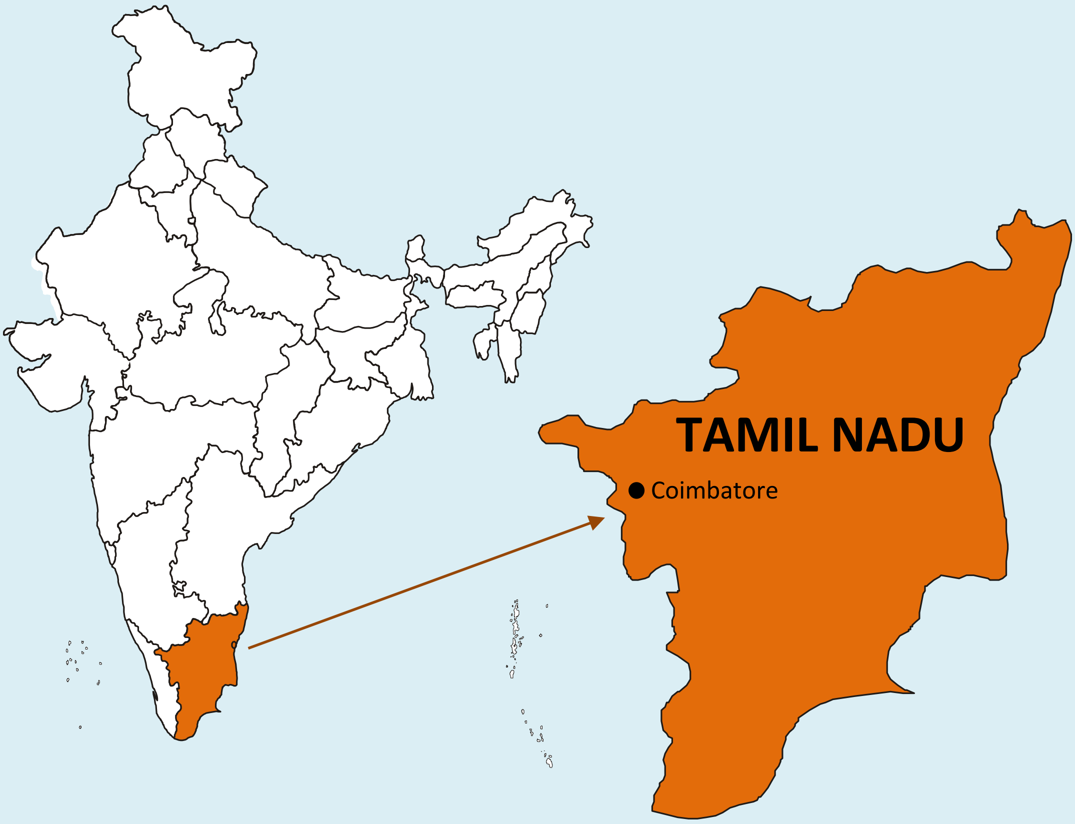
Cluster Profile
Coimbatore foundries



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Contents

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TERI team is indebted to IIF–Coimbatore Chapter, Coimbatore Industrial Infrastructure Association (COINDIA) and Southern India Engineering Manufacturers' Association (SIEMA) for providing support and information related to foundry units in Coimbatore cluster. TERI extends its sincere thanks to Mr Jayakumar Ramdass, Chairman, IIF–Coimbatore Chapter; Mr Mahendra Ramdass, Chairman, COINDIA; and Mr S Kuppusamy, Vice President, PSG Foundry for organizing field visits and interactions with fellow foundry-men during the study for the preparation of this cluster profile report.

Last but not least, our sincere thanks to MSME entrepreneurs and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Coimbatore foundries

Overview of cluster

Coimbatore, located in the state of Tamil Nadu, is an important industrial cluster in India. The industrial activities in the cluster developed in the 1930s, with the setting-up of many textiles and spinning units since the local weather was suitable for yarn processing. Initially, the metal casting industry flourished in Coimbatore to cater to the needs of the local textile machinery manufacturers. Subsequently with the start of pump manufacturing in Coimbatore in 1930 and electric motors in 1937, it became an important cluster for manufacture of monoblocks, domestic pumps and subsequently submersible pumps. In 1970s, the wet-grinder was developed in Coimbatore for grinding of rice and lentils used in local recipes. The motor and drive-system of wet-grinders use casting components. Till date, the cluster is by far the largest producer of wet-grinders in India. Subsequently, major automobile manufacturing units like came up in surrounding areas like Hyundai, Honda, Leyland, Allwyn Nissan, Pricol, L&T, LMW and Mahindras. The setting-up of these automobile units created a great demand for castings as well.

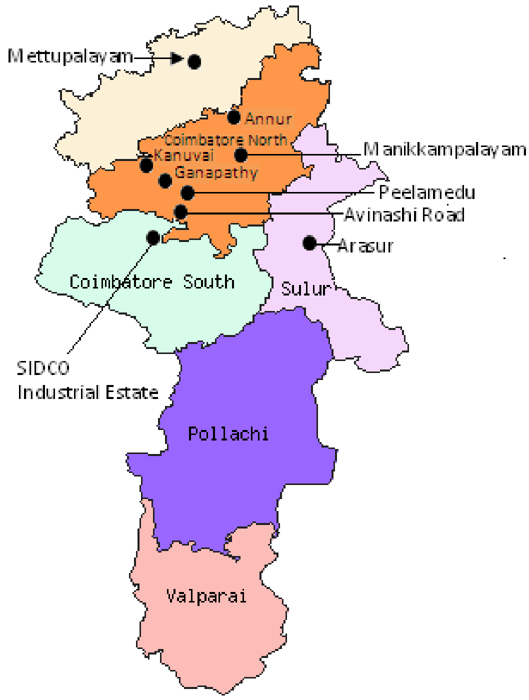
Product types and production capacities

The major raw materials used include base metals (pig iron, steel, borings, scrap and foundry returns) and alloys (ferro-silicon, ferro-manganese, iron sulphide, silicon carbide, etc). In addition, small quantities of other metals like copper and tin are added for special grades and SG iron castings.

There are about 535 foundry units in Coimbatore cluster. They are scattered both within and outside the city. Some of larger geographical concentration of foundry units are Arasur, Annur, Avinashi Road, Ganapathy, Kanuvai, Manikkampalayam, Mettupalayam, Peelamedu and SIDCO Industrial Estate and. These areas have been depicted in figure 1.0.

About 15 foundries are of large-scale, 70 in medium scale and balance in small and micro category. The production of castings of the cluster is about 2,000 tonne per day (about 0.6 million tonne per annum). The foundry industry employs about 10,000 direct employees. The estimated turnover of the foundries in the cluster is approximately Rs 3,400 crore per annum.

Several of the foundries in the cluster are of captive type i.e. they produce castings for use in the end-products being manufactured by the firm for different end-use applications. There



Major concentrations of foundry industry in Coimbatore are also a number of jobbing foundries which manufacture a diverse range of castings as per market orders (refer table).

Distribution of foundries

Product	Share
Automotive	15%
Pump-sets	50%
Wet-grinders	10%
Textile machinery	10%
Jobbing foundries	15%

Energy scenario in the cluster

Coke and electricity are the major sources of energy for the foundries. Electricity is sourced from Tamil Nadu Generation and Distribution Corporation Ltd. (TANGEDCO) or from wind farms operating in the state. Coke is procured from different distributors. It may be noted that the growth of foundries in the cluster has been adversely affected due to the power shortage in the state. Electricity utilities have put a ceiling of the maximum power demand (called quota demand) that can be used by the industry. The quota demand has been fixed at 80% of the average demand utilised by the industry during previous year. The industry is required to pay 20% higher tariff if it uses electricity in the peak hours (6 am – 9 am and 6 pm – 10 pm). There is a 5% rebate on the power tariff in the off-peak hours (11 pm – 5 am). Hence most of the foundry units in the cluster are operating in two shifts at present (1) 8 am to 6 pm and (2) and 10 pm to 8 am. The details of major energy sources and tariffs are shown in table.

Prices of major energy sources

Type	Remarks	Price
Coke	Low ash	Rs 23,000 - 28,000 per tonne
Electricity	HT I-A	Energy charge : Rs 6.35 per kWh Demand charge: Rs 350 per kVA per month
	LT III-B	Energy charge : Rs 6.35 per kWh Demand charge: Rs 35 per kW per month

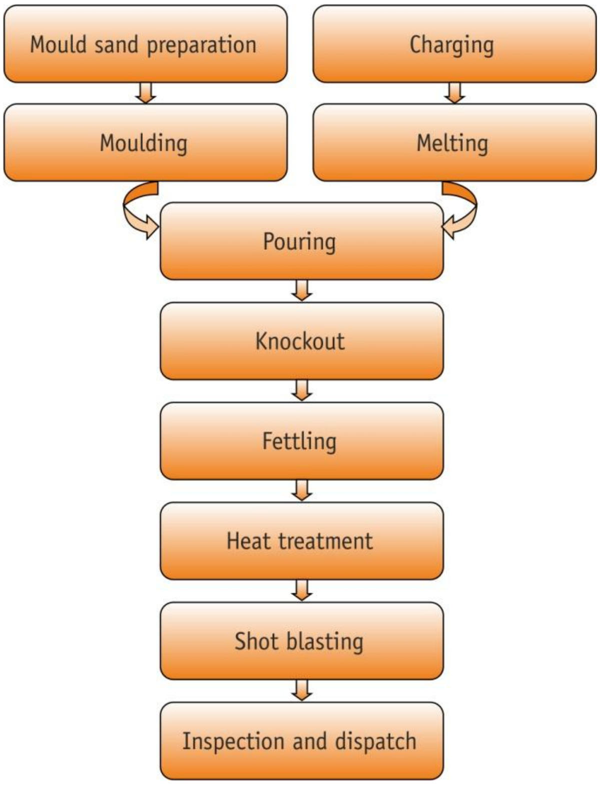
Production process

The major steps of process are mould sand preparation, charge preparation followed by melting, pouring, knockout and finishing. The steps are explained below.

1. **Mould sand preparation**. Fresh sand is mixed with bentonite and other additives and mixed in muller to make green sand.
2. **Moulding.** The mould sand is pressed by machines or manually on the pattern to make the mould. Then the upper and lower halves of mould are assembled together to prepare the complete mould.
3. **Charging.** The charged metallic such as pig iron, scrap, foundry returns and other alloys are weighted and charged in the furnace for melting.
4. **Melting.** The metal charge is melted in either a cupola or induction furnace.

5. **Pouring.** After melting, the molten metal is transferred and poured into the moulds using ladles operated either manually or with cranes.
6. **Knock-out.** The moulds are left to cool for certain time after which the castings are knocked-out from the mould either manually or using a machine.
7. **Finishing.** The finishing operation which involves removal of runners/risers, shot blasting and cleaning of castings.

A simplified process flow diagram of a typical foundry is given in the figure.



Process flow chart

Technologies employed

Some of the major foundry processes/equipment are described below.

(i) Melting furnace

The melting of raw material is either done using electricity in an induction furnace or coke in a cupola (conventional or divided blast type).

Induction furnace: Induction furnaces operate on medium frequency, three phase electrical supply. The size of connected load of an induction furnace varies from 150 kg (100 kW) to 5 tonne (2 MW). However, the most common specification of induction furnace used in foundry industry is 500 kg (550 kW). The theoretical electrical energy required for melting one tonne of iron and heating upto 1500°C is 396 kWh. In an induction furnace, a number of energy losses take place which increases the specific energy consumption to about 600–950 kWh per tonne of iron.

Induction furnace

Cupola: The capacity of cupola is generally indicated by the internal diameter of the shaft. Majority of the cupolas falls in the size range of 21 inch (2.2 tph) to 40 inch (6 tph). Cupolas are of two types based of blasting mechanism i.e. conventional blast and divided blast. The metal tapping could be intermittent or continuous based on operation of foundry.

Cupola

(ii) Moulding and core preparation

Preparation of the mould is an important process in casting industry. The mould is divided into two halves - the cope (upper half) and the drag (bottom half), which meet along a parting line. Both mould halves are contained inside a box, called a flask, which itself is divided along this parting line. The mould cavity is formed by packing sand around the pattern (which is a replica of the external shape of the casting) in each half of the flask. The sand can be packed manually, but moulding machines that use pressure or impact to pack the sand are commonly used. Cores are placed inside the moulds to create void spaces. Cores are baked in ovens which are usually electrical fired.

(iii) Sand preparation

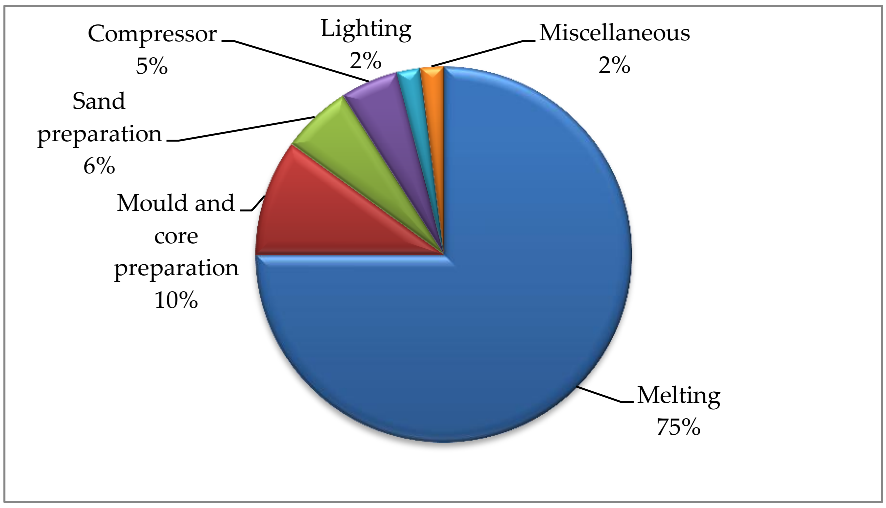
Some foundries have installed a sand plant for sand preparation. The sand plant consists of sand muller, sand mixer, conveyors, bucket elevators, knockout and sand sieve. Electricity is used to run these machines. Sand mixers have typical batch size of 200 to 1000 kg. The connected load of these mixers is in the range of 10 to 100 kW.

(iv) Air compressors

Compressed air is mainly used to operate moulding machines, pneumatic grinders, mould cleaning and for other miscellaneous uses in a foundry. The connected load of an air compressor size may range from a few kW (single air compressor) for a small-scale cupola foundry unit to 55 kW (3-4 air compressors) for a medium-scale foundry having moulding machines.

Energy consumption

Foundry uses two main forms of energy: coke and/or electricity. Melting accounts for a major share of about 70-80% in a foundry unit. The other important energy consuming areas include moulding, core preparation and sand preparation. The share of energy usage in a typical small and medium foundry is given in the figure.



Typical energy use in a foundry

(i) Unit level consumption

The specific energy consumption (SEC) varies considerably in a foundry depending on the type of furnace and degree of mechanisation. On an average, induction furnace based foundry units consume about 1,000–1,200 kWh per tonne of good castings. Out of this, about 600–700 kWh is consumed per tonne of molten metal and the balance is consumed in other associated operations and in rejections and wastages. In cupola, the average coke consumption varies between 10-15% of the metal melted and 15-20% on good castings. Typical energy consumption of an induction furnace based unit is given in table.

Typical energy consumption in induction furnace based foundry units

Production – saleable castings (tonne/yr)	Electricity (kWh/yr)	Total energy (toe/yr)	Annual energy bill (million INR)
500	5,50,000	47	3.9
1000	11,00,000	95	7.7
2000	22,00,000	189	15.5

(ii) Cluster level consumption

The energy consumption pattern in the cluster is given in table.

Energy consumption of the Coimbatore foundry cluster (2014-15)

Energy type	Annual consumption	Equivalent energy (toe)	Annual energy bill (million INR)
Electricity	460 million kWh	39,740	3000
Thermal (Coke)	32,000 tonnes	18,900	790
	Total	**58,640**	**3,790**

Energy saving opportunities and potential

Some of the major energy-saving opportunities in the foundry units in the cluster are discussed below.

(i) Replacement of existing conventional cupola with divided blast cupola

For cupola based foundries, replacement of conventionally designed cupolas with an energy efficient 'divided blast cupolas' (DBC) is the major option. The investment for a new DBC is expected to pay back within one year on account of coke saving alone.

(ii) Replacement of inefficient induction furnace with efficient induction furnace

Older induction furnaces having higher SECs e.g. 750 kWh per tonne of molten metal or higher can be replaced with new EE induction furnaces. With new furnaces, an SEC level of about 550 kWh per tonne of molten metal can be achieved. The capital investment in the new furnace will have an attractive payback period of less than one year.

(iii) Lid mechanism for induction furnace

Most of the induction furnaces do not have a lid which results in higher heat losses due to radiation and convection (about 4-6% of energy input). A lid mechanism helps in reducing these losses in an induction furnaces and the payback period for installation of lids is less than one year.

(iv) Reduction in rejections

A large number of foundries have high rejection level (6-9%), which can be brought down to below 5% through improved process control. This can be achieved with on or marginal investments.

(v) Cleaning of runner and risers before re-melting

Foundry returns i.e. runners and risers constitute a significant share of charge material. Further foundry returns will have moulding sand sticking to them (2-4% by weight). If not cleaned, this will lead to slag formation and hence higher energy consumption levels. By using shot/tumble blast, the sand be cleared from foundry returns before returned to induction furnace for re-melting. This would result in considerable energy saving and would require marginal or no investments.

(vi) Providing glass wool cover for ladle

The ladles used for transfer of molten metal from furnace to moulds are usually not covered resulting in radiation losses. The heat loss can be reduced by providing covers for ladles which would result in energy savings and would require very low investment.

(vii) Retrofitting air compressor with variable frequency drive

During normal operation, an air compressor operated on unloading position for more than half the time. Installation of variable frequency drive (VFD) to the air compressor will minimise the unload power consumption. The investment for VFD is about Rs 2-3 lakh and has a simple payback period of about 2 years.

(viii) Arresting the compressed air leakage

Compressed air is an expensive utility in a plant. However, in most cases, air leakages in piping system are quite high (above 20%) and go unnoticed. The compressed air leakage can be brought down to about 5% with good housekeeping practices. The foundry can save a considerable amount of energy by controlling compressed air leakages with no investment.

(ix) Reduction in pressure setting of air compressor

The pressure setting of air compressors are often much higher than the actual air pressure requirement in the plant. The typical unload and load pressure settings are 7.5 and 6.5 bar respectively. Reducing the compressed air pressure as per end-use requirements will result in high energy savings. Reduction of generation pressure by one bar can lead to energy saving of 6%.

(x) Replacement of rewound motors with energy efficient motors

Rewinding of motors result in a drop in efficiency by 3-5%. It is better to replace all old motors which has undergone rewinding three times or more. The old rewound motors may be replaced with EE motors (IE3 efficiency class). This would results into significant energy savings with simple payback period of 2 to 3 years.

(xi) Replacement of inefficient pumps with energy efficient pumps

Very often the pumps used in cooling water circuit of an induction furnace are inefficient and selection is not done on technical basis. This results in higher power consumption. The inefficient pumps may be replaced with energy efficient pumps. The investments are paid back in a year or two.

Major stakeholders

There are several industry associations related to the foundry industry in Coimbatore. The major industry associations are the following:

- *SIEMA (Southern India Engineering Manufacturers' Association)*: SIEMA is the only association in Coimbatore registered under the Companies Act way back in 1952. Most of the members are engaged in manufacture of electric motors, mono-block pumps and submersible pumps. SIEMA is the major promoter of two other organizations - Si'Tarc (a NABL accredited laboratory for testing and calibration of electrical, mechanical and chemical aspects) and COINDIA.
- *CODISSIA (Coimbatore District Small Industries Association)*: Established in 1969, CODISSIA has got a diversified membership base of industries including foundries. The association has a permanent trade fair complex and was a joint promoter of the Si'Tarc along with SIEMA.
- *IIF (The Institute of Indian Foundrymen), Coimbatore Chapter* : The Coimbatore chapter of IIF is one of the most vibrant chapters in the Southern Region. The chapter has its own office and conference facilities.
- *COSMAFAN (Coimbatore Tiny and Small Foundry Owners Association)*: COSMAFAN represents the smaller castings units in the cluster. The association, along with COINDIA, has procured about 100 acres of land in Arasur and about 50 acres of land in Manikkampalayam to establish common premises (*foundry parks*) with state-of-the-art facilities. The common facilities were established under the Industrial Infrastructure Upgradation Project which was implemented by COINDIA.
- *COFIOA (The Coimbatore Foundry and Industry Owners Association)*: They represent the small and micro scale foundry units in the cluster.

The 'District Industries Centre' (DIC), Coimbatore provides several incentives to MSMEs like the Back Ended Interest Subsidy Scheme. Under this scheme, MSMEs can avail 3% interest subsidy (subject to a maximum of Rs 10 lakhs) on term loans loan on technology.

Cluster development activities

Scientific and Industrial Testing and Research Centre (Si'Tarc) was established in 1987 to promote the testing, research and engineering industrial activities of this region. It was developed with assistance from Industrial Development Bank of India (IDBI) under the small industrial development fund. SIEMA and CODISSIA jointly developed the centre for the cluster.

COINDIA (Coimbatore Industrial Infrastructure Association), a 'special purpose vehicle' (SPV) created under Government of India guidelines for implementing this project under Govt. Of India guidelines for Industrial Infrastructure Upgradation Scheme (IIUS), was conceived and promoted by SIEMA with the support of IIF-Coimbatore Chapter, COSMAFAN and COFIOA. The project costing about Rs 60 crores was implemented for the growth and improvement of competitiveness and export capability of pumps, motors, and casting manufacturers in the Coimbatore cluster. Arasur and Manikkampalayam were developed as foundry parks with common facilities. A modern tool room and rapid prototyping machine was also set up. The testing facilities at Si'Tarc were also strengthened under the project.

About TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI (The Energy and Resources Institute) is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to tackling issues of global climate change across many continents and advancing solutions to growing urban transport and air pollution problems, TERI's activities range from formulating local and national level strategies to suggesting global solutions to critical energy and environmental issues. The Industrial Energy Efficiency Division of TERI works closely with both large industries and energy intensive Micro Small and Medium Enterprises (MSMEs) to improve their energy and environmental performance.

About SDC

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Swiss Agency for Development and Cooperation SDC

SDC (Swiss Agency for Development and Cooperation) has been working in India since 1961. In 1991, SDC established a Global Environment Programme to support developing countries in implementing measures aimed at protecting the global environment. In pursuance of this goal, SDC India, in collaboration with Indian institutions such as TERI, conducted a study of the small-scale industry sector in India to identify areas in which to introduce technologies that would yield greater energy savings and reduce greenhouse gas emissions. SDC strives to find ways by which the MSME sector can meet the challenges of the new era by means of improved technology, increased productivity and competitiveness, and measures aimed at improving the socio-economic conditions of the workforce.

About SAMEEEKSHA

SAMEEEKSHA (Small and Medium Enterprises: Energy Efficiency Knowledge Sharing) is a collaborative platform set up with the aim of pooling knowledge and synergizing the efforts of various organizations and institutions - Indian and international, public and private - that are working towards the development of the MSME sector in India through the promotion and adoption of clean, energy-efficient technologies and practices. The key partners are of SAMEEEKSHA platform are (1) SDC (2) Bureau of Energy Efficiency (BEE) (3) Ministry of MSME, Government of India and (4) TERI.

As part of its activities, SAMEEEKSHA collates energy consumption and related information from various energy intensive MSME sub-sectors in India. For further details about SAMEEEKSHA, visit http://www.sameeeksha.org