Cluster Profile Report
Kolhapur Foundry Industry

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




SIDBI
भारतीय लघु उद्योग विकास बैंक
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ENERGY IS LIFE BEE CONSERVE IT

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Contents

List of tables

List of figures

List of abbreviations

Automotive Mission Plan	AMP
Bureau of Energy Efficiency	BEE
Common Facility Centre	CFC
Detailed Project Report	DPR
District Industries Centre	DIC
Energy Efficiency	EE
Financial Institute	FI
Global Environmental Facility	GEF
Gokul Shirgaon Industrial Manufacturers' Association	GOSHIMA
Industrial Infrastructure Upgradation Scheme	IIUS
Institute of Indian Foundrymen	IIF
Kolhapur Engineering Association	KEA
Local Service Provider	LSP
Maharashtra Industrial Development Corporation	MIDC
Maharashtra State Electricity Distribution Company Limited	MSEDCL
Manufacturers Association of Kagal-Hatkanangale	MAKH
Micro, Small, and Medium Enterprise	MSME
Million Tonnes	MT
Shiroli Manufacturers Association of Kolhapur	SMAK
Small Industries Development Bank of India	SIDBI
Specific Energy Consumption	SEC
Strengths Weaknesses Opportunities and Strengths	SWOT
The Energy and Resources Institute	TERI
United States Dollar	USD
World Bank	WB

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TERI is grateful to the progressive management of Small Industries Development Bank of India (SIDBI) for vesting its confidence in TERI for carrying out this prominent assignment for the Kolhapur Cluster and for their full-fledged coordination and support throughout the study.

The study team is indebted to Mr Sanjay Karkhanis (President IIF–Kolhapur chapter), Mr Srikant D Dudhane (Director, Kolhapur Engineering Association [KEA]), and office bearers of all other cluster associations for showing keen interest in the study and for their wholehearted support and cooperation for the preparation of this cluster profile report.

Last but not least, the interactions and deliberations with cluster coordinating agencies, industry associations, Cluster Coordination Committee members, MSME entrepreneurs, technology providers, and all those who were directly or indirectly involved throughout the study were exemplary and the whole exercise was thoroughly a rewarding experience for TERI.

TERI Team

Certificate of originality

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

Executive Summary

The Indian foundry industry is a leading engineering sector with annual production of over 7 million tonnes of castings, accounting for about 8–9% of total castings production in the world. There are approximately 4,500 foundry units in the country out of which 90% can be classified as small-scale units, 8% as medium-scale units, and 2% as large-scale units. The foundry industry is dispersed across various geographical clusters, of which the Kolhapur cluster is one of the major ones. Kolhapur was traditionally an agro-based economy. Demand for oil engines and agricultural implements grew with industrialization in the region. This led to the emergence of the foundry industry which evolved around the 1960s. Today Kolhapur is a leading foundry cluster, renowned for manufacturing quality castings.

There are approximately 300 foundry units located in the Kolhapur and Sangli districts of the region. While units in Sangli are located mainly in the Miraj and Palus industrial areas, foundries in the Kolhapur district are spread across eight major industrial estates. The cluster primarily manufactures ferrous (iron) castings covering both SG iron and grey-iron castings. The total production of the Kolhapur foundry cluster is estimated to be 600,000 tonnes per annum. A majority of the foundry units in the cluster cater to the automotive sector along with other sectors such pumps/valves, sugar, textiles, etc. The cluster has experienced growth in turnover, employment and exports over the past few years. Almost 30% of production is being exported to several countries and catering to numerous industries.

There are several support institutions working in the cluster and assisting foundry industries on different aspects such as technology, raw materials, fabrication, testing, financing, labour, training and capacity building, marketing, grievances, knowledge dissemination, etc. The Kolhapur Engineering Association (KEA) is the apex organization of the cluster. In addition, many foundries are members of other relevant forums such as Institute of Indian Foundrymen (IIF), Kolhapur, and industry associations based in different industrial areas of the cluster. Furthermore, there are government bodies along with academic institutes and local service providers/suppliers operating in the cluster. There are several banks/financial institutes in the cluster. However, investments focusing only on energy efficiency projects are presently low in the cluster.

Kolhapur foundries use the conventional sand casting production method which involves several processes such as preparation, melting, and finishing. The processes are highly energy consuming and energy intensive. The cluster consumes over 1000 million kWh of electrical energy and over 120,000 tons of coke per year. The specific energy consumption (SEC) of the foundries also ranges between 1000–1200 kWh per tonne of good castings. Rising energy costs and high share of energy in total production costs indicate the urgent need for energy efficiency in the cluster. Though the cluster is undergoing a technological shift from coke-based cupola furnaces to electrically operated induction furnaces, immense scope exists for technology modernization and energy savings in process technologies such as induction furnaces, mixers, grinders as well in cross-cutting technologies such as compressors, pumps, motors, etc.

1.0 About the project

1.1 Project overview

The World Bank with the support from Global Environmental Facility (GEF) has designed the MSME Energy Efficiency (EE) project as a 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 as under:

1) 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 MSME units in identifying additional EE projects in the future thereby aiding in widespread replication.
2) To raise the quality of EE investment proposals from a technical and commercial perspective, and thus 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.
3) To expand the uses of existing guarantee mechanisms for better risk management by banks to catalyse additional commercial finance for energy efficiency.
4) To establish a monitoring and evaluation system for the targeted clusters.

The GEF implementing agency for this project is the World Bank and the executing agencies are SIDBI and BEE. The five targeted MSME clusters covered under the project and the indicative information are given in Table 1.

Table 1: Five targeted MSME clusters covered under the project and the indicative information

S.No	Cluster	Main Fuel
1	Kolhapur (Foundry)	Electricity/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. Specialised 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 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

Foundries manufacture various types of castings which can be divided into the following categories — ferrous, non-ferrous, aluminium alloy, graded cast iron, ductile iron, and steel. Castings are mainly used in automobiles, railways, pumps, compressors and valves, diesel engines, cement industry, electrical industry, textile machinery, sanitary pipes and fittings, power generation, construction, and many other specialized applications. About 32% global output of foundry industry goes to auto industries and the balance to other downstream engineering sectors. The current foundry industry is worth USD 34 billion and the Automotive Mission Plan (AMP) of 2006–2016 envisages a four-fold growth by 2016.[1]

2.2 Industry statistics

India accounts for about 8–9% of total castings production in the world. The major casting producing regions in the world are depicted in Figure 1.[2] In the year 2009, India's casting production was estimated to be nearly 7.4 million tonnes (MT). India is the second-largest producer of both grey-iron castings as well as steel castings next to China. Indian foundry industry produces various grades of value-added castings as per various international standards.

Figure 1: The major casting producing regions in 2009

There are approximately 4,500 foundry units in India out of which 80% can be classified as small-scale units, 15% as medium-scale units, and just 5% as large-sale units. Approximately, 20% of the foundry units have ISO international quality accreditation. There are several foundry clusters in India. Some of the major clusters are Howrah, Coimbatore, Rajkot, Kolhapur, Ahmedabad, Batala, Jalandhar, Ludhiana, Belgaum, Chennai, Agra, Pune, and Vijayawada.

[1] IIF Presentation – International Foundry Forum, Barcelona 2010
[2] Source: 44th Census of World Casting Production (2009)

2.3 Overview of cluster

2.3.1 Geographical location

Kolhapur is situated in the southwest corner of Maharashtra and shares its eastern and southern border with the State of Karnataka (Figure 1). Kolhapur serves as the headquarters of the Kolhapur district. Kolhapur is connected to major Indian cities like Mumbai, Pune, Hyderabad, Bangalore, Solapur, Nagpur, Tirupati, Ahmedabad, Delhi, Dhanbad through express trains. Kolhapur is also connected by road with Mumbai to the north and Bangalore to the south by National Highway 4 which extends all the way down till Chennai. The city is located about 395 km from Mumbai and 240 km from Pune.

Kolhapur is one of the fastest-growing cities in Maharashtra and is one of the highest per capita income cities in India. The city is a hub for industry, comprising over 1000 energy-intensive industries covering different sectors. These industries comprise mainly of automotive, foundries, engineering spares, sugar industries, and textile mills. There are nine industrial estates in Kolhapur, of which three are Maharashtra Industrial Development Corporations (MIDC) and six are corporate industrial estates. Several large Indian companies have established presence in Kolhapur including Kirloskar Oil Engines, Vardhaman Textiles, Raymond Textiles, Menon Group, Gokul Milk, Eurotex, etc.

2.3.2 History and evolution

Kolhapur district blessed with fertile soil and watered by 14 rivers was traditionally an agro-based economy. The second and third decades of the 20th century witnessed Kolhapur coming to the forefront in sugarcane cultivation and downstream jaggery manufacture became a major industry. Improved methods and appliances came into demand and oil engines were found to be more efficient. Cane crushers made of steel became popular and were imported from England. In course of time, routine wear and tear created a demand for replacement parts, and farmers went to Kolhapur city, where skilled craftsmen, normally employees of machinery traders reconditioned them. Thus, a large business for repair of cane crushers came up in Kolhapur.

The outbreak of the Second World War in 1939 further propelled growth of the domestic engineering industry. The supply routes by sea were disrupted and increasing cane production pushed up the demand for agricultural machinery and oil engines. The skilled mistries then began to make first spare parts for imported machinery and subsequently, simple agricultural implements. Oil engines soon became the mainstay of industrial activity in Kolhapur.

As industrial activity grew, Shivaji Udyamnagar was established and given land for promoting industrial activity. At this time, the Kolhapur Engineering Association was allotted land and the industrial base of Kolhapur came up through a cooperative effort. The growth of the local agricultural machinery and oil engines industry created the need for locally available castings. This led to the emergence of the foundry industry in Kolhapur. The fourth and fifth decades of the 20th century saw several progressive entrepreneurs including S Yashwant, YP Powar, Mirasaheb, Hudli, Gadre, Samani, Utkur, and C Menon emerge and ensure rapid growth of the Kolhapur engineering and foundry industry. The post-Independence period saw continued growth of the oil engine industry which required cast components and several foundries started after 1960. Today, Kolhapur is an established foundry cluster, renowned for manufacturing quality castings in India. In fact, some large corporates including Reliance Industries have invested in foundry industries of Kolhapur.

2.3.3 Inventorization of units

As of date, there are approximately 300 foundry units located in the Kolhapur and Sangli districts of the region. Almost all these units fall under the MSME definition of the Ministry of MSME which is classified on the basis of the unit's total investment in plant and machinery.

The foundry units may also be categorized into small, medium, and large categories based on their annual production as follows:

- Small Units (annual production up to 1,000 tonnes)
- Medium Units (annual production 1,001 tonnes to 10,000 tonnes)
- Large Units (annual production more than 10,000 tonnes)

Based on such a categorization, Figure 2a below shows the approximate distribution of units in the Kolhapur foundry cluster.

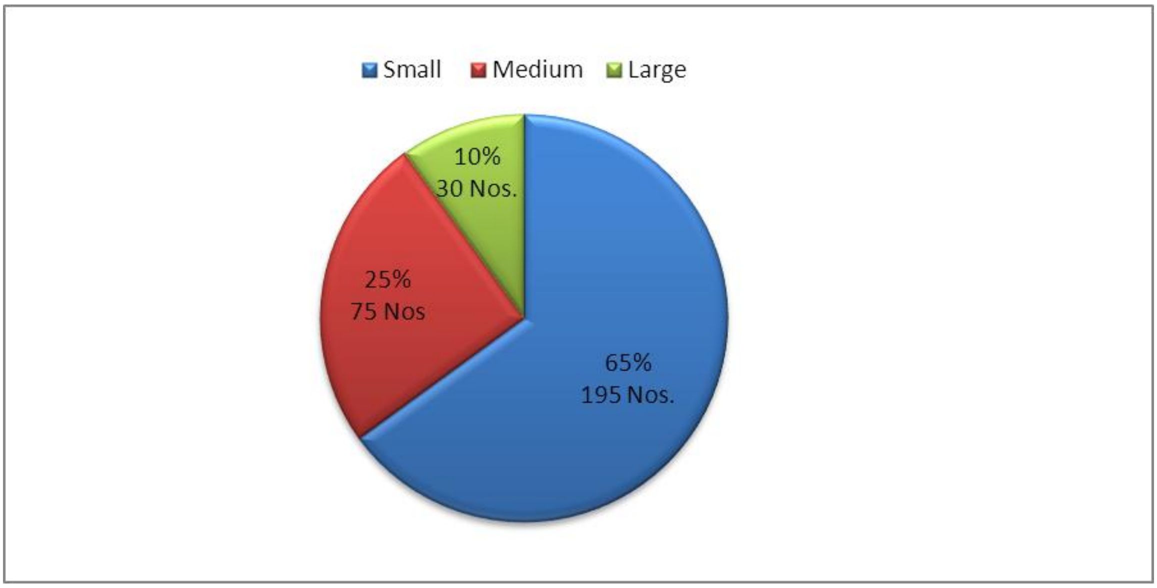

Figure 2a: Distribution of foundry units in Kolhapur cluster

Out of the 300 foundries present in Kolhapur, about 250–275 units are present in the Kolhapur district and 20–25 units in the Sangli district. While units in Sangli are located mainly in the Miraj and Palus industrial areas, foundries in the Kolhapur district are spread across eight major industrial estates. These include:

- Kolhapur city
- Shiroli MIDC
- Gokul Shirgaon MIDC
- Kagal 5-star MIDC
- Ichalkaranji industrial estate
- Jaisingpur industrial area
- Laxmi industrial area
- Hatkanagale industrial area

The approximate number of foundry units in each of the industrial clusters is indicated in Figure 2b.

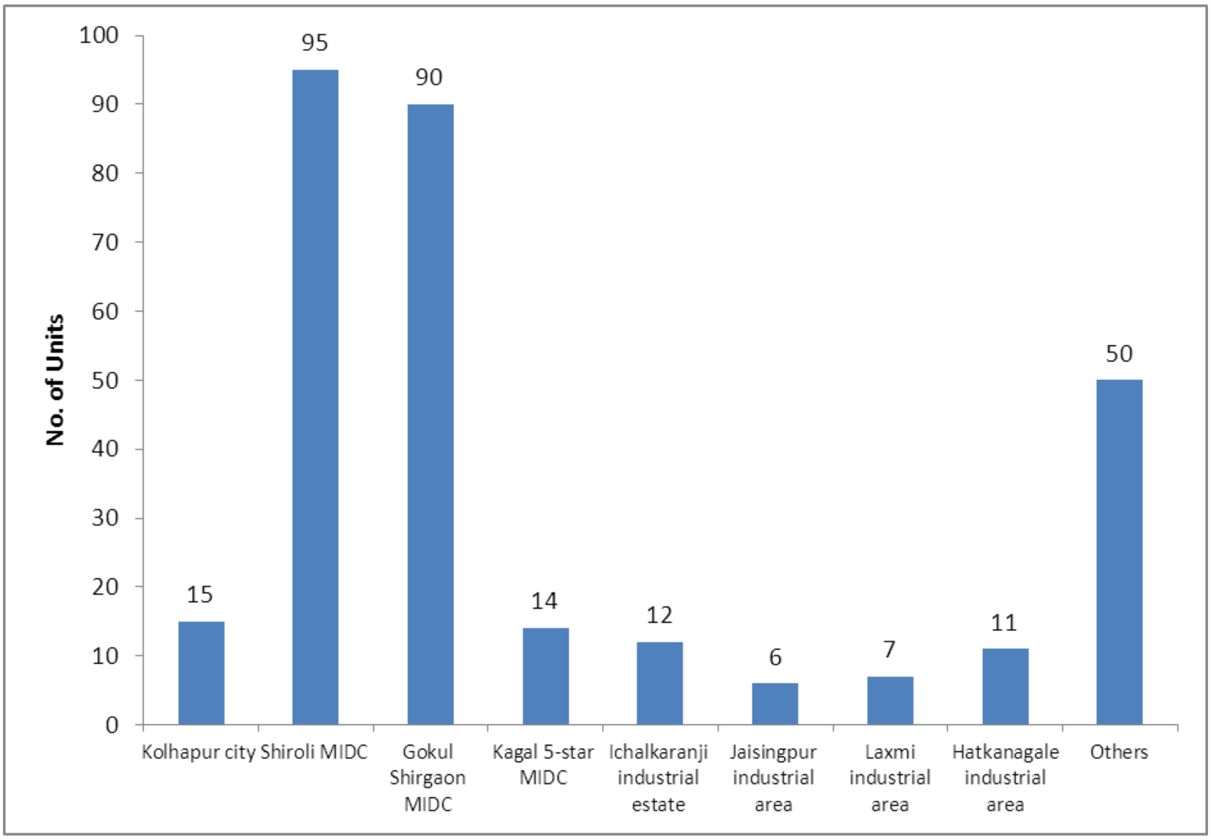

Figure 2b: Approximate distribution of foundry units in different industrial clusters

The following units are amongst the leading foundries, in terms of total production of castings, in the Kolhapur cluster.

- Shriram foundry
- Ghatge Patil
- Menon and Menon
- Saroj Iron

- Sound Casting
- Caspro metal
- Marvellous metals
- Yash Metallics
- Mantri Metallics
- Jadhav Industries

2.3.4 Raw material usage in cluster

The major raw materials used in Kolhapur foundries include base metal (pig iron and scrap), ferrous alloys, and moulding sand. The raw materials are procured from different parts of the country. For example, while some of the base metal is locally supplied, some is bought from Goa. Similarly, quantities of ferrous alloy are imported from Karnataka.

Table 2 gives the details of major raw material sources and approximate price.

Table 2: Sources and prices of major raw materials

Raw material	Source (city/region)	Price (INR/tonne)
Pig iron/scrap	Goa/Kolhapur	32,000
Coke	Imported	30,000
Sand	Konkan/Western ghats	1,250
Bentonite	Indian	4,600

2.3.5 Products manufactured

Kolhapur is a significant contributor to the total castings production in India. The cluster primarily manufactures ferrous (iron) castings covering both SG iron and grey-iron castings. The total production of the Kolhapur foundry cluster is estimated to be 600,000 tonnes per annum. This accounts for about 7–8% of India's total casting production. While many units produce between 50 and 200 tonnes of castings per month, a few larger units in the cluster have production capacity between 2500 and 3500 tonnes per month.

The foundry industry in Kolhapur, though traditionally catered to oil engine industries, has diversified its supply base to a variety of consumers. However, still a majority of the foundry units in the cluster cater to the automotive sector. Many units in Kolhapur are producing castings for cylinder heads, clutch housing, covers, gears, etc., and a few of the larger and highly mechanized units are also producing engine castings such as blocks and heads. Figure 3 shows the distribution of castings by end-use segments.[3]

[3] 2007/08 data

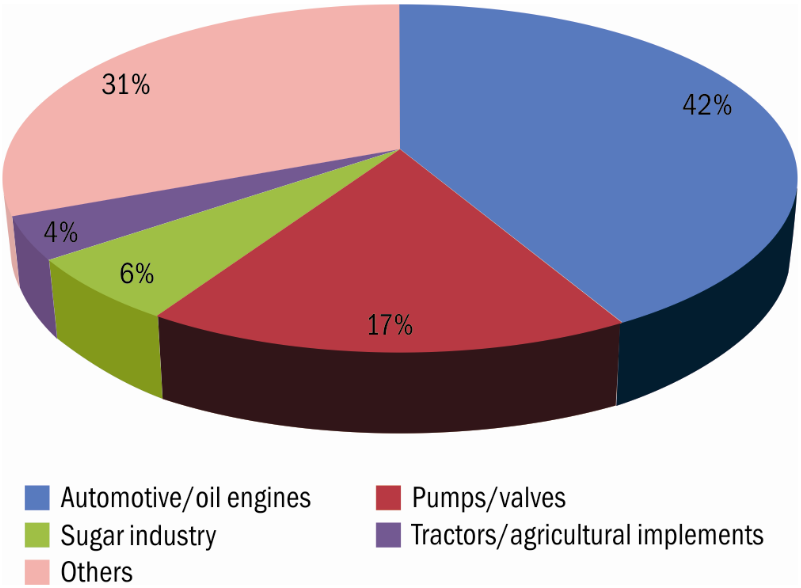

Figure 3: Distribution of castings by end-use segment in Kolhapur

2.3.6 Technological upgrades undertaken by units in the recent past

The main technology in the foundry process is a "furnace" which is used for melting. The furnace is either coke fired (cupola) or electricity powered (induction furnace). It has been observed, that many foundries have shifted towards use of induction furnace in the recent past. Figure 4 shows the share of melting technologies in the cluster. Industry estimates show that around 70% foundries are now using induction furnace based melting process and 30% are using cupola melting. Induction furnaces are a better option for producing spheroid graphite (SG) iron castings, and since many industries are now shifting towards this form of production, a simultaneous shift towards induction furnaces has also been observed. Some units are also duplexing. In addition to furnaces, technological up gradation has also taken place in moulding section with a few foundries also going for high pressure moulding lines.

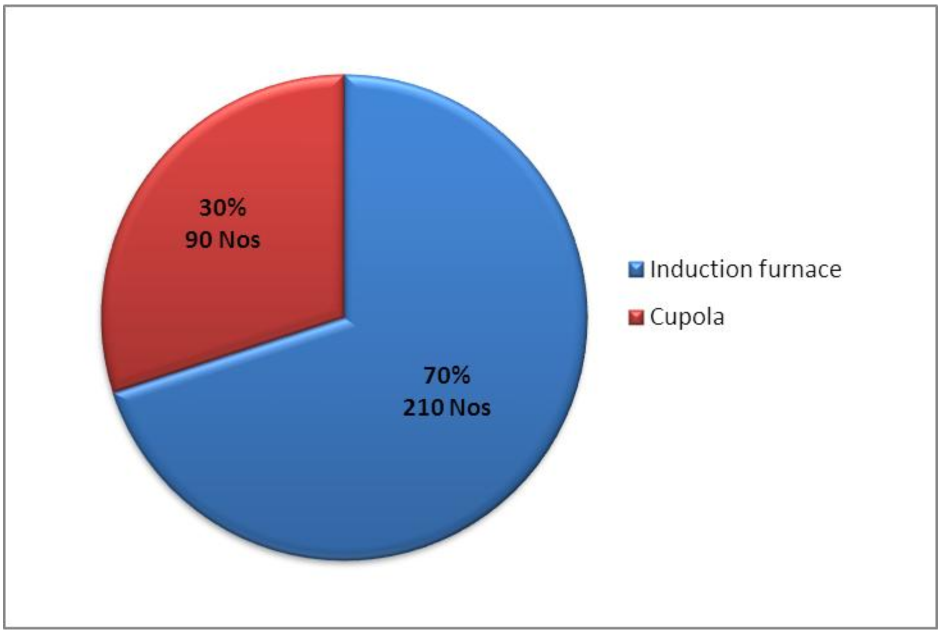

Figure 4: Share of melting technologies

2.3.7 Value chain analysis

The analysis in Figure 5[4] shows a high increase, of 42% over the past 4 years, in the cost of producing a casting. Energy is a significant parameter impacting to this increase in cost, contributing about 15–20% of the total production cost.

Traditionally, a large share of the Kolhapur casting production has catered to the domestic market. However, exports have seen a rise, especially in the last decade. Presently, about 30% of production is being exported. The exports are catering to numerous industries in these countries such as automobiles and engineering items. The growth in exports can be attributed to value chain improvement of the Kolhapur industry, especially its ability to supply complete machined components

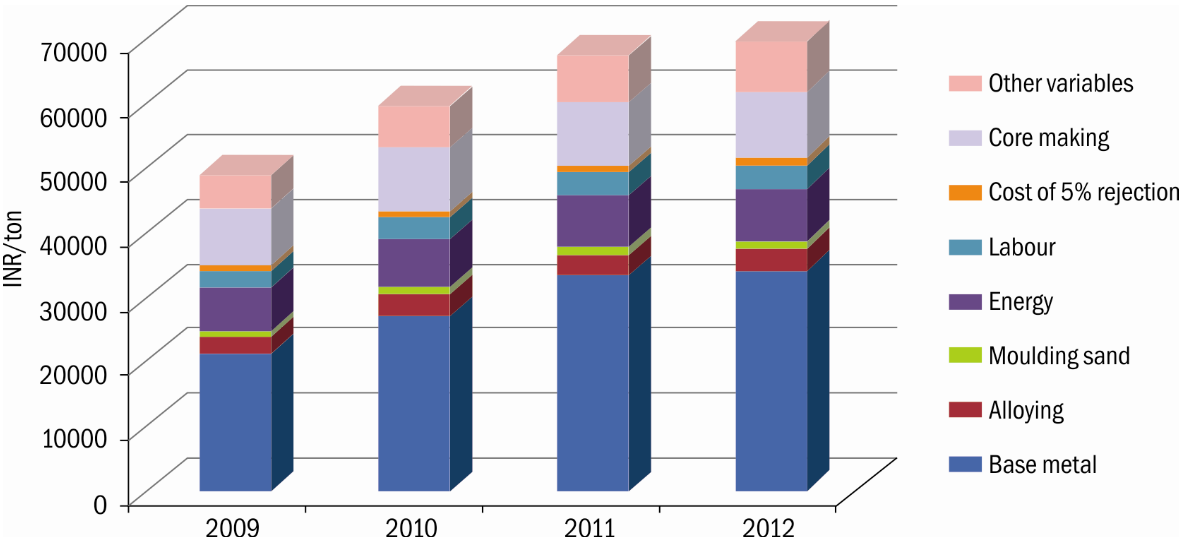

Figure 5: Cost breakdown of castings (2009–2012)

2.3.8 Current market scenario

The foundry industry is directly impacted by cyclical market trends occurring in various engineering sectors. Automobile giants such as TATA, M&M, Ashok Leyland, Eicher, Maruti, Hyundai, etc., source critical castings for their industries from the Kolhapur foundry industry. However, since the automotive sector is currently facing slow down due to global recession, the Kolhapur foundries are also feeling an impact. The overall price of inputs has been on the rise resulting in rising prices of castings.

2.3.9 Cluster-level turnover, exports, profitability and employment

The Kolhapur cluster produces an estimated combine tonnage output of 600,000 tonnes per annum. Increased global demand for castings over time has brought about a concurrent increase in demand for quality products at competitive cost. This has impacted the turnover, exports, and employment numbers in the industry. Table 3 shows turnover, exports, and employment in the cluster for 2007–2008 and extrapolated values till 2011–2012 at 20, 10, and 7%, respectively. The extrapolation is estimated to be based on discussions with the industry associations and leading foundry industries in the cluster. In addition, the industry provides

[4] IIF-Kolhapur chapter data

indirect employment to nearly 100,000 people. Further, discussions with various key stakeholders indicated that the profitability of individual units/ cluster were not available in public domain.

Table 3: Turnover, exports, and employment values for the Kolhapur foundry cluster

Year	Turnover (INR million)	Exports (INR million)	Direct employment (Number)
2007–08	25,000	7,800	31,000
2008–09	30,000	8,580	33,170
2009–10	36,000	9,438	35,492
2010–11	43,200	10,382	37,976
2011–12	51,800	11,420	40,635

2.3.10 Social and environmental aspects in the cluster

There are no major social issues in the cluster. Most of the workers have been provided safety equipment such as gloves, helmets, jackets, etc. However, it has been found that sometimes the workers do not use safety equipment since ambient temperatures are quite high. It is possible to increase the use of safety equipment by designing more user-friendly equipment suitable for local conditions.

Air pollution and disposal of waste sand are the major environmental concerns in the cluster. Particulate emissions from furnaces lead to indoor and outdoor air pollution. Most foundry units have incorporated pollution control systems to meet the emission norms. However, it is possible to improve the efficiency of existing pollution control systems to improve the ambient air quality. Since most units are not reusing their sand, there is increasing pressure on disposal of used sand. It is possible technically to re-use almost 80% of sand after reclamation. However, the high cost of sand reclamation systems is a major concern especially for small- and medium-scale units.

2.3.11 Cluster development activities

Research on competitiveness of the Indian industry has shown that inadequate industrial infrastructure is a major factor inhibiting growth and competitiveness of industries in India. Keeping this in mind, the central government through the Department of Industrial Policy and Promotion (Ministry of Commerce and Industry) launched the Industrial Infrastructure Upgradation Scheme (IIUS) in December 2003. The objective of this scheme is to enhance competitiveness of the industry by providing quality infrastructure to existing industrial clusters through a Public-Private-Partnership (PPP) mode. The foundry industry in Kolhapur is in the process of utilizing this scheme. Leveraging the platform of the Kolhapur Engineering Association (KEA) and other industry associations, in particular Gokul Shirgaon Industry Manufacturers Association (GOSHIMA) and Shiroli Manufacturers Association of Kolhapur (SMAK), foundry units have formed a Special Purpose Vehicle (SPV) named as the "Kolhapur Foundry and Engineering Cluster". A Detailed Project Report (DPR) was prepared and submitted to the government. The DPR comprised a proposal that would:

1) Establish two sand reclamation facilities in Gokul Shirgaon and in Shiroli.
2) Establish a Common Facility Centre (CFC) for testing, CAD/CAM training and electronic library.
3) Improve general infrastructure such as roads and water supply.

The government has approved the project and sanctioned INR 70 crores for its implementation. Out of this total amount, 75% has been contributed by the central, 10% by the state, and 15% by the Kolhapur industries. INR 42 crores is being dispatched as first phase and commissioning of the project is expected to commence in the immediate future.

3.0 Major cluster actors

3.1 Industry associations

The major industry associations in the cluster are given in Table 4.

Table 4: Major industry associations and support bodies in Kolhapur

Name of association	Location	Chairperson/director
Institute of Indian Foundrymen (IIF), Kolhapur	Rajarampuri	Mr S Karkhanis
Kolhapur Engineering Association (KEA)	Shivaji Udyamnagar	Mr S D Dudhane
Gokul Shirgaon Manufacturers Association (GOSHMA)	Gokul-Shirgaon	Mr A Azri
Shiroli Manufacturers Association of Kolhapur (SMAK)	Shiroli	Mr D D Patil
Manufacturers Association of Kagal Hatkanangale (MAKH)	Kagal-Hatkanangale	Mr A Dudhane
Ichalkaranji Engineering Association	Ichalkaranji	Mr D M Biradar

Details of two of the major associations are given in Sections 3.1.1 and 3.1.2.

3.1.1 Kolhapur Engineering Association

The Kolhapur Engineering Association (KEA), located in the heart of the city is the apex organization of the cluster. KEA has a membership of over 500 members comprising foundries, automotive, sugar, textile, agricultural implements, engineering, and other industries. The services and activities of the association include grievance redressal, training and organizing seminars, etc. The association has a conference room and a 125 seating capacity auditorium.

3.1.2 IIF: Kolhapur chapter

The IIF Kolhapur chapter is the key institution working specifically towards the needs of the Kolhapur foundry industry. The chapter has strength of about 275 members comprising foundry units as well as individual foundry consultants, equipment suppliers, and Local Service Providers (LSPs). The Kolhapur chapter is quite active in the cluster. The chapter not only provides support on technical issues and growth of the members, but is also dedicated towards addressing various issues faced by the cluster regarding raw materials, labour, etc. In addition, activities of the chapter encompass seminars, workshops, technical programmes at managerial level, and monthly training programmes for shop-floor workers, trade fair visits and dissemination of newsletters, and other knowledge products.

3.2 Government bodies associated with MSMEs in the cluster

There are government bodies such as the District Industries Centre (DIC), Kolhapur, the MSME testing lab, and government polytechnic present in the cluster. The DIC is involved in the registration of the industries and also facilitates VAT benefits on plant and machinery investments. The MSME testing lab offers numerous testing facilities including physical testing, microstructure testing, spectro analysis as well as chemical testing and is well utilized by the local foundries. The Government Polytechnic in Kolhapur offers a certificate course for workers/fresh graduates in foundry technology in collaboration with IIF, Kolhapur. A government-run ITI is also present in the cluster.

3.3 Academic and R&D institutions

There are various training and academic institutes that support the foundry industry either directly or indirectly. In addition to the government polytechnic and ITI, there are 2–3 private ITIs and six private engineering colleges of which DY Patil is one of the largest. The colleges offer post-graduate courses in mechanical, electrical, and metallurgical engineering. Amongst these, Shivaji University has initiated an exclusive EE cell, which is offering courses in energy management, energy auditing, and energy modelling. The cell also undertakes energy audits for local industries.

3.4 Service/technology providers

There is good presence of local service providers in the cluster. There are around 50 main local service providers which include energy auditors, fabricators, equipment suppliers, technology providers, testing centres, etc. Fabricators are present for cupola design and commissioning, and induction furnace suppliers have set up local service offices for installation and maintenance of induction furnaces. While, most of the equipment is available locally, a few units are procuring certain equipments such as moulding and sand mixing machines from Coimbatore. In addition to the government-testing laboratory, certain private labs offering microstructure, ferrous alloy, raw material, and sand; tensile-testing facilities are also present in the cluster. In fact, some of the bigger foundries have also set up their own in-house fabrication, input supply, and testing service facilities.

3.5 Financial institutes/banks

3.5.1 Lead Bank

The Bank of India (BOI) is the lead bank in the Kolhapur district with seven branches.

3.5.2 Nationalized and commercial banks

There are about 20 commercial, cooperative, and nationalized banks operating in the cluster. Some of the key banks along with Small Industries Development Bank of India (SIDBI) include Bank of Baroda, State Bank of India, and ICICI. Most of these banks are assisting in expansion and infrastructural upgradation of the units. However, investments focusing only on EE projects are presently low in the cluster.

3.5.3 Financial institutions

There are various financial institutes (FI) in Kolhapur. SIDBI is one of the leading FI in the cluster.

4.0 Technology used and production process

4.1 Foundry technologies

There are several types of equipment and technologies that are widely used in the Kolhapur foundry process. Some of the major ones include:

- Melting furnaces
- Sand mullers
- Intensive mixers
- Pneumatic grinders
- Shell moulding machine
- Core oven
- Shell core shooters
- Knockout machine
- Shot blast machine

The major equipments are described below.

4.1.1 Major equipment used in foundry units

(a) Melting furnaces

Two types of melting furnaces are commonly used in a foundry — cupola and induction furnace. While cupola uses coke to melt the metallic charge materials, an induction furnace uses electrical energy. Although the energy cost per tonne of molten metal is lower in a cupola, other advantages of induction furnaces, viz., faster start-up, lower manpower requirement, and lower emissions have contributed to their increasing popularity among foundry units in Kolhapur cluster.

(b) Sand mullers

These are used for green sand preparation. Fresh sand is mixed with bentonite and other additives and mixed in muller to make green sand. These usually come in small size of around 300 kg per batch, with typical connected drive of 10 kW and cycle time come about 7–10 minutes.

(c) Intensive mixers

Cores are forms that are placed into the mold to create the interior contours of the casting. They are typically made of clay-free silica sand mixture. The sand is thoroughly mixed with suitable binders, water, and other ingredients in intensive mixers. This equipment basically has two motor drives, used to rotate the blades and perform mixing. A typical 10 tonne per hour, 500 kg batch-intensive mixture has a total connected load of around 70 kW.

(d) Shell-moulding machine

This is usually located below the sand mixer. Sand from a hopper falls into the moulding box and then pneumatically or hydraulically pressed to make the final mould. High pressure moulding machines can use moulding sand having lower moisture contents and hence higher mould densities can be achieved. The castings have better dimensional accuracy and better surface finish.

(e) Knock-out machine

The knock-out machine has grated base, and it has two vibrators one on either side or a single vibrator.

(f) Shot blasting

There are different types of shot-blasting machines available; the most common ones in Kolhapur foundry cluster are double door, two shooters type. It has four drives, two for shooters, one of bucket rotating, and one for dust collection. Typical 1 tonne per batch shot blast machine has total connected load of around 25 kW.

4.2 Foundry process description

Different stages in manufacturing of a casting include the following:

1) Preparation of moulds and charge material

This involves preparation of (*i*) moulding sand, (*ii*) casting moulds, and (*iii*) charge (metals and alloys). Fresh sand is mixed with bentonite and other additives and processed to prepare green sand, which is the most commonly used moulding sand in Kolhapur, typical batch size varies between 200–500 kg. The green sand is then used to prepare moulds for the castings. Simultaneously, metal scrap, pig iron, and other alloys are loaded in the furnace for melting. The ratio between raw materials depends on final casting properties. A typical cast iron casting has raw material in following percentage: metal scrap (25%), boring (60%), pig iron (10%), and others (5%).

2) Melting stage

The metal is then melted in either a cupola furnace — conventional or divided blast — or induction furnace. The typical temperature requirement for CI casting is around 1500°C, steel casting is around 1650°C, and for aluminium casting 750°C. Once the melting is completed, the molten metal is poured into the sand moulds using a ladle operated either manually, automatically, or semi-automatically, that were prepared in the first stage and allowed to cool down and harden.

3) Finishing stage

Once the metal has taken shape of the mould, it is removed, shot blasted, and cleaned. It also goes through some machining, if required. The final product is tested using spectrometer and packed for dispatch. Meanwhile, the sand from the moulds is either disposed or treated in a sand reclamation plant for reuse. Units using sand reclamation in Kolhapur are generally able to reuse about 80% of the sand. A more technical illustration of the manufacturing process of a typical foundry unit in the Kolhapur cluster is presented in Figure 6.

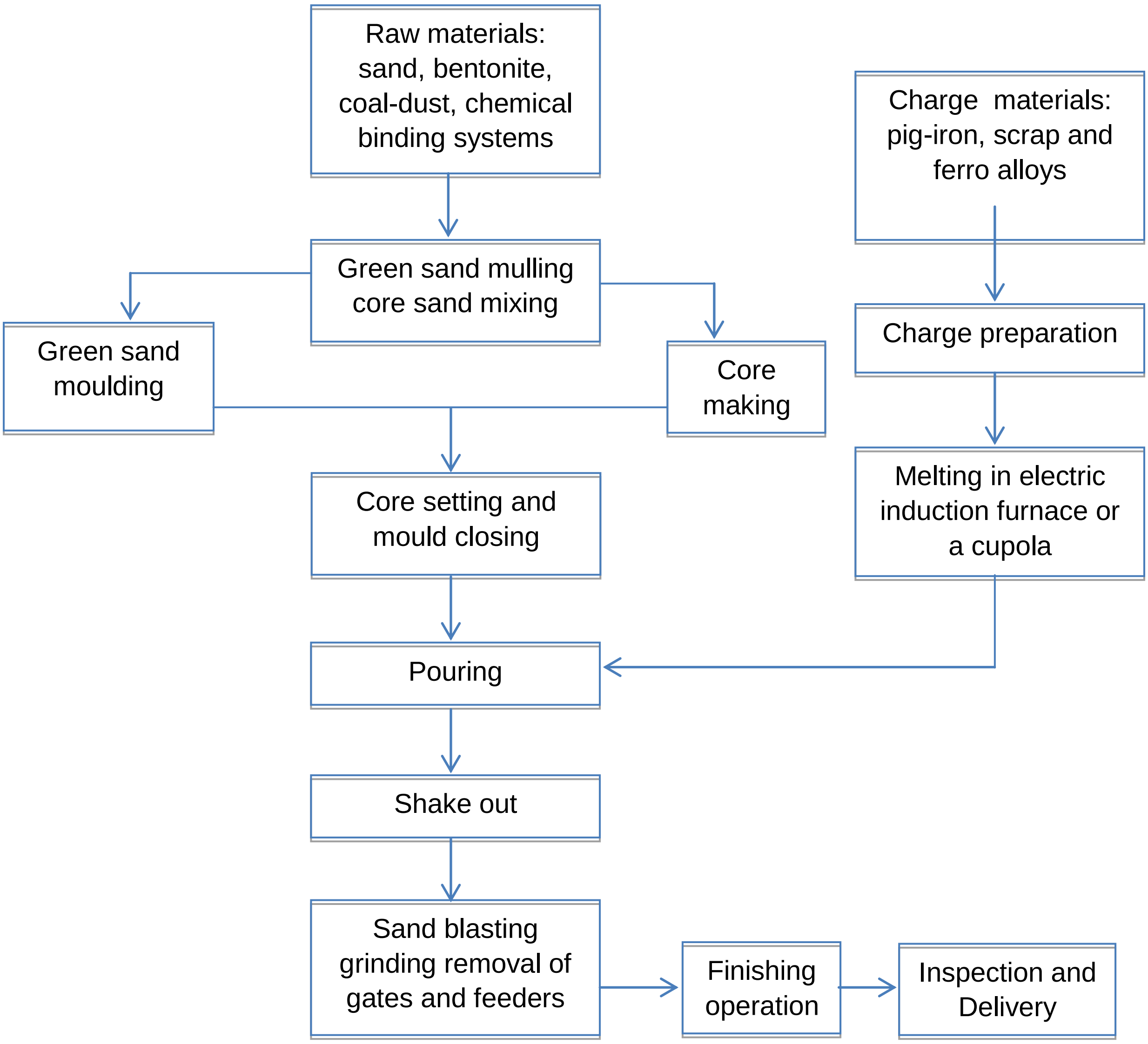

Figure 6: Manufacturing process of a typical foundry unit in Kolhapur

5.0 Estimated energy consumption pattern and saving potential

5.1 Types of fuel and usage in MSMEs

5.1.1 Fuel types and quantity used in typical MSME units

Foundry uses two main forms of energy: coke and electricity. In a foundry using induction furnace for melting, electricity accounts for about 85–95% of the total energy consumption of the unit. Induction furnace is major electricity consuming equipment, it consumes about 70–85% of total electrical energy consumption. If the foundry units are heat treating the castings then diesel consumption comes out to around 15–25% of the total energy consumption of the unit. In cupola-based units, coke typically accounts for 85–90% of the total energy consumption of the unit.

5.1.2 Specifications and characteristics

Coke is used in foundries where the melting process is done in a cupola furnace (conventional or divided blast) and electricity is used in units where melting is done in an induction furnace. Other processes in a foundry such as sand preparation, machining, shot blasting, etc., are all operated using electricity, irrespective of whether the foundry is cupola based or induction based. Metallurgical coke is being used as fuel in cupola based units in the cluster. The calorific value of the coke varies between 5500–6500 kcal/kg.

5.1.3 Price/Tariff

Electricity

The price of electricity has increased from INR 5.90 per unit to INR 8.50 per unit in Kolhapur. Figure 7 shows the trend over the last four years. The price shows an increment of over 15% during this period.

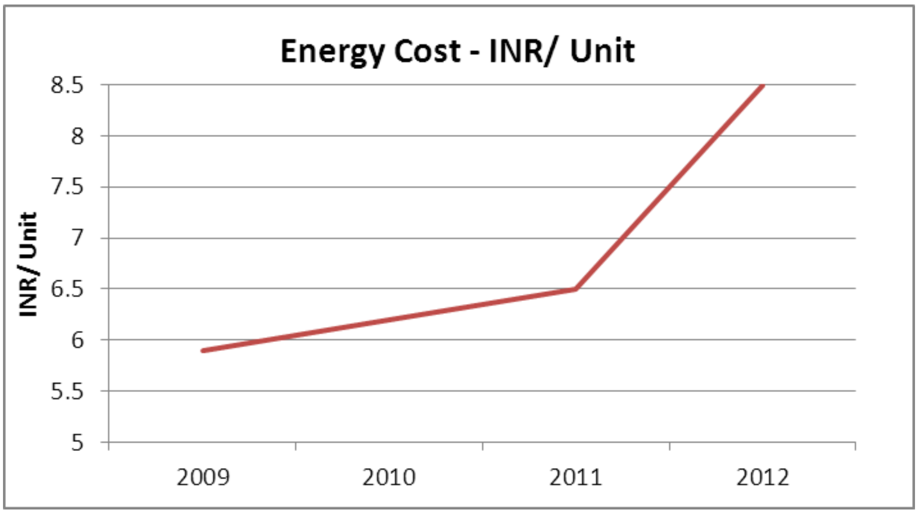

Figure 7: Energy price (2009–2012)

Source: IIF-Kolhapur chapter data

Coke

The price of coke has increased over the last year and is presently about INR 30,000 per tonne.

5.1.4 Sources

Electricity to Kolhapur is supplied from the Maharashtra State Electricity Distribution Company Limited (MSEDCL). MSEDCL supplies electricity to 3.63 lakh industrial consumers sourcing its power from thermal, hydro, gas, and non-conventional sources like solar, wind, bagasse, etc. Coke is being supplied from various sources which include Sesa-Kembla Goa, Gujarat NRE, and also from some suppliers in Nagpur.

5.2 Energy consumption pattern

5.2.1 Electrical and thermal

The energy consumption pattern in the cluster is given in Table 5. The table shows that energy consumption in the foundry industry is considerably large. More importantly, the specific energy consumption (SEC), which is the energy intensity of a plant, is also quite high in this sector, including the Kolhapur cluster. Discussions revealed that on average, an induction furnace based unit in the cluster consumes approximately 1000–1200 kWh per tonne of good castings. Out of this, about 600–700 kWh per tonne is consumed for melting and about 400–600 kWh per tonne is consumed for other associated operations within the foundry unit. In cupola, the average coke to melt ratio is observed to vary between 1:8 and 1:9.

Table 5: Annual energy consumption of the Kolhapur foundry cluster

Energy type	Annual consumption	Annual energy bill (INR)
Electricity	1185 million kWh	870
Thermal (Coke)	128,111 tonnes	367

Source: See Tech report on Kolhapur foundry cluster (2012)

5.2.2 Utility-wise energy share

The share of energy usage across different utilities in a typical small and medium foundry is given in Figure 8. As shown, the majority of energy is consumed for the melting process (about 70%). Moulding, core making, and sand preparation are also significant consumers in the process.

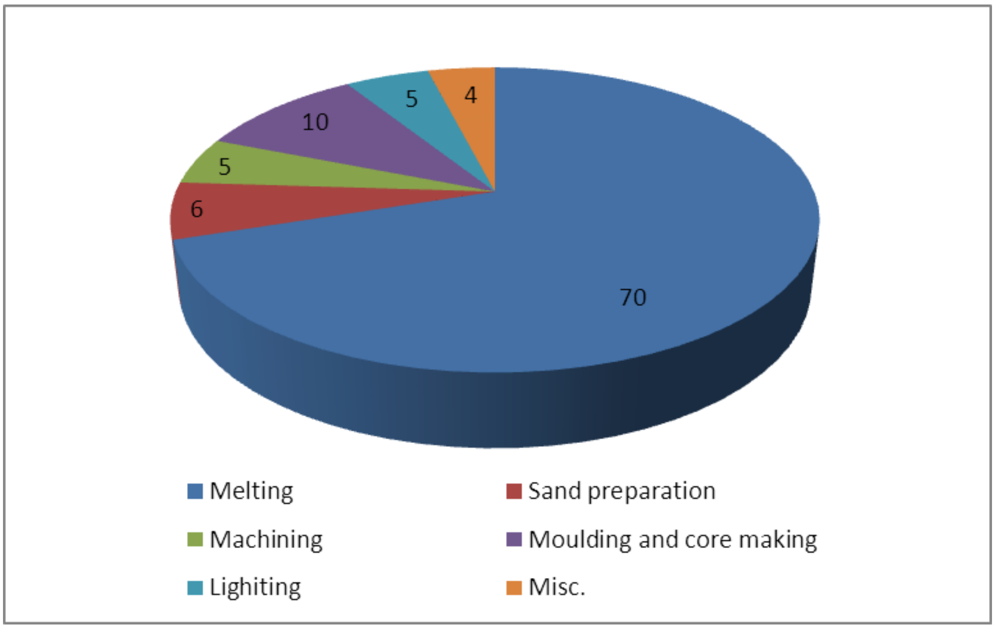

Figure 8: Utility-wise energy share in MSME
Source: IIF (2012) – 60th IIF transactions

5.3 Energy-saving potential

As mentioned in the earlier sections, Kolhapur foundries are steadily switching over from coke-based cupolas to electricity-operated induction furnaces. While this is a positive trend from an EE perspective, significant technology upgradation and energy efficiency scope still remains within induction furnaces in the cluster. Large savings through temperature and frequency controls, harmonic loss reduction, etc., are possible in induction furnace foundry units. There is also considerable scope for improving other process technologies in the plant such as sand mixing, pneumatic grinding, machining, sand reclamation, etc. Most of the units are still using conventional machines for these processes, and penetration of EE designs can be promoted. In addition to process technologies, foundries also use numerous cross-cutting technologies such as compressors, motors, pumps, etc. It is observed that these types of technologies are generally outmoded and inefficient, especially in the smaller units. Overall, there are only a few foundries that are mechanized and automated, while the rest are employing manual processes and hence there is good scope for technology enhancement. 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.

A few possible energy-saving opportunities are as listed below:

- Replacement of reciprocating type air compressor by screw type
- Transformer tap setting
- Air compressor pressure setting
- Use of energy-efficient sand mixture
- Improvement in lighting system
- Replacement of old and inefficient pumps and motor
- Adoption of sand reclamation systems

6.0 Major challenges and suggestions for improvement in the cluster

6.1 Technology

The use of out-dated and outmoded technologies is a major challenge in the cluster. Availability of EE technologies, weak linkages with suppliers and low levels of knowledge on modern technologies are the main reasons for lack of technology up gradation in the cluster. Enabling policies for technology development and customization; demonstration of proven technologies and enhanced knowledge dissemination are necessary for facilitating technology up gradation in the cluster.

6.2 Energy

The share of energy cost in total production costs along with the price of energy is on the rise in Kolhapur. This is having a burden on maintaining competitiveness, especially for the smaller units. In this context, EE is critical for the industry. There is immense scope for energy savings. Energy audits can recommend significant savings in not only melting and process technologies but also in auxiliaries, which consume a significant share of energy. However, the foundries in Kolhapur 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 foundries should then be sensitized on the investments, payback, and return along with concessional financing options available. 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 Kolhapur foundry industry is cyclical recessionary trends occurring in major end-use segments such as the automotive sector. Competition from China is also quite strong and requires industry to remain competitive. Therefore, it is important for Kolhapur foundries to minimize resources and costs. While energy is one important parameter, overall resource efficiency through adoption of lean manufacturing practices is critical.

6.4 Raw material and their quality

Availability of fresh sand is becoming a rising issue in the cluster. This is mainly because most units are not operating sand reclamation plants at their units. The cluster-level bodies have undertaken a PPP initiative which will establish two sand reclamation facilities in the cluster. This has been approved and is likely to considerably reduce demand for fresh sand in the cluster.

6.5 Products and their quality

The Kolhapur cluster is renowned for manufacturing quality castings in India. The cluster supplies products to numerous sectors all across the country as well as internationally. However, to progress and move up the value chain ladder, the cluster needs to focus on better manufacturing practices and stringent quality control. It is envisioned that quality improvements/rejection rates will improve further with the establishment of a new testing facility under the PPP cluster project.

6.6 Manpower and skills

Availability of skilled labour is a major issue, not only in Kolhapur foundries, but across the Indian foundry sector in general. Labour retention rates are low and workers tend to shift jobs to industries with easier and cleaner environments. It has been observed, that due to the high demand for labour, many industries from other cities such as Pune and Mumbai are also recruiting students from Kolhapur ITIs/polytechnics. While several training initiatives specifically focusing on the foundry industry are being undertaken by IIF and government polytechnic, a need for scaling up such facilities is definitely required.

6.7 Environmental

Although maintaining good environment conditions is a challenge in the rugged and generally dusty atmosphere prevailing in foundries, most units have requisite permits from state pollution control bodies. The major challenge has been the soil and water pollution concerns arising from disposal of waste sand. However, this issue is expected to be reduced once the common sand reclamation facilities are established and 70–80% sand is reused by the factories.

6.8 Social

On the social side, human resources and labour are provided with basic amenities along with insurance for workers. However, most foundries operate with non-mechanised technologies requiring need for a lot of manual operations. This raises the concern of safety for workers, which is generally inadequate across the foundries. Measures need to be taken to ensure greater worker safety through provision of safety equipment's as well as awareness building on safety in the cluster.

7.0 SWOT Analysis

This section highlights the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the cluster.

7.1 Strengths

- The cluster is renowned for producing high quality castings
- Foundries are shifting towards induction furnace melting
- Good availability of alloys
- Regular supply of electricity
- Strong industrial base
- Proximity to Mumbai and Pune

7.2 Weaknesses

- Low degree of mechanization and automation
- Use of inefficient manufacturing practices
- High energy consumption and increasing input prices
- Declining sand availability and growing sand disposal issues
- Labour shortages
- Slowdown in market

7.3 Opportunities

- Increased EE in melting furnace technologies
- Potential to reduce energy cost through implementation of energy audit recommendations
- Increased use of robotic operations and simulation technologies
- Easier availability of bank loans
- Lean manufacturing practices
- Common sand reclamation facility
- Status of a regional export centre

7.4 Threats

- Technological obsolescence, especially in the smaller foundries
- Lower manufacturing costs in countries such as China
- Global rise in price of raw material and fuels
- Non-proven technology for green sand reclamation
- Continued recession

8.0 Conclusion

Kolhapur is one of the renowned foundry clusters in India, comprising about 300 MSMEs and producing around 600,000 tonnes of castings per annum. The cluster is well supported by industry associations/bodies, government agencies, and local service providers. Despite being recognized for good quality castings, 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 TERIs efforts. Overall, the holistic approach adopted by the project will be extremely useful in achieving the goal of improving EE in the cluster.