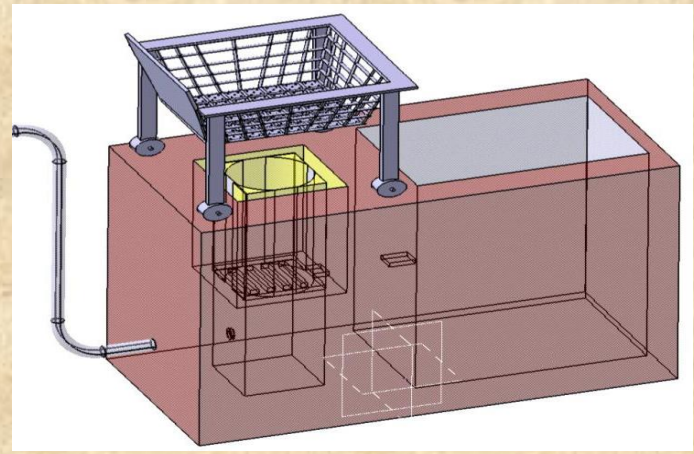
MANUAL ON ENERGY CONSERVATION MEASURES IN BRASS AND ALUMINIUM CLUSTER JAGADHRI



Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By

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Hyderabad

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ZENITH ENERGY SERVICES PVT LIMITED
HYDERABAD

CHAPTER 1 INTRODUCTION

1.1 About BEE'S SME Program

The Government of India has enacted the Energy Conservation Act – 2001 due to high energy saving potential in industries, agriculture, domestic and transport sectors; to reduce the gap between demand and supply; to reduce environmental emissions through energy saving; and to effectively overcome the barriers. The Act provides the much-needed legal framework and institutional arrangement for embarking on an energy efficiency drive.

The Bureau of Energy Efficiency (BEE), an agency of the Union Ministry of Power, has introduced a programme "BEE SME Program" to help small and medium enterprises (SMEs) to use energy efficiently.

As a part of the implementation of "BEE-SME Programme" about 35 SME clusters were identified. After ground-level situation analysis, 29 of them have been selected for further activities in consultation with the Ministry of Micro, Small and Medium Enterprises (MoMSME).

According to the Indian Institute of Foreign Trade, SMEs contribute about 6% of the country's GDP. Although energy is an important input required for economic and social development, attaining higher energy efficiency is considered an important element in meeting India's future energy challenges and ensuring its energy security.

The SME sector is facing rising energy costs and on the other hand, prices and cost pressures are soaring. The government, from time to time, has offered various fiscal incentives and other interventions to SMEs, as well as help for technology up-gradation and improvements in performance efficiency, but a program for energy saving of this kind is novel and has tremendous potential.

Jagadhri has been identified as one of the clusters to implement the BEE-SME Program. BEE has entrusted M/s Zenith Energy Services (P) Ltd to implement the project.

1.2 Project Objectives

The BEE SME Program is aimed at improving Energy Efficiency of Small and Medium Enterprises by technological interventions in the various clusters of India. The Energy Intensity in SME is intended to be enhanced by helping these industries in the mostly energy intensive cluster units identified 29 SME clusters of India to through improve Energy efficiency and performance through technology interventions and also develop the consistent steps for successful implementation of energy efficiency measures and projects in the cluster units and also financial planning for the SME owners.
The project also aims at creating a platform for dissemination of best practices and best available technologies in the market for energy efficiency and conservation and to create awareness among cluster unit owners and also the demonstration projects may stimulate adoption of successful/available technologies.

The BEE SME program have been designed in such a way that to set up to a deal with specific needs of the industries in the SME sector for energy efficiency and designed to overcome all the common barriers for implementation of Energy Efficient technologies and equipments/processes. The following are proposed to be covered under BEE SME program:

1. **Energy Use and Technology Studies** – The studies are aimed for status of the technologies installed, energy use pattern and its cost, operating practices, identification of the technologies and measures for improving energy efficiency etc
2. **Conduct Dissemination Program –** Disseminate the Technologies and measures identified & best practices in the cluster units in reducing energy consumption.

3. **Implementation of EE measures –** Preparation of bankable and replicable detailed project reports for facilitating the cluster unit owners for implementation. The DPR's are to be prepared for a minimum of 5 technologies for various sizes capacities

4. **Identification of the Local Services Providers –** The program also aimed for identification of local service providers and capacity building to facilitate them for implementation of the technologies in the clusters

5. **Facilitation of Innovative Financing Mechanisms –** The program also aims for encouraging the SME owners in implementation of technologies through innovative financing schemes. The project also aims to impart training for the officials of various financial institutions like SIDBI and local lead bankers of the clusters location for evaluating energy efficiency related projects.

The BEE SME program model developed is innovative and designed in such a way that the involvement of various stakeholders like SME owners, consultants, technology providers, Local Service Providers, Financial institutions etc to facilitate :

- To identify the technologies and process up-gradation from various the detailed studies undertaken by the consultants.
- Active involvement of Financial Institutions to overcome financial barriers and development of a financial model for the technologies/equipments identified which are readily available and at best possible interest.

1.3 Expected Project Outcome

The BEE SME program aims at improving energy efficiency in various cluster units of the country. On overall, the program creates opportunities for all the stakeholders in the cluster viz. SME owners, Local Service Providers, Equipment Suppliers and Financial Institutions.

Initially, a situation analysis had been carried out and detailed information pertaining to the technologies employed, energy use pattern and financial strengths of SME's in the cluster were established.

The present BEE SME Program implementation in **Jagadhri Brass and Aluminium** Cluster, the following outcomes are expected

Energy Use and Technology Analysis

The detailed comprehensive energy use and technology studies in various cluster units has explored the information on status of **Jagadhri Brass and Aluminium** Cluster, production capacities, present status of the technologies employed, energy consumption pattern, identified all possible measures for energy efficiency and conservation, techno-economic feasibility of the identified measures, energy saving potential in the units surveyed and in total cluster units, technologies and equipments available locally, technical capabilities of LSP's for implementation, environmental impact due to reduction in energy consumption, etc. The major projects to be implemented which have more impact on energy conservation and common technologies which are more or less applicable for all the cluster units were identified for preparation of bankable detailed project reports and incorporated in the manual

Implementation of EE measures

To facilitate SME owners for implementation of energy efficiency measures by developing the bankable detailed project reports for a minimum of 5 technologies for various capacities as per the suitability of cluster unit sizes. These DPR's can be replicate as per the unit suitability for availing loans from financial institutions. The DPR contains various technical and financial indicators like IRR, NPV, ROI, etc for projecting the project viability. A total of 15 DPR's will be prepared

Capacity Building of LSP's and Bankers

The local service providers and equipments suppliers has already been identified in **Jagadhri Brass and Aluminium** Cluster and the capability building programs planned for various stakeholders like local service providers, bankers and equipments suppliers to facilitate them for implementation of the energy efficiency measures.

A Conclusion dissemination workshop to be conducted to provide the information for all the stakeholders for the status and achievement of the program

1.4 Project Duration

The total duration of the project is 18 months and the details of the duration for each activity are furnished in Figure 1 below:

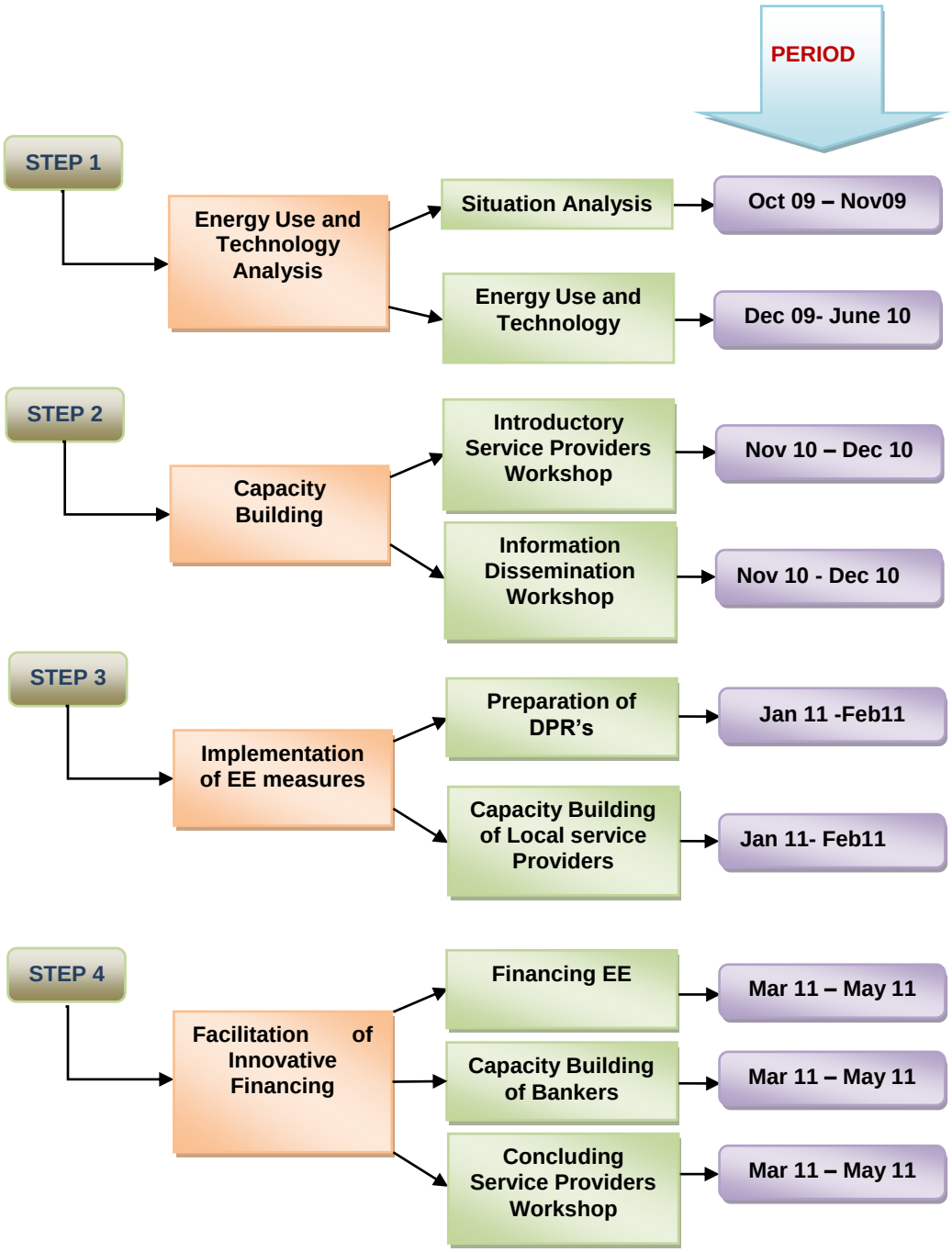

Figure 1: Project Duration

1.5 Identified Clusters under the BEE SME Program

The BEE has identified 29 SME Clusters to implement the BEE SME Program for energy efficiency improvement and the list of chosen clusters are furnished below in Table 1:

Table 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*

1.6 About the present study

BEE has awarded the Jagadhri Brass and Aluminium cluster study to Zenith Energy Services Pvt. Ltd based on the competitive bidding under BEE SME program. Zenith Energy Services Pvt Ltd had taken the task of implementing the program and two full time energy auditors were deployed in the cluster and a project office had been established at Jagadhri with all facilities like state of art energy audit instruments, Laptops, Printers, and Internet etc. As a part of the program, the details of the studies undertaken in cluster units are furnished in Table 2.

Table 2: The details of the studies undertaken in cluster units

Sl.No	Type of audits	*No. of units covered*
1	Preliminary Energy Audits	20
2	Detailed Energy Audits	40
3	Technology audits	20

The studies were conducted covering all types of industries and capacities in the cluster and the reports were submitted to all individual units for implementation of measures identified. Based on the studies carried out and data analysis, a cluster manual had been prepared for the following:

- Cluster details
- Products manufactured
- Energy forms used, costs, availability and consumption pattern
- Technologies/equipments installed
- Efficiencies levels of the equipments installed
- Measures & technologies/equipments identified for energy conservation and saving, Investment required
- Simple payback period
- Various barriers for implementation
- Local Service Providers details

1.7 Structure of the Report

The present report has been divided into the following Chapters:

Chapter 1: Introduction
Chapter 2: Overview of Jagadhri Cluster
Chapter 3: Energy Audit and Technology Assessment
Chapter 4: Conclusions

Chapter 1: This chapter discusses about BEE SME program, project objectives, project outcomes and about the present study.

Chapter 2: Discusses broadly about the cluster, classification of units, energy situation, energy forms used and their availability, production capacities of the units, products manufactured, manufacturing process, technologies employed, current policies of various state and central government for energy efficiency and energy conservation, various issues and barriers in implementation of EE measures and technology up-gradation etc.

Chapter 3: Highlighted the methodology adopted, observations made on process and technologies, energy consumption profile, efficiencies of the equipments installed, housekeeping practices adopted, availability of data and information, technology gap analysis, energy conservation and measures identified, cost benefit analysis, Local service providers availability, technology providers availability, etc

Chapter 4: Highlighted the environmental benefits and quantity of GHG emission reduction expected due to implementation of the measures identified for energy saving.

CHAPTER 2
ABOUT JAGADHRI CLUSTER

2.1 Overview of Jagadhri SME Cluster

2.1.1 Cluster Background

Industrial development in Jagadhri (Yamuna Nagar) District could be attributed to the presence of a large number of plywood industries, Brass**,** Aluminium, and Stainless Steel industries. Northern Railway Workshop employing thousands is the town's largest single industry. The Shree Gopal Paper Mills of Ballarpur Industries Limited is the town's another big industry. Third largest are Saraswati Sugar Mills & ISGEC. The sugar mill is known as largest sugar mill in Asia. Apart from it there is the leaf spring company Jai Parabolic as well as many plywood and board companies.

Jagadhri is renowned for the brass utensils, sheets, coils, strips and also Aluminium & Stainless steel utensils, there are about 150 to 200 brass and aluminium industries in the cluster. The brass & copper sheets, strips, coils and aluminium utensils produced in Jagadhri cluster are renowned in the country. These industries are located at Jesico colony, Jaroda gate, Gobindpuri road, Durga garden, Aggarsain Chowk, Tejli gate HSIIDC Manakpur etc. Majority of the industries have been in operation for the last 15 to 30 years. The main raw materials are brass, copper and aluminium scrap is being procured from local agents.

The cost of energy as a percentage of manufacturing cost varies anywhere between 3% to 5%. Majority of the industries located in Jagadhri uses coke and furnace oil as energy in process for pit melting and a very few units are using electricity for induction furnaces for melting. Pit melting process requires large amount of thermal energy, inducing a high share of energy cost. The energy cost is next to the raw materials cost. Majority of the industries in the cluster units are dependent on local technologies of low end and with little investment initiatives and technology up-gradation. The units started recently employing latest technologies and equipments for better quality, production and efficiency.

2.1.2 Product Manufactured

The main products manufactured in cluster units are brass utensils, sheets, coils, strips and also Aluminium utensils. The brass sheets produced are supplied to various appliances manufacturing industries and the utensils produced are sold in the entire India through dealer network. **Jagadhri** is the biggest cluster in India producing utensils, sheets & circles.

On other hand, there are few units engaged in performing hot rolling work in the cluster and these units normally working on job work basis.

2.1.3 Classification of units

The **Jagadhri Brass and Aluminium** Cluster units can be broadly classified:

2.1.3.1 Classification based on type of industry

i) Brass industries units having production capacity 15-50 tons/month

ii) Aluminium industries units having production capacity 20- 80 tons/month

Out of 175 units, one hundred (100) units are of Brass units, seventy five (75) are Aluminium units. The categorization of the units based on type of industry is furnished graphically in Figure 2.

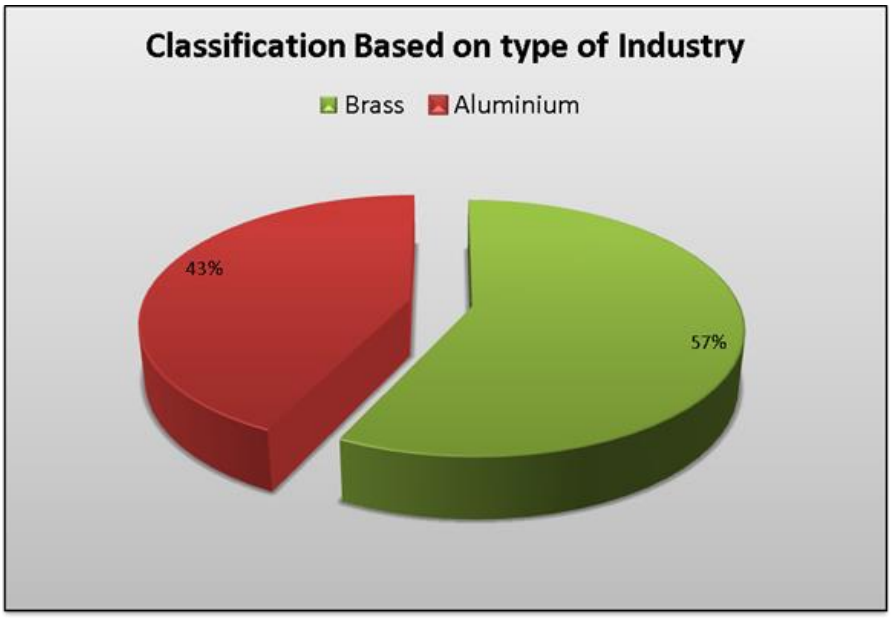

Figure 2: Classification of units based on type of industry

2.1.3.2 Classification based on production facilities

In **Jagadhri Brass and Aluminium** Cluster, out of 175 units, about 30 units are having only hot rolling facilities, 45 units having only cold rolling facilities and 100 units are of integrated type having both hot rolling and cold rolling facilities. The classification based on production facility is furnished graphically in Figure 3.

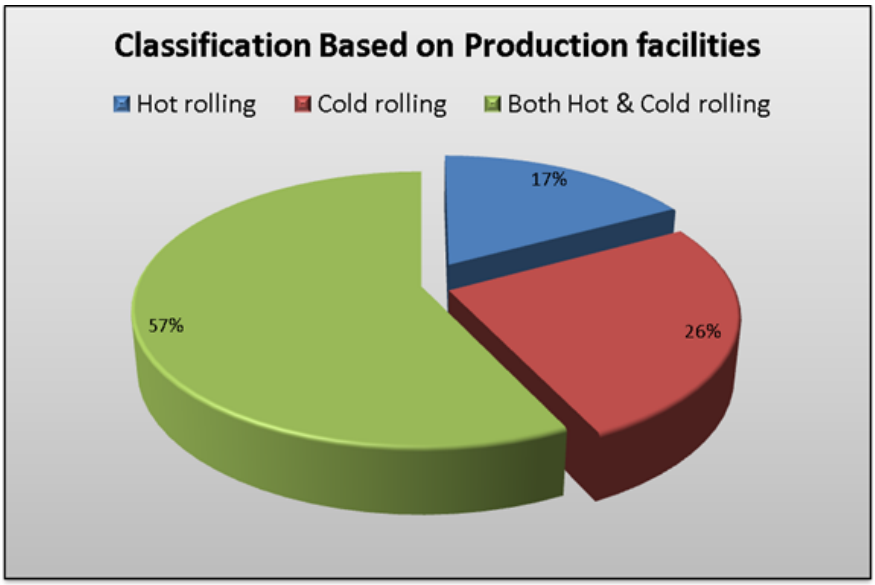

Figure 3: Classification of units based on production facilities

2.1.3.3 Classification based on annual energy bill

Out of 175 units, 90 units have energy bill below Rs.5.00 lakhs per annum, 60 units recorded energy bill between Rs.5.0 lakhs to Rs. 10 lakhs per annum and the balance 25 units have energy bill above Rs. 10.00 lakhs. The classification based on annual energy bill is furnished graphically in Figure 4.

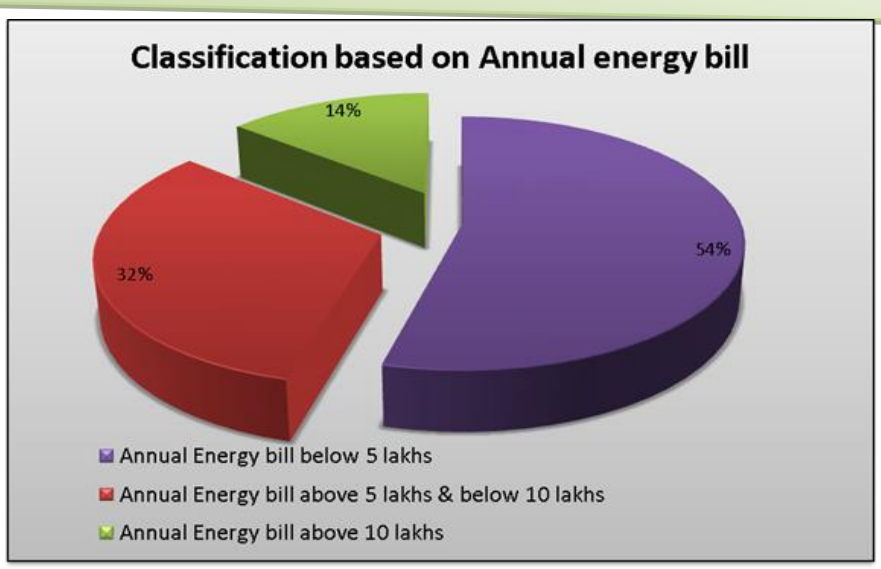

Figure 4: Classification of units based on annual energy bill

2.1.4 Raw materials used

The main raw materials used in **Jagadhri Brass and Aluminium** Cluster units are:

- Copper
- Zinc
- Brass scrap
- Aluminium scrap

2.2 Energy Consumption scenario of the Cluster

The cluster units require fuels and electricity for melting, annealing and hot & cold rolling applications. Furnace oil and Coke are used as fuel for melting and annealing of brass & aluminium. Electricity is required for operating the Hot and Cold rolling machines and lighting. The major fuels used in the cluster units are imported coke, wood and Furnace oil.

2.2.1 Fuels used and price

The major fuels used in the cluster units are imported coke, wood and Furnace oil. The prevailing prices of fuels in the cluster are furnished below in Table 3.

Table 3: Prevailing price range of fuels in the cluster

Sl.No	Fuel type	Price range (Rs.)
1	Imported coke	19,000 – 27,000 per ton
2	Wood	2,500 – 4,500 per ton
3	Furnace oil	30 per litre
4	Electricity	4.50 per kWh

2.2.2 Energy Consumption

The main energy forms used in a typical unit of the cluster are electricity, imported coke, wood and Furnace oil. Electricity is used for driving the prime movers of Hot and Cold rolling machines and lighting. Electricity, Imported coke and wood are used in melting and annealing furnaces. The annual energy consumption of the three typical units in the cluster is furnished in Table 4 below:

Table 4: Annual energy consumption of the three typical units

Details	Value	Unit -1	Unit -2	Unit -3
Imported coke	tons	57	--	--
Wood	tons	180	600	750
Furnace oil	Kilo liters	54	216	130
Electricity	kWh	1,59,600	16,02,032	1,33,200
Final production	tons	720	900	480

The annual consumption of fuels and electricity of the entire cluster units are furnished table 5 below:

Table 5: Annual energy consumption of the cluster units

Sl.No	Type of energy	Consumption	Tons of oil Equivalent (TOE)
1	Imported coke	7,600 tons	4,560
2	Wood	59,000 tons	18,880
3	Furnace oil	6,500 klts	6,500
4	Electricity	25 Gwh	2,150
	Total		32,090

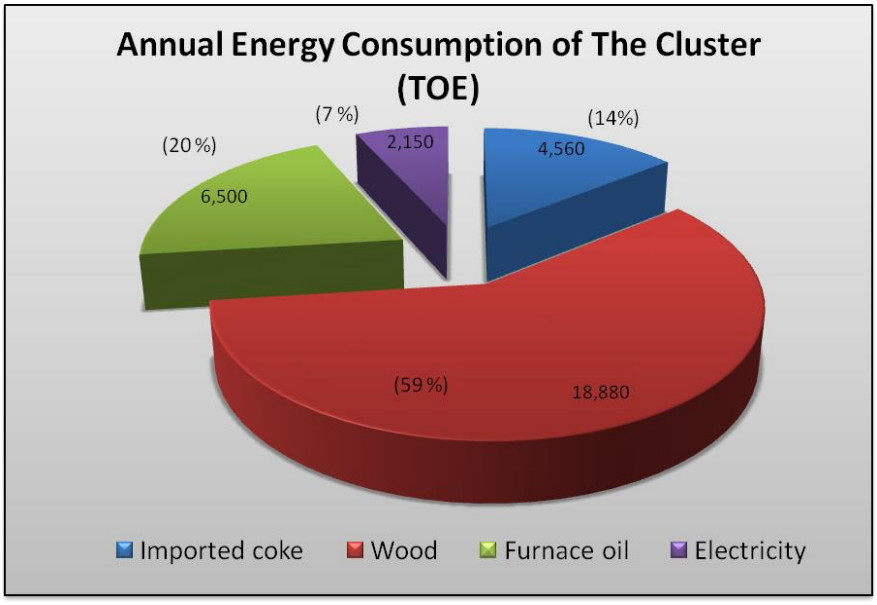

Figure 5: Annual energy consumption of the cluster (TOE)

2.2.3 Specific Energy Consumption

The specific energy consumption for various units in the cluster like melting, annealing, hot & cold rolling is furnished below in Table 6:

Table 6: Specific energy consumption

Equipment	Units	Minimum SEC	Maximum SEC	Average SEC (for whole cluster)
Induction furnace	kWh/kg	0.166	0.193	0.179
Pit furnace(coke fired)	kg/kg	0.110	0.150	0.130
Annealing furnace	Kg/kg	0.150	0.260	0.205
Pit furnace (oil fired for brass melting)	lts/kg	0.115	0.125	0.120
Pit furnace (oil fired for Aluminium melting)	lts/kg	0.130	0.150	0.140

2.3 Manufacturing process

2.3.1 Process Technology

The main process adopted in Brass and Aluminium cluster units are melting, annealing, acid washing, hot & cold rolling, shearing and pressing are as follows:

2.3.1.1 Melting

Different types of melting process are Induction melting, Coke fired pit melting & Oil fired pit melting

INDUCTION MELTING

Induction Furnace is used in some units for melting the scrap brass. Grid electricity is used for induction furnaces. The production capacity of the induction furnaces normally varies from 700 kgs/batch to 1500 kgs/batch in the cluster and about four to six batches are produced in a day. The furnace is operated on single shift basis

A small blower of 3HP to 5 HP is used for cooling of induction coils. The Induction furnace design and the photographs taken during normal operational time taken were furnished below in figures 6

Figure 6: The Induction furnace design and the photographs taken during normal operational

The Induction furnace is the electrical furnace in which the heat is generated by electro magnetic supplied by induction coil, this induction coil lined with refractories & ramming mass which acts as a crucible and high frequency alternating current is used to generate electro magnetic flux inside the Induction furnace. The outer side of the furnace is fabricated and insulated with steel drum. The normal time for each batch of melting is one and half hours and subsequently the batch time reduces by about 15 minutes to 20 minutes than the initial batch

COKE FIRED PIT MELTING

Pit Furnace is a common type of furnace used in all cluster units for melting the scrap brass in the crucibles. Coke is used as fuel and the production capacity of the pit furnace in the cluster units is varying from 600 kgs to 900 kgs per batch. Normally about 4 to 5 batches are produced in a day. The furnace is operated on single shift basis normally 12 hours.

The pit furnace design and the photographs taken during normal operational time taken were furnished below in figures 7

Figure 7: The pit furnace design and the photographs taken during normal operational

The pit furnace is a rectangular pit lined with refractories and the crucible is inserted in the furnace and coke is feeded underneath and sides of the pit furnace. The outer side of the furnace is lined with red bricks. After feeding coke and inserting crucible in the pit and the firing of the coke is started. The normal time for each batch of melting is two and half hours and subsequently the batch time reduces by about 20 minutes to 30 minutes than the initial batch

A small blower of local make of 1 HP is used for supplying combustion air and then casting of billets of required sizes.

The casting process photographs taken during normal operational time taken were furnished below

Figure 8: Casting process photographs taken during normal operational

OIL FIRED PIT MELTING – ALUMINIUM MELTING UNITS

Pit Furnace is a common type of furnace used in all cluster units for melting the Aluminium scrap in the crucibles. The furnace oil is used as fuel and the production capacity of the pit furnace in the cluster units is varying from 400 kgs to 800 kgs per batch. About 4 to 6 batches are produced in a day. The furnace is operated on single shift basis

The pit furnace is a circular pit lined with refractories and the crucible is inserted in the furnace and combustible furnace oil with air blowered from bottom side of the pit furnace. The outer side of the furnace is lined with red bricks. The normal time for each batch of melting is one and half hours and subsequently the batch time reduces by about 15 minutes to 20 minutes than the initial batch..

A blower of 5 HP is used for supplying combustion air. The pit furnace design and the photographs taken during normal operational time taken were furnished below .

Figure 9: The pit furnace design and the photographs taken during normal operational

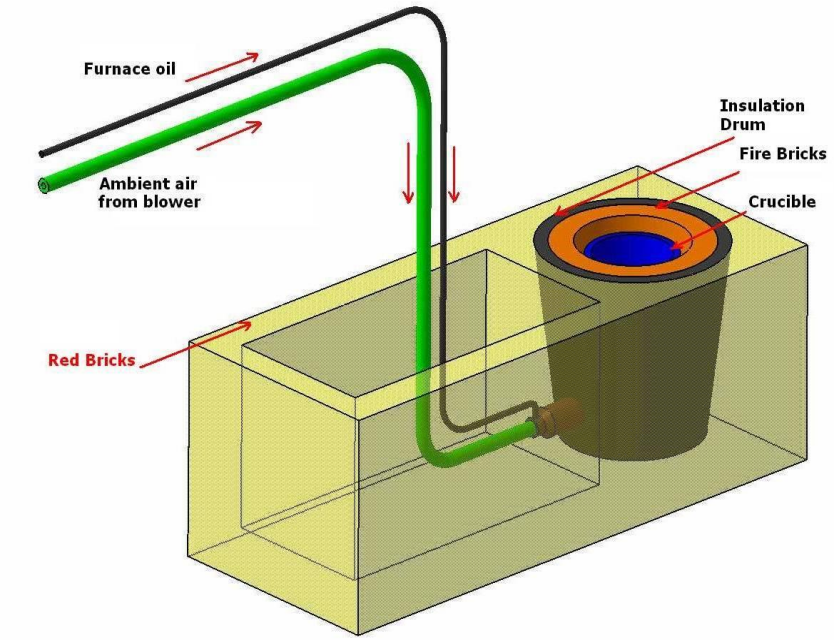

Figure 10: Schematic diagram of oil fired melting furnace

2.3.1.2 Annealing

Different types of Annealing process are as follows:

a) Electric annealing

b) Wood fired annealing

c) Oil fired annealing

ELECTRIC ANNEALING

The brass sheets are heat treated for about 5 to 6 hours in a day by electrical energy and the production capacity of the annealing furnace in the cluster units is varying from 1000 kgs to 3000 kgs per batch The annealing furnace is bogie type furnace fabricated with steel body and the inside of the furnace is constructed with the refractory bricks and insulation materials. The annealing furnace design and the photographs during normal operational time are furnished below:

Figure 11: The annealing furnace photographs during normal operational

WOOD FIRED ANNEALING

Wood Fired Annealing Furnace is a common type of annealing furnace found in the cluster and is normally installed in smaller and medium size units. The wood fired furnace is used for heat treatment of the brass sheets and circles and also reheating of the billets before hot rolling. The wood is used as fuel and the production capacity of the wood fired furnace in the cluster units is varying from 2000 kgs to 4000kgs per batch The temperature required for annealing and re-heating the billets is 600 to 650 oC. The brass sheets are heat treated for about 10 to 12 hours in a day. The annealing furnaces are of very old design and are constructed with red bricks and only the hearth of the furnace is constructed with the refractory bricks. The design of the annealing furnace is more or less identical in all cluster units. The annealing furnace design and the photographs during normal operational time are furnished below:

Figure 12: The annealing furnace photographs during normal operational

OIL FIRED ANNEALING

The brass coils is heat treated for about 8 to 10 hours in a day. The furnace oil is used as fuel and the production capacity of the oil fired bell furnace in the cluster units is varying from 3000 kgs to 4000 kgs per batch. The annealing furnaces are bell type furnace fabricated with insulation steel drum as shown in figure.The design of the bell annealing furnace is more or less identical in all the coil plant units. The bell annealing furnace photographs during normal operational time are furnished below:

Figure 13: The Bell annealing furnace photographs during normal operational

2.3.1.3 Rolling

In **Jagadhri** cluster two types rolling methods are used:

a) Hot rolling

b) Cold rolling

The distinction between hot rolling and cold rolling does not depends solely on the temperature, but rather on the processing temperature with respect to the material recrystallization temperature. When the processing temperature of the mechanical deformation of Brass or Aluminium is above the recrystallization temperature, the process is termed as hot rolling otherwise, it is cold rolling.

HOT ROLLING

The primary function of the Hot rolling is to reheat Brass billets or hot casted billets nearly to their melting point, then roll them thinner and longer sheets through rolling machine driven by motors having capacity around 100 HP and annealing up the lengthened brass or aluminium sheets and used for the next process.

Figure 14: Hot rolling process and the photographs during normal operational

COLD ROLLING

Cold working processes allow desirable metal qualities that cannot be obtained by hot working, such as eliminating errors attending shrinkage. As such, a much more compact and higher dimensional accuracy metal can be obtained with cold working. Furthermore, the final products have a smoother surface (better surface finish) than those of hot working and the strength, hardness as well as the elastic limit is increased. However, the ductility of the metal decreases due to strain hardening thus making the metal more brittle. As such, the metal must be heated from time to time (annealed) during the rolling operation to remove the undesirable effects of cold working and to increase the workability of the metal.

Figure 15: Cold rolling photographs during normal operational

2.3.1.4 Shearing

Shearing is a process for cutting sheet metal to required size out of larger sheets such as roll sheets. Shears are used as the intermediate or finished step in preparing for cold rolling or circle cutting processes.

Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the material to fail. The most common cutting processes are performed by applying a shearing force, and are therefore sometimes referred to as **shearing processes**.

When a great enough shearing force is applied, the shear stress in the material will exceed the ultimate shear strength and the material will fail and separate at the cut location. This shearing force is applied by two tools, one above and one below the sheet. The tool above the sheet delivers a quick downward blow to the sheet metal that rests over the lower tool.

A small clearance is present between the edges of the upper and lower tools, which facilitates the fracture of the material. The size of this clearance is depends upon several factors, such as the specific shearing process, material and sheet thickness.

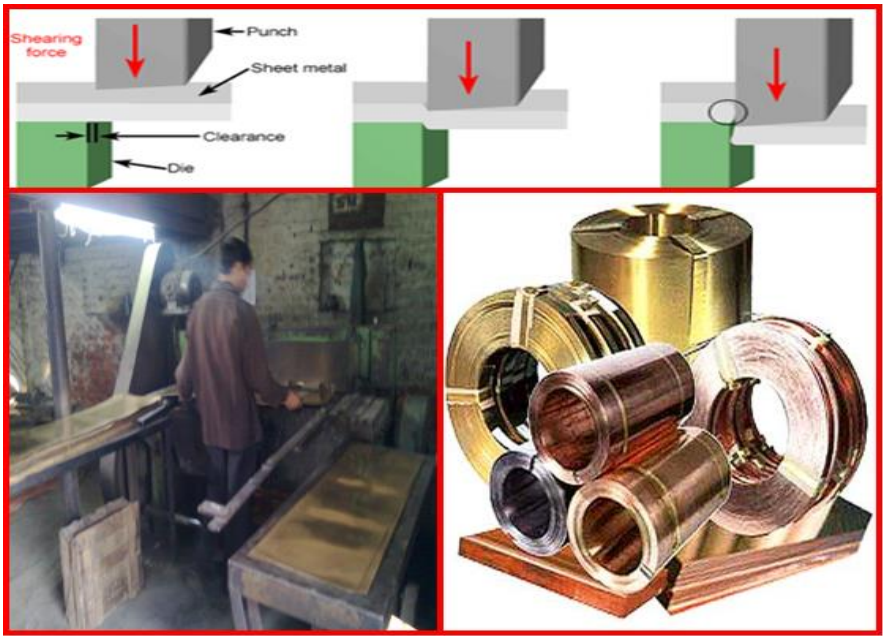

Figure 16: Shearing process photographs during normal operational

2.3.1.5 Pressing

Pressing is a metal forming process in which sheet metal is stretched into the desired part shape. A tool pushes downward on the sheet metal, forcing it into a die cavity in the shape of the desired part. The tensile forces applied to the sheet cause it to plastically deform into a utensil-shaped part. Pressing is most effective with ductile metals, such as aluminum, brass, copper, and mild steel. Examples of parts formed with Pressing include milk tanks, cans, cups, kitchen utensil sinks, pots and pans.

The Pressing processes machine either in **cam or hydraulic** type is used having capacity 25 HP to 63 HP motors, its consists of blank, blank holder, punch, and dies. The blank is a piece of sheet metal, typically a circle, which is pre-cut from annealed material and will be formed into the part. The blank is clamped down by the blank holder over the die, which has a cavity in the external shape of the part. A tool called a punch moves downward into the blank and draws, or stretches, the material into the die cavity.

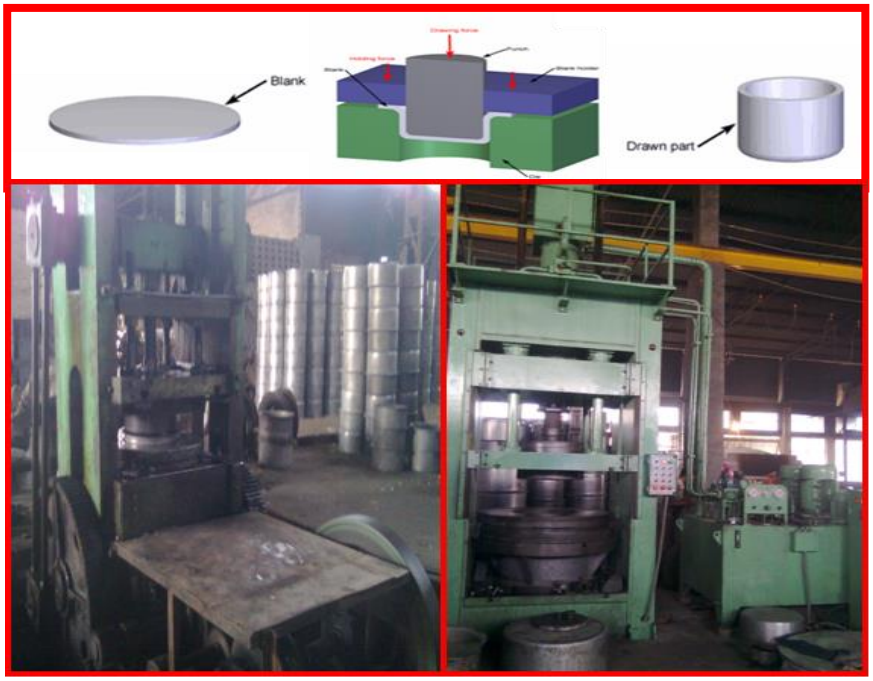

Figure 17: Pressing process and the photographs during normal operational

The movement of the punch is usually **cam or hydraulically** powered to apply enough force to the blank. Both the die and punch experience wear from the forces applied to the sheet metal and are therefore made from tool steel or carbon steel. In each step, a punch forces the part into a different die, stretching the part to a greater depth each time. After a part is completely drawn, the punch and blank holder can be raised and the part removed from the die. The portion of the sheet metal that was clamped under the blank holder may form a flange around the part that can be trimmed off.

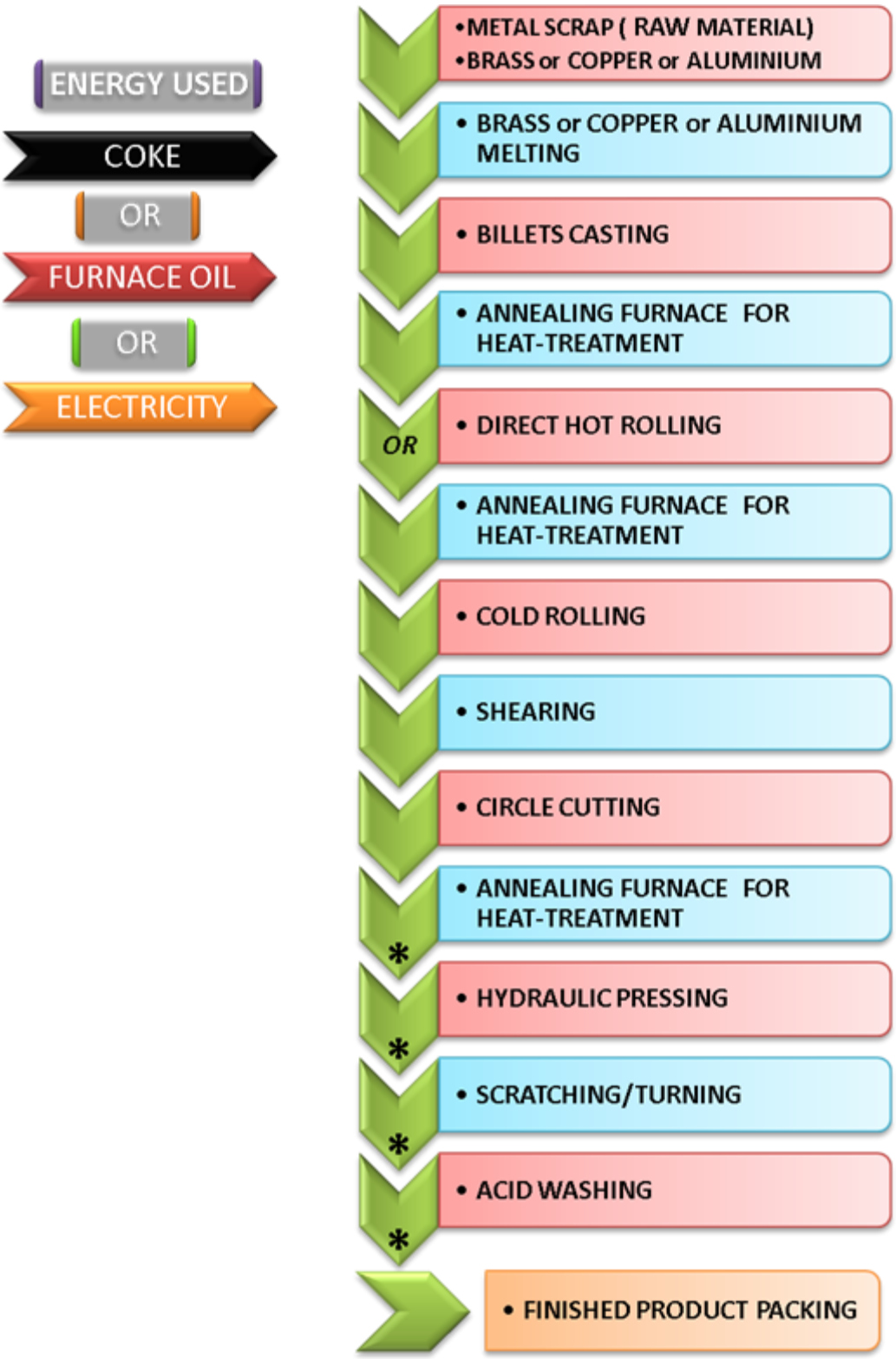

Figure 18: The Process adopted for induction, coke & oil melting

**For Product / Utensils Manufacturing*

2.4 Current policies and Initiatives of Local bodies

About HAREDA

The Haryana Renewable Energy Development Agency (HAREDA) (HAREDA) is a Government of Haryana Undertaking Agency established in the year 2003. HAREDA is a 'Nodal Agency' for promotion of renewable energy sources and 'State Designated Agency' for implementation of Energy Conservation Act, 2001 in the State of Haryana. Promotion of Energy Efficiency in the industrial and buildings sector form one of the major mandates of the EC Act as it has tremendous potential for improvement.

Energy Conservation Cell

An Energy Conservation Cell has been set up and look after the energy conservation activities in the State. The Energy Conservation Cell consists of one Additional Director, one Project Director, one Sr. Technical Manager, two Project Officers and three Assistant Project Officers. The Cell works under the guidance of the Director, RE & HAREDA & Financial Commissioner & Secretary to Govt. Haryana –cum- Chairman, HAREDA.

Ministry of New & Renewable Energy, Govt. of India and HAREDA introduced a scheme for bio mass gasifier as mention below

Biomass gasifier system is basically a reactor in which wood chips/cotton stalks and other woody biomass is burnt in a controlled quantity of air to produce combustible gas generally known as producer gas. This gas, after cooking and cleaning can be used as fuel for thermal applications or it can be fed to the diesel-Genset to produce electricity and it can save 60 to 80% of diesel normally consumed otherwise or 100% producer gas engine can be operated without using any other fuel.

Ministry of New & Renewable Energy , Govt. of India, introduced a scheme on promoting applications of these system as an Demonstrative Project and the scheme is being implemented through the concerned State Nodal Agencies. To promote this technology, financial incentive in the form of subsidies are being provided by Govt. ofIndia & the State Govt. as per detail given below:

Table 7: subsidies for to promote technology

Progrmame	Approx. cost	Central financial assistance	State subsidy
Biomass Gasifier for Thermal Application (100 KW capacity)	8.00 lacs	2.00 lacs/ 300 KW	10% of the system cost with maximum of Rs.80,000/-
Biomass Gasifier for Electrical Application (100 KW capacity in dual fuel mode)	12.00 lacs	2.50 lacs/ 100 KW	10% of the system cost with maximum of Rs.1,20,000/-
Biomass Gasifier for Electrical Application (100 KW capacity in 100% producer gas mode mode)	25.00 lacs	10.00 lacs/ 100 KW	10% of the system cost with maximum of Rs.2,50,000/-
Producer Gas Engine alone (100 KW capacity)	12.00 lacs	8.00 lacs/ 100 KW	10% of the system with maximum of Rs.1,20,000/-
Biomass Cogeneration (non-bagasse)	3.00 crore/MW	Rs.20.00 lacs per MW	Rs.20.00 lacs per MW
The amount of capital subsidy would be calculated on pro-rata basis of installed capacity and would be limited to a maximum of 5 MW capacity irrespective of installed capacity			

2.5 Major barriers for implementation of Energy Efficiency

2.5.1 Energy Availability

The main energy forms used in the cluster units are firewood, imported coke, and electricity. the firewood is available abundantly in the area. Though, the electricity is available, the power cuts in the area are severe and the availability is only 75% and cost of electricity supplied by the Haryana State Electricity Board is high as compared with other States. Some of the units has installed DG sets for un interrupted power supply to reduce production loss and solidification of the material in the furnaces

The severe power cuts imposed by the state electricity board is one of the major barrier facing by SME owners in the cluster

2.5.2. Technological Issues

The major technical barriers that prevented the implementation of energy efficiency measures are as below:

- Lack of awareness and information about the technologies available in the market
- No knowledge among the workforce about energy conservation and efficiency
- The majority of the managers in cluster units are non technical and are working based on experience and doesn't have technical knowledge
- Dependency on local technology suppliers who do not have sufficient knowledge on efficient equipments

2.5.3 Lack of Technical know-how & Organizational capacity

The majority of the **Brass and Aluminium** unit owners do not have in-depth technical expertise, knowledge or training about energy efficiency, and are dependent totally on local technology suppliers or service companies, who normally rely on established and commonly used technology. The lack of technical know-how made it impossible for the **Brass and Aluminium** unit owners to identify the most effective technical measures.

Though, some of the SME owners are interested in implementing energy efficiency measures, the lack of knowledge and technical know-how, made them to depend on the local suppliers.

These are however can be overcome by motivating them to attend the awareness programs and detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

2.5.4 Financial Issues

About 20% of the units in the cluster have good financial strength and are implementing various energy efficiency measures available in the market.

The balance 80% of the units in the cluster does not have adequate financial strength to implement the identified EE measures as it requires considerable investment, as these industries have low financial strengths and can be overcome by providing soft loans at lower interest rates.

Further, the units owners are not aware of monetary benefit due to implementation of energy efficiency measures and also present losses in the existing technologies identified.

Lack of interest of investing on the new technologies, as these industries getting profits with the existing technologies

CHAPTER 3
ENERGY AUDIT AND TECHNOLOGY ASSESSMENT STUDY

3.1 Methodology adopted

3.1.1 Energy use and Technical Assessment study

3.1.1.1 Pre-energy audit activities

The pre-energy audit activities comprised collection of preliminary information from cluster units for products manufactured, production capacity, status of technologies / equipments installed, willingness of the unit for the study, and implementation of the measures identified.

3.1.1.2 Preliminary Energy Study

The following methodology has been adopted for preliminary energy audit study:

a) Collection of past energy consumption details and energy bill

b) Establish specific energy consumption, if possible

c) List out major energy consuming areas of the plant

d) Level of technologies adopted (latest or old, crude or efficient, local or reputed company make)

e) Status of instruments installed in the plant and necessary instrumentation required for the detailed study

f) Identify areas for special attention for low cost measures with quick payback period

g) Understanding detailed manufacturing process with energy and material balance

h) Identify areas for detailed study and measurements required

i) Collect bottleneck areas of the plant for detailed study

3.1.1.3 Detailed Energy Study

The following methodology has been adopted for conducting detailed energy study:

- Monitoring of energy related parameters of various equipment / machines using portable instruments of ZESL
- Collection of operating data from various measuring instruments / gauges installed in the plant
- Collection of past operating data / historical data from log books and data registers
- 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 / monitored by ZESL
- Technology status of the equipments installed
- Detailed process flow of the plant
- Identification of energy wastage areas and quantification of energy losses
- Identification of suitable measures for reducing energy wastages
- Identification of areas for reuse and recycle

Table 8: The details of the studies undertaken in cluster units

Sl.No	Type of audits	No. of units covered
1	Preliminary Energy Audits	20
2	Detailed Energy Audits	40
3	Technology audits	20

3.1.1.4 Technical Audit

The methodology adopted for conducting technical audit is as follows:

- Identify major equipments and technologies of the plant
- Whether the equipments installed is local make or reputed company make
- Various energy sources available in the vicinity of the cluster
- Energy use and specific energy consumption details
- Identify major constraints for installing energy efficient equipments
- Whether energy efficient equipment suppliers are available locally and identify the suppliers
- The strategy followed for selection of equipment suppliers by the management
- Any research or survey carried out prior to selection of the technologies adopted and available
- Detailed interviews with the management for the interest in adopting new technologies for efficiency improvement
- Financial strength and investment that can be made for the improvement of energy efficiency by the plant management

3.2. Observations made

3.2.1 Manufacturing Process and Technology employed

There are about 200 units in the cluster, which are engaged in the processing of brass and aluminium utensils, circles and sheets. The main raw material is brass and aluminium scrap & Copper and Zinc

The process flow diagram of a typical unit of the cluster is furnished in the Figure 10 below:

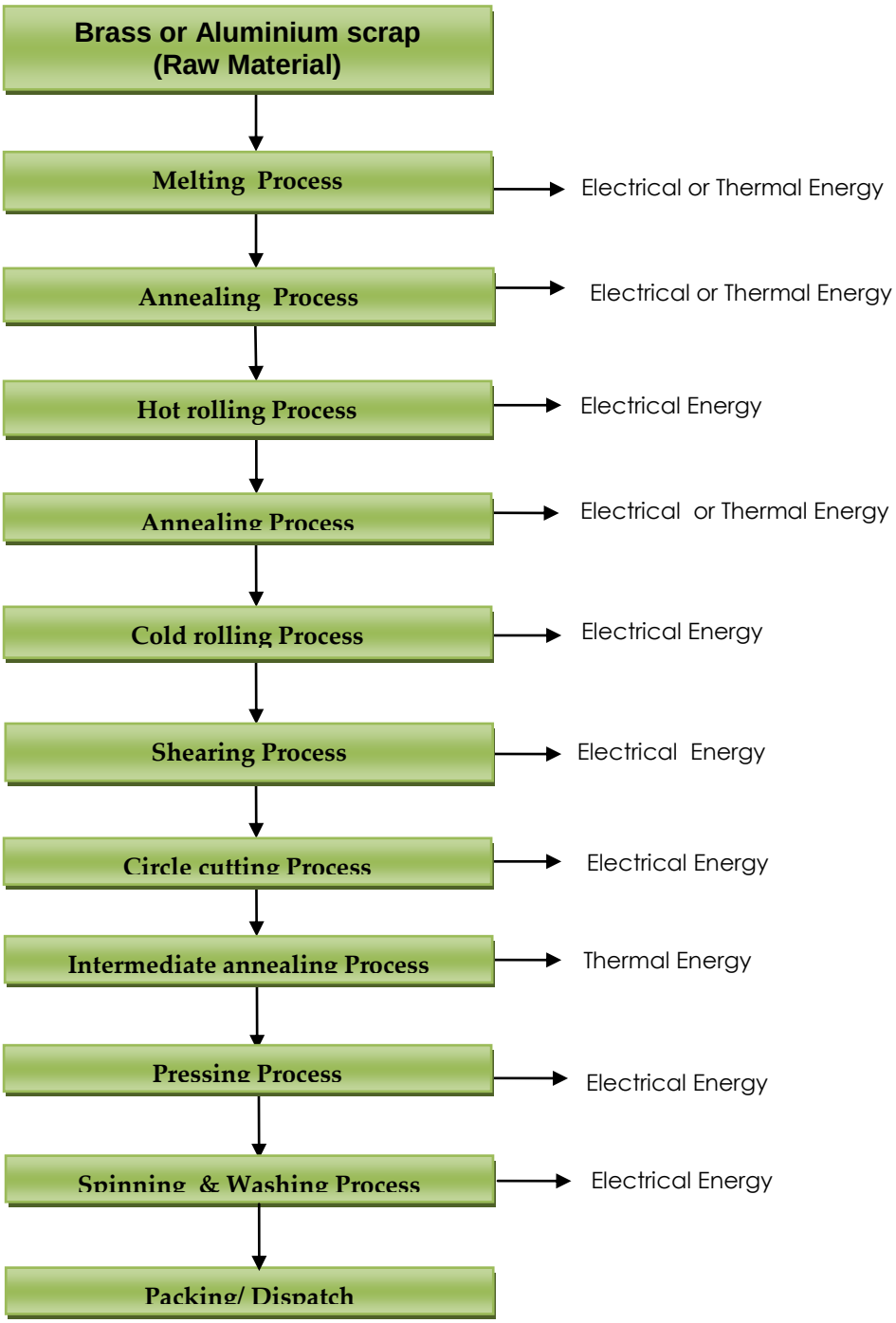

Figure 19: Process flow chart

(For a typical Brass and Aluminium unit in the cluster)

The comprehensive study of the units carried out by ZESL has revealed the following:

i) The status of present technologies installed like pit and annealing furnace is poor as compared to the technologies and practices / equipments available in the market. Various technological gaps have been identified in the cluster units as under and these may be due to lack of awareness on the technologies available and non availability of LSPs or equipment suppliers.

ii) Though, the managements are interested in implementation, the energy loss areas and EE technologies could not be identified by the management/workers or LSPs for implementation due to lack of awareness. Hence, the unit owners are depending entirely on illiterate workers and the local technology suppliers for their low cost and their availability any point of time.

iii) Further, the sector faces deficiencies such as the lack of technology sharing, lack of technical manpower, technical knowledge among workforce and inadequacies of strong organizational structure, and professional attitude.

3.2.2 Energy Consumption profile

The supply and consumption pattern of energy inputs are analyzed in the cluster and the details are furnished below:

3.2.2.1 Fire wood, imported coke, Furnace oil and Electricity

The majority units of the cluster use firewood, furnace oil , electricity and imported coke as fuel for melting and annealing furnaces. The coke consumption in cluster units varies from 60 to 80 tons per annum depending on production capacity and production facilities of the plant.

The variation of prices of different forms of energy used in the clusters are furnished below table 9:

Table 9: Variation of different forms of energy price in cluster units

Sl.No	Fuel type	Price range (Rs.)
1	Imported coke	19,000 – 27,000 per ton
2	Wood	2,500 – 4,500 per ton
3	Furnace oil	30 per litre
4	Electricity	4.50 per kWh (including service charges)

The specific electricity consumption of three typical units is furnished below table 10:

Table 10: Specific energy consumption

Details	Value	Unit -1	Unit -2	Unit -3
Imported coke	tons	57	100	--
Wood	tons	180	96	432
Furnace oil	Kilo liters	54	--	75
Electricity	kWh	1,59,600	1,70,664	2,13,324
Final production	tons	720	680	480
Specific Electricity consumption	kWh/kg	0.26	0.25	0.44
Specific oil consumption	lts/kg	0.125	--	0.15
Specific coke consumption	Kg/kg	0.130	0.145	--
Specific wood consumption	Kg/kg	0.150	0.140	0.10

3.2.2.2 Electricity

HT & LT connection:

This tariff will be applicable for supply of electricity to HT consumers contracted for 70 kW above and LT connection for below 70 kW for regular power supply and requiring the power supply for the cluster units.

Demand Charges;

Table11: Billing demand up to contract demand.

Sl.No	Category of consumers	Energy charge
(a)	H.T. INDUSTRY(For above 70 kW demand)	409 paise / unit
(b)	L.T. INDUSTRY-up to 70 kW demand	428 paise / unit

Power Factor Adjustment Charges:

(a) The power factor adjustment charges shall be levied at the rate of 1% on the total amount of electricity bills for the month under the head “Energy Charges” for every 1% drop or part thereof in the average power factor during the month below 90%.

(b) In addition to the above clause the monthly average power factor falls below 90% lagging, the consumer shall have to pay a surcharge of 1% of SOP charges for every 1% decrease in power factor upto 80% and 2% of SOP charges for every 1% decrease in power factor below 80%.the total amount of electricity bill for that month under the head “Energy Charges”, will be charged.

Power Factor Rebate:

Rebate of 0.5% on SOP will be allowed for every 1% increase in power factor above 90%”. Thus, it is evident that penalty/ rebate is applicable on SOP (sale of power) and hence consumers not maintaining the required power factor pays a penalty while those maintaining better power factor than the required power factor i.e. 0.9 are entitled for rebate.

The annual electricity consumption in cluster units varies from 0.3 lakhs kWh to 12 lakhs kWh depending on the quality, process adopted, products produced, production capacity of the units installed, and type of equipments installed. The unit cost of electricity in the cluster is Rs. 4.50.

3.2.3 Capacity Utilization

Most of the units operate for 12 hours in a day and 300 days per annum. Most of the units operate their process equipments continuously. The melting & annealing are operated about 70% to the rated capacity where as rolling machines and other equipments are operated as per the requirement and largely operate over 50% to 60%.

3.2.4 Housekeeping practices

About 15% of the units are adopting good operating practices and however, there is monitoring of fuel consumption, process parameters, production, instrumentation for various equipments are not practiced and these may be due to lack of awareness.

3.2.5 Availability of data and Information

The data and information pertaining to energy procurement and consumption is available in some of the cluster units. However, the SME owners are not willing to provide information on production and other data. However, the data such as energy consumption and production

monitored during the field visits have been used for evaluating specific energy consumption and potential for energy saving.

3.2.6 Any other relevant Aspect

Majority of the machine operators and helpers deployed in the cluster units are non technical and illiterates and their knowledge is based on the past experience. They do not have technical skills and knowledge on energy conservation. This is one of the important factors for inefficiency of the process and energy losses.

3.3 Technology gap analysis

3.3.1 Technology up-gradation

i) The state of art of technology of the units installed is poor as compared to the technologies available in the market. Various technological gaps were identified in the units as under and these may be due to lack of awareness on the technologies available, quantum of energy loss, lack of awareness among the workforce, etc.

ii) There is a tremendous need for these industries to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas.

iii) The **Brass and Aluminium** industries is an unorganized sector with low engineering, limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, and operational skill. The sector also faces deficiencies such as the lack of access to technology and technology sharing and the inadequacies of strong organizational structure, professional attitude etc.

iv) There are many technologies and energy efficient equipments available in the market and local service providers in dealing with these technologies.

3.3.2 Process upgradation

Though, there is potential for process upgradation in the cluster units for improving the quality and enhancing production, many industry owners are not willing for process upgradation due to high investment and low returns. Further, majority of the unit owners are marketing their products through agents and does not have knowledge on the market demand, trend, and requirement. The details of equipment-wise technology gaps identified and technology interventions required are furnished below:-

Table 12: Technology gaps identified and technology interventions

Sl.No	Equipments	Technology Gaps Identified	Technology Interventions
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	• Energy Cost is more by using coke and furnace oil • Low efficient due to heat storage in the refractories and more space for coke feeding • No control on fuel feeding through out the process	• Install Wood Gasifier for Brass and Aluminium melting furnaces and reduces energy cost and pollution is reduced.
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	• No control on fuel feeding through out the process • There is no uniform distribution of the	• Install Wood Gasifier for Brass and Aluminium Annealing furnaces reduces energy cost and

		temperature in the furnace and is found to be varying at different locations. • The temperature is also higher than required due to uncontrolled charging of wood leading to high fuel consumption.	pollution is reduced. • Uniform distribution of the temperature in the entire furnace and hence quality also improves
3	**Waste heat recovery system for Pit furnaces**	• The high temperature waste flue gases is vented to the atmosphere without any heat recovery	• Install waste heat recovery system for pre-heating the charge and/or combustion air
4	**Energy efficient Pit furnace for Brass or copper melting**	• Inferior design of the pit furnace with squared fire brick structure and hence more heat storage in the refractories and more space for coke feeding though, it is not required. • High radiation losses through side walls and from the opening of the crucible	• The Energy efficient pit furnace consists of internal circular surface instead of the present rectangular surface for reducing heat absorption by the refractories and also for reducing quantity of coke feeding. • The refractories used are partially reflective type and hence the heat transfer will be higher.
5	**Modified wood fired annealing furnace (*Source NPC)**	• There is no proper provision for supplying combustion air and the combustion air intake and flue gas exit takes place from the front door through which material is being fed • Inadequacies in maintaining and controlling uniform furnace temperature resulting in uneven surface hardness • Excess temperature resulting in oxide formation on the surface of the products, the temperature in the furnace was found to be 500^{o}C or more in some cases, whereas the desired annealing temperature for aluminium should be around 425 ^{o}C -450 ^{o}C depending on the material composition	• Proper flue gas passage provided through the floor of the furnace and provision of chimney with damper, has created proper draft for the combustion process. Separate passage for the combustion air through the side of the furnace. • Uniform temperature inside the furnace achieved.

6	**Installation of Thermocouples for annealing furnaces**	• No Temperature monitoring system in annealing furnaces and the temperature is not uniform in various locations of the furnace • The temperature is also higher than required due to absence of instrumentation leading to high fuel consumption.	• Install thermocouples for annealing furnaces and monitor temperature on continuous basis for the furnaces for reducing fuel consumption
7	**Induction furnaces for brass and copper melting**	• The Un burnt coke left underneath the pit furnace is continued to burn even after the completion of the melting process • Due Inferior design of the pit furnace overall thermal efficiency is low.	• Replacing pit fired furnaces by induction furnaces for brass and copper melting..

3.4 Energy Conservation measures identified

3.4.1 Description of proposals including technology/product specifications

The various proposals have been identified for implementation in the cluster units for reducing energy consumption consisting of high, medium and No/ low investment measures

3.4.1.1 Wood gasifier for Brass and Aluminium melting.

Background

Based on the detailed energy audits conducted in various units of the cluster, the operating thermal efficiency levels of the present traditional pit furnaces are in the range of 8 to 15%. Further, the brass and copper melting with coke and furnace oil is costly and cost of these fuels is ever increasing in future due to more demand for the fossil fuels. The biomass is available in plenty in the area and also easily available.

Recommendation

The melting of brass and aluminium by wood gasifier is economical and efficient and further, the wood is available in plenty in the area and is renewable source of energy and the carbon credits also can be claimed.

Biomass Gasification

Gasification is the process of converting solid fuels to gaseous fuel. It is not simply pyrolysis; pyrolysis is only one of the steps in the conversion process and is combusted with air (partial supply of air) and reduction of the product of combustion, (water vapour and carbon dioxide) into combustible gases, (carbon monoxide, hydrogen, methane, some higher hydrocarbons) and inerts, (carbon dioxide and nitrogen). The process produces gas with some fine dust and condensable compounds such as tar.

The producer gas generated is used for thermal application and heat generated by combustion of biogas is used for melting the brass. Like other gaseous fuels, producer gas can also controlled critically. This also paves way for more efficient and cleaner operation. The producer gas can be conveniently used in number of applications as mentioned below.

Figure 20: Wood gasifier

Thermal Energy

Thermal energy of the order of 5 MJ is released, by flaring 1 m3 of producer gas in the burner. Flame temperatures as high as 1250 0C can be obtained by optimal pre-mixing of air with gas. For applications which require thermal energy, gasifier can be a good option as a gas generator, and retrofitted with existing devices. The biomass gasifier system is best suited for hot air dryers, kilns, furnaces and boilers.

In non-ferrous metallurgical and foundry industries high temperatures (~650 - 1000 oC) are required for melting metals and alloys and normally melting is done by expensive fuel oils or electrical heaters. Gasifier are well suited for such applications.

Wood Gasifier

This system is meant for biomass having density in excess of 250 kg/m3. Theoretically, the ratio of air-to-fuel required for the complete combustion of the wood, defined as stoichiometric combustion is 6:1 to 6.5:1, with the end products being CO2 and H2O. Whereas, in gasification the combustion is carried at sub-stoichiometric conditions with air-to-fuel ratio being 1.5:1 to 1.8:1. The product gas thus generated during the gasification process is combustible. This process is made possible in a device called gasifier with limited supply of air. A gasifier system basically comprises of a reactor where the gas is generated, and is cooled, cleaned and is burned. The clean combustible gas generated can be used for power generation in diesel-generators or for thermal use by directly supplying to the combustor through an ejector.

The cost benefit analysis of installing dual fuel gasifier system for brass melting is furnished below:

Table 13: cost benefit analysis of installing dual fuel gasifier system for brass melting

Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass melting per batch	600	kgs/batch
2	Coke consumption per batch	80	kgs/batch
3	Cost of Coke	27	Rs
4	Fuel cost per batch	2160	Rs/batch

Gasifier System

Sl.No	Parameter	Details	Units
1	Present quantity of brass melting per batch	600	kgs/batch
2	Wood consumption in gasifier	300	kgs/batch
3	Cost of wood	3	Rs/batch
4	Wood cost per batch	900	Rs/batch
5	Electricity cost	41	Rs/batch
6	Man power cost	80	Rs/batch
7	Furnace oil consumption in gasifier	8	Ltrs/batch
8	Furnace oil cost	200	Rs/batch
9	Total energy cost per batch	1221	Rs/batch

Cost Benefit analysis

Sl.No	Parameter	Details	Units
1	Monetary savings due to wood gasifier system per batch	939.0	Rs/batch
2	No. of batches per day	4.0	batches/day
3	No. of days of operation per annum	300	days/annum
4	Monetary savings per annum	11.3	Rs. lakhs
5	Investment required	15.0	Rs. lakhs
6	Payback period	1.3	years

Table 14: cost benefit analysis of installing gasifier system for Aluminium melting
Present system

S.NO	PARAMETER	VALUE	UNIT
1	Present quantity of aluminum melting per batch	400	kgs/batch
2	Furnace oil consumption per batch	46.5	kgs/batch
3	Cost of furnace oil	30	Rs
4	Fuel cost per batch	1395	Rs/batch

Gasifier System

S.NO	PARAMETER	VALUE	UNIT
1	Present quantity of aluminum melting per batch	400	kgs/batch
2	Wood consumption in gasifier	175	kgs/batch
3	Cost of wood	3	Rs/batch
4	Wood cost per batch	525	Rs/batch
5	Electricity cost	41	Rs/batch
6	Man power cost	80	Rs/batch
7	Total energy cost per batch	646	Rs/batch

Cost Benefit analysis

S.NO	PARAMETER	VALUE	UNIT
1	Monetary savings due to wood gasifier system per batch	749.0	Rs/day
2	No. of batches per day	5.0	batchs/day
3	No. of days of operation per annum	300	days/annum
4	Monetary savings per annum	11.2	Rs.lakhs
5	Investment required	15.0	Rs.lakhs
6	Payback period	1.3	years

Table 15: Gasifier Specification

Sl.No	Parameter	Details
1	Model	GT-700
2	Mode	Burning Application
3	Rated output	200 KW (Can replace up to 50 L/Hr of FO)
4	Design	Down Draft with Throat
5	Fuel	Wood Chips
6	Feed size	2" - 3" (any dimensions)
7	Fuel Consumption	175 Kg/Hour (Corresponds to Max.rated output)
8	Moisture content of fuel	15%
9	Fuel Feeding Cycle	Hourly once
10	Fuel charging	Manually
11	Hopper Holding Capacity	800 Kg (Approx.)
12	Auxiliary Power	6 HP

The coke fired and oil fired melting system replace with wood gasifier system for brass and aluminium melting can be implemented in about 100 units in the cluster. The annual fuel saving is estimated for both coke and furnace oil monetary saving of Rs. 1120 lakhs per

annum. The total investment required for 100 units is Rs. 1500 lakhs and simple pay back period is 1.3 years.

Benefits:

- Low cost of energy cost
- Low operating costs
- Reduces GHG emissions
- Improved combustion
- The fuel feeding can be critically controlled
- Reliable, continuous delivery of cost effective energy and reduces dependence on fossil fuels

3.4.1.2 Wood gasifier for Brass and Aluminium annealing furnaces

The gas generated in the gasifier can be used for supplying heat to the furnace. The gasifier system used for melting purpose can also be used for annealing furnace heat requirement also, as the melting process is carried during day time and whereas annealing is done in the nights.

It is estimated that a minimum of 15% to 20% of the present wood consumption savings can be reduced due to the following reasons:

The cost benefit analysis of installing biomass gasifier system for annealing furnace is furnished below:

Table 16: Cost benefit analysis of installing biomass gasifier system for annealing furnace
Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass annealing per batch	5400	kgs/batch
2	Coke consumption per batch	800	kgs/batch
3	Cost of Coke	4.5	Rs
4	Fuel cost per batch	3600	Rs/batch
5	Present wood consumption	240	tonnes/annum

Cost Benefit Analysis

Sl.No	Parameter	Units	Value
1	Proposed saving of wood on wood gasifier annealing furnace	%	20
2	Present wood consumption	tonnes/annum	240
3	wood savings per annum	tonnes/annum	48
4	Proposed wood consumption	tonnes/annum	192
5	Monetary savings per annum	lakhs	2.16
6	Investment	lakhs	8
8	Pay back period	years	3.5

The wood fired annealing system replace with wood gasifier system for brass and aluminium annealing can be implemented in about 75 units in the cluster. The annual fuel saving is estimated for wood is Rs. 162 lakhs per annum. The total investment required for 75 units is Rs. 600 lakhs and simple pay back period is 3.5 years.

Benefits:

- Improved combustion
- Better control of the furnace temperature and reduces over heating
- Optimum temperature is maintained at 400 ^{o}C to 450 ^{o}C, instead of 550 ^{o}C to 600 ^{o}C at present
- Less radiation losses from the grate
- The fuel feeding can be critically controlled

3.4.1.2.1 Waste heat recovery system for Pit furnaces

Background

There is no heat recovery from the flue gases of the pit furnaces and vented to the atmosphere without any heat recovery.

Recommendation

By install waste heat recovery system for pit furnace, the efficiency of the Energy efficient pit furnace will be increased by atleast 5%. The coke savings is estimated as 30% of the present consumption. The cost benefit analysis of Energy efficient pit furnace is furnished below:

Table 17: Cost benefit analysis for waste heat recovery system for pit furnace
Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass melting per batch	600	kgs/batch
2	Coke consumption per batch	80	kgs/batch
3	Cost of Coke	27	Rs
4	Fuel cost per batch	2160	Rs/batch
5	Present coke consumption	96	tonnes/annum

Cost Benefit Analysis

Sl.No	Parameter	Units	Value
1	Proposed saving of coke on Energy efficient furnace	%	10
2	Present coke consumption	tonnes/annum	96
3	coke savings per annum	tonnes/annum	10
4	Proposed coke consumption	tonnes/annum	86
5	Monetary savings per annum	Rs. Lakhs	1.92
6	Investment	Rs. Lakhs	0.3
7	Pay back period	Months	2

Installing waste heat recovery system for pit furnaces is furnished in the figure below:

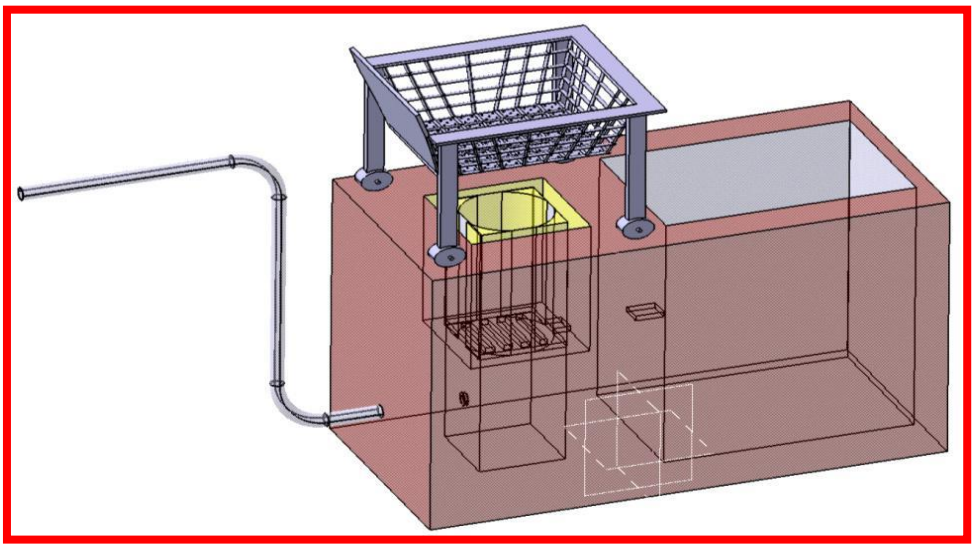

Figure 21: Waste heat recovery system for pit furnace

By installing waste heat recovery system for both coke and oil fired pit furnace for brass and copper melting. These systems can be implemented in about 50 units in the cluster. The annual fuel saving is estimated for both coke and furnace oil monetary saving of Rs. 96 lakhs per annum. The total investment required for 50 units is Rs. 15 lakhs and simple pay back period is 2 months.

Benefits:

- Reduces production cost
- Improves working environment
- Reduces GHG emissions
- Lesser pay-back period

3.4.1.3 Energy efficient pit furnace for brass melting

Background

The pit furnace is a rectangular lined with refractories and the crucible is inserted in the furnace and coke is feeded underneath and sides of the pit furnace. The outer side of the furnace is lined with red bricks. Coke consumption furnished below

Recommendation

It is recommended to install new and Energy efficient pit furnace developed by Zenith Energy Services Pvt Ltd. The main features of the Energy efficient furnace consists of internal circular surface instead of the present rectangular surface for reducing heat absorption by the refractories and also for reducing quantity of coke feeding.

Table 18: Cost benefit analysis of Energy efficient pit furnace

Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass melting per batch	600	kgs/batch
2	Coke consumption per batch	80	kgs/batch
3	Cost of Coke	27	Rs
4	Fuel cost per batch	2160	Rs/batch
5	Present coke consumption	96	tonnes/annum

Cost Benefit Analysis

Sl.No	Parameter	Units	Value
1	Proposed saving of coke on Energy efficient furnace	%	10
2	Present coke consumption	tonnes/annum	96
3	coke savings per annum	tonnes/annum	10
4	Proposed coke consumption	tonnes/annum	86
5	Monetary savings per annum	Rs. Lakhs	1.92
6	Investment	Rs. Lakhs	0.3
7	Pay back period	Months	2

A Energy efficient pit furnace is furnished in the figure below:

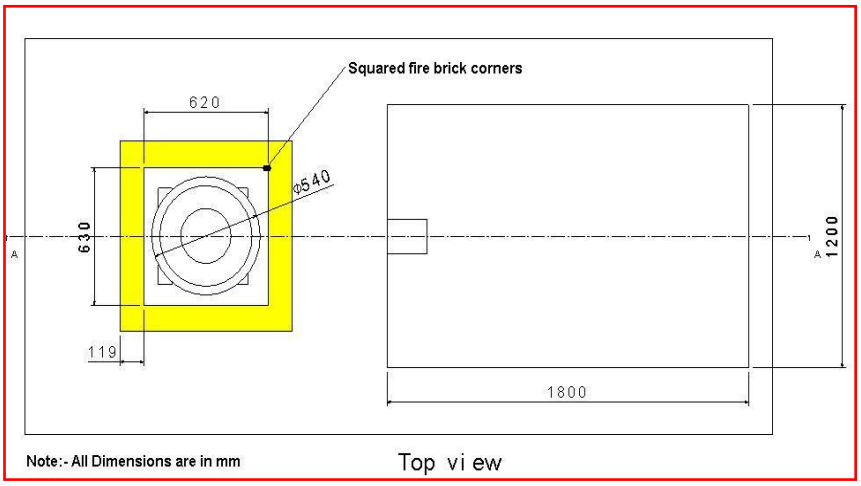

Figure 22: Present pit furnace with squared fire brick corners

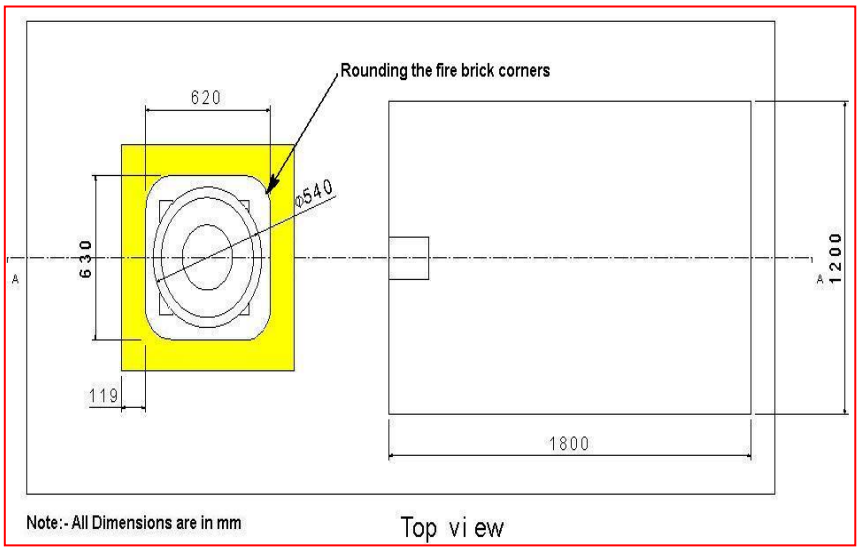

Figure 23: Energy efficient pit furnace by Rounding of fire brick corners

By modifying pit furnace, this modification can be implemented in about 50 units in the cluster. The annual fuel saving is estimated for coke is Rs. 96 lakhs per annum. The total investment required for 50 units is Rs. 15 lakhs and simple pay back period is 2 months.

Benefits:

- Reduces production cost
- Improves working environment
- Reduces GHG emissions
- Lesser pay-back period

3.4.1.4 Modified wood fired annealing furnace (*Source NPC)

Background

The cluster units have wood fired furnace for heat treatment of the brass and aluminium sheets and circles and also reheating of the billets for hot rolling. The low efficiency of the Annealing furnace is due to Lack of instrumentation for monitoring the annealing temperature.

Recommendation

Modified Furnace The modified furnace was designed by NPC and constructed at one of the progressive units in the cluster. The major changes in the modified furnace are:

- Proper flue gas passage provided through the floor of the furnace and provision of chimney with damper, which has created proper draft for the combustion.
- Separate passage for the combustion air through the side of furnace

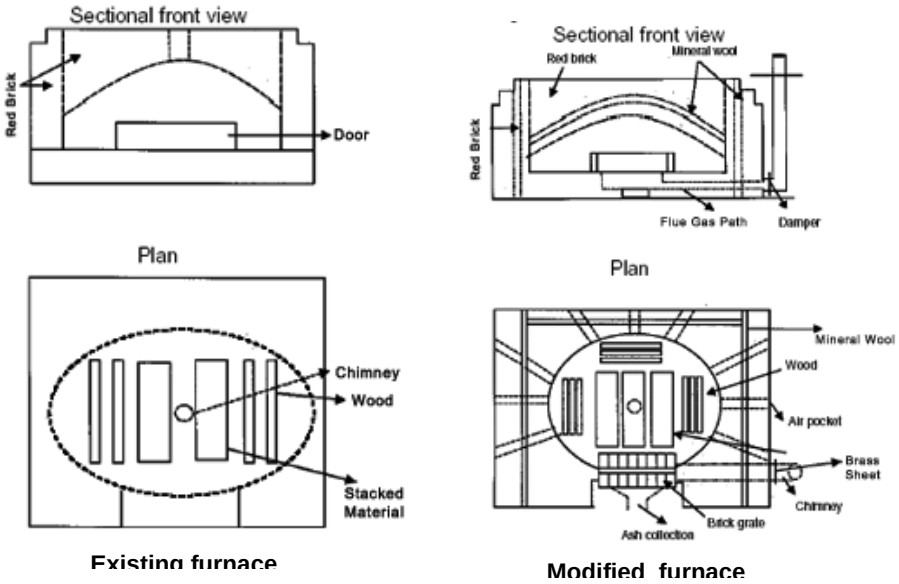

Figure 24: Modified wood fired furnaces

Table 19: Cost benefit analysis for Modified wood fired annealing furnaces
(Source NPC url: http://wmc.nic.in/Newsletters/March%202002.pdf)
Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass annealing per batch	2700	kgs/day
2	Wood consumption per day	400	kgs/day
3	Cost of wood	4.5	Rs
4	Fuel cost per batch	1800	Rs/day
5	Present wood consumption	70	tonnes/annum

Cost Benefit Analysis

Sl.No	Parameter	Units	Value
1	Proposed saving of wood by modifying wood fired furnace	%	30
2	Present wood consumption	tonnes/annum	70
3	wood savings per annum	tonnes/annum	21
4	Proposed wood consumption	tonnes/annum	49
5	Monetary savings per annum	lakhs	0.95
6	Investment	lakhs	0.6
7	Pay back period	Months	7.0

Upgradation existing wood fired furnace with modified wood fired annealing furnace. This installation can be implemented in about 100 units in the cluster. The annual fuel saving is estimated for wood is Rs. 94.5 lakhs per annum. The total investment required for 100 units is Rs. 55 lakhs and simple pay back period is 7 months.

***Benefit*:**

- Reduces fuel consumption
- Mineral wool packing for better heat retention.

3.4.1.5 Installation of Thermocouples for annealing furnaces

Background

The cluster units have wood fired furnace for heat treatment of the brass and aluminium sheets and circles and also reheating of the billets for hot rolling. The low efficiency of the Annealing furnace is due to Lack of instrumentation for monitoring the annealing temperature.

Recommendation

Install thermocouples for annealing furnaces for time to time monitoring.

The temperature is also maintained which leading to reduce fuel consumption.

Thermocouples for annealing furnaces are furnished in the figure below:

Table 20: Cost benefit analysis for Thermocouples for annealing furnaces

Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass annealing per batch	5400	kgs/day
2	Wood consumption per day	800	kgs/day
3	Cost of wood	4.5	Rs
4	Fuel cost per batch	3600	Rs/day
5	Present wood consumption	240	tonnes/annum

Cost Benefit Analysis

Sl.No	Parameter	Units	Value
1	Proposed saving of wood by installing thermocouples	%	10
2	Present wood consumption	tonnes/annum	240
3	wood savings per annum	tonnes/annum	24
4	Proposed wood consumption	tonnes/annum	216
5	Monetary savings per annum	lakhs	1.08
6	Investment	lakhs	0.5
7	Pay back period	Months	6

By installing thermo couples for wood fired annealing furnace. This installation can be implemented in about 150 units in the cluster. The annual fuel saving is estimated for wood is Rs. 162 lakhs per annum. The total investment required for 150 units is Rs. 75 lakhs and simple pay back period is 6 months.

***Benefit*:**

- Reduces fuel consumption
- Improves working environment for workers due to proper monitoring of temperatures

3.4.1.5 Induction furnaces for brass and copper melting

Background

Based on the detailed energy audits conducted in various units of the cluster, the operating thermal efficiency levels of the present traditional pit furnaces are in the range of 8 to 15%. Further, the brass and copper melting with coke and furnace oil is costly and cost of these fuels is ever increasing in future due to more demand for the fossil fuels.

Recommendation

- Fuel wastage, pollution due to flue gases and oxidation of material is reduced and quality of material is improved.
- Overall thermal efficiency is more compared to present pit fired furnaces.
- Reduces GHG emissions

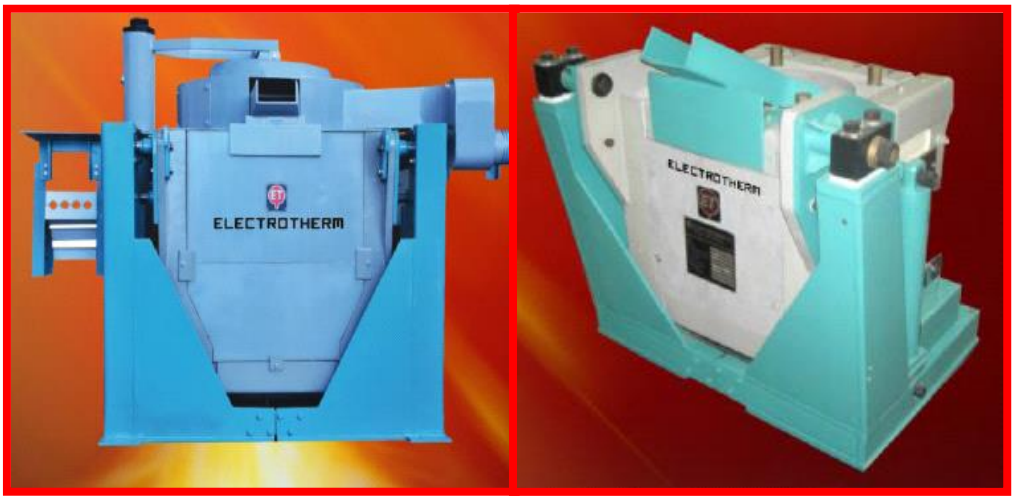

Figure 26: Induction furnace

The cost benefit analysis of installing induction furnace system for brass melting is furnished below:

Table 21: Cost benefit analysis for induction furnace system

Present system

Sl.No	Parameter	Details	Units
1	Present quantity of Brass melting per batch	600	kgs/batch
2	Coke consumption per batch	80	kgs/batch
3	Cost of Coke	27	Rs
4	Fuel cost per batch	2160	Rs/batch

Induction System

Sl.No	Parameter	Details	Units
1	Present quantity of brass melting per batch	600	kgs/batch
2	Electricity consumption in induction furnace	200	kWh/batch
3	Cost per unit	4.5	Rs/batch
4	Electricity cost per batch	900	Rs/batch
6	Man power cost	80	Rs/batch
9	Total energy cost per batch	980	Rs/batch

Cost Benefit analysis

Sl.No	Parameter	Details	Units
1	Monetary savings due to induction furnace per batch	1180	Rs/batch
2	No. of batches per day	4	batches/day
3	No. of days of operation per annum	300	days/annum
4	Monetary savings per annum	14.16	Rs. lakhs
5	Investment required	18.6	Rs. lakhs
6	Payback period	1.3	years

Table 22: Induction Furnace Specification

Sl.No	Parameter	Details
1	MF Output Power Rated (KW)	250
2	At Input KVA	289
3	Line PF at full load	0.94
4	Power Supply Unit Input Voltage(Nominal) (Volts)	415
5	Frequency (Hz)	500
6	MF Output Voltage (Volts)	850
7	Power Supply Unit Efficiency (%)	94
8	Nominal Capacity of furnace in Kg for Copper / Brass	750
9	Melting Rate of Copper / Brass (•)	Copper at 12000 C- 720 Kg/Hr Brass at 9500 C - 810 Kg/Hr
10	Water Storage capacity of emergency overhead tank in liters	2500

The coke fired and oil fired melting system replace induction furnace for brass and copper melting can be implemented in about 30 units in the cluster. The annual fuel saving is estimated for both coke and furnace oil monetary saving of Rs. 424 lakhs per annum. The total investment required for 30 units is Rs. 558 lakhs and simple pay back period is 1.3year.

Benefits:

- Reduces energy consumption and hence effects the production cost
- Reduces GHG emissions due to reduction in electricity consumption
- More discharge for the same power consumption and hence reduces processing time
- Reduces maintenance costs due to improved quality of material.
- Reduces production down time.

3.4.2 Life cycle analysis for the suggested Energy saving proposals

The life cycle analysis for each of the suggested energy saving proposal has been prepared as per the Indian industry norms, government policies, and as per the guarantee provided by the equipment/technology suppliers and presented below .

Table 23: Life cycle analysis for energy saving proposals suggested

Sl.No	Energy Saving Proposal	Life cycle analysis
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	The life of the Wood Gasifier is considered at 20 years. The depreciation is considered at 80% by straight line method.
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	The life of the Wood Gasifier is considered at 20 years. The depreciation is considered at 80% by straight line method.
3	**Waste heat recovery system for Pit furnaces**	The life of the Waste heat recovery system is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
4	**Energy efficient Pit fired furnace for Brass or copper melting**	The life of the Energy efficient Pit fired furnace is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
5	**Modified wood fired annealing furnace (*Source NPC)**	The life of the Thermocouples is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
6	**Installation of Thermocouples for annealing furnaces**	The life of the Thermocouples is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
7	**Induction furnaces for brass and copper melting**	The life of the Induction furnaces is considered at 20 years. The depreciation is considered at 5.28% by straight line method.

3.4.3 Cost of Implementation

The investment required for various proposals identified for different capacities of the measures identified for **Jagadhri Brass and Aluminium** Cluster is furnished below.

Table 24: Details of cost of implementation

Sl.No	Equipment Details	Capacity	Investment (Rs. In Lakhs)
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	200 kWe	15.0
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	75 kWe	8.0
3	**Waste heat recovery system for Pit furnaces**	600 kg capacity	0.3
4	**Energy efficient Pit fired furnace for Brass or copper melting**	600kg capacity	0.3
5	**Modified wood fired annealing furnace (*Source NPC)**	2000 kg capacity	0.6
6	**Installation of Thermocouples for annealing furnaces**	2000 kg capacity	0.5
7	**Induction furnaces for brass and copper melting**	250 kW	18.6

3.4.4 Monetary savings

As per the detailed audits carried out on various equipments of **Jagadhri Brass and Aluminium** Units, the monetary savings have been estimated for each proposal and the details are furnished below:

Table 25: Energy saving details for the suggested energy saving proposals

Sl. No	Equipment Details	Investment (Rs. in Lakhs)	Monetary savings (Rs. in lakhs)	Payback period (years)
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	15.0	11.3	1.3
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	8.0	2.16	3.5
3	**Waste heat recovery system for Pit furnaces**	0.3	1.92	0.2
4	**Energy efficient Pit fired furnace for Brass or copper melting**	0.3	1.92	0.2
5	**Modified wood fired annealing furnace (*Source NPC)**	0.6	0.95	0.6
6	**Installation of Thermocouples for annealing furnaces**	0.5	1.08	0.5
7	**Induction furnaces for brass and copper melting**	18.6	14.6	1.3

3.4.6 Issues/barriers in implementation of EE proposals

The major barriers identified for implementation of the proposals in the cluster units are described below:

- One of the major barriers is the lack of awareness and information among the cluster owners on energy / monetary losses, EE technologies, and energy efficiency. A few demonstration projects may motivate them to take up the projects.
- About 80% of the cluster unit owners doesn't have financial strength for implementation of high cost technologies like wood gasifier. However, the owners are interested to implement low cost measures having quick payback periods of less than 1 year.
- Though, LSPs are available in the cluster, they don't have technical strengths for supply of efficient equipments.
- Production loss during implementation of the energy saving proposals

3.4.7 Availability of Technologies in Local / National

For majority of the technologies and proposals identified, the equipments suppliers/ dealers / branch offices are available locally in **Jagadhri**. The high investment technologies like Induction furnaces need to be procured from other places like Delhi. Among the technologies / equipments identified for implementation for **Jagadhri Brass and Aluminium** cluster units, some of the measures can be implemented by the local service providers and the balance equipments can be procured at nearest city i.e., Delhi or Ambala. The details of equipment which can be implemented by LSPs and those needs to be procured from other cities is furnished below :

Table 26: Details of technologies available for the suggested proposals

Sl.No	Equipment details	LSPs	India (Delhi, Gujarat)
1	Wood Gasifier for Brass and Aluminium melting furnaces	√	
2	Wood Gasifier for Brass and Aluminium Annealing furnaces	√	
3	Waste heat recovery system for Pit furnaces	√	
4	Energy efficient Pit fired furnace for Brass or copper melting	√	
5	Modified wood fired annealing furnace (*Source NPC)	√	
6	Installation of Thermocouples for annealing furnaces		√
7	Induction furnaces for brass and copper melting		√

Note: √ Available

3.5 Identification of Technologies/Equipments for DPR preparation

The majority of the industries in the cluster are engaged in the processing of brass and Aluminium sheets, circles and utensils. The manufacturing processes and equipments installed are identical for most of the cluster units.

Based on the detailed studies carried out, there is considerable potential in all cluster units for energy conservation and efficiency.

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

The technologies/equipments considered for preparation of detailed project report are furnished in Table 26:

Table 27: The list of technologies for DPR preparation

Sl.No	Technology/equipment	No. of DPR's	Capacities
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	3 no	200 kWe
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	3 no	75 kWe
3	**Waste heat recovery system for Pit furnaces**	3 no	600 kg capacity
4	**Energy efficient Pit fired furnace for Brass or copper melting**	2 no	600kg capacity
5	**Modified wood fired annealing furnace (*Source NPC)**	1 no	2000 kg capacity
6	**Installation of Thermocouples for annealing furnaces**	2 no	2000 kg capacity
7	**Induction furnaces for brass and copper melting**	2 no	250kW

3.6 Environmental benefits

3.6.1 Reduction in GHG emissions

The major GHG emission reduction source is CO_2 due to implementation of the technologies identified, as the technologies will reduce fossil fuels like coke and furnace oil consumption.

3.6.2 Reduction in other emissions

The technologies identified upon implementation for the **Jagadhri Brass and Aluminium** cluster units will reduce wood, coke and furnace oil consumption. The reduction in coke and

furnace oil consumption will reduce sulphur dioxide and Suspended Particulate Matter (SPM) emissions to the atmosphere. The sulphur content is varying from 0.6% to 0.8% in the imported coke and the quantity of sulphur dioxide emission reductions due to reduction in firewood, coke and furnace oil consumption in the cluster units is estimated as coke saving 4,199 tons/annum, fire wood savings 9311 tons/annum and furnace oil saving 2,027 kilo liters/annum (Refer table 28)

Table 28: Estimated annual fuel savings in the cluster

Sl. No	Energy conservation measure	Annual Energy/Fuel saving	Annual Monetary saving (Rs. lakhs)	Implementation cost (Rs. Lakhs)	Simple payback period (Years)	Issues in implementation	Short listed for DPR preparation (Yes/No)	No of units this can be implemented	Annual energy saving potential in cluster
1	Wood gasifier for (coke fired melting)	42 tons of coke	11.3	15	1.3	• Lack of awareness on EC measures • Cost of implementation	Yes	50	2093 tons of coke
2	Wood gasifier for (oil fired melting)	37 kiloliters of furnace oil	11.2	15	1.3		Yes	50	1867 kilo liters of furnace oil
3	Wood gasifier for annealing	48 tons of wood	2.16	8	3.5		Yes	75	3600 tons of wood
4	Waste heat recovery for (coke fired melting)	7.1 tons of coke	1.92	0.3	0.2	• Lack of awareness on EC measures	Yes	25	178 tons of coke
5	Waste heat recovery for (oil fired melting)	6.4 kilo liters of furnace oil	1.92	0.3	0.2		Yes	25	160 kilo liters of furnace oil
6	Energy efficient pit furnace for (coke fired melting)	7.1 tons of coke	1.92	0.3	0.2		Yes	50	356 tons of coke
7	Modified wood fired annealing furnace (*Source NPC)	21.1 tons of wood	0.95	0.6	0.6	• No confidence on saving	Yes	100	2111 tons of wood
8	Thermo couples for annealing furnace	24 tons of wood	1.08	0.5	0.5	• Lack of awareness on EC measures	Yes	150	3600 tons of wood
9	Induction furnace for melting	52.4 tons of coke	14.16	18.6	1.3	• Cost of implementation	yes	30	1573 tons of coke

S. No	Fuel	Total fuel savings/annum in the cluster
1	Coke	4199 tons
2	Furnace oil	2027 klts
3	Wood	9311 tons

CHAPTER 4
Systematic Approach for Energy Conservation by TEM/SGA

4.1 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

4.2 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 intelligentia 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.

4.3 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.

4.4 Total Energy Management (TEM)

Every point in factories has potential for Energy Conservation. Total Energy Management is implemented, by all the people's participation, step by step utilizing "Key Step Approach" in a systematic manner, as shown below:

1) Top management policy/Goal
   - Develop a policy statement
   - Set targets
2) Proper EC Organization including Assignment of Energy Manager
   - Establish proper EC organization (utilizing SGA)
   - Assignment of Energy Manager
3) Data collection and Analysis
   - Collect data on current energy use
   - Analyze the collected data
   - Identify management strength and weakness
   - Analyze stakeholders' needs
   - Anticipate barriers to implement
   - Estimate the future trend
4) Selecting EC Measures/Projects
   - Selecting EC Measures
   - Selecting EC Projects
   - Make out a plan/program
5) Prioritizing
6) Developing an Action Plan
7) Training the related members
8) Awareness-raising and Motivation
9) Implementing the Action Plan (including monitoring and controlling
10) Evaluation (Management review)
11) Analysis for future planning (Standardization and Dissemination)

The following figure shows these Key Steps for implementing Energy Conservation activities.

Steps of the Key Step Approach.

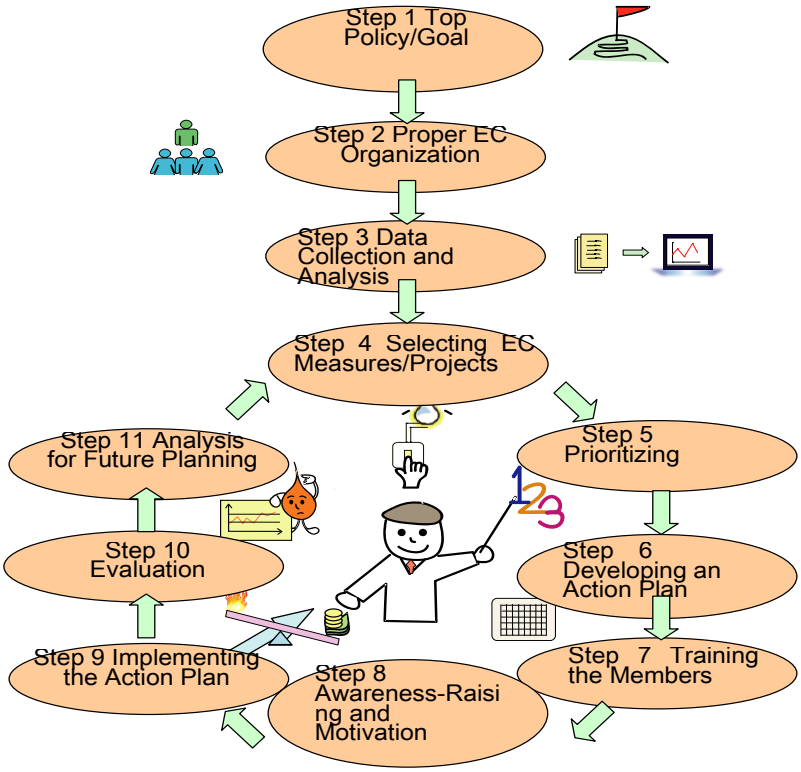

Figure 27: Key Step Approach

Each step is explained in this order as below:

Step 1 : Top Management policy/Goal

It is the most important for the success of Energy Conservation activities within companies or factories to have clear and official commitment of top management – either the corporate top (senior) management or factory managers. The top (senior) management shall announce explicit commitment to the Energy Management (or Energy Conservation) and behave along this line – for example, participate in EC (Energy Conservation) events and encourage the people there for EC promotion.

This Handbook is primarily meant for Energy Managers for the use of EC promotion within factories, on the assumption that top management has already committed to that. However, there may be cases where top management would learn about Energy Management (or Energy Conservation) by this Handbook, or Energy Managers would make efforts to persuade top management to support or commit to Energy Management (or Energy Conservation) with the help of this Handbook.

(1) Develop a policy statement

It is desired that the top (senior) management announces the "Energy Policy Statement". This is very effective to let people inside and outside the company clearly know the management's commitment to Energy Management (or Energy Conservation). The format of the energy policy statement is various, but it usually includes the goal or objective of the company and the more concrete targets in the field of Energy Management (or Energy Conservation). It often shows the major measures and timetables. The statement shall match the company's mission statement or overall management strategy plan.

(2) Set targets

The targets shall be concrete and specific so that everyone can understand it.

Step 2 : Proper EC Organization including Assignment of Energy Manager

In some countries, where the EC Promotion Act is in force, the designated factories have obligation of assigning Energy Managers. In relation to Energy Management, however, the word "Energy Managers" is here used as a Manager or a Coordinator, separate from the above-said legal obligation, who works exclusively for Energy Management (or Energy Conservation) purposes, ranging from gathering energy-related information to drafting EC plans/programs and promoting or coordinating during implementation. To the proper Energy Management, this type of Energy Manager is indispensable. How to position this Energy Manager within the company organization is also an important issue and needs careful decision. In some cases, Energy Committee, with members from the major departments, may be formed to assure the company-wide or factory-wide cooperation, as shown in the following figure.

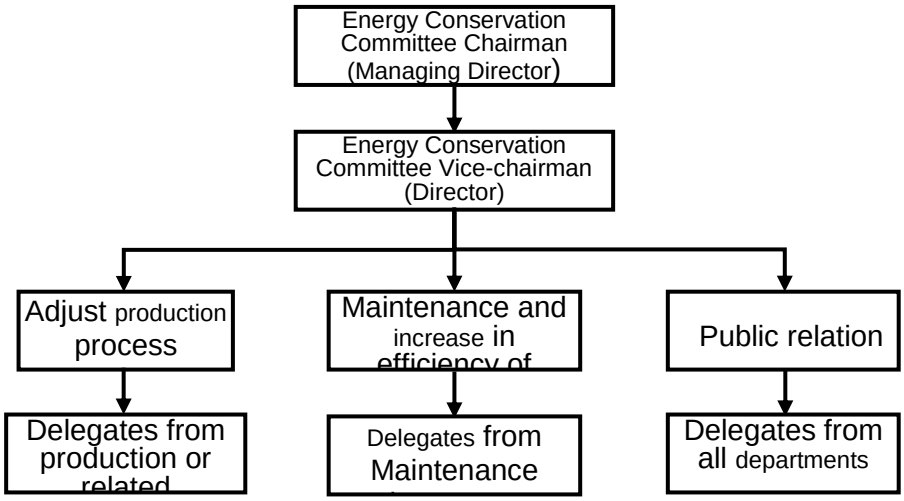

Figure 28: Example of energy conservation committee's organization

Actually there are many ways of forming EC organization, depending on the situation of factories or institutions, such as the size, kind of business, etc. In any case, it is very effective to utilize SGA (Small Group Activities) and there are also many ways to do that. The important thing is to design and make out the organization carefully to meet the purpose. In practical sense to do that, there may be the following five widely applicable ways of establishing the organization.

(1) Utilize Line (Formal) Job-related Organization for TEM purpose

(2) Use TPM Organization for TEM purpose

(3) Use TQM Organization for TEM purpose

(4) Add Employee Suggestion System to Energy Conservation Organization for TEM purpose

(5) Utilize another organization for TEM purpose

The easy and practical way may be starting from easy form of TQM, or QCC (Quality Control Circle) activities.

Furthermore, because TPM is closely related to job-related organization, (1) and (2) may be often give the same kind of results. (An example of this form is shown in Part 3, 2 "How is SGA related to Energy Conservation?" (page 21).

Step 3 : Data collection and Analysis

Before trying to make out any future programs or action plans, it is essential for the company or factory management to understand the current situation in a proper and accurate manner. This includes not only the status of their own operation but also other relevant information such

as competitors' operation, circumstances around the company and their trend in future, positioning the company itself in the local and global markets, and so on.

The key steps for this purpose are shown below:

(1) Collect data on current energy use and analyze them

The current data of energy consumption shall be obtained by measurement, calculation or estimation for the individual operation units (energy cost centers) with classification of kinds of energy (fuels types, utility types, etc.). The data shall be gathered regularly and arranged/summarized daily, weekly, monthly, by seasons or annually. Then the data shall be checked for the past historical trend and interpreted with relation to operational modes and production scales. That shall also be utilized for the forecast of future trends.

(2) Identify Management Strength and Weakness

Then the data shall be compared with the best practice data or benchmarks in the industry. If such reference data are hardly available, the historical data of their own operation and estimated data for the competitors would be utilized for this purpose. At the same time, the strength and the weakness of the company shall be evaluated considering the competitors' situations in the local and global markets. This would serve the purpose of making out a realistic Energy Management plan later.

(3) Analyze stakeholders' needs

Stakeholders are top (and senior) management, middle managers, staff/engineers and workers/operators. Other stakeholders in the normal business sense, such as the shareholders and lenders, need not be considered here for the moment. The needs and intention of those stakeholders shall be summarized and taken into consideration.

(4) Anticipate barriers to implement

Making out a realistic and practical program also needs consideration of anticipated barriers for the implementation of Energy Management program or action plan.

Some possible examples of such barriers are:

- Insufficient understanding and support by top management
- Insufficient understanding and cooperation of managers within factories
- Insufficient awareness of people to get successful results
- Insufficient capability of people due to lack of training
- Insufficient available technology due to lack of information
- Insufficient availability of manpower for EC activities within factories
- Insufficient budget for EC activities due to the company's financial status

(5) Estimate the future trend

The future trend of energy supply-demand balance is estimated based on checking and analysis of the historical data. That data of future trend would also be a basis of the program of excellent Energy Management.

In analyzing the collected data and developing ideas of Energy Conservation, it is very often useful to think of the following techniques of finding problems and solutions:

Suppress: Using during the time in which it is not necessary to use. Examples include using electricity before or after working hours or when there is no one working.

Stop: Using equipment when it is not necessary. Examples include using all lightings during break time.

Reduce: Amount, pressure, temperature, speed, or brightness, or quality that exceed requirement. Examples include reducing intensity of lighting if not necessary.

Prevent: Prevent leakage or loss of energy. Examples include reducing space that leads to outside in order to prevent the leakage of heat into air.

Improve: Improve or repair machines to increase efficiency or modify manufacturing process to the one which enables us to conserve energy more. Examples include changing transparent sheet over the roof.

Store: Re-use the discarded energy. Examples include re-using heat from exhaust fume in order to reduce use of electric heater to warm heavy oil.

Change: Change how to use, type of energy, or energy sources to a suitable one from technical or economic point of view. Examples include changing the grade of heavy oil to an appropriate one or changing furnace systems or welding machines to the ones that use gas.

Increase Production

Examples include improving production process. This will lead to the reduction of energy usage per production amount.

Step 4: Selecting EC Measures/Projects

Based on the aforesaid understanding of the current status and position of the company (factory), various EC measures are studied and many EC Projects are proposed. Comparison among these measures and projects are made with consideration of a lot of factors, such as technical, economic, intangible, and so on.

Then a plan/program is developed based on these study results. To do this, it is very important to consider the following issues:

The plan/program shall be realistic, practical and attainable with due consideration of many related elements and management resources of the company or factory. It also shall be expressed in terms of the measurable or quantifiable parameters, including Fuel Usage Index, Electricity Usage Index, Energy Usage Index, etc. It usually includes a lot of managerial measures of Energy Management (or Energy Conservation) promotion activities such as motivation techniques, means to improve awareness, training, and so on. In other words, the following items are often useful in comparing and selecting alternative plans:

1. Effects of energy conservation: Activities that can conserve energy more than others are more promising.
2. Investment amount: Activities that require less investment are more promising.
3. Pay-back period: Activities with short pay-back period for investment amount in equipment are more promising because all energy conservation will be profits after pay-back period.
4. Length of implementation: Activities that can be performed in a short period are more promising because they do not influence production process of the factory.
5. Number of personnel required: Activities that require a large number of personnel tend to be burdensome.
6. Importance to executives and reputation of the company: Some activities provide little financial benefit but cause good image or reputation.
7. Risk of the project: Some activities bring about big financial benefits but involve high risk from various factors. In this case projects have less importance.

Step 5: Prioritizing

Many EC measures and projects are prioritized based on the internal studies including comparison among their alternatives, in the manner explained in the above.

Step 6 : Developing an Action Plan

The priority consideration then gives birth to the Action Plan. The plan shall be clear, practical and comprehensive with proper schedule and budgeting.

Shown below is an example of such a plan.

Table 29: Example of energy saving plan

Detail of the plan	Length (Months)						Person in charge	Budget	Inspected by
	1	2	3	4	5	6			
1. Turn off electricity when there is no one around							Mr. Prayat		
2. Turn off air-conditioner 30 minutes before stop working							Miss Aom		
3. Reduce welding machine's current according to the specification of the metal used for welding							Mr. Matthayas		
4. Close welding machine after working							Miss Thanom		

Step 7: Training the related members

This issue is very important to secure the success of project Implementation, because the people is the most important resources that determines the success of the plan.

Step 8: Awareness-raising and Motivation

To have the total power of "all members' participation" combined together, it is also very crucial how to raise awareness and motivation of related people within the company (or factory).

Shown below is an example of awareness raising plan.

Table 30: Example of awareness raising campaign

Detail of the plan	Length (Months)						Person in charge	Budget	Inspected by
	1	2	3	4	5	6			
1. Display the results of energy conservation every month	*	*	*	*	*	*	Mr.Prayat	-	Mr. Laaied
2. Evaluate every month	*	*	*	*	*		Miss Aom	-	Mr. Laaied
3. Perform energy conservation activity every 6 months	*					*	Mr. Matthayas	-	Mr. Laaied
4. Perform "Finding measures" activity in order to make energy conservation plan	*					*	Miss Thanom	-	Mr. Laaied
5. Provide rewards to sections that have achieved high efficiency						*		-	

Step 9: Implementing the Action Plan (including monitoring and controlling)

The organizational force established in the said planning step shall be utilized fully to ensure smooth implementation of the program. Energy Manager and/or the committee shall continue working to promote the activities and report to top management on the status quo.

The actual records of implementation shall be closely watched and monitored. If some problems arise, or some variance between the planned figures and the actual record is observed, then necessary actions shall be taken immediately.

Step 10 : Evaluation (Management Review)

After the program is completed, the report shall be submitted to the top (senior) management. The results shall be assessed and analyzed for any good and bad points. The lesson shall be utilized as a feedback in the subsequent plan/program.

Thus the activities are repeated to form a cyclic movement.

The result of evaluation must be announced on the board in order to inform employees, so that they will be given motivation for the next activities. Evaluation can be divided into 2 types as follows.

- Short-term evaluation for the follow-up of the performance
- Long-term evaluation for the evaluation of the whole project that will be used for the future planning

Evaluation can be made in the following 3 levels.

1. **Self Audit:** Self evaluation that is made in a small group or a department based on the predefined form. (Inspection may be made every month).
2. Upper **Manager Audit:** Evaluation that is made by the section/department manager intended to raise performance of the activity. (Inspection may be made every 3 month).
3. **Top Management Audit:** Evaluation made by the executives of the organization that will be used for the evaluation of annual bonus. (Inspection may be made every 6 month).

In some cases, top management could think of adopting external people (outside consultants) to evaluate the results of Energy Conservation activities. Even in those cases, internal evaluation should be made to gain the fruits as much as possible.

Step 11 : Analysis for future planning (Standardization and Dissemination)

The successful results and the lessons learned are to be analyzed and arranged into the standard form which can be easily utilized by anyone in the factory. The standardized documents or information are to be disseminated all over the company.

Moreover, Energy Conservation should be incorporated as a part of daily jobs and performed continuously in a systematic manner. For this purpose, activities for energy conservation must be incorporated as a part of company's basic or business plan. If a problem is found as a result of evaluation, improvement or modification will be done and the objectives will be achieved. If the results reach or exceed the objective, information must be gathered in order to set it as a "Work Standard," which will be used in setting a new activity plan.

4.4 Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the cumination 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.

4.5 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 28.

4.6 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.

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

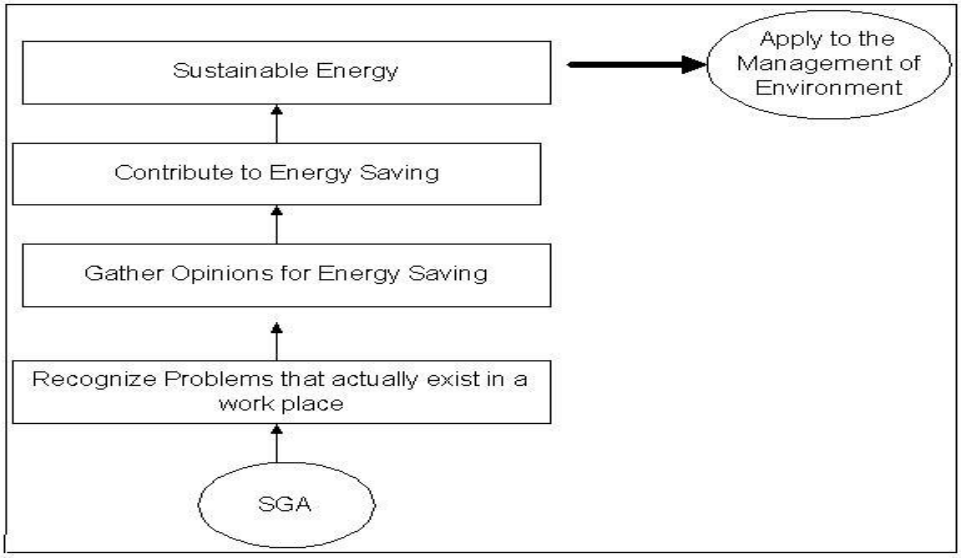

Figure 29: Relationship of SGA and energy saving

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.

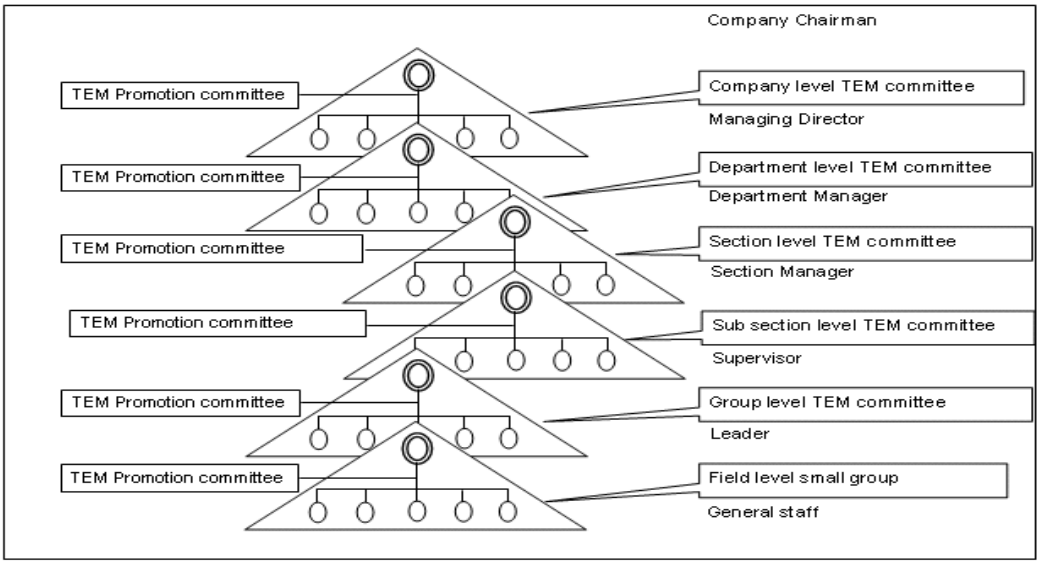

Figure 30: Positioning of SGA in Main Job Structure

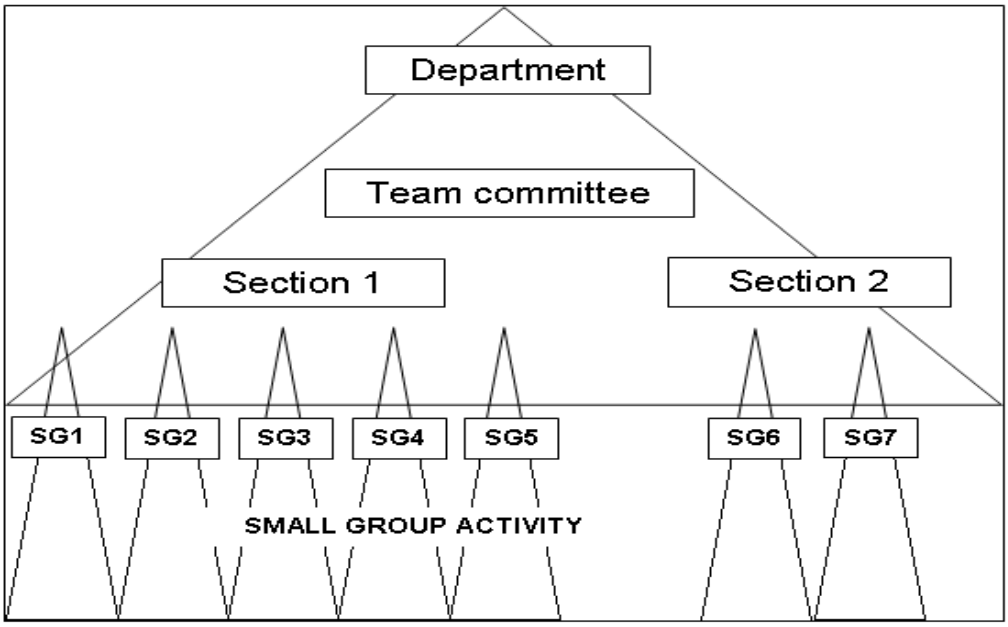

Figure 31: Positioning of SGA in Main Job Structure

4.7 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

4.8 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

4.9 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

4.10 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

4.11 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

4.12 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

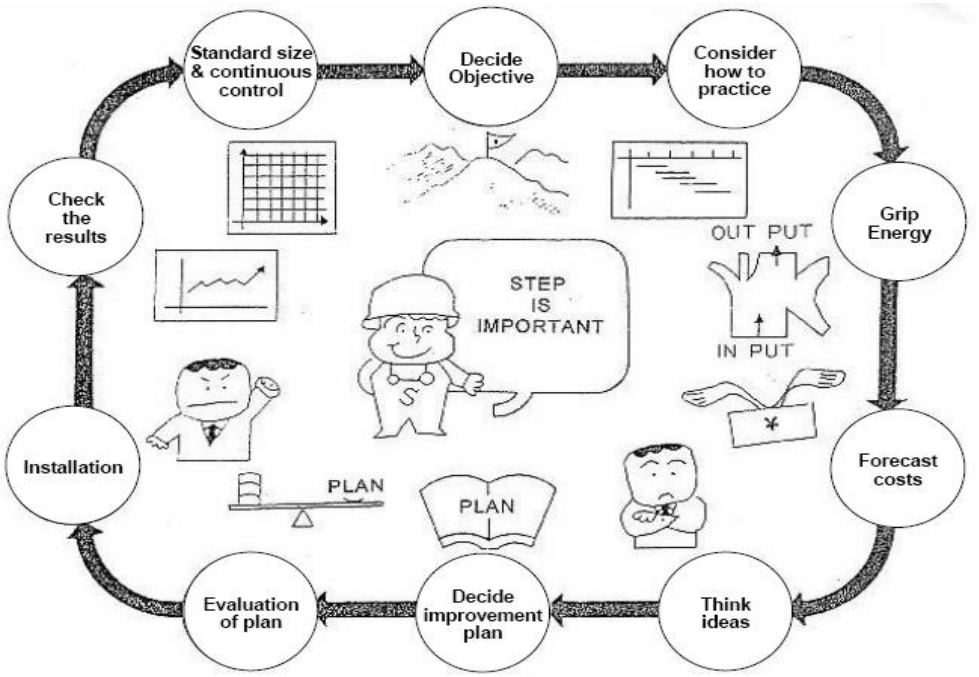

Figure 32: Steps of Small Group Activities

- 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

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.

Figure 33: SGA

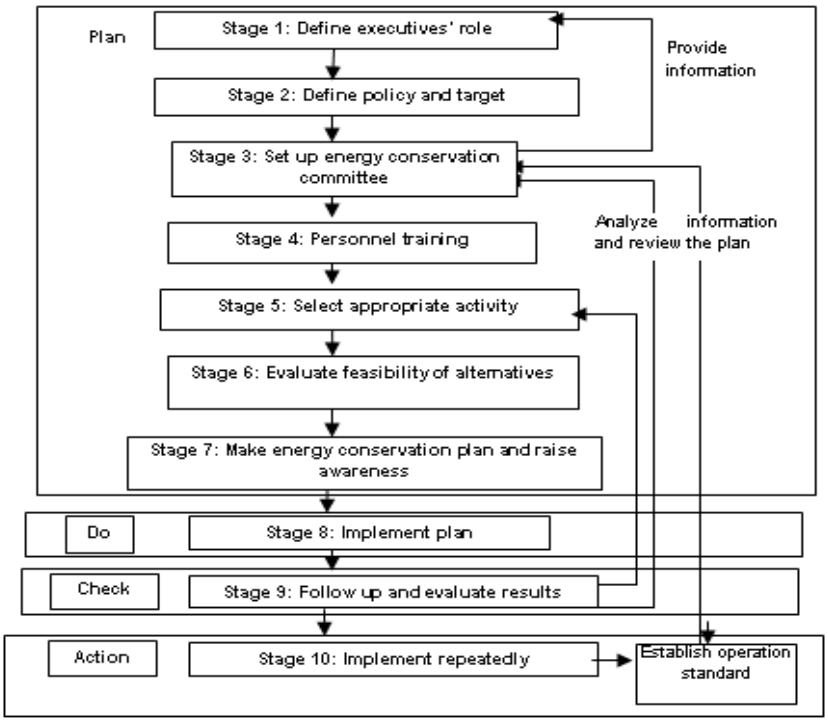

Figure 34: 10 STAGES

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

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.

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.

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.

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.

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

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.

Stage 8: Implement Plan

Implement according to the plan of each group.

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.

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.

4.13 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.

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

4.14.1 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-

Figure 35: Five steps

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) Seito / 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.

4.15 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.

CHAPTER 5
CONCLUSIONS

5.1 Summary of Energy saving measures identified for the Cluster

The summary of the energy saving proposals identified for **Jagadhri Brass and Aluminium** units is furnished below in Table 30:

Table 30: Summary of energy saving proposals identified for Jagadhri Brass and Aluminium cluster

Sl. No	Energy Saving Proposals
1	Wood Gasifier for Brass and Aluminium melting furnaces
2	Wood Gasifier for Brass and Aluminium Annealing furnaces
3	Waste heat recovery system for Pit furnaces
4	Energy efficient Pit fired furnace for Brass or copper melting
5	Modified wood fired annealing furnace (*Source NPC)
6	Installation of Thermocouples for annealing furnaces
7	Induction furnaces for brass and copper melting

5.2 Technology gap assessment for Energy saving proposals Identified for the Cluster

The technology gap assessment had been carried for each of the energy saving proposal recommended and is furnished below .

Table 31: Technology gap assessment for the suggested energy saving proposals

Sl.No	Technology Identified	Gap Assessment
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	• Energy Cost is more by using coke and furnace oil • Low efficient due to heat storage in the refractories and more space for coke feeding and more heat in waste flue gases • No control on fuel feeding through out the process
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	• No control on fuel feeding through out the process • There is no uniform distribution of the temperature in the furnace and is found to be varying at different locations. • The temperature is higher than required due to uncontrolled charging of wood leading to high fuel consumption.
3	**Waste heat recovery system for Pit furnaces**	• The high temperature waste flue gases is vented to the atmosphere without any heat recovery

4	**Energy efficient Pit fired furnace for Brass or copper melting**	• Inferior design of the pit furnace with squared fire brick structure and hence more heat storage in the refractories and more space for coke feeding though, it is not required. • High radiation losses through side walls and from the opening of the crucible
5	**Modified wood fired annealing furnace (*Source NPC)**	• There is no proper provision for supplying combustion air and the combustion air intake and flue gas exit takes place from the front door through which material is being fed • Inadequacies in maintaining and controlling uniform furnace temperature resulting in uneven surface hardness
6	**Installation of Thermocouples for annealing furnaces**	• No temperature monitoring system and controlling • The temperature is also higher than required due to no monitoring system which leading to high fuel consumption.
7	**Induction furnaces for brass and copper melting**	• The Un burnt coke left underneath the pit furnace is continued to burn even after the completion of the melting process • Due Inferior design of the pit furnace overall thermal efficiency is low.

5.3 Techno–Economic analysis for suggested Energy saving proposals

The details of techno economic analysis of various energy saving proposals identified for **Jagadhri Brass and Aluminium** units is furnished below

Table 32: Techno – Economic analysis for various energy saving proposals suggested

Sl.No	Energy saving proposal	Techno economic analysis	Remarks
1.	**Wood Gasifier for Brass and Aluminium melting furnaces**	• The technology will replace inefficient pit furnaces and also reduces production cost due to avoid of costly fuels like coke and furnace oil • High investment and lower payback period	Technically and financially viable
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	• The technology will replace inefficient annealing furnaces and also reduces production cost and energy cost. • There is uniform distribution of the temperature in the furnace. • Control on fuel supply through out the process	Technically and financially viable
3	**Waste heat recovery system for Pit furnaces**	• The technology will upgrade the pit furnace with waste heat recovery system for pre-heating the charge.	Technically and financially viable

4	**Energy efficient Pit fired furnace for Brass or copper melting**	• The technology will upgrade the pit furnace with Energy efficient pit furnace consists of internal circular surface instead of the present rectangular surface for reducing heat absorption by the refractories and also for reducing quantity of coke feeding. • The refractories used are partially reflective type and hence the heat transfer will be higher.	Technically and financially viable
5	**Modified wood fired annealing furnace (*Source NPC)**	• The technology will upgrade the annealing furnace with modified wood fired annealing furnace	Technically and financially viable
6	**Installation of Thermocouples for annealing furnaces**	• The technology will upgrade the annealing furnace with thermocouples for time to time monitoring. • The temperature is also maintained which leading to reduce fuel consumption.	Technically and financially viable
7	**Induction furnaces for brass and copper melting**	• The technology will replace inefficient pit furnaces and also reduces production cost due to avoid of costly fuels like coke and furnace oil • High investment and lower payback period.	Technically & financially viable

5.4 Barriers in Implementation of identified Energy saving proposals

Table 33: Barriers in implementation for various energy saving proposals suggested

Sl.No	Energy saving proposal	Barriers identified	Steps to overcome barriers
1	**Wood Gasifier for Brass and Aluminium melting furnaces**	• High initial investment • Lack of Skilled manpower • Space availability • Lack of interest to invest high investment	• Providing soft loans and subsidies may motivate the unit owners for implementation • Training programs, Demonstration and motivation • Identifying the units having space for implementation
2	**Wood Gasifier for Brass and Aluminium Annealing furnaces**	• High initial investment • Lack of Skilled manpower • Space availability	• Providing soft loans and subsidies may motivate the unit owners for implementation

		• Lack of interest to invest high investment	• Training programs, Demonstration and motivation • Identifying the units having space for implementation
3	**Waste heat recovery system for Pit furnaces**	• Lack of knowledge on the benefits and economics	• A few Demonstration projects in the cluster will disseminate the technology
4	**Energy efficient Pit fired furnace for Brass or copper melting**	• Lack of knowledge on the benefits and economics	• A few Demonstration projects in the cluster will disseminate the technology
5	**Modified wood fired annealing furnace (*Source NPC)**	• Lack of knowledge on the benefits and economics	• A few Demonstration projects in the cluster will disseminate the technology
6	**Installation of Thermocouples for annealing furnaces**	• Lack of knowledge on the benefits and economics	• A few Demonstration projects in the cluster will disseminate the technology
7	**Induction furnaces for brass and copper melting**	• High initial investment • Space availability • Lack of interest due to high initial investment	• Providing soft loans and subsidies may motivate the unit owners for implementation • Training programs and motivation

5.5 Short listed Technology/Products for DPRs

The following technologies were identified for preparation of detailed project reports for **Jagadhri Brass and Aluminium** Cluster:

- Wood Gasifier for Brass and Aluminium melting furnaces
- Wood Gasifier for Brass and Aluminium Annealing furnaces
- Waste heat recovery system for Pit furnaces
- Energy efficient Pit fired furnace for Brass or copper melting
- Modified wood fired annealing furnace ***(*Source NPC)***
- Installation of Thermocouples for annealing furnaces
- Induction furnaces for brass and copper melting

5.6 Summary of level of awareness on Energy savings and Energy saving Technologies in Jagadhri Cluster

The level of awareness on energy saving among the SME owners in the cluster is poor. About 20% of the unit owners have good conscious on energy saving technologies and is limited to some selected technologies like induction furnaces and electric annealing furnaces and doesn't have knowledge on other energy saving technologies like wood gasifier system, Waste heat recovery system, power factor maintain energy loss areas in the plant and quantities. The lack of awareness may be due to lack of skilled and technical manpower among other factors. Further, the unit owners do not have interest on costly products, as the same low efficient product/equipments are available at half of the cost.

The energy saving technologies are implemented based on success stories in the cluster units and practical demonstration of the energy saving technologies in the units.

Though the clusters units are in operation since last 6 decades, the achievement on energy efficiency in the cluster units is poor and same old technologies are continued.

Some of the low cost demonstration projects in the cluster may motivate the SME owners in implementation of the energy saving technologies.

LIST OF ANNEXURE

ANNEXURE – 1

Technical calculations of typical unit in the cluster

Efficiencies of present furnaces

a) Efficiency Evaluation for pit furnace coke fired

1) Fuel used : Coke
2) Quantity of brass melted (M) : 2400 kgs/day
3) Specific heat of brass (Cp) : 0.092 kcal/kg ^{o}C
4) Initial temperature of brass(t1) : 30 ^{o}C
5) Final temperature of brass (molten metal)(t2) : 1021 ^{o}C

6) Heat output : (Q) = M Cp (t2-t1)
= 2400 X 0.092 X (1021-30)
= **2, 18,812 kcal/day**

7) Quantity of Hard Coke consumption (m) : 320 kgs/day
8) Calorific value of Hard Coke (CV) : 6000 kcal/kg

9) Heat input : (E) = m X CV
= 320 X 6000
= **19,20,000 kcal/day**

10) Efficiency : (n) = Q/E
= **218812** = 11.4%
1920000

(n) = 11.4 %

b) Efficiency Evaluation for pit furnace oil fired

1) Fuel used : Furnace oil
2) Quantity of Aluminium melted (M) : 3200 kgs/day

3) Specific heat of Aluminium (Cp) : 0.22 kcal/kg ^{o}C
4) Initial temperature of Aluminium (t1) : 30 ^{o}C
5) Final temperature of Aluminium (molten metal)(t2) : 690 ^{o}C
6) Heat output : (Q) = M Cp (t2-t1)
= 3200 X 0.22 X (690-30)
= **4, 64,640 kcal/day**
7) Quantity of Furnace oil consumption (m) : 409.2 kgs/day
8) Calorific value of Furnace oil (CV) : 10,000 kcal/kg

9) Heat input : (E) = m X CV
= 409.2 X 10000
= **40, 92,000 kcal/day**

10) Efficiency: (n) = Q/E
= **464640** = 11.4%
4092000

(n) = 11.4 %

c) Efficiency Evaluation for wood fired Annealing furnace

1) Fuel used : Fire wood
2) Quantity of brass annealed (M) : 5400 kgs/day
3) Specific heat of brass (Cp) : 0.092 kcal/kg ^{o}C
4) Initial temperature of brass (t1) : 30 ^{o}C
5) Final temperature of brass (annealed metal) (t2) : 600 ^{o}C

6) Heat output : (Q) = M Cp (t2-t1)
= 5400 X 0.092 X (600-30)
= **2, 83,176 kcal/day**

7) Quantity of Fire wood consumption (m) : 800 kgs/day
8) Calorific value of Fire wood (CV) : 3200 kcal/kg

9) Heat input : (E) = m X CV
= 800 X 3200
= **2560000 kcal/day**

10) Efficiency: (n) = Q/E
= $\frac{\mathbf{283176}}{\mathbf{2560000}}$ = 11.1%

(n) = 11.1 %

d) Efficiency Evaluation for induction furnace

1) Energy used : Electricity
2) Quantity of brass melting (M) : 3600 kgs/day
3) Specific heat of brass (Cp) : 0.092 kcal/kg ^{o}C
4) Initial temperature of brass (t1) : 30 ^{o}C
5) Final temperature of brass (melting metal) (t2) : 1021 ^{o}C

6) Heat output : (Q) = M Cp (t2-t1)
= 3600 X 0.092 X (1021-30)
= **3, 28,219 kcal/day**

7) Quantity of electricity consumption (e) : 600 kWh
8) 1 kWh = 860 kcal

9) Heat input : (E) = e X 860
= 600 X 860
= **5,16,000 kcal/day**

10) Efficiency: (n) = Q/E
= $\frac{\mathbf{3, 28,219}}{\mathbf{5,16,000}}$ = 63.6%

(n) = 63.6 %

ANNEXURE – 2

Details of technologies/services providers for the cluster

a) Wood gasifier

1) **Chanderpur Works Pvt Ltd**
Yamuna Nagar, Haryana -135001
Tel: +91-1732-203460/62, 9812029113
Fax : +91-1732-203463
cpwindia@gmail.com

2) **Ankur Scientific Energy Technologies Pvt. Ltd.**
'Ankur' , Near Navrachana School, G.I.P.C.L Circle, Sama,
Vadodara - 390024, Gujarat - India
Phone no. 0265-2788447(Mktg) / 2793098 / Fax 0265-2794042
Cell: 9824875771 / 9099260072 / 9510865302
Email ID : shashank.chatterjee@ankurscientific.com

3) **Associated Engineering Works**
Gamini Compund, Main Road,
Tanuku, Andhra Pradesh - 534211
INDIA
+(91)8819-222950(phone)
+(91)8819-223410(phone)
+(91)8819-224801(fax)
Email ID : aewgamini@rediffmail.com
Email ID : gasfromwood@gmail.com

4) **Infinite Energy Pvt. Ltd.**
Regd Office: 1 floor,"Baba house",149 A,kilokri,opp.Maharani Bagh,New Delhi 110014
Works: Village-Bakhri,opp sainik colony,Faridabad,Haryana
Ph: 011-65273819, 65191937
Mob: 9212084933
Fax: 011-26903696
E-mail: infinitenergy@vsnl.net
infenergy@gmail.com

b) Induction and annealing furnace

5) **Electrotherm (India) Limited**
Mr. Sharat Chojar (M) 98104 22911 / Mr. Anurag Gupta (M) 98119 56239
Delhi Branch Ph: 011 2592 0224
E-mail: eildel@electrotherm.com

6) **Pioneer Furnaces Pvt.ltd.**
Vithal Udyognagar, Anand, Gujarat-388121
Email: contact@pioneerfurnaces.com
Tel: +91-2692-236182/236197
Fax:+91-2692-36595

7) **Pees Induction Equipments Pvt Ltd**
Chennai, Tamil Nadu – 600062
Tel: +91-44-64996989
Mob: +91-9940613540/9444122843
Email : peesinductionequipments@gmail.com

8) **Simplicity Engineers pvt ltd**
Mayapuri, New Delhi – 110064
Tel: +91-11-28115978, 28116979, 28113048, 28115803
Fax: +91-11-28116273, 28117273
Email: simplicity@vsnl.com

c) Thermocouples ,Rolling motor machines & power press- hydraulic

9) **A R Engineering Works**
Mfrs. of Furnaces, Dryers, Sccuzor, Washing machine etc
Jesico Colony, Jagadhri – 135003
Ph: 01732-316704
Mob: 9355580704, 9355580705

10) **Ambika Enterprises**
Mfrs. of: All types of Electrical Control panels, turnkey project of HT/LT & Mechanical
Workshop Road, Yamuna Nagar-135001
01732-250796/255796/255797
Fax 01732-250398
Email: ambikaenterprises@gmail.com

11) **Ashoka Engineers**
Mfrs. of: Rolling machines, power press- hydraulic toggle and German type
Ashok Dhiman
Tejli Gate, Jagadhri-135003
01732-244990, 9215744990, 9215944990

12) **Industrial Equipments Company**
Prem Nagar, Workshop road, Yamuna Nagar – 135001
Tel: 01732-260260, 327176
Fax: 01732-260260
Email: Iec_ynr@yahoo.co.in

13) **Modern Machinery Mart**
Authorised Dealer: Crompton Greaves Motor, pump set
Radaur Road, Old bus stand, Yamuna Nagar – 135001
Tel: 01732-250371, 251471

ANNEXURE – 3

Financial schemes (if any) available with local banks for improving energy efficiency in the cluster

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 lakh or 15% of investment in eligible machinery/Plant equipments whichever is lower. For more details of the scheme visit:

www.laghu-udyog.com/scheme/sccredit.htm

2. SIDBI Financing Scheme for Energy Saving Projects in MSME sector under JICA Line of Credit

The Japan International Corporation Agency (JICA) has extended a line of credit to SIDBI for financing Energy Saving projects in Micro, Small and Medium Enterprises (MSMEs). This project is expected to encourage MSME units to undertake energy saving investment in plant and machinery to reduce energy consumption, enhance energy efficiency, reduce CO_2 emissions, and improve the profitability of units in the long run.

3. Eligible Sub Projects/ Energy Saving Equipment List under JICA line of Credit:

- Acquisition (including lease and rental) of energy saving equipments, including newly installing, remodeling and upgrading of those existing
- Replacement of obsolete equipments and/or introduction of additional equipment which would improve performance
- Equipments/ Machinery that meets 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 involves change in process and technologies as a whole, duly supported by technical consultancy will be eligible for coverage.

Financial parameters:

The financial parameters for appraising the project are:

Parameter	Norms
Minimum Assistance	Rs. 10 lakh
Minimum promoters contribution	25% for existing units; 33% for new units
Interest rate	The project expenditure eligible for coverage under the line will carry a rate of interest rate of 9.5-10% p.a
Upfront fee	Nonrefundable upfront fee of 1% of sanctioned loan plus applicable service tax
Repayment period	Need based. Normally the repayment period does not extend beyond 7 years. However, a longer repayment period of more than 7 years can be considered under the line if necessary

Eligibility criteria for units (Direct assistance):

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

For further details eligible energy saving equipments/machinery, projects can be financed under this scheme and details of scheme, please contact the nearest SIDBI branch office or refer to SIDBI website (**www.sidbi.in**)

TECHNOLOGY UPGRADATION FUND SCHEME (TUFS) FOR BRASS AND ALUMINIUM & JUTE INDUSTRIES IN SSI SECTOR

A scheme devised by Govt. of India, Ministry of **Brass and Aluminium**, to enable SSI units **Brass and Aluminium**/Jute industrial sector) to induct State-of-the-art technology in which technology levels are bench marked in terms of specified machinery for each sector of **Brass and Aluminium** industry. Machinery with technology levels lower than that specified will not be permitted for funding under the TUF scheme.

Eligible Borrowers Sole Proprietorships, Partnerships, Co-operative Societies, private / public limited companies.

- Existing units with or without expansion and new units
- Existing units proposing to modernize and/or expansion with state-of-the-art-technology
- New units which are being set up with appropriate technology

Quantum Of Loan & Mode Of Assistance Assistance shall be need based and NO CEILING on project cost/amount of loan. Assistance shall be by way of Term Loan.

Margin 15 to 25% of the project cost

Security 1st charge on fixed assets financed under the scheme Additional security such as personal guarantees, pledge of promoters share holdings as determined by Bank on merits of the case

Incentive Available Under The Scheme

Interest Reimbursement at the rate of 5% of the interest payment made by the unit to Bank on the loan outstanding. No Interest Reimbursement will be available for the extended period of loan or during the NPA status of the loan.

Repayment Within 7 years including moratorium up to 1 year

ANNEXURE – 4

Name and address of units in the cluster

S.No.	Name of the Industry	Contact person	Address
1	Aggarwal Dhatu Udyog	Suresh Aggarwal	Kali Mandir
2	Ahuja metal industries	Subhash Ahuja	Jesico Colony
3	Akash Enterprises	Goel Nikhar	Jaroda Gate
4	Alliiance industries	Surinder Jain	Yamuna Nagar Road
5	Anand metal works	Iteshbir S. Anand	Chhachhrauli Road
6	Arun Metal industries	Nitesh Goel	Jesico Colony
7	Avon metal industries	Jatinder Singh Anand	Near Kali Mandir
8	Balaji strips	Ranjit K. Goel	Jesico Colony
9	Bhagwan Alloys	Sanjay Sharma	HSIIDC
10	BK metal rolling mills	Bimal kishore	Jaroda Gate
11	chanana udyog	Deshbandu Chanana	Chaneti Road
12	Datta steels	Surinder Singh	Tejli Gate
13	Dawarka enterprises	Sanjay Garg	Gauri Shankar Link Road
14	Desh metal works	Harsaran Dass Sita Ram	Jesico Colony
15	dharam udyog	Dharam Pal Gupta	Durga Garden
16	Gupta Metal Industries	Saurabh Gupta	Gauri Shankar Link Road
17	Guru Nanak metal rolling mills	Vishal	Manohar Colony
18	Himalayan rolling mills	Ankush Goel	Aggarsain Chowk
19	J B Industries	Ankush Jain	Durga Garden
20	J.R. Engineers	Ragbir Singh	Aggarsain Chowk
21	Jagannath metal industries	Ajay Garg	Gobindpuri Road
22	Jai Ganesh metal industries	S P Jain	Hanuman Gate
23	JN metal industries	Narinder Garg	Jaroda Gate
24	Krishan Lal Batra & Bros	varun	Jaroda Gate
25	Krishna Engineering Industries	Parivesh Goel	Chhachhrauli Road
26	Laxmi Udyog		Gauri Shankar Link Road
27	Madaan metal rolling mills	Kharati Lal	Manohar Colony
28	Madaan Udyog	Dalip Madaan	Railway Outagency
29	Metals & Alloys	Vivek Goel	Jesico Colony
30	Mittal engineering industries	Rajiv Mittal	Old Bilaspur Road
31	Narsi metal industries	Harish	Manohar Colony
32	P R steels	Nitin Soni	HSIIDC
33	Padam metal & rolling mills	Deepak Jain	Court Road
34	PD metal industries	Davinder Gupta	Hanuman Gate
35	Pearl strips	Samit Gupta	Puran Vihar
36	Priena strips	Billu	Jesico Colony
37	Priya industries	Joginder Singh	Mukerji Park
38	Rahul steels	Sushil Bansal	Tejli Gate
39	Rama rolling & general mills	Raman Kohli	Ambala Road
40	RD metal rolling mills	Deepak Massey	Jesico Colony

41	S R Metals	Rajiv Mittal	Durga Garden
42	SAB and company	Ravindra kumar	Jaroda Gate
43	Sach Enterprises	Amit Kapoor	Durga Garden
44	Sai Kripa Industries	Rajat Madaan	HSIIDC
45	Saraswati Udyog	Kamal Saluja	Aggarsain Chowk
46	Shahkumbhari	Babblu Kapoor	Durga Garden
47	Shibu enterprises	kanta prasad garg	Gandhi Marg
48	Shivashankar metal works	Gireesh Kohli	Court Road
49	Shri S R Metals		Court Road
50	Shyam Sunder strips	Rajneesh Goel	Jaroda Gate
51	Singla enterprises	B B Singla	Jaroda Gate
52	Sri Krishna strips	Mohit	Jesico Colony
53	Subash Syndicate	Subhash Dhiman	Tejli Gate
54	Supreme strips	Ranjan Roheela	Buria Gate
55	Surya Impex	Munish Mittal	Tejli Gate
56	T C Jain Metal Ind. Pvt. Ltd	Nitin Jain	Yamuna Nagar Road
57	The Himalaya metal industries	Mohan Shyam	Near Kali Mandir
58	Usha Enterprises	Sanjay	Manohar Colony
59	Uttam industries	Jaswant Singh Bhatia	Court Road
60	Zindal industries	Sanjay Zindal	Jesico Colony

ANNEXURE – 5

Quotations for recommendations

WOOD GASIFIER

Associated Engineering Works
the ultimate resource of non-convetional energy
GAMINI

To

Date: 20/08/2010

Zenith Energy Services (P) Ltd
10-5-6-/B, My Home Plaza, **(Kind attn: T. Krishna .Head of EE)**
Masabtank, Hyderabad-500028

Dear Sir,

Sub: Quotation for Gasifier for Aluminium Melting Rotary Furnace–Reg.

We thank you very much for your mail enquiry regarding gasifier system for replacing oil burning for aluminium melting. We are happy to inform that our wood gas system is suitable for melting of aluminium replacing furnace oil burning and can save substantial running costs.

(Using our Wood Gasifier one litre furnace oil can be replaced with 3.5 kgs of woodchips thereby saving more than 50% running costs compared to oil)

We are in this line of activity since two decades and we received "DSIR NATIONAL AWARD" from Government of India for developing innovative Gasifiers. We also refer to our phone discussions on various points and basing on them we are submitting our offer below.

DESCRIPTION:
Thermal Mode Gasifier consisting of Gasification Reactor, Stock Hopper, Charge Hopper, Gas Cleaning Dust-Box, loading platform with steps along with Producer Gas Burner.

SPECIFICATIONS FOR GASIFIER:

Model	: GT-700
Mode	: Burning Application
Rated output	: 200 KW (Can replace upto 50 L/Hr of FO)
Design	: Down Draft with Throat
Fuel	: Wood Chips
Feed size	: 2" - 3" (any dimensions)
Fuel Consumption	: 175 Kg/Hour (Corresponds to Max.rated output)
Moisture content of fuel	: 15%
Fuel Feeding Cycle	: Hourly once
Fuel charging	: Manually
Hopper Holding Capacity	: 800 Kg (Approx.)
Auxiliary Power	: 6 HP
Floor Space	: 400 Sq.ft(20' Ht).

Associated Engineering Works, Gamini Compound, Main Road,
Tanuku-534211. AP. Ph: 08819 222950, email: gasfromwood@gmail.com, URL: www.gasfromwood.com

Description of main items are as below:

GASIFIER :

This Gasifier is of downdraft design with throat and vertical in nature. The fuel is fed from the top of the Hopper once in one hour interval. Air is admitted through a nozzle and gas is formed by high temperature oxidation & subsequent reduction. A rotating grate is provide at the bottom of the Gasifier. The ash & coal pieces fall through this grate. The Gasifier bottom is open and stands in an open top water tank of 2' height. The ash from the combustion of feed fall into this water tank and to be collected once in a day. The Gasifier is provided with a loading platform with Steps for loading of Wood chips in to the Hopper.

REFRACTORY LINING:

The Gasifier inside is lined with Castable refractory cements for containing heat in the reaction zone and to protect the metal surfaces. The refractory coating will be laid at the time of installation at site.

GAS CLEANING SUB-SYSTEM:

The Gas from the Gasifier exits at high temperature and this gas contain dust particles. These will be separated from the gas by gravity using Dust Box. The clean gas will be transported through an insulated gas line up to the Gas Burner for burning.

GAS BURNER:

The Burner is specially designed and developed for burning Producer Gas generated in the Gasifier. The primary air for burning the gas is supplied by a separate Air Blower.

OUR SCOPE OF SUPPLY:

GASIFIER -Consisting of Reaction Chamber, Stock Hopper, Charge Hopper, Platform with Steps & all necessary interconnecting pipes and fittings.Air Blower with Motor for gas generation,Producer Gas Burner, Gas Cleaning Dust Box,Air Blower with Motor for gas combustion and Installation of Gasifier at your site.

Associated Engineering Works, Gamini Compound, Main Road,
Tanuku-534211. AP. Ph: 08819 222950, email: gasfromwood@gmail.com, URL: www.gasfromwood.com

Associated Engineering Works
the ultimate resource of non-convetional energy
GAMINI

ITEMS IN USER SCOPE:

- Civil works like Construction of Open Top Water Tank for installing Gasifier.
- Unloading of material at site and arranging assistance to our persons during the time of installation.

PRICE OF THE SYSTEM:

The cost of Gasifier described as above is: **Rs.13,50,000/- (Rupees Thirteen Lacs Fifty Thousand only).**

The above cost is ex-works Tanuku . CST @2% is extra against form 'c'. Transportation charges at actual to be paid.

PAYMENT TERMS:

50% Mobilization advance along with the firm order. 25% Amount before dispatch, and balance 25% after installation at site.

MODE OF PAYMENT:

Through DD or RTGS to our Bank account.

DELIVERY:

The system will be delivered in 6 weeks after receiving firm order with advance.

GUARANTEE:

The Gasifier is guaranteed for one year.

TRAINING OF OPERATORS:

Our persons will give training to operators for One week in the factory in daily operation and maintenance of Gasifier.

In addition central Government is offering 80% Income Tax Depreciation on the Gasifier Investment in the first year of purchase. This is additional benefit over and above the direct savings.

Associated Engineering Works, Gamini Compound, Main Road,
Tanuku-534211. AP. Ph: 08819 222950, email: gasfromwood@gmail.com, URL: www.gasfromwood.com

Associated Engineering Works
the ultimate resource of non-convetional energy
GAMINI

WOOD CHIP CUTTER (Accessory):

Gasifier needs cut wood chips for running and it can not run on long stems/sticks. We offer WOOD CHIP CUTTER for preparing chips from long Stems/stalks. This is a multi blade circular saw machine and has a capacity of cutting up to 400 Kgs per hour. This is powered by 12.5 HP Motor.

The cost of this special Wood Chip Cutter including 12.5 HP Motor is **Rs.2,00,000/-(Rupees Two lacs only).**

In case cut wood chips available locally, then this machine is not needed. In the absence of any supplier of cut wood chips, this machine is suggested. We attached few photographs showing the installations and gas burning to give an idea.

The pay back on investment will be few months only.

Please study the details and we are ready to submit any more details if needed.

Thanking You,

Yours faithfully,

for Associated Engineering Works,
(G.M.Satyanarayana)
Mg.Director
Mobile: 093470 6790

Associated Engineering Works, Gamini Compound, Main Road,
Tanuku-534211. AP. Ph: 08819 222950, email: gasfromwood@gmail.com, URL: www.gasfromwood.com

INDUCTION FURNACE

Zenith Energy Services Pvt. Ltd., Haryana

)oc No. 031E005 Rev. 01

OFFER FOR 250 KW / 750 KG MEDIUM FREQUENCY INDUCTION FURNACE

Sr. No.	Description	Qty.	Price (Rs. in Lacs)
1	250 kW Solid State Power Supply Unit with DM Water Circulating Unit.	1 No.	10.80
2	750 Kg Aluminum Frame Melting Furnace with Hydraulic Tilting Arrangement, Bus bar, Water Cooled Cables, etc	1 No.	7.80
3	Hydraulic Power Pack	1 No.	
	Total Price for above: Rs.18.60 Lacs (RUPEES EIGHTEEN LACS SIXTY THOUSAND ONLY)		

Please refer to our standard terms and conditions attached with this offer for price basis and commercial terms.

for ELECTROTHERM (INDIA) LIMITED

SHAILESH BHANDARI
MANAGING DIRECTOR

Encl: 1. Scope of Supply, Doc No 031D006 Rev 01
2. Technical Specification, Doc No. 031D005 Rev. 02
3. Terms & Conditions, Doc No 031D007 Rev. 05

Zenith Energy Services Pvt. Ltd., Haryana

Doc No. 031 D005 Rev. 02

TECHNICAL SPECIFICATION

MEDIUM FREQUENCY INDUCTION MELTING FURNACE

Sr. No.	Description	Rating
1.	MF Output Power- Rated (KW)	250
2.	At Input KVA	289
3.	Line PF at full load	0.94
4. *	Power Supply Unit Input Voltage (Nominal) (Volts)	415
5.	Frequency (Hz)	500
6.	MF Output Voltage (Volts)	850
7.	Power Supply Unit Efficiency (%)	94
8.	Nominal Capacity of furnace in Kg for Copper/Brass	750
9.	Melting Rate of Copper/Brass (•)	Copper at 1200^0 C - 720 Kg/Hr Brass at 950^0 C - 810 Kg/Hr
10. **	Water Storage capacity of emergency overhead tank in liters	2500

** Emergency tank capacity has been calculated on the basis of 40% flow rate for 1 hour. It is presumed that emergency power is available to refill the overhead tank in case of power failure.

- Melt rate specified is on charge weight with best charging practices and best melting operations, excluding all non productive time (when furnace is not doing any melting operation viz. initial charging, de-slagging, holding for chemical analysis, superheating and pouring)
- The scrap should be clean, sized and dense, yield should be better than 98%. Slag consumes nearly double the power than that consumed by scrap.
- Furnace lining should be in hot condition after second heat of lining with recommended lining thickness. Water temperature of coil should be as specified.
- Input Power to the melting system should be at rated voltage. Power drops if the input supply drops below 98.5%.
- There should not be any stoppages during heat while trial run.
- The charging and slag removal should be uniform and without any noticeable delay.

Zenith Energy Services Pvt. Ltd., Haryana

Doc No. 031E005 Rev. 01

OFFER FOR 175 KW / 500 KG MEDIUM FREQUENCY INDUCTION FURNACE

Sr. No.	Description	Qty.	Price (Rs. in Lacs)
1	175 kW Solid State Power Supply Unit with DM Water Circulating Unit.	1 No.	10.20
2	500 Kg Aluminum Frame Melting Furnace with Hydraulic Tilting Arrangement, Bus bar, Water Cooled Cables, etc	1 No.	5.60
3	Hydraulic Power Pack	1 No.	
	Total Price for above: Rs.15.80 Lacs (RUPEES FIFTEEN LACS EIGHTY THOUSAND ONLY)		

Please refer to our standard terms and conditions attached with this offer for price basis and commercial terms.

for ELECTROTHERM (INDIA) LIMITED

SHAILESH BHANDARI
MANAGING DIRECTOR

Encl: 1. Scope of Supply, Doc No 031D006 Rev 01
2. Technical Specification, Doc No. 031D005 Rev. 02
3. Terms & Conditions, Doc No 031D007 Rev. 05

Energy efficient pit furnace

TIN : 06741616247

01732-316704
94166-80705
93555-80705

A. R. ENGG. WORKS

Manufacturers of :

BRASS & S.S. BRUSH, ALL TYPE OF FURNACES, DRYERS, SCCUZOR, WASHING MACHINE
FOR BRASS SHEET & COIL MILL, MANUAL & ELECTRICAL CRAINS FITTINGS WORKS
DEALS IN : FIRE BRICKS, REFACTORY PRODUCTS, BURNERS, BLOWERS, ASBESTOS SHEETS ETC.

C-1, 682, JESICO COLONY, JAGADHRI - 135 003 (HARYANA)

Ref. No..... Dated 5/4/10

To

Zenith Energy Services (P) Ltd

Hyderabad (India)

Sub : Modified pit furnace
(Approx Pit Size : 620 mm x 630mm)

Sir,

We are pleased to quote above mentioned modified pit furnace with circular brick corners in reference to telephonic enquiry dated 04-04-2010 as under:

The complete modified pit furnace fabricated with:

1. Refractory Bricks
2. Refractory Cement
3. Red Bricks will cost : **Rs. 30,000/-**
   (Rupees thirty thousand only /-)

The above rates are ex- works Jagadhri. Taxes extra as applicable at the time of delivery. Payment 40%, 50% is running payment and balance 10% after commissioning and trial.

Hope your will find our rates most competitive and will do favour as with your valued order.

Thanking you,

Yours faithfully,

For **A.R. Engg. Works,**

Waste heat recovery system

TIN : 06741616247

01732-316704
94166-80705
93555-80705

A. R. ENGG. WORKS

Manufacturers of :

BRASS & S.S. BRUSH, ALL TYPE OF FURNACES, DRYERS, SCCUZOR, WASHING MACHINE
FOR BRASS SHEET & COIL MILL, MANUAL & ELECTRICAL CRAINS FITTINGS WORKS
DEALS IN : FIRE BRICKS, REFACTORY PRODUCTS, BURNERS, BLOWERS, ASBESTOS SHEETS ETC.

C-1, 682, JESICO COLONY, JAGADHRI - 135 003 (HARYANA)

Ref. No. ..... Dated 5/4/10

To

Zenith Energy Services (P) Ltd.
Hyderabad (India)

Sub. : Waste Heat Recovery System with Moveable Trolly
(Approx. Trolly Size : 800mm x 800mm x 450mm)

Sir,

We are pleased to quote our rates for the above mentioned Waste Heat Recovery System with Moveable Trolly in reference to your telephonic enquiry dated 04-04-2010 as under :

The complete waste recovery system febricated with :

1. Mild Steel (Angle, Channel, MS Sheet)
2. S.S. Sheet & S.S. Rod
3. 4 Nos. Wheels
4. Nut Bolts & Mill Store Materials etc. will cost **Rs. : 30,000 /-**
   (Rupees Thirty thousand only /-)

The above rates are ex-works Jagadhri. Taxes extra as applicable at the time of delivery. Payment 40% advance, 50% is running payment and balance 10% after commissioning and trial.

Hope you will find our rates as most competitive and will do favour as with your valued order.

Thanking You,

Yours faithfully,
For **A.R. Engg. Works,**

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