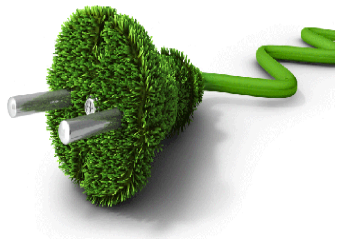
DETAILED PROJECT REPORT
ON
SOLAR WATER HEATING SYSTEM
(1000 LPD)
(SOLAPUR TEXTILE CLUSTER)



ENERGY IS LIFE
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Bureau of Energy Efficiency

Prepared By

ZenithEnergy
Horizons Beyond Energy

Reviewed By

ISTSL

SOLAR WATER HEATING SYSTEM
(1000 LPD)

SOLAPUR TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Solar Water Heating System (1000 LPD)

Textile SME Cluster, Pune, Maharashtra (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **SLP/TXT/SHW/11**

For more information

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan
R. K. Puram, New Delhi – 110066

Telephone +91-11-26179699
Fax +91-11-26178352
Websites: www.bee-india.nic.in
Email: jsood@beenet.in/ pktiwari@beenet.in

Acknowledgement

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

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

Contents

List of Annexure

List of Tables

List of Figures

List of Abbreviation

BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
FD	Forced Draft
SS	Stainless Steel
GHG	Green House Gases
HP	Horse Power
IBR	Indian Boiler Regulation
IRR	Internal Rate of Return
ID	Induced Draft
NPV	Net Present Value
ROI	Return on Investment
SME	Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

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

Since Solapur cluster is one of the largest clusters in textile sector in India, accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient technologies, so as to facilitate maximum replication in other textile clusters in India. Solapur textile cluster is mainly famous for cotton towel and bed sheet products. The main form of energy used in the cluster units are grid electricity, wood, kerosene and small quantity of coal. Wood, kerosene and coal are used in boiler and stoves 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. kerosene fuel based conventional stoves with 1000 LPD solar water heating system (SWHS).

The project activities reduce overall kerosene consumption by 1500 litre 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, dept 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	1.61
2	Debit equity ratio	ratio	3:1
3	Monetary benefit	₹ in lakh	0.61
4	Simple payback period	years	2.64
5	NPV	₹ in lakh	0.05
6	IRR	%age	11.44
7	ROI	%age	30.34
8	DSCR	ratio	1.50
9	Procurement and implementation schedules	week	8-10

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 upgradation 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 mils 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, kerosene 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, and kerosene stove for hot water generation. Details of annual energy consumption and production of three typical units are furnished in the Table 1.1 below:

Table 1.1Energy consumption of a typical unit

S.No	Particular	Unit	Unit 1	Unit 2	Unit 3
1	Electricity consumption	kWh	69840	67600	69360
2	kerosene consumption	litre	1200	1800	2400
3	Production	kg	54000	75000	96000

Production processg

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*

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 and kerosene oil are 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.

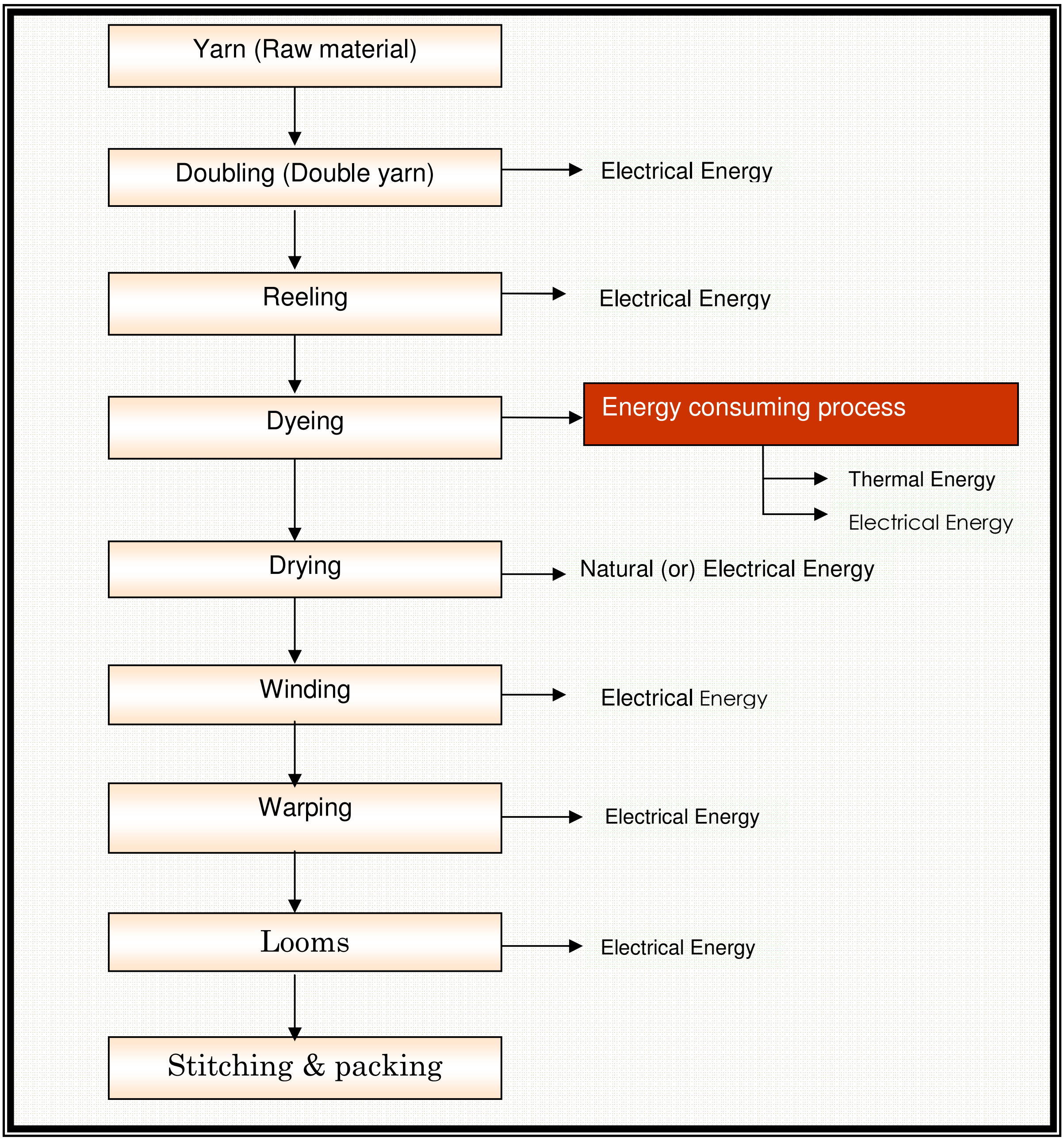


Figure 1.1 Process flow chart of typical textile unit

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, kerosene and GN Husk briquettes. The wood and GN husk briquettes are used as fuel for thermic fluid heaters, boilers, chulhas and kerosene stove 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 42 percent of the total energy cost and remaining accounts for electrical energy.

In a typical textile manufacturing unit of the cluster, the annual kerosene consumption for dyeing is 2200 litre and average production capacity of typical textile unit in Solapur textile cluster is around 6500 kg per month.

1.2.1 Specific energy consumption

Specific electrical and 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 3 typical units having kerosene stove 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 litre/kg of yarn
1	Unit 1	0.022
2	Unit 2	0.024
3	Unit 3	0.025

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 10 unit using conventional kerosene stove having poor energy efficiency are being used in entire cluster for hot water generation. The performance of various existing kerosene stove are evaluated and furnished in Annexure 1.

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 kerosene stove

Technical gap analysis in kerosene stove

The following technology gaps in kerosene stove are identified in a typical unit:

- 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 stove
- High fuel cost

From the above mentioned analysis it is clear that the performance of the existing conventional kerosene stove is poor in terms of energy, environment and social aspects. Based on above facts, the present inefficient stove is to be replaced with (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. Stove is used for hot water generation in few of units.

1.4 Establishing the baseline for the technology/equipment

Energy consumption in chulhas would depend on the followings:

- Initial temperature of water
- Dyeing temperature of water which depends on the color of the yarn
- Quantity of hot water required
- Climate conditions
- Calorific value of kerosene

Energy use and technology audit studies were conducted in various units of Solapur textile cluster, the baseline energy consumption of present inefficient stove and their performance data is furnished in Annexure 1.

1.4.1 Energy audit methodology adopted

The following methodology was adopted to evaluate the performance of kerosene stove

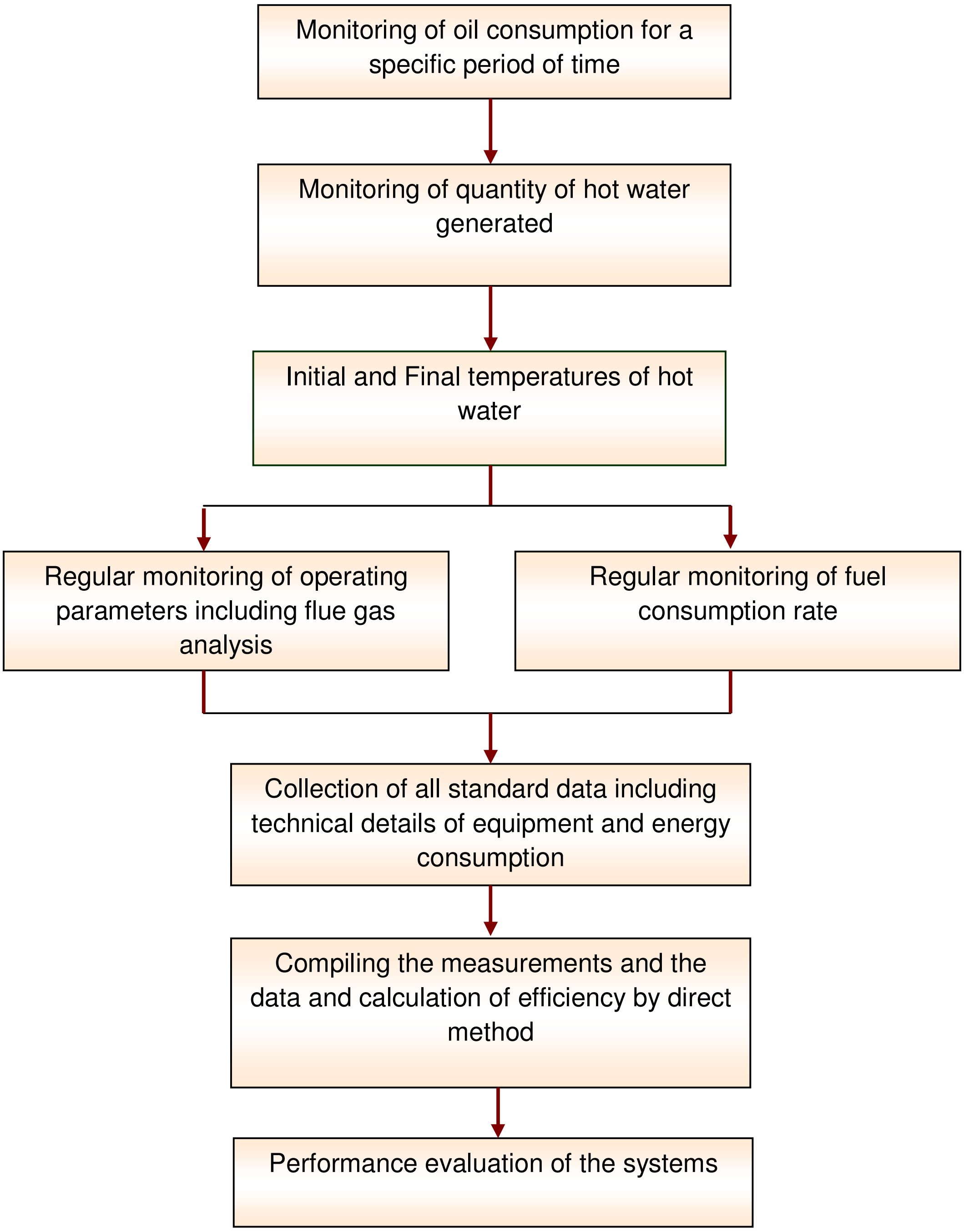


Figure 1.2 Energy audit methodology

1.4.2 Operating efficiency

The operating efficiency of the kerosene stove installed in various units of the cluster used for hot water generation is 10% and details has been given in Annexure 1.

1.5 Barriers in adoption of proposed technology / equipments

Major barriers in the upgradation of technology in the cluster are

- 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 ₹ 3.47 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)

Some of the SME unit owners are willing to adopt SWHS technology however they often encounter difficulty in finding credible local suppliers of SWHS for installation and its maintenance, design of system, proper size of system and availability of space.

2 TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Solar water heating system (SWHS)

2.1.1 Description of technology/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 hot water 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 rely 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℃. 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 2.1below:

Table 2.1 Comparison of kerosene stove with SWHS

S. No	Details	Kerosene stove	SWHS
1	Kerosene 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 stove. Hence proposed equipment is suitable with existing process.

2.1.4 Availability of equipment / technology

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 1000 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. Technology provider identified has successfully implemented SWHS in few units of the cluster.

2.1.5 Source of equipment supplier

The technology/service provider "M/s TATA BP Solar India Ltd" is one of the leading companies in India engaged in the manufacture and supply of SWHS and having experience of more than 3 decades. 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	NA	Solar water heating system(SWHS)
Model	NA	VIJRA
Capacity	LPD	1000
Temperature of hot water	°C	60
Ambient temperature	°C	25

VAJRA 1000 LPD Non-Press, Non- HHC, Thermosyphon type Solar Water Heating system @ 60 deg. C consisting of:

- 1 nos. x 1000 lit. insulated SS304 hot water storage tanks
- 4 nos. of TBP make solar flat plate collectors
- Mounting stand for tanks & collectors

2.1.7 Terms and conditions in sales of SWHS

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

Table 2.3 Terms & conditions of sale for energy efficient boiler

Particular	*Condition*
Price	Transportation, Loading – Unloading & Handling Charges at actual
Insurance	0.45%
Taxes	CST 4% and exempted from excise duty
Payment	Advance 50% along with firm order. 40% after pro forma invoice submission before delivery. Balance 10% within a week after installation and successful
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 ever is 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 8-12 year depending upon its maintenance, cleaning and uses.

2.3 Suitable unit for Implementation of proposed equipment

Large quantities of hot water is required in the dyeing process and the proposed system will give an output of 1000 LPD, which replaces about 2000 LPD hot water generation in conventional systems like kerosene stove .

3 ECONOMIC BENEFIT DUE USES OF SWHS

3.1 Technical benefit

3.1.1 Fuel saving

Kerosene savings due to installation of SWHS in a typical unit having 1000 LPD hot water generation capacity is estimated as 1500 litre per annum. Kerosene savings is estimated based on the present kerosene stove efficiency of 10%.

3.1.2 Electricity saving

Project implementation will not save 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 stove is ` 0.61 lakh per annum. Energy & monetary benefit analysis of energy efficient boiler is presented in Table 3.1 below:

Table 3.1: Energy and cost benefit analysis of Kerosene Stove

S.No	Parameter	Unit	Value
1	Kerosene consumption in existing stove	litre/annum	1500
2	Operational hours	hours	8
3	Operational days per annum	Days	240
4	Fuel consumption in SWHS	-	Nill
5	Kerosene oil saving	litre/annum	1500
6	Cost of kerosene oil	`/litre	40.66
7	Total monetary benefit	` in lakh	0.61

3.2 Social benefits

3.2.1 Improvement in working environment in the plant

The replacement of inefficient stove with SWHS will reduce the kerosene oil consumption and will improve the work condition and environment.

3.2.2 Improvement in skill set of workers

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

3.2.3 Impact on wages/emoluments

No significant impact on wages and emoluments of the workers.

3.3 Environmental benefits

3.3.1 Reduction in effluent generation

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

3.3.2 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 1500 litre kerosene oil per year thereby; reducing 6 tonnes 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.

Taking CO_2 emission factor as 4 tCO_2 per kilo litre of kerosene oil consumption

3.3.3 Reduction in other emissions like SOx

Kerosene has very low sulphur content and hence there is no significant impact on SO_x emissions.

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 ₹ 1.55 lakh it includes 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 ₹ 0.02 lakh, and interest during implementation which is ₹ 0.03 lakh. The total cost of implementation of the SWHS is estimated at ₹ 1.60 lakh and 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	1.55
2	Erection & Commissioning	0.02
3	Investment without interest	1.57
4	Interest during implementation	0.03
5	Total	1.60

4.2 Arrangement of funds

4.2.1 Entrepreneur’s contribution

The total cost of the proposed technology is estimated at ₹ 1.60 lakh. The entrepreneur’s contribution is 25% of total project cost, which is ₹ 0.48 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ₹ 1.12 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 ₹ 0.40 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 ₹ 0.27 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

Total project cost of the proposed technology is ₹ 1.60 lakh and monetary savings is ₹ 0.62 lakh hence the simple payback period works out to be 2.58 years.

4.3.3 Net Present Value (NPV)

The net present value of the investment at 10 % works out to be ₹ 0.06 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 11.64%.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 28.82%.

Details of financial indicator are shown in Table 4.2 below:

Table 4.2: Financial indicator of project

S. No	Particulars	Unit	Value
1	Simple Pay Back period	Month	31
2	IRR	%age	11.64
3	NPV	lakh	0.06
4	ROI	%age	28.82
5	DSCR	Ratio	1.55

4.4 Sensitivity analysis

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

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

In each scenario, other inputs are assumed as constant. The financial indicators in each of the above situation are indicated along with standard indicators in Table 4.3 below:

Table 4.3: Sensitivity analysis in different scenario

Particulars	DSCR	IRR	ROI	NPV
Normal	1.55	11.64%	28.82%	0.06
5% increase in fuel savings	1.63	13.89%	29.51%	0.15
5% decrease in fuel savings	1.46	9.38%	28.05%	-0.02

4.5 Procurement and implementation schedule

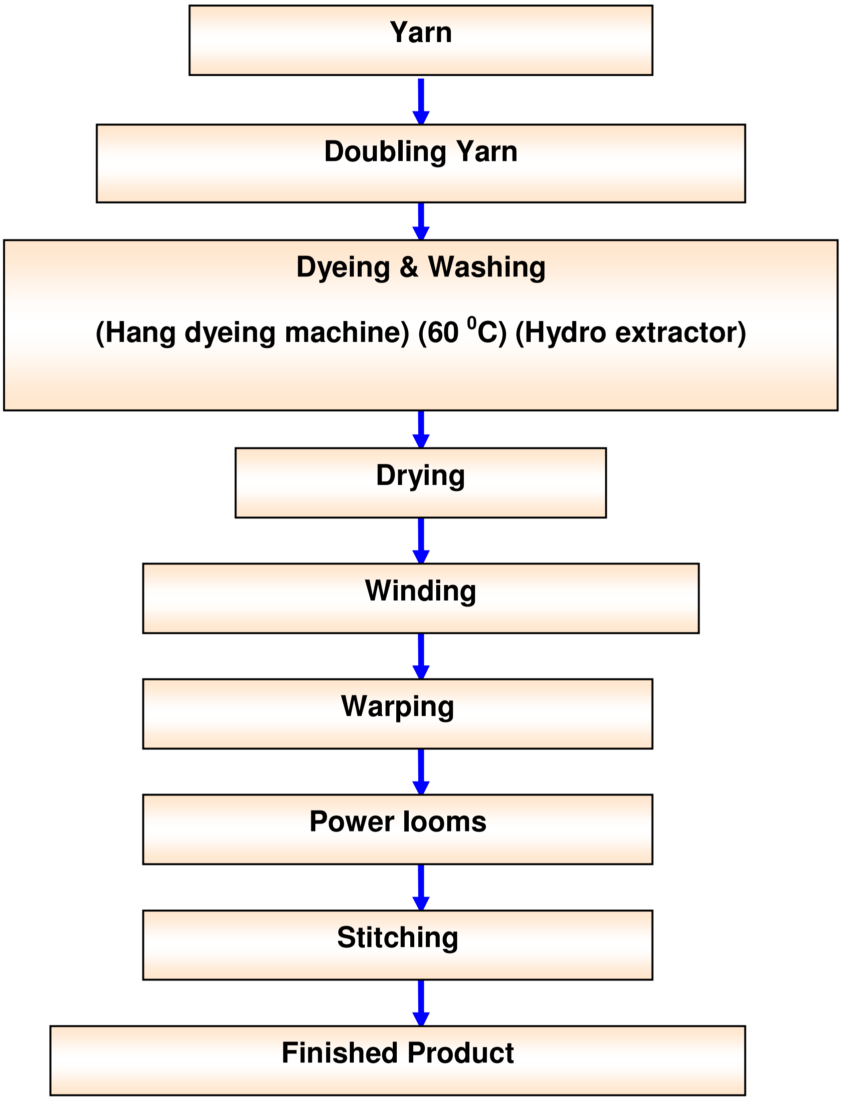
The project is expected to be completed in 8 to 10 weeks from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6.

Annexure

Annexure – 1 Efficiency of the existing kerosene stoves - Direct Method

S.No	Particular	Unit	value
1	Quantity of hot water generated	litre	400
2	Initial temperature of water	^0C	30
3	Final temperature of water	^0C	80
4	Kerosene oil consumption	litre/day	20
5	Calorific value of kerosene oil	kCal/litre	8500
6	Heat input	kCal/day	170,000
7	Heat output	kCal/day	20,000
8	Efficiency	%age	11.76

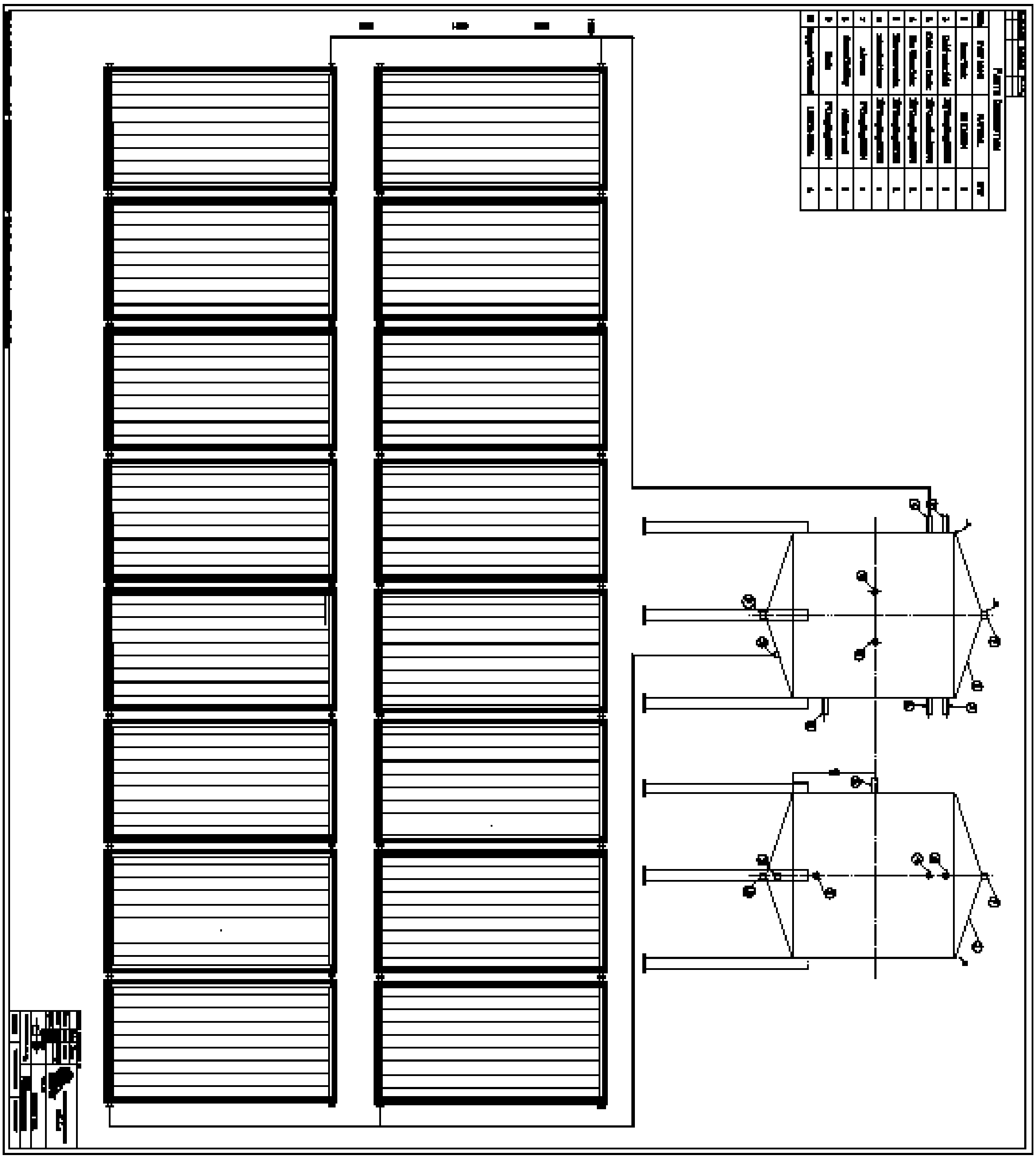
Annexure – 2 Process flow diagrams



Annexure - 3 Detailed technology assessment report

S.No	Particular	Unit	Value	
			Existing technology	Proposed technology
1	Name	NA	Kerosene stove	SWHS
2	Operating hour	hr	8	8
2	Operating days	days	240	240
4	Kerosene consumption	litre/year	1500	Nill
5	Kerosene saving	litre/year	0	1500
6	Cost of kerosene oil	`/litre	40.66	-
8	Efficiency	%age	10	-
9	Cost of project	` in lakh	-	1.61
10	Monetary saving	`in lakh	-	0.61

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	2000 LPD		
Detail	Unit	Value	
Installed Capacity	LPD	1000	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)	1.55	Feasibility Study
Erection & Commissioning (5%)	% on Plant & Equip	0.02	Feasibility Study
Investment without IDC	₹ (in lakh)	1.57	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.03	Feasibility Study
Total Investment	₹ (in lakh)	1.60	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	0.48	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	1.12	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			
kerosene savings	litre/year	1500	
Cost	₹/litre	41	
St. line Depn.	%	5.28	Indian Companies Act

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	1.12	0.18	0.94	0.10
2	0.94	0.24	0.70	0.08
3	0.70	0.28	0.42	0.06
4	0.42	0.30	0.12	0.03
5	0.12	0.12	0.00	0.00
		1.12		

WDV Depreciation:

Particulars / years	1	2	3	4
Plant and Machinery				
Cost	1.60	0.32	0.06	0.01
Depreciation	1.28	0.26	0.05	0.01
WDV	0.32	0.06	0.01	0.00

Projected Profitability

Particulars / Years	1	2	3	4	5
Revenue through Savings					
Fuel savings	0.62	0.62	0.62	0.62	0.62
Total Revenue (A)	0.62	0.62	0.62	0.62	0.62
Expenses					
O & M Expenses	0.06	0.07	0.07	0.07	0.08
Total Expenses (B)	0.06	0.07	0.07	0.07	0.08
PBDIT (A)-(B)	0.55	0.55	0.54	0.54	0.54
Interest	0.10	0.08	0.06	0.03	0.00
PBDT	0.45	0.46	0.49	0.51	0.53
Depreciation	0.08	0.08	0.08	0.08	0.08
PBT	0.37	0.38	0.40	0.43	0.45
Income tax	-	0.07	0.15	0.17	0.18
Profit after tax (PAT)	0.37	0.31	0.25	0.26	0.27

Computation of Tax (₹ in lakh)

Particulars / Years	1	2	3	4	5
Profit before tax	0.37	0.38	0.40	0.43	0.45
Add: Book depreciation	0.08	0.08	0.08	0.08	0.08
Less: WDV depreciation	1.28	0.26	0.05	0.01	-
Taxable profit	(0.83)	0.21	0.43	0.50	0.53
Income Tax	-	0.07	0.15	0.17	0.18

Projected Balance Sheet (₹ in lakh)

Particulars / Years	1	2	3	4	5
LIABILITIES					
Share Capital (D)	0.48	0.48	0.48	0.48	0.48
Reserves & Surplus (E)	0.37	0.68	0.93	1.19	1.46
Term Loans (F)	0.94	0.70	0.42	0.12	0.00
Total Liabilities D)+(E)+(F)	1.79	1.86	1.84	1.79	1.94

Assets					
Gross Fixed Assets	1.60	1.60	1.60	1.60	1.60
Less: Accm. Depreciation	0.08	0.17	0.25	0.34	0.42
Net Fixed Assets	1.52	1.44	1.35	1.27	1.18
Cash & Bank Balance	0.27	0.43	0.49	0.53	0.76
Total Assets	1.79	1.86	1.84	1.79	1.94
Net Worth	0.85	1.16	1.41	1.67	1.94
Debt Equity Ratio	1.96	1.46	0.88	0.26	0.01

Projected Cash Flow: **(₹ in lakh)**

Particulars / Years	0	1	2	3	4	5
Sources						
Share Capital	0.48	-	-	-	-	-
Term Loan	1.12					
Profit After tax		0.37	0.31	0.25	0.26	0.27
Depreciation		0.08	0.08	0.08	0.08	0.08
Total Sources	1.60	0.45	0.39	0.34	0.34	0.35
Application						
Capital Expenditure	1.60					
Repayment of Loan	-	0.18	0.24	0.28	0.30	0.12
Total Application	1.60	0.18	0.24	0.28	0.30	0.12
Net Surplus	-	0.27	0.15	0.06	0.04	0.23
Add: Opening Balance	-	-	0.27	0.43	0.49	0.53
Closing Balance	-	0.27	0.43	0.49	0.53	0.76

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

Particulars / months	0	1	2	3	4	5
Profit after Tax		0.37	0.31	0.25	0.26	0.27
Depreciation		0.08	0.08	0.08	0.08	0.08
Interest on Term Loan		0.10	0.08	0.06	0.03	0.00
Salvage/Realizable value						-
Cash outflow	(1.60)	-	-	-	-	-
Net Cash flow	(1.60)	0.55	0.48	0.40	0.37	0.36
IRR	11.64%					

NPV	0.06

Break Even Point **(₹ in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***
Variable Expenses					
Oper. & Maintenance Exp (75%)	0.05	0.05	0.05	0.06	0.06
Sub Total *(G)*	0.05	0.05	0.05	0.06	0.06
Fixed Expenses					
Oper.& Maintenance Exp (25%)	0.02	0.02	0.02	0.02	0.02
Interest on Term Loan	0.10	0.08	0.06	0.03	0.00
Depreciation *(H)*	0.08	0.08	0.08	0.08	0.08
Sub Total (I)	0.20	0.18	0.16	0.13	0.11
Sales (J)	0.62	0.62	0.62	0.62	0.62
Contribution (K)	0.57	0.56	0.56	0.56	0.56
Break Even Point (L= G/I)	34.91%	32.77%	28.71%	23.86%	19.11%
Cash Break Even {(I)-(H)}	19.96%	17.76%	13.63%	8.72%	3.88%
Break Even Sales (J)*(L)	0.21	0.20	0.18	0.15	0.12

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***Total***
Net Profit Before Taxes	0.37	0.38	0.40	0.43	0.45	2.03
Net Worth	0.85	1.16	1.41	1.67	1.94	7.03
						28.82%

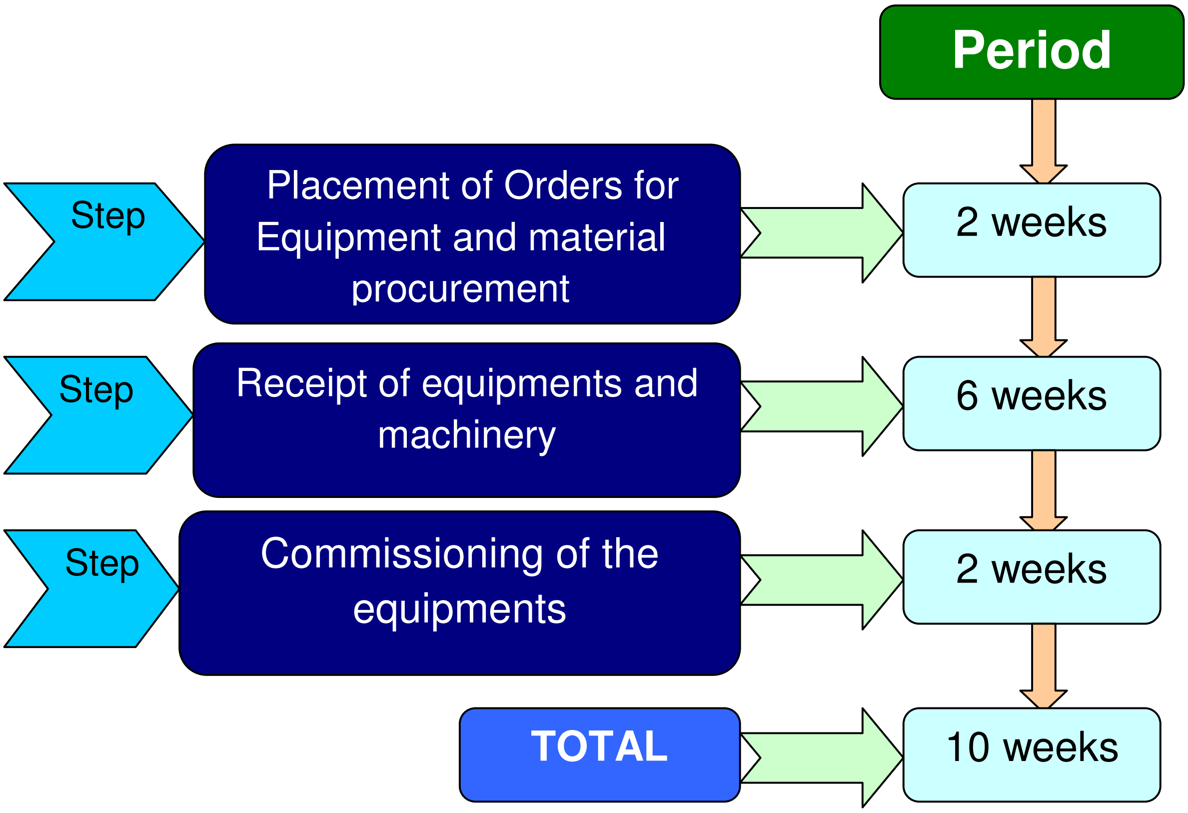
Debt Service Coverage Ratio ***(₹ in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***Total***
Cash Inflow						
Profit after Tax	0.37	0.31	0.25	0.26	0.27	1.46
Depreciation	0.08	0.08	0.08	0.08	0.08	0.42
Interest on Term Loan	0.10	0.08	0.06	0.03	0.00	0.27
Total (M)	0.55	0.48	0.40	0.37	0.36	2.15

DEBT

Interest on Term Loan	0.10	0.08	0.06	0.03	0.00	0.27
Repayment of Term Loan	0.18	0.24	0.28	0.30	0.12	1.12
Total (N)	0.28	0.32	0.34	0.33	0.12	1.39
Average DSCR (M/N)	1.55					

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



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 Product Company** No. A-2/10, Rambaug Colony, Navi Peth Pune, Maharashtra - 411 030, India +(91)-(20)-24334494/ +(91)-9371007016 Email: aquahot@rediffmail.com **Priya Enterprises** F–17 / 2:1, Ashirvad Co-Op Housing Society Sector - 29, Vashi, Navi Mumbai,-400703 Tele/Fax-022-27668030. Mob:9820958400 Email : oxycon2002@yahoo.co.in/pramodj1954@rediffmail.com

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

TATA BP SOLAR INDIA LTD.,
103,Gera Sterling, North Main Road, Koregaon Park, Pune – 411 001
Tel. No. 91 20 26138262, 26122344, Fax: 91 20 66012741
Website: www.tatabpsolar.com

A. Technical Specifications

FLAT PLATE COLLECTORS
COLLECTOR SPECIFICATION (I.S.I Mark)

1. Collector Frame : Specially Designed Extruded Aluminium
2. Collector Type : **Cu-Cu** Fin and tube type **Laser Welded Fins.**
3. Absorber Coating : Selective – **NALSUN Coating.**
4. Absorber Plate : Copper
5. Raiser : Cu Dia 12.9mm
6. Inlet Header : Copper -Dia 25.4mm
7. Bottom Insulation : Rock wool, below raiser assembly.
8. Side Insulation : Rock Wool
9. Reflective Foil : Aluminium Sheet .
10. Coating Absorptivity : > 0.95.
11. Coating Emmissivity : < 0.20
12. Transmitivity : 85%
13. Glazing (Cover) : **Toughened Clear Glass.**
14. Gasket for Glass (Beeding) : EPDM U Type Gasket
15. Collector Back Sheet : Aluminium.
16. Hardware : Stainless Steel – 304
17. Finish Spray Painting : Golden Yellow
18. Insulation : Rock wool.
19. Grommet : EPDM for Frame and Mack Black for Glass retaining angles
20. Sealing : Silicon sealant between Glass, Clamp and Casing.
21. Header Inlet & Outlet : Brass Flanges
22. Weight : 38 Kg (Dry), 46 Kg (Flooded)
23. Collector Support Structure : 35 x 35 x 3 mm, M. S. angle, black painted.
24. Operating Conditions : 10 ºC. To 50 ºC.
25. Window Velocity : 75 Km/Hr*
26. Termination : 65 mm Dia. Brass Flanges with 4 holes of Dia. 7mm at PCD 45mm, EPDM Gasket & 4 nos. of M6 x 20, SS 304 Bolts.

Features :-

- Corrosion resistance, Extruded Aluminium sections with Stainless Steel fasteners.
- High Transmissivity, Toughened and Tempered Glass.
- Designed, Manufactured and Certified as per " BIS" standard specifications.
- Design Registered with Patent Office (Patent Reg. No. 175095).

TATA BP SOLAR INDIA LTD.,
103,Gera Sterling, North Main Road, Koregaon Park, Pune – 411 001
Tel. No. 91 20 26138262, 26122344, Fax: 91 20 66012741
Website: www.tatabpsolar.com

SCOPE OF SUPPLY & PRICE SCHEDULE

TATA BP SOLAR MAKE SOLAR WATER HEATERS

A. VAJRA 1000 LPD Non-press, Non-HHC, Thermosyphon type Solar Water Heating System @ 60 deg. C

No	Item & Description	Qty.	Rate/Unit	Amount
1.	**VAJRA 1000 LPD Non-Press, Non- HHC, Thermosyphon type Solar Water Heating system @ 60 deg. C consisting of:** i) 1 nos x 1000 lit. insulated SS304 hot water storage tanks, ii) 8 nos. of TBP make solar flat plate collectors, iii) Mounting stand for tanks & collectors,	1 set	1,47,000.00	1,47,000.00
2	Over Head Cold water tank 1500 Ltrs. Capacity with Fabricated stand.	1 Nos.	If required	By customer
3.	Cold water line– GI pipe size 1"	Mtr		By customer
4.	Hot water line – Kitec make hot water composite piping -----------------------1" -----------------------3/4" -----------------------1/2"	Mtr.		By customer
5	**Fabricated supporting structure required for the elevation of the system and the Hot water tank.**	--	---	**By Customer**
	SUB TOTAL			**1,47,000.00**
	CST @ 4% as applicable			Extra
	Excise			NA
	Insurance @ 0.45%			Included
5.	Installation & Commissioning , Material Lifting Charges			8500.00
6.	Transportation, Loading - Unloading & Handling Charges			Extra as acutal
	GRAND TOTAL			**1,55,500.00**

Note:- ** We have considered the ambient temp is 24-25 deg. C
1. Shadow free area required for the solar system @ 30 sqm
2. Cold water inlet & hot water outlet piping will be charged as per the final measurements.
3. These systems are designed to working pressure at normal gravity pressure.
4. Customer should provide overhead cold water tank if required.

For TATA BP SOLAR INDIA LTD.,

Ujwal V Dusane

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