DETAILED PROJECT REPORT
ON
ENERGY EFFICIENT BOILER (600 kg/hr)
(SOLAPUR TEXTILE CLUSTER)











Bureau of Energy Efficiency

Prepared By

ZenithEnergy
Horizons Beyond Energy

Reviewed By

ISTSL

ENERGY EFFICIENT BOILER
(600 kg/hr)

SOLAPUR TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Energy Efficient Boiler (600kg/hr)

Textile SME Cluster, Solapur, Maharashtra (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **SLP/TXT/EEB/07**

For more information

Bureau of Energy Efficiency (BEE)

(Ministry of Power, Government of India)

4th Floor, Sewa Bhawan

R. K. Puram, New Delhi – 110066

Fax +91-11-26178352

Telephone +91-11-26179699

Websites: www.bee-india.nic.in

Email: jsood@beenet.in/ pktiwari@beenet.in

Acknowledgement

We sincerely appreciate the efforts of industry, energy auditors, equipment manufacturers, technology providers, consultants and other experts in the area of energy conservation for joining hands with Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India for preparing the Detailed Project Report (DPR) under BEE SME Program in SMEs clusters. We appreciate the support of suppliers/vendors for providing the adoptable energy efficient equipments/technical details to the SMEs.

We have received very encouraging feedback for the BEE SME Program in various SME Clusters. Therefore, it was decided to bring out the DPR for the benefits of SMEs. We sincerely thank the officials of BEE, Executing Agencies and ISTSL for all the support and cooperation extended for preparation of the DPR. We gracefully acknowledge the diligent efforts and commitments of all those who have contributed in preparation of the DPR.

Contents

List of Annexure

List of Table

List of Figures

List of Abbreviation

BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
GHG	Green House Gases
HP	Horse Power
IRR	Internal Rate of Return
NPV	Net Present Value
ROI	Return on Investment
SME	Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Zenith Energy Services Pvt. Ltd is executing BEE - SME program in Solapur textile cluster, supported by Bureau of Energy Efficiency with an overall objective of improving the energy efficiency in cluster units.

Since Solapur cluster is one of the largest clusters in textile sector in India, accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient technologies, so as to facilitate maximum replication in other textile clusters in India.

Solapur textile cluster is mainly famous for cotton towel and bed sheet products. The main form of energy used in the cluster units are grid electricity, wood, and small quantity of coal. Wood and coal are used in boiler for generating hot water which is further used in dyeing of yarn.

This DPR highlighted the energy, environment, economic and social benefits by replacing less efficient existing technology i.e. conventional boiler with 600 kg/hr energy efficient boiler.

The project activities reduce overall wood consumption by 207 Tonne year and there is no saving in electricity consumption.

Project cost, debt equity ratio, monetary benefit, simple payback period, internal rate of return, net present value, debt service coverage ratio etc for proposed energy efficient boiler are furnished in table below:

S.No	*Parameter*	*Unit*	*Value*
1	Project cost	₹ in lakh	5.91
2	Debit equity ratio	ratio	3:1
3	Monetary benefit	₹ in lakh	5.18
4	Simple payback period	years	1.14
5	NPV	₹ in lakh	9.55
6	IRR	%age	57.08
7	ROI	%age	36.73
8	DSCR	ratio	3.61
9	Process down time during implementation	days	7

The projected profitability and financial indicators shows that the project will be able to earn profit from inception and replacement of conventional boiler with energy efficient boiler project is financially viable and technically feasible.

ABOUT BEE SME PROGRAMME

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

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

Energy use and technology studies

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

Capacity building of stake holders in cluster on energy efficiency

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

Implementation of energy efficiency measures

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

Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

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

1 INTRODUCTION

1.1 About the SME cluster

The products manufactured in Solapur Textile Cluster are cotton terry towels and bed sheets. The towels and bed sheets manufactured in the Solapur cluster are renowned in the country and have good market in India. The main raw material for the units is cotton yarn, which is procured from local spinning mill and agents. The cost of energy (electrical and thermal energy) as percentage of manufacturing cost varies between 8 and 10%.

Majority of the cluster units are of integrated type, where the raw material yarn is processed in-house to the final product. The energy cost is second to the raw materials cost. Majority of the units in the cluster are dependent on local / run of the mill technologies of low end and with little investment initiatives and technology up-gradation.

The main energy forms used in the cluster units are grid electricity, wood, and small quantity of coal. The electricity is used in power looms, doubling machines, winding machines, hydro extractors, warping machines and lighting. Wood is used as fuel for thermic fluid heaters, boilers and chulhas for hot water generation. The details of annual energy consumption of a typical unit having a production capacity of approximately 1, 72,800 kg are furnished in the Table 1.1 below:

Table 1.1Energy consumption of a typical unit

S.No	Particular	Unit	Value
1	Electricity consumption	MWh	319
2	Wood consumption	Tonne	480
3	Production	kg	1, 72,800

Production process

The main process operations for production of towels and bed sheets in cluster units are:

Doubling

In the Doubling process, thin single yarn is converted to double yarn for strengthening the yarn by using doubling machine.

Yarn dyeing

Initially, the yarn is soaked in soap water for 24 hours to remove the dirt and other foreign

materials and then after yarn is taken for bleaching. Bleaching is carried out by soaking the yarn in tanks mixed with bleaching agents and after completion of the process; the yarn is washed with normal water.

The hank dyeing machine tanks are filled with required quantity of normal water and required chemicals and dyeing agents are added. The temperature of the water is raised by oil circulation or direct steam injection. Fire wood is used as fuel. The required colors are added to the yarn and the dyeing process takes about 90 to 120 minutes per batch. After dyeing, the yarn is washed with normal water, and the yarn is taken for soaping for colour fixation in hot water for about 20 minutes in hank dyeing machines. The water is drained to the waste drainage lines.

Drying

The wet yarn is taken to hydro extractors for removing the water in the yarn and taken for drying in the natural sunlight.

Winding

The yarn after drying is taken for winding in which the yarn is wounded to bobbins and cones. The winded yarn is taken for further process.

Warping

In warping, the winded yarn is wound to beams according to designed pattern (customized designs). Then the beams are taken for Weaving.

Weaving

The beams, which are wound with yarn are taken and placed in power looms where the designed pattern is already set. In power looms, the yarn is converted to final product (towel or bed sheets) by weaving machine. The product obtained from weaving is taken for stitching and packing. The general process flow diagram of a typical unit for production of towels and bed sheets is furnished in Figure 1.1 below.

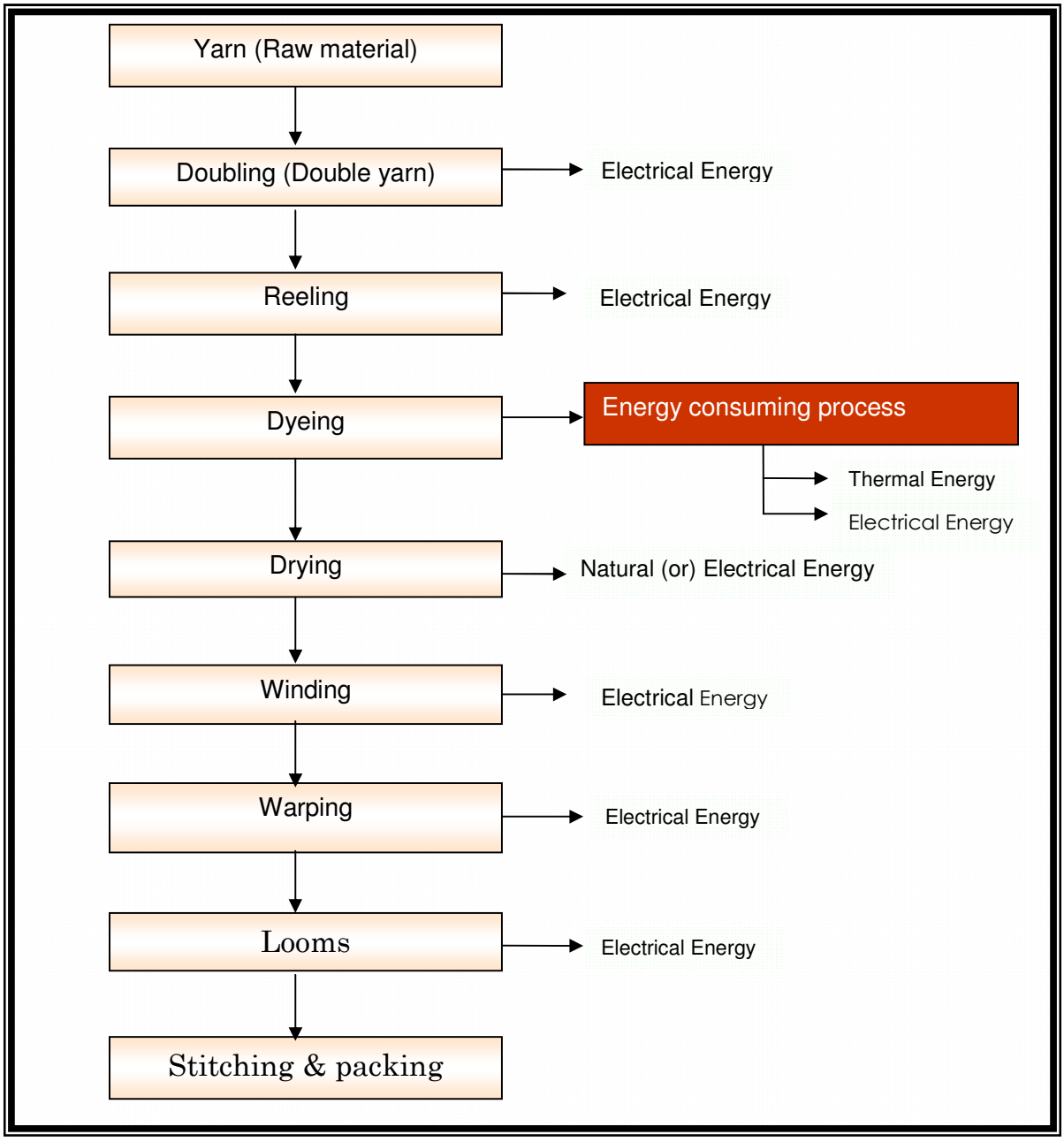


Figure 1.1 Process flow chart of typical textile unit

The production process as depicted above is similar for all textile units in Solapur textile cluster. However, depending on type of product and product quality, the above stated process flow varies as per the requirement.

1.2 Energy performance in Solapur textile cluster

The main energy sources for Solapur cluster units are electricity and fuels such as Wood & GN Husk briquettes. The wood and GN husk briquettes are used as fuel for thermic fluid heaters, boilers and chulhas for hot water generation and electricity is used for operation of prime movers of doubling machine motors, ID fans, pumps, hank dyeing machine drives, power loom drives, winding machine motors, etc. Majority of the units in the Solapur textile cluster are using wood for thermal energy generation due to easy availability and economical point of view.

Energy cost is around 8 to 10 percent of manufacturing cost in typical manufacturing unit, out of which the cost of thermal energy works out to 42 percent of the total energy cost and remaining accounts for electrical energy.

In typical textile manufacturing unit, the annual electricity and wood consumption is 3, 19,506 kWh and 480 tonnes respectively. Average production capacity of typical textile manufacturing unit is around 1, 72,800 kg per annum.

1.2.1 Specific energy consumption

Specific electrical and thermal energy consumption in textile units depends on the final product manufactured in that unit. Specific electrical and thermal energy consumption of typical textile unit of Solapur Textile cluster is 1.84 kWh/kg of final product and 2.77 kg of wood /kg of final product respectively (includes all colours dyeing in cold water, medium temperature water and high temperature water)

The electricity consumption for the boiler is not considered, as the capacity of the boiler feed water pump is low accordingly the cost of energy consumption is negligible.

The average specific fuel consumption per kg of the yarn (dyeing process only) for 3 typical units is furnished below in Table 1.2.

Table 1.2 Specific energy consumption of a typical unit

S.No	*Name of unit*	*Fuel Consumption kg*	*Production kg*	*Specific energy consumption kCal/kg*
1	Banda Industries	2000	620	10,322
2	Munot Textiles	800	150	17,066
3	Laxmipathi Industries	800	260	9,846

1.3 Identification of technology/equipment

1.3.1 Description of technology/equipment to be replaced

During energy use and technology audit studies in various textile industries in Solapur textile cluster, it has been observed that most of the textile units are using inefficient boilers for hot water generation whose efficiency is low. The performance of various existing boilers are evaluated and analyzed for various losses are furnished in Annexure 1.

Figure 1.2 In-efficient boiler operations at typical textile industry

From energy use and technology gap audit studies in various textile industries in Solapur textile cluster, the following were identified:

- Energy efficiency improvement opportunities
- Environment and working conditions improvement
- Design flaws in the conventional boiler
- Operational & maintenance practices in conventional boiler

Technical gap analysis in wood fired boiler

Technology gaps in wood fired inefficient boilers are identified and described in details below:

Poor heat transfer efficiency:

The present boiler is of single pass system. The heat transfer is poor due to low heat transfer area and short contact time between flue gas and oil and hence leads to inefficiency and high flue gas losses.

Heat loss from charging door: The fuel charging door remains more or less open during the entire operation due to various reasons; those are human error and non compatibility of wood logs in combustion chamber or Grate is not designed to accommodate wood log size and vice versa.

No waste heat recovery:

Though, the waste heat recovery (WHR) system doesn't have potential in smaller size boilers, as the boiler is of single pass system, hence there exists enormous potential in flue gases of the boiler. The temperature of the flue gases is found to be in the range of 240 to 270 ^{o}C, as the boiler is of single pass system. The high temperature flue gases is vented to the atmosphere without any waste heat recovery

Low loading of the boiler:

The capacity utilization of the boiler is low and is less than 20% and hence considerable reduction in thermal efficiency of the boiler.

No control on fuel firing:

In the existing boiler, there is no control over fuel firing in combustion chamber

Poor insulation on boiler:

The surface temperature of the boiler is high due to poor insulation leading to high radiation losses

From the above mentioned analysis it is clear that the performance of the existing conventional boiler is poor in terms of energy, environment and social aspects. Based on above facts, the present inefficient boiler is to be replaced with new energy efficient boiler.

1.3.2 Role in process

For production of towels and bed sheets of different colours, the dyeing of cotton yarn is vital and dyeing process requires hot water. The boiler is used for hot water generation required for processing by directly injecting the steam into the water and also to maintain the constant temperature during the dyeing and soaping process.

1.4 Establishing the baseline for the technology/equipment

Energy consumption in boiler would depend on below mentioned things

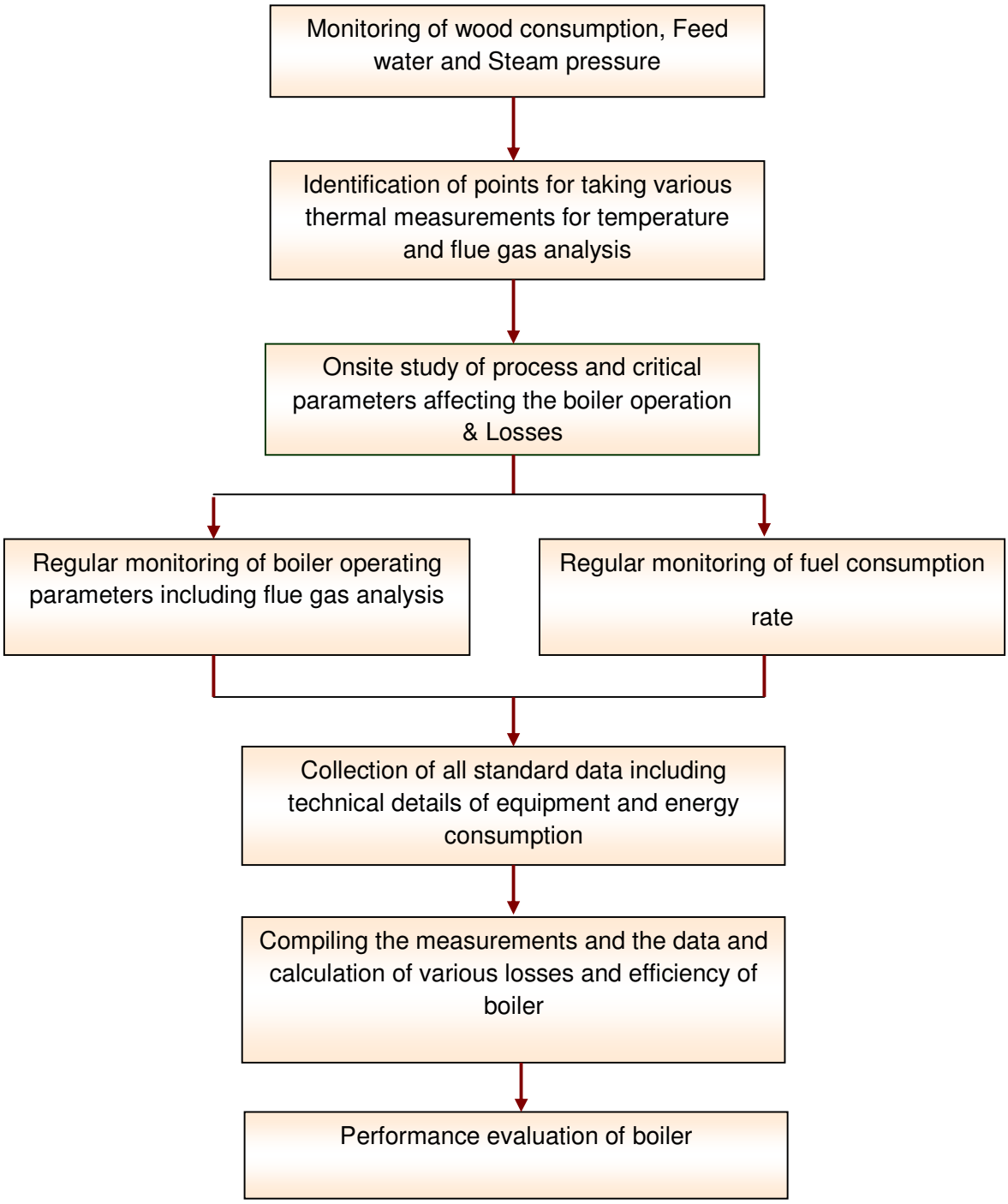
- Cold water temperature
- Dyeing temperature which depends on the colour of the yarn
- Quantity of hot water required

- Climate conditions
- Operational & maintenance practices in boiler
- Type of wood and its calorific value

Energy use and technology audit studies were conducted in various units of Solapur textile cluster, the baseline energy consumption of present inefficient boilers and the performance of the same is carried out and attached in Annexure 1.

1.4.1 Energy audit methodology adopted

The following methodology was adopted to evaluate the performance of boilers:


Monitoring of wood consumption, Feed water and Steam pressure
Identification of points for taking various thermal measurements for temperature and flue gas analysis
Onsite study of process and critical parameters affecting the boiler operation & Losses
Regular monitoring of boiler operating parameters including flue gas analysis
Regular monitoring of fuel consumption rate
Collection of all standard data including technical details of equipment and energy consumption
Compiling the measurements and the data and calculation of various losses and efficiency of boiler
Performance evaluation of boiler

1.4.2 Operating efficiency

The operating efficiency of the existing boiler is 39.56% and details of operating parameters recorded, estimation of various associated losses and efficiency of the boilers for unit is furnished in Annexure 1.

1.5 Barriers in adoption of proposed technology / equipments

Major barriers in the up gradation of technology in the cluster are

- Non availability of technology
- Distrust on technology supplier
- Lack of information about energy efficiency among all unit still persists

The other barriers identified for implementation of energy efficient in Solapur textile cluster are presented in below sections.

1.5.1 Technological Barrier

The major technical barriers that prevented the implementation of new energy efficient boiler are:

- Lack of awareness and information about the new and emerging energy efficient technologies available in the market.
- Dependence on local equipment suppliers for uninterrupted after sales service
- The majority of the textile unit owners / entrepreneurs do not have in-depth technical expertise
- The lack of technical know-how made it impossible for the textile unit owners to identify the most effective technical measures.

1.5.2 Financial Barrier

Some major financial barriers which prevent the implementation of proposed technology are:

- Implementation of the proposed project activity requires considerable investment of ₹ 5.91 lakh, which is a significant investment and not commonly seen in the cluster for energy efficiency.
- The majority of the unit owners are of the view that it makes business sense for them to invest in enhancing production capacity rather than making investment in energy efficiency.

- The unit owners in the cluster are wary of approaching banks for financial assistance due to their old perception that getting loan sanctioned from Banks involves lot of paper work / documentation and needs collateral security.

However, the financial attractiveness of the project activity may motivate the owners to move forward in taking up initiatives in energy conservation and efficiency.

1.5.3 Manpower skill

The non-availability of skilled manpower in the cluster is one of the major barriers. Though, the skilled manpower is available in the cluster, they are not aware of energy conservation / efficiency and its importance.

The training with equipment suppliers for importance of energy use and conservation will create awareness among workforce thereby make them aware about efficient use of energy and its conservation.

1.5.4 Other barrier (if any)

The non-availability of local suppliers for new energy efficient boilers

2 TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detail description of equipment

2.1.1 Description of technology

The new energy efficient wood fired boiler is a packaged, horizontal, 3 pass solid fuel fired boiler with fully wet back for high energy efficiency. The boiler is of natural draft and suitable for firing all kinds of solid fuels. The boiler is manually fired and simple designed for ease in operation and maintenance.

. .

Figure 2.1: Energy efficient wood fired boiler

The proposed energy efficient boiler mainly consists of the following elements.

- A feed water pump for supplying water to the boiler
- Grate and ash ports for fuel feeding and ash removal
- Refractory for minimizing radiation loss
- Control panel with fuse, temperature controls and contactors
- Insulation and mild steel cladding

Comparison of Inefficient boiler with new energy efficient boiler

The technical, economical, environmental and safety aspects of the present inefficient boiler and new energy efficient boiler are compared on life cycle of equipment, and same is presented in Table 2.1 below:

Table 2.1 Comparison of Inefficient boiler with Energy efficient boiler

S. No	Details	Inefficient boiler	Energy efficient boiler
1	Wood consumption	High	Low
2	Environment pollution	High	Low
3	Safety of workers	Poor	Good
4	Maintenance	High	Low
5	Operational cost	High	Low
6	Availability of local service providers	Yes	Yes / limited
Technical comparison between boiler & energy efficient boilers			
7	Draught system	Natural	Induced
8	Fuel combustion	Partial	Complete
9	Waste heat recovery	No	Yes
10	Heat losses through grate and surface	High	Low
11	Radiation losses	More due to insulation damage	Less
12	Utilization of heat	Less (Single/two pass system)	Maximum (three pass system)
13	Capacity utilization	Low	Optimum
14	Combustion chamber	Conventional	Water walled
16	Operation and maintenance	Less easy	Easy
17	Time required for attaining the water temperature	More due to higher capacity	Less, as optimum size boiler selected

From the above table it is evident that energy efficient boiler has significant advantages over existing conventional boilers w.r.t energy, environmental, economic & safety aspects. Hence, it is justifiable to install energy efficient boiler in place of conventional boiler.

2.1.2 Equipment specification

Equipment specification of new wood fire energy efficiency boiler wood fired boiler along with Term of sales, performance guarantee and after service set ails are furnished in Annexure 8.

2.1.3 Suitability with existing process

New proposed equipment is used for hot water generation which is earlier generated by conventional boiler. Hence new proposed equipment is completely suitable with existing process.

2.1.4 Availability of equipment

The technology/equipment identified for implementation is available in Pune, which is 200 KM from Solapur. Though, the local service providers are available, they don't have technical capability of fabricating the energy efficient designed boiler.

2.1.5 Source of equipment supplier

Technology/Service provider selected for implementation of the proposed energy efficiency project is having experience in producing and supplying of energy efficient boilers, hot water generators, waste heat recovery systems etc. Details of equipment supplier are given in Annexure 7.

2.1.6 Technical specifications of equipment

Technical specifications of proposed energy efficient boiler are presented in Table 2.2 below:

Table 2.2: Technical specifications

Details	*Units*	*Value*
Name of equipment	NA	New energy efficient boiler
Model	NA	RSBW 600
Capacity	kg/hr	600
Working pressure	kg/cm^2	10
Maximum temperature	^oC	177
Fuel used	NA	Wood
Fuel consumption	kg/hr	34.2
Thermal efficiency	%	65±2
Feed control	NA	Manual
Combustion Draft	NA	Induced
Water pump motor	hp	2.0
Total connected load	hp	3.0
Electric supply	NA	3 PH,415 V,50 HZ,AC,4 wire
Dry weight(approx)	kg	2300

Scope of supply under the model of RSBW 600 wood fired boiler is furnished in table below:

- Pressure parts fabricated out of IBR quality ERW tubes, duly certified by IBR Inspector
- Refractory type wood firing furnace with fire door, ash door and firing grate
- Pre-wired control panel with fuse, temperature controller & contractors.
- Reciprocating water pump motor assembly
- Mineral wool insulation with mild steel cladding

2.1.7 Terms and conditions in sales of Energy efficient boiler

The terms and conditions of sale of energy efficient boiler of the Ross Boilers are furnished below:

Table 2.3: Terms & conditions of sale for energy efficient boiler

Price	***₹ 5.30,000 (Ex-Works Unpacked)***
Insurance	1% of Ex-works price
Taxes	Excise: 8.24% (or) As applicable at the time of delivery
Payment	Advance 50% along with firm order. Balance 50% against Performa invoice prior to dispatch
Delivery	6-8 weeks from the date of order with advance
Inspection	Inspection of equipment prior dispatch, at your own cost
Commissioning	₹ 2500 per day plus to & fro charges at actual Lodging & boarding of our service engineer to be arranged by the customer
Inspection	At our works prior to dispatch

2.1.8 Process down time during Implementation

For implementation of the project activity, it is proposed to take about 10 weeks and 7 days may be required as a process down time. Details of complete procurement and implementation schedules are given in Annexure 6.

2.2 Suitable unit for Implementation of proposed equipment

The cluster has boilers of different capacities ranging from 500 kg/hr to 1000 kg/hr and the present utilisation is from 100 kg/hr to 300 kg/hr. Hence, for the existing boilers of 600 kg/hr to 1000 kg/hr capacity, a 600 kg/hr rated capacity boiler is suggested for the cluster units.

The capacity had been justified based on the following assumptions:

- Time required for dyeing with hot water is 1hr and 45 minutes including loading and unloading
- Time required for soaping is 45 minutes including loading and unloading
- Dark colour dyeing is carried out for one or two batches in a day as per the requirement.

3 ECONOMIC BENEFIT DUE USES OF NEW ENERGY EFFICIENT BOILER

3.1 Technical benefit

3.1.1 Fuel saving

Based on the detailed studies carried out in various units of Solapur textile cluster, the average wood consumption in a typical unit is 480 tonnes per annum. Whereas, the estimated wood consumption of proposed energy efficient boiler for the same production and steam generation is 273 tonnes per annum thereby, wood saving would be 207 tonnes per annum.

3.1.2 Electricity saving

Project implementation will lead no saving of electricity consumption, as the energy efficient boiler is of natural draft.

3.1.3 Improvement in product quality

Product quality achieved would be same as the present quality. It does not have any impact in improving the quality of the product.

3.1.4 Increase in production

The proposed equipment does not contribute to any increase in production.

3.1.5 Reduction in raw material consumption

Raw material consumption is same even after the implementation of proposed technology.

3.2 Monetary benefits

Annual monetary savings due to implementation of energy efficient boiler in place of the conventional boiler is ₹ 5.18 lakh per annum. Energy & monetary benefit analysis of energy efficient boiler is presented in Table 3.1 below:

Table 3.1: Energy and cost benefit analysis of energy efficient boiler

S.No	Parameter	Unit	Value
1	Wood consumption in existing boiler	Tonne/annum	480
2	Operational hours	Hours	8
3	Operational days per annum	Days	240
4	Wood consumption in proposed equipment	Tonne/annum	273
5	Wood saving	Tonne/annum	207
6	Cost of wood	₹/tonne	2500
7	Total monetary benefit	₹ in lakh	5.18

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The energy measures identified will utilize state-of-the-art technologies to ensure energy efficiency and energy conservation of non renewable wood. The replacement of inefficient boiler with energy efficient boiler will reduce the fuel consumption and will improve the work condition and environment. As the project activity will have less radiation losses.

3.3.2 Improvement in skill set of workers

The training provided by equipment suppliers will improve the technical skills of manpower for better operation and maintenance of boiler. Hence the technology implemented will create awareness about energy conservation among the worker and improves skill set of workers.

3.3.3 Impact on wages/emoluments

The awareness about the technologies and training imparted during implementation of the project will lead to direct and indirect increase in the wages of the employees, as it improves the technical skills of the workforce

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

There is no significant impact in effluent generation due to implementation of the project

3.4.2 Reduction in GHG emission such as CO_2, NOx

Implementation of this project will lead to reduction in CO_2 emissions due to reduction in overall fuel consumption. Implementation of this project will result in saving of 207 Tonne of wood per year thereby; reduce 290 tonne CO_2 emissions per year from one unit. Similarly, there are many similar type of unit in Solapur, and if all units will implement this project then significant amount of CO_2 emission reduction possible per year. This will also help in getting the carbon credit benefit through Clean Development Mechanism (CDM) project.

Taking CO_2 emission factor is 1.4 tCO_2 per tonne of wood consumption

3.4.3 Reduction in other emissions like SOx

As wood doesn't contain sulphur and hence there is no impact on SO_x emissions.

3.4.4 Reduction of deforestation

Reduction in wood consumption will automatically reduce the deforestation

4 INSTALLATION OF NEW ENERGY EFFICIENT EQUIPMENT

4.1 Cost of project

4.1.1 Cost of equipment

The total cost of equipment and machinery is estimated ₹ 5.30 lakh, which includes boiler, pumps, refractory lining, insulation, induced draft fan, chimney, electrical works and control panel with temperature controllers. Though the cost of boiler as per quotation of the recommended technology supplier is ₹ 5.30 lakh.

4.1.2 Other costs

Other cost includes erection & commissioning cost which is ₹ 0.27 lakh, civil works which is ₹ 0.20 lakh and interest during implementation which is ₹ 0.14 lakh. The total cost of implementation of the energy efficient boiler is estimated at ₹ 5.91 lakh and furnished in Table 4.1 below:

Table 4.1: Details of project cost

S.No	*Details*	*Cost (₹ in lakh)*
1	Equipment and machinery	5.30
2	Erection & Commissioning	0.27
3	Civil works	0.20
4	Interest during implementation	0.14
5	Total	5.91

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 5.91 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 1.48 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ₹ 4.43 lakh.

4.2.3 Subsidy by Government

As the overall energy efficiency in the project is more than 15% it qualifies for subsidy of 25 % of the project cost as per the NMCP scheme of Ministry of MSME, GoI. 25 % of the project

cost in this case works out to ₹ 1.48 lakh. As the subsidy is normally available after implementation of the project the same has not been taken in the project cost and means of finance. On receipt of subsidy from Ministry of MSME, GoI through the nodal agency the amount of subsidy is generally set off [reduced] from the loan outstanding by the lender bank. Availability of this subsidy will make the project economically more attractive.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above mentioned assumptions, the net cash accruals starting with ₹ 2.63 lakh in the first year operation and gradually increases to ₹ 15.44 lakh at the end of sixth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 5.91 lakh and monetary savings due to reduction in wood consumption is ₹ 5.18 lakh hence the simple payback period works out to be 1.14 year

4.3.3 Net Present Value (NPV)

The net present value of the investment at 10 % works out to be ₹ 9.55 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 57.08%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 36.73%.

Details of financial indicator are shown in Table 4.2 below:

Table 4.2: Financial indicator of project

S.No	Particulars	Unit	Value
1	Simple Pay Back period	Month	13
2	IRR	%age	57.08

S.No	Particulars	Unit	Value
3	NPV	lakh	9.55
4	ROI	%age	36.73
5	DSCR	Ratio	3.61

4.4 Sensitivity analysis

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like when there is an increase in fuel savings or decrease in fuel savings. Following two scenarios has been considered

- Increase in fuel savings by 5%
- Decrease in fuel savings by 5%

In each scenario, other inputs are assumed as constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Table 4.3: Sensitivity analysis in different scenario

Particulars	DSCR	IRR	ROI	NPV
Normal	3.61	57.08%	36.73%	9.55
5% increase in fuel savings	3.63	57.51%	36.78%	9.64
5% decrease in fuel savings	3.58	56.66%	36.69%	9.45

4.5 Procurement and implementation schedule

The project is expected to be completed in 10 weeks from the date of financial closure. The detailed of procurement and implementation schedule of project implementation is furnished in Annexure 6.

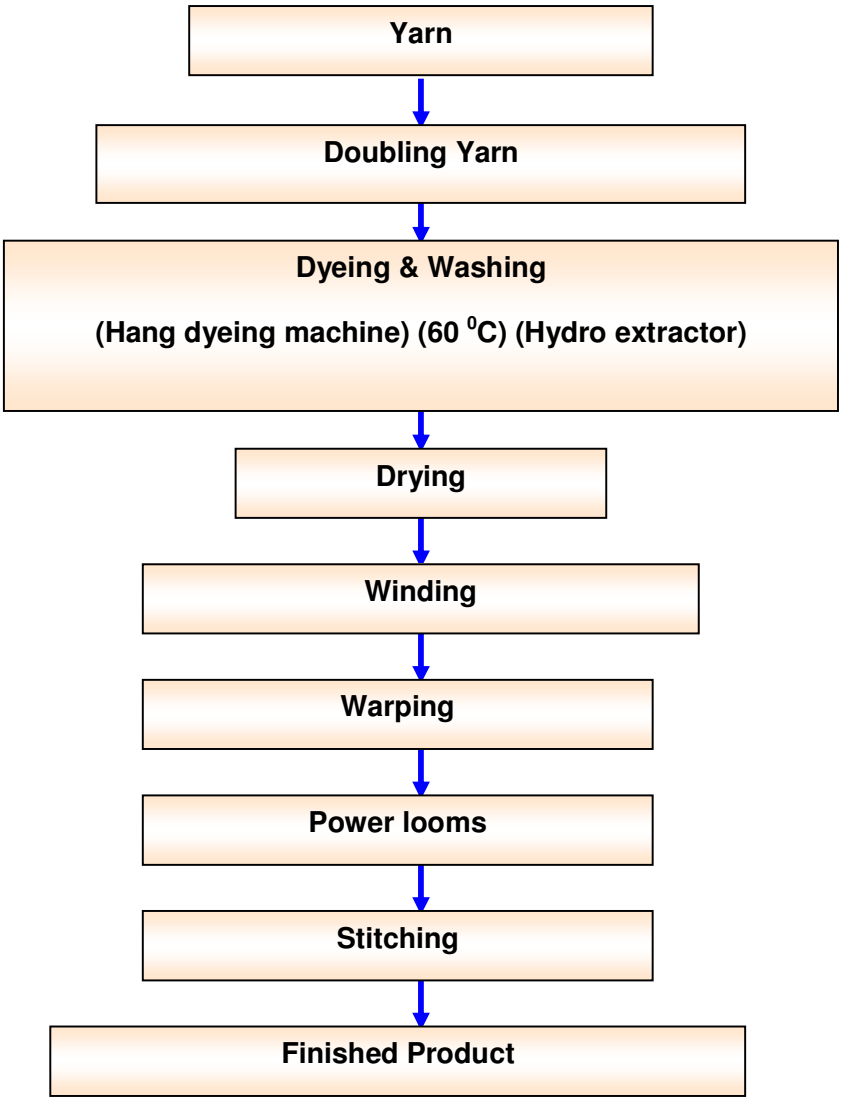
Annexure

Annexure – 1 Efficiency of the existing boiler - Direct Method

Unit 1 - (Banda Textiles))

S.No	*Particular*	*Unit*	*Value*
1	Boiler Capacity	kg/hr	2000
2	Steam pressure	kg/cm^2	10
3	Operating hours	hrs	8
4	Quantity of steam generated	kg/day	4000
5	Boiler feed water temperature	^0C	30
6	Fuel Consumption	kg/day	2000
7	Calorific value of fuel	kCal/Kg	3200
8	Enthalpy of steam (@ 10 kg/ cm^2)	kCal/Kg	663
9	Heat Input	kCal/day	64,00,000
10	Heat output	kCal/day	25,32,000
11	Efficiency	%age	39.56

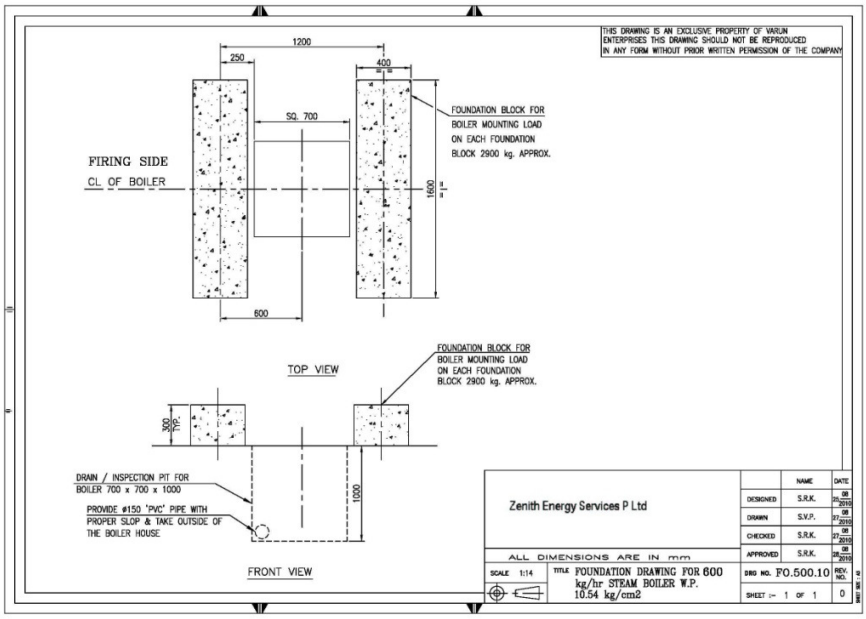
Annexure – 2 Process flow diagram



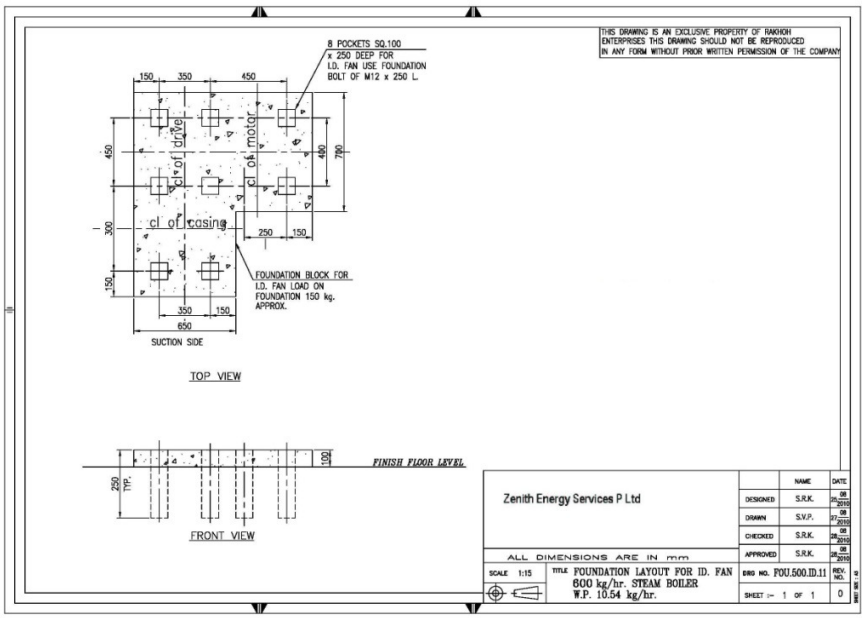
Annexure - 3 Detailed technology assessment reports

S.No	Particular	Unit	Value	
			Existing equipment	Proposed equipment
1	Operating hour	hrs	8	8
2	Operating days	days	240	240
3	Temperature of feed water	^{0}C	25	25
4	Temperature of hot water required	^{0}C	55-60	55-60
5	Steam pressure	kg/cm^2	5	10
6	Calorific value of wood	kCal/kg	3200	3200
7	Wood consumption	Tonne/annum	480	273
8	Efficiency of equipment	%age	35 -40	65±2
9	Saving of wood consumption	Tonne	-	207
10	Cost of wood	₹ / Tonne	2500	2500
11	Monetary saving	₹ in lakh	-	5.18
12	Cost of project	₹ in lakh	-	5.94

Annexure – 4 Drawings for proposed electrical & civil works



With Induced Draft Fan foundation



Annexure- 5 Detailed financial calculations & analysis for financial indicators

Assumptions

Name of the Technology	Energy Efficient Boiler		
Rated Capacity	600 kg/hr		
Detail	**Unit**	**Value**	
Installed Capacity	kg/hr	600	Feasibility Study
No of working days	Days	240	Feasibility Study
No of Shifts per day	Shifts	1	Feasibility Study
Capacity Utilization Factor	%age	NA	Feasibility Study
Proposed Investment			
Plant & Machinery	₹(in lakh)	5.30	Feasibility Study
Erection & Commissioning (5%)	% on Plant &	0.27	Feasibility Study
Civil Work	₹ (in lakh)	0.20	Feasibility Study
Investment without IDC	₹ (in lakh)	5.77	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.14	Feasibility Study
Total Investment	₹ (in lakh)	5.91	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	1.48	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	4.43	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period [excluding	Months	60	Assumed
Interest Rate	%age	10	SIDBI's rate of interest for energy
Estimation of Costs			
O & M Costs	% Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Wood savings	Tonne / year	207	
Cost	₹ / Tonne	2500	
St. line Depn.	%age	5.28	Indian Companies Act

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	4.43	0.66	3.77	0.44
2	3.77	0.89	2.88	0.38
3	2.88	0.89	1.99	0.29
4	1.99	0.89	1.11	0.20
5	1.11	0.89	0.22	0.11
6	0.22	0.22	0.00	0.02
		4.43		

WDV Depreciation

Particulars / years	1	2	3	4	5	6
Plant and Machinery						
Cost	5.91	5.02	4.27	3.63	3.08	2.62
Depreciation	0.89	0.75	0.64	0.54	0.46	0.39
WDV	5.02	4.27	3.63	3.08	2.62	2.23

Projected Profitability

Particulars / Years	1	2	3	4	5	6	Total
Revenue through Savings							
Fuel savings	5.18	5.18	5.18	5.18	5.18	5.18	31.05
Total Revenue (A)	5.18	5.18	5.18	5.18	5.18	5.18	31.05
Expenses							
O & M Expenses	0.24	0.25	0.26	0.27	0.29	0.30	1.61
Total Expenses (B)	0.24	0.25	0.26	0.27	0.29	0.30	1.61
PBDIT (A)-(B)	4.94	4.93	4.91	4.90	4.89	4.87	29.44
Interest	0.44	0.38	0.29	0.20	0.11	0.02	1.44
PBDT	4.50	4.55	4.63	4.70	4.78	4.85	28.00
Depreciation	0.31	0.31	0.31	0.31	0.31	0.31	1.87
PBT	4.18	4.24	4.31	4.39	4.46	4.54	26.13
Income tax	1.23	1.29	1.35	1.41	1.47	1.52	8.27
Profit after tax (PAT)	2.96	2.95	2.96	2.98	3.00	3.02	17.86

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6
Profit before tax	4.18	4.24	4.31	4.39	4.46	4.54
Add: Book depreciation	0.31	0.31	0.31	0.31	0.31	0.31
Less: WDV depreciation	0.89	0.75	0.64	0.54	0.46	0.39
Taxable profit	3.61	3.80	3.99	4.16	4.31	4.46
Income Tax	1.23	1.29	1.35	1.41	1.47	1.52

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6
Liabilities						
Share Capital (D)	1.48	1.48	1.48	1.48	1.48	1.48
Reserves & Surplus (E)	2.96	5.90	8.86	11.84	14.84	17.86
Term Loans (F)	3.77	2.88	1.99	1.11	0.22	0.00
Total Liabilities D)+(E)+(F)	8.20	10.26	12.34	14.43	16.54	19.34

Assets						
Gross Fixed Assets	5.91	5.91	5.91	5.91	5.91	5.91
Less: Accm. Depreciation	0.31	0.62	0.94	1.25	1.56	1.87
Net Fixed Assets	5.60	5.29	4.97	4.66	4.35	4.04
Cash & Bank Balance	2.60	4.98	7.36	9.76	12.19	15.30
Total Assets	8.20	10.26	12.34	14.43	16.54	19.34
Net Worth	4.43	7.38	10.34	13.32	16.32	19.34
Debt Equity Ratio	2.55	1.95	1.35	0.75	0.15	0.00

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

Particulars / Years	0	1	2	3	4	5	6
Sources							
Share Capital	1.48	-	-	-	-	-	-
Term Loan	4.43						
Profit After tax		2.96	2.95	2.96	2.98	3.00	3.02
Depreciation		0.31	0.31	0.31	0.31	0.31	0.31
Total Sources	5.91	3.27	3.26	3.27	3.29	3.31	3.34
Application							
Capital Expenditure	5.91						
Repayment of Loan	-	0.66	0.89	0.89	0.89	0.89	0.22
Total Application	5.91	0.66	0.89	0.89	0.89	0.89	0.22
Net Surplus	-	2.60	2.37	2.39	2.40	2.42	3.11
Add: Opening Balance	-	-	2.60	4.98	7.36	9.76	12.19
Closing Balance	-	2.60	4.98	7.36	9.76	12.19	15.30

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

Particulars / months	0	1	2	3	4	5	6
Profit after Tax		2.96	2.95	2.96	2.98	3.00	3.02
Depreciation		0.31	0.31	0.31	0.31	0.31	0.31
Interest on Term Loan		0.44	0.38	0.29	0.20	0.11	0.02
Salvage/Realizable value		2.96	2.95	2.96	2.98	3.00	3.02
Cash outflow	(5.91)	-	-	-	-	-	-
Net Cash flow	(5.91)	3.71	3.64	3.56	3.49	3.42	3.36
IRR	57.08%						

NPV	9.55

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6
Variable Expenses						
Oper. & Maintenance Exp	0.18	0.19	0.20	0.21	0.22	0.23
Sub Total (G)	0.18	0.19	0.20	0.21	0.22	0.23
Fixed Expenses						
Oper. & Maintenance Exp	0.06	0.06	0.07	0.07	0.07	0.08
Interest on Term Loan	0.44	0.38	0.29	0.20	0.11	0.02
Depreciation *(H)*	0.31	0.31	0.31	0.31	0.31	0.31
Sub Total (I)	0.81	0.75	0.67	0.58	0.49	0.41
Sales (J)	5.18	5.18	5.18	5.18	5.18	5.18
Contribution (K)	5.00	4.99	4.98	4.97	4.96	4.95
Break Even Point (L= G/I)	16.29%	15.05%	13.36%	11.67%	9.97%	8.28%
Cash Break Even {(I)-(H)}	10.05%	8.79%	7.09%	5.39%	3.68%	1.97%
Break Even Sales (J)*(L)	0.84	0.78	0.69	0.60	0.52	0.43

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	Total
Net Profit Before Taxes	4.18	4.24	4.31	4.39	4.46	4.54	26.13
Net Worth	4.18	4.24	4.31	4.39	4.46	4.54	26.13
							36.73%

Debt Service Coverage Ratio

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	Total
Cash Inflow							
Profit after Tax	2.96	2.95	2.96	2.98	3.00	3.02	17.86
Depreciation	0.31	0.31	0.31	0.31	0.31	0.31	1.87
Interest on Term Loan	0.44	0.38	0.29	0.20	0.11	0.02	1.44
Total **(M)**	3.71	3.64	3.56	3.49	3.42	3.36	21.18

Debt

Interest on Term Loan	0.44	0.38	0.29	0.20	0.11	0.02	1.44
Repayment of Term Loan	0.66	0.89	0.89	0.89	0.89	0.22	4.43
Total (N)	1.11	1.26	1.17	1.09	1.00	0.24	5.87
Average DSCR (M/N)	3.61						

Annexure -6 Details of procurement and implementation plan with schedule/timelines

Details of procurement and implementation –Energy Efficient Boiler

S. No	Activity	Weeks				
		1 - 2	2 - 4	4 - 6	6 - 8	8 - 10
1	Collection of quotations and order finalization					
2	Designing by the supplier as per the requirement					
3	Fabrication at the equipment supplier workshop					
4	Delivery					
5	Commissioning , Trial runs and Insulation					

Break up of process down time

S. No.	*Activities*	*Days*						
		1	*2*	*3*	*4*	*5*	*6*	*7*
1	Time required for dismantling or re-location of the existing boiler							
2	Civil works and curing							
3	Installation							
4	Commissioning, Trial & Insulation							

Note: The Process down time is considered for item 1, 3 and 4 only. As the civil foundations and installation of water storage tanks and water distribution lines are laded during plant in operation.

Annexure -7 Details of equipment service providers

Equipment details	Service/technology providers
Energy efficient boilers	***ROSS BOILERS*** Address : 33, Al Ameen Society, Gultekdi, Pune - 411037, Maharashtra, India Phone : 91-20-24269393/24272293/24274717 Fax : 91-20-24272293/24269562 ***THERMAX LTD.*** Dhanraj Mahal, 2nd Floor, Chatrapati Shivaji Maharaj Marg, Nr. Gateway of India Mumbai - 400 039 Ph : 022 - 6754 2222 Fax : 022 - 22040859

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

Quotation :

Unit Model : RSBW 600

ROSS WOOD FIRED IBR STEAM BOILER

Technical Specifications :

Steam output (from & at 100 Deg. C):	600 kgs/hr
Working pressure :	10.5 kg /sq.cm
Steam Temperature :	179 deg C
Fuel :	WOOD
Fuel Consumption : (E = 65 %, N.C.V. = 3500 KCal/Kg)	142 kgs/hr#
Thermal efficiency (NCV) :	65 ± 2%
Feed Control :	Manual
Water Pump Motor:	2.0 HP
Combustion Draft :	Induced
Total Connected Load :	3 HP
Electric Supply :	3 PH, 415 V, 50HZ, AC, 4 Wire system
Overall Dimentions (approx.) :	
Width :	1700 mm
Depth :	2000 mm
Height :	2600 mm
Dry Weight (approx.) :	2300 kgs

Fuel consumption is based on N.C.V. (net calorific value) of fuel at 3,500 Kcals/kg. & Steam Boiler efficiency of 65 %.
The efficiency is guaranteed subject to clean internal & external heat transfer surfaces.

* Specifications are subject to reasonable change without prior notice.

BATTERY LIMITS : As specified in the P & I diagram.

Price Annexture :

Price :	530,000.00	(Ex-Works Unpacked)
Packing & Forwarding :	At actuals.	
Insurance :	1% of Ex-works price	
Taxes :	Excise : 8.24% Or As applicable at the time of delivery Sales tax : 12.50% VAT OR 3% CST against form C.	
Payment Terms :	Advance 50% along with firm order. Balance 50% against performa invoice prior to despatch.	
Delivery Period :	6-8 weeks from the date of order with advance.	
Commissioning :	Rs 2500/- per day plus to & fro charges at actuals. Lodging & boarding of our service engineer to be arranged by the customer.	
Inspection :	At our works prior to despatch	
Validity :	The quotation is valid for 60 days.	
Jurisdiction :	Subject to Pune Jurisdiction	

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

Zenith Energy Services Pvt. Ltd
10-5-6/B, My Home Plaza, Masab
Tank HYDERABAD, AP 500 028
Phone: 040 23376630, 31,
Fax No.040 23322517
Website: www.zenithenergy.com

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