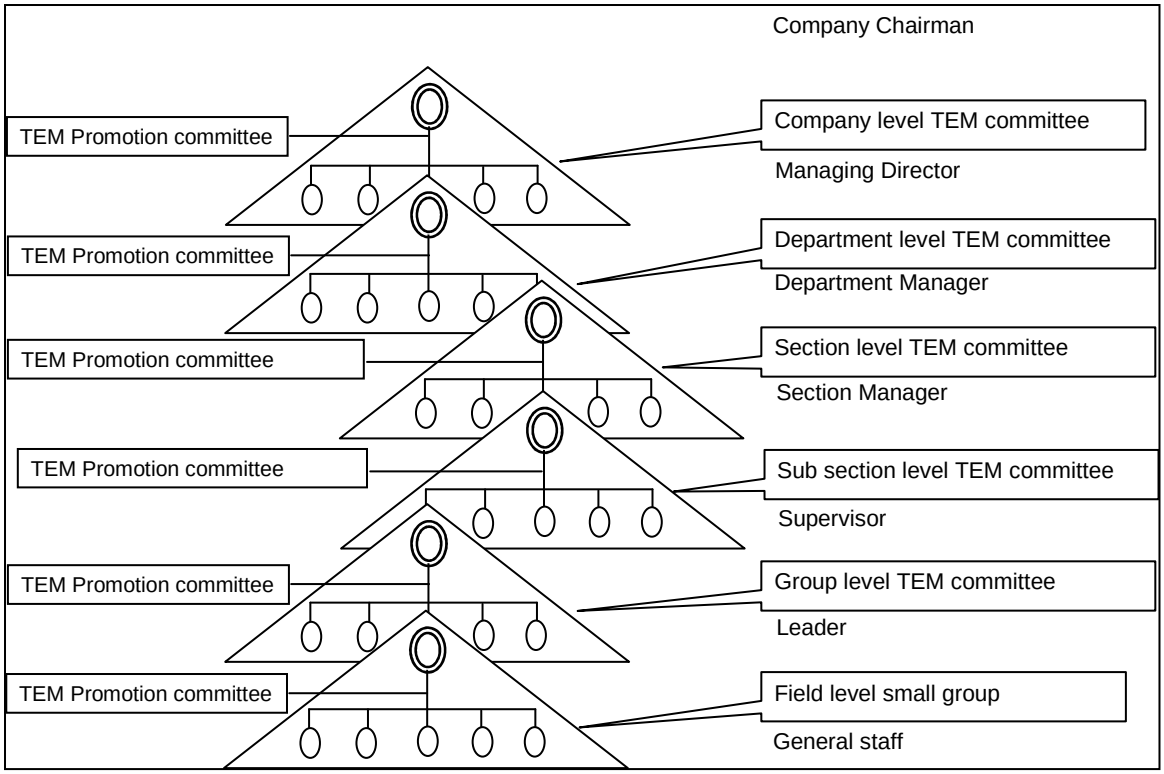


Figure 4.3: Example of Organizational Structure with Overlapping

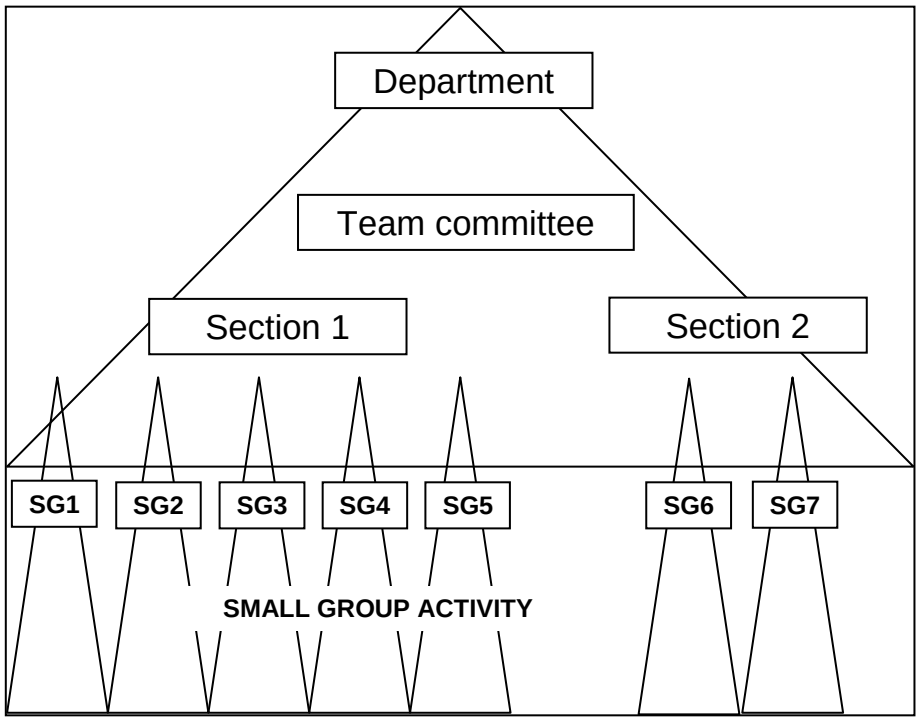


Figure 4.4: Positioning of SGA in Main Job Structure

4.3.2.1 Executives level

➥ Define the policy and target for Total Energy Management

- Follow-up and manage activities to make sure that activities are implemented according to the policy
- Consider opinions and suggestions from the promotion office
- Consider reports from promotion committee from various levels

4.3.2.2 Level of Total Energy Management promotion office

- Make sure that whole activities are done in the correct direction, without delay and smoothly
- Find a suitable method that makes it possible to implement activities continuously and without slowdown
- Listen to opinions and suggestions from small groups in order to use for improving
- Provide advice for Total Energy Management to various groups
- Persons in charge of the office must be those with good personal relationship, friendly, and with spirit of good service

4.3.2.3 Medium level

- Define the policies of each department that are consistent with the policy of the Total Energy Management and the target of the company
- Define numerical targets to sub-groups apart from the target of the company as a whole
- Follow-up the progress in order to provide to sub-groups
- Report the progress along with suggestions and opinions to upper level committee periodically

4.3.3 Workers/Operators level

- Implement small group activities with various themes and achieve target
- Report progress and problems encountered during implementation to upper level committee periodically
- Ask for support, suggestions, and opinions from upper level committee

4.3.4 Responsibility of Energy Conservation committee

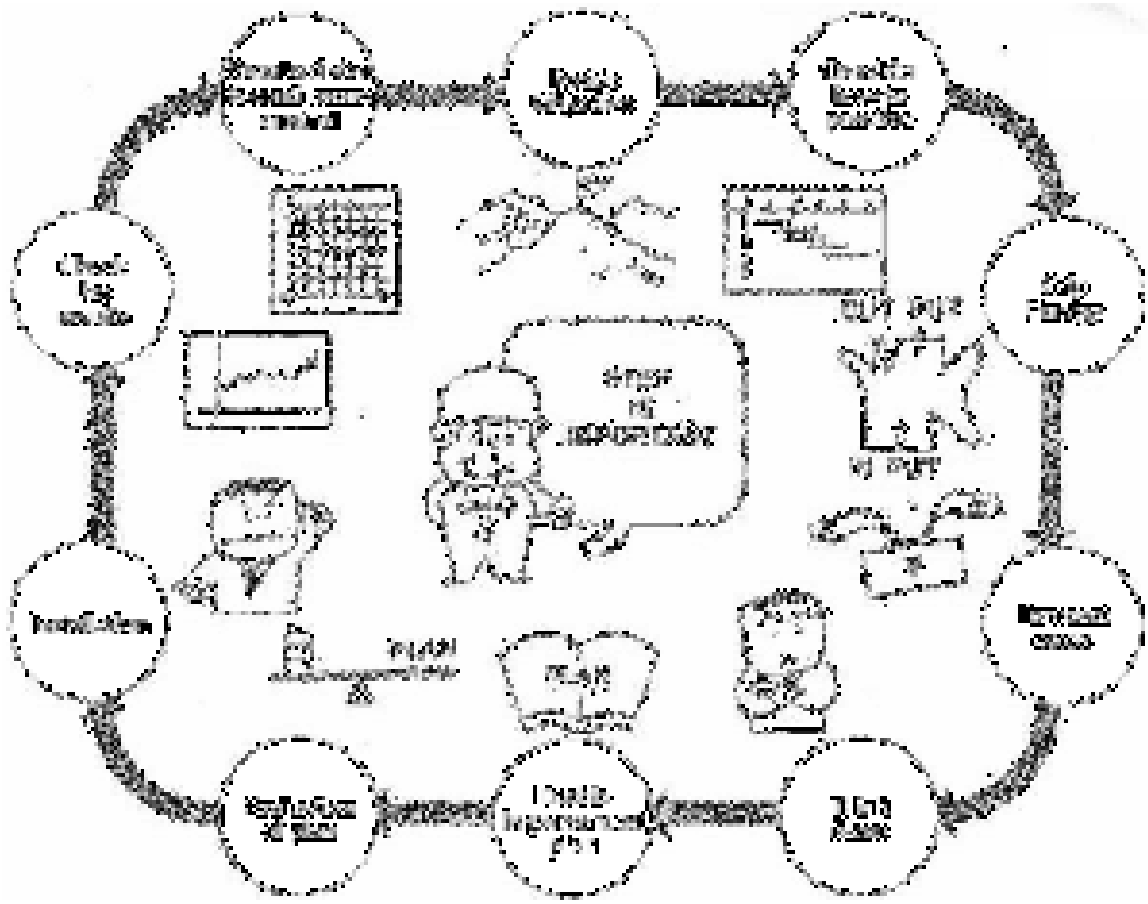
- Gather and analyze information on costs related to energy every month
- Analyze and solve problems related to energy
- Find a method for energy conservation
- Prepare energy conservation plan

- Follow-up the result of implementing the plan
- Perform activities such as public relationship for encouraging employees to participate
- Offer training to small group in each department

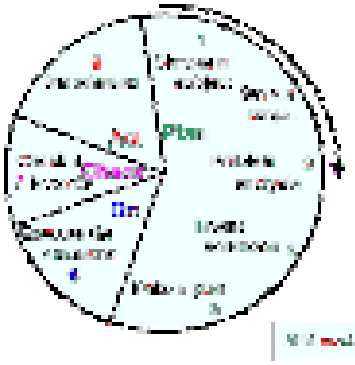
4.4 STEPS OF SMALL GROUP ACTIVITIES FOR ENERGY CONSERVATION

Small group activities for Energy Conservation can be done by using "10 Stages for Success", based on "PDCA Management Cycle", as shown below and in pictorial forms

- Plan: Make an efficient plan in order to improve operation



- Do: Implement according to the plan
- Check: Check if implementation was according to the plan
- Act: Judge what to improve, what to learn and what to do from what we have checked



Please note that these stages are substantially the same as "Key Steps" explained earlier, but put more stress on utilization of SGA. So readers

could read and use either method up to their preference.

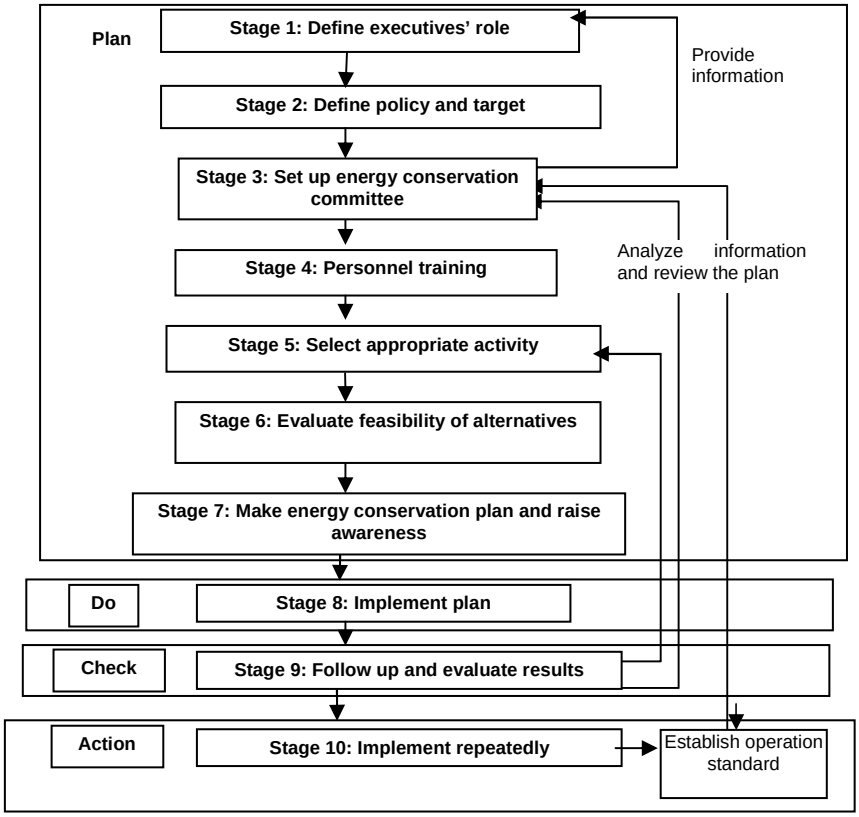


Figure 4.5: 10 Stages for Success

4.4.1 Stage 1: Define Executive's Role

In promoting small group activities, support must be provided such as basic environmental support. Therefore, executives must provide follow up support to employees of their companies.

- Establish a special unit that provides support to small group activities
- Prepare a system for managing small group activities in the company
- Prepare annual plan for small group activities
- Prepare a venue for meeting, consultation, advice or suggestion
- Establish a system for giving rewards to high achieving employees
- Establish a reporting system starting from informing what to do until reporting of the results
- Establish a fair system for evaluating results
- Establish a system for providing support and training to employees

4.4.2 Stage 2: Define Policy and Target

- Executives must announce a policy of supporting small group activities.

- Energy conservation committee must act as an advisor in order to set a numerical target that is consistent with total energy management (TEM) policy and the target of the organization. Specific targets must be set for each group.

We can see that responsibilities in stages 1 and 2 are mainly those of executives and committee. Responsibility of employees will become clearer from stage 3 and afterwards.

4.4.3 Stage 3: Set up Energy Conservation Committee

The principle of small group activities (SGA) is to divide into groups based on the scope of responsibility. The size of the group will depend on the size of organization. However, size of the group should not be too large. Usually a size of 5 to 10 persons is considered appropriate. It is important to define responsibilities clearly so that every member of the group can have their responsibility and participate in the activities.

4.4.4 Stage 4: Personnel Training

This stage will help employees to have more knowledge and understanding, have new ideas, and have more belief in their own responsibility.

4.4.5 Stage 5: Select Appropriate Activity

In doing small group activities, each member must be able to think, express their own ideas, and make decisions based on reality and by investigating electrical equipment, machines, and office equipment that exist in the area of their responsibility. Items to consider include size, number, where to use, situation of usage, current situation, and the number of hours usage per day.
By this we can evaluate the current situation of energy usage. Also by judging if there are more machines than needed, we can choose suitable activities and real problems for the organization.

4.4.6 Stage 6: Evaluate feasibility of alternatives (Analyze problems and decide on the measures and activities in each point)

Each group will gather ideas on the reasons for the problems, obstacles, and how to solve problems in order to decide on the problems, measures, and importance of activities and thus evaluate on the feasibility of activities to do based on advice from department manager. Basically, the following activities are not suitable for small group activities.

- Highly technical issues
- Issues that require a long time or many people to implement

We have identified the following problems through small group activities.

- Issues on material quality or production that influence energy usage
- Behavior on energy usage
- Efficiency of machines or equipment that uses energy

- Awareness toward environment and energy usage
- Safety costs for energy conservation

4.4.7 Stage 7: Make Energy Conservation Plan and Raise Awareness

Each group must prepare its activity plan. Generally, implementation for small group activities takes 6 months to 1 year. Activities to be implemented should correspond to the objectives of each group. Besides, it might help to listen to opinions of all organizations in order to receive support from all other organizations.

4.4.8 Stage 8: Implement Plan

Implement according to the plan of each group.

4.4.9 Stage 9: Follow Up and Evaluate Results

After implementing the plan, each member of small groups will follow up and evaluate the result by analyzing result, search for strong and weak points of activities, find a way to improve the activities and report on general achievement.

4.4.10 Stage 10: Implement Repeatedly

Energy conservation is an activity that must be implemented repeatedly. Therefore, it is necessary to implement each activity repeated and make improvement to each activity. If we are satisfied with the results, by achieving the objectives of activities, we should provide rewards in order to give motivation for continuing the small group activities and implement creative activities.

Dos and Don'ts in Energy Conservation

- Don't Emphasize the mistakes in the past. It is better to talk about the present.
- Don't Be worried about the theory or principles. Don't spend too much time in discussion or analysis of problems in meeting rooms.
- Don't Think that an activity can be done perfectly from the beginning. It is necessary to do the job continuously by having experiences and judging by ourselves.
- Do Start with an activity that requires small amount of investment.
- Do Raise awareness so that all employees understand the necessity and importance of energy conservation and participate in it.
- Do Start the activity now without postponing to tomorrow.
    - Tools that are Used Often for Small Group Activities for Energy Conservation

4.5 5S

5S is a contraction derived from the Japanese words Seiri, Seito, Seiso, Seiketsu, and Shitsuke. It is simple methodology that is also extremely useful in practical and realistic

life. 5S is a set of actions to be followed through every day activities to advance the operational surroundings and circumstances. 5S is made in order to provide fortification to every personage in diverse profitable and industrialized fields. 5S is an extremely practical contrivance and skill set for anyone who wants to generate a more prolific environment within the workplace or who wants to make it their profession to make other people's businesses more proficient and productive. 5S occupy a list of products including eyewear, ear protectors and safety gears. Look into these different products that make up the significance of an industrialized security supply. Lean Six Sigma experts promise or guarantee for the efficiency of 5S as an enlightening enhancement to better working surroundings in an association. If you dig up Six Sigma guidance that is paid for by your company, you will be in a position to work for your company and make things better for you as well as for everyone. 5S is very useful in lots of industries and job markets, but can often fail simply because of the lack of recognition concerning changes in the office.

5S consists of five steps that are crucial for the completion of 5S. The 5S steps are described as follows-

- Seiri / Sort- This is very logical term in, which identification of the contents take place, data base of the products have been created and, then any kind of sorting take place just to arrange the products and removal of unwanted items. Classification of the

products is necessary, which is called Red Tagging. It is important just to identify factors, right from whether it is needed, existing amount obligatory amount, occurrence of necessity, and so on.

- Seito / Systemize- This step in 5S process consists of removal of unwanted items permanently and one more task that to be take place is decision that means you have to decide that what is required to be in what place. Place the items in such manner that you could retrieve them within 30 seconds of requirement.
- Seiso / Brush away/ Sweep- Examine al the items on the daily basis. The process is not that much time consuming, but essential to clean up your workplace and most required in 5S. The conscientiousness to keep the office clean should be circulated between everyone in the group.
- Seiketsu / Homogenize- This important step of 5S involves the visual control, which is important to keep your organization well- organized and clean. It is a complete evaluation to improve the working conditions.
- Shitsuke / Self Control- This step is quite essential, but critical because it involves all the discipline to ensure the 5S standards, it also takes charge of dedication and commitment.

4.6 QCC (QUALITY CONTROL CIRCLE)

QCC (Quality control circle) means controlling quality through group activities. For this, it is necessary to work hand in hand and achieve objective quality or customers' request. With this, we can find weak points, find the cause of problems, gather ideas for problem solving and systematically prepare quality and thus, solve problems such as material loss, production costs, working hours, or productivity. This is also a very useful tool to tackle with Energy Conservation problem. So many factories or institutions are encouraged to utilize this tool.

CHAPTER – 5

5.0 Conclusion

5.1 SUMMARY

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

Table 5.1: Summary of Maintenance/General House Keeping proposals in Bangalore Machine Tool Cluster

S. No	Housekeeping practices/No cost energy conservation measures	Issues in implementation
1	Proper tightening/tensioning of belts in various drives	➥ Lack of awareness EC measure
2	lubrications of gear systems	➥ Lack of awareness EC measure
3	Cleaning of compressor filters regularly	➥ Lack of awareness EC measure
4	Switch off the lights after completion of work	➥ Lack of awareness EC measure
5.	Continuous monitoring of Compressed air leakage	➥ Lack of awareness EC measure

Table 5.2: Summary of energy saving proposals in Bangalore Machine Tool Cluster

S. No	Energy conservation measure	Annual energy/Fuel saving kWh/annum	Annual Monetary saving (Rs. lakh)	Implementation cost (Rs. lakh)	Simple payback period (years)	Applicable to number of units in cluster (Nos.)	Annual cluster saving potential of particular EC measure(Rs. lakh)
1	Replacement of CNC milling, turning machines with CNC Turn –mill centre	-	8.81	55.0	6.2	25	220.3

S. No	Energy conservation measure	Annual energy/Fuel saving kWh/annum	Annual Monetary saving (Rs. lakh)	Implementation cost (Rs. lakh)	Simple payback period (years)	Applicable to number of units in cluster (Nos.)	Annual cluster saving potential of particular EC measure(Rs. lakh)
	or new CNC Turn-mill centre						
2	Replacement of conventional milling machines with CNC milling machine or new CNC milling machine	-	16.49	70.0	4.2	36	593.6
3	Replacement of conventional lathes with CNC lathes or new CNC Lathes	-	8.12	40.0	4.9	36	292.3
4	Conversion of conventional machines into CNC machines	-	8.17	45.0	5.5	8	65.4
5	Installation of 5-axis machine	-	36.56	150.0	4.1	36	1316.2
6	Replacement of old, inefficient motors with energy efficient motors	10502	0.48	1.2	2.5	50	24.0
7	Replacement of Reciprocating compressors with screw compressors or new screw compressors with VFD	34718	1.59	3.0	1.9	60	95.2
8	Optimisation of contract Demand and installation of MD controller	-	0.76	0.2	0.3	15	11.4
9	Optimisation of compressor discharge pressure	2009	0.09	-	0.0	75	6.9
10	Installation of Del-star convertors	4660	0.21	0.6	2.7	50	10.5
11	Installation of Energy saver for	485	0.03	0.1	3.0	10	0.3

S. No	Energy conservation measure	Annual energy/Fuel saving kWh/annum	Annual Monetary saving (Rs. lakh)	Implementation cost (Rs. lakh)	Simple payback period (years)	Applicable to number of units in cluster (Nos.)	Annual cluster saving potential of particular EC measure(Rs. lakh)
	welding machines						
12	Improvement insulation of Furnace	39758	1.89	0.6	0.3	15	28.4
Total Energy/Cost reduction Possibilities using Proposed Recommendations in the Bangalore Machine Tool Cluster							**2664.3**

Table 5.3: Summary of EC and Technology Up-gradation proposals in Bangalore Machine Tool Cluster

S. No.	Item/ Description	Annual Monetary saving (Rs. lakh)	Implementation cost (Rs. lakh)	Simple payback period (years)	Potential for Replication, %	Annual cluster saving potential of particular EC measure(Rs. lakh)
1	Replacement of conventional Horizontal Machine centre with CNC Horizontal Machine Centre or new CNC Horizontal Machine centre	29.247	150	5.13	23	672.7
2	Replacement of conventional Grinding Machine with CNC Grinding Machine or new CNC Grinding Machine	10.023	50	4.99	15	150.3
3	Replacement of conventional Gear Grinding Machine with CNC Gear Grinding Machine or new CNC Gear Grinding Machine	192.495	700	3.64	18	3464.9
4	Replacement of conventional Gear Hobbing Machine with CNC Gear Hobbing Machine or new CNC Gear Hobbing Machine	41.295	205	4.96	18	743.3

S. No.	Item/ Description	Annual Monetary saving (Rs. lakh)	Implementation cost (Rs. lakh)	Simple payback period (years)	Potential for Replication, %	Annual cluster saving potential of particular EC measure(Rs. lakh)
5	Replacement of conventional Wire cut machine with CNC Wire cut Machine or new CNC Wire cut Machine	14.895	60	4.03	18	268.1
6	Replacement of conventional Turret Punch machine with CNC Turret Punch Machine or new CNC Turret Punch Machine	29.295	120	4.10	20	585.9
7	Replacement of conventional cutting machine with CNC Laser Cutting Machine or new CNC Laser Cutting Machine	192.495	550	2.86	20	3849.9
8	Replacement of conventional Bending Machine with CNC Bending Machine or new CNC Bending Machine	14.895	40	2.69	20	297.9
Total Energy/Cost reduction Possibilities using Proposed Recommendations in the Bangalore Machine Tool Cluster						**10033**

Table 5.4: Summary of other energy conservation proposals in Bangalore Machine Tool Cluster

S. No.	Item/ Description	Annual energy/Fuel saving kWh/annum	Annual Monetary saving (Rs.)	Implementation cost (Rs.)	Simple payback period (years)
1	Power factor improvement and installation of APFC Panel	-	18000	11000	0.61
2	Replacement of conventional tube lights with energy efficient ones	4155	18989	58500	3.08
3	Installation of Lighting saver	1865	8521	15000	1.76

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

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

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

Major energy sources being used in cluster are the Electrical energy and Diesel. Annual electrical energy consumption and Diesel Consumption in Bangalore cluster is around **2,26,79,100 kWh** and **99,376 litres** respectively. Total energy consumption in the Bangalore Machine Tool cluster is around **85,196 GJ.** After implementation of proposed energy conservation measures, the possibilities of reduction the energy/cost of the cluster is estimated to be about Rs. 2664 Lakh per annum. However these implementation will required the investment of Rs. 11376 Lakh initially. The payback period estimated for these proposals is about 4.2 years, which is very acceptable to the cluster.

ANNEXURE – 1: DETAILED TECHNOLOGY ASSESSMENT REPORT

Most of the Machine Tool industries in unorganized sector i.e. especially machine tool industries in Bangalore Cluster has these characteristics, low engineering, limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, operational skill etc. This sector also faces deficiencies such as the lack of access to technology and technology sharing and the inadequacies of strong organizational structure, professional attitude etc.

Comprehensive Study conducted at various Bangalore units in Bangalore Machine Tool cluster to assess the technology gap in different processes and utilities.

The various factors, which influence the management towards implementation energy efficiency and energy conservation projects in chemical units in Bangalore Machine Tool cluster, are:

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

Technical gap in analysis in below mentioned areas are identified and details are presented below sections:

Equipments/Systems	Areas/Operation
Sealed Quenching Furnaces	Quenching
Forced Air Circulation Furnaces	Tempering
Gas Carburising Furnaces	Carburising and Case Hardening
Bogie Hearth Furnace	Stress Relieving/ normalising
Annealing Furnace	Annealing
Electrical Motors	Utility
Air Compressors	Utility

Furnaces

Thermal efficiency of furnaces is the ratio of heat delivered to a material and heat supplied to the heating equipment.

The purpose of a heating process is to introduce a certain amount of thermal energy into a product, raising it to a certain temperature to prepare it for additional processing or change its properties.

The main losses in the furnace are:

- Heat storage in the furnace structure
- Losses from the furnace outside walls or structure
- Heat transported out of the furnace by the load conveyors, fixtures, trays, etc.
- Radiation losses from openings, hot exposed parts, etc.
- Heat carried by the cold air infiltration into the furnace
- Heat carried by the excess air used in the burners.

Based on the data measured/collected from the plant during energy audit, The efficiency calculations of the GCF and FAC furnaces are given below:

Particulars	GCF-2	GCF-3	FAC-2
Furnace Efficiency- Direct Method			
Energy Consumption per Hour (kWh)	43.45	55.23	26.58
Heat Input per hour (kcal/Hr)	37367.00	47497.80	22858.80
Weight of the Material In Furnace (Kgs)	500.00	800.00	800.00
Initial Temperature of the Furnace (^{O}C)	836.00	495.00	140.00
Final Temperature of the Furnace (^{O}C)	920.00	600.00	228.00
Temperature Rising per Hour (^{O}C)	84.00	105.00	88.00
Specific Heat (kcal/kgs/degC)	0.12	0.12	0.12
Heat Utilized for material Heating per Hour (kcal/Hr)	5040.00	10080.00	8448.00
Efficiency (%)	13.49	21.22	36.96

The results of measurements, observations and analysis of the Bogie Hearth Furnace is given in table.

Particulars	Bogie Hearth Furnace
Heat Inputs:	
Kerosene oil Consumption per Hour (Lts)	7.06
Kerosene Consumption (kg)	5.65
Calorific Value (kcal/kG)	9000.00
Heat Input (kcal)	50832.00
Energy Consumption per Hour (kWh)	39.62
Heat Input per hour (kcal/Hr)	34073.20
Total Heat Input per Hour (KCal/Hr)	84905.20
Weight of the Material In Furnace (Kgs)	800.00
Initial Temperature of the Furnace (^{O}C)	253.00

Particulars	Bogie Hearth Furnace
Final Temperature of the Furnace (^{O}C)	760.00
Temperature Rising per Hour (^{O}C)	507.00
Specific Heat (kcal/kgs/degC)	0.12
Heat Utilised for material Heating per Hour (kcal/Hr)	48672.00
Efficiency	57.33

The detailed study has been carried out for evaluating operating efficiency of the furnace and to identify measures, which can affect fuel savings. The following sections present the performance assessment and measures for reducing energy consumption. The details of the performance of the Annealing furnace are furnished below:

Particulars	Annealing Furnace
Energy Consumption per Hour (kWh)	33.79
Heat Input per hour (kcal/Hr)	29059.40
Weight of the Material In Furnace (Kgs)	1000.00
Initial Temperature of the Furnace (^{O}C)	410.00
Final Temperature of the Furnace (^{O}C)	504.00
Temperature Rising per Hour (^{O}C)	94.00
Specific Heat (kcal/kgs/degC)	0.12
Heat Utilised for material Heating per Hour (kcal/Hr)	11280.00
Efficiency	38.82

It can be seen that the furnace efficiencies have been varying from 13 to 57%. These are short term evaluations based on field data. In order to make a precise heat balance, design data and full cycle time temperature and energy consumption data is required, which is beyond the scope of the present assignment. The expected efficiency of electrical resistance heated furnace should be about 60% at about 70 to 80% of the designed

Electrical Motors

The energy audit of electrical motors installed in this machine tools manufacturing unit was carried out to study, analyse and identify the potential for energy conservation opportunity. The study included motors installed in the manufacturing process as well as in utility section of the plant. The study focussed broadly on the following three aspects, which have bearing on energy efficiency of motors:

- Loading of motors
- Nature of load (fixed or variable)
- Motor operating efficiency and energy saving options

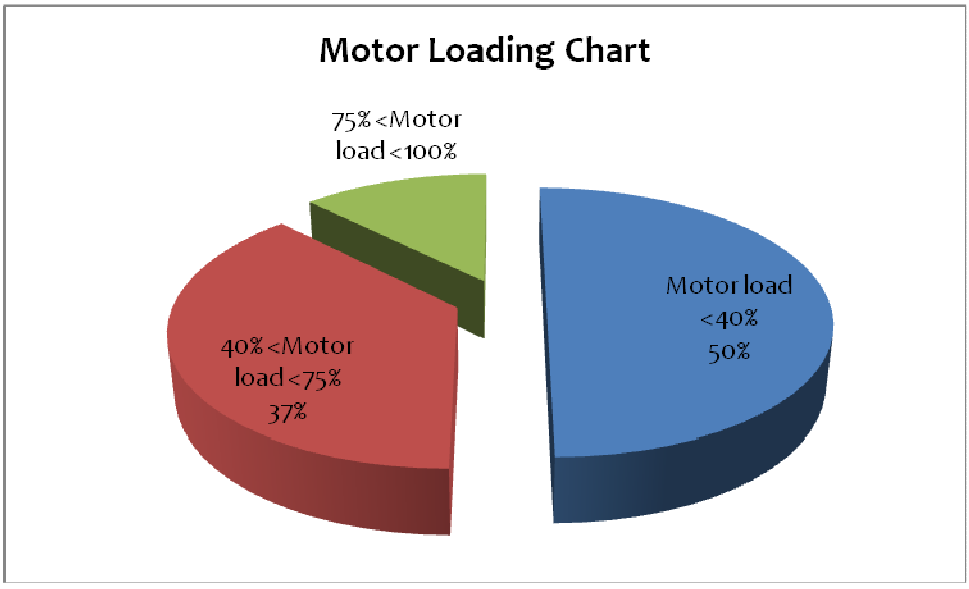
The details of the measurements taken and observation made about each of the above three aspects are detailed in the following sections.

The drives in the unit associated with the various production machinery and utility section as suggested by the plant personnel were considered for the energy audit study and electrical

parameters logged for a period to study the behaviour of these motors. The results are given in table.

Machine Name	Rated Capacity, kW	Voltage, Volt	Current, Amp	Power factor, pf	Active Power, kW	Loading, %
CNC Machine 5002 (Turning)	5.75	387	4.75	0.54	1.72	29.9
CNC - Milling VMC (ABC 5020)	5.75	407	6.25	0.72	3.17	55.2
CNC 5019 Turning	5.75	421	5.86	0.53	2.26	39.4
CNC 5000 Turning	7.5	408	6.72	0.8	3.80	50.7
Conversion Machine 5014	3.75	408	2.55	0.53	0.96	25.5
Air Compressor	7.5	412	11.46	0.75	6.13	81.8
CNC Turning Machine - 5018	7.5	413	7.39	0.6	3.17	42.3
CNC Turning Machine - 5001	7.5	402	6.39	0.51	2.27	30.3

From the table, the health of the motor was analysed by checking their operation loading pattern. Motor loadings were calculated by dividing measured input power by the designed input power at full load condition. In most of the cases designed input power is calculated by dividing shaft power by designed efficiency. In case design details are not available, designed full load motor efficiency is assumed equal to that of other motors of same make.



The operational loading of the plant, taken as a whole has been given in Figure. From this figure, it may be observed that under-loaded motors i.e. below 40% is in the population (50%) in the plant whereas the optimum loaded motors are very few. Motors are loaded in the range of 40% to 75% and 75% to 100% is only 37 % & 13% respectivly. There are no motors have been found to be over

100% loaded. Air compressor motor are found to be most optimally loaded in comparison to other sections of the plant.

Electrical Motors

Compressors are designed to deliver a fixed quantity of air at certain pressure. But, due to ageing, wear and tear or poor maintenance, compressor may not be able to deliver the same volume of air as specified by the manufacturer in the nameplate. By performing the FAD (Free Air Delivery) test, actual output of a compressor with reference to the inlet conditions can be assessed. This test determines the pumping capacity of the compressors in terms of FAD, i.e. air pumped at atmospheric conditions. Following tests are generally carried out for evaluating the operating capacity of compressors.

- Pump-up test
- Suction velocity method

The pump-up test of a compressor needs isolation of the air receiver and compressor from rest of the plant. During the study, standby receiver used to conduct the test by pump-up method however leakage test also could not be done due to continuous operation of the plant.

Based on the data measured/collected from the plant during energy audit, the actual output of the compressors with respect to suction condition was calculated and is given in Table.

Particulars	Unit	Value
Rated Capacity	M3/Min	1.17
Operating Pressure	kg/cm2	9
Initial Pressure	kg/cm2	0
Atmospheric pressure	kg/cm2	1.013
Capacity of Receiver	M3	0.27
Additional holdup of volume	M3	0.01
Pump-up time	Seconds	120
Actual FAD	M3/Min	1.02
Actual Free Air Delivery	(NM^3/Hr)	61.4
Isothermal Power	KW	3.4
Motor input power	KW	6.2
Efficiency of Motor	%	83
Shaft input power	KW	5.16
Isothermal Efficiency	%	66.1

It is to be noted that the FAD of any compressor should not be less than 80% of their rated capacity in order to achieve optimum operational efficiency.

Another important parameter to determine the performance of compressors is the specific power consumption (SPC) – power consumed per cfm of compressed air delivery. For a double acting reciprocating compressor, the recommended SPC should always be less than 0.14

kW/M3/hr at 6 – 7 bar (g) pressure. However, it was measured to 0.172 kW/M3/hr, which were appropriate.

Plant is operating one compressor to fulfil the demand of Instruments/Service. The pressure requirement of the compressed air is about 5.0 – 5.5 kg/cm2 (g) for instruments and about 5.5 kg/cm^2 (g) for bottling plant and 3.0 kg/cm2 (g) service air requirements. Hence, the plant has set the minimum and maximum pressures at 7.5 – 8.0 kg/cm2 (g) for all applications in the plant considering the line losses. By separating the generation of compressed air for the areas and reducing the generation pressure, the plant will be able to reduce the power consumption of the compressed air systems significantly.

Air compressor is connected with the motor drive by V-belts. The plant may use corrugated V-belts or poly V-belts, which increases the tension of the belts as well as reduces the slips. This would offer an energy saving potential of 3 – 5%.

ANNEXURE – 2: DETAILS OF TECHNOLOGY/SERVICE PROVIDERS

Energy Audit study/Energy Conservation studies

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D-11, Road No: 28,
Waghle Industrial Estate, Thane 400604,
Tel: +91-22-2583 5504

Energy Efficient Electrical Motors

Crompton & Greaves
No. 562/640, I Floor Janardhan Towers
Bannerghatta Main Road , Bilekahalli
Bengaluru - 560076
Karnataka India

Auto-Star-Delta Starter

Samson Trading Co.
9, Kakad Complex,
Marol Pipe Line,Below Hotel Sun-n-sheel,
Andheri East,Mumbai - 400059
91-91-22-2830 0376
http://www.samsonpumps.net

Vijay Energy Products Pvt, Ltd,
Sagar Apartments, G.F-23,
Gopalakrishna Road, T Nagar, Chennai - 600017.
+91-44-28156540/28152906.

Maximum Demand Controller

Sun Electro Control Systems Pvt Ltd
No.112/4, Nr Peenya 2nd Stage,
18th Crs, Doddanna Indl Estate, Peenya Iind Stage,
Bangalore – 560058
www.sunelectrocontrols.com
www.sunecs.com
Khodays Control Systems PVT LTD
No.B-187, 5TH MN,2ND STG,
Peenya Indl Estate,
Bangalore - 560058

CNC Machine Converter/Retrofitting of CNC

Evgreen

No.5, 12th main , Kempamma Layout,
Lakshmidevinagar, Opp.
I.R.PolynTechnic, Peenya III Phase,
Bangalore-560058,
Phone no: 080 – 41228897, 41228897, 22724598,
srinivasan@evgreenindia.com
SHREE ENGINEERING
"Anupam" Apartment, Flat No.08,
Right Bhusari Colony, Paud Road,
Pune – 411029. Maharashtra, India.

Lighting Transformer

Beblec (India) Pvt. Ltd
134, Sipcot Industrial Complex,
Hosur, 635 126 Tel: 91-4344- 276358,
www.beblec.com
ES Electronics
483, 4th Main Road, Nagendra Block,
B S K 1st Stage, Bangalore 560 050
Tel: 91- 80-25727836
Shepherd Transformer Industries
C-132, Ghatkopar Industrial Estate,
L.B.S. Marg, Ghatkopar (W),
Mumbai 400 086, Tel: 91-22-2500 8480

CNC Machine/CNC Technology Providers

Ace Micromatic Machine Tools Pvt.Ltd
Plot no.533, 10th main,
4th Phase, Peenya Industrial area,
Bangalore-560058

Haas Automation,
Manav Marketing Pvt Ltd
430-431,12TH cross,
4th Phase,Peenya Industial Area,
Bangalore 560058
India
Phone:91-80-4117 9452/53
Fax: 91-80-4117 9451
manav@giasbg01.vsnl.net.in

Jyoti CNC automation Pvt.ltd,
No.7, 6th Main Road, Shrikanteswara Nagar,
Mahalakshmipuram Lay out,
Bangalore

DMG Mori Seiki India Machines and Services Pvt Ltd
"Parimala Towers" #64 Jalahalli Camp Cross,Off MES Road, Yeshwanthpur
IN-560022 Bangalore.
Phone: +91 80 40896508

Mazak company,
Concord Towers,
14th Floor, UB City,
Bangalore

ANNEXURE – 3: QUOTATIONS OF TECHNO COMMERCIAL BIDS FROM SERVICE/TECHNOLOGY PROVIDERS

DMG – innovative technologies
www.[illegible]

Price Specification

DMU 60 monoBLOCK

Highlights

- High speeds with 0.7 g acceleration as standard, up to 30 m/min feed and rapid [illegible]
- Tool magazines with 24 pockets as standard
- Multi-purpose machine with 3 axes as standard, optional 3+2, 4 or 5 axes
- Compact [illegible] design [illegible] along x-traverse together with an integrated scraper-band chip conveyor as standard

DMG / MORI SEIKI [illegible]
Transport case India: [illegible]
Page 2 of 3

DECKEL MAHO
DMU 60 monoBLOCK

Price Specification

EUR

Basic machine

P-A0040* DMU 60 monoBLOCK
Universal Milling Machine
730 mm x 560 mm x 560 mm /
Main drive: Motorspindle 12,000 rpm
15 kW / 20 hp (40% duty cycle)
10 kW / 13.5 hp (100% duty cycle)
Spindle taper SK 40 to DIN 69871
Tool clamping to DIN 69072
Manual swivel milling head
Tool change system pick-up
24 magazine pockets SK 40
Rigid table 1,000 mm x 600 mm
Chip conveyor
3D CNC control

P-B0062* 3D control Heidenhain iTNC 530

P-C0176* NC rotary table integrated in rigid table Ø 600 mm / Ø 23.6 in
1,000 mm x 600 mm / 39.4 in x 23.6 in
1x T-slot 14 H7 / 0.55 H7
(aligned slot, table centre)
4x T-slots 14 H12 / 0.55 H12
(clamping slots)
distance between slots: 63 mm / 2.4 in
max. table load: 500 kg / 1,100 lbs
Basic machine without rigid table

P-W0046* Controlled NC swivel milling head
(B-axis) incl. hydraulic clamping
Spindle offset 100 mm / 4 in
Swivel range -120°/+30°
Traverse range X-axis reduced
by 100 mm / 4 in

P-K0220* Infrared measuring probe
Type Renishaw PP60 optical (OMP 60)
SK 40 or optionally chosen spindle taper

P-C0004 Spray pistol with pump
1 bar/4.0 l/min
14.5 psi/1.04 gallons/min
(theoretical pump performance)

P-H0001 Electronic handwheel iTNC 530

DMU 60 monoBLOCK / Series 2245 valid [illegible] / Price status [illegible]

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Price Specification

CTX 310 eco V3 Turn Mill Center

Highlights

- [illegible]
- Simple programming – 15" TFT
- Comprehensive tool management with visual representation
- Visual support for setup and diagnosis
- [illegible]
- [illegible]
- [illegible]

DMG / MORI SEIKI [illegible]
Transport costs India: [illegible]
Page 2 of [illegible]

FAMOT
CTX 310 eco

Price Specification

EUR

Basic machine

C-A2075	CTX 310 eco V3 Turning centre with CNC control and SlimLinePanel, incl. Chip Tank Hydraulic hollow clamping attachment, max. bar capacity Ø 51 mm Hydraulic chuck 3 jaws 210 mm, make Autogrip, type 3008-2140
C-A1710?	CNC control SIEMENS SINUMERIK 810D with ShopTurn
C-PF[illegible]	Chip Removal Package - chip conveyor [illegible] - A colour signal lamp
C-Z2[illegible]	Coolant Spray Gun

Services

C-C0104	Dispatch basic machine
C-Y0006	Seafreight Packing: wooden base and vacuum foil

<u>The Total cost of the machine on CIF Chennai basis will be EUR 77,000=00</u>

<u>The best package price on CIF Chennai basis will be EUR 56,000=00</u>

CTX 310 eco / [illegible]

ANNEXURE – 4: ELECTRICAL TARIFF

LOW TENSION PLANS-5 (LT-5)

Tariff Schedule - LT-5 Applicable to:

Heating & Motive power (including lighting) installations of industrial Units, Workshops, Poultry Farms, Sugarcane Crushers, Coffee Pulping, Cardamom drying, Mushroom raising installations, Flour, Huller & Rice Mills, Wet Grinders, Milk dairies, Dry Cleaners and Laundries having washing, Drying, Ironing etc., Bulk Ice Cream and Ice manufacturing Units, Coffee Roasting and Grinding Works, Cold Storage Plants, Bakery Product Mfg. Units, KSRTC workshops/Depots, Railway workshops, Drug manufacturing units and Testing laboratories, Printing Presses, Garment manufacturing units, Bulk Milk vending Booths, Swimming Pools of local Bodies, Tyre retreading units, Stone crushers, Stone cutting, Chilly Grinders, Phova Mills, pulverizing Mills, Decorticators, Iron & Red-Oxide crushing units, crematoriums, hatcheries, Tissue culture, Saw Mills, Toy/wood industries, Viswa Sheds with mixed load sanctioned under Viswa Scheme, Cinematic activities such as Processing, Printing, Developing, Recording theatres, Dubbing Theatres and film studios, Agarbathi manufacturing unit., Water supply installations of KIADB & industrial units, Gem & Diamond cutting Units, Floriculture, Green House, Biotech Lab, Hybrid seed processing unit. Information Technology industries engaged in development of hardware & Software, Silk filature units, Aqua Culture, Prawn Culture, Brick manufacturing units, Silk / Cotton colour dying, Stadiums maintained by Govt. and local bodies, Fire service stations, Gold / Silver ornament manufacturing units, Effluent treatment plants, Drainage water treatment plants, LPG bottling plants and petroleum pipeline projects, Piggery farms, Analytical Lab. for analysis of ore metals, Satellite communication centers, Mineral water processing plants / drinking water bottling plants and soda fountain units.

Tariff Schedule - LT-5 (a)

Fixed Charges :	a) Rs.25/- per HP for 5 HP and below.	
	b) Rs. 30/-per HP for above 5 HP and below 40 HP.	
	c) Rs.40/- per HP for 40 HP & above but below 67 HP.	
	d) Rs.110/- per HP for 67 HP & above.	
Demand based tariff	Optional*	
Fixed Charges :	Above 5 HP and less than 40 HP	Rs. 50 per KW of billing demand
	40 HP and above but less than 67 HP	Rs. 70 per KW of billing demand
	67 HP and above	Rs. 160 per KW of billing demand
Energy Charges :	0-500 units	330 paise per unit
	501-1000 units	415 paise per unit
	Above 1000 units	435 paise per unit

Tariff Schedule - - LT-5 (b)

Fixed Charges :	a) Rs.20/- per HP for 5 HP and below.

	b) Rs. 25/-per HP for above 5 HP and below 40 HP.	
	c) Rs.35/- per HP for 40 HP & above but below 67 HP.	
	d) Rs.100/- per HP for 67 HP & above.	
Demand based tariff	Optional*	
Fixed Charges	Above 5 HP and less than 40 HP	Rs. 40 per KW of billing demand
	40 HP and above but less than 67 HP	Rs. 60 per KW of billing demand
	67 HP and above	Rs. 150 per KW of billing demand
Energy Charges :	0-500 units	330 paise per unit
	501 to 1000 units	390 paise per unit
	Above 1000 units	425 paise per unit

HIGH TENSION PLANS HT-2(A)

Tariff Schedule - HT-2(a) Applicable to:

Industries, Factories, Workshops, Universities, Educational Institutions belonging to Government, Local bodies, Aided Institutions, Hostels of all Educational Institutions, Research & Development Centres, Industrial Estates, Milk dairies, Rice Mills, Phova Mills, Roller Flour Mills, News Papers, Printing Press, Railway Workshops/KSRTC Workshops/ Depots, Crematoriums, Cold Storage, Ice & Ice-cream mfg. Units, Swimming Pools of local bodies, Water Supply Installations of KIADB and other industries, all Defence Establishments. Hatcheries, Poultry Farm, Museum, floriculture, Green House, Bio Technical Laboratory, Hybrid Seeds processing Units, Stone Crushers, Stone cutting, Bakery Product Manufacturing Units, Mysore Palace illumination, Film Studios, Dubbing Theatres, Processing, Printing, Developing and Recording Theaters, Tissue Culture, Aqua Culture, Prawn Culture, Information Technology Industries engaged in development of Hardware & Software, Drug Mfg. Units, Garment Mfg. Units, Tyre retreading units, Hospitals run by Charitable Institutions & ESI Hospitals, Nuclear Power Projects, Stadiums maintained by Government and local bodies. And also Railway Traction, Effluent treatment plants and Drainage water treatment plants other than local bodies, LPG bottling plants, petroleum pipeline projects, Piggery farms, Analytical Lab. for analysis of ore metals, Saw Mills, Toy/wood industries, Satellite communication centers, and Mineral water processing plants / drinking water bottling plants.

Tariff Schedule - HT-2(a)(i)

Demand Charges :	Rs.180/- per KVA of billing demand per month.	
Energy Charges :	For the first one lakh units	430 paise per unit
	For the balance units	465 paise per unit
Applicable to :	Railway Traction and Effluent Treatment Plants.	
Demand Charges :	Rs.180/- per KVA of billing demand per month.	
Energy Charges :	430 paise per unit for all the units.	

Tariff Schedule - HT-2(a)(ii)

Demand Charges :	Rs.170/- per KVA of billing demand per month	
Energy Charges :	For the first one lakh units	430 paise per unit
	For the balance units	460 paise per unit
Applicable to :	Railway Traction and Effluent Treatment Plants.	
Demand Charges :	Rs.180/- per KVA of billing demand per month.	
Energy Charges :	430 paise per unit for all the units.	

TOD Tariff applicable to HT 2(a)(i) & (ii) category at the option of the Consumer.

Time of Day	Increase + / reduction (-) in energy charges over the normal tariff applicable
22.00 Hrs to 06.00 Hrs	(-) 80 paise per unit
06.00 Hrs to 18.00 hrs	0
18.00 Hrs to 22.00 Hrs	+ 80 paise per unit

ANNEXURE – 5: FINANCIAL SCHEMES AVAILABLE WITH LOCAL BANKS FOR IMPROVING ENERGY EFFICIENCY IN CLUSTER

1. Credit linked capital Subsidy scheme (CLCSS)

Under this scheme, the ministry of MSME is providing subsidy to upgrade technology (Machinery/plant equipments). Subsidy limit per unit is Rs. 15 lakh or 15% of investment in eligible machinery/Plant equipments whichever is lower. For more details of the scheme visit:

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

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

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

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

- Acquisition (including lease and rental) of energy saving equipments, including newly installing, remodeling and upgrading of those existing
- Replacement of obsolete equipments and/or introduction of additional equipment which would improve performance
- Equipments/ Machinery that meets energy performance standards/Acts
- Introduction of equipments that utilize alternative energy sources such as natural gas, renewable energy etc., instead of fossil fuels such as Oil and Coal etc.
- Clean Development Mechanism (CDM) projects at cluster level that involves change in process and technologies as a whole, duly supported by technical consultancy will be eligible for coverage.

Financial parameters:

The financial parameters for appraising the project are:

Parameter	Norms
Minimum Assistance	Rs. 10 lakh
Minimum promoters contribution	25% for existing units; 33% for new units
Interest rate	The project expenditure eligible for coverage under the line will carry a rate of

Parameter	Norms
	interest rate of 9.5-10% p.a
Upfront fee	Non-refundable upfront fee of 1% of sanctioned loan plus applicable service tax
Repayment period	Need based. Normally the repayment period does not extend beyond 7 years. However, a longer repayment period of more than 7 years can be considered under the line if necessary

Eligibility criteria for units (Direct assistance):

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

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

3. Scheme for Financing Energy Efficiency Projects

PURPOSE:

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

ELIGIBILITY

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

LIMIT:

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

Project cost may include the following:

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

RATE OF INTEREST:

- Bank's BPLR from time to time.

REPAYMENT :

- Maximum 5 years, including moratorium, if any.

SECURITY :

a. For Sole Banking Accounts:
   Extension of first charge on all fixed assets.

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

Grant from IREDA:

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

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