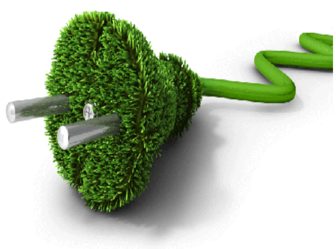
DETAILED PROJECT REPORT
ON
SOLAR WATER HEATING SYSTEM
(500 LPD)
(SOLAPUR TEXTILE CLUSTER)



Bureau of Energy Efficiency

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SOLAR WATER HEATING SYSTEM
(500 LPD)

SOLAPUR TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Solar Water Heating System (500 LPD)

Textile SME Cluster, Pune, Maharashtra (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **SLP/TXT/SHW/12**

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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 Abbreviations

BEE	Bureau of Energy Efficiency
CO_2	Carbon Dioxide
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
GHG	Green House Gases
Kg	Kilo Gram
LPD	Litre per Day
IRR	Internal Rate of Return
NPV	Net Present Value
ROI	Return on Investment
SWHS	Solar Water Heating System
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 chulhas with 500 LPD solar water heating system (SWHS).

The project activities reduce overall wood consumption by 19.6 tonne per 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 solar water heating system are furnished in table below:

S.No	Parameter	Unit	Value
1	Project cost	₹ in lakh	1.04
2	Debit equity ratio	ratio	3:1
3	Monetary benefit	₹ in lakh	0.49
4	Simple payback period	years	2.12
5	NPV	₹ in lakh	0.31
6	IRR	%age	22.22
7	ROI	%age	33.15
8	DSCR	ratio	1.77
9	Procurement and implementation Time	week	10

The projected profitability and financial indicators shows that the project will be able to earn profit from inception and replacement of conventional chulhas with SWHS 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 stakeholders 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 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 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 1,00,800 kg are furnished in the Table 1.1below:

Table 1.1Energy consumption of a typical unit

S.No	Particular	Unit	Value
1	Electricity consumption	kWh	83,900
2	Wood consumption	Tonne	22
3	Production	kg	1,00,800

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

**Details of Mayuri Textiles, Solapur*

ENERGY IS LIFE B E E CONSERVE IT

materials and thereafter 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 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 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.

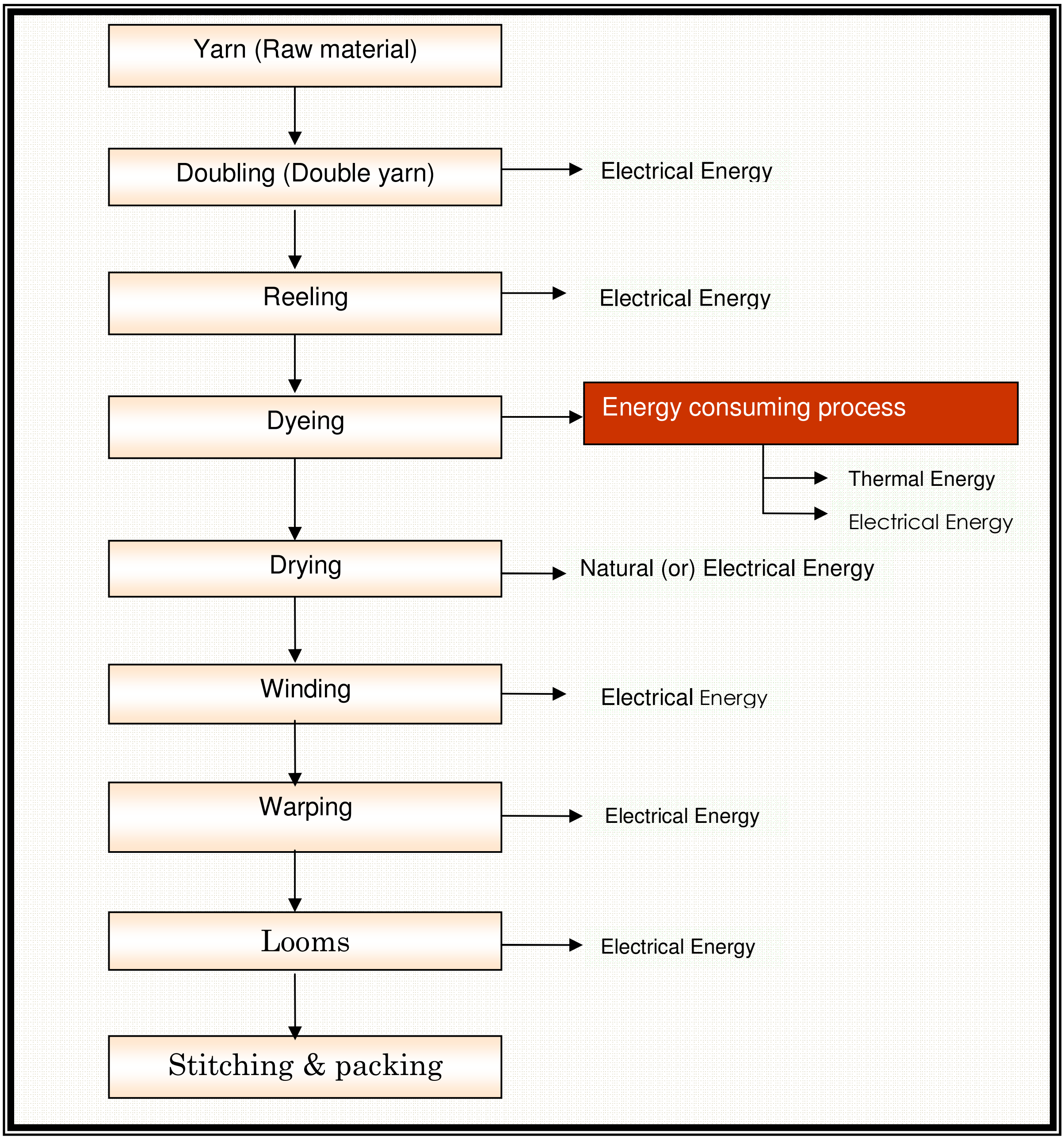


Figure 1.1 Process flow chart of typical textile unit

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 their easy availability and cost competitiveness.

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 21 percent of the total energy cost and remaining accounts for electrical energy.

In a typical textile manufacturing unit of the cluster, the annual wood consumption is 22 Tonne respectively. Average production capacity of typical textile manufacturing unit is around 1,00,800 kg per annum.

1.2.1 Specific energy consumption

Specific thermal energy consumption in textile units depends on the final product manufactured in that unit.

The average specific fuel consumption per kg of the yarn (dyeing process only) for 2 typical units having chulhas for hot water generation is furnished below in Table 1.2.

Table 1.2 Specific energy consumption of typical units

S.No.	Name of unit	Specific fuel consumption kg of wood/kg of yarn
1	Rapelli Exports Pvt Ltd	0.60
2	Burgul Textiles	0.67

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 about 250 to 300 conventional chulhas having poor energy efficiency are being used in entire cluster. The performance of various existing chulhas are evaluated and furnished in Annexure 1.

Figure 1.2 Conventional chulhas operation at 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 chulhas

Technical gap analysis in wood fired chulhas

The following technology gaps in wood fired inefficient chulhas are identified in a typical unit:

- The conventional local chulhas has no mechanism for air circulation and smoke removal
- Heat losses through the grate openings from the front and back end sides
- No control on air supply for combustion
- Radiation losses from all sides of the chulhas
- Lack of monitoring of wood feeding

From the above mentioned analysis it is clear that the performance of the existing conventional chulhas is poor in terms of energy, environment and social aspects. Based on above facts, the present inefficient chulhas is to be replaced with solar hot water system (SHWS).

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. Chulhas is used for hot water generation and also to maintain the constant temperature throughout the dyeing and soaping process.

1.4 Establishing the baseline for the equipment

Energy consumption in chulhas would depend on the followings:

- Cold water temperature
- Dyeing temperature which depends on the color of the yarn
- Quantity of hot water required
- Climate conditions
- 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 chulhas and their performance data is attached in Annexure 1.

1.4.1 Energy audit methodology adopted

The following methodology was adopted to evaluate the performance of existing chulhas

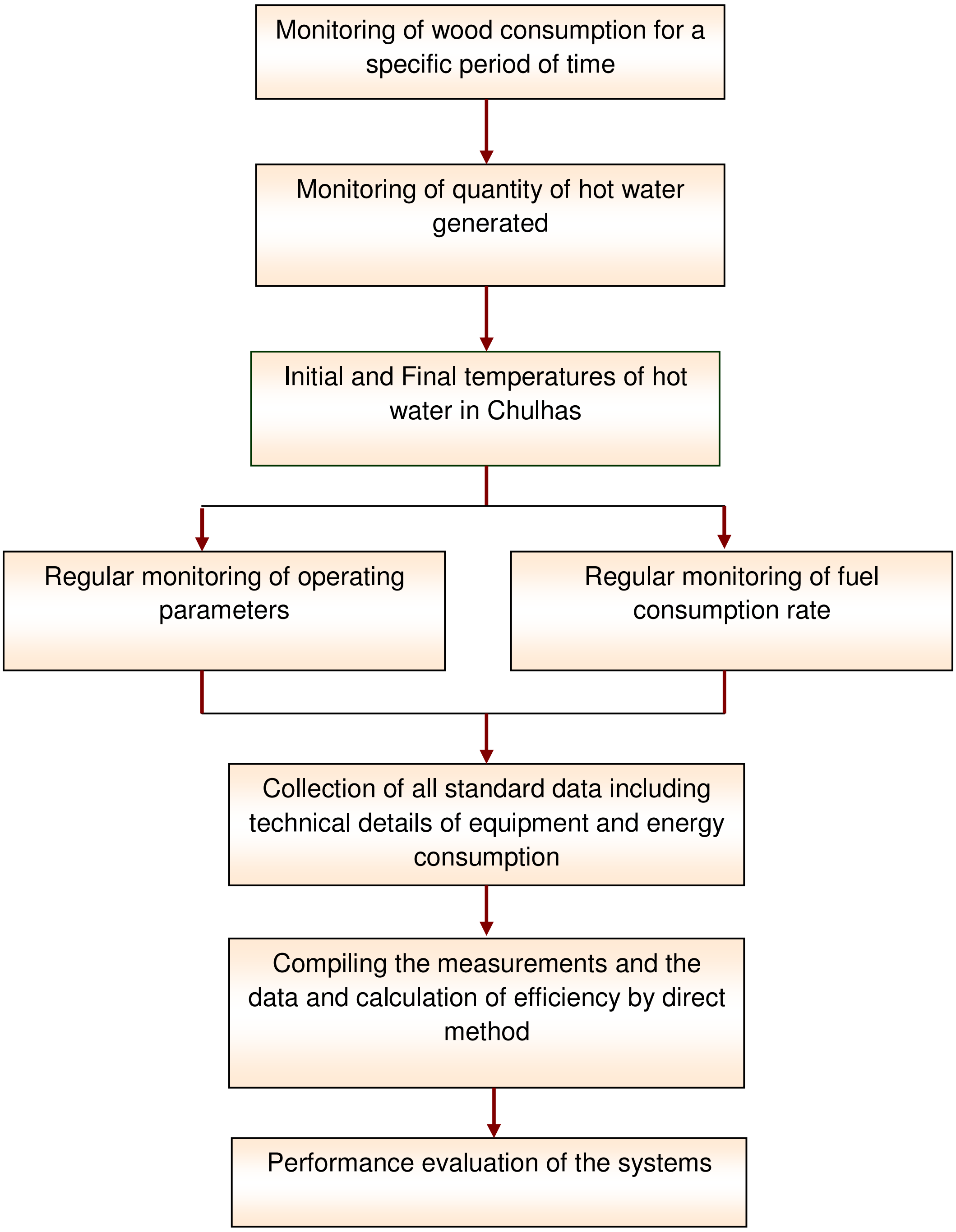


Figure 1.3 Energy audit methodology

1.4.2 Operating efficiency

The operating efficiency of the chulhas installed in various units of the cluster used for hot water generation for 3 units is furnished in Table 1.3 below and further details of efficiency calculation are shown in Annexure 1.

Table 1.3 Operating efficiency of three different units

S.No	Name of the unit	Unit	Value
1	Rapelli Exports Pvt Ltd	%age	4.50
2	Ajantha Textile Corporation	%age	4.60
3	Burgul Textiles	%age	5.00

1.5 Barriers in adoption of proposed equipment

Major barriers in the upgradation of technology in the cluster are as follow:

- Non availability of desired technology in the local market
- Distrust on technology supplier
- Lack of information about energy efficiency

The other barriers identified for implementation of energy efficiency in Solapur textile cluster are as under:

1.5.1 Technological Barrier

The major technical barriers that prevented the implementation of SWHS in typical unit:

- Lack of awareness and information about the new and emerging technologies available in the market.
- A lack of awareness about the favorable lifecycle economics of SWHS technology vis à vis present system of hot water generation.
- Dependence on local equipment suppliers for uninterrupted after sales service.
- The lack of technical know-how made it impossible for the textile unit owners to identify the most effective technical measures.
- The availability of solar radiation is intermittent in nature and hence, the production process may disrupt and need to depend on auxiliary heating system, which requires additional investment and maintenance of the equipments.

1.5.2 Financial Barrier

The Financial barriers for adoption of SWHS are most common. Some major financial barriers which prevent the implementation of proposed technology are:

- Implementation of the proposed project activity requires investment of ₹ 1.04 lakh, which is a significant investment and not commonly seen in the cluster for energy efficiency.
- Low cost of conventional fuel is the main reason for low demand or low penetration of SWHS technology. Further, the high initial cost of the solar hot water system due to dependence on expensive imported systems makes the SWH technology costly leading to reluctance in its adoption by cluster units.
- Relative high investment and comparative low returns is also one of the major financial barriers for the adoption of SWHS.
- 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 and the other benefits such as subsidy & depreciation for the equipments may motivate the unit owners to move forward in adopting SWHS.

1.5.3 Manpower skill

Skilled manpower is not required for adoption / operation of SWHS.

1.5.4 Other barrier (if any)

- Institutional practices are also one of the most common barriers for growth in SWHS markets. With conventional hot water generation overwhelmingly dominating the market in the cluster and SME owners wishing to adopt SWH technology often found difficulty in identifying the suppliers, system design and installation, proper sizing, install and maintain solar water heating systems.
- Further, market linkages between the various stakes holders involved in the SWH industry are often underdeveloped

2 EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Solar Water Heating System (SWHS)

2.1.1 Description of equipment

The Solar Hot Water Systems consists of two main parts:

- Solar collector
- Storage tank

The collector used in such SWHS is of flat-plate type. The solar radiation directly falls on the collector surface and the solar energy is converted into thermal energy. Water is circulated in tube and gets heated by solar energy. Heated water is then stored in the storage tank for use in the process. However, the existing conventional system is sometimes also maintained to provide the thermal heat required during inclement weather conditions.

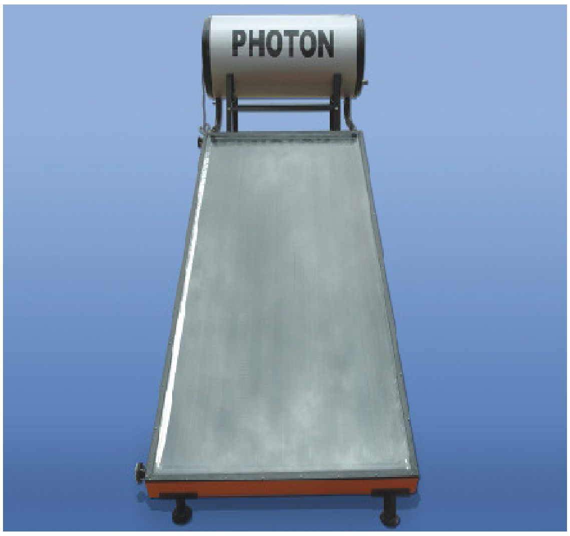


Figure 2.1 Solar Water Heating System

Solar water heating systems can be either active or passive. However, the present DPR is prepared for passive solar water system which is most commonly used.

Passive solar water heaters

Passive solar water heating system works on Thermosyphon principal. Such systems are economical and reliable choice. These systems work on the natural convection of water. As water in the solar collector heats, it becomes lighter and rises naturally into the storage tank above. Meanwhile, the cooler water flows down the pipes to the bottom of the collector, enhancing the circulation.

Solar collectors

Solar collectors are the key component of SWHS. Solar collectors gather the sun's energy, transform its radiation into heat, and then transfer that heat to water. There are several types of solar collectors viz flat-plate collector, evacuated-tube collector and integer collector-storage system. However, Flat –plate collectors are generally used.

Flat-plate collectors

Flat-plate collectors are the most common solar collector for SWHS. A typical flat-plate collector is an insulated metal box with a glass or plastic cover (called the glazing) and a dark-colored absorber plate. These Collectors, heat liquid or air at temperatures less than 80°C. Liquid flat-plate collector's heat liquid as it flows through tubes in or adjacent to the absorber plate. The simplest liquid systems use potable water, which is heated as it passes directly through the collector and then flows to the process line.

Comparison of conventional chulhas with SWHS is shown in Table 2.1 below:

Table 2.1 Comparison of chulhas with SWHS

S. No	*Details*	*Chulhas*	*SWHS*
1	Wood consumption	High	No fuel required
2	Environment pollution	High	Pollution free
3	Safety of workers	Poor	Good
4	Maintenance	High	Low (only cleaning of collector surface)
5	Operational cost	High	Nill
6	Availability of local service providers	Yes	Yes / limited
7	Hot water generation	Continuous	Intermittent
8	Fuel cost	High	Nill
9	Man power	Required	No required
10	GHG emission	High	No GHG emission

Though, the availability of hot water is intermittent and requirement of hot water is partially met, the other benefits of solar hot water systems such as relatively nil operational and maintenance cost, clean and free form of energy and other economic benefits such as availability of capital subsidy and accelerated depreciation etc makes it attractive proposition for the cluster units to install solar hot water system.

2.1.2 Equipment specification

Equipment specification of SWHS along with terms of sales, performance guarantee and after sales services details are furnished in Annexure 8.

2.1.3 Suitability with existing process

The proposed new equipment is used for hot water generation which was earlier generated by conventional chulhas. Hence proposed equipment is 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 install solar hot water system of 500 LPD capacity for dyeing and soaping process.

The company representatives of various solar equipment suppliers are locally available in Solapur and these companies will also provide necessary guidance for documentation required for getting loan and financial incentives available for installing SWHS.

The technology provider identified has successfully implemented SWHS in few units of the cluster.

2.1.5 Source of equipment supplier

The technology/service provider “Photon Energy System Ltd. is one of the leading companies in India engaged in the manufacture and supply of SWHS and having experience of more than 14 year. Details of other service providers are given in Annexure 7.

2.1.6 Technical specifications of equipment

Technical and design specifications of proposed SWHS are given in Table 2.2 below:

Table 2.2: Technical specifications

Details	Units	Value
Name of equipment	-	Solar water heating system
Model	-	Premium
Type	-	Non pressurized
Capacity	LPD	500
Temperature of hot water	^oC	60

Details	***Units***	***Value***
Test pressure	Kg/Cm^2	0.9
Hot water storage tank	Number	1(500 ltr)

Further complete detail of technical specifications of SWHS is shown in Annexure 8.

2.1.7 Terms and conditions in sales of SWHS

The terms and conditions of the company for supply of solar hot water system are shown in Table 2.3 below:

Table 2.3 Terms & conditions of sale for energy efficient solar hot water system

Particular	***Condition***
Price	Transportation, Loading - Unloading & Handling Charges at actual
Insurance	0.45%
Payment	Advance 50% along with firm order.40% after pro forma invoice submission before delivery
Taxes	CST 4% and exempted from excise duty
Delivery	7 weeks from the date of order with advance
Inspection	Inspection of equipment prior dispatch, at your own cost
Commissioning	Included in total cost
Inspection	At our works prior to dispatch
Guarantee	18 months from the date of Performa invoice or 12 months from the date of completion of installation, which is ever less

2.1.8 Process down time during Implementation

There is no process down time, as the proposed equipment is additional equipment.

2.2 Life cycle of equipment

The life expectancy of SWHS is 8-10 year depending upon its maintenance, cleaning and uses.

2.3 Suitable unit for Implementation of proposed equipment

Small quantities of hot water is required in the dyeing process and the proposed system will give an output of 500 LPD, which replaces about 500 LPD hot water generation in conventional chulhas systems .

3 ECONOMIC BENEFITS DUE TO USES OF SWHS

3.1 Technical benefits

3.1.1 Fuel saving

Wood savings due to installation of SWHS in a typical unit having 500 LPD hot water generation capacities is estimated at 19.6 tonne per annum.

3.1.2 Electricity saving

Project implementation will not reduce electricity consumption.

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 SWHS in place of the conventional chulhas is ₹ 0.49 lakh per annum. Energy & monetary benefit analysis of SWHS is presented in Table 3.1 below:

Table 3.1: Energy and cost benefit analysis of SWHS

S.No	Parameter	Unit	Value
1	Wood consumption in existing chulhas	Tonne/annum	19.6
2	Operational hours	hour	8
3	Operational days per annum	Days	251
4	Wood consumption in proposed equipment	Tonne/annum	Nill
5	Wood saving	Tonne/annum	19.6
6	Cost of wood	₹/Tonne	2500
7	Total monetary benefit	₹ in lakh/year	0.49

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The replacement of inefficient chulhas with SWHS will reduce the wood consumption and will improve the working condition and environment.

3.3.2 Improvement in skill set of workers

The technology implemented will create awareness among the workforce towards clean and renewable energy systems.

3.3.3 Impact on wages/emoluments

No significant impact on wages and emoluments of the workers.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

There is no major 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 19.6 tonne of wood per year thereby; reducing 27.5 tonne of 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 as 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

Most of units in the cluster are using non renewable wood for hot water generation; by implementing SHWS will reduce consumption of non renewable wood and thus automatically reduces 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 ₹ 1.00 lakh, total cost includes for solar collectors, insulated hot water tanks of SS make, mounting stands for hot water tank & collectors besides the installation & commissioning cost.

4.1.2 Other costs

Other cost includes erection & commissioning cost which is ₹ 0.01 lakh, and interest during implementation which is ₹ 0.03 lakh. The total cost of implementation of the SWHS is estimated at ₹ 1.04 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	1.00
2	Erection & Commissioning	0.01
3	Investment without interest	1.01
4	Interest during implementation	0.03
5	Total	1.04

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 1.04 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 0.26 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ₹ 0.78 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 ₹ 0.26 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 4 years excluding initial moratorium period is 3 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 ₹ 0.29 lakh in the first year operation and gradually increases to ₹ 0.76 lakh at the end of fifth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 1.04 lakh and monetary savings due to reduction in wood consumption is ₹ 0.49 lakh hence the simple payback period works out to be 2.12 years.

4.3.3 Net Present Value (NPV)

The net present value of the investment at 10 % works out to be ₹ 0.31lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 22.22%.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 33.15%.

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	months	25
2	IRR	%age	22.22
3	NPV	lakh	0.31
4	ROI	%age	33.15
5	DSCR	ratio	1.77

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 10%
- Decrease in fuel savings by 10%

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	1.77	22.22%	33.15%	0.31
5% increase in fuel savings	1.86	24.82%	33.65%	0.38
5% decrease in fuel savings	1.68	19.58%	32.58%	0.24

4.5 Procurement and implementation schedule

The project is expected to be completed in 8 to 10 weeks from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6

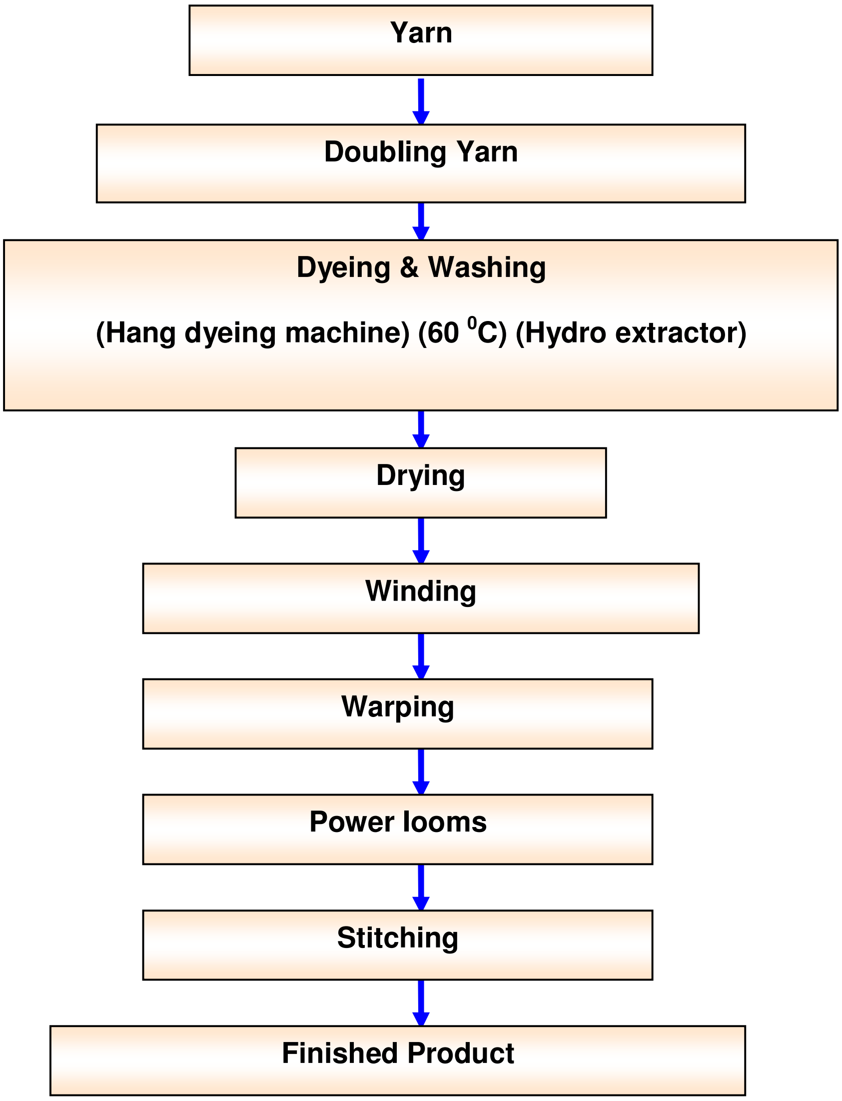
Annexure

Annexure - 1 Efficiency of the existing chulhas - Direct Method

Case 1:

S.No	Particular	Unit	value
1	Quantity of hot water generated	litre	350
2	Initial temperature of water	^{0}C	30
3	Final temperature of water	^{0}C	63
4	Temperature difference	^{0}C	33
5	Calorific value of wood	kCal/kg	3200
6	Heat input	kCal/day	2,51,087
7	Heat output	kCal/day	11,550
8	Efficiency	%age	4.60
9	Wood saving	Tonne/annum	19.6

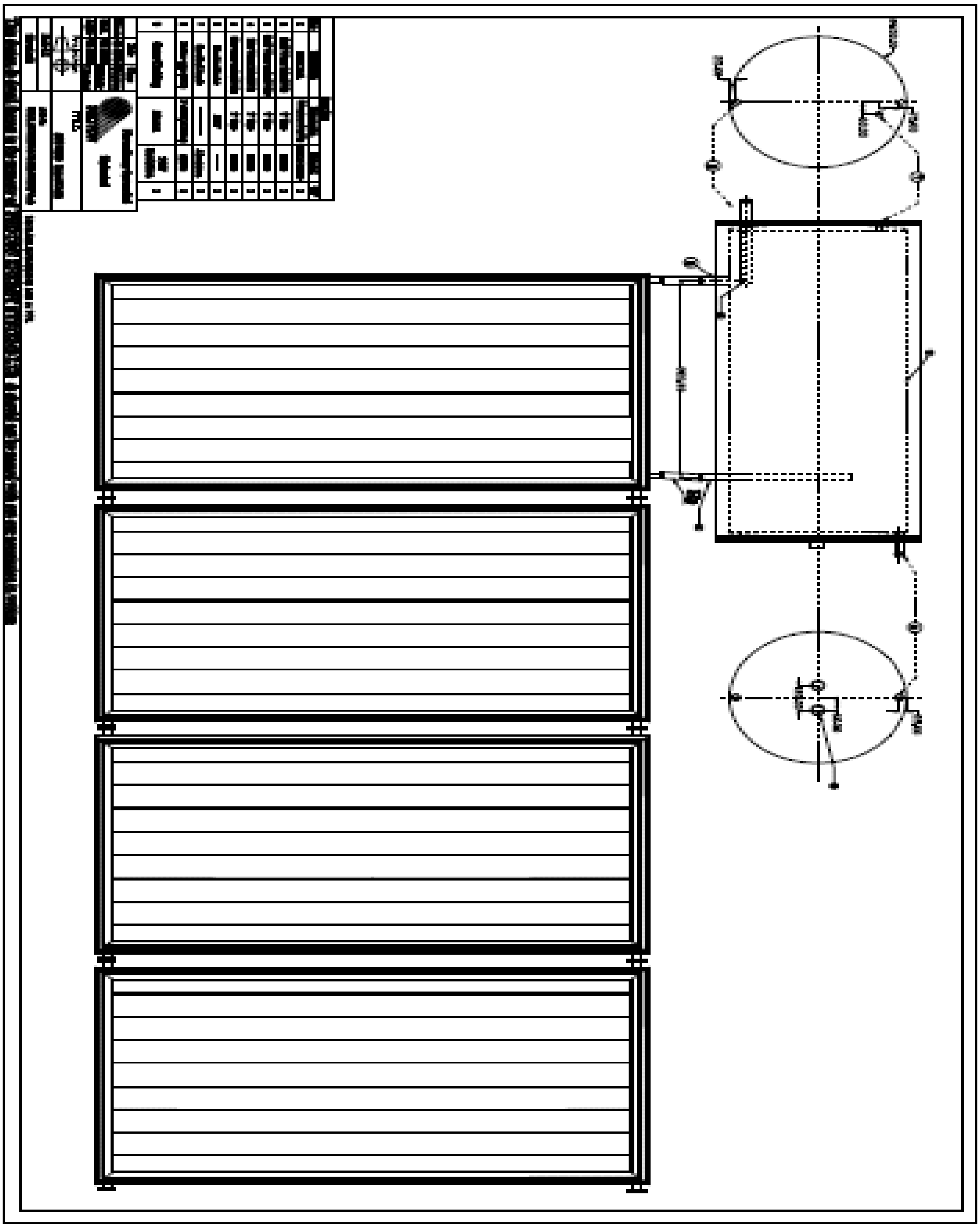
Annexure - 2 Process flow diagrams



Annexure - 3 Detailed technology assessment report

S.No	Particular	Unit	Value	
			Existing Equipment	Proposed Equipment
1	Name	-	Chulhas	SWHS
2	Operating hour	hour	8	8
2	Operating days	days	251	251
4	Wood consumption	Tonne/year	19.6	Nill
5	Wood saving	Tonne/year	-	19.6
6	Cost of wood	₹/Tonne	2500	-
9	Cost of project	₹ in lakh	-	1.04
10	Monetary saving	₹ in lakh	-	0.49

Annexure – 4 Drawings for proposed electrical & civil works



Annexure - 5 Detailed financial calculations & analysis for financial indicators

Assumptions

Name of the Technology	Solar Hot Water System		
Rated Capacity	500 LPD		
Detail	Unit	Value	
Installed Capacity	LPD	500	Feasibility Study
No of working days	Days	240	Feasibility Study
No of Shifts per day	Shifts	1	Feasibility Study
Capacity Utilization Factor	%age		Feasibility Study
Proposed Investment			
Plant & Machinery	₹(in lakh)	1.00	Feasibility Study
Erection & Commissioning (5%)	% on Plant & Equip	0.01	Feasibility Study
Investment without IDC	₹ (in lakh)	1.01	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.03	Feasibility Study
Total Investment	₹ (in lakh)	1.04	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	0.26	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	0.78	Feasibility Study
Loan Tenure	Years	4	Assumed
Moratorium Period	Months	3	Assumed
Repayment Period [excluding moratorium]	Months	48	Assumed
Interest Rate	%age	10	SIDBI's rate of interest for energy efficiency project
Estimation of Costs			
O & M Costs	% Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Wood savings	Tonnes/year	19.6	
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	0.78	0.09	0.69	0.07
2	0.69	0.12	0.57	0.06
3	0.57	0.24	0.33	0.05
4	0.33	0.26	0.07	0.02
5	0.07	0.07	0.00	0.00
		0.78		

WDV Depreciation:

Particulars / years	1	2	3	4	5
Plant and Machinery					
Cost	1.04	0.21	0.04	0.01	1.04
Depreciation	0.83	0.17	0.03	0.01	0.83
WDV	0.21	0.04	0.01	0.00	0.21

Projected Profitability

Particulars / Years	1	2	3	4	5
Revenue through Savings					
Fuel savings	0.49	0.49	0.49	0.49	0.49
Total Revenue (A)	0.49	0.49	0.49	0.49	0.49
Expenses					
O & M Expenses	0.04	0.04	0.04	0.05	0.05
Total Expenses (B)	0.04	0.04	0.04	0.05	0.05
PBDIT (A)-(B)	0.45	0.45	0.45	0.44	0.44
Interest	0.07	0.06	0.05	0.02	0.00
PBDT	0.38	0.38	0.40	0.42	0.44
Depreciation	0.05	0.05	0.05	0.05	0.05
PBT	0.33	0.33	0.34	0.37	0.39
Income tax	-	0.07	0.12	0.14	0.15
Profit after tax (PAT)	0.33	0.25	0.22	0.23	0.24

Computation of Tax

(₹ in lakh)

Particulars / Years	1	2	3	4	5
Profit before tax	0.33	0.33	0.34	0.37	0.39
Add: Book depreciation	0.05	0.05	0.05	0.05	0.05
Less: WDV depreciation	0.83	0.17	0.03	0.01	-
Taxable profit	(0.45)	0.22	0.37	0.42	0.44
Income Tax	-	0.07	0.12	0.14	0.15

Projected Balance Sheet

(₹ in lakh)

Particulars / Years	1	2	3	4	5
Liabilities					
Share Capital (D)	0.26	0.26	0.26	0.26	0.26
Reserves & Surplus (E)	0.33	0.58	0.80	1.03	1.26
Term Loans (F)	0.69	0.57	0.33	0.07	0.00
Total Liabilities D)+(E)+(F)	1.27	1.41	1.39	1.35	1.52

Assets					
Gross Fixed Assets	1.04	1.04	1.04	1.04	1.04
Less: Accm. Depreciation	0.05	0.11	0.16	0.22	0.27
Net Fixed Assets	0.98	0.93	0.87	0.82	0.76
Cash & Bank Balance	0.29	0.48	0.51	0.54	0.76
TOTAL ASSETS	1.27	1.41	1.39	1.35	1.52
Net Worth	0.58	0.84	1.06	1.29	1.52
Debt Equity Ratio	1.17	0.67	0.31	0.05	0.00

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

Particulars / Years	0	1	2	3	4	5
Sources						
Share Capital	0.26	-	-	-	-	-
Term Loan	0.78					
Profit After tax		0.33	0.25	0.22	0.23	0.24
Depreciation		0.05	0.05	0.05	0.05	0.05
Total Sources	1.04	0.38	0.31	0.27	0.28	0.29
Application						
Capital Expenditure	1.04					
Repayment of Loan	-	0.09	0.12	0.24	0.26	0.07
Total Application	1.04	0.09	0.12	0.24	0.26	0.07
Net Surplus	-	0.29	0.19	0.03	0.02	0.22
Add: Opening Balance	-	-	0.29	0.48	0.51	0.54
Closing Balance	-	0.29	0.48	0.51	0.54	0.76

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

Particulars / months	0	1	2	3	4	5
Profit after Tax		0.33	0.25	0.22	0.23	0.24
Depreciation		0.05	0.05	0.05	0.05	0.05
Interest on Term Loan		0.07	0.06	0.05	0.02	0.00
Salvage/Realizable value						
Cash outflow	(1.04)	-	-	-	-	-
Net Cash flow	(1.04)	0.45	0.37	0.32	0.30	0.29
IRR	22.22%					

NPV	0.31

Break Even Point ***(₹ in lakh)***

Particulars / Years	1	2	3	4	5
Variable Expenses					
Oper. & Maintenance Exp (75%)	0.03	0.03	0.03	0.03	0.03
Sub Total ***(G)***	0.03	0.03	0.03	0.03	0.03
Fixed Expenses					
Oper.& Maintenance Exp (25%)	0.01	0.01	0.01	0.01	0.01
Interest on Term Loan	0.07	0.06	0.05	0.02	0.00
Depreciation *(H)*	0.05	0.05	0.05	0.05	0.05
Sub Total (I)	0.13	0.13	0.11	0.09	0.07
Sales (J)	0.49	0.49	0.49	0.49	0.49
Contribution (K)	0.46	0.46	0.46	0.46	0.46
Break Even Point (L= G/I)	29.04%	28.10%	24.45%	19.33%	14.83%
Cash Break Even {(I)-(H)}	17.13%	16.16%	12.47%	7.31%	2.82%
Break Even Sales (J)*(L)	0.14	0.14	0.12	0.09	0.07

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*Total*
Net Profit Before Taxes	0.33	0.33	0.34	0.37	0.39	1.75
Net Worth	0.58	0.84	1.06	1.29	1.52	5.29
						33.15%

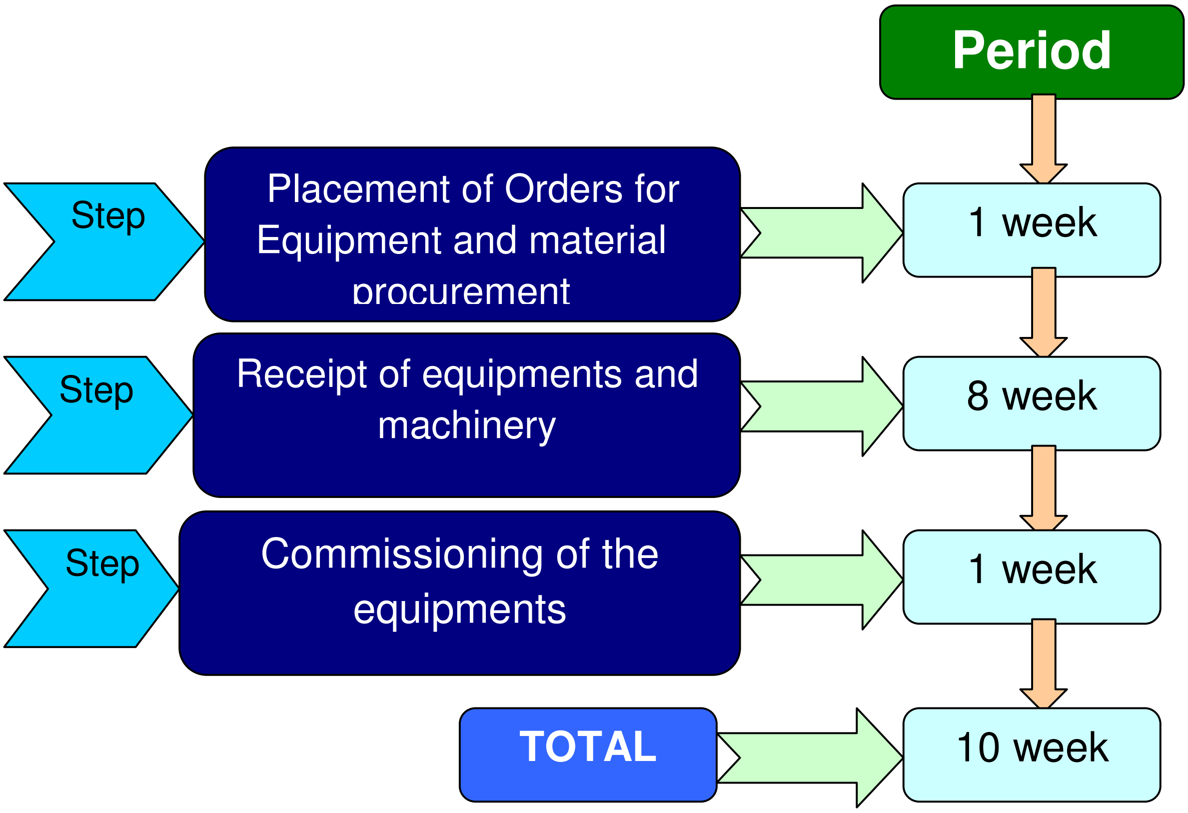
Debt Service Coverage Ratio ***(₹ in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*Total*
Cash Inflow						
Profit after Tax	0.33	0.25	0.22	0.23	0.24	3.24
Depreciation	0.05	0.05	0.05	0.05	0.05	1.10
Interest on Term Loan	0.07	0.06	0.05	0.02	0.00	0.90
Total (M)	0.45	0.37	0.32	0.30	0.29	1.74

DEBT

Interest on Term Loan	0.07	0.06	0.05	0.02	0.00	0.20
Repayment of Term Loan	0.09	0.12	0.24	0.26	0.07	0.78
Total (N)	0.16	0.18	0.29	0.28	0.07	0.98
Average DSCR (M/N)	1.77					

Annexure -6 Details of procurement and implementation schedule



Annexure -7 Details of equipment service providers

Equipment details	*Service/technology providers*
Solar Water Heating System	**TATA BP SOLAR INDIA LTD.** Ujwal V Dusane Sr. Engineer (Sales & Mktg) – Thermal 103,Gera Sterling, North Main Road, Koregaon Park, Pune – 411 001
Solar Water Heating System	**Photon Energy System Ltd.** Plot No.775-K, Road No.45, Jubilee Hills, Hyderabad-500 033 Corp. Office: Unit 19, Mount View Enclave, Rd no 12, Banjara Hills, Hyderabad-500032 Tel: +9140 2333 1337 / 1338 / 1339, Fax: +9140 23331340 E-mail: mrmurthy@photonsolar.in Website: www.photonsolar.in

Annexure - 8 Quotations for proposed equipment

PHOTON ENERGY SYSTEMSLIMITED
REGD.OFFICE: Plot No.775-K, Road No.45, Jubilee Hills, Hyderabad-500 033
Corp. Office: Unit 19, Mount View Enclave, Rd no 12, Banjara Hills, Hyderabad-500032
Tel: +9140 2333 1337 / 1338 / 1339, Fax: +9140 23331340
E-mail: mrmurthy@photonsolar.in Website: www.photonsolar.in

To **Date: 6th Oct, 2010**

Zenith Energy
10-5-6/B, My Home Plaza,
Masabtank,
Hyderabad – 500 028,
A.P. India.

Kind attn: Mr. Krishna,
Dear Sir,

Sub: Offer for Solar Water Heating System,

We thank you for showing interest in our product. We are pleased to introduce our self as one of the leading manufacturer's of solar water heating systems in India and are proud to state that we are pioneers and trendsetters in the industry. We are a 14 years old company having more than 1000 lakh liters of installation experience in solar water heating system. We are the first & largest ETC Solar Company in India.

Our solar pv panels are the best in the industry, and are well known for our quality products with reliable after sale service, our dealers and service center network has crossed leaps and bounders of the countries in Asia, Europe, and America & Africa. As many as 6 leading brands in India are buying from us and distributing in there brand in India and abroad.
By this back ground we are claiming that we have capabilities to execute a project of this magnitude and installation in your site.
Find our below our best competitive price, this is as per MNRE (Ministry of New & Renewable Energy Delhi, Government of India) technical specifications.

We have the capability, confidence, technical excellence, and manufacturing base to satisfy your requirement and make this project a success .Awaiting your positive reply at the earliest, for any clarifications please feel free to contact us.

For Photon Energy Systems Ltd

M.Ramamurthy,
Manager – Marketing.

PHOTON

Commercial Offer,
For E.T.C. Solar Water Heating System:

S.No.	System Description	Qty	Price / Unit In Rs	Total Amount
1.	**Supply of Photon Premium model Solar Water Heating System 500 LPD @ 60 C (Non Pressurized System)**	01 set	60,500 /-	**60,500 = 00**
	Bill of Material = 1) ETC Manifold = 01 No.			
	2) Hot water Storage Tank 1 No, 500 LTR , S.S.- 1.6 mm thick, With 50 mm Thick P.U.F., Insulation with S.S.Cladding.			**Photon Scope**
	Including: 3) Internal Piping & Accessories.			**Photon Scope**
	4) Installation , Testing & Commissioning			**2,420 = 00**
	Excluding: 1) Vat @ 4% Extra			**Photon Scope**
	2) Transportation Cost			
	TOTAL			**62,920 = 00**

For Photon Energy Systems Ltd,

Authorized Signature.

ENERGY IS LIFE BEE CONSERVE IT

Commercial Offer,
For F.T.C. Solar Water Heating System:

S.No.	System Description	Qty	Price / Unit In Rs	Total Amount
1.	**Supply of Photon Premium model Solar Water Heating System 500 LPD @ 60 C (Non Pressurized System)** Bill of Material = 4) Flat plate collector's = 04 No's 5) Hot water Storage Tank 1No, 500 LTR , S.S.-304 Grade, with1.6 mm thick, with 50 mm Thick P.U.F. Insulation with S.S.Cladding. **Including:** 6) Internal Piping & Accessories. 4) Installation , Testing & Commissioning **Excluding:** 1) Vat @ 4% Extra 2) Transportation Cost	01 set	70,800 /-	70,800 = 00 Photon Scope Photon Scope 2,832 = 00 Photon Scope
	TOTAL			73,632 = 00

For Photon Energy Systems Ltd,

Authorized Signature.

PHOTON

Terms & Condition:

Payment Terms	50% Advance along with purchase order, 40% Before the Dispatch, and 10% Against commissioning. Against commissioning whichever is earlier.
Validity	30 days from offer date
Installation cost	**Including**
Taxes	**Tax extra**
Delivery	Within 2weeks after receipt of firm order along with Advance ,
Transport charges	**Including**
Warranty	Two year's for : Hot water storage Tank, And 5 years for: Flat plate Collectors, : Vacuum Tubes (Coating), Warranty is not applicable for breakages.

For Photon Energy Systems Ltd,

Authorized Signature.

COLLECTOR SPECIFICATION For PHOTONIZER Model	
Coating	Black chrome - *Copper to copper collector* Absorotivity - 96.00 ± 0.02 Emmissivity - 0.12 ± 0.02
Specification	As per BIS " ISI "
glass	Toughened 4 mm thick
Size of the collector	2 m x 1 m
Number of copper fins	9 fins of 99.9% Cu-Cu
Test pressure	6.0 Kg/Cm²
TANK / ACCESSORIES SPECIFICATION	
Tank:	
Tank Capacity	200 liters x
Type	Horizantal - @ 1.0 kg / Cm²
Tank Material	SS304, TIG welding FOR SOFT WATER APPLICATION ONLY.** IF WATER IS HARD (Above 400 PPM) We ARE RECOMMEDED TO GO FOR SS-316 MODEL
Thickness	Dish - Shell - 0.5 mm.
End Fittings	3/4" BSP SS 304 collar for CWI, HWO & SA 3/4" BSP SS 304 collar for electrical back up heater
Tank Insulation:	
Material	PUF
Thickness	50mm
Cladding	SS-430 0.3mm (minimum)
Finish - Shell	SS-430 * DELUX MODEL
Finish - Dish	SS-430
Stands For solar collector :	
Material	MS ISA 30 x 30 x 3 thick
Finish	Electrostatic Powder coated - PP
Type	Fixed / demountable as per site
System internal piping: Hot & Cold	
Material	HOSE PIPE
Size	3/4
Length	As req at the site

ETC SPECIFICATIONS

COLLECTOR SPECIFICATION	
Coating	Black chrome – *on outer surface of inner tube* Absorotivity – 96.00 ± 0.02 Emmissivity – 0.12 ± 0.02
Dia of the tube	47 mm OD
Mane fold, (if more then 500 LPD)	SS- 304, Insulated
Tube length	1500 mm
Number of Tubes 100 lpd 200lpd 300lpd 500lpd	15 30 46 60/64 (As per MNRE specification)
Test pressure	0.9 Kg/Cm^2

TANK / ACCESSORIES SPECIFICATION	
Tank:	
Tank Capacity	**500 ltrs per day**
Type	**Horizontal – Non Pressurized @ 1.0 kg / Cm^2**
Tank Material	**SS304, TIG welding only**
Thickness	**Dish – Shell – 0.5mm (minimum)**
End Fittings	**3/4" BSP SS 304 collar for CWI, HWO & SA 3/4" BSP SS 304 collar for electrical back up heater**
Tank Insulation:	
Material	**P.U.F.**
Thickness	**50mm as per MNRE,**
Cladding	**Stainless Steel,**
Finish – Dish	**Al With Powder coating**
Stands:	
Material	**MS angle**
Finish	**Electrostatic Powder coated - PP**
Type	**Fixed to hold the tank / manifolds as the case may be**

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