

MANUAL ON ENERGY CONSERVATION MEASURES IN FOUNDRY CLUSTER BATATA, JALANDHAR & LUDHIANA



Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By



MANUAL ON ENERGY CONSERVATION MEASURES IN FOUNDRY INDUSTRY

Based on findings of BEE's SME Program for
Batala, Jalandhar & Ludhiana Foundry Cluster

March, 2011



Confederation of Indian Industry

Sector 31-A, Chandigarh 160 030

Tel : 0172-2607228, 2605868, 5080784

Fax : 0172-2606259, 2614974

Email : harinder.singh@cii.in

Website: www.ciicfc.org



**Bureau of Energy Efficiency (BEE),
Ministry of Power, Government of India,
New Delhi**

www.bee.nic.in

DISCLAIMER

This manual has been developed by CII for BEE on the terms of engagement as Executing Agency. Contents in this report are based on observations made during the field studies at Batala, Jalandhar & Ludhiana, data and information provided by the units and based on information generally available to the public from sources believed to be reliable. No representation is made that it is timely accurate or complete. CII has taken due care in compilation of data and information, however CII does not guarantee the accuracy adequacy or completeness of any information and it is not responsible for errors or omissions or for the results obtained from the use of such information and specially states that it has no financial liability to what so ever to the users of this manual. This manual is published with the understanding that CII is supplying information but is not attempting to render detail engineering services; if such services are required the assistance of an appropriate professional organization (Technology suppliers & LSPs) should be sought.



ACKNOWLEDGEMENT

CII – AVANTHA Centre for Competitiveness for SMEs acknowledges with thanks to the Bureau of Energy Efficiency, Ministry of Power for giving us opportunity to implement ‘**BEE SME Project in Batala, Jalandhar and Ludhiana Foundry Cluster**’.

We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

Bureau of Energy Efficiency

- Dr. Ajay Mathur- Director General
- Ms Abha Shukla - Secretary
- Mr. Jitendra Sood - Energy Economist
- Mr. Pawan Kumar Tiwari - Advisor, SME
- Mr. Rajiv Yadav – Project Economist
- Mr. Gaurav Kumar - Project Engineer

CII - AVANTHA Centre for Competitiveness for SMEs is also thankful to “**Batala, Jalandhar & Ludhiana Foundry & Machine Tools Industry Association & Units**” for their valuable inputs, co-operation, support and identification of the units for Energy Use and Technology Audit studies in Batala, Jalandhar & Ludhiana Foundry Industry Cluster.

We take this opportunity to express our appreciation for the excellent support provided by various unit owners, local service providers and various equipment suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the cluster manual.

CII would also like to place on record our sincere thanks to all the SME owners, plant in-charges and all workers of the unit for their support during the Energy Use & Technology Audit Studies.



Harinder Jeet Singh
Principal Counselor & Head
CII - AVANTHA Centre for Competitiveness for SMEs
Confederation of Indian Industry

Description	Page No
Acknowledgement	1
Chapter 1: About BEE SME program	7-14
1.1 Project objectives	9
1.2 Expected project outcome	11
1.3 Project duration	13
1.4 Identified clusters under the program	14
Chapter 2: BJI Foundry Cluster scenario	16-25
2.1 Overview of SME cluster	16
2.1.1 Cluster background	16
2.1.2 Product manufactured	17
2.1.3 Classification of units	17
2.1.4 Production capacity (in tonnes or pieces per year) detail	18
2.1.5 Raw materials used	19
2.2 Energy Situation in the cluster	19
2.2.1 Types of fuels (fossils, biomass, waste, byproducts, etc) used and prices	20
2.2.2 Fuels and electricity consumption in a typical unit	20
2.2.3 Specific energy consumption (in appropriate unit)	22
2.3 Manufacturing process/technology overview in a typical unit	22
2.3.1 Process technology	22
2.3.2 Process flow diagram	24
2.4 Issues related to energy usage and conservation and barrier in technology up gradation	24
2.4.1 Technological Barrier	24
2.4.2 Financial Barrier	25
2.4.3 Manpower	25
Chapter 3: Energy Audit and Technology assessment	25-66
3.1 Methodology adopted for	26

3.1.1 Energy use and technical study	26
3.2 Observations made during the energy use and technology studies carried out in the cluster	28
3.2.1 Manufacturing process and technology/equipments employed	28
3.2.2 Energy consumption profile & availability	28
3.2.3 Capacity utilization factor	29
3.2.4 Housekeeping Practices	29
3.2.5 Availability of data and information	29
3.3 Technology gap analysis in Foundry Industries	30
3.3.1 Technology up-gradation	30
3.3.2 Process up-gradation	31
3.4 Energy conservation measures identified	32 - 66
A) Replacement of Blast Copula with Divided Blast Copula	33
B) Installing Induction furnace in place or Oil Fired Rotary Furnace	41
C) Installation of APFC to maintain unity power factor	50
D) Replace 40 W Light by T5, 28 W Light	53
E) Optimize Combustion Efficiency of Furnace by Reducing Excess Air	57
F) Replace 100 W GLS bulb by 20 W CFL	60
G) Providing insulation & lid over furnace to avoid radiation losses	62
H) Use of Energy Efficient motor in place of re-winded motors	64
3.5 Identification of technology for DPR preparation	67
Chapter 4: Environmental benefits	69
Chapter 5: Small Group Activities	70
Chapter 6: Conclusion	83
Annexure–1: Detailed technology/equipment assessment report including the design technical specifications, in the format provided by BEE.	87



Annexure– 2: Details of technologies/services providers for the cluster	93
Annexure– 3: Gov Schemes for Energy Efficiency	95
Annexure– 4: Details of technologies/services providers for the cluster	



ABBREVIATIONS

MSME	Micro Small and Medium Enterprises
SMEs	Small and Medium Enterprises
GOI	Government of India
BEE	Bureau of Energy Efficiency
EE	Energy Efficiency
IRR	Internal Rate of Return
DPRs	Detailed Project Reports
tpa	Tonnes Per Annum
MTOE	Metric Tonnes of Oil Equivalent
mkCal	Million Kilo Calories
kW	Kilo Watt
hp	Horsepower
kWh	Kilo Watt Hour
SDA	State Designated Agency
GHGs	Green House Gasses
LSPs	Local Service Providers

ABOUT BEE SME PROGRAM

Worldwide the Micro, Small and Medium Enterprises (MSMEs) have been accepted as engines of economic growth to promote and accelerate equitable development. The major advantage of this sector is its enormous employment potential at significantly low capital involvement. This can be established from the simple fact that the MSMEs constitute over 90% of total enterprises in most economies and are credited with generating the highest rates of employment growth and also account for a major share of industrial production and exports. In Indian context, MSMEs play a pivotal role in the overall industrial economy. In recent years the sector has consistently registered higher growth rate as compared to the overall industrial sector. With its agility and dynamism, the sector has shown admirable innovativeness and adaptability to survive the recent economic downturn and recession.

As per available statistics (the 4th Census of MSME Sector), this sector employs an estimated 59.7 million persons spread over 26.1 million enterprises. It is estimated that in terms of value, MSMEs have a 40% share in total industrial output at a huge volume of producing over 8,000 value-added products. At the same time, MSMEs contribute nearly 35% share in Direct Export and 45% share in the Overall Export from the country. SMEs exist in almost all-major sectors in the Indian industry such as Food Processing, Agricultural Inputs, Chemicals & Pharmaceuticals, Electrical & Electronics, Medical & Surgical Equipment, Textiles and Garments, Gems and Jewellery, Leather and Leather Goods, Meat Products, Bioengineering, Sports goods, Plastics Products, Computer Software etc.

However, despite the significant contributions made to towards various aspects of the nation's socio-economic scenario, this sector too faces several critical issues that require immediate attention. One such factor that falls in the ambit of this publication is the prevalence of age old technologies across the sectors and inherent inefficiencies associated with resource utilization, including, energy. The National Mission for Enhanced Energy Efficiency in Industry under the National Action Plan for Climate Change (released by Government of India on June 30, 2008) has emphasized the need for improving Energy Efficiency (EE) in the manufacturing sector. A number of sector-specific studies have also unanimously confirmed that energy intensity in the industry can be reduced with the widespread adoption of proven and commercially available technologies which will improve EE and produce global benefits from reduced Green House Gasses (GHGs) emissions. As a result of increasing awareness towards efficient usage of energy and other resources, there has been a visible reduction in energy intensity in comprehensive Indian industrial sector. However, focusing the observation on

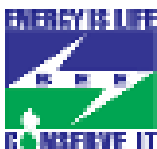


the MSME sector reveals that the energy intensity per unit of production is much higher than that of the organized large scale sector. Since energy cost is significant contributor to the overall production cost of SMEs due to high and rising energy costs in current scenarios, it is required to increase the Energy Efficiency (EE) levels in order to ensure the sustenance of SMEs. One of the ways to reduce the inefficiencies is by replacing the conventional/old/obsolete technology with feasible and adaptable energy efficient technologies. This would not only contribute towards reduction in production cost, but would also improve the quality and productivity of MSME products. However, while knowing the way out, there are still numerous barriers (as listed below) and market failures that have prevented widespread adoption of new energy efficient technologies.

Key barriers in promotion and adoption of EE technologies in Indian SME sector:

- Lack of awareness and capability on the part of SMEs to take up energy conservation activities
- Lack of scientific approach on monitoring and verification of performance assessment of installed equipments and utilities.
- Non availability of benchmark data for various equipments/process
- Low credibility of the service providers such as equipment suppliers and their technologies
- The SME owners are more concerned on production and quality rather than energy efficiency and conservation
- The key technical personnel employed in the SME units are based on their past experience in similar industries rather than technically qualified personnel and hence, they are not aware of the latest technologies or measures which improve energy efficiency
- Lower priority to invest in improving efficiency than in expansion (this may be due to lack of knowledge on cost benefit)

Majority of SMEs are typically run by entrepreneurs and are leanly staffed with trained technical and managerial persons to deploy and capture energy efficiency practice to reduce manufacturing cost and increase competitive edge. Therefore, it will be useful to build energy efficiency awareness in the SMEs by funding/subsidizing need based studies in large number units in the SMEs and giving energy conservation recommendations including short term energy conservation opportunities, retrofit/replacement options and technology up-gradation opportunities.



In this context, the Bureau of Energy Efficiency (BEE) has laid adequate emphasis on the SME sector as presented in the Working Group on Power for 11th Five-Year Plan (2007-2012)-Sub-Group 5. Consequently, the Bureau has initiated the Energy Efficiency Improvement program in 29 SME clusters in India.

1.1 PROJECT OBJECTIVES

The BEE SME Program is aimed to improve Energy Efficiency in SME sector by technological interventions in the various clusters of India. The EE in SMEs is intended to be enhanced by helping these industries in the 29 energy intensive SME clusters of India by:

- Technology interventions
- Sustaining the steps for successful implementation of EE measures and projects in clusters
- Capacity building for improved financial planning for SME entrepreneurs.

The program also aims at creating a platform for;

- Dissemination of the best practices and the best available technologies available in the market for energy efficiency and conservation
- To create awareness in the clusters, and
- To demonstrate the new technology interventions/ projects to stimulate adoption of similar technology/projects in the clusters.

The BEE SME program has been designed in such a way so as to address the specific needs of the industries in the SME sector for EE improvement and to overcome the common barriers in way of implementation of EE technologies in cluster through knowledge sharing, capacity building and development of innovative financing mechanisms. Major activities in the BEE SME program are listed below:

- Energy use and technology studies
- Capacity building of stake holders in cluster for building EE projects
- Implementation of energy efficiency measures
- Facilitation of Innovative financing mechanisms for implementation of energy efficiency projects

The brief objective of each of these activities is presented below:

1. Energy Use and Technology Analysis:-

An in-depth assessment of the various production processes, energy consumption pattern, technology employed and possible energy conservation potential and operational practices in cluster by means of conducting detailed energy audits and technological gap assessment studies in a cluster is presented herewith. The energy audit study includes analysis of the overall energy consumption pattern, study of production process, identification of energy intensive steps/sub-processes and associated technology gap assessment for the individual units. The study also focuses on identifying the Best Operating Practices and the EE measures already implemented in the units.

2. Capacity building of stakeholders

The aim of this activity is capacity building of the enrolled LSPs to equip them with the capability to carry on the implementation of the EE technology projects in cluster on a sustainable basis. The needs of the LSPs will be identified as a preparatory exercise to this activity, as to what they expect from the BEE Program in terms of technical and managerial capacity building.

3. Implementation of EE measures

To implement the EE and technology up-gradation projects in the clusters, technology specific Detailed Project Reports (DPRs) for five different technologies for three scales of operation will be prepared. The DPRs will primarily address the following:

- Comparison of existing technology with feasible and available EE technology
- Energy, economic, environmental & social benefits of proposed technology as compared to conventional technology
- Details of technology and service providers of proposed technology
- Availability of proposed technology in local market
- Action plan for implementation of identified energy conservation measures
- Detailed financial feasibility analysis of proposed technology

4. Facilitation of innovative financing mechanisms

Research and develop innovative and effective financing mechanisms for easy financing of EE measures in the SME units in the cluster. The easy financing involves following three aspects:

- Ease in financing procedure
- Availability of finance on comparatively easy terms and relaxed interest rates
- Compatibility and availing various other Central/ State Governments' incentive schemes like CLCSS, TUFF etc.

1.2 EXPECTED PROJECT OUTCOME

The outcome of BEE-SME Program will be an assessment of total energy usage, preparedness of the cluster to undertake further action and a list of units where further action is recommended along with filled in data collection formats. Expected project outcome of BEE SME program in clusters are:

Energy Use and Technology Analysis

The outcome of the activity will include identification of the EE measures, potential of renewable energy usage, fuel switching, feasibility analysis of various options, and cost benefit analysis of various energy conservation measures including evaluation of financial returns in form of payback period, IRR and cash flows. The cost liability of each measure, including the capital and operational cost will also be indicated.

The identified EE measures will be categorized as per the following types:

- Simple housekeeping measures/ low cost measures
- Capital intensive technologies requiring major investment.

The sources of technology for each of the suitable low cost and high cost measures, including international suppliers as well as local service providers (LSPs)/ technology suppliers, in required numbers shall be identified. It is envisaged to create a knowledge bank of detailed company profile and CVs of key personnel of these technology sources. The knowledge bank will also include the capability statements of each of these sources.

The EE measures identified in the energy audit study will be prioritized as per their energy saving potential and financial feasibility. The inventorization survey would establish details like the cluster location, details of units, production

capacity, technologies employed, product range, energy conservation potential along with possible identified EE measures and respective technology suppliers.

The specific outcomes of this activity will be as follows:

- Determination of energy usage and energy consumption pattern
- Identification of EE measures for the units in cluster
- Development and preparation of case studies for already implemented EE measures and Best Operating Practices in the units
- Evaluation of technical & financial feasibility of EE measures in terms of payback period, IRR and cash flows.
- Enlisting of Local Service Providers(LSPs) for capacity building & training including creation of knowledge bank of such technology suppliers
- Capacity building modules for LSPs
- Development and preparation of cluster manuals consisting of cluster details and EE measures identified in cluster.

Implementation of EE measures

The aim of this activity is development and finalization of bankable DPRs for each of the EE projects which would be presented before the SME units for facilitation of institutional financing for undertaking the EE projects in their respective units.

The activity will ensure that there is close match between the proposed EE projects and the specific expertise of the Local Service Providers (LSPs). These DPRs will be prepared for EE, renewable energy, fuel switching and other possible proposed measures during course of previous activities. Each DPR will include the technology assessment, financial assessment, economic assessment and sustainability assessment of the EE project for which it has been developed. The technology assessment will include the details of the design of equipment/technology along with the calculation of energy savings. The design details of the technology for EE project will include detailed engineering drawing for the most commonly prevalent operational scale, required civil and structural work, system modification and included instrumentation and various line diagrams. The LSPs will be required to report the progress of the implementation of each such project to BEE PMC. Such implementation activities can be undertaken by the LSPs either solely or as a group of several LSPs.

Capacity Building of LSP's and Bankers

The outcome of this activity would be training and capacity building of LSPs so as to equip them with necessary capacity to undertake the implementation of proposed EE projects as per the DPRs. Various training programs, training modules and literature are proposed to be used for the said activity. However, first it is important to ascertain the needs of the LSPs engaged, as in what they expect from the program in terms of technical and managerial capacity building. Another outcome of this activity will be enhanced capacity of banking officers in the lead banks in the cluster for technological and financial feasibility analysis of EE projects that are proposed by the SME units in the cluster. This activity is intended to help bankers in understanding the importance of financing energy efficiency projects, type and size of projects and ways and means to tap huge potential in this area. Different financing models would be explained through the case studies to expose the bankers on the financial viability of energy efficiency projects and how it would expand their own business in today's competitive environment.

Concluding workshop

The outcome of this activity will be the assessment of the impact of the project as well as development of a roadmap for future activities. The workshop will be conducted for the representatives of the local industrial units, industry associations, LSPs and other stakeholders so that the experiences gained during the course of project activities including implementation activities of EE project can be shared. All the stakeholders in the project will share their experience relating to projects undertaken by them as per their respective roles. Effort from industrial units as well as LSPs to quantify energy savings thus achieved would be encouraged. This would lead to development of a roadmap for implementing similar programs in other clusters with greater efficiency and reach.

1.3 PROJECT DURATION

Activity	Time
Energy Use & Technology Audit	January to April 2010
Capacity Building	Oct 2010
Introductory Service Providers Workshop	Oct 2010
Information Dissemination Workshop	Oct 2010
Implementation of EE Measures	December 2010
Preparation of DPRs	April to October 2010
Capacity Building of Local Service Providers	November 2010
Facilitation of Innovative Financing	December 2010
Financing EE	December 2010
Capacity Building of Bankers	December 2010
Concluding Service Providers Workshop	December 2010

1.4 IDENTIFIED CLUSTER UNDER THE PROGRAMME

29 most energy intensive MSME clusters across different end use sectors have been identified to implement the BEE SME program for EE improvement. The details of industrial sector and identified cluster are provided in Table 1.1 below:

Table 1.1: List of Clusters identified for BEE SME Program

S. No.	Cluster Name	Location
1	Edible oil cluster	Alwar
2	Machine components cluster	Bangalore
3	Ice slabs cluster	Bhimavaram
4	Brass cluster	Bhubhaneswer
5	Sea food processing cluster	Cochin
6	Fire bricks cluster	East & West Godavari
7	Rice mills cluster	Ganjam
8	Milk processing cluster	Gujarat
9	Galvanizing and Wire drawing cluster	Howrah
10	Foundry cluster	Jagadhri
11	Limestone cluster	Jodhpur
12	Tea processing cluster	Jorhat
13	Foundry	Ludhiana, Batala, Jalandhar
14	Paper processing cluster	Muzzafar Nagar
15	Sponge iron cluster	Orissa
16	Dyes and chemicals cluster	Vapi
17	Bricks and tiles cluster	Varanasi
18	Rice mills cluster	Vellore
19	Dyes and chemicals cluster	Ahmedabad
20	Brass cluster	Jamnagar
21	Textile cluster	Pali
22	Textile cluster	Surat
23	Tiles cluster	Morvi
24	Textile cluster	Solapur
25	Rice mills cluster	Warangal
26	Tiles cluster	Mangalore
27	Textile cluster	Tirupur
28	Coir cluster	Alleppey
29	Glass cluster	Firozabad

As a part of BEE SME program, one of cluster identified is Batala, Jalandhar and Ludhiana Foundry cluster. It was proposed to carry out energy use and technology audit

studies in approximately 200 units in Batala, Jalandhar and Ludhiana Foundry cluster covering all types and sizes of the industries to understand/give valuable insight into the process of developing energy efficiency solutions relevant to the SME industries in Batala, Jalandhar and Ludhiana Foundry cluster.



BATALA, JALANDHAR AND LUDHIANA FOUNDRY CLUSTER SCENARIO

2.1 OVERVIEW OF SME CLUSTER

Indian foundry industry is very energy intensive. The energy input to the furnaces and the cost of energy play an important role in determining the cost of production of castings.

Major energy consumption in medium and large scale foundry industry is the electrical energy for induction and Arc furnaces.

Furnace oil is used in rotary furnaces. In Small foundry industry, coal is used for metal melting in Cupola furnaces. The energy costs contribute about 25 - 30% of the manufacturing cost in Indian foundry industry.

There are approximately 450 units, engaged in Foundry Cluster (automobile parts, agricultural implements, machine tools, diesel engine components, manhole covers, sewing machine stands, pump-sets, decorative gates and valves) production. The major locations wherein the units are spread are G.T. Road, Industrial area, Focal Point in Batala.

In Jalandhar Dada Colony Industrial Area, Focal point, Focal Point Extn, Udyog Nagar, I.D.C, Kapurthala Road & Preet Nagar. In Ludhiana Focal Point Phase 5 to 8, Janta Nagar, Bhagwan Chowk Area & Industrial area – A/B. .

Units in Batala are in operation since last 30 – 35 years & there are some 200 units manufacturing lathe machines, milling/ pantograph, fan bodies, pump bodies etc.

Most of the units in Batala are using Cupola for melting as the normal production capacity of the units in Batala is 150 to 200 tpm, whereas only some units are having capacity of 100 to 150 tpm.

Availability of Electricity in Batala – across Dhir Road, GT Road is an issue; power is available from the grid for maximum 12/14 hours a day. There are some units in Jalandhar and Ludhiana having induction furnace in the range of 500 kg to 1 ton capacity whereas other units which are using local scrap as well as have high melting temperatures are having cupola and rotary furnace and has a capacity of minimum 5 ton per day.

2.1.1 CLUSTER BACKGROUND

The Indian metal casting industry is as old as the Indian civilization and its primordial manifestations were found in the religious figures like 'Natraja', the dancing deity. The root of modern metal casting industry was laid out in the year 1850 A.D and grew with the development of the engineering sector. The

establishment of TISCO, Bengal Iron Company and the IISCO led to some remarkable new uses of castings, in domestic as well as industrial areas. India has around 5000 foundries, producing about 3.24 MT of castings worth Rs10,000 Crores. It ranks sixth in terms of production. The foundry produces a wide variety of castings such as manhole covers, pipe and pipe fittings, sanitary items, tube well body, metric weights, automobile components, railway parts, electric motor, fan body etc. 90% of the castings produced are from the SSI sector.

Confederation of Indian Industry (CII) in coordination with Bureau of Energy Efficiency (BEE), Government of India has taken up initiative to enhance Energy Efficiency of Foundry Units across Batala, Jalandhar and Ludhiana, Punjab through BEE - BJL Foundry SME Cluster Program for Energy Efficiency.

The objective of the project is to accelerate the adoption of Energy efficiency technologies & practices through knowledge sharing, capacity building and development of innovative financing mechanisms.

2.1.2 THE PRODUCTION PROCESS

A Foundry deals with the process of casting of moulds formed with sand or some other material. The whole process can be classified into six stages, which are:

- 1. Designing by Methoding and Gating** The design supplied by the customer is further modified to provide necessary allowances and selection of parting line. Methoding and Gating are the tools to achieve this. While Methoding consists of feeders, which compensate the shrinkages in the castings, the Gating system consists of spruce and runner and in-gates that allow the molten metal into the mold. This is the crucial step and entails developmental time of 2 to 3 months, and in certain cases it can even take up to 8 months. The process is usually carried out on trial and error basis.
- 2. Pattern Making** This refers to the Replica of castings that are prepared on the basis of drawings given by the Customer. These patterns are usually made with wood.
- 3. Molding and Core Making** Moulds are prepared in the sand with the help of patterns to get the same shape as that of the pattern. Core making is useful for getting hollowness in the castings.
- 4. Melting and Casting** Metals are melted in suitable furnaces to get the required composition and then the molten metal is poured into the moulds by means of 'ladles'.
- 5. Fettling:** After solidification, the castings are removed from the mould boxes and unwanted metal attachments like runners and raisers are removed and the sand adhered to the casting is cleaned. Later these castings are sent for further operations like heat treatment and machining.
- 6. Testing and Inspection** Before dispatching of the components, visual and dimensional inspection is carried out. In some cases, as per the customer requirement, non-destructive tests like ultrasonic radiography etc. are carried out

to know the internal soundness of the casting. Though the above process appears to be simple, the foundry men have to take care of numerous parameters, right from selection of raw materials to dispatch of the final product. This demands technical knowledge for ensuring good quality castings.

2.1.3 PRODUCT MANUFACTURED

Batala, Jalandhar & Ludhiana are major location for foundry industries in Punjab. Majority of the foundry units are in the small-scale sector and produce G.I. castings like Automotive/oil engine, Tractor parts, Pump/Fans ,Machine parts ,Agricultural implements etc.

2.1.3 CLASSIFICATION OF UNITS

Broadly units are classified with respect to production capacity;

- 1) Large Scale Units
- 2) Medium Scale Units
- 3) Small Scale Units

Large Scale Units

These units are having annual Casting production above 1500 Metric Tonnes. There are around 50 such units in B JL Foundry Cluster.

Medium Scale Units

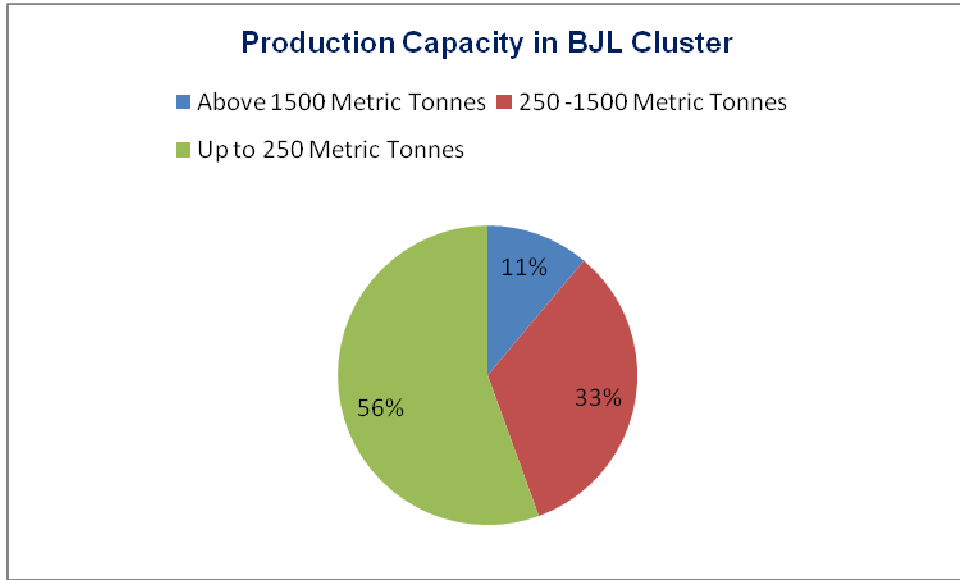
These units have annual Casting production in the range of 250 -1500 Metric Tonnes and there are around 150 units of medium scale size.

Small Scale Units

These units are having annual Casting production up to 250 Metric Tonnes. There are around 250 such units in B JL Cluster.

2.1.4 PRODUCTION CAPACITY

Total production capacity in B JL cluster can be estimated approx. 237500 T/yr. However the capacity utilisation factor is very less. This is mainly because most of the units in B JL cluster operate for 1 – 4 days/month. The main reason behind this is, demand pattern and also power situation. The Production Capacity of the Foundry Units in above mentioned category during Year 2009-10 are as follows;



2.1.5 RAW MATERIALS USED

Cast Iron is used as main raw material. A list of other types of raw material used and their source is mentioned below;

RAW MATERIAL	SOURCE	
	LOCAL	OUTSIDE
Pig iron, steel scrap, cast iron scrap, coke, lime stone, ferro-alloys, silicon, manganese,	Cast Iron scrap, Steel scrap and Ferroalloys	<u>Pig Iron:</u> Goa, Hospet, Bellary <u>Coke:</u> Goa, Jharia from Bihar, importers from Chennai, Reliance pet coke <u>Furnace Oil:</u>

2.2 ENERGY SITUATION IN THE CLUSTER

Major energy sources being used in foundry cluster are electricity and fuels such as Coal, Furnace Oil, and Diesel. This depends on application of technology, process requirement, availability, and economic and safety point of view. The two forms of energy being used in foundry sector in typical foundry unit are electrical energy and thermal energy. Electrical energy is being used in melting of iron in induction furnaces, operation of electrical utilities and thermal energy is being used in cupola furnaces operation. Availability and consumption of various fuels in typical foundry unit is mentioned in below sections.

Coal used in foundry cluster is of different grade and is available with local dealers also. Furnace oil prices are highly market dependent. SEB is the main source of electricity supply. However availability of electricity is one of the key issues.



2.2.1 TYPES OF FUEL (FOSSILS, BIOMASS, WASTE, BYPRODUCTS, ETC)

The following are the commonly used fuels & their prices are given herein;

Sr. No.	Name of Fuel Used	Price Rs/ Kg
1.	Furnace oil	Rs.32.00
2.	Coal	Rs.15.00
3.	Pet Coke	Rs.35.00

Fuel is mainly used in furnaces & for DG sets. However major consumers of fuel are furnaces only.

2.2.2 FUELS AND ELECTRICITY CONSUMPTION

In this cluster there are three types of furnace used for melting the material. These are;

1. Cupola
2. Rotary Furnace
3. Induction Furnace

Energy consumption for a typical unit based on above furnaces in shown in below tables;

For Cupola

Types of Furnace	Types of Fuel Used	Running hr/Day	Production Capacity	Fuel Consumption/Day	Specific Energy Consumption/Ton molten material	Specific energy Consumption in rupees
Cupola	Coal + Electricity for Blower Motor	8	15 Metric Tonnes	3.2 Metric Tonnes Coal + 110 kWh electricity	0.2 Metric Ton Coal + 8 kWh electricity	Rs. 2800 + Rs 40.0 = Rs.2840

* Assuming Coal Rate Rs.14,000/ton

*Assuming electricity Rs 5.0/kWh

*Blower Motor Capacity 20 Hp

For Rotary Furnace

Types of Furnace	Types of Fuel Use	Running hr/Day	Production Capacity	Fuel Consumption/Day	Specific Energy Consumption/Ton molten material	Specific Energy Consumption in rupees
Rotary Furnace	Furnace + Electricity for Rotary Motor	8	10 Metric Tonnes	1430 Ltr Furnace Oil + 55 kWh electricity	143 Ltr Furnace Oil + 5.5 kWh electricity	Rs. 4290 + Rs 27.5 = Rs.4317.5

* Assuming Furnace Oil Rate Rs.30.0 /Lt

* Assuming electricity Rs 5.0/kWh

* Rotary Motor Capacity 10 Hp

For Induction Furnace

Types of Furnace	Types of Fuel Use	Running hr/Day	Production Capacity	Fuel Consumption/Day	Specific Energy Consumption/Ton molten material	Specific energy Consumption in rupees
Induction Furnace	Electricity	4	8 Metric Tonnes	4800 kWh electricity	600 kWh electricity	Rs. 3000/

Induction furnace capacity 175 kWh/500 kg

* Assuming electricity Rs 5.0/kWh

Total Electricity Energy Consumption in BJL Foundry Cluster

Electricity Uses Pattern	Unit Consumed in kWh	Total Unit Consumption kWh
Blower Motor for Cupola	962100	26.92 Lakhs
Rotary Motor for Rotary Furnace	330000	
Melting material in Induction Furnace	1400000	

Calculation Basis;

*100 units of Copula having melting capacity 250 metric Tonnes per year with 8 hour operation per day and 140 operating days in a year

*50 units of Rotary Furnace having melting capacity 250 metric Tonnes per year with 8 hour operation per day and 140 operating days in a year

* 15 units of Induction Furnace having melting capacity 1000 metric Tonnes per year with 20 hour operation per day and 300 operating days in a year

Total Thermal Energy Consumption in BJL Foundry Cluster;

Thermal Energy Uses Pattern	Consumption per Year
Coal for Cupola	5000 Metric Tonnes
Furnace Oil for Rotary Furnace	17.8 Lakhs Litter

Calculation Basis:

*100 units of Copula having melting capacity 250 metric Tonnes per year with 8 hour operation per day and 140 operating days in a year

*50 units of Rotary Furnace having melting capacity 250 metric Tonnes per year with 8 hour operation per day and 140 operating days in a year



2.2.3 SPECIFIC ENERGY CONSUMPTION

Specific energy consumption of Foundry units depends upon the production capacity & their corresponding power consumption. Specific energy consumption also depends on type of furnace. A brief summary of specific energy consumption depending upon type of furnace is shown in below table;

Sl. No	Types of Furnace	Types of Fuel	Specific Fuel Consumption / One kg Molten Material	In Terms of Rupees
1	Cupola	Coal	0.2 kg	Rs 2.6
2	Rotary Furnace	Furnace Oil	0.15 Lt	Rs 4.20
3	Induction Furnace	Electricity	0.6 kWh	Rs. 3.0

*Assuming Coal rate Rs.13.0 /kg

*Assuming F.O rate Rs. 28.0 /Lt.

*Assuming electricity rate Rs 5.0/kWh

2.3 MANUFACTURING PROCESS/TECHNOLOGY OVERVIEW IN A TYPICAL UNIT

The manufacturing process of foundry industry is almost similar in all the units. The utilities and auxiliary equipment varies depending upon the requirement. The manufacturing process in foundry industry includes metal melting, sand preparation, pattern making, mould preparation, casting and machining.

2.3.1 PROCESS TECHNOLOGY

The manufacturing process is described as below;

Melting Section:

The raw material is melted in melting furnace. The melting furnace can be an induction furnace or rotary or arc furnace or cupola furnace. Molten metal from the melting furnace is tapped in Ladles and then transferred to the holding furnaces. Typically the holding furnaces are induction furnaces. The holding furnace is used to maintain the required molten metal temperature and also acts as a buffer for storing molten metal for casting process. The molten metal is tapped from the holding furnace whenever it is required for casting process.

Sand Plant:

Green sand preparation is done in the sand plant. Return sand from the moulding section is also utilised again after the reclamation process. Sand Mullers are used for green sand preparation. In the sand mullers, green sand, additives and water are mixed in appropriate proportion. Then the prepared sand is stored in bunkers for making moulds.

Pattern Making:

Patterns are the exact facsimile of the final product produces. Generally these master patterns are made of aluminium or wood. Using the patterns the sand moulds are prepared.

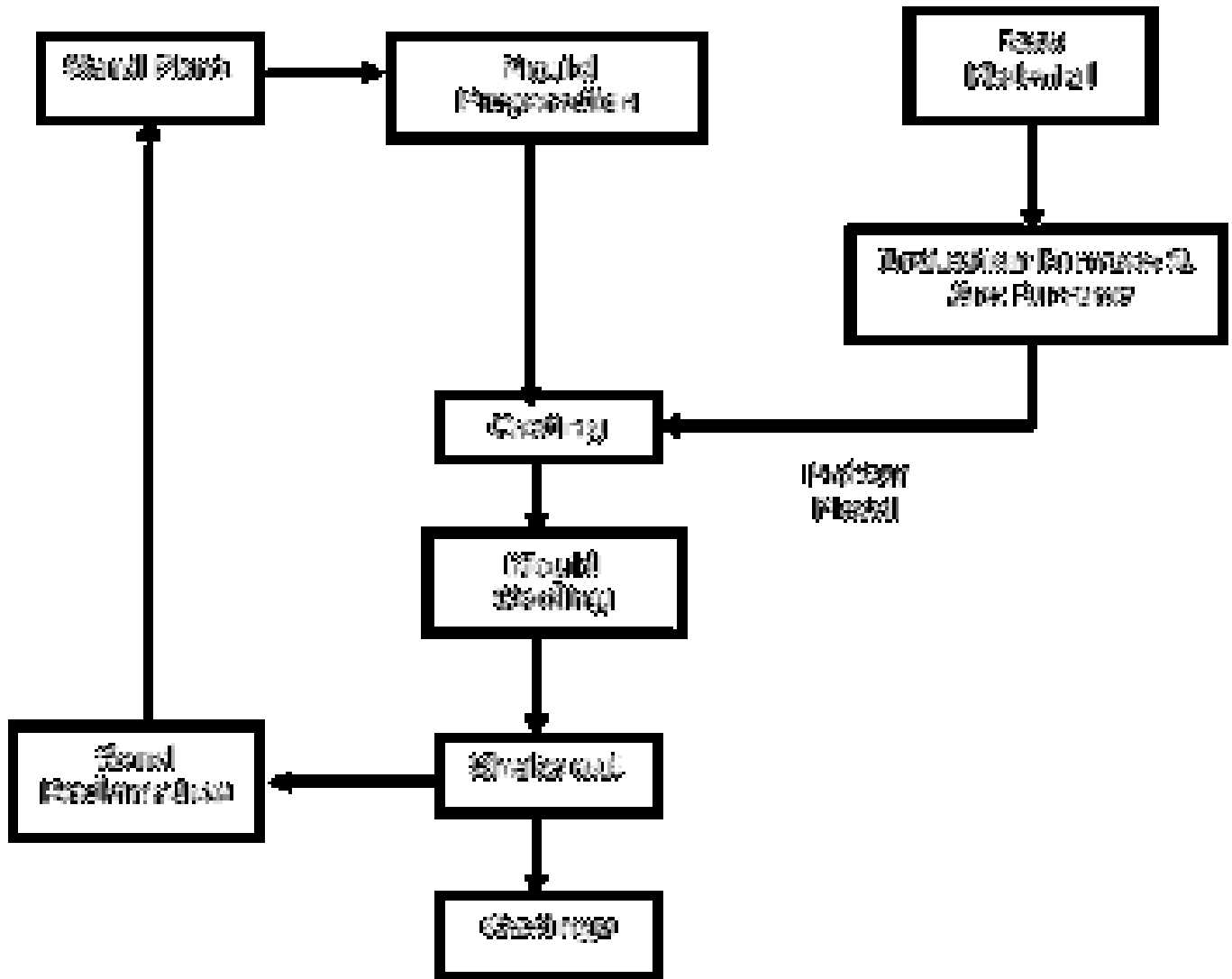
Mould Preparation:

In small-scale industries still the moulds are handmade. Modern plants are utilising pneumatic or hydraulically operated automatic moulding machines for preparing the moulds. After the moulding process if required the cores are placed at the appropriate position in the moulds. Then the moulds are kept ready for pouring the molten metal.

Casting:

The molten metal tapped from the holding furnace is poured into the moulds. The molten metal is allowed to cool in the moulds for the required period of time and the castings are produced. The moulds are then broken in the shake out for removing the sand and the used sand is sent back to the sand plant for reclamation and reuse. The castings produced are sent to fettling section for further operations such as shot blasting, heat treatment etc. depending upon the customer requirements.

2.3.2 PROCESS FLOW DIAGRAM



2.4.1 TECHNOLOGICAL BARRIER

- ❖ Maximum foundry units of Batala uses blast cupola furnace which consume more fuel as compared to divided blast cupola furnace.
- ❖ Most of the units are using quite old and re-winded motors which lead to increase in power consumption, which can be reduced by use of energy efficient motors.
- ❖ In Jalandhar maximum units use Rotary furnace for melting. Due to poor insulation, the losses in rotary furnaces are higher.
- ❖ Maximum foundry units in Jalandhar use oil fired rotary furnace which can be replaced with divided blast cupola or induction furnace.

- ❖ Units in Jalandhar and Ludhiana region have low power factor which leads to either higher energy bill or penalty for the same.
- ❖ Many of the units in the BJJ Cluster use energy intensive lighting system which leads to higher power consumption.
- ❖ In many of the units there is opportunity to reduce surface heat losses by providing proper insulation.
- ❖ Many induction furnace units have power quality problem which leads to harmonics.
- ❖ Most of induction furnace units do not achieve maximum power factor incentive from PSEB due to improper sizing of capacitor bank
- ❖ In most of the unit's material handling is manual which results in non uniform production this can be rectified by automated material (Conveyor Belt) system. Another benefit will be reduced labour cost.

2.4.2 FINANCIAL BARRIER

Finance is one of the major issues in energy efficiency. There is need to develop attractive financing mechanism in order to create interest among industry for technology adoption.

2.4.3 MANPOWER

Skilled workers are locally available in BJJ Cluster to operate furnaces/machines. However, there is hardly any engineer employed in these enterprises and the production process remains traditional. This is one of the lacunae of the BJJ Foundry Cluster.

Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness among workforce. These programs should be organized with equipment suppliers.

ENERGY USE AND TECHNOLOGY ASSESSMENT IN CLUSTER

Energy audit team have assessed the energy productivity of unit through a detailed study and discussed the various energy issues.

3.1 METHODOLOGY ADOPTED FOR ENERGY USE & TECHNOLOGY AUDIT STUDIES

A well planned methodology was adopted to execute the energy use and technology audit studies and to achieve the desired project objectives. Major steps which were followed during the energy use & technology studies of the project are mentioned below:

- Data Collection
- Measurements
- Analysis
- Technical discussion
- Conclusion

The primary objective of the energy audits is to quantify the existing electricity consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operating practices. Pre-planned methodology was followed to conduct the energy audits. The following sections describe details of methodology adopted in energy use and technology audits in BJJ Foundry Cluster.

Energy audit team has collected all relevant information related to energy with respect to production. Measurements were taken with involvement of plant people. Analyses of all the data captured have been done and then on basis of measurement discussions were held with the plant team.

3.1.1.1 PRE ENERGY AUDIT ACTIVITIES

Energy audit team have assessed the energy productivity of unit through a study and discussed the various energy issues. At first energy audit team have taken plant round to have feel of plant and to understand plant team's expectation through energy audit. Plant management assigned one technical person as coordinator, who has given all kind of details of energy and in his presence data measurement were taken. Finally at the end of audit, there was discussion with all plant team regarding findings of energy saving in plant.



3.1.1.2 PRELIMINARY ENERGY STUDY

Around 120 Preliminary energy audit studies have been conducted in BJJ Foundry Cluster. Methodology followed in preliminary energy audit study is shown below:

- Collection of past energy consumption details and energy bill
- List out major energy consuming areas of the plant
- Existing technology of various processes and utilities (latest or old, local or reputed company make etc)
- Identification of the areas for special attention for low cost measures with quick payback period
- Understanding the detailed process with energy and material balance
- Establish specific energy consumption, if possible for the each typical equipment/process
- Identify the areas for detailed energy audit study and measurements

All details of the connected load in the plants have been collected during the detailed energy audit. On the basis of power study, suggestions were discussed with plant team. Similarly lighting study was conducted at plant which is also having good potential for energy savings.

3.1.1.3 DETAILED ENERGY STUDY

Detailed energy study was done in plants which are having annual capacity of molten material production more than 500 MT. Actual running power factor was recorded from the current month's electricity bills. On site measurement of all big size motors i.e. Cupola blower motor, Sand mixing motor was taken, survey of lighting system was also done with plant team. All the suggested measures were discussed with the plant team with techno-economic measures & their corresponding investment. Rotary and cupola furnaces were also studied in detail.

More than 70 detailed energy audit studies were conducted in BJJ Foundry Cluster. The methodology followed in detailed energy audit study is presented below:

- Collection of past energy consumption details and energy bill
- Listing of major energy consuming areas of the plant
- Identifying existing technology of various processes and utilities (latest or old, crude or efficient, local or reputed company make etc)
- Status of instruments installed in the plant and necessary instrumentation required for the detailed study

- Identification of the areas for special attention for low cost measures with minimum payback period
- Understanding the detailed process with energy and material balance
- Monitoring & measuring of different parameters of various equipment/machines to evaluate performance
- Collection of operational data from various measuring instruments/gauges installed in the plant
- Compilation of design data/name plate details of various equipment from design manuals and brochures
- Discussions with concerned plant personnel to take note of operating practices and shop-floor practices being followed in the plant and to identify specific problem areas and bottlenecks if any with respect to energy consumption
- Critical analysis of data collected and parameters monitored
- Identification of energy wastage areas and quantification of energy losses
- Identification of suitable energy conservation measures for reducing energy consumption

3.2 OBSERVATIONS MADE DURING THE ENERGY USE AND TECHNOLOGY STUDIES CARRIED OUT IN THE CLUSTER

Energy audit team made many observations during visit, that includes molten material handling process, technology or equipment employed, energy availability, utility energy consumption and many more which are listed below.

3.2.1 MANUFACTURING PROCESS AND TECHNOLOGY/ EQUIPMENT EMPLOYED

The manufacturing process of foundry industry is almost similar in all the units. The utilities and auxiliary equipment varies depending upon the requirement. The manufacturing process in foundry industry includes metal melting, sand preparation, pattern making, mould preparation and casting. Which are describe above

Equipment employed:

- 1) Furnace (Induction/Rotary/Cupola)
- 2) Sand Mixing unit
- 3) Mould preparing units
- 4) Mould Baking units
- 5) Grinder
- 6) Plant Distribution System
- 7) Plant Lightning System

3.2.2 ENERGY CONSUMPTION PROFILE AND AVAILABILITY

Energy consumption profile varies from starting to end of process. Highest energy consuming equipments is Furnace (Induction/Rotary/Cupola). Availability of energy is definitely an issue with most of the industrial areas. However with

improve in energy efficiency, gap between demand & supply can be reduced to some extent.

3.2.3 CAPACITY UTILIZATION FACTOR

This factor can be divided into two parts:

- 1) Machine capacity utilization factor
- 2) Plant capacity utilization factor

As far as machine capacity utilization is concerned, it varies. Loading of the motors is directly proportional to the plant capacity. Loading of Transformer is also having the same variation pattern proportional to plant production.

Coal/Furnace oil consumption is almost uniform throughout the production. Plant capacity utilization is also having the same pattern some plants are running 340 days per annum but some are running only 200-150 days per annum depending upon the market demand.

3.2.4 HOUSEKEEPING PRACTICES

Operational practices in majority of the plant are not very good. There is good possibility to improve the same. There are no specific procedures followed for any particular operation & maintenance of equipments/machines. Knowledge on energy conservation is not much. There is lack of fuel/electricity monitoring system in the foundry cluster.

By improving the operational practices alone, there is possibility to reduce energy consumption by 2 – 3%. Some of the suggested housekeeping practices are presented below;

- ✓ Monitor charging time in melting furnace
- ✓ Reduce holding time in melting furnace to ensure minimum fuel/electricity consumption
- ✓ Planning for scheduling furnace operation should be done
- ✓ Air for combustion should be monitored
- ✓ Furnace temperature should be controlled
- ✓ Idle running of blowers/equipments should be avoided
- ✓ Training programs & awareness session may be organised to showcase benefits of better housekeeping practices.
- ✓ There is need to create sufficient space & process for storage of raw material, coke & furnace oil storage. Also proper flouing & covering of the coal storage yard is required which can reduce unwanted dust & carpet losses.

3.2.5 AVAILABILITY OF DATA INFORMATION

As plant persons are very cautious about the end products quality, almost every plant is having quality lab inside the plant. They have keen observation of the products according to the client's requirement. Audit team had taken all the required data to analyse specific energy consumption of the plant.

The main problem which is observed is that little awareness about energy consumption. There is need of proper monitoring of plant energy consumption which is directly proportional to the production. Plant team extended good cooperation during energy study, which made smooth running of project.

3.3 TECHNOLOGY GAP ANALYSIS

Foundry units in unorganized sector has these characteristics; low engineering, limited technology innovation, poor R&D base, low level of human resource on knowledge of technology and operational skill etc. This sector also faces deficiencies such as the lack of access to technology, technology sharing, lack of strong organizational structure, professional attitude etc

Majority of Foundry units in BJJ Foundry Cluster are using low end technologies in their processes and utilities. The performance of those processes/equipments is poor as compared to the technologies available in the market. There are various technological gaps which were identified in units as under:

- Lack awareness on the technologies available
- Lack of awareness on quantum of energy loss and its monetary benefit
- Lack of awareness among the workforce etc.

There is a tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the some of the progressive managements, they are interested in improving the energy efficiency of their units by adopting energy efficient technologies in market. From technology audit studies conducted in BJJ Foundry Cluster, below mentioned areas were identified for technology up gradations;

- Copula Furnace
- Induction Furnace
- Rotary Furnace
- Surface Insulation for reducing heat loss of furnace
- Plant Lightning System
- Electrical Motors

As far as technology is concerned, most of the units are running traditionally. Almost all units are using Blast Copula, Single frequency induction furnace, old/ re-winded motors, which are less efficient. There are various reasons of not having technology up-gradation in foundry as mentioned;

- Remote location
- Unskilled labour
- Lack of awareness
- Stringent with same process flow
- Lack of finance

3.3.1 TECHNOLOGY UP-GRADATION

Now a day, there are various new technologies available in market for above said equipments which are not only energy efficient but are also having good productivity. Technology up gradation can be done in every equipment and utilities which are installed. Most of the equipments which are installed are very old such as almost all copula are Blast type which consume more energy compared to Divided blast copula, motors are re-winded many times, which are used as blower for copula are having motors in the range of 15-20 hp contribute to more power consumption. Energy efficient lamps are available in market which is very competitive with other incandescent lamps. For utilising day light now transparent sheets are available in market which can reduce the operating hours of lamps. For street light also, energy efficient lamps are available in market which not only saves energy but also give good lux level. A list of suggested technologies is shown in below table;

Equipments	Old Technologies	New Technologies	Saving Potential
Copula	Blast Copula	Divided Blast Copula.	15 % (Coal Consumption)
Oil Fired Rotary Furnace	Rotary Furnace	Induction Furnace	25 % Energy saving (Approx.)
Power Factor Improvement	Manual Control	APFC with Additional Capacitor For Maintaining PF 0.99	10-15 % Electricity saving
Insulation & Lid cover to avoid radiation losses	Open lid/poor insulation	Good insulating material/lid cover	2% savings
Insulation Paint For Rotary and Copula Furnace	No Insulation over surface	Insulation paint over surface of furnace	5 -7 % Fuel saving

Excess Air in Blast Copula	No Flue gas Monitoring system	Flue gas monitoring with damper control	5-7% Electricity saving
Energy Efficient motors for Blowers	Old re-winded motors	Use of Energy Efficient motors	3-5% savings
Lightning System	40 W with convectional choke	T/5 28 w Tube Light	40%

3.3.2 PROCESS UP-GRADATION

For up gradation of process, plant people can go for Blast copula to Divided Blast Copula, similarly Oil fired rotary furnace to small induction furnace conversion. Such type of arrangement reduces the plant energy consumption as well as results in smooth operation of plant.

3.4 ENERGY CONSERVATION MEASURES IDENTIFIED

Complete process of Foundry units was studied and energy audit team have discussed the various energy saving projects with plant team. There are various energy saving projects like Replacement of lighting system by energy efficient lighting system, replacement of Blast copula to Divided Blast Copula, similarly Oil fired rotary furnace to small induction furnace which are available in market. Possibility of technological improvement is more in all the Cluster units because all units are operated in conventional way the following key improvement measures are analysed during the audit for technological improvement.

3.4.1 PROPOSAL FOR ENERGY CONSERVATION INCLUDING TECHNOLOGY UP GRADATION

Various energy conservation proposals are identified for Foundry Units B JL Foundry Cluster. Details of identified energy conservation proposals along with its cost benefit analysis and issues in implementation of each proposal are presented in following sections.

1. Replace Blast Copula with Divided Blast Copula
2. Replace Oil Fired Rotary furnace to small Induction furnace
3. Install APFC to maintain close to unity power factor
4. Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses
5. Optimize Combustion Efficiency of Furnace by Reducing Excess Air
6. Replace 40 W Light by T5, 28 W Light
7. Replace 100 W GLS bulb by 20 W CFL
8. Install Vibratory Feeder for material loading in furnaces
9. Replace Old Re-winded Motors with Energy Efficient Motors

A) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACE BLAST COPULA WITH ENERGY EFFICIENT DIVIDED BLAST COPULA

Background

During energy audit at Batala region it was found that maximum units are using Blast Copula for melting. The installed furnace is utilized for melting the material at temperature of 1300 to 1500°C. Furnace remains in operation for 96 hrs/ yr. Cupola is the most common type of melting furnace used for the production of grey iron castings in all foundries at Batala.

Some of the contributing factors that were identified for this poor energy performance are listed below.

- Incorrect blast rate
- Lower blast air pressure
- Incorrect distribution of air between the top and lower tuyeres
- Turbulent (non-linear) entry of air into the cupola
- Incorrect sizing of cupola parameters such as tuyere area, well depth, and stack height among others
- Poor operating and maintenance practices
- Poor control of feed materials (shape, size, weight, sequence)

Divided Blast Cupola

Divided blast cupola (DBC) or twin blast cupola is a proven technology for improving the energy performance at a modest investment. As, is evident from its name, a DBC supplies blast air to the cupola furnace at two levels through a double row of tuyeres.

The DBC was developed & designed by TERI (The Energy & Resource Institute). And the successful implementation of DBC has been done by TERI at many places like Rajkot, Kolkata etc. Fabrication design drawings of the DBC are provided by TERI & its authorised vendors. The advantages of a DBC, compared to a conventional cupola, are as follows.

- A higher metal tapping temperature and higher carbon pick-up are obtained for a given charge- coke consumption.
- Charge-coke consumption is reduced as high as 30% and the melting rate is increased, while maintaining the same metal tapping temperature.

3.4.1.2 Benefits of Divided Blast Cupola:

Following advantages can be achieved with DBC;

- Optimum blower specifications (quantity and pressure)
- Optimum ratio of the air delivered to the top and bottom tuyeres
- Minimum pressure drop and turbulence of the combustion air
Separate wind-belts for top and bottom tuyeres
- Correct tuyere area, number of tuyeres, and distance between the two rows of tuyeres
- Optimum well capacity
- Higher stack height
- Mechanical charging system
- Stringent material specifications



**Conventional Cold Blast Cupola
Cupola**



Divided Blast

Sample Operating Procedure for DBC

A) Coke bed preparation

1. Place the required firewood on the sand-bed.
2. Add the first instalment of bed coke (1/4th of total bed-coke weight). Only selected size of coke should be used in the bed.
3. All lower tuyere covers should be open and the tuyere valves should be closed at the time of ignition of the bed.

4. Observe the ignition of the first instalment of coke and add second instalment when the ignition is found to be satisfactory.
5. Similarly, observe the ignition and put in the third instalment.
6. Keeping the fettling door open, close the lower tuyere covers and blow-off for about 30 seconds.
7. After blow-off, ensure there is no hanging of coke in the bed. If any hanging is observed, poke through the tuyeres to consolidate bed.
8. Close the fettling door, add the fourth instalment of bed coke and check the final bed height with gauge.

B. Charging and cupola operation

1. Charge the bed limestone and start charging immediately.
2. Avoid charging large pieces of metallic.
3. When the stack is full, close the tuyere covers and open all upper and lower tuyere valves.
4. Start blower.
5. The stack should always be full during the melting. If for any reason this is not the case, the blower should be shut off and the condition rectified.
6. Whenever the blower is switched off, all the tuyere covers should be opened and tuyere valves closed.
7. The tuyeres must be kept clear at all times. This requires constant attention by the cupola operators.
8. If it becomes apparent that the bed height is being burnt away (e.g. blast being turned off) or if conditions in the cupola become excessively oxidizing then a coke/limestone booster should be added.

C. Plant shut down procedure

1. After last charge is added and stack is blowing down, reduce blast flow to top tuyeres and increase flow to bottom tuyeres.
2. On tapping last metal, turn off the blower.
3. Open emergency tap hole on siphon box and drain.
4. Open all tuyeres.
5. Remove props and open bottom drop doors (warning: make sure no water is in the drop area).
6. Drop bottom and check that coke bed has been cleared from tuyeres and that there is no slag inside the tuyeres.

Summary of operating tips in a Cupola:

Dos	Don'ts
Ensure that the bottom sand is free from iron, etc., and that it has the proper cupola. It consumes energy as well as moisture and clay content.	Don't hold the molten charge inside the cupola. It consumes energy as well as changes the metallurgical properties of different batches.
Measure the bed coke height with a calibrated gauge. If needed, add green coke to bring the height to the required level.	Once charging starts, do not stop till, (i) the cupola shaft is filled with the charging material, (ii) the cupola is lit up, and (iii) the blower and tuyeres are switched on.
While charging, ensure that the diagonal dimension of a single piece of metal is less than 1/3rd the hearth diameter.	Doesn't use wet inoculants.
Use light section scrap for filling up, to increase the initial tap temperatures.	Don't allow very heavy raw material pieces weighing more than 1% of the hourly melting rate, in the cupola.
Dry and thoroughly pre-heat all runners and ladles daily.	

3.4.1.3 Life Cycle Analysis

Installation of Divided Blast Copula will save fuel consumption as compared to Blast Copula. Initially Blast Furnace operation, Warm /Hot Blast Cupola and Oxygen Enriched Cupola were developed which were not much successful, particularly in small and medium size units. In Divided Blast Cupola, air is supplied through two sets of blast pipe, tuyeres and wind box. The pressure and volume of each air supply can be separately controlled.

BCIRA figures suggest following benefits with Divided Blast Cupola –

- ✓ **40-50°C increase in metal tapping temperature**
- ✓ **15-32% reduction in coke consumption for same melting ratio**
- ✓ **11-22 % increase in melting rate at same temperature and coke consumption**
- ✓ **Improved combustion efficiency will reduce carbon dioxide emissions by as much as 25-30%**
- ✓ **15-32% reduction in coke consumption for same melting ratio**



Calculation of savings for replacing Blast Copula with Divided Blast Copula

In following section, cost comparison of a blast cupola & divided blast cupola is compared to better understand actual saving potential with DBC.

Plant Specifications with Blast Cupola

SI.No.	Description	Value
1	Casting Material	10 tons
2	Coal consumption for 8 hour operation	2.5 tons
3	Ash in Coal	14.3 %
4	Blower Power Consumption (20 Hp rated)	14.1 kW
5	Melt temperature at spout	1345°C to 1478°C
6	Temperature of flue gas (below charging door)	250°C to 350°C
7	Ferro-Silicon consumption	1500 kg
8	Ferro-Manganese consumption	1000 kg
9	Rejected castings	700 kg

Plant Specifications with DBC

The same foundry unit running with divided blast (cold blast) cupolas (DBS) at a new site. The specifications of the DBC were as follows:

No. of Cupola	One
Desired melting rate	2.8 ton / hour
Operation	Continuous
Desired metal temperature at spout	1425°C to 1475°C
Typical melting campaign duration	6 – 8 hours

It was decided to use a common mechanical charging system to feed the charge materials to the two cupolas during audits.

Divided Blast Cupola Operation Data

A summary of the Post-commissioning energy audit is provided below

SI.No.	Description	Value
1	Casting Material	10 tons
2	Cole consumption for 8 hour operation	2.0 tons
3	Blower Power Consumption (15 Hp rated)	12.5 kW
4	Ash in Cole	14.3 %
5	Melt temperature at spout	141°C to 1500°C
6	Temperature of flue gas (below charging door)	130°C to 190°C
7	Ferro-Silicon consumption	1500 kg
8	Ferro-Manganese consumption	1000 kg
9	Rejected castings	450 kg

Cost Savings

On the basis of the pre-commissioning and the post-commissioning audit results, the savings from implementation of the DBC were worked out. In below given table total savings obtained

from reduced consumption of coal and other materials as well as reduction in rejection levels is summarised.

Actual cost savings per ton of melt output

Sl. No.	Consumption of Coal In Conventional Cupola/ton of molten material	Consumption of Coal In Divided Blast Copula/ ton of molten material	Savings after Implementation of DBC/ ton of molten material	Monetary Savings Rs/ton of molten metal
1	250 kg	200 kg	50 kg	Rs.750/ *Assuming Coal rate Rs 15/kg

Reduced rejects

Sl. No.	Rejection of material In Conventional Cupola for 8 hour operation	Rejection of material In Divided Blast Copula for 8 hour operation	Savings of material after implementation of DBC for 8 hour operation	Monetary savings Rs/ton of molten metal
1	700 kg	500 kg	200 kg	Rs.400/ Assuming energy cost for one kg raw casting will Rs.2/

* The above calculation of rejection of material is for 10 tons. So per ton saving will be approximately Rs.40/.

So total saving of fuel per ton molten material = Rs.750 + Rs.40
= **Rs. 790**

Total Cost Savings

Hence, there was a savings of the order of Rs 790/ per ton of molten metal in the foundry unit. For a typical foundry unit at BJL foundry units, melting about 500 tons of metal a year having cupola furnace, so the total savings translates to about **Rs 3.9 Lakhs** per year. The capital cost of a DBC, inclusive of civil work, platforms, bucket charging system etc, is about **Rs 6.0 Lakhs**. The payback period will be **18 – 20 Months**.

*** It is also possible to retrofit a conventional cupola to DBC, by simply changing the blower and blast arrangement. The capital cost of the retrofit option is about Rs 2.0 Lakhs. The capital investment, even in a new DBC, usually pays back within a year, depending on the amount of metal melted in the foundry unit.**

3.4.1.4 Cost of Installing Divided Blast Copula

Cost of implementing this proposal varies in plant as per production capacity. By implicating above project Cluster Units can save energy as well as the molten material quality will be improved due to high temperature.

Total cost of installing Divided Blast Cupola would be **Rs. 6.0 Lakhs/DBC**. The total cost



of replacing around 60 Blast Cupola by Divided Blast Cupola would be approx. **Rs. 360.0 Lakhs.**

3.4.1.5 Saving by Installing Divided Blast Copula

Installation of Divided Blast Copula gives a good energy saving potential and so money saving. The above project implementation will save approx **1800 ton/yr coal (approx.) kWh** for BJL Cluster, Monetary Saving after installation of Divided Blast Copula will be approx. **Rs. 234.0 Lakhs.**

3.4.1.6 Simple Payback Period

The payback period will be **18 – 20 Months**

3.4.1.7 Issues / Barrier in Implementation of Divided Blast Copula

Some of the issues are listed below;

- ✓ Less awareness
- ✓ Lack of exposure
- ✓ Lack of knowledge on metallurgy and technical skills
- ✓ No quality check on inputs, in-process and output
- ✓ Use of old obsolete and traditional technology
- ✓ Lack of technology service providers

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned divided blast copulas are available in local/ national market with some government subsidy. The Energy & Resource Institute) TERI is playing a key role in promoting use of DBC for melting application.

3.4.1.8 Availability of local service providers

The Energy & Resource Institute

TERI, India Habitat Centre, Lodhi Road, New Delhi – 110 003

Mr. Girish Sethi

Director

Tel: 011-24682100/2111; Fax: 011- 24682144/2145

e-mail:

girish.sethi@teri.res.in

prosanto@teri.res.in

Punjab State Council for Science & Technology

Mr. Ranjit Singh

MGSIPA Complex, Adjacent Sacred Heart School, Sec-26, Chandigarh

Phone: 0172-2795001/2792325/2792787

E-mail – ranjit-185@yahoo.com

Mob – 09855243089

B A Industries

Mr. Tawinder Singh

G.T.Batala-143505(Pb)

Tel : 01871-242502

Mob: 98151-62502



B) 3.4.2.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR -

INSTALL INDUCTION MELTING FURNACE IN PLACE OF OIL FIRED ROTARY FURNACE

Background

Rotary furnaces are being used for melting applications in foundries. Furnace remains in operation for 250 hr/yr (Approx.). Rotary furnace is the most common type of melting furnace used for the production of grey iron castings in foundry units in Jalandhar.

More than 90% of Pipe Fittings being used in India are made in Jalandhar. Oil Fired Rotary Furnaces are very popular for making malleable pipe fittings (and scaffoldings) due to less initial cost.

Recent hike in Furnace Oil & Pig Iron has forced to adopt other option to counter the increased operating cost. Induction furnaces can be a better option in place of rotary furnaces.

Benefits of Induction Technology

- ✓ Low melting cost
- ✓ Low rejection rates
- ✓ Less pollution i.e. environment friendly
- ✓ Cheaper scrap material can be used
- ✓ Less burning losses of alloys & Pig Iron
- ✓ Higher production
- ✓ Better quality (malleability)
- ✓ S.G. Iron Castings can be made

3.4.2.2 Benefits of Installing Induction Melting Furnace

Comparison of Cost of Fuel in induction furnace & rotary furnace;

Furnace oil is being used in Rotary Furnace as fuel. On an average one litter F.O. is used to get 7 Kg Malleable Iron. The cost of F.O. is Rs. 32.0/per litter (without excise duty). So, the melting cost is Rs. 4.57 per kg of liquid metal.

Whereas, induction furnaces require electricity for its operation. On an average 600 units are required to melt one MT of Liquid Metal. The cost of electricity is Rs.4.50 per unit. So, the melting cost is Rs. 2.70 per kg of liquid metal.

Hence the savings on per kg of liquid metal = (Rs.4.57 – Rs.2.70)
= **Rs. 1.87/kg**

Comparison of Burning Losses in Rotary Furnace vs Induction Furnace

In Rotary Furnaces flames interact with alloys (Silicon) & pig iron. Due to oxidation and splashing losses are observed on an average 9%. In Induction Furnaces metal melt itself



by inner heating, so there are very less burning losses. It is observed that in Induction Technology 7% burning losses can be saved. The cost of Pig Iron is Rs. 29 – 35/per kg.

Hence the savings on per kg of Pig Iron = (7% of Rs. 35.0)
= **Rs. 2.45/kg of metal**

Comparison of cost savings by use of scrap material in induction furnace as compared to use of pig iron in rotary furnace

C.I. Borings, waste material cannot be used in Rotary Furnaces. The cost of boring is Rs. 27.0 per kg. Recovery of metal in boring is approximate 90%. So, the cost of boring becomes Rs. 30.0 per kg. Borings consume approx. 0.65 units per Kg or it cost Rs. 2.75 per kg to melt.

Hence the cost of liquid metal is Rs. 32.75/kg. In case of melting Pig Iron it becomes Rs. 37.70 per kg (Rs 35.0 + Rs 2.70). So the saving is Rs. 4.95 per kg. In Induction Furnace upto 30% of boring waste can be used without compromising the quality.

Hence the benefit per kg can be = (30% of Rs. 4.95)
= **Rs. 1.48**

Comparison of Cost on the basis of rejection rates in Induction furnace as compared to rotary furnace

This is the main factor to choose Induction Furnace. In Rotary Furnaces first & last tapping of metal rejects due to low temperature. As well as there are no homogeneous metal. So during the annealing process 7-10% raw castings (before galvanizing & machining) rejected due to the hardness. While such type of draw backs are minimized in Induction Furnace. Hence on an average 5% more production is achieved.

Cost of raw casting is Rs.55.0 per kg. 7 T casting is made in a 1MT Induction Furnace in 12hrs. In a month it is 175 MT i.e. (5% of 175T) 8.75T more production is achieved. So the profit is around **Rs. 4.80 Lakhs/month.**

3.4.2.3 Life cycle analysis for Installing Induction Melting Furnace

Calculation for a Single Unit

<p>Comparison by Cost of Fuel:</p> <p>One liter F.O is used to get 7 Kg Malleable Iron Cost of 1 liter F.O = Rs.32.0 (approx.) So melting cost of per one kg liquid metal = Rs. 4.57 For Induction furnace 600 units required to get 1000 kg melting material</p> <p>For 1 kg malleable required electricity unit = 0.6 Unit</p> <p>Cost of electricity/Unit = Rs.4.50 (Approx.) For 1 kg malleable required electricity in rupees = Rs.2.70</p> <p>So, % of saving = 40 %</p>	<p>Comparison by Burning Losses</p> <p>In Rotary Furnaces flames interact with alloys (Silicon) & pig iron. So due to oxidation and splashing losses are observed on an average = 9%. In Induction Furnaces metal melt itself by inner heating, so there are very less burning losses. It is observed that in Induction Technology 7% burning losses can be saved. The cost of Pig Iron is Rs.35.00 per kg. (Approx.)</p> <p>Hence the savings on per kg of Pig Iron = (7% of Rs. 35.00)</p>
<p>Comparison by Rejection of Material</p> <p>This is the main factor to choose Induction Furnace. In Rotary Furnaces first & last tapping of metal rejects due to low temperature. So during the annealing process 7-10% raw castings (before galvanizing & machining) rejected due to the hardness. While such type of draw backs are minimized in Induction Furnace. Hence on an average 5% more production is achieved. Cost of raw casting is Rs.55.00 per kg. 7T casting is made in a 1MT Induction Furnace in 12hrs. In a month it is 25MT i.e. (5% of 25T) 1.25T more production is achieved. So the profit is around Rs.0.70 Lakhs/month.</p> <p>So,5% saving in raw casting material</p>	<p>Comparison by use of scrap Material</p> <p>C.I. Borings, waste material cannot be used in Rotary Furnaces. The cost of boring is Rs. 27.00 per kg. Recovery of metal in boring is approximate 90%. So, the cost of boring becomes Rs. 30.00 per kg. Borings consume approx. 0.65 units per Kg or it cost Rs. 2.75 per kg to melt. Hence the cost of liquid metal is Rs. 32.75/kg. In case of melting Pig Iron it becomes Rs. 37.70 per kg.(Rs. 35.00+Rs.2.70). So the saving is Rs. 4.95 per kg. In Induction Furnace upto 30% of boring can be used without compromising the quality. Hence the benefit per kg can be = (30% of Rs. 4.95) = Rs. 1.48</p> <p>So, 4 % saving on total molten material</p>

*** From above it is concluded that there is 30 % saving in cost for melting material in induction furnace as compared to rotary furnace;**

Yearly capacity of the plant = 800 ton/year (Approx.)

Per kg melting cost in oil fired rotary furnace = Rs. 4.57

Totally energy cost for melting 800

tons material in oil fired rotary furnace	= Rs. 36.5 Lakhs
Per kg melting cost in induction	= Rs. 2.70
Totally energy cost for melting 800 ton material in oil fired rotary furnace	= Rs. 21.5 Lakhs
Savings	= (Rs.36.5 – Rs 21.5) Lakhs = Rs. 15.0 Lakhs
Investment	= Rs. 20.0 Lakhs (Approx.) (Investment is for 175 kW, 500 kg Induction furnace)
Pay back	= $20.0 \times 12/15.0$ = 16 months

3.4.2.4 Cost of Installing Induction Melting Furnace

Cost of implementing this proposal varies in plant as per capacity and size of plant with respect to production capacity. Total cost of implementation 175 kW, 500 kg Induction furnace would be around **Rs. 20.0 Lakhs**. For around 20 units, the cost would be Rs. 400.0 Lakhs.

3.4.2.5 Savings by Installing Induction Melting Furnace

Around **Rs. 15.0 Lakhs/yr** can be achieved by installing induction furnace in place of rotary furnace. Savings by replacing around 20 such units would be around Rs. 300.0 Lakhs.

3.4.2.6 Simple payback period of Installing Induction Melting Furnace

Installation of induction furnace in place of oil fired rotary furnace has payback of 16 to 20 Months.

3.4.2.7 Issues / barrier in implementation of Induction Melting Furnace

Major issue in implementing this proposal is cost of implementation. All the technical and commercial aspects have been discussed with unit people.

3.4.2.8 Availability of technology / Product in local/ National / International Market

Now days when energy cost is high, it is inefficient practice to use oil fired rotary furnace. As far as technology is concerned Energy efficient induction furnaces are available in local/ national market. It is well proven technology which is adopted in many of the other

similar and dissimilar units.

3.4.2.9 Availability of local service providers

Mr. Ajit Charturvedi

Inductotherm India Pvt Ltd

203, Vikram Tower, 16, Rajendra Place, New Delhi

Contact No: 09311150284

Phone: 011-41536796

Mr. Inderdeep Singh

Megatherm

Main Jeevan Nagar Road, Opp. Veer Palace, Jeevan Nagar

Ludhiana

Contact No: 09915046606

Phone No: 0612670402

Mr. Saurabh Bhardwaj

Electrotherm India Ltd

181 A, South Rajendra Path, Jotwara, Jaipur

Contact No: 09309001512

Phone 0271723461

C) 3.4.3.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

IMPROVE THE EXCITING PLANT POWER FACTOR TO GET MORE INCENTIVES FROM SEB

Background

It is a well known fact that poor power factor of the load connected to the electrical grid result in higher demand and burdens the utility grid for transporting the active well as reactive power from the generating station to the actual user. Only the active power is converted into useful forms while reactive power causes magnetizing losses.

The capacitor has several uses in electrical power network;

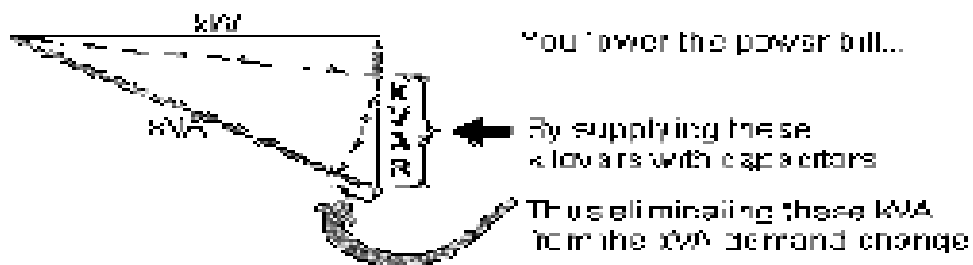
1. Reduces the total kVA drawn from the mains
2. Free up capacity for additional load
3. Relives electrical network from carrying reactive power.
4. Relives the user of payment of penalty imposed by the utility provider on account of poor power factor.
5. Earns incentives for the user from the utility provider (SEB) if power factor maintained beyond certain level.

Thus, installing power factor improvement device make good sense with a pay back of less time. The power factor correction system primarily comprise of connecting capacitor of calculating suitable ratings across the three phase supply.

Induction furnace, Induction motors, transformers and many other electrical loads require magnetizing current (kVAR) as well as actual power (kW). By representing these components of apparent power (kVA) as the sides of a right triangle, we can determine the apparent power from the right triangle rule: $kVA^2 = kW^2 + kVAR^2$.

To reduce the kVA required for any given load, we must shorten the line that represents the kVAR. This is precisely what capacitors do by supplying kVAR right at the load; the capacitors relieve the utility of the burden of carrying the extra kVAR. This makes the utility transmission/distribution system more efficient, reducing cost for the utility and their customers. The ratio of actual power to apparent power is usually expressed in percentage and is called power factor.

$$P.F = kW/kVA$$



Role of APFC (automatic power factor Compensation) for Improving Power Factor

For an Industry with dynamically changing loads, Automatic PF Compensation affords the best Return on Investment. Automatic PF Correction also avoids Leading PF situations by switching off extra capacitors.

3.4.3.2 Benefits of Improve the Existing Plant Power Factor

1. Reduces the total kVA drawn from the mains
2. Free up capacity for additional load
3. Relieves electrical network from carrying reactive power.
4. Relieves the user of payment of penalty imposed by the utility provider on account of poor power factor.
5. Earns incentives for the user from the utility provider (SEB) if power factor maintained beyond certain level.



3.4.3.3 Life Cycle analysis for Implementing APFC with Extra Capacitor

Calculation

Maintain a high power factor, which will lead to reduced demand, better voltage, high system efficiency as well as rebates from the electricity supplying company. The power factor can be improved by installing capacitors in the electrical system

Cost benefit analysis of power factor improvement

Existing load of the unit (KW)	700
Monthly Electricity Bill (Approx.)	Rs. 5.0 Lakhs
Existing power factor	0.96
Desired power factor	0.99
Existing Monthly Rebate	Rs.1250/
Capacitor required (kVAR)	110
New Monthly/yearly Rebate	Rs. 5000/month Rs. 0.60/yr
Cost of capacitors @ Rs 300/kVAR	Rs.0.33 Lakhs
Simple payback period	6

3.4.3.4 Cost of Implementing APFC with Extra Capacitor

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of a100 kvar capacitor bank with APFC with a rate of Rs. 15000 – 20000. Some of the units are not having sufficient capacity of capacitor for maintaining PF Unity. So there is need of adding some additional capacitor bank with APFC. Total cost of implementation of APFC with capacitor bank for all the units in BJJ Cluster is approx. Rs. 8.0 Lakhs.

3.4.3.5 Simple Payback Period

Implementing APFC with Extra capacitor to get more incentives form SEB has very lucrative payback of only **6 Months**.

3.4.1.6 Issues / barrier in Implementing APFC with Extra Capacitor

There are no such hard and fast issues or barriers in implementing this proposal, since

all the technical and commercial aspect being discussed with unit people. This proposal does not require much capital for implementation, so could be implemented at first priority. It is advisable to use good quality of capacitor bank with microcontroller based APFC.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. It is observe that using APFC can help to maintaining high power factor. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of Local Service Providers

Mr. Neeraj Verma

ABB Ltd

Contact No: 09878613484

Mr. Chander M. Kapoor

Naac Energy Control (p) Ltd

Contact No:09811199085

Mr. Rajesh Jain

Siemens Ltd

Contact No: 09987089336

Mr. Chandar Subhas

Havells India

Mall Mandi, Batala

Contact No: 01871243110

Mr. Manmeet Singh

Dhamija Trading Co. Opp St No-6

Bhagwan Chowk, Jalandhar

D) 3.4.4.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

INSTALLATION OF T5 LAMPS IN PLACE OF 40 W LIGHT

Background

During Audit, study of lighting was carried out for energy savings. There are many lights of 40 W each, with electrical choke which are having losses of around 15 watts/ballast. Energy efficient T5, 28 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power. Reflector lamps are used when light is only desired to be emitted in a single direction, or when an application requires the maximum amount of light. T5 lamps deliver 2900 Lumens, which is more than 2000 lumens with 40 W tubes.



40W – FTL



T/5 – 28 W FTL

3.4.4.2 Benefits of T5 lamps in place of 40 W Light

Advantages:

- Low mercury content
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches
- Reduces sick building syndrome
- Operates at low voltage
- High PF (0.99)

- Instant start up

3.4.4.3 Life cycle analysis for T5 lamps in place of 40 W Light

Calculation

Power comparison for T5 lamp & 40 W lamps is shown in below table;

Type	Power Consumption including ballast
Conventional fluorescent lamp (40 W with electrical choke)	55 W / Tube
Energy efficient T5 lamp (28 W with electronic choke)	28 W / Tube

Comparison of energy consumption between 40 W lamp and T5 lamps

Saving	25 W / lamp
Running Hours	5000 hrs/year
Energy Saving	=0.025 kW/lamp x 5000 hrs/yr X Rs. 4.8 / kWh = Rs. 600/ year/lamp

Typically a fluorescent lamp will last between 10 to 20 times as long as an equivalent incandescent lamp when operated several hours at a time. The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labour is costly. Replacement of T5 lamps can be done on failure and replacement basis for any lamp.

3.4.4.4 Cost of Installation

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of T lamps lies in range of 600-700 each. All the units can replace existing 40 W tube light with energy efficient T5 lamps of 28 W. Total cost of implementation of T5 lamps in place of 40 W tubes for all the units in BJL Cluster is approx. **Rs. 15.0 Lakhs**

3.4.4.5 Saving Potential

Installation of T5 lamps gives a good energy saving potential and so money saving. As already said all units can install T 5 lamps, it will lead to save running power of 40 W tube. In almost all the units 40 W tube runs continuously which lead to increase in energy consumption of units. Replacement of T5 lamps will save approx. 50 MWh for BJL Foundry units. Savings after installation of **T5 lamps in place of 40 W Light** will be

approx. **Rs. 25.0 Lakhs.**

3.4.4.6 Simple Payback Period

Installation of T 5 lamps in place of 40 W tube has payback of around 20 – 24 months.

3.4.4.7 Issues / barrier in Installation of T5 lamps in place of 40 W Light

This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use T5 lamps on failure and replacement basis.

3.4.4.8 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.4.9 Availability of local Service Providers for T5 lamps

Nortorn Engineers Works

Batala

Contact No: 09814055142

Mr. Jaswant Light

Jalandhar

Contact no: 01812490334

New light group

Jalandhar

Contact No: 08872221700

E) 3.4.5.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

PROVIDE SURFACE INSULATION BY INSULATION PAINT COATING OF COPULA/ROTARY FURNACE TO REDUCE HEAT LOSSES

Background

During energy audit CII and plant team jointly studied the Cupola furnace of all units. During detailed study, it is observed that insulation of Cupola furnace is poor. The skin temperature of furnace is on the higher side i.e in the range of 100-120⁰C. Ideally, skin temperature for the furnaces should not be more than ambient + 20⁰C. Higher skin temperature means more surface heat loss into the atmosphere. As temperature increases ambient +30⁰C, the furnaces should be reinsulated.

Operating principle of insulation paint coating of Copula/Rotary furnace:

Heat naturally flows from warm area to cooler areas, regardless of direction. In winter, heat flows from the inside of a building to the outside. This flow of heat can never be stopped completely, but the rate at which it flow can be reduced by using material which have a high resistance to heat flow.

Radiation - Any object will radiate heat to cooler objects around it by giving off “heat waves”. This is a direct transfer of heat from one object to another, without heating the air in between. This is the same process in which the Earth receives heat from Sun or a wood stove supplies heat to its surroundings.

How does insulation work?

Insulation is any material that slows the rate of heat flow from a warm area to a cooler one. The more the rate is slowed, the better the insulative qualities of the material. Its ability to resist heat flow is measured as an R or RSI (metric) value, the higher the R-value, the more the material will resist the flow of heat. In order to be effective, insulation materials must be able to reduce the transfer of heat by conduction, convection and radiation; this is determined by both its physical properties and installation.

Why insulation paint?

Insulation paint reduces the insulative demands placed on conventional insulation which may have been poorly installed or have deteriorated due to dampness or age.

What it does for furnace

It is an insulating paint that achieves remarkable energy efficiency through superior insulation. It works by blocking heat transfer (heat Flow) through the surface that has been painted. The technology is similar to that which is very successfully used to dissipate heat from the Space Shuttle and other space vehicles upon atmospheric re-



entry. The use of above paint can drastically reduce the energy consumption of furnace

What it looks like

This paint is mixture of very complex spheres in a paint media having the appearance of a very mild texture feel to the paint finish but is not noticeable to the eye. If a sprayer is being used for paint application the all screen filters should be removed.

Selection & Specification Data

Generic Type Single-package silicone Aluminium Finish

Description; High-performance finish for areas exposed to extreme temperatures. Suitable for service upto 600⁰C..

Features; Resistant to thermal shock Provides outstanding long-term Performance when applied over Carbozinc inorganic zinc primers upto 400⁰ C & 2 coats of same paint upto 600⁰C Air-dries to touch (full film formation properties occurs after curing)

Color	Aluminium
Finish	Bright, Smooth & Lustrous.
Flash Point	Above 27 ⁰ C
Primers	Inorganic zincs upto 400 ⁰ C. Same paints as primer for service up to 600 ⁰ C
Dry Film	25 microns / per coat
Solids Content	By Wt : 38 ± 2
Theoretical	10 m ² / lit
VOC Values	As Supplied
Dry Temp.	600 ⁰ C
Resistance	
Limitations	Do not use for immersion service. Do not exceed thickness recommendation. Excessive film thickness may result in blistering and delamination when the temperature is increased.

3.4.5.2 Benefits of Providing Surface Insulation

During detailed study, it is observed that insulation of Cupola furnace is poor. The skin temperature of furnace is on the higher side i.e in the range of 100-120⁰C. Ideally, skin temperature for the furnaces should not be more than ambient+20⁰C. Higher skin temperature means more surface heat loss into the atmosphere. As temperature increases ambient+30⁰C, the furnaces should be reinsulated.

3.4.1.3 Life cycle analysis for Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses

Calculation for a Single Units

Average skin temperature of furnace, Ts = 120⁰C.

Total Surface Area with damaged insulation = 5 sq. meters.

Ambient Temperature, T_a = 30°C.

For Economical insulation thickness T_s to be reduced to $T_a + 15 = 40^\circ\text{C}$

Surface Heat Loss S = $[10 + (T_s - T_a)/20] \times (T_s - T_a) \times \text{Area}$
= 6525 kcal/hr

Operating Hours = 96 Hrs/yr

Net Heat loss = 96 Hrs x 6525 kcal/hr
= 626400 kcal/Year

Assuming 100% heat transfer Efficiency of furnace

In terms of coal Equivalent Loss = 626400/4500
= 139.2 kg of coal

Cost of Heat loss = 139 x Rs 20 /kg
= **Rs. 2784 /yr**

Investment required for insulating = **Rs. 600**

Pay Back = Rs. 600 x 12/2784
= **3 months**

3.4.5.4 Cost of providing Surface Insulation

Cost of insulating one cupola furnace would be approx. Rs. 600/. Total cost of implementation of Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses in units at BJL Cluster would be approx. **Rs. 12.0 Lakhs.**

3.4.5.5 Saving from implementing Insulation Paint

Savings per cupola furnace would be approx. Rs. 2500. Saving by providing surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses in units at BJL Cluster is approx **Rs. 72.0 Lakhs.**

3.4.5.6 Simple Payback Period of implementing proposal of Provide surface insulation by insulation paint coating

Implementing proposal of Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses has payback of only Three to Four Months

3.4.5.7 Issues / barrier in implementation

This project is very simple. As such there would not be any issues.

.

3.4.5.8 Availability of local Service Providers

Star Paint & Oil Industries

Crescent Chambers, 56, Tamarind Street Fort

Mumbai 400 023

Tel: +91-22-2265 2243 / 2265 2289 / 2265 2904, Fax: +91-22-2265 3201

Email: info@starpaintindia.com, sales@starpaintindia.com

F) 3.4.6.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

OPTIMIZE COMBUSTION EFFICIENCY OF FURNACE BY REDUCING EXCESS AIR

Background

Coal is being used in cupola furnaces in foundry sector. Flue gas analyses were carried out on site of cluster units to check the excess air levels of furnace. Results of flue gas analysis are mentioned below;

Flue Gas Analysis:

Parameters

Excess Air %	90 %
Flue Gas Temp. °C	250-300

Bench Mark Values for coal boilers:

Air required per Kg of coal	10.8%
Flue gas per Kg of coal	11.7%
CO ₂ in Flue gas	10-13%
Excess air	30-60%

It can be interpreted from the above that furnace is being operated at higher oxygen levels than the recommended value.

Losses due to lower CO₂ level

When the CO₂ content of the flue gas is low (less than 8 percent) heat is lost in flue gases.

Low carbon dioxide content may be caused by;

- Small burner nozzle
- Air leakage into the furnace or boiler
- Under-firing in the combustion chamber

Losses due to higher oxygen level

Higher oxygen level in flue gas indicates that these utilities are fed with more air than the actual requirement for complete burning. It means higher loss due to heat carried away by the flue gases, because with each unit volume of oxygen about 3.5 volume of nitrogen gas is also coming with the air and carrying away the heat from the boiler as flue gases. On the other side air forced draft fan is doing more work and consuming more power to supply this excess amount of air.

3.4.6.2 Benefits of Optimizing Combustion Efficiency of Furnace by Reducing Excess Air

By controlling excess air quantity, coal consumption would be reduced. And since extra unwanted air would be avoided, it will result in higher furnace temperature, hence high melting temperature.

3.4.1.3 Life Cycle Analysis

Calculation for a Single Unit

Flue Gas Analysis:

O₂% = % oxygen level in flue gas
Percentage Excess air = $O_2\% \times 100 / (21 - O_2\%)$

Parameters

Excess Air % 90 %
Flue Gas Temp. 0C 250-300

Bench Mark Values for Cupola:

Air required per Kg of coal 10.8%
Flue gas per Kg of coal 11.7%
CO₂ in Flue gas 10-13%
Excess air 30-60%

*Every 15% reduction in excess air 1% fuel can be save

Excess Air % = 90 %
Bench Mark Value of Excess Air = 60 %
= (90-60) %
= 30%

***Every 15% reduction in excess air 1% fuel can be save**

Fuel Saving = $30/15$
= 2%
Total Fuel consumption = 96 ton/yr
Saving = 0.02×96 ton/yr
= **1.92 ton/yr**
Cost of coal = $1920\text{kg/yr} \times \text{Rs } 20 /\text{kg}$
= **Rs. 38,400/yr**

Investment required for Damper Controlling = **Rs. 0.10**
Pay back = $0.1 \times 12/0.38$
= **3 months**

Flue gas analysis was carried out during the energy audit. Only damper is required to be installed to control air flow.

3.4.6.4 Cost of implementation

Cost of implementing this proposal is very less. Cost of damper control lies in range of **Rs. 3000-4000 each**. Total cost of implementation of above project for all the units in BJJ Cluster is approx. **Rs. 2.0 Lakhs**.

3.4.6.5 Saving

Implementation of above project gives a good energy saving potential in fuel .Around Rs. 35,000 can be saved. This project needs low investment cost, so implementation can be done on priority basis. Monetary Saving after implementing above project will be approx. **Rs. 10.0 Lakhs**

3.4.6.6 Simple Payback Period

Implementation of above project has payback of only Two to Three months only.

3.4.6.7 Issues / barrier

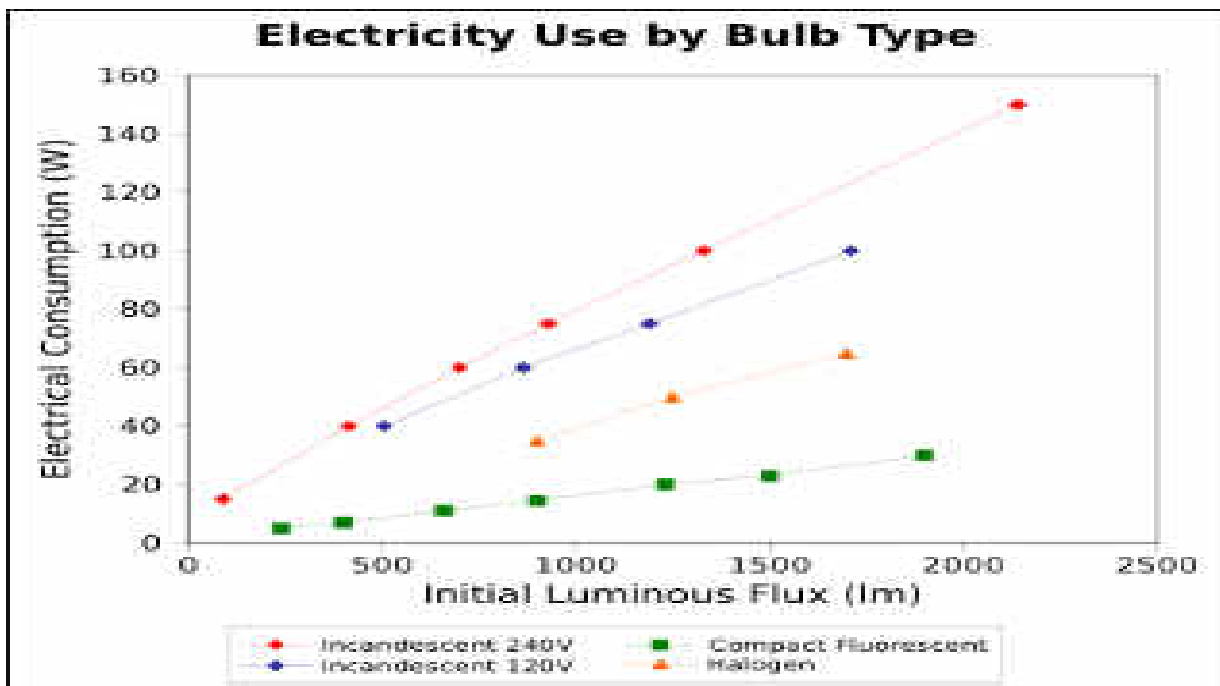
This proposal does not require more capital for implementation, so could be implemented as per priority of plant.

G) 3.4.7.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF 100 W INCANDESCENT LAMPS BY 20 W CFL

Background

During Audit, study of lighting was carried out for energy saving. In some of the plant there are many incandescent lamp of 100 W. Energy efficient CFL of 20 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power.



3.4.7.2 Benefits of Replacing 100 W Incandescent lamps by 20 W CFL

Advantages:-

- Reduced energy cost
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduced work related headaches
- Reduces sick building syndrome
- Reduce your energy costs
- Save up to 80% of the energy
- Instant start up
- Long life 8 to 15 times of incandescent lamp

3.4.1.3 Life Cycle Analysis

Installing 20 W CFL in place of 100 W incandescent lamps saves power consumption for lighting since it saves running power of light. In some units incandescent lamps are used for lighting purpose. All lighting of 100 W incandescent lamps can be replaced by 20 W lamps whose power consumption is much lower than incandescent lamps.

So cumulatively it saves lot of electrical energy.

Type	Power Consumption including ballast
Incandescent lamps (100 W)	100 W
CFL	20 W

Comparison of energy consumption between 100 W incandescent lamps and 11 CFL

Saving	80 W / lamp
Running Hours	3000 hrs/year
Energy Saving	=0.080 kW/lamp x 3000 hrs/yr X Rs. 4.8 / kWh = Rs. 1280/ year/lamp

The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labor is costly.

Replacement of incandescent lamps by 20 W CFL can be done on failure and replacement basis for any lamp.

3.4.7.4 Cost of Replacing 100 W incandescent lamps by 20 W CFL

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of 20 W CFL lies in range of 80 to 100 each. Some of the units are only having incandescent lamps for lighting purposes, which can be replaced by 20 W CFL. Total cost of implementation of 20 W CFL in place of incandescent lamps for all the units in BJJ Cluster is approx. **Rs. 0.50 Lakh.**

3.4.7.5 Saving of Replacement of 100 W incandescent lamps by 20 W CFL

Replacement of incandescent lamps by 20 W CFL will save approx 3140 kWh for BJJ Cluster units. Monetary saving after installation of 20 W CFL will be approx. **Rs. 2.0 Lakhs.**

3.4.7.6 Simple payback period of Replacing 100 W incandescent lamps by 20 W CFL

Installation of 20 W CFL in place of 100 W incandescent lamps has lucrative payback of only Four Months.

3.4.7.7 Issues / barrier

This is a very simple proposal and hence there would not be any issues.

3.4.7.8 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market.

3.4.7.9 Availability of local service providers

Nortorn Engineers Works

Batala

Contact No: 09814055142

Mr. Jaswant Light

Jalandhar

Contact no: 01812490334

New Light Group

Jalandhar

Contact No: 08872221700

H) 3.4.2.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR

– PROVIDE LID TO REDUCE RADIATION LOSSES IN INDUCTION FURNACE

Background

In an induction furnace the radiation losses are estimated about 3 to 5%. This radiation loss can be minimized by providing closed hood for the furnace and a cover. A well-fitted furnace lid in closed position limits radiation losses to about 1% of power input against 7-10% in open furnace.

A. Heat radiation from crucible body

App. Size (mt.)	App. Area in Sq. Ft.	Avg. Body temp.	Ambient Temp.	Total Losses KCal/ hr.	Energy loss KCal/ hr Total Operation Time 3 Hour
1.6 M Dia, 2.8 M height	151.3	60 - 80	25 - 45	2837	8510

B. Heat radiated from open crucible

Sr. No.	Temperature on Average in Deg.Centigrade	Energy loss KW/m ²	Energy loss Kw/ hr Total Operation Time 3 Hour	Energy loss KCal/ hr Total Operation Time 3 Hour
1	1050	125	375	427845

* In above calculations, crucible diameter has been taken as 1.3 Meters and average emissivity as 0.5

$$\begin{aligned} \text{So total energy loss (A +B) for 3 hour operation} &= 8510 \text{ KCal/ hr} + 427845 \text{ KCal/ hr} \\ &= 436355 \text{ KCal/ hr} \\ &= 508 \text{ kWh} \end{aligned}$$

* Plant Running hour (Induction furnace)

$$\text{in a year} = 708 \text{ hr}$$

$$\text{So total energy loss in terms of electricity} = 1.2 \text{ Lakhs kWh}$$



= Rs 6.0 Lakhs

* Taking electricity Rs.5/kWh

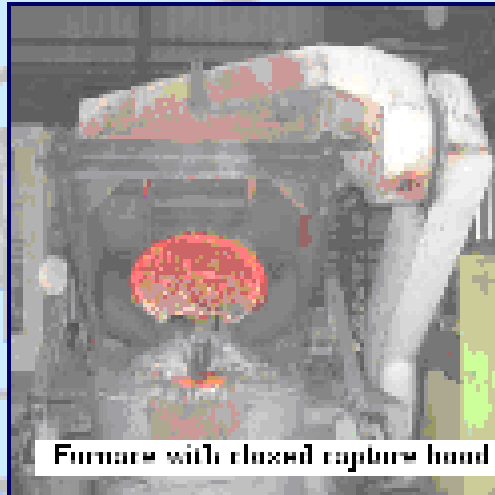
Investment for lid insulation

& furnace cover

= Rs 5.0 Lakhs (Approx.)

Pay Back

= 10 Months



3.4.2.9 Availability of local service providers

Mr. Ajit Charturvedi

Inductotherm India Pvt Ltd

203, Vikram Tower, 16, Rajendra Place, New Delhi

Contact No: 09311150284

Phone: 011-41536796

Mr. Inderdeep Singh

Megatherm

Main Jeevan Nagar Road, Opp. Veer Palace, Jeevan Nagar

Ludhiana

Contact No: 09915046606

Phone No: 0612670402

Mr. Saurabh Bhardwaj

Electrotherm India Ltd

181 A, South Rajendra Path, Jotwara, Jaipur

Contact No: 09309001512

Phone 0271723461

I) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF RE-WIDED MOTORS BY ENERGY EFFICIENT MOTORS

Background

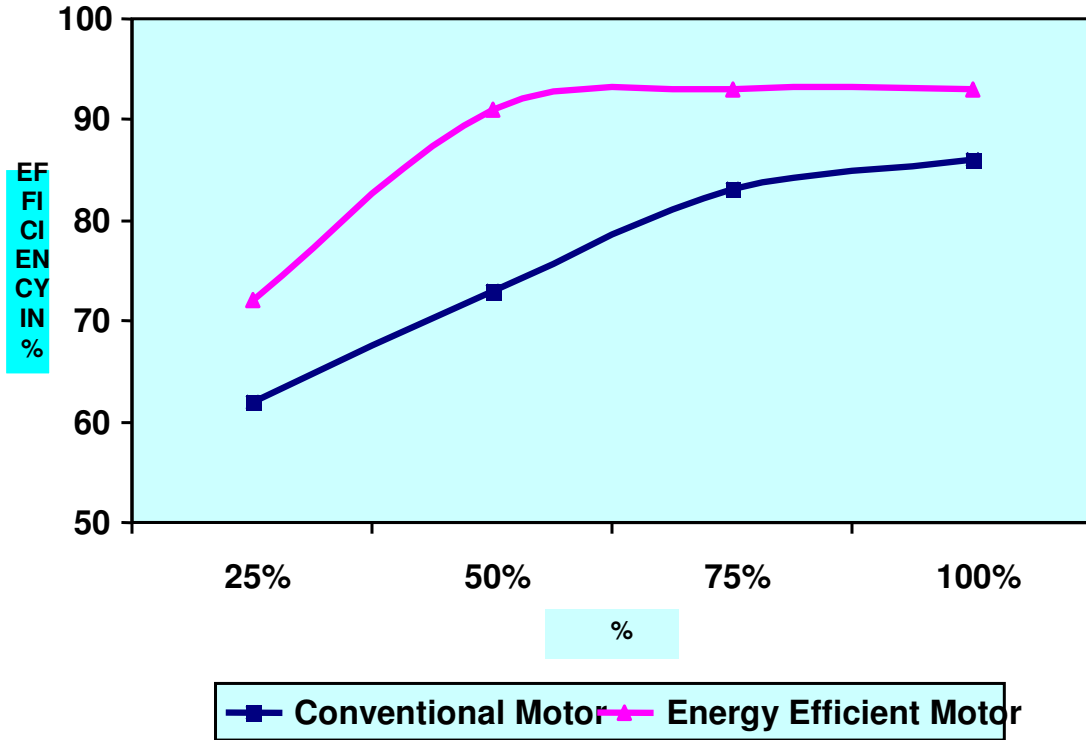
Each Cupola and Rotary furnace motors were studied during visit, its instantaneous power measurement being taken at site to analyze the motors.

During the audit it was observed that the maximum of motors are re-winded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors.



Standard vs High Efficiency Motors

Efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.



3.4.1.2 Benefits of Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Advantages:-

- Less power consumption
- High efficiency
- Less losses
- Wide range with good efficiency
- Less starting torque

3.4.1.3 Life cycle analysis for Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Calculation

Installation of Energy efficient motors in place of re-winded motors will save the power, as Energy efficient motors (EEF1) have 4-5 % efficiency higher than standard motor. Higher efficiency lead to save lot of energy as all these motors are having large capacity of around 15-20 hp.

Equipment (20 hp)	Power consumption
Standard / Re-winded motor	15 kW
Energy efficient motor	14 kW
Saving potential	1 kW

Comparison of energy consumption between Standard and energy efficient motor



Saving	1 kW/motor
Running Hours	10 hrs/day 2000 hrs/year
Energy Saving	= 1 kW/Motor x 2000 hrs/yr X Rs. 5.0 / kWh = Rs. 0.10 Lakh/ year/motor

As far as life cycle of Energy efficient motor is concerned, they are having long time than standard motor.

3.4.1.4 Cost of Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Cost of implementing this proposal varies in plant as per capacity and size of plant. Blower & Rotary motors require Energy efficient motors since almost plant load is by these motors. Total cost of implementation of Energy efficient motors for all the units in BJL Cluster is approx. **Rs. 10.0 Lakhs**

3.4.1.5 Monetary Saving from Replacement of Re-winded Motors by Energy Efficient Motors

Installation of energy efficient motor gives a good energy saving potential and so money is saving. In almost all the units standard motors runs continuously which lead to increase in energy consumption of oil units. Energy efficient motors will save approx **2 Lakhs kWh** for BJL Foundry Cluster units. Monetary Saving after installation of Energy efficient motors will be approx. **Rs. 10.0 Lakhs**. The cost of one motor would be around Rs. 15,000/motor.

3.4.1.6 Simple payback period of Replacement of Re-winded Motors by Energy Efficient Motors

Installation of energy efficient motors in place of standard motors has payback of only 18 Months.

3.4.1.7 Issues / barrier in implementation Replacement of Re-winded Motors by Energy Efficient Motors

Major issue in implementing this proposal is cost of implementation. All the technical and commercial aspects have been discussed with unit people. It is advisable to use Energy efficient motors at place of re-winded motors. One of the barriers in implementing this proposal is vendors.

3.4.2 Availability of technology / Product in local/ National / International Market

Now days when energy cost is high, it is poor practice to use re-winded motors. As far as technology is concerned Energy efficient motors are available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units. Local vendors can arrange energy efficient motors at order.

3.4.3 Availability of local service providers

Bharat Bijlee Ltd

Mr. Rakesh Verma

Sr. Manager – Marketing

rakesh.verma@bharatbijlee.com

09871861872



3.5 IDENTIFICATION OF TECHNOLOGIES / EQUIPMENT FOR DPR PREPARATION

From energy use and technology audit studies carried out in BJI Foundry units Cluster, it became apparent that the equipments/utilities installed are inefficient, inferior quality and consuming more energy. There is considerable potential in Foundry cluster units for energy conservation by replacing the old/obsolete technology/equipments with energy efficient technologies/equipments.

As the process and equipments are more or less similar in all cluster units in BJI foundry Cluster, all the technologies/equipments identified can be replicated as per the requirement of the units and detailed project reports for the specific technologies prepared also can be replicated in different foundry units as per the capacity requirement.

The following technologies/equipments were considered for preparation of detailed project report;

Sr. No	List of Technologies for DPR Preparation	Justification for Selection of Technology
1	Replacement of Blast Copula with Divided Blast Copula	This technology is already implemented in a few units and savings have been achieved. DBC are one of the best available low cost energy efficient technologies available for Foundry industry. Units have shown readiness for its implementation.
2	Replace Oil-fired Rotary furnace to Induction furnace	This technology is implemented in a few units and savings have been achieved. Induction furnaces are best option in place of rotary inefficient furnaces for mall capacity intermittent use, where production is taken in batches.
3	Installation of APFC	This is the simplest and widely accepted measure for energy cost reduction in all the industries. Many of the units have installed capacitors and APFC panel however due to lack of technical understanding of PF, monitoring of PF is not adequate. Many of the unit owners did not know the amount of benefit by power factor improvement. They just knew that there is incentive provided by SEB but how much is not known. After increase in awareness, the understanding on PF is

		improving however this measure has to be taken as a specific measure till the results are not achieved on sustained basis. Periodical checking of the de-rated capacitors and their replacement is must.
4	Providing insulation to the Cupola furnaces	As a routine maintenance insulation levels must be regularly checked. If timely corrective measure is not taken then the losses will go up over a period of time. So it is not an option. This measure can be implemented during annual shut down. For implementation of this measure, creating the awareness is required. Loss quantification due to poor insulation needs to be explained by the LSP to the unit owners then the unit owners will definitely be going to implement insulation improvement as a regular maintenance activity.
5	Use of Energy Efficient correct size motor	Energy efficient motors are gaining popularity. There is good opportunity to replace old motors in Furnace blowers with energy efficient motors
6	Installation of Energy efficient lighting systems	Many plants have already started using energy efficient lights.

ENVIRONMENTAL BENEFITS

As Foundry Units are not producing any hazardous pollutants, it is not having direct relation to benefits to environment. Only the copula chimney and fume of induction furnace can create some pollution problem, but all units have pollution control device for copula furnace.

Although improvement in energy efficiency will give indirect benefits to environment, as reduction in electricity consumption will lead to saving of environment.

1000 units generation will give saving of 0.86 tonnes of CO₂

4.1 Reduction in GHG emission such as CO₂, NO_x

As implementation of above proposal will give reduction in electrical energy consumption, it will directly lead to reduced formation of Green house gases.

In all units of BJL Cluster, there is potential to reduce approximately **28000 MWh of electricity**. It will lead to reduced CO₂ emission which is having potential of approx **24080 T** Per annum equivalent to **7082.35 MT** Per annum of Carbon. Reduction in formation of SO_x due to reduced coal consumption will lead to improved environment condition. This reduction of CO₂ will be at power plant.

SMALL GROUP ACTIVITIES/TOTAL ENERGY MANAGEMENT

1. Introduction

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development.

In this situation Energy Conservation (EC) is the critical needs in any countries in the world.

Of special importance of Energy Conservation are the following two aspects:

- (1) Economic factors
- (2) Environmental impacts

1.1 Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

Notably, the wave of energy conservation had struck the Indian intelligentsia 3 years earlier when a Fuel Policy Committee was set up by the Government of India in 1970, which finally bore fruits three decades hence in the form of enactment of the much awaited Energy Conservation Act, 2001 by the Government of India. This Act made provisions for setting up of the Bureau of Energy Efficiency, a body corporate incorporated under the Act, for supervising and monitoring the efforts on energy conservation in India.

Brief History of energy efficiency movement in India and associated major milestones are as follows

- 1974: setting up of fuel efficiency team by IOC, NPC and DGTD (focus still on industry)
- 1975: setting up of PCAG (NPC main support provider) : focus expanded to include agriculture, domestic and transport
- 1978: Energy Policy Report of GOI: for the first time, EE as an integral part of national energy policy – provided detailed investigation into options for promoting EE
- Post 1980, several organizations started working in EC area on specific programs (conduct of audits, training, promotion, awareness creation, demonstration projects, films, booklets, awareness campaigns, consultant/product directories)



- Some line Ministries and organizations like BICP, BIS, NPC, PCRA, REC, Ministry of Agriculture, TERI, IGIDR, CSIR, PETS (NPTI)
- State energy development agencies
- Industry associations
- All India financial institutions

The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provisions of the Energy Conservation Act, 2001. The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors.

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets and that is good for the national trade balance, too.

1.2 Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. The problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHG). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

2 Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the culmination of zero break-downs, zero defects, and zero waste. Enterprising employees identify the problem, be it in "man, material, method, or machine," and develop cost-effective and practical methods for solving the problem.

2.1 Importance of SGA

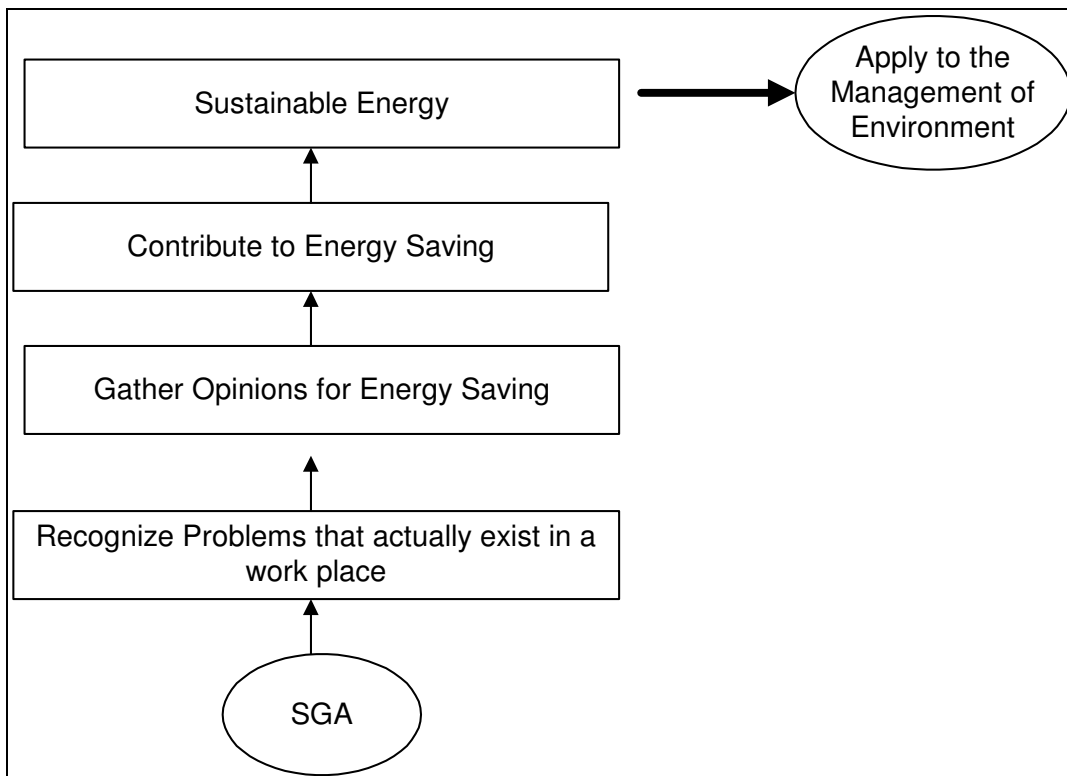
SGA are activities by group of employees at operator (working Group) level. They aim to solve problems that occur at the place taken care of by each employee and put emphasis on participation and team work. Factories can apply small group activities to many kinds of work along with normal work or other measures that are already underway. The burden on employees will not increase because of small group activities.



They are not only bringing benefits to factories but also boosting the knowledge and ability in performing jobs of employees, improving communication among employees, increasing creativity, and make it possible to express their own proposal with less hesitation to management. As a result, employees will start to think “This is our problem.” This SGA can be applied to Energy Conservation, too, with successful results, as shown in Figure 13.

2.2 How SGA leads to Energy Conservation?

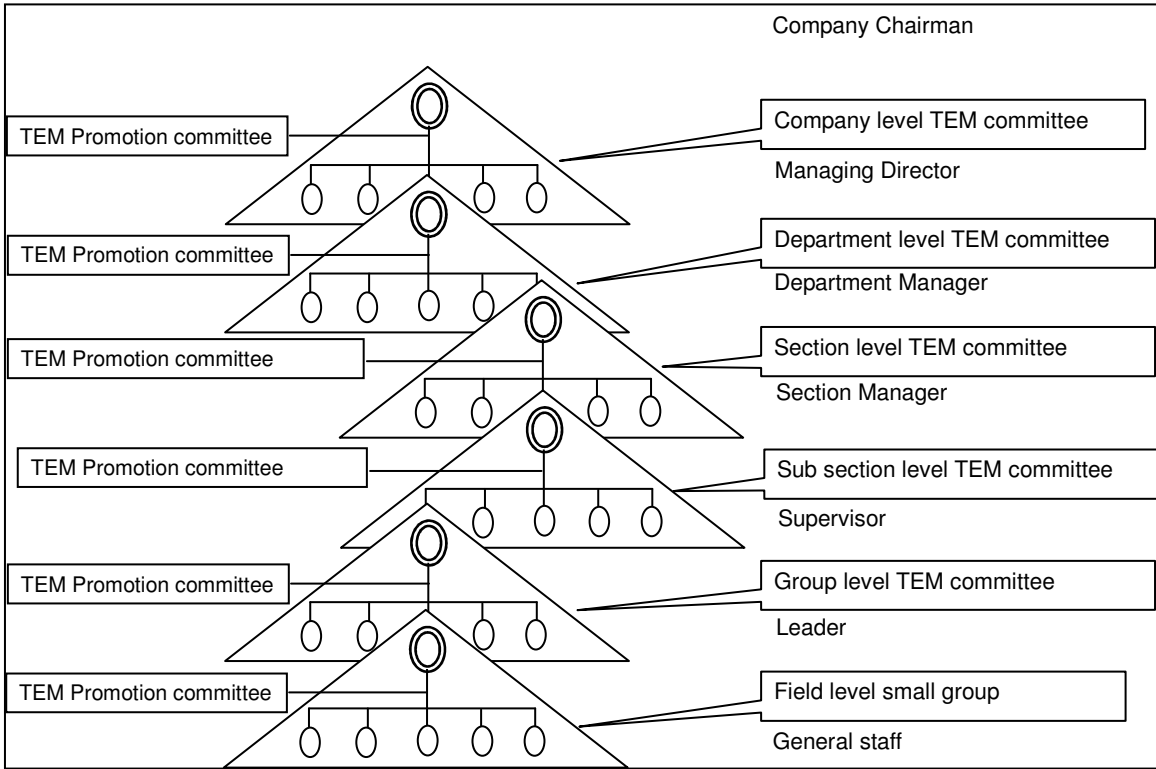
An excellent example of organizational structure that promotes energy management emphasizing participation is that they form overlapping small groups as in figure 14. The feature of this structure is that a small group for energy management is distributed to various sections as in figure 15, which is a recipe for success of Total Energy Management (TEM) and makes various communications and management of activities more efficient and effective.



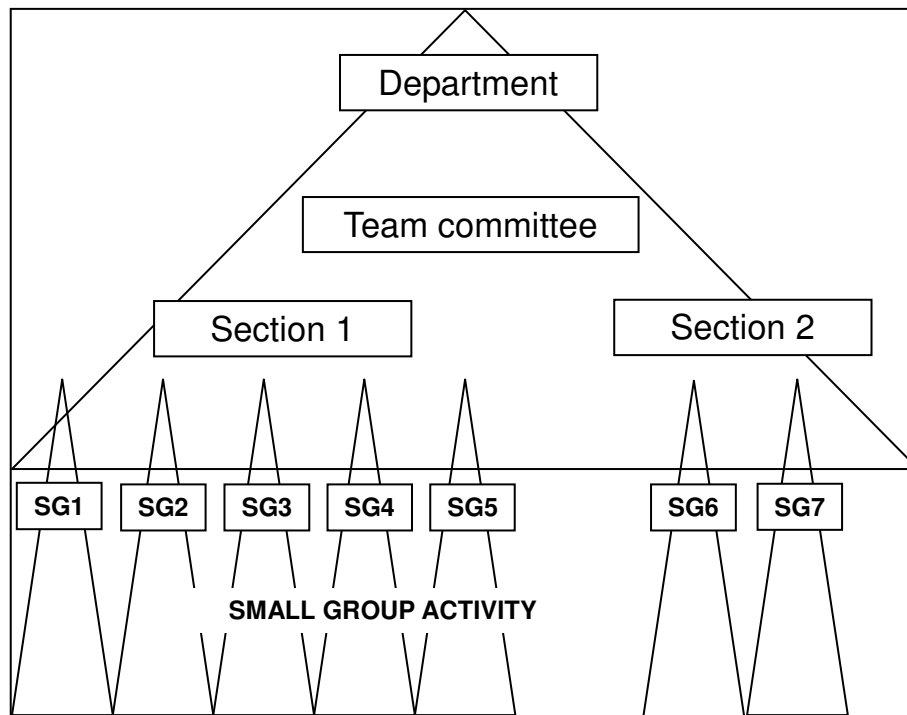
Relationship of SGA and energy saving

Small group activities for total energy management (TEM) are the activities in which employees of all levels in production or management, starting from the top to the bottom, participate in order to reduce loss related to their own job by improving their job. In order for the activities to succeed, management of all levels must provide support in necessary training and equipment, communication of policies, and the setting of problems to solve.

Small group activities for TEM can be divided into 4 or 5 levels depending on the scale of the organization. This division is in order to emphasize the fact that everyone must improve in their job under the responsibility to each other. It also enables us to make improvement without overlapping. The following example shows utilizing the existing job-related organization as much as possible, as already mentioned in Part 2, 2."Strategy for Improving the Efficiency of Energy Usage further", Step 2 Proper EC Organization including Assignment of Energy Manager (page 12).



Example of Organizational Structure with Overlapping



Positioning of SGA in Main Job Structure

2.2.1 Executives level

- Define the policy and target for Total Energy Management
- Follow-up and manage activities to make sure that activities are implemented according to the policy
- Consider opinions and suggestions from the promotion office
- Consider reports from promotion committee from various levels

2.2.2 Level of Total Energy Management promotion office

- Make sure that whole activities are done in the correct direction, without delay and smoothly
- Find a suitable method that makes it possible to implement activities continuously and without slowdown
- Listen to opinions and suggestions from small groups in order to use for improving
- Provide advice for Total Energy Management to various groups
- Persons in charge of the office must be those with good personal relationship, friendly, and with spirit of good service

2.2.3 Medium level

- Define the policies of each department that are consistent with the policy of the Total Energy Management and the target of the company
- Define numerical targets to sub-groups apart from the target of the company as a whole
- Follow-up the progress in order to provide to sub-groups
- Report the progress along with suggestions and opinions to upper level committee periodically

2.2.4 Workers/Operators level

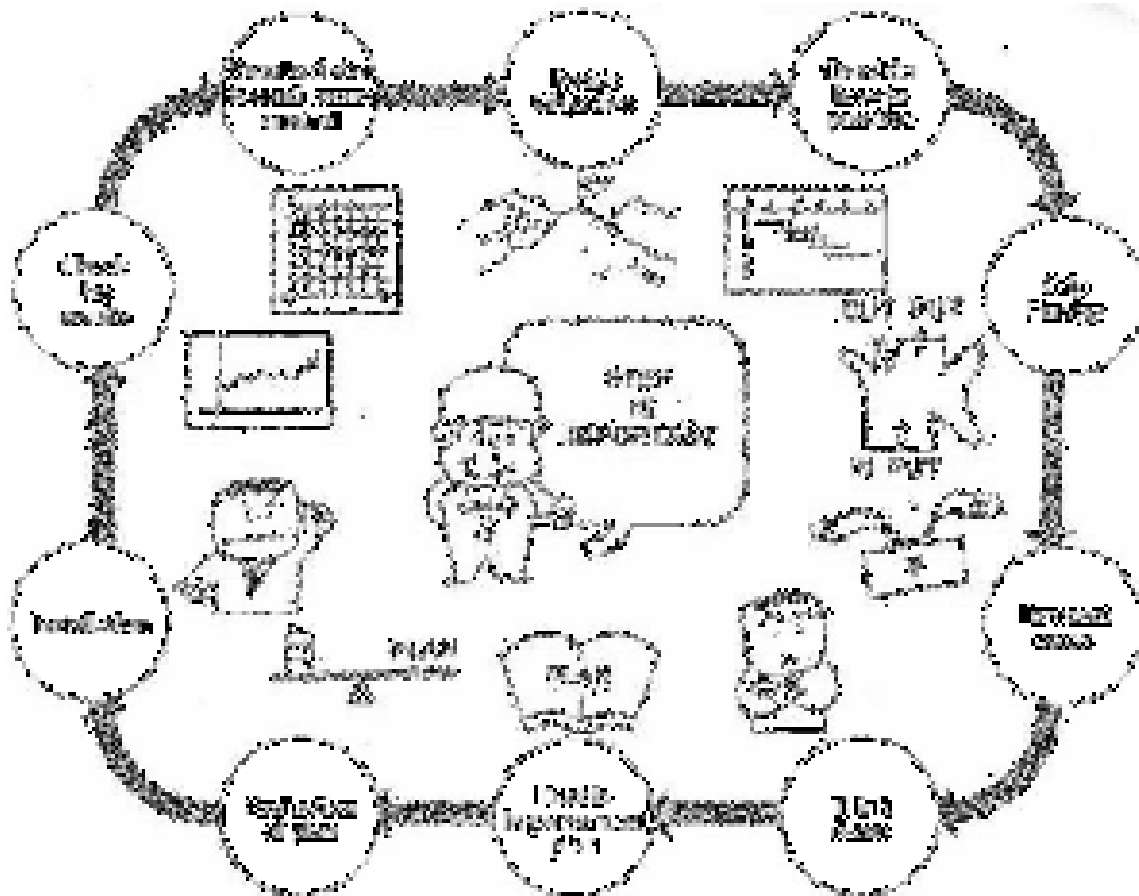
- Implement small group activities with various themes and achieve target
- Report progress and problems encountered during implementation to upper level committee periodically
- Ask for support, suggestions, and opinions from upper level committee

2.2.5 Responsibility of Energy Conservation committee

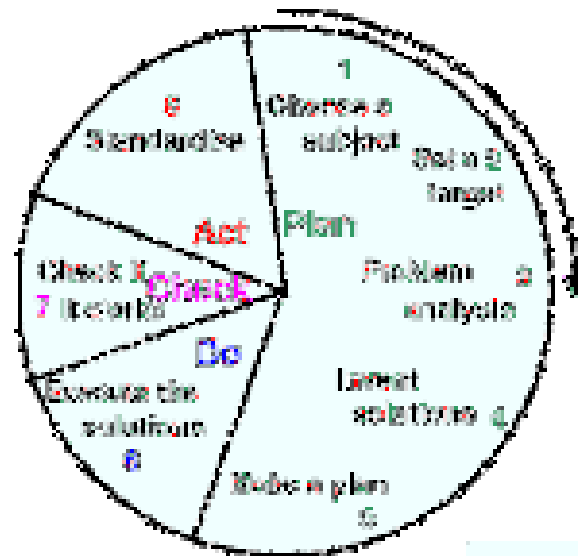
- Gather and analyze information on costs related to energy every month
- Analyze and solve problems related to energy
- Find a method for energy conservation
- Prepare energy conservation plan
- Follow-up the result of implementing the plan
- Perform activities such as public relationship for encouraging employees to participate
- Offer training to small group in each department

2.3 Steps of Small Group Activities for Energy Conservation

Small group activities for Energy Conservation can be done by using “10 Stages for Success”, based on “PDCA Management Cycle”, as shown below and in pictorial forms

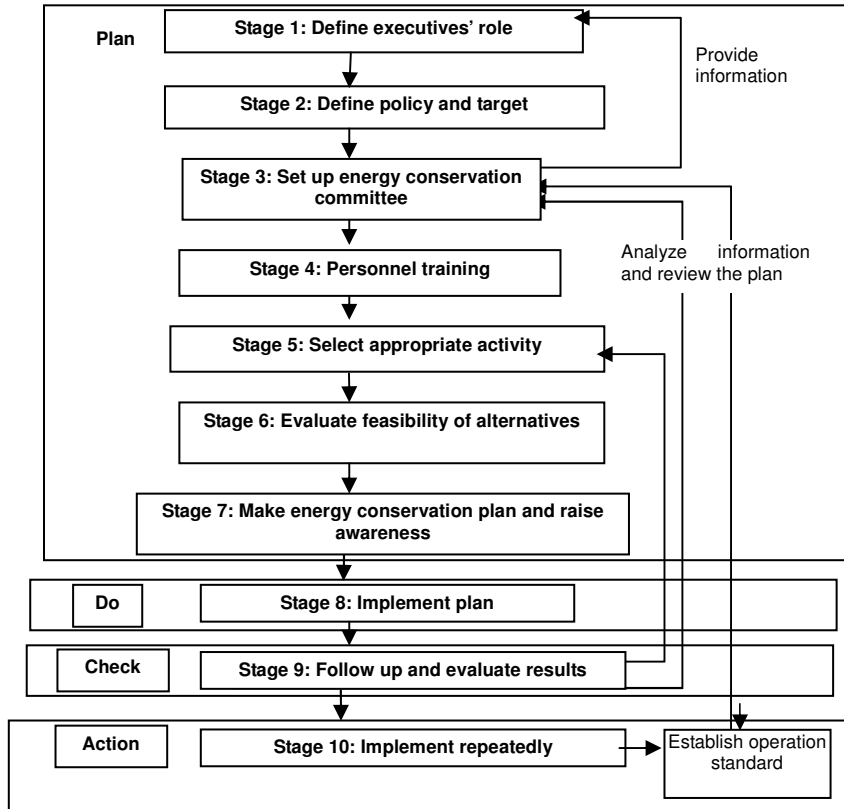


- Plan: Make an efficient plan in order to improve operation
- Do: Implement according to the plan
- Check: Check if implementation was according to the plan
- Act: Judge what to improve, what to learn and what to do from what we have checked



304/2010

Please note that these stages are substantially the same as “Key Steps” explained earlier, but put more stress on utilization of SGA. So readers could read and use either method up to their preference.



10 Stages for Success

2.3.1 Stage 1: Define Executive’s Role

In promoting small group activities, support must be provided such as basic environmental support. Therefore, executives must provide follow up support to employees of their companies.

- Establish a special unit that provides support to small group activities
- Prepare a system for managing small group activities in the company
- Prepare annual plan for small group activities
- Prepare a venue for meeting, consultation, advice or suggestion
- Establish a system for giving rewards to high achieving employees

- Establish a reporting system starting from informing what to do until reporting of the results
- Establish a fair system for evaluating results
- Establish a system for providing support and training to employees

2.3.2 Stage 2: Define Policy and Target

- Executives must announce a policy of supporting small group activities.
- Energy conservation committee must act as an advisor in order to set a numerical target that is consistent with total energy management (TEM) policy and the target of the organization. Specific targets must be set for each group.

We can see that responsibilities in stages 1 and 2 are mainly those of executives and committee. Responsibility of employees will become clearer from stage 3 and afterwards.

2.3.3 Stage 3: Set up Energy Conservation Committee

The principle of small group activities (SGA) is to divide into groups based on the scope of responsibility. The size of the group will depend on the size of organization. However, size of the group should not be too large. Usually a size of 5 to 10 persons is considered appropriate. It is important to define responsibilities clearly so that every member of the group can have their responsibility and participate in the activities.

2.3.4 Stage 4: Personnel Training

This stage will help employees to have more knowledge and understanding, have new ideas, and have more belief in their own responsibility.

2.3.5 Stage 5: Select Appropriate Activity

In doing small group activities, each member must be able to think, express their own ideas, and make decisions based on reality and by investigating electrical equipment, machines, and office equipment that exist in the area of their responsibility. Items to consider include size, number, where to use, situation of usage, current situation, and the number of hours usage per day. By this we can evaluate the current situation of energy usage. Also by judging if there are more machines than needed, we can choose suitable activities and real problems for the organization.



2.3.6 Stage 6: Evaluate feasibility of alternatives (Analyze problems and decide on the measures and activities in each point)

Each group will gather ideas on the reasons for the problems, obstacles, and how to solve problems in order to decide on the problems, measures, and importance of activities and thus evaluate on the feasibility of activities to do based on advice from department manager. Basically, the following activities are not suitable for small group activities.

- Highly technical issues
- Issues that require a long time or many people to implement

We have identified the following problems through small group activities.

- Issues on material quality or production that influence energy usage
- Behavior on energy usage
- Efficiency of machines or equipment that uses energy
- Awareness toward environment and energy usage
- Safety costs for energy conservation

2.3.7 Stage 7: Make Energy Conservation Plan and Raise Awareness

Each group must prepare its activity plan. Generally, implementation for small group activities takes 6 months to 1 year. Activities to be implemented should correspond to the objectives of each group. Besides, it might help to listen to opinions of all organizations in order to receive support from all other organizations.

2.3.8 Stage 8: Implement Plan

Implement according to the plan of each group.

2.3.9 Stage 9: Follow Up and Evaluate Results

After implementing the plan, each member of small groups will follow up and evaluate the result by analyzing result, search for strong and weak points of activities, find a way to improve the activities and report on general achievement.

2.3.10 Stage 10: Implement Repeatedly

Energy conservation is an activity that must be implemented repeatedly. Therefore, it is necessary to implement each activity repeated and make improvement to each activity. If we are satisfied with the results, by achieving the objectives of activities, we should provide rewards in order to give motivation for continuing the small group activities and



implement creative activities.

Dos and Don'ts in Energy Conservation

- ✕ Don't Emphasize the mistakes in the past. It is better to talk about the present.
- ✕ Don't Be worried about the theory or principles. Don't spend too much time in discussion or analysis of problems in meeting rooms.
- ✕ Don't Think that an activity can be done perfectly from the beginning. It is necessary to do the job continuously by having experiences and judging by ourselves.
- ✓ Do Start with an activity that requires small amount of investment.
- ✓ Do Raise awareness so that all employees understand the necessity and importance of energy conservation and participate in it.
- ✓ Do Start the activity now without postponing to tomorrow.

2.4 Tools that are Used Often for Small Group Activities for Energy Conservation

2.4.1 5S

5S is a contraction derived from the Japanese words **Seiri, Seito, Seiso, Seiketsu,** and **Shitsuke**. It is simple methodology that is also extremely useful in practical and realistic life. 5S is a set of actions to be followed through every day activities to advance the operational surroundings and circumstances. 5S is made in order to provide fortification to every personage in diverse profitable and industrialized fields. 5S is an extremely practical contrivance and skill set for anyone who wants to generate a more prolific environment within the workplace or who wants to make it their profession to make other people's businesses more proficient and productive. 5S occupy a list of products including eyewear, ear protectors and safety gears. Look into these different products that make up the significance of an industrialized security supply. Lean Six Sigma experts promise or guarantee for the efficiency of 5S as an enlightening enhancement to better working surroundings in an association. If you dig up Six Sigma guidance that is paid for by your company, you will be in a position to work for your company and make things better for you as well as for everyone. 5S is very useful in lots of industries and job markets, but can often fail simply because of the lack of recognition concerning changes in the office.





5S consists of five steps that are crucial for the completion of 5S. The 5S steps are described as follows-

1. Seiri / Sort- This is very logical term in, which identification of the contents take place, data base of the products have been created and, then any kind of sorting take place just to arrange the products and removal of unwanted items. Classification of the products is necessary, which is called Red Tagging. It is important just to identify factors, right from whether it is needed, existing amount obligatory amount, occurrence of necessity, and so on.
2. Seiton / Systemize- This step in 5S process consists of removal of unwanted items permanently and one more task that to be take place is decision that means you have to decide that what is required to be in what place. Place the items in such manner that you could retrieve them within 30 seconds of requirement.
3. Seiso / Brush away/ Sweep- Examine al the items on the daily basis. The process is not that much time consuming, but essential to clean up your workplace and most required in 5S. The conscientiousness to keep the office clean should be circulated between everyone in the group.

4. Seiketsu / Homogenize- This important step of 5S involves the visual control, which is important to keep your organization well- organized and clean. It is a complete evaluation to improve the working conditions.

5. Shitsuke / Self Control- This step is quite essential, but critical because it involves all the discipline to ensure the 5S standards, it also takes charge of dedication and commitment.

2.4.2 QCC (Quality control circle)

QCC (Quality control circle) means controlling quality through group activities. For this, it is necessary to work hand in hand and achieve objective quality or customers' request. With this, we can find weak points, find the cause of problems, gather ideas for problem solving and systematically prepare quality and thus, solve problems such as material loss, production costs, working hours, or productivity. This is also a very useful tool to tackle with Energy Conservation problem. So many factories or institutions are encouraged to utilize this tool.



CONCLUSION

5.1.1 SUMMARY OF ALL ENERGY SAVING PROPOSALS/MEASURES IDENTIFIED FOR THE CLUSTER

S. No	Energy Saving Proposal
1.	Replacement of Blast Copula with Divided Blast Copula
2.	Installation of APFC to maintain unity power factor
3.	Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses
4.	Replace 40 W Light by T5, 28 W Light
5.	Optimize Combustion Efficiency of Furnace by Reducing Excess Air
6.	Installing Induction furnace in place of Oil Fired Rotary Furnace
7.	Replace 100 W GLS bulb by 20 W CFL
8.	Use of Energy Efficient motor in place of re-winded motors
9	Providing insulation & lid over furnace to avoid radiation losses

5.1.2 SUMMARY OF ALL TECHNOLOGY GAP ASSESMENT FOR ALL ENERGY SAVING PROPOSALS / MEASURES IDENTIFIED FOR THE CLUSTER

S. No	Present System	Proposed System
1	Blast Copula for melting material	Replace Blast Copula with Divided Blast Copula
2	No Automatic Power Factor Controller for maintaining higher power factor	Installation of APFC with some extra capacitor to maintain unity power factor
3	Oil Fired Rotary Furnace	Induction Furnace
4	No insulation over furnaces	Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses
5	No Damper Control For reducing excess air	Optimize Combustion Efficiency of Furnace By Reducing Excess Air
6	Conventional T/8 40 W Tube Light	Replace 40 W Light by T5, 28 W Light
7	100 W GSL Bulb	20 W CFL
8	Old re-winded for blower	Energy Efficient motors
9	Open Lid	Lid cover & insulation for induction furnace



5.1.3 SUMMARY OF TECHNO ECONOMICS (COST SAVING AND SIMPLE PAYBACK PERIOD) FOR ALL ENERGY SAVING PROPOSALS/MEASURES IDENTIFIED FOR THE CLUSTER

S. No	Proposal Identified	Saving Per Annum Rs (Lakh)	Investment per Annum Rs (Lakh)	Payback Period (Month)
1.	Replace Blast Copula with Divided Blast Copula	234	360	18
2.	Installation of APFC to maintain unity power factor	15.0	8.0	6
3.	Provide surface insulation by insulation paint coating of Copula/Rotary furnace to reduce heat losses	72	12	3
4.	Replace Oil Fired Rotary Furnace to Induction furnace	300	400	16
5.	Replace 40 W Light by T5, 28 W Light	15.0	25.0	20
6.	Optimize Combustion Efficiency of Furnace By Reducing Excess Air	10	2	3
7.	Replace 100 W Gsl bulb by 20 W CFL	2.0	0.5	3
8.	Provide Lid to reduce Radiation losses in Induction Furnace	60.0	50.0	10
9.	Replacement of Re-winded Motors by Energy Efficient Motors	10.0	12.0	15
	Total	718	869.5	15

5.1.4 SUMMARY OF BARRIERS IN IMPLEMENTATION OF IDENTIFIED ENERGY SAVING PROPOSAL

S No	Barriers
1	Technology awareness
2	Financial issues
3	Remote location
4	Labor dependency
5	Availability of Vendors

5.1.5 SUMMARY OF SHORTLISTED TECHNOLOGY PRODUCTS FOR DPR

S No	Technology Products
1	Divided Blast Copula
2	Induction Furnace
3	Capacitor Bank with APFC
4	Insulation Paint for Rotary/Copula Furnace
6	Energy Efficient 28 W Tube Light

5.2 SUMMARY OF LEVEL OF AWARENESS ON ENERGY EFFICIENCY AND ENERGY EFFICIENT PRODUCTS IN CLUSTER

As compare to other SME sector, foundry sector is well organized. The Institute of Indian Foundrymen Association plays a key role in technology transfer & awareness. Every year they organize conference & exposition to show case technology & energy efficient products.

In BJL Cluster, level of awareness on energy efficiency and energy efficient products is better. Many of the unit owners visit European Countries for business & technology input.

During the detailed energy audit, all possible energy saving aspects has been discussed with plant team. Advantages of energy consumption reduction & production improvement point of view.



Annexure 1

Detailed Technology Assessment Report

Findings of the assessment study are as follows. These calculations are for a typical foundry unit.

1. Installation of Divided Blast Cupola in place of Blast Cupola Furnace
2. Installation of Induction Furnace in place of Rotary Furnace
3. Improvement in insulation
4. Improve in Power Factor by installing APFC
5. Installation of Energy Efficient Motors for Blowers
6. Installation of CO₂ based sand drying system
7. Vibratory feeding system in place of manual feeding system

1. INSTALLATION OF DIVIDED BLAST CUPOLA IN PLACE OF BLAST CUPOLA FURNACE

Calculation of savings for replacing Blast Copula with Divided Blast Copula

In following section, cost comparison of a blast cupola & divided blast cupola is compared to better understand actual saving potential with DBC.

Plant Specifications with Blast Cupola

Sl. No.	Description	Value
1	Casting Material	10 tons
2	Coal consumption for 8 hour operation	2.5 tons
3	Ash in Coal	14.3 %
4	Blower Power Consumption (20 Hp rated)	14.1 kW
5	Melt temperature at spout	1345°C to 1478°C
6	Temperature of flue gas (below charging door)	250°C to 350°C
7	Ferro-Silicon consumption	1500 kg
8	Ferro-Manganese consumption	1000 kg
9	Rejected castings	700 kg

Plant Specifications with DBC

The same foundry unit running with divided blast (cold blast) cupolas (DBS) at a new site. The specifications of the DBC were as follows:

No. of Cupola	One
Desired melting rate	2.8 ton / hour
Operation	Continuous
Desired metal temperature at spout	1425°C to 1475°C
Typical melting campaign duration	6 – 8 hours

Divided Blast Cupola Operation Data

A summary of the Post-commissioning energy audit is provided below

Sl.No.	Description	Value
1	Casting Material	10 tons
2	Cole consumption for 8 hour operation	2.0 tons
3	Blower Power Consumption (15 Hp rated)	12.5 kW
4	Ash in Cole	14.3 %
5	Melt temperature at spout	141°C to 1500°C
6	Temperature of flue gas (below charging door)	130°C to 190°C
7	Ferro-Silicon consumption	1500 kg
8	Ferro-Manganese consumption	1000 kg
9	Rejected castings	450 kg

Cost Savings

On the basis of the pre-commissioning and the post-commissioning audit results, the savings from implementation of the DBC were worked out. In below given table total savings obtained from reduced consumption of coal and other materials as well as reduction in rejection levels is summarized.

Actual cost savings per ton of melt output

Sl. No.	Consumption of Coal In Conventional Cupola/ton of molten material	Consumption of Coal In Divided Blast Copula/ ton of molten material	Savings after Implementation of DBC/ ton of molten material	Monetary Savings Rs/ton of molten metal
1	250 kg	200 kg	50 kg	Rs.750/ *Assuming Coal rate Rs 15/kg

Reduced rejects

Sl. No.	Rejection of material In Conventional Cupola for 8 hour operation	Rejection of material In Divided Blast Copula for 8 hour operation	Savings of material After implementation of DBC for 8 hour operation	Monetary savings Rs/ton of molten metal
1	700 kg	500 kg	200 kg	Rs.400/ (Assuming energy cost for one kg raw casting will Rs.2/)

* The above calculation of rejection of material is for 10 tons. So per ton saving will be approximately Rs.40/.

So total saving of fuel per ton molten material = Rs.750 + Rs.40
= **Rs. 790**

Total Cost Savings for DBC

Hence, there was a savings of the order of Rs 790/ per ton of molten metal in the foundry unit. For a typical foundry unit at BIL foundry units, melting about 500 tons of metal a year having cupola furnace, so the total savings translates to about **Rs 3.9 Lakhs** per year. The capital cost of a DBC, inclusive of civil work, platforms, bucket charging system etc, is about **Rs 6.0 Lakhs**. The payback period will be **18 – 20 Months**.

2. INSTALL INDUCTION MELTING FURNACE IN PLACE OF OIL FIRED ROTARY FURNACE

Comparison of Cost of Fuel in induction furnace & rotary furnace;

Furnace oil is being used in Rotary Furnace as fuel. On an average one litter F.O. is used to get 7 Kg Malleable Iron. The cost of F.O. is Rs. 32.0/per litter (without excise duty). So, the melting cost is Rs. 4.57 per kg of liquid metal. In induction furnace, on an average 600 units are required to melt one MT of Liquid Metal. The cost of electricity is Rs.4.50 per unit. So, the melting cost is Rs. 2.70 per kg of liquid metal.

Hence the savings on per kg of liquid metal = (Rs.4.57 – Rs.2.70)
= **Rs. 1.87/kg**

Comparison of Burning Losses in Rotary Furnace vs Induction Furnace

In Rotary Furnaces flames interact with alloys (Silicon) & pig iron. Due to oxidation and splashing losses are observed on an average 9%. In Induction Furnaces metal melt itself by inner heating, so there are very less burning losses. It is observed that in Induction Technology 7% burning losses can be saved. The cost of Pig Iron is Rs. 29 – 35/per kg.

Hence the savings on per kg of Pig Iron = (7% of Rs. 35.0)
= **Rs. 2.45/kg of metal**

Comparison of cost savings by use of scrap material in induction furnace as compared to use of pig iron in rotary furnace

C.I. Borings, waste material cannot be used in Rotary Furnaces. The cost of boring is Rs. 27.0 per kg. Recovery of metal in boring is approximate 90%.So, the cost of boring becomes Rs. 30.0 per kg. Borings consume approx. 0.65 units per Kg or it cost Rs. 2.75 per kg to melt. Hence the cost of liquid metal is Rs. 32.75/kg. In case of melting Pig Iron it becomes Rs. 37.70 per kg (Rs 35.0 + Rs 2.70). So the saving is Rs. 4.95 per kg. In Induction Furnace up to 30% of boring waste can be used without compromising the quality.

Hence the benefit per kg can be = (30% of Rs. 4.95)
= **Rs. 1.48**

Comparison of Cost on the basis of rejection rates in Induction furnace as compared to rotary furnace

This is the main factor to choose Induction Furnace. In Rotary Furnaces first & last



tapping of metal rejects due to low temperature. As well as there are no homogeneous metal. So during the annealing process 7-10% raw castings (before galvanizing & machining) rejected due to the hardness. While such type of draw backs are minimized in Induction Furnace. Hence on an average 5% more production is achieved. Cost of raw casting is Rs.55.0 per kg. 7 T casting is made in a 1MT Induction Furnace in 12hrs. In a month it is 175 MT i.e. (5% of 175T) 8.75T more production is achieved. So the profit is around **Rs. 4.80 Lakhs/month**.

*** From above it is concluded that there is 30 % saving in cost for melting material in induction furnace as compared to rotary furnace;**

Yearly capacity of the plant	= 800 ton/year (Approx.)
Per kg melting cost in oil fired rotary furnace	= Rs. 4.57
Totally energy cost for melting 800 tons material in oil fired rotary furnace	= Rs. 36.5 Lakhs
Per kg melting cost in induction	= Rs. 2.70
Totally energy cost for melting 800 ton material in oil fired rotary furnace	= Rs. 21.5 Lakhs
Savings	= (Rs.36.5 – Rs 21.5) Lakhs = Rs. 15.0 Lakhs
Investment	= Rs. 20.0 Lakhs (Approx.) (Investment is for 175 kW, 500 kg Induction furnace)
Pay back	= 20.0 x 12/15.0 = 16 months

3. IMPROVE THE EXISTING PLANT POWER FACTOR TO GET MORE INCENTIVES FROM SEB

Cost benefit analysis of power factor improvement

Existing load of the unit (KW) =	700
Monthly Electricity Bill (Approx.) =	Rs. 5.0 Lakhs
Existing power factor =	0.96
Desired power factor =	0.99
Existing Monthly Rebate =	Rs.1250/
Capacitor required (kVAr) =	110
New Monthly/yearly Rebate =	Rs. 0.60/yr



Cost of capacitors @ Rs 300/kVAr =	Rs.0.33 Lakhs
Simple payback period =	6 Months

4. LIFE CYCLE ANALYSIS FOR PROVIDE SURFACE INSULATION BY INSULATION PAINT COATING OF COPULA/ROTARY FURNACE TO REDUCE HEAT LOSSES

Calculation for a Single Unit;

Average skin temperature of furnace, Ts = 120°C.
 Total Surface Area with damaged insulation = 5 sq. meters.
 Ambient Temperature, Ta = 30°C.

For Economical insulation thickness Ts to be reduced to Ta +15 = 40°C

Surface Heat Loss S = $[10 + (Ts-Ta)/20] \times (Ts-Ta) \times \text{Area}$
 = 6525 kcal/hr

Operating Hours = 96 Hrs/yr
 Net Heat loss = 96 Hrs x 6525 kcal/hr
 = 626400 kcal/Year

Assuming 100% heat transfer Efficiency of furnace

In terms of coal Equivalent Loss = 626400/4500
 = 139.2 kg of coal

Cost of Heat loss = 139 x Rs 20 /kg
 = **Rs. 2784 /yr**

Investment required for insulating = **Rs. 600/**

Pay Back = Rs. 600 x 12/2784
 = **3 months**

5. REPLACEMENT OF RE-WINDED MOTORS BY ENERGY EFFICIENT MOTORS

Installation of Energy efficient motors in place of re-winded motors will save the power, as Energy efficient motors (EEF1) have 4-5 % efficiency higher than standard motor. Higher efficiency lead to save lot of energy as all these motors are having large capacity of around 15-20 hp.

Equipment (20 hp)	Power consumption
Standard / Re-winded motor	15 kW
Energy efficient motor	14 kW
Saving potential	1 kW

Comparison of energy consumption between Standard and energy efficient motor

Saving	1 kW/motor
Running	10 hrs/day

Hours	2000 hrs/year
Energy Saving	= 1 kW/Motor x 2000 hrs/yr X Rs. 5.0 / kWh = Rs. 0.10 Lakh/ year/motor

Annexure 2

Details of Technology / Service Providers in BJJ Foundry Cluster

Energy Conservation Measure	Source of Product/Technology	Details of Local Vendor /Service Provider
1. Divided Blast Cupola	The Energy & Resource Institute	TERI, India Habitat Centre, Lodhi Road, New Delhi – 110 003 Mr. Girish Sethi Tel: 011-24682100/2111; Fax: 011- 24682144/2145 e-mail: girish.sethi@teri.res.in prosanto@teri.res.in
2. Cupola Furnaces, Air Pollution Control Devices,	B. A .Industries	Mr.Tawinder Singh G.T.Batala-143505(Pb) Tel : 01871-242502 Mob: 98151-62502
3. Cupola Furnaces, Air Pollution Control Devices	Punjab State Council for Science & Technology	Mr. Ranjit Singh Punjab State Council for Science & Technology MGSIPA Complex, Adjacent Sacrea Heart School,Sec-26,Chandigarh Phone:0172-2795001/2792325/2792787 E-mail – ranjit-185@yahoo.com Mob – 09855243089
4. Induction Furnace	Megatherm	Mr. Inderdeep Singh Megatherm Main Jeevan Nagar Road, Opp.Veer Palace, Jeevan Nagar Ludhiana Contact No:09915046606 Phone No:0612670402
5, Induction Furnace	Inductotherm	Mr. Ajit Charturvedi Inductotherm India Pvt. Ltd 203,Vikram Tower,16,Rajendra Place, New Delhi Contact No:09311150284 Phone: 011-41536796

6. Coal Suppler	4 JB Coal Dipot	Near Raja Hospital, Basti Road, Jalandhar-144001 Phone : + 91 - 181 - 2401738
7. Coal Suppler	Kanchan Coal Company	42, Windsor Park, Jalandhar-144008 Phone : + 91 - 181 - 2254203
8. APFC Panel	ABB	Mr. Neeraj Verma Power Product SCO-13-14-15 Sector-34A Chandigarh Phone: 0172-4321845 Telefax: 0172-2601618 Mobile: 09878613484 email: neeraj.verma@in.abb.com
9.. APFC Panel	Havells	Mr. Chandar Subhas Havels India, Mall Mandi, Batala, Contact No:01871243110
10. APFC Panel	Havells	Mr. Manmeet Singh, Dhamija Trading Co.Opp St No-6, Bhagwan Chowk, Jalandhar
11.T/5 Lamp (28 Watt.)	Havells	Nortorn Engineers Works Batala Contact No:09814055142
12.T/5 Lamp (28 Watt.)	Havells	Mr. Jaswant Light Jalandhar Contact no: 01812490334
13. T/5 Lamp (28 Watt.)	Havells	New light group Jalandhar Contact No: 08872221700
14. Insulation Paint	Star Paint & Oil Industries	Crescent Chambers, 56, Tamarind Street, Fort, Mumbai 400 023. Tel: +91-22-2265 2243 / 2265 2289 / 2265 2904 Fax: +91-22- 2265 3201 Email: info@starpaintindia.com , sales@starpaintindia.com
15. Energy Efficient Motors	Bharat Bijlee Ltd	Mr. Rakesh Verma Sr. Manager – Marketing rakesh.verma@bharatbijlee.com 09871861872

Annexure 3

Financial Schemes Available with Local Banks for Improving Energy Efficiency in the Cluster

Most of the Nationalized & Private Sector Banks are located in Batala, Jalandhar & Ludhiana providing loans to the required foundry units. SIDBI offices are also located in Jalandhar & Ludhiana.

Government Fiscal Incentives for MSME Sectors

The Ministry of micro, Small and Medium Enterprises (MoMSME) provides support to activities in MSME units. The schemes that are eligible for the foundry industry are given below.

1. Credit Linked Capital Subsidy Scheme (CLCSS)

Under this scheme, the Ministry of MSME is providing subsidy to upgrade technology (Machinery/Plant equipments). Subsidy limit per unit is Rs. 15 lacs or 15% of investment in eligible Machinery/ Plant equipments whichever is lower. For more details of the scheme visit www.laghu-udyog.com/schemes/sccredit.htm

2. Credit Guarantee Fund Trust for MSE

This scheme will cover both term loan and working capital facility upto Rs.100 lacs. Under this scheme, loan will be sanctioned without any collateral security or third party guarantee. For more details of the scheme visit www.cgfmse.in

3. Market Development Assistance Scheme

To encourage MSME entrepreneurs to tap overseas market potential and represent India in the overseas market, Government of India is reimbursing 75% of air fare by economy class and 50% space rental charges of stalls for exhibition of their products in the overseas trade fairs/ exhibitions. For more details of the scheme visit www.fisme.org.in/MDA%20Faq.doc

4. Quality Up-Gradation/Environment Management Scheme

Under this scheme charges would be reimbursed for acquiring ISO - 9000/ISO - 14001/HACCP certifications to the extent of 75% of the expenditure (maximum to Rs. 75,000/- in each case). For more details of the various schemes visit <http://msme.gov.in/>

5. SIDBI Financing Scheme for Energy saving project in MSME Sector

To improve the energy efficiency levels in various MSME sectors, SIDBI is providing loans to eligible projects under JICA line of credit at a nominal rate of interest of 9.5 - 10% p.a. For more details of the list of eligible projects under this line of credit visit: www.sidbi.in

SIDBI Financing Scheme for Energy Saving Projects in MSME Sector under JICA Line of Credit

The Japan International Cooperation Agency (JICA) has extended a line of credit to SIDBI for financing Energy Saving projects in Micro, Small and Medium Enterprises (MEMEs). This project is expected to encourage MSME units to undertake energy saving investments in plant and machinery to reduce energy consumption, enhance energy efficiency, reduce CO₂ emissions, and improve the profitability of units in the long run.

Eligible Sub Projects/ Energy Saving Equipment List under JICA Line of Credit

- ✓ Acquisition (including lease and rental) of energy saving equipments, including installing, remodeling and upgrading of those existing
- ✓ Replacement of obsolete equipments and/or introduction of additional equipments which would improve performance.
- ✓ Equipments/Machinery that meet energy performance standards/ Acts
- ✓ Introduction of equipments that utilize alternative energy sources such as natural gas, renewable energy etc., instead of fossil fuels such as oil and coal etc.
- ✓ Clean Development Mechanism (CDM) projects at cluster level that involve change in process and technologies as a whole, duly supported by technical consultancy, will be eligible for coverage.

Eligible Criteria for Units (Direct Assistance)

- ✓ Existing units should have satisfactory track record of past performance and sound financial record
- ✓ Projects will be screened as per Energy Saving list, which is available on the SIDBI website
- ✓ Units should have minimum investment grade rating of SIDBI
- ✓ Projects which may result in negative environmental and social impacts are also not eligible under this scheme

List of Equipments which are already approved for Loan from JICA (SIDBI)

Sl. No.	Registered Equipment/Technology
1	Divided Blast Cupola
2	Medium Frequency Induction Furnace (by replacing Arc Furnace or Main Frequency Furnace)
3	Heat Recovery System for Stress Relieving Furnaces
4	Variable Frequency Drive for Screw Compressors
5	Oil Fired Core Drying Oven
6	Gas Fired Cupola
7	kWh Indicator for Induction Furnace
8	Induction Furnace with Cooling Tower & Water Treatment Plant
9	Waste Heat Recovery System for Exhaust Gases
10	Energy Efficient Short Blasting Machine
11	Variable Speed Sand Mixer

12	Automatic Pouring System
13	Energy Efficient Motors
14	Energy Efficient Transformers
15	Energy Efficient Fluorescent Lamps
16	Capacitors





Confederation of Indian Industry
संघटन

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes.

CII is a non-government, not-for-profit, industry led and industry managed organisation, playing a proactive role in India's development process. Founded over 115 years ago, it is India's premier business association, with a direct membership of over 8100 organisations from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 90,000 companies from around 400 national and regional sectoral associations.

CII catalyses change by working closely with government on policy issues, enhancing efficiency, competitiveness and expanding business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for sectoral consensus building and networking. Major emphasis is laid on projecting a positive image of business, assisting industry to identify and execute corporate citizenship programmes. Partnerships with over 120 NGOs across the country carry forward our initiatives in integrated and inclusive development, which include health, education, livelihood, diversity management, skill development and environment, to name a few.

CII has taken up the agenda of “Business for Livelihood” for the year 2010-11. Businesses are part of civil society and creating livelihoods is the best act of corporate social responsibility. Looking ahead, the focus for 2010-11 would be on the four key Enablers for Sustainable Enterprises: Education, Employability, Innovation and Entrepreneurship. While Education and Employability help create a qualified and skilled workforce, Innovation and Entrepreneurship would drive growth and employment generation.

With 64 offices and 7 Centres of Excellence in India, and 7 overseas in Australia, China, France, Singapore, South Africa, UK, and USA, and institutional partnerships with 223 counterpart organisations in 90 countries, CII serves as a reference point for Indian industry and the international business community.



Business enterprises worldwide are increasingly focusing on enhancing production and improving quality, while reducing costs. In such a scenario, it is important for small and medium enterprises (SMEs) to remain competitive.

The CII - AVANTHA Centre for Competitiveness for SMEs was established in 2004, with a view to providing SMEs in India with a one-stop consultancy service. There are more than 11.86 million SMEs in India, which contribute nearly 40 per cent of the country's total industrial output. If the country's economy is to be strengthened, it is imperative that these SMEs receive tactical support to remain competitive.

The Chandigarh-based CII - AVANTHA Centre for Competitiveness for SMEs aims to build competitive and visionary SMEs. The Centre offers consultancy services on a wide range of critical issues such as manufacturing excellence, energy management, cost management, human resource development, etc. Although the Centre does provide services to individual companies, it encourages the formation of groups or clusters of SMEs. A number of companies, which share the same location, sector or even OEM vendor, are allocated to these clusters. This approach encourages SMEs to form, share and draw from a common knowledge pool.

The CII - AVANTHA Centre for Competitiveness for SMEs has successfully established such clusters at Mohali, Gurgaon and Jalandhar and is running parallel clusters across the country at Jaipur, Faridabad, Lucknow, Pune, Kolkata, Chennai and various other locations. Apart from offering consultancy services, the Centre is also committed to helping SMEs remain abreast of contemporary issues through seminars, conferences and training programmes.

The Centre offers the following services

- Clusters for Competitiveness
- Energy Audit and Management
- Manufacturing Excellence
- Total Cost Management
- Human Resource Management
- Corrosion Management
- New Product Development



Bureau of Energy Efficiency (BEE)

(Ministry of Power, Government of India)

4th Floor, Sewa Bhawan, R. K. Puram, New

Delhi – 110066

Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 –
11 – 26178352

Websites: www.bee-india.nic.in,

www.energymanagertraining.com