Best Practices - Energy Efficiency In Forging Industry

For the BEE - GEF - World Bank Project

Financing Energy Efficiency at MSMEs

THE WORLD BANK

ENERGY IS LIFE BEE CONSERVE IT

gef

Prepared by

CII Confederation of Indian Industry

CII-AVANTHA Centre for Competitiveness for SMEs

Disclaimer

While every care has been taken in compiling this Case Study, neither Bureau of Energy Efficiency nor Confederation of Indian Industry accepts any claim for compensation, if any entry is wrong, abbreviated, cancelled, omitted or inserted incorrectly either as to the wording, space or position in the Booklet. The case study is only an attempt to create awareness on energy conservation and sharing of best practices being adopted in India.

Each recipient must conduct its own analysis of the information contained in this booklet and is advised to carry out its own investigation into the proposed project, the legislative and regulatory regime which applies there and by all matters pertinent to the proposed project and to seek its own professional advice on the technical, financial, regulatory and taxation consequences of entering into any agreement or arrangement relating to the proposed project.

BEE encourages use and distribution of its publication. Content from this document may be used freely and copied accurately into other formats without prior permission, provided that proper attribution is given to the original sources, and that the content is not used for commercial purposes.

About the Project: FINANCING ENERGY EFFICIENCY AT MSMEs

The "Financing Energy Efficiency at MSMEs" project is a part of the Global Environmental Facility (GEF) Programmatic Framework (2010-14) for Energy Efficiency in India with an objective to increase demand for energy efficiency investments in targeted MSMEs clusters and to build their capacity to access commercial finance.

The GEF implementation agency for the project is World Bank. The project will be jointly executed by Bureau of energy Efficiency (BEE) and Small Industries Development Bank of India (SIDBI).

The project aspires to address the current gap in the understanding between energy auditors and bank loan officers and demonstrate a viable mechanism of synergic tie-up between MSMEs, energy auditors, financial consultants/chartered accountants, local industrial or MSME associations and local bankers.

The five Target clusters under the GEF-World Bank project "Financing Energy Efficiency at MSMEs" are Ankleshwar (Chemical), Faridabad (Mixed), Kolhapur (Foundry), Pune (Forging), and Tirunelveli (Lime Kiln).

Implemented as part of the large MSME energy efficiency program of the BEE, the project has engaged focused efforts in 5 targeted clusters, which include:

To increase demand for energy efficiency products and services, and mobilize a large group of "decision – ready" units in partnership with local industrial associations, energy professionals, local service providers and leading vendors of energy efficiency equipments.

These energy efficiency demand creation activities will then be linked with the leading programmes of various financial institutions in the specific cluster.

Based on the findings of project-supported energy audits, enlisted units shall receive support in preparation of bankable Detailed Project Report (DPR)/ application document in a format acceptable to the banks to process the loan applications under current or new lending schemes and hand-holding support in reaching closure for identified investments.

Objective of this Booklet

The objective is to prepare an Energy Conservation Booklet for Forging Industry covering the topics like energy saving potential, technologies available to improve energy efficiency, equipment suppliers. The end objective of the activity is market development for energy efficiency / conservation products & services. The whole effort is to prepare a simplified and user-friendly booklet based on actual study done in a Forging Plant & inputs from various stakeholders in energy efficiency sector. Confederation of Indian Industry (CII) – AVANTHA Centre for Competitiveness for SMEs was awarded the task of preparing this booklet by Bureau of Energy Efficiency.

CONTENT

CHAPTER – 1

INDIAN FORGING INDUSTRY

Introduction

Forging industry is a basic industry and such industries tend to grow in a country in relation to the rate of growth of its GDP. As far as India is concerned, we expect our GDP to continue to grow and therefore, the basic industries will grow and so will the industry.

Current Market Overview

The Indian forging industry has emerged as a major contributor to the manufacturing sector of the Indian economy. The Indian forging industry, growing at a compound annual growth rate of about 23% over the previous five years, is expected to grow to INR 1800billion by 2016 Overall production reached 9,83,000 TPA from 9,29, 000 TPA during last year; a YoY growth of 12% (Source-www.indianforging.org)

Industry characteristics

⇒ Capital intensive

The industry is becoming capital intensive with increasing globalization and entry of more MNC auto companies in the domestic market. The forging manufacturers need to invest aggressively in upgrading technology to meet their strict product norms.

⇒ Fragmented nature

The Indian forgings industry is characterized by fragmented production capacities; the organized sector accounts for a 55% share with 10 large units dominating the industry.

⇒ Raw material intensive

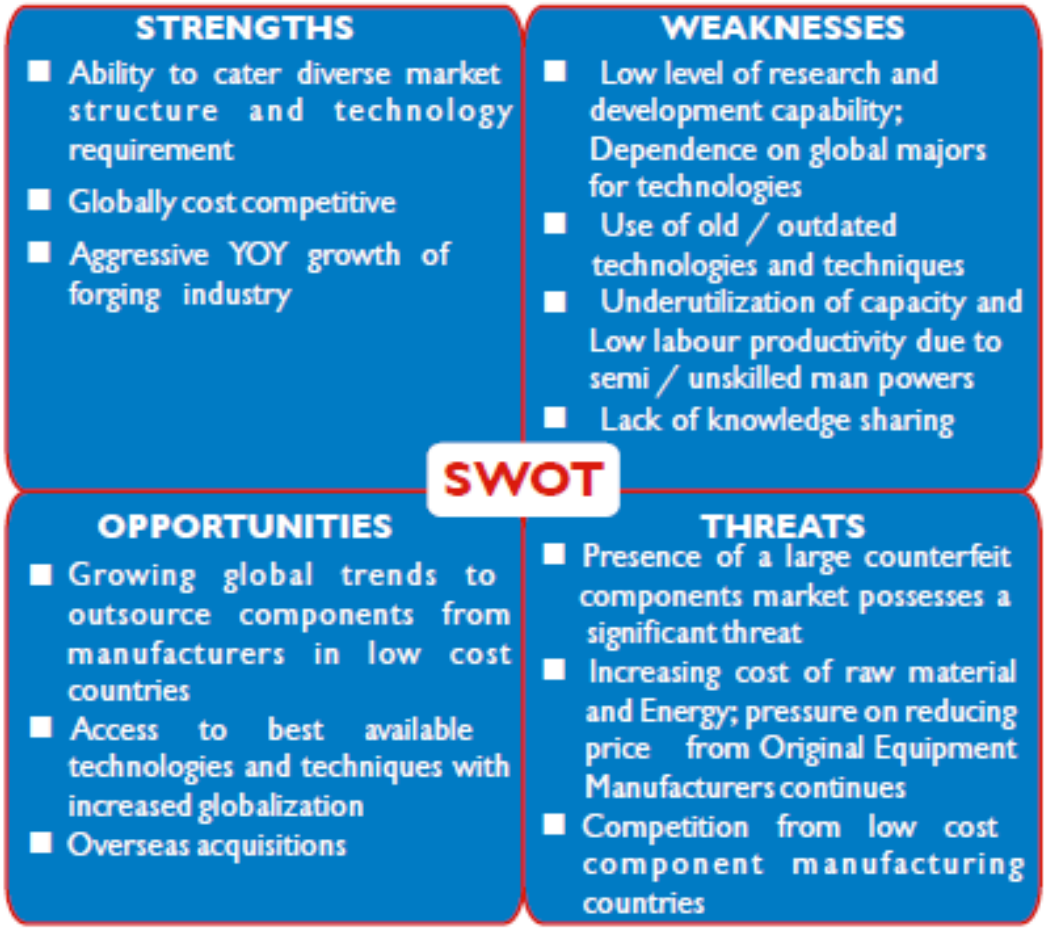
Raw material costs approximate 60% of the total cost and the major raw materials are carbon, alloy, stainless steel, aluminum, titanium, brass, copper and high temperature alloys, which contain cobalt, nickel or molybdenum.

⇒ Technology

The Indian industry lacks adequate R & D, which has necessitated the need for foreign collaboration. The techniques comprise the mechanical drop hammer, sophisticated hydraulic and pneumatic processes etc.

Indian Forging Industry – SWOT Analysis

A scan of the internal and external environment is an important part of the strategic planning process. Environmental factors internal to the firm usually can be classified as Strengths (S) and Weaknesses (W), and those external to the firm can be classified as Opportunities (O) and Threats (T). Such an analysis of the strategic environment is referred to the as a SWOT analysis. SWOT analysis of Indian forging sector gives the following points:



- **Individual contribution from Small, Medium and Large Industries**

The composition of the Indian forging industry can be categorized into four sectors- large, medium, small and tiny. By and large, the Indian forging industry still remains highly fragmented, with around 400 units ,out of which only 9 -10 are large units scattered all over India. These SMEs form the backbone of the industry. Under the Micro Sector, the units are far too many and the number is difficult to estimate. The organized sector accounts for about 65-70% of the total forging production in the country, while unorganized players (who are mainly small and Micro units) cater mainly to job work and the replacement market or tier 3 or tier 4 component manufacturers. Presently, the Auto Industry is the mainstay of forging demand and is responsible for about 70% of the total forging production. Other identified drivers of growth in the non-automotive sector are Oil and Gas (including flanges), Aerospace & Civil Aviation, Energy & Nuclear Application and others.

CHAPTER – 2

TECHNICAL FEATURES OF FORGING INDUSTRY

Predominant Technologies being used & Production Process in Forging Industry

The typical production process involves heating of MS blanks in a reheating furnace up to a temperature range of 1050 – 1150^{0}C. The heated material is then passed on to forging press, better known as hammer. Other than heating and forging, there are also a number of other process, both upstream and downstream side, for example, die sharpening, blank shearing, material pushing, heat treatment and so on. All these processes also require energy. Thus, it can well be concluded that forging is one the most energy intensive process in the manufacturing industry.

In most of the forging industry in SME category in India, fuel fired furnaces are being in use for process heating. Mostly conventional designed furnaces are being used, which have no monitoring system for fuel/electricity consumption.

The process parameters like temperature, time of operation etc are manually operated, verified and controlled. Nowadays gas fired furnace & electrical induction furnace are replacing oil fired furnace. Drop forging hammer are the second most high energy consumer, use pneumatic power and electrical motor for the operation.

In most of the units manual operation & control system are used to operate equipments. Based on the present operating system in forging industry and available best technology, there is very good potential in forging industry to improve upon energy consumption

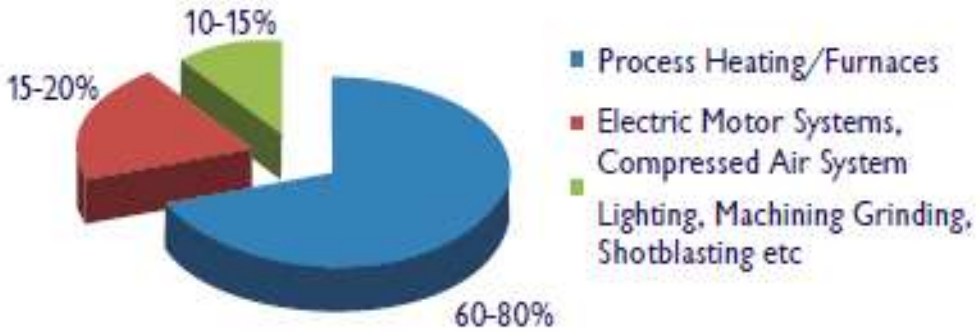
Energy Intensity in Indian Forging Industry

Energy cost represents 10% to 12% of the cost of production for a forging/heat treating plant. For an induction furnace, specific energy consumption varies from 400 to 600 kWh/t of forging. The specific fuel consumption varies highly depending on the size of the blank, but it averages around 130 litres per tonne. Specific fuel consumption in well designed efficient furnace can come down to 80 litres per MT. The average Specific Energy Consumption (SEC) in small die forging units is 160-170 litres of furnace oil per MT of forged product. In large die forging units, the SEC is estimated at 120 litres per MT of forged product, compared to an achievable SEC of 90- 100 litres/ton in small die forging units and 70-80 liters per MT in large die forging units.

Energy Consumption Pattern in a Forging Industry

Heating and heat treatment furnaces are the major thermal & electrical energy consumers. Process Heating/Furnaces alone accounts for 60 – 80% of the total energy consumption. Electric motor systems, compressed air system account for 15 – 20% & others like lighting, machining, grinding, shot-blasting etc account for 10 – 15% of total energy consumption in a forging industry.

Energy Consumption Pattern in a Forging Industry



CHAPTER – 3

ENERGY CONSERVATION MEASURES IN A FORGING INDUSTRY

In forging industry substantial reduction in energy consumption can be achieved by improving the operational practices, fine tuning the operating parameters, application of low cost automation & upgrading technology. A list of possible energy conservation opportunities in three categories is listed below;

➧ Energy Saving Potential in Indian Forging Industry

The energy saving potential considering the short term and medium term energy saving projects is 10-12 % of the total energy consumption. The energy saving potential considering the long-term energy saving projects, which have payback period of about 3-4 years, is in the range of 15-20%.

➧ Short, Medium and Long term Energy Saving Projects

⇒ Short-term energy saving proposals

- ✓ Optimize the overall loading of furnaces by better planning of jobs
- ✓ Improve combustion efficiency of heating & heat treatment furnace
- ✓ Operate furnaces at the optimum temperature
- ✓ Reduce heat losses from furnace openings
- ✓ Maintaining correct amount of furnace draft
- ✓ Arrest compressed air leakages by vigorous maintenance
- ✓ Optimize overall operating pressure of compressors based on the system requirement
- ✓ Provide ball valves at the user ends of compressed air cleaning hoses and other similar points
- ✓ Install Tran vector nozzle for cleaning applications involving compressed air
- ✓ Replace the delta connection with permanent star in case of motors, which are lightly loaded.

⇒ Medium-term energy saving proposals

- ✓ Install kWh indicator cum integrator for induction furnace
- ✓ Use of Translucent sheets for maximize use of day light
- ✓ Use of Eco Ventilators of hot air exhaust
- ✓ Use of automation for temperature control in forging and heat treatment furnace
- ✓ Improve the overall Insulation levels and close the openings in furnaces, so as to minimize heat losses.
- ✓ Install Automatic Power Factor Control (APFC) System
- ✓ Replace faulty capacitor banks
- ✓ Relocate capacitors to the machine ends, or from the MSBs to the SSBs (at the substation ends), to minimise voltage drop in cables
- ✓ Install Automatic - Star - Delta - Star converter in the lightly loaded motors which handle fluctuating loads
- ✓ Install automatic voltage stabilizers for lighting circuits and other precision electronic circuits.
- ✓ Install lighting transformers in all major lighting feeders and operate the lighting circuit at 210 V

⇒ **Long term energy saving proposals**

- ✓ Install air pre heater for preheating the combustion air supply to the heat treatment furnaces & heating furnace
- ✓ Replace existing oil fired heating & heat treatment furnaces with gas fired furnaces
- ✓ Provide ceramic fiber insulation for batch operated furnaces
- ✓ Practice oxygen enrichment in furnace
- ✓ Segregate high pressure and low pressure compressed air users in the forging industry
- ✓ Install variable frequency drive for the screw compressor
- ✓ Replace pneumatic operated tools with electrical tools
- ✓ Use energy efficient equipment in allied operations like hammers, compressors, machine tools and machining centers, heat treatment etc.
- ✓ Install energy efficient reheating furnace with flat roof
- ✓ Use of energy efficient motors
- ✓ Use of energy efficient air compressor
- ✓ Use of online O2 measurement and control system

CHAPTER - 4

CASE STUDIES ON ENERGY CONSERVATION IN A FORGING INDUSTRY

The contents of the case study are based on the actual implementation done by a Forging industry in India. A Detailed Energy Audit & Post Implementation study was conducted by the Energy Audit team of Confederation of Indian Industry at the identified Forging Unit to recommend, monitor & verify the improvement done to save energy consumption by the plant. The detailed Energy Audit & post implementation study at the identified unit comprised of the following activities:

- Detailed data collection of power consuming equipment and operating parameters
- Power measurements of major electrical and thermal energy consumers
- Verification of actual implementation of energy saving projects done by the plant
- Analysis of collected data and measurements to develop specific energy saving case studies.
- Discussion with the plant personnel on the identified case studies.

Sl. No	Energy Conservation Case Study in a Forging Industry	Energy Savings Achieved (%age)
1	Conversion of fuel of forging & Heat Treatment furnace from furnace oil to natural gas	15 - 25%
2	Recovery of waste heat from forging furnaces using air pre heater	20 – 25%
3	Improve insulation to reduce radiation heat losses	10 – 15%
4	Installation of energy efficient compressors	10 -15%
5	Installation of leakage proof compressed air pipelines	3-5%
6	Energy conservation through installation of eco ventilator in place of electric exhaust fans	100%
7	Conversion of shot blasting motor to permanent star connections	5 – 10%
8	Maintaining Power factor to 0.99	1 – 2%

ENERGY CONSERVATION OPTION NO 1

- **CONVERSION OF FUEL OF FORGING & HEAT TREATMENT FURNACE FROM FURNACE OIL TO NATURAL GAS**

Forging furnace

The forging furnace is used for preheating billets and ingots to attain a 'forge' temperature. The furnace temperature is maintained at around 1200 to 1250 Deg C. Forging furnaces use an open fireplace system and most of the heat is transmitted by radiation. The typical load is 5 to 6 ton with the furnace operating for 16 to 18 hours daily. The total operating cycle can be divided into (i) heat-up time (ii) soaking time and (iii) forging time. Specific fuel consumption depends upon the type of material and number of 'reheats' required.

Background

The plant has furnace oil fired forging & heat treatment furnaces. From Jan 2011 plant started converting their Forging/HT Furnace fuel from Furnace Oil to Natural Gas. Fuel switch from Furnace Oil to natural gas became fully operational by June 2011 onwards.

Present Scenario

Considering present landing cost (Basic+ taxes+ Transportation+ losses) of furnace oil @ Rs. 40/liter and Natural Gas cost @ Rs.30/SCM, estimating 1 liter of Furnace Oil is equivalent to 1 SCM of Natural Gas (based on calorific value of furnace oil and natural gas and Burner efficiency of Furnace oil and natural gas). **There is a saving potential of around 25% in cost by converting fuel from Furnace oil to Natural Gas.**

Based on the actual data collection & measurement done at the identified forging unit, the cost comparison between FO fired furnace & natural gas fired furnace is explained below.

Production and Fuel Consumption Details for Forging Furnace

Based on the Production and Furnace Oil consumption details of forging furnace in year 2010, the specific energy consumption of forging furnace is 94 Kg of FO/Ton of Production. Considering average FO cost of Rs. 38.1/KG (for June -Oct 2011), the fuel cost/Ton of production is Rs. 3581/T of Production. Based on the Production and Natural Gas consumption details of forging furnace in year 2011, the specific energy consumption of forging furnace is 100 SCM/Ton of Production. Considering average Gas cost of Rs. 29.04/KG (for June -Oct 2011), the fuel cost/Ton of production would have been Rs. 2904/T of Production. This shows a marginal benefit of Rs. 677/Ton of Production in cost savings due to conversion of fuel from FO to Natural Gas.

Production and Fuel Consumption Details for Heat Treatment Furnace

Based on the Production and Furnace Oil consumption details of heat treatment in year 2010, the specific energy consumption of heat treatment is 50.6 Kg of FO/Ton of Production. Considering average FO cost of Rs. 38.1/KG (for June -Oct 2011), the fuel cost/Ton of

production would have been Rs. 1928/T of Production. Based on the Production and Natural Gas consumption details of heat treatment in year 2011, the specific energy consumption of heat treatment is 55.0 SCM/Ton of Production. Considering average Gas cost of Rs. 29.04/KG (for June -Oct 2011), the fuel cost/Ton of production is Rs. 1597.2/T of Production. This shows a marginal benefit of Rs. 330/Ton of Production in cost savings due to conversion of fuel from FO to Natural Gas.

Additional Benefits

- More Efficient
- Less Pollution
- Better Control
- Less Complicated Burners
- Less Maintenance
- Better working environment

Summary

The Estimated savings potential for Forging Furnace is around Rs.677/Ton of production and The Estimated savings potential for Heat Treatment Furnace is around Rs.330/Ton of production.

ENERGY CONSERVATION OPTION NO 2

WASTE HEAT RECOVERY FROM FORGING FURNACES USING AIR PRE HEATER

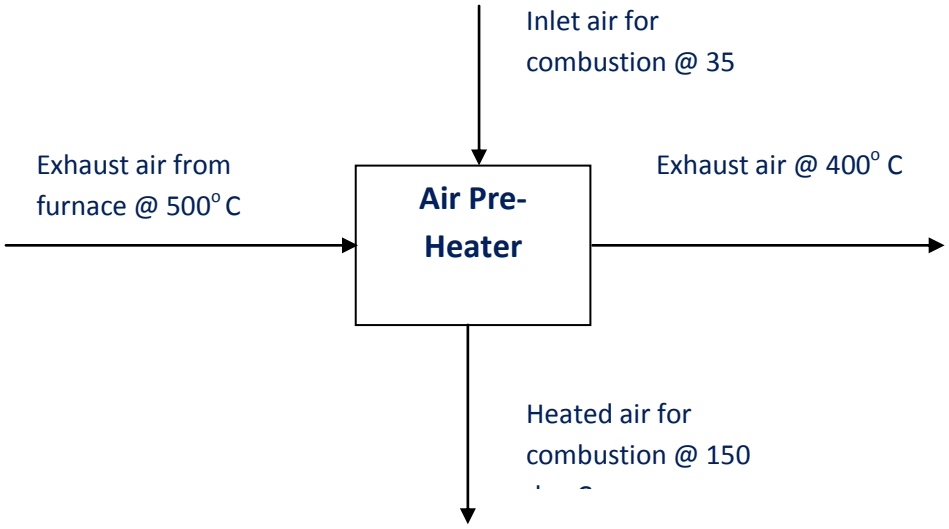
Background

Forging furnace is being in operation to pre-heat steel blocks up to 1100 deg cent before drop forging operation. The furnace exhaust temperature is around 500 deg C.

Present Scenario

Waste heat recovery system is being installed to pre-heat the combustion air for the furnace. The fresh air for combustion is being pre – heated by means of circulating the same through an air to air heat exchanger. Every 20 deg C rise in temperature of fresh air will improve the efficiency of the furnace by 1 %. Therefore, it is estimated that around 5% savings in fuel is being achieved by installing combustion air pre-heater from flue gases.

Given below is the flow- diagram depicting the same;



Summary

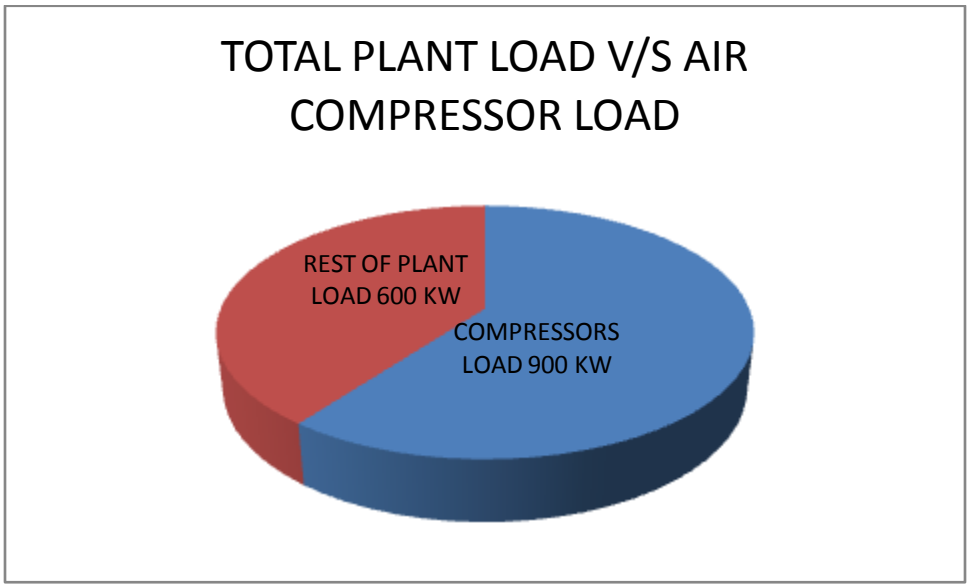
Based on the average production rate of 1250 T/month & specific gas consumption of about 100 SCM/T @ Rs. 29/SCM, it is estimated that annual savings being achieved by the plant due to installation of waster heat recovery system to pre-heat combustion air is around Rs. 18.0 Lakhs/yr (considering 5% savings in gas consumption)

ENERGY CONSERVATION OPTION NO 3

INSTALLATION OF ENERGY EFFICIENT COMPRESSORS

Background

Compressed Air is one of the most commonly used utility for a variety of end users. Pneumatic power and instrumentation systems are very popular due to its ruggedness, inherent safety from fire hazard, convenience of getting linear motion as well as high speeds and total freedom from electro-magnetic interference. Air Production can be one of the most expensive and least understood process in a manufacturing/process facility. In industries, production demands accounts for only 50% of the total demand on the compressor, the remainder is lost. It has been shown however, that several energy conservation opportunities exists, that are simple to understand and cost effective to implement.



Past Installation and operating details

9 numbers of screw compressors are installed for entire plant demand. Generally 7 nos. of screw compressors were running in parallel to meet compressed air requirement. Compressed air is being used for drop forging machines. Rating, description and specific energy consumption of all nine compressors is given in table 3 below.

Sr. No	Description	Rating (cfm)	Quantity	SEC (kW/100 cfm)
1	LP Compressor No 1	650	1	15.5
2	LP Compressor No 2	550	1	20.5
3	LP Compressor No 3	550	1	19.8
4	LP Compressor No 4	500	1	22.8

5	LP Compressor No 5	480	1	25.6
	Average SEC			20.8
Sr. No	**Description**	**Rating (cfm)**	**Quantity**	**SEC (kg of fuel/100 cfm)**
1	DP Compressor No 6	630	1	4.76
2	DP Compressor No 7	450	1	5.5
3	DP Compressor No 8	440	1	5.7
4	DP Compressor No 9	537	1	5.6
		4787	9	

It is clear from the above table that SEC of LP compressor 2,3,4,5 is on higher side and SEC of DP compressor 7, 8, 9 is on higher side.

- **Present Scenario**

Based on the specific energy consumption measurement, plant has replaced old in-efficient compressors with new energy efficient compressors

- **Present Installation and operating details**

Sr. No	Description	Rating (cfm)	Quantity	SEC (kW/100 cfm)
1	New LG Compressor No 1	1085	1	16.75
2	New LG Compressor No 2	1085	1	16.75
3	New Kaiser Compressor No 1	1500	1	16.5
4	LP Compressor No 1	650	1	16.5
5	LP Compressor No 4	500	1	22.5
	Average SEC			17.8
Sr. No	**Description**	**Rating (cfm)**	**Quantity**	**SEC (kg of fuel/100 cfm)**
1	DP Compressor No 6	630	1	Running only in case of power failure
2	DP Compressor No 7	450	1	
3	DP Compressor No 8	440	1	
4	DP Compressor No 9	537	1	
		4787	9	

Past Average SEC (kw/100 CFM) = 20.8 kW/100 cfm

Present Average SEC (kw/100 CFM)	= 17.8 kw/100 cfm
Savings	= 3.0 kW/100 cfm
Approximate plant requirement	= 4500 cfm
Total savings	= 3.0 x 4500 / 100 kW
	= 135 kW
Approx. Operation Hours in Year	= 7000 approx
Total savings in kWh	= 135 x 7000 kWh
	= 945000 kWh
Average Unit rate for 1 kWh	= Rs. 6/kWh
Annual Savings	= Rs. 945000 x 6
	= **Rs. 56.70 Lakhs/yr**

- **Summary**

The annual saving achieved by the plant by replacing old in-efficient compressor with new compressors is **Rs. 56.7 Lakhs**. It is approx. 15% of total value of compressed air cost to the plant. This saving is achieved by installation of 3 new high efficient Screw Compressors.

ENERGY CONSERVATION OPTION NO 4

ENERGY CONSERVATION THROUGH INSTALLATION OF ECO VENTILATOR IN PLACE OF ELECTRIC EXHAUST FANS

Background

Fumes are generated create a lot of problem in working area of plant, so electrical exhaust fans are used to exhaust fumes from the production area. Now day's eco-ventilators, which do not consume electricity, are being in use to exhaust fumes. The identified forging plant has installed eco-ventilators in place of electrical exhaust fans and has saved significantly on energy consumption.

Operating principle of eco ventilator

A natural air ventilator works on natural movement of wind by utilizing the velocity energy of wind to induce air flow by centrifugal action. Centrifugal force on ventilator is caused by spinning of blades that create a low pressure region, which attracts and throws out the hot air allowing it to be replaced by fresh and cool air from outside. Ecovent's suction process works on slowest velocity of wind as well, there by ventilating the heat and moisture at all wind speed – even when there is no wind, the flywheel affects the rotor cage uses the stored energy to constantly remove the unwanted air, giving rise to ventilation.

ECO Ventilator

Advantages

- No Electricity consumption
- No Maintenance costs
- Hot air directly exhausted through ventilator
- Improved working condition
- Increases productivity
- High temperature alloy material
- Easy to install
- Eco friendly and economical

Benefits:

Number of Eco ventilator installed	= 20 nos
Number of Exhaust Fan Stopped	= 16 nos

Rating of one Exhaust fan	= 0.75 kW
Savings in KW	= 16 x 0.75 kW
	= 12 kW
Approx. no. of operational hours in year	= 8000 hrs
Savings in kWh	= 12 x 8000 kWh
	= 96000 kWh
Average Unit rate for 1 KWH	= Rs. 6/kWh
Annual Savings	= Rs. 96000 x 6
	= **Rs. 5.76 Lakhs**

- **Summary**

The annual saving achieved by the plant by installing Eco-ventilators is **Rs. 5.76 Lakhs**.

ENERGY CONSERVATION OPTION NO 5

INSTALLATION OF LEAKAGE PROOF AIR PIPE LINE TO MINIMISE COMPRESSED AIR LEAKAGES

Background

Compressed Air is one of the most commonly used utility for a variety of end users. Pneumatic power and instrumentation systems are very popular due to its ruggedness, inherent safety from fire hazard, convenience of getting linear motion as well as high speeds and total freedom from electro-magnetic interference.

Observation

Compressed air leakage is very common in any industry. Higher the pressure more will be the leakage. More the leakage, higher will be the pressure drop at the farthest user point. However compressed air leakage can be avoided to a certain limit with proper leakage management system and awareness. Plant team has done well in plugging the air leakage in their plant. They have changed their main header pipe line and many sub header pipe lines, by which they are able to save at least 3-5% of air leakages of the plant.

Approximate plant requirement	= 4500 cfm
Total savings	= 3% x 4500 cfm
	= 135 cfm
Average SEC of Compressor	= 17.5 kW/100 cfm
Power Saving	= 135 x 17.5 / 100 kW
	= 23.63 kW
Approx. Operation Hours in Year	= 7000 approx
Total savings in KWH	= 23.63 x 7000 kWh
	= 165410 kWh
Average Unit rate for 1 KWH	= Rs. 6/kWh
Annual Savings	= Rs. 165410 x 6
	= **Rs. 9.92 Lakhs**

Summary

The annual saving achieved by the plant is **Rs. 9.92 Lakhs**. This saving is achieved by installation of compressed air lines and arresting of air leakages.

ENERGY CONSERVATION OPTION NO 6

IMPROVED INSULATION TO REDUCE RADIATION HEAT LOSSES

Refractory

Refractory is used in furnaces to retain the heat in the chamber. This material can withstand the action of abrasive or corrosive solids, liquids or gases at high temperatures. The various combinations of operating conditions, in which refractories are used, make it necessary to manufacture a range of refractory materials with different properties. Refractory materials are made in varying combinations and shapes depending on their applications.

Background

Furnaces were found to be the target areas for energy conservation measures. The skin temperatures of furnaces were on the higher side i.e. in the range of 170^0C. The ambient temperature was 40^0C. Surface heat losses increase exponentially with temperature. The radiation losses vary as fourth power of temperature. A comparison is shown below;

Temperature	**Heat loss**
100^0C	1100 Kcal/hr/m2
300^0C	15000 Kcal/hr/m2

Previously Average skin temperature of identified area Ts	= 170°C
Total surface area for insulation (All Forging and Heat Treatment Furnaces 7 nos)	= 50.0 m^2
Ambient Temperature Ta	= 30°C
Latest surface temperature	= 50°C
Surface Heat Loss saved from furnace	= [10+ (Ts-Ta)/20] X (Ts-Ta) X Area Kcal/hr = [10 + (170-50)/20] X (170-50) X 50 Kcal/hr = 96000 kCal/ hr
Calorific value of fuel	= (96000 kCal/ hr)/(10000 kCal/kg)
Fuel Saving/Hr	= 9.6 kg/hr
Annual Saving	= 8000 hrs/yr X 9.6 kg/hr =76800 kg/ Year
Cost of Fuel	= Rs. 35.0/kg
Annual saving	= 76800 kg/yr X Rs.35.0/kg = **Rs. 26.88 Lakhs**

Summary

The annual saving achieved by the plant is **Rs. 26.88 Lakhs**. This saving is achieved by installation of new refractory in forging and heat treatment furnaces.

ENERGY CONSERVATION OPTION NO 7

CONVERSION OF SHOT BLASTING MOTOR TO PERMANENT STAR CONNECTIONS

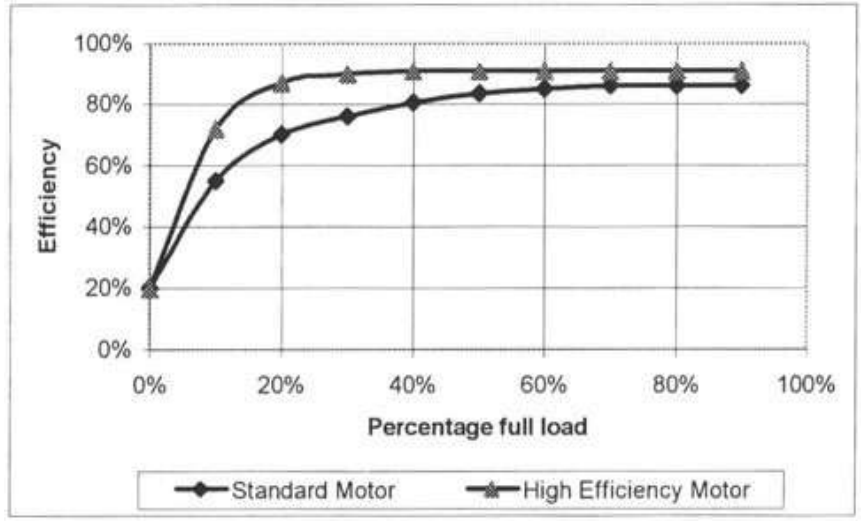
Background

Under-loaded motors are less efficient due to fixed losses and also operate at lower power factor. Motor efficiency (η) and power factor varies with % loading, which leads to following effect.

- Very high voltage related losses.
- Lower operating power factor.
- High copper loss.
- Motor operates in less efficiency range.

S No	Identified Motors	Rated kW	Power - kW
1	Shot Blasting Machine	7.5	2.75

There is a potential of up to 5 -10% saving in annual power consumption by converting Lightly Loaded Motors in Permanent Star Mode. Following graph depicts the relation between % loading of motors and its operating efficiency.



Motors normally operated in delta mode, so lightly loaded motors can be operated in star mode. Effect on motor performance operating in star mode;

- Reduction in voltage related losses
- Operates with improved PF
- Reduction in copper losses

- Motor efficiency improves
- With Conversion of Lightly Loaded Motors in Permanent Star Mode savings will be:

Annual operating hours	= 8000 hrs/year
Saving potential	= 5%
Monitory saving	= 2.75 x 8000 x 6 x 5% = **Rs 0.06 Lakh**
Investment	**= Nil**

- **Summary**

The annual saving achieved by the plant is **Rs. 0.06 Lakh**. This saving is achieved by converting Lightly Loaded Motors in Permanent Star Mode.

CHAPTER – 5

LIST OF SUPPLIER ENERGY EFFICIENT SYSTEM & TECHNOLOGY

Supplier of Heat Exchangers & Waste Heat Recovery System	
Mr. Saurabh **Forbes Marshall Pvt Ltd** PB#29,Mumbai-Pune Road Kasarwadi, Pune 411 034 Tel : (020)-27145595/39858555 Fax : (020)-27147413,9922440254 corpcomm@forbesmarshall.com	**Forbes Marshall Pvt Ltd** D-109 & 110, 1st Floor Okhla Indl. Area Phase - 1 New Delhi – 110 020. Mobile: 09910481600 Tel: 91 (0) 11 26814540, 41, 42 Ext. 204 Fax : 91 (0) 11 42831522 delhiseg@forbesmarshall.com
Forbes Marshall Pvt Ltd 403, Crescent Towers Opp. Enadu, Seethammadhara Visakhapatnam - 530 013 Tel : 0891-2552538 Fax : 0891-2535576 vizag@forbesmarshall.com	**Forbes Marshall Pvt Ltd** Rishi Tower, Premises No. 02/315, New Town, Kolkata, West Bengal - 700 156 Behind Tata Medical Centre and opposite Unitech Building Gate No. 2, Tel : 033- 3026 1254 Fax : 033- 3026 1260 kolkata@forbesmarshall.com
Thermax Ltd 9 Community Centre, Basant Lok New Delhi-110057 Tel : +011-46087200 Fax : +011-26148662	**Thermax Ltd** Thermax House,14 Mumbai-Pune Road Wakdewadi, Pune 411 003 Tel: 91-20-66051200/25542122 Fax: 91-20-25542242
Mr. B G Kulkarni **Transparent Energy Systems Pvt Ltd** Pushpa Heights,1st Floor, Bibwewadi Corner, Pune - 411 037 Tel no : 020-24211347, 24212390 Fax : 91-20-2421253	Mr. Y D Chawan Director **Opel Energy Systems Pvt Ltd** Office- Shop No. 12, Anantnagar,Pune-43 Tel-020-24377646, 9822002047 email-ydc@vsnl.net/ ydck90@yahoo.co.in web site- www.opelenergysystems.com
Alfa Laval (India) Limited Head Office Country, Manufacturing Unit, Mumbai-Pune Road, Dapodi, Pune 411 012 Phone: + 91 202 710 71 00 Fax: + 91 202 714 77 11 E-mail: india.info@alfalaval.com Web page: www.alfalaval.com	**Alfa Laval (India) Limited** Sales Office No 793, 12th Main, First Cros, HAL, 2nd Stage Indira Nagar, Bangalore, Karnataka 560 008 India Phone: +91 80 3051 42 00 Fax: +91 80 3051 42 42 E-mail: india.info@alfalaval.com Web page: www.alfalaval.co.in
Alfa Laval (India) Limited Sales Office 704-705, Ansal Bhavan, 16 Kasturba Gandhi Marg 110 001 New Delhi India	**Alfa Laval (India) Limited** Sales Office House No. 510, Sector 8-B Chandigarh 160 018 India

Phone: +91 11 412 933 00 Fax: +91 11 412 933 43 E-mail: india.info@alfalaval.com Web page: www.alfalaval.co.in	Phone: +91 172 254 44 27 Fax: +91 172 25 44 687 E-mail: india.info@alfalaval.com Web page: www.alfalaval.co.in
Esgee Metal Craft 10 Dr. Rajendra Prasad Sarani, 5th Floor, Kolkata - 700 001 Phone : 033-2262 1878 Fax : 033-2242 5582	**Transparent Energy Systems Pvt Ltd** 1st Floor Pushpa Heights, Bibwewadi Corner Pune - 411037 Tel. : +91-020-24211347/24215665/24212390 Fax : +91-020-24212533 Email : trans@pn2.vsnl.net.in projectsales@tespl.com
Mr. Sharad Amin Director **Energy Machine** No. 444, G. I. D. C., Phase IV, Vithal Udhyognagar Anand, Gujarat - 388 121, India Telephone: +(91)-(2692)-232662/ 236210/ 2323309	
Supplier of Air Compressors	
Mr. S. N. Bansal **Kirloskar Pneumatic Co Ltd** Hadapsar Industrial Estate, Pune 411 031 Tel. : 020-26870133, 26727000, 09910204195 Fax : 020-26870297, 26870634	**Atlas Copco (India) Ltd** 8th floor, Shyamala Tower, Saligramam, 600093. Sh 113, Chennai, Tamil Nadu 044 39156000
Mr. Abhijit Laulkar **Atlas Copco India Ltd** 401-406,Vishwa Sadan, 9 Janak Puri, New Delhi, 110058 Tel :011 30949090, 9373338298 Fax: 0124 3027945	Vinay Jain Business Manager - Portable Energy Atlas Copco Compressor Sales A division of **Atlas Copco (India) Limited** Seva Nagar, Dapodi, Pune 411 012 +91 20 3985 2315 +91 93125 04774 / 99101 59191 vinay.jain@in.atlascopco.com
Kaeser Compressors (India) Pvt Ltd Plot No. 1&2, Survey No. 297, 298 & 299; Indo-German Technology Park, Village Urawade Mulshi, Pune - 412 108 Tel:020 20291210/1211 Fax:020 22922344 Cell No: 098900 44624	Mr. Gurvinder Singh **Hallmark Compressor (P) Ltd** 1805, GIDC, Phase-3, Opp. Sunrise Packing, GIDC, Vatva, Ahmedabad - 382445 Tel : 079-25895118 / 25834445 Fax: 079- 25832627 Cell No: 09327066521 / 09974565612

Ingersoll-Rand (India) Ltd Plot No 35, KIADB Industrial Area, Bidadi, Bengaluru - 562109 Tel: +91 80 22166001 No.8, 2nd Floor, Whites Road, Royapettah, Chennai - 600 014 Tel: +91 44 28523362, 28520900	**Ingersoll-Rand (India) Ltd** Office Unit No.31, 3rd Floor (2nd level) Kalpataru Square, Kondivita Lane Andheri East, Mumbai – 400059 Tel: +91 22 61540500, 21-30, GIDC Estate, Naroda, Ahmedabad 382330, Tel: +91 79 22820323, 22820123
Mr. Jitender Kaul **Ingersoll-Rand (India) Ltd** 310, Ansal Tower, 38 Nehru Place New Delhi – 110019 Tel : 011–40511300 Cell No: 09810826439	**Ingersoll-Rand (India) Ltd** 402-403, Plot No. 5 Baani Corporate One Jasola District Center New Delhi -110025 Tel: +91 11 43206400, 45251200
Chicago Pneumatic India Ltd Unitech Cyber Park, Tower –C, Ground Floor, Netaji Subhash Marg, Sector 39, Gurgaon 122002 Tel: 0124-3027961 Fax: 0124 -3027973 Cell No: 09312406866	
Supplier of Eco-Ventilators	
Mr. Ashok Gupta **Anchit Ispat Pvt Ltd** B- 352, Nehru Ground, Faridabad – 121001, Tel : 0129-2421625/ 2416118/ 4032114 Telefax : 0129-2416118 Cell : 09810027706	Mr. Rahul B. Nair **Blaze Engineers** TF-27, Sitaram Commercial Complex, Nr. Chhani G.E.B, Chhani Road, Vadodara - 391740, Tel: 0265-6506841/2760958 Fax: 0265-2760958, Cell: 09227130206
Vibrant Engineering 301, Palace Plaza Palace Road Nr. Kashivishvanath Temple Vadodara - 390 001 Fax: 0265-2424782, Cell: 098240 - 73959	Mr. John Kutty (CEO) **Classic Fibreglass Industries** 902/2, GIDC Estate, Opp. Vasu Healthcare Pvt. Ltd., Makarpura, Vadodara - 390010 Tel:0265-3932044/2971441 Fax:0265-3932044 Cell:09428819744
Airier Natura Pvt Ltd No. 2 & 3, 4th Main, Airier Complex, Balaji Layout, Bangalore-560094 Tel: +91 80 23417353 / 23417753 / 23410784 Fax: +91 80 23417353 Mobile: +91 9945275853 E-mail: info@airier.com / marketing@airier.com	Mr. Dilip B Rathod Sai Corporations 11-12, Yakshshree Complex, Chhani Jakat Naka, Near Keyya Motors Vadodara Gujarat +91-0265-3014125 saicorporations@gmail.com http://www.saicorpo.com Mr. Avinash Y. Kulkarni (Proprietor)

	Ved Energy Systems Unit No. 102, Anupreet, 145, Bhusari Colony, Kothrud, Pune - 411038, Maharashtra, India +919822115376
Supplier of Insulation & Refractory	
Ace Refractories Ltd Flat No. 207, 2nd Floor New Delhi House 27, Barakhamba Road New Delhi – 110001 Tel: 011- 41571131/32 Fax: 011-23312682	Mr. Yogesh Pandey **Lloyd Insulation Ltd** Punj House M-13, Connaught Place, New Delhi-110001 Tel: 011-30882900-30882906 Fax:011 - 30882894,30882895
Sharadaa Ceramics Pvt. Ltd 387, SIDCO Industrial Estate, Ambattur, Chennai-600098 Tel.: 044-26254365, 366, 26358941 Fax: 044 26253271	Mr. Nilakantha Brahmachari **Tata Refractories Limited** PO: Belpahar, Dist- Jharsuguda Tel: 06645 251097 Fax: 06645 25024 Cell: 9238047062 Email : nilkanth@tataref.com
Haryana Ceramic & Allied Products Ind Devi Nagar, G.T. Road (Behind Baba Deep Singh Gurudwara) Ambala City Phone No. : +91-171-2890832 / 2890740	**Furmats India** 405, Pratap Chambers, Gurudwara Road, Karol Bagh, New Delhi-110 005 (INDIA) Telephone : +91 11 4154 7700 Fax : +91 11 4154 8800 Email : info@furmats.com furmatsmarketing@furmats.com
Mr. Apurva Jain **Alwar Refractories Ltd** A-13, M.i.a , Alwar Rajasthan India Tel:+91-144-2881907 / 2881170 Fax:+91-144-2881907 arplalwar@yahoo.com http://www.alwarrefractories.com	Mr. Alok Khemka P.O. Khatakura, Via - Kamakhyanagar, Dist. **Dhenkanal, Orissa, India** Tel: +91-6769-270588 Fax: +91-6769-270866 Email: khemkarefractories@hotmail.com

Global Refractory Service Mr. S. K. Hasan Ali 14/38, N.S.K Nagar, 2nd Street, Arumbakkam Chennai, Tamil Nadu 600106 Tel: +91-89399-34786 Email: global_refra@yahoo.in http://www.globalrefractoryservice.com	**Sonali International** Mr. K. Chakrabarti 246 Shyambabu's Ghat, Chinsurah, Hooghly West Bengal 712101 Tel : +91-33-26801232 / 65195912 Fax: +91-33-26801232 Email: kalyan_agni@yahoo.com
Supplier for Gas Burners	
Laxmi Narayan Burners Plot No. D-194, Uma Udhyog Nagar, M.G.Road No.4, Udhna Ughyog Nagar, Udhna, Surat - 394210 +91-261-6590305, 92288 55679 Mr. Dharmesh Mewada 092279-52991 sales@laxminarayanburners.com	**Unitech Combustion** Mr. Nilay Hansora (Manager) Plot No. 133, Pushpak Industrial Estate, Phase- 1, G. I. D. C., Vatva, Ahmedabad, Gujarat - 382 445, India nilay_031@yahoo.com 9825391251
Weishaupt **Rajni International** 405-406, Shapath-II Sarkhej-Gandhinagar Road Bodakdev, Ahmedabad 380 015 Opp. Rajput Club India Phone: +91 79 2687160-5 Fax: +91 79 2687160-9 abirla@rajniglobal.com www.rajnigroup.com	**Pratham Engineering Systems** Mr. Anant Joshi A - 20, Swapna Sagar, S. No. 10/3 - D, Benkar Vasti, Near Kailas Jeevan Factory, Dhayri - Narhe Road, Dhayri, Pune, Maharashtra - 411 041, India Email : prathamengg2000@yahoo.co.in, info@prathamengg.com, sales@prathamengg.com Telephone : +(91)-(20)-24690632 Mobile : +(91)-9822312780/ 9922412780 Fax : +(91)-(20)-24690632
Advance Heating Systems 207, Vandaman Complex 8, Facilty Center, Mayapuri Phase-II, New Delhi 110064, India. Phone No. : +91-011-28112315 / 32914872 Email Address : advanceheat@yahoo.com	**Saz Boilers** Address : Pl. No-44, Swami Vivekanand Industrial Estate, Sasane, Nagar, Hadapsar, Pune, Maharashtra-411028 India Phone No : 91-20-26970840 Mobile No: 9822036995 Fax : 91-20-26970420 E-mail : saz@sazboilers.com
Supplier for Natural Gas	
Gail India Ltd Bharat Scouts and Guides Building, Ground Floor, 16, Mahatama Gandhi Marg, I.P.Estate New Delhi – 110002 91-011-43542542 (EPABX), Extn : 509, 91-011-43542595 / 65397242 zgmnzm@gail.co.in	**Indraprastha Gas Limited** IGL Bhawan Plot No. 4, Community Centre, Sector 9, R K Puram, New Delhi - 110022 Phone : 91-11-46074607 Fax : 91-11-26171860/26171863/26171921 Website : www.iglonline.net

Reliance Industries Limited Makers Chambers - IV, Nariman Point, Mumbai 400 021 91-22-2278 5000	**Oil and Natural Gas Corporation Ltd.(ONGC)** Jeewan Bharti Tower II, 124 Indira Chowk New Delhi 110001 Tel : 01123310156
Oil India Limited Plot No. 19, Near Film City, Sector 16A, Noida - 201301 Phone: 0120 - 2488333 to 2488347 (EPABX) Fax: 0120 - 2488310 E-mail: oilindia@oilindia.in	**Oil India Limited** Duliajan - 786 602, Assam Fax: +91 - 0374 - 2800433 Public Relations Dept.: +91-0374-2800427 Materials Dept. (Purchase Section): +91-0374-2800491 Head, Contracts: +91-0374-2800548 Head, Personnel: +91-0374-2800543 Head, IT: +91-0374-2800411 E-mail: oilindia@oilindia.in
Oil India Limited D. No. 11-4-7 Nookalamma Temple Street Ramarao Pet Kakinada - 533004, Andhra Pradesh Phone: 0884 - 2302176 Fax: 0884 - 2352383 E-mail: oilkgbproject@gmail.com	**Adani Energy Ltd** 8th Floor, Heritage Building, Nr. Gujarat Vidhyapith, B/h Visnagar Nagrik Bank, Usmanpura, Ahmedabad – 380013
Adani Energy Ltd Plot no. 434, Sector 21 C Faridabad, Haryana-121002	**Adani Energy Ltd** Plot No. A- 1/ 11, Sector B Aliganj Main Road Lucknow – 226024 (UP)

ENERGY AUDIT BY

- **CII - AVANTHA CENTRE FOR COMPETITIVENESS FOR SMES CONFEDERATION OF INDIAN INDUSTRY (CII)**

- **How CII can help us in reducing our energy consumption?**

CII – AVANTHA Centre for Competitiveness can help you in reducing your plant / building energy consumption. The centre carries detailed energy audit of plants and building catering to all sectors. The output of the detailed energy audit is realized in terms of identification of specific equipment/ process base energy saving projects. The plant management can implement the projects based on the report and reduce the energy consumption. The centre also provides training on energy management and audit to the plant technical team. The training is a mixture of basic principles, technical details and case studies related to energy conservation.

- **If I want to go for detailed Energy audit, what is the procedure?**

The following points explain the procedure for carrying out Energy Audit:

- ✓ An energy audit questionnaire is sent to the company after the receipt of the enquiry.
- ✓ Visit to company for preliminary energy survey (subjected to energy consumption pattern as per the questionnaire)
- ✓ Submission of a Techno commercial offer, containing the tangible and non tangible benefits that a company can achieve after the detailed Energy audit
- ✓ Visit for Company for detailed energy audit. (The detailed energy audit is carried out after the agreement on all terms and condition from both sides) The detailed energy audit is carried by a team of experts, certified by BEE with latest state of the art instruments.
- ✓ A report containing specific energy saving projects with cost benefits analysis is submitted to the plant.

- **Please Contact for Further Information;**

CII – AVANTHA Centre for Competitiveness for SMEs
Confederation of Indian Industry
Sector 31-A, Chandigarh 160 030
Tel: 0172-5022522, 5080781, 5080784 (D), Fax: 0172-2606259, 2614974
Email: sanjay.namdeo@cii.in
Website: www.ciicfc.org

REFERENCES

Detailed Energy Audit reports of CII

Internet

Data & Statistics

Association of Indian Forging Industry - www.indianforging.org
Bureau of Energy Efficiency - www.beeindia.in
Petroleum Conservation & Research Association - www.pcra.org
Investors Manual for Energy Efficiency prepared by CII

Institutions

World Bank – www.worldbank.org
CII – Green Business Centre – www.greenbusinesscentre.com
The Energy & Resources Institute – www.teriin.org
USAID – www.usaid.gov

Visit to Companies

Sadhu Forging Ltd, Faridabad
Eastman Cast & Forge Ltd, Ludhiana
Surindera Cycles, Ludhiana

For more information please contact

Bureau of Energy Efficiency (BEE)
Ministry of Power, Government of India
4th Floor, Sewa Bhawan
R K Puram, New Delhi – 110066
T: +91-11-26179699
F: +91-11-26178352
Website: www.beeindia.net
bee-wbpmu@beenet.in
vaggarwal@beenet.in

CII – AVANTHA Centre for Competitiveness for SMEs
Confederation of Indian Industry
Sector – 31-A, Chandigarh 160030, India
T: +91-172-5022522, 2607228, 2605868
F: +91-172-2606259, 2614974
sanjay.namdeo@cii.in
www.ciicfc.org
www.cii.in