MANUAL ON ENERGY CONSERVATION MEASURES IN BRASS CLUSTER JAMNAGAR




Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By

Winrock International India

Acknowledgement

We are thankful to the Bureau of Energy Efficiency, Ministry of Power for giving the opportunity to implementation of '**BEE SME project in Jamnagar Brass cluster'**. We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

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Winrock International India (WII) is also thankful to "The **Jamnagar Factory Owners Association, Jamnagar**" for their valuable inputs, co-operation, support and identification of the units for Energy Use and Technology Audit studies in Jamnagar Brass cluster.

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

WII is also thankful to all the SME owners, plant in charges and all workers of the unit owners for their support during the energy use and technology audit studies and in implementation of the demonstration projects.

Winrock International India,
New Delhi

Contents

ANNEXS

Annexure 1: Detailed technology assessment report

Annexure 2: Details of technology / service providers in Jamnagar Brass Cluster

Annexure 3: Techno commercial bids from service / technology provider

Annexure 4: Policy guidelines/subsidy schemes available with State governments for improving energy efficiency in cluster

Annexure 5: Financial schemes available with local banks for improving energy efficiency in cluster

List of Tables:

List of Figures:

Abbreviations

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

About BEE SME Program

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

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

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

As a result of increasing awareness towards efficient usage of energy and other resources, there has been a visible reduction in energy intensity in comprehensive Indian industrial sector. However, focusing the observation on the MSME sector reveals that the energy

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

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

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

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

In this context, the Bureau of Energy Efficiency (BEE) has laid adequate emphasis on the SME sector as presented in the Working Group on Power for 11th Five-Year Plan (2007-2012)-Sub-Group 5. Consequently, the Bureau has initiated the Energy Efficiency Improvement program in 25 SME clusters in India.

1.1 PROGRAM OBJECTIVES

The BEE SME Program is aimed to improve Energy Efficiency in SME sector by technological interventions in the various clusters of India. The EE in SMEs is intended to be enhanced by helping these industries in the 25 energy intensive SME clusters of India by:

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

The program also aims at creating a platform for

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

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

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

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

➲ *Energy use and technology studies*

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

focuses on identifying the Best Operating Practices and the EE measures already implemented in the units.

➲ *Capacity building of stakeholders*

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

➲ *Implementation of EE measures*

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

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

➲ *Facilitation of innovative financing mechanisms*

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

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

1.2 EXPECTED PROJECT OUTCOME

Expected project outcome of BEE SME program in clusters are:

➲ *Energy Use and Technology Analysis*

The outcome of the activity will include identification of the EE measures, potential of renewable energy usage, fuel switching, feasibility analysis of various options, and

cost benefit analysis of various energy conservation measures including evaluation of financial returns in form of payback period, IRR and cash flows. The cost liability of each measure, including the capital and operational cost will also be indicated.

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

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

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

The EE measures identified in the energy audit study will be prioritized as per their energy saving potential and financial feasibility. The inventorization survey would establish details like the cluster location, details of units, production capacity, technologies employed, product range, energy conservation potential along with possible identified EE measures and respective technology suppliers.

The specific outcomes of this activity will be as follows:

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

➲ *Implementation of EE measures*

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

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

➲ *Capacity Building of LSP's and Bankers*

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

➲ *Concluding workshop*

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

lead to development of a roadmap for implementing similar programs in other clusters with greater efficiency and reach.

1.3 IDENTIFIED CLUSTERS UNDER THE PROGRAM & TARGET CLUSTER FOR IMPLEMENTATION

25 most energy intensive MSME clusters across different end use sectors have been identified to implement the BEE SME program for EE improvement. The details of industrial sector and identified cluster are provided in Table 1 below:

Table 1.1: *List of clusters identified for BEE SME Program*

S. No.	Cluster Name	Location
1.	Oil Milling	Alwar; Rajasthan
2.	Machine Tools	Bangalore; Karnataka
3.	Ice Making	Bhimavaram; Andhra Pradesh
4.	Brass	Bhubaneswar; Orissa
5.	Sea food processing	Kochi, Kerala
6.	Refractories	East &West Godavari, Andhra Pradesh
7.	Rice Milling	Ganjam, Orissa
8.	Dairy	Gujarat
9.	Galvanizing	Howrah, West Bengal
10.	Brass& Aluminum	Jagadhari, Haryana
11.	Limestone	Jodhpur, Rajasthan
12.	Tea processing	Jorhat, Assam
13.	Foundry	Batala, Jalandhar & Ludhiana, Punjab
14.	Paper	Muzzafarnagar, Uttar Pradesh
15.	Sponge iron	Orissa
16.	Chemicals& Dyes	Vapi, Gujarat
17.	Brick	Varanasi, Uttar Pradesh
18.	Rice Milling	Vellore, Tamil Nadu
19.	Chemical	Ahmedabad, Gujarat
20.	Brass	Jamnagar, Gujarat
21.	Textile	Pali, Rajasthan
22.	Textile	Surat, Gujarat
23.	Tiles	Morbi, Gujarat
24.	Textile	Solapur, Maharashtra
25.	Rice Milling	Warangal, Andhra Pradesh

As a part of BEE SME program, one of cluster identified was the Jamnagar, Brass cluster. It was proposed to carry out energy use and technology audit studies in 75 units in the Jamnagar Brass cluster covering all types and sizes of the industries to understand/give valuable insight into the process of developing energy efficiency solutions relevant to the SME industries in the Jamnagar, Brass cluster.

Jamnagar Brass Cluster Scenario

2.1 INTRODUCTION

In India Brass metal industry are located mainly in the states of Gujarat, Haryana, Orissa, Assam and Uttar Pradesh. But there is a subtle difference between the products manufactured in these states. The products manufactured in Haryana, Orissa, Assam & Uttar Pradesh are mostly brass metal handicrafts and utility items made out of sheet metal components or single piece casting, whereas in Gujarat it is mostly brass-machined components. From the point of view of its application or usage pattern, the products manufactured in Uttar Pradesh, Orissa, Assam & Haryana are consumer products and are used as gift, utility or decorative items, whereas the products manufactured in Gujarat can be classified as industrial product and consumed by industries as a part/component of their final product. Unlike the above four states, the brass part products in Gujarat require a lot of machining activities like turning, milling, grinding, drawing, boring, threading etc.

Jamnagar known as the brass city of India, has been an important industrial centre since long for brass related parts. Jamnagar is inhabited by a various types of brass related work units which include Brass foundry; Brass parts manufacturing, Electroplating and Extrusion units. There are about 3500 brass related units alone in Jamnagar. Majority of these Brass units in Jamnagar are in operation since last 15 to 20 years. All these units are located in pockets of Shankartekri, MP Shah Udyognagar, Patel colony and Dared areas.

Jamnagar Brass cluster like many other clusters was in dire-straits with regard to the energy efficiency and conservation. In almost all units, whether big or small, there had been no conscious effort to take up energy conservation and energy efficiency measures as a part of day to day operations. Many a times, the small scale entrepreneur was not even aware of measures that could bring down the percentage energy cost, which automatically brings down the manufacturing cost. Some of the bigger units had experimented with few parameters to improve energy efficiency in the units, but the results and outcome was confined to them only. All the units in Jamnagar Brass cluster had been operating in traditional conditions and most of equipments/utilities using in cluster were procured from the local suppliers. They are making the equipments on their traditional expertise, which had remained unchanged over the years.

Till now there has been very little focus on energy conservation activities in the units. Also, there have been no concrete external interventions as well to help the small

units come out of their shell and rise up to the necessary energy efficiency benchmarks.

2.1.1 Raw material used

The raw material requirement of the Jamnagar Brass cluster is met mainly from the following three sources:

- Old brass, copper and bronze utensils
- Imported brass scrap and honey
- Brass scrap from ship breaking yard

Majority of the raw material requirement in Jamnagar Brass cluster is met through imports. The countries from which it is imported are USA, Singapore, Gulf and European countries. The imported raw material is available mainly in three forms i.e. Honey scrap, Dross of brass & Pale in the form of strips.

Figure 2.1: ***Raw material using in Jamnagar*** Brass cluster

The quality of brass scrap and honey varies widely and its composition is not uniform. Most of the times, this scrap is made of two to three different metals and the job of the worker is generally to separate other metals (like aluminium, iron) from the copper and brass. It is a tedious process but still practice in Jamnagar. Moreover the separating process can never be 100% accurate and a lot of impurities and other metals reach the foundry for melting. As a result the quality of casting is affected.

Technically speaking brass is an alloy of Copper and Zinc and ratio of these products is 60:40 respectively. For getting the right products and good quality, it is important that this composition is maintained. However, due to the heterogeneous nature of the scrap (honey) and different alloying of the base metal, it becomes almost impossible to maintain this ratio. As a result, the quality of the final product varies, defects are produced and the rejection rate increases.

Apart from the Brass scrap; copper, zinc, led, other metal alloys and clay etc are used as raw material depends on the final product requirement.

2.1.2 Products manufactured

Major products manufactured in Jamnagar Brass cluster are:

- Building hardware like Door & Window Hinges, Stoppers, Knobs, Studs, Handles
- Sanitary & bathroom fittings Like Venetian Blinds, Hangers, Taps, Curtain fittings
- Electronic & Electrical accessories Like Socket pin, Battery terminal, switches, tester, computer sockets
- Automobile & Cycle tube valves, Industrial control valves
- Agricultural Implements like Tractor accessories
- Brass jewellery and Buttons like Necklace, Ear rings, Bracelet, Rings, Bangles
- Various other precision machine components as per customers specification
- Pen parts

The products manufactured in the Jamnagar Brass cluster weigh in a range from 1 gm to 10 kg and in terms of its length and diameter it varies from .05 mm to 60 cm. The following figure shows the classification of Brass part manufacturing units based on type of manufacturing product.

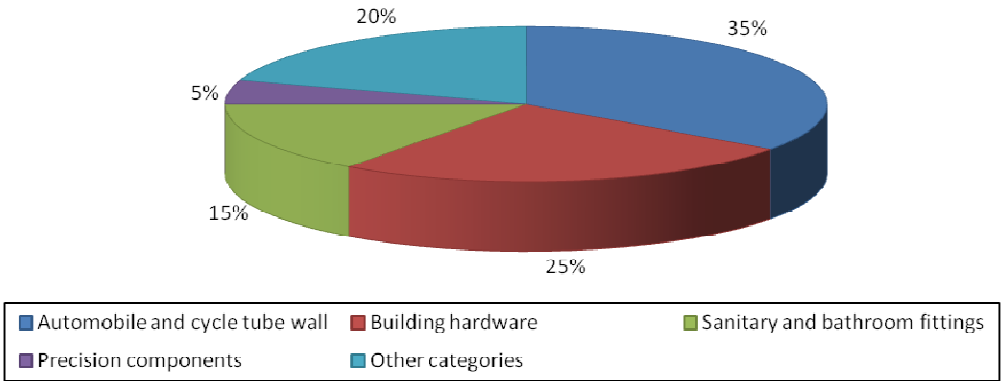

Figure 2.2: *Classification of Brass part manufacturing units in Jamnagar Brass cluster*

2.2 CLASSIFICATION OF UNITS

Brass units in Jamnagar are classified based on the type of operation of the units and as well as production capacity.

2.2.1 Type of operation

Brass units in Jamnagar Brass cluster are engaged in three different types of operations; those are:

- Casting (Brass foundry & Extrusion)
- Machining
- Electroplating

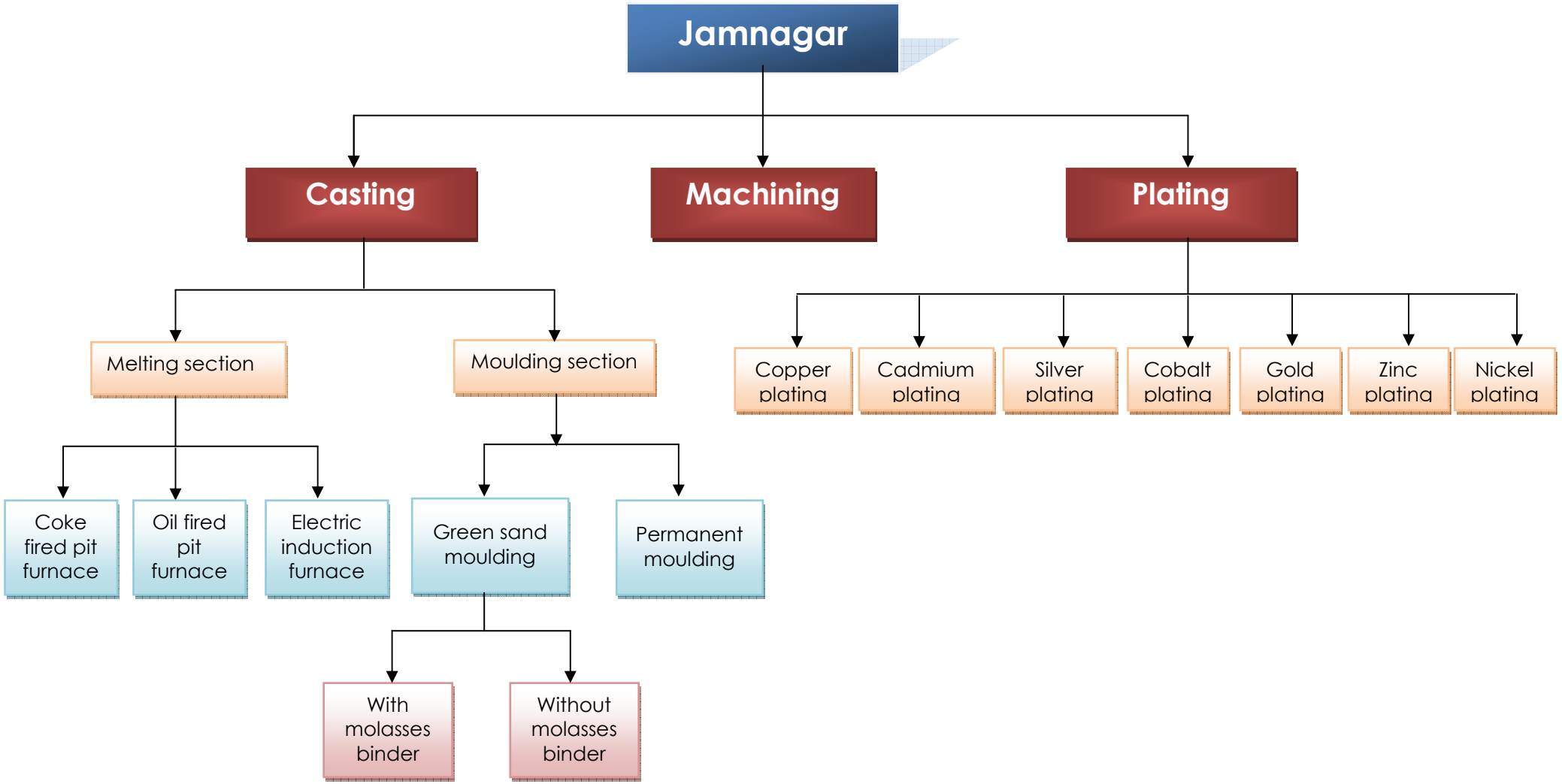

Figure 2.3: ***Classification of Brass units in Jamnagar Cluster based on type of operation***

There are around 3500 units in Jamnagar Brass cluster, out of which 2100 are Machining units, 900 are foundry units, 350 are electroplating units and 150 are extrusion units. Percentage distribution of different type of operational units in Jamnagar Brass cluster is furnished in figure below:

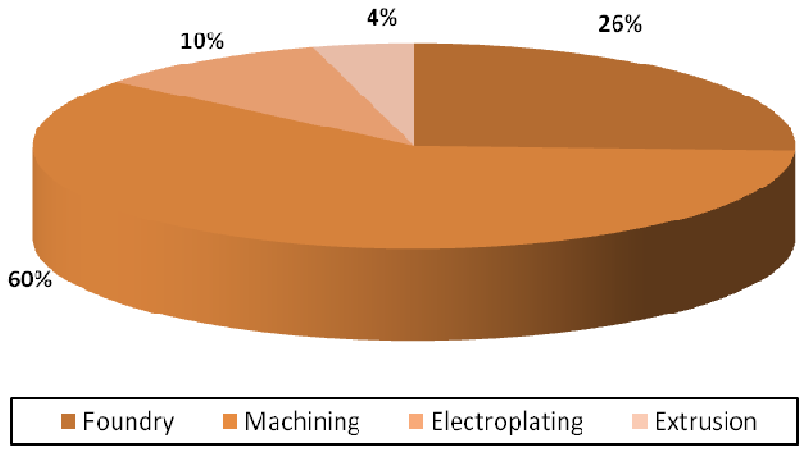

Figure 2.4: ***Percentage distribution of different type of operation in units in Jamnagar Brass cluster***

2.2.2 Production capacity

Annual production capacities of Brass units in will depend on the type of operation; Brass units in Jamnagar under each type of operation are classified based on production capacity. Following figures shows the percentage classification of Brass Foundry and extrusion plants based on production capacity:

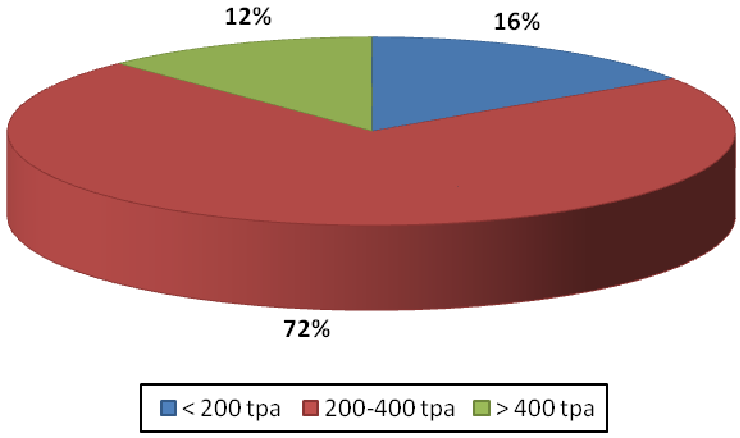

Figure 2.5: ***Classification of Brass foundry units based on production capacity***

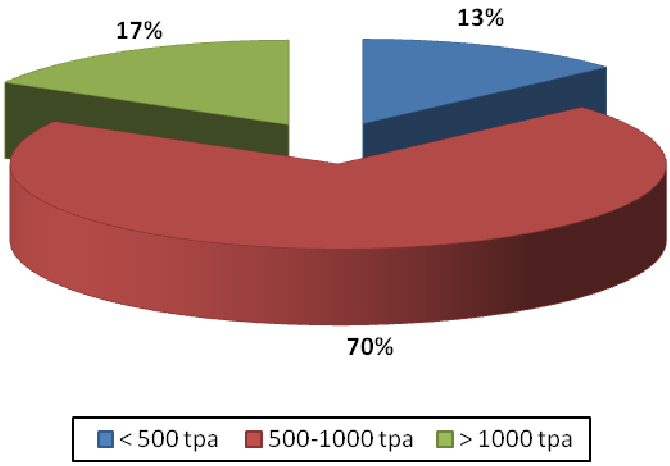

Figure 2.6: ***Classification of Brass extrusion units based on production capacity***

2.3 ENERGY SITUATION IN CLUSTER

Major energy sources being used in manufacturing of Brass parts in Jamnagar Brass cluster are electricity and fuels such as Coal, Furnace Oil and Liquid petroleum gas. This depends on application of technology, process requirement, availability, and economic and safety point of view. The two forms of energy being used in manufacturing of Brass parts in typical Brass unit are electrical energy and thermal energy. Electrical energy is being used in melting of Brass in induction furnaces, operation of electrical utilities and thermal energy is being used in Brass melting operation.

Availability and consumption of various fuels in typical Brass manufacturing unit is presented in below sections.

2.3.1 Type of fuels used in Jamnagar Brass cluster

Details of fuels used in Jamnagar Brass cluster is presented in table below:

Table 2.1: ***Details of fuels used in cluster and its prices***

S. No	Name of fuels	Cost of fuel (Rs)	Units	Gross Calorific values
1	High grade coal	17	kg	6500 kCal/kg
2	Liquid Petroleum Gas	24	Nm^3	9500 kCal/Nm^3
3	Furnace oil	28	liter	9300 kCal/kg

2.3.2 Energy consumption in typical brass unit

Energy consumption (thermal energy & electrical energy) in Brass unit depends on type of unit and final product manufacturing in unit. Annual Electrical energy and thermal energy consumption in typical Brass foundry, Extrusion unit, Machining and Electroplating unit is presented in tables below:

Table 2.2: *Annual Energy consumption in different capacities of Brass Foundry units*

Parameter	Unit	<200 tpa	200-400 tpa	>400 tpa
Annual electrical energy consumption	kWh per annum	3300	3800	12300
Annual electrical energy consumption	kCal per annum	2,890,800	3,328,800	10,774,800
Annual coal consumption	tpa	28	40	129.2
Annual thermal energy consumption	kCal per annum	182,000,000	260,000,000	839,800,000
Annual production capacity	tpa	175	250	840
Total annual energy consumption in one unit of different capacity	kCal	184,890,800	263,328,800	850,574,800
Total annual energy consumption in one unit of different capacity	MTOE	18.48	26.33	85.05

Table 2.3: *Annual Energy consumption in different capacities of Brass Extrusion units in Jamnagar Brass cluster*

Parameter	Unit	<500 tpa	500-1000 tpa	>1000 tpa
Annual electrical energy consumption	kWh per annum	280,000	810,500	1,126,785
Annual electrical energy consumption	kCal per annum	245,280,000	709,998,000	987,063,660
Annual furnace oil consumption	liters per annum	13,000	37,000	55,000
Annual thermal energy consumption	kCal per annum	127,400,000	362,600,000	539,000,000
Annual production capacity	tpa	360	1000	1500
Total annual energy consumption in one unit of different capacity	kCal	372,680,000	1,072,598,000	1,526,063,660
Total annual energy consumption in one unit of different capacity	MTOE	37.26	107.25	152.60

Table 2.4: *Annual Energy consumption in Brass machining units in Jamnagar Brass cluster*

Parameter	Unit	Value
Annual electrical energy consumption	kWh per annum	27001
Annual electrical energy consumption	kCal per annum	23,653,333
Annual production capacity	tpa	50

Parameter	Unit	Value
Total Annual energy consumption one unit	MTOE	2.36
Total Annual energy consumption in all machining units in cluster	MTOE	4968.6

Table 2.5: ***Annual energy consumption in Brass electroplating units in Jamnagar Brass cluster***

Parameter	Unit	Value
Annual electrical energy consumption	kWh per annum	29,973
Annual electrical energy consumption	kCal per annum	26,257,142
Annual production capacity	tpa	30
Total Annual energy consumption one unit	MTOE	2.625
Total Annual energy consumption in all electroplating units	MTOE	919

Annual energy consumption in different type of units is calculated and details of the same are presented in same below:

Table 2.6: ***Annual Energy consumption in different type of Brass units in Jamnagar Brass cluster***

S. No	Type of Unit	Energy consumption (MTOE)
1	Extrusion	15822
2	Foundry	29061
3	Machining	4967
4	Electroplating	919

Total annual energy consumption in cluster is around 50,770 MTOE (Metric Tonne of oil equivalent). Percentage of total energy consumption in different type of units in cluster is presented in figure below:

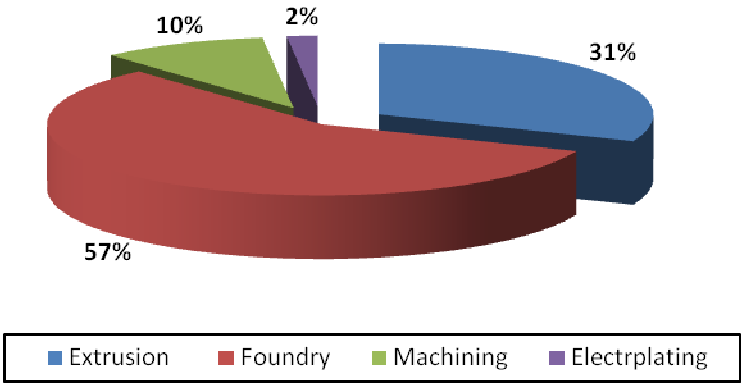

Figure 2.7: ***Percentage of total energy consumption in different type of units in Jamnagar Brass cluster***

2.3.3 Value of specific energy consumption of typical Brass unit in Jamnagar Brass cluster

Specific electrical energy and thermal energy consumption in typical Brass units in Jamnagar cluster depends on type of unit and final product manufacturing in that unit. Specific electrical energy and thermal energy consumption in typical Brass foundry unit, Brass extrusion unit, Machining unit and Electroplating unit in Jamnagar Brass cluster is presented in tables below:

Table 2.7: ***Specific energy consumption of typical Brass foundry unit***

Parameter	Unit	<200 tpa	200-400 tpa	>400 tpa
Electrical specific energy consumption	kWh/kg of brass rod	0.021	0.015	0.014
Electrical specific energy consumption	kCal/kg of brass rod	17.52	13.31	12.26
Thermal specific energy consumption	kg of coal /kg of brass rod	0.16	0.16	0.15
Thermal specific energy consumption	kCal/kg of brass rod	1040	1040	1001
Total specific energy consumption	kCal/kg of brass rod	1057.52	1053.31	1013.26
Thermal energy consumption	%	98.34	98.74	98.79
Electrical energy consumption	%	1.66	1.26	1.21
Specific energy cost	Rs/kg of Brass rod	3.17	3.14	3.02

Table 2.8: *Specific energy consumption of typical Brass extrusion unit*

Parameter	Unit	<500 tpa	500-1000 tpa	>1000 tpa
Electrical specific energy consumption	kWh/kg of brass rod	0.84	0.81	0.77
Electrical specific energy consumption	kCal/kg of brass rod	735.84	700.81	674.52
Thermal specific energy consumption	kg of oil /kg of brass rod	0.05	0.04	0.04
Thermal specific energy consumption	kCal/kg of brass rod	450.80	392.00	362.62
Total specific energy consumption	kCal/kg of brass rod	1186.64	1092.81	1037.12
Percentage of thermal energy consumption	%	37.99	35.87	34.96
Percentage of electrical energy consumption	%	62.01	64.13	65.04
Specific energy cost	Rs/kg of Brass rod	5.64	5.44	5.194

Table 2.9: *Specific energy consumption of typical Brass machining unit*

Parameter	Unit	Value
Electrical specific energy consumption	kWh/kg of final product	0.54
Electrical specific energy consumption	kCal/kg of final product	473.04
Specific energy cost	Rs./kg of final product	3.24

Table 2.10: *Specific energy consumption of typical Brass electroplating unit*

Parameter	Unit	Value
Electrical specific energy consumption	kWh/kg of final product	0.99
Electrical specific energy consumption	kCal/kg of final product	875.21
Specific energy cost	Rs./kg of final product	5.99

2.4 MANUFACTURING PROCESS OVERVIEW ON TYPICAL BRASS PART MANUFACTURING UNIT

The production process mentioned in the below chart is almost similar to most of Brass part manufacturing units in the Jamnagar Brass cluster. However, depending on the final product, quality of final product manufacturing unit and raw material properties, stated process flow is altered to suit the requirement of industry.

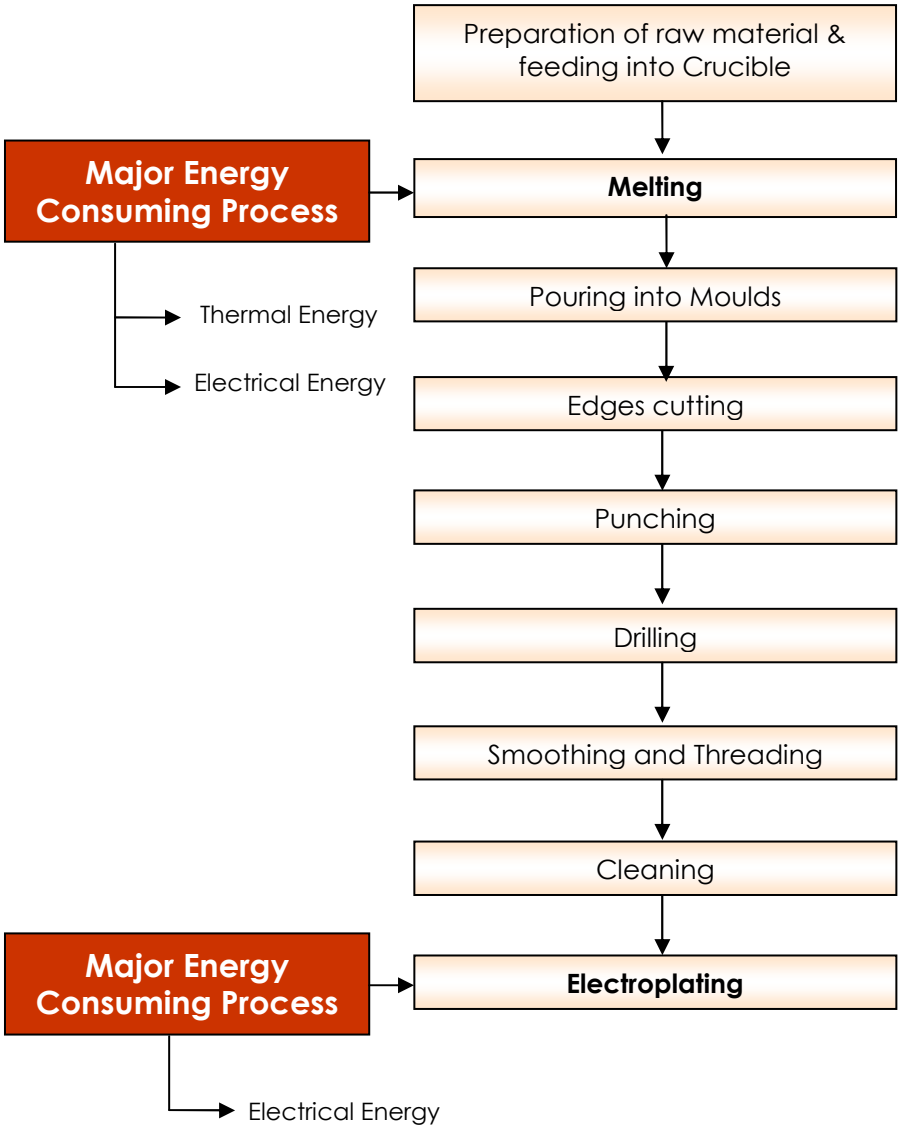

Figure 2.8: ***Process flow chart and important energy consuming stages of manufacturing of Brass part in typical unit in Jamnagar Brass cluster***

2.5 ISSUES RELATED / BARRIERS IN IMPLEMENTATION OF ENERGY CONSERVATION MEASURES / TECHNOLOGY UPGRADATION

The processes to do with technology and innovations in SMEs are different from those that take place in large firm context. Technology in the SME sector has an increasingly complex or combinative character, most of the SMEs units in cluster are regarded for their labour intensive and the capability work with local resources. In the past, SME entrepreneurs have given less emphasis to technology in order to reduce initial cost of plant /machinery. Major barriers in up-gradation of technology in the cluster are:

- Lack of awareness on energy efficiency
- Lack of organizational commitment

- Narrow focus on energy
- Not clear about their existing level of operations and efficiency, due to lack of instrumentation & non availability of energy consumption data
- Limited manpower
- Cost of energy conservation options
- Orthodox mind set of entrepreneurs
- Non availability of clean fuels

Details of the other barriers in the implementation of energy efficient technologies / equipments in the Jamnagar Brass cluster are presented in below sections:

2.5.1 Technological Barrier

Majority of the Brass units entrepreneurs in Jamnagar Brass cluster do not have any in depth technical expertise and knowledge on energy efficiency, and are dependent on local technology suppliers or service companies, who normally also rely on established and commonly used technology. The lack of technical know-how has made it difficult for the Brass unit owners to identify the most effective technical measures.

Most of Brass units in Jamnagar Brass cluster have been established several years ago when energy efficiency was not important issue for the operation of a plant. They are operating with outdated technology and low end technologies.

As majority of the entrepreneurs in cluster are not aware of the energy losses in the plant, there may be a strong feeling that the energy efficiency initiatives in manufacturing facility can have a cascading effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced / retrofitted equipment falls below design values.

There is a strong feeling in the Brass unit entrepreneurs that, energy efficiency initiatives are difficult and they do not wish to take the risks such as business interruption due to production loss vis-a-vis the drive to save energy. These can however be overcome by motivating them to attend the awareness programs and use the 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.

2.5.2 Financial Barrier

Significant amount of investment is not commonly seen in most of Jamnagar Brass industries. Further, from the business perspective for any industry owner, it is more viable, assured and convenient to invest on project expansion for improving the production capacity, rather than make piecemeal investment in retrofit and replace options for energy savings. Investment returns on large capacity addition or technology adoption shows up prominently in terms of savings and helps in benchmarking operations. Further, there is a strong feeling among the industry owners that, energy conservation-initiatives of replacement and retrofit nature is not a common practice as it involves large capital investment against low returns. In view of this, and given the limited financial strength of entrepreneurs from Brass units in Jamnagar, they would not take the risks to invest in energy efficiency measures.

2.5.3 Manpower

Skilled workers are locally available to run the machines available in Jamnagar. However, there is hardly any engineer employed in these enterprises and the production process remains traditional. This is one of the lacunae of the Jamnagar Brass Parts cluster.

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

2.5.4 Non availability of clean fuel

The existing foundry units are using coal and furnace oil as sources of energy for melting and casting operation. This creates a lot of environmental and health problems in cluster. Majority of the industries in Jamnagar are ready to shift to clean fuels such as Natural gas because of environmental, social and economical reasons. Due to non availability of clean fuel in Jamnagar cluster implementation of clean fuel technology operation in cluster has taken a backseat. Since a long time people in Jamnagar are trying to get the gas (CNG) pipe line, but till now they have not succeeded.

Energy use and Technology Assessment in Cluster

3.1 METHODOLOGY ADOPTED FOR ENERGY USE & TECHNOLOGY AUDIT STUDIES

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

- Discussion with the industry representatives/local industry association
- Inventorization of the units so as to understand their energy consumption pattern
- Selection of suitable representative units for carrying out energy use and technology assessment studies

The primary objective of the energy audits is to quantify the existing fuel consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operation practices like hot metal temperature, existing air-fuel ratio, blower and burner parameters etc. Pre-planned methodology was followed to conduct the energy audits. The following sections describe details of methodology adopted in energy use and technology audits in Jamnagar Brass cluster.

3.1.1 Pre-energy use & technology audit studies

Brass industries in Jamnagar area have organized themselves into one association called The **Jamnagar Factory Owners Association**. The following table gives the coordinates of the association.

Table 3.1: *Details of the Jamnagar Brass units association*

Name of the association	Jamnagar Factory Owners Association
Contact Person	Shri Ramjibhai A. Patel
Profile	President-Jamnagar Factory Owners Association
Contact Details	Plot no: 370/372, GIDC Industrial area, Shankar Tekri, Udyognagar, Jamnagar- India Email: jfoa@sancharnet.in

The association provides a platform for development of mutual understanding among the industries and discussion relating to common problems and identification of viable solution. Therefore, as a first step for making inroads in the cluster, the association and its office bearers were approached. Detailed discussions with the association were held on apprising the association about the objective of the project, tentative schedule of the activities being undertaken and expected project outcome.

The office bearers of associations were apprised about benefits of the project for the industries and cluster. The association took up the task of dissemination of all this information among their respective member units. The outcome of this activity was introduction of project concept to the association and later on to the industry. This helped in identifying progressive and interested entrepreneurs in the cluster.

3.1.2 Preliminary energy audit studies

53 Preliminary energy audit studies are conducted in Jamnagar Brass cluster. Methodology followed in preliminary energy audit study is presented below:

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

3.1.3 Detailed energy audit studies

22 Detailed energy audit studies are conducted in Jamnagar Brass cluster. The methodology followed in detailed energy audit study is presented below:

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

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

3.2 OBSERVATIONS MADE DURING ENERGY USE AND TECHNOLOGY AUDIT STUDIES

Observations made during the energy use and technology audit studies in various processes/equipments are presented in the below sections:

3.2.1 Manufacturing process and technology/equipments installed

Brass part manufacturing in Jamnagar Brass cluster comprises three main operations; those are Casting, Machining & Electro plating.

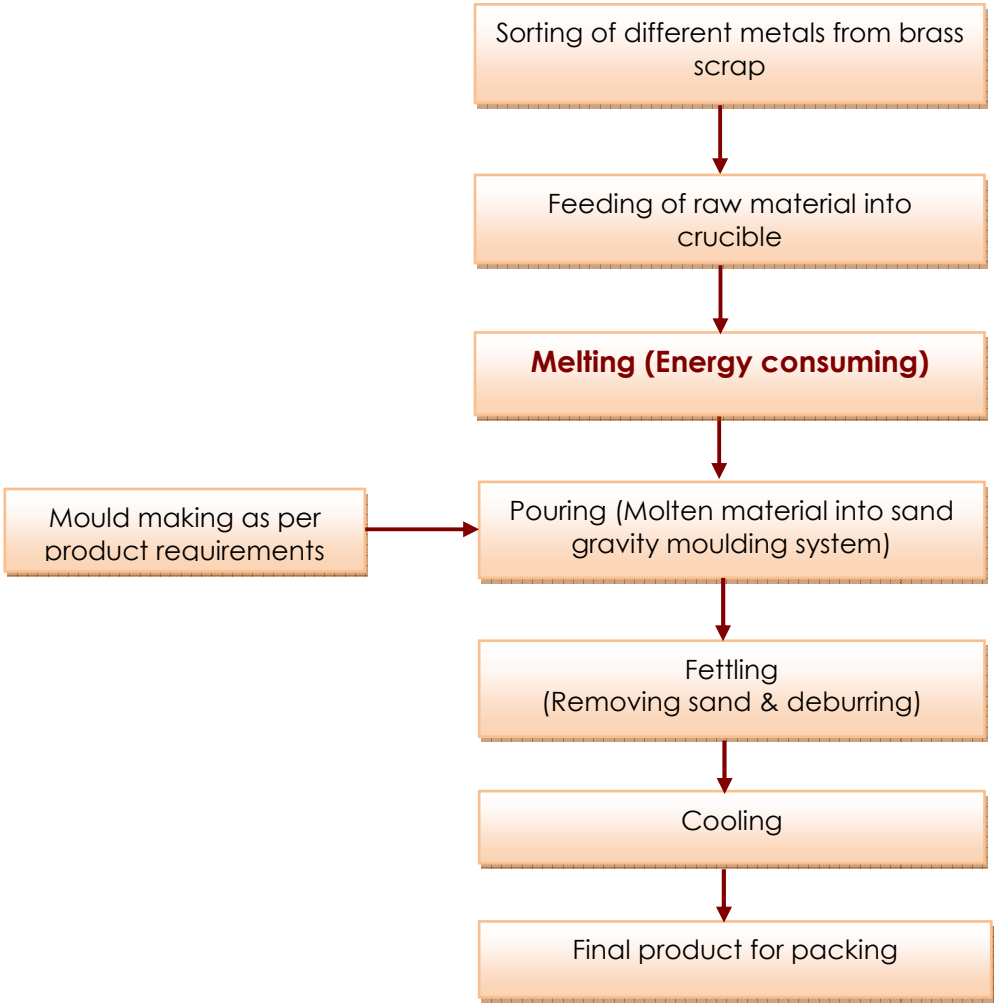

Figure 3.1: ***Manufacturing process of Brass rods at typical Brass foundry unit***

Majority of the Brass foundry/casting units in Jamnagar Brass cluster use coal fired pit furnaces. Brass scrap is used as major raw material for melting; it is mixed with the in-house cuttings and turnings. The scrap is fed manually into the melting crucible while the furnace is kept on the firing mode. Brass scrap is completely melted at 1100 deg C. Generally it takes from 1.2 to 1.5 hours for the material to melt completely. Molten metal is drawn from the crucibles; same is poured in a mould to get the final casting.

From the above process flow diagram it is clear that melting is major energy consuming process in the overall manufacturing process of Brass rods. Brass Melting is done in crucibles made of silicon carbide, better known among the industry as "**Graphite crucibles**". The crucibles are kept inside a round pit and coal is feed into the annual space between crucible & furnace. Annular space between the crucible and the furnace serves as the space for combustion.

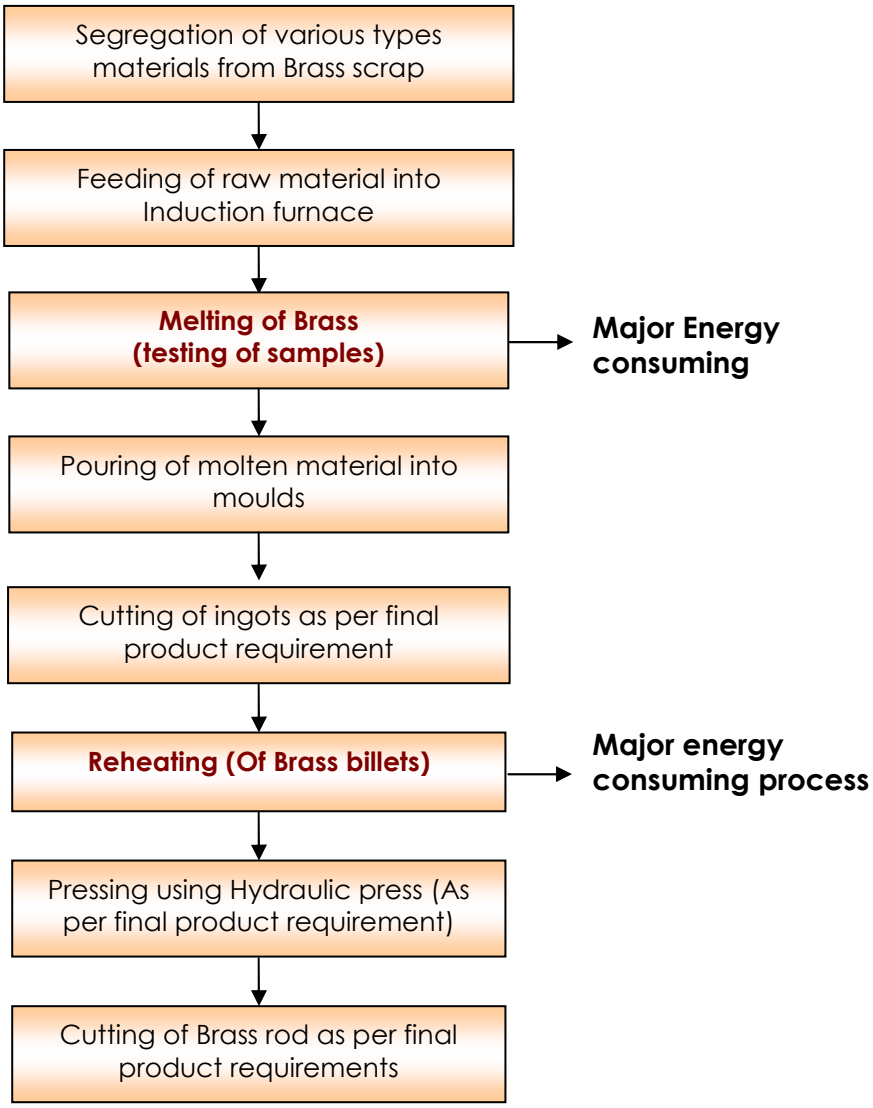

Figure 3.2: *Manufacturing process of Brass rods at typical extrusion unit*

Around 150 of the Brass foundry/casting units in Jamnagar Brass cluster use Electrical induction furnaces for melting of Brass. Brass scrap is used as major raw material for melting; it is mixed with the in-house cuttings and turnings. The scrap is fed manually into the melting crucible while the furnace is kept on the firing mode. Brass scrap is melted by electrical energy. It generally it takes from 1.2 to 1.5 hours for the material to melt completely. Molten metal is drawn from the crucibles and the same is poured in a mould. After the Brass billets are reheated in the reheating furnace, extruded brass rods are out from the hydraulic press as per the final product requirements.

From the above process flow diagram it is clear that melting and reheating are major energy consuming process in the overall manufacturing process of Brass rods. Brass Melting is done in electrical induction furnaces and reheating of billets is done by using oil fired reheating furnaces.

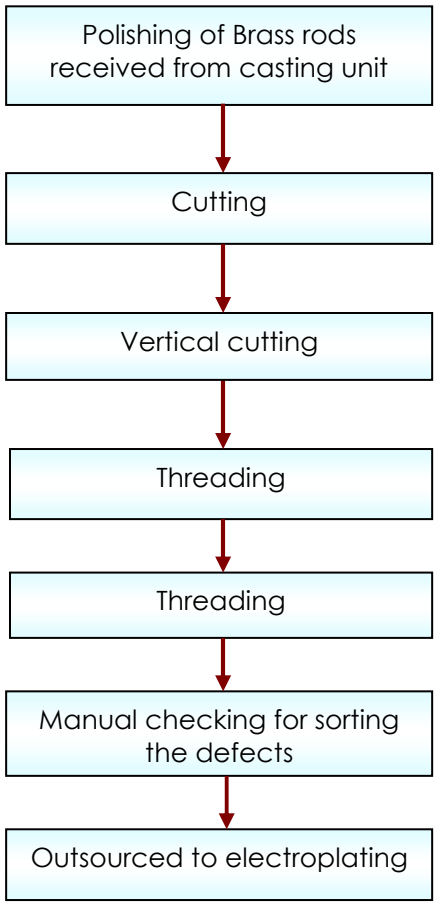

Figure 3.3: ***Manufacturing process of Brass parts at typical Machining unit***

The cast brass rod/wire then goes through various machining operations like drawing, cutting, milling, threading etc. The machining process is job specific and varies from one product to another. Major energy used in all operation is electrical energy.

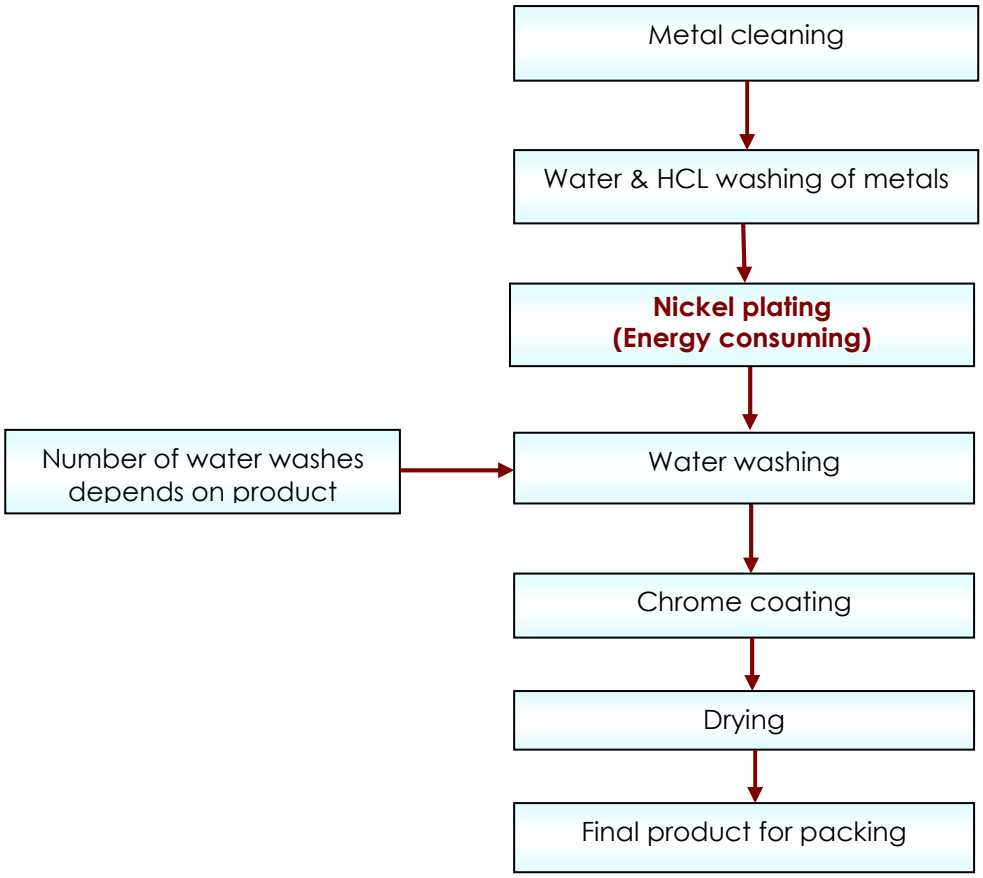

Figure 3.4: *Manufacturing process of Brass parts at typical Machining unit*

The parts for machining are then sent to plating shop for electroplating. Some of the plating operations done in Jamnagar are - Nickel plating, Zinc Plating, Copper plating, Cadmium plating, Silver plating, cobalt plating and gold plating.

The main process of electroplaters is electroplating and this is an electro-mechanical process. In this process the plating bath is media for ion exchange process. For electroplating DC Power source of low voltage and high current is required. This high DC current will flow in one direction simultaneously; metal ions will flow in other directions. In electro plating process the plating metal is linked with cathode of DC source and anode of DC source is linked with job on which plating is required. This complete system is mounted in a tank with solution and this chemical solution is media for ion exchange process. Quality of the plating merely depends on the retention time of material in process tank and intensity of DC source.

Initially they will set received jobs on the jig with the help of copper wire for hanging the job in the electroplating tank. After that material is cleaned in the metal cleaner tank followed by mild acid tanks followed by water tanks depends on the product requirements. Now the job is ready for Nickel plating and the material is hanged in Nickel coating tank followed by water washing. At this stage material is ready with

nickel coating and if the requirement is only of Nickel coating then material directly goes to drying process. Otherwise the material will go to Chrome coating tank for chrome plating. In this tank jobs are hanged through jig on anode of DC source for certain definite time. Finally it goes to drying operation to remove the water particles in it. From the above process flow diagram it is clear that Nickel plating is major energy consuming process in the overall electroplating operation. Generally total process of electroplating operation will take around 1 to 3 hours; it depends on type of material and customer requirements.

➲ *Energy consumption profile of various utilities in typical Brass units*

The major energy consuming equipments installed in typical Extrusion plant in Jamnagar Brass cluster are:

- Induction furnaces
- Reheating furnaces
- Hydraulic presses
- Motors
- Other utilities

The percentage energy consumption of various utilities in typical extrusion plant in Jamnagar Brass cluster is presented in figure below:

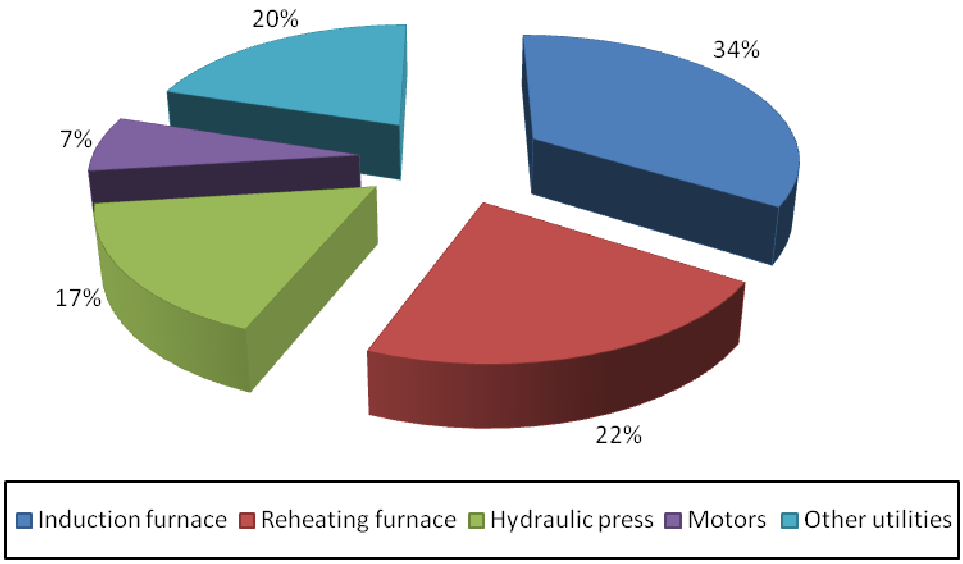

Figure 3.5: ***Percentage energy consumption of different utilities in typical extrusion plant in typical Jamnagar Brass cluster***

From the above figure it is clear that Induction furnace will consume 34% of overall energy, reheating furnaces are consuming around 22% of total energy and remaining utilities are consuming around 34% of total energy.

3.2.2 House keeping Practices

Majority of the Brass industries in Jamnagar Brass Cluster are maintaining very poor operational practices in different utilities in their units. There are no specific procedures followed in any of the units for the operation of the various equipments/utilities in industries. Either the workers or the management doesn't have the knowledge on energy conservation and efficiency. There is no monitoring of fuels or electricity on daily basis in any of the units surveyed.

By improving the operational practices in various utilities in Brass units, efficiency will improve by around 2-5%. Some of the suggested house-keeping practices in Brass industries are presented below:

- Reduce charging time in melting furnace
- Reduce Holding time in melting furnaces to ensure minimum fuel/ electricity consumption while holding (non-productive operation)
- Production planning and scheduling for furnace operation, especially batch melting furnaces, should be done is such a manner so as to have minimum cold starts of the furnace. Each cold start consumes 10 – 20% higher energy than regular furnace running and also leads to premature wear of refractory
- Controlling air infiltration through furnace openings in reheating furnace
- Maintaining proper combustion air pressure in reheating furnace
- Regulate combustion air blower opening with change in fuel supply rate in reheating furnace
- Turn off combustion air supply with cut off in fuel supply regulated by thermostat. Both combustion air and fuel supply should be interlinked with the auto cut operation of thermostat.
- Fuel storage should be done in accordance with the available guidelines for storing that particular kind of fuel.
- Fuel supply lines and the storage should be checked for leakage once in a week for any leakage and blockage
- Burner flame should never directly impinge on the material or the refractory. It increases scale losses, reduces refractory life and causes inefficient heating.
- Digital temperature indicators and automatic controllers in place of human monitoring further reduces the chances of overheating of material and subsequent energy& material loss
- Furnace gates should be opened only when required for material flow. In case of heat treatment furnaces, use of proper digital temperature indicators are recommended as it eliminates the unnecessary opening of furnace gates for checking temperature
- Minimization of bath drag out and water evaporation from hot baths to maintain constant conductivity

3.2.3 Availability of data and information

A majority of the units in Jamnagar cluster are do not have any instrumentation or data monitoring systems to monitor various operational parameters in Processes/equipments/utilities. Few instruments are installed in some of the units in the cluster for monitoring of operational parameters in their units. Accuracy of readings from these instruments is also poor.

Most of entrepreneurs in Jamnagar Brass cluster are not interested in sharing the energy consumption data, due to various reasons. Very few entrepreneurs share their energy consumption against production data in the respective months/annum.

3.3 TECHNOLOGY GAP ANALYSIS IN BRASS INDUSTRIES

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

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

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

There is a tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the some of the progressive managements, they are interested in improve the efficiency their units by replacing the conventional technology with energy efficient technologies in market.

From technology audit studies conducted in Jamnagar Brass cluster, below mentioned areas were identified for technology up gradations; those are:

- Conventional pit furnaces for Brass melting
- Conventional reheating furnaces
- Molding system

Technical gap analysis in above mentioned areas is presented in the following sections:

3.3.1 Conventional oil fired pit furnaces

Technology gaps/design flaws in conventional coal fired pit furnace system are identified and same is presented in details below:

- **Waste heat recovery system**: From energy use & technology audit studies it was observed that, there is no waste heat recovery system to recover the heat losses from hot flue gasses in pit furnaces. Major amount of heat is lost in flue gasses in pit furnaces. This amount to around 35% of total energy input.
- **Preheating of charge/air**: In majority of the systems it was observed that, there is no system for preheat of charge/air. Preheating of charge to around 200-300 deg C will reduce the energy consumption by 5-8%.
- **Insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration. Also, the insulation required for plugging heat loss through the pit furnace was usually done with locally available red bricks, which do not serve the purpose of insulation.
- **Combustion space:** From Technology audit it was observed that combustion space in existing system is not sufficient for proper combustion, which causes poor combustion system efficiency**.**
- **Burners:** Majority of units are using locally fabricated burners for the combustion of fuel oil. These burners were either a far copy of a properly designed burner or sometimes substandard and locally designed. Many times, oil could be seen leaking from the burner joints.
- **Selection and size of Blower system:** A proper capacity blower is necessary for combustion air to be delivered at correct pressure and in appropriate volume. The existing blowers in majority of the units are either locally fabricated without any proper design parameters or are under/over- sized without any consideration for correct air pressure.
- **Inadequate sizing of heating and pumping unit:** In most of the units it was observed that heating and pumping system are not designed properly. This is mainly due to lack of awareness about the standard oil temperature and pressure at the combustion stage and the benefits thereof.

3.3.2 Conventional coal fired Pit furnaces:

Technology gaps/design flaws in conventional coal fired pit furnace system are identified and same is presented in details below:

- **Waste heat recovery system**: From energy use and technology studies it was observed that, there is no heat recovery system to recover heat from hot flue gasses in coal fired pit furnaces. Major percentage of heat is lost in flue gasses in pit furnaces, which amounts to 35-45% of total input energy; which causes poor efficiency of pit furnaces.

Figure 3.6: ***Coal fired brass melting furnace*** operation

- **Insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration.
- **Preheating of charge**: In majority of the systems it was observed that, there is no system for preheat of charge. By preheating of charge to around 200-300 deg C will reduce the energy consumption by 5-8%.
- **Poor mixing of material in crucible:** From technology audit studies it was observed that, there is temperature difference between upper and lower portion of material in crucible due to air pockets between dust & ware and poor mixing of material in crucible. This is affecting the efficiency of furnace as well as burning loss in furnace.
- **Working environment is not safe:** During pouring operation operators are directly exposed to high temperature furnace.

3.3.3 Conventional oil fired reheating furnaces (Billet heaters)

Technology gaps/design flaws in conventional oil fired reheating furnace system are identified and details are described below:

- **Air-Fuel ratios:** From energy use and technology studies it was observed that, air fuel ratio is not proper. This reduces the furnace efficiency by3-5%.

Figure 3.7: *Operation of conventional oil fired Billet heater*

- **Location of chimney:** In majority of industries, chimney was located at centre of reheating furnaces; this causes the poor heat transfer between flue gasses and charge; this automatically leads to poor heat transfer efficiency between flue gas and reheating material.
- **Waste heat recovery system:** This is the one of the area where major amount of heat energy is lost; in majority of the units is not installed waste heat recovery system to recover the heat from flue gasses. In a few cases it was observed that efficiency of existing waste heat recovery system is poor. Around 35% of heat input energy to reheating furnace is lost in the flue gasses.
- **Preheating of charge and combustion air:** In majority of the systems it was observed that, there is no system for preheat of charge and air.
- **Insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration. Also, the insulation required for plugging heat loss through the pit furnace was usually done with locally available red bricks, which do not serve the purpose of insulation.
- **Burner:** Majority of units are using locally fabricated burners for the combustion of fuel oil. These burners were either a far copy of a properly designed burner or sometimes substandard and locally designed. Many a times, oil could be seen leaking from the burner joints. Same types of burners were used for a large range of fuel flow rates.

- **Selection and size of Blower system:** A proper capacity blower is necessary for combustion air to be delivered at correct pressure and in appropriate volume. The existing blowers in the majority of the units are either locally fabricated without any proper design parameters or are under/over- sized without any consideration for correct air pressure.
- **Inadequate sizing of heating and pumping unit:** In majority of the units it was observed that heating and pumping system are not designed properly. This is mainly due to lack of awareness about the standard oil temperature and pressure at the combustion stage and the benefits thereof.

3.3.4 Sand gravity based moulding system

- **Quality of product**: In Energy use and technology audit studies it was observed that quality of product from sand gravity based molding system is poor compared to other technologies available in market.
- **Rejection rate:** Around 10-20% of final casting is rejected due to improper mixing of sand, variation of moisture content in sand, improper making of moulding system etc.
- **Pouring time:** Time being taken to pour the molten material in system is high - this reduces the productivity.
- **More metal loss:** Manual pouring of molten material in molding system will take around 45min - this increases fuel consumption and metal loss.
- **Working environment is not safe:** During pouring operation operators are directly being exposed to high temperature furnace.

3.4 ENERGY CONSERVATION PROPOSALS

Various energy conservation proposals are identified for Brass units in Jamnagar Brass cluster. Details of identified energy conservation proposals along with its cost benefit analysis and issues in implementation of each proposal are presented in following sections.

3.4.1 Replacement of conventional Reheating furnace with energy efficient reheating furnace

➲ **Background**

Existing reheating furnaces being used in majority of the industries are of very primitive design; have poor preheating of charge, they do not have waste heat recovery system and poor heat transfer efficiency between hot flue gasses & Billets. It is recommended to replace the conventional reheating furnace with energy efficient reheating furnace.

Figure 3.8: *Operation of Energy efficient reheating furnace*

➲ Benefits of proposals

Major advantages of replacing conventional reheating furnace with energy efficient reheating furnace are presented below:

- Improved product quality
- Saving in reheating time - it automatically leads to energy savings
- Improved working environment
- Productivity improvements

➲ Cost benefits analysis

Cost benefits analysis of the replacing the conventional reheating furnace system with energy efficient reheating furnace system in typical Brass industry is presented in table below:

Table 3.2: *Cost benefits analysis of replacing of conventional reheating furnace system with energy efficient reheating furnace system*

Parameter	Units	Value
Efficiency of existing reheating furnace	%	17.59
Specific fuel consumption of conventional reheating furnace	liters/tonne	37.03
Efficiency of energy efficient reheating furnace	%	28.00
Specific fuel consumption of energy efficient reheating furnace	liters/tonne	23.26
Savings in fuel consumption	liters/tonne	13.77
Annual production capacity	tonne	500
Annual fuel savings after replacing conventional reheating furnace with energy	liters/annum	6885

Parameter	Units	Value
efficient reheating furnace		
Annual monetary saving @ Rs. 28/liter	Rs.lakh	1.93
Implementation cost	Rs.lakh	4.00
Simple payback period	years	2.07

From the above table it is clear that replacement of conventional reheating system with energy efficient reheating system is financially attractive.

➲ **Issues in implementation**

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Cost of implementation

3.4.2 Installation of Air-fuel control system in conventional reheating furnace

➲ **Background**

From energy use and technology audit study, it was observed that high level of excess air was present in the flue gas. Though a representative amount of excess air is required for proper combustion, but larger quantities of excess air result in excessive heat loss through flue gases, as well as cooling of the combustion chamber due to excess air. In a few cases it was observed that excess air present in reheating furnace is less than excess air required for complete combustion. Both the abovementioned cases lead to improper fuel combustion, which automatically leads to poor furnace efficiency. It is recommended to install proper air-fuel control system in conventional reheating furnace system.

➲ **Technical specifications of proposal**

This ratio controller comes under the brand Ratiotrol and the model no. Ratiotrol – 7052 – 0 was selected for the single burner and heavy oil parameters. Details of ratio trolls are presented below:

➲ **Benefits of proposals**

Major advantages of installing Air fuel controllers in reheating furnace are presented below:

- Improved product quality
- Saving in reheating time, it automatically leads to energy savings
- Improved working environment
- Productivity improvements

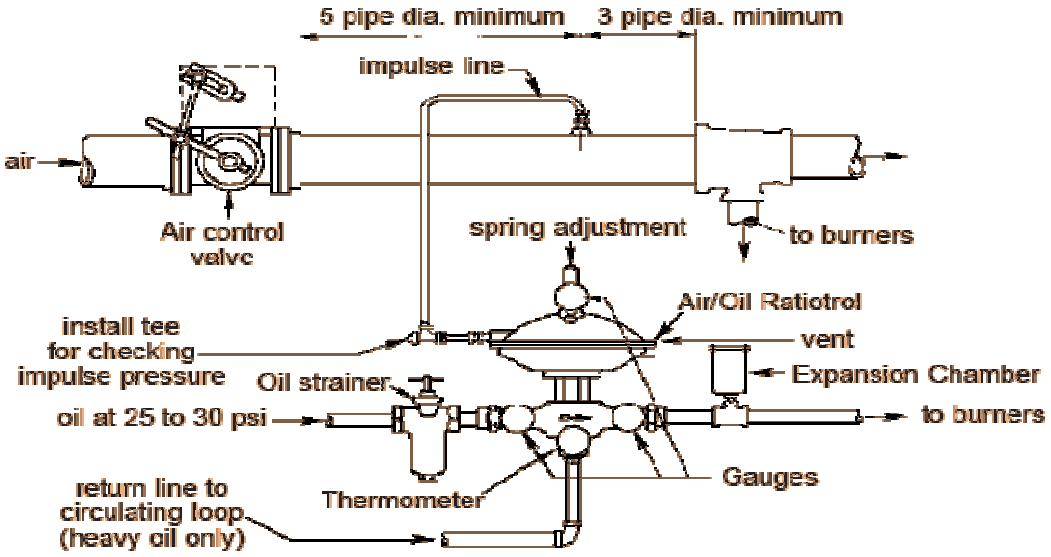

Figure 3.9: ***Details of Ratio trolls 7052-0 model***

➲ Cost benefits analysis

Cost benefits analysis of installing the Air-fuel controller's i.e. ratiotrols in conventional reheating furnace system in typical Brass industry is presented in table below:

Table 3.3: ***Cost benefits analysis of installing the Air-Fuel controller's i.e. ratiotrols in conventional reheating furnace***

Parameter	Units	Value
Efficiency of existing reheating furnace without ratio controllers	%	17.59
Specific fuel consumption in reheating furnace without ratio controllers	liters/tonne	37.03
Specific fuel consumption	mkCal/Tonne	0.32
Existing excess air levels in reheating furnace	%	9.41
Efficiency of existing reheating furnaces after installation of ratio controllers and avoiding air infiltration in reheating furnace	%	20.99
Specific fuel consumption in reheating furnace with ratio controllers	liters/tonne	31.03
Savings in furnace oil consumption after installation of Air-fuel controllers	liters/tonne	6
Annual production capacity	tonnes	500
Annual fuel savings due to installation of ratio controllers in reheating furnace	liters/annum	3,000
Annual monetary saving @ Rs. 28/Liter	Rs.lakh	0.84
Implementation cost	Rs.lakh	0.30
Simple payback period	years	0.34

From the above table it is clear that installation of ratio controllers in reheating system is attractive in energy, economic and environmental point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measures
- ➥ Cost of implementation

3.4.3 Improving the insulation of reheating furnaces

➲ Background

From energy use and technology studies it was observed that, proper insulation seemed to be a forgotten factor in majority of Brass extrusion units. As a result, skin temperatures as high as 100 deg C on furnace walls and 130 deg C on furnace roofs. This led to high radiation losses through the furnace, which sometimes accounted as high as 3-7 % of the overall losses. To overcome this shortcoming, the insulation thickness and quality were reconsidered in various zones of furnace. A separate lining for each part of the body of the furnace like the hearth, walls, roof, heating and soaking zone and preheating zone was designed and laid down.

Use of insulation materials like Hysil sheet, ceramic blanket etc was introduced to the furnace makers, who till now did not use these materials either due to lack of awareness or to bring down the cost of construction of the furnace. Brick lining in the existing furnace varied from 12 inches to 14 inches in thickness and comprised mainly of the inferior grade firebricks and a single layer of insulation bricks. Also, same type of refractory material and insulation material was used for main chamber as well as preheating zone irrespective of the temperature difference. It is recommended to use the proposed insulation and refractory material for proper insulation of furnace and technical specification of same is presented in table below:

➲ Technical specification

Technical specifications of refractory and lining in the proposed reheating furnace are presented in table below:

Table 3.4: *Technical specifications of refractory and lining in the proposed reheating furnace*

Wall	Soaking & Heating Zone	230mm refractory (70% Alumina)
		115 mm insulation (Hot face insulation)
		50 mm (Hysil Sheet)
		75 mm Ceramic blanket (50 mm 128 kg/m3 + 25 mm 96 kg/m3 density)

	Pre-heating Zone	230mm refractory (60% Alumina)
		115 mm insulation (Hot face Insulation)
		50 mm (Hysil Sheet)
		75 mm Ceramic blanket (96 kg/m3)
Hearth	Soaking & Heating Zone	230mm refractory (80% Alumina)
		115 mm insulation (Hot face insulation)
		75 mm (Hysil Sheet)
		25 mm Ceramic blanket (128 kg/m3)
	Pre-heating Zone	230mm refractory (60% Alumina)
		115 mm insulation (Hot face insulation)
		50 mm (Hysil Sheet)
		50 mm Ceramic blanket (96 kg/m3)
Roof	Soaking & Heating Zone	230mm refractory (70% Alumina)
		115 mm insulation (Hot face insulation)
		100 mm Ceramic blanket (50 mm 128 kg/m3 + 50 mm 96 kg/m3 density)
		75 mm insulation Tile (Cold face)
	Pre-heating Zone	230mm refractory (60% Alumina)
		115 mm insulation (Hot face insulation)
		100 mm Ceramic blanket (50 mm 128 kg/m3 + 50 mm 96 kg/m3 density)
		75 mm insulation Tile (Cold face).
Burner		115 mm refractory (70% Alumina) +
		115 mm Hot Face insulation
		100mm ceramic blanket (128 density)
		75 mm insulation tile (Cold face).

➲ Benefits of proposals

Major advantages of use proper refractory and lining in energy efficient reheating furnace are presented below:

- ➥ Saving in reheating time, it automatically leads to energy savings
- ➥ Improved working environment
- ➥ Productivity improvements

➲ Cost benefits analysis

Cost benefits analysis of the installing the suitable refractory and lining in reheating furnace is presented in table below:

Table 3.5: ***Cost benefits analysis of installing the suitable refractory and lining in reheating furnace***

Parameter	Units	Value
Average surface temperature of Reheating furnace with existing insulation	deg C	112
Specific fuel consumption with existing insulation	Liters/tonne	39
Average surface temperature of Reheating furnace with proposed refractory and lining	deg C	55
Specific fuel consumption after installation of proposed insulation	liter/tonne	35.3
Savings in fuel consumption	Liters/tonne	3.7
Annual production capacity	tonne	500
Annual fuel savings due to installation of suitable refractory & lining	liters/annum	1,850
Annual monetary saving @ Rs. 28/Liter	Rs. lakh	0.52
Implementation cost	Rs. lakh	0.75
Simple payback period	years	1.4

From the above table it is clear that installation of suitable refractory and lining system in place of conventional refractory and lining system is financially attractive.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers

3.4.4 Installation of temperature gauges in Reheating furnace

➲ Background

In the existing reheating furnace operation billet temperature is being measured by operator's experience. Most of units it was observed that billet temperature is more than required temperature for pressing operation; this will increases fuel consumption in reheating furnaces. Apart from that, this reduces the quality of material. It is recommended to install temperature gauges in reheating furnaces for proper temperature control.

➲ Technical specification

Recommended reheating temperatures of different type of material in reheating furnace are presented in table below:

Table 3.6: ***Recommended reheating temperatures different materials***

S. No	Type of material	Temperature (deg C)
1	Free cutting brass	700/750
2	Forging brass	700/750
3	Modify forging brass	600/650
4	High tensile brass	700/750
5	Lead free brass	800/850
6	IS319-II	800/850
7	DTP	800/850
8	SVF	800/850
9	CuZn40Pb2	800/850
10	C-3602	800/850
11	C-345	800/850

➲ Benefits of proposals

Major advantages of use of temperature controllers are presented below:

- ➥ Quality improvements
- ➥ Reduction of reheating time, it automatically leads to energy savings
- ➥ Productivity improvements

➲ Cost benefits analysis

Cost benefits analysis of the installing the temperature gauges in reheating furnace is presented in table below:

Table 3.7: ***Cost benefits analysis of installing temperature gauges in reheating furnace***

Parameter	Units	Value
Temperature of billet without temperature gauges in reheating furnace	deg C	795
Specific fuel consumption without temperature gauges in reheating furnace	liters/tonne	39
Actual temperature required for pressing operation of billet	Deg C	750

Parameter	Units	Value
Specific fuel consumption after installation of temperature gauges	liters/tonne	37.20
Savings in fuel consumption after installation of temperature gauges	liters/tonne	1.80
Annual production capacity	tonnes	500
Annual fuel savings due to installation of temperature gauges	liters/annum	900
Annual monetary saving @ Rs. 28/Liter	Rs.lakh	0.25
Implementation cost	Rs.lakh	0.20
Simple payback period	years	0.80

From the above table it is clear that installation of suitable temperature gauges in reheating system is financially attractive.

➲ **Issues in implementation**

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers

3.4.5 Improving the insulation of coal fired brass melting furnace

➲ **Background**

From energy use and technology studies it was obsseved that insulation was forgotten factor and in many units in Jamnagar, as a result, skin temperatures of melting furnaces as high as 110 deg C. This led to high radiation losses through the furnace, which sometimes accounted as high as 3-7 % of the overall losses. To overcome this shortcoming, the insulation thickness and its layering quality were reconsidered.

Figure 3.10: *Insulation in conventional coal fired pit furnace*

It is recommended to install suitable refractor lining and insulation system to plug the heat losses from melting furnace.

➲ Benefits of proposals

Major advantages of improving the insulation of coal fired brass melting furnace are presented below:

- ➥ Reduction of melting time, it automatically leads to energy savings
- ➥ Productivity improvements
- ➥ Improved working environment

➲ Cost benefits analysis

Cost benefits analysis of the improving the insulation of Bras melting furnace is presented in table below:

Table 3.8: ***Cost benefits analysis of improving the insulation of Brass melting furnace***

Parameter	Units	Value
Average surface temperature of melting furnace with existing insulation	deg c	110
Specific coal consumption in melting furnace with existing insulation	Kg/tonne	195
Specific coal consumption in melting furnace with existing insulation	mkCal/tonne	1.08
Efficiency of melting furnace with existing insulation	%	11
Efficiency of melting furnace with improved insulation	%	12.20
Savings in coal consumption	Kg/tonne	19
Annual production capacity	tonne	300
Annual coal savings due to installation of suitable insulation in melting furnace	Kg/annum	5,700
Annual monetary saving @ Rs. 18/Kg	Rs.lakh	1.02
Implementation cost	Rs.lakh	0.30
Simple payback period	years	0.30

From the above table it is clear that installation of suitable lining and refractory system in melting furnace is financially attractive.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers

3.4.6 Replacement of conventional coal fired furnace with gas fired furnace:

➲ Background

Presently brass melting units are being used high grade coal as fuel for melting purpose. From energy use and technology audit studies it was observed that conventional coal fired has efficiency of around 11% due to various reasons mentioned in technology assessment report. It is recommended to replace conventional coal fired furnace with gas fired furnace.

Figure 3.11: ***Operation of coal fired brass furnace melting operation in typical bras unit***

➲ Benefits of proposals

Major advantages of replacing the conventional coal fired brass melting furnace with gas fired melting furnace was presented below:

- ➥ Specific fuel cost in gas fired melting furnace is low compared to coal fired melting furnace
- ➥ Environment friendly
- ➥ Productivity improvements
- ➥ Improved working environment

➲ Cost benefits analysis

Cost benefits analysis of the replacing conventional coal fired Brass melting furnace with energy efficient gas fired melting furnace is presented in table below:

Table 3.9: ***Cost benefits analysis of replacing the conventional coal fired brass melting furnace with energy efficient gas fired melting furnace***

Parameter	Units	Value
Efficiency of existing coal fired furnace	%	11
Specific coal consumption in conventional coal fired melting furnace	Kg/tonne	195
Specific fuel consumption in conventional coal fired melting furnace	mkCal/tonne	1.08
Specific fuel cost in conventional coal fired melting furnace	Rs./Kg	3.50
Efficiency of the proposed gas fired melting furnace	%	17
Specific energy consumption in energy efficient gas fired melting furnace	Nm^3/tonne	72
Specific fuel consumption in gas fired melting furnace	mkCal/tonne	0.69
Specific fuel cost in Energy efficient gas fired melting furnace (@24Rs/Nm^3)	Rs./Kg	1.80
Savings in specific fuel cost by using energy efficient gas furnace in place of conventional coal fired furnace	Rs./tonne	1700
Annual production capacity	tonnes	200
Annual monetary savings due to installation of energy efficient gas fired inplace of conventional coal fired melting furnace	Rs.lakh/annum	3.40
Implementation cost of gas fired melting furnace	Rs.lakh	2.50
Simple payback period	years	0.74

From the above table it is clear that replacement of conventional coal fired Brass melting furnace with energy efficient gas fired melting furnace is attractive in energy, economic and environmental point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers
- ➥ New development in cluster

3.4.7 Replacement of conventional coal fired pit furnace with Rotary furnace

➲ Background

Presently a majority of Brass melting units in Jamnagar are using high grade coal as fuel for melting purpose. From energy use and technology audit studies it was observed that conventional coal fired has efficiency of around 11% due to various

reasons mentioned in technology assessment report. Apart from poor furnace efficiency, coal fired pit type of furnace has melting loss of around 4-5% and more operational& maintenance cost. It is recommended to replace conventional coal fired furnace with gas fired rotary furnace.

➲ Benefits of proposals

Major advantages of replacing the conventional coal fired brass melting furnace with gas fired rotary melting furnace was presented below:

- Specific fuel cost in gas fired melting furnace is low compared to coal fired melting furnace
- Environment friendly
- Productivity improvements
- Improved working environment
- Utilization of waste heat
- Uniform heating due to rotary movement
- Reduction of burning loss compared to conventional pit furnace
- Regular operation & maintenance is avoided
- Preheating of charge, this will reduces the fuel consumption
- Automatic pouring system

➲ Cost benefits analysis

Cost benefits analysis of the replacing conventional coal fired melting furnace with energy efficient rotary fired melting furnace is presented in table below:

Table 3.10: ***Cost benefits analysis of replacing the conventional coal fired brass melting furnace with energy efficient rotary gas fired melting furnace***

Parameter	Units	Value
Efficiency of existing coal fired furnace	%	11
Specific coal consumption in conventional coal fired melting furnace	Kg/tonne	195
Specific fuel consumption in conventional coal fired melting furnace	mkCal/tonne	1.08
Specific fuel cost in conventional coal fired melting furnace	Rs./Kg	3.50
Efficiency of the proposed rotary gas fired melting furnace	%	21
Specific energy consumption in energy efficient gas fired melting furnace	Nm^3/tonne	58
Specific fuel consumption in gas fired melting furnace	mkCal/tonne	0.57
Specific fuel cost in Energy efficient gas fired melting furnace (@24Rs/Nm^3)	Rs./Kg	1.40

Parameter	Units	Value
Savings in specific fuel cost by using energy efficient rotary gas furnace in place of conventional coal fired furnace	Rs./tonne	2100
Annual production capacity	tonnes	200
Annual monetary savings due to installation of energy efficient rotary based gas fired in place of conventional coal fired melting furnace	Rs.lakh/annum	4.20
Implementation cost of Rotary based gas fired melting furnace	Rs.lakh	12
Simple payback period	years	2.9

From the above table it is clear that replacement of conventional coal fired Brass melting furnace with energy efficient rotary gas fired melting furnace is attractive in energy, economic and environmental point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers
- ➥ New technology development

3.4.8 Replacement of conventional oil fired pit furnace with energy efficient oil fired furnace

➲ Background

From energy use and technology audit studies it was observed that conventional oil fired pit furnace has poor efficiency due to poor combustion space, improper location & size of burners and improper capacity of blower system etc. It is recommended to replace conventional oil fired furnace with energy efficient oil fired furnace.

➲ Benefits of proposals

Major advantages of replacing the conventional oil fired brass melting furnace with energy efficient oil fired melting furnace was presented below:

- ➥ Specific energy cost reduction
- ➥ Productivity improvements
- ➥ Improved working environment
- ➥ Utilization of waste heat
- ➥ Preheating of charge - this will reduces the fuel consumption

➲ Cost benefits analysis

Cost benefits analysis of replacing conventional oil fired Bras melting furnace with energy efficient oil fired brass melting furnace is presented in table below:

Table 3.11: ***Cost benefits analysis of replacing the conventional oil fired brass melting furnace with energy efficient oil fired melting furnace***

Parameter	Units	Value
Specific fuel consumption of conventional oil fired melting furnace	liters/tonne	130
Efficiency of existing oil fired furnace	%	10.20
Specific fuel consumption in conventional oil fired melting furnace	mkCal/tonne	1.21
Specific fuel cost in conventional oil fired melting furnace	Rs./Kg	3.60
Efficiency of energy efficient oil fired furnace	%	13.96
Specific fuel consumption in energy efficient oil fired melting furnace	liters/tonne	95
Specific fuel consumption in energy efficient oil fired melting furnace	mkCal/tonne	0.88
Specific fuel cost in Energy efficient gas fired melting furnace (@28Rs/liter)	Rs./Kg	2.66
Savings in specific fuel cost by using energy efficient oil fired furnace in place of conventional oil fired furnace	Rs./tonne	940
Annual production capacity	tonnes	200
Annual monetary savings due to installation of energy efficient oil fired melting furnace in place of conventional oil fired melting furnace	Rs.lakh/annum	1.88
Implementation cost of energy efficient oil fired furnace	Rs.lakh	4.00
Simple payback period	years	2.20

From the above table it is clear that replacement of conventional oil fired Brass melting furnace with energy efficient oil fired melting furnace is attractive in energy, economic and environmental point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers

3.4.9 Replacement of conventional rectifiers with energy efficient in electro plating units

➲ Background

From energy use and technology audit studies it was observed that presently a majority of electro plating units are using inefficient AC-DC rectifier for electro plating purpose. It is recommended to replace conventional inefficient rectifier with energy efficient rectifier.

Figure 3.12: *Operation of energy efficient rectifier in electroplating unit*

➲ Benefits of proposals

Major advantages of replacing the conventional rectifier with energy efficient rectifier in electroplating units are presented below:

- ➥ Reduction of energy cost
- ➥ More energy efficient
- ➥ Improved power factor
- ➥ Compact in size

➲ Cost benefits analysis

Cost benefits analysis of the replacing conventional rectifier with energy efficient rectifier in electroplating units is presented in table below:

Table 3.12: *Cost benefits analysis of replacing the conventional rectifier with energy efficient rectifier*

Parameter	Units	Value
Energy consumption of conventional rectifier with full load operation	kWh	7
Energy consumption of energy efficient rectifier	kWh	4.20
Energy saving due to replacing conventional rectifier with energy efficient rectifier	kWh	2.80
Annual operational hours of Rectifier	hours	1500
Annual energy saving due to replacement of conventional rectifier with energy efficient one	kWh	4,200
Annual monetary saving due to replacement of conventional rectifier with energy efficient one (@ Rs 6/kWh)	Rs. lakh/annum	0.25
Implementation cost of Energy efficient rectifier	Rs. lakh	0.4
Simple payback period	years	1.6

From the above table it is clear that replacement of conventional rectifier system with energy efficient rectifier system is attractive in energy and economic point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure
- ➥ Non availability of suitable local service providers

3.4.10 Replacement of conventional under loaded motors with suitable rating energy efficient motor in Hydraulic press

➲ Background

From energy use and technology audit studies it was observed that loading of motors installed in hydraulic press in majority of units is around 40-60%. Efficiency and power factor of under loaded motors is poor compared to full load of motor. It is recommended to replace the under loaded conventional motors with energy efficient motors of appropriate rating of motor.

➲ Benefits of proposals

Major advantages of replacing the conventional under loaded motors with suitable energy efficient motor in hydraulic press is presented below:

- ➥ Improved efficiency of hydraulic press
- ➥ Improved power factor

➲ Cost benefits analysis

Cost benefit analysis of replacing the conventional under loaded motors with suitable size of energy efficient motors in Hydraulic press is presented in table below:

Table 3.13: *Cost benefit analysis of replacing under loaded conventional motors with energy efficient motors of suitable rating in hydraulic press*

Parameter	Units	Value
Rating of motor in Hydraulic press	hp	150
Rated full load efficiency of existing motor	%	91
Full load rated efficiency of energy efficient motor (Eff1)	%	94.3
Energy consumption of conventional motors at existing load	kW	67
Power saving due to replacement of conventional motors with appropriate rating energy efficient motors	kW	2.34
Annual operational hours	hours	3,000
Annual energy savings	kWh	7,020

Parameter	Units	Value
Annual monetary savings (@6 Rs/kWh)	Rs.lakh	0.42
Investment required for replacement of conventional motors with energy efficient motors	Rs.lakh	1.5
Simple payback period	Years	3.57

From the above table it is clear that replacement of conventional under loaded motors with suitable size energy efficient motors is attractive in Energy, and Economic point of view.

➲ Issues in implementation

- ➥ Lack of awareness on proposed energy conservation measure

3.4.11 Replacement of conventional v belts with synchronous belts in various drives

➲ Background

V-belts have power transmission efficiency of only 93% resulting in a loss of 7% energy input due to inherent design problems of V-belts. It is recommended to replace the V-belts with energy efficient synchronous transmission belts, which have higher transmission efficiency of 98% compared to V-belts. The increase in efficiency of flat belts is due to superior material properties and operational characteristics.

➲ Benefits of proposals

- ➥ Synchronous belts offer longer life than conventional v belt system
- ➥ 20-50% narrower pulley widths compared to v belts pulleys
- ➥ High tensile strength and very high modulus viscosity
- ➥ Reliability of flat belts is good
- ➥ Less wear pulleys in flat belt system compared to V-belt system

➲ Cost Benefit analysis of proposal

Cost benefit analysis of replacing conventional V belts with energy efficient belts are presented in table below:

Table 3.14: ***Cost benefit analysis of replacing of conventional v belts with synchronous belts***

Parameters	Units	Value
Rating of the motor	hp	15
Input power consumption of the motor with conventional V belts	kW	10.20
Input power consumption of the motor with energy	kW	9.78

Parameters	Units	Value
efficient synchronous belts		
Electrical power saving after replacing the conventional V belts system with synchronous belts	kW	0.43
Annual operational hours of the motors	hours	4000
Energy savings due to installation of the synchronous belts in place of conventional belts	kWh	1700
Monetary savings (@ Rs. 6/kWh)	Rs.lakh	0.10
Investment required for replacing conventional v belts with energy efficient ones	Rs.lakh	0.10
Simple payback period	years	1

➲ Issues/barriers in implementation

- ➥ Lack of awareness on energy conservation measure
- ➥ Non availability of products in local market
- ➥ High cost in implementation

3.4.12 Installation of timers in cooling towers

➲ Background

From Energy use and technology audit studies it was observed that a majority of the cooling towers in extrusion plants are operates continuously irrespective of water temperature. It is recommended to install timers in cooling towers. These timers will switch on/off the cooling tower fans depending on water temperature.

Figure 3.13: ***Operation of cooling tower in typical Brass extrusion unit****Error! Bookmark not defined.*

➲ Benefits of proposals

Benefits of installing the timers in cooling tower system are presented below:

- ➥ Energy saving
- ➥ Uniform temperature of cooling water

➲ Cost Benefit analysis of proposal

Cost benefit analysis of installing timers in cooling tower system is presented in table below

Table 3.15: *Cost benefit analysis of installation of timers in cooling tower system*

Parameter	Units	Value
Rating of motor installed in cooling tower fans	kW	5
Operational hours per day without timer system	hours	10
Motor input power	kW	4.2
Operational hours per day with timer system	hours	8
Power saving due to installation of timers in cooling tower fan system	kWh/day	8.40
Annual energy saving due to installation of timers in cooling tower system	kWh/annum	2,520
Annual monetary saving after installation of timers in cooling tower system (@ Rs 6/kWh)	Rs. lakh/annum	0.15
Implementation cost	Rs.lakh	0.10
Simple payback period	years	0.67

From the above table it is clear that installation of timers in cooling tower system is financially attractive.

➲ Issues/barriers in implementation

- ➥ Lack of awareness on energy conservation measure

3.4.13 Replacement of conventional cooling tower system with energy efficient cooling tower system

➲ Background

From Energy use and technology audit studies it was observed that majority of the cooling towers fans are being used with Aluminium as material for manufacturing of

fan blades. It is recommended to replace the conventional cooling towers with energy efficient one.

➲ Benefits of proposals

Benefits of replacing the conventional cooling tower system with energy efficient cooling tower system is presented below:

- ➥ Energy saving
- ➥ Less noisy

➲ Cost Benefit analysis of proposal

Cost benefit analysis of replacing conventional cooling towers with energy efficient cooling tower system is presented in table below

Table 3.16: ***Cost benefit analysis of replacing conventional cooling tower system with energy efficient cooling tower system***

Parameter	Units	Value
Rating of motor installed in cooling tower fan	kW	5
Input power of cooling tower fan with conventional cooling tower blades	kW	4.20
Input power of cooling tower fan with energy efficient blades	kW	3.10
Annual operational hours	hours	3,000
Power saving due to energy efficient cooling tower inplace of conventional cooling tower	kW	1.10
Annual energy saving due to replacement of conventional cooling tower with energy efficient cooling tower	kWh/annum	3,300
Annual monetary saving after Replacing conventional cooling tower system with energy efficient one (@ Rs 6/kWh)	Rs. lakh/annum	0.20
Implementation cost	Rs.lakh	0.30
Simple payback period	years	1.50

From the above table it is clear that replacement of conventional cooling tower system with energy efficient cooling tower system is financially attractive.

➲ Issues/barriers in implementation

- ➥ Lack of awareness on energy conservation measure

3.5 AVAILABILITY OF TECHNLOGY SUPPLIERS/LOCAL SERVICE PROVIDERS FOR IDENTIFIED ENERGY CONSERVATION PROPOSALS

Technology suppliers/local service providers for identified major energy saving proposals mentioned in above sections in cluster are available in cluster, except few of the new developed proposals.

Details of the identified technology supplier/local service providers in Jamnagar Brass cluster are furnished in Annexure-2 and same is attached along with this report.

3.6 IDENTIFIED TECHNOLOGIES FOR DPR PREPARATION

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

As the process and equipments are more or less similar in all cluster units in Jamnagar Brass cluster, all the technologies/equipments identified can be replicated as per the requirement of the units and detailed project reports for the specific technologies prepared also can be replicated in different chemical units as per the capacity requirement. The following technologies/equipments were considered for preparation of detailed project report.

- Coal fired melting furnace
- Reheating furnace
- Oil fired melting furnace
- Moulding system
- Fuel switching options in melting
- Fuel switching option in Reheating furnace

3.6.1 Justification for technologies/equipments identified for DPR preparation

Energy saving potential and replication potential in percentage of number of units of identified technology up gradation projects are presented in table below.

Table 3.17: ***Energy saving potential and replicability of identified technology up gradation projects***

Area for Technology up gradation	Existing technology	Technology up gradation measure	Energy saving potential (%)	Replicability potential in no of units	Replicability potential in cluster of total units (%)
Melting system	Conventional coal fired pit furnace	Energy efficient gas fired furnace	25-35	595	17
		Rotary based gas fired furnace	30-50	140	4
Reheating furnace	Conventional reheating furnace system	Energy efficient oil fired redesigned reheating furnace	30	105	3
		Energy efficient gas fired reheating furnace	30-40	140	4
Moulding system	Sand gravity based casting system	Continuous casting system	15-25	525	15
		Low pressure die casting system	20-30	105	3
Melting system	Conventional oil fired pit furnace	Energy efficient oil fired pit furnace	30-40	35	1

Environmental Benefits

In this chapter various environmental benefits after implementation of proposed energy conservation measures are discussed in this chapter.

4.1 GHGS REDUCTION

All proposed energy conservation measures will have less energy consumption or fuel consumption compared to conventional/existing system; this automatically leads to reduction of GHGs emissions. Reduction of GHGs emissions leads to improved environment and better compliance with environmental regulations

Major GHGs emission reduction due to saving of grid electricity and fuels is CO_2, reduction of other GHGs are negligible. Annual GHGs reduction potential identified in cluster is around 90142 tonnes of CO_2.

4.2 IMPROVED WORKING ENVIRONEMNT

Due to overall improvement in working condition, as no direct exposure to heat & poisonous fumes would reduce the health issues of working environment and surrounding population would improve substantially.

Conclusion

5.1 SUMMARY

In this section summary of outcome of energy use and technology studies conducted in Jamnagar Brass cluster is discussed, which include identified energy conservation measures, its energy & monetary benefits, payback period, issues in implementation are discussed. Details of the same are furnished in table below:

Table 5.1: *Summary of energy saving proposals in Jamnagar Brass cluster*

S. 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	Replacement of conventional Reheating furnace with energy efficient reheating furnace	7,000 liters of furnace oil	1.96	4	2.04	▪ Lack of awareness on EC measure ▪ Cost of implementation	Yes	120	840,000 liters of furnace oil
2	Installation of Air-fuel control system in conventional reheating furnace	3000 liters of furnace oil	0.84	0.3	0.34	▪ Lack of awareness EC measure ▪ Cost of implementation	No	90	270,000 liters of furnace oil
3	Improving the insulation of reheating furnaces	1,850 liters of furnace oil	0.52	0.75	1.4	▪ Lack of awareness EC measure	No	80	148,000 liters of furnace oil
4	Installation of temperature gauges in reheating furnace	900 liters of furnace oil	0.25	0.2	0.8	▪ Lack of awareness EC measure ▪ Non availability of local service provider	No	100	90,000 liters of furnace oil

S. 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
5	Improving the insulation of coal fired brass melting furnace	5,700 Kg of coal	1.02	0.3	0.3	▪ Lack of awareness EC measure ▪ Non availability of suitable local service provider	No	700	3,990,000 Kg of coal
6	Replacement of conventional coal fired furnace with gas fired furnace	76.4 mkCal	3.4	2.5	0.74	▪ Lack of awareness EC measure ▪ Non availability of suitable LSP ▪ New development	Yes	595	45,458 mkCal
7	Replacement of conventional coal fired pit furnace with Rotary furnace	114 mkCal	4.2	12	2.9	▪ Lack of awareness EC measure ▪ Non availability of suitable LSP ▪ New technology development	Yes	140	15,960 mkCal
8	Replacement of conventional oil fired pit furnace with energy efficient oil fired furnace	7,000 liters of Furnace oil	1.88	4	2.2	▪ Lack of awareness EC measure ▪ Non availability of LSP	Yes	35	245,000 of furnace oil
9	Replacement of conventional rectifiers with energy efficient in electro plating units:	4,200 kWh	0.25	0.4	1.6	▪ Lack of awareness EC measure ▪ Non availability of suitable LSP	No	200	840,000 kWh
10	Replacement of conventional under loaded motors with suitable rating energy efficient motor in Hydraulic press	7,026 kWh	0.42	1.5	3.57	▪ Lack of awareness EC measure ▪ Non availability of suitable LSP	No	120	843,120 kWh
11	Replacement of conventional	1,700 kWh	0.102	0.1	1	▪ Lack of awareness EC	No	1500	2,550,000 kWh

S. 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
	v belts with synchronous belts in various drives					measure ▪ Non availability of suitable LSP			
12	Installation of timers in cooling towers	2,520	0.15	0.1	0.67	▪ Lack of awareness EC measure	No	120	302,400 kWh
13	Replacement of conventional cooling tower system with energy efficient cooling tower system	3,300	0.2	0.3	1.5	▪ Lack of awareness EC measure ▪ Non availability of LSP	No	120	396,000 kWh

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

Level of awareness on energy efficiency and energy conservation products in the Jamnagar Brass cluster is poor, due to below mentioned reasons.

- Lack of awareness on the Energy efficiency
- Lack of organizational commitment
- Narrow focus on Energy
- Not clear about their existing level of operations and efficiency, due to lack of instrumentation & non availability of Energy consumption data
- Limited manpower
- Lack of trained manpower
- Limited information on new technologies
- Cost of Energy conservation options

Major energy sources being used in cluster are Coal, Furnace oil and Electrical energy. Annual energy consumption of above mentioned sources in different type of operations in Jamnagar cluster is presented in table below:

Table 5.2: *Annual energy consumption of various energy sources in Jamnagar Brass cluster*

S. No	Type of Unit	Electrical energy consumption (kWh/annum)	Coal consumption (tpa)	Furnace oil consumption (liters per annum)
1	Extrusion	118,872,125	Not Applicable	5,520,000
2	Foundry	465,920	44,132	Not Applicable
3	Machining	56,702,100	Not Applicable	Not Applicable
4	Electroplating	10,490,550	Not Applicable	Not Applicable
	Total	186,530,695	44,132	5,520,000

Total Annual energy consumption in the cluster is around 66,775 MTOE (Tonnes of Oil Equivalent). After implementation of proposed energy conservation measures will save the 4,931,520 kWh of electrical energy, 44,132 tonne of coal and 1,085,000 liters of furnace oil. **Annual energy saving potential identified in cluster is around 8,005 MTOE, which is around 11.9% of total energy consumption.**

Detailed Technology Assessment Report

Most of the chemical industries in Jamnagar Brass cluster has these characteristics, those are low engineering, limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, operational skill etc. This 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.

Comprehensive Study conducted at different types of Brass units in Jamnagar Brass cluster to assess the technology gap in different processes and utilities. Following technical gaps are observed during our study:

- The state of art of technology of the unit for some of the equipments installed is poor as compared to technologies available in market. There are various technological gaps were identified in Brass units as under technology audit studies and these may be due to lack awareness on the technologies available, quantum of energy loss and its monetary benefit, lack of awareness among workforce etc.
- There is tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the management, they are interested in improve the efficiency of the plant by adopting this type of technology instead of going for retrofit options in the existing equipments.

The various factors which influence the management towards implementation energy efficiency and energy conservation projects in Brass units in Jamnagar Brass cluster are:

- Energy efficiency and energy conservation is a low cost investment option which reduces energy consumption
- Low capital investment
- The energy efficiency improvement will enhance the plant management to be competitive in local and global markets by reducing production cost
- To conserve depleting fossil fuels
- The energy efficiency and conservation reduces GHG emissions because of low carbon dioxide and particulate emissions
- Energy efficiency and conservation is a viable strategy to meet future energy needs of the expanding plans in the industry
- The energy efficiency and conservation places no financial and administrative burden as no separate manpower is required and only training of operation and maintenance of the technologies adopted is envisaged
- The return on investment is attractive with lower pay back periods.

From technology audit studies conducted in Jamnagar Brass cluster, below mentioned areas were identified for technology up gradations; those are:

- Conventional pit furnaces for Brass melting
- Conventional reheating furnaces
- Moulding system
- Fuel switching options in melting furnaces
- Fuel switching options in reheating furnaces

Technical gap analysis in above mentioned areas is presented in below sections:

➲ *Conventional Oil fired pit furnaces*

Technology gaps/design flaws in conventional coal fired pit furnace system are identified and described the details below:

- **Waste heat recovery system**: in energy use and technology audit studies it was observed that, there is no waste heat recovery system to recover the heat losses from hot flue gasses in pit furnaces. Major percentage of heat is lost in flue gasses in pit furnaces, this amount to around 40% of total energy input.
- **Preheating of charge/air**: In majority of the systems it was observed that, there is no system for preheat of charge/air. By preheating of charge to around 200-300 deg c will reduce the energy consumption by 5-8%.
- **Use of poor insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration to a high extent. Also, the insulation required for plugging heat loss through the pit furnace was usually done with locally available red bricks, which do not serve the purpose of insulation.
- **Inadequate volume for combustion and hot gases:** In majority of the units are observed combustion space in existing system is not sufficient for proper combustion, which causes poor combustion system efficiency**.**
- **Improper location of burner**
- **Poor capacity and scientifically designed burner:** Majority of units are using locally fabricated burners for the combustion of fuel oil. These burners were either a far copy of a properly designed burner or sometimes substandard and locally designed. Many a times, oil could be seen leaking from the burner joints. Same types of burners were used for a large range of fuel flow rates irrespective of fuel flow requirement.
- **Poor mixing of material in crucible:** In Majority of the cases it was observed that, due to air pockets between dust &ware; heat transfer between metal to metal contact is poor, this cause's thermal ingredient top and bottom portion. This is affecting the efficiency as well as burning loss in furnace.

- **Poor selection and size of Blower system:** A proper capacity blower is necessary for combustion air to be delivered at correct pressure and in appropriate volume. The existing blowers in the Majority of the units are either locally fabricated without any proper design parameters or are under/over- sized without any consideration for correct air pressure.
- **Inadequate sizing of heating and pumping unit:** In most of the units it was observed that heating and pumping system are not designed properly. This is mainly due to lack of awareness about the standard oil temperature and pressure at the combustion stage and the benefits thereof.

➲ *Conventional coal fired Pit furnaces*

Technology gaps/design flaws in conventional coal fired pit furnace system are identified and described the details below:

- **No heat recovery system**: From energy use and technology studies it was observed that, there is no heat recovery system to recover the heat from hot flue gasses in coal fired pit furnaces. Major percentage of heat is lost in flue gasses in pit furnaces, which amounts to 35-45% of total input energy; which causes the poor efficiency of pit furnaces.
- **Use of poor insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration to a high extent; which do not serve the purpose of insulation.
- **Preheating of charge/air**: In majority of the systems it was observed that, there is no system for preheat of charge/air. By preheating of charge to around 200-300 deg c will reduce the energy consumption by 5-8%.
- **Poor mixing of material in crucible:** In majority of the cases it was observed that, due to air pockets between dust &ware; metal to metal contact and transfer of heat is poor, this cause's thermal ingredient top and bottom portion. This is affecting the efficiency as well as burning loss in furnace.
- **Working environment is not safe:** During pouring operation operators are directly exposed to high temperature furnace**.**
- **No dust collection system**

➲ *Conventional oil fired reheating furnaces (Billet heaters)*

Technology gaps/design flaws in conventional oil fired reheating furnace system are identified and details are described below:

- **Poor Air-Fuel ratios:** From energy use and technology studies it was observed that, air fuel ratio is not proper. Due to poor designed control system of air-fuel ratios. It is effacing the furnace efficiency.

- **Location of chimney:** In majority of industries, chimney was located at centre of reheating furnaces; this causes the poor heat transfer between Flue gasses and charge; this automatically leads to poor heat transfer efficiency between flue gas and reheating material.
- **Waste heat recovery system**: This is the one of the area where major amount of heat energy is lost, in majority of the units are not installed waste heat recovery system to recover the heat from flue gasses. Few cases it was observed that efficiency of existing waste heat recovery system is poor. Around 35% of heat input energy is loss in the flue gasses.
- **Preheating of charge/air**: In majority of the systems it was observed that, there is no system for preheat of charge/air.
- **Use of poor insulating material:** Furnace lining of the existing furnace was done with the locally available firebricks. The firebricks with low alumina content tend to get worn out in a short duration to a high extent. Also, the insulation required for plugging heat loss through the pit furnace was usually done with locally available red bricks, which do not serve the purpose of insulation.
- **Improper location of burner**
- **Poor capacity and scientifically designed burner:** Majority of units are using locally fabricated burners for the combustion of fuel oil. These burners were either a far copy of a properly designed burner or sometimes substandard and locally designed. Many a times, oil could be seen leaking from the burner joints. Same types of burners were used for a large range of fuel flow rates.
- **Poor selection and size of Blower system:** A proper capacity blower is necessary for combustion air to be delivered at correct pressure and in appropriate volume. The existing blowers in the majority of the units are either locally fabricated without any proper design parameters or are under/over- sized without any consideration for correct air pressure.
- **Inadequate sizing of heating and pumping unit:** In most of the units it was observed that heating and pumping system are not designed properly. This is mainly due to lack of awareness about the standard oil temperature and pressure at the combustion stage and the benefits thereof.

➲ ***Sand gravity based moulding system***

- **Poor quality of product**: In Energy use and technology audit studies it was observed that quality of product from sand gravity based molding system is poor compared other technologies available in market.

- **Rejection of material is more:** Around 10-20% of final casting is rejected due to Improper mixing of sand, variation moisture content in sand, improper making of Moulding system etc.
- **Limitation in product manufactured from sand gravity based casting system**:
- **Pouring time is more:** This reduces the productivity
- **More metal loss:** Manual pouring of molten material in molding system will take around 45min; this will increases fuel consumption and metal loss.
- **Working environment is not safe:** During pouring operation operators are directly exposed to high temperature furnace**.**

Annexure 2

Details of Technology / Service Providers in Jamnagar Brass Cluster

S. No	Name of company	Contact person	Address of company	Technology / service provider for
1.	Sujata Machine tools	Dayaljibhai P.Nakum	Opp: Ravi Petrol Pump, Rajkot Highway, Jamnagar	❖ All kinds of machine tools and machines used in Machining operation
2	Wesman Thermal Engineering Processes Private Limited	Shyamalesh Kar	503-504 Eros Apartment, 56 Nehru Place, New Delhi-India	❖ Oil & Gas fired Burners ❖ Blower ❖ Heating& Pumping unit ❖ Reheating furnace
3	Parshottam Dayalji & Co.	Atul/Kiran	Sp shed no55, Shankar tekri, Udyognagar, Jamnagar	❖ Ancillary for all kinds of Brass foundry units ❖ Moulding and pouring equipments
4	Vishnu Crucible Pvt Ltd (Vesuvius)	Suresh Khattar	A-38, GIDC,S.T Udyognagar, Jamnagar	❖ Silicon Graphite crucible
5	Applied machine tools	M.K. Dudhaiya	Plot no. 500/D, G.I.D.C, Shankar tekri, Udyognagar, Jamnagar	❖ All kinds of machine tools and machines used in Machining operation
6	REW Rolex Engineering works	Rameshbhai P. Parmar	Plot no, 515/3, Nr. Bank of Baroda, Shankar tekri, Udyognagar, Jamnagar	❖ Mould systems
7	Coal trader	Navin bhai	Shankar Tekri, Udyognagar, Jamnagar	❖ Coal
8	MICO Hydraulics	Prakash R.Parti	215/2, GIDC, Phase-II, DARED, Jamnagar	❖ Hydraulic system ❖ Reheating furnace
9	AVANI Electronics	Ramesh Bhai	27, shreeji Industrial Estate, Near Ajanta Clock, Rajkot Highway, Morbi-363641	❖ Digital Rectifier
10	Kelvin Machine tools	Krishnakanthbhai/ Bharat bhai	Shankar Tekri, Udyognagar, Jamnagar	❖ All kinds of machine tools and machines used in Machining operation
11	M/s Supersonic	Prashant Vanjare	H.O.26, 27, 50 New Satguru Nanik Industrial Estate Western Express Highway, Goregaon (E) Mumbai: 400063 Fax: 26854296 Tel: 26854322/4926/5212	❖ Ultrasonic cleaning machine

Techno Commercial Bids from Service/Technology Provider

1. Gas fired Pit furnace:

EM EM ENGINEERS

Address: A-4/235, Paschim Vihar, New Delhi-110063 (INDIA)

Ref: Date: 24-May-10

M/s Winrock International India,
788, UV-Phase V, Gurgaon,
Haryana, India.

Kind Attn: Mr. Sripal Rao

Subject: Gas Fired Brass Melting Furnace.

Dear Sir,

As per our discussions please find attached our offer for Gas heated Brass Melting Furnace

TECHNICAL DATA

Capacity	:	To accommodate Crucible of capacity 250 – 300 Kgs of Brass.
Max. temperature	:	1050 Deg. C
Normal	:	950 Deg. C
Fuel	:	Gas (Pl specify NG or LPG)
Thickness of outer shell	:	5 mm M.S.
Thickness of top plate	:	12 mm
Type of Insulation	:	Energy saving Ceramic Fibre Blankets along with refractory bricks at bottom of the furnace and element holding bricks.
Price with Silicon Carbide Crucible and Automatic Temperature Control Panel.	:	Rs.2,60,000/- (Rs. Two Lac Sixty thousand only) each, ex-our works, New Delhi

DESCRIPTION

The Furnace consists of Indigenous Silicon carbide Crucible enclosed with a refractory / ceramic fibre chamber.

The outer casings of the equipment is made out of substantial steel framework with welding and screw joints wherever required.

SCOPE OF SUPPLY

FURNACE DULY LINED WITH CERAMIC FIBRE BLANKETS, REFRACTORIES, FITTED WITH 1 NO. AUTOMATIC TEMPERATURE CONTROL PANEL, 1 NO. SILICON CARBIDE CRUCIBLE.

Trust you will find our offer in line with your requirement. However if you need any further information / clarification, please get in touch with us and we would be pleased to attend to the same.

We assure you of our best services at all times.

Thanking you

Yours Truly

For **EM ENGINEERS**

(MANISH KUMAR SOOTA)
BE (MECH), MBA

GENERAL TERMS & CONDITIONS

PRICES

Prices quoted by us are ex-our works, Delhi

PAYMENT

50% value of the order will be payable as advance along with the order and balance upto 100% value of each consignments along with full value of taxes, duties and any other levies as applicable at the time of dispatch will be payable against the Performa invoice prior to dispatch.

PACKING & FORWARDING

The charges shall be extra at actual.

INSURANCE

If desire by the customer we can cover the goods to be dispatched against transit insurance at an additional charge of 0.75% of the insured value.

TAXES & DUTIES

Central / State Government Sales Tax, Octroi and /or other statutory levies as applicable at the time of delivery will be charged extra and to be borne by the client. At present Central sales tax in is 2% against form 'C' OR 12.5% VAT whichever is applicable.

EXCLUSIONS

Our services does not include any civil engineering works such as Water Tank, Baskets, cabling from main to panel, panel to transformer, transformer to furnace, Water connections, other utility connections, pipe lines etc. although consultancy regarding the above jobs can be given or any other item not specifically mentioned in our offer.

ERECTION & COMMISSIONING

The equipment will be completely assembled and will be ready for use prior to dispatch from our works. There are only to be installed at client's premises with the various utility connections like power, oil line, water etc. as applicable. These connections will have to be done by the client we shall however, provide necessary drawings, instructions and manuals. In case the client desires the visit of our engineer for the commissioning of these ready assembled equipment we can dispatch our Engineer on chargeable basis. Our charges for the visit of our Engineer will be Rs. 1,500/- per day, including his days of travel, both To & fro Third AC Railways fare, both ways, local conveyance, lodging boarding expenses at actual.

For safety and better performance of our equipment, we recommend making use of our engineer's services.

DELIVERY

The delivery will be done within 4-6 weeks, subject to delays due to reasons beyond our control. All delivery schedule subject to delays by customers for payment, drawing approval and other obligations by customer.

During erection and commissioning of equipment, the services of unskilled labour, gas cutting /welding sets, standard tools, chain pulley /crane, suitable material handling facilities, water supply, power and /or other utility, oil/gas supply have to be provided free of cost by the client.

2. QUOTATION FOR ULTRASONIC CLEANING SYSTEM MODEL – 1000 WATTS

1.	Power Input	:	230V Single Phase AC supply.
2.	Ultrasonic Power	:	1000 watts.
3.	Frequency	:	25 ± 3 KHZ.
4.	Ultrasonic Generator	:	Solid state module in the machine structure. Cooling is achieved by inbuilt cooling fans. The Circuit is having safety protections like movs & diodes. Control panel is having safety fuses along with indication for generators & switches. Panels are duly powder coated.
5.	Transducer	:	PZT sandwiched type, bonded at the front of the tank with a special weldbond technique.
6.	Tank dimension	:	16”x 16” x 26” (LxBxH)
7.	Tank capacity	:	102 liters
8.	Tank Material	:	Stainless steel 316 grade 16 s.w.g sheet metal fabrication of high quality, round corners, buffed & polished surfaces. All joints are argon arc welded.
9.	Heater	:	1.5 kw x 2nos. heaters are provided. controlled thermostatically.
10.	Tank cabinet	:	Panels are powder coated.
11.	Lid	:	Lid fabricated out of stainless steel sheet is provided on top of the tank.
12.	Drain	:	1” BSP Ball valve is provided for draining of the tank.

BUSINESS TERMS

Basic Price	:	Rs. 1,05,000/- (Rs. One Lakh Five Thousand Only)

QUOTATION FOR ULTRASONIC CLEANING SYSTEM – 1500 WATTS

1.	Power Input	:	415 V Three Phase AC Supply.
2.	Ultrasonic Power	:	1500 Watts.
3.	Frequency	:	22 ± 3 KHz.
4.	Ultrasonic Generator	:	Solid state module in the machine structure cooling is achieved by inbuilt cooling fans. The circuit is having safety protections like Moves and diodes. Control panel is having Safety fuses along with indication for Generators and switches. Panels are duly powder coated.
5.	Transducer	:	PZT sandwiched type, bonded at the front & back side of the tank with a special weld bond technique.
6.	Tank dimension	:	18” x 18” x 30” (LxBxH)
7.	Tank capacity	:	150 Liters
8.	Tank material	:	Stainless Steel 316 grade 16 s.w.g. sheet metal fabrication of high quality, round corners, buffed and polished surface. All joints are argon arc welded.
9.	Tank cabinet	:	Panels are duly powder coated.
10.	Heater	:	2 KW x 2 nos heaters are provided, controlled thermostatically.
11.	Lid	:	Lid fabricated out of stainless steel sheet is provided on top of the tank.
12.	Drain	:	Ball valve is provided for draining of the tank.

BUSINESS TERMS

Basic Price	:	Rs. 1,48,000/- (Rs. One Lakh Forty Eight Thousand Only)

Policy guidelines/subsidy schemes available with State governments for improving energy efficiency in cluster

1. Energy audit subsidy scheme by GEDA (Gujarat Energy Development Agency)

The Gujarat Energy Development Agency (GEDA), is nodal Agency established by the Government of Gujarat for promoting use of renewable energy sources and energy conservation in Gujarat. GEDA is also the State Designated Agency for implementing the Energy Conservation Act-2001(EC Act) enacted by the Govt. of India. 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.

There is a potential for conserving 30-40% energy in some key industrial clusters. Absence of systematic energy monitoring mechanism is a major factor that is responsible for a large amount of unproductive energy utilisation in industries. GEDA's Energy Audit Scheme provides financial assistance as well as technical expertise through trained & experienced energy expert, to industries and building owners for analysing their energy usage and to increase their profits through achievement of higher energy efficiency.

Energy audits of industrial units, commercial complexes, hotels and hospitals are covered under this subsidy scheme. The subsidy will cover upto 50 % cost of the Energy Audit Study (EAS), upto a maximum of Rs.20, 000/-. Industries with a electrical CD of less than 200 kVA and commercial complexes with a electrical CD less than 75 kW would only be eligible for subsidy under this Scheme.

During the year 2009-10 subsidy shall be provided to 250 industries and commercial buildings , qualifying the eligibility norms of the scheme, on first-come-first-served basis.

Procedures for Applying For Subsidy

1. An industry willing to avail subsidy is required to apply in the format in Form I. Services of GEDA authorized Energy Audit Consultant engaged may be taken for applying procedures.

2. Application should be submitted to GEDA office alongwith
   - Proposal of the Energy Audit consultant engaged by the industry - financial offer & scope of study.
   - Latest Annual Report of the Industry applying for subsidy.

3. Subsidy sanction issued by GEDA would indicate subsidy amount; elaborate scope of study; duration of study (with last date for report submission) and Terms & conditions of sanction.

Procedures for Claiming Subsidy

1. Submission of one copy of draft Energy Audit Report, alongwith industry's comment, to GEDA before the specified last date.
2. Formal presentation of the report by the Consultant, in presence of GEDA representative and the concerned executives from the industry. The presentation to be arranged in the premises of the Industry, with prior intimation, on a mutually convenient date.
3. Acceptance of the EA Report, with modifications, if any, after the formal presentation.
4. Submission of 2 copies Final Report, spirally or comb bound, alongwith the Declaration (as per Form II) duly signed/sealed, proof of payment made to the Energy Audit Consultant for the EA study and implementation energy conservation measures suggested in the report with time schedule, estimates of savings and investments required.

Terms and Conditions of EAS Subsidy Sanction

1. The scope of the EA Study would be as specified by GEDA in its sanction.
2. The work eligible for the EAS subsidy would include assessment of energy use in the industry, outline of cost-effective measures, scope of energy saving, estimates of investments for implementation of corrective measures suggested, payback periods and reporting of results of these activities. Other works, in particular tariff comparison and analysis, preparation of tender specifications and tender evaluation, detailed design work, work connected with implementation of measures and long term Consultancy work **are not eligible for subsidy under the scheme.**
3. Any industry within the Gujarat will be eligible for availing subsidy under this scheme 'once' provided the industry has not availed subsidy under any other government scheme.
4. Energy audits conducted by GEDA authorized energy audit consultants will only be valid for availing subsidy under this scheme.
5. The energy audit must be conducted as per the scope defined in GEDA's sanction letter. Any deviation in the specified scope of study will result in cancellation of the subsidy.
6. The industry must forward the draft report to GEDA with its comments. A formal presentation of the report by the energy audit consultant, in the premises of the industry should be arranged in the presence of GEDA official(s) and concerned executives from within the industry. **Only after the Presentation and discussion the report will be accepted.**

7. The claim for subsidy is subject to the sanction issued by GEDA. Any claim without a prior sanction of GEDA would not be entertained. All payments made by the industry to the Energy Audit Consultant should be done so by cheque or demand draft only.

8. It is mandatory for the industry to implement EC measures so as to achieve atleast 20% of the financial saving projected in the Final Report.

9. GEDA shall follow up on the post-audit implementation by the industry, with either a written communication or a personal visit by its representative to the industry. The industry would be obliged to respond positively to such visits and/or correspondences.

10. GEDA reserves the right to reject an application for EAS subsidy without giving reasons and to change the terms and conditions of the scheme and to terminate the scheme at any time.

11. The Energy Audit Report would be a confidential document. However, GEDA reserves the right to use and publish data and information generated during the study, for dissemination to other similar industries. The industry may have the option of not indicating its name on the Report. In such cases GEDA's sanction number & date should be mentioned in the Report.

12. If the study is not completed within the specified time limit, GEDA may decide to cancel the subsidy. However, extension, if required, may be requested, before the due date of reporting, stating reasons for the extension.

13. **Terms of Payment of Energy Audit Subsidy**

GEDA shall release subsidy amount directly to the industry against submission of two copies of the Final Report. The industry shall submit the subsidy claim letter alongwith `Declaration' (Form II) and proof of payment released to the Energy Audit Consultant. The subsidy would be disbursed as follows:

- 50% against submission of Final Report
- 50 % against submission of the post-audit Feedback Report, duly certified jointly by the industry and the Energy Audit Consultant. Payment can be claimed a within one month from the date of submission of the Final Report

For further assistance please contact:
Sr. Project Executive / Project Executive,
Gujarat Energy Development Agency,
4th Floor, Block No 11-12, Udyog Bhavan,
Sector-11, Gandhinagar.

2. Assistance for Environment Management to MSMEs

Assistance for environment Management to MSMEs

1 Name of the Scheme

Scheme of assistance for Environment Management to MSMEs.

2 Operative Period

From 11/06/2009 to 10/06/2014

3 Who is eligible to get the benefit ?

Any MSME unit engaged in manufacturing and who intends to set up facilities for waste management/ pollution prevention and abatement will be eligible for assistance under this Scheme.

4 Eligible Activities

The following facilities setup with application of Innovative / State of art technology will be considered as an eligible activity:

- Substitution & Optimization of raw material including catalysts
- Rainwater harvesting
- Any other pre-identified environment management project
- Implementation of cleaner production and clean technology measures, etc.

5 Assistance available

The following quantum of assistance shall be provided:

S.N	Eligible Activity	Quantum of Assistance per project
A	Substitution & Optimization of raw material including catalysts	Upto 25% of cost of plant & machinery; ceiling of Rs 10 lakh per project.
B	Rainwater harvesting	Upto 50% of cost of fixed capital investment ; ceiling of Rs 5 lakh per project
C	Any other pre-identified environment management project	Upto 25% of cost of plant & machinery; ceiling of Rs 10 lakh per project
D	Implementation of cleaner production and clean technology measures, etc.	Upto 50% of cost of plant & machinery; ceiling of Rs 10 lakh per project.

The quantum of assistance under activity at sr. no A and D would be decided by State Level Committee, on the basis of scrutiny of the project report of the eligible activity to be carried out by the Gujarat Cleaner Production Center (GCPC). The quantum of

assistance under activity at sr. no C would be decided by State Level Committee, and the quantum of assistance of activity at sr. no. B will be decided by District Level Committee.

6 Check List

S. N	Particulars	Remarks
1.	Copy of legal status of applicant such as memorandum of article and company registration certificate or partnership deed or registration under society act / trust act etc. and list of directors/partners with addresses.	
2.	Copy of land allotment by GIDC/ sale deed land & copy of 7/12	
3.	Copy of IEM NO. /EM No./Regn.No.	
4.	GPCB NOC/ CONSENT for establishing project	
5.	Please submit detailed project report as applicable.	
6.	Process Diagram of proposed Project.	
7.	Implementation Schedule	
8.	Copy of any other financial assistance granted by GoG and/or GoI for same component or project	
9.	Declaration as per application	
10.	Affidavits regarding any outstanding Government dues and any pending court case against Govt.	

7 Procedure

1. The unit will have to apply to IC/concerned DIC prior to the implementation of the project in prescribed format for assistance along with documents as specified in check list, within one year from the date of issue of quality certificate.
2. On receipt of application with all details, IC/DIC Office will scrutinize the application and submit to the committee for decision within 60 days.
3. After the decision of the committee IC Office will convey the decision within 8 days.
4. The applicant will submit detail expenditure to IC office and/or concerned DIC. DIC will carry out site visit, verify the assets and expenditure incurred and submit the report to IC office within 30 days.
5. IC Office will issue pay order within 15 days and amount will be disburse as per availability of grant.

8 Contact officer for further details /query

Name : MR. N.M. Trivedi
Designation: Dy. Commissioner of Industries (Incentive)
Address : Block No. 1, 6th Floor, Udyog Bhavan, Sector 11, Gandhinagar-382 017
Phone : + 91 79 23252594, 23252588
E-mail : icinc@gujarat.gov.in

Assistance to encouraging Green practice and environmental audit to MSMEs

1 Name of the Scheme

Scheme for assistance to encouraging "Green" practices and environmental audit to MSMEs.

2 Operative Period

From 11/06/2009 to 10/06/2014

3 Who is eligible to get the benefit ?

Eligible Unit means any MSME engaged in manufacturing and who intends to encourage green practices in its unit.

4 Eligible Activities

1. Use of Clean, Efficient and Innovative Pollution Control Equipments in industries
2. Periodic Environmental Audits except those covered under Rules and Judgments
3. Encouraging Environment Management System – setting up of Environment Management Cell
4. Purchase of new equipments/ systems related to safety, occupational health for a cluster of industries (minimum 10 industries in a cluster)
5. Installation of Solar System leading to at least 5% energy saving

5 Assistance available

The following quantum of assistance shall be provided:

S.N	Eligible Activity	Quantum of Assistance per project
A	Use of Clean, Efficient and Innovative Pollution Control Equipments in industries	Upto 25% of cost of equipments; or maximum Rs. 2.5 lakh/ Units
B	Periodic Environmental Audits except those covered under Rules and Judgments	Upto 50% of fees of audit services; or maximum Rs.25,000/ audit

C	Encouraging Environment Management System – setting up of Environment Management Cell	Upto 25% of cost of equipments; or maximum Rs 5 lakh/ plant once in a lifetime
D	Purchase of new equipments/ systems related to safety, occupational health for a cluster of industries (minimum 10 industries in a cluster)	Upto 25% of cost of equipments; or maximum Rs 25 lakh/ cluster. The assistance under the scheme will be provided to industrial association or SPV formed by the Industrial Units.
E	Installation of Solar System leading to atleast 5% energy saving	Upto 25% of cost of system; Rs 2.5 lakh / plant

6 Check List

S. N	Particulars	Remarks
1.	Copy of legal status of applicant such as memorandum of article and company registration certificate or partnership deed or registration under society act / trust act etc. and list of directors/partners with addresses.	
2.	Copy of land allotment by GIDC/ sale deed land & copy of 7/12	
3.	Copy of IEM NO./EM No./Regn.No.	
4.	GPCB NOC/ CONSENT for establishing project	
5.	Please submit as applicable, • Equipment wise list with cost and justification for purchase of particular equipment. • Equipment wise cost along with the use of particular equipment • Give details of average present and past consumption of energy/electricity and energy/ electricity saving by installation new equipment with cost	
6.	Copy of Audit report along with payment made to auditor for scheme - B	
7.	Detail justification to setup environment management cell in the unit and its proposed expenditure for scheme - C	
8.	List of beneficiaries of project for scheme - D	
9.	Process Diagram of proposed Project.	
10.	Implementation Schedule	
11.	Copy of any other financial assistance granted by GoG and/or GoI for same component or project	
12.	Declaration as per application	

7 Procedure

- The unit will have to apply to concerned DIC prior to the implementation of the project in prescribed format for assistance along with documents as specified in check list, within one year from the date of issue of quality certificate.
- On receipt of application with all details, DIC will carry out inspection for verification of document and eligible expenditure. The inspection will be completed within 15 working days.
- DIC GM will scrutinize the inspection report and will sanction /reject the application within 10 days.
- After issuance of sanction letter payment will be made within 10 days, subject to availability of grant.

8 Contact officer for further details /query

Name : MR. N.M. Trivedi
Designation: Dy. Commissioner of Industries (Incentive)
Address : Block No. 1, 6th Floor, Udyog Bhavan, Sector 11, Gandhinagar-382 017
Phone : + 91 79 23252594, 23252588
E-mail : icinc@gujarat.gov.in

Financial schemes available with local banks for improving energy efficiency in 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.

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

Parameter	Norms
	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**)

3. Scheme for Financing Energy Efficiency Projects

PURPOSE:

- Financing SMEs for acquisition of equipments, services and adopting measures for enhancement of energy efficiency/conservation of energy.

ELIGIBILITY

- SME units financed by bank as also other units desirous of shifting their account to Bank of Baroda.

LIMIT:

- Upto 75% of the total project cost, subject to maximum of Rs. 1/- crore. (Minimum amount of loan Rs. 5/- Lakhs).

Project cost may include the following:

- Cost of acquisition/modification/renovation of equipment/software.
- Cost of alterations to existing machinery.
- Cost of structural / layout changes.
- Cost of energy audit/consultancy.
- Preparation of Detailed Project Report (DPR).

RATE OF INTEREST:

- Bank's BPLR from time to time.

REPAYMENT :

- Maximum 5 years, including moratorium, if any.

SECURITY :

a. For Sole Banking Accounts :
   Extension of first charge on all fixed assets.
b. For Consortium/Multiple Banking Accounts :
   first charge on equipments acquired out of loan and collateral, if any, with the total security coverage being not less than 1.25.

Grant from IREDA:

- IRDEA, at present, gives a grant of Rs. 25,000/- for projects costing Rs. 1/- crore or below to meet partial cost of Energy Audit. This grant is available for the first 100 projects (SME Sectors only) approved by them.

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