MANUAL ON ENERGY CONSERVATION MEASURES IN RICE MILL CLUSTER GANJAM, ORISSA

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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.

Ganjam 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 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 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 to be prepared for a minimum of 5 technologies for various capacities
4. **Identification of the Local Services Providers –** The program also aimed for identification of local service providers and provide 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 interests.

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 Ganjam 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 Ganjam 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 replicated 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 in terms of technical and financial. 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 Ganjam 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:

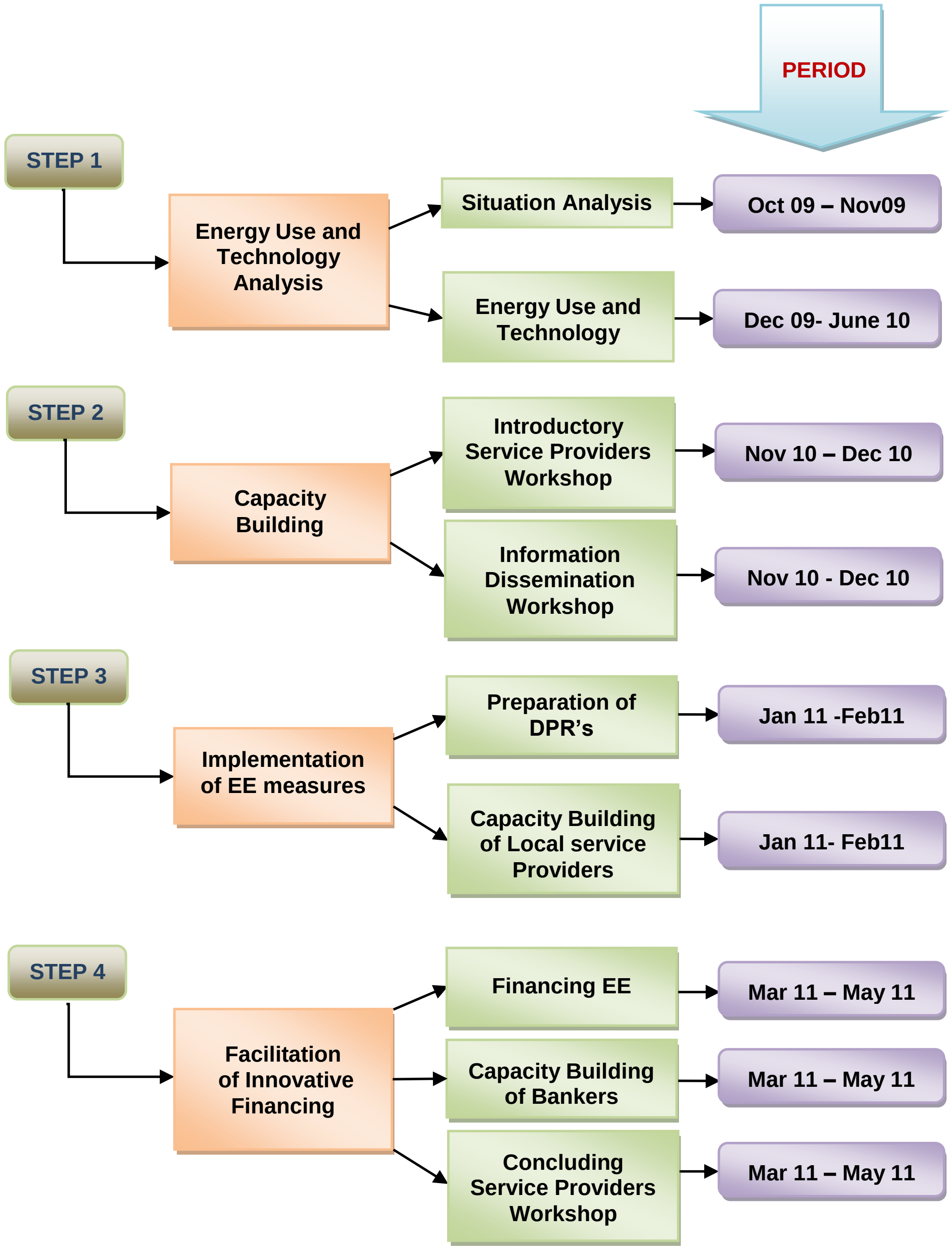


Figure 1: Project Duration

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	Ganjam
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 Ganjam Rice Mills cluster study to Zenith Energy Services Pvt. Ltd(ZESL) based on the competitive bidding under BEE SME program. ZESL 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 Ganjam 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

S.No	Type of audits	No. of units covered
1	Preliminary Energy Audits	20
2	Detailed Energy Audits	20
3	Technology audits	20

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 Ganjam 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 quantification of GHG emission reduction expected due to implementation of the measures identified for energy saving.

CHAPTER 2
ABOUT GANJAM CLUSTER

2.1 Overview of Ganjam SME Cluster

2.1.1 Cluster Background

Rice is the staple food of majority of Indians and specifically in eastern Indian. Paddy is one of the major crop cultivated in the eastern states especially in the state of Orissa. The rice comes out of milling of paddy and 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 250 rice mills in ganjam rice mills cluster covering Berhampur, Hinjilicut, Bhanjanagar and Ganjam areas.

The cost of energy as a percentage of paddy cost varies anywhere between 1%-1.5%. The rice milling units in the cluster use grid electricity as the main source of energy.

2.1.2 Product Manufactured

The major activity of the cluster rice mill units is processing of paddy for production of rice to cater domestic market and providing levy for Food Corporation of India (FCI). The rice produced in these mills are of medium and high quality and is marketed through dealer network in different places of the state.

2.1.3 Classification of units

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

2.3.1.1 Classification based on production

In **Ganjam Rice Mills** Cluster, there are about 250 units, the rice mills can be categorized into two types based on production capacity, and they are:

- Less than 10 TPD
- Above 10 TPD

There are 108 rice mills having production capacity less than 10 TPD and balance 142 rice mills falls under second category having production capacity more than 10 TPD. The classification based on production capacity is furnished graphically in Figure 2.

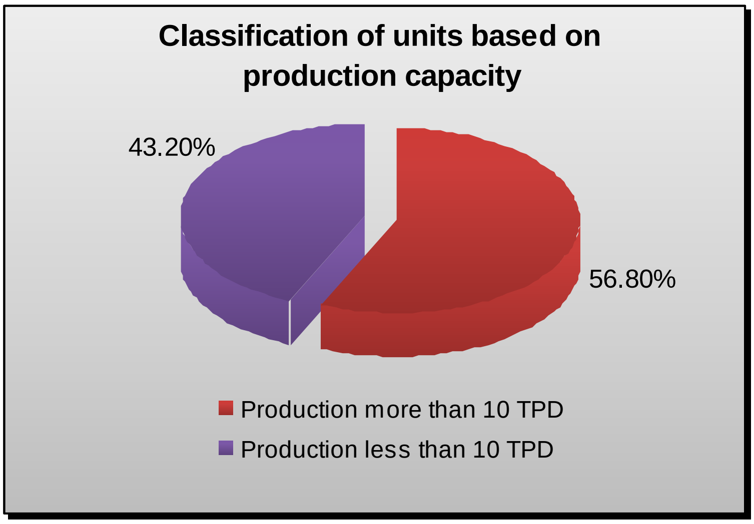


Figure 2: Classification of units based on production facilities

2.1.3.2 Classification based on annual energy bill

Out of 250 units, 21 units have energy bill below Rs.1.00 lakh per annum, 221 units have energy bill between Rs.1.00 lakh to Rs. 5.00 lakhs per annum and the balance 8 units have annual energy bill above Rs. 5 lakhs. The classification of the rice mills based on annual energy bill is furnished graphically in Figure 3.

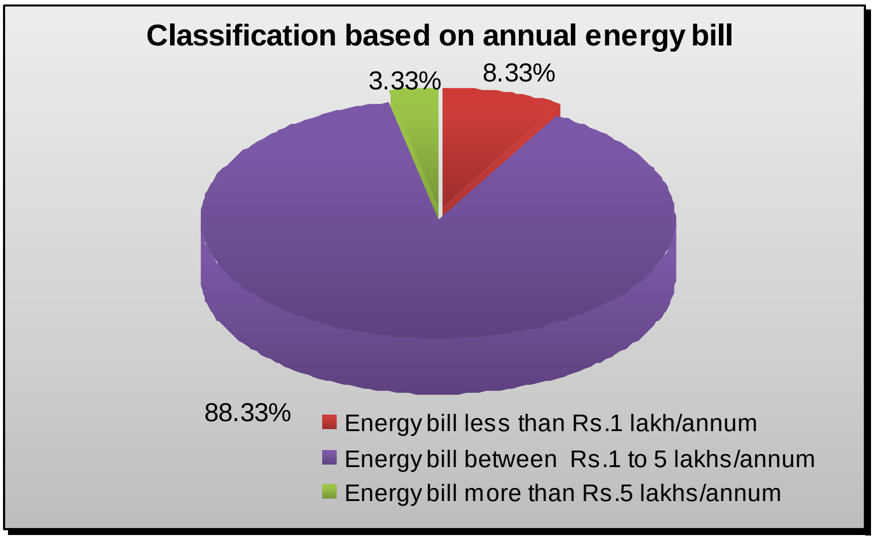


Figure 3: Classification of units based on annual energy bill

2.1.4 Raw materials used

The main raw material for **Ganjam Rice Mills** Cluster units is paddy.

2.2 Energy Consumption scenario of the Cluster

The main energy source for rice mills of the cluster is grid electricity. Electricity is required for operating the prime movers of rice mill machinery like elevators, paddy cleaners, rubber shellers, separators, whiteners/cones and blowers.

2.2.1 Fuels used and price

No fuels are used in the cluster. The prevailing price of grid electricity in the cluster are furnished below in Table 2.1.

Table 2.1: Prevailing price of grid electricity in the cluster

S.No	Fuel type	Price range (Rs.)
1	Electricity	4.20 per kWh

2.2.2 Electricity Consumption

The annual electricity consumption of the three typical rice mill units of various production capacity in the cluster is furnished in Table 2.2 below:

Table 2.2: Annual energy consumption of the three typical rice mill units

Details	Value	Unit -1 (8 tons/day)	Unit -2 (27 tons/day)	Unit -3 (40 tons/day)
Electricity	kWh/annum	18,571	85,714	2,00,000

The annual consumption of electricity of all rice mills of the cluster are furnished table 2.3 below:

Table 2.3: Annual energy consumption of all rice mills of the cluster

S.No	Type of energy	Consumption	Tons of oil Equivalent (TOE)
1	Electricity	kWh/annum	1248
	Total	1,45,15,000	**1248**

2.2.3 Specific Energy Consumption

The specific energy consumption for various rice mill units of the cluster had been evaluated and the average value of the cluster is furnished below in Table 2.4:

Table 2.4: Specific energy consumption

Equipment	Units	Minimum SEC	Maximum SEC	Average SEC (for whole cluster)
Electricity	kWh/ton	11	20	15.5

2.3 Manufacturing process

2.3.1 Paddy Processing

2.3.1.1 Pre-cleaning

The paddy contains foreign material such as straw, weed seeds, soil and other inert material. If this are not removed prior to shelling the efficiency of the rubber sheller and the milling recovery is reduced.

The 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.

The second separation retains the grains but allows broken grains, small stones and weed seeds to pass through. Aspirator is installed to remove the dust and light empty grains.

2.3.1.2 Rubber Sheller

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 (rubber sheller)and as a result of pressure and friction most of the paddy is dehusked (hulled), where husk and brown rice are separated.

2.3.1.3 Separator

The output from the huller is a mixture of brown rice, husk, broken paddy etc. The huller aspirator removes the lighter material such as husk, bran and very small broken rice. The remainder passes onto the paddy separator where the unhulled paddy rice is separated from the brown rice. The amount of paddy present depends on the efficiency of the husker, and normally less than 10%. Paddy separators work by making use of the differences in specific gravity, buoyancy and size between paddy and brown rice. Paddy rice has a lower specific gravity, higher buoyancy, and is physically bigger, longer and wider than brown rice

The compartment type of paddy separator uses the difference in specific gravity and the buoyancy to separate paddy and brown rice. When paddy and brown rice move over an inclined plane, they move at different speeds depending on their specific gravity, their shape and contact area, smoothness of inclined surface and the co-efficient of sliding friction. Brown grains are smaller, heavier, rounder and smoother and will slide faster than paddy grains. The processing capacity of the compartment separator is dependent on the compartment area. For a 2-ton/hr capacity rice mill, a 45-compartment separator made up of 15 compartments on each of three decks is used.

2.3.1.4 Whitening and Polishing

In the process of whitening, the skin and 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.

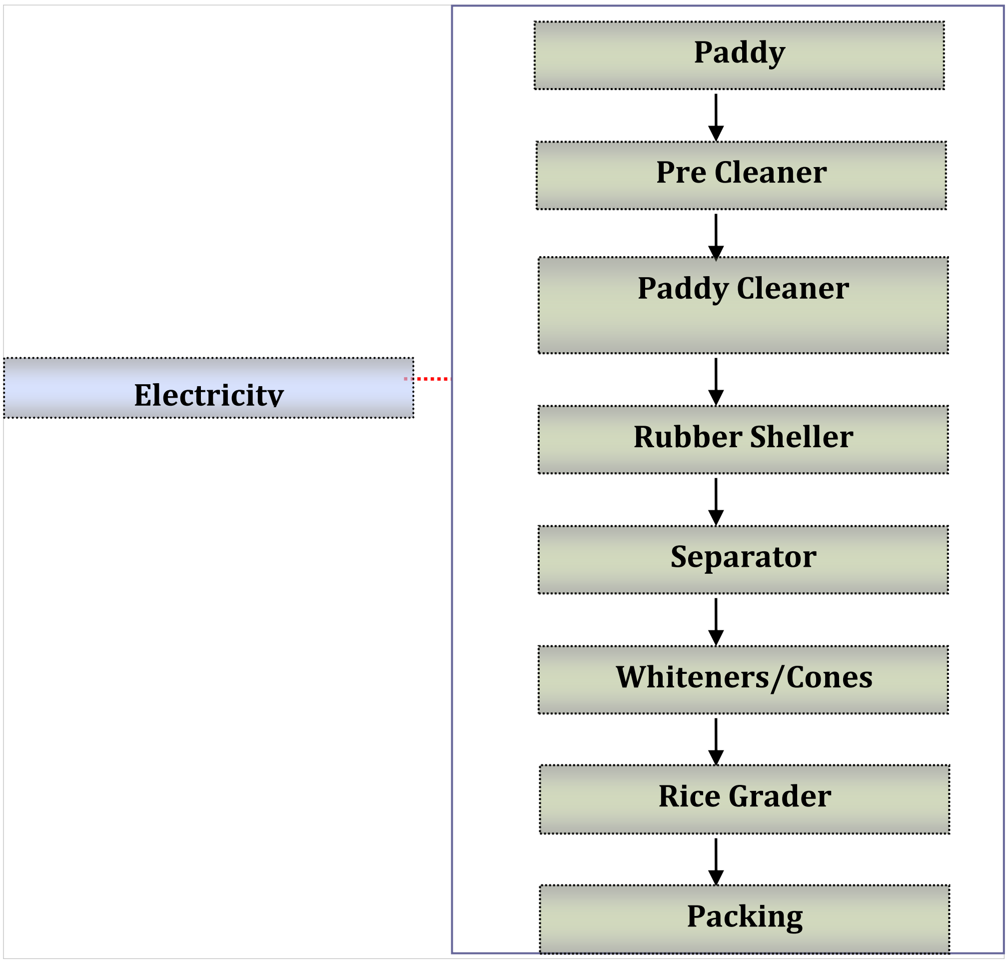
2.3.1.5 Rice grader

After polishing, the white rice is separated into head rice, 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".

2.3.1.6 Elevators

The elevators are used at different stages of milling for transferring paddy, brown rice and white rice during the milling process

Figure 4 The detailed process flow diagram of a rice mill is furnished below.



2.4 Current policies and Initiatives of Local bodies

No policies are currently available for energy conservation and efficiency projects at the state level and is under development.

2.5 Major barriers for implementation of Energy Efficiency

2.5.1 Energy Availability

The major energy source for the rice mill units in the cluster is grid electricity. Though, the electricity is available, the power cuts are imposed for about 2 hours in day due to power shortage. The voltage supply by the state electricity board is poor and is found to be only 300 volts-350 volts in about 30% of the rice mills, there may be due to overloading of the distribution transformers.

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 supervisors in cluster units are non technical and illiterates and are working based on experience.
- 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 rice mill owners would implement the equipments/ technologies based on the success stories of the equipment/technologies installed in the neighbouring industries in the area/cluster.

Though, some of the 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

In the whole cluster, very few units taken initiation for implementing the energy efficiency equipments as a part of expansion or quality improvement.

The other units either don't have adequate financial strength or not interested investing in new technologies to avoid risk due to fear of the business as the rice milling industry sector is an agro based and largely dependence on government policies .

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

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

S.No	Type of audits	No. of units covered
1	Preliminary Energy Audits	20
2	Detailed Energy Audits	20
3	Technology audits	20

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 250 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 local agents. The process is more or less identical in all rice mills of the cluster.

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

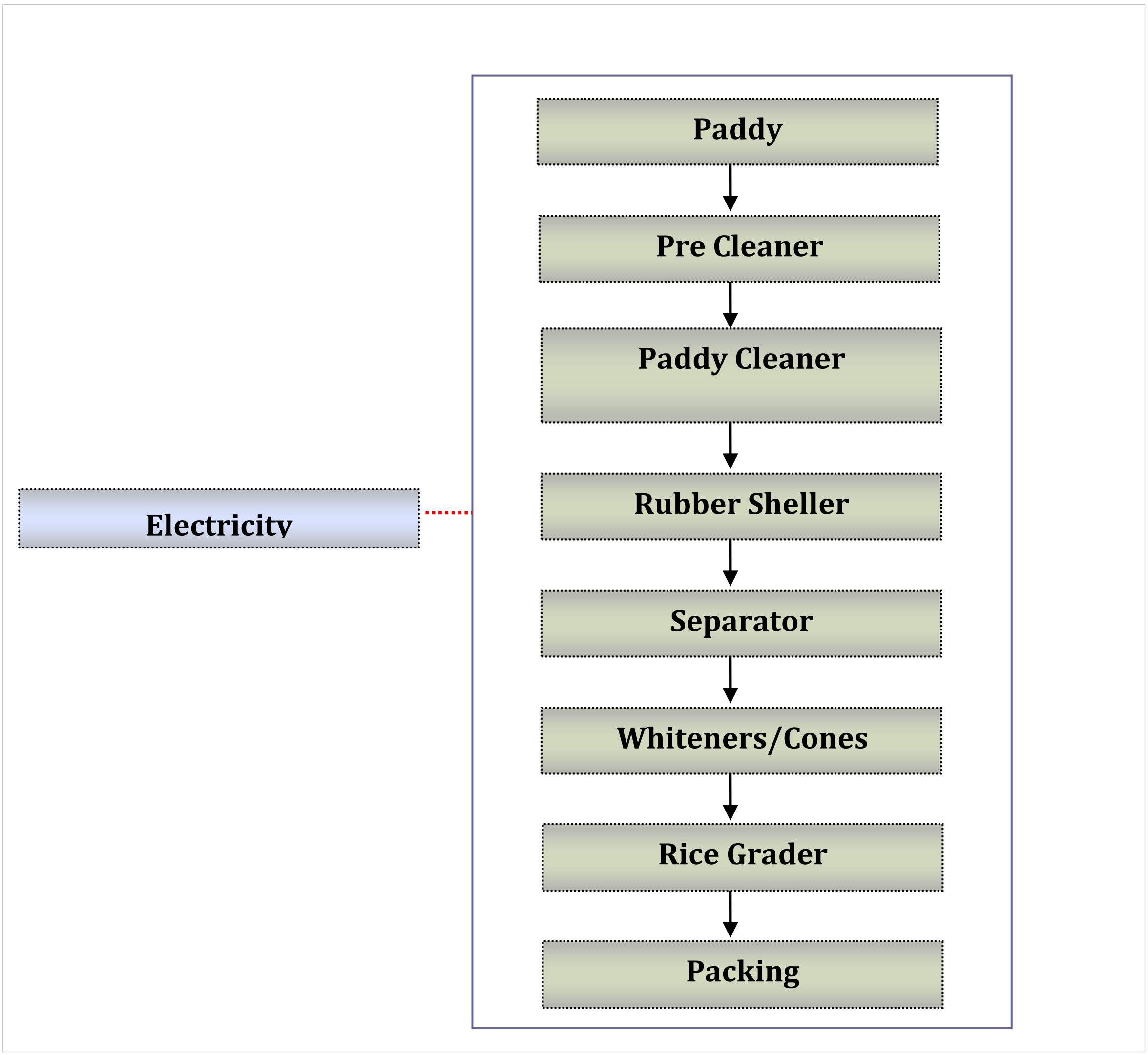


Figure 5: Process flow chart

(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 in cluster units 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 Electricity

The majority units of the cluster use grid electricity for the rice mill operation. The prevailing price of grid electricity used in the cluster is furnished below table 3.2:

Table 3.2: Prevailing price of grid electricity in cluster unit

S.No	Fuel type	Price range (Rs.)
1	Electricity	4.20 per kWh

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

Table 3.3: Specific energy consumption

Details	Value	Unit -1	Unit -2	Unit -3
Electricity	kWh	18,571	85,714	2,00,000
Specific Electricity consumption	kWh/ton	11	13	17

3.2.2.2 Electricity

Tariff Description	Consumption Slab range in kWhr (Units) and billing period (One month)	Fixed charges per service for one month	Energy Charges Paise /kW hr (unit)	Monthly Minimum in Rupees
LT Tariff 5	Consumption from 0 units to 750 units per month	Rs.30/-	420	Rs.40/KW or part thereof of the contracted load.
	Consumption from 751 units and above per month	Rs.30/-	420	

3.2.3 Capacity Utilization

The processing of paddy for production of rice involves milling. The capacity utilization of rice mills is 60%-70% .

3.2.4 Housekeeping practices

Based on the detailed energy audits carried out in the cluster units, no unit is adopting good operating practices. There may be due to the lack of awareness and knowledge.

3.2.5 Availability of data and Information

The data and information pertaining to electricity consumption is available for latest months only. The unit owner are not willing to provide the data for quantity of paddy processing. 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 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 equipments deployed.

3.3 Technology gap analysis

3.3.1 Technology up-gradation

i) The equipments installed in the units are poor as compared to the technologies/ equipments available in the market. The various technological gaps were identified in the cluster units 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 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 are dealing with these technologies.

3.3.2 Process up gradation

Though, there is potential for process up gradation in the cluster units for improving the quality and enhancing production, many industry owners are not willing for process up gradation due to high initial investment. The details of equipment-wise technology gaps identified and technology interventions are furnished below:-

Table 3.4: Technology gaps identified rice mill technology interventions

S.No	Equipments	Technology Gaps Identified	Technology Interventions
1	**Common Drive System**	• All machinery are driven by a common shaft drive leading to high transmission losses and more power consumption.	• Install individual motors for all equipments
2	**Paddy Cleaner**	• The paddy cleaners are of local make and consuming more power due to inferior design	• Install energy efficient paddy cleaner.
3	**Separator**	• The separators are of local make and consuming more power due to inferior design	• Install energy efficient separator.
4	**Elevators**	• The elevator buckets are of iron and MS materials and consuming more power due to heavy weight	• Plastic buckets for elevators
5	**Electric Motors**	• The motors installed are very old and rewinded number of times and hence consuming more power.	• Install new energy efficient motors.

6	***Voltage Stabilizer***	• *The voltage supply is poor and very low due to overloading of the EB distribution transformers and hence over drawl of the current and power consumption.*	• *Install voltage stabilizers.*

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

The milling process combines a number of operations that produces rice from paddy. The process involves:

3.4.1.1 Common Drive System

Background

In about 50 % of the rice mills, the rice mill equipments such as pre-cleaner, paddy cleaner, separator, rubber sheller, whitener/cone, grader are driven by a single common shaft drive system. In these common drive system, all the rice mill machinery like paddy cleaner, rubber sheller, whitener/cone, separator, rice grader and elevators are connected to a single common shaft driven by a single electric motor. All the equipments are connected by a long belt drives transmitting mechanical energy to the rice mill equipments. The present single drive system has the following disadvantages w.r.t power consumption:

- High transmission losses due to longer belt drive systems.
- Low efficiency of the motor during under loading, when one or two equipments are operated
- Possibility of operation of motor for idle running for longer periods.
- More chances of production loss due to single motor drive system
- Low power factor due to partial load operation.
- Even for small equipment operation like elevator or paddy cleaner need to be operated higher capacity motor hence more losses.

Figure 6: Common Shaft System

Recommendations:

As discussed above, the single and common drive system with long transmission driven is inefficient and consumes more power consumption. It is recommended to replace the present single and common drive motor system with individual drive system. The individual drive system consists of an individual motor for each equipment separately and are operated as per the requirement. Apart from reduction in transmission losses, the power consumption is also reduced due to avoidance of part load operation and idle operation of the equipments. The capacity of motors to be installed for individual machines is furnished below in table 3.5:

Table 3.5 Suggested capacity of the motors for individual equipments

S.No	Equipment	Suggested HP
1	Elevators	1 HP (for 2 elevators)
2	Chaluni 2 no's	1 HP each
3	Rubber Sheller	7.5 HP
4	Cones 2 no's	10 HP each
6	Separator	2 HP

As per the studies carried out in similar type of industries in the cluster units, it is estimated that about 30% of total power consumption of the rice mill can be reduced. The cost benefit analysis of installing individual motors and drive system is furnished below in table 3.6:

Table 3.6 Cost benefit analysis on individual motors in a typical unit

Details	Value	Units
Total power consumption per annum	28,857	kWh
% savings expected	30	%
Power savings per annum	8,657	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	0.36	Rs.in lakh
Investment required	1.00	Rs.in lakh
Income due to dispose of old machinery	0.25	Rs.in lakh
Net investment required	0.75	Rs.in lakh
Payback period	25	Months

There are about 125 rice mill units have common shaft drive system, where are the equipments are driven by a common shaft. Further, there are about 87 rice mills where some of the equipments like separator, rubber sheller and pre cleaner are operated by common shaft and other equipments by individual motors. The individual drive system can be implemented in 212 rice mills and the monetary savings is estimated as Rs.79.74 lakhs. The investment required is estimated as Rs.177.00 lakhs and the pay back period is about 2 years.

3.4.1.2 Separator

Background

The separators are used for separating broken rice, unfinished rice and finished rice. Majority of the separators installed in the rice mills units are local make. The separators are of inferior design and consuming more power.

Recommendations:

It is recommended to replace the present separators with new reputed company make separators such as suri engineering works, ricetec, milltech etc., The reputed make separator consumes less power due to better design and productivity is also more for the same capacity. The following are the features of reputed make Separator:

- Precise construction assures stone less paddy
- Negligible loss of paddy
- Vibro Motors assure noiseless trouble free operations
- Self cleaning system for maximum operating efficiency
- Removes immature grains along with other impurities

Figure 7: Separator

The cost benefit analysis of replacing the present local make separator with new reputed make separator is furnished below:

Table 3.7 Cost Benefit Analysis for Separator in a typical unit

Details	Value	Units
Total power consumption of the present separator per annum	6,480	kWh
% savings expected	50%	%
Power savings per annum	3,240	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	0.14	Rs. in lakhs
Investment required	0.40	Rs. in lakhs
Income due to dispose of old machinery	0.10	Rs. in lakhs
Net investment required	0.30	Rs. in lakhs
Payback period	26	Months

There are about 250 rice mill units in the cluster. The efficient separators can be implemented in about 150 rice mills. The monetary savings is estimated as Rs.25.17 lakhs due to implementation of the activity. The investment required is estimated as Rs.74.00 lakhs and the payback period is 3 years.

3.4.1.3 Paddy Cleaner

Background

The paddy cleaner is used for removing immature grains and waste from the paddy. Majority of the paddy cleaner in the cluster units are of local make and are of inferior design and consuming more power for the same production w.r.t the equipments available in the market.

Recommendation

It is recommended to replace the present paddy cleaner with new reputed company make paddy cleaner such as milltech, ricetec, suri engineering works etc., The reputed make paddy cleaner is efficient and consumes less power and also the productivity is also more for the same capacity.

Figure 8: Paddy Cleaner

The cost benefit analysis of replacing the present paddy cleaners with new paddy cleaners is furnished below:

Table 3.8 Energy Saving Potential for Paddy Cleaner

Details	Value	Units
Total power consumption of the present paddy cleaner per annum	9,600	kWh
% savings expected	50%	%
Power savings per annum	4,800	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	0.20	Rs. in lakhs
Investment required	0.40	Rs. in lakhs
Income due to dispose of old machinery	0.10	Rs. in lakhs
Net investment required	0.30	Rs. in lakhs
Payback period	18	Months

There are about 250 rice mill units in the cluster. The new efficient paddy cleaners can be implemented in 150 rice mills. The monetary savings is estimated as Rs.22.21 lakhs. The investment required is estimated as Rs.60.00 lakhs and the payback period is 3 years.

3.4.1.4 Elevators

Background

The elevators are the most common type of equipment found in rice milling industries. The elevators are used for transferring the paddy, semi finished and finished rice. The detailed studies undertaken in various rice mills, it is found that majority of the rice millers are using iron or MS material buckets for elevators. The iron or MS buckets consume more power due to heavy weight than the plastic buckets. There are about 15 elevators in a typical unit of the cluster. All elevators are connected by 1 HP motor each.

Figure 9: Elevator iron buckets

Recommendation

The replacement of iron and MS buckets with plastic buckets for elevators will reduce the power consumption by 10 %.

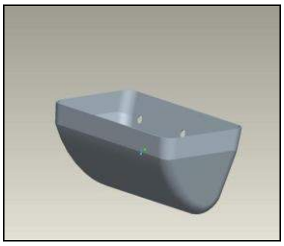


Figure 10: Elevator plastic buckets

The cost benefit analysis is furnished below table 3.9:

Table 3.9 Cost Benefit Analysis for Elevators in a typical unit

Details	Value	Units
No. of elevators	15	nos
No of hours of operation/day	15	hrs
No of days of operation /annum	300	days
Total power consumption of elevators	50,625	kWh/year
% Savings expected	10	%
Power savings per annum	5,062	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	21,263	Rs.
Investment required	30,000	Rs.
Payback period	17	months

The plastic buckets can be taken up in 208 units of the cluster. The monetary savings is estimated as Rs.4.97 lakhs. The investment required is estimated at Rs. 11.00 lakhs and the payback period is 2.3 years.

Benefits:

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

3.4.1.5 Voltage Stabilizer

Background

The power distribution by the state electricity board is very poor in the cluster. About 20-30% of the units are facing low voltage problem due to overloading of electricity board distribution transformer. Based on the detailed energy studies conducted in the cluster, the voltage supply is measured to be between 297 volts to 350 volts. The current drawn by the motors is high due to low voltage and failure of the motors.

Recommendation

It is recommended to install voltage stabilizer for constant and optimum voltage supply. By optimizing voltage supply, the power consumption of the rice milling equipments reduces by 10%-15% of the total power consumption.

Figure 11: Voltage Stabilizers

The cost benefit analysis of installing voltage stabilizer is furnished below:

Table 3.10 Cost Benefit Analysis for Voltage Stabilizers

Details	Value	Units
Total power consumption of the unit per annum	44,862	kWh
% savings expected	15%	%
Power savings per annum	6,729	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	0.28	Rs. in lakhs
Investment required	0.50	Rs. in lakhs
Payback period	21	Months

The voltage stabilizers can be installed in 75 units in the cluster. The monetary savings is estimated as Rs.21.19 lakhs. The investment required is estimated at Rs. 37.50 lakhs and the payback period is 21 months.

3.4.1.6 Energy Efficient Motors

Background

Based on detailed energy audits conducted in the cluster units, about 30% of the units are more than 10 years old. The motors installed are old and rewinded number of times due to frequent burning of the motors.

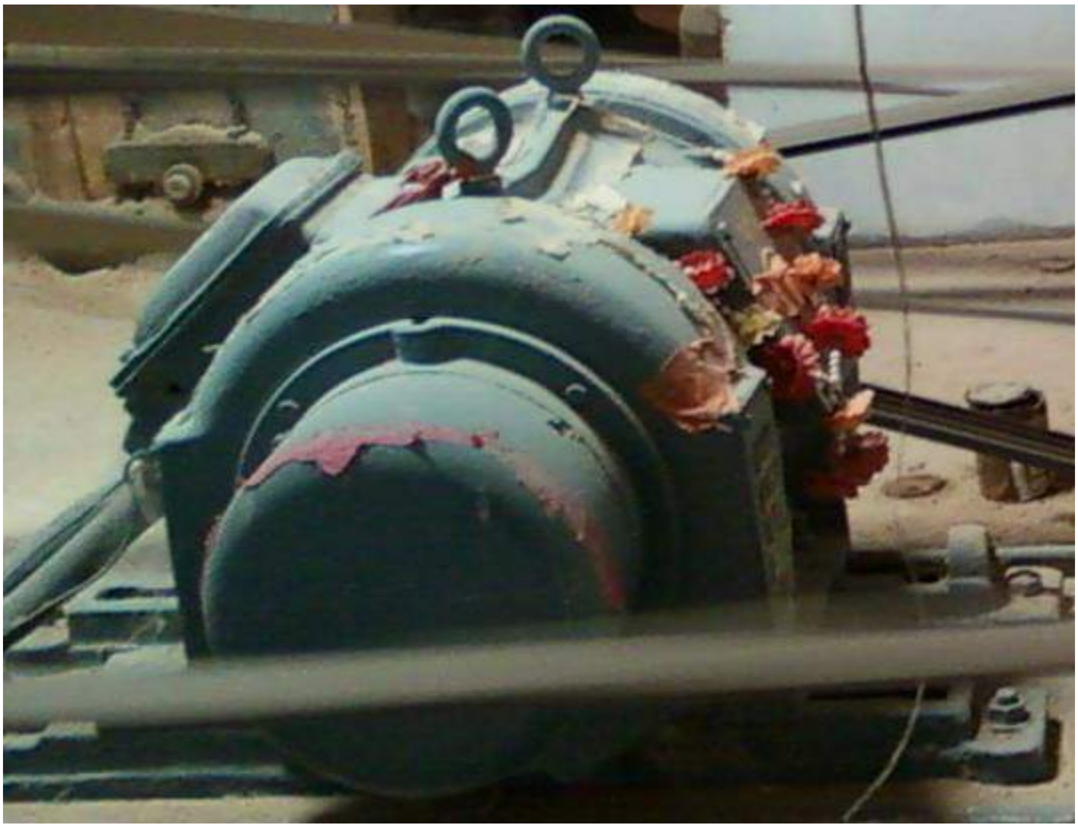


Figure 12: Old and Rewinded Inefficient motor

Recommendation

It is well known fact that the rewinded motors have less efficiency than the new motors. The studies indicate that the efficiency of the rewinded motors drops by 5%-10% for the repeated rewinded motors. Hence, it is recommended to install new energy efficient motors by replacing old and rewinded motors.

Figure 13: Energy efficient motor

The cost benefit analysis is furnished below:

Table 3.11 Cost Benefit Analysis for Energy Efficient Motors for Whole Cluster

Details	Value	Units
Total power consumption of energy efficient motors per annum	39,60,000	kWh
% savings expected	10%	%
Power savings per annum	39,600	kWh
Monetary savings per annum(@Rs.4.20 per kWh)	16.63	Rs. in lakhs
Investment required	25.00	Rs. in lakhs
Payback period	18	Months

The installation of energy efficient motors can be taken up in 50 units in the cluster. The monetary savings is estimated as Rs.16.63 lakhs. The investment required is estimated at Rs. 25.00 lakhs and the payback period is 18 months.

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 3.12: Life cycle analysis for energy saving proposals suggested

S.No	Energy Saving Proposal	Life cycle analysis
1	Individual motor Drive System	The life of the individual motors is considered at 15 years. The depreciation is considered at 80% by straight line method.
2	Separator	The life of the separator is considered at 15 years. The depreciation is considered at 5.28% by straight line method.
3	Paddy Cleaner	The life of the paddy cleaner is considered at 15 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	Voltage stabilizers	The life of the voltage stabilizers is considered at 10 years. The depreciation is considered at 5.28% by straight line

		method
6	Energy efficient motors	The life of the energy efficient motors is considered at 15 years. The depreciation is considered at 80% by straight line method.

3.4.3 Cost of Implementation

The investment required for various energy saving proposals identified for **Ganjam Rice Mills** Cluster units is furnished below.

Table 3.13: Details of cost of implementation

S.No	Equipment Details	Capacity	Investment (Rs. In Lakhs)
1	Individual Drive System	-	177.00
2	Separator	2 TPH	74.00
3	Paddy Cleaner	2 TPH	60.00
4	Plastic buckets for elevators	-	11.00
5	Voltage stabilizers	-	37.50
6	Energy Efficient Motors	-	25.00

3.4.4 Monetary savings

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

Table 3.15: Monetary Savings and Payback Period for the suggested energy saving proposals

S. No	Equipment Details	Investment (Rs. in Lakhs)	Monetary savings (Rs. in lakhs)	Payback period (years)
1	Individual motor Drive System	177.00	79.74	2
2	Separator	74.00	25.17	3
3	Paddy Cleaner	60.00	22.21	3
4	Plastic buckets for elevators	11.00	4.97	2
5	Voltage stabilizers	37.50	21.19	2
6	Energy Efficient Motors	25.00	16.60	2

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.
- Majority of the cluster unit owners doesn't have financial strength for implementation of the energy efficient equipment.
- Though, LSPs are available in the cluster, they don't have technical strengths for supply of efficient equipments.

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 Bhubaneswar, Cuttack, as Ganjam and Berhampur are small towns and majority of the rice mills are located in Berhampur and surrounding villages. Among the technologies / equipments identified for implementation for Ganjam 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., Bhubaneswar, Vijayawada and Kakinada. The detail of equipment which can be implemented by LSPs and those needs to be procured from other cities is furnished below:

Table 3.16: Details of technologies available for the suggested proposals

Sl.No	Equipment details	LSPs (Bhubaneswar)
1	Common Shaft System	√
2	Separator	√
3	Paddy Cleaner	√
4	Plastic buckets for elevators	√
5	Voltage Stabilizers	√
6	Energy Efficient Motors	√

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 3.17:

Table 3.17: The list of technologies for DPR preparation

S.No	Technology/equipment	No. of DPR's	Capacities
1	Replacement of the common shaft drive with individual drive system	3	1 ton/hr, 1.5 ton/hr, 2ton/hr
2	Separator	3	1 ton/hr, 2 ton/hr, 3ton/hr
3	Paddy Cleaner	3	1 ton/hr, 2 ton/hr, 3ton/hr
4	Energy efficient motors	3	30 HP, 40 HP, 50 HP
5	Voltage stabilizers	3	25 KVA, 50 KVA, 100 KVA

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 grid electricity. The total GHG emission reduction is estimated at 2,102 t CO_2/ annum due to implementation of the various energy saving proposals in the cluster.

3.6.2 Reduction in other emissions

The technologies identified upon implementation for the **Ganjam Rice mills** Cluster units will reduce Electricity consumption and hence, there is no impact on other emissions.

Table 3.18: Estimated annual fuel/electricity savings in the cluster

S. 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 can be implemented
1	Common drive system with individual motors	19,09,530 kWh	79.74	177.00	2.2	Yes	212
2	Separator	5,99,225 kWh	25.17	74.00	2.9	Yes	150
3	Paddy Cleaner	5,28,750 kWh	22.21	60.00	2.7	Yes	150
4	Elevators	1,18,354 kWh	4.97	11.00	2.3	No	208
5	Voltage stabilizers	5,04,703 kWh	21.19	37.50	1.7	Yes	75
6	Energy efficient motors	3,96,000 kWh	16.63	25.00	1.5	Yes	50
	TOTAL	**40,56,562 kWh**	**130.05**	**272.50**	**13.30**	**-**	**-**

Table 3.19: Estimated annual fuel/electricity savings in the cluster

S. No	Fuel	Total fuel savings/annum in the cluster
1	Electricity	**40,56,562 kWh**

ENERGY IS LIFE BEE CONSERVE IT

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