Share of Total PNG used
1	Dyes, pigments, and other basic chemicals	475	271.4	71
2	Pesticides	58	50.25	13
3	Pharmaceutical	190	60.3	16
	TOTAL	723	382	100

5.2.3 Electrical Energy

Electricity is primarily used in the electric motors to run utilities like agitator systems of reaction vessels, centrifuge, gas/air/liquid air circulation pumps, chilling plants, and air compressors. Electricity in Ankleshwar and Panoli industrial estates is supplied by Dakshin Gujarat Vij Company Ltd (DGVCL) at both HT as well as LT levels under various consumer categories. Applicable tariff of various such categories is given in Table 5.2.3.

Table 5.2.3: Applicable electricity tariff plans in Ankleshwar

S. No.	Category	For billing demand upto the contract demand	Demand Charges	Energy Charges	
1	LTMD	For first 40 kW of billing demand	Rs 65/- per kW per month	435 Paise per Unit	
		Next 20 kW of billing demand	Rs 100/- per kW per month		
		Above 60 kW of billing demand	Rs 165/- per kW per month		
		For billing demand in excess of the contract demand	Rs 210/- per kW		
2	HTP-1	For first 500 kVA of billing demand	Rs 100/- per kVA per month	Upto 500 kVA of billing demand	Rs 4 per Unit
		For next 500 kVA of billing demand	Rs 200/- per kVA per month	For next 2000 kVA of billing demand	Rs 4.2 per unit
		For billing demand in excess of 1000 kVA	Rs 270/- per kVA per month	For billing demand in excess of 2500 kVA	Rs 4.3 per Unit
		For billing demand in excess over the contract demand	Rs 370/- per kVA per month		

Annual electricity consumption by the chemical industries of Ankleshwar (including LT and HT category industries) stood at 960 million units in the year 2011–12 as per data gathered from DGVCL, Bharuch. Monthly variation of electricity consumption in Ankleshwar chemical units is indicated in Figure 5.2.3.

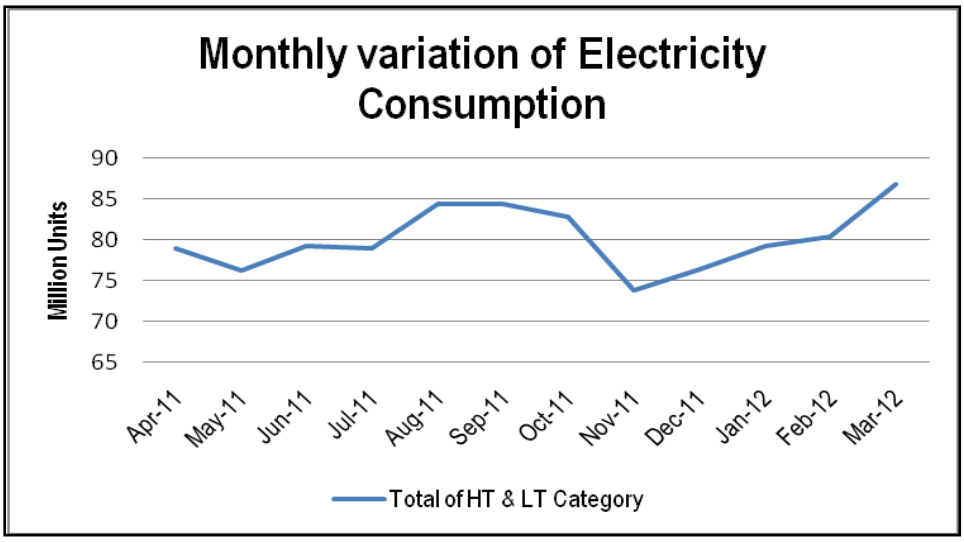


Fig. 5.2.3: Monthly variation of electricity consumption

5.2.4 Firewood

Firewood is primarily used in boilers and hot air generators. The firewood market is unorganized and so it is supplied to the cluster from nearby villages in trucks. This is a conventional source of energy and is only used by some micro and small scale units in the cluster. The total annual consumption of firewood by the chemical units in Ankleshwar is estimated to be about 3,250 tonnes. Gujarat Pollution Control Board is taking measures to persuade the units to stop using firewood as a fuel.

5.2.5 Other Sources (Water and Ice)

Apart from energy, chemical industries also consume large quantities of water and ice in the process. GIDC water supply division is the sole supplier of raw water to the units in Ankleshwar. To maintain the temperature in some of the sub-processes of chemical industries, ice in the form of ice blocks is used as a substitute for the chilling system in some of the micro and small scale chemical plants. Ice is generally supplied by the local ice manufacturing plants located in the cluster itself.

Table 5.2.5: Other sources of energy

S. No.	Source	Cost	Unit	Supplier
1	Water	1	Rs/Litre	GIDC water supply division
2	Ice	80	Rs/Block of 125 kg	Local manufacturers

5.3 Annual Energy Consumption Pattern

Total annual energy consumption of chemical manufacturing units in Ankleshwar is estimated to be about 408,423 tonnes of oil equivalent (toe) as per data gathered from various sources for 2010–11. Detailed break-up of various sources of energy and the annual consumption by the chemical industry of Ankleshwar for the year 2010–11 is mentioned in Table 5.3.

Table 5.3: Annual energy consumption

Energy Source	Annual Energy and Resources Consumption	Unit	Annual Energy Consumption (in toe)
Electricity	715*	Million Units/year	61,364
Natural Gas	381.9**	Million SCM/year	324,677
Firewood	3250***	Tonnes/year	1,040
Total			408,423

Source:
*DGVCL, Bharuch
**Gujarat Gas
***Estimated

The graphical representation of annual consumption of various energy sources in the chemical units of Ankleshwar is shown in Figure 5.3.

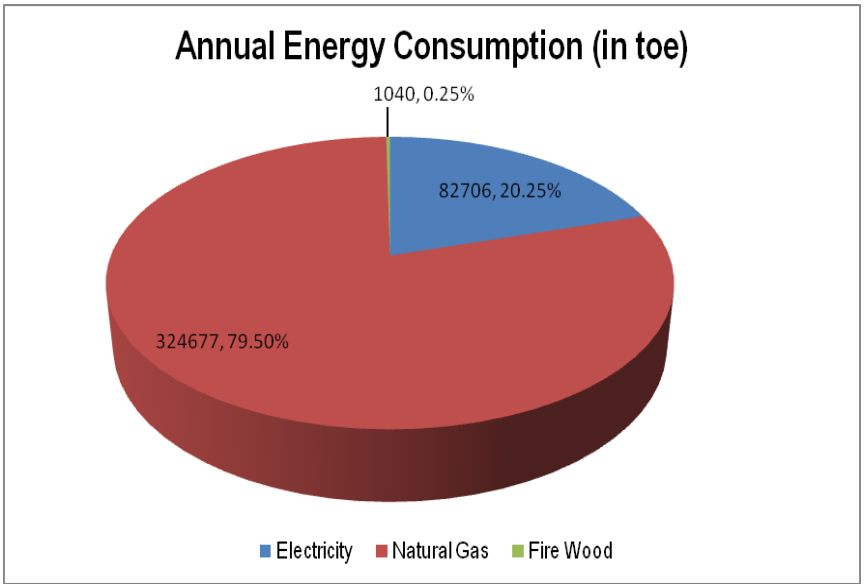


Fig. 5.3: Annual energy consumption (in toe)

This clearly indicates that natural gas is the major source of energy for the chemical units of Ankleshwar followed by electricity. The consumption of firewood is almost negligible.

5.4 Energy Saving Potential

The units in the cluster primarily use locally fabricated technologies especially for thermal and process equipment, which are conventionally designed and inefficient. The electrical motors are rewound multiple times and mechanical conditions of these motors are also poor. Initial observations from the units visited provide a substantial estimate of energy saving potential. Some of the energy conservation measures having significant saving potential and replication potential in chemical cluster are mentioned below.

- Steam generation and distribution system
  - Fuel switchover
  - Fuel to air ratio optimization
  - Improvement in insulation
  - Condensate recovery
  - Waste heat recovery
- Thermic fluid heater
  - Automation with VFD and temperature control mechanism
- Hot air generator
  - Fuel switchover
  - Fuel to air ratio optimization
  - Improvement in insulation
  - Hot air distribution and circulation system at utilization end (hot air chambers)
  - Improved drying system

- Compressed air system
    - Leakage reduction
    - Improvement in operating practices
    - Upgrade in existing technology (reciprocating to screw)
- Reaction vessels and process
    - Replacement of belt driven horizontal agitator by direct drive vertical agitator
    - Two-way valve with temperature control mechanism for heating and cooling process
    - Improvement in insulation system in vessels using jacket heating/cooling
    - Installation of electrical chiller machine to eliminate the use of ice-based chilling system
    - Application of VFD in centrifuge and ball mills
- Electrical distribution system
    - Improvement in billing power factor to avoid the excess demand as well as penalty from utility board
    - Load management
- Other areas
    - Rewound and old electrical motors may be replaced by EEF-1 category motor
    - Improvement in pumping system
    - Use of energy-efficient lighting systems
    - Use of cogged type poly V belt

Overall, the adoption of energy-efficient technologies and the best operating practices can lead to significant energy savings in the chemical units. However, saving potential will vary from unit to unit. Walk-through audits will be conducted to identify areas for detailed analysis and detailed energy audits will be carried out to identify implementable EE projects and their energy saving potential.

6.0 Major Challenges and Suggestions for improvement in the Cluster

6.1 Technology

The use of conventionally designed/obsolete technologies and out-dated operating practices are the major challenges in the cluster. Lack of availability of EE technologies, weak linkages with suppliers and low levels of knowledge of local fabricators on modern technologies are the major bottlenecks hindering technology upgradation in the cluster. Capacity building of local fabricators on new/improved equipment designs, enabling policies for technology development, and customization; demonstration of proven technologies and enhanced knowledge dissemination are necessary for facilitating technology upgradation in the cluster.

6.2 Energy

Interactions with the industry stakeholders revealed that there is no shortage of electricity or natural gas supply to the cluster, in fact Gujarat boasts of a power surplus state. But, the major challenge is the staggering rise in the price of primary source of energy, i.e. natural gas. It has become increasingly difficult for the chemical units to obtain gas at quota prices. As a result, some of the micro and small scale units have shifted to firewood for their heating process requirements, which is not an eco-friendly option. In such a situation, it is inevitable for the units to shift to energy-efficient technologies and reduce their gas and electricity consumption. Energy audits can recommend significant savings in not only major process technologies, but also in auxiliaries, which consume a significant share of energy. However, the chemical units in Ankleshwar require step-by-step handholding for implementation of EE technologies. The process should involve identification of suitable technologies/practices along with suppliers/fabricators that can provide these technologies through energy audits. The units should then be sensitized on the investments, payback, and return along with concessional financing options available. The operators/workers should be trained on the best operating practices. The assistance should continue till implementation and even post implementation to ensure that the technologies implemented are being used along with best operating practices.

6.3 Marketing

The major market-based challenge facing the chemical industry is cyclical recessionary trends occurring in major end-use segments, such as the textile sector. Recession in European markets has led to a huge reduction in the export of chemicals from Ankleshwar. Competition from China is also quite strong and it requires the industry to remain competitive. Therefore, it is important for the chemical units to minimize resources and costs. The units need to focus more on penetrating the domestic markets and should explore opportunities in new international markets simultaneously. The units should acquire international certifications especially related to environment preservation that can position their brand well in the minds of international customers.

6.4 Raw Material and their Quality

The rising price of raw materials poses a major challenge to the cluster units in keeping their manufacturing costs under control. The small scale operation of the units hinders their capacity to buy raw materials at the most economic price structure. Absence of a big quantum of business prevents these units from effective negotiation of terms and prices. Joint procurement of raw materials by some units can help them in obtaining a better price from the raw material supplier. While energy is one of the important parameters, overall resource efficiency through adoption of lean manufacturing practices is critical.

6.5 Products and their Quality

The Ankleshwar cluster is renowned for manufacturing quality chemicals in India especially when a lot of these chemicals are supplied to large pharmaceutical companies located in the cluster. The cluster supplies chemicals to numerous sectors all across the country as well as internationally. However, to progress and climb the value chain ladder, the cluster needs to focus on better manufacturing practices and stringent quality control. Implementation of statistical quality control tools can help the units achieve higher standards of quality of their products.

6.6 Manpower and Skills

There is an acute shortage of skilled manpower in the cluster especially after the implementation of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREG), as the immigrant labour has become unavailable. There is resistance among the workers to work in chemical units due to their polluted nature. Also, transmission of intermediate product is mostly done manually in small units, which is increasing the dependence upon scarce human resources. While several training initiatives specifically focussing on the chemical industry are being undertaken by the government ITIs and polytechnics, a need for scaling up such facilities is definitely required.

Also options for atomization of processes may be explored to reduce the unit's dependence on labour.

6.7 Environment and Pollution Control

The major challenge in front of the chemical units of Ankleshwar is to control their effluent discharge and pollution. The Ankleshwar chemical cluster was declared 'critically polluted' among 42 other clusters in India by MoEF, GoI. MoEF has induced the cluster units to invest in technologies for their effluent treatment. It keeps a check on the pollution levels of Ankleshwar and operates through GPCB. Because of the critically polluted status, GPCB has not been granting clearances to some companies to expand their production or to run some of their existing facilities. More than Rs 300 crore has been invested by chemical units in Ankleshwar to reduce their pollution, so that the cluster can come out of the critically polluted area. Common Effluent Treatment Plants have been set up by the industries associations in association with GIDC for treatment and safe disposal of industrial effluent.

Since the major focus of the unit owners is towards dealing with the pollution woes of their units, shifting their focus towards energy efficiency will be a major challenge.

6.8 Social

On the social side, human resources and labour are provided with basic amenities along with insurance for workers. However, most chemical units operate with non-mechanized technologies and require a lot of manual operations. This raises the concern of safety for the workers especially since some units manufacture dangerous chemicals. Measures need to be taken to ensure better safety of the worker through provision of safety equipment as well as awareness building on safety in the cluster.

7.0 SWOT Analysis

A SWOT (Strength, Weakness, Opportunities, and Threats) analysis of the chemical units in the Ankleshwar cluster has been carried out to understand the real situation of the cluster. Today, the chemical industries of Ankleshwar face a lot of challenges primarily to control their effluent discharge and pollution. They also face challenges due to increasing cost of energy and raw materials. Though, the cluster has many regional advantages that help it to remain at the forefront of the Indian chemical industry. The units today need to become efficient in order to maintain a decent profit margin and keep their manufacturing costs under control, and for that they have to adopt energy efficient and clean technologies in their processes.

The SWOT analysis of the Ankleshwar chemical cluster is given below.

Strengths

- Situated on National Highway 8 (NH 8), adjacent to Delhi–Mumbai railway line
- Proximity to sea for waste/effluent discharge
- Active industry association exists in the cluster
- Provision of common effluent treatment facilities
- Adequate supply of energy sources, like natural gas, electricity, and so on
- Locally available raw materials
- Locally available technology suppliers and fabricators
- Huge domestic and international market for chemicals
- Entrepreneurship zeal in local community

Weaknesses

- Polluting nature of chemical industries
- Closure of a number of units due to pollution-related issues
- Energy cost is not a critical factor for individual units
- Soaring prices of natural gas
- No land left in Ankleshwar for expansion
- Escalating raw material prices
- Acute shortage of manpower
- Low level of technology
- Lack of government support
- Inefficient production processes
- Low capacity utilization
- Short product life cycle

Opportunities

- Included in Delhi–Mumbai Industrial Corridor (DMIC) zone
- Proximity to Dahej port
- Scope of expansion in Dahej SEZ
- Atomization of processes
- Strong domestic market

- Enormous scope for adoption of energy–efficient technologies
- Benefit from on-going WB–GEF projects

Threats

- Labelled as 'critically polluted' cluster by MoEF, GoI
- Refusal of expansion plans by GPCB due to increased pollution levels
- Competition from Chinese companies
- Soaring prices of natural gas
- Shortage of manpower
- Entry of substitute products in the market

8.0 Conclusion

Ankleshwar region is one of the renowned chemical clusters in India, comprising over 600 MSMEs, manufacturing all major types of chemicals. The cluster is well-supported by industry associations/bodies, government agencies, and local service providers. Despite being recognized as a chemical hub, the cluster is highly energy consuming and energy intensive, and offers immense scope for energy savings through adoption of best available technologies and operating practices.

However, such adoption requires facilitation support since industries lack the capacity, technical expertise, and financing for carrying out the improvements themselves. The World Bank/GEF/SIDBI project on financing energy efficiency is a timely intervention given the current status of EE in the cluster. The role entrusted upon TERI to conduct walk through audits, detailed audits, and implementation support will directly address the technical capacity and financing barriers hindering penetration of EE in the cluster. Activities conducted by other consultants to address knowledge and awareness barriers in the cluster will lend good peripheral support to TERI's efforts. Overall, the holistic approach adopted by the project will be extremely useful in achieving the goal of improving EE in the cluster.