MANUAL ON ENERGY CONSERVATION MEASURES IN RICE MILLS CLUSTER VELLORE

Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By

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MANUAL ON ENERGY CONSERVATION MEASURES IN RICE MILL CLUSTER VELLORE, TAMILNADU

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ZENITH ENERGY SERVICES PVT LIMITED
HYDERABAD

CHAPTER 1 INTRODUCTION

1.1 About BEE'S SME Program

The Government of India has enacted the Energy Conservation Act – 2001 due to high energy saving potential in industries, agriculture, domestic and transport sectors; to reduce the gap between demand and supply; to reduce environmental emissions through energy saving; and to effectively overcome the barriers. The Act provides the much-needed legal framework and institutional arrangement for embarking on an energy efficiency drive.

The Bureau of Energy Efficiency (BEE), an agency of the Union Ministry of Power, has introduced a programme "BEE SME Program" to help small and medium enterprises (SMEs) to use energy efficiently.

As a part of the implementation of "BEE-SME Programme" about 35 SME clusters were identified. After ground-level situation analysis, 29 of them have been selected for further activities in consultation with the Ministry of Micro, Small and Medium Enterprises (MoMSME).

According to the Indian Institute of Foreign Trade, SMEs contribute about 6% of the country's GDP. Although energy is an important input required for economic and social development, attaining higher energy efficiency is considered an important element in meeting India's future energy challenges and ensuring its energy security.

The SME sector is facing rising energy costs and on the other hand, prices and cost pressures are soaring. The government, from time to time, has offered various fiscal incentives and other interventions to SMEs, as well as help for technology up-gradation and improvements in performance efficiency, but a program for energy saving of this kind is novel and has tremendous potential.

Vellore Rice Mills Cluster has been identified as one of the clusters to implement the BEE-SME Program. BEE has entrusted M/s Zenith Energy Services (P) Ltd to implement the project.

1.2 Project Objectives

The BEE SME Program is aimed at improving Energy Efficiency of Small and Medium Enterprises by technological interventions in the various clusters of India. The Energy Intensity in SME is intended to be enhanced by helping these industries in the mostly energy intensive cluster units identified 29 SME clusters of India to through improve Energy efficiency and performance through technology interventions and also develop the consistent steps for successful implementation of energy efficiency measures and projects in the cluster units and also financial planning for the SME owners.

The project also aims at creating a platform for dissemination of best practices and best available technologies in the market for energy efficiency and conservation and to create awareness among cluster unit owners and also the demonstration projects may stimulate adoption of successful/available technologies.

The BEE SME program have been designed in such a way that to set up to a deal with specific needs of the industries in the SME sector for energy efficiency and designed to overcome all the common barriers for implementation of Energy Efficient technologies and equipments/processes. The following are proposed to be covered under BEE SME program:

1. **Energy Use and Technology Studies** – The studies are aimed for status of the technologies installed, energy use pattern and its cost, operating practices, identification of the technologies and measures for improving energy efficiency etc
2. **Conduct Dissemination Program –** Disseminate the Technologies and measures identified & best practices in the cluster units in reducing energy consumption.
3. **Implementation of EE measures –** Preparation of bankable and replicable detailed project reports for facilitating the cluster unit owners for implementation. The DPR's are to be prepared for a minimum of 5 technologies for various sizes capacities
4. **Identification of the Local Services Providers –** The program also aimed for identification of local service providers and capacity building to facilitate them for implementation of the technologies in the clusters
5. **Facilitation of Innovative Financing Mechanisms –** The program also aims for encouraging the SME owners in implementation of technologies through innovative financing schemes. The project also aims to impart training for the officials of various financial institutions like SIDBI and local lead bankers of the clusters location for evaluating energy efficiency related projects.

The BEE SME program model developed is innovative and designed in such a way that the involvement of various stakeholders like SME owners, consultants, technology providers, Local Service Providers, Financial institutions etc to facilitate :

- To identify the technologies and process up-gradation from various the detailed studies undertaken by the consultants.
- Active involvement of Financial Institutions to overcome financial barriers and development of a financial model for the technologies/equipments identified which are readily available and at best possible interest.

1.3 Expected Project Outcome

The BEE SME program aims at improving energy efficiency in various cluster units of the country. On overall, the program creates opportunities for all the stakeholders in the cluster viz. SME owners, Local Service Providers, Equipment Suppliers and Financial Institutions.

Initially, a situation analysis had been carried out and detailed information pertaining to the technologies employed, energy use pattern and financial strengths of SME's in the cluster were established.

The present BEE SME Program implementation in Vellore Rice Mills Cluster, the following outcomes are expected

Energy Use and Technology Analysis

The detailed comprehensive energy use and technology studies in various cluster units has explored the information on status of Vellore Rice Mills Cluster, production capacities, present status of the technologies employed, energy consumption pattern, identified all possible measures for energy efficiency and conservation, techno-economic feasibility of the identified measures, energy saving potential in the units surveyed and in total cluster units, technologies and equipments available locally, technical capabilities of LSP's for implementation, environmental impact due to reduction in energy consumption, etc. The major projects to be implemented which have more impact on energy conservation and common technologies which are more or less applicable for all the cluster units were identified for preparation of bankable detailed project reports and incorporated in the manual

Implementation of EE measures

To facilitate SME owners for implementation of energy efficiency measures by developing the bankable detailed project reports for a minimum of 5 technologies for various capacities as per the suitability of cluster unit sizes. These DPR's can be replicate as per the unit suitability for availing loans from financial institutions. The DPR contains various technical and financial indicators like IRR, NPV, ROI, etc for projecting the project viability. A total of 15 DPR's will be prepared

Capacity Building of LSP's and Bankers

The local service providers and equipments suppliers has already been identified in Vellore Rice Mills Cluster and the capability building programs planned for various stakeholders like local service providers, bankers and equipments suppliers to facilitate them for implementation of the energy efficiency measures.

A Conclusion dissemination workshop to be conducted to provide the information for all the stakeholders for the status and achievement of the program

1.4 Project Duration

The total duration of the project is 18 months and the details of the duration for each activity are furnished in Figure 1 below:

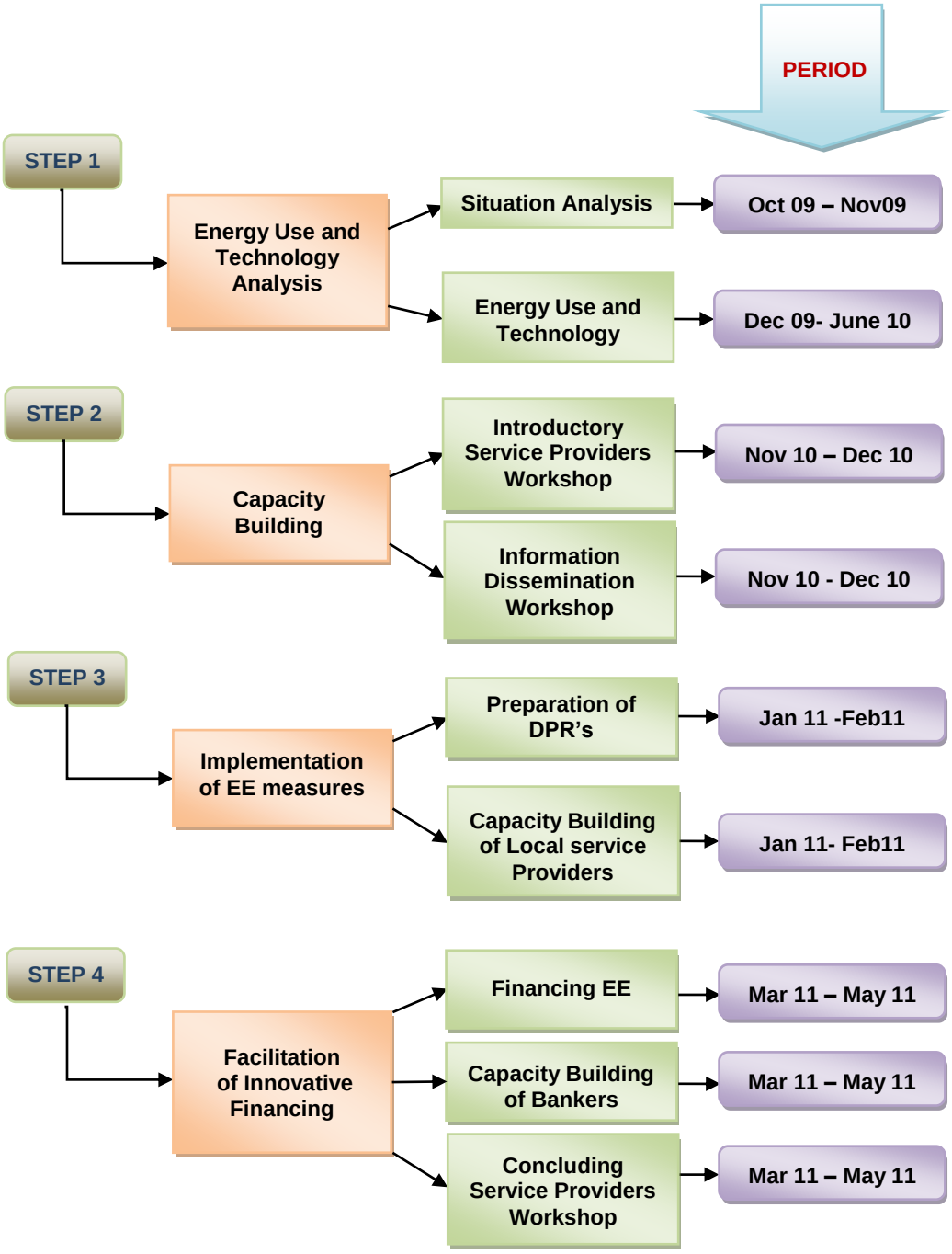


Figure 1: Project Duration

1.5 Identified Clusters under the BEE SME Program

The BEE has identified 29 SME Clusters to implement the BEE SME Program for energy efficiency improvement and the list of chosen clusters are furnished below in Table 1.1:

Table 1.1: List of clusters identified for BEE SME Program

S. No.	Cluster Name	Location
1.	Edible oil cluster	Alwar
2.	Machine components cluster	Bangalore
3.	Ice slabs cluster	Bhimavaram
4.	Brass cluster	Bhubhaneswer
5.	Sea food processing cluster	Cochin
6.	Fire bricks cluster	East &West Godavari
7.	Rice mills cluster	Ganjam
8.	Milk processing cluster	Gujarat
9.	Galvanizing and Wire drawing cluster	Howrah
10.	Foundry cluster	Jagadhri
11.	Limestone cluster	Jodhpur
12.	Tea processing cluster	Jorhat
13.	Foundry	Ludhiana, Batala, Jalandhar
14.	Paper processing cluster	Muzzafar Nagar
15.	Sponge iron cluster	Orissa
16.	Dyes and chemicals cluster	Vapi
17.	Bricks and tiles cluster	Varanasi
18.	Rice mills cluster	Vellore
19.	Dyes and chemicals cluster	Ahmedabad
20.	Brass cluster	Jamnagar
21.	Textile cluster	Pali
22.	Textile cluster	Surat
23.	Tiles cluster	Morvi
24.	Textile cluster	Solapur
25.	Rice mills cluster	Warangal
26	Tiles cluster	Mangalore
27	Textile cluster	Tirupur
28	Coir cluster	Alleppey
29	Glass cluster	Firozabad

1.6 About the present study

BEE has awarded the Vellore Rice Mills cluster study to Zenith Energy Services Pvt. Ltd based on the competitive bidding under BEE SME program. Zenith Energy Services Pvt Ltd had taken the task of implementing the program and two full time energy auditors were deployed in the cluster and a project office had been established at Vellore with all facilities like state of art energy audit instruments, Laptops, Printers, and Internet etc. As a part of the program, the details of the studies undertaken in cluster units are furnished in Table 1.2.

Table 1.2: The details of the studies undertaken in cluster units

Sl.No	Type of audits	No. of units covered
1	Preliminary Energy Audits	10
2	Detailed Energy Audits	10
3	Technology audits	10

The studies were conducted covering all types of industries and capacities in the cluster and the reports were submitted to all individual units for implementation of measures identified. Based on the studies carried out and data analysis, a cluster manual had been prepared for the following:

- Cluster details
- Products manufactured
- Energy forms used, costs, availability and consumption pattern
- Technologies/equipments installed
- Efficiencies levels of the equipments installed
- Measures & technologies/equipments identified for energy conservation and saving, Investment required
- Simple payback period
- Various barriers for implementation
- Local Service Providers details

1.7 Structure of the Report

The present report has been divided into the following Chapters:

Chapter 1: Introduction
Chapter 2: Overview of Vellore Cluster
Chapter 3: Energy Audit and Technology Assessment
Chapter 4: Conclusions

Chapter 1: This chapter discusses about BEE SME program, project objectives, project outcomes and about the present study.

Chapter 2: Discusses broadly about the cluster, classification of units, energy situation, energy forms used and their availability, production capacities of the units, products manufactured, manufacturing process, technologies employed, current policies of various state and central government for energy efficiency and energy conservation, various issues and barriers in implementation of EE measures and technology up-gradation etc.

Chapter 3: Highlighted the methodology adopted, observations made on process and technologies, energy consumption profile, efficiencies of the equipments installed, housekeeping practices adopted, availability of data and information, technology gap analysis, energy conservation and measures identified, cost benefit analysis, Local service providers availability, technology providers availability, etc

Chapter 4: Highlighted the environmental benefits and quantity of GHG emission reduction expected due to implementation of the measures identified for energy saving.

CHAPTER 2
ABOUT VELLORE CLUSTER

2.1 Overview of Vellore SME Cluster

2.1.1 Cluster Background

Rice is the staple food of majority of Indians and specifically in Southern Indian. Paddy is one of the major crop cultivated in the Southern states especially in the state of Tamilnadu. The Rice comes out of milling of paddy. Hence rice milling is an important activity in the state.

Rice mills are the lifeline for the economic development of rural India. The rice mills are generally located in the rural areas and near to paddy growing area. There are about 340 rice mills in Vellore rice mills cluster covering Arni, Arcot and Vellore areas.

The cost of energy as a percentage of processing cost of paddy cost varies anywhere between 4-5%. The rice milling units in the cluster use wood, GN Husk and Rice Husk as fuels for boilers, hot air dryers and bed dryers.

2.1.2 Product Manufactured

The major activity of the cluster units is processing of paddy for production of rice to cater for the domestic market and providing Levy for Food Corporation of India (FCI). The rice produced in these mills is of high quality and is marketed through dealer network in different places of the state. The most common variety of rice produced in the cluster rice mills is Ponni rice for domestic market requirement. The most typical feature of the Ponni rice is the final moisture content is maintained at 8.5% to 9.0%, where as in the normal practice in other states the final moisture content is maintained at 12% to 13%.

2.1.3 Classification of units

The **Vellore Rice Mills** Cluster units can be broadly classified:

2.1.3.1 Classification based on production

In **Vellore Rice Mills** Cluster, there are about 340 units, the rice mills can be categorized into two types based on production capacity, and they are:

- Less than 15 TPD
- Above 15 TPD

There are 125 rice mills having production capacity less than 15 TPD and balance 215 rice mills falls under second category having production capacity more than 15 TPD. The classification based on production capacity is furnished graphically in Figure 2.

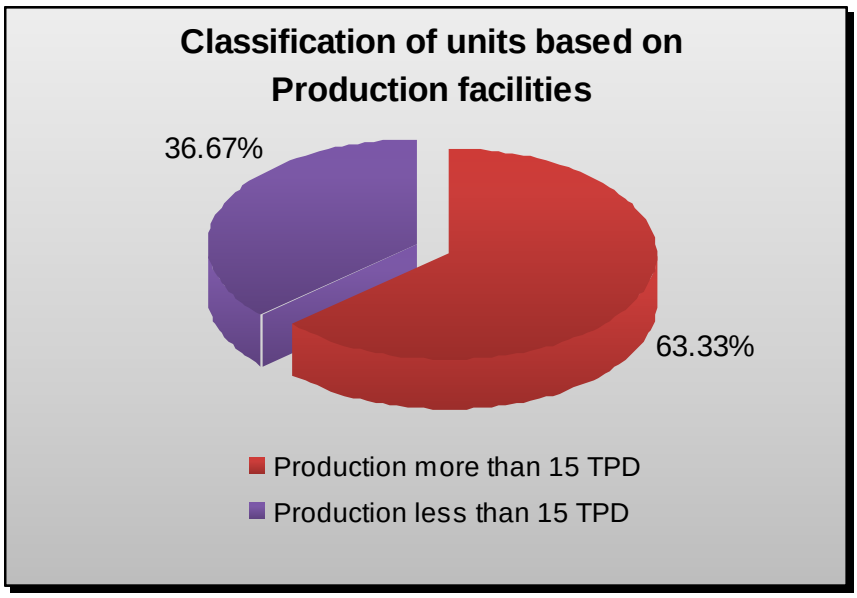


Figure 2: Classification of units based on production facilities

2.1.3.3 Classification based on annual energy bill

Out of 340 units, 102 units have energy bill below Rs.30 lakhs per annum, 159 units have energy bill between Rs.30 lakhs to Rs. 40 lakhs per annum and the balance 79 units have energy bill above Rs. 40 lakhs. The classification based on annual energy bill is furnished graphically in Figure 3.

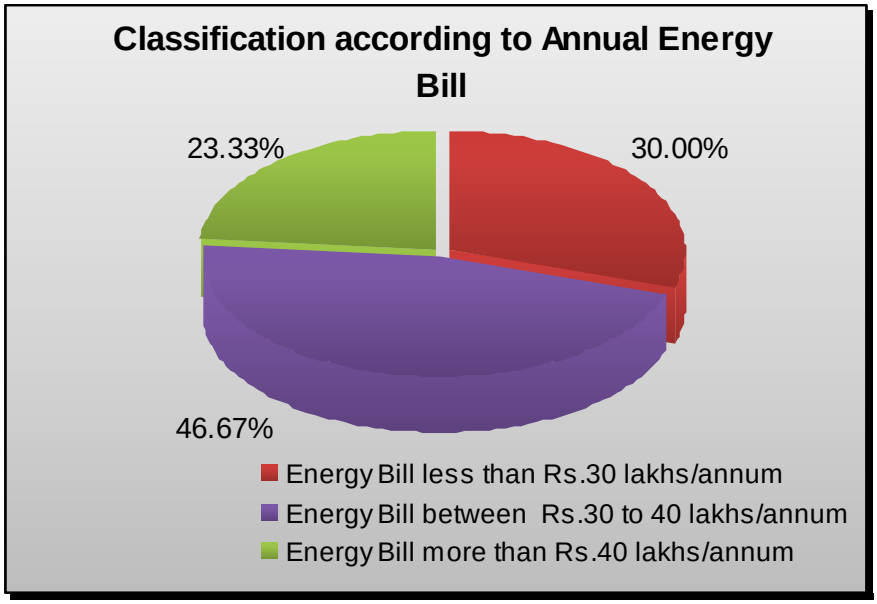


Figure 3: Classification of units based on annual energy bill

2.1.4 Raw materials used

The main raw material used in **Vellore Rice Mills** Cluster units is paddy.

2.2 Energy Consumption scenario of the Cluster

The main energy forms used in rice mills of the cluster are electricity, wood, GN husk and rice husk. The fuels are used for the boiler and hot air dryers. Electricity is required for operating the rice mill machinery like Elevators, paddy cleaners, hullers, whiteners, silky, sortex, separators and air compressors.

2.2.1 Fuels used and price

The major fuels used in the cluster units are wood, GN husk and rice husk. The prevailing prices of fuels and electricity in the cluster are furnished below in Table 2.1.

Table 2.1: Prevailing price range of fuels & electricity in the cluster

Sl.No	Fuel type	Price range (Rs.)
1	Wood	2,500 per ton
2	GN Husk	3,500 per ton
3	Rice Husk	2,500 per ton
4	Electricity	4.90 per kWh

2.2.2 Energy Consumption

The main energy forms used in a typical unit of the cluster are electricity, wood, GN husk and rice husk. The annual energy consumption of the three typical units and quantity of paddy processing in the cluster is furnished in Table 2.2 below:

Table 2.2: Annual energy consumption of the three typical units

Details	Value	Unit -1	Unit -2	Unit -3
Wood	tons	660	660	600
GN Husk	tons	264	330	540
Electricity	kWh	2,28,576	4,82,880	2,93,880
Paddy processing	tons	4,950	4,950	4,950

The annual consumption of fuels and electricity of the entire cluster units are furnished table 2.3 below:

Table 2.3: Annual energy consumption of the total cluster units

Sl.No	Type of energy	Consumption	Tons of oil Equivalent (TOE)
1	Wood	1,81,979 tons/annum	63693
2	GN Husk	77,900 tons/annum	31167
3	Rice Husk	27,200 tons/annum	13883
4	Electricity	7,92,84,965 kWh/annum	6819
	Total		**115562**

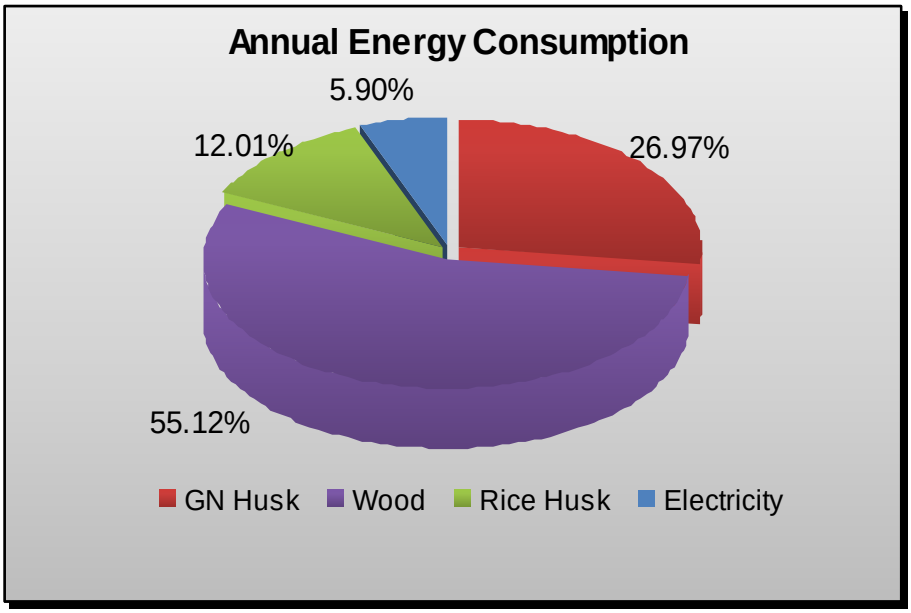


Figure 4: Annual energy consumption of the cluster (TOE)

2.2.3 Specific Energy Consumption

The specific energy consumption for various units in the cluster for major equipments installed in the rice mills is furnished below in Table 2.4:

Table 2.4: Specific energy consumption

Equipment	Units	Minimum SEC	Maximum SEC	Average SEC (for whole cluster)
Boiler	kg/kg	0.07	0.09	0.08
Hot air dryer	kg/kg	0.07	0.12	0.10
Electricity	kWh/ton	22	40	31

2.3 Manufacturing process

2.3.1 Paddy Processing

The milling process in larger commercial mills combines a number of operations that produces higher quality and higher yields of rice from paddy. The process involves:

1. Soaking of raw paddy in normal water for about 12 hours
2. Cooking the soaked paddy by the steam
3. Natural drying of paddy to reduce moisture content
4. Pre-cleaning of paddy in paddy cleaners
5. Drying of the paddy in the hot air dryers
6. Pre-cleaning the paddy prior to milling
7. Removing the husk or outer layer from the paddy
8. Polishing or whiting the brown rice to remove the bran layer
9. Separating the broken grains from the whole kernels by rice graders
10. packing the raw rice in the bags

Soaking, Cooking and Drying

The raw paddy procured is directly feeded to the tanks and soaked in normal water for about 12 hours. After completion of the soaking process, the water is drained from the tanks. Then the soaked paddy is cooked by direct injection of steam to the paddy. The cooked paddy is then dried by using natural sunlight or bed dryer for reducing the moisture content from 24 to 18%.

The paddy containing moisture content of 18% is dried in the hot air dryer for about 16 to 18 hours and the final moisture content is reduced to 8.5 to 9.0% . then the paddy is taken to the raw mill for further processing.

Pre-cleaning

When paddy comes into the mill it contains foreign material such as straw, weed seeds, soil and other inert material. If this is not removed prior to hulling the efficiency of the huller and the milling recovery are reduced.

Most pre-cleaners separate three groups of materials:

- The first separation is done by scalping or removing the objects that are larger than the grain. Either a flat oscillating screen or a rotary drum screen that allows the grain to pass through but retains straw can do this.
- The second separation retains the grains but allows broken grains, small stones and weed seeds to pass through. An air aspirator may also be incorporated to remove the dust and the light empty grains

Huller

The objective of a hulling/dehusking operation is to remove the husk from the paddy grain with a minimum of damage to the bran layer and, if possible, without breaking the brown rice grain. Since, the structure of the paddy grain makes it necessary to apply friction to the grain surface to remove the husk; it leads to breaking of some of the rice.

The paddy is fed into the center of the machine through a small hopper. A vertically adjustable cylindrical sleeve regulates the capacity and equal distribution of the paddy over the entire surface of the rotating disc, paddy is forced between the two discs and as a result of pressure and friction most of the paddy is dehusked (hulled).

Whitening and Polishing

In the process of whitening, the silver skin and the bran layer of the brown rice are removed. During polishing of the whitened rice, the bran particles still sticking to the surface of the rice are removed and the surface of the rice is slightly polished to give it a glazed appearance. For

further whitening if required as per the market demand or for export market, the polished rice is further processed in the silky machine for additional polishing.

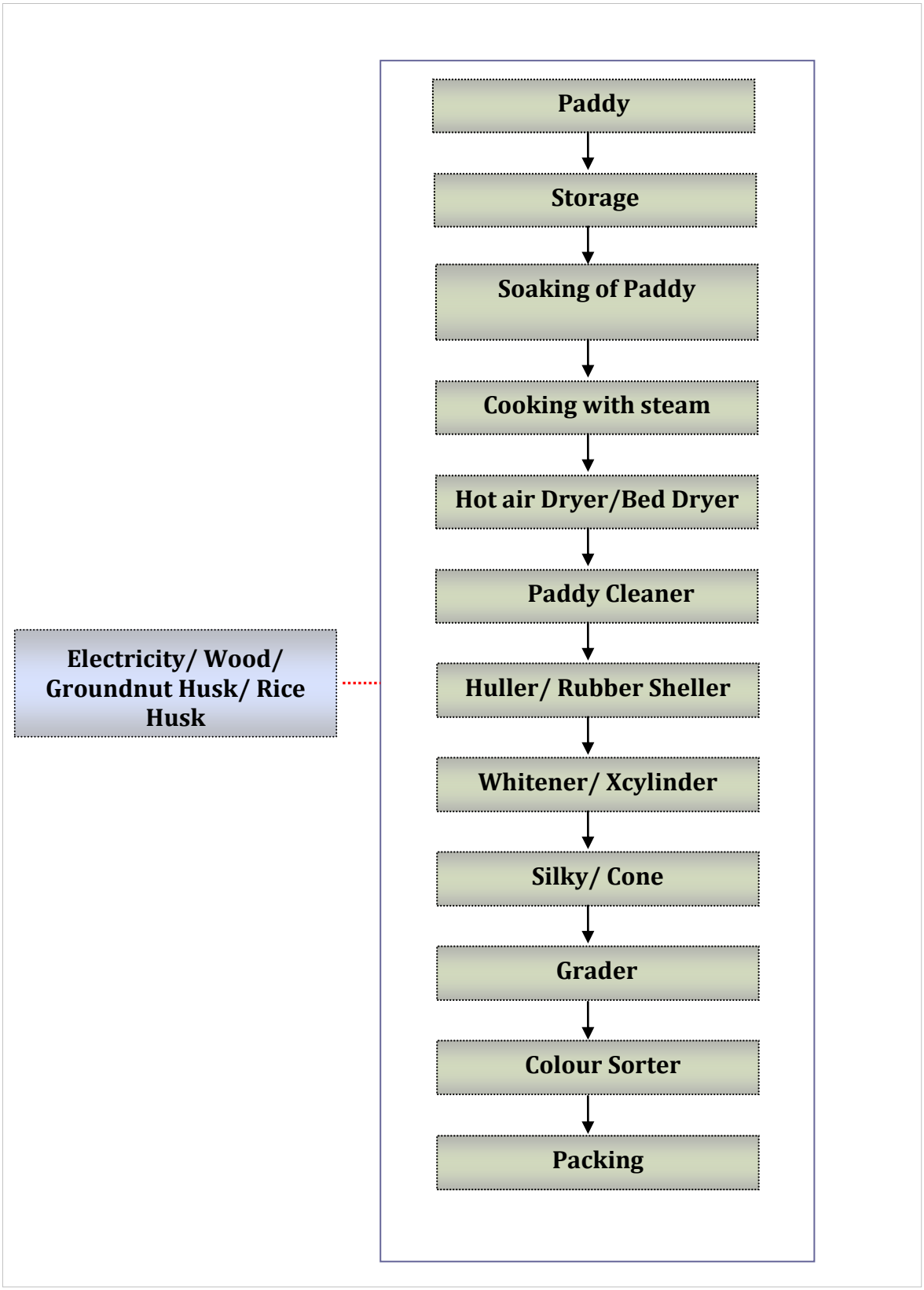
Rice grader

After polishing, the white rice is separated into head rice and, large and small broken rice by a sifter. Head rice is normally classified as kernels, which are 75-80% or more of a whole kernel. The sifter is made up of a series of oscillating or cylindrical screens through which the rice passes. The output from the bottom screen is the very fine broken tips and is called the "brewers".

Elevators

The elevator buckets are made of MS material. Due to heavy weight of the buckets, the elevator motors consume more power.

The detailed process flow diagram of the unit is furnished below.



2.4 Current policies and Initiatives of Local bodies

No policies are currently available for energy conservation and efficiency projects. The energy audit is mandatory for the industries having 500 kVA contract maximum demand by an empanelled consultant of the SDA

2.5 Major barriers for implementation of Energy Efficiency

2.5.1 Energy Availability

The main energy forms used in the cluster units are wood, GN husk and rice husk and electricity. Though, the electricity is available, the power cuts are imposed for about 2 hours in day due to power shortage. Some of the units has installed DG sets for un interrupted power supply to reduce production loss.

2.5.2. Technological Issues

The major technical barriers that prevented the implementation of energy efficiency measures are as below:

- Lack of awareness and information about the technologies available in the market
- No knowledge among the workforce about energy conservation and efficiency
- The majority of the managers in cluster units are non technical and illiterates and are working based on experience and doesn't have technical knowledge
- Dependency on local technology suppliers who do not have sufficient knowledge on efficient equipments

2.5.3 Lack of Technical know-how & Organizational capacity

The majority of the unit owners do not have technical expertise, knowledge or training about energy efficiency, and are dependent totally on local technology suppliers or service companies, who normally rely on established and commonly used technology. Further, the SME owners mainly concentrate on trading activities, which is crucial for the rice milling industry and least priority for energy related activities and machinery.

The SME owners will install based on the success of the equipment/technologies installed in the neighboring industries in the area.

Though, some of the SME owners are interested in implementing energy efficiency measures, the lack of knowledge and technical know-how, made them to depend on the local suppliers.

These are however can be overcome by motivating them to attend the awareness programs and detailed report on the benefits of the measures identified and cost benefit analysis.

Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

2.5.4 Financial Issues

About 10% of the units in the cluster have good financial strength and are implementing various new technologies available in the market and mostly are related to enhancing the production.

The other units either don't have adequate financial strength or not interested investing in new technologies to avoid risk due fear of the business.

Further, the units owners are not aware of monetary benefit due to implementation of energy efficiency measures and also present losses in the existing technologies identified.

Lack of interest of investing on the new technologies, as these industries getting profits with the existing technologies

CHAPTER 3 ENERGY AUDIT AND TECHNOLOGY ASSESSMENT STUDY

3.1 Methodology adopted

3.1.1 Energy use and Technical Assessment study

3.1.1.1 Pre-energy audit activities

The pre-energy audit activities comprised collection of preliminary information from cluster units for products manufactured, production capacity, status of technologies / equipments installed, willingness of the unit for the study, and implementation of the measures identified.

3.1.1.2 Preliminary Energy Study

The following methodology has been adopted for preliminary energy audit study:

a) Collection of past energy consumption details and energy bill

b) Establish specific energy consumption, if possible

c) List out major energy consuming areas of the plant

d) Level of technologies adopted (latest or old, crude or efficient, local or reputed company make)

e) Status of instruments installed in the plant and necessary instrumentation required for the detailed study

f) Identify areas for special attention for low cost measures with quick payback period

g) Understanding detailed manufacturing process with energy and material balance

h) Identify areas for detailed study and measurements required

i) Collect bottleneck areas of the plant for detailed study

3.1.1.3 Detailed Energy Study

The following methodology has been adopted for conducting detailed energy study:

- Monitoring of energy related parameters of various equipment / machines using portable instruments of ZESL
- Collection of operating data from various measuring instruments / gauges installed in the plant
- Collection of past operating data / historical data from log books and data registers

- Compilation of design data / name plate details of various equipment from design manuals and brochures
- Discussions with concerned plant personnel to take note of operating practices and shop-floor practices being followed in the plant and to identify specific problem areas and bottlenecks if any with respect to energy consumption
- Critical analysis of data collected / monitored by ZESL
- Technology status of the equipments installed
- Detailed process flow of the plant
- Identification of energy wastage areas and quantification of energy losses
- Identification of suitable measures for reducing energy wastages
- Identification of areas for reuse and recycle

Table 3.1: The details of the studies undertaken in cluster units

Sl.No	Type of audits	No. of units covered
1	Preliminary Energy Audits	10
2	Detailed Energy Audits	10
3	Technology audits	10

3.1.1.4 Technology Audit

The methodology adopted for conducting technical audit is as follows:

- Identify major equipments and technologies of the plant
- Whether the equipments installed is local make or reputed company make
- Various energy sources available in the vicinity of the cluster
- Energy use and specific energy consumption details
- Identify major constraints for installing energy efficient equipments
- Whether energy efficient equipment suppliers are available locally and identify the suppliers
- The strategy followed for selection of equipment suppliers by the management
- Any research or survey carried out prior to selection of the technologies adopted and available
- Detailed interviews with the management for the interest in adopting new technologies for efficiency improvement
- Financial strength and investment that can be made for the improvement of energy efficiency by the plant management

3.2. Observations made

3.2.1 Manufacturing Process and Technology employed

There are about 340 rice milling units in the cluster, which are engaged in the processing of paddy for rice production. The main raw material is paddy and is procured/purchased the farmers through various agents:

The process flow diagram of a typical rice milling unit of the cluster is furnished in the Figure 5 below:

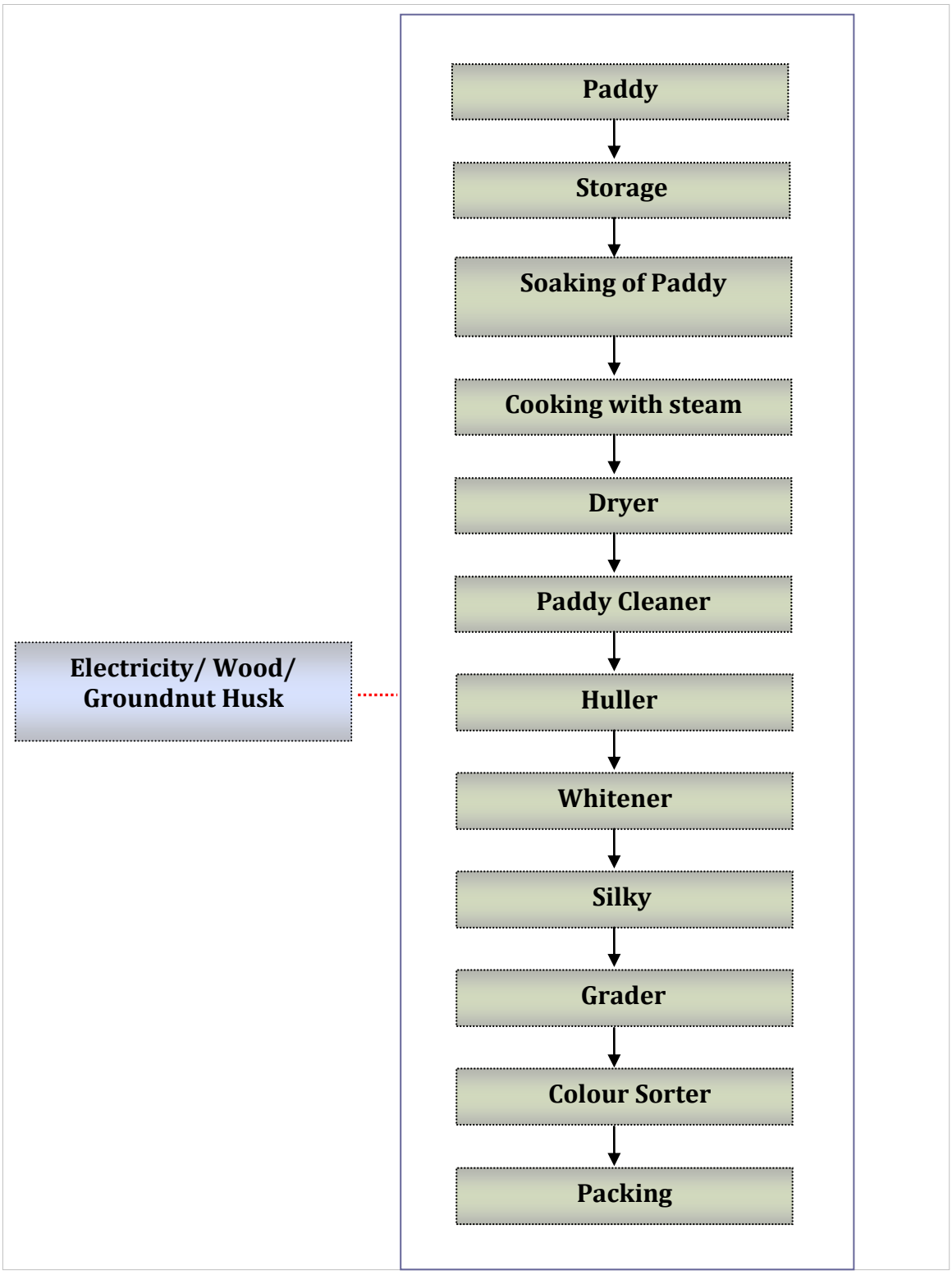


Figure 5: Process flow chart

(For a typical rice milling unit in the cluster)

The comprehensive study of the units carried out by ZESL has revealed the following:

i) The status of present technologies installed like boiler, hot air dryers and raw mill machinery is poor as compared to the technologies and practices / equipments available in the market. Various technological gaps have been identified in the cluster units as under and these may be due to lack of awareness on the technologies available and non availability of LSPs or equipment suppliers.

ii) Though, the managements are interested in implementation, the energy loss areas and EE technologies could not be identified by the management/workers or LSPs for implementation due to lack of awareness. Hence, the unit owners are depending entirely on illiterate workers and the local technology suppliers for their low cost and their availability any point of time.

iii) Further, the sector faces deficiencies such as lack of technical manpower, technical knowledge among workforce and unit owners and largely concentrated on the trading related activities by the owners.

3.2.2 Energy Consumption profile

The supply and consumption pattern of energy inputs are analyzed in the cluster and the details are furnished below:

3.2.2.1 Wood, GN Husk, Rice Husk and Electricity

The majority units of the cluster use firewood, GN Husk, Rice Husk and electricity for the rice mill operation. The variation of prices of different forms of energy used in the clusters is furnished below table 3.2:

Table 3.2: Variation of different forms of energy price in cluster units

Sl.No	Fuel type	Price range (Rs.)
1	Wood	2,500 per ton
2	GN Husk	3,500 per ton
3	Rice Husk	2,500 per ton
4	Electricity	4.90 per kWh (including service charges)

The specific electricity consumption of three typical units is furnished below table 3.3:

Table 3.3: Specific energy consumption

Details	Value	Unit -1	Unit -2	Unit -3
Wood	tons	660	660	600
GN Husk	tons	264	330	540
Electricity	kWh	2,28,576	4,82,880	2,93,880
Paddy Processing	tons	4950	4950	4950
Specific Electricity consumption	kWh/kg	0.04	0.10	0.06
Specific wood consumption	kg/kg	0.13	0.13	0.12
Specific GN Husk consumption	kg/kg	0.05	0.07	0.11

3.2.2.2 Electricity

Tariff Description	Consumption Slab range in kWhr (Units) and billing period (One or two months)	Fixed charges per service for two months	Energy Charges Paise /kW hr (unit)	Monthly Minimum in Rupees
LT Tariff III-B	Consumption from 0 units to 750 units per month/ 0 units to 1500 units for two months	Rs.60/-	400	Rs.40/KW or part thereof of the contracted load.
	Consumption from 751 units and above per month/ 1501 units and above for two months	Rs.60/-	500	

3.2.3 Capacity Utilization

The processing of paddy for production of Ponni rice involves soaking, cooking, drying and milling. All the process steps require different duration for each step. The capacity utilization of raw mills are 33% (24 hour basis), dryer utilization is 100% and cooking for 25% only, as the production capacity of these mills are limited based on the dryer capacity and raw mills are operated for about 7 to 8 hours in a day.

3.2.4 Housekeeping practices

Based on the detailed energy audits carried out in the cluster units, no unit is adopting good operating practices. The instrumentation also poor in the units, further, there is no monitoring of fuel consumption, process parameters, instrumentation for various equipments are not practiced and these may be due to lack of awareness.

3.2.5 Availability of data and Information

The data and information pertaining to electricity consumption is available and however, the fuel consumption details are not maintained in the records. The data for quantity of paddy processed are not willing to provide information. However, the data such as energy consumption and production monitored during the field visits have been used for evaluating specific energy consumption and potential for energy saving.

3.2.6 Any other relevant Aspect

Majority of the machine operators and helpers deployed in the cluster units are non technical and illiterates and their knowledge is based on the past experience. They do not have technical skills and knowledge on energy conservation. This is one of the important factors for inefficiency of the process and energy losses.

3.3 Technology gap analysis

3.3.1 Technology up-gradation

i) The state of art of technology of the units installed is poor as compared to the technologies available in the market. Various technological gaps were identified in the units as under and these may be due to lack of awareness on the technologies available, quantum of energy loss, lack of awareness among the workforce and unit owners, etc.

ii) There is a need for these industries to adopt energy efficient technologies.

iii) The Rice Milling Cluster units are fall under unorganized sector with low engineering, limited technology innovation and as well as low level of human resource on knowledge of technology, and operational skills. The 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.

iv) There are many technologies and energy efficient equipments available in the market and local service providers in dealing with these technologies.

3.3.2 Process upgradation

Though, there is potential for process upgradation in the cluster units for improving the quality and enhancing production, many industry owners are not willing for process upgradation due to high investment and low returns. Further, majority of the unit owners are marketing their products through agents and does not have knowledge on the market demand, trend, and requirement. The details of equipment-wise technology gaps identified and technology interventions required are furnished below:-

Table 3.4: Technology gaps identified and technology interventions

Sl.No	Equipments	Technology Gaps Identified	Technology Interventions
1	**Boilers**	• Energy Cost is more by Single flue gas path system • Poor heat transfer efficiency • No Waste Heat Recovery and high flue gas losses • Low loading of the boiler • The basic instrumentation like pressure gauges were also not installed • No proper monitoring of fuel feeding to the boiler • Overall inferior design of the boiler	• New Improved Design high efficiency boiler.

2	**Hot Air Dryers**	• Inferior design and high flue gas losses • High surface radiation losses. • MS tubes for heat exchanger hence less heat transfer efficiency	• New efficient hot air dryers • Copper tubes for heat exchanger
3	**Natural drying of paddy**	• For natural drying of paddy in open conditions is costly due to high manpower cost • The quality of the paddy may be deteriorated • Production loss in case of rains and also likely chances of damaging the products	• Install bed dryer and avoid natural drying
4	**Elevators**	• The elevator buckets are of iron and MS, which are heavy and consumes more power. •	• Plastic buckets for elevators
5	**ID and FD fans of Boilers**	• The flow is controlled by mechanical dampers and hence more power consumption	• Install variable frequency drives
6	**Rice Mill Machinery**	• The rice mill machinery installed are very old • The electricity consumption per unit of production is high as compared to latest and efficient machinery available in the market.	• Install new rice mill machinery
7	**Air Compressors**	• The compressed air is generated at higher pressure than required	• Optimize compressed air pressure
8	**Blowers**	• The blowers installed are of local make and the efficiency of the blowers is low.	• Install new energy efficient blowers

3.4 Energy Conservation measures identified

3.4.1 Description of proposals including technology/product specifications

The various proposals have been identified for implementation in the cluster units for reducing energy consumption consisting of high, medium and No/ low investment measures

3.4.1.1 Boilers

Background

The boilers are installed in the cluster units for steam generation. Steam is used for cooking of paddy. Steam is generated at 1 kg/cm^2 to 2 kg/cm^2 in the boilers and is for cooking purpose.

Based on detailed studies carried in cluster units, majority of the boilers installed in the various rice mills of the cluster were found to be inefficient due to inferior design like single pass system, high flue gas losses, heat losses through grate and high radiation losses with efficiencies around 25 to 40%. The low efficiency can be attributed to sub-optimal loading of boiler, inferior boiler design, old/obsolete and local boilers, and absence of waste heat recovery.

Boilers

Recommendation

It is recommended to install new boilers having efficiency over 70% by replacing the present boilers.

The features of high efficiency boilers are furnished as under:

- The boiler is of three-pass construction consisting of furnace section as first pass and two convective tubular pass.
- The boiler is fully wet back construction, which is located in the rear of the furnace effectively, quenches streaks of flame entering it ensures complete turnaround mixing of the gases prior to entering the second pass.
- The front smoke box also ensures complete turnaround and the mixing of the gases prior to entering the third and final pass of the smoke tubes.
- The bigger diameter smoke tube ensure smooth passage of flue gases and prevent choking, clinkering at the tube ends. Further it makes cleaning easy.
- Fuel firing system consists of fixed grate made of heat resistance, cast iron, complete with furnace refractory for reducing radiation losses
- Adequate heating surface ensures guaranteed performance.
- Adequate grate area and furnace volume to ensure safe grate loading and furnace heat loading
- Optimum gas velocities are maintained to ensure minimum pressure drop on gas side and most effective heat transfer

- The staggered tube arrangement in convective zone ensures effective water circulation and hence heat transfer
- MS hinged door, completed insulated with heat resistance refractory provided for easy access to the smoke side of the boiler
- Compact, quick steaming, sturdy and dependable, this units are simple to install.

The new efficient boilers can be installed in about 295 units. The annual fuel savings is estimated is 54,967 tons of wood, groundnut husk, rice husk and monetary savings of Rs.1,924 lakhs per annum. The total investment required for 295 units is Rs.1,768 lakhs and simple payback period is less than 1.00 year.

The select technical details of the proposed energy-efficient boilers are furnished below in Table 3.5:

Table 3.5: Select technical details of energy-efficient boilers

Boiler Capacity	500 kg/hr	750kg/hr	1000 kg/hr
Steam output (kg/hr)	500 kg/hr	750 kg/hr	1000 kg/hr
Fuel	Solid Agro waste	Solid Agro waste	Paddy Husk
Steam pressure (kg/cm^2)	10.54	10.54	10.54
Efficiency, %	72 ± 2	72 ± 2	72 ± 2
Fuel consumption GN Husk (kg/hr) Rice Husk(kg/hr)	 130 130	 210 210	 230 230
Electrical load (kW)	7.5	7.5	11.2

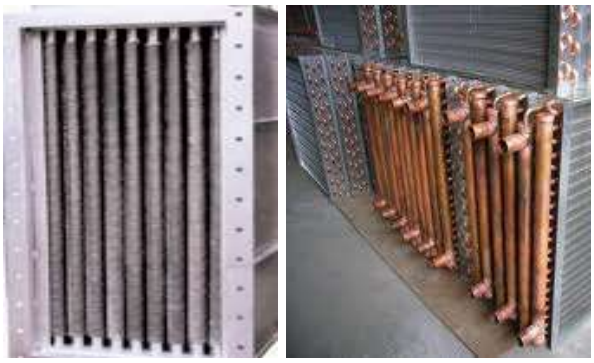
***Benefit*:**

- Reduces fuel consumption and faster generation of steam
- Reduces GHG emissions
- Improves working environment for workers due to reduction in radiation losses and flue gas temperatures

Heat Exchanger tubes

Background

The hot air dryers are installed in the cluster units for drying the paddy in the dryer by hot air. Based on detailed studies carried in cluster units, majority of the dryers has MS heat exchangers. The MS heat exchanger tubes will have less efficiency than the copper tubes.



Heat Exchangers (MS and Copper)

Recommendation

It is recommended to replace the present MS heat exchanger tubes with copper tubes, the copper tubes will have more heat transfer efficiencies. The replacement of MS tubes with Copper tubes can be implemented in 45 units. The annual fuel savings is estimated is 1,590 tons of wood or rice husk and monetary savings of Rs.56.0 lakhs per annum. The total investment required for 45 units is Rs.45 lakhs and simple payback period is less than 1.00 year.

Benefits:

- Low cost of energy cost
- Low operating costs
- Reduces GHG emissions
- More life of the heat exchanger

Bed Dryer for drying Paddy

Background

In Vellore rice milling industries, the paddy after cooking with steam is dried naturally in the open conditions. The drying of paddy under natural conditions is labor intensive and involves high cost and also paddy quality may deteriorate due to dust and also production loss occurs during rainy season.

Bed Dryer

Recommendation

The installation of bed dryer will reduce labor cost considerably and also the quality of the paddy will improve. The production also enhances due to more production during rainy season.

Fludised bed dryers can be implemented in about 130 units in the cluster. The annual fuel savings is estimated as 4,290 tons of wood. The monetary savings were estimated as Rs.579.00 lakhs per annum due to fuel savings and reduction in labour cost. The total investment required for 130 units is Rs.780 lakhs and simple payback period is 1.50 years.

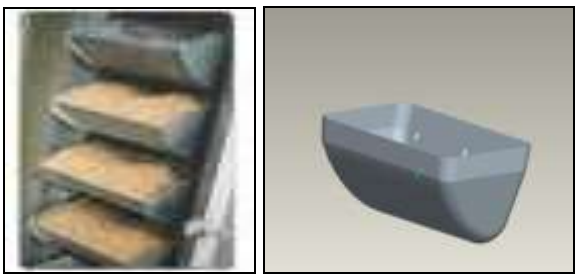
Benefits:

- Low operating cost
- More production
- Quality of the paddy enhances
- Avoids raw material damage during rainy season

3.4.1.2 Elevators

Background

The elevators are common type of equipment found in rice milling industries. The elevators are used for transferring the paddy to various equipments. The detailed studies undertaken in various rice mills, it if found that majority of the rice millers are using iron or MS buckets for elevators. The iron or MS buckets consume more power due to heavy weight than the plastic buckets.



Elevator buckets

Recommendation

The replacement of Iron and MS Buckets with plastic buckets for elevators will reduce the power consumption and also reduces maintenance cost. The cost benefit analysis is furnished below table 3.6:

Table 3.6: Cost benefit analysis for elevators in a typical unit

Parameters	value	unit
No. of elevators	15	nos
no of hrs	6	hrs
no of days	330	days
Total power consumption of elevators	22,275	kWh/year
% savings expected	10%	
Power savings per annum	2,228	kWh
Monetary savings per annum(@Rs.4.90 per kWh)	10,915	Rs.
Investment required	30,000	Rs.
Payback period	33	months

There are about 6 to 15 elevators in each unit. The elevators are connected by 1 HP motor each.

It is recommended to replace MS buckets with plastic buckets, which consume less power, the plastic buckets can be taken up in around 330 units in the cluster. The Monetary savings is estimated as Rs.42.00 lakhs. The investment required is estimated at Rs. 47.00 lakhs and the payback period is 1.1 years.

Benefits:

- Low electricity consumption
- Reduces GHG emissions
- Easy cleaning of the buckets

Hot Air Dryer Blowers

Background

The blowers are one of the major energy consuming equipments in the rice milling industries and the blowers are installed for hot air dryer, removing dust, husk and bran in the raw mills. Majority of the blowers installed are of local make and blowers are found to be inefficient.

The blowers developed by the heat flow engineers have higher efficiency than the local blowers due to the following reasons:

- Double impeller and double suction type drier fan
- The impeller blades are made of Aluminium Alloy, which is lighter than MS and impeller is critically designed and hence more efficiency
- The blowers are powered by a totally enclosed fan cooled, A.C induction motor, suitable for continuous duty. Motor stator is made of low watt loss steel laminations

assembled under pressure and rigidly locked in the frame. Dynamically balanced rotor ensures vibration and noise free operations. Shaft is made of quality steel, precision ground of ample size for transmitting the rated Horsepower.

Dryer Blower

The cost benefit analysis of installing energy efficient blowers is furnished below in table 3.7

Table 3.7: Cost Benefit Analysis of Hot Air Dryer Blowers

Parameters	Value	Units
Capacity of installed blower	11	kW
Actual Power Measured	8.5	kW
Air flow	28,000	(m3/hr)
Pressure	50	mm of Wc
Efficiency of the existing Blower & motor	44.9	%
Efficiency of the new energy efficient blower	70	%
Power savings	2.9	kW
Power Savings per Annum	11,484	kW
Monetary Savings	0.56	Rs.(Lakhs)
Investment	0.60	Rs.(Lakhs)
Payback Period	1.1	Years

There are about 300 air dryer blowers in the cluster units. The energy efficient blowers can be installed in about 100 in the cluster units. The annual electricity savings is estimated is 11,48,400 kWh per annum and monetary savings of Rs. 57.50 lakhs per annum. The total investment required is Rs.60.00 lakhs and simple payback period is 1.1years

The technical specifications of energy efficient blowers for various capacities of hot air dryers are furnished below in Table 3.8:

Table 3.8: Technical specifications of energy-efficient blower for various capacities of Hot Air Dryers

Capacity of Dryer (Tonnes)	Model	Air flow (m^3/hr)	*Power (kW)*
12	PS-3	22400	*3.75*
16	PS-4	28000	*5.63*
20	PS-5	33000	*5.63*

24	PS-6	38500	*7.50*
32	PS-8	48000	*11.25*
40	*PS-10*	*58000*	*15.00*

Source: Heat Flow Engineers, Ahmedabad

Benefits:

- Reduces power consumption and hence effects the production cost
- Low investment and high returns, the payback period is less than 6 months
- Reduces GHG emissions due to reduction in electricity consumption
- Reduces maintenance costs due to improved quality of blowers parts
- Reduces production down time

Variable Frequency Drives for ID and FD fans

Background

There are number of equipments in Vellore Rice Mills Cluster units, where the flow is controlled by mechanical dampers for fans such as ID and FD fans of the hot air dryers.

If the flow can be controlled by reducing the speed of the fan, this would offer a more efficient means of achieving flow control. In fact the saving is greater than that might initially be expected. As the speed of the fan is reduced, the flow will reduce partially, while the power required by the fan reduce with the cube of the speed.

The mechanical constriction of the flow may reduce the load on the motor/fan/pump motor. But the constriction itself is an energy loss, which is obviously an inefficient operation. If the flow or speed can be controlled by reducing the speed of motor, this would offer a more efficient means of achieving flow control. In fact the saving is greater than that might initially be expected. As the speed of the blower is reduced, the required speed/flow will reduce partially, while the power required by the fan reduce with cube of speed, for instance, if the speed is reduced by 10%, the flow reduces by 10%, pressure reduces by 15% and power consumption reduces by 25%.

VFD

Recommendation

It is recommended to install VFD's for ID and FD fans. A minimum savings of 20% can be realized. The variable frequency drives are available as per the capacity of the motor and no. of speeds required. The cost benefit analysis of installing a VFD is furnished below:

Table 3.9: The cost benefit analysis of installing a VFD is furnished below:

Details	Value	unit
Power consumption ID & FD fan of the boiler	6.73	kW
Achievable savings (20 %)	1.35	kW
no. of hours of operation per annum	7,920	hours
Power savings per annum	10,660	kWh
Monetary savings	0.52	Rs. in lakhs/annum
investment required	0.30	Rs. in lakhs/annum
payback period	7	months

Benefits of VFD's

The benefits of installing the drives are as follows:

- Reduction in breakdowns and smooth start
- Unity power factor
- Reduction in breakages and motor burnts
- Improved life of the motor and increased production
- Reduction in production cost and maintenance cost due to frequent failures of belts, bearings, yarn breakages
- Improved power factor (.98 across speed range)
- Maximize power distribution system
- Reduced Inrush Currents
- Minimize Peak Demand Charges
- Soft Start/Soft Stop

- Eliminates Mechanical Shock and Stress on Power Train (couplings, belts, drive shafts, gear boxes, etc.)
- Reduce Utility (Operating) Costs
- Reduced Energy Consumption, Process Operates at Most Efficient Point
- Allows Load Shedding
- May Qualify for Utility Rebates
- Controlled Acceleration and Deceleration
- Eliminates Motor Voltage Imbalance
- Input Power Phase Reversal Protection

VFD for ID and FD fans

VFD's can be installed for about 68 units in the cluster. The annual electricity savings is estimated is 7,24,902 kWh per annum and monetary savings of Rs.35.52 lakhs per annum. The total investment required is Rs.20.40 lakhs and simple payback period is 7 months.

3.4.1.4 Air Compressors

Background

The air compressors are installed in the selected units having sortex machines.. The compressed air is used for sortex machine requirement. Majority of the air compressors installed are of reciprocating type. The compressed air is generated at 10 kg/cm^2 and where as actual requirement is 5 kgs/cm^2 for Sortex machine as recommended by the machine supplier. It is well known fact that, for every 1 kgs/cm^2 increase in compressed air pressure, the power input to the compressor increases by 6%.

The study of compressed air usage and the pressure requirements show that a reduction in generation pressure by 3 kg/cm^2 can be made without affecting the end-use equipment performance. Reduction in generation pressure has the advantages of reduction in power consumption (by 15%), increase in FAD and also reduction in leakage losses and maintenance costs.

Recommendation

1. It is recommended to reduce the compressed air generation pressure from the present 10 kgs/cm^2 to 6 kg/cm^2 to augment pressure drops in the compressed air distribution lines. The cost benefit analysis is furnished below:

Table 3.10: Cost benefit analysis for Air Compressors

Sl.No	Details	Value	Unit
1	Power input to the compressor	7.5	kW
2	No. of hours of operation/year	6,000	
3	% savings expected	15%	
4	Power Savings per annum	6,750	kWh
5	Monetary savings per annum	33,075	Rs.
6	Investment required	Nil	
7	Payback period	Immediate	

The above recommendation can be adopted in 317 units in the cluster. So the Monetary savings can be estimated as Rs.126 lakhs/annum. There is no investment required.

3.4.1.5 Mechanized Soaking and Cooking unit

Background

In majority of the rice mills, the paddy is handled manually during soaking and cooking of paddy. The paddy from the bags is unloaded to the soaking tanks. After soaking process is completed, the soaked paddy is removed from the soaking tanks manually and loaded for cooking. The process of handling paddy is labor intensive and handling cost is high. Based on the discussions had with the rice mill owners, it is found that, about 20 workers are required for loading and unloading of the paddy and about Rs.4,000 is spent towards labor charges.

Mechanized soaking

Recommendation

It is recommended to install mechanized Soaking and cooking unit for reducing the labor charges. The system consists of elevators and SS tanks for soaking tanks and cooking of paddy at a height of 25 to 35 feet. The paddy is unloaded from the bags manually and loaded to the tanks through elevators and paddy is unloaded after completion of the process.

The mechanized soaking and cooking unit can be installed in about 102 units in the cluster. The estimated Monetary saving is Rs.11.63 lakhs/annum. Investment required for 102 units is Rs 20 lakhs and the payback period is 1.8 years.

***Benefit*:**

- Reduces production cost
- Reduces the dependence on workers
- Improves production and reduces loading and unloading time

3.4.2 Life cycle analysis for the suggested Energy saving proposals

The life cycle analysis for each of the suggested energy saving proposal has been prepared as per the Indian industry norms, government policies, and as per the guarantee provided by the equipment/technology suppliers and presented below.

Table 3.11: Life cycle analysis for energy saving proposals suggested

Sl.No	Energy Saving Proposal	Life cycle analysis
1	Energy efficient boiler.	The life of the boiler is considered at 20 years. The depreciation is considered at 80% by straight line method.
2	Copper tubes for heat exchanger	The life of the copper tubes is considered at 5 years.
3	Fluidized bed dryer	The life of the Bed dryer is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
4	Plastic buckets for elevators	The life of the plastic buckets for elevators is considered at 10 years. The depreciation is considered at 5.28% by straight line method.
5	Variable frequency drives	The life of the variable frequency drives is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
6	Air compressors	Reduce the present 10 kgs/cm^2 to 6 kg/cm^2 to augment pressure drops in the compressed air distribution lines
7	Energy efficient hot air dryer blowers	The life of the hot air dryer blowers is considered at 20 years. The depreciation is considered at 20% by straight line method.
8	Mechanized Soaking and Cooking Unit	The life of the mechanized soaking unit is considered at 20 years. The depreciation is considered at 5.28% by straight line method

3.4.3 Cost of Implementation

The investment required for various proposals identified for different capacities of the measures identified for **Vellore Rice Mills** Cluster is furnished below.

Table 3.12: Details of cost of implementation

Sl.No	Equipment Details	Capacity	Investment (Rs. In Lakhs)
1	Energy efficient boiler	500 kg/hr/750 kg/hr/1000 kg/hr	1,768
2	Copper tubes for heat exchanger	13 TPD and 15 TPD	45
3	Bed dryer	15 TPD	780
4	Plastic buckets for elevators	-	47
5	Variable frequency drives	7.5 HP and 10 HP	20.40
6	Air compressors	15 HP	-
7	Energy efficient hot air dryer blowers	15 TPD,18 TPD and 20 TPD	24
8	Mechanized Soaking and Cooking Unit	15 TPD and 20 TPD	20

3.4.4 Monetary savings

As per the detailed audits carried out on various equipments of **Vellore Rice Mills Cluster** units, the monetary savings have been estimated for each proposal and the details are furnished below:

Table 3.13: Energy saving details for the suggested energy saving proposals

Sl. No	Equipment Details	Investment (Rs. in Lakhs)	Monetary savings (Rs. in lakhs)	Payback period (years)
1	Energy efficient boiler	1,768	1,924	0.90
2	Copper tubes for heat exchanger	45	56	1.00
3	Bed dryer	780	579	1.30
4	Plastic buckets for elevators	47	42	1.10
5	Variable frequency drives	20.40	35.52	0.57
6	Air compressors	0	126	Immediate
7	Energy efficient hot air dryer blowers	60	57.50	1.10
8	Mechanized Soaking and Cooking Unit	20	11.60	0.80

3.4.6 Issues/barriers in implementation of EE proposals

The major barriers identified for implementation of the proposals in the cluster units are described below:

- One of the major barriers is the lack of awareness and information among the cluster owners on energy / monetary losses, EE technologies, and energy efficiency. A few demonstration projects may motivate them to take up the projects.
- About 80% of the cluster unit owners doesn't have financial strength for implementation of high cost technologies.
- Though, LSPs are available in the cluster, they don't have technical strengths for supply of efficient equipments.
- Production loss during implementation of the energy saving proposals

3.4.7 Availability of Technologies in Local / National

For majority of the technologies and proposals identified, the equipments suppliers/ dealers / branch offices are available in Chennai, as Arni and Arcot are small towns. Among the technologies / equipments identified for implementation for Vellore Rice Mills cluster units, some of the measures can be implemented by the local service providers and the balance equipments can be procured at nearest city i.e., Chennai or Vellore. The detail of equipment which can be implemented by LSPs and those needs to be procured from other cities is furnished below:

Table 3.14: Details of technologies available for the suggested proposals

Sl.No	Equipment details	LSPs (Chennai)	India
1	Energy efficient boiler	√	
2	Copper tubes for heat exchanger	√	√
3	Bed dryer	√	
4	Plastic buckets for elevators	√	
5	Variable frequency drives	√	
6	Energy efficient hot air dryer blowers	√	
7	Mechanized Soaking and Cooking Unit	√	

Note: √ Available

3.5 Identification of Technologies/Equipments for DPR preparation

The majority of the industries in the cluster are engaged in the processing of paddy for production of rice. The manufacturing processes and equipments installed are identical for most of the cluster units.

Based on the detailed studies carried out, there is considerable potential in all cluster units for energy conservation and efficiency.

As the process and equipments are more or less similar in all cluster units, all the technologies / equipments identified can be replicated as per the requirement and detailed project reports for the specific technologies prepared also can be replicated for different units as per the capacity requirement.

The technologies/equipments considered for preparation of detailed project report are furnished in Table 3.15:

Table 3.15: The list of technologies for DPR preparation

Sl.No	Technology/equipment	No. of DPR's	Capacities
1	Energy Efficient Boilers	3 no	500,750 and 1000 kgs/hr
2	Fluidized Bed Dryer	3 no	15 and 20 TPD
3	Copper tubes for Heat Exchanger	2 no	13 and 15 TPD
4	Variable frequency drives	2 no	7.5 and 10 HP
5	Mechanized Soaking and Cooking unit	2 no	15 and 20 TPD
8	Energy Efficient Hot Air dryer Blowers	3 no	15, 18 and 20 TPD

3.6 Environmental benefits

3.6.1 Reduction in GHG emissions

The major GHG emission reduction source is CO_2 due to implementation of the technologies identified, as the technologies will reduce fossil fuels like coke and furnace oil consumption.

3.6.2 Reduction in other emissions

The technologies identified upon implementation for the **Vellore Rice mills** Cluster units will reduce wood, Electricity consumption.

Table 3.16: Estimated annual fuel/electricity savings in the cluster

Sl. No	Energy conservation measure	Annual Energy/Fuel saving Per Annum	Annual Monetary saving (Rs. lakhs)	Implementation cost (Rs. Lakhs)	Simple payback period (Years)	Short listed for DPR preparation (Yes/No)	No of units this can be implemented
1	Energy Efficient Boiler	54,967 tons	1,924	1,768	0.90	Yes	295
2	Energy Efficient Hot Air Dryer Blowers	11,48,400 kWh	57.5	60	1.1	Yes	100
3	Elevators	8,55,123 kWh	42	47	1.1	No	330
4	Fluidized Bed dryer	4,290 tons	579	780	1.3	Yes	130
5	VFD	7,24,902 kWh	35.52	20.40	0.57	Yes	68
6	Air Compressors	25,64,246 kWh	126	-	Immediate	No	317
7	Mechanized Soaking and Cooking unit	-	11.60	20	1.73	Yes	102
8	Copper Tubes for Heat Exchanger	1590	56	45	1.00	Yes	45

Table 3.17: Estimated annual fuel/electricity savings in the cluster

S. No	Fuel	Total fuel savings/annum in the cluster
1	GN Husk	51,068 tons
2	Wood	5,259 tons
3	Electricity	41,43,353 kWh

CHAPTER 4 SYSTEMATIC APPROACH FOR ENERGY CONSERVATION BY TEM/SGA

4.1 Introduction

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development.

In this situation Energy Conservation (EC) is the critical needs in any countries in the world.Of special importance of Energy Conservation are the following two aspects:

(1) Economic factors

(2) Environmental impacts

4.2 Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

Notably, the wave of energy conservation had struck the Indian intelligentia 3 years earlier when a Fuel Policy Committee was set up by the Government of India in 1970, which finally bore fruits three decades hence in the form of enactment of the much awaited Energy Conservation Act, 2001 by the Government of India. This Act made provisions for setting up of the Bureau of Energy Efficiency, a body corporate incorporated under the Act, for supervising and monitoring the efforts on energy conservation in India.

Brief History of energy efficiency movement in India and associated major milestones are as follows

- 1974: setting up of fuel efficiency team by IOC, NPC and DGTD (focus still on industry)
- 1975: setting up of PCAG (NPC main support provider) : focus expanded to include agriculture, domestic and transport
- 1978: Energy Policy Report of GOI: for the first time, EE as an integral part of national energy policy – provided detailed investigation into options for promoting EE
- Post 1980, several organizations started working in EC area on specific programs (conduct of audits, training, promotion, awareness creation, demonstration projects, films, booklets, awareness campaigns, consultant/product directories)
- Some line Ministries and organizations like BICP, BIS, NPC, PCRA, REC, Ministry of Agriculture, TERI, IGIDR, CSIR, PETS (NPTI)
- State energy development agencies

- Industry associations
- All India financial institutions

The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provisions of the Energy Conservation Act, 2001. The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets and that is good for the national trade balance, too.

4.3 Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. The problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHG). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

4.4 Total Energy Management (TEM)

Every point in factories has potential for Energy Conservation. Total Energy Management is implemented, by all the people's participation, step by step utilizing "Key Step Approach" in a systematic manner, as shown below:

1) Top management policy/Goal
   - Develop a policy statement
   - Set targets
2) Proper EC Organization including Assignment of Energy Manager
   - Establish proper EC organization (utilizing SGA)
   - Assignment of Energy Manager
3) Data collection and Analysis
   - Collect data on current energy use
   - Analyze the collected data

- Identify management strength and weakness
- Analyze stakeholders' needs
- Anticipate barriers to implement
- Estimate the future trend

4) Selecting EC Measures/Projects
   - Selecting EC Measures
   - Selecting EC Projects
   - Make out a plan/program
5) Prioritizing
6) Developing an Action Plan
7) Training the related members
8) Awareness-raising and Motivation
9) Implementing the Action Plan (including monitoring and controlling
10) Evaluation (Management review)
11) Analysis for future planning (Standardization and Dissemination)

The following figure shows these Key Steps for implementing Energy Conservation activities.

Steps of the Key Step Approach.

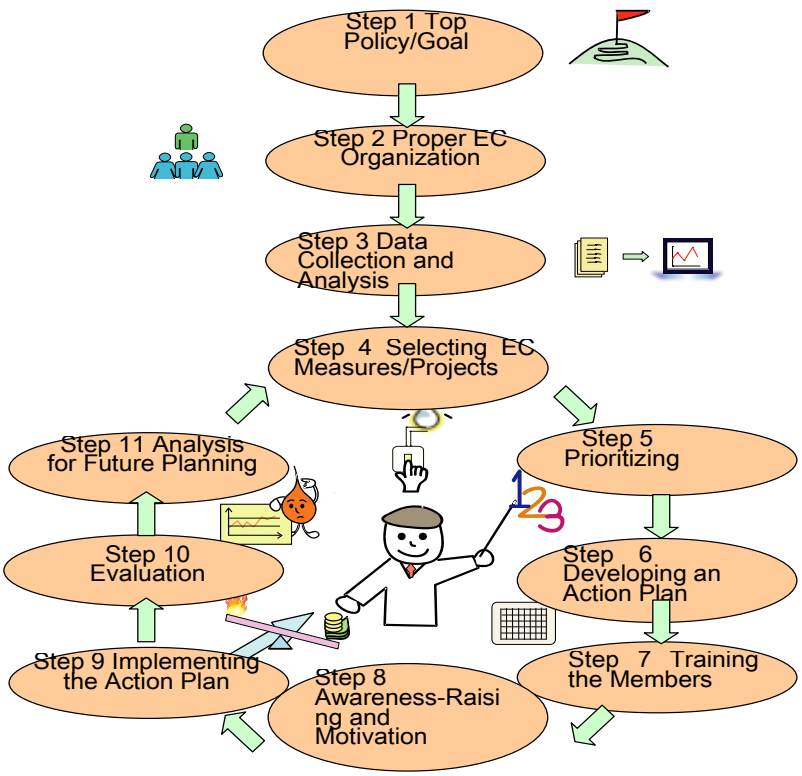


Figure 6: Key Step Approach

Each step is explained in this order as below:

Step 1: Top Management policy/Goal

It is the most important for the success of Energy Conservation activities within companies or factories to have clear and official commitment of top management – either the corporate top (senior) management or factory managers. The top (senior) management shall announce explicit commitment to the Energy Management (or Energy Conservation) and behave along this line – for example, participate in EC (Energy Conservation) events and encourage the people there for EC promotion.

This Handbook is primarily meant for Energy Managers for the use of EC promotion within factories, on the assumption that top management has already committed to that. However, there may be cases where top management would learn about Energy Management (or Energy Conservation) by this Handbook, or Energy Managers would make efforts to persuade top management to support or commit to Energy Management (or Energy Conservation) with the help of this Handbook.

(1) Develop a policy statement

It is desired that the top (senior) management announces the "Energy Policy Statement". This is very effective to let people inside and outside the company clearly knows the management's commitment to Energy Management (or Energy

Conservation). The format of the energy policy statement is various, but it usually includes the goal or objective of the company and the more concrete targets in the field of Energy Management (or Energy Conservation). It often shows the major measures and timetables. The statement shall match the company's mission statement or overall management strategy plan.

(2) Set targets

The targets shall be concrete and specific so that everyone can understand it.

Step 2: Proper EC Organization including Assignment of Energy Manager

In some countries, where the EC Promotion Act is in force, the designated factories have obligation of assigning Energy Managers. In relation to Energy Management, however, the word "Energy Managers" is here used as a Manager or a Coordinator, separate from the above-said legal obligation, who works exclusively for Energy Management (or Energy Conservation) purposes, ranging from gathering energy-related information to drafting EC plans/programs and promoting or coordinating during implementation. To the proper Energy Management, this type of Energy Manager is indispensable. How to position this Energy Manager within the company organization is also an important issue and needs careful decision. In some cases, Energy Committee, with members from the major departments, may be formed to assure the company-wide or factory-wide cooperation, as shown in the following figure.

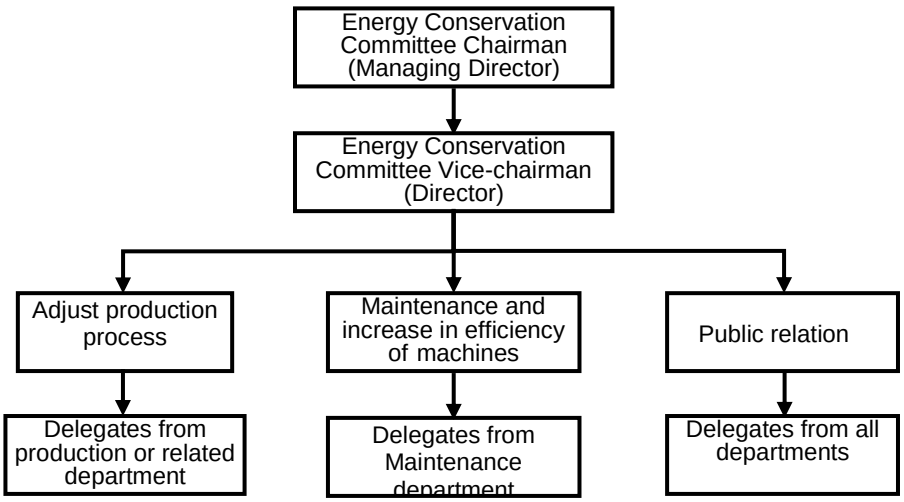


Figure 7: Example of energy conservation committee's organization

Actually there are many ways of forming EC organization, depending on the situation of factories or institutions, such as the size, kind of business, etc. In any case, it is very effective to utilize SGA (Small Group Activities) and there are also many ways to do that. The important thing is to design and make out the organization carefully to meet the purpose. In practical sense to do that, there may be the following five widely applicable ways of establishing the organization.

(1) Utilize Line (Formal) Job-related Organization for TEM purpose

(2) Use TPM Organization for TEM purpose

(3) Use TQM Organization for TEM purpose

(4) Add Employee Suggestion System to Energy Conservation Organization for TEM purpose

(5) Utilize another organization for TEM purpose

The easy and practical way may be starting from easy form of TQM, or QCC (Quality Control Circle) activities.

Furthermore, because TPM is closely related to job-related organization, (1) and (2) may be often give the same kind of results. (An example of this form is shown in Part 3, 2 “How is SGA related to Energy Conservation?” (page 21).

Step 3: Data collection and Analysis

Before trying to make out any future programs or action plans, it is essential for the company or factory management to understand the current situation in a proper and accurate manner. This includes not only the status of their own operation but also other relevant information such as competitors’ operation, circumstances around the company and their trend in future, positioning the company itself in the local and global markets, and so on.

The key steps for this purpose are shown below:

(1) Collect data on current energy use and analyze them

The current data of energy consumption shall be obtained by measurement, calculation or estimation for the individual operation units (energy cost centers) with classification of kinds of energy (fuels types, utility types, etc.). The data shall be gathered regularly and arranged/summarized daily, weekly, monthly, by seasons or annually. Then the data shall be checked for the past historical trend and interpreted with relation to operational modes and production scales. That shall also be utilized for the forecast of future trends.

(2) Identify Management Strength and Weakness

Then the data shall be compared with the best practice data or benchmarks in the industry. If such reference data are hardly available, the historical data of their own operation and estimated data for the competitors would be utilized for this purpose. At the same time, the strength and the weakness of the company shall be evaluated considering the competitors’ situations in the local and global markets. This would serve the purpose of making out a realistic Energy Management plan later.

(3) Analyze stakeholders' needs

Stakeholders are top (and senior) management, middle managers, staff/engineers and workers/operators. Other stakeholders in the normal business sense, such as the shareholders and lenders, need not be considered here for the moment. The needs and intention of those stakeholders shall be summarized and taken into consideration.

(4) Anticipate barriers to implement

Making out a realistic and practical program also needs consideration of anticipated barriers for the implementation of Energy Management program or action plan.

Some possible examples of such barriers are:

- Insufficient understanding and support by top management
- Insufficient understanding and cooperation of managers within factories
- Insufficient awareness of people to get successful results
- Insufficient capability of people due to lack of training
- Insufficient available technology due to lack of information
- Insufficient availability of manpower for EC activities within factories
- Insufficient budget for EC activities due to the company's financial status

(5) Estimate the future trend

The future trend of energy supply-demand balance is estimated based on checking and analysis of the historical data. That data of future trend would also be a basis of the program of excellent-Energy Management.

In analyzing the collected data and developing ideas of Energy Conservation, it is very often useful to think of the following techniques of finding problems and solutions:

Suppress: Using during the time in which it is not necessary to use. Examples include using electricity before or after working hours or when there is no one working.

Stop: Using equipment when it is not necessary. Examples include using all lightings during break time.

Reduce: Amount, pressure, temperature, speed, or brightness, or quality that exceed requirement. Examples include reducing intensity of lighting if not necessary.

Prevent: Prevent leakage or loss of energy. Examples include reducing space that leads to outside in order to prevent the leakage of heat into air.

Improve: Improve or repair machines to increase efficiency or modify manufacturing process to the one which enables us to conserve energy more. Examples include changing transparent sheet over the roof.

Store: Re-use the discarded energy. Examples include re-using heat from exhaust fume in order to reduce use of electric heater to warm heavy oil.

Change: Change how to use, type of energy, or energy sources to a suitable one from technical or economic point of view. Examples include changing the grade of heavy oil to an appropriate one or changing furnace systems or welding machines to the ones that use gas.

Increase Production

Examples include improving production process. This will lead to the reduction of energy usage per production amount.

Step 4: Selecting EC Measures/Projects

Based on the aforesaid understanding of the current status and position of the company (factory), various EC measures are studied and many EC Projects are proposed. Comparison among these measures and projects are made with consideration of a lot of factors, such as technical, economic, intangible, and so on.

Then a plan/program is developed based on these study results. To do this, it is very important to consider the following issues:

The plan/program shall be realistic, practical and attainable with due consideration of many related elements and management resources of the company or factory. It also shall be expressed in terms of the measurable or quantifiable parameters, including Fuel Usage Index, Electricity Usage Index, Energy Usage Index, etc. It usually includes a lot of managerial measures of Energy Management (or Energy Conservation) promotion activities such as motivation techniques, means to improve awareness, training, and so on. In other words, the following items are often useful in comparing and selecting alternative plans:

1. Effects of energy conservation: Activities that can conserve energy more than others are more promising.
2. Investment amount: Activities that require less investment are more promising.
3. Pay-back period: Activities with short pay-back period for investment amount in equipment are more promising because all energy conservation will be profits after pay-back period.
4. Length of implementation: Activities that can be performed in a short period are more promising because they do not influence production process of the factory.

5. Number of personnel required: Activities that require a large number of personnel tend to be burdensome.
6. Importance to executives and reputation of the company: Some activities provide little financial benefit but cause good image or reputation.
7. Risk of the project: Some activities bring about big financial benefits but involve high risk from various factors. In this case projects have less importance.

Step 5: Prioritizing

Many EC measures and projects are prioritized based on the internal studies including comparison among their alternatives, in the manner explained in the above.

Step 6: Developing an Action Plan

The priority consideration then gives birth to the Action Plan. The plan shall be clear, practical and comprehensive with proper schedule and budgeting.

Shown below is an example of such a plan.

Table 4.1: Example of energy saving plan

Detail of the plan	Length (Months)						Person in charge	Budget	Inspected by
	1	2	3	4	5	6			
1. Turn off electricity when there is no one around							Mr. Prayat		
2. Turn off air-conditioner 30 minutes before stop working							Miss Aom		
3. Reduce welding machine's current according to the specification of the metal used for welding							Mr. Matthayas		
4. Close welding machine after working							Miss Thanom		

Step 7: Training the related members

This issue is very important to secure the success of project Implementation, because the people are the most important resources that determines the success of the plan.

Step 8: **Awareness-raising and Motivation**

To have the total power of "all members' participation" combined together, it is also very crucial how to raise awareness and motivation of related people within the company (or factory).

Shown below is an example of awareness raising plan.

Table 4.2: Example of awareness raising campaign

Detail of the plan	Length (Months)						Person in charge	Budget	Inspected by
	1	2	3	4	5	6			
1. Display the results of energy conservation every month	*	*	*	*	*	*	Mr.Prayat	-	Mr. Laaied
2. Evaluate every month	*	*	*	*	*		Miss Aom	-	Mr. Laaied
3. Perform energy conservation activity every 6 months	*					*	Mr. Matthayas	-	Mr. Laaied
4. Perform "Finding measures" activity in order to make energy conservation plan	*					*	Miss Thanom	-	Mr. Laaied
5. Provide rewards to sections that have achieved high efficiency						*		-	

Step 9: Implementing the Action Plan (including monitoring and controlling)

The organizational force established in the said planning step shall be utilized fully to ensure smooth implementation of the program. Energy Manager and/or the committee shall continue working to promote the activities and report to top management on the status quo.

The actual records of implementation shall be closely watched and monitored. If some problems arise, or some variance between the planned figures and the actual record is observed, then necessary actions shall be taken immediately.

Step 10: Evaluation (Management Review)

After the program is completed, the report shall be submitted to the top (senior) management. The results shall be assessed and analyzed for any good and bad points. The lesson shall be utilized as a feedback in the subsequent plan/program.

Thus the activities are repeated to form a cyclic movement.

The result of evaluation must be announced on the board in order to inform employees, so that they will be given motivation for the next activities. Evaluation can be divided into 2 types as follows.

- Short-term evaluation for the follow-up of the performance
- Long-term evaluation for the evaluation of the whole project that will be used for the future planning

Evaluation can be made in the following 3 levels.

1. **Self Audit:** Self evaluation that is made in a small group or a department based on the predefined form. (Inspection may be made every month).

2. Upper **Manager Audit:** Evaluation that is made by the section/department manager intended to raise performance of the activity. (Inspection may be made every 3 month).
3. **Top Management Audit:** Evaluation made by the executives of the organization that will be used for the evaluation of annual bonus. (Inspection may be made every 6 month).

In some cases, top management could think of adopting external people (outside consultants) to evaluate the results of Energy Conservation activities. Even in those cases, internal evaluation should be made to gain the fruits as much as possible.

Step 11: Analysis for future planning (Standardization and Dissemination)

The successful results and the lessons learned are to be analyzed and arranged into the standard form which can be easily utilized by anyone in the factory. The standardized documents or information are to be disseminated all over the company.

Moreover, Energy Conservation should be incorporated as a part of daily jobs and performed continuously in a systematic manner. For this purpose, activities for energy conservation must be incorporated as a part of company's basic or business plan. If a problem is found as a result of evaluation, improvement or modification will be done and the objectives will be achieved. If the results reach or exceed the objective, information must be gathered in order to set it as a "Work Standard," which will be used in setting a new activity plan.

4.4 Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the cumination of zero break-downs, zero defects, and zero waste. Enterprising employees identify the problem, be it in "man, material, method, or machine," and develop cost-effective and practical methods for solving the problem.

4.5 Importance of SGA

SGA are activities by group of employees at operator (working Group) level. They aim to solve problems that occur at the place taken care of by each employee and put emphasis on participation and team work. Factories can apply small group activities to many kinds of work along with normal work or other measures that are already underway. The burden on employees will not increase because of small group activities. They are not only bringing benefits to factories but also boosting the knowledge and ability in performing jobs of employees, improving communication among employees, increasing creativity, and make it possible to express their own proposal with less hesitation to management. As a result,

employees will start to think "This is our problem." This SGA can be applied to Energy Conservation, too, with successful results, as shown in Figure 28.

4.6 How SGA leads to Energy Conservation?

An excellent example of organizational structure that promotes energy management emphasizing participation is that they form overlapping small groups as in figure 14. The feature of this structure is that a small group for energy management is distributed to various sections as in figure 15, which is a recipe for success of Total Energy Management (TEM) and makes various communications and management of activities more efficient and effective.

Small group activities for total energy management (TEM) are the activities in which employees of all levels in production or management, starting from the top to the bottom, participate in order to reduce loss related to their own job by improving their job. In order for the activities to succeed, management of all levels must provide support in necessary training and equipment, communication of policies, and the setting of problems to solve

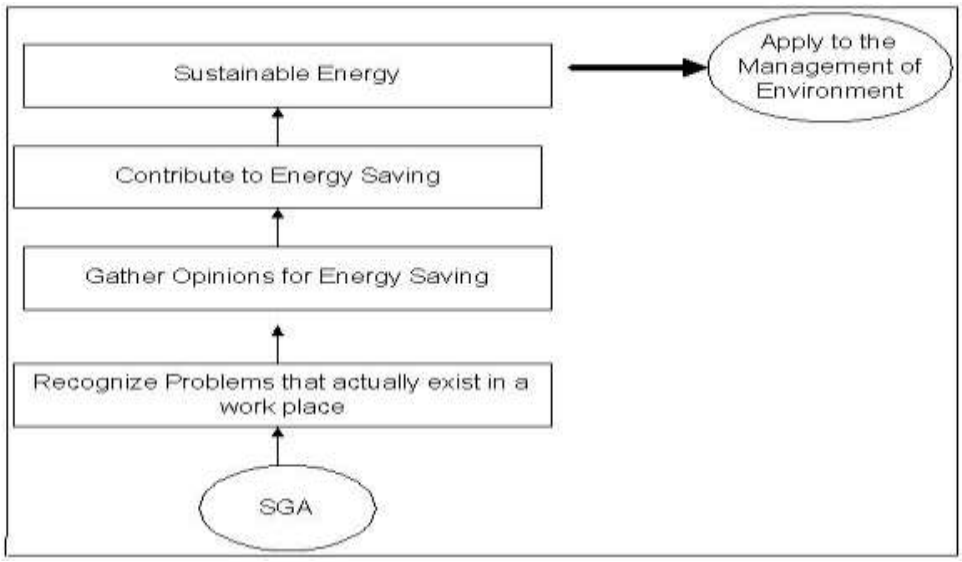


Figure 8: Relationship of SGA and energy saving

Small group activities for TEM can be divided into 4 or 5 levels depending on the scale of the organization. This division is in order to emphasize the fact that everyone must improve in their job under the responsibility to each other. It also enables us to make improvement without overlapping. The following example shows utilizing the existing job-related organization as much as possible, as already mentioned in Part 2, 2."Strategy for Improving the Efficiency of Energy Usage further", Step 2 Proper EC Organization including Assignment of Energy Manager.

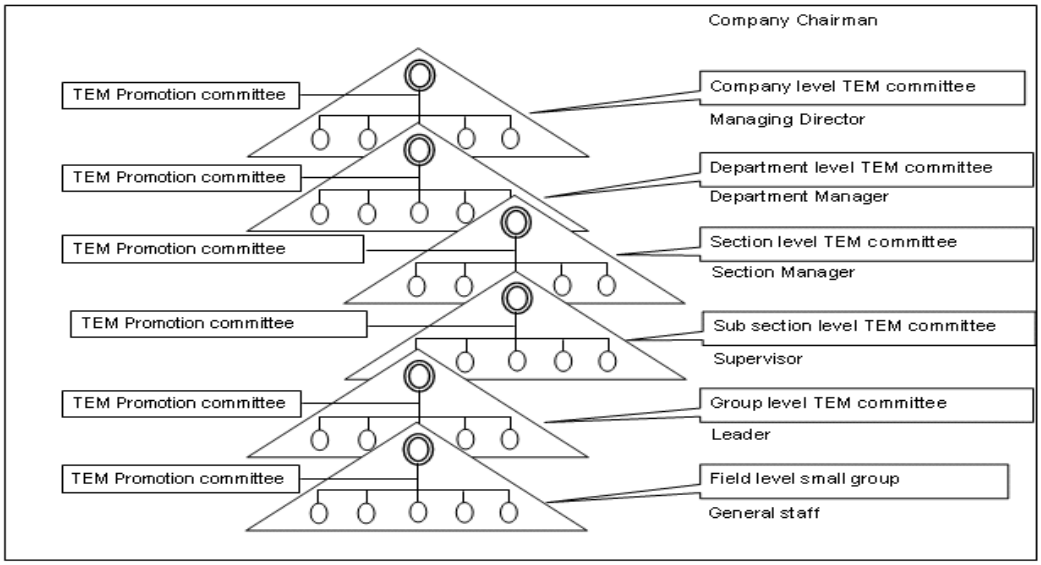


Figure 9: Positioning of SGA in Main Job Structure

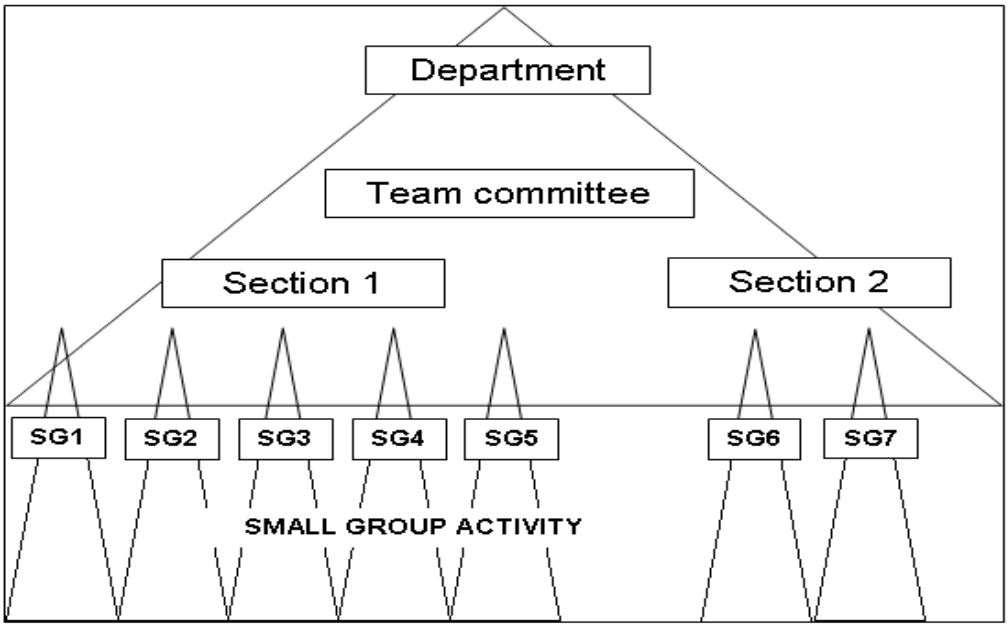


Figure 10: Positioning of SGA in Main Job Structure

4.7 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

4.8 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

4.9 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

4.10 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

4.11 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

4.12 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

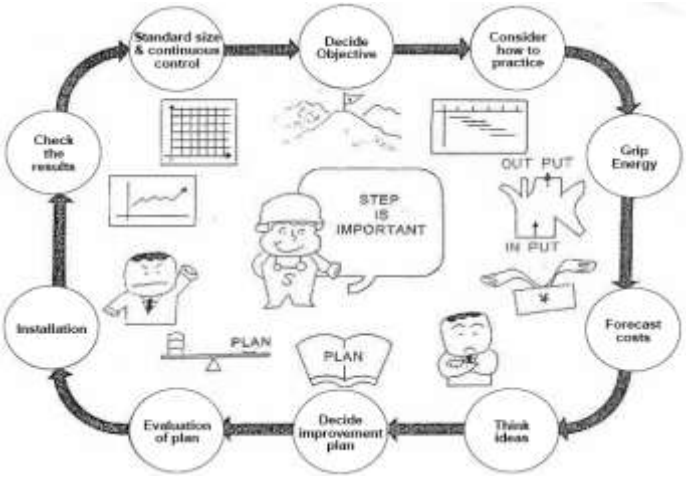


Figure 11: Steps of Small Group Activities

- 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 12: SGA CIRCLE

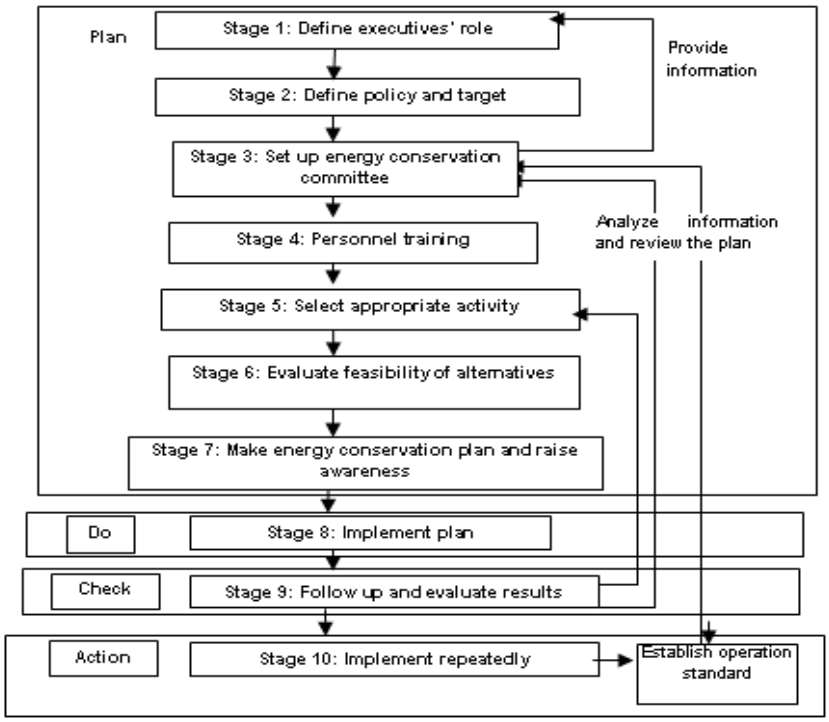


Figure 13: 10 STAGES

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

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.

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.

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.

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.

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

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.

Stage 8: Implement Plan

Implement according to the plan of each group.

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.

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.

4.13 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.

4.14 Tools that are Used Often for Small Group Activities for Energy Conservation

4.14.1 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

Figure 14: Five steps

1) 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.

2) 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.

3) 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.

4) 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.

5) 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.

4.15 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
CONCLUSIONS

5.1 Summary of Energy saving measures identified for the Cluster

The summary of the energy saving proposals identified for Vellore Rice Mill Cluster units is furnished below in Table 30:

Table 5.1: Summary of energy saving proposals identified for Vellore Rice Mills Cluster

Sl. No	Energy Saving Proposals
1	Energy efficient boiler
2	Energy efficient hot air dryer blowers
3	Copper tubes for heat exchanger
4	Fluidized Bed dryer
5	Plastic buckets for elevators
6	Variable frequency drives
7	Mechanized Soaking and Cooking Unit

5.2 Technology gap assessment for Energy saving proposals Identified for the Cluster

The technology gap assessment had been carried for each of the energy saving proposal recommended and is furnished below.

Table 5.2: Technology gap assessment for the suggested energy saving proposals

Sl.No	Technology Identified	Gap Assessment
1	**Energy efficient boiler.**	• The boilers are of Single pass flue gas path system leading to low heat transfer and high flue gas losses • Low loading of the boilers less than 40% • No waste heat recovery leading to reduction in efficiency of the system • High Heat losses from the grate and surface due to damaged insulation and opening of the charging doors • No control on fuel firing • No monitoring of air supply • Partial combustion leading to un-burnt carbon

2	**Copper tubes for heat exchanger**	• Low heat transfer due to MS tubes and high fuel consumption • Frequent damage of the dryer tubes • High replacement cost
3	**Bed dryer**	• High labor cost for natural dyeing • Production damage during rainy and uncertainties in the climate • Less production and depends on the climate suitability
4	**Plastic buckets for elevators**	• High power consumption due to more weight of iron and MS buckets
5	**Variable frequency drives**	Flow of ID and FD fans are controlled by mechanical dampers leading to increased power consumption
6	**Energy efficient hot air dryer blowers**	• Low efficiency of the dryer blowers due to inferior design • High power consumption
7	**Mechanized Soaking and Cooking Unit**	• High labor cost • Low production • Dependence on the labor and cluster is facing acute shortage of labor

5.3 Techno–Economic analysis for suggested Energy saving proposals

The details of techno economic analysis of various energy saving proposals identified for

Vellore Rice Mill Cluster units is furnished below

Table 5.3: Techno – Economic analysis for various energy saving proposals suggested

Sl.No	Energy saving proposal	Techno economic analysis	Remarks
1.	**Energy efficient boiler.**	• The technology will replace inefficient boilers and reduces production cost due less fuel consumption • High investment and lower payback period	Technically and financially viable
2	**Copper tubes for heat exchanger**	• Reduces fuel consumption in the dryer due to better heat transfer •	Technically and financially viable
3	**Bed dryer**	• The technology will avoid of natural drying of paddy and reduces production due to avoid of labor cost for loading and loading of the paddy	Technically and financially viable

4	**Plastic buckets for elevators**	• The technology will reduce electricity consumption due to avoid of heavy MS and iron buckets. •	Technically and financially viable
5	**Variable frequency drives**	• Will improve the life of the equipments life • Lesser breakdowns • No operation and maintenance required • Locally available • Local service providers are available • Low investment, high returns and quick payback periods	Technically and financially viable
6	**Energy efficient hot air dryer blowers**	• The technology will replace inefficient blowers and reduces production cost due to less power consumption.	Technically and financially viable
7	**Mechanized Soaking and Cooking Unit**	• Reduces production cost • Enhances production • Reduces dependence on labor	Technically & financially viable

5.4 Barriers in Implementation of identified Energy saving proposals

Table 5.4: Barriers in implementation for various energy saving proposals suggested

Sl.No	Energy saving proposal	Barriers identified	Steps to overcome barriers
1	**Energy efficient boiler.**	• High initial investment • Lack of awareness on the losses and benefits • Lack of Skilled manpower • Lack of interest to invest high investment	• Providing soft loans may motivate the unit owners for implementation • Training programs, Demonstration and motivation
2	**Copper tubes for heat exchanger**	• Lack of awareness on the losses and benefits • Dependence on local suppliers	• Training programs, Demonstration and motivation
3	**Bed dryer**	• High initial investment • Lack of knowledge on the benefits and economics	• Providing soft loans may motivate the unit owners for implementation
4	**Plastic buckets for elevators**	• Lack of knowledge on the benefits and economics	• Training programs
5	**Variable frequency drives**	• Lack of awareness of the drives	• Training programs, Demonstration and

		• Lack of knowledge on the benefits and economics	motivation
6	**New efficient hot air dryer blowers**	• Lack of awareness of the efficient blowers • Lack of awareness on the losses and benefits	• Providing soft loans may motivate the unit owners for implementation •
7	**Mechanized Soaking and Cooking Unit**	• High initial investment	• Providing soft loans may motivate the unit owners for implementation

5.5 Short listed Technology/Products for DPRs

The following technologies were identified for preparation of detailed project reports for **Vellore Rice Mills** Cluster:

- Energy Efficient Boilers
- Fluidized Bed Dryer
- Energy Efficient Hot Air Dryer blowers
- Copper tubes for hot Air Dryer Heat Exchanger
- Variable Frequency Drives
- Mechanized Soaking and Cooking unit

5.6 Summary of level of awareness on Energy savings and Energy saving Technologies in Vellore Cluster

The level of awareness on energy saving among the SME owners in the cluster is poor. About 10% of the unit owners have good conscious on energy saving technologies and is limited. The owners are more concerned about the market and procurement of paddy at competitive rates rather than on energy.

The energy saving technologies are implemented based on success stories in the cluster units and practical demonstration of the energy saving technologies in the units.

Though the clusters units are in operation since last 2 decades, the achievement on energy efficiency in the cluster units is poor and same old technologies are continued.

Some of the demonstration projects in the cluster may motivate the SME owners in implementation of the energy saving technologies.

LIST OF ANNEXURE

ANNEXURE – 1

Technical calculations of typical unit in the cluster

a) Efficiency Evaluation for Boiler

S.No	PARAMETER	DETAILS	UNIT
1	Fuel used	GN Husk	
2	Quantity of steam generated	1050	kg/batch
3	Enthalpy of steam at 50 PSI	654	kcal/batch
4	feed water temp	30	kcal
5	Heat output	655200	kcal/batch
6	Quantity of fuel consumption	750	kg/batch
7	Calorific value of fuel	4000	kcal/kg
8	Heat input	3000000	kcal/batch
9	Efficiency	21.84	%

b) Hot Air Dryer Blower

S.No	Parameters	Value	Units
1	Capacity of installed blower	11	kW
2	Actual Power Measured	8.5	kW
3	Air flow	28000	(m3/hr)
4	pressure	50	mm of Wc
5	Efficiency of the existing Blower & motor	44.9	%
6	Efficiency of the new energy efficient blower	70	%
7	Power savings	2.9	kW
8	Power Savings per Annum	11484	kWh
9	Monetary Savings	0.56	Rs.(Lakhs)
10	Investment	0.60	Rs.(Lakhs)
11	Simple Payback Period	1.1	Years

c) Fluidized Bed Dryer

S.No	Capacity	15	TPD
1	Wood consumption	1.00	TPD
2	Labour cost for natural drying	1,500	Rs./day
3	Fuel Cost	3500	Rs./day
4	Estimated savings 10 %	350	Rs./day
5	Reduction of labour cost	1,000	Rs./day
6	Monetary savings per annum	4.5	Rs. in lakhs
7	Investment required	6.0	Rs. in lakhs
8	Simple payback period	1.3	Years

d) Variable Frequency Drives

S.No	Details	Value	unit
1	Power consumption ID & FD fan of the boiler	6.73	kW
2	Achievable savings (20 %)	1.35	kW
3	No. of hours of operation per annum	7,920	hours
4	Power savings per annum	10,660	kWh
5	Monetary savings	0.52	Rs. in lakhs/annum
6	Investment required	0.30	Rs. in lakhs/annum
7	Simple Payback period	7	months

e) Air Compressors

Sl.No	Details	Value	Unit
1	Power input to the compressor	11	kW
2	No. of hours of operation/year	6,000	
3	% savings expected	15%	
4	Power Savings per annum	9900	kWh
5	Monetary savings per annum	51975	Rs.
6	Investment required	Nil	
7	Payback period	Immediate	

f) Elevators

Sl.No	Details	Value	Unit
1	No. of elevators	5	nos
2	no of hrs	12	hrs
3	no of days	330	days
4	Total power consumption of elevators	14850	kWh/year
5	% savings expected	10	%
6	Power savings per annum	1485	kWh
7	Monetary savings per annum(@Rs.4.90 per kWh)	7,796	Rs.
8	Investment required	10,000	Rs.
9	Payback period	15	months

g) Lighting

S.No	Particulars	Existing	Proposed	Unit
1	Type of lamp	40W/4ft FTL	T5 Lamp	-
2	Wattage of lamps	40	28	W
3	Watt loss per ballast	12	2	W
4	No. of lamps to be replaced	8	8	No.
5	Average Operating Hours per day	12	12	Hours/Days
6	Energy consumption	1747.2	1008	kWh/year
7	Energy savings		739.2	kWh/year
8	Energy cost savings		3881	Rs./ year
9	Initial cost / lamps		500	Rs.
10	Initial investment cost		4000	Rs.
11	Payback period		12	Months

ANNEXURE – 2

Details of technologies/services providers for the cluster

a) Boiler

Veesons Energy Systems Pvt. Ltd
Murugesan.A
SR.Engineer / Proposals
2, Industrial Estate,
Trichy - 620 0015
Cell : 98424 50431
Phone : 2501010/11/15
Email ID: am@veesons.com

b) Hot Air Dryer

Heat Flow Engineer.
Shop No.F-6,
Sagun Cassa Tower,
Nr. Prernathirth Jain temple,
Satellite Road, Jodhpur,
Ahmedabad, Gujarat India 380015
Tele : 91- 98250 07390 , 98795 07390, 99798893703)

c) Fluidized Bed Dryer

Sunshine Rice Tech
479, Bangalore Highway,
Nazarathpet, Poonamallee,
Chennai - 602103, Tamil Nadu, India
Phone:91-44-26496250/26494855
Fax:91-44-26494855/26496250
Key Personnel
MR. S. K. BABU (Managing Director)
Mobile : +919444025390

d) Variable Frequency Drives

Shree NM Electricals Limited
188 (Old # 151) Govindappa Street,
Chennai 600 001.
Tele Fax: +91 (0) 44 25369144 / 42165871
RIM No: 32950229
E-mail: chennai@shreenm.com

e) Air Compressors

- **Abhinav Agencies**
  OldNo.184/New No.276,
  Linghi Chetty Street,
  Chennai-600001
  044-42620586, 25212198, 9380212198
  Mr. Jayakumar
  Email ID: abhinavagencies@yahoo.com

- **Ashveera Pneumatic Services**
  Flat.No.4;"Raag Durbar", 10-B,
  Venkatesa Nagar Main Road, Saligramam, Chennai-93
  044-23765180, 64594912, 9840033239
  Mr. Devaraj
  Email ID: ashveera.pneumatics@gmail.com,
  ashveera.chennai@gmail.com

- **Swathi Equipment Pvt Ltd**
  No2, 1st Floor, Welders Street,
  Off Mount Road
  Chennai-2
  044-28601685, 9941254704
  044-42158317
  Mr. K Gnanasambandam
  Email ID: swathi@vsnl.com

ANNEXURE – 3

Financial schemes (if any) available with local banks for improving energy efficiency in the 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.

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

Eligibility criteria for units (Direct assistance):

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

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

TECHNOLOGY UPGRADATION FUND SCHEME (TUFS)

A scheme devised by Govt. of India, Ministry of Power, to enable SSI units (Rice mill unit) to induct State-of-the-art technology in which technology levels are bench marked in terms of specified machinery for each sector of **rice mills** industry. Machinery with technology levels lower than that specified will not be permitted for funding under the TUF scheme.

Eligible Borrowers Sole Proprietorships, Partnerships, Co-operative Societies, private / public limited companies.

- Existing units with or without expansion and new units
- Existing units proposing to modernize and/or expansion with state-of-the-art-technology
- New units which are being set up with appropriate technology

Quantum Of Loan & Mode Of Assistance Assistance shall be need based and NO CEILING on project cost/amount of loan. Assistance shall be by way of Term Loan.

Margin 15 to 25% of the project cost

Security 1st charge on fixed assets financed under the scheme Additional security such as personal guarantees, pledge of promoters share holdings as determined by Bank on merits of the case

Incentive Available Under The Scheme

Interest Reimbursement at the rate of 5% of the interest payment made by the unit to Bank on the loan outstanding. No Interest Reimbursement will be available for the extended period of loan or during the NPA status of the loan.

Repayment Within 7 years including moratorium up to 1 year

ANNEXURE – 4

Name and address of units in the cluster

S.No.	Name of the Industry	Contact person	Address
1	Sri Kadarkarai Modern Rice mill	A. Arumuga Chettiar	1110, Vellore Road, Seevor
2	AMG Modern Rice Mill	M.Arunganathan	ITI, Chetpet Road, Arni
3	Anandi Modern Rice Mill	C. Arun Kumar	Rattinamangalam, Arni
4	Annamalai Modern Rice Mill	Annamalai	Rattinamangalam, Arni
5	Bhuvaneshwari Modern Rice Mill	A.R. Rajendran	Chetpet Road, Arni
6	Dhana lakshmi Modern Rice Mill	R.Venkatesan	875, Rattinamangalam, Arni
7	GMP Modern Rice Mill	M.Udayakumar	877/B3, Rattinamangalam, Arni
8	ISN Modern Rice Mill	Manik Basha	Thiruvannamalai Road, Arni
9	JDP Modern Rice Mill	Dayalan	Chetpet Road, Arni
10	LPM Modern Rice Mill	L.Padmanaban	1/279,Chetpet Road, Arni
11	Manohara Modern Rice Mill	Dayalan	Chetpet Road, Arni
12	Murthy Modern Rice Mill	S.Kumar	Kalleripattu Road, Velapadi, Arni
13	MVS Modern Rice Mill	M.V.Shivaji	42/C, Chetpet Road, Arni
14	Sri Padmaraj Mullaikudi Modern Rice Mill	S.Padmaraj	14/3, 7, Vandavasi Road, Arni
15	Parameshwari Modern Rice Mill	B,Natarajan	Chetpet Road, Arni
16	Renugambal Modern Rice Mill	S.Babu	Chetpet Road, Arni
17	RVK Modern Rice Mill	Ramesh Kumar	Vandavasi Road, Arni
18	Selvambal Modern Rice Mill	L.Padmanaban	Chetpet Road, Arni
19	Shivakanthan Modern Rice Mill	K.R.S.Ratina Swami	Near Association, Arni
20	Shree Jayalakshmi Modern Rice Mill	N.Suresh Babu	815/3, Rattinamangalam, Arni
21	Sri Kumaran Modern Rice Mill	T.N.Perumal	185, Chetpet Road, Arni
22	Sri Lakshmi Modern Rice Mill	A.Doss	878, Rattinamangalam, Arni
23	Subbiah Modern Rice Mill	S.Baskar	34/4, Kalleripattu, Arni
24	Prakash Modern Rice Mill	T.Perumal	1/189, Chetpet Road, Arni
25	VKR Modern Rice Mill	R.Venkatesan	34/8, Kalleripattu, Arni
26	VMD Modern Rice Mill	P.Sarvanan	Near Association, Arni
27	VNM Modern Rice Mill	V.N.Nityanandham	1/184, Chetpet Road, Arni
28	VPR Modern Rice Mill	Ramakrishnan	Vellore Road, Arni
29	VS Modern Rice Mill	V.Subramani S.Kandaswamy	869/3, Rattinamangalam, Arni
30	YHK Modern Rice Mill	H.Sreeman	873/3, Rattinamangalam, Arni

ANNEXURE – 5

Quotations

VEESONS
ENERGY SYSTEMS PVT. LTD.

ANNEXURE – 1

MAIN SPECIFICATIONS

1.0.	TYPE OF BOILER	: HORIZONTAL MULTI TUBULAR DRY BACK TWO PASS SMOKE TUBE BOILER.
2.0.	DESIGN, FABRICATION, INSPECTION & TESTING CODE	: IBR 1950 WITH LATEST AMENDMENTS.
3.0.	MODEL	: DB-04-N & DB-05-N
4.0.	EVAPORATION CAPACITY (F & A 100°C)	: 500 KG/HR & 750 KG/HR
5.0.	MAX. WORKING PRESSURE (SAFETY VALVE SET OFF)	: 150 PSI(G) / 10.54 KG/CM^2(G)
6.0.	FUEL	: SOLID AGROWASTE
7.0.	GROSS CALORIFIC VALUE	: 4000 KCAL/KG
8.0.	MODE OF COMBUSTION	: NATURAL DRAUGHT
9.0.	TYPE OF FEEDING	: MANUALLY THROUGH FIRE DOOR

VEESONS ENERGY SYSTEMS PVT. LTD.

ANNEXURE – 2

PRICE SCHEDULE AND COMMERCIAL TERMS

1.0. PRICE SCHEDULE :

1.1. STANDARD SUPPLY

1.1.1. SUPPLY OF 'VEESONS' HORIZONTAL MULTITUBULAR DRY BACK 2 PASS SMOKE TUBE STEAM BOILER OF MODEL DB-N AS DETAILED SCOPE OF SUPPLY IN ANNEXURE – 3. } RS.7,00,000/- (FOR 500 KG/HR) } RS.7,82,000/- (FOR 750 KG/HR)

2.0 COMMERCIAL TERMS :

2.1.	BASIS OF PRICE	: EX-WORKS, TRICHY.
2.2.	TAXES AND DUTIES	: EXTRA AS APPLICABLE AT THE TIME OF DESPATCH / INVOICING. AT PRESENT RATES APPLICABLE ARE,
	A) CENTRAL EXCISE DUTY(CED)	: 10%) AT PRESENT EXEMPTED
	B) EDUCATIONAL CESS	: 2 % ON ED) SINCE AGROWASTE IS
	C) SECONDARY & HIGHER EDUCATIONAL CESS	: 1 % ON ED) USED AS FUEL.
	D) VAT	: 4 %
2.3.	PACKING & FORWARDING	: 2 % ON BASIC PRICE
2.4.	GUIDANCE OF ERECTION AND COMMISSIONING	: 2 % ON BASIC PRICE
2.5.	TRANSPORTATION & TRANSIT INSURANCE	: BUYER'S SCOPE.
2.6.	TERMS OF PAYMENT	: 75 % ADVANCE ALONGWITH ORDER. BALANCE PAYMENT PLUS TAXES AND DUTIES 7 DAYS BEFORE READINESS OF BOILER AGAINST PROFORMA INVOICE.
2.7.	DELIVERY PERIOD	: WITHIN 45-60 DAYS FROM THE DATE OF RECEIPT OF YOUR TECHNICALLY & COMMERCIALLY CLEAR PURCHASE ORDER ALONG WITH FULL ADVANCE.
2.8.	VALIDITY	: OUR OFFER IS VALID FOR 15 DAYS FROM THE DATE OFFERED, AFTERWARDS SUBJECTED TO MARKET FLUCTUATIONS.

VEESONS ENERGY SYSTEMS PVT. LTD.

ANNEXURE – I

TECHNO COMMERCIAL OFFER

I. MAIN SPECIFICATION

1.0.	Type of Boiler	: Horizontal Multitubular 3 pass - wet back Fluidised front feed Smoke tube Package Boiler.
2.0.	Design, Fabrication, Inspection & Testing Code	: IBR 1950 with latest Amendments.
3.0.	Model	: FFF
4.0.	Evaporation Capacity	: 1000 Kg/hr (F&A 100°C)
5.0.	Max Working Pressure (Safety valve set off)	: 10.54 Kg/cm^2(g) / 150 PSI (g)
6.0.	Fuel	: Paddy husk
7.0.	Gross Calorific Value (GCV)	: 3275 K.cal/Kg
8.0.	Type of feeding	: Fluidised Front Feeding
9.0.	Mode of combustion	: Forced draught

ANNEXURE – 2

VEESONS ENERGY SYSTEMS PVT. LTD.

PRICE SCHEDULE AND COMMERCIAL TERMS

1.0 PRICE SCHEDULE :

1.1 STANDARD SUPPLY

1.1.1 Supply of 'VEESONS' Horizontal Multitubular fluidised front feed smoke tube steam Boiler of Model FFF as detailed STANDARD SCOPE OF SUPPLY in Sl.No.III. } Rs.9,96,000/-

2.0 COMMERCIAL TERMS :

2.1.	Basis of Price	: Ex-Works, Trichy.
2.2.	Taxes and duties	: Extra as applicable at the time of despatch / invoicing. At present rates applicable are,
	a) Central excise duty(CED)	: 10.30 % (At present exempted if agrowaste is used as fuel)
	b) Sales Tax (VAT)	: 4 %
2.3.	Packing & Forwarding	: 2% on basic Price.
2.4.	Guidance of Erection and Commissioning	: 2% on basic price.
2.5.	Transportation & Transit Insurance	: Buyer's Scope.
2.6.	Terms of payment	: 50 % advance alongwith order. Balance payment plus taxes and Duties 7days before readiness of boiler against proforma invoice.
2.7.	Delivery period	: Within 45-60 Days from the date of receipt of your technically & commercially clear Purchase order along with full advance.
2.8.	Validity	: Our offer is valid for 30 days from the date offered, afterwards subjected to market fluctuations.

Kilburn Engineering Limited

Regd. Office : Four Mangoe Lane, 3rd Floor, Surendra Mohan Ghosh Sarani, Kolkata - 700 001, India
Phone : (91) 33 2231 3337 / 3450, 4003 5154 / 55, Fax : (91) 33 2231 4768
E-mail : kilbncal@cal2.vsnl.net.in, Web : www.kilburnengg.com

Offer No.: KEL/S/Paddy/0102
Date: 10.01.2011

Zenith Energy Services (P) Limited
10-5-6/B, My Home Plaza, Masab Tank,
Hyderabad - 500 028
Andhra Pradesh, India
Mobile: 9440234294

Kind attn.: Mr. Krishna

Sub: Your requirement for Parboiled Paddy drying system
Capacity – **5 T/Hr.** (Moisture reduction from **36% to 18%**)

Dear Sir,

With reference to the above, we are pleased to submit our offer for Parboiled Paddy drying system (1 no. VFBD) having input capacity of **5 T/hr.** (Moisture reduction of 36% to 18%)) as per the enclosed Technical Specification as under:

	Capacity of dryer
Particulars	**5 Tons / hr.**
Cost of 1 no. paddy drying system (1 no. VFBD). (Price is Ex works Taloja). (P&F, Freight & CST would be extra as mentioned in Terms and Conditioned enclosed with this offer).	Rs.30.00 Lacs

We hope the offer is in line with your requirement.

We now look forward to receive your valued order which on receipt will receive our most prompt attention.

Our all other Terms & Conditions are enclosed for your ready reference.

Thanking you & assuring you of our best attention at all times.

Yours faithfully,
FOR KILBURN ENGINEERING LTD,

TRIPAL MESHRAM
+91 7799 221112
tripal@kilburnengg.com

Encl: Terms and Conditions

Page 1

Terms and Conditions:

1. **Price**: Ex-works Taloja, Distt – Raigad (Maharashtra).
2. **Packing & Forwarding** @ 4.5% of our Ex-works value.
3. **Freight** : To Pay basis
4. **Central Sales Tax / VAT:** Extra at Actual as application at the time of dispatch. Presently the value of VAT is 12.50 %. & CST is 2% against form 'C'.
5. **Octroi**: Will be borne by you, if charged at the destination.
6. **Transit Insurance**: Shall be charged extra @ 1 % of Ex-works value, if to be arranged by us.
7. **Delivery:** 16-18 weeks from the date of receipt of order along with advance.
8. **Terms of Payment**: 60% advance along with order and balance against Proforma Invoice prior to dispatch. However, the payment terms can be discussed during final negotiation.
9. **Validity:** 30 days from the date hereof & thereafter subject to our confirmation in writing.
10. **Cancellation & Termination of Order** : In case you desire to cancel / terminate an order for any reasons whatsoever, the cancellation shall be subject to just and adequate compensation to KEL for quantum of work done and commitments made till the receipt of notice / agreement for cancellation. KEL shall not be liable / responsible for any consequential damages / claims. The termination fee equals to 20 % of the order value shall be payable over and above the compensation claim, if an order is cancelled for any reason not attributable to KEL.

Any changes in duties ruling at the time of dispatch shall be applicable.

Kilburn Engineering Limited

Regd. Office : Four Mangoe Lane, 3rd Floor, Surendra Mohan Ghosh Sarani, Kolkata - 700 001, India
Phone : (91) 33 2231 3337 / 3450, 4003 5154 / 55, Fax : (91) 33 2231 4768
E-mail : kilbncal@cal2.vsnl.net.in, Web : www.kilburnengg.com

Offer No.: KEL/S/Paddy/0101
Date: 10.01.2011

Zenith Energy Services (P) Limited
10-5-6/B, My Home Plaza, Masab Tank,
Hyderabad - 500 028
Andhra Pradesh, India
Mobile: 9440234294

Kind attn.: Mr. Krishna

Sub: Your requirement for Parboiled Paddy drying system
Capacity – **3 T/Hr.** (Moisture reduction from **36% to 18%**)

Dear Sir,

With reference to the above, we are pleased to submit our offer for Parboiled Paddy drying system (1 no. VFBD) having input capacity of **3 T/hr**. (Moisture reduction of 36% to 18%)) as per the enclosed Technical Specification as under:

	Capacity of dryer
Particulars	**3 Tons / hr.**
Cost of 1 no. paddy drying system (1 no. VFBD). (Price is Ex works Taloja). (P&F, Freight & CST would be extra as mentioned in Terms and Conditioned enclosed with this offer).	Rs.22.00 Lacs

We hope the offer is in line with your requirement.

We now look forward to receive your valued order which on receipt will receive our most prompt attention.

Our all other Terms & Conditions are enclosed for your ready reference.

Thanking you & assuring you of our best attention at all times.

Yours faithfully,
FOR KILBURN ENGINEERING LTD,

TRIPAL MESHRAM
+91 7799 221112
tripal@kilburnengg.com

Encl: Terms and Conditions

AN ISO-9001:2000 CERTIFIED COMPANY
Head Office : Plot no. 112, Minerva Industrial Estate,
P. K. Road, Mulund (West), Mumbai - 400 080, India, Ph. : 022 2593 6300, Fax : 022 2591 7554
A WILLIAMSON MAGOR GROUP ENTERPRISE

Terms and Conditions:

1. **Price**: Ex-works Taloja, Distt – Raigad (Maharashtra).
2. **Packing & Forwarding** @ 4.5% of our Ex-works value.
3. **Freight** : To Pay basis
4. **Central Sales Tax / VAT:** Extra at Actual as application at the time of dispatch. Presently the value of VAT is 12.50 % & CST is 2% against form 'C'.
5. **Octroi**: Will be borne by you, if charged at the destination.
6. **Transit Insurance**: Shall be charged extra @ 1 % of Ex-works value, if to be arranged by us.
7. **Delivery:** 16-18 weeks from the date of receipt of order along with advance.
8. **Terms of Payment**: 60% advance along with order and balance against Proforma Invoice prior to dispatch. However, the payment terms can be discussed during final negotiation.
9. **Validity:** 30 days from the date hereof & thereafter subject to our confirmation in writing.
10. **Cancellation & Termination of Order** : In case you desire to cancel / terminate an order for any reasons whatsoever, the cancellation shall be subject to just and adequate compensation to KEL for quantum of work done and commitments made till the receipt of notice / agreement for cancellation. KEL shall not be liable / responsible for any consequential damages / claims. The termination fee equals to 20 % of the order value shall be payable over and above the compensation claim, if an order is cancelled for any reason not attributable to KEL.

Any changes in duties ruling at the time of dispatch shall be applicable.

Control
ENGINEERING
COMPANY

MIG : B - 28, 1st Floor,
Indian Airlines Employees Colony
Prakashnagar, Begumpet
Hyderabad - 500 016
Telefax : 040 2790 6498
E-mail : cecohyd@cecoelectronics.in

With reference to the above we thank you very much for your interest on our LSIS KOREA (FORMERLY KNOWN AS LGIS) make AC Variable Frequency Drives. In continuation to the above we are here with submitting our most competitive offer for the above cited requirement for your kind consideration and perusal.

Following is the quotation for the same.

Sl.No	Description	Qty.	Unit Price
	LSIS Korea make (FORMERLY KNOWN AS LGIS KOREA make) AC Variable Frequency Drive suitable for 3-phas 440V input and 3Ph 440V output squirrel cage induction motor with output Frequency up to 400Hz.		
1.1	SV040iG5A-4 rated at 4 KW / HP	1No.	19,800.00
1.2	SV055iG5A-4 rated at 5.5 KW / 7.5HP	1No.	28,200.00
1.3	SV075iG5A-4 rated at 7.5 KW / 10HP	1No.	31,500.00

TERMS & CONDITIONS:

Price	:	Net & Ex-works Kolkata.
Excise Duty	:	10.30% extra as applicable at the time of dispatch.
CST	:	Extra @ 2%, against declaration form C
Delivery	:	With in one week from the date of issue of P.O.
Payment	:	30% advance and balance against delivery
Warranty	:	12 months from the date of installation or 15 months from the date of dispatch which ever is earlier.

Hope you will find the above in order and place your valued order on us at an early date. However if you require any further clarification/confirmation in this regard you may please feel free to contact us.

Control
ENGINEERING
COMPANY

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TIN : 33624021419 Cell : 09842495329
9443412817

QUOTATION

SRI KRISHNA ENGINEERING WORKS

(Manufacturers, Suppliers of Modern Rice Mill Machineries Par - Boiling & Drying Plants)
Door No. 1.67. C, East Street, Main Road, Kattur - 610104, kodavasal (TK) Thiruvarur (DT)
Prop. : V. SUDHA (Tamil Nadu)

M/s. A.R. RAJENDIRAN Avl.
SRI BUVANESWARI MODERN RICE MILL,
No.1/280 CHEIPET ROAD,
Arni Town,
Tiruvannamalai District.

No.	34	Date	24.12.2010

Your Order No..... Date.....

D.Note No..... Date.....

S.No.	DESCRIPTION RICE MILL SPARES	Qty. Nos.	Rate Rs.	Total Rs.	Ps.
	Cost of supply of 16 tones per batch a capacity of SS High Exchanger driyer attached 1 No. Seat boxer bed driyer attached platform and ladder driyer attached blower, set of Double two compartment of G.I. Fin Heat exchangers all its connected accessories			19,00,000	00
	VAT 4%			76,000	00
	Total			19,76,000	00

(Rupees nineteen lakhs and seventy six thousand only).

E & O.E.

Payment to be made by Drafts or Crossed Cheques only

For SRI KRISHNA ENGINEERING WORKS

Manager

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