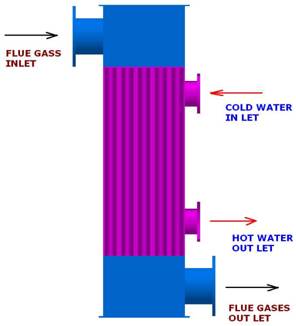
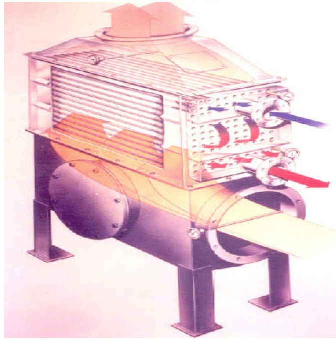
DETAILED PROJECT REPORT
ON
WASTE HEAT RECOVERY THROUGH ECONOMIZER (BOILER)
(SOLAPUR TEXTILE CLUSTER)



Bureau of Energy Efficiency

Prepared By

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ISTSL

WASTE HEAT RECOVERY THROUGH ECONOMIZERFROM BOILER

SOLAPUR TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Waste Heat Recovery Through Economizer from Boiler

Textile SME Cluster, Solapur, Pune, Maharashtra (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.**: SLP/TXT/WHE/013**

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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, and 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.

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List of Abbreviation

BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
FD	Forced Draft
GHG	Green House Gases
HP	Horse Power
IRR	Internal Rate of Return
ID	Induced Draft
NPV	Net Present Value
SIDBI	Small Industries Development Bank of India
ROI	Return on Investment
SME	Small and Medium Enterprises
TFH	Thermic Fluid Heater
WHRS	Waste Heat Recovery System

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 boiler for dyeing process. The cost of energy used in dyeing process constitutes the major portion of the overall energy cost in majority of textile industries in Solapur cluster.

Presently, the flue gas at 270^{o}C from thermic fluid heater is released in the atmosphere leading to wasting of heat from the system. Waste heat recovery system such as economizer is used to generate hot water which is directly used in process or as feed water in boiler. The proposed project implementation will lead to reduction in wood consumption by 38 tonnes per year however; this intervention will not have any effect on the existing consumption 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)	1.56
2	Wood saving	tonne/year	38
3	Monetary benefit	₹(in Lakh)	1.14
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	1.37
6	NPV	₹(in Lakh)	
7	IRR	%age	
8	ROI	%age	
9	DSCR	ratio	
10	Procurement and Implementation time	days	8-10

The projected profitability and cash flow statements indicate that the project is 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 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 Brief introduction about

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 to 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 next to the raw materials cost. Majority of the units in the cluster are dependent on local technologies of low end and with little investment initiatives and technology up-gradation.

1.1.1 Production process

The main 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 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 hank dyeing machine tanks are filled with required quantity of normal water and required textiles 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 natural drying in the 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 sheet) 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 sheet is furnished in Figure 1.1.

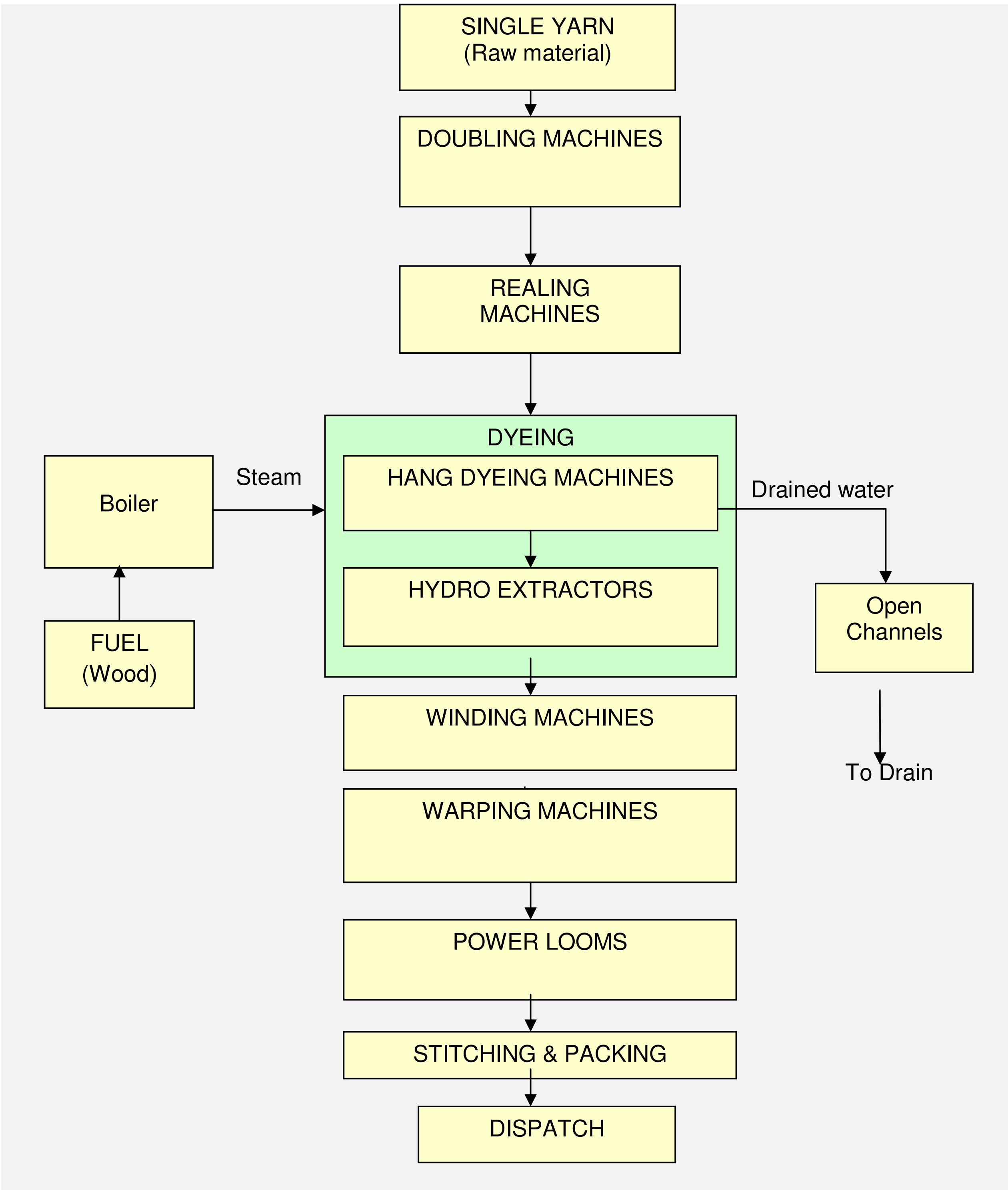


Figure 1.1 Process flowchart of a textile unit

1.2 Energy performance in existing equipment

1.2.1 Fuel and electricity consumption

The main energy used in a typical unit in the cluster is electricity and wood. Electricity is used for driving the prime movers of pumps, hydro extractors, winding machines, power looms, lighting. Wood is used as fuel in thermic fluid heater for hot water generation. The energy consumption of a typical unit in the cluster is furnished in Table 1.1 below:

Table 1.1 Energy consumption (Banda Textile)

Detail	*Unit*	*Value*
Wood consumption	Tonne per year	480
Production	Tonne per year	216

1.2.2 Average production

The average production in a year in a typical unit of the cluster is 216 tonnes of yarn dyeing, which includes light, medium, and dark colors. The dyed yarn will be used in the same unit for further process and/or also taken for their sister units located in the same area.

1.3 Existing equipment to be upgraded

1.3.1 Description of existing equipment

The thermic fluid heaters and boilers are used in cluster units for hot water generation and for maintaining water temperature during dyeing process. Wood is commonly used as fuel. Majority of the boilers and thermic fluid heaters installed doesn't have waste recovery system which leads to loss of thermal efficiency.

Considering the above facts and for improving energy efficiency and to reduce wood consumption in thermic fluid heaters, the waste heat recovery system (Economizer) for hot water generation is identified. The efficiencies evaluated for boiler during energy use & technology audit is furnished in Annexure 1.

1.3.2 Role in process

The proposed technology (WHRS) is additional equipment and will be installed in the existing systems (boilers) to recover heat in waste flue gases to generate hot water. The hot water generated in the WHRS can be used in dyeing and soaping process.

1.4 Baseline for existing equipment

1.4.1 Design and operating parameters

The design and operating parameters of the existing thermic fluid heater are given below in Table1.2

Table 1.2 Design and operating parameters of boiler

S. No	Particular	Unit	value
1	Installed capacity	tonne per hour	2
2	Fuel used	NA	Wood
3	ID fan motor	hp	10
4	Feed water pump	hp	7.5
5	Quantity of steam generated	Kg/day	1800
6	No. of hours of operation	hr	8

1.4.2 Efficiency of boiler

The efficiency of the boiler has been evaluated in different industries and the calculation for a typical unit of the cluster having boiler is furnished in Annexure 1.

1.4.3 Specific fuel and electricity consumption

The specific fuel consumption per kg of yarn processing in typical 2 units of the cluster separately for dyeing and soaping process is furnished in Table 1.3 below

Table 1.3 Specific fuel and electricity consumption

Name of the unit	*Specific power consumption (kWh/kg)*		*Specific fuel consumption (kCal/kg)*	
	Dyeing	*Soaping*	*Dyeing*	*Soaping*
Laxmipathi Industries	0.034	0.017	1700	850
Banda Industries	0.014	0.007	2133	1067

1.5 Barriers for adoption of proposed technology/equipment

1.5.1 Technological barriers

The major technical barriers that prevented the adoption of energy efficiency measures are

- Dependence on local equipment suppliers and hence adopting low end inefficient technologies
- The majority of the textile unit owners/entrepreneur does not have in-depth technical expertise and knowledge.
- The lack of technical know-how made it impossible for the textile unit owners to identify the most effective technical measures.
- Absence of technical person with local service providers

1.5.2 Financial barrier

The lack of awareness about the favorable lifecycle economics of WHRS technology and monetary benefit

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

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 making them aware about efficient use of energy and its conservation.

1.5.4 Other barrier (If any)

No other barriers

2 TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of proposed equipment

2.1.1 Description of equipment

The purpose of the economizer is to increase boiler efficiency by recovering heat that would otherwise be lost in the form of flue gas and use it to heat the water. It is proposed to use shell and tube heat exchanger type economizer

Figure 2.1 Economizer

2.1.2 Equipment specifications

The shell contains the tube bundle, and internal baffles, to direct the fluid in the shell over the tubes in multiple passes. The economizer consists of series of tubes, where the water is passed through the tubes and waste flue gases in the shell and heat is absorbed by the water and can be used for the process requirement or can be used as boiler feed water. The tubes are totally enclosed and the outer surface is insulated with glass wool and aluminum cladding. The hot waste flue gases give up the heat and are then vented to the atmosphere.

2.1.3 Justification of equipment & integration with existing process

Boilers are the most commonly found equipment in the Solapur Textile Cluster. All the boilers are wood fired. The studies were carried out in 51 units, out of 51, 18 units have boilers, 6 units have thermic fluid heaters and the remaining units have chulhas for thermal energy requirement in the process. As per the studies carried out in various units, none of the boiler has waste heat recovery system. In many cases, the temperature of the flue gases at the exit of the boilers is found to be varying between 230℃ to 270℃

Installing economizer for hot water generation will reduce the fuel consumption by utilizing the heat of waste flue gases and hot water generated can be used in the process and hence reducing the wood consumption.

2.1.4 Superiority over existing equipment

The proposed technology enhances the efficiency for the following reasons

- The precious heat available in the waste flue gases is utilized and thus reduces wood consumption
- The economizer will reduce the process time
- By heating the water it is also helping to prevent thermal shock in boilers as the same reduces the load on the equipments
- Reduces thermal pollutants to the atmosphere due to reduction in temperature of waste flue gases

2.1.5 Availability of equipment

The equipment identified for implementation is available in Pune, which is 200 km from Solapur. Though, a number of local service providers are available, they don't have technical capability of designing and fabricating the energy efficient waste heat recovery system.

2.1.6 Source of equipment for the project

The technology is indigenous and is locally available.

2.1.7 Service/equipment providers

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.

2.1.8 Terms and conditions in sales of Energy efficient equipment

The terms of sales of the equipment supplier are

- 50% advance along with the order
- 50% against Performa invoice prior to dispatch

The equipment supplier will provide after sales service at free of cost for a period of one year from the date of commissioning.

2.1.9 Process down time during implementation

Implementation of the proposed project activity is expected to take about 2 days time. 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 for 2 shifts in a day for 2 or 3 days or the equipment is commissioned during weekly holiday and hence no processing down time is considered.

2.2 Life cycle assessment and risks analysis

The life of the proposed economiser is 15 years and no majors risks are identified, as the proposed equipment is additional to the existing system

2.3 Suitable unit for implementation of proposed equipment

The economizer is designed such that the maximum amount of heat available in the waste flue gases is recovered and after recovery, the exhaust flue gas temperature will be about 120^{o}C

3 ECONOMIC BENEFITS OF ENERGY EFFICIENT ECONOMIZER

3.1 Technical benefits

3.1.1 Fuel savings per year

The fuel savings due to installation of the economizer for boiler for hot water generation is estimated as 38 tonne per annum, which is 8% of total wood consumption.

3.1.2 Electricity savings per year

Though, the electricity savings is possible however, the quantum being negligible therefore the same has not been considered.

3.1.3 Improvement in product quality

There is no significant impact on product quality.

3.1.4 Increase in production

As the hot water is generated by utilizing the waste heat available in the flue gases and can be directly used for the process, hence, production may increase.

3.1.5 Reduction in raw material consumption

There is no significant reduction in raw material consumption.

3.2 Monetary benefits

The monetary benefit by implementation / installation of the economizer is estimated as ₹0.75lakh per annum due to reduction in wood consumption.

Table 3.1 Energy and cost benefit analysis of energy efficient boiler

S.No	Parameter	Unit	Value
2	Operational hours	hours	8
5	Wood saving	tonnes/annum	38
6	Cost of wood	`/tonne	3000
7	Total monetary benefit	`(in lakh)	1.14

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 fuels. The project activity will have less radiation losses and un-burnt carbon in ash and hence will improve working environment

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new and energy efficient. The technology implemented will create awareness among the workforce and improve the skill set of 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 activity.

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

The major GHG emission source is CO_2. The technology will reduce non renewable wood consumption due to better efficiency than the baseline equipment. The total emission reductions are estimated as 53 tonne of CO_2 per annum due to implementation of the project activity. 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 reduces per year. This will also help in getting the carbon credit benefit through Clean Development Mechanism (CDM) project.

3.4.3 Reduction in other emissions like SOx

The technology reduces the wood consumption, which doesn't contain sulphur. 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 equipments

The total cost of equipment and machinery is estimated at ₹ 1.50 lakh, which includes cost of economizer, insulation and installation, distribution lines, water tank, insulation, need based civil works etc

4.1.2 Other costs

The total cost of implementation of the hot water generator is estimated at ₹1.55 lakh. The above cost includes cost of equipment/machinery, cost of fabrication (and/or) commissioning charges and the details are furnished in Table 4.1 below:

Table 4.1 Details of project cost

S.No	Details	Cost (` in lakh)
1	Equipment and machinery	1.50
2	Erection & Commissioning	0.02
3	Interest during implementation	0.04
5	Total cost	1.56

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹1.56 lakh. The entrepreneur's contribution is 25 % of total project cost, which is ₹0.39 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which is ₹1.09 lakh.

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 ₹0.39 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 lending 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 10.00% which is prevailing interest rate of SIDBI for energy efficiency projects.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above mentioned assumptions, the net cash accruals starting with ₹ 0.89 lakh in the first year operation and gradually increases to ₹ 2.14 lakh at the end of fourth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 1.55 lakh and monetary savings due to reduction in wood consumption is ₹ 1.14lakh and the simple payback period works out to be 1.36 years (16months).

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.00% interest rate works out to be ₹1.35 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 49.24%. 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 39.76% for an investment of ₹1.35lakh.

Table 4.2 Financial indicator of project

S.No	Particulars	Unit	Value
1	Simple Pay Back period	Month	16
2	IRR	%age	49.24%
3	NPV	lakh	1.35
4	ROI	%age	39.76%
5	DSCR	Ratio	2.62

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

A sensitivity analysis has been worked 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 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 in Table 4.3 below:

Table 4.3 Sensitivity analysis in different scenario

Particulars	*DSCR*	*IRR*	*ROI*	*NPV*
Normal	2.62	49.24%	39.76%	1.35
5% increase in fuel savings	2.73	52.36%	40.57%	1.47
5% decrease in fuel savings	2.50	46.08%	38.87%	1.23

As it could be seen from the above table, the project is highly sensitive to fuel savings, the debt service coverage ratio works out to be 2.50 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

Annexure 1 Efficiency of the Boiler

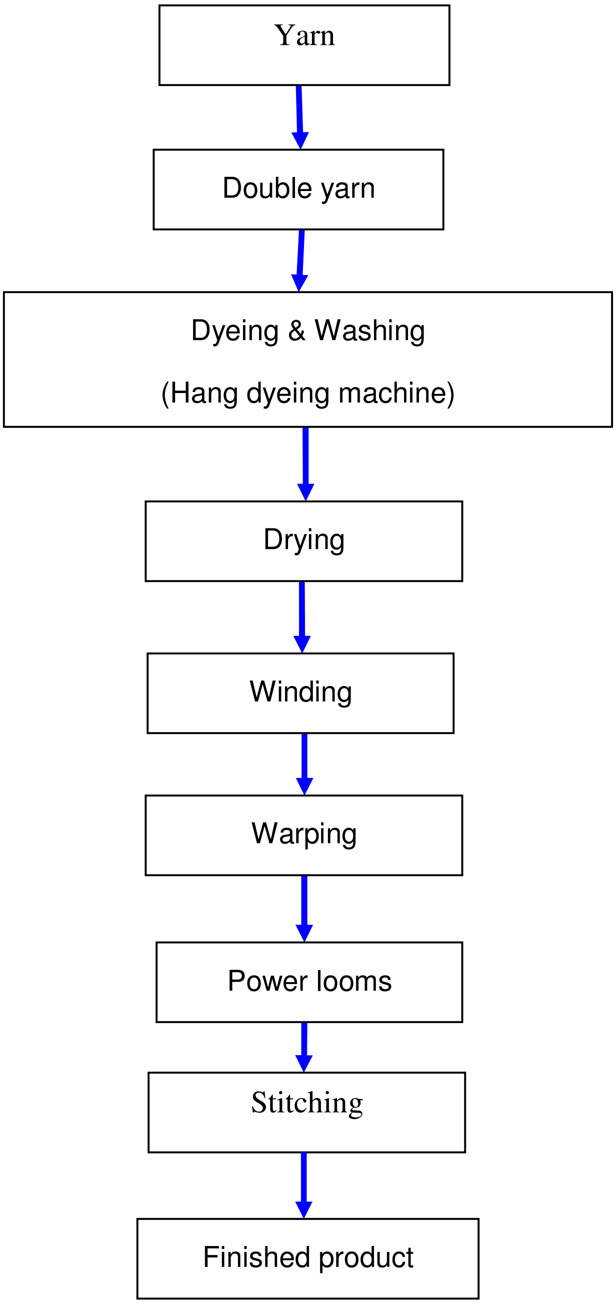
Direct Method Laxmipathi Industries)

Details	***unit***	***Value***
Boiler Capacity	kg/hr	2000
Steam pressure	Kg/cm^2	10
No. of hours of operation/day	hr	8
Quantity of steam generated	kg/day	1800
Boiler feed water enthalpy at 30^{o}C	kCal/kg	30
Wood Consumption	kg/day	800
Briquettes consumption	kg/day	200
Calorific value of wood	kCal/kg	3200
Calorific value of briquettes	kCal/kg	4200
Enthalpy of steam (@ 10 kg/ cm^2)	kCal/kg	663
Heat Input	kCal/kg	3400000
Heat output	kCal/kg	1139400
Efficiency	%	33.5

Case-2 (Banda Industries)

Details	***unit***	***Value***
Boiler Capacity	kg/hr	2000
Steam pressure	Kg/cm^2	10
No. of hours of operation/day	hrs	8
Quantity of steam generated	kg/day	4000
Boiler feed water enthalpy at 30°C	kCal/kg	30
Fuel Consumption	kg/day	2000
Calorific value of fuel	kCal/kg	3200
Enthalpy of steam (@ 5 kg/ $cm^{2)}$	kCal/kg	663
Heat Input	kCal/kg	6400000
Heat output	kCal/kg	2532000
Efficiency	%	39.5

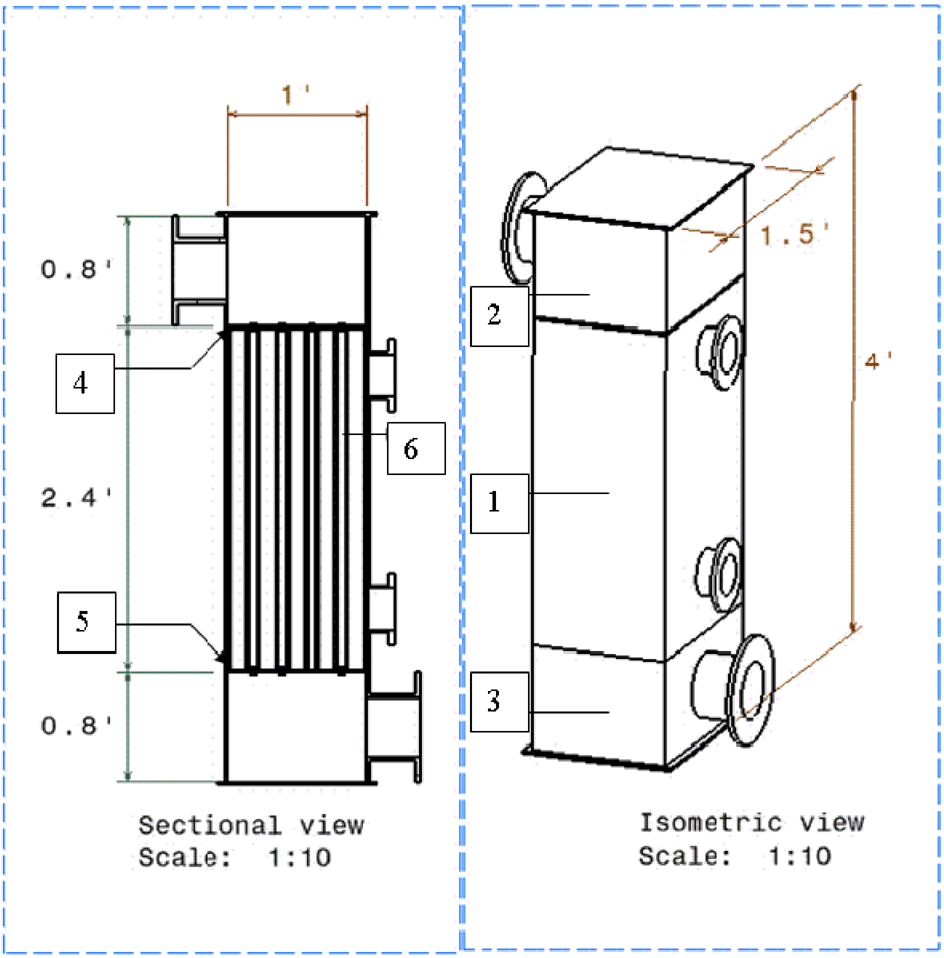
Annexure-2 Process flow diagram



Annexure-3 Detailed technology assessment report of economizer

S.No	Particular	Unit	Value	
			Existing	Proposed
1	Operating hour	hr	8	8
2	Operating days	days	240	240
3	Temperature of hot water required	^{0}C	55-60	55-60
4	Flue gas temperature	^{0}C	360	120
5	Calorific value of wood	kCal/kg	3200	3200
6	Efficiency of equipment	%age	30 -40	NA-
7	Saving of wood consumption	tonne	NA	38
8	Cost of wood	₹ / tonnes	2500	3000
9	Monetary saving	₹ in lakh	NA	1.14
10	Cost of project	₹ in lakh	NA	1.56

Annexure-4 Electrical & civil work Drawings for proposed equipment



All dimensions are in ft'

ZENITH ENERGY SERVICES (P) LTD

ZenithEnergy
Horizons Beyond Energy

ECONOMIZER

SCALE 1:10 | WEIGHT (kg) XXX

Sl.No	Description	Size	Material
1	Shell	4.0 ft X 1.5 ft X 1.0 ft X 5 mm thick	MS
2	Top shell	0.8 ft X 1.5 ft X 1.0 ft X 5 mm thick	MS
3	Bottom shell	0.8 ft X 1.5 ft X 1.0 ft X 5 mm thick	MS
4	Top tube sheet	1.5 ft X 1.0 ft X 10 mm thick	SS - 310
5	Bottom tube sheet	1.5 ft X 1.0 ft X 10 mm thick	SS - 310
6	Tubes	2 " X 5 mm thick	SS - 310
7	No of tubes	35 Nos	
8	Insulation		GW 75 mm thick
9	Bolts & Nuts		STD

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Annexure-5 Financial analysis of Waste Heat Recovery System

Assumptions

Name of the Technology	**Waste heat recovery system(Economiser)**		
Rated Capacity	***NA***		
Detail	**Unit**	**Value**	
Installed Capacity	NA		Feasibility Study
No of working days	Days	250	Feasibility Study
No of Shifts per day	Shifts	1	Feasibility Study
Capacity Utilization Factor	%		Feasibility Study
Proposed Investment			
Plant & Machinery	₹(in lakh)	1.50	Feasibility Study
Erection & Commissioning (1%)	% on Plant & Equip	0.02	Feasibility Study
Investment without IDC	₹ (in lakh)	1.52	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.04	Feasibility Study
Total Investment	₹ (in lakh)	1.56	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	0.39	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	1.16	Feasibility Study
Loan Tenure	Years	4	Assumed
Moratorium Period	Months	3	Assumed
Repayment Period [excluding moratorium]	Months	48	Assumed
Interest Rate	%	10	SIDBI's rate of interest for energy efficiency project
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	38	
Cost	₹/Tonne	3000	
St. line Depn.	%	5.28	Indian Companies Act

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

Years	***Opening Balance***	***Repayment***	***Closing Balance***	***Interest***
1	1.16	0.18	0.98	0.10
2	0.98	0.26	0.72	0.09
3	0.72	0.28	0.44	0.06
4	0.44	0.32	0.12	0.03
5	0.12	0.12	0.00	0.01
		1.16		

WDV Depreciation:

Particulars / years	1	2	3	4
Plant and Machinery				
Cost	1.55	0.31	0.06	0.01
Depreciation	1.24	0.25	0.05	0.01
WDV	0.31	0.06	0.01	0.00

Projected Profitability

Particulars / Years	1	2	3	4
Revenue through Savings				
Fuel savings	1.14	1.14	1.14	1.14
Total Revenue (A)	1.14	1.14	1.14	1.14
Expenses				
O & M Expenses	0.06	0.07	0.07	0.07
Total Expenses (B)	0.06	0.07	0.07	0.07
PBDIT (A)-(B)	1.08	1.07	1.07	1.07
Interest	0.10	0.09	0.06	0.03
PBDT	0.98	0.99	1.01	1.04
Depreciation	0.08	0.08	0.08	0.08
PBT	0.89	0.91	0.93	0.95
Income tax	-	0.25	0.33	0.35
Profit after tax (PAT)	0.89	0.65	0.60	0.61

Computation of Tax **(₹ in lakh)**

Particulars / Years	1	2	3	4
Profit before tax	0.89	0.91	0.93	0.95
Add: Book depreciation	0.08	0.08	0.08	0.08
Less: WDV depreciation	1.24	0.25	0.05	0.01
Taxable profit	(0.27)	0.74	0.96	1.03
Income Tax		0.25	0.33	0.35

Projected Balance Sheet (₹ in lakh)

Particulars / Years	1	2	3	4
Liabilities				
Share Capital (D)	0.39	0.39	0.39	0.39
Reserves & Surplus (E)	0.89	1.55	2.15	2.76
Term Loans (F)	0.98	0.72	0.44	0.12
Total Liabilities D)+(E)+(F)	2.27	2.66	2.98	3.27
Assets				
Gross Fixed Assets	1.55	1.55	1.55	1.55
Less: Accm. Depreciation	0.08	0.16	0.25	0.33
Net Fixed Assets	1.47	1.39	1.31	1.22
Cash & Bank Balance	0.80	1.27	1.68	2.04
Total Assets	2.27	2.66	2.98	3.27
Net Worth	1.28	1.94	2.54	3.15
Debt Equity Ratio	2.54	1.87	1.15	0.32

Projected Cash Flow: (₹ in lakh)

Particulars / Years	0	1	2	3	4
Sources					
Share Capital	0.39	-	-	-	-
Term Loan	1.16				
Profit After tax		0.89	0.65	0.60	0.61
Depreciation		0.08	0.08	0.08	0.08
Total Sources	1.29	0.61	0.47	0.43	0.44
Application					
Capital Expenditure	1.55				
Repayment of Loan	-	0.18	0.26	0.28	0.32
Total Application	1.55	0.18	0.26	0.28	0.32
Net Surplus	-	0.80	0.48	0.40	0.37
Add: Opening Balance	-	-	0.80	1.27	1.68
Closing Balance	-	0.80	1.27	1.68	2.04

Calculation of Internal Rate of Return (₹ in lakh)

Particulars / months	0	1	2	3	4
Profit after Tax		0.89	0.65	0.60	0.61
Depreciation		0.08	0.08	0.08	0.08
Interest on Term Loan		0.10	0.09	0.06	0.03
Salvage/Realizable value					0.16
Cash outflow	(1.55)	-	-	-	-
Net Cash flow	(1.55)	1.08	0.82	0.74	0.87

IRR	46.18%

NPV	1.26

Break Even Point ***(₹ in lakh)***

Particulars / Years	1	2	3	4
Variable Expenses				
Oper. & Maintenance Exp (75%)	0.05	0.05	0.05	0.05
Sub Total ***(G)***	0.05	0.05	0.05	0.05
Oper.& Maintenance Exp (25%)	0.02	0.02	0.02	0.02
Interest on Term Loan	0.10	0.09	0.06	0.03
Depreciation *(H)*	0.08	0.08	0.08	0.08
Sub Total (I)	0.20	0.19	0.16	0.13
Sales (J)	1.14	1.14	1.14	1.14
Contribution (K)	1.09	1.09	1.09	1.09
Break Even Point (L= G/I)	18.15%	17.02%	14.71%	12.08%
Cash Break Even {(I)-(H)}	10.65%	9.51%	7.18%	4.53%
BREAK EVEN SALES (J)*(L)	0.21	0.19	0.17	0.14

Return on Investment ***(₹ in lakh)***

Particulars / Years	1	2	3	4	Total
Net Profit Before Taxes	0.89	0.91	0.93	0.95	3.68
Net Worth	1.28	1.94	2.54	3.15	8.91
					41.37%

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

Particulars / Years	1	2	3	4	Total
CASH INFLOW					
Profit after Tax	0.89	0.65	0.60	0.61	2.76
Depreciation	0.08	0.08	0.08	0.08	0.33
Interest on Term Loan	0.10	0.09	0.06	0.03	0.28
TOTAL (M)	1.08	0.82	0.74	0.72	3.37

DEBT

Interest on Term Loan	0.10	0.09	0.06	0.03	0.28
Repayment of Term Loan	0.18	0.26	0.28	0.32	1.04
TOTAL (N)	0.28	0.35	0.34	0.35	1.32
Average DSCR (M/N)	2.55				

Annexure-6 Details of procurement and implementation schedule

S. No	Activity	Weeks				
		1-2	2-4	4-6	6-8	8-10
1	Collection of quotations and order					
2	Designing					
3	Fabrication					
4	Delivery					
5	Commissioning					

Break up of process down time.

S. No.	*Activities*	*Days*											
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1	Civil foundations												
2	Water storage system												
3	WHR in flue gas path system												
4	Installation												
5	Insulation												
6	Commissioning and trial												

Annexure-7 Details of technology/equipment and service providers with contact nos.

Equipment details	*Service/technology providers*
Waste Heat Recovery System	**TATI ENGINEERING WORKS** Nagnath Society, C -27/7, MIDC Akkalkot Road, Behind Yallaling Math, Nagnath Society 413 005 Tel: 0217 2655446 Mobile: 9822088930 **THERMAX Ltd.** Dhanraj Mahal, 2nd Floor, Chatrapati Shivaji Maharaj Marg, Nr. Gateway Of India Mumbai - 400 039 Ph : 022 - 6754 2222 Fax : 022 - 22040859 **ROSS BOILERS** Address : 33, Al Ameen Society, Gultekdi, Pune - 411037, Maharashtra, India Phone : 91-20-24269393/24272293/24274717 Fax : 91-20-24272293/24269562

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

|| श्री मार्कंडेय प्रसन्न ||

Phone : Offi. : 0217- 2391446
Cell : 9422653501
09422458805

TATI ENGINEERING WORKS

Nagnath Society, C-27/7, M.I.D.C., Akkalkot Rd.,
Behind Yallaling Math, Solapur 413 005

Manufacturers of Hank Dyeing Machines, Washing Machines, Colour Mixing Stainers, Care Machines, Hydro Extractors, Hydraulic Power Packs & Machines as Per Customers Specifications

Ref. No. 188

Date :

QUOTATION

Date 27/08/2010

To,

Zenith Energy Pvt. Ltd.,
Mz Home Plaza,
Hasab Tank,
Hyderabad.
Ph.040- 23376630 / 31

1.	Radiator Steam Generator size: 1.0ft X 1.5ft X 4.0ft with 2" tube	:	1 No.	42,000=00

Terms & Conditions

☺Price: Ex-works, Solapur.☺ Delivery: 5 Weeks after your confirmed order. ☺ Payment Terms: 50% advance along with your confirmed order, balance against delivery, before dispatch. ☺ Taxes: All taxes will be extra as per rate at the time of delivery. Present rate: 13%MST, 10% surcharge on MST + 1% TOT or 13% CST or 4% CST against 'C' Form. ☺ Excise Duty: As applicable at the time of delivery. ☺Transit Insurance: 0.7% of selling price of the machine / device. ☺ Packing: At actuals.☺ Commission charges will be charge extra & will be traveling expenses plus lodging, Boarding expenses of our deputed employees + Rs. 500/- per person per day
☺ Validity: 60days
Other Terms & Conditions Overleaf.

For Tati Engineering Works

Authorised Signatory

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