DETAILED PROJECT REPORT
ON
HOT WATER GENENRATOR (80000kCal/hr)
(SOLAPUR TEXTILE CLUSTER)











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Bureau of Energy Efficiency

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ISTSL

ENERGY EFFICIENTHOT WATER GENERATOR (80000kCal/hr)

SOLAPUR TEXTILE CLUSTER

BEE, 2010
Detailed Project Report on Energy Efficient Hot Water Generator (80000kcal/hr)
Textile SME Cluster, Solapur, Pune, Maharashtra (India)
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Detail Project Report No.**: SLP/TXT/HWG/10**

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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.

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List of Abbreviations

kWh	kilo Watt Hour
GoI	Government of India
SME	Small and Medium Enterprises
IBR	Indian Boiler Regulation
GHG	Green House Gas
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
O&M	Operational & Maintenance
NPV	Net Present Values
ROI	Return on Investment
IRR	Internal Rate of Return
DSCR	Debt Service Coverage Ratio
PBT	Profit Before Tax
PAT	Profit After Tax
ID	Induced Draft
HWG	Hot Water Generator
TFH	Thermic Fluid Heater
SIDBI	Small Industries Development of India

EXECUTIVE SUMMARY

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

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

The main energy forms used in the cluster units are Wood. Wood is used as fuel in thermic fluid heater for hot water generation. Thermal energy cost required in dyeing process is one of the major costs in majority of textile industries at Solapur textile cluster.

Replacement of thermic fluid by hot water generator will lead to reduction in wood consumption by 40 tonne per year however; this intervention will not have any effect on the existing consumption pattern of electricity.

The total investment, debt equity ratio for financing the project, monetary savings, Internal rate of return (IRR), Net present value (NPV),Debt service coverage ratio (DSCR), Return on investment (ROI) etc. for implementing energy efficient economizer is furnished in Table below

S.No	Particular	Unit	Value
1	Project cost	₹(in Lakh)	2.76
2	Wood saving	tonnes / year	40
3	Monetary benefit	₹(in lakh)	1.68
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	1.64
6	NPV	₹(in lakh)	2.69
7	IRR	%age	43.32
8	ROI	%age	33.74
9	DSCR	ratio	2.52
10	Process Implementation time	weeks	10

The projected profitability and cash flow statements indicate that the proposed project implementation will be financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

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 audit

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 up energy efficiency projects in the clusters

Implementation of energy efficiency measures

To implement the technology up-gradation projects in clusters, BEE have 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 TO THE EXISTING SITUATION

1.1 About the solapur textile cluster

The products manufactured in Solapur Textile Cluster are cotton terry towels and bed sheets. The towels and bed sheets 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 mills 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 for power looms, doubling machines, winding machines, hydro extractors, warping machines and lighting. Wood is used as fuel for boilers, thermic fluid heaters, and chulhas for hot water generation. The details of annual energy consumption of a typical unit having a production capacity of 1.44 lakh kg of final product of the cluster are furnished in the table 1.1 below:

Table 1.1 Details of annual energy consumption of a typical unit

Particulars	***Unit***	***Value***
Electricity consumption	kWh	1,96,800
Wood consumption	tonne	104
Production	kg	1,44,000

1.1.1 Production process

The main operational process 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 after soaking, the 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 hang 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 hang dyeing machines. The water is drained to the waste drainage lines. 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. 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.

Existing process flow in textile industry:

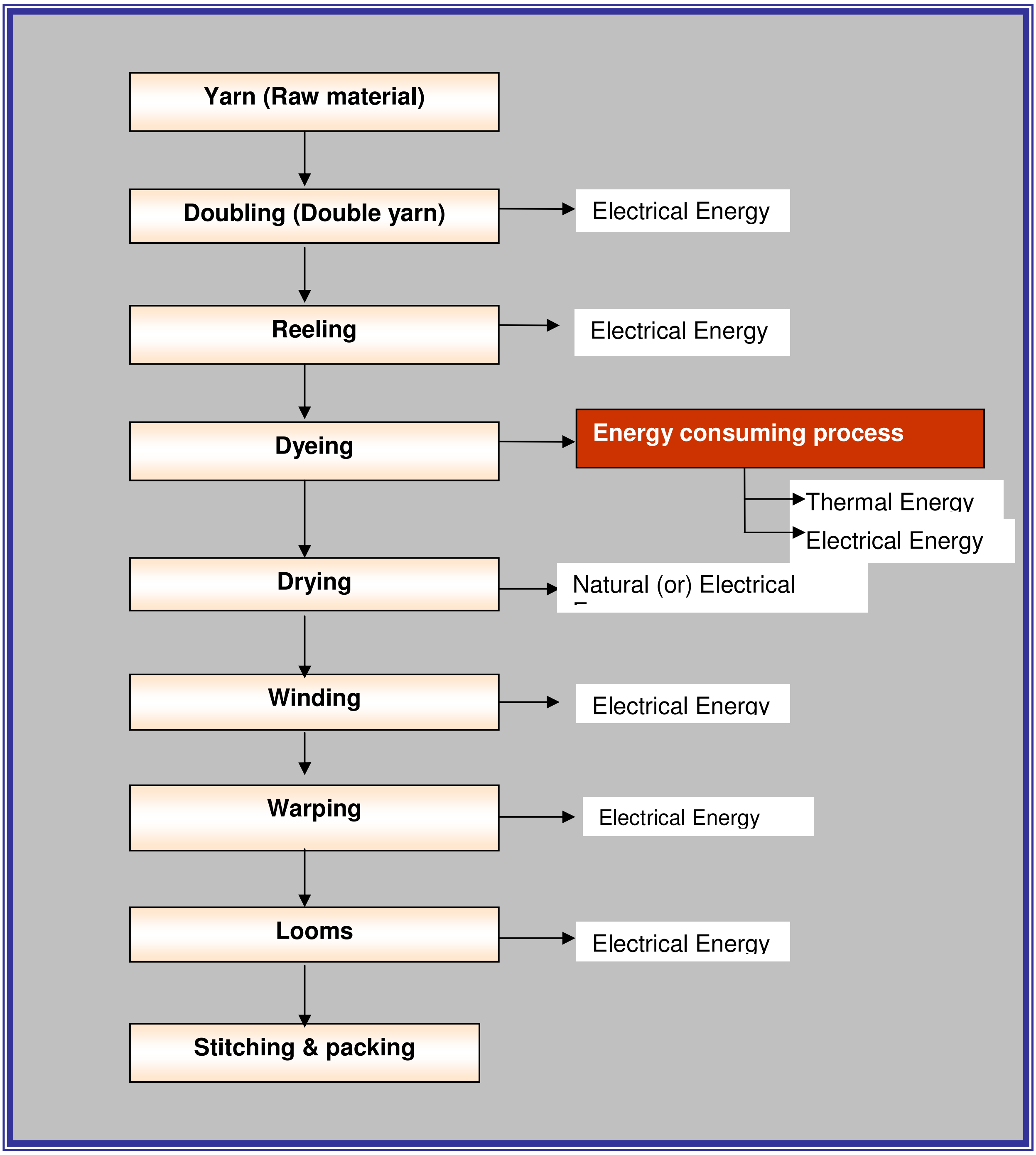


Figure 1.1 Process flow chart of typical textile unit

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 of the industry.

1.2 Energy performance in solapur textile cluster

Majority of the industries located in Solapur are engaged in manufacturing of towels and bed sheets. The main energy sources for Solapur cluster units are electricity and fuels such as Wood & briquettes. The wood and GN husk briquettes are used as fuel for boilers, thermic fluid heaters 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 a typical textile manufacturing unit annual consumption of electrical energy and wood is 1,96,800 kWh and 104 Tonne respectively. Average production capacity of a typical textile manufacturing unit in Solapur textile cluster is around 1,44,000 kg per annum.

Specific energy consumption of final product

Specific electrical and thermal energy consumption in textile unit depends upon the final product manufactured in that unit. The electrical and thermal energy consumption of typical textile unit is 1.37 kWh/kg of final product and 0.44 kg of wood/kg of final product respectively (includes all colours dyeing in cold water, medium temperature water and high temperature water)

Specific energy consumption – Dyeing Process only

The average specific electricity consumption and specific fuel consumption per kg of the yarn dyeing process for 3 typical units and for different process are furnished below in Table 1.2 and Table 1.3:

Table 1.2 Average specific electricity consumption

Unit name	Production	Electricity consumption	Specific fuel consumption
	kg	kWh/day	kWh/kg
Gaddam Textiles	400	656	1.64
Kendole Textiles	300	350	1.16
Jamuna Industries	400	427	1.06

Table 1.3 Average specific fuel consumption

Unit Name	Fuel consumption	Production	Heat input	Specific fuel consumption
	kg	kg	kCal	kCal/kg
Gaddam Textiles	265	400	8,84,000	2,210
Kendole Textiles	200	300	6,40,000	2,133
Jamuna Industries	300	400	9,60,000	2,400

1.3 Proposed equipment to be upgrade

1.3.1 Description of existing equipment

During Energy use and technology audit studies in various textile industries in Solapur textile cluster, it was observed that most of the textile units are using inefficient thermic fluid heaters (and boilers) for generation of hot water and it is found that the efficiencies of the existing thermic fluid heaters (and boilers) are low. The performance of various thermic fluid heaters and boilers in Solapur textile units are evaluated and analyzed for various losses and the details are furnished in Annexure 1.

Figure 1.2 Thermic Fluid Heater

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 safety improvement of workers
- Design flaws in the conventional thermic fluid heater
- Operational & maintenance practices in conventional thermic fluid heater

Technical gap analysis in wood fired Thermic fluid heater:

Details of technology gaps in wood fired Thermic fluid heaters and boilers are as under:

Poor heat transfer efficiency

The present thermic fluid heater 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. The flue gas losses are found to be range of 35 to 40%.

Heat loss from charging door

The 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. Grate/combustion chamber is not designed to accommodate wood log size and vice versa.

Loss due to excess air

Stable combustion conditions require the right amounts of fuels and oxygen. High excess air level leads to high flue gas losses and drop in thermal efficiency. As per the stiochometric air analysis, the excess air optimum level is 45 to 5o% for wood fired thermic fluid heaters and boilers. Whereas, the excess air supply is above 100%

No waste heat recovery

The temperature of the flue gases is found to be in the range of 350 to 360^{o}C as the thermic fluid heater is of single pass system. The high temperature flue gases is vented to the atmosphere without any waste heat recovery

Low loading of the thermic fluid heater

The capacity utilization of the thermic fluid heater is low and is less than 30% and hence reduction in thermal efficiency of the system

No control on fuel firing

In Conventional / existing thermic fluid heater, there is no control system of fuel firing in combustion chamber

Uncontrolled temperature of oil

There is no temperature control of oil and is manually controlled. The oil is heated even after completion of process.

Poor insulation on thermic fluid heater

The surface temperature of the thermic fluid heater is high due to poor insulation leading to high radiation losses

From the above mentioned analysis, it is clear that thermic fluid heater has poor performance from Energy, Environment and Social point of view. Existing conventional wood fired thermic fluid heater installed in most of the textile industries has poor energy efficiency thus generating / emitting more GHGs (Green House Gases), etc. Due to above mentioned reasons; the thermic fluid heater is to be replaced with energy efficient hot water generator.

1.3.2 Role in process

For production of towels and bed sheets of different colours, the dyeing of cotton yarn is vital and dying process requires hot water. Thermic fluid heater is used for hot water generation required for processing and to maintain the constant temperature throughout dyeing.

Though, numbers of technologies / equipments are available for the purpose, the thermic fluid heater has been chosen for easy maintenance and for avoiding IBR boiler installation in the cluster units.

1.4 Baseline for existing equipment

Energy consumption in thermic fluid heater would depend on following:

- Dyeing temperature which depend on the color of the yarn required
- Climate conditions
- Operational & maintenance practices in hot water generator
- 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 thermic fluid heater and the performance of the same is carried out and attached in Annexure 1.

1.4.1 Energy audit methodology

The following methodology was adopted to evaluate the performance of thermic fluid heater:

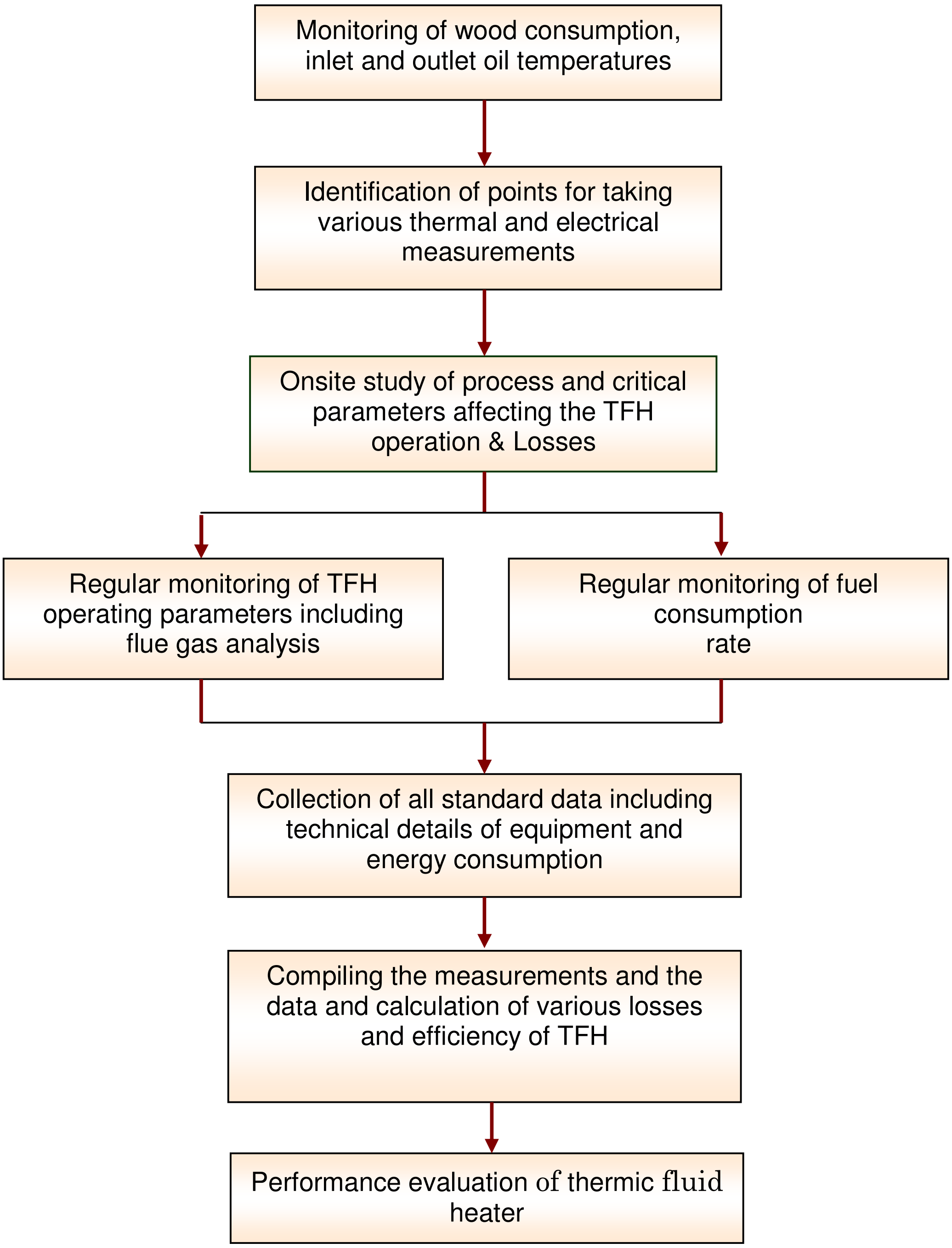


Figure 1.3 Energy audit methodology

1.4.2 Operating efficiency

The operating efficiency of the existing thermic fluid heater is 22.00% and the details of operating parameters recorded, estimation of various associated losses and efficiency of the TFH are furnished in Annexure 1.

1.4.3 Specific energy consumption

The specific fuel consumption per kg of yarn processing in three typical units of the cluster separately for dyeing and soaping process is furnished below

Table 1.4 Details of specific energy consumption

Name of the unit	*Specific power consumption (kWh/kg)*	*Specific fuel consumption (kcal/kg)*
Gaddam Textiles	1.64	2,210
Kendole Textiles	1.16	2,133
Jamuna Industries	1.06	2,400

1.5 Barriers for adoption of proposed equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of energy efficient hot water generator are

- Lack of awareness and information about the new and emerging energy efficient technologies
- Dependence on local equipment suppliers for uninterrupted after sales service and hence adopting low end inefficient technologies
- The main focus of SME owners is on uninterrupted production of the plant by necessary repair work at low costs, than on investing on new technologies.
- More focus on investing in enhancing production capacity for the economic viability of the plant, than benefits in the form of future savings due to implementation of energy efficiency measures.
- The majority of the textile unit owners/entrepreneurs do not have in-depth technical expertise, knowledge or training about energy efficiency, and are dependent on local technology suppliers or service companies, whom they normally rely for established

and commonly used technology. The lack of technical know-how makes it difficult for the textile unit owners to identify the most effective technical measures.

1.5.2 Financial Barrier

Implementation of the proposed project activity requires investment of ₹ 2.76 lakh per unit. Such investment is not commonly seen in the cluster units, as the units have less financial strength. Further, from the business perspective of SMEs, it is more viable, assured, and convenient to invest on project expansion for improving the production capacity or quality, rather than make piecemeal investment in retrofit and replace options for energy savings. In view of this and given the limited financial strength of the textile mills, it is evident that the owners would not like to take the risk and invest in energy efficiency measures.

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 Skilled manpower

The non-availability of skilled manpower having awareness about energy efficiency and related issues 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. Their prime responsibility is to maintain machines and ensure uninterrupted production by minimizing down time as per the targets set by the management.

Specialized training with the local service providers for better operation and maintenance of the equipments, importance of energy use and conservation will create awareness among workforce thereby enhancing their skill set about efficient use of energy and its conservation.

1.5.4 Other barrier (If any)

The non-availability of local supplier for efficient hot water generator

2 PROPOSED ENERGY EFFICIENT EQUIPMENT

2.1 Energy Efficient Wood Fired Hot Water Generator

2.1.1 Description of equipment

Figure 2.1 Energy efficient wood fired Hot Water Generator

The hot water generator is a compact and ready to install and can be installed where ever space is available.

The proposed hot water generator mainly consists of the following elements.

The hot water generator converts the energy available in fuels into thermal energy in the form of hot water

- The hot water generator consists of a pump for circulating the water from the tank to generator. The hot water generated can be directly used for the process or can be circulated in the heat exchanger tubes for heating the fluids.
- The hot water generator may be natural draft or induced draft fan system.
- The fuel injection and removal of resultant ash is carried out manually.

Comparison of Thermic Fluid Heater with Hot Water Generator

Technical, economic, Environmental and safety aspects of thermic fluid heater and hot water generator are compared on life cycle of equipment; same is given in Table 2.1 below:

Table 2.1 Comparison of Thermic fluid heater with Hot water generator

S. No	Details	Thermic fluid heater	Hot water generator
1	Wood consumption	High	Low
2	Environment pollution	High	Low

S. No	Details	Thermic fluid heater	Hot water generator
3	Safety of workers	Poor	Good
4	Maintenance	High	Low
5	Operational cost	High	Low
6	Availability of local service providers	Yes	Yes
	Technical comparison between thermic fluid heater & hot water generators		
7	Draught system	Forced	Natural or forced
8	Fuel combustion	Partial(due to inefficient combustion chamber design)	Complete
9	Waste heat recovery	No	Yes
10	Heat losses through grate and surface	High	Low
11	Radiation losses	More	Less
12	Utilisation of heat	Less (Single pass system)	Maximum (multi pass system)
13	Capacity utilisation	Low	Optimum
14	Combustion chamber	Conventional	Water walled
15	Secondary air ducting	No	Yes (partly flue gases are recirculated to the furnace)
16	Operation and maintenance	Less easy	Easy

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 details 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 thermic fluid heater. Hence new proposed equipment is completely suitable with existing process.

2.1.4 Availability of equipment

Based on the detailed energy use and technology audits conducted in various textile industries in Solapur Textile cluster, it is suggested to replace the present conventional thermic fluid heater with energy efficient hot water generator of suitable capacity of 80,000kCal/hr.

The technology identified for implementation is available locally 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 equipment.

The technology identified is available in the state of Maharashtra and implemented successfully in few units in cluster. The investment required for implementation of the identified measures has good financial returns and the proposed measure is technically and financially viable.

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 suppliers are given in Annexure 7.

2.1.6 Technical specifications

Design specifications of proposed Energy Efficient hot water generator are presented in Table 2.3 below:

Table 2.2 Technical specifications of existing and proposed technology

Details	*Units*	*Existing technology*	*Proposed technology*
Name of equipment	NA	Thermic Fluid Heater	Hot Water Generator
Model	NA	-	RHBW-80-HWG
Capacity	NA	600 kg/hr	80,000 kCal/hr
Maximum temperature	^{0}C	200	95
Fuel used	NA	Wood or Briquettes	Wood
Fuel consumption	kg/hr	104	33
Thermal efficiency	%age	22	70±2
Firing control	NA	Manual	Manual
Combustion Draft	NA	Natural	Natural
Water pump motor	hp	1	3.0
Total connected load	hp	1	3.0
Electrical Supply	NA	3 hp, 415 V, 50 Hz, AC, 4 Wire	3 hp, 415 V, 50 Hz, AC, 4 Wire

Scope of supply under the model of RHBW 80 hot water generator is furnished below:

- Pressure parts fabricated out of the high temperature resistance carbon steel tubes & plates.

- Water walled wood firing furnace with fire door, ash door & firing grate.
- Mineral wool insulation with mild steel cladding.
- Centrifugal water pumps motor assembly (mono block).
- Pre-wired control panel with contractors, fuse & temperature controller.
- Water level indicator.

2.1.7 Terms and conditions of sales

The terms and conditions of sale of hot water generator of the Ross Boilers is furnished in Table 2.4 below:

Table 2.3 Terms & conditions in sale for energy efficient HWG

Price	Quoted process is each unpacked, ex works.
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	4-6 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 3 to 4 days. Normally, the dyeing process is carried out for 8 hours in a day. To augment the process down time during implementation, the dyeing process can be carried out in 2 shifts in a day for 2 or 3 days and hence no processing down time.

2.2 Suitable unit for implementation of proposed technology

Hot water generators are available in different capacities like 80,000kCal/hr, 1,00,000 kCal/hr. For this DPR, the capacity of 80,000kCal/hr is selected based on assessment carried out in sample units. About 400 kg of dyeing and about 400 kg of soaping can be done in 8 hours of operation. Details of calculation for sizing of hot water generator are given in Annexure 1.

3 ECONOMIC BENEFITS OF PROPOSED EUIPMENT

3.1 Technical benefits

3.1.1 Fuel saving

Analysis was carried out on thermic fluid heater, average wood consumption from various energy use and technology audit studies in textile units in Solapur textile cluster; it comes out to be 104 tonne per annum while wood consumption in proposed energy efficient hot water generator is 64 tonne per annum hence, total wood savings is estimated as 40 tonne per annum.

3.1.2 Electricity saving

No electricity savings are considered, as the proposed hot water generator system also requires a pump for hot water circulation from tank to HWG and hank dyeing machines to the hot water tank.

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 after implementation of energy efficient hot water generator in place of thermic fluid heater is ₹ 1.68 lakh per annum. Energy & cost benefit analysis of energy efficient hot water generator in place of existing thermic fluid heater is presented in Table 3.1 below:

Table 3.1 Energy and cost benefit of Hot water generator

Parameter	Unit	Value
Present wood consumption of existing thermic fluid heater	Tonne/annum	104
Operational hours	hours/day	8
Operational days per annum	Days/annum	240

Parameter	***Unit***	***Value***
Wood consumption of Energy efficient hot water generator	tonne/annum	64
Wood saving	tonne/annum	40
Cost of wood	₹/kg	4.20
Cost savings after implementation	₹ lakh	1.68
Cost of implementation	₹lakh	2.76
Simple payback period	months	19

3.3 Social benefits

3.3.1 Improvement in working environment

The energy measures identified will utilize state-of-the-art technologies to ensure energy efficiency and conservation of non renewable wood. The replacement of thermic fluid heater with hot water generators will reduce the fuel consumption and will improve the work condition and environment. As the project activity will have less radiation losses and unburnt carbon in ash.

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new and energy efficient. The training provided by equipment suppliers will improve the technical skills of manpower for better operation and maintenance; hence the technology implemented will create awareness among the workforce and will improve their skill set.

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 during operation and maintenance of equipments. Further, the remuneration will improve in the market or in other companies of the work force.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

The effluent generation due to implementation of the project activity is insignificant.

3.4.2 Reduction in GHG emission such as CO_2, NOx, etc

The major GHG emission reduction source is CO_2 and the technology will reduce non renewable wood consumption due to better efficiency than the existing equipment. The total emission reductions are estimated as 56 tonne of CO_2 (taking CO_2 emission factor as 1.4 tCO_2 per Tonne of wood consumption) per annum due to implementation of the project activity. Therefore, units of the cluster may become eligible for carbon credit under Clean Development Mechanism (CDM).

3.4.3 Reduction in other emissions like SOx

As the technology reduces the wood consumption and doesn't contain sulphur and hence there is no impact on SOx emissions.

3.4.4 Reduction of deforestation

Most of units in the cluster are using the non renewable wood for hot water generation; therefore, by adopting the proposed energy efficient wood fired hot water generator in place of thermic fluid heater will reduce consumption of non renewable wood. Wood consumption is low in proposed energy efficiency hot water generator compared to thermic fluid heater, which is expected to reduce the deforestation.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Cost of equipment

The total cost of plant and machinery is estimated at ₹ 2.00 lakh, which includes hot water generator, pumps, chimney, and electrical works and distribution system.

4.1.2 Other costs

The total cost of implementation of the hot water generator is estimated at ₹ 2.76 lakh. The above cost includes cost of equipment/machinery, cost of fabrication (and/or) commissioning charges and the details are furnished below

Table 4.1 Details of project cost

S. No	Details	Cost (₹ in lakh)
1	Equipment and machinery	2.00
2	Erection & Commissioning	0.30
3	Interest during implementation	0.06
4	Other charges (Contingency)	0.30
5	Total	2.76

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 2.76 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 0.69 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which is ₹ 2.07 lakh.

4.2.3 Subsidy by Government

As the overall energy efficiency in the project is more than 15% therefore 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 ₹ 0.69 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

4.2.4 Terms & conditions of loan

The interest rate is considered at 10.00% which is SIDBI'S Lending rate for energy efficiency projects. The loan tenure is assumed 5 years and the moratorium period is 6months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, initial own funds (Equity) required is ₹ 0.69 lakh.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 2.76 lakh and monetary savings due to reduction in wood consumption is ₹ 1.68 lakh and the simple payback period works out to be 1.64 years (19 months).

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.00% works out to be ₹ 2.69 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 43.32 %. 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 33.74% for an investment of ₹ 2.76 lakh.

Table 4.2 Financial indicator of project

S. No	Particulars	Unit	Value
1	Simple Pay Back period	months	19
2	IRR	%age	43.32%
3	NPV	lakh	2.69
4	ROI	%age	33.74%
5	DSCR	ratio	2.52

4.4 Sensitivity analysis

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like there is an increase in fuel savings or decrease in fuel savings. For the purpose of sensitive analysis, two scenarios are considered are.

- 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	NPV	ROI	DSCR	IRR
Normal	2.69	33.74%	2.52	43.32%
5% increase in fuel savings	2.93	34.20%	2.64	45.98%
5% decrease in fuel savings	2.45	33.35%	2.40	40.63%

As could be seen from the above table, though the project is highly sensitive to fuel savings, DSCR works out to be 2.45 times in worst scenario, which indicates the strength of the project.

4.5 Procurement and Implementation schedule

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

Annexure 1 Efficiency of the Thermic Fluid Heater (Indirect Method)

Case-1 (Gaddam Industries)

S.No	Parameter	Unit	Value
1	Fuel used	-	Briquettes
2	Quantity of steam generated	kg/day	400
3	Enthalpy of steam	kCal/day	656
4	Heat output	kCal/day	2,50,400
5	Quantity of Briquettes consumption	kg/day	265
6	Calorific value of Briquettes	kCal/kg	4,200
7	Heat input	kCal/day	11,13,000
8	Efficiency	%age	22.5

Case –2 (Kendole Textiles)

S.No	Parameter	Unit	value
1	Fuel used	-	Briquettes
2	Quantity of steam generated	kg/day	300
3	Enthalpy of steam	kCal/day	656
4	Heat output	kCal/day	1,87,800
5	Quantity of Briquettes consumption	kg/day	200
6	Calorific value of Briquettes	kCal/kg	3,200
7	Heat input	kCal/day	6,40,000
8	Efficiency	%age	29.3

Case –3 (Jamuna Industries)

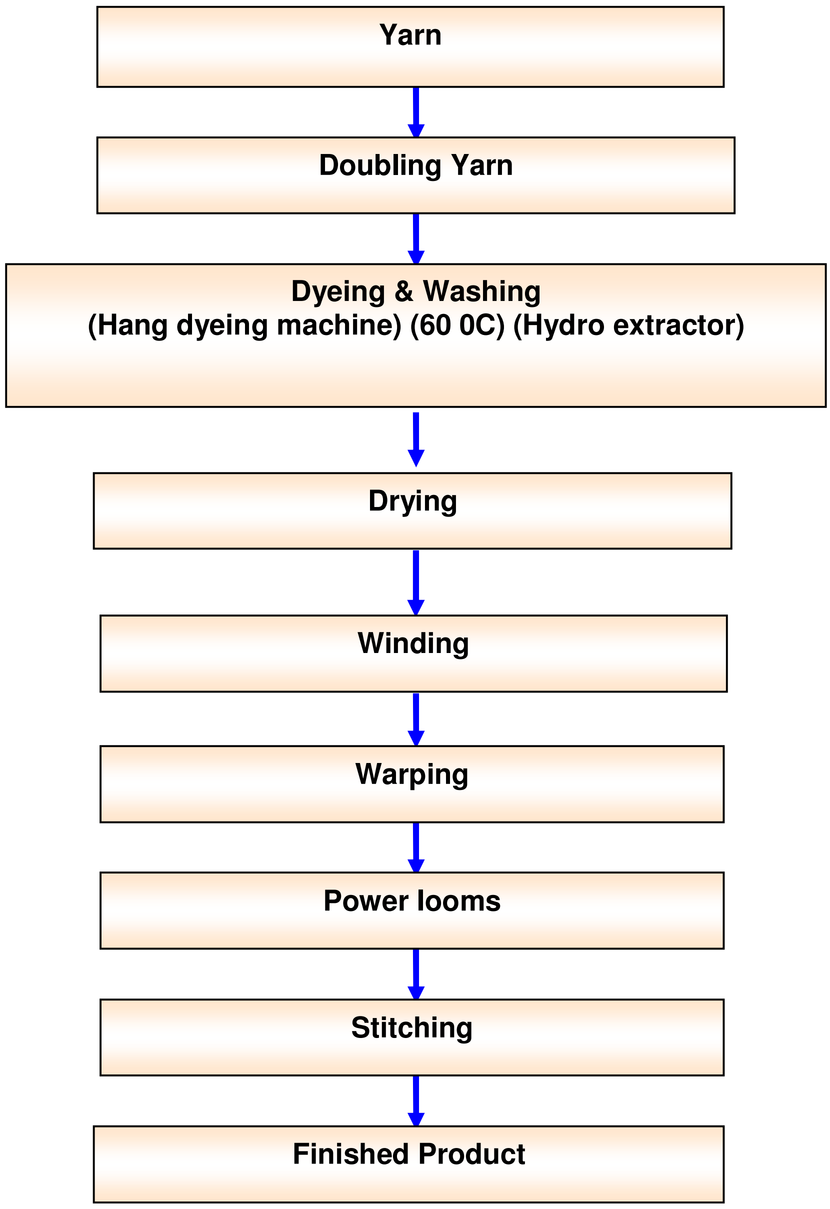
S.No	Parameter	Unit	value
1	Fuel used	-	Briquettes
2	Quantity of steam generated	kg/day	500

3	Enthalpy of steam	kCal/day	656
4	Heat output	kCal/day	3,13,000
5	Quantity of Briquettes consumption	kg/day	300
6	Calorific value of Briquettes	kCal/kg	3,200
7	Heat input	kCal/day	9,60,000
8	Efficiency	%age	32.6

Capacity calculation for hot water generator

S.No	Details	Unit	Value
1	No. of batches - dyeing	-	1
2	No. of batches - soaping	-	3
3	Water requirement per batch	liters	1100
4	Hours of operation	hours	8
5	Wood consumption	kg/day	432
6	Calorific value of wood	kCal/kg	3200
7	Average water temperature (initial)	°C	30
8	Average water temperature (final)	°C	55
9	Average temperature difference	°C	25
10	Heat input	kCal	13,82,400
11	Ambient temperature(T_a)	°C	30
12	Heat required for hot water generation	kCal/day	1,10,000
13	Heat required for maintaining the water temp at 55^0C	kCal/day	1,00,000
14	Total heat required	kCal/day	2,10,000
15	Heat to be supplied at 60% efficiency	kCal/day	3,50,000
16	Heat transfer efficiency 80%	kCal/day	3,37,500
17	% loading of the hot water generator (80%)	kCal/day	5,46,875

Annexure 2 Process Flow Diagram



Annexure 3 Detailed Technology Assessment

S.No	Particular	Unit	Value	
			Existing equipment	Proposed equipment
1	Operating hour	hrs	8	8
2	Operating days	days	240	240
3	Fuel Used	-	Wood /briquettes	Wood /briquettes
4	Thermal Efficiency	%age	22	70±2
5	Firing control	NA	Manual	Manual
6	Calorific value of wood	kCal/kg	3200	3200
7	Wood consumption	Tonne/annum	104	64
8	Saving of wood consumption	Tonne		40
9	Cost of wood	₹ / Tonne	4200	4200
10	Monetary saving	₹ in lakh	1.68	
11	Cost of project	₹ in lakh	2.76	

Basis for Selection of Equipment

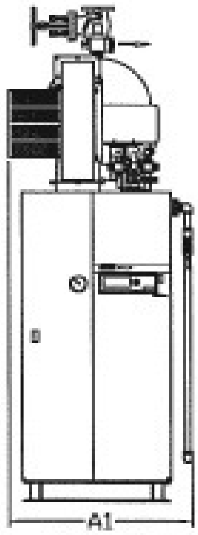
For a hot water generator, various factors influence the selection and sizing of the plant. Hence, for economical hot water generation, the following were considered

- Quantity of hot water required
- Temperature of hot water
- Time required for heating
- Quantity of water required for re-heating and circulation
- Cost economics

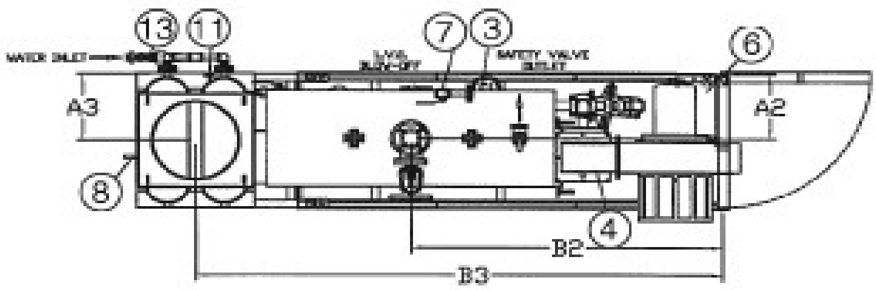
Annexure 4 Electrical & civil work Drawings for proposed equipment

Major civil works is not required for the technology hence no drawings are furnished

Front view and top view of hot water generator



FRONT VIEW



TOP VIEW

Annexure 5 Detailed financial analysis of Hot Water Generator

Assumptions

Name of the Technology	*Hot water generator*		
Rated Capacity	80000kCal/hr		
Detail	Unit	Value	
Installed Capacity	kCal/hr	80000	Feasibility Study
No of working days	Days	240	Feasibility Study
No of Shifts per day	Shifts	1	Feasibility Study
Proposed Investment			
Plant & Machinery	₹ (in lakh)	2.00	Feasibility Study
Erection & Commissioning (15%)	% on Plant &	0.30	Feasibility Study
Civil work	₹ (in lakh)	0.10	
Investment without IDC	₹ (in lakh)	2.40	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.06	Feasibility Study
Other charges(Contingency)	₹ (in lakh)	0.30	Feasibility Study
Total Investment	₹ (in lakh)	2.76	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	0.69	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	2.07	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period [excluding	Months	66	Assumed
Interest Rate	%age	10	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% Plant & Equip	4.00	Feasibility Study
Annual Escalation	%	5.00	Feasibility Study
Estimation of Revenue			
Wood savings	Tonnes/year	40	-
Cost	₹/Tonne	4200	-
St. line Depn.	%age	5.28	Indian Companies Act
O & M Costs	% on Plant &	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study

Estimation of Interest on Term Loan (₹ in lakh)

Years	*Opening Balance*	*Repayment*	*Closing Balance*	*Interest*
1	2.07	0.07	2.00	0.19
2	2.00	0.24	1.76	0.19
3	1.76	0.36	1.40	0.16
4	1.40	0.48	0.92	0.12
5	0.92	0.60	0.32	0.06
6	0.32	0.32	0.00	0.01
		2.07		

WDV Depreciation:

Particulars / years	1	2	3	4	5	6
Plant and Machinery						
Cost	2.76	2.35	1.99	1.69	1.44	1.22
Depreciation	0.41	0.35	0.30	0.25	0.22	0.18
WDV	2.35	1.99	1.69	1.44	1.22	1.04

Projected Profitability

Particulars /	1	2	3	4	5	6	Total
Revenue through Savings							
Fuel savings	1.68	1.68	1.68	1.68	1.68	1.68	10.08
Total Revenue	1.68	1.68	1.68	1.68	1.68	1.68	10.08
Expenses							
O & M	0.10	0.10	0.11	0.11	0.12	0.13	0.67
Total	0.10	0.10	0.11	0.11	0.12	0.13	0.67
PBDIT (A)-(B)	1.58	1.58	1.57	1.57	1.56	1.55	9.41
Interest	0.19	0.19	0.16	0.12	0.06	0.01	0.73
PBDT	1.39	1.39	1.41	1.45	1.50	1.55	8.68
Depreciation	0.13	0.13	0.13	0.13	0.13	0.13	0.78
PBT	1.26	1.26	1.28	1.32	1.37	1.42	7.90
Income tax	0.33	0.35	0.38	0.41	0.43	0.46	2.37
Profit after tax	0.93	0.91	0.90	0.91	0.93	0.95	5.54

Computation of Tax (₹ in lakh)

Particulars / Years	1	2	3	4	5	6
Profit before tax	1.26	1.26	1.28	1.32	1.37	1.42
Add: Book depreciation	0.13	0.13	0.13	0.13	0.13	0.13
Less: WDV depreciation	0.41	0.35	0.30	0.25	0.22	0.18
Taxable profit	0.98	1.04	1.11	1.19	1.28	1.36
Income Tax	0.33	0.35	0.38	0.41	0.43	0.46

Projected Balance Sheet (₹ in lakh)

Particulars / Years	1	2	3	4	5	6
Liabilities						
Share Capital (D)	0.69	0.69	0.69	0.69	0.69	0.69
Reserves & Surplus (E)	0.93	1.84	2.74	3.65	4.58	5.54
Term Loans (F)	2.00	1.76	1.40	0.92	0.32	0.00
Total Liabilities D)+(E)+(F)	3.62	4.29	4.83	5.26	5.59	6.23

Assets

Gross Fixed Assets	2.76	2.76	2.76	2.76	2.76	2.76
Less: Accm. Depreciation	0.13	0.26	0.39	0.52	0.65	0.78
Net Fixed Assets	2.63	2.50	2.37	2.24	2.11	1.98
Cash & Bank Balance	0.99	1.79	2.46	3.02	3.48	4.25
Total Assets	3.62	4.29	4.83	5.26	5.59	6.23

Net Worth	1.62	2.53	3.43	4.34	5.27	6.23
Debt Equity Ratio	1.23	0.70	0.41	0.21	0.06	0.00

Projected Cash Flow: **(₹ in lakh)**

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***
Sources							
Share Capital	0.69	-	-	-	-	-	
Term Loan	2.07						
Profit After tax		0.93	0.91	0.90	0.91	0.93	0.95
Depreciation		0.13	0.13	0.13	0.13	0.13	0.13
Total Sources	2.76	1.06	1.04	1.03	1.04	1.06	1.08
Application							
Capital Expenditure	2.76						
Repayment of Loan	-	0.07	0.24	0.36	0.48	0.60	0.32
Total Application	2.76	0.07	0.24	0.36	0.48	0.60	0.32
Net Surplus	-	0.99	0.80	0.67	0.56	0.46	0.76
Add: Opening Balance	-	-	0.99	1.79	2.46	3.02	3.48
Closing Balance	-	0.99	1.79	2.46	3.02	3.48	4.25

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

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***
Profit after Tax		0.93	0.91	0.90	0.91	0.93	0.95
Depreciation		0.13	0.13	0.13	0.13	0.13	0.13
Interest on Term Loan		0.19	0.19	0.16	0.12	0.06	0.01
Salvage/Realizable							
Cash outflow	(2.46)	-	-	-	-	-	-
Net Cash flow	(2.46)	1.25	1.22	1.19	1.16	1.13	1.09
IRR	43.32%						

NPV	2.69

Break Even Point **(₹ in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***
Variable Expenses						
Oper. & Maintenance Exp (75%)	0.07	0.08	0.08	0.09	0.09	0.09
Sub Total *(G)*	0.07	0.08	0.08	0.09	0.09	0.09
Fixed Expenses						
Oper.& Maintenance Exp (25%)	0.02	0.03	0.03	0.03	0.03	0.03
Interest on Term Loan	0.19	0.19	0.16	0.12	0.06	0.01
Depreciation *(H)*	0.13	0.13	0.13	0.13	0.13	0.13
Sub Total (I)	0.34	0.34	0.32	0.28	0.22	0.17
Sales (J)	1.68	1.68	1.68	1.68	1.68	1.68
Contribution (K)	1.61	1.60	1.60	1.59	1.59	1.59
Break Even Point (L= G/I)	21.34%	21.52%	19.81%	17.34%	14.12%	10.75%
Cash Break Even {(I)-(H)}	13.26%	13.41%	11.68%	9.19%	5.95%	2.56%

Break Even Sales (J)*(L)	0.36	0.36	0.33	0.29	0.24	0.18

Return on Investment **(₹ in lakh)**

Particulars / Years	1	2	3	4	5	6	Total
Net Profit Before Taxes	1.26	1.26	1.28	1.32	1.37	1.42	7.90
Net Worth	1.62	2.53	3.43	4.34	5.27	6.23	23.42
							33.74%

Debt Service Coverage Ratio **(₹ in lakh)**

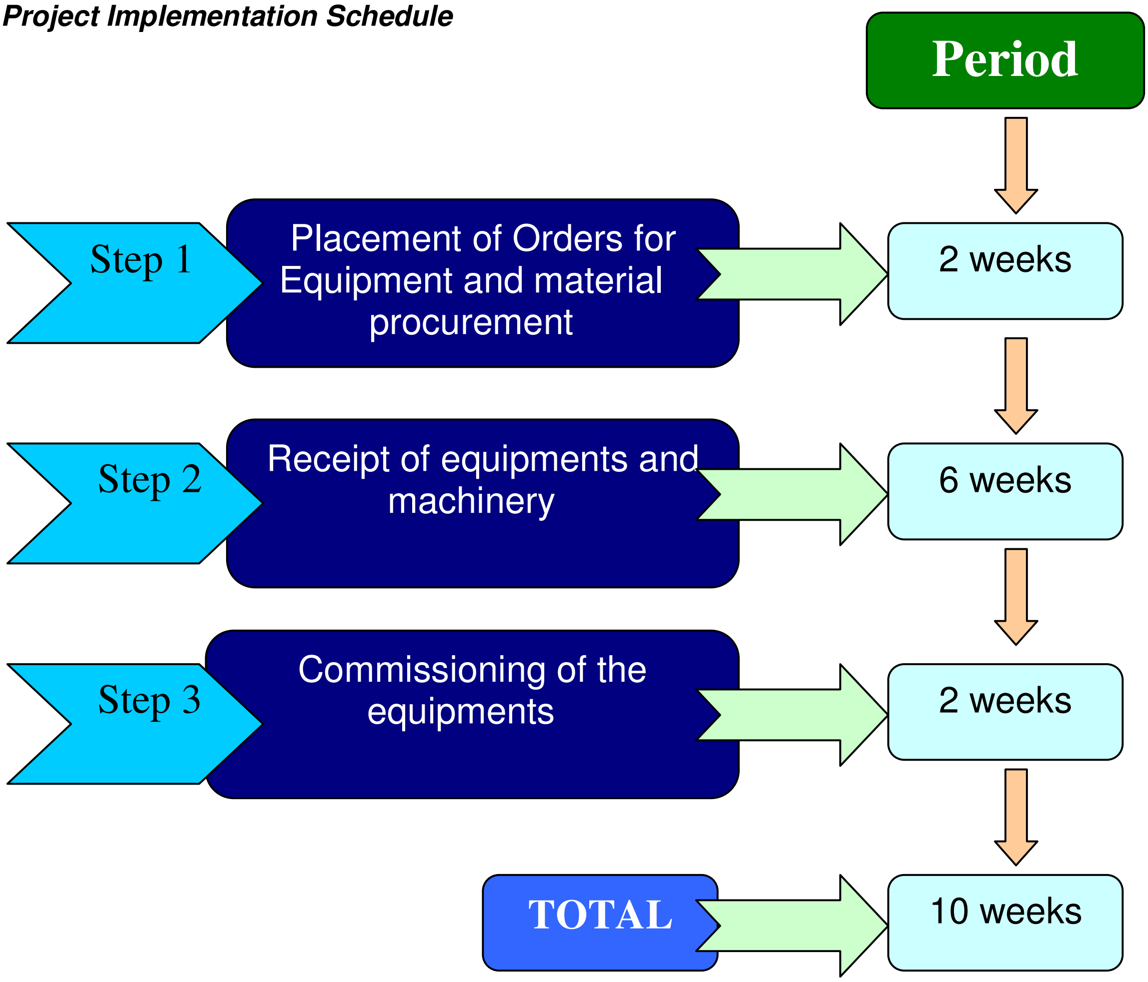
Particulars / Years	1	2	3	4	5	6	Total
Cash Inflow							
Profit after Tax	0.93	0.91	0.90	0.91	0.93	0.95	5.54
Depreciation	0.13	0.13	0.13	0.13	0.13	0.13	0.78
Interest on Term Loan	0.19	0.19	0.16	0.12	0.06	0.01	0.73
Total (M)	1.25	1.22	1.19	1.16	1.13	1.09	7.04

DEBT

Interest on Term Loan	0.19	0.19	0.16	0.12	0.06	0.01	0.73
Repayment of Term Loan	0.07	0.24	0.36	0.48	0.60	0.32	2.07
Total (N)	0.26	0.43	0.52	0.60	0.66	0.33	2.80
Average DSCR (M/N)	2.52						

Annexure 6 Details of procurement and implementation plan

Project Implementation Schedule



Annexure 7 Details of equipment and service providers

Name of company	***Ross Boilers***
Address of company	33, Al Ameen Society, Gultekdi, Pune - 411037, Maharashtra
Contact no & Fax no	Phone:91-20-24269393/24272293/24274717 Fax:91-20-24272293/24269562

Name of company	***Thermax Ltd.***
Name of contact person	Dhanraj Mahal
Address of company	2nd Floor, Chatrapati Shivaji Maharaj Marg, Nr. Gateway of India, Mumbai
Contact no & Fax no	Ph:022 - 6754 2222 Fax:022 - 22040859
Contact email ids	vadher@ad1.vsnl.net.in
Company website	www.aerothermsystem.com

Annexure 8 Quotations of proposed equipment

To,
ZENITH ENERGY SERVICES PVT LTD
N 5, 6/B My Home Plaza
Masab Tank

HYDERABAD
Andra Pradesh 500028
Phone Tel : 040-23376630, email : krishna@zenithenergy.com

Quotation No. : **15/R/Q/09-10**
Date : 28/10/09

Unit Mode : **RHBW 80**

ROSS WOOD FIRED HOT WATER GENERATOR

Technical Specifictions :

Heat Output :	80,000 Kcals/hr
Max. Temperature :	95 deg C
Hot Water Flow Rate :	16,000 lts/hr.
Fuel :	WOOD
Fuel Consumption : (E = 70 %, N.C.V. = 3500 Kcals/kg)	33 Kgs/hr#
Thermal Efficiency (NCV) :	70± 2%
Firing Control :	Manual
Combustion Draft	Natural
Water Pump Motor:	3 HP
Total Connected Load :	3 HP
Electric Supply :	3 PH, 415 V, 50 HZ, AC, 4 Wire system.
Overall Dimensions (approx.) :	
Width :	800 mm
Depth :	650 mm
Height :	2200 mm
Dry Weight (approx.) :	700 kgs.

Fuel consumption is based on N.C.V. (net calorific value) of fuel at 3,500 Kcals/kg. & Hot Water Generator efficiency of 70 %.
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 :	**132,000.00/-** (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 2% CST against Form C.
Payment Terms :	Advance 50% along with firm order. Balance 50% against performa invoice prior to despatch.
Delivery Period :	4-6 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 Juridiction

Unit Mode : **RHBW 80**

ROSS WOOD FIRED HOT WATER GENERATOR

Design Features :

* Outside the preview of Indian Boiler Regulations.
* Designed for maximum efficiency.
* Water walled combustion chamber.
* No qualified boiler attendant required.
* Manual firing with natural draught.
* Designed for ease of operation and maintenance.
* All Standard parts ensures easy availability of spares.

Scope Of Supply :

* Pressure parts fabricated out of high temperature resistance carbon steel tubes (E.R.W.) & plates.
* Centrifugal water pump motor assembly (Monobloc).
* Water walled wood firing furnace with fire door, ash door & firing grate.
* Mineral wool insulation with mild steel cladding.
* Pre-wired control panel with contactors, fuse & temperature controller.
* Water level indicator.

Control Instruments and Safeties :

* Pressure indicator to indicate water pressure.
* Temperature Indicator to indicate water temperature & to give alarm in case of high temperature & low temperature.
* Safety relief valve at the unit outlet.

This Offer Excludes :

* Erection and commissioning of the unit at site.
* All civil & structural work for installing the boiler.
* Water softener assembly.
* Main chimney and flue gas ducting from boiler to chimney.
* Any other items or services not specifically mentioned in our scope of supply.
* Raw water, soft water service tanks.
* Main switch and supply cable upto control panel.
* All water piping from tank to unit inlet and from unit outlet to utility and return piping.
* Spares for installation, operation and maintenance.

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