MANUAL ON ENERGY CONSERVATION MEASURES IN TEXTILE CLUSTER SURAT, GUJARAT

Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By

Zenith Energy Services Pvt. Ltd., Hyderabad

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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, 25 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.

Surat 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 25 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 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 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 Surat Textile Cluster, the following outcomes are expected

1.3.1 Energy Use and Technology Analysis

The detailed comprehensive energy use and technology studies in various cluster units has explored the information on status of Surat Textile 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 are incorporated in the manual

1.3.2 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. A total of 15 DPR's will be prepared

1.3.3 Capacity Building of LSP's and Bankers

The local service providers and equipments suppliers has already been identified in Surat Textile 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 as indicated in Figure 1 below :

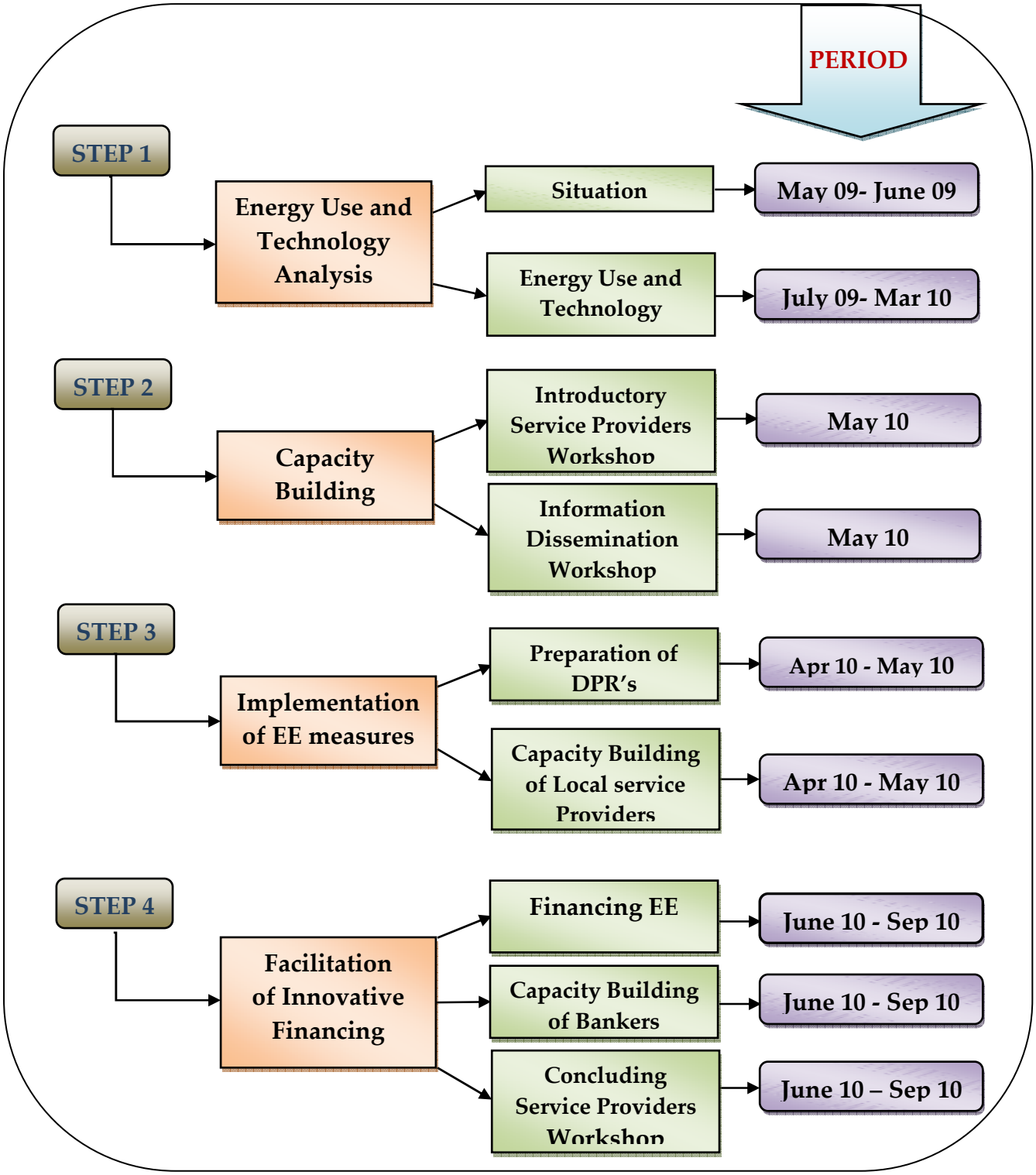


Figure 1: Project Duration

1.5 Identified Clusters under the BEE SME Program

The BEE has identified 25 SME Clusters to implement the BEE SME Program for energy efficiency improvement and the list of chosen clusters are furnished below in Table 1:

Table No.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

1.6 About the present study

BEE has awarded the Surat Textile cluster study to Zenith Energy 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 Surat with all facilities like state of art energy audit instruments, laptops, printers and internet facilities etc. As a part of the program, the details of the studies undertaken in cluster units are furnished in Table 2.

Table 2: Details of the studies undertaken in cluster units

Type of audits	No. of units Covered
Preliminary Energy Audits	15
Detailed Energy Audits	60
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, savings and 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 Surat Cluster
- Chapter 3 : Energy Audit and Technology Assessment
- Chapter 4 : Conclusions

Chapter 1: The 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 SURAT CLUSTER

2.1 OVERVIEW OF SURAT SME CLUSTER

2.1.1 Cluster Background

Industrial development in Surat District could be attributed to the presence of a large number of diamond processing, textiles, and chemical & petrochemical industries. During 2006-07, Surat contributed a maximum of 11.5% of Gross Domestic Product to the State. Surat, known as the synthetic capital of India hosts over 600,000 power looms and provides over 12 lakh jobs. It contributes 18% to the total manmade fiber exports and 40% of manmade fabric production in India. Surat has been very successful in attracting a sizeable amount of production.

Surat is renowned for the synthetic sarees and dress materials and there are about 400 industries in the cluster. The sarees and dress materials produced in Surat cluster are renowned in the country and abroad, are marketed in India and also exported to various countries. These industries are located at Palsana, Sachin, Pandesara and Surat city Industrial Areas. Majority of the industries have been in operation for the last 15 to 30 years. The main raw material polyester grey cloth is being procured from local polyester producers.

Large number of small and medium textile processing units are located in Surat. The cost of energy as a percentage of manufacturing cost varies anywhere between 12% to 15%. Majority of the industries located in Surat are of wet process and a very few units are engaged in the production of grey fabric with power looms. Wet process requires high amounts of thermal energy in the form of hot water and steam, inducing a high share of energy cost. The energy cost is next to the raw materials cost. Processing is the weakest link in the supply chain of textile industry. Majority of the industries in the cluster units are dependent on local technologies of low end and with little investment initiatives and technology up-gradation. The units started recently employing latest technologies and equipments for better quality, production and efficiency. These units are located in Palsana industrial area.

2.1.2 Products Manufactured

Majority of the units in the cluster are of integrated type, where grey cloth (Raw material) is purchased from outside and the same is processed for dyeing and printing. The main products manufactured in cluster units are synthetic sarees & dress materials and cotton dress materials. More than 80% of the units are engaged in job works wherein, local traders provide the design and raw material (grey cloth) and the units process the raw material for dyeing and printing as desired by the traders.

Apart from dyeing and printing, Jari work, embroidery and other hand works are also carried out in the cluster, manually by the ladies on job work basis.

The products manufactured in the cluster units has good domestic and international market. Surat is the biggest cluster in India producing synthetic sarees and materials.

2.1.3 CLASSIFICATION OF UNITS

The Surat Textile Cluster Units can be broadly classified as follow.

2.1.3.1 Classification Based On Production Capacity

i) Small-scale units having production capacity of less than 50,000 meters/day of processing.
ii) Medium size units having production capacity of more than 50,000 meters and below 1,00,000 meters/day.
iii) Large units having production capacity of above 1,00,000 meters/day of processing.

Out of 400 textile units, one hundred and forty six (146) units are of small scale, one hundred and sixty eight (168) are medium size and the balance eighty six (86) units fall under large scale category.

The average total production capacity of the 400 units is 280 lakh meters per day and the categorization of the units based on production capacity is furnished graphically in Figure 2.

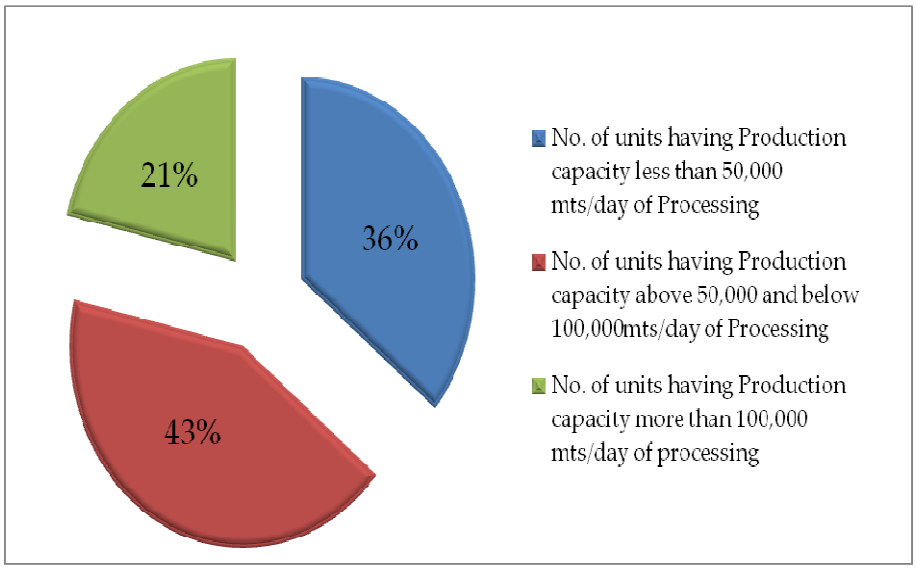


Figure 2: Classification of Units Based on Production Capacity

2.1.3.2 Classification Based On Production Facilities

In Surat Textile Cluster, out of 400 units, about 70 units are having only dyeing facility, 330 units are of integrated type having both dyeing and printing facilities. The classification based on production facility is furnished graphically in Figure 3.

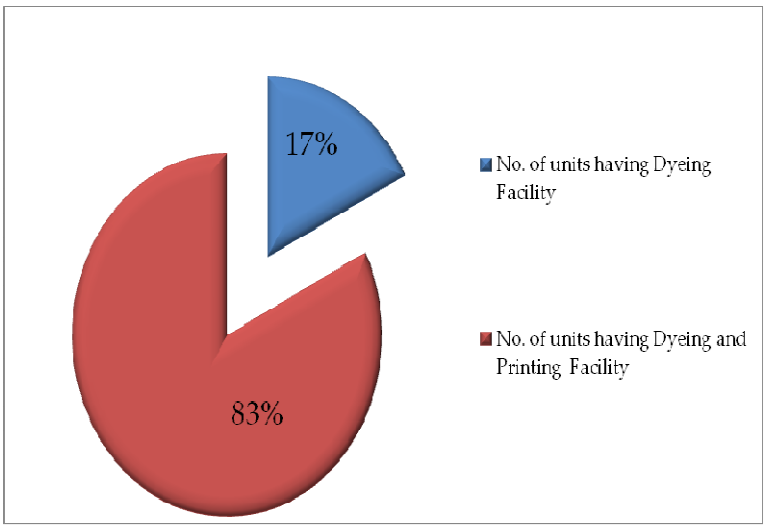


Figure 3: Classification of units based on production facilities

2.1.3.3 Classification Based On Annual Energy Bill

Out of 400 units, 155 units have energy bill between Rs.100 lakhs and Rs.300 lakhs per annum, 197 units recorded energy bill between Rs.300 lakhs and Rs. 500 lakhs per annum; and the balance 48 units have energy bill above Rs.500 lakhs. The classification based on annual energy bill is furnished graphically in Figure 4.

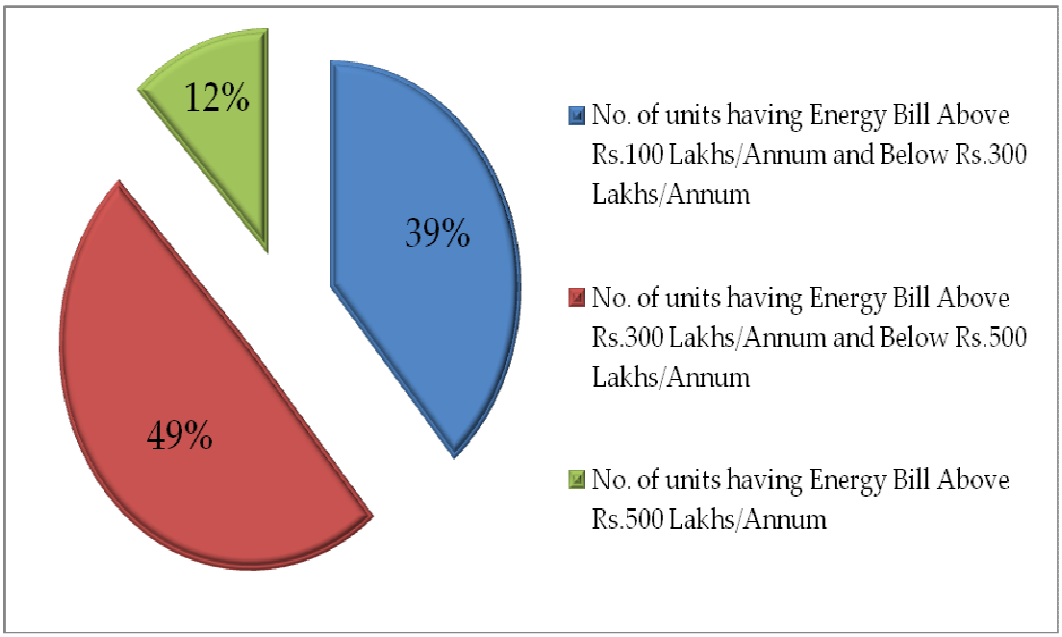


Figure 4: ***Classification of units based on annual energy bill***

2.1.3.4

a) Classification Of Units of 75 Units Surveyed

Out of 75 units, twenty seven (27) units are of small scale, thirty two (32) are medium size, and the remaining sixteen (16) units fall under large scale category. The total production capacity of the 75 units surveyed is 51 lakh meters per day and the categorization of the units based on production capacity is furnished graphically in Figure 5.

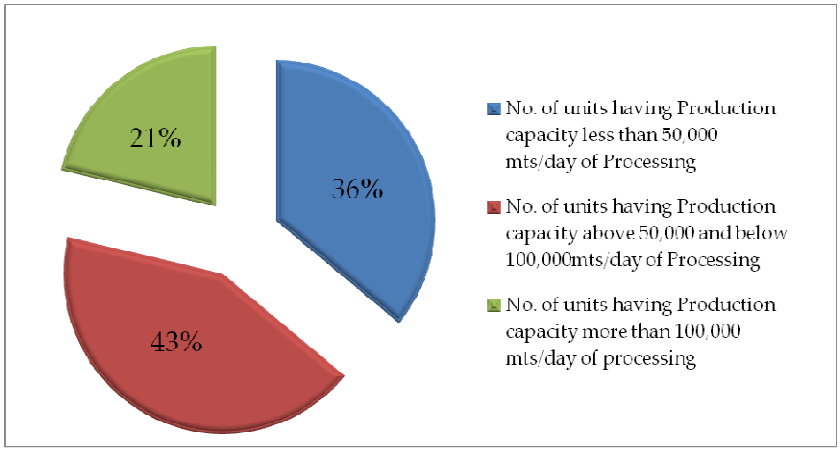


Figure 5: Classification of units based on production capacity (75 Units)

b) Classification Of Units Based On Production Facilities

In Surat Textile Cluster, out of 75 units surveyed, about 25 units are having only dyeing facilities, 49 units are of integrated type having both dyeing and printing facilities and the remaining one unit has weaving facilities only. The classification based on production facility is furnished graphically in Figure 6.

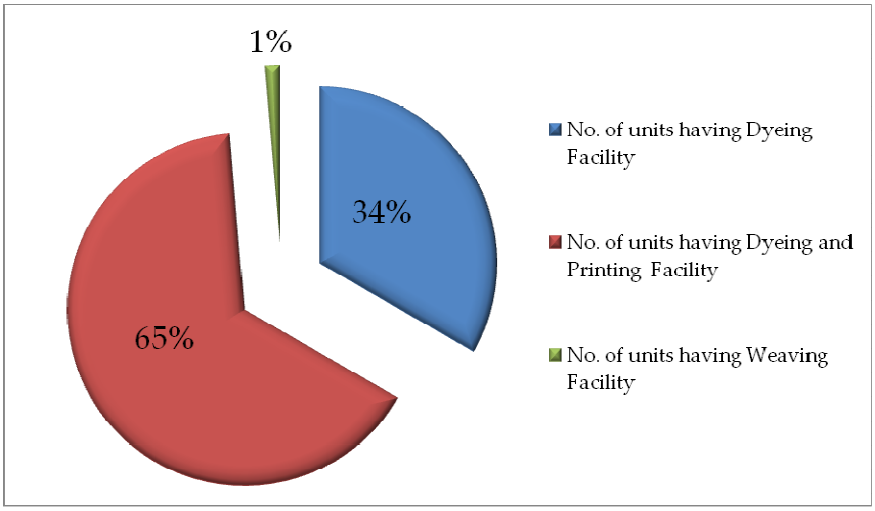


Figure 6: ***Classification of units (75 Nos.) based on production facilities***

c) Classification Of Studied Units Based On Annual Energy Bill

Out of 75 units surveyed, only one unit has received energy bill less than Rs.100 lakhs per annum, 28 units have energy bill between Rs.100 lakhs and Rs.300 lakhs per annum, 37 units recorded energy bill between Rs.300 lakhs and Rs. 500 lakhs per annum; and the balance 9 units have energy bill above Rs. 500 lakhs. The classification based on annual energy bill is furnished graphically in Figure 7.

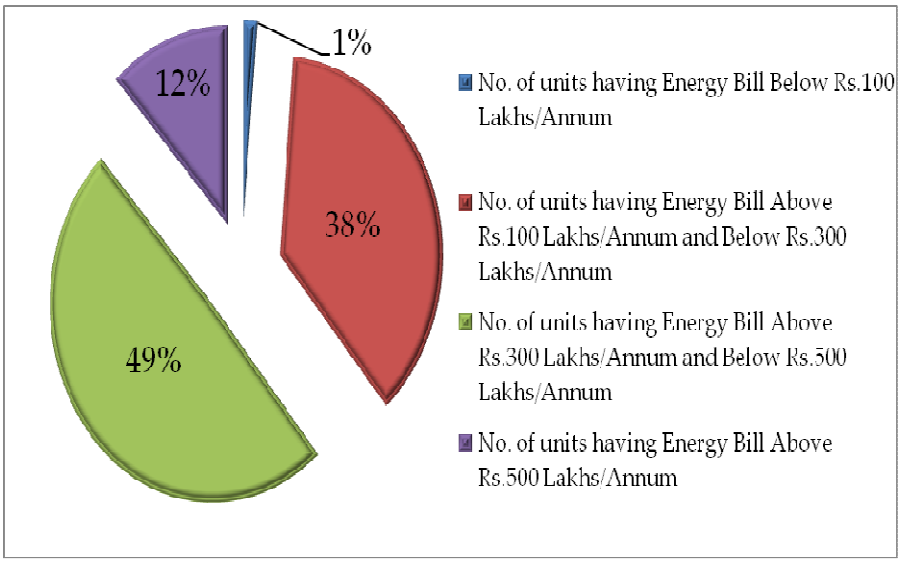


Figure 7: Classification of units based on annual energy bill (75 Units)

2.1.4 RAW MATERIALS

The main raw materials used by Textile units in Surat Cluster are:

- Polyester yarn
- Grey cloth
- Dyeing agents
- Bleaching agents
- Caustic
- Soaping agents

2.2 ENERGY SCENARIO OF THE CLUSTER

The cluster units require fuels and electricity for sourcing, dyeing, printing and weaving. Heat is used for scouring, dyeing and printing process for application and dye fixation. Electricity is required for operating the electrical motors and lighting. The major fuels used in the cluster units are Imported Coal, Lignite, Natural gas and Biomass (Groundnut husk briquettes and Wood).

2.2.1 Fuels Used And Price

The major fuels used in the cluster units are lignite, imported coal, natural gas and biomass. The prevailing prices of fuels in the cluster are furnished below in Table 3.

Table 3: Prevailing Fuel Price Of Fuels Used In The Cluster

S. No	Fuel type	Price Range (Rs.)
1	Lignite	2,500–2,800 / ton
2	Imported coal	3,500–3,800 / ton
3	Natural gas	11.5 per SCM
4	Biomass (Groundnut husk briquettes & Wood)	3,500 / ton
5	Electricity	5.60 per kWh

2.2.2 Energy Consumption

The main energy forms used in a typical unit of the cluster are electricity, natural gas, lignite, biomass materials such as non renewable wood and imported coal. Electricity is used for driving the prime movers of pumps, fans, drives, and for lighting. Lignite and imported coal are used in boilers for steam generation. Natural gas is used in Stenter's (for heat setting) and natural gas based generators. The annual energy consumption of the three typical units in the cluster is furnished in Table 4a below:

Table 4a : Annual Energy Consumption Of The Three Typical Units

Details	Value	Unit -1	Unit -2	Unit -3
Electricity consumption	kWh	10.78 lakh	6.33 lakh	22.25 lakh
Imported coal consumption	tons	7,200	8,822	2,727
Natural gas	SCM	12.86 lakh	13.79 lakh	6.12 lakh
Final production	Meters	153 lakh	150 lakh	115 lakh

The annual consumption of fuels and electricity of the total cluster units are furnished below:

Table 4a: Total Annual Energy Consumption Of The Cluster Units

Type of energy	Annual Consumption	Tons of Oil Equivalent (TOE)
Electricity	725.7 GWh	62,411
Natural gas	3,147 lakh scm	2,83,230
Imported Coal	23, 00,972 tons	9, 43,398
TOTAL		**12, 89,039**

2.2.3 Specific Energy Consumption

The specific energy consumption for various types units of the cluster like dyeing, dyeing and printing (integrated) and weaving units are furnished below in Table 5:

Table 5: Specific Energy Consumption

Equipment	Units	Minimum SEC	Maximum SEC	Average SEC (for whole cluster)
Saflina machines	kWh/meter	0.011	0.013	0.012
Drum Washer machine	kWh/meter	0.012	0.016	0.014
Jet Dyeing machine	kWh/meter	0.016	0.019	0.017
Stenter machine	kWh/meter	0.018	0.020	0.019

2.3 MANUFACTURING PROCESS

2.3.1 Process Technology

The main process operation for dyeing and printing process of synthetic sarees and dress materials adopted in cluster units are as follows:

2.3.1.1 Fabric pre-treatment

Fabric pre-treatment includes various processes. The processes can be applied either as separate steps or as combined steps.

In fabric pre-treatment continuous processes is used. Fabrics are pretreated in open width or rope form. The pre-treatment process is carried out in different methods like scouring, bleaching and shrinking process of bulkiness in pressure vessels. Batch wise pre-treatment on dyeing machines is used as variety of small lots is to be scheduled and handled.

Various processes adopted in pretreatment are elaborated below:

i.) ***Scouring:***

Scouring and cleaning is carried out in soflina machine. Fabric scouring is done mainly to remove the oily substances, nitrogenous compounds, waxes and proteins and natural coloring material from the fabric by treating it with hot alkaline liquors containing other required chemicals like wetting agent, defoamer, detergent, and stabilizer.

ii.) ***Bleaching:***

Bleaching is carried out to remove the colored impurities from textile fibers. Fabric in its natural form contains so many minerals, waxes, proteins and coloring matters, etc. In order to attain a bright substrate for dyeing, bleaching or printing and to make the fabric uniformly water absorbent, a pretreatment is essential. So the first and foremost textile processing operation is called pretreatment, that remove the unwanted matters, such as color, minerals, waxes and oils and stains from the grey material. The pretreatment operation utilizes a lot of water and the quality of water plays a vital role in the cleaning of textile materials. Better the quality of water better will be the processed material.

iii.) Shrinking process:

Shrinking process is performed in drum washer machine. This process is mainly used to shrink the bulkiness of the fabric, in order to attain the required size and thickness of the fabric. This Process is done in high temperature high pressure closed vessels and it is performed in batch type in the presence bleaching chemicals.

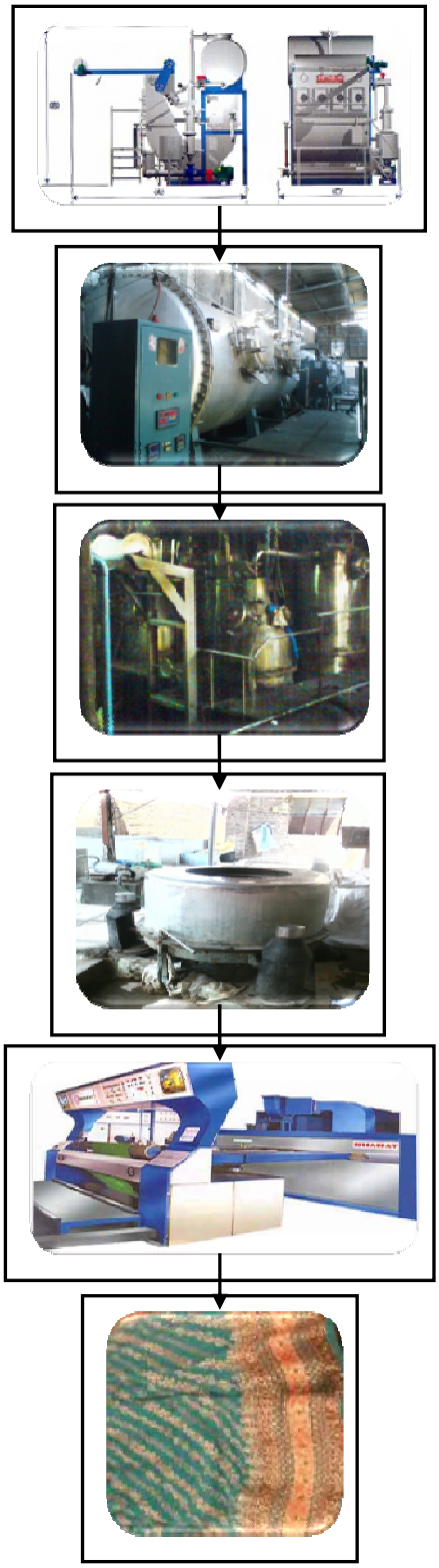
2.3.1.2 Dyeing

Dyeing is the process of imparting colors to the material through a dye (color). In which a dye is applied to the substrate in a uniform manner to obtain an even shade with a performance and fastness appropriate to its final use. This process is mainly performed in Jet Dyeing Machines and Jigger machines.

Initially, the jet machines are filled with required quantity of water and after attaining the required temperature, the fabric is loaded. The temperature of the liquor is raised by addition of indirect steam or direct steam. When the temperature reaches 120°C to 130°C, the required chemicals like bleaching chemicals (Hydrogen peroxide and brightening agent) are added and the water is completely drained after the process is completed.
Depending on the plant operating practice, some of the plants are recycling the water for cleaning purpose.

Dyeing of fabric is carried out in jet dyeing machines. The temperature of the solution is raised to 50°C. Concentrated dyestuff solution is prepared separately and is added to the liquor. After the addition of dyes, the temperature is raised to 130°C and maintained for about 60 minutes.

After whitening/dyeing, the fabric is unloaded from the machine and taken to the folding and rolling machines for improving the width of cloth, which gets shrunk during the washing and dyeing process.



2.3.1.3 Printing

In Surat cluster three types printing methods are used. Most of the units are following the flat bed printing, rotary printing and some units follows hand printing. Hand printing is the old method to print the fabric. The flat bed printing has provision for printing 10 to 14 colors simultaneously. The color print paste prepared is fed onto the screens from which it is transferred to the fabric fed in. The fabric after print paste transfer is passed through a drying chamber at 145°C. The dried and printed fabric is taken for further processing.

i.) Flat bed screen printing:

The first of the modern printing methods is flat-bed screen printing. In the textile industry, this process is an automated version of the older hand operated screen printing. For each color in the print design, a separate screen must be constructed or engraved. If the design has four colors, then four separate screens must be engraved. The modern flat-bed screen-printing machine consists of an in-feed device, a glue trough, a rotating continuous flat rubber blanket, flat-bed print table harnesses to lift and lower the flat screens, and a double-blade squeegee trough. The in-feed device allows for precise straight feeding of the textile fabric onto the rubber blanket. As the cloth is fed to the machine, it is lightly glued to the blanket to prevent any shifting of fabric or distortion during the printing process. The blanket carries the fabric under the screens, which are in the raised position. Once under the screens, the fabric stops, the screens are lowered, and an automatic squeegee trough moves across each screen, pushing print paste through the design or open areas of the screens. The screens are raised, the blanket precisely moves the fabric to the next color, and the process is repeated. Once each color has been applied, the fabric is removed from the blanket and then processed through the required fixation process. The rubber blanket is continuously washed, dried, and rotated back to the fabric in-feed area.

ii.) Rotary screen printing:

In Rotary Screen printing machine, a flat screen is simply shaped into a roll by sealing the ends of the flat screen together and thus addresses the deficiencies of Flat Bed Printing Machines such as low productivity, and non-continuous patterns. The simple modification converts a semi-continuous process to a continuous one.

In basic operation, rotary screen and flat screen-printing machines are very similar. Both use the same type of in-feed device, glue trough, rotating blanket (print table), dryer, and fixation equipment.

Typical speeds are from 50-120 yards per minute (45-100 mpm) for rotary screen printing depending upon design complexity and fabric construction. Estimates indicate that this technique controls approximately 65% of the printed fabric market worldwide.

2.3.1.4 Drying and Finishing

After printing, the drying process is performed in loop machine, where the temperature is maintained between 130°C to 170°C for better color setting. After passing through the loop machines, the printed fabric is washed in a series of normal water and hot water washing in the presence of chemicals for color setting. After completion of the washing process, the printed and washed fabric is subjected to heat setting process in Stenter and then pressing and finishing treatments.

i.) Color setting and washing process:

After printing, initially drying process carried out in Loop machine. In this machine printed colors are penetrated in to the fabric, where both thermal and electrical energy are used to set the color on the fabric.

ii.) Heat setting:

Heat setting is carried out on fabrics made of manmade fibres or blends of them with natural fibres to relax tensions in the textile fibres due to upstream fibre/yarn/fabric processing and to improve the dimensional stability of the textiles. Heat setting is carried out continuously in stenters at temperatures between 150°C-220°C.

The application of heat is done by hot air, on a pin stenter at 220°C for 20-30 seconds for polyester goods and at a lower temperature range of 190 °C -225 °C for 15 -20 seconds for polyamides. Acrylics may be heat set partially

Figure 8: The Process adopted for Dyeing of fabric

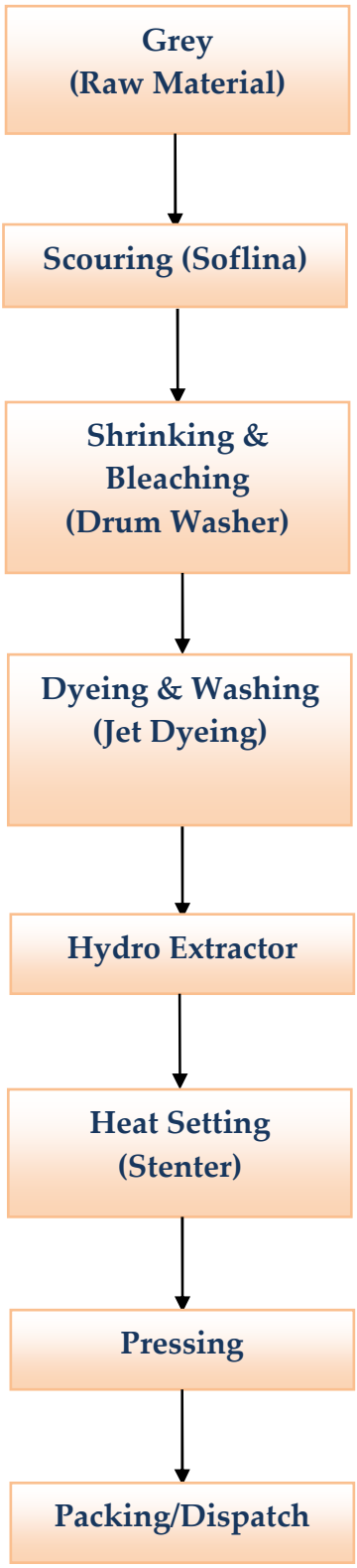
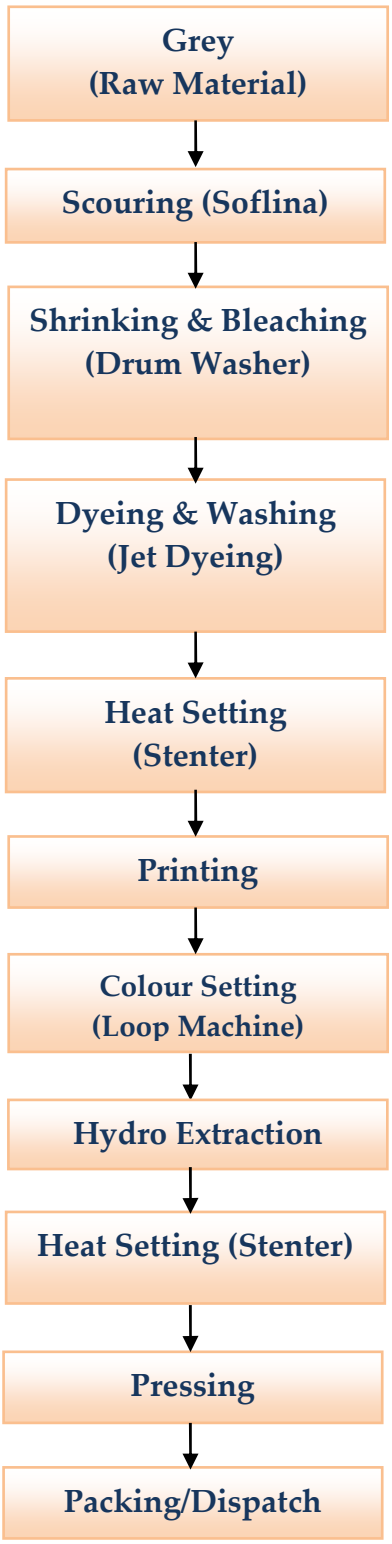


Figure 9: The Process adopted for Printing of fabric



2.4 CURRENT POLICIES AND INITIATIVES OF LOCAL BODIES

About GEDA

Gujarat Energy Development Agency (GEDA) is a Government of Gujarat Undertaking Agency established in the year 1979. GEDA is a 'Nodal Agency' for promotion of renewable energy sources and 'Designated Agency' for implementation of Energy Conservation Act, 2001 in the State of Gujarat.

Gujarat Energy Development Agency (GEDA), is Nodal Agency established by the Government of Gujarat for prompting use of renewable energy sources and energy conservation in Gujarat. GEDA is also the State Designated Agency for implementing the Energy Conservation Act-2001 enacted by the Govt. of India. Promotion of Energy Efficiency in the industrial and buildings sector form one of the major mandates of the EC Act as it has tremendous potential for improvement.

The various schemes are offering by GEDA in the field of energy efficiency and the detailed are furnished below:

GEDA Energy Audit Scheme

GEDA's Energy Audit Scheme provides financial assistance as well as technical expertise through trained & experienced energy experts, to industries and building owners for analyzing their energy usage and to increase their profits through achievement of higher energy efficiency. Energy audits of industrial units, commercial complexes, hotels and hospitals are covered under this subsidy scheme.

The subsidy will cover up to 50 % cost of the Energy Audit Study (EAS), upto a maximum of Rs.20,000/-. Industries having Contract Maximum Demand of less than 200 kVA and commercial complexes having Contract Maximum Demand of less than 75 kW would only be eligible for subsidy under this Scheme.

Scheme for Mass Scale Walk-through Energy Audit of SMEs in Gujarat
Background

The Industrial Sector of Gujarat is a major energy consumer – both thermal and electrical energy. The industrial sector constitutes more than 35% of the energy used in the state. The SMEs form a vital part of the Industrial Sector and represent nearly 40% of the country's GDP. The SMEs account for a large share of energy consumption and energy cost forms a big portion of the total manufacturing cost. Reduction in the energy consumption through efficiency improvement in SMEs could enhance the profitability and cutting edge of the SMEs. At present there are around 3 lakh SME units in Gujarat and their share exceeds 30% of total manufacturing and exports of the State. Some of the important SME clusters in Gujarat include:

1. Readymade Garments, at Ahmedabad
2. Drugs & Pharmaceuticals, at Ahmedabad
3. Dyes & Intermediates, at Ahmedabad
4. Re-rolling Mills at Bhavnagar
5. Plastic Industry at Dhoraji;
6. Brass Parts at Jamnagar;
7. Chemicals at Nandesari, Vapi & Ankleshwar;
8. Ferrous Castings, at Rajkot
9. Wrist Watch & Components at Rajkot;
10. Power looms, Diamonds, Gems & Jewellery, Jari at Surat;
11. Pottery & Ceramics at Surendranagar (Than) & Wankaner;
12. Ceramic Products at Thangadh and
13. Petrochemicals at Vadodara.
14. Diesel Engines, at Rajkot
15. Electric motors, at Rajkot
16. Machine Tools, at Rajkot

Improving Energy Efficiency in Small & Medium Enterprises (SMEs)

With rapid globalization SMEs are facing business risks where cost of manufacturing is going up every day and competition is bringing down the selling price of their products. These demands for an innovative approach to cut down input costs on recurring basis so as to remain competitive. This would require focused approach for improving productivity & efficiency, adoption of newer technology, capacity building of human resources, innovative financing options, and cluster based projects on Research & Development etc.

One of the primary input costs for SMEs is Energy; therefore conservation of Energy demands utmost importance to remain competitive on a global scale.

Energy Audit Scheme For SMEs of Gujarat

Gujarat Energy Development Agency (GEDA), with the objective of promoting fast-track Energy Efficiency (EE) Improvement, is introducing a novel Scheme for rendering technical guidance and assistance to the SMEs in the State. GEDA has proposed to help SME sector through an intensified energy auditing program to be executed by force of qualified Energy Auditors (EAs). GEDA approved Energy Auditors would be deployed to carry out Walk-Through Energy Audits (WTEA) of selected SMEs units and submit a Energy Audit Report with recommendations and suggestions for reducing the energy consumption in the SME unit audited.

A Walk-Through energy Audit is a simple visual investigative audit and table-top survey of the Energy Bills of the manufacturing facility. The WEA report would comprise of the submission of the energy Consumption pattern of the work place and suggestions for Energy Conservation. The WEA would also point out good 'House Keeping' practices relevant to the industry being audited. Depending upon type and size of industry WEA may be carried out in 1 – 3 days.

Scope of the Scheme

It has been proposed to carry out a 5000 walk-through energy audits during the year 2009-10 under the Scheme. GEDA shall depute its approved Energy Auditors to carry out the assignment, the entire cost of which shall be borne by GEDA. Other benefits to the SMEs include:

1. Invaluable energy consultancy & guidance at "no cost".
2. Documented information on options and opportunities for energy saving in the industry. Concise report of WTEA with pinpointed quickly implement able EC measures would be submitted to the industry for further implementation.
3. List of qualified vendors for procuring EE Technologies to help the SMEs in the procurement and EC implementation process.
4. Based on the findings of the WTEA SMEs would be selected for conducting Detailed Energy Audit (DEA) under the GEDA Industrial Energy Audit Subsidy Scheme during the subsequent year.

2.5 MAJOR BARRIERS FOR IMPLEMENTATION OF ENERGY EFFICIENCY MEASURES

2.5.1 Energy Availability

The main energy forms used in the cluster units are lignite, imported coal, natural gas, and electricity. As the port is near to the Surat city, the imported coal and lignite are available abundantly. *Though, the electricity is available, the cost of electricity supplied by the Gujarat State Electricity Board is high as compared with other States.* For reducing the production cost, a few units have installed natural gas fired generators.

The electricity generation by natural gas is low as compared with grid electricity cost. Though, natural gas is available in the area and its availability is less than 50% of the requirement and therefore the units need to depend on grid power.

This is one of the major barrier facing by SME owners in the cluster for implementing natural gas based systems.

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 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 textile unit owners do not have in-depth 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. The lack of technical know-how made it impossible for the textile unit owners to identify the most effective technical measures.

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 40% of the units in the cluster have good financial strength and are implementing various energy efficiency measures available in the market.

The balance 60% of the units in the cluster does not have adequate financial strength to implement the identified EE measures as it requires considerable investment.

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

3.1.1.4 Technical 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

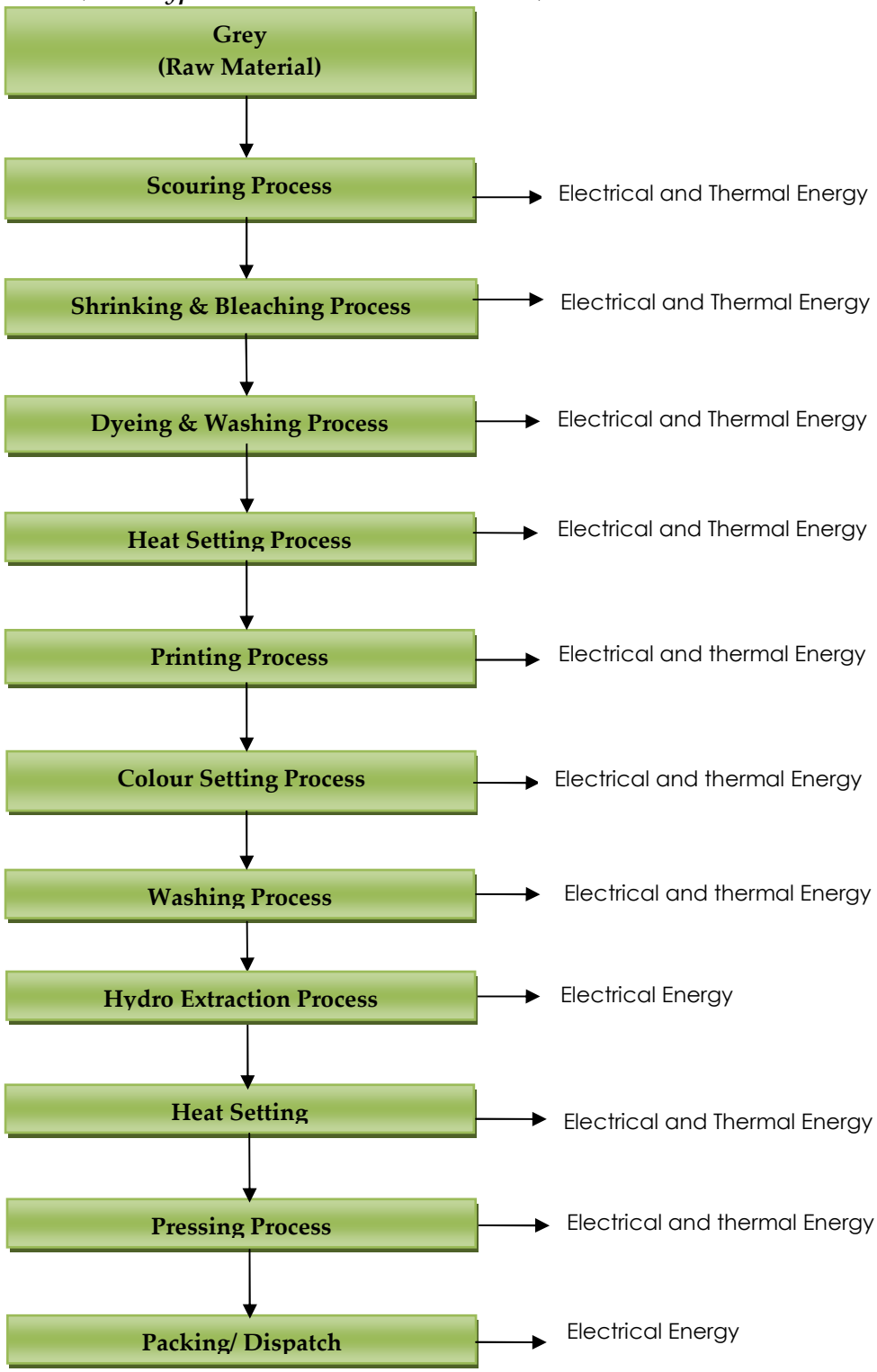
3.2 OBSERVATIONS MADE

3.2.1 Manufacturing Process And Technology Employed

There are about 400 units in the cluster, which are engaged in the production of synthetic sarees and dress materials. The main raw material is grey cloth. The process flow diagram of a typical unit of the cluster is furnished in the Figure 10 below:

Figure 10: Process flow chart

(For a typical textile unit in the Cluster)



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

i) The status of some of the technologies installed like stenters, boilers, pumps, steam distribution system, etc 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) The textile mills is an unorganized sector with limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, and operational skill. The sector faces deficiencies such as the lack of technology sharing, lack of technical manpower, technical knowledge among workforce and inadequacies of strong organizational structure, and professional attitude.

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 Lignite/ Imported coal and Natural gas

The majority units of the cluster use lignite and imported coal as fuel for boilers and thermic fluid heaters. The coal consumption in cluster units varies from 1800 to 19000 tons per annum depending on production capacity and production facilities of the plant.

Natural gas is used in stenters, printing, loop machine, and zero-zero machines and also used in generators for electricity generation. The natural gas consumption varies from 1.66 lakhs SCM to 16.41 lakhs SCM per annum depending on the production capacity and equipments installed. The variation of consumption of different forms of energy used in the clusters are furnished below table 6:

Table 6: Variation of different forms of energy consumption in cluster units

S. No	Fuel type	Price range (Rs.)
1	Lignite	2,500 – 2,800 per ton
2	Imported coal	3,500 – 3,800 per ton
3	Natural gas	11.5 per SCM
4	Biomass (Groundnut husk briquettes and Wood)	3,500 per ton
5	Grid Electricity	5.60 per kWh

3.2.2.2 Electricity

HTP-I:

This tariff will be applicable for supply of electricity to HT consumers contracted for 100 kVA and above for regular power supply and requiring the power supply for the purposes not specified in any other HT categories.

Demand Charges;

For billing demand up to contract demand.

(a)	For first 500 kVA of billing demand	Rs.100/- per kVA per month
(b)	For next 500 kVA of billing demand	Rs.140/- per kVA per month
(c)	For next 1500 kVA of billing demand	Rs.210/- per kVA per month
(d)	For billing demand in excess of 2500 kVA	Rs.240/- per kVA per month

For Billing Demand in Excess of Contract Demand

For billing demand in excess over the contract demand	Rs.370 per kVA per month

PLUS

Energy Charges

For Entire Consumption During The Month

(a)	Upto 1000 kVA billing demand	390 Paise per Unit
(b)	For 1001 kVA to 2500 kVA billing demand	410 paise per Unit
(c)	Above 2500 kVA billing demand	420 Paise per Unit

PLUS
Time of Use Charges:

(These charges shall be levied from a consumer having contract demand or actual demand of 500 kVA and above):

For energy consumption during the two peak periods, viz., 0700 Hrs to 1100 Hrs and 1800 Hrs to 2200 Hrs	75 Paise per Unit

Power Factor Adjustment Charges:

(a) The power factor adjustment charges shall be levied at the rate of 1% on the total amount of electricity bills for the month under the head "Energy Charges" for every 1% drop or part thereof in the average power factor during the month below 90% upto 85%.

(b) In addition to the above clause, for every 1% drop or part thereof in average power factor during the month below 85% at the rate of 2% on the total amount of electricity bill for that month under the head "Energy Charges", will be charged.

Power Factor Rebate:

If the power factor of the consumer's installation in any month is above 95%, the consumer will be entitled to a rebate at the rate of 0.5% (half percent) in excess of 95% power factor on the total amount of electricity bill for that month under the head "Energy Charges" for every 1% rise or part thereof in the average power factor during the month above 95%.

The electricity consumption in cluster units varies from 4.70 lakhs kWh to 41.11 lakhs kWh depending on the quality, process adopted, products produced, production capacity of the units installed, and type of equipments installed. The unit cost of electricity in the cluster is Rs. 5.60 and specific electricity consumption of three typical units is furnished below table 7:

Table 7: Specific electricity consumption

Units	Type 1	Type 2	Type 3
Specific Electricity consumption (kWh/mts)	0.070	0.042	0.193

3.2.3 Capacity Utilization

Most of the units operate for 24 hours in a day and 350 days per annum. Most of the units operate their process equipments continuously. The Jet machines, stenters, Loop machines and printing machines are operated over 100% to the rated capacity of the machines and where as the drum machines and other equipments are operated as per the requirement and largely operate over 70%

The overall production capacity utilization of the plants is above 80% for all the units surveyed. The high capacity utilization is due to good market for the products manufactured in the cluster units

3.2.4 Housekeeping practices

About 30% of the units are adopting good operating practices and however, the basic procedures adopted for steam distribution, condensate recovery, installation of steam traps is poor in majority of the units and these may be due to lack of awareness.

3.2.5 Availability of data and Information

The data and information pertaining to energy procurement and consumption is available in some of the cluster units. However, no single unit was ready to reveal production. 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 for some of the equipments 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, etc.

ii) There is a tremendous need for these industries to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the management, they are interested in improving the efficiency of the utilities rather than process equipments.

iii) The textile mills is an unorganized sector with low engineering, limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, and operational skill. 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 good 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 8: Technology gaps identified and technology interventions

Equipments	Technology Gaps Identified	Technology Interventions
Jet Dyeing and Drum machines	• Constant speed irrespective of quantity of the water circulation required • Low efficient & local water circulation Pumps • No Waste Heat recovery from hot drained Effluents	• Install Variable Frequency Drives for water circulation pumps • Energy efficient and reputed branded pumps • Waste heat recovery from hot drained effluents.
Saflina machine	• Constant speed irrespective of quantity of the water circulation required • Low efficient & local water circulation Pumps	• Install Variable Frequency Drives for water circulation pumps • Energy efficient and reputed branded pumps
Stenter machine	• Conventional local made blowers for Stenter chambers • Constant speed of blower • Conventional Stenter machine	• Install energy efficient fans • Install VFD's for blowers • Replace conventional Stenter with EWHA Stenter machine
Printing machine	• Conventional local made blowers for Stenter chambers • Constant speed of blower	• Install energy efficient fans • Install VFD's for blowers
Boiler	• No Speed control for ID and FD fans • No excess air control • No Condensate recovery from jet dyeing machines and saflina machines • Poor condensate recovery system	• Install VFD's for ID and FD fans. • Install automatic oxygen trim system • Install the ball float steam traps and PPPU for condensate

	• Poor steam distribution system, malfunctioning of steam traps, by pass valves open and improper selection of steam traps • Manual blow down and energy loss due to over blow down quantity than required	recovery from jet and saflina machines • Proper maintenance of steam traps • New Improved Design and high efficiency boiler with automatic blow down control system
Thermopac	• No speed control for ID and FD fans • No excess air control • No speed control for thermic fluid circulation pump	• Install VFD's for ID and FD fans. • Install automatic oxygen trim system • Optimization of Thermic fluid pump speed by installing VFD
Jiggers	• No temperature controls	• Install Temperature controls
Washing	• No temperature controls	• Install Temperature controls
Grid electricity and steam generation in boilers	• High cost and low efficiency	• Install Co-generation system for sequential generation of steam and electricity
Power Generation	• Reduction of steam pressure in PRV's	• Install energy conservation turbine to generate free power by using energy available in steam which reduced in PRV's
Grid Electricity and Steam generation in boilers	• High cost and low efficiency	• Install NG generator with co-generation system for steam and hot water generation.

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, which are presented below: These proposals are of high investment, medium and low investment measures and zero cost and other measures were included good housekeeping practice section:

3.4.1.1 Natural gas generator with cogeneration

Background

The main energy forms required for the process operations of Surat Textile Cluster industries are electricity and heat. Electricity is used for driving the prime movers of pumps, fans, air compressors, drives, lighting, stenter m/c drives, etc. The heat in the form of pressurized steam is used in jet machines, drum machines and final washing etc. More than 90% of the cluster units electricity is imported from the Gujarat State Electricity Board and is purchased at Rs. 5.80 per unit. The natural gas is also available in the Surat and is supplied by Gujarat Gas Company Limited at Rs.11.50 per SCM.

Recommendation

The electricity generated by natural gas generators is cheaper than the electricity supplied by the grid. Further, the steam and hot water can be generated from the waste flue gases of the generator which can be used for process requirements.

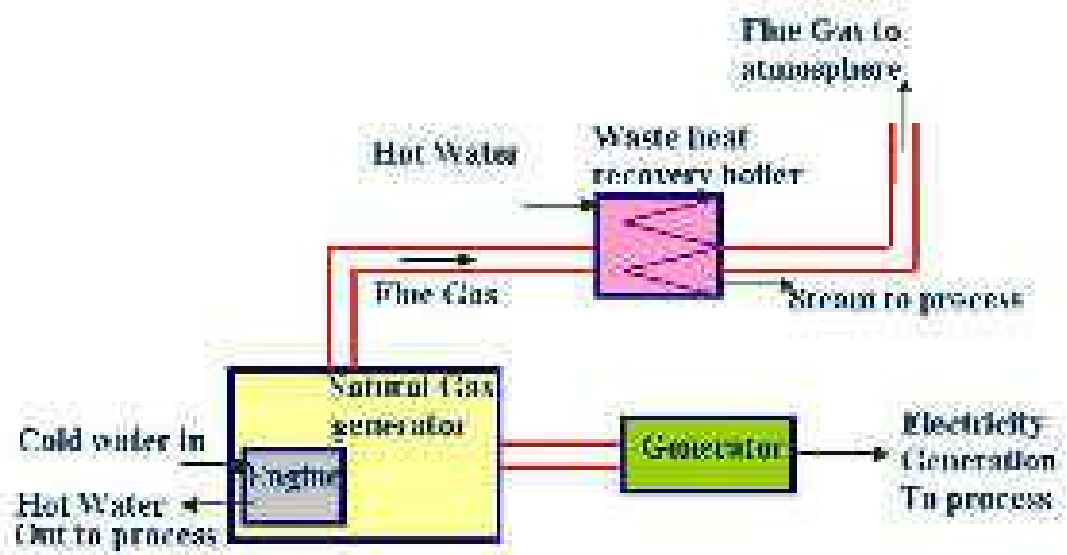


Figure 11: Schematic Diagram Of Natural Gas Co-Generation

The cost benefit analysis of installing Natural Gas Generator with Co-generation is furnished below in Table 9:

Table 9: **Cost Benefit Analysis of Natural Gas Co-Generation System**

Details	Value
Capacity of the natural gas generator	500 kVA
Electricity Generation	360 kWh/hr
Natural Gas consumption	160 Nm^3/hr
Natural Gas cost	Rs.11.5/ scm = Rs.1840
Average unit cost	Rs. 5.11
Quantity of steam generation	230 kg/hr
Equivalent coal savings	60 kg/hr
Monetary benefit due to coal savings	Rs.180 per hour
monetary benefit due to hot water generation	Rs.220 per day
Cost of grid electricity per day	Rs.2088
Monetary savings due to reduction in electricity cost (50% is considered due to shortage in natural gas availability)	2,088 – 1,840 = Rs. 248/hr = 124 (at 50%)
Total Monetary savings/day	Rs 7955 per day
Monetary savings per annum(@350 days of operation per year)	Rs.27.84 lakhs/annum
Investment required for 500 kVA generator	Rs.100.00 lakhs
Simple payback period	3.60 years

There are about 200 industries having natural gas facility, the natural gas generator can be installed for about 100 units in the cluster. The annual monetary savings of Rs. 278.40 Lakhs per annum. The total investment required for 100 units is Rs.10000.00 Lakhs and simple payback period is 3.60 years

The product specifications for natural gas engine/generators models and technical specifications are furnished below in Table 10:

Table 10: Cummins Natural gas generator specifications

Model	Displacement (Cu in/ lit)	No of Cylinders	Prime Power (kWe) 50 Hz	Est. Natural Gas Consumption (SCM/Hr)	Base Load (kWe) 50 Hz
G6B-5.9-G	360 / 5.9	6	40	14	32
G-855-G	855/14	6	100	37	85
GTA-855-G	855/14	6	144	52	122
GTA-1710-G	1710/28	12 V	304	103	245
GTA-1150-G	1150/19	6	200	76	160
GTA-2300-G	2300/38	12 V	400	135	320
GTA-3067-G	3067/50	16 V	500	187	400

Source: Cummins Engines

Benefits:

- Low cost of electricity
- Free steam and hot water and hence reduces fuel consumption in boilers
- Low operating costs
- Reduces GHG emissions
- As electricity is generated and consumed in the same plant, hence reduces transmission and distribution losses
- Generates employment directly and indirectly and also enhances the skills of workers
- Low investments and quick payback periods than normal conventional power plants
- Reduces the pressure on grid system and high investment for power supply infrastructure
- Reliable, continuous delivery of cost effective power and reduces dependence on fossil fuels

3.4.1.2 Steam based cogeneration system

Background

The Surat Textile cluster units require significant quantum of thermal energy in the form of steam and electricity. At present, the steam is generated in low pressure boilers and coal is used as fuel. Whereas, electricity is either imported from the grid or generated in natural gas generators (about 5% to 10%).

Cogeneration : Use of steam is mandatory for the units involved in Textile Wet Processing and typical capacity available in the units is 2 to 3 TPH. Cogeneration is proven technology for maximizing Steam Utilization efficiency. With the development of smaller steam turbines which run at pressures like 42 Kg/Cm^2 and produce 1 Kw power for every 14 Kg steam. Further development of condenser for this scale of turbine, power availability has become reliable and free from steam load of the unit which otherwise keeps fluctuating.

Cogeneration is the concept of producing two forms of energy from one fuel. One of the forms of energy must always be heat and the other may be electricity or mechanical energy. In a conventional power plant, fuel is burnt in a boiler to generate high-pressure steam. This steam is used to drive a turbine, which in turn drives an alternator through a steam turbine to produce electric power. The exhaust steam is generally condensed to water which goes back to the boiler.

As the low-pressure steam has a large quantum of heat, which is lost in the process of condensing, the efficiency of conventional power plants is only around 35%. In a cogeneration plant, high efficiency levels, in the range of 85%–90%, can be reached. This is so, because the low-pressure exhaust steam coming out of the turbine is not condensed, but used for heating.

Since cogeneration can meet both power and heat needs, it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption.

The cogeneration plants are best suited for Surat Textile cluster units, as both electricity and thermal energy required is well balanced.

The cogeneration plant essentially consists of a high pressure boiler, extraction cum back pressure or back pressure turbine and alternator of the required capacity. The high pressure steam generated is passed through the turbine-alternator for generation of electricity and the exhaust steam from the turbine at low pressure is used for the process requirement. The schematic diagram of the proposed cogeneration system is furnished below in Figure 11:

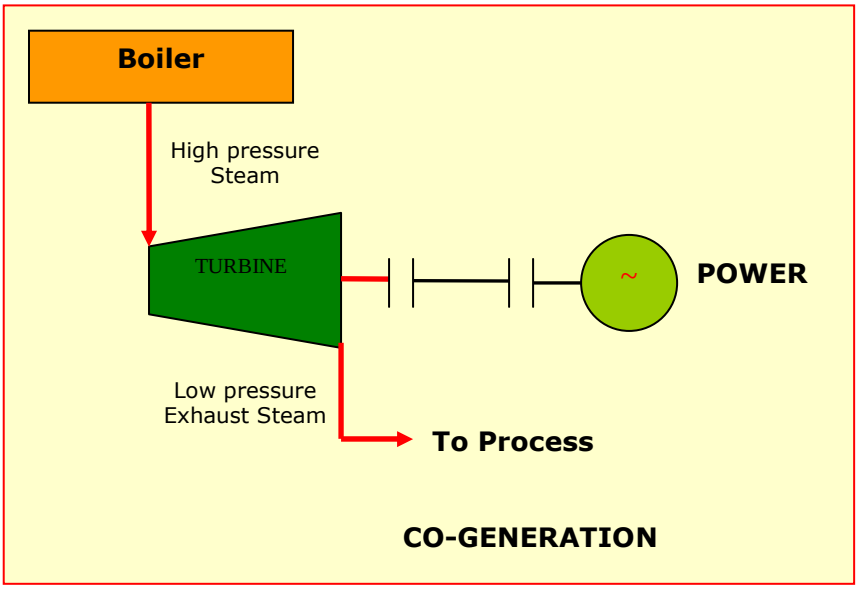


Figure 12: Schematic Diagram Of Proposed Cogeneration Scheme

The Cost benefit analysis for a 500 kW Coal Based co-generation plant is furnished below:

Baseline Energy Cost

Steam requirement per hour	= 5 tons
Coal consumption per hour	= 740 kg
(@GCV of imported coal 5800 kcal/kg,	
Steam pressure 7 kgs/cm^2 & 70% boiler efficiency)	
Electricity requirement/hr	= 400 kWh
Coal cost/hour	= Rs.2590
(@Rs.3.50 per kg)	
Electricity cost/hour	= Rs.2320
(Rs.5.80 per unit of electricity)	
Total energy cost	**= Rs.4910**

Coal based Co-generation Cost (Project Scenario)

Capacity of the co-generation plant	= 500 kW
No. of units generated/hr	= 400 kWh
Steam generation	= 5500 kg
Coal consumption (@boiler efficiency 80% & 32 kgs/cm^2 & 330^{0}C superheat)	= 760 kg
Coal cost (Rs.3.50/kg)	= Rs.2660
Total fuel cost	**= Rs.2660**
Monetary savings/hr	**= Rs. (4910 – 2660)**
	= Rs.2250
Monetary/annum	**= Rs.78.70 lakhs**
Capital invested for co-generation plant	**= Rs.350.00 lakhs**
Simple payback period	**= 4.4 years**

There are about 400 units in the cluster; the steam based cogeneration can be implemented in about 75 units. The annual monetary savings is estimated as Rs. 5900.00 lakhs per annum. The total investment required for 75 units is Rs.26250.00 lakhs and simple payback period is 4.40 years.

The technical specifications for a 500 kW and 1000 kW cogeneration plant are furnished in Table 11 below:

Table 11: Technical specifications for cogeneration plant

S. No	Details	500 kW	1000 kW
1	Boiler capacity (MCR)	6 TPH	12 TPH
2	Pressure and super heat temperature	35 kg/cm^2 & 350 ^{0}C	35 kg/cm^2 & 350 ^{0}C
3	Turbine steam inlet pressure	33 kg/cm^2 & 350 ^{0}C	33 kg/cm^2 & 350 ^{0}C
4	Turbine steam outlet pressure	3.5 kg/cm^2	3.5 kg/cm^2
5	Quantity of steam at turbine inlet	6 TPH	12 TPH
6	Power generated	500 kW	1000 kW
7	Steam available for process requirement	5.5 TPH	11 TPH

Source: Turbotech Precision Engineering Pvt. Ltd

Benefits:

- Cogeneration is a low cost future source of power for meeting the in-plant requirements of steam and power
- Augments supply of power in a regime of endemic shortages in the power sector
- Promotes energy conversion efficiency and thereby conserves scarce fossil fuels
- Ensures reliable, continuous delivery of cost effective power and reduces dependence on fossil fuels
- The carbon released to the atmosphere as CO2 by cogeneration is no greater than what would have been produced by alternative methods
- It insulates the textiles units from the undependable utility supplies and reduces production costs considerably
- Cogeneration is a viable strategy to meet future energy needs of the textile sector
- The cogeneration results in benefits of localized power generation, particularly at the tail end of the grid, in terms of zero transmission and distribution losses, reliable and quality power, reduced equipment wear and tear of the transformer taking pressure off from the central grid
- The cogeneration system reduces the GHG emissions, offers an environment friendly solution for additional power generation with the same quantity of coal used for steam generation.
- It eliminates foreign exchange out flow as most of the plant and machinery required for cogeneration plant, are indigenously available.
- The cogeneration plant has a lower gestation period compared to the conventional power plants
- It has much lower installation and operating costs compared to the conventional power plants
- The cogeneration plant places no financial and administrative burden on the utility as it is executed and managed by the same units
- The return on investment is attractive with a lower pay back period.

3.4.1.2.1 Tri-generation Micro Turbine - Energy Conservation Turbine

Turbo Tech's Energy Conservation Turbines (ECT) have varied applications in industry helping to generate valuable energy in the form of electric power. The power generated is in the form of incidental power, which otherwise would have been wasted into the environment. Since ECT can utilize saturated steam, it becomes highly beneficial for industries using saturated steam.

Typically an ECT is used in parallel with a pressure reducing valve (PRV) or pressure reducing desuper-heater station (PRDS) downstream of the boiler. When the application requirement of steam is at lower pressure than the generation of steam in the boiler typically the steam is passed through a PRV or a PRDS . By installing an ECT in parallel to PRV/PRDS, whatever steam energy would have been wasted due to pressure reduction can be recovered in the form of electrical power, thus reducing power cost.

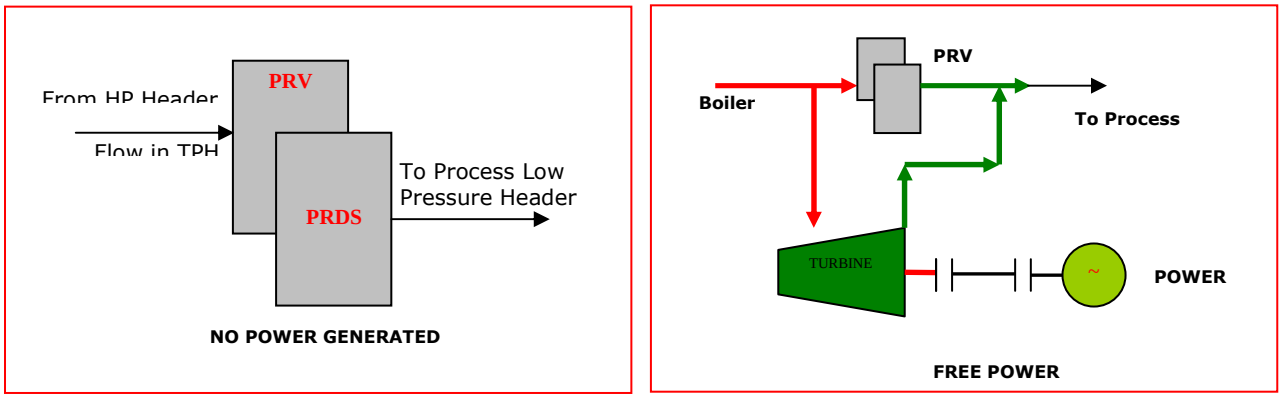


Figure 13: Energy Conservation Turbine

The Cost benefit analysis for installing energy conservation turbine is furnished below in Table 12:

Table 12. Cost Benefit Analysis of Energy Conservation Turbine

S. No	Details	Units	Value
1	Steam quantity generated	TPH	4.00
2	Steam pressure	kgs/cm^2	10.5
3	Steam required for process	kgs/cm^2	3.5 to 4.0
4	Capacity of energy conservation turbine can be installed	kW	60
5	Power generation/day (@90% load)	kWh	1300
6	Monetary savings per annum	Rs. in lakhs	26.39
7	Investment required	Rs. in lakhs	40.00
8	Simple Payback period	Years	1.50

The energy conservation turbine can be installed in about 200 cluster units. The annual monetary savings due to implementation of the project activity is Rs. 5280.00 lakhs per annum. The total investment required for 200 units is Rs. 8000.00 lakhs and simple payback period is 1.50 years

Benefits:

- Proven GHG reduction potential
- Huge untapped potential for energy conservation
- Pay back period is 6 – 18 month only
- High Utilization Factor (about 80 – 95%) equals best "bang-for-buck" compared to other Clean-Tech investments
- Island foundation is not required, there by saving substantially on installation cost.

3.4.1.3 Generate hot water from hot drained water of Jet Machines

Background

In many units of Surat Textile Cluster, the hot water at 90°C to 130°C is drained after completion of the dyeing process in jet machines. Some of the plants are partly recovering the heat and in others plants, the hot water is completely drained. In Majority of the units, the jet machines are installed with heat exchangers and water circulation and water distribution system is required for recovering heat and storage tanks for storing hot water.

Recommendation

The process requires considerable quantities of hot water in final washing, dyeing and for boiler feed water. Before the hot water is drained, the hot water can be passed through a heat exchanger to recover heat for generation of hot water and hot water can be used for further process.

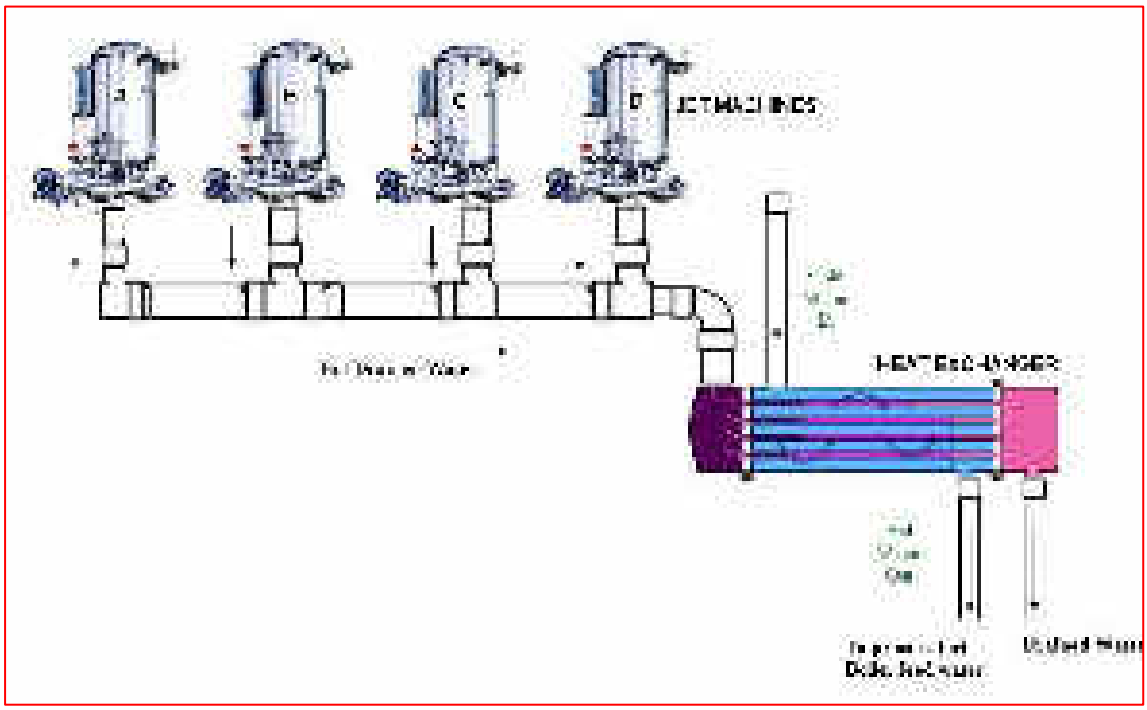


Figure 14: Schematic diagram of heat recovery system

The Cost benefit analysis of heat recovery system from hot drained water of Jet machines is furnished below in Table 13:

Table No. 13 : Cost benefit analysis of heat recovery from hot drained water of Jet machines

S.No.	Parameter	Value	Units
1	Days of operation per annum	350	Days
2	Quantity of hot water drained	85,000	liters/day
3	Average quantity per day for conservative purpose (80%)	68,000	liters/day
4	Temperature of hot drain water	90	^{o}C
5	Quantity of heat can be recovered	27,20,000	kcal/day
6	Boiler efficiency	51	%
7	Calorific value of fuel	5800	kcal/kg
8	Fuel savings	886	kgs/day
		292	tons/annum
9	Fuel cost	3,500	Rs./ton
10	Monetary savings per annum	10.22	Rs. in lakhs
11	Investment for tank, heat exchanger and distribution system	6.00	Rs. in lakhs
12	Payback period	6	Months

The proposed scheme can be implemented in about 300 units. The annual fuel savings is estimated is 50,000 tons of coal and monetary savings of Rs. 1750.00 lakhs per annum. The total investment required for 300 units is Rs. 1800.00 lakhs and simple payback period is around one year

3.4.1.4 Energy Efficient Boilers

Background

The boilers are installed in the cluster units for steam generation. Steam is used in dyeing and washing process. Based on detailed studies carried in cluster units, some of the boilers were found to be inefficient due to inferior design like single pass system, high flue gas losses and high radiation losses and efficiencies around 40% only. 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.

Recommendation

The boilers with efficiency of 75% have been suggested for installation by replacing the present boilers.

The salient features of high efficiency boilers are furnished as under:

- The boiler is of three-pass / multipass construction consisting of furnace section as first pass and number of 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.

Table 14: Performance Evaluation of the boiler

Parameter	Value	Unit
Boiler Capacity	kgs/hr	5000
Rated pressure	kgs/cm^2	7.5
No. of hours of operation/day	Hrs	24
Quantity of steam generated	kgs/hr	2000
Boiler feed water temperature	^oC	46
Fuel Consumption	kgs/hr	850
Calorific value of fuel	kcal/Kg	4000
Enthalpy of steam (@ 5 kgs/ cm^2)	kcal/Kg	663
Heat Input	kcal/hr	3400000
Heat output	kcal/hr	1234200
Efficiency	%	36.3

Table 15: Cost benefit analysis of installing new energy efficient boiler

S.No	Parameter	Unit	Value
1	Proposed capacity of the boiler	Kgs/hr	5000
2	Efficiency of the new boiler	%	75
3	Efficiency of the present boiler	%	60
4	Increase in operating efficiency	%	15
5	Fuel savings	%	21
6	Present fuel consumption	tons/yr	7,344
7	Fuel savings	tons/yr	1,500
8	Monetary savings (@Rs.2200per tonne of lignite)	Rs. lakhs/yr	33.00
9	Investment	Rs. lakhs	32.00
10	Payback period	Years	1.0

The new efficient boilers can be installed in about 50 units by replacing existing old boilers. The annual fuel savings is estimated is 75,000 tons of coal and monetary savings of Rs.1650.00 lakhs per annum. The total investment required for 50 units is Rs.1600.00 lakhs and simple payback period is 1.00 year.

The select technical details of the proposed energy-efficient boilers are furnished below in Table 16:

Table 16: Select technical details of energy-efficient boilers

Boiler Capacity	2000 kg/hr	3000 kg/hr	4000 kg/hr
Steam output (kg/hr)	2000 kg/hr	3000 kg/hr	4000 kg/hr
Fuel	Coal/lignite	Coal/lignite	Coal/lignite
Steam pressure (kg/cm^2)	10.54	10.54	10.54
Efficiency, %	72 ± 2	72 ± 2	72 ± 2
Fuel consumption Coal (kg/hr) Lignite(kg/hr)	277 346	415 519	554 692
Electrical load (kW)	15	20	22.5

Source: Rajdeep Boilers Pvt. Ltd. Surat

***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

3.4.1.5 Variable Frequency Drives (VFD)

Background

Normally, more than 50% of 3 phase-AC induction motors are fitted to fans or pumps. The flow from most fans and pumps is controlled by restricting the flow by mechanical dampers is used on fans, and valves are used on pumps. This mechanical constriction will control the flow and may reduce the load on the fan or pump motor, but the constriction itself adds an energy loss, which is obviously inefficient.

If the flow can be controlled by reducing the speed of the fan or pump 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 fan or pump is reduced, the flow will reduce partially, while the power required by the fan or pump reduce with the cube of the speed.

The flow can be reduced by 20%; the corresponding speed reduction will be 80% of the normal speed; this will reduce the power consumption to 0.8^3 = 51.2%.

This level of potential energy savings makes the use of VFD to control flow, one of the most cost effective investments in energy efficiency.
The typical applications where energy savings can be confidently expected in Surat Textile Units, by using VFD, include:

- Induced draft fans and forced draft fans for boilers
- Jet Machine water circulation pumps
- Stenter blower, Loop machine blowers, and printing machine drive systems
- Process pumps

Table 17 : Cost Benefit Analysis of Installing VFD's

S.No	Details	Unit	Value
1	No. of jet machines	Nos	3
2	Capacity	HP	10
3	No. of working hours per day	Hours	24
4	No. of Working days in a year	Days	330
5	Energy consumption of jet machines per annum	kWh/annum	53,163
6	Savings		20%
7	Estimated annual savings	kWh	29106
8	Cost	Rs/kWh	5.5
9	Monetary savings per annum	Rs/annum	160,083
10	Monetary savings per annum in lakhs	Lakhs	1.60
11	Cost of variable frequency drive	Rs.	40,000
12	Investment	Lakhs	1.20
13	Pay back period	Months	10

VFD's for jet machines

The VFD's can be installed for about 300 Jet machines in the cluster units. The annual electricity savings is estimated is 29,34,360 kWh per annum and monetary savings of Rs.161.38 lakhs per annum. The total investment required is Rs. 120.00 lakhs and simple payback period is 10 months.

Install VFD's for stenter machines fans

The VFD's can be installed for about 100 fans of Stenter machines in the cluster. The annual electricity savings is estimated is 6,01,920 kWh per annum and monetary savings of Rs. 33.10 lakhs per annum. The total investment required is Rs.40.00 lakhs and simple payback period is 1.2 years.

The benefits of installing the VFD are as follows:

- Reduction in breakdowns and smooth start
- Unity power factor
- Reduction in breakage and motor burnt
- Improved life of the motor and increased production
- Reduction in production cost and maintenance cost due to frequent failures of belts, bearings, yarn breakages
- Soft Start/Soft Stop
- Eliminates Mechanical Shock and Stress on Power Train (couplings, belts, drive shafts, gear boxes, etc.)
- Reduced Energy Consumption, Process Operates at Most Efficient Point
- Eliminates Motor Voltage Imbalance
- Input Power Phase Reversal Protection

The VFDs are available as per the capacity of the motor and no. of speeds required.

3.4.1.6 Energy Efficient pumps

The pumps are one of the major energy consuming equipments in textile industries and the pumps are installed for boiler feed water pumps, jet machine water circulation pumps, process circulation pumps, and plant water supply pumps. Majority of the pumps installed are of local make and pumps are found to be highly inefficient.

KSB and CRI pumps have higher efficiency than the local pumps due to the following reasons :
The impellers, diffusers, and shaft of these pumps are made up of AISI stainless steel and designed to deliver best possible hydraulic efficiency. The impellers and diffusers are of best efficiency and extended life.
These pumps 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.

The cost benefit analysis of installing energy efficient pumps is furnished below in table 18

Table No. 18 : Cost Benefit Analysis of energy efficient pumps

Parameters	Units	Value
Capacity of installed pump	kW	7.5
Flow (Q)	M^3/Hr	50
Head (H)	mH	22
Actual Power Measured	kW	7.32
Efficiency of the Motor	%	0.92
Pump Efficiency	**%**	**45**
Capacity of recommended pump	kW	7.5
Efficiency of the new pump	%	0.70
Power Consumption	kW	4.7
Power Savings per hour	kW	2.7
Power Savings per Annum	kW	17,595
Monatary Savings	**Rs.(Lakhs)**	**0.96**
Investment	**Rs.(Lakhs)**	**1.00**
Payback Period	**Years**	**1.00**

There are about 4200 circulation pumps connected to the jet machines in entire cluster units and these pumps can be replaced with new energy efficient KSB pumps. The annual electricity savings is estimated is 738,99,000 kWh per annum and monetary savings of Rs. 4200.00 lakhs per annum. The total investment required is Rs. 4200.00 lakhs and simple payback period is 1.0 years

The technical specifications of energy efficient pumps for various capacities of jet machines are furnished below in Table 19:

Table 19: Technical specifications of energy-efficient pumps for various capacities of Jet Machines

Capacity of Jet Machine	150 kg	200 kg	250 kg
Model			
Flow (m^3/hr)	50	60	60
Head (meter)	25	30	30
BKW	3.98	3.98	3.98
kW of the motor	5.5	7.5	7.5
Efficiency (%)	75.94	77.00	77.00
Speed	2900	2900	2900
Operating temperature	140 ^{0}C	140 ^{0}C	140 ^{0}C

Source: Pooja Agencies (KSB Pumps), Surat

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
- More discharge for the same power consumption and hence reduces processing time
- Reduces maintenance costs due to improved quality of pump parts
- Reduces production down time

3.4.1.7 Online flue gas monitoring system & Integration with FD fan

Background

The Surat Textile Cluster units have large number of boilers of various capacities. Based on the studies carried out in different industries, it has been observed that the excess air supply is not monitored properly and leading to increased fuel consumption. Though, the variable frequency drives have been installed for ID and FD fans, the excess air is not monitored.

Recommendation

The online flue gas analyzer will monitor continuously the oxygen % in the flue gas and controls the air supply to the boiler by increasing / decreasing the RPM of ID/FD fans and hence reduces fuel consumption. The cost benefit analysis is furnished below in table 20:

Table 20: Cost benefit analysis - Online flue gas monitoring system

Details	Unit	Value
Present fuel consumption	tons/annum	6048
Estimated fuel savings	%	2.7
Fuel savings per annum	tons/annum	163
Monetary savings	Rs. in lakhs	5.47
Investment	Rs. in lakhs	5.00
Payback period	years	1.0

The online flue gas monitoring system can be installed for about 300 boilers. The annual fuel savings is estimated is 36,000 tons of coal and monetary savings of Rs.1641.00 lakhs per annum. The total investment required for 300 units is Rs.1500.00 lakhs and simple payback period is 1.0 year.

The technical specifications of the online oxygen analyzer are furnished below in Table 21:

Figure 15: Schematic Diagram Of Online Oxygen Analyser

Table 21: Oxitec 5000 - Online Oxygen Analyzer

S.No	Technical details
1	Range : 0 - 25% (dual range)
2	Accuracy :+/_0.2% of measured value
3	Resolution: 0.01% Oxygen
4	Probe length : 520mm, 950mm, 1865mm
5	Filters : Ceramic , sintered metal (depending on fuel type)
6	Flue gas temperature : above dew point to 760 deg.c standard (higher up to 1400 ^{0}C for dust free flue gas application)
7	Power supply : 110/220VAC, 50/60Hz , 200VA
8	Reference air purging : 50LPH@4bar pressure

Source: Forbes Marshall

Benefits:

- Optimizes fuel consumption and hence reduces production cost
- Reduces GHG emissions for the quantity of fuel saved
- Low investment and high returns

3.4.1.8 Pressure Powered Pumping Packaged Unit (PPPPU) for improving condensate recovery

Background

In many Surat Textile Cluster units, the condensate recovery is poor and condensate is recovered partly due to improper condensate line design and faulty steam traps.

Recommendation

Pressure Powered Pumping Packaged Unit (PPPPU) is a positive displacement pump unit operated by steam, compressed air or pressurized gas. The unit is specifically designed to pump hot liquids of specific gravity 1.0 down to 0.9. This unit is a complete solution to collect condensate, pump it to desired level and destination, to measure the condensate temperature and meter the condensate quantity. PPPPU has to be preceded with properly sized flash vessel depending upon the condensate parameters

The product is a tailor made and is designed as per no. of lines to be connected, quantity of condensate, distance, etc and is designed after site inspection of the equipment supplier.

Table 22: Cost benefit analysis – Condensate recovery

Parameter	Units	Value
Days of operation per annum	Days	330
Quantity of condensate water drained	liters/day	15,000
Temperature of hot drain water	^{o}C	90
Quantity of heat can be recovered	kcal/day	595,000
Boiler efficiency	%	47
Calorific value of fuel	kcal/kg	6,000
Fuel savings	kgs/day	213
	tons/annum	70
Fuel cost	Rs./ton	3350
Monetary savings per annum	Rs.	2,35,225
Investment for Traps, Pipeline, PPPPUnit	Rs. lakhs	5.00
Payback period	Years	2 years

The new condensate recovery system with new ball float traps can be implemented in about 100 units in the cluster. The annual fuel savings is estimated is 5,000 tons of coal and monetary savings of Rs.250 lakhs per annum. The total investment required for 100 units is Rs. 500.00 lakhs and simple payback period is 2 years

Benefits:

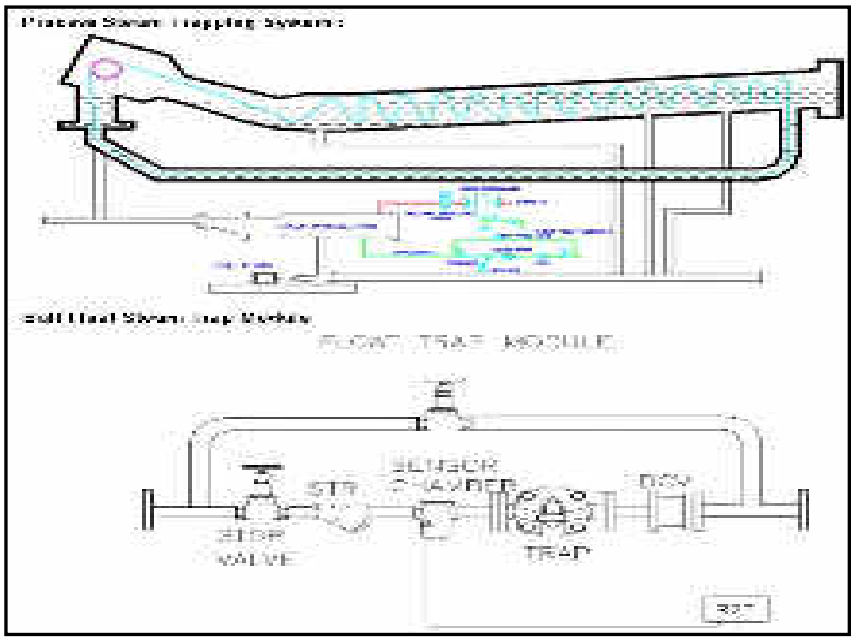
- Improves condensate recovery and hence reduces fuel consumption
- Reduces water consumption
- Reduces water treatment chemicals and thus reduces production cost
- Effects on steam generation rate
- Reduces power consumption, as pumps are not required for transferring the condensate to boiler feed water tanks
- Low investment and high returns

3.4.1.9 Install proper Steam traps for saving on steam costs

Background

As per the survey carried out in Surat Textile cluster units, in majority of the industries, thermodynamic steam traps were installed for all process equipments, where steam is supplied. Majority of the traps were found to be leaking or the bypass valves were opened leading to heavy steam leakages. This may be due malfunctioning of the steam traps

The textile units need steam continuously and often in fluctuating loads. At the same time, there can be no compromise on the quality of steam, requiring all condensate to be drained immediately. Incorrect trap selection, like intermittent discharge traps, increases steam costs by causing water-logging and steam leaks through bleed holes and leading to steam losses or increased steam consumption and fuel consumption. The diagram depicting steam trapping system is shown in Figure 9 below:



Source: Forbes Marshall

Figure 16: Steam trapping system

Recommendation

An indirect steam heating application needs trapping with suitable type and size of trap. In case of all process equipment, a Ball Float Steam Trap should be selected. A trouble free operation of steam trap is of biggest importance for efficient process. Thus, preventive maintenance of steam trap is necessary. This is achieved by installing a Strainer before trap and monitoring the performance of steam trap online using a Sensor chamber and monitoring System. When trap is discharging into closed loop condensate circuit, it is necessary to avoid any back flow and back pressure on the trap to ensure high capacity and effective operation. A Disc Check Valve plays important role in steam trapping in closed loop condensate circuit. Spirax Marshall Steam Trap Module is designed to offer complete steam trapping, monitoring and maintenance solution.

Jet dyeing is done to relieve dimensional stress as well as to achieve good dye penetration. Approximate steam load in the heat exchanger is 300 kg/hr. The temperature of liquor is to be maintained at 130 to 140 °C by using dry saturated steam at pressure of 4 bar (g).

To ensure that there is no water/condensate logging in the steam space of the heat exchanger, immediate removal through Ball Float Steam Trap Module is necessary. The ball float traps are available in various sizes as per the quantity of condensate removed and pipe lines sizes.

Benefits:

- Reduces steam leakages and consumption
- Improves condensate recovery
- Faster heat supply
- Reduces water and water treatment chemicals
- Reduces fuel consumption and GHG emissions
- Low investment and high returns

3.4.1.10 Energy efficient Stenters for power saving

The Stenter machine is vital equipment in the Surat Textile Cluster industries and is used for preparing the material for printing and color setting after printing. The Stenter is one of the most energy consuming equipment in the industry and considerable quantity of fuels and electricity is consumed.

The energy efficient EHWHA stenters consumes less power compared to local make stenters due to efficient fans and less resistance to the air circulation. As per the details provided the EHWHA, about 30% of the total power consumption of the stenters can be reduced.

COST ECONOMICS:

Old Stenter machine

No. of stenter machines	: 2 no's
Production with old stenter machines	:80,000 mts/day
Power consumption/hr	: 70 kWh/machine

New Stenter machine

Production with new stenter machines	: 80, 000 mts/day
Power consumption/hr	: 45 - 50 kWh
Power savings per annum	: 2,10,000 kWh
Monetary savings per annum	: Rs.12.18 lakhs
Investment for new stenter machine	: Rs.95 lakhs
Simple payback period	: 8 years

Benefits:

- Reduces precious fossil fuels and electricity
- Improves production
- Improves the quality of the product for uniform distribution of hot air in the stenters
- Easy to operate and maintenance
- Reduces GHG emissions
- High investment and lower payback period

Due to high initial investment and it may not possible to replace the present stenters with new energy efficient stenters

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 in Table 23.

Table 23: Life cycle analysis for energy saving proposals suggested

S.No	Energy Saving Proposal	Life cycle analysis
1	**Natural Gas generators**	The life of the natural gas generator is considered at 20 years. The depreciation is considered at 5.28% by straight line method.
2	**Steam based Co-generation system**	The life of the steam based cogeneration system is considered at 20 years and 80% depreciation during first year The depreciation is considered at 5.28% by straight line method.
3	**Heat exchanger**	The life of the heat exchanger and other waste heat recovery equipments is considered at 15 years and the initial heat transfer efficiency is 75% and the efficiency de-rates by 1% for each year of operation. The depreciation is considered at 5.28% by straight line method and 80% depreciation during first year
4	**Boiler (Energy efficient)**	The life of the boiler is considered at 20 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method
5	**Variable frequency drive**	The life of the VFD'sis considered at 20 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method
6	**Energy efficient pumps**	The life of the pumps is considered at 20 years. The depreciation is considered at 5.28% by straight line method
7	**Online flue gas monitoring system**	The life of the system is considered at 10 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method
8	**Pressurized power pumping unit**	The life of the PPPU is considered at 10 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method
9	**Steam traps**	The life of the stream traps is considered

		at 10 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method
10	**Gas stenters**	The life of the stenters is considered at 20 years and 80% depreciation during first year. The depreciation is considered at 5.28% by straight line method

3.4.3 Cost benefit analysis

The investment required for various proposals identified for different capacities of the measures identified for Surat Textile Cluster is furnished in Table 24:

Table 24: Details of cost of implementation

Equipment Details	Plant and Machinery Cost (Rs. In Lakhs)	Other Costs (Rs. In Lakhs)	Total cost (Rs. In Lakhs)
Natural gas generators			
1000 kW	180.00	22.00	202.00
500 kW	100.00	15.00	115.00
Steam based cogeneration systems			
1 MW	550.00	270.00	820.00
0.5 MW	300.00	180.00	480.00
Heat recovery from hot drained water			
10 jet machines	5.00	-	5.00
20 jet machines	8.00	-	8.00
Variable frequency drives			
3 HP	0.20	-	0.20
5 HP	0.25	-	0.25
7.5 HP	0.30	-	0.30
10 HP	0.40	-	0.40
15 HP	0.50	-	0.50
Energy efficient Boilers			
1.0 TPH	8.00	1.00	9.00
2.0 TPH	13.00	1.00	14.00
3.0 TPH	18.00	1.00	19.00
Energy efficient Pumps			

150 kg	0.55	0.05	0.60
200 kg	0.75	0.05	0.80
250 kg	0.75	0.05	0.80
Online flue gas monitoring system			
FM CODEL VCEM5100	3.50	0.15	3.65
Pressurized power pumping Unit with new ball float traps			
10 jet Machines	2.00	0.75	2.75
15 jet Machines	3.00	1.25	4.25
20 jet Machines	4.00	2.10	6.10
Gas Stenters			
6 chambers	120	6.00	126
7 chambers	140	7.00	147

Table 25: Energy saving details for the suggested energy saving proposals

S. No.	Energy Conservation Measures	Energy Saving Potential		Total Saving Potential in kTOE	Monetary Savings (Rs. In lakhs)	Cost of the implementation (Rs. In lakhs)	Simple Payback Period (in months)	No. of units may adopt the technology	Total Saving potential of the cluster, kTOE
		Electricity, kWh/Yr	Coal, Tonnes/yr						
1	Natural gas generator with cogeneration	480000	–	0.041	27.24	100.00	42.0	100	4.128
2	Steam based cogeneration system	1568???	–	0.117	76.70	350.00	53.0	75	8.752
3	Tri-generation Micro Turbine	455000	–	0.039	26.39	40.00	18.0	200	7.826
4	Heat recovery system		292	0.163	10.72	5.00	6.0	300	50.808
5	Energy Efficient boilers	–	1500	0.872	25.00	32.00	17.0	50	43.590
6	Variable Frequency Drives	9722	–	0.001	0.53	0.45	10.0	400	0.334
7	Energy Efficient pumps	17985		0.003	0.98	1.07	13.0	4000	6.355
8	Online flue gas monitoring system		163	0.095	5.47	5.00	11.0	300	28.592
9	Pressure Powered Pumping Packaged Unit (PPPPU)	–	70	0.041	3.24	5.00	22.0	100	4.050
10	Steam trapping system	–	–	–	–	–	–	–	–
11	Energy efficient systems	105000		0.009	8.03	47.50	–	–	–

Table 25: Energy saving details for the suggested energy saving proposals

3.4.4 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 70% of the cluster unit owners doesn't have financial strength for implementation of high cost technologies like natural gas generators, steam based co-generation system, and high efficient stenters. However, the owners are interested to implement low cost measures having quick payback periods of less than 2 years.
- 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

3.4.5 Availability of Technologies in Local / National / International market

For majority of the technologies and proposals identified, the equipments suppliers/ dealers / branch offices are available locally in Surat. The high investment technologies like natural gas generators, co-generation system, high efficiency gas stenters need to be procured from other places like Mumbai. Among the technologies / equipments identified for implementation for Surat textile cluster units, some of the measures can be implemented by the local service providers and the balance equipments can be procured at nearest city ie. Ahmedabad or Mumbai. The details of equipment which can be implemented by LSPs and those needs to be procured from other cities is furnished below in Table 26:

Table 26: Details of technologies available for the suggested proposals

Equipment details	LSPs	India (Mumbai & Ahemadabad)	International
Natural gas generators		√	√
Steam based Cogeneration system		√	
Heat exchanger	√	√	
Energy efficient boiler	√	√	
Variable frequency drive		√	
Energy efficient pumps	√	√	
Online flue gas monitoring system	√	√	
Pressurized power pumping unit	√	√	
Steam traps	√	√	
Gas stenters		√	√
Automatic blow down control system	√	√	

Note: √ Available

3.4.6 Availability of LSPs for Implementation of suggested proposals

The details of availability of LSPs for implementation of energy saving proposals identified are furnished below in Table 26:

3.5 Identification of Technologies/Equipments for DPR preparation

The majority of the industries in the cluster are engaged in the processing of synthetic sarees and dress materials. 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 27:

Table 27: The list of technologies for DPR preparation

Technology/equipment	No. of DPR's	Capacities
Natural gas generators	2 nos	• 500 kW • 1000 kW
Steam based Cogeneration system	2 nos	• 500 kW • 1000 kW
Heat exchanger	2 nos	As per no. of Jet Machines
Energy efficient boilers	3 nos	• 2 TPH • 3 TPH • 4 TPH
Online flue gas monitoring system	1 nos	NA
Pressurized power pumping unit with new steam traps	2 nos	10 Jet and 20 Jet machines
Gas stenters	2 nos	6 chamber and 7 chambers

Cogeneration : Use of steam is mandatory for the units involved in Textile Wet Processing and typical capacity available in the units is 2 to 3 TPH. Cogeneration is proven technology for maximizing Steam Utilization efficiency. With the development of smaller steam turbines which run at pressures like 42 Kg/cm2 and produce 1 Kw power for every 14 Kg steam. Further development of condenser for this scale of turbine, power availability has become reliable and free from steam load of the unit which otherwise keeps fluctuating.

3.6 ENVIRONMENTAL BENEFITS

3.6.1 Reduction in waste generation

By implementing various energy saving proposals identified, there is significant reduction in waste generation/effluents such as in jet machines, washing section, and boiler blow down.

3.6.2 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 consumption and fossil fuels like coal. The total emission reductions is estimated as **15,985** tons of CO_2 per annum (total grid electricity can be saved is 19.03 GWh/annum and emission factor is 840 tCO_2/GWh) due to reduction in grid electricity consumption and **1,28,452** tons of CO_2 due to reduction in coal consumption (quantity of coal savings is 60,401 tons and emission factor for imported coal is 2.12 tCO_2/ton of coal). The total estimated CO_2 emission reduction per annum is **1,44,347** tons of CO_2 in the 75 units surveyed

3.6.3 Reduction in other emissions

The technologies identified upon implementation for the Surat Textile cluster units will reduce grid electricity and coal consumption. The reduction in grid coal consumption will reduce sulphur dioxide and SPM emissions to the atmosphere. The sulphur content is varying from 0.4% to 0.6% in the imported coal and the quantity of sulphur dioxide emission reductions due to reduction in coal consumption in the cluster units is estimated as 482 tons per annum

CHAPTER 4
CONCLUSIONS

4.1 Summary of Energy saving measures identified for the Cluster

The summary of the energy saving proposals identified for Surat Textile units is furnished below in Table 28:

Table 28: Summary of energy saving proposals identified for Surat Textile cluster

S. No	Energy Saving Proposals
1	Natural gas generators
2	Steam based Cogeneration system
3	Heat recovery from drained hot water of jet machines and drum machines
4	Energy efficient boilers
5	Variable frequency drives
6	Energy efficient pumps
7	Online flue gas monitoring system
8	Pressurized power pumping unit
9	Steam traps
10	Efficient gas stenters
11	Automatic blow down control system
12	Optimizing excess supply in the boiler and thermic fluid heaters
13*	Arrest hot air leakages in the stenters and printing machines

**the proposals were included in individual reports of the units and discussed as the measures are included in housekeeping practices*

4.2 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 in Table 29.

Table 29: Technology gap assessment for the suggested energy saving proposals

S.No	Technology Identified	Gap Assessment
1	**Natural gas generators**	The electricity required for plant equipments is imported from grid and the prevailing tariff is Rs.5.80 per kWh. Though, natural gas is available in the area, only 7 units out of 75 units have installed natural gas generators due to lack of awareness on the technology and the associated benefits of natural gas based cogeneration: the technical benefits over the present scenario are: • Low cost of electricity • Steam is generated in waste heat recovery boiler at absolute zero cost • Free hot water from Jacket cooling water system
2	**Coal based Cogeneration system**	The Surat Textile cluster units require significant quantities of electricity and heat in the form of steam. Electricity is imported from grid and steam required is generated in low pressure boilers. The major technology gaps of the present system are: • The cogeneration system efficiency is above 85%, where as the overall efficiency of the present system is 55% only. • Two forms of energy is generated with single fuel i.e., Coal in co-generation system. • Electricity is generated absolutely at free of cost • An efficient and sustained co-generation enables the plant to isolate itself from the

		vagaries of power • Not depending on external power and hence reduces transmission and distribution losses
3	**Heat recovery from hot drained water**	The steam is required in jet machines for washing and dyeing process. After completion of the process, the hot water at 90°C is completely drained to the CETP. This a common practice in all cluster units. No single unit is recovering heat from hot drained water. The following are the advantages of installing waste heat recovery systems: • Reduces fuel consumption • Increases efficiency of the system • Hot water is readily available and hence reduces the time for hot water generation. As per estimates, about 3% of fuel consumption can be saved in the cluster units.
4	**Energy efficient Boiler**	Boilers are installed in the cluster units for hot water generation in the jet machine. Based on detailed studies carried in considerable of industries, some of the boilers were found to be inefficient and the efficiencies were found to be only 30 to 45%. The following technological gaps were identified for low efficiency: • The boilers are of single pass or two pass flue gas path system leading to low heat transfer and high flue gas losses • Low loading of the boilers less than 20% • High heat losses from the grate and surface due to damaged insulation and opening of the charging doors • No control on fuel firing • Partial combustion leading to un-burnt carbon • Very old boilers and damaged heat exchanger tubes The boilers with 70% efficiency are available in the market and the equipment suppliers are available locally. The features of high

		efficiency boilers are furnished as under: • The boiler is of three pass constructions 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 turn around mixing of the gases prior to entering the second pass. • The front smoke box also ensures complete turn around 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.
5	**Variable frequency drives**	The following are the technological gaps for fans and pumps: • Flow in pumps and fans are controlled by throttling and mechanical dampers leading to increased power consumption • Frequent failures of the machine By installing variable frequency drive, it is possible to operate the motor as per speed requirement and also to achieve speed variation and smooth startup as well as energy saving due to running the motor at low speeds. The VFD's were installed in about 50% of the units surveyed. The variable frequency drives can be installed for ID and FD fans, oil circulation pumps,

		water circulation pumps, stenter fans. About 15 to 20% of the total energy consumption for above equipments can be reduced by installing VFD's.
6	**Energy efficient pumps**	The major electricity consuming equipments of the textile industry are pumps. Majority of the industries in the cluster installed local make pumps. The following technology gaps were identified for low efficiency: • Pump impellers are of inferior design and local make • Pumps were installed on HP basis and not on head and flow • The pumps installed are of high head than required • No preliminary assessment of pressure and flow required • Low suction head for the pumps installed
7	**Online flue gas monitoring system**	The capacity of the boilers installed in the cluster units are varying from 3 to 10 TPH capacity. • No monitoring of excess air in flue gases • No knowledge on controlling air for boiler operators • Manual control of air supply
8	**Pressurized power pumping unit and steam traps**	The condensate recovery is poor in the plant due to the following technology constraints: • Faulty steam traps leading to heavy steam leakages • Thermodynamics traps were installed for process equipments instead of ball float traps leading to heavy steam leakages • Electrical pumps were used for pumping the condensate
9	**Automatic blow down control system**	The blow down is monitored manually for maintaining the TDS in boiler feed water: • The boiler operators doesn't have knowledge on TDS to be maintained and quantity of blow down to be drained • High quantity of blow down than required leading to high fuel consumption, increased consumption of chemicals and

		water
10	**Gas stenters**	Stenters are one of the major consuming equipments of textile industry. The power consumption of gas stenter is high due to following technology gaps: • Low efficient circulation fans installed for stenter and are locally produced • Poor air circulation system

4.3 Techno–Economic analysis for suggested Energy saving proposals

The details of techno economic analysis of various energy saving proposals identified for Surat Textile units is furnished below in Table 30:

Table 30: Techno – Economic analysis for various energy saving proposals suggested

S.No	Energy saving proposal	Techno economic analysis	Remarks
1.	**Natural gas generators**	The technology will replace high cost electricity and reduces coal consumption in boilers as small quantities of steam and hot water is generated by using waste flue gases of generator The natural gas generator is proven technology and are successfully in operation since so many decades. Medium investment, high returns and quicker payback periods.	Technically and financially viable
2	**Coal based cogeneration system**	The technology will replace import of high cost grid electricity and avoids of burning of coal in low pressure boilers. The electricity and steam is generated from a single source of fuel. The cogeneration system is proven technology and are successfully in operation since so many decades. High investment and high returns	Technically and financially viable
3	**Energy efficient Boiler**	The technology will replace inefficient boilers, proven technology, equipment suppliers are locally available, high efficiency, local service providers and skilled manpower are available locally. High returns and quick payback periods	Technically and financially viable

4	**Heat recovery from hot drained water jet machines**	The technology will recover heat from hot waste water, reduces fuel consumption, enhances thermal efficiency, proven technology, locally available, no operation and maintenance required. Low investment and high returns	Technically and financially viable
5	**Variable frequency drives**	• Improves life of the equipments life • Lesser breakdowns • No operation and maintenance required • Local service providers are available Low investment, high returns and quick payback periods	Technically & financially viable
6	**Energy efficient pumps**	Energy efficient pumps are available locally. Low investment and quick payback periods	Technically & financially viable
7	**Online flue gas monitoring system**	Locally available, proven technology, easy to install, automatically monitors the air supply Low investment and high returns	Technically & financially viable
8	**Pressurized power pumping units and steam traps**	Locally available, easy to install and operate, no manpower is required for operation and maintenance. Low investment and high returns.	Technically & financially viable
9	**Automatic blow down control system**	Locally available, proven technology, easy to install, automatically monitors the blow down quantity. Low investment and high returns.	Technically & financially viable
10	**Gas stenters**	Locally available, proven technology, local service providers are available, easy to operate and maintenance. High investment required and low returns.	Technically & financially viable

4.4 Barriers in Implementation of identified Energy saving proposals

Table 31: Barriers in implementation for various energy saving proposals suggested

S.No	Energy saving proposal	Barriers identified	Steps to overcome barriers
1	Natural gas generators	• High Initial investment • Shortage of natural gas availability	• The natural gas supply to be improved • Providing soft loans may motivate the unit owners for implementation • Awareness Programs.
2	Steam based Cogeneration system and Energy Conservation turbine	• High initial investment • Skilled manpower availability • No technical strengths for in house workers • Space availability • Lack of interest to invest due to high capital.	• Providing soft loans may motivate the unit owners for implementation. • Awareness Programs.
3	Heat recovery from drained hot water of jet machines and drum machines	• Lack of awareness.	• Training programs and motivation
4	Energy efficient boilers	• No willingness among the promoters due to high investment	• Providing soft loans may motivate the unit owners for implementation
5	Variable frequency drive	• Lack of knowledge on the benefits and economics	• Distribution of success stories / case studies.
6	Energy efficient pumps	• Lack of interest due to high cost compared to local make pumps	• A few Demonstration projects in the cluster will disseminate the technology
7	Online flue gas monitoring system	• Lack of knowledge and cost economics	• Training programs and motivation
8	Pressurized power pumping unit	• Lack of knowledge and cost economics	• Training programs and motivation
9	Steam traps & automatic blowdown	• Lack of knowledge and cost economics	• Training programs and motivation
10	Gas stenters	• High initial investment • High payback period	• ---

4.5 Short listed Technology/Products for DPRs

The following technologies/products were identified for preparation of detailed project reports for Surat Textile Cluster:

- Natural gas generators
- Coal based cogeneration
- Heat recovery from hot drained water
- New efficient boilers
- Pressurized power pumping system
- Online flue gas monitoring system
- Gas stenters

4.6 Summary of level of awareness on Energy savings and Energy saving Technologies in Surat Cluster

The level of awareness on energy saving among the SME owners in the cluster is poor. About 30% of the unit owners have good conscious on energy saving technologies and is limited to some selected technologies like variable frequency drives and waste heat recovery systems and doesn't have knowledge on other energy saving technologies like cogeneration system, steam distribution system, selection of traps, energy loss areas in the plant and quantities. The lack of awareness may be due to non-availability of skilled and technical manpower. Further, the unit owners do not have interest on costly products, as the same low efficient product/equipments are available at half of the cost.

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

Though the clusters units are in operation since last 4 decades, the achievement on energy efficiency in the cluster units is poor.

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

LIST OF ANNEXURE

ANNEXURE – 1

GOOD HOUSE KEEPING PRACTICES

EQUIPMENT MODIFICATION

• Install meters to maintain correct liquor ratio in jet dyeing machine, preferably electronic ones.
• Install temperature controllers for Jet and Drum Machines
• Install temperature gauges for the jet machines and washing drums
• Install pressure gauges for jet machine water circulation pumps
• Replace long jet machines with U-jet low liquor ratio machines.
• Install doctor blade in the printing machine to wipe off excess print paste
• Introduce vacuum slitters before stenter to reduce excess moisture and minimize energy consumption.
• Introduce squeezers before and after every wash tank in the washing section to
minimize the use of chemicals and water.
• Atomize color preparation to reduce dye wastage

RECYCLING OF WASTE WATER

• Recover steam condensate and reuse as boiler feed water to save energy and]
reduce waste water.
• Reuse rinse water after scouring and dyeing in the subsequent scour bath and dye bath preparation
• Reuse scour bath water after removing oil.
• Avoid contamination of cooling water by minimizing the leakages in heat exchangers and recycle the water.
• Recycle the treated waste water for blanket and screen washings.
• Use treated effluent for first wash of dye containers in colour room.

IMPROVED HOUSE KEEPING AND WORK PRACTICES

- Arrest gaps in stenter walls and doors to reduce energy losses.
- Control moisture content in stenter exhaust by controlling the flow of air and speed of the stenter.
- Cover all jiggers to minimise loss of energy
- Arrest leaks in the steam line and provide proper insulation
- Take measures to avoid spillages in dyeing and washing sections.
- Segregate scour bath and dye bath effluents and treat separately.
- Isolate wet operations namely dyeing, washing, screen washing from the printing and stenter area.
- Plan production schedule to optimise batch size
- Clean dye containers with high pressure low volume wash techniques to minimise water consumption
- Optimise batch size
- Plan dyeing schedule starting from lighter shades to darker shades to reduce washings.
- Avoid approximation in measuring chemicals & dyes
- Reduce rejects by maintaining proper records and avoid repetition of same mistakes.
- Use Grey cloth with less than 3% oil content.
- Excess air and flue gas temperature are two important parameters on which the boiler/hot water generator/thermopac's efficiency depends.
- A 22^{o}C reduction in the flue gas temperature reduces the fuel consumption by 1%.
- 10-15% reduction in excess air quantity (above the recommended excess air percentage) increases the boiler/hot air generator/thermopac's efficiency by 1%. Similarly, 1% reduction of residual oxygen in the flue gas reduces fuel consumption by 1%.
- Recover the sensible heat from the hot flue gas for heating the boiler water(via economizer) or preheating the combustion air(via air-preheater)

Steam Distribution System:

- Recover and return condensate to the boiler, as it still carries about 15-20% of the total steam energy.
- Every 6^{o}C rise in feed water temperature by heat recovery or condensate recovery corresponds to a 1% saving in fuel consumption in the boiler.
- Install temperature gauges at all steam heating equipments and avoid overheating of material.

- Fix all steam leakages as soon as they are identified. A 3-mm diameter hole on a pipeline carrying steam at 7 kg/cm2 would waste 33,000 litres of fuel oil per year.

Insulate all steam/condensate pipes and condensate/hot water tanks with insulation material like mineral wool. The heat loss from 100 feet of a bare 2-inch pipe carrying saturated steam at 10 kg/cm^2 is equivalent to a fuel loss of about 1100 litres of fuel oil per month

ANNEXURE – 2

Details of technologies/services providers for the cluster

Please write the list of vendors equipment wise.

Example

1. **Natural Gas based captive power plant**
   a. **XYZ Corporation**
      Shri. A B Dubey
      Sr. Manager – Sales
      Address Line – 1
      Address Line – 2
      Address Line – 3
      Phone
      Fax
      Email
      Webportal

   b. **ABC Limited**
      Shri. X Y Zebra
      Managing Director
      Address Line – 1
      Address Line – 2
      Address Line – 3
      Phone
      Fax
      Email
      Webportal

2. **VFD**

S.No.	Company Name	Contact person	Phone no's	Address
1	Heatex	Ranjit bhai	982511870	Palsana, Surat
2	Bhagyarekha(Devrekha) Engineers Pvt. Ltd	Amit Naik	98251 48738	GIDC, Sachin, Surat
3	Sparrow Tex Engineering	Parimindar saini	9898090536	GIDC, Pandesara, Surat
4	Bharat Engineering Corporation (LUCY)	Ajay D. Modi	9825970403	GIDC, Sachin, Surat
5	Texfab Engineers	Mukesh Pachauri	9898042000	GIDC, Sachin, Surat
6	Stenmech Engineering works Pvt Ltd	Manoj Gandhi	9825144989	GIDC, Sachin, Surat
7	Accurate Trans Heat Pvt Ltd	Omprakash	2397268	GIDC, Sachin, Surat
8	Sun Engineers	Niraj Desai	9327382482	GIDC, Sachin, Surat
9	Anjani Industries		9825141190	Sachin, Surat
10	Shridhar Engineering	Satyen choksi	2279829	Udyognagar, Udhana, Surat
11	Forbes Marshall	Satyen Mehata	92256 37451	Ring Road, Surat
12	Rajdeep Boilers Pvt Ltd	Aravind Singh	93769 96710	GIDC, Sachin, Surat
13	Shri Indtex Boilers Pvt Ltd	Gunvant nayak	2823370	Naroda, Ahemadabad
14	Energy Pack Boilers Pvt Ltd		91 - 2676 - 247247/247055	Halol
15	Jay Pumps Pvt Ltd (grounfos pumps)	Shailesh kachadia	9979898205	Ring Road, Surat
16	Pooja Agencies (KSB pumps)	Amar dalal	9824444424	Ring Road, Surat
17	Shiv Texpro (printing machines)		9909009477	Udhna, Surat
18	Powercare Engineers (gensets)		261-2311999	Ring Road, Surat
19	Sudhir Gensets Ltd	Chandramohan	9825135849	Ring Road, Surat
20	Thermax(Boiler)	Sanjay Kumar Misri	020-25542122, 9823355547	Pune(kasarwadi)
21	Forbes Marshal(Boiler)	Satyen Mehta	9879487770	Pune(kasarwadi)
22	Accurate	Omprakash(manger)	0261-2397268	Sachin
23	Sun	Niraj desai(manager)	91-261-2397128, 9825118321	Sachin
24	Tangent Technologies	Anurag Guptha	91-265-2291264/2291568, 9825500449	Vadodara, Gujarat
25	Lubi Electronics	Ravi Kiran (Executive Manager)	91-9394301005, 040-23402586	Ahmedabad, Gujarat

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.

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) FOR TEXTILE & JUTE INDUSTRIES IN SSI SECTOR

A scheme devised by Govt. of India, Ministry of Textiles, to enable SSI units Textile/Jute industrial sector) to induct State-of-the-art technology in which technology levels are bench marked in terms of specified machinery for each sector of textile 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	Nav Nidhi Dye & Ptg Mills Pvt Ltd.	Mahesh Malpani	Thatithayya
2	Kadmawala Dye & Ptg Mills Pvt Ltd.	Mukesh Kadmawala, Dinesh kadmawala	Thatithayya
3	Tribeni Processors Pvt Ltd	Rameshwar	Thatithayya
4	Niharika Dye & Ptg Mills Pvt Ltd.	Nanabhai	Thatithayya
5	Ganesh Laxmi Processors Pvt Ltd.	Anil Pandey	Kadodara
6	Krishna Terine Prints Pvt. Ltd.	Dinesh Bhai	Kadodara
7	Jay Bharat Dye & Ptg Mills Pvt. Ltd.	Bhageerat bhai	Kadodara
8	Priya Dye & Ptg Mills Pvt. Ltd.	Mani Kumar Jain	Kadodara
9	Sai Jyothi Fashions Pvt. Ltd.	K.K. Singh	Vareli
10	Subhalena Textile (weaving Unit)	Ashit C. Jariwala	Pandesara
11	Beetex India Limited	Rakesh Somani	Pandesara
12	Salasar Creations Pvt. LTD.	Vishal Kokra	Pandesara
13	Akashganga Processors Pvt. Ltd.	Rakesh Somani, Mishraji	Pandesara
14	Gupta Dye & Ptg Mills	Sandeep Goyal	Pandesara
15	Jayshaleen Dye & Ptg Mills Pvt Ltd	Manoj Bajaj	Pandesara
16	Tulsi Syntex Pvt Ltd	Bhavani Bhai	Pandesara
17	Ambica Syntex Pvt. Ltd.	Hemanth Bhai	Pandesara
18	Kanishka Prints Pvt.Ltd.	Sanjay Bhai	Pandesara
19	Pragati Fashions	Ram Mohan Agarwal	Pandesara
20	Riddhi Siddhi Prints Pvt Ltd	Vallabh Bhai, Anil Bhai	Pandesara
21	Pratibha Fabrics Ltd	Deepchand Sharma	Pandesara
22	Trishla silks mills P Ltd	Bimal prasad Jain	Pandesara
23	Shanti Prakash Dyeing & Printing Mills Pvt.ltd	Aditya Khurana	Pandesara
24	Rashmi Dyeing Mills Pvt. Ltd.	Bittu Bhai	Pandesara
25	Tirupati Prints Pvt. Ltd.	Mehool Bhai	Pandesara
26	Ashoka Dye & Ptg Mills Pvt. Ltd.	Narendra bhai	Pandesara
27	Sumati Prints P Ltd	Shashi Bhushan Jain	Pandesara
28	Bhagawati silk mills Pvt Ltd	Manoj Giri	Pandesara
29	Rohit Dyeing & Finishing Works	Rohit S Bachkaniwala	Vadtal Devdi
30	Agarwal Textile Mills	Binay Agarwal	Vadtal Devdi
31	Suprabhat Prints Pvt. Ltd	Vishnukanth bhai	Sachin
32	Hi-Choice Processors Pvt. Ltd.	Manoj Daga	Sachin
33	Utsav Silk Mills	Chandrakanth	Sachin
34	ESS PEE Industries (Gujart) Ltd	Achchhelal Vishwakarma	Sachin
35	Prabhavana Dye & ptg Mills Pvt ltd	Achchhelal Vishwakarma	Sachin
36	Amit Poly Prints Pvt Ltd	Achchhelal	Sachin

		Vishwakarma	
37	Jai tulasi Tex Prints Pvt Ltd	Sunil kumar Jain	Sachin
38	Shilpa Dyeing & Ptg Mills Pvt. Ltd	R.P.Sharma	Sachin
39	Shree Hajarimal Dye& Ptg Mills Pvt Ltd	R.P.Sharma	Sachin
40	Vimlon Dye& Ptg Mills Pvt. Ltd	Mukesh C. Ranka	Sachin
41	Vitrag Silk Mills Pvt Ltd	Mukesh Jain	Sachin
42	Jai Jitendra Prints Private Limited	Satender Jain	Sachin
43	Kirtida Silk Mills	Sanjay	Sachin
44	S.L.Banthia Textile Industries Pvt. Ltd.	Mahesh Banthia	Sachin
45	Vaishali Silk Mills Pvt Ltd	Madan Narang	Sachin
46	Manila Processors (P) Ltd	Manoj Manilawala	Sachin
47	Pushpanjali Dye&Ptg Mills Pvt Ltd	Girish Sethi	Sachin
48	Shree Chakradhar Synthetics	Vinu Bhai, pankaj bhai	Sachin
49	Dada Associates	Shakil Shaik	Pandesara
50	Barucha & Sons	Shaiesh Bharucha	Pandesara
51	Annapurna Industries Pvt Ltd	Narayan Asopa	Pandesara
52	Shree Siddhi Vinayak Saree Pvt. Ltd	Manish Shah	Pandesara
53	Aradhana Industries Pvt Ltd	Avinash	Pandesara
54	Ujala Dye & Ptg Mills Pvt Ltd	Sanjay Bagla	Pandesara
55	Tarana Prints Pvt Ltd	Narsing Bhai	Pandesara
56	Narayana Processors (P) Ltd	Jittu Bhai	Pandesara
57	Rachna Group Of Industries	Ritu Priya Arya	Pandesara
58	Global Syntex	Abdul Salam	Pandesara
59	Jay Mata Di Dye & Ptg Mills Pvt Ltd	Akash B. Adnani	Thatithayya
60	Mahadev Silk Mills Pvt Ltd	Amit Rathi	Thatithayya
61	MG Prosessors Pvt Ltd	Sanjay Kumar Gupta	Thatithayya
62	Rajni Silk Mills Pvt Ltd	Lalit Bohir	Thatithayya
63	Mahavir dye& ptg Mills Private Ltd	Dhiru Bhai	Thatithayya
64	Bhaskar Silk Mills Pvt Ltd	Ashok Tibrewal	Thatithayya
65	Sunita Processors Pvt Ltd	Narendra Begani	Thatithayya
66	Samta Silk Mills Pvt Ltd	Deepak Jain	Thatithayya
67	Raghunandan Dye & Ptg Mills Pvt Ltd	Anil Kasat	Thatithayya
68	Rajshree Dye&Ptg Mills Pvt Ltd	Uma Shankar bang	Thatithayya
69	Harshad Dye&Ptg Mills Pvt Ltd	Sarvan Bhai	Thatithayya
70	Santosh Textile Mills	Madhav Khaitan	Thatithayya
71	Prabhakar Processors Pvt Ltd	Saurav Tibrewal	Thatithayya
72	Muralidhar Tex Prints Pvt Ltd	Aditya Chaudhary	Thatithayya
73	Rajhans Poly Prints Pvt Ltd	Sanjay Jain	Vareli
74	Radhey Dye & Ptg Mills	Somveer Bhai	Vareli
75	Bhavana Silk Mills Pvt Ltd	Taresh sanwal	Vareli

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