DETAILED PROJECT REPORT
ON
ENERGY EFFICIENT MOTORS
(BANGALORE MACHINE TOOL CLUSTER)











ENERGY IS LIFE
BEE
CONSERVE IT

Bureau of Energy Efficiency

Prepared By

PCRA

sAsIndiA

Reviewed By

ISTSL

ENERGY EFFICIENT MOTORS 7.5 kW CAPACITY

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

Detailed Project Report on Installation of Energy Efficient Motors

Bangalore Machine Tool cluster, Karnataka (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.:

For more information

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan
R. K. Puram, New Delhi – 110066

Telephone +91-11-26179699
Fax +91-11-26178352
Websites: www.bee-india.nic.in
Email: jsood@beenet.in/pktiwari@beenet.in

Acknowledgement

We are sincerely thankful to the Bureau of Energy Efficiency, Ministry of Power, for giving us the opportunity to implement the ‘BEE SME project in Bangalore Machine Tool cluster’. We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

Shri Dr. Ajay Mathur, Director General

Smt Abha Shukla, Secretary

Shri Jitendra Sood, Energy Economist

Shri Pawan Kumar Tiwari, Advisor, SME

Shri Rajeev Yadav, Project Economist, BEE

Petroleum Conservation Research Association is also thankful to “Karnataka Small Scale Industries Association, Bangalore, Peenya Industrial Association, Bangalore and Bangalore Machine Tool manufacturers Association, Bangalore” for their valuable inputs, co-operation, support and identification of the units for energy use and technology audit studies and facilitating the implementation of BEE SME program in Bangalore Machine tools cluster.

We take this opportunity to express our appreciation for the excellent support provided by Machine Tool Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the cluster manual.

PCRA is also thankful to all the SME owners, plant in charges and all workers of the SME units for their support during the energy use and technology audit studies and in implementation of the project objectives.

Petroleum Conservation Research Association

Bangalore

Contents

List of Annexure

List of Tables

List of Figures

List of Abbreviations

BEE	Bureau of Energy Efficiency
CNC	Computer Numerical Controlled
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EA	Energy Audit
EE	Energy Efficiency
INR	Indian National Rupee
IRR	Internal Rate Of Return
kWh	kilo Watt Hour
NPV	Net Present Values
O&M	Operational & Maintenance
MSME	Micro Small and Medium Enterprises
PAT	Profit After Tax
PBT	Profit Before Tax
ROI	Return on Investment
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Bureau of Energy Efficiency (BEE) appointed Petroleum Conservation Research Association as the executing agency for Machine Tools of Bangalore under BEE's SME programme. Under this project, the executing agency carried out studies in the Machine Tools of Bangalore. Out of a total of 100 machine tools units, study was conducted in 30 units. Preliminary audits were undertaken in all the 30 units whereas detailed energy audits were conducted in 10 of these units.

Bangalore has evolved as one of the most important production centers in the Machine tool sector despite there being nothing favorable for proliferation of a cluster. The place lacks all possible resources, from raw materials to fuels and to skilled man power newer technologies as well which is the most important for processing of Machine tools. Today there are 100 units in Bangalore alone and the production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum.

Energy forms a major chunk of the processing cost with over 30% weight age in the cost basket. As per the preliminary and detailed energy audit findings, there exists potential of saving over 30% electricity and 50% fuel in the applications in power process industries with over all general payback period of less than six year. The payback period in these industries is higher due to their working schedule and lower utilization of facilities.

Based on the energy audits, the executing agency submitted their report to BEE in form of a cluster manual with recommendations for energy conservation & savings potentials in the Machine Tools sector. The one of the recommendation made in the cluster manual is listed below:

In a machine tools unit, the electricity cost is about 5% of total cost and the rest of it is the cost of raw material (metals) that would be drawn. However, the electricity cost is still about ` 10.36 lakh. Any technology that saves even 10% could provide substantial incentives to the units. Motors are used in a variety of applications in the machine tools industry, of which the primary one is to turn the spindles where tools of various sizes are curved up. The typical motors used at present in the machine tools unit units are normal motors. Their ratings vary from 0.55 kW to 30 kW.

This bankable DPR also found eligible for subsidy scheme of MoMSME for "Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises" under "National Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S. No	Particular	Unit	Value
1	Project cost	` (in lakh)	0.22
2	Electricity saving	kWh	2702.16
3	Monetary benefit	` (in lakh)	0.14
4	Simple payback period	Year	1.61
5	NPV	` (in lakh)	0.27
6	IRR	%age	43.36
7	ROI	%age	27.03
8	DSCR	ratio	2.53
9	CO_2 reduction	Tonne/Annum	1.8
10	Procurement and implementation schedule	week	5

The projected profitability and financial indicators shows that the project will be able to earn profit from inception and project is financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Gujarat Dairy Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion

1 INTRODUCTION

1.1 Brief about the SME cluster

About SME cluster

The Machine Tools Cluster of Bangalore is located in the Bangalore district. Bangalore, also known as Bengaluru is the capital of the Indian state of Karnataka, located on the Deccan Plateau in the south-eastern part of Karnataka. Bangalore was inducted in the list of Global cities and ranked as a "Beta World City" alongside Geneva, Copenhagen, Boston, Cairo, Riyadh, Berlin, to name a few, in the studies performed by the Globalization and World Cities Study Group and Network in 2008. These machine units have been classified into following clusters within the district:

- Abbegere
- Bommasandra
- Peenya

Bangalore is the "HUB" for machine tools in India. The cluster accounts for 60% of the value of production of machine tools in the country. Bangalore is predominantly a metal cutting cluster. The structure of machine tool industry in Bangalore has at its apex 6 large machine tool manufacturers, about 100 small and medium machine tool manufacturers, their suppliers and vendors in large numbers.

Product Manufactured

In SME cluster of Machine Tools at Bangalore, there are varieties of products manufactured that include spindles, centre grinding machines, ID grinding machines, Self centering Steady Rests, Bar feeding attachments, Rotary tables, Index tables, Special purpose machines, Co-ordinate Measuring machines, aerospace fixtures, CNC Machine enclosures, Sound proofs, armature rewinding machines etc. There are supporting industries like heat treatment are also located in the cluster. These products/ machines are usually utilized in automobile industry, aerospace industry, CNC Machine industry across the globe. These are products custom made to suit the requirements of ISRO, HAL, BEML, MICO, BHEL, Kirloskar Electric, Bayforge Ltd etc.

Production Process

Typically, process for machine tool units in Bangalore is not the same for all industries involving various activities, as the end products of the industry are different for each industrial unit. Therefore, there is some variation in the flow of activities depending on the customized requirement of the products. However, these activities could be grouped together as shown below, though not in the same order as mentioned.

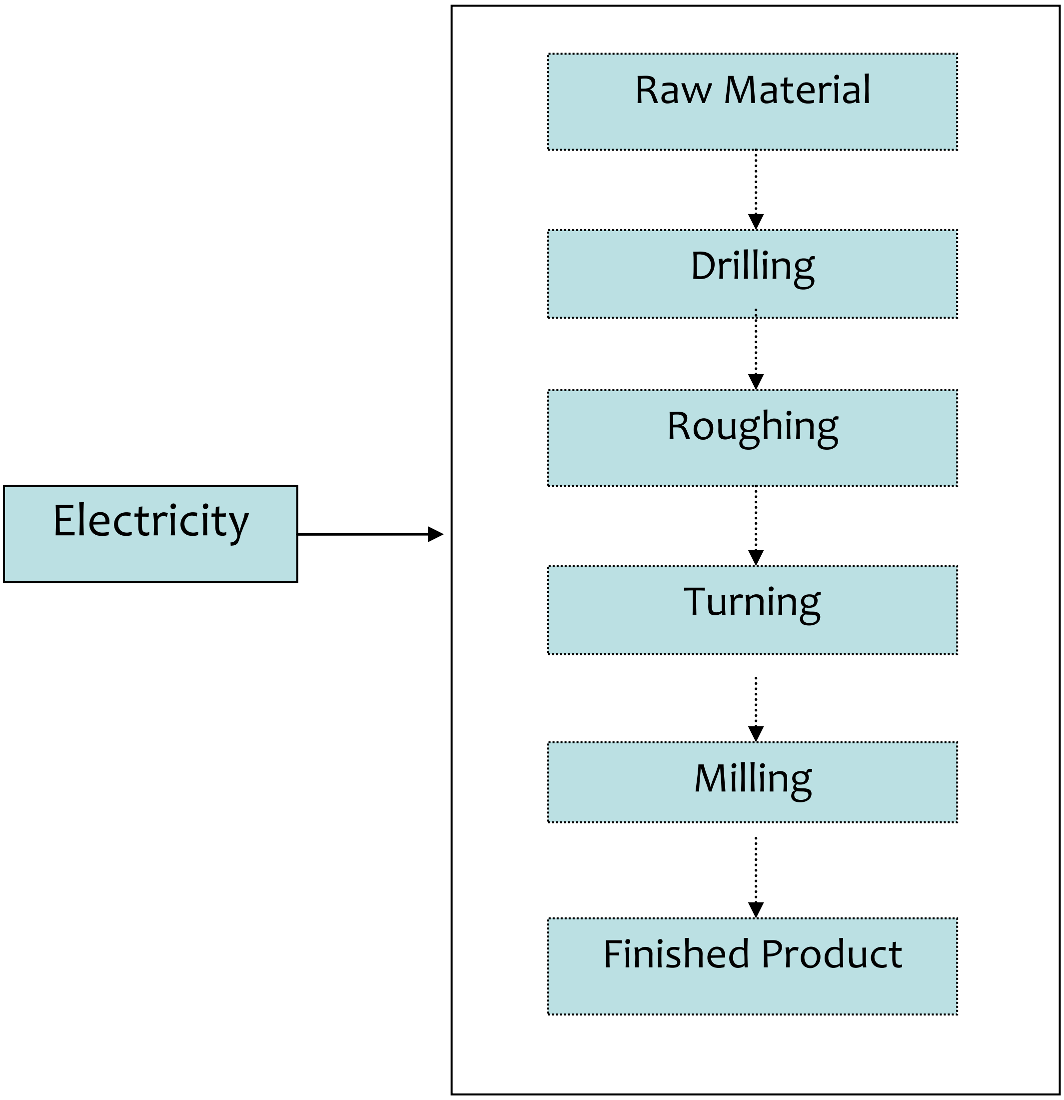
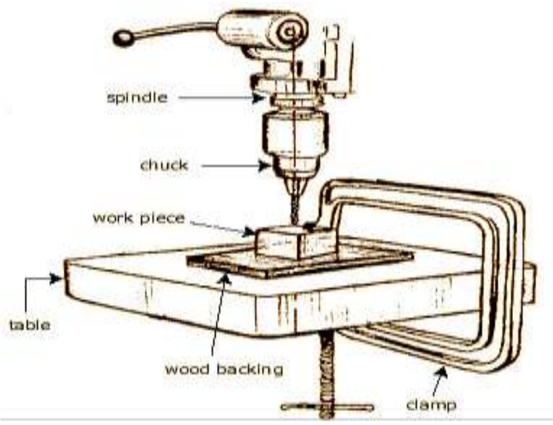
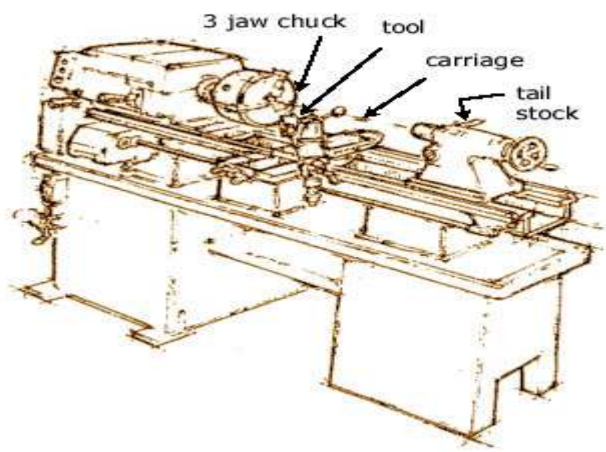


Figure 1.1 Process flow chart of typical Machine Tools Unit

Drilling Process



Drilling is the most common machining process whereby the operation involves making round holes in metallic and nonmetallic materials. Approximately 75% of all metal- cutting process is of the drilling operation. Drills usually have a high length to diameter ratio that is capable of producing deep hole, however due to its flexibility, necessary precaution need to be taken to maintain accuracy and prevent drill from breaking.



Drilled holes can be either through holes or blind holes. A through holes is made when a drill exits the opposite side of the work; in blind hole the drill does not exit the workpiece.

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

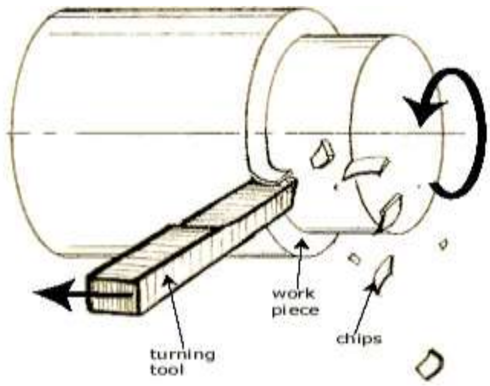
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

For fluted drill bits, any chips are removed via the flutes. Chips may be long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long gummy chips reducing machinability.

When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

Turning Process

Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or lathe, work piece, fixture, and cutting tool. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and allowed to rotate at high speeds. The cutter is typically a single-point cutting tool that is also secured in the machine, although some operations make use of multi-point



tools. The cutting tool feeds into the rotating work piece and cuts away material in the form of small chips to create the desired shape. Turning is used to produce rotational, typically axi-symmetric, parts that have many features, such as holes, grooves, threads, tapers, various diameter steps, and even contoured surfaces. Parts that are fabricated completely through turning often include components that are used in limited quantities, perhaps for prototypes, such as custom designed shafts and fasteners. Turning is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Due to the high tolerances and surface finishes that turning can offer, it is ideal for adding precision rotational features to a part whose basic shape has already been formed.

Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated lathe which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC, and is commonly used with many other types of machine tool besides the lathe.

When turning, a piece of material (wood, metal, plastic, or stone) is rotated and a cutting tool is traversed along 2 axes of motion to produce precise diameters and depths. Turning can be either on the outside of the cylinder or on the inside (also known as boring) to produce tubular components to various geometries. Although now quite rare, early lathes could even be used to produce complex geometric figures, even the platonic solids; although until the advent of CNC it had become unusual to use one for this purpose for the last three quarters of the twentieth century. It is said that the lathe is the only machine tool that can reproduce itself.

The turning processes are typically carried out on a lathe, considered to be the oldest machine tools, and can be of four different types such as straight turning, taper turning, profiling or external grooving. Those types of turning processes can produce various shapes of materials such as straight, conical, curved, or grooved work piece. In general, turning uses simple single-point cutting tools. Each group of work piece materials has an optimum set of tools angles, which have been developed through the years.

The bits of waste metal from turning operations are known as chips (North America), or swarf (Britain). In some areas they may be known as turnings.

Turning specific operations include:

- ***Hard turning***

Hard turning is a turning done on materials with a Rockwell C hardness greater than 45. It is typically performed after the work piece is heat treated.

The process is intended to replace or limit traditional grinding operations. Hard turning, when applied for purely stock removal purposes, competes favourably with rough grinding. However, when it is applied for finishing where form and dimension are critical, grinding is superior. Grinding produces higher dimensional accuracy of roundness and cylindricity. In addition, polished surface finishes of Rz=0.3-0.8z cannot be achieved with hard turning alone. Hard turning is appropriate for parts requiring roundness accuracy of 0.5-12 microns, and/or surface roughness of Rz 0.8–7.0 microns. It is used for gears, injection pump components, hydraulic components, among other applications.

- ***Facing***

It is part of the turning process. It involves moving the cutting tool at right angles to the axis of rotation of the rotating workpiece. This can be performed by the operation of the cross-slide, if one is fitted, as distinct from the longitudinal feed (turning). It is frequently the first operation performed in the production of the work piece, and often the last- hence the phrase "ending up".

- ***Parting***

This process is used to create deep grooves which will remove a completed or part-complete component from its parent stock.

- ***Grooving***

Grooving is like parting, except that grooves are cut to a specific depth by a form tool instead of severing a completed/part-complete component from the stock. Grooving can be performed on internal and external surfaces, as well as on the face of the part (face grooving or trepanning).

Non-specific operations include:

- ***Boring***

Machining of internal cylindrical forms (generating) a) by mounting work piece to the spindle via a chuck or faceplate b) by mounting work piece onto the cross slide and placing cutting tool into the chuck. This work is suitable for castings that are to awkward to mount in the face plate. On long bed lathes large work piece can be bolted to a fixture on the bed and a shaft passed between two lugs on the work piece and these lugs can be bored out to size. A limited application, but one that is available to the skilled turner/machinist. In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole.

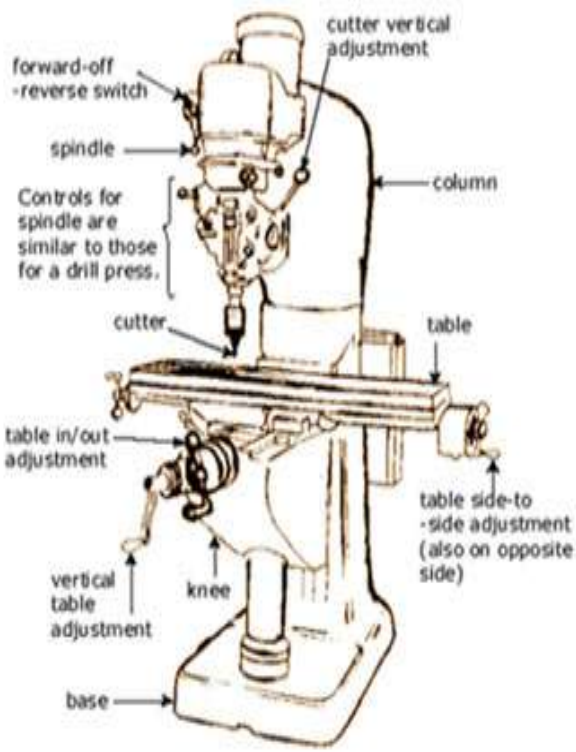
There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Lineboring (line boring, line-boring) implies the former. Backboring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

- ***Knurling***

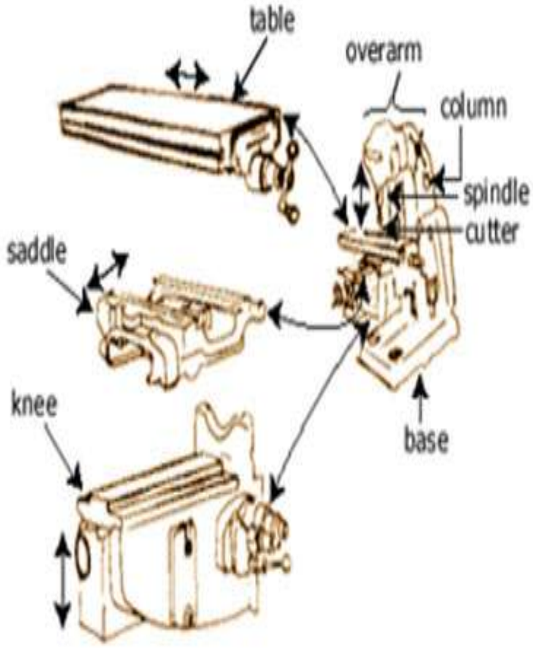
The cutting of a serrated pattern onto the surface of a part to use as a hand grip using a special purpose knurling tool.Threading both standard and non-standard screw threads can be turned on a lathe using an appropriate cutting tool. (Usually having a 60, or 55° nose angle) Either externally, or within a bore. [Generally referred to as single-point threading. tapping of threaded nuts and holes a) using hand taps and tailstock centre b) using a tapping device with a slipping clutch to reduce risk of breakage of the tap threading operations include a) all types of external and internal thread forms using a single point tool also taper threads, double start threads, multi start threads, worms as used in worm wheel reduction boxes, lead screw with single or multi start threads. b) by the use of threading boxes fitted with 4 form tools, up to 2" diameter threads but it is possible to find larger boxes than this.

Milling Process

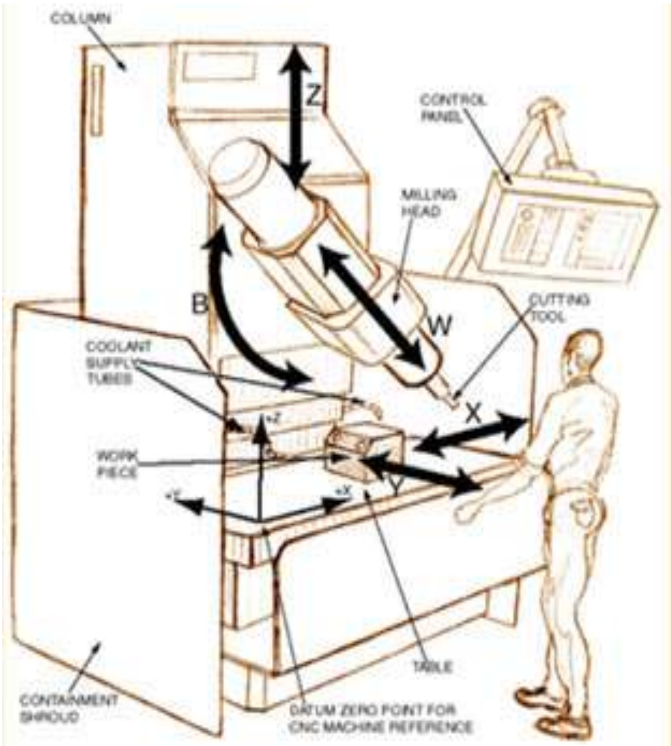
Milling is the most common form of machining, a material removal process, which can create a variety of features on a part by cutting away the unwanted material. The milling process requires a milling machine, work piece, fixture, and cutter. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to a platform inside the milling machine. The cutter is a cutting tool with sharp teeth, which is also secured in the milling machine and rotates at high speeds. By feeding the workpiece into the rotating cutter, material is cut away from this work piece in the form of small chips to create the desired shape.



Milling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three-dimensional surface contours. Parts that are fabricated completely through milling often include components that are used in limited quantities, perhaps for prototypes, such as custom designed fasteners or brackets. Another application of milling is the fabrication of tooling for other processes. For example, three-dimensional molds are typically milled. Milling is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Due to the high tolerances and surface finishes that milling can offer, it is ideal for adding precision features to a part whose basic shape has already been formed.



Milling is as fundamental as drilling among powered metal cutting processes. Milling is versatile for a basic machining process, but because the milling set up has so many degrees of freedom, milling is usually less accurate than turning or grinding unless especially rigid fixturing is implemented. For manual machining, milling is essential to fabricate any object that is not axially symmetric. Below is illustrated the process at the cutting area. A typical column-and-knee type manual mill is shown. Such manual mills are common in job shops that specialize in parts that are low volume and quickly fabricated. Such job shops are often termed 'model shops' because of the prototyping nature of the work.



The parts of the manual mill are separated below. The knee moves up and down the column on guide ways in the column. The table can move in x and y on the knee and the milling head can move up and down.

CNC Machines: Computer Numerical Control (CNC) Milling is the most common form of CNC. CNC machines are traditionally programmed using a set of commands known as G-codes. G-codes represent specific CNC functions in alphanumeric format.

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption

The machine tool industries in this cluster use electricity from grid to meet their electrical energy requirement. Some of the industrial units having the backup power generator (Diesel Based) to meet the demand in case of grip power supply failure or scheduled power cut from the grid. The main and primary energy for machine tool industries is the electricity for operation of production and utility services. In manufacturing of some category of products, heat treatment process required to achieve the desired material properties. In heat treatment units of the clusters, which are very few in numbers (only 14 %) are using electricity as the main source of energy even in the process of heat treatment, which is usually outsourced. The percentage segregation of used energy in the cluster is given in figure 1.2, which reveals that the 95.9% of energy used in the cluster is drawn from the Bangalore Electricity Supply Company Limited (BESCOM) grid whereas only 4.1% of total energy required is being generated by thermal energy (High Speed Diesel) using DG sets.

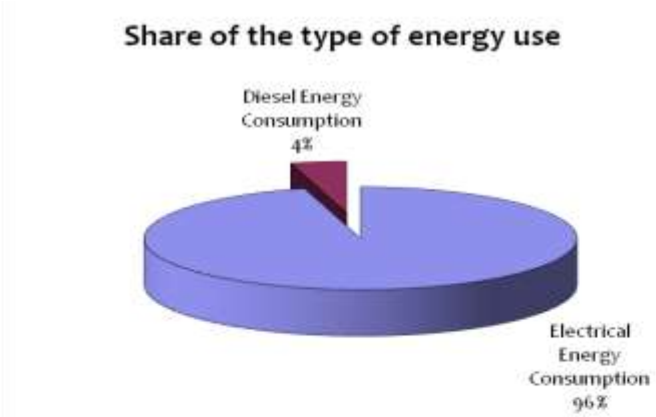


Figure 1.2: Share of Energy Type used in the Machine Tool Units

1.2.2 Average production

Production capacity of machine tool units in Bangalore cluster depends on the type of product being produced in unit. Production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum. The following figure shows the classification of machine tool units in Bangalore cluster based on production capacity. The production capacity as the weight of the metal removed in case of components, accessories and SPM making industries. In case of Heat treatment, weight of the material treated has been considered as the production capacity. The above methodology is adopted as major energy is spent towards removing the metal, as per the specifications of the product, while carrying out jobs such as milling, turning, grinding and drilling. In case of heat treatment units, major energy is spent in the heat treatment furnaces. Hence, the weight of material processed is taken as production capacity.

1.2.3 Specific energy consumption

The specific energy consumption depends on the final product being manufactured by the machine tool units; therefore SEC has been classified according to the types of products produced in the cluster. Details of the SEC depending on the type of products is shown in the following table

Table 1.1 Energy Consumption Pattern of Machine Tools Cluster

Type of units	Specific Energy Consumption, GJ/Tonne	Specific Energy Consumption, kWh/Tonne
Components	24.8	6472
Accessories	19.7	5118
Machines	2.2	600
Heat Treatment	64.2	15057
Average	27.7	6811.8

1.3 Identification of technology/equipment

In a machine tools unit, the electricity cost is about 5% of total cost and the rest of it is the cost of raw material (metals) that would be drawn. However, the electricity cost is still about ` 10.36 lakh. Any technology that saves even 10% could provide substantial incentives to the units. Motors are used in a variety of applications in the machine tools industry, of which the primary one is to turn the spindles where tools of various sizes are curved up. The typical motors used at present in the machine tools unit units are normal motors. Their ratings vary from 0.55 kW to 30 kW.

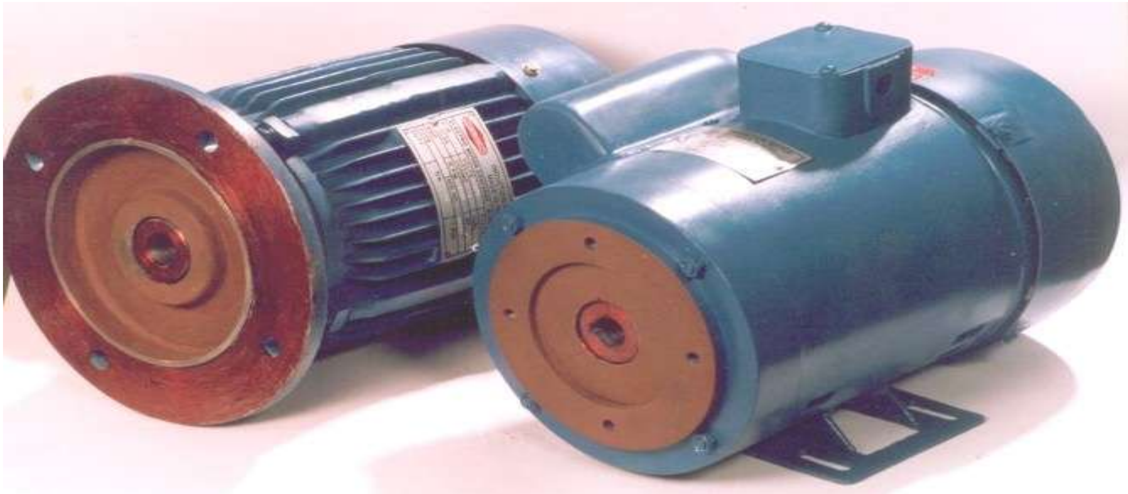
Existing Motors specifications for the cluster are shown in Table 1.2 below.

Table 1.2 Typical specifications of present motors

S. No.	Parameters	Detail
1	Manufacturer	SIMENS, KIRLOSKAR and also many from local fabricators
2	Capacity	0.55 kW to 30 kW
3	Efficiency	64% to 90%
4	Operation	Continuous
5	Motor type	Induction motor
6	Voltage ratings	415 V +/- 10 V, 3 Phase, 50 Hz +/- 5%.
7	Ambient temperature	max 50 Deg C
8	Number of poles	4
9	Speed	1500 rpm

1.3.1 Description of technology/equipment

An electric motor converts electrical energy into mechanical energy. Most electric motors operate through interacting magnetic fields and current-carrying conductors to generate force, although a few use electrostatic forces. The reverse process, producing electrical energy from mechanical energy, is done by generators such as an alternator or a dynamo. Many types of electric motors can be run as generators, and vice versa. For example a starter/generator for a gas turbine, or traction motors used on vehicles, often perform both tasks. Electric motors and generators are commonly referred to as electric machines. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current (e.g., a battery powered portable device or motor vehicle), or by alternating current from a central electrical distribution grid. The smallest motors may be found in electric wristwatches. Medium-size motors of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of ships, pipeline compressors, and water pumps



with ratings in the millions of watts. Electric motors may be classified by the source of electric power, by their internal construction, by their application, or by the type of motion they give.

The physical principle of production of mechanical force by the interactions of an electric current and a magnetic field was known as early as 1821. Electric motors of increasing efficiency were constructed throughout the 19th century, but commercial exploitation of electric motors on a large scale required efficient electrical generators and electrical distribution networks.

1.3.2 Role in process

Electric motors and generators are commonly referred to as electric machines. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current (e.g., a battery powered portable device or motor vehicle), or by alternating current from a central electrical distribution grid. The smallest motors may be found in electric wristwatches. Medium-size motors of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of ships, pipeline compressors, and water pumps with ratings in the millions of watts. Electric motors may be classified by the source of electric power, by their internal construction, by their application, or by the type of motion they give.

1.4 Benchmarking for existing specific energy consumption

The baseline data has been established based in the energy audits conducted in a total number of 30 machine units out of which 20 were preliminary audits and 10 were detailed audits. The total production cost estimated based on the various technologies dependent cost of production of these units. The typical motors used at present in the galvanizing and wire drawing units are normal motors. Their ratings vary from 0.55 kW to 30 kW. The subject of the present DPR is however is for 7.5 kW energy efficient (EEF1) motors. Considering a 9.3 kW standard motor to be replaced by 7.5 kW energy efficient (EEF1) motor for present analysis, here are the specifications for it.

Table 1.3 Present motor specifications

S. No.	Parameter	Detail
1	Manufacturer	SIMENS
2	Capacity	9.3 kW
3	Motor Efficiency	80%
4	Operation	Continuous
5	Motor type	Induction
6	Voltage rating	415 V +/- 10 V, 3 Phase, 50 Hz +/- 5%.
7	Ambient temperature	max 50 Deg C
8	Number of poles	4
9	Speed	1440rpm

Maximum efficiency of the 9.3 kW standard motor is 87.5% (IS 12615). The reduction is due to poor loading and poor quality rewinding as given in Annexure-1. Electricity consumption in the motors depend on the following parameters

- Condition of the motor including bearings
- Number of times it has been rewound
- Quality of the components present.

Electricity requirement in the wire-drawing plant depends on the production. Detail of electricity consumption in a typical unit is given in Table 1.4 below:

Table 1.4 Energy Consumption Pattern of Machine Tools Cluster

S. No.	*Energy Type*	*Unit*	*Value*
1	Electricity	kWh/year	24906

1.4.1 Design and operating parameters /specification

In present scenario of the machine tools industries, machine cannot afford to breakdown, frequent change of the job settings and dependency on manpower since the investment cost of the machine is high. Each downtime is a lost for the investor.

List of Motors	Rated	Measured		% Loading	Operating Hrs	Estimated Annual Consumption in kWh	Estimated Annual Expenditure in `
Motor Name	kW	PF	kW				
Case - 1	9.3	0.29	5.85	51%	12	24570	122850
Case - 2	9.3	0.278	6.01	52%	12	25242	126210
Average	9.3	0.284	5.93	51%	12	24906	124530

From economic point of view, in order to produce part at effective cost is by producing at high volume. Machine components become expensive which requires new type of maintenance to cater this problem. The Motors generally operated for 12 hours a day, with 350 days of operation.

1.4.2 Operating efficiency analysis

To determine the Energy use and technical study, individual units were identified within different locations of the Bangalore Machine Tools clusters in Bangalore district. It is integral to target different units in the clusters as it accounts for deviations in type of prudcts, job properties, sourcing of raw materials, and variations in manufacturing and housekeeping operations. The overall step by step methodology followed for Energy use and technical study is as below:

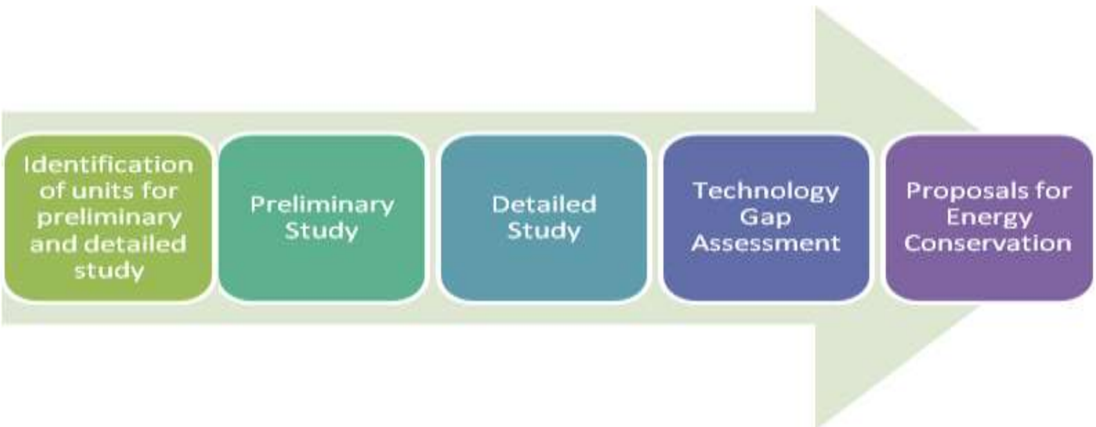


Figure 1.3 Energy auditing methodology

Preliminary energy study

The preliminary study is the first stage in conducting an energy and technology assessment of the machine tools manufacturing units in the cluster. The aim of the preliminary study is collecting information relating to production, machinery and energy use to get an overview of energy sources, raw materials, processes involved, etc of the units within the cluster. Preliminary energy studies were conducted at 30 machine tools manufacturing units in the Bangalore cluster and the time taken for each study was 1 – 2 days.

Detailed energy study

Detailed energy studies are conducted to get an in depth break up of energy usage of each of the associated processes in the machine tools manufacturing. It covers the quintessential steps in preliminary study and provides a thorough analysis of the functioning of units. Since electricity is the main source of energy used, there are some guidelines which need to be maintained while analyzing and measuring the electricity consumption pattern of the individual unit.

1.4.3 Specific fuel and electricity consumption

The main and basic energy used in the manufacturing process of machine tools is electricity in this unit. The liquid fuel (HSD) energy is mainly using to operate the diesel power generators during the power cut/non-availability of the electrical power from state electricity board.

1.5 Barriers for adoption of proposed technology/equipments

1.5.1 Technological Barrier

Technology obsolescence in the machine tool business is extremely rapid. Product lifecycles are declining and currently average life cycle is no more than 3 years! Thus, in a globalized India, SMEs have been and will continue to face challenges they have not seen before. In the past, most of the products have been a result of 'Reverse Engineering'. Unlike the Japanese and Koreans, the Indian manufacturers have not graduated to the next level of 'Improving' the technology of reverse engineered products. Thus, product technology obsolescence is a major issue facing the Bangalore machine tools industry today.

There is a definitive void in development and existing facilities for Research and Development in this sector. Institutes in the past have been integral in facilitating technology transfers and improvement in the machine tools manufacturing cluster all over India, However there is need for continuous Research and Development associated processes.

1.5.2 Financial Barrier

The restricted availability and the inability to raise resources are common to all types of small businesses. However, the machine tools sector, by its very nature, is a high financial outlay driven business. Average product costs are greater, gestation period of investments – longer, time to market – higher and a purchasing system – not yet fully matured. All this means greater, than most other businesses, financial resource requirement. This, in turn, puts the machine tool SMEs in a particular disadvantage.

1.5.3 Manpower Skill

Machine downtime ranged from 1 percent to as high as 20 percent in some cases. Labour efficiency ranged between 60 percent to 95 percent. Lower labour efficiency and labour utilization has manifested in lower employee productivity. Labour utilization has been lower as compared to other sectors because of surplus labour since only 26 percent of the companies have undergone downsizing and lack of awareness of productivity methodologies. Only 65 percent of the companies used CNC or NC machines because most of the smaller players get almost 95 percent of their products outsourced and they only do assembling. In fact, as high as 17 percent of the companies get 100 percent of the manufacturing activities subcontracted. However, on an average 75 percent of the companies subcontracted some amount of their manufacturing. The subcontracting was mainly done due to capacity constraints followed by cost considerations.

1.5.4 Vendor Linkages:

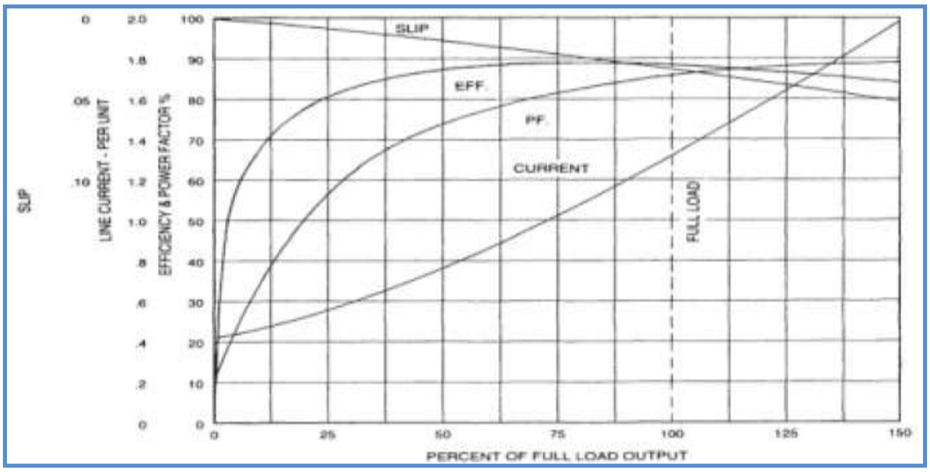
No other business requires such complex level of vendor linkages as the machine tools. For materials, electrical, electronics, hydraulics, pneumatics, metallurgy, tribology, measurement controls – the list of myriad technology linkages is endless. This requires exceptional networking capabilities and plenty of time to be spent by owner of accompany/CEO himself.

2 TECHNOLOGY OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology selected

2.1.1 Description of technology

Energy-efficient motors (EEM) are the ones in which design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulation of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors. Furthermore, energy-efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher inertia loads, and are less affected by supply voltage fluctuations.



2.1.2 Technology specification

The energy efficient motors that need to be used depend upon necessity. Some are of 0.5 kW rating and some as high as 30 kW. Detailed technical specifications of 7.5 kW energy efficient motors are furnished in Table 2.1 below:.

Table 2.1 Equipment Speciation

S. No.	Parameter	Detail
1	Manufacturer	ABG
2	Model	TEFC sq cage
3	Operation	Continuous (S1)

S. No.	Parameter	Detail
4	Capacity	7.5 kW
5	Efficiency	90.1 %
6	Motor type	Induction motor
7	Voltage rating	415 V +/- 10 V, 3 Phase, 50 Hz +/- 5%.
8	Ambient temperature	max 45 Deg C
9	Insulation Class	F class
10	Protection	IP55
11	Number of poles	4
12	Speed	1500 rpm

Further details of EEM's are shown in Annexure-3.

Table 2.2 Energy Consumption Profile

2.1.3 Suitability or integration with existing process

The motors used in the units are at present the conventional ones with present maximum efficiency of about 87.5% (IS 12615). Further, the loading of those motors are also low in general. For that low loading and poor quality rewinding the efficiency become 80.42%. Hence, those have to be downsized to reduce the energy bill in any case. While doing that, buying and installing energy efficient motors would certainly help by making a maximum efficiency of 90.1% available.

The following are the reasons for selection of this technology:

- Maximum efficiency goes up to 90.1%
- It will reduce the total operating energy cost of the plant.
- It reduces the GHG emissions
- This project is also applicable for getting the carbon credit benefits.

2.1.4 Superiority over existing technology

The benefits of Energy efficient motors are manufactured using the same frame as a standard T-frame motor, however these have:

- Higher quality and thinner steel laminations in the stator.
- More copper in the windings.
- Optimized air gap between the rotor and stator.
- Reduced fan loses.
- Closer matching tolerances.
- A greater length

Use of this technology reduces the amount of electricity consumed by the unit. It can amount to savings of the order of ` 13511for the company with paybacks of about 2.1 years. Further, as the cost of electricity is on an upward trend, this is certainly profitable in the long run.

2.1.5 Availability of technology

CNC based technology providers are basically multinational companies providing the services in all the major cities of the country. The technology is widely available and lots of national and multinational manufacturers are suppling their products to these industries including the machine tools industry.

2.1.6 Source of technology

This technology is already in use in some machine tools units in the cluster where the production requirment is ame. They also got the results of reduction in energy consumption as well as reduction in rejection of material and the technology is running successfully.

2.1.7 Service/technology providers

There are about 5 technology providers are available in the cluster for this system including Hind motors, ABG Motors, havlles, is the service provider for this technology. They have the experience in supplying the EE Motors and provided consultancy & implementation support. The detailed contact information of all service providers is provided in annexure - .

2.1.8 Terms and condition of sales

Sales and after implementation of technology support information is provided in the annexure - .

2.1.9 Process down time during implementation

The installation of EE Motor can be done in the 2 days, Thus implementation of this technology will not affect the process.

2.2 Life cycle assessment and risks analysis

In case installation of Energy Efficient Motor, the technology and machine will continue to work up to 15 years under proper maintains. No need to any further huge modification after one time installation, in case of risk analysis there is a need of proper maintains and timely oiling.

2.3 Suitable unit/plant for implementation of proposed technology

Suitable unit for implementation of this technology are machine tools unit having the installed capacity of electrical drives 7.5 – 9.3 kW. The approximate 30 units in the cluster found eligible to adopt this technology.

3 ECONOMIC BENEFITS FROM NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel saving

Since the primary source of energy in a motor is electricity, the suggested technology does not contribute to fuel savings.

3.1.2 Electricity saving

After implementation of project, the unit would consume about 2702.16 kWh/yr of less electricity. As the cost of electricity rises, the monetary savings would only rise.

3.1.3 Improvement in product quality

The quality of the product would still remain the same. It shall have no impact on the way tools are drawn but merely make the process more efficient.

3.1.3 Increase in production

The production will remain the same as in present.

3.1.4 Reduction in raw material consumption

Raw material consumption would also remain same even after the implementation of the proposed technology.

3.1.5 Reduction in other losses

Since in the primary mode, the unused energy is dissipated via heat, which can wear out, say, the bearing of the motor more quickly, while motors that are more efficient would increase the longevity of the device. Further, right sized and more efficient motors would require less cooling and thereby reduces the dependence on the cooling apparatus like fans and chilled fluids. Thus, it has more indirect benefits.

3.2 Monetary benefits

The monetary benefits of the unit are mainly due to reduction in the electricity consumption by 2549 kWh/yr. This amounts to monetary savings of ` 13511 per year. A detailed estimate of the saving has been provided in the table 3.1.

Table 3.1 Energy and monetary benefit

S. No.	Parameter	Unit	Value
1	Capacity of the existing motor	kW	9.3
2	Operational power consumption	kW	5.93
3	Existing efficient of motor	%	80
4	Capacity of proposed technology	kW	7.5
5.	Efficiency of proposed technology	%	90.1
6.	Proposed power consumption with new technology	kW	5.27
7	Reduction in operational power consumption	kW	0.665
8	Proposed rated capacity	kW	7.5

S. No.	Parameter	Unit	Value
9	Number of operating hours (estimated)	Hours	4065
10	Cost of electricity consumption	`/year	5
11	Savings in electricity by using energy efficient motors	kWh/year	2702.16
12	Monetary savings due to electricity savings	`/year	13511
13	Total monetary benefit	` /year	13511

3.3 Social benefits

3.3.1 Improvement in working environment

Reduction in electricity consumption would probably not change the working environment apart from making the management happier.

3.3.2 Improvement in skill

The workers would probably not find too much of a difference in the day to day operation of the device. Hence, their skills are probably going to be unaffected..

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

As the existing and proposed technology are based on the clean fuel based operation. No effluent generation or reduction will effect.

3.4.2 Reduction in GHG emission such as CO2, NOx, etc

The measure helps in reducing CO_2 emission since it demands less electricity off the grid. An estimate suggests that a saving of 2702.16 kWh/year of electricity reduces 2026.62 kg of CO_2 equivalent per year.

3.4.3 Reduction in other emissions like SOx

As the existing and proposed technology is based on the clean fuel based operation therefore Sulphur is not present in electricity; hence there is no impact on SO_X emissions.

4 IMPLEMENTATION OF NEW ENERGY EFFICIENT TECHNOLOGY

4.1 Cost of technology implementation

4.1.1 Cost of technology

The costs of equipments that will be required for Installation of Energy Efficient motors 7.5 kW are provided in Table 4.1 below:

Table 4.1 Cost of equipment

S. No.	Particular	Cost
1	Cost of Energy efficient motors	` 16800

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

S. NO.	Particulars	Cost
1.	Taxes & Duties	` 2621/-
2.	Electrical & Utility Expanses & other Charges	` 2268/-
	Total (` in lakh)	` 0.22/-

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost i.e. ` 0.054 lakh & financial institutes can extend loan of 75%.

4.2.2 Loan amount.

The term loan is 75% of the total project cost i.e. ` 0.163 lakh, with repayment of 5 years considered for the estimation purpose.

4.3 Financial indicators

4.3.1 Cash flow analysis

Detail cash flow analysis for new proposed technology is given in Annexure–5.

4.3.2 Simple payback period

The estimated payback period is about 1.61 years.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 0.27 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 43.36 %. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 27.03 %.

Table 4.4   Financial indicator of proposed technology

Particulars	Unit	Value
Simple Pay Back period	years	1.61
IRR	%age	43.36
NPV	` in lakh	0.27
ROI	%age	27.03
DSCR	ratio	2.53

4.4 Sensitivity analysis

In different situation energy saving may increase or decrease on the basis of this scenarios a sensitivity analysis in realistic, pessimistic and optimistic has been carried out on the basis of two scenarios as considers.

Electricity saving increase by 5%

Electricity saving decrease by 5%

Table 4.5   Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	43.36%	0.27	27.03	2.53
5% increase in electricity saving	46.29%	0.30	27.21	2.66
5% decrease in electricity saving	40.42%	0.24	26.84	2.40

Assuming all provision and resource input would be similar during economic analysis

4.5 Procurement and implementation schedule

Procurement and implementation schedule for proposed project are shown in Table 4.4 below.

Table 4.5   Implementation Schedule

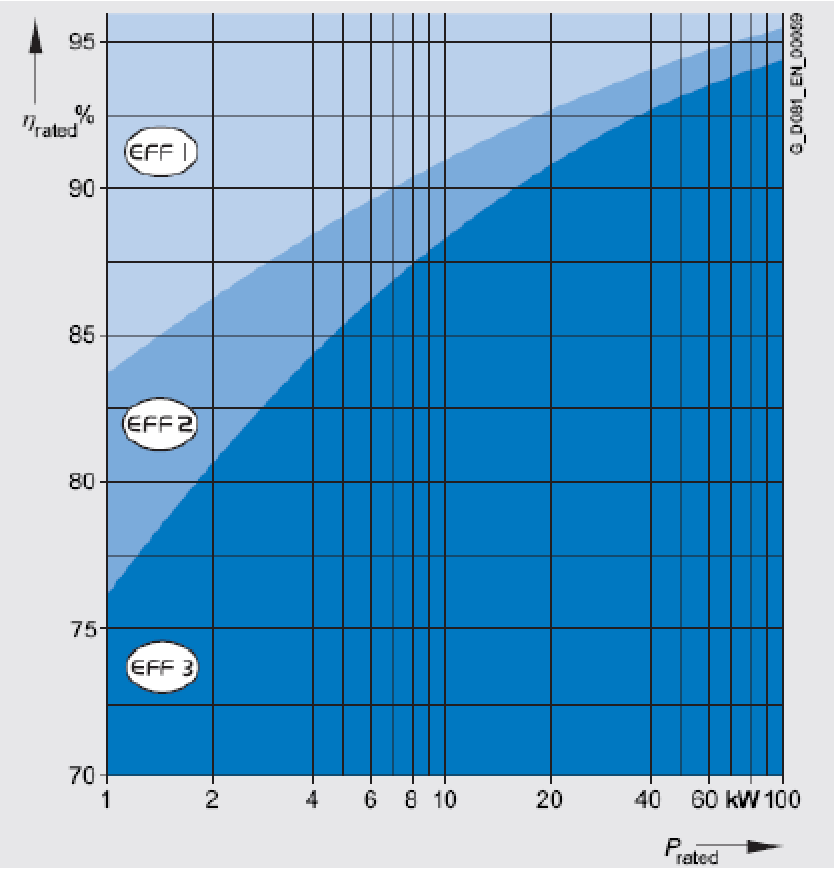
S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Delivery after placing order							
2	Erection & commissioning of EEM motor							
3	Cabling & electrical panel fitting							
4	Trial Operation							
5	Training							

ANNEXURE

Annexure 1: Energy audit reports used for establishing

The results of detail energy audit for machine tools units are given below:

List of Motors	Rated	Measured		% Loading	Operating Hrs	Estimated Annual Consumption in kWh	Estimated Annual Expenditure in `
Motor Name	kW	PF	kW				
Case - 1	9.3	0.29	5.85	51%	12	24570	122850
Case - 2	9.3	0.278	6.01	52%	12	25242	126210
Average	9.3	0.284	5.93	51%	12	24906	124530



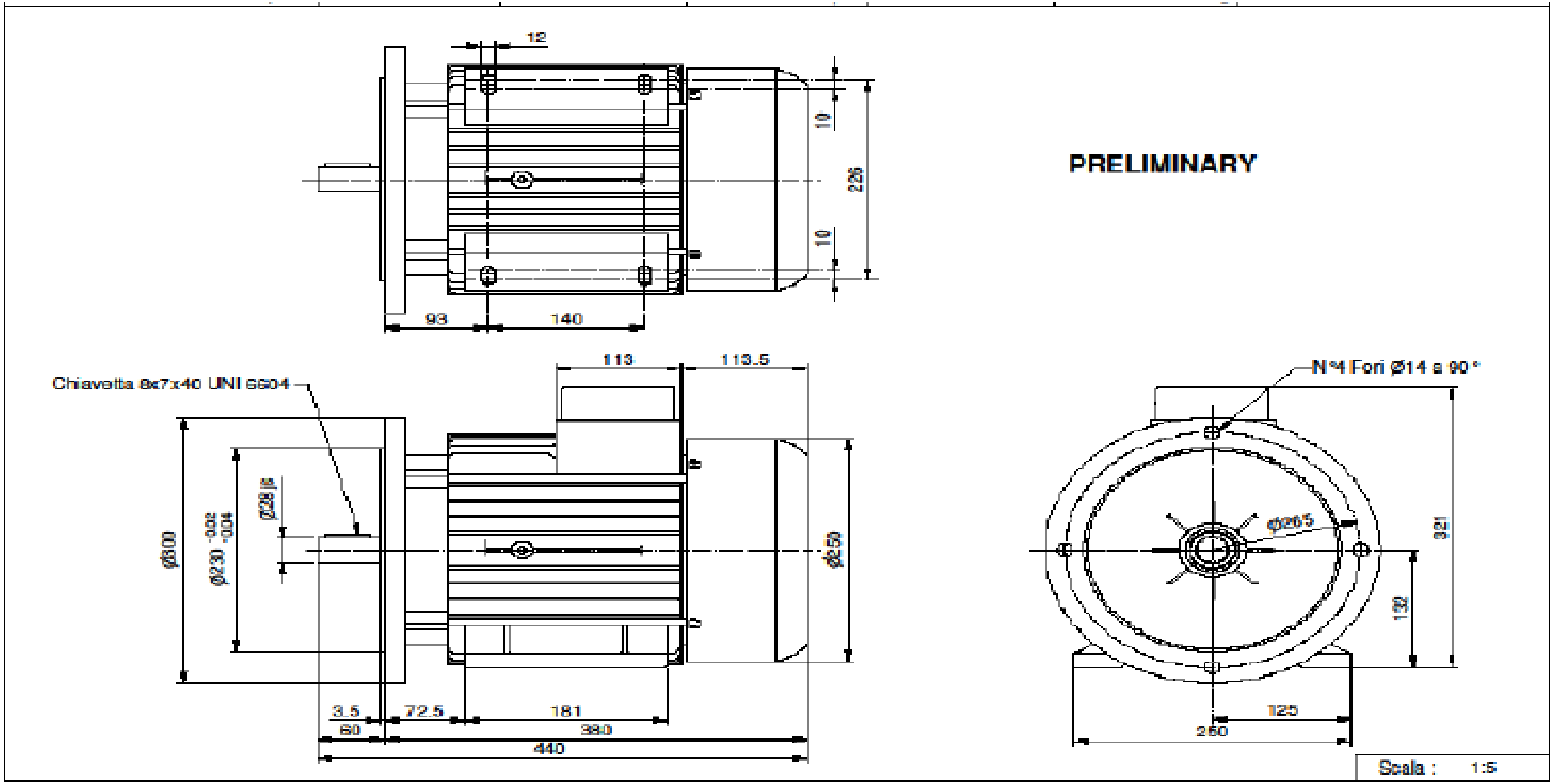
Annexure 2: Process flow diagram

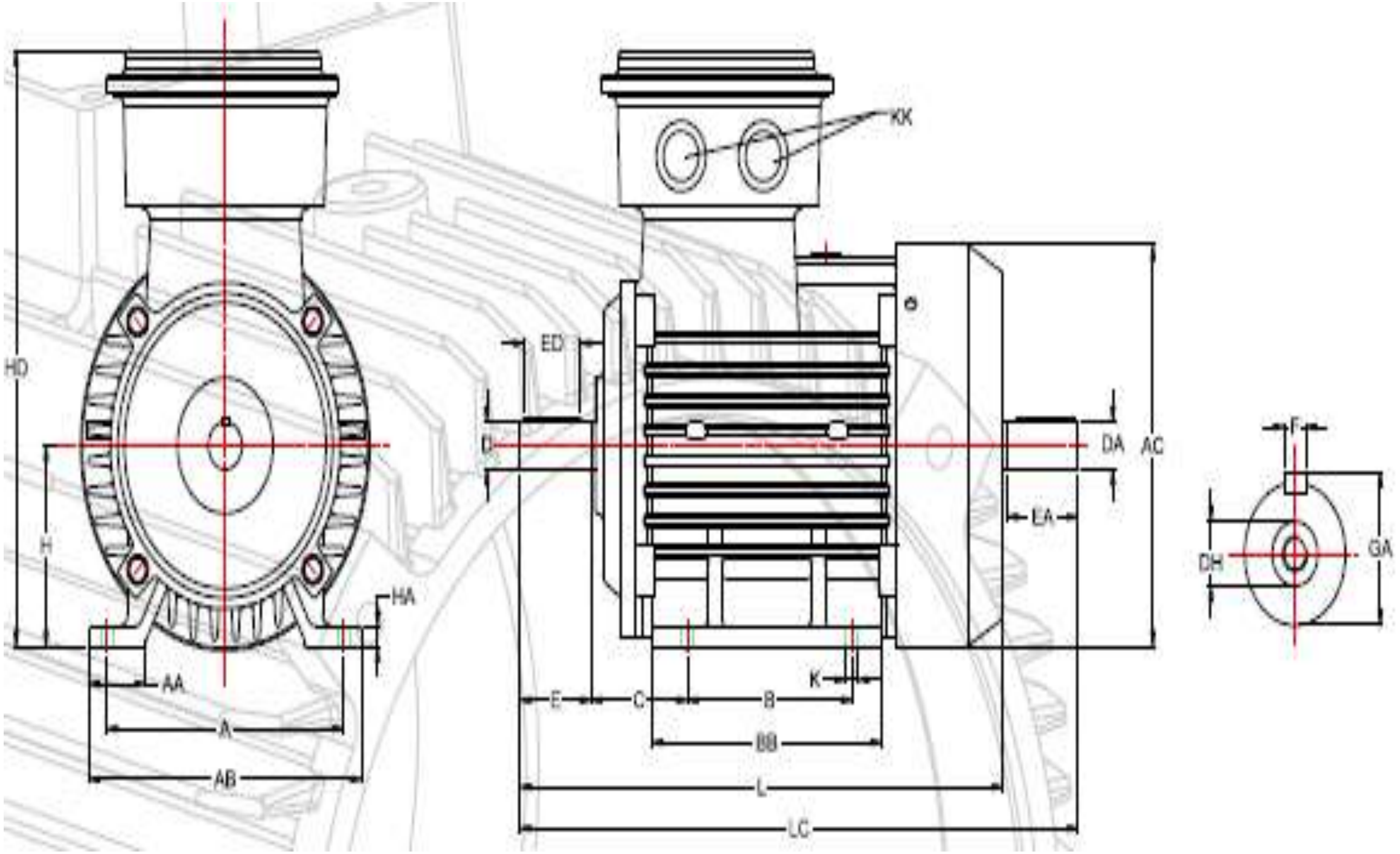
Energy Efficient motor is retrofitted to machining machine process in machine tools manufacturing units. This will not disturb a part of the process or machinery.

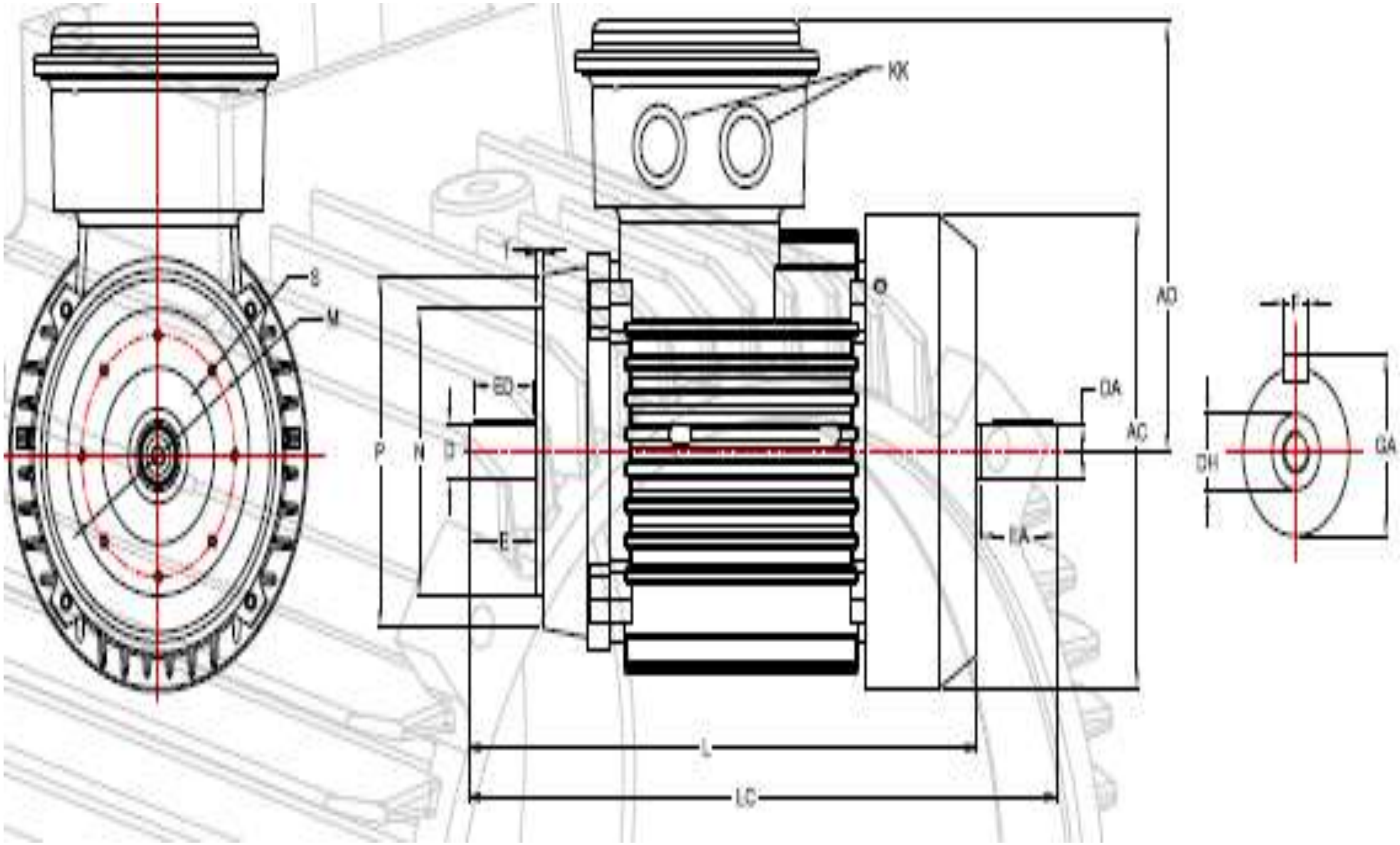
Annexure 3: Detailed Technology Assessment Report

Particulars	Unit	Capacity - 1
Rated Installed Capacity of the Motor	kW	9.3
Present Rated installed Input Motor capacity	kW	11
Measured power consumption	kW	5.93
Present % Load on the motor		51
Estimated efficiency at present operating conditions	%	80
Proposed efficiency of energy efficient motor (eff1) at this load	%	90.1
Proposed input power to energy efficient motor (eff1)	kW	5.27
Reduction in operating power	kW	0.66
Proposed motor size	kW	7.5
Annual operating hours	Hours	4065
Estimated saving potential	kWh/annum	2702.16
Estimated cost saving (@ ` 5/- per kW)	`/annum	13511
Initial Investment	`	21690
Payback Period	Years	1.61

Annexure 4: Technical Drawing of 7.5 kW Induction Motor (EFF-1 Category)




HD
H
AA
A
AB
HA
ED
D
E
C
B
K
BB
L
LC
KK
DA
AC
EA
F
DH
GA


KK
S
M
AD
DA
AC
GA
DH
F
P
N
D
ED
E
EA
L
LC

Annexure 5: Detailed financial calculations & analysis for financial indicators

Assumption

Name of the Technology	***Energy Efficient Motor***		
Rated Capacity			
Details	***Unit***	***Value***	***Basis***
Installed Capacity	kW	7.5	Feasibility Study
Proposed Investment			
Plant & Machinery	`	16800	Feasibility Study
Taxes and duties	`	2621	Feasibility Study
Electrical & Utility expenses	`	2268	Feasibility Study
Total Investment	`	21690	Feasibility Study
Financing pattern			
Own Funds (Equity)	`	5423	Feasibility Study
Loan Funds (Term Loan)	`	16268	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Production Cost Saving (Electricity, Material, Manpower & Utility)	`/Year	2702.16	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan ***(` in lakh)***

Years	***Opening Balance***	***Repayment***	***Closing Balance***	***Interest***
1	0.16	0.01	0.15	0.02
2	0.15	0.02	0.13	0.01
3	0.13	0.02	0.10	0.01
4	0.10	0.04	0.07	0.01
5	0.07	0.04	0.03	0.01
6	0.03	0.03	0.00	0.00
		0.16		

WDV Depreciation

Particulars / years	***1***	***2***
Plant and Machinery		
Cost	0.22	0.04
Depreciation	0.17	0.03
WDV	0.04	0.01

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8
Revenue through Savings								
Total Revenue (A)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Expenses								
O & M Expenses	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Total Expenses (B)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
PBDIT (A)-(B)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Interest	0.02	0.01	0.01	0.01	0.01	0.00	-	-
PBDT	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12
Depreciation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PBT	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.11
Income tax	-	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Profit after tax (PAT)	0.09	0.07	0.06	0.06	0.07	0.07	0.07	0.07

Computation of Tax **`(in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.11
Add: Book depreciation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Less: WDV depreciation	0.17	0.03	-	-	-	-	-	-
Taxable profit	(0.07)	0.08	0.11	0.11	0.12	0.12	0.12	0.12
Income Tax	-	0.03	0.04	0.04	0.04	0.04	0.04	0.04

Projected Balance Sheet **`(in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Reserves & Surplus (E)	0.09	0.17	0.23	0.29	0.36	0.43	0.49	0.56
Term Loans (F)	0.15	0.13	0.10	0.07	0.03	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	0.30	0.35	0.39	0.41	0.44	0.48	0.55	0.62
Assets								
Gross Fixed Assets	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Less: Accm. Depreciation	0.01	0.02	0.03	0.05	0.06	0.07	0.08	0.09
Net Fixed Assets	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.13
Cash & Bank Balance	0.09	0.15	0.20	0.24	0.28	0.34	0.41	0.49
Total Assets	0.30	0.35	0.39	0.41	0.44	0.48	0.55	0.62
Net Worth	0.15	0.22	0.28	0.35	0.41	0.48	0.55	0.62
Dept equity ratio	2.78	2.34	1.89	1.23	0.55	0.05	0.05	0.05

Projected Cash Flow: **`(in lakh)**

Particulars / Years	0	1	2	3	4	5	6	7	8
Sources									
Share Capital	0.05	-	-	-	-	-	-	-	-
Term Loan	0.16								
Profit After tax		0.09	0.07	0.06	0.06	0.07	0.07	0.07	0.07
Depreciation		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total Sources	0.22	0.11	0.08	0.07	0.08	0.08	0.08	0.08	0.08
Application									
Capital Expenditure	0.22								
Repayment of Loan	-	0.01	0.02	0.02	0.04	0.04	0.03	-	-
Total Application	0.22	0.01	0.02	0.02	0.04	0.04	0.03	-	-

Net Surplus	-	0.09	0.06	0.05	0.04	0.04	0.05	0.08	0.08
Add: Opening Balance	-	-	0.09	0.15	0.20	0.24	0.28	0.34	0.41
Closing Balance	-	0.09	0.15	0.20	0.24	0.28	0.34	0.41	0.49

Calculation of Internal Rate of Return ***`(in lakh)***

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		0.09	0.07	0.06	0.06	0.07	0.07	0.07	0.07
Depreciation		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Interest on Term Loan		0.02	0.01	0.01	0.01	0.01	0.00	-	-
Cash outflow	(0.22)	-	-	-	-	-	-	-	-
Net Cash flow	(0.22)	0.12	0.10	0.09	0.08	0.08	0.08	0.08	0.08
IRR	43.36%								
NPV	0.27								

Break Even Point ***` (in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Operation & Maintenance Exp (75%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sub Total (G)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed Expenses								
Operation & Maintenance Exp (25%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Term Loan	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
Depreciation *(H)*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sub Total (I)	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02
Sales (J)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Contribution (K)	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12
Break Even Point (L= G/I) (%)	25.95%	22.34%	20.62%	18.47%	15.80%	12.75%	12.14%	12.35%
Cash Break Even {(I)-(H)} (%)	16.93%	13.29%	11.54%	9.36%	6.65%	3.57%	2.93%	3.08%
Break Even Sales (J)*(L)	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02

Return on Investment ***`(in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.83
Net Worth	0.15	0.22	0.28	0.35	0.41	0.48	0.55	0.62	3.06
ROI 27.03%									

Debt Service Coverage Ratio ***`(in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	0.09	0.07	0.06	0.06	0.07	0.07	0.07	0.07	0.43
Depreciation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
Interest on Term Loan	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.06
Total (M)	0.12	0.10	0.09	0.08	0.08	0.08	0.08	0.08	0.55

Debt

Interest on Term Loan	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.06
Repayment of Term Loan	0.01	0.02	0.02	0.04	0.04	0.03	0.00	0.00	0.16
Total (N)	0.03	0.04	0.04	0.04	0.04	0.03	0.00	0.00	0.22
Average DSCR (M/N)	2.53								

Annexure 6: Details of procurement and implementation plan

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Delivery after placing order							
2	Erection & commissioning of EEM motor							
3	Cabling & electrical panel fitting							
4	Trial Operation							
5	Training							

Annexure 7: Details of technology/equipment and service providers

Name of Organization	***Communication Address***	***Contact No.***
ABG Motors Ltd.	No. 45 Nagarur, Husker Road, Off Tumkur Road Bangalore 562123	Tel.:+91-80-2371 6171-75, 2371 6789 /90
Hind Motors	Hindustan Motor Mfg. Co. 32/A, Vidyavilla Compound, Old Nagardas Road, Andheri (East), Mumbai - 400 069 India	Tel: 42500500 (30 Lines), 28201316, 28360651, 28380080, 28380081 Fax: 28380947 Email Id: Sales@Hindmotors.Com
Havells	QRG Towers, 2D, Sec- 126, Express way, Noida - 201304 UP (India)	Tel: + 91- 120- 4771000 Fax: +91 - 120- 4772000 E-mail: marketing@havells.com **Intl. Busi. Div :** ibd@havells.com

Annexure 8: Quotations or Techno-commercial bids for new technology/equipment

ABG

Mr. A Thangadurai
Manager-PCRA
Chennai
Mob:+91 94426 30838

ABG/ PCRA/ PR
August 8, 2011

Dear Sir,

Your verbal enquiry for Energy Efficient Motors

We thank you for your enquiry for Induction Motors.

Our offer is as follows: -

TEFC sq cage induction motor, suitable for operations on 415V, 50c/s, AC supply.
Class F insulation, IP 55 enclosure as per IS 325. As per IS 12615

kW	HP	Rpm	Const	Frame	Efficiency		Net Unit Price
7.5	10	1500	B3	132M	Eff1	90.1%	Rs 16,800.-
7.5	10	1500	B3	132M	Eff2	87%	Rs. 15,220.-

Prices quoted above are Ex-Our works in Bangalore.

Taxes and Duties shall be charged extra at actuals.

Payment : 50% advance with the order balance against pro-forma Invoice on readiness of the Motors.

Warranty
All equipments offered in this specification shall be guaranteed for operation under normal conditions for a period of 12 months from the date of final acceptance at manufacturer's works or 18 months from the date of arrival at site whichever is earlier. This guarantee covers defective design, materials and workmanship only and shall not be applicable to damages sustained through misuse of the equipment.
ABG Motors will not be responsible / liable for any contingency charges or loss of profit arising on account of ABG Motors agreeing to undertake repair / replacement of equipment / component under warranty.

Validity: This offer is valid for a period of 15 days from the date of offer, subsequent to which we would request you to take our confirmation of the same in writing.

ABG MOTORS LIMITED

Works: No.45, Nagarur, Huskur Road, Off Tumkur Road, Bangalore – 562 123. INDIA Tel.:+91-80-2371 6789/ 6790
Regd. Off: 5th Floor, Bhupati Chambers, 13, Mathew Road, Mumbai – 400 004. INDIA Tel.:+91-22-6656 3000 Fax: +91-22-2369 5257

ABG

Delivery:
Efficiency 1 : 4 weeks
Efficiency 2 : 6 weeks upon receipt of your Purchase Order and advance amount

Please feel to contact us for any further information you may require.

Thanking you and assuring you of our best services at all times
Yours truly,
ABG Motors Limited

Prakash Rao
098458 44663 (M)

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

PCRA, Southern Region
Petroleum Conservation Research Association T.M.B. Mansion, First Floor, 739, Anna Salai,
Chennai – 600002
System & Solution (India)
www.sas.ind.in
ems@sas.ind.in

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri,
New Delhi-110058
Tel: +91-11-28525534,
Fax: +91-11-28525535
Website: www.techsmall.com