COMPREHENSIVE ENERGY AUDIT REPORT

"PROMOTING ENERGY EFFICIENCY AND RENEWABLE ENERGY IN SELECTED MSME CLUSTERS IN INDIA"

Vishal Tools & Forgings Pvt. Ltd.

B-9, Focal Point Extension, Jalandhar, Punjab-144 004

19-05-2015

Submitted to

BUREAU OF ENERGY EFFICIENCY

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Submitted by

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As a part of this assignment, work in Jalandhar Handtools cluster was awarded to DESL and DESL is grateful to GEF-UNIDO-BEE PMU for their full-fledged coordination and support throughout the study.

The study team is indebted to Mr. Jyoti Prakash, MD, Vishal Tools Industries for showing keen interest in the energy audit and also thankful to the management of M/s Vishal Tools and Forgings Pvt. Ltd. for their wholehearted support and cooperation for the preparation of this comprehensive energy audit report, without which the study would not have steered to its successful completion. Special thanks to other members of the unit for their diligent involvement and cooperation.

It is well worthy to mention that the efforts being taken and the enthusiasm shown by all the plant personnel towards energy conservation and sustainable growth are really admirable.

Last but not the least, the interaction and deliberation with Mr. Sukh Dev Raj, President, Hand tool manufacturers association, Jalandhar, technology providers and all those who were directly or indirectly involved throughout the study were exemplary. The entire exercise was thoroughly a rewarding experience for DESL.

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DESL Team

DESL Team

Project Head	**Mr. R. Rajmohan** Chief Executive Officer
Team leader and co-coordinator	**Mr. Suparno R Majumdar** Consultant
Team member(s)	**Mr. Mithlesh Priya** Analyst
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ABBREVIATIONS

Abbreviations	Expansions
APFC	Automatic Power Factor Correction
BEE	Bureau of Energy Efficiency
CEA	Comprehensive Energy Audit
CFL	Compact Fluorescent Lamp
CRV	Chromium Vanadium
DESL	Development Environergy Services Limited
DG	Diesel Generator
EE	Energy Efficiency
EPIA	Energy Performance Improvement Action
FO	Furnace Oil
GEF	Global Environment Facility
HSD	High Speed Diesel
HVAC	Heating Ventilation and Air Conditioning
LED	Light Emitting Diode
LT	Low Tension
MD	Maximum Demand
MS	Mild Steel
MSME	Micro, Small and Medium Enterprises
MT	Metric Tons
MTOE	Million Tons of Oil Equivalent
MV	Mercury Vapour
No.	Number
PF	Power Factor
PID	Proportional-Integral-Derivative
PNG	Piped Natural Gas
PSPCL	Punjab State Power Corporation Limited
R & C	Radiation & Convection
RE	Renewable Energy
SEC	Specific Energy Consumption
SEGR	Specific Energy Generation Ratio
SLD	Single Line Diagram
SME	Small and Medium Enterprises
UNIDO	United Nations Industrial Development Organization
VFD	Variable Frequency Drives

EXECUTIVE SUMMARY

Bureau of Energy Efficiency (BEE) in association with the United Nations Industrial Development Organization (UNIDO) and Global Environment Facility (GEF) is implementing a project titled “Promoting energy efficiency and renewable energy technology in selected MSME clusters in India”. The objective of the project is to provide impetus to energy efficiency initiatives in the micro, small and medium enterprises (MSMEs) sector in India.

As part of this project, DESL has been engaged to implement the project in the MSME hand tool cluster in Jalandhar, Punjab. There are about 400 units scattered over three industrial areas in Jalandhar, viz. focal point, old industrial area and basti area. The major products manufactured include spanners and wrenches, pliers, screw drivers, etc with an average annual production of 50,000 metric tons in the cluster.

The project awarded to DESL consists of six major tasks:

- Conducting pre–activity cluster workshop defining the agenda of this engagement.
- Comprehensive energy audit in 6 selected units.
- Development of cluster specific best operating practices document for the top 5 energy using equipments / processes in the industry.
- Identification of set of energy auditing instruments used for carrying out periodic energy audits in the units.
- Enumeration of common regularly monitorable parameters at the process level which have impact on energy performance and listing of appropriate instrumentation for the same.
- Conducting 3 post energy audit training workshops based on preceding outputs of this activity.

Brief Introduction of the Unit

Table 1: Details of Unit

Name of the Unit	M/s Vishal Tools & Forgings Pvt. Ltd.
Constitution	Private Limited
MSME Classification	Medium
No. of years in operation	NA
Address: Registered Office	B-9, Focal Point Extension, Jalandhar, Punjab - 144004
Administrative Office	B-9, Focal Point Extension, Jalandhar, Punjab – 144004
Factory	B-9, Focal Point Extension, Jalandhar, Punjab – 144004
Industry-sector	Hand Tool
Products Manufactured	Spanners, Wrenches, Pliers, Pincers, Vices, Clamps etc
Name(s) of the Promoters / Directors	Mr. Jyoti Parkash

Comprehensive Energy Audit

The study was conducted in 3 stages:

- **Stage 1:** Walk through energy audit of the plant to understand the process, energy drivers, assessment of the measurement system, assessment of scope, measurability, formulation of audit plan and obtaining required information
- **Stage 2:** Detailed energy audit data collection and field measurements for performance evaluation of equipments/ systems, estimation of savings potential, technology assessment and understanding of project constraints
- **Stage 3:** Data analysis, initial configuration of projects, savings quantification, vendor consultation, interaction with the unit and freezing of projects for implementation and preparation of energy audit report

The production process of the unit

The main process equipments in the unit include the following:

The production process includes blanking, heating, forging, trimming, broaching, grinding, barreling, heat treatment, shot blasting, calibration, polishing, electroplating and packing.

The raw materials used are mainly MS and CRV steel. The raw material is blanked and then sent to a forging furnace for heating. The heated material (work piece) is removed from the forging furnace and forged using hammers. The forged work piece is then cut and trimmed into desired shapes and the unnecessary burrs along the edges are removed in trimming operation.

The trimmed work piece is then treated in the heat treatment furnace for hardening, quenching and tempering to attain desired metallurgical properties like strength, stability and durability.

Post heat treatment, in order to get the necessary surface finish and polish the work pieces are shot blasted after which they are placed in vibrating glazing machines along with a measured quantity of ceramic material (in form of ceramic stones). Due to the vibrating action of this machine, the work piece and the ceramic materials rub against each other and in this process the work piece gets further polished.

The polished work piece is then sent for electroplating, where it is dipped for a certain period of time inside hot nickel and chromium baths to attain the desired final glaze and finishing. From the electroplating section the finished products are packed and dispatched.

The main process equipments are furnace, hammer, broaching machines, blanking machines, heat treatment furnace, vibrators, shot blasting machine.

Identified Energy Performance Improvement Actions

The comprehensive energy audit covered all the equipments which were operational during the field study. Thermal energy constitutes 28% and grid electricity constitutes 51% of the total plant energy. The identified energy performance improvement actions are given in Table – 2.

Table 2 Summary of EPIA

Sl. No.	Name of the project	Estimated energy savings						
		(FO)	Electricity	HSD	Material savings cost	Monetary savings	Estimated investment	Simple payback period
		Litre/y	kWh/y	Litre/y	Rs. lakh/y	Rs. lakh/y	Rs. lakh	y
1	Installation of PID controller for excess air control on forging-1	7,644	788		1.2	4.3	7.00	1.6
2	Installation of PID controller for excess air control on forging-2	5,250	788		1.6	3.8	7.00	1.9
3	Installation of PID controller for excess air control on forging-3	7,336	788		0.7	3.6	7.00	1.9
4	Replacement of existing motor with EE motor		132,806			10.0	9.64	0.96
5	Replacement of 380 kVA DG with new DG			29,675		14.8	19.50	1.3
6	Installation of energy efficient fan instead of conventional fan		17,186			1.3	3.72	2.9
7	Retrofit of CFL 40 watt to led tube light of 16 watt		1,568			0.1	0.14	1.16
8	Replacement of CFL 45 watt, 23 watt, and WMV light of 250 watt to 16 watt ,10 watt and 80 watt LED light		15,313			1.16	1.50	1.3
9	Installation of energy monitoring system on sectional energy consuming area	3522	72,958	2,705		8.3	0.75	0.1
10	Installation of servostablizer with separate feeder of lighting and fan load		21,158			1.6	0.80	0.5
11	Replacement of present burner with energy efficient burner	5870				2.3	0.73	0.3
	Total	29,622	263,353	32,390	3.5	51.5	57.8	1.1

The projects proposed will result in energy savings of 20.89% (approx.) and energy cost savings of Rs. 51.5 lakh on implementation.

1 INTRODUCTION

1.1 Background and Project objective

Bureau of Energy Efficiency (BEE) in association with the United Nations Industrial Development Organization (UNIDO) and Global Environment Facility (GEF) is implementing a project titled "Promoting energy efficiency and renewable energy technology in selected MSME clusters in India". The objective of the project is to provide impetus to energy efficiency initiatives in the micro, small and medium enterprises (MSMEs) sector in India.

The targeted 12 MSME clusters under the project and the indicative information are given below:

Table 3 List of 12 targeted MSME clusters covered under the project

Sl. No.	Sub – sector	Cluster
1	Brass	Jagadhri, Jamnagar
2	Ceramic	Khurja, Morbi, Thangarh
3	Dairy	Gujarat, Madhya Pradesh
4	Foundry	Belgaum, Coimbatore, Indore
5	Hand tools	Jalandhar, Nagaur

The objectives of this project are as under:

- Increasing capacity of suppliers of energy efficiency (EE) and renewable energy (RE) based products, service providers and financing institutions;
- Increasing the levels of end-use demand and implementation of EE and RE technologies and practices by MSMEs;
- Scaling up of the project to the national level;
- Strengthening policy, institutional and decision making frameworks.

1.2 Scope of work for Comprehensive Energy Audit

The general scope of work for comprehensive energy audits is as follows:

- Data Collection
  - Current energy usage (month wise) for all forms of energy for the period April-2014 to March-2015 (quantity and cost)
  - Data on production for the corresponding period (quantity and cost)
  - Data on production cost and sales for the corresponding period (cost)
  - Mapping of process
  - Company profile including name of the company, constitution, promoters, years in operation and products manufactured
  - Existing manpower and levels of expertise
  - List of major equipments and specifications
- Analysis:

- Energy cost and trend analysis
- Energy quantities and trend analysis
- Specific consumption and trend analysis
- Performance evaluation of major energy consuming equipments / systems
- Scope and potential for improvement in energy efficiency

- Correlate monthly production data with electricity and fuel consumption for a period of 12 months of normal operation for individual sections of the overall plant.
- Detailed process mapping to identify major areas of energy use.
- To identify all opportunities for energy savings in the following areas
    - Electrical: Power Factor, transformer loading, power quality, motor load, compressed air systems, conditioned air systems, cooling water systems, lighting load, electrical metering, monitoring and control system.
    - Thermal: Furnaces, steam and hot water systems (including hot water lines tracing, pipe sizes, insulation), heat recovery systems etc.
- Evaluate the energy consumption vis-à-vis the production levels and to identify the potential for energy savings / energy optimization (both short term requiring minor investments with attractive payback, and mid to long terms system improvement needing moderate investments and with payback period of 2.9 years).
- Classify parameters related to EE enhancements such as estimated quantum of energy savings, investment required, time frame for implementation, payback period, re-skilling of existing manpower, etc. and to classify the same in order of priority.
- Design an "energy monitoring system" for effective monitoring and analysis of energy consumption, energy efficiency.

1.3 Methodology

1.3.1 Boundary parameters

Following boundary parameters were set for coverage of the audit.

- Audit covered all possible energy intensive areas and equipments which were operational during the field study
- All appropriate measuring systems including portable instruments were used
- The identified measures normally fall under short, medium and long-term measures

1.3.2 General methodology

The following flow chart illustrates the methodology followed for carrying out different tasks:

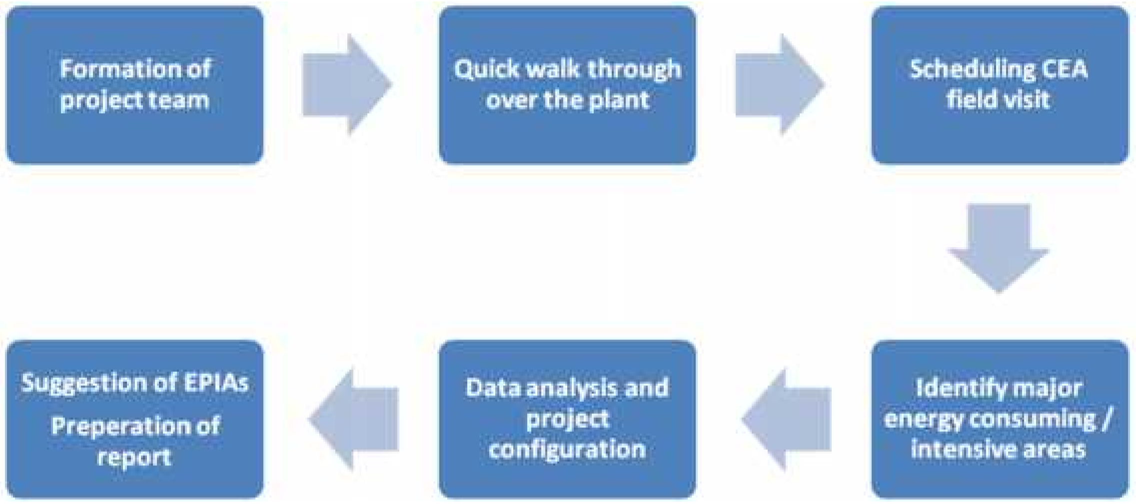


Figure 1: General methodology

The study was conducted in 3 stages:

- **Stage 1:** Walk through energy audit of the plant to understand the process, energy drivers, assessment of the measurement system, assessment of scope, measurability, formulation of audit plan and obtaining required information
- **Stage 2:** Detailed energy audit-testing and measurement for identification of savings potential, technology assessment and understanding of project constraints
- **Stage 3**: Data analysis, initial configuration of projects, savings quantification, vendor consultation, interaction with the unit and freezing of projects for implementation and preparation of energy audit report

1.3.3 Comprehensive energy audit – field assessment

A walk through was carried out before the audit with a view to:

- Understand the manufacturing process and collect historical energy consumption data
- Obtain cost and other operational data for understanding the impact of energy cost on the units financial performance
- Assess the energy conservation potential at macro level
- Finalize the schedule of equipment's and systems for testing and measurement

The audit identified the following potential areas of study:

- Heating and Forging
- Electrical motors used in process
- Fans and lighting loads

Further activities carried out by the team after walk through study included:

- Preparation of the process and energy flow diagrams
- Study of the system and associated equipments

- Conducting field testing and measurement
- Data analysis for preliminary estimation of saving potential at site
- Discussion with the unit on the summary of findings and energy efficiency measures identified

Audit methodology involved system study to identify the energy losses (thermal / electrical) and then finding solutions to minimize the same. This entailed data collection, measurements / testing of the system using calibrated, portable instruments, analyzing the data / test results and identifying the approach to improve the efficiency. The following instruments were used during the energy audit

Table 4 Energy audit instruments

Sl. No.	Instruments	Make	Model	Parameters Measured
01	Power Analyzer – 3 Phase (for un balanced Load) with 3 CT and 3 PT	Enercon and Circutor	AR-5	AC Current, Voltage, Power Factor, Power, Energy, Frequency, Harmonics and data recording for minimum 1 sec interval
02	Power Analyzer – 3 Phase (for balance load) with 1 CT and 2 PT	Elcontrol Energy	Nanovip plus mem	AC Current, Voltage, Power Factor, Power, Energy, Frequency, Harmonics and data recording for minimum 2 sec interval
03	Digital Multi meter	Motwane	DM 352	AC Amp, AC-DC Voltage, Resistance, Capacitance
04	Digital Clamp on Power Meter – 3 Phase and 1 Phase	Kusam - Meco	2745 and 2709	AC Amp, AC-DC Volt, Hz, Power Factor, Power
05	Flue Gas Analyzer	Kane-May	KM-900	O2%, CO2%, CO in ppm and Flue gas temperature, Ambient temperature
06	Digital Temperature and Humidity Logger	Dickson		Temperature and Humidity data logging
07	Digital Temp. & Humidity meter	Testo	610	Temp. & Humidity
08	Digital Anemometer	Lutron and Prova	AM 4201	Air velocity

Sl. No.	Instruments	Make	Model	Parameters Measured
			And AVM-03	
09	Vane Type Anemometer	Testo	410	Air velocity
10	Digital Infrared Temperature Gun	Raytek	Minitemp	Distant Surface Temperature
11	Contact Type Temperature Meter	Testo	925	Liquid and Surface temperature
12	High touch probe Temperature Meter	CIG		Temperature upto 1300 deg C
13	Lux Meter	Kusum Meco (KM-LUX-99) and Mastech		Lumens
14	Manometer	Comark	C 9553	Differential air pressure in duct
15	Pressure Gauge	Wika		Water pressure 0 to 40 kg

1.3.4 Comprehensive energy audit – desk work

Post audit off-site work carried out included:

- Re-validation of all the calculations for arriving at the savings potential
- Quick costing based on DESL database or through vendor interactions as required
- Configuration of individual energy performance improvement actions
- Preparation of draft audit report

2 ABOUT THE MSME UNIT

2.1 Particulars of the unit

Table 5: General particulars of the unit

Sl. No.	Particulars	Details
1	Name of the unit	M/s Vishal Tools & Forgings Pvt. Ltd.
2	Constitution	Private Limited
3	Date of incorporation / commencement of business	NA
4	Name of the contact person Mobile/Phone No. E-mail ID	Mr. Jyoti Parkash +91-181 - 5031001 jyoti@vishaltools.com
5	Address of the unit	B-9, Focal Point Extension, Jalandhar - 144004
6	Industry / sector	Hand Tools
7	Products manufactured	Spanners, Wrenches, Pliers, Pincers, Vices, Clamps etc
8	No. of operational hours	8
10	No. of days of operation / year	330
11	Whether the unit is exporting its products (yes / no)	Yes

3 DETAILED TECHNICAL FEASIBILITY ASSESSMENT OF THE UNIT

3.1 Description of manufacturing process

3.1.1 Process & Energy flow diagram

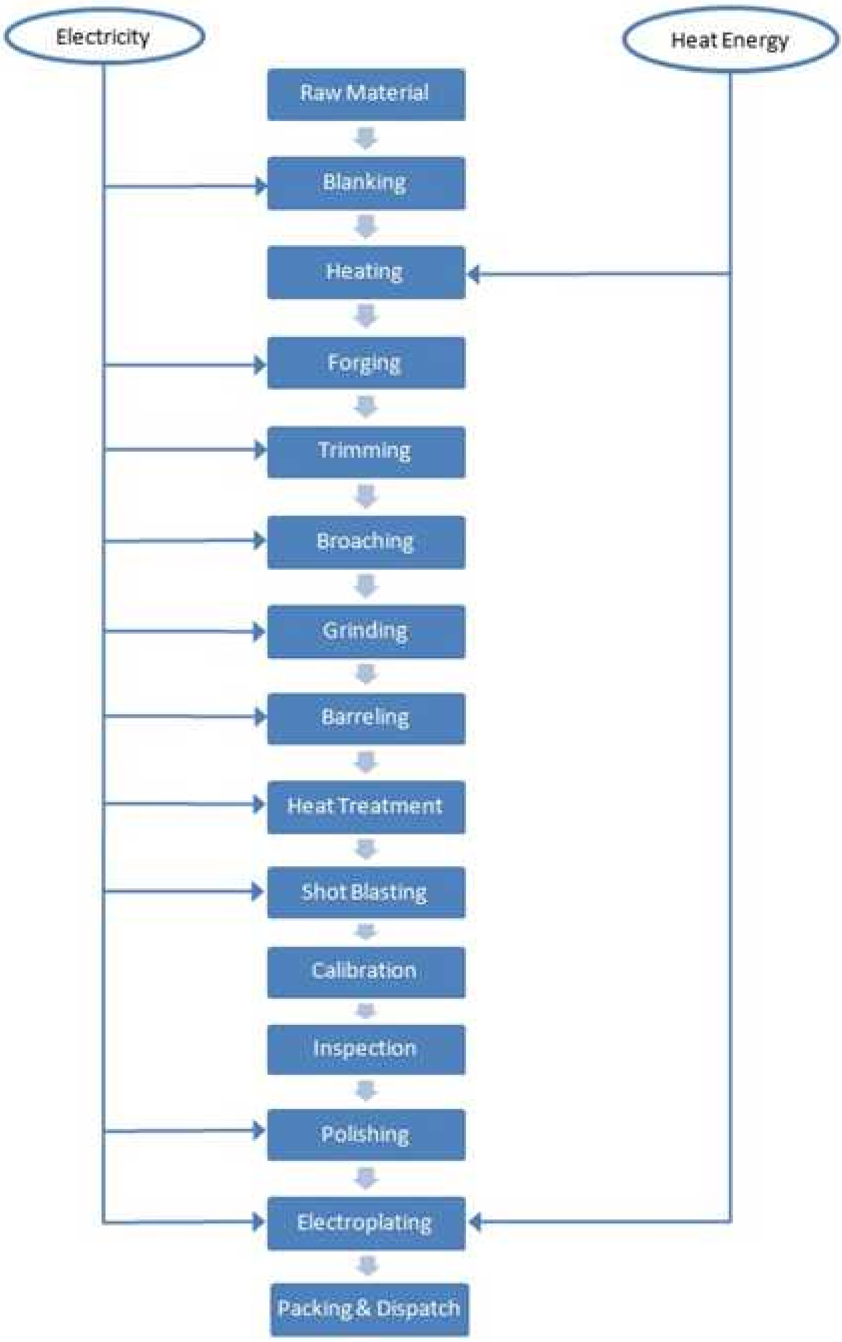


Figure 2: Process flow diagram

3.1.2 Process description

M/s Vishal Tools & Forgings Pvt. Ltd. is a manufacturer of Spanners, Wrenches, Pliers, Pincers, Vices, Clamps, etc.

The process description is as follows:

Raw Material

The main raw materials used are round and flat Mild Steel and Chromium Vanadium Steel.

Blanking

It is a process in which the work piece is removed from the primary metal strip and the piece removed is called the blank metal scrap.

Heating

The unit has 4 oil fired forging furnaces for heating the work pieces. The temperature maintained is around 700 – 1,000^{0}C.

Forging

The red hot work pieces taken out from the forging furnace are placed on the lower fixed die above the anvil. A ram moves downwards with gravity action. Below the ram is is the upper die which is fixed to it. After several strokes of the upper die on the work piece, the work piece takes the desired shape

Trimming

In this machine, the forged material is pressed to give it a uniform shape by removing the unnecessary burrs along the edges. The speed of the press is controlled and it travels at a low speed when it comes down and exerts maximum pressure just before pressing.

Grinding

This is a process where-by sand paper is used to do the side grinding of the “trimmed work piece”.

Broaching

It is similar to trimming in which a toothed tool called broach is used to remove materials from the ground work piece. Two types of broaches are employed, i.e. linear for open sections and rotary for circular sections.

Barreling

In this operation, ceramic stones are used to remove the scales from the work piece using a rubbing action.

Heat Treatment

Heat treatment is done to impart required metallurgical properties to the work piece for improving the working life of manufactured equipment (hand-tool). The main processes involved are hardening, quenching and tempering. Electrical heat treatment furnaces are used for this purpose.

Shot Blasting

It is done to clean and polish the work piece.

Calibration and inspection

The finished product is calibrated to check the dimensions, size, shape, etc. and is visually inspected before the final finishing process.

Glazing

In this machine, the ceramic material and the work pieces are placed together on the vibrating glazing machines. Due to vibrating action of this machine, the work piece and the ceramic materials (in the form of solid stones) rub against each other, and in this process the work piece gets polished.

Electro plating

The final shining and glazing of the product is done using electroplating, where-by, air is circulated using a blower inside a nickel tank. The final product is dipped inside this tank and kept in that condition for a certain period of time and then taken out and cleaned in hot water tanks to get the final touch.

3.2 Inventory of process machines / equipments and utilities

The major energy consuming equipments in the plant are:

- **Blanking Machine:** Here, the raw material is cut into required shape before it is heated in a furnace
- **Forging furnace:** FO fired forging furnaces are used for heating the material for forging. The operating temperature of FO fired furnace is around 1000-1100^{0}C. 5 oil fired furnaces are used in the plant.
- **Hammer:** Hammers are used in forging process, in which material is pressed against a die using a drop hammer. 5 hammers are used in the plant, each adjacent to a forging furnace.
- **Broaching machine:** This machine is used to remove materials from edges of the work piece to give it a better edge finish. Large motors are employed in this machine for this purpose.
- **Heat treatment furnace:** The heat treatment furnace consists of electrical heaters for hardening and tempering. Hardening is done around a temperature of 750 – 800^{0}C and tempering is done at around 300 -350^{0}C.
- **Electroplating:** Electroplating is the process of plating one metal onto another by hydrolysis, most commonly for decorative purposes or to prevent corrosion of a metal. There are specific types of electroplating such as copper plating, silver plating, and chromium plating.

3.2.1 Types of energy used and description of usage pattern

Both electricity and thermal energy are used in different manufacturing processes. The overall energy use pattern in the unit is as follows:

- Electricity is being sought from two different sources:
    - From the Utility, Punjab State Power Corporation Limited (PSPCL)
    - Captive backup Diesel Generator sets for the whole plant

- Thermal energy is used for following applications:
    - Fuel Oil for forging furnace

Total energy consumption pattern for the period April-14 to March-15, from different sources are as follows:

Table 6: Energy cost distribution

Particulars	Energy cost distribution		Energy use distribution	
	Rs. Lakhs	% of Total	MTOE	% of Total
Grid –Electricity	187.59	67	209.10	51
Diesel –DG	45.08	16	88.00	21
Thermal – FO	46.96	17	115.1	28
Total	**279.63**	**100**	**412.2**	**100**

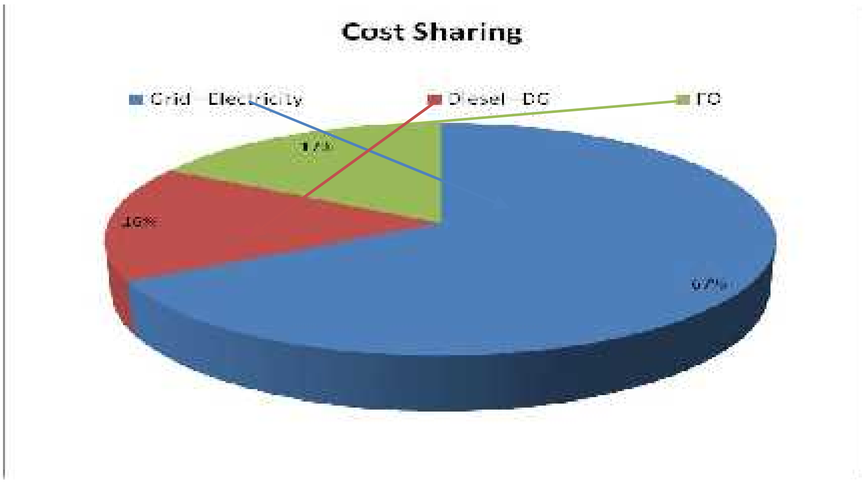


Figure 3: Energy cost share

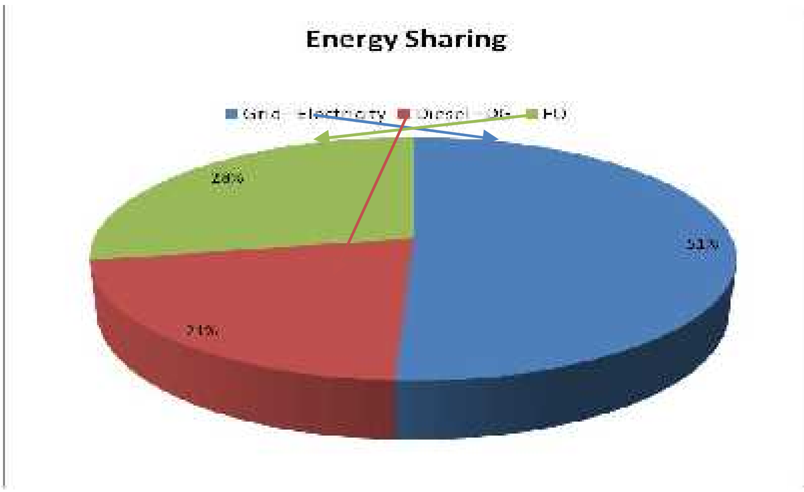


Figure 4: Energy use share

Major observations are as under:

- The unit uses both thermal and electrical energy for manufacturing operations. Electricity is supplied from the grid and self generated through DG sets when the grid power is not available. Thermal energy consumption is in the form of FO, which is used for heating in forging furnace.
- FO used in the furnace accounts for 17% of the total energy cost and 28% of overall energy consumption.
- Electricity used in the process accounts for the remaining 92% of the energy cost; of which diesel used for self generation is 8% of the overall cost.

3.3 Analysis of electricity consumption by the unit

3.3.1 Baseline parameters

Following are the general baseline parameters, which have been considered for the techno-economic evaluation of various identified energy cost reduction projects, as well as for the purpose of comparison after implementation of the projects. The rates shown are the landed rates.

Table 7: Baseline parameters

Electricity Rate (Excluding Rs./kVA)	6.14	Rs./ KVAH inclusive of taxes
Weighted Average Electricity Cost	7.56	Rs./ kWh for 2012-13
Percentage of total DG based Generation	8%	
Average Cost of HSD	50.00	Rs./Litre for April 2015
Average Cost of FO	40.00	Rs./Litre for April 2015
Annual Operating Days per year	330.00	Days/yr
Annual Operating Hours per day	8.00	Hr/day
Production	2528	MT

3.3.1 Electricity load profile

Following observations have been made from the utility inventory:

- The plant and machinery load is 792.4 kW
- The utility load (lighting and fans) is about 82.4 kW including the single phase load
- The plant total connected load is 874.8 kW

A pie chart of the entire connected load is shown in the figure below:

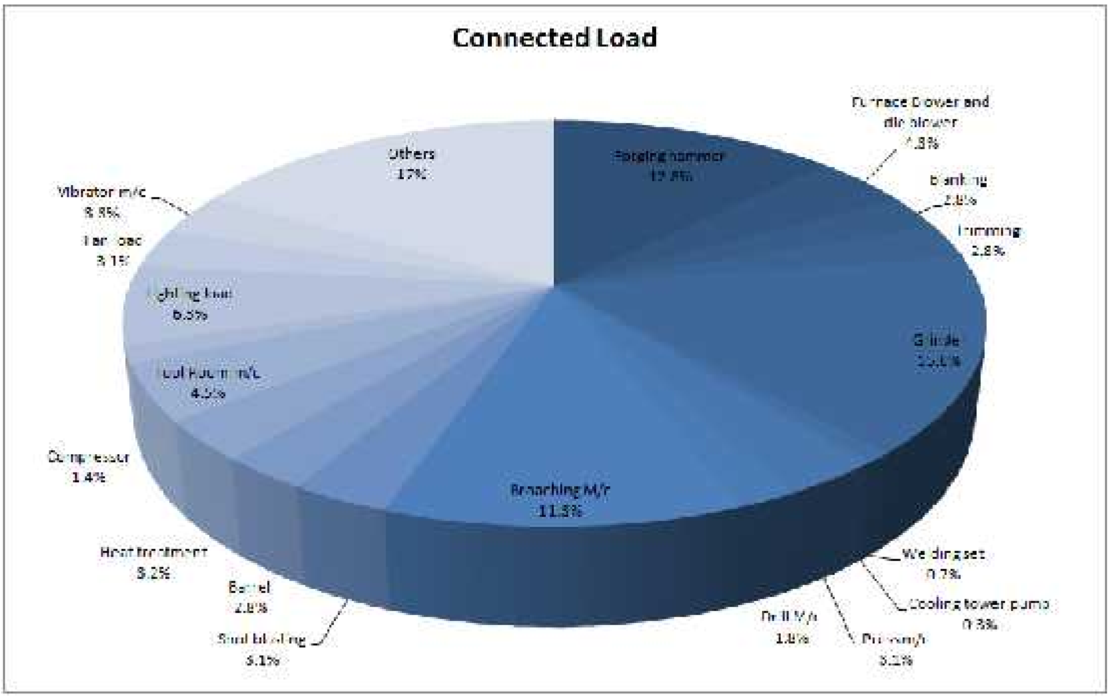


Figure 5: Details of connected load

As shown in the pie chart of connected load, the maximum share of connected load is divided between electroplating section – 17%, grinder – 15.6%, forging hammer – 12.8%, heat treatment – 3.2%, barrel machine – 2.8%, shot blasting – 3.1%, press machine – 3.1%, trimming – 2.8%, vibrator – 3.3%, blanking– 2.8%, drill machine – 1.8%, air compressor – 1.4%, furnace blower and die blower – 4.3%, welding sets – 0.7% and broaching – 11.3%. Lighting and fan load together contribute around 6.3 % of the connected load.

An analysis of area wise electricity consumption has been computed to quantify the electricity consumption in the individual processes. The area wise energy consumption details are shown as under:

Table 8: Area wise electricity consumption (estimated)

Consumption		kW	kWh/year	% of Total
Forging hammer	:	111.9	332343.00	12.64%
Furnace Blower and die blower	:	37.5	111375.00	4.24%
Blanking	:	24.2	72007.65	2.74%
Trimming	:	24.2	72007.65	2.74%
Grinder	:	136.5	405458.46	15.42%
Welding set	:	6.2	18526.86	0.70%
Cooling tower pump	:	2.2	6646.86	0.25%
Press m/c	:	27.2	80870.13	3.08%
Drill M/c	:	15.7	46528.02	1.77%
Broaching M/c	:	98.5	292461.84	11.12%

Shot blasting	:	27.2	80870.13	3.08%
Barrel	:	24.6	73115.46	2.78%
Heat treatment	:	28.1	83370.87	3.17%
Tool Room m/c	:	39.1	116109.18	4.42%
Compressor	:	11.9	39388.80	1.50%
Lighting load	:	55.2	182226.00	6.93%
Fan load	:	27.2	89760.00	3.41%
Vibrator m/c	:	28.7	85301.37	3.24%
Others	:	148.5	441047.97	16.77%
Total		*874.8*	*2629415.3*	*100%*

This is represented in the figure below:

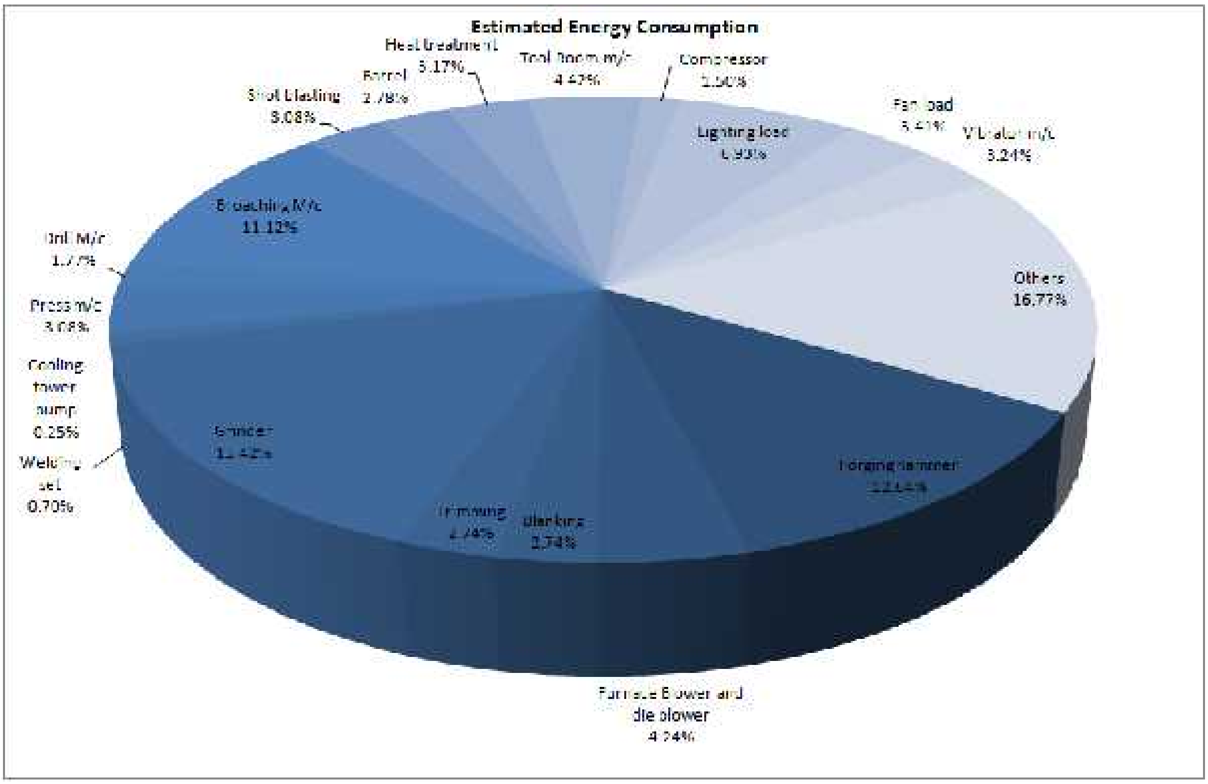


Figure 6: Area wise electricity consumption

There is a small difference between the estimated energy consumption and actual consumption recorded (<1%). This is attributed to assumptions made on operating load (based on measurement), diversity factor and hours of operation (based on discussion with plant maintenance).

3.3.2 Sourcing of electricity

The unit is drawing electricity from two different sources:

- Utility (PSPCL) through regulated tariff

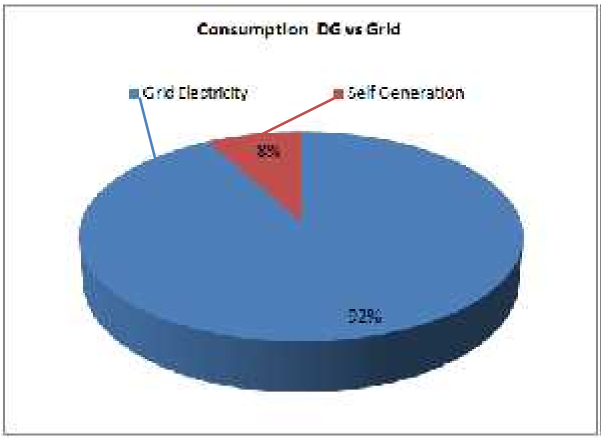
- Captive DG set which is used as a backup source for supplying electrical power in case of grid power failure

The share of utility power and DG power is shown in the table and figure below:

Table 9: Electricity share from grid and DG

	Consumption (kWh)	%	Cost (Rs.)	%
Grid Electricity	2,431,917	92	18,759,048	81
Self Generation	211,671	8	4,507,622	19
Total	**2,643,588**	**100**	**23,266,669**	**100**

The pie charts below show the share of grid and captive DG based electricity:



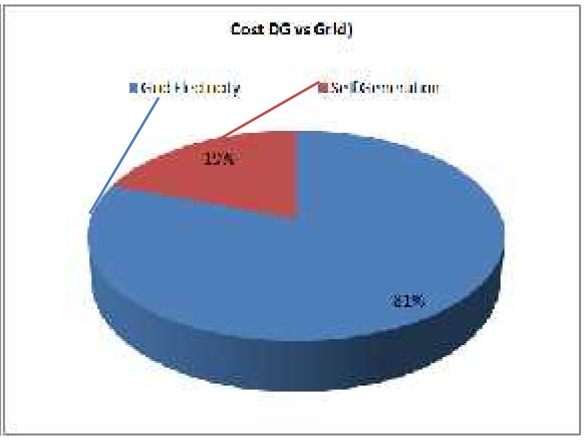


Figure 7: Share of electricity by source and cost

The share of electrical power as shown in the above chart indicates the condition of power supply from the utility. The requirement of power supply from backup source, i.e. DG set is about 8% of the total power which is not very high. Although the share of DG power in terms of kWh is just 8% of the total electrical power, but it accounts for about 19% in terms of total cost of electrical power. This indicates the high cost of DG power due to rise in the price of diesel. For economical operation of the plant, utilization of DG set needs to be minimized, but it will depend upon the supply condition of the grid as well as the power requirement of the plant.

3.3.3 Supply from utility

Electricity is supplied by PSPCL. The unit has one HT energy meter provided by the distribution company in the premise. Details of the supply are as follows:

a)	Power Supply	:	11 kV line
b)	Contract Demand	:	803 kVA
c)	Sanctioned Load	:	1098.045 kW
d)	Nature of Industry	:	HT – G

The tariff structure is as follows:

Table 10: Tariff structure

Particulars	Tariff Structure	
Present energy charge	6.14	Rs./kVAh
PLEC Charge	0.23	Rs./kVA
Octroi Charge	0.10	Rs./kVAh
Municipality tax	0.00	Rs./kVAh
Electricity duty	0.00	Rs./kVah

(As per bill of Feb 2015)

Table 11: Evaluation of Electricity bill

Month	Sanctioned Load	Contract Demand	Peak load allowed	Recorded Maximum Demand	PF	Electricity Consumption		Energy Charges	Energy Charge Rs./ kVAh	Fuel Cost Adjustment Charge	Fuel Charge Rs/ kVAh	PLEC Charges	PLEC Charge Rs./kVAh	Total Rentals	Octroi Charges	ED Charges	Total Charge
	kW	kW	kW	kVA		kVAH	kWH	Rs.		Rs.		Rs.		Rs.	Rs.	Rs.	Rs.
May-14	1098	803	250	601	0.98	204590	200784	1256183	6.14	7074	0.03	47952	0.23	469	20591	148603	1539795
Jun-14	1098	803	250	597	0.99	205595	202774	1262353	6.14	7691	0.04	47498	0.23	469	20718	146362	1555799
Jul-14	1098	803	250	593	0.99	206633	204725	1268724	6.14	8606	0.04	48033	0.23	469	20861	142623	1577702
Aug-14	1098	803	250	593	0.99	206828	204855	1269926	6.14	9290	0.04	46224	0.22	469	20947	135058	1599762
Sep-14	1098	803	250	600	0.99	215790	213292	1324951	6.14	9212	0.04	47466	0.22	469	21975	126581	1707426
Oct-14	1098	803	250	601	0.98	204590	200784	1256183	6.14	7074	0.03	47952	0.23	469	20591	148603	1539795
Nov-14	1098	803	250	616	0.96	199565	190835	1225329	6.14	3991	0.02	50220	0.25	469	19957	159812	1459775
Dec-14	1098	803	250	614	0.97	201445	194970	1236872	6.14	4029	0.02	45360	0.23	469	20145	161317	1468187
Jan-15	1098	803	250	595	0.99	206045	204335	1265116	6.14	6556	0.03	53460	0.26	469	20605	165317	1511520
Feb-15	1098	803	250	578	1.00	188905	187980	1159877	6.14	9445	0.05	43740	0.23	469	18891	152012	1384434
Mar-15	1098	803	250	599	0.99	226990	225800	1393719	6.14	11350	0.05	46980	0.21	469	23358	104559	1875058
Apr-15	1098	803	250	601	0.98	204590	200784	1256183	6.14	7074	0.03	47952	0.23	469	20591	148603	1539795

The single line diagram of electrical distribution system is shown in the figure below:

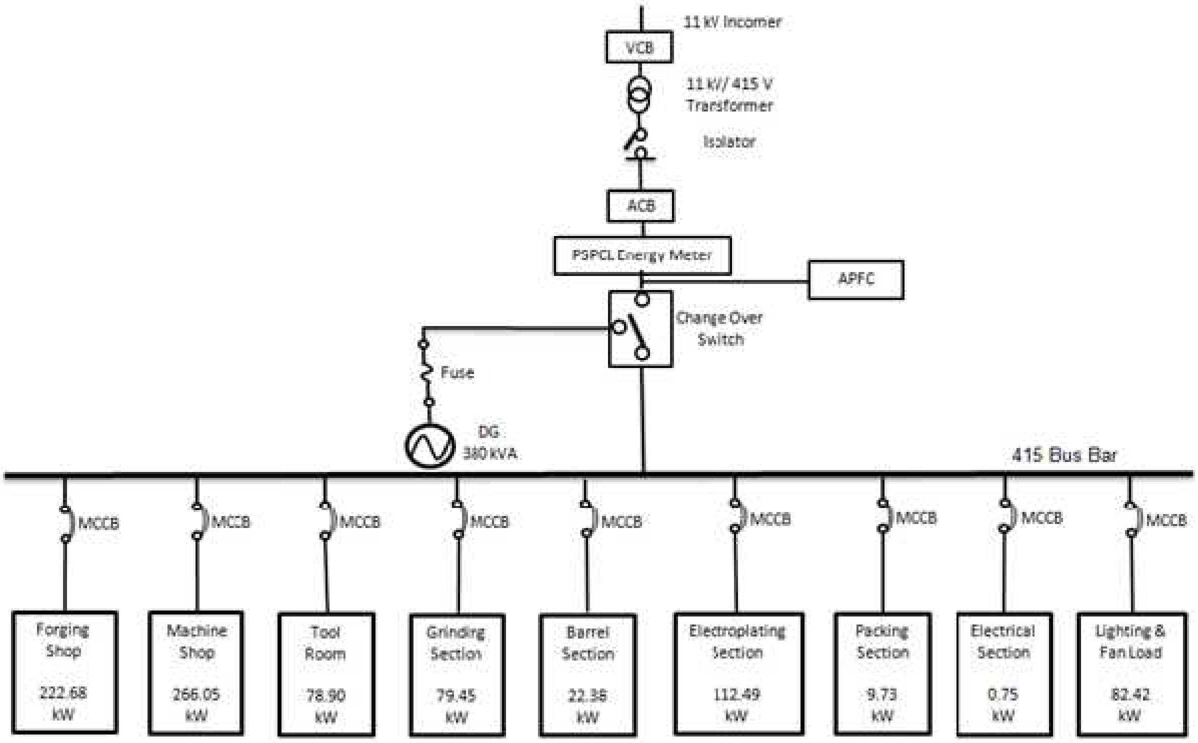


Figure 8 SLD of electrical load

Power factor

The utility bills of the unit reflect the average monthly power factor. A study was conducted by logging of the main incomer by using a power analyzer. The average power factor was measured to be 0.95 with the maximum being 1.

Maximum demand

The average maximum demand recorded from electricity bill analysis is 599 kVA.

3.3.4 Self – generation

The unit has 1 DG set of 380 kVA. The unit does not have a system for monitoring the energy generation and fuel usage in the DG set. However, diesel purchase records are maintained by the unit. The DG performance test was done during the audit and specific fuel consumption (SFC) was calculated as 2.35 kWh/litre. Annually Diesel consumption by the DG set is 90152 litres generating around 211671 kWh at a cost of Rs. 45.07 lakh.

Note: Month wise diesel consumption data was not provided by the unit, hence it is being taken in an average account which is computed annually too.

3.3.5 Month wise electricity consumption

Month wise total electrical energy consumption from different source is shown as under:

Table 12: Electricity consumption & cost

Months	Electricity Used (kWh)			Electricity Cost (Rs.)		
	Grid	DG	Total	Grid	DG	Total
	kWh	kWh	kWh	Rs.	Rs.	Rs.
May-14	200,784	17,639	218,423	1,539,795	375,635	1,915,430
Jun-14	202,774	17,639	220,413	1,555,799	375,635	1,931,434
Jul-14	204,725	17,639	222,364	1,577,702	375,635	1,953,337
Aug-14	204,855	17,639	222,494	1,599,762	375,635	1,975,397
Sep-14	213,292	17,639	230,931	1,707,426	375,635	2,083,062
Oct-14	200,784	17,639	218,423	1,539,795	375,635	1,915,430
Nov-14	190,835	17,639	208,474	1,459,775	375,635	1,835,410
Dec-14	194,970	17,639	212,609	1,468,187	375,635	1,843,822
Jan-15	204,335	17,639	221,974	1,511,520	375,635	1,887,155
Feb-15	187,980	17,639	205,619	1,384,434	375,635	1,760,069
Mar-15	225,800	17,639	243,439	1,875,058	375,635	2,250,693
Apr-15	200,784	17,639	218,423	1,539,795	375,635	1,915,430
Total	**2,431,917**	**211,671**	**2,643,588**	**18,759,048**	**4,507,622**	**23,266,669**

The month wise variation in electricity consumption is shown graphically in the figure below:

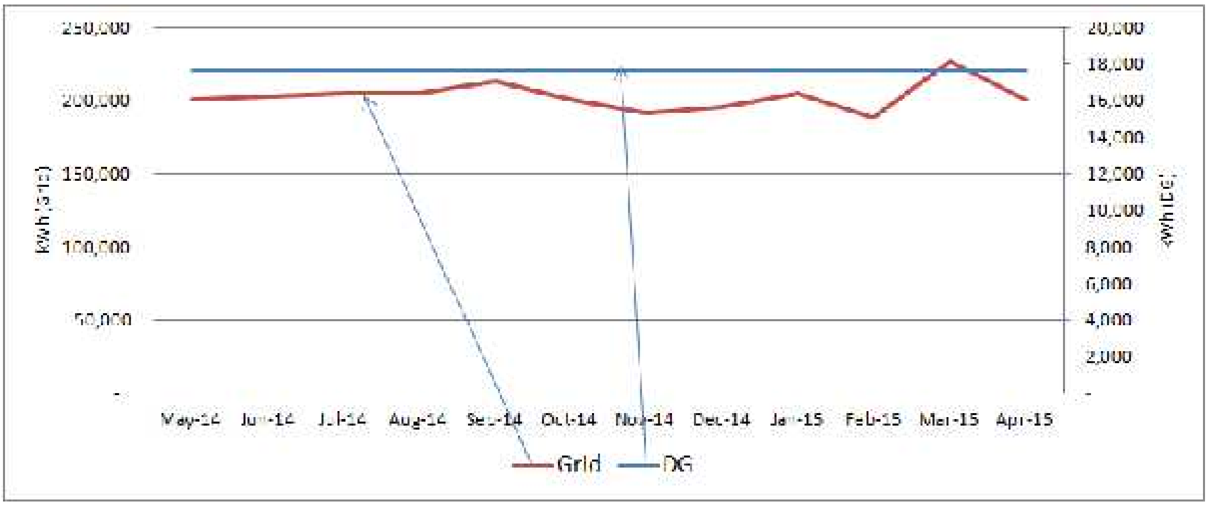


Figure 9: Month wise variation in electricity consumption from different sources

As shown in the figure above, the consumption of electrical energy was on the higher side during the months of September '14 and March '15. However, it was noticed that electricity consumption during the month of Feb '15 was less which indicates that the production in that month might have been low. The corresponding month wise variation in electricity cost is shown in the figure below:

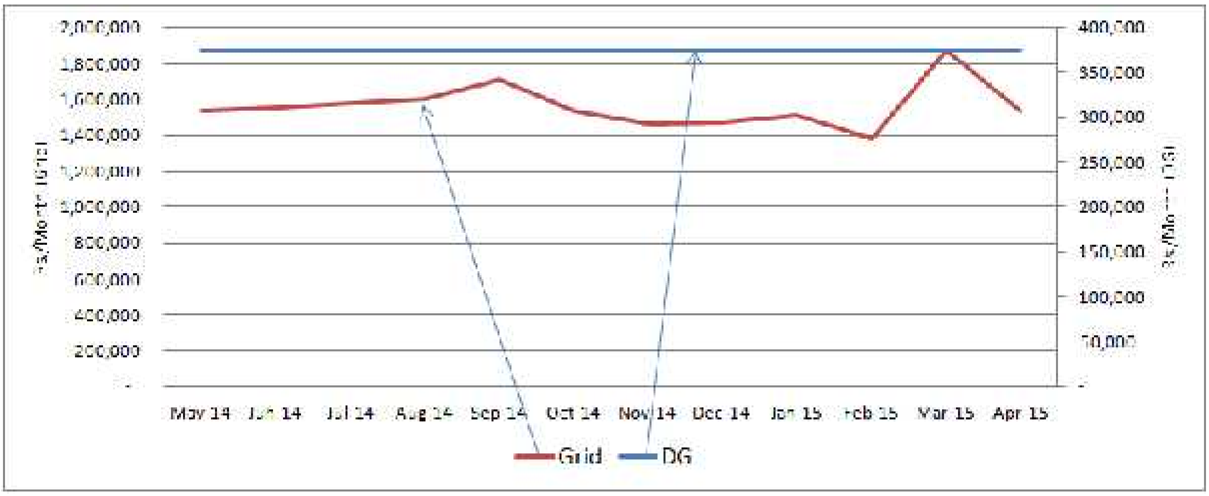


Figure 10: Month wise variation in electricity cost from different sources

The annual variation of cost of energy from the utility as well as the DG set is shown in the figure below:

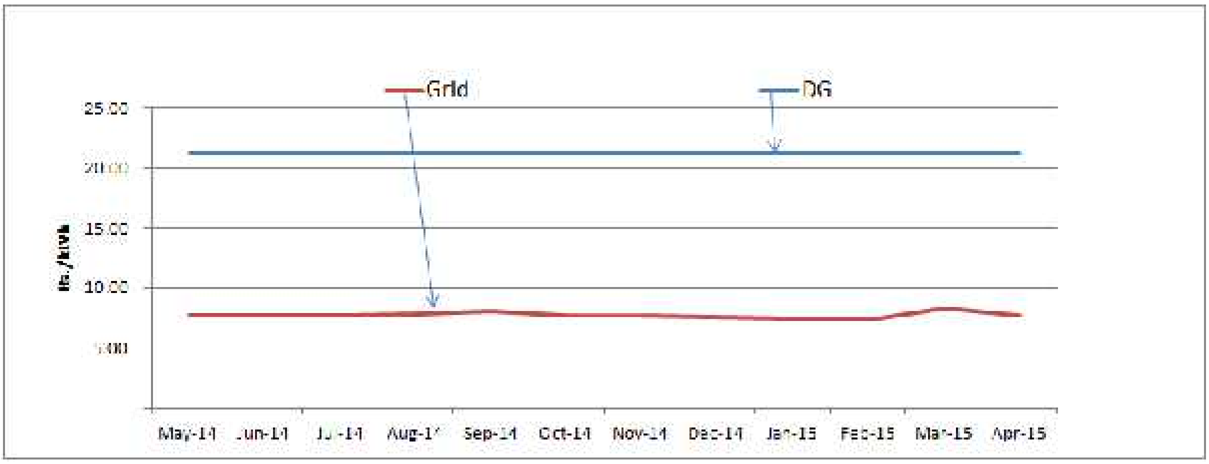


Figure 11: Average cost of power (Rs./kWh) from different sources

The above graph clearly indicates that the cost of electrical energy from DG set is very high, nearly 3 times the cost of utility power.

3.4 Analysis of thermal consumption by the unit

The fuel used in forging furnace is FO which costs Rs. 40/litre. There is no meter installed for measurement of fuel consumption in the forging furnace. In electroplating section, HSD is used as fuel in the boiler for generation of hot water. Flow meter to measure fuel consumption in the boiler was not present.

The data of fuel (FO) consumption and cost is given below:

Table 13: FO used as fuel

Month	Fuel Consumption (Litre/Month)	Rs./Month
May-14	9,783	391,336
Jun-14	9,783	391,336
Jul-14	9,783	391,336
Aug-14	9,783	391,336
Sep-14	9,783	391,336
Oct-14	9,783	391,336
Nov-14	9,783	391,336
Dec-14	9,783	391,336
Jan-15	9,783	391,336
Feb-15	9,783	391,336
Mar-15	9,783	391,336
Apr-15	9,783	391,336
Total	**117,401**	**4,696,032**

The fuel consumption in furnace is considered constant, as no data was recorded by the plant and it is based on average value given by the unit personnel. The average monthly consumption of furnace oil was 9,783 litre per month and average cost of furnace oil consumption was Rs. 391,336 per month.

3.5 Specific energy consumption

Annual production data was available from the unit in metric tons (MT). Based on the available information, various specific energy consumption parameters have been estimated as shown in the following table. ***It is to be noted here that though annual production value was provided, the monthly data for the same was not provided by the unit.***

Table 14: Overall specific energy consumption

Parameters	Value	UoM
Annual Grid Electricity Consumption	2,431,917	kWh
Annual DG Generation Unit	211,671	kWh
Annual Total Electricity Consumption	2,643,588	kWh
Diesel Consumption for Electricity Generation	90,152	Litres
Annual fuel consumption in furnace (FO)	117,401	Litre
Annual Energy Consumption; MTOE	412	MTOE
Annual Energy Cost	279.63	Lakh Rs
Annual Production	2528	MT
SEC; Electricity from Grid	1,046	kWh/MT
SEC; Thermal	46	Litre/MT
SEC; Overall	0.163	MTOE/MT
SEC; Cost Based	11061	Rs./MT

Basis for estimation of energy consumption in terms of tons of oil equivalent are as follows:

- Conversion Factors
  - Electricity from the Grid : 860 kCal/Kwh
  - 1koe (kg oil equivalent) : 10,000 kCal
- GCV of Diesel : 11,840 kCal/ kg
- Density of HSD : 0.8263 kg/litre
- GCV of FO : 10,500 Kcal/kg
- Density of FO : 0.9337 kg/litre
- CO_2 Conversion factor
  - Grid : 0.89 kg/kWh
  - Diesel : 3.07 tons/ ton
  - FO : 3.1 tons/litre

3.6 Identified energy conservation measures in the plant

Diagnostic Study

A detailed study was conducted during CEA in the unit. Observations regarding energy performance of various processes/equipments were recorded and a few ideas of EPIAs were developed. Summary of key observations is as follows:

3.6.1 Electricity Supply from Grid

The parameters at the main electrical incomer from PSPCL supply for the unit was recorded for 10 hours using the portable power analyzer.

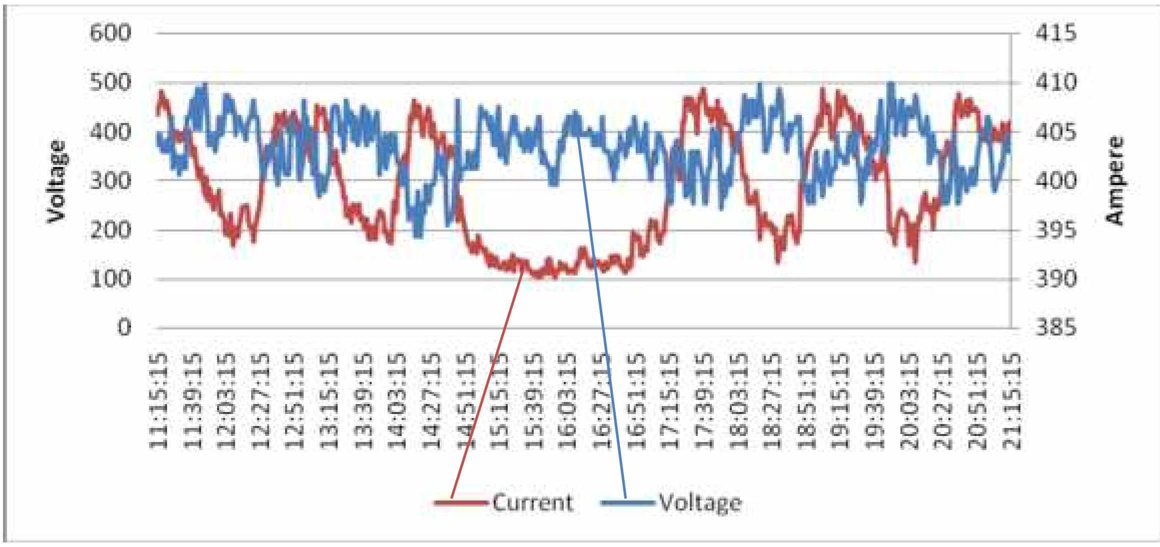


Figure 12: Current and Voltage profile

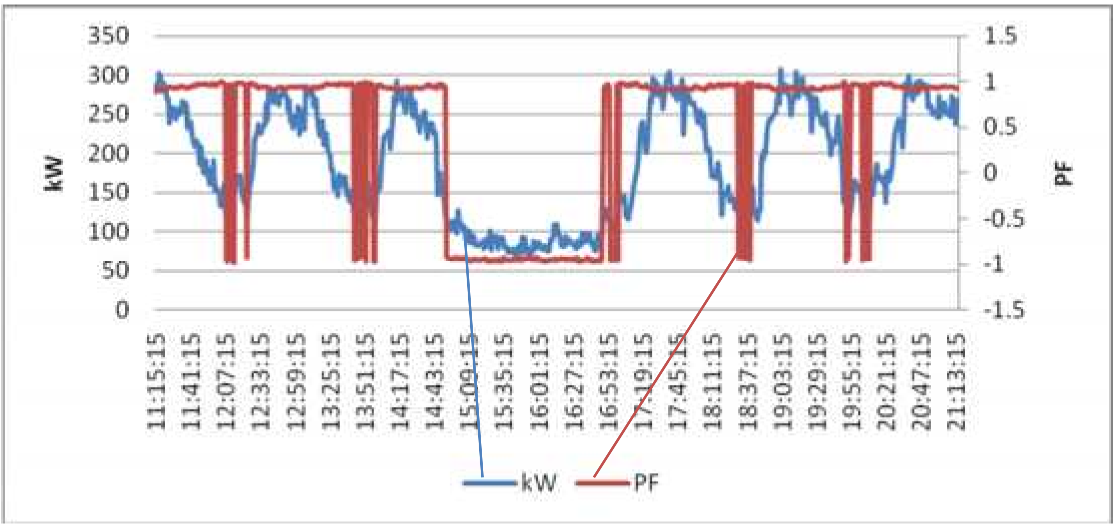


Figure 13: Power factor and load profile

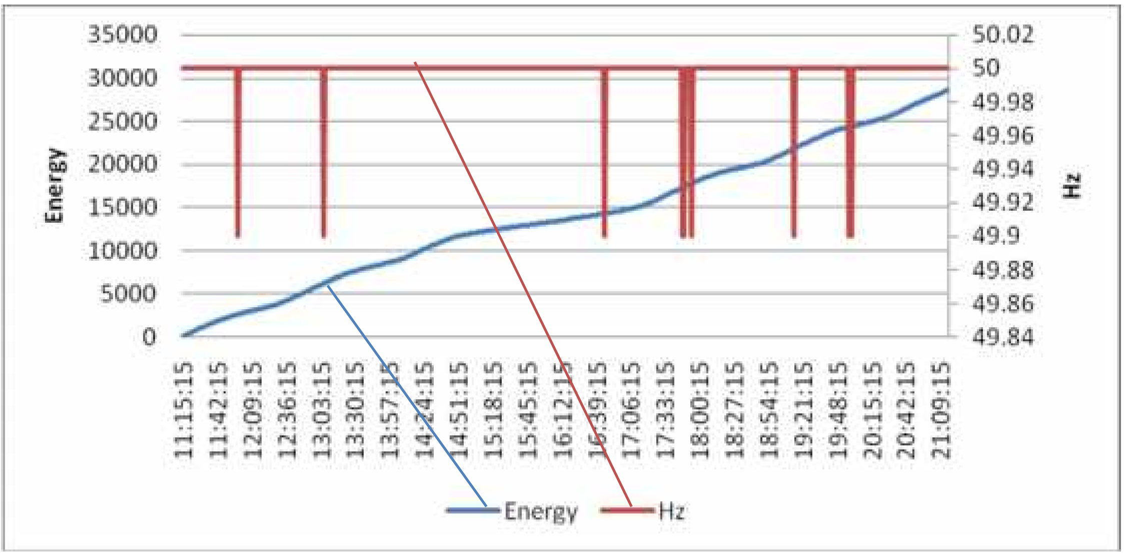


Figure 14: Energy and Harmonics profile

Following observations have been made:

Table 15: Diagnosis of electric supply

Name of Area	Present Set-up	Observations during field Study & measurements	Ideas for energy performance improvement actions
Electricity Demand	Power is supplied to this unit from PSPCL through transformer. The unit has an HT connection. The contract demand of the unit is 803 kW	The maximum kVA identified from the electricity bill was 616.40 kVA which was less than the contract demand.	No EPIAs were suggested.

	and sanctioned load is 1,098.045 kW.		
Power Factor	Unit has an HT connection and billing is in kVAh. The utility bills reflect the PF of the unit. The unit has an APFC panel installed to control the power factor.	The average PF found during the measurement was 0.95 and maximum was 1.	No EPIAs were suggested.
Voltage variation	The unit has no separate lighting feeder and no servo stabilizer for the same.	The voltage profile of the unit was satisfactory and it was recommended to put a separate lighting feeder and install a servo stabilizer for lighting and fan load to reduce the voltage from 403.33 V (lighting voltage) to 390 V.	Installation of servo stabilizer for lighting and fan load.

In order to monitor the overall energy performance, installation of a basic energy monitoring system has been proposed to the unit.

3.6.2 DG Performance

The unit has 1 DG set of 380 kVA. The unit does not have a system for monitoring the energy generation and fuel usage in DG. Diesel purchase records are, however, maintained by the unit. As part of the performance testing, measurements were conducted on the DG set by keeping track of the diesel consumption (by measuring the top up to the diesel tank) and recording of kWh generated during the same period. The key performance indicators of the DG set are evaluated and Specific Fuel Consumption of the DG is as follows:

Table 16: Analysis of DG set

Particulars	DG
Rated KVA	380
Specific Energy Generation Ratio (kWh/Litre)	2.35

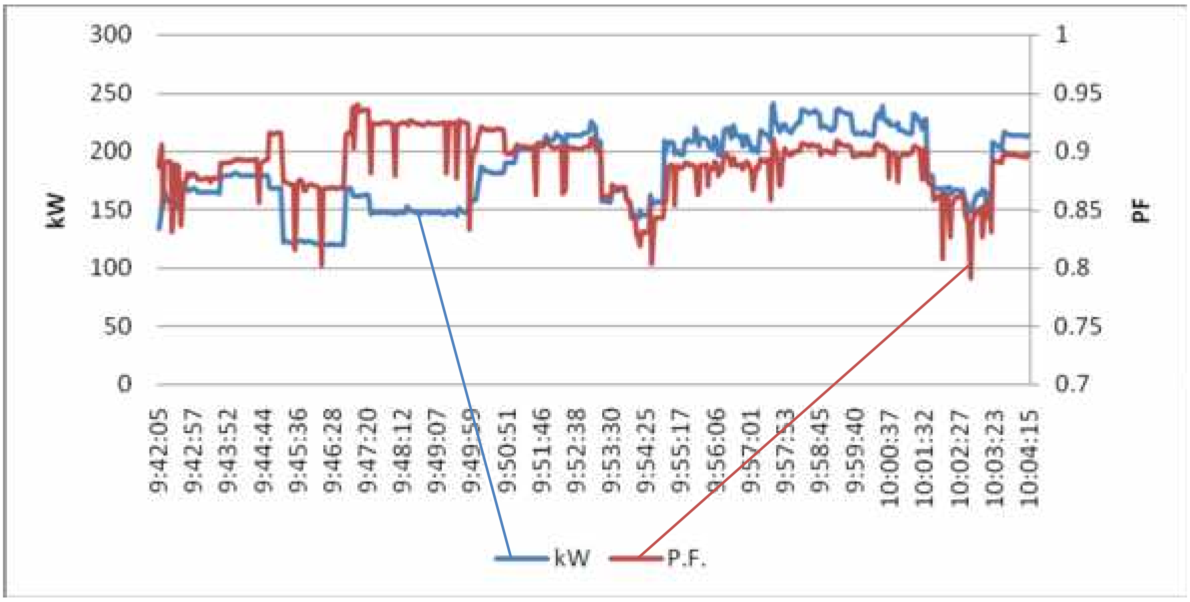


Figure 15: Power factor and load profile

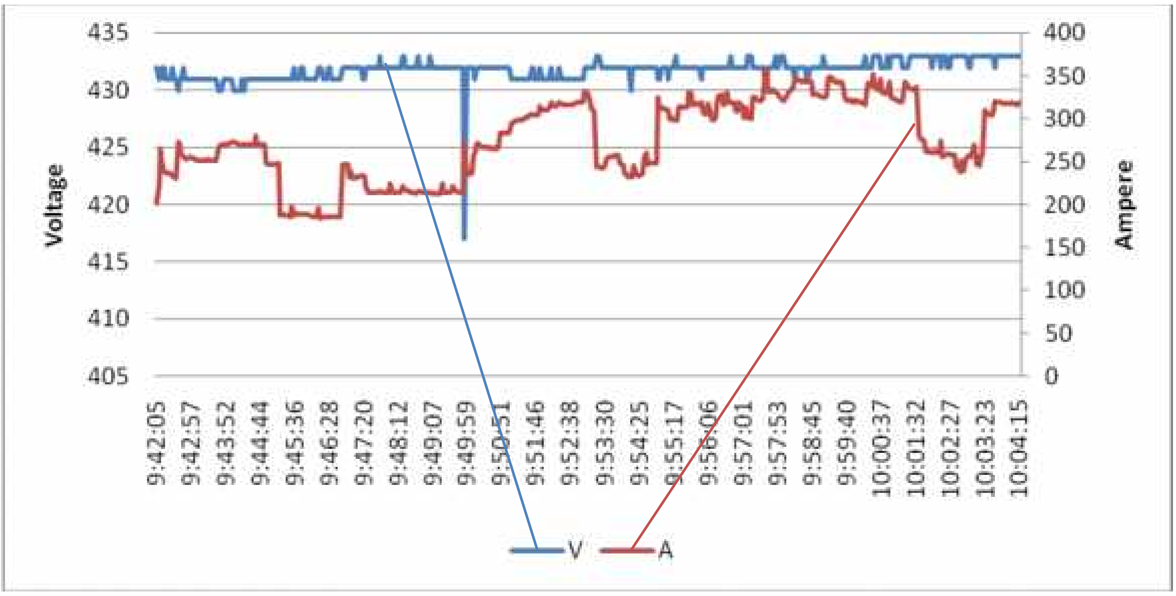


Figure 16: Voltage and Current Profile

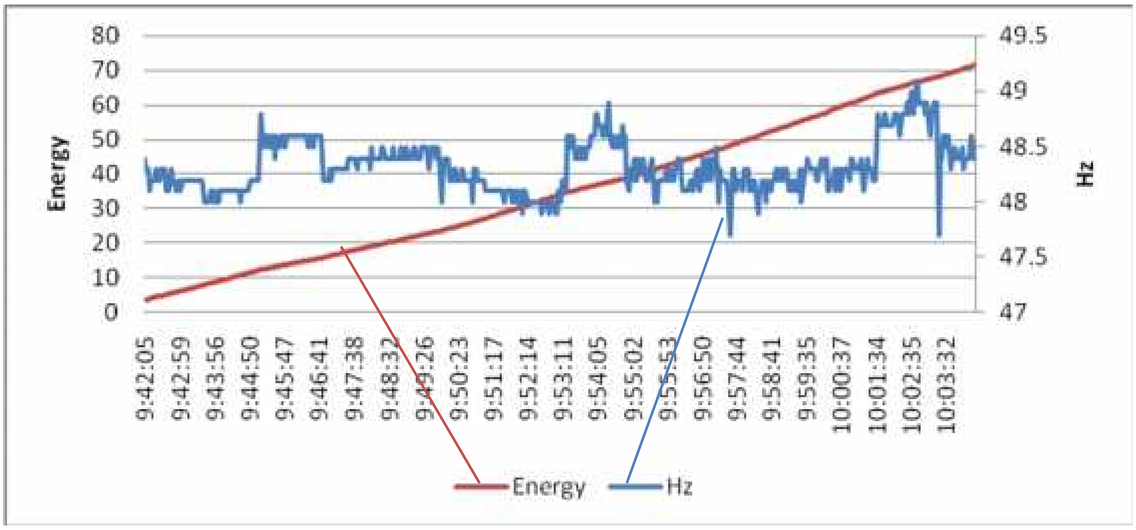


Figure 17: Energy and Harmonics Profile

The observations made are as under:

- The SFC of DG set is 2.35 kWh/litre
- The power factor is 0.89
- The present average frequency of the DG set is 48.32 Hz

3.6.3 Electrical consumption areas

The section-wise consumption of electrical energy, developed in consultation with the unit is indicated in Table 6. Around 90.58% of energy consumption is in the manufacturing operations and 9.42% is in the utilities.

Details of the measurements done, observations made and energy conservation measures are as follows:

<table>
<tr><th>Name of Area</th><th>Present Set-up</th><th>Observations during field Study & measurements</th><th>Proposed Energy performance improvement actions</th></tr>
<tr><td>Forging</td><td>There are 4 hammer motors for forging upto 60 HP. Hammer constitutes 13% of total energy consumption.</td><td>Study was conducted on a blanking machine and hammer motor 3

The results of the study are as below:
<table><tr><th>Machine</th><th>Avg. kW</th><th>Avg. PF</th></tr><tr><td>Hammer #2</td><td>40.79</td><td>0.88</td></tr><tr><td>Hammer #3</td><td>13.98</td><td>0.61</td></tr></table></td><td>No EPIAs were suggested for hammer.</td></tr>
<tr><td>Broaching</td><td>There are 5 broaching machines having rated motor power from 20 HP to 30 HP and study was conducted on 2 machines.</td><td>The results of the study are as below:
<table><tr><th>Machine</th><th>Avg. kW</th><th>Avg. PF</th></tr><tr><td>Broaching #1</td><td>0.77</td><td>0.55</td></tr><tr><td>Broaching #3</td><td>0.86</td><td>0.38</td></tr></table></td><td>No EPIAs were suggested for broaching machines.</td></tr>
<tr><td>Air-compressor</td><td>There are 2 air compressors installed and they account for 1% of total plant energy .</td><td>Both the air compressors were studied and their free air delivery test was conducted to calculate the specific power consumption

The results of the study are as below:
<table><tr><th>Machine</th><th>Avg. kW</th><th>SPC (kW/CFM)</th></tr><tr><td>Compressor 1</td><td>8.96</td><td>0.25</td></tr><tr><td>Compressor 2</td><td>15.75</td><td>0.24</td></tr></table></td><td>No EPIAs were suggested.</td></tr>
<tr><td>Heat treatment section</td><td>In heat treatment section, the study was conducted on both hardening and tempering furnaces which includes</td><td>All heaters, blowers and conveyors were studied

The results of the study are as below:
<table><tr><th>Machine</th><th>Avg.</th><th>Avg. PF</th></tr></table></td><td>No EPIAs were suggested.</td></tr>
</table>

	hardening heaters, tempering heaters, conveyor and blower motor.		kW	
		Hardening Heater 1	11.33	0.99
		Hardening Heater 2	11.68	0.99
		Tempering Heater 1	1.21	0.66
		Tempering Heater 2	0.37	0.41
		Cooling Blower	0.98	0.99

3.6.4 Thermal consumption areas

As discussed in the earlier section, about 17 % of energy cost and 28% of the energy use is in the furnace. The details of present set-up, key observations made and potential areas for energy cost reduction have been mentioned in the table below:

Name of Area	Present Set-up	Observations during field Study & measurements	Proposed Energy performance improvement actions
Forging furnace[1]	The fuel used for heating in forging furnaces is FO.	There was no metering system available for measuring the fuel consumption in the forging furnaces.	Installation of flow meters are recommended.
	The required combustion air for fuel firing is supplied by blower (FD fan).	The O_2 level in flue gases of furnaces 1, 2 and 3 were above 10%.	Installation of PID for excess air control.
	The insulation of furnaces is poor.	The surface temperatures of furnace walls were high.	Reduction in radiation and convection losses by proper insulation of the furnaces.

[1] The fuel firing rate and material weight data used in calculations has been taken from logbooks provided by unit.

4 EE TECHNOLOGY OPTIONS AND TECHNO – ECONOMIC FEASIBILTY

During the CEA of the plant, all energy consuming equipments and processes were studied. The analysis of all major energy consuming equipments and appliances were carried out which have already been discussed in earlier section of this report.

Based on the analysis, Energy Performance Improvement Actions (EPIAs) have been identified; each of which are described below:

4.1 EPIA 1, 2 & 3: Excess air control in forging furnaces using PID

Technology description

It is necessary to maintain optimum excess air levels in combustion air supplied for complete combustion of the fuel. The excess air levels are calculated based on oxygen content in the flue gases. The theoretical air required for combustion of any fuel can be known from the ultimate analysis of the fuel. All combustion processes require a certain amount of excess air in addition to the theoretical air supplied. Excess air supplied needs to be maintained at optimum levels, as too much excess air results in excessive heat loss through the flue gases. Similarly, too little excess air results in incomplete combustion of fuel and formation of black coloured smoke in flue gases.

Generally, in most of the furnaces, fuel is fired with too much of excess air. This results in formation of excess flue gases, taking away the heat produced from the combustion and increasing the fuel consumption. This also results in formation of excess GHG emissions. The excess air effects the formation of ferrous oxide resulting in increase in the burning losses.

A PID controller, if installed, will measure the oxygen levels in the flue gases at the exit of the furnace and based on that the combustion air flow from FD fan (blower) can be regulated. Subsequently, proper temperature and optimum excess air can be attained in the furnace.

Study and investigation

At the time of CEA, there was no proper automation and control system installed in the forging furnaces to maintain the optimum excess air levels. Fuel was fired from the existing burner and no air flow control mechanism was in place for maintaining proper combustion of the fuel. It was found that the oxygen level in furnace 1, furnace 2 and furnace 3 were 14.97%, 11.93% and 15.00% which indicates very high excess air levels. This results in high heat loss due to dry flue gas from the furnace.

Recommended action

It is recommended to install control system i.e. PID control, to regulate the supply of excess air for complete combustion. As a thumb rule, reduction in every 10% of excess air will save 1% in specific fuel consumption.

The cost benefit analysis of the energy conservation measure is given below:

Table 17: Cost benefit analysis (EPIA 1) - Forging furnace-1

Parameters	UOM	Present	Proposed
Production of material	tph	0.18	
Oxygen level in flue gas	%	14.70	4.00
Excess air control	%	233.33	23.53
Dry flue gas loss	%	13.63	
Specific fuel consumption	kg/t	69.72	55.10
Saving in specific fuel consumption	kg/h		2.70
Operating hrs of forging furnace	Hrs/Year	2,640	2,640
Saving in fuel consumption per year	kg/year		7,137
Savings in fuel cost	Rs. lakh/y		3.06
Installed capacity of blower	kW	3.73	3.73
Running load of blower	kW	2.98	2.69
Operating hours	hrs/y	2,640	2,640
Electrical energy consumed	kWh/y	7,878	7,090
Savings in terms of power consumption	kWh/y		787.78
Savings in terms of cost of electrical energy	Rs. lakh/y		0.06
Reduction in the burning loss inside the furnace	%		0.50
Total material savings	tpy		2.44
Cost of saved material	Rs. lakh/year		1.22
Monetary savings	Rs. lakh/Y		4.34
Estimated investment	Rs. lakh		7.00
Simple payback	y		1.61

Table 18: Cost benefit analysis (EPIA 2) – Forging furnace-2

Parameters	UOM	Present	Proposed
Production of material	tph	0.61	
Oxygen level in flue gas	%	11.93	4.00
Excess air level	%	131.62	23.53
Dry flue gas loss	%	9.34	
Specific fuel consumption	kg/t	28.29	25.24
Saving in specific fuel consumption	kg/h		1.86
Operating hrs of forging furnace	Hrs/Year	2,640	2,640
Saving in fuel consumption per year	kg/year		4902.39

Savings in fuel cost	Rs. Lakh/y		2.10
Installed capacity of blower	kW	3.73	3.73
Running load of blower	kW	2.98	2.69
Operating hours	hrs/y	2,640	2,640
Electrical energy consumed	kWh/y	7,878	7,090
Savings in terms of power consumption	kWh/y		788
Savings in terms of cost of electrical energy	Rs. Lakh/y		0.06
Reduction in the burning loss inside the furnace	%		0.20
Total material savings	tpy		3.21
Cost of saved material	Rs. Lakh/year		1.60
Monetary savings	Rs. Lakh/Y		3.76
Estimated investment	Rs. lakh		7.00
Simple payback	y		1.86

Table 19: Cost benefit analysis (EPIA 3) – Forging furnace-3

Parameters	UOM	Present	Proposed
Production of material	tph	0.17	
Oxygen level in flue gas	%	15.00	4.00
Excess air control	%	250.00	23.53
Dry flue gas loss	%	14.31	
Specific fuel consumption	kg/t	69.18	53.51
Saving in specific fuel consumption	kg/h		2.59
Operating hrs of forging furnace	Hrs/Year	2,640	2,640
Saving in fuel consumption per year	kg/year		6849.64
Savings in fuel cost	Rs. lakh/y		2.93
Installed capacity of blower	kW	3.73	3.73
Running load of blower	kW	2.98	2.69
Operating hours	hrs/y	2,640	2,640
Electrical energy consumed	kWh/y	7,878	7,090
Savings in terms of power consumption	kWh/y		787.78
Savings in terms of cost of electrical energy	Rs. lakh/y		0.06
Reduction in the burning loss inside the furnace	%		0.30
Total material savings	tpy		1.31
Cost of saved material	Rs. lakh/year		0.66
Monetary savings	Rs. lakh/Y		3.65
Estimated investment	Rs. lakh		7.00
Simple payback	y		1.92

4.2 EPIA 4: Replacement of old, inefficient (and several times re-wounded) motors with energy efficient motors

Technology description

Replacing old, inefficient (and several times re-wounded) existing motors of the forging section (5 numbers) and barrel section (1 number) with energy efficient motors will reduce power consumption of those motors by approximately 50%. The energy efficient motors have minimum losses and are capable of delivering power at efficiency of over 90%. These motors have class F insulation level and are made of high grade materials.

Study and investigation

The audit team has identified 6 motors (5 in forging section and 1 in barrel section) which are old and re-wound several times and having efficiency below 60%.

Recommended action

It is recommended to replace the present motors of the forging hammers and simplicity machine in barrel section (as in the table below) with energy efficient motors. The cost benefit analysis for this energy conservation measure is given below:

Table 20: Cost benefit analysis (EPIA 4)

Parameters	UOM	Forging Shop										Barrel Section	
		AS IS	TO BE	AS IS	TO BE	AS IS	TO BE	AS IS	TO BE	AS IS	TO BE	AS IS	TO BE
Rated Power	kW	29.84	29.84	44.76	44.76	37.3	37.3	5.595	5.595	3.73	3.73	5.595	5.595
Efficiency of motor	%	45%	90%	58%	90%	45%	90%	58%	90%	56%	90%	58%	90%
Average Load	kW	20.89	10.44	31.33	20.19	26.11	13.06	3.92	2.52	2.61	1.62	3.92	2.52
Net Power Savings	kW		10.44		11.14		13.06		1.39		0.99		1.39
Running Hours	hr/y		2,640		2,640		2,640		2,640		2,640		2,640
No. of motors	Nos.		1		1		1		3		6		4
Savings in terms of power consumption	kWh/y		27,572		29,410		34,465		11,029		15,624		14,705
Avgerge weighted cost	Rs./kWh		7.56		7.56		7.56		7.56		7.56		7.56
Total Investment	Rs. lakh		1.54		2.28		1.89		1.04		1.51		1.39
Monetary Savings	Rs. lakh		2.09		2.22		2.61		0.83		1.18		1.11
Simple Payback	Years		0.74		1.02		0.72		1.25		1.28		1.25

- Motor load assumed as 70%

4.3 EPIA 5: Replacement of DG set with a new EE DG set

Technology description

Replacement of present DG set with a new DG set will help in increasing specific energy generation ratio, i.e. the amount of electricity (kWh) from 1 litre of diesel. Normally, the standard specific fuel consumption (SFC) given for new DG set is 3.5 kWh/litre.

Study and investigation

The measured SFC of the present 380 kVA DG set was 2.35 kWh/litre, which was very low as per standards.

Recommended action

It is recommended to replace the 380 kVA DG with a new DG having SEGR of 3.5 kWh/litre. The cost benefit analysis of the DG replacement is given in the table below:

Table 21: Cost benefit analysis (EPIA 5)

Parameters	UOM	DG Replacement	
		AS IS	TO BE
Rated kVA	kVA	380	380
Operating Hours	hr	1,155	1,155
No of Units generated	kWh/y	211,671	211,671
Diesel Consumed	litres	90,152.43	60,477.41
Specific Energy Consumption	kWh/litre	2.35	3.50
Annual Diesel savings	litre/y		29,675
Diesel Cost	Rs.		50
Investment	Rs. lakh		19.50
Monetary Savings	Rs. lakh		14.84
Simple Payback	Years		1.31

4.4 EPIA 6: Replacing conventional ceiling fans with new energy efficient ceiling fans

Technology description

Replacing old ceiling fans of conventional types installed in various sections of the plant with energy efficient fans will reduce power consumption of fans by almost half. The energy efficient fans have a noiseless operation and are controlled by electronic drives which on speed reduction automatically sense the rpm and reduce power consumption.

Study and investigation

The unit is having about 124 fans which are old and are recommended to be replaced with energy efficient fans.

Recommended action

It is recommended to replace the existing ceiling fans with energy efficient fans. The cost benefit analysis of the same is given below in the table below:

Table 22: Cost benefit analysis (EPIA 6)

Data & Assumptions:	UOM	Ordinary fan	Superfan
Number of fans in the facility	Nos.	124	124
Run hours per day	hr/day	12	12
Power consumption at Maximum speed	Watts	70	35
Number of working days/year	days	330	330
Tariff for Unit of electricity	Rs./kWh	7.56	7.56
Fan unit price	Rs./pc	1,500	3,000
Electricity consumption			
Electricity demand	kW	8.68	4.34
Power consumption by fans in a year	kWh/y	34,373	17,186
Savings in terms of power consumption	kWh/y		17,186
Monetary savings	Rs. lakh/y		1.30
Estimated investment	Rs. lakh/y		3.72
Payback period	Years		2.86

4.5 EPIA 7 & 8: Replacement of present lighting fixtures with Energy efficient lighting fixtures

Technology description

Replacing conventional lights like T-12s, T-8s, CFLs, etc with LED lights will help reduce power consumption and also result in higher illumination (lux) levels for the same power consumption.

Study and investigation

The unit is having 11 nos. T-12 tube lights, 51 nos. 45 W CFLs, 23 nos. 15 W CFLs and 4 nos. 250 W Mercury vapor (MV) lamps.

Recommended action

It is recommended to replace the above mentioned light fixtures with energy efficient LED lamps which will help in reducing present lighting energy consumption. The cost benefit analysis for the EPIA is given below:

Table 23: Cost benefit analysis (EPIA 7)

Particulars	Unit	Existing	Proposed
Fixture	**UOM**	**T-12**	**16 Watt LED tube light**
Power consumed of T-12	W	40	16
Power consumption of magnetic ballast	W	12	0
Total power consumption	W	52	16
Operating Hours/day	hr	12	12
Annual days of operation	day	330	330
Energy Used per year/fixture	kWh	206	63
Average weighted cost	Rs./kWh	7.56	7.56
No. of Fixture	Nos.	11	11
Power consumption per year	kWh/y	2,265	697
Operating cost per year	Rs. lakh/y	0.17	0.05
Saving in terms of power consumption	kWh/y		1,568
Monetary savings	Rs. lakh/y		0.12
Investment per fixture of LED	Rs. lakh		0.0125
Investment of project	Rs. lakh		0.1375
Payback period	Years		1.16

Table 24: Cost benefit analysis (EPIA 8)

Particulars	Unit	Existing	Proposed	Existing	Proposed	Existing	Proposed
Fixture	**UOM**	**45 W CFL**	**18 Watt LED Square Round Panel**	**23 W CFL**	**10 Watt LED Star Bulb**	**250 W MV lamp**	**80 Watt LED Bay light**
Power consumption of light	W	45	18	23	10	250	80
Power consumption of Magnetic ballast	W	10	0	7	0	40	0
Total power consumption	W	55	18	30	10	290	80
Operating Hours/day	Hr	12	12	12	12	24	24
Annual days of operation	Day	330	330	330	330	330	330
Energy Used per year/fixture	kWh	218	71	119	40	2,297	634
Energy Rate	Rs./kWh	7.56	7.56	7.56	7.56	7.56	7.56

No. of Fixtures	Nos.	51	51	15	15	4	4
Power consumption per year	kWh/Year	11108	3635	1782	594	9187	2534
Operating cost per year	Rs. Lakh/Year	0.84	0.27	0.13	0.04	0.69	0.19
Savings in terms of electrical energy	kWh/Year		7473		1188		6653
Savings in terms of cost	Rs. lakh/Year		0.57		0.09		0.50
Investment per fixture of LED	Rs. lakh		0.0175		0.008		0.123
Investment of project	Rs. lakh		0.8925		0.12		0.492
Payback period	Years		1.58		1.34		0.98

4.6 EPIA 9: Installation of energy monitoring system on sectional energy consuming area

Technology description

Installation of energy monitoring systems in the unit will help to monitor energy consumption by various machines. This will help in setting the benchmark energy consumption with respect to production for the machines. If an increase in energy consumption is noticed for any machine, then the reasons for the increased consumption can be diagnosed and proper remedial actions can be taken.

Study and investigation

During the site survey, it was found that online data measurement was not being done on the main incomer, as well as at various electrical panels for measuring energy consumption. It was also noticed that there were no proper fuel monitoring system installed in the DG sets and in forging furnaces, like online flow-meters.

Recommended action

It is recommended to install online electrical energy monitoring systems (smart energy meters) on the main incomer and on various electricity distribution panels. It is also recommended to install online flow-meters on the individual DG set and forging furnaces to measure the oil (HSD, FO, etc) flow. This measure will help in reducing energy consumption by approximately 3% from its present levels. The cost benefit analysis for this measure is given below:

Table 25: Cost benefit analysis (EPIA 9)

Parameters	Unit	As Is	To Be
Energy monitoring savings (Electrical sections)	%		3.00
Energy consumption of major machines per year	kWh/y	2,431,917	2,358,960
Annual electricity saving per year	kWh/y		72,958
W. Average Electricity Tariff	Rss/kWh		7.56
Annual monetary savings	Rs. lakh/y		5.52
Estimate of Investment	Rs. lakh		0.35
Simple Payback	Years		0.06
Energy monitoring savings (furnace fuel)	%		3.00
Current fuel consumption	kg/y	109,617	106,329
Annual fuel savings per year	kg/y		3,289
Unit Cost	Rs./kg		42.84
Annual monetary savings	Rs. lakh/y		1.41
Estimate of Investment	Rs. lakh		0.20
Simple Payback	Years		0.14
Energy monitoring saving (DG fuel)	%		3.00
Current fuel consumption	litre/y	90,152	87,448
Annual fuel savings per year	litre/y		2,705
Diesel cost per unit	Rs./litre		50
Monetary savings	Rs. lakh		1.35
Investment for the DG fuel consumption meter	Rs. lakh		0.20
Simple Payback	Years		0.15

4.7 EPIA 10: Installation of servo stabilizer for lighting and fan load

Technology description

Normally, single phase loads such as lighting and fan load require only 390 V instead of 415 V. A separate lighting feeder with reduced voltage can serve the purpose.

Study and investigation

Presently, the single phase loads are operating at 403.33 V and there is no separate feeder for lighting and fan loads

Recommended action

It is recommended to install separate feeder for lighting and ceiling fan loads and reduce the voltage levels in that feeder from 403.33 V to 390.2 V. The cost benefit analysis of the energy conservation measure is given below:

Table 26: Cost benefit analysis (EPIA 10)

Parameters	Unit	As Is	To Be
Load considered for voltage reduction (Light + Fan)	kW	82.42	82.42
Load considered for voltage reduction (Light + Fan)	KVA	83.15	83.15
Average Voltage	V	403.33	403.33
% reduction In voltage	%		3.5
% reduction in Energy consumption	%		6.82
Average Power Factor of System	EB Bill	0.98	0.99
Operating Hours in a year	hr		3,960
Energy Consumption before Voltage Regulation	kWh/y		326,383
Energy Consumption after Voltage Regulation	kWh/y		304,111
Efficiency of Servo Stabilizer	%		95
Net Saving from Voltage Regulation	kWh/y		21,158
Saving in kVAh	kVAh/y		21,372
Electricity tariff from Grid	Rs./kVAh	7.56	7.56
Monetary Savings	Rs. lakh		1.62
Sizing of Servo Stabilizer	kVA		87.52
Investment Estimate	Rs. lakh		0.8
Payback	Years		0.49

4.8 EPIA 11: Replacement of present inefficient burners with new EE burners

Technology description

The EE burners are decided on the basis of furnace temperature, dimensions and the production. They have a film technology, where each droplet of oil is surrounded by the air increasing the surface area exposed to air resulting in efficient burning. Hence, the fuel consumption is reduced.

Study and investigation

The present fuel firing for the given production was high. It was monitored during the CEA thet production of most of the furnaces was much lower than the standard capacity.

Table 27: Furnace specifications for the EE burners

Parameters	UoM	Forging furnace-1	Forging furnace-2	Forging furnace-2
Fuel Firing rate	Litres/hr	47.20	590.81	161.13
Production	kg/hr	184.8	607.2	165.6
Area of the furnace	m2	2.862	2.8448	2.8188

Recommended action

It is recommended to replace the inefficient burners with new EE burners. The cost benefit analysis of the burner's replacement is given in the table below:

Table 28: Cost benefit analysis (EPIA 11)

		Forging furnace-1		Forging furnace-2		Forging furnace-3	
Parameters	**Unit**	**As Is**	**To Be**	**As Is**	**To Be**	**As Is**	**To Be**
Production rate of the forging furnace	kg/hr	49	49	607	607	166	166
Total numbers of burners	Nos.	1.0	1.0	1.0	1.0	1.0	1.0
Total numbers of energy efficient burner required	Nos.	1.0	1.0	1.0	1.0	1.0	1.0
Estimated savings by energy efficient burner	%		5.0		5.0		5.0
Current fuel firing in forging furnace	kg/hr	13	12	17	16	11	11
Savings in fuel per hours	kg/hr		0.64		0.86		0.57
Number of operating days	days	330	330	330	330	330	330
Number of operating hours per day	hrs	8	8	8	8	8	8
Total savings per year into fuel firing	kg/yr		1701		2268		1512
Unit cost of fuel	Rs./kg		42.84		42.84		42.84
Cost savings per year	Rs. Lakh/yr		0.73		0.97		0.65
Estimated investment for all burners	Rs. Lakh		0.2		0.2		0.2
Payback period	Yr		0.3		0.2		0.4

5 ANNEXURE

Furnace 1 efficiency calculations

Input parameters

Input Data Sheet		
Type of Fuel		**Furnace Oil**
Source of fuel	**Local vendor**	
	Value	**Units**
Furnace Operating temperature (Heating Zone)	1010	*Deg C*
Final temperature of material (at outlet of Heating zone)	960	*Deg C*
Initial temperature of material	42	*Deg C*
Average fuel Consumption	12.9	*Kg/hr*
Flue Gas Details		
Flue gas temperature after APH (in chimney; APH installed)	160	*deg C*
Preheated air temp erature	150	*deg C*
O2 in flue gas	14.70	*%*
CO2 in flue gas	4.62	*%*
CO in flue gas	100.0	*ppm*
Atmospheric Air		
Ambient Temp erature	42	*Deg C*
Relative Humidity	45.6	*%*
Humidity in ambient air	0.03	*kg/kgdry air*
Fuel Analysis		
C	*84.00*	**%**
H	*12.00*	**%**
N	*0.00*	**%**
O	*1.00*	**%**
S	*3.00*	**%**
Moisture	*0.00*	**%**
Ash	*0.00*	**%**
Weighted Average GCV of FO	*10500*	kcal/kg
Ash Analysis		
Unburnt in bottom ash	*0.00*	%
Unburnt in fly ash	*0.00*	%
GCV of bottom ash	*0*	kCal/kg
GCV of fly ash	*0*	kCal/kg
Material and flue gas data		
Weight of material (Raw material) being heated in furnace	185	*Kg/Hr*
Weight of Stock	185	*kg/hr*
Specific heat of material	0.12	*Kcal/kgdegC*
Average specific heat of fuel	0.417	*Kcal/kgdegC*

fuel temperature	70	*deg C*
Specific heat of flue gas	0.26	*Kcal/kgdegC*
Specific heat of superheated vapour	0.45	*Kcal/kgdegC*
Heat loss from surfaces of various zone		
For Ceiling		
Natural convection heat transfer rate from ceiling	2.8	*Kcal/m2degC*
External temp erature of ceiling	371	*deg K*
Room Temp erature	315	*deg K*
Ceiling surface area	4.22	*m2*
Emissivity of furnace body surface	0.75	
For side walls		
Natural convection heat transfer rate from sidewall surfaces	2.2	*Kcal/m2degC*
External temp erature of side walls	334	*deg K*
Sidewall surface area	9.8822	*m2*
For Hearth		
Natural convection heat transfer rate from flue gas duct surfaces	1.5	*Kcal/m2degC*
External temp erature of side walls	341.1470833	*deg K*
External surface area	2.862	*m2*
Outside dia of flue gas duct	*0.15*	*m*
For radiation loss in furnace(through charging and discharging door)		
Time duration for which the material enters through preheating zone and exits through Furnace	0.52	*Hr*
Area of opening in m2	0.56	*m2*
Coefficent based on profile of furnace opening	0.7	
Maximum temperature of air at furnace door	428	*deg K*

Efficiency calculations

Calculations	Values	Unit
Theoretical Air Required	14.01	kg/kg of fuel
Excess Air supplied	233.33	%
Actual Mass of Supplied Air	46.69	kg/kg of fuel
Mass of dry flue gas	46.61	kg/kg of fuel
Amount of Wet flue gas	47.69	Kg of flue gas/kg of fuel
Amount of water vapour in flue gas	1.08	Kg of H2O/kg of fuel
Amount of dry flue gas	46.61	kg/kg of fuel
Specific Fuel consumption	69.72	kg of fuel/ton of material
Heat Input Calculations		
Combustion heat of fuel	732,106	Kcal/ton of material
Sensible heat of fuel	820	Kcal/ton of material
Total heat input	732,926	Kcal/ton of material

Heat Output Calculation		
Heat carried away by 1 ton of material (useful heat)	116,184	Kcal/ton of material
Heat loss in dry flue gas per ton of material	99,874	Kcal/ton of material
Loss due to H2 in fuel	47,982	Kcal/ton of material
Loss due to moisture in combustion air	75	Kcal/ton of material
Loss due to partial conversion of C to CO	715	Kcal/ton of material
Loss due to convection and radiation (openings in furnace - inlet & outlet door of furnace)	1,054	Kcal/ton of material
Loss Due to Evaporation of Moisture Present in Fuel	-	Kcal/ton of material
Total heat loss from furnace body	27,977	Kcal/ton of material
Heat loss due to unburnts in Fly ash	-	Kcal/ton of material
Heat loss due to unburnts in bottom ash	-	Kcal/ton of material
Unaccounted heat lossess	439,065	Kcal/ton of material
Heat loss from furnace body and ceilings		
Heat loss from furnace body ceiling surface	3228	Kcal/hr
Heat loss from furnace body side walls surfaces	1469	Kcal/hr
Heat loss from hearth	473	Kcal/hr
Total heat loss from furnace body	27977	Kcal/tons
Furnace Efficiency	**15.87**	%

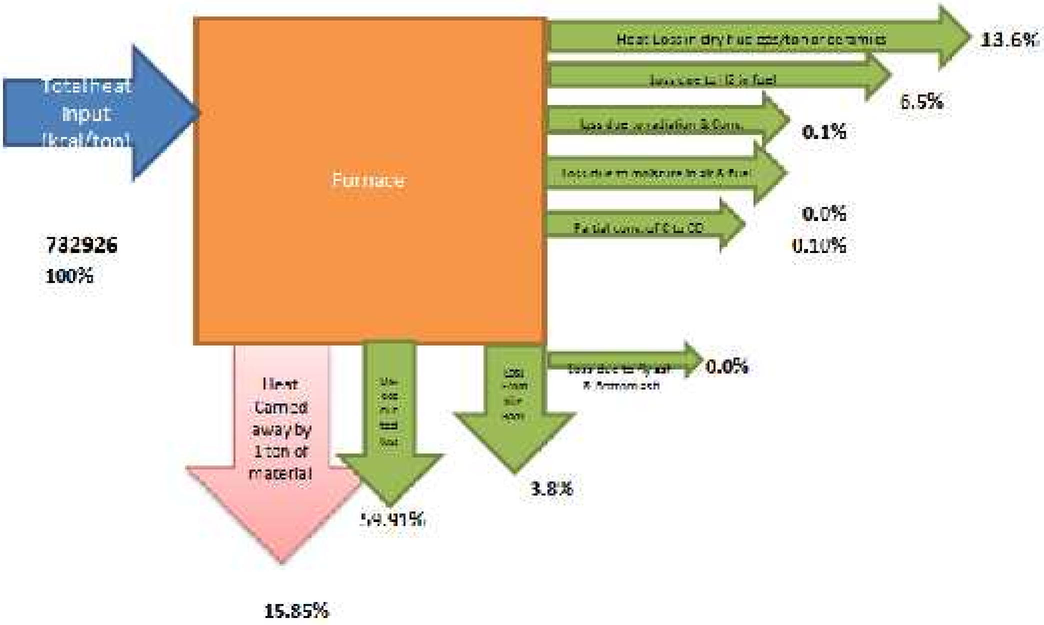


Figure 18: Sankey diagram Furnace 1

Furnace 2 efficiency calculations

Input Data Sheet		
Type of Fuel		**Furnace Oil**
Source of fuel	**Local vendor**	
	Value	**Units**
Furnace Operating temperature (Heating Zone)	840	*Deg C*
Final temperature of material (at outlet of Heating zone)	791	*Deg C*
Initial temperature of material	43	*Deg C*
Average fuel Consumption	17.2	*Kg/hr*
Flue Gas Details		
Flue gas temperature after APH (in chimney;APH installed)	160	*deg C*
Preheated air temperature	120	*deg C*
O2 in flue gas	11.93	*%*
CO2 in flue gas	13.29	*%*
CO in flue gas	27.7	*ppm*
Atmospheric Air		
Ambient Temperature	43	*Deg C*
Relative Humidity	45.6	*%*
Humidity in ambient air	0.03	*kg/kgdry air*
Fuel Analysis		
C	*84.00*	%
H	*12.00*	%
N	*0.00*	%
O	*1.00*	%
S	*3.00*	%
Moisture	*0.00*	%
Ash	*0.00*	%
Weighted Average GCV of FO	*10500*	kcal/kg
Ash Analysis		
Unburnt in bottom ash	*0.00*	%
Unburnt in fly ash	*0.00*	%
GCV of bottom ash	*0*	kCal/kg
GCV of fly ash	*0*	kCal/kg
Material and flue gas data		
Weight of material (Raw material) being heated in furnace	607	*Kg/Hr*
Weight of Stock	607	*kg/hr*
Specific heat of material	0.12	*Kcal/kgdegC*
Average specific heat of fuel	0.417	*Kcal/kgdegC*
fuel temperature	70	*deg C*
Specific heat of flue gas	0.26	*Kcal/kgdegC*
Specific heat of superheated vapour	0.45	*Kcal/kgdegC*
Heat loss from surfaces of various zone		
For Ceiling		
Natural convection heat transfer rate from ceiling	2.8	*Kcal/m2degC*

External temp. of ceiling	367	*deg K*
Room Temperature	316	*deg K*
Ceiling surface area	4.16	*m2*
Emissivity of furnace body surface	0.75	
For side walls		
Natural convection heat transfer rate from sidewall surfaces	2.2	*Kcal/m2degC*
External temperature of side walls	326	*deg K*
Sidewall surface area	9.548	*m2*
For Hearth		
Natural convection heat transfer rate from flue gas duct surfaces	1.5	*Kcal/m2degC*
External temperature of side walls	341.72	*deg K*
External surface area	2.8448	*m2*
Outside dia of flue gas duct	*0.15*	*m*
For radiation loss in furnace(through charging and discharging door)		
Time duration for which the material enters through preheating zone and exits through Furnace	0.85	*Hr*
Area of opening in m2	0.56	*m2*
Coefficent based on profile of furnace opening	0.7	
Maximum temperature of air at furnace door	428	*deg K*

Efficiency calculations

Calculations	Values	Unit
Theoretical Air Required	14.01	*kg/kg of fuel*
Excess Air supplied	131.62	*%*
Actual Mass of Supplied Air	32.44	*kg/kg of fuel*
Mass of dry flue gas	32.36	*kg/kg of fuel*
Amount of Wet flue gas	33.44	*Kg of flue gas/kg of fuel*
Amount of water vapour in flue gas	1.08	*Kg of H2O/kg of fuel*
Amount of dry flue gas	32.36	*kg/kg of fuel*
Specific Fuel consumption	28.29	*kg of fuel/ton of material*
Heat Input Calculations		
Combustion heat of fuel	297,086	*Kcal/ton of material*
Sensible heat of fuel	314	*Kcal/ton of material*
Total heat input	297,401	*Kcal/ton of material*
Heat Output Calculation		
Heat carried away by 1 ton of material (useful heat)	95,598	*Kcal/ton of material*
Heat loss in dry flue gas per ton of material	27,771	*Kcal/ton of material*
Loss due to H2 in fuel	19,450	*Kcal/ton of material*
Loss due to moisture in combustion air	51	*Kcal/ton of material*
Loss due to partial conversion of C to CO	28	*Kcal/ton of material*

Loss due to convection and radiation (openings in furnace - inlet & outlet door of furnace)	528	*Kcal/ton of material*
Loss Due to Evaporation of Moisture Present in Fuel	-	*Kcal/ton of material*
Total heat loss from furnace body	6,503	*Kcal/ton of material*
Heat loss due to unburnts in Fly ash	-	*Kcal/ton of material*
Heat loss due to unburnts in bottom ash	-	*Kcal/ton of material*
Unaccounted heat losses	147,471	*Kcal/ton of material*
Heat loss from furnace body and ceilings		
Heat loss from furnace body ceiling surface	2824	*Kcal/hr*
Heat loss from furnace body side walls surfaces	668	*Kcal/hr*
Heat loss from hearth	456	*Kcal/hr*
Total heat loss from furnace body	6503	*Kcal/tons*
Furnace Efficiency	**32.18**	*%*

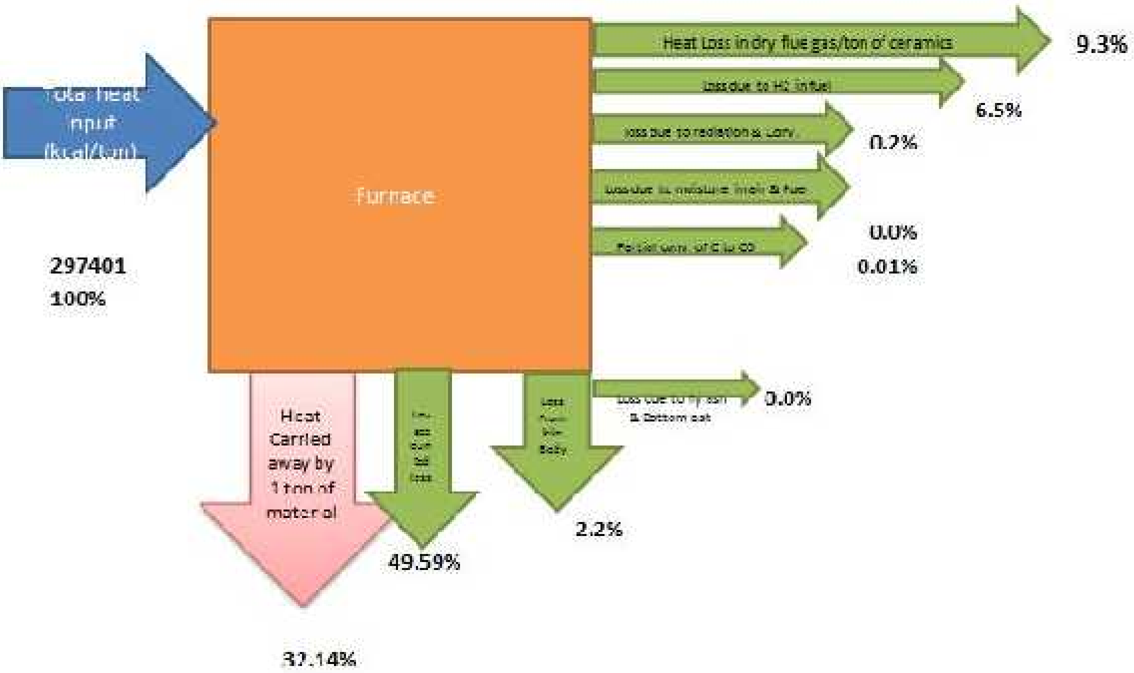


Figure 19: Sankey diagram Furnace 2

Furnace 3 efficiency calculations

Input Data Sheet		
Type of Fuel	**30:70**	**Furnace Oil**
Source of fuel	**Local vendor**	

	Value	Units
Furnace Operating temperature (Heating Zone)	835	*Deg C*
Final temperature of material (at outlet of Heating zone)	785	*Deg C*
Initial temperature of material	42	*Deg C*
Average. fuel Consumption	11.5	*Kg/hr*
Flue Gas Details		
Flue gas temp. after APH (in chimney;APH installed)	160	*deg C*
Preheated air temp erature	120	*deg C*
O2 in flue gas	15	*%*
CO2 in flue gas	4.0	*%*
CO in flue gas	68.0	*ppm*
Atmospheric Air		
Ambient Temperature	42	*Deg C*
Relative Humidity	45.6	*%*
Humidity in ambient air	0.03	*kg/kgdry air*
Fuel Analysis		
C	*84.00*	%
H	*12.00*	%
N	*0.00*	%
O	*1.00*	%
S	*3.00*	%
Moisture	*0.00*	%
Ash	*0.00*	%
Weighted Average GCV of Fuel	*10500*	kcal/kg
Ash Analysis		
Unburnt in bottom ash	*0.00*	%
Unburnt in fly ash	*0.00*	%
GCV of bottom ash	*0*	kCal/kg
GCV of fly ash	*0*	kCal/kg
Material and flue gas data		
Weight of material (Raw material) being heated in furnace	166	*Kg/Hr*
Weight of Stock	166	*kg/hr*
Specific heat of material	0.12	*Kcal/kgdegC*
Average. specific heat of fuel	0.417	*Kcal/kgdegC*
fuel temperature	70	*deg C*
Specific heat of flue gas	0.26	*Kcal/kgdegC*
Specific heat of superheated vapour	0.45	*Kcal/kgdegC*
Heat loss from surfaces of various zone		
For Ceiling		
Natural convection heat transfer rate from ceiling	2.8	*Kcal/m2degC*
External temp. of ceiling	370	*deg K*
Room Temp.	315	*deg K*
Ceiling surface area	4.16	*m2*

Emissivity of furnace body surface	0.75	
For side walls		
Natural convection heat transfer rate from sidewall surfaces	2.2	*Kcal/m2degC*
External temperature of side walls	332	*deg K*
Sidewall surface area	9.4883	*m2*
For Hearth		
Natural convection heat transfer rate from flue gas duct surfaces	1.5	*Kcal/m2degC*
External temp. of side walls	349	*deg K*
External surface area	2.8188	*m2*
Outside dia of flue gas duct	*0.15*	*m*
For radiation loss in furnace(through charging and discharging door)		
Time duration for which the material enters through preheating zone and exits through Furnace	0.37	*Hr*
Area of opening in m2	0.56	*m2*
Coefficent based on profile of furnace opening	0.7	
Maximum temperature of air at furnace door	543	*deg K*

Efficiency calculations

Calculations	Values	Unit
Theoretical Air Required	14.01	*kg/kg of fuel*
Excess Air supplied	250.00	*%*
Actual Mass of Supplied Air	49.02	*kg/kg of fuel*
Mass of dry flue gas	48.94	*kg/kg of fuel*
Amount of Wet flue gas	50.02	*Kg of flue gas/kg of fuel*
Amount of water vapour in flue gas	1.08	*Kg of H2O/kg of fuel*
Amount of dry flue gas	48.94	*kg/kg of fuel*
Specific Fuel consumption	69.18	*kg of fuel/ton of material*
Heat Input Calculations		
Combustion heat of fuel	726,408	*Kcal/ton of material*
Sensible heat of fuel	814	*Kcal/ton of material*
Total heat input	727,222	*Kcal/ton of material*
Heat Output Calculation		
Heat carried away by 1 ton of material (useful heat)	95,184	*Kcal/ton of material*
Heat loss in dry flue gas per ton of material	104,061	*Kcal/ton of material*
Loss due to H2 in fuel	47,608	*Kcal/ton of material*
Loss due to moisture in combustion air	78	*Kcal/ton of material*
Loss due to partial conversion of C to CO	558	*Kcal/ton of material*
Loss due to convection and radiation (openings in furnace - inlet & outlet door of furnace)	3,096	***Kcal/ton of material***
Loss Due to Evaporation of Moisture Present in Fuel	-	*Kcal/ton of material*
Total heat loss from furnace body	30,321	*Kcal/ton of material*

Heat loss due to unburnts in Fly ash	-	*Kcal/ton of material*
Heat loss due to unburnts in bottom ash	-	*Kcal/ton of material*
Unaccounted heat lossess	446,316	*Kcal/ton of material*
Heat loss from furnace body and ceilings		
Heat loss from furnace body ceiling surface	3086	*Kcal/hr*
Heat loss from furnace body side walls surfaces	1311	*Kcal/hr*
Heat loss from hearth	625	*Kcal/hr*
Total heat loss from furnace body	30321	*Kcal/tons*
Furnace Efficiency	**13.10**	*%*

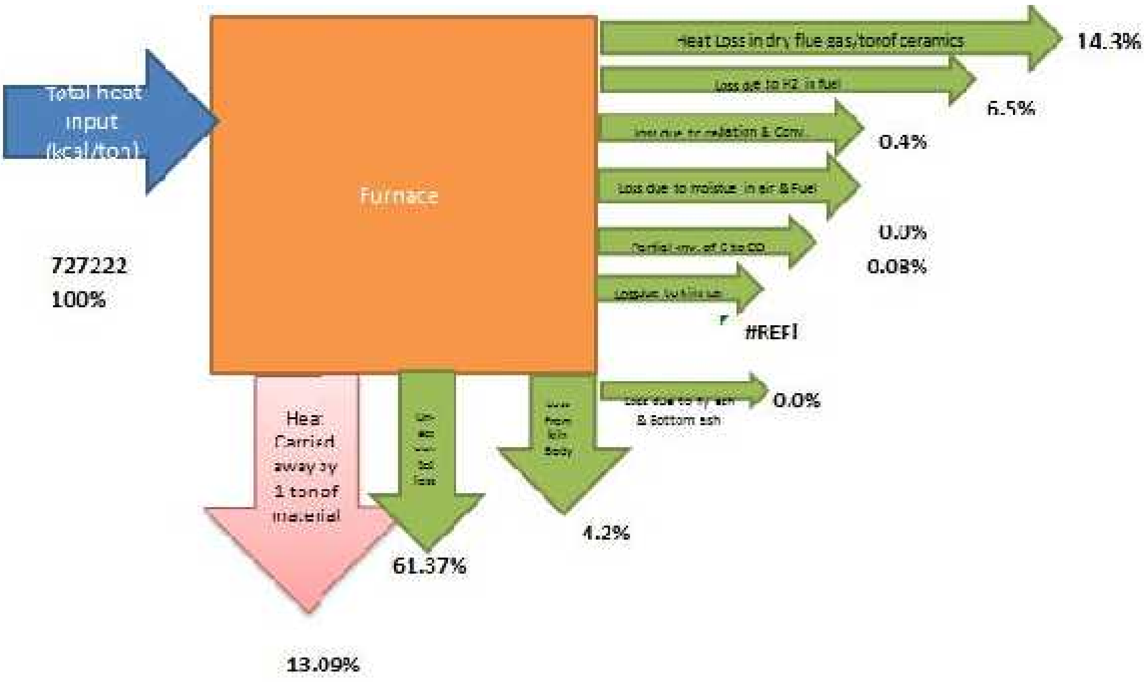


Figure 20: Sankey diagram of forging furnace 3

6 LIST OF VENDORS

Details of some of the suppliers for energy equipments are given in the table below:

EPIA 1, 2 & 3: Excess Air Control

Sl. No.	Name of Company	Address	Phone No	E-mail /Website
Automation				
1	Delta Energy Nature Contact Person Gurinder Jeet Singh, Director	F-187, Indl. Area, Phase-VIII-Bm Mohali-160059	Tel.: 0172-4004213/ 3097657/ 2268197 Mobile: 9316523651 9814014144 9316523651	dengjss@yahoo.com den8353@yahoo.com
2	International Automation Inc Contact Person Sanjeev Sharma)	# 1698, First Floor, Canara Bank Building, Near Cheema Chowk, Link Road, Ludhiana	Office: +91-161-4624392, Mobile: +91-9815600392	Email: interautoinc@yahoo.com
3	Happy Instrument	Yogesh 20, Proffulit Society, Nr Navo Vas, Rakhial, Ahmedabad-380021	079-22771702 9879950702	yogesh@happyinstrument.com
4	Wonder Automation	Kulwinder Singh E-192, Sector 74, Phase 8-B, Industrial Area, SAS nagar Mohali	0172-4657597 98140 12597	info@wonderplctrg.com admn.watc@gmail.com hs@wonderplctrg.com

EPIA 4: Replacement of old motors with Energy Efficient Motors

Sl. No.	Name of Company	Address	Phone No.	E-mail
1	Havells India Contact Person: Mr. Niranjan	QRG Towers,2D,Sec-126,Express way,Noida-201304,UP	Mr.Niranjan Sanghvi(9314060101),Mr.Vishwanathan(9899104105),Mr Sanjeev	niranjan.singhvi@havells.com

Sl. No.	Name of Company	Address	Phone No.	E-mail
	Sanghvi		Nayyar(9818499726)	
2	Crompton Greaves- Dealer Contact Person: Mr. Ajay Gupta	New Delhi-110019	Mobile : 9811888657	Email: NA

EPIA 5: DG Replacement

Sl. No.	Name of Company	Address	Phone No.	E-mail / Website
1	Mahindra Powerol Engines & DG set Contact Person: Mr.Pankaj Katiyar Marketing	Jeevan Tara Building,5,Parliament street,delhi-1	Mobile: +91-9818494230	katiyar.pankaj@mahindra.com
2	Cummins Power Generation Contact Person: Rishi Gulati Senior Manager-Power Electronics	Cummins India Limited Power Generation Business Unit 35/A/1/2, Erandawana, Pune 411 038, India	Phone: (91) 020-3024 8600 , +91 124 3910908 Mobile: +91 9350191881	cpgindia@cummins.com rishi.s.gulati@cummins.com
3	BNE Company Contact Person: Mr Bhavneet Singh, Marketing	7B, Kiran Shankar Roy Road, 3rd Floor, Kolkata 700 001	Mobile : +91- 9831048994	bnecompany@gmail.com, bne_company@yahoo.com

EPIA 6: Installation of EE fans instead of conventional fans

Sl. No.	Name of Company	Address	Phone No.	E-mail
1	Super fans Contact Person:			
2	Usha pumps Contact Person: Mr. KB Singh	J-1/162, Rajouri Garden, Rajouri Garden New Delhi, DL 110005	011(23318114),011 2510 4999,01123235861(Mr.Manish)	Email: kb_singh@ushainternational.com

EPIA 7 & 8: Energy Efficient Lights

Sl. No.	Name of Company	Address	Phone No.	E-mail
1	Osram Electricals Contact Person: Mr. Vinay Bharti	OSRAM India Private Limited,Signature Towers, 11th Floor,Tower B, South City - 1,122001 Gurgaon, Haryana	Phone: 011-30416390 Mob: 9560215888	vinay.bharti@osram.com
2	Philips Electronics Contact Person: Mr. R. Nandakishore	1st Floor Watika Atrium, DLF Golf Course Road, Sector 53, Sector 53 Gurgaon, Haryana 122002	9810997486, 9818712322(Yogesh-Area Manager), 9810495473(Sandeep-Faridabad)	r.nandakishore@phillips.com, sandeep.raina@phillips.com
3	Bajaj Electricals Contact Person: Mr. Kushgra Kishore	Bajaj Electricals Ltd,1/10, Asaf Ali Road, New Delhi 110 002	9717100273, 011-25804644 Fax : 011-23230214 ,011-23503700, 9811801341(Mr.Rahul Khare), (9899660832)Mr.A	kushagra.kishore@bajajelectricals.com, kushagrakishore@gmail.com; sanjay.adlakha@bajajelectricals.com

Sl. No.	Name of Company	Address	Phone No.	E-mail
			tul Baluja, Garving Gaur(9717100273), 9810461907(Kapil)	

EPIA 9: Energy Monitoring System

Sl. No.	Name of Company	Address	Phone No	E-mail /Website
Automation				
1	Iadept Marketing Contact Person: Mr. Brijesh Kumar Director	S- 7, 2nd Floor, Manish Global Mall, Sector 22 Dwarka, Shahabad Mohammadpur, New Delhi, DL 110075	Tel.: 011-65151223	iadept@vsnl.net ,info@iadeptmarketing.com
2	Aimil Limited Contact Person: Mr. Manjul Pandey	Naimex House A-8, Mohan Cooperative Industrial Estate, Mathura Road, New Delhi - 110 044	Office: 011-30810229, Mobile: +91-981817181	manjulpandey@aimil.com
3	Panasonic India Contact Person: Neeraj Vashisht	Panasonic India Pvt Ltd Industrial Device Division (INDD) ABW Tower,7th Floor, Sector 25, IFFCO Chowk, MG Road,Gurgaon - 122001, Haryana,	9650015288	neeraj.vashisht@in.panasonic.com

EPIA 10: Installation of servo-stabilizer with separate feeder of lighting and fan load

Sl. No.	Name of Company	Address	Phone No.	E-mail
1	Servostar Contact Person: Mr. Salman Khan	40, Shakarpur Khas, Near Modern Happy School,Delhi	Salman-9811273753, 9350033639), 011- 22460453, 22040519 , Fax No-011-22459653	sales@servostar.in jeewangarg@servostar.in salman@servostar.in
2	Jindal Electricals Contact Person: Mr. Rahul Kumar Shrivasatava	41, Shakarpur Khas, (Near Modern Happy School) Delhi – 92 (India)	9910993167(Mr.Rahul), (011) 22460453, 9350809090	Email: delhi@jindalrectifiers.com

EPIA 11: Installation of EE Burners

Sl. No.	Name of Company	Address	Phone No	E-mail /Website
Automation				
1	ENCON Thermal Engineers (P) Ltd Contact Person: Mr V B Mahendra, Managing Director Mr. Puneet Mahendra, Director	297, Sector-21 B Faridabad – 121001 Haryana	Tel.: +91 129 4041185 Fax: +91 129 4044355 Mobile: +919810063702 +919971499079	sales@encon.co.in kk@encon.co.in www.encon.co.in
2	TECHNOTHERMA FURNACES INDIA PVT. LTD.	206, Hallmark Commercial Complex, Near Nirmal Lifestyles, L.B.S. Marg, Mulund West, Mumbai - 400 080. India.	T: 022-25695555	Furnace@technotherma.net

Sl. No.	Name of Company	Address	Phone No	E-mail /Website
3	Therm process	Mr. Sanjay Parab B/1203-O2 Commercial Complex, Minerva Estate, Opp Asha Nagar, P.K.Cross Road, Mulund (W) Mumbai-400080	T: 022-25917880/82/83 M: 9967515330	thermprocess@yahoo.com sanjay@thermprocess.com