DETAILED PROJECT REPORT
ON
ENERGY CONSERVATION TURBINE (60 kW)
(SURAT TEXTILE CLUSTER)

Bureau of Energy Efficiency

Prepared By

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ENERGY CONSERVATION TURBINE
(60 KW)

SURAT TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Energy Conservation Turbine (60 kW)

Textile SME Cluster, Surat, Gujarat (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: ***SRT/TXT/ECT/04***

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We take this opportunity to express our appreciation for the excellent support provided by Textile Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the Detailed Project Report (DPR).

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Zenith Energy Services Pvt. Ltd.

Hyderabad

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Lists of Abbreviation

BEE	- Bureau of Energy Efficiency
DPR	- Detailed Project Report
DSCR	- Debt Service Coverage Ratio
ECT	- Energy Conservation Turbine
kWh	- kilo Watt Hour
GHG	- Green House Gases
HP	- Horse Power
IRR	- Internal Rate of Return
MoMSME	- Ministry of Micro Small and Medium Enterprises
NPV	- Net Present Value
ROI	- Return on Investment
SME	- Small and Medium Enterprises
PRV	- Pressure Reducing Valve
PRDS	- Pressure Reducing and De-superheated Valve
PBT	-Profit Before Tax
PAT	-Profit After Tax
SIDBI	-Small Industries Development Bank of India

EXECUTIVE SUMMARY

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

Surat is renowned for the synthetic sarees and dress materials and there are about 450 above industries in the cluster and is chosen for energy efficiency improvements by implementing energy efficient measures/technologies, so as to facilitate maximum replication in other textile clusters in India.

The major energy forms used in the cluster are electricity and fuels like Imported Coal, Lignite, natural gas and biomass product. Electricity is used for driving the prime movers of pumps, fans, drives, and for lighting. Lignite and imported coal are used in boilers for steam generation. Natural gas is used in Stenters and natural gas based generators

This DPR is prepared for installation of Energy Conservation Turbine (ECT) of 60 kW capacity for generating electricity for captive use by avoiding pressure reduction of steam in PRV's and same is done in ECT and utilizing the energy available in steam. DPR highlights the details of the study conducted for assessing the potential for generating electricity by installing ECT instead of reducing the pressure in PRV's/PRDS various units of the cluster, possible electricity generation and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for "Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises" under "National Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table:

S.No	*Particular*	*Unit*	*Value*
1	Project cost	₹(in lakh)	41.50
2	Electricity saving	kWh / year	4,53,600
3	Monetary benefit	₹(in lakh)	25.40
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	1.64

S.No	Particular	Unit	Value
6	NPV	₹(in lakh)	52.12
7	IRR	%age	43.28
8	ROI	%age	26.94
9	DSCR	ratio	2.59
10	Process down time	day	4

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of ECT will be financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

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

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

Energy use and technology audit

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

Capacity building of stake holders in cluster on energy efficiency

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

Implementation of energy efficiency measures

To implement the technology up-gradation project in the 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 cluster

The products manufactured in Surat Textile Cluster are synthetic sarees and dress materials and the produced here are renowned in the country and abroad and have good domestic market. The main raw material for the cluster units is grey cloth and procured from local weaving units and agents. The cost of energy (electrical and thermal energy) as percentage of manufacturing cost varies between 12 and 15%.

Majority of the cluster units are of integrated type, where the raw material “grey cloth” is processed in-house to the final product like sarees and dress materials. Most of the units of the cluster are working on Job basis, where the textile agents will provide design and grey cloth and grey cloth is processed as per design provided by the client. The energy cost is next to the raw materials cost.

Production process

The main process operation for dyeing and printing process of synthetic sarees and dress materials adopted in cluster units are as follows:

Fabric pre-treatment

The main purpose of the fabric pre-treatment process is to remove oil, grease and other materials and to whiten the grey cloth though bleaching. The various process adopted in pre-treatment are scouring, bleaching and shrinking process.

Dyeing

Dyeing is the process of imparting colors to the material through a dye (color). In which a dye is applied to the substrate in a uniform manner to obtain an even shade with a performance and fastness appropriate to its final use. This process is mainly performed in Jet Dyeing Machines and Jigger machines

Dyeing of fabric is carried out in jet dyeing machines. The temperature of the solution is raised to 50℃. Concentrated dyestuff solution is prepared separately and is added to the liquor. After the addition of dyes, the temperature is raised to 130℃ and maintained for about 60 minutes.

After whitening/dyeing, the fabric is unloaded from the machine and taken to the folding and rolling machines for improving the width of cloth, which gets shrunk during the washing and dyeing process.

Printing

In Surat cluster three types printing methods are used. Most of the units are following the flat bed printing, rotary printing and some units follows hand printing. Hand printing is the old method to print the fabric. The flat bed printing has provision for printing 10 to 14 colors simultaneously. The color print paste prepared is fed onto the screens from which it is transferred to the fabric fed in. The fabric after print paste transfer is passed through a drying chamber at 145℃. The dried and printed fabric is taken for further processing.

Drying and Finishing

After printing, the drying process is performed in loop machine, where the temperature is maintained between 130℃ to 170℃ for better color setting. After passing through the loop machines, the printed fabric is washed in a series of normal water and hot water washing in the presence of chemicals for color setting. After completion of the washing process, the printed and washed fabric is subjected to heat setting process in Stenter and then pressing and finishing treatments.

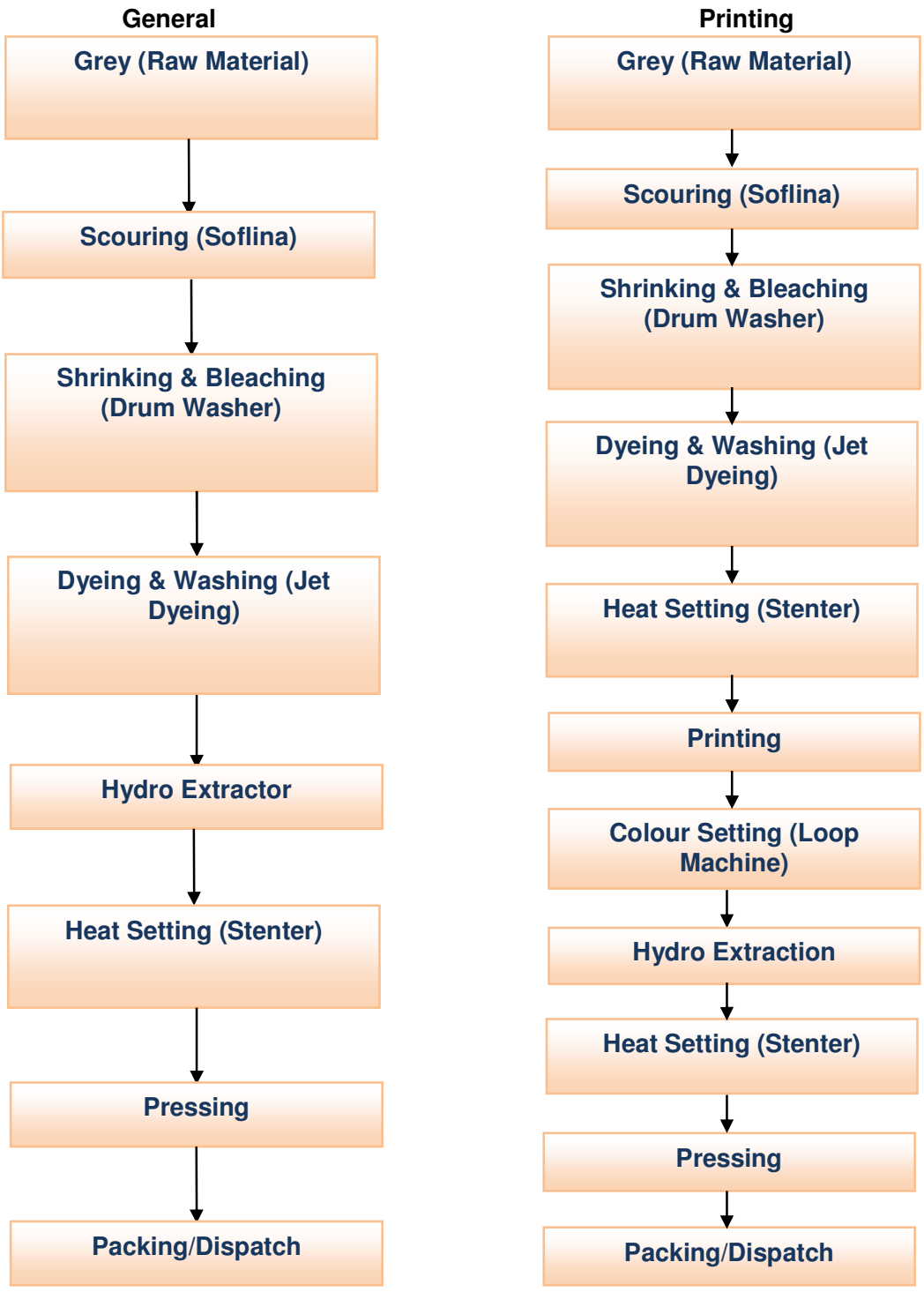


Figure 1.1: General Process Flowchart of Surat Textile Cluster

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption of a typical unit

The main energy forms used in a typical unit in the cluster are electricity, coal/lignite and natural gas. Electricity is used for driving the prime movers of pumps, fans, stenter fans, ID and FD fans, conveyers, loop machines drives, lighting etc. Imported coal and lignite are used as fuel in boilers for steam generation and whereas natural gas is used as fuel in generators for electricity generation, stenters, printing and loop machines. The energy consumption of a typical unit in the cluster having steam requirement of 4 TPH and steam pressure is reduced in PRV's/PRDS and is furnished in Table 1.1 below:

Table 1.1: Energy consumption of a typical unit (Navanidhi dyeing & printing Mills Pvt Ltd)

S.No.	Details	Unit	Value
1	Coal/lignite Consumption	tonne/annum	7200
2	Grid Electricity consumption	MWh/annum	1078
3	Natural gas consumption	million SCM/annum	1.28
4	Production (quantity processed)	Lakh mt/annum	175

1.2.2 Average production by a typical unit in the cluster

The average production in a year in a typical unit is 175 lakh meters of final product

1.2.3 Specific Energy Consumption

Specific energy consumption both electrical and thermal energy per Lakh mts of production for a typical unit is furnished in Table 1.2 below:

Table 1.2: Specific energy consumption for a typical unit (Navanidhi Dyeing Printing Mills Pvt Ltd)

S. No.	*Type of Fuel*	*Units*	*Specific Energy Consumption*
1	Coal Consumption	tonne/ lakh meter	41.14
2	Grid Electricity consumption	MWh kWh/ lakh meter	6.2
3	Natural gas consumption	Million SCM/ lakh meter	0.007

Equipment wise Specific Energy Consumption

The specific energy consumption of the equipments used in the Surat textile industries is given in Table 1.3 below wherever possible.

Table 1.3 Equipment wise Specific Energy Consumption

Equipment	Units	Minimum SEC	Maximum SEC	Average SEC (whole cluster)
Soflina machines	kWh/meter	0.011	0.013	0.012
Drum Washer machine	kWh/meter	0.012	0.016	0.014
Jet Dyeing machine	kWh/meter	0.016	0.019	0.017
Stenter machine	kWh/meter	0.018	0.020	0.019

1.3 Existing technology/equipment

1.3.1 Description of existing technology

Steam is generated in the boilers at pressure of 7 to 10.7 kg/cm^2 and this steam pressure is reduced in the PRV's/PRDS valve as per the pressure requirement in the process.

1.3.2 Role in process

Textile unit requires considerable quantities of steam at lower pressure of 2.5 kg/cm^2 to 3.0 kg/cm^2. The prevailing practices in all cluster units generating steam at 7 to 10.7 kg/cm^2. The steam is then passed through PRV/PRD's for reducing the pressure as required.

Installation of ECT is additional equipment for generation of free electricity for captive purpose, by avoiding reduction of steam pressure in PRV's/PRDS and electricity generated will partially reduces electricity imported from the grid.

1.4 Establishing the baseline

1.4.1 Design and operating parameters

The present electricity consumption and connected load of a typical plant in the cluster units is 1272 MWh and has maximum contract demand of 400 kVA and the plants are operated for 24 hrs and 350 days in a year.

1.4.2 Electricity and Steam consumption

Electricity and steam consumption of various three cluster units and the steam pressure is reduced in PRV's/PRDS is presented in Table 1.4 below:

Table 1.4 Electricity Consumption in three typical units

S. No	Name of the unit	Power consumption (MWh)	Boiler capacity (TPH)
1	Samta Silk Mills Pvt Ltd	1078	6
2	Bhagawati silk mills Pvt Ltd	843	6
3	Riddhi Siddhi Prints Pvt Ltd	1272	4

1.5 Barriers for adoption of new and energy efficient technology / equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of the gas based co-generation systems in the cluster are:

- Lack of awareness of the technology and losses due to reduction of steam pressure in PRV's/PRDS

1.5.2 Financial Barrier

- Lack of awareness of the losses and monetary benefit of the ECT
- Lack of financial strengths to invest for the system

1.5.3 Skilled manpower

Not applicable

1.5.4 Other barriers (If any)

New Technology and hence fear of the reliability of the equipment.

2. TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of equipment selected

2.1.1 Description of equipment

Turbo Tech's Energy Conservation Turbines (ECT) has varied applications in industry helping to generate valuable energy in the form of electric power. The power generated is in the form of incidental power, which otherwise would have been wasted into the environment. Since ECT can utilize saturated steam, it becomes highly beneficial for industries using saturated steam. Typically an ECT is used in parallel with a pressure reducing valve (PRV) or pressure reducing Desuper-heater station (PRDS) downstream of the boiler. When the application requirement of steam is at lower pressure than the generation of steam in the boiler typically the steam is passed through a PRV or a PRDS. By installing an ECT in parallel to PRV/PRDS, whatever steam energy would have been wasted due to pressure reduction can be recovered in the form of electrical power, thus reducing power cost.

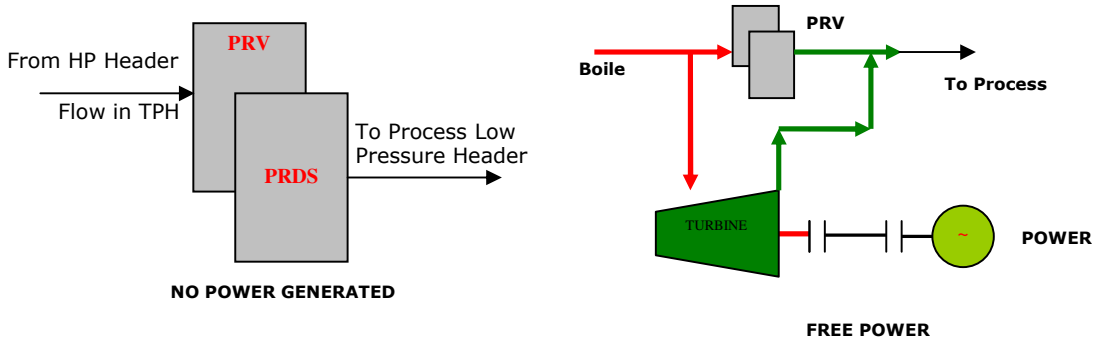


Figure 2.1: Schematic Diagram of Energy Conservation Turbine

2.1.2 Equipment specifications

The detailed specifications of the 60 kW Energy Conservation Turbine suggested is furnished in Table 2.1below:

Table 2.1: Equipment specifications 60 kW ECT

S. No.	Parameter	Unit	Detail
1	Rated Capacity of the turbine alternator	kW	60
2	Voltage	Volt	433
3	Steam Inlet Flow to turbine	TPH	4
4	Steam outlet Flow of turbine	TPH	4
5	Steam Inlet pressure to turbine	kg/cm^2	10.7
6	Steam outlet pressure of turbine	kg/ cm^2	3.5

2.1.3 Integration of equipment with existing process and reasons for selection

The ECT is used in parallel with a pressure reducing valve (PRV) or pressure reducing Desuper-heater station (PRDS) downstream of the boiler. When the requirements of steam at lower pressure than the generation of steam then steam is passed through a PRV or a PRDS. By installing an ECT in parallel to PRV/PRDS, whatever steam energy would have been wasted due to pressure reduction can be recovered in the form of electrical power, thus reducing power cost. There is no additional fuel required for generating electricity and is produced the energy wasted in PRD's/PRV's.

2.1.4 Superiority over existing technology/equipment

The following are the benefits of the ECT

- Proven GHG reduction potential
- Huge untapped potential for energy conservation
- Strong business incentive for Customers,
- Low month pay-back
- High Utilization Factor (about 80 – 95%) equals best "bang-for-buck" compared to other Clean-Tech investments
- Island foundation is not required, thereby saving substantially on installation cost

2.1.5 Availability of the proposed equipment

The Energy Conservation Turbine (ECT) suppliers are locally available.

2.1.6 Source of technology/equipment for the project

The proposed equipment is locally available

2.1.7 Service/technology providers

The service providers are locally available and contact details of service providers are given in Annexure 7.

2.1.8 Terms and condition in sales of equipment

Terms of Payment

50% Advance with purchase order, and remaining 50% along with taxes and duties against Performa Invoice before dispatch

Excise Duty, Sales Tax & Other Levies

The quoted prices are exclusive of all taxes, duties, levies such as excise duty, central/local sales tax, octroi, etc. as are applicable at the time of dispatch

Warranty

The supplier shall repair or replace at free of cost, on ex – works basis the whole or any portion of material which under normal and proper use and maintenance proves defective in material and/or workmanship within 12 months from the date of commissioning or 18 months from the date of shipment of equipment whichever is earlier, provided prompt notice is given of such defects.

2.1.9 Process down time during implementation

The process down time is considered at one week and details are provided in Annexure 6.

2.2 Life cycle assessment and risks analysis

The operation life cycle of Energy Conservation Turbine is considered to 15 years.

2.3 Suitable unit for implementation of proposed equipment

The proposed Energy Conservation Turbine is suitable for the units generating the steam at 7 to 10 kg/cm^2 for 4 TPH flow and has installed PRV at utilization end.

3. ECONOMIC BENEFITS OF PROPOSED EQUIPMENT

3.1 Technical benefits

3.1.1 Fuel savings

Installation of energy conservation turbine (ECT) doesn't have any effect on fuel savings. ECT generates electricity and will partially avoid electricity imported from grid.

3.1.2 Electricity savings

The capacity of the ECT is 60 kW which generate about 4, 53,600 kWh per annum for 350 days and 24 hours per day of operation at 90% turbine load fraction. Hence implementation of project will avoid import of 4, 53,600 kWh of electricity from grid.

3.1.3 Improvement in product quality

The project activity generates electricity and avoids partial electricity import from the grid and hence doesn't have effect on product quality ***directly or indirectly.***

3.1.4 Increase in production

There is no significant impact on production ***directly or indirectly.***

3.1.5 Reduction in raw material consumption

No significant impact on the raw materials consumption ***directly or indirectly.***

3.1.6 Reduction in other losses

There is no significant impact on other looses ***directly or indirectly.***

3.2 Monetary benefits

The installation of ECT avoids about 4, 53,600 kWh electricity imported from grid. The average unit cost is ₹ 5.60 and the monetary benefit due to installation of ECT is estimated at ₹ 25.40 lakh per annum.

Table 3.1 Energy and Monetary Benefit due to Project Implementation

S. No.	*Particulars*	*Unit*	*Value*
1	Capacity of ECT	kW	60
2	Electricity saving per annum	kWh	4,53,600
3	Electricity cost per unit	₹/ kWh	5.60
4	Total Monetary benefits	₹ (In lakh)/ annum	25.40

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

No significant impact on the working environment

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new. The technology implemented will create awareness and operation and maintenance of the new technology and hence improves skills of the workers.

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

The major GHG emission reduction source is CO_2. The technology will reduce grid electricity consumption of 4,53,600 kWh per annum and grid emission factor is considered at 0.85 tonne of CO_2 per MWh and the emission reductions are estimated at 385 tonne of CO_2 per annum due to implementation of the project activity.

3.4.3 Reduction in other emissions like SOx

No significant impact on SO_x emissions at the plant level and same is reduced at the power plant.

4. IMPLEMENTATION OFPROPOSED EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Cost of equipments

The total cost for installation of ECT is estimated at ₹ 39.00 lakh, which includes turbine, alternator, Panels, switches and cabling etc.

4.1.2 Other costs

The erection and commissioning, civil and electrical modifications is estimated at ₹ 2.50 lakh and is included in the cost of technology and equipments. The details of the item wise cost are furnished in Table 4.1 below:

Table 4.1 Detail of project cost

S.No	Particulars	Unit	Value
1	Turbine and Generator	₹ (in Lakh)	39.00
2	Panel, switch & cabling, Elec. modi etc	₹ (in Lakh)	2.50
3	Investment without IDC	₹ (in Lakh)	41.50
4	Interest During Implementation	₹ (in Lakh)	0.00
5	Total Investment	₹ (in Lakh)	41.50

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at ₹ 10.38 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which works out at ₹ 31.13 lakh.

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. The loan tenure is 5 years and the moratorium period is 6 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with ₹ 18.24 lakh in the first year operation and increases to ₹ 95.47 lakh at the end of eighth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 41.50 lakh and monetary savings due to reduction in grid electricity import is ₹ 25.40 lakh and payback period works out to be 1.64 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.0% interest rate works out to be ₹ 52.12 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 43.28 %. Thus the project is financially viable. The average DSCR works out at 2.59.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 26.94%.

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 power generation and decrease. For the purpose of sensitive analysis, two scenarios are considered are.

- Increase in power generation by 5%
- Decrease in power generation 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.

S.No.	Particulars	IRR	NPV	ROI	DSCR
1	Normal	43.28	52.12	26.94	2.59
2	5% increase in power generation	46.16	41.22	32.38	2.72
3	5% decrease in power generation	40.39	47.27	26.74	2.45

As can be seen from above, the project is highly sensitive to power savings, the debt service coverage ratio works out to be 2.45 times in worst scenario, which indicates the strength of the project.

4.5 Procurement and implementation schedule

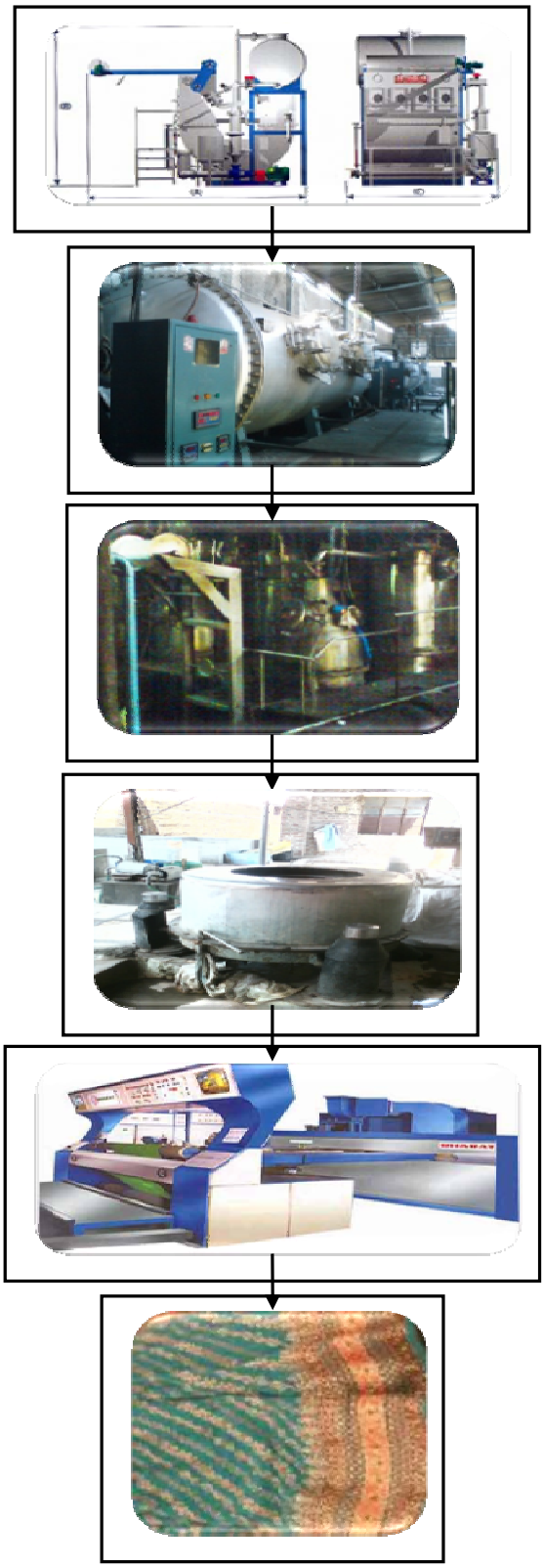
The project is expected to be completed in 8-10 weeks from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6.

Annexure

Annexure 1 Electricity generation from turbine

Sr. No.	Parameter	Units	Details
1	Capacity of Energy Conservation Turbine	kW	60
2	Operating hours per day	hour	24
3	Operating days per annum	days	350
4	Load factor	%age	90
4	Electricity saving per annum	kWh	4,53,600
5	Electricity cost per unit	₹/ kWh	5.60
6	Monetary benefits per annum	₹ In lakh	25.40
7	Project cost	₹ in lakh	41.50
8	Payback period	Years	1.64

Annexure 2 Process flow diagram



Annexure 3 Technology Assessment Report – ECT

Turbo Tech's Energy Conservation Turbines (ECT) has various applications in industry helping to generate valuable energy in the form of electric power. The power generated is in the form of incidental power, which otherwise would have been wasted into the environment. Since ECT can utilize saturated steam, it becomes highly beneficial for industries using saturated steam.

Typically an ECT is used in parallel with a pressure reducing valve (PRV) or pressure reducing De-super heater station (PRDS) downstream of the boiler. When the steam is required at low pressure than this steam is passed through a PRV or a PRDS. By installing an ECT in parallel to PRV/PRDS, whatever steam energy would be wasted due to pressure reduction can be recovered in the form of electrical power, thus reducing electricity consumption and power cost.

Design Highlights

Based upon Aerospace Gas Turbine design principle (high speed, advanced materials)

- High Speed, High Efficiency in small sizes
- Stainless Steel Casings for Erosion/Corrosion resistance to Wet Steam
- Single light-weight skid, no civil works
- User-Friendly Digital Controls
- Pay-Back in 10 - 20 months

Product Highlights:

- Huge untapped potential for energy conservation (about 3 000 MW in India itself)
- Applicable globally
- Strong business incentive for Customers,
- High Utilization Factor (about 80 – 95%) equals best "bang-for-buck" compared to other Clean-Tech investments
- Island foundation is not required, thereby saving substantially on installation cost.

Basis for Selection of Equipment

The various factors influence the selection and sizing of the equipment. In evaluating the financials for the energy conservation turbine, the following points were considered:

- Quantity of steam generated

- Maximum rated pressure of the present boilers

- Actual steam generation pressure

- Steam pressure required for the process

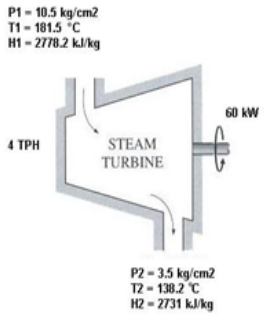
- Quantity of steam required for the process

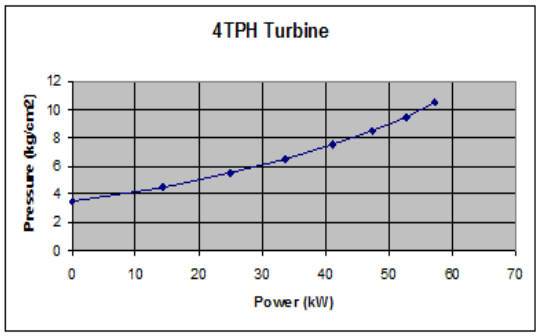
- Cost economics

Based on above facts, a 60 kW capacity energy conservation turbine has been selected for the plants having 4 TPH steam requirement and requires electricity for the process.

4 TPH STEAM TURBINE

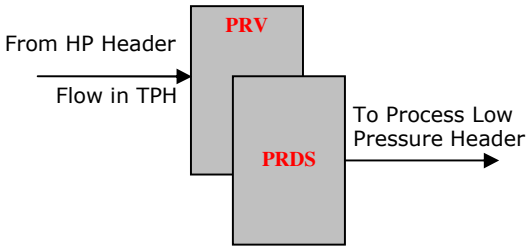
Sl.No	P1	P2	T1	T2	H1	H2	Work Out put (W)	Flow (Q) (4TPH)	Power (P) (kW)	Turbine Efficiency (n)	Actual Power (P_o) (kW)
1	3.5	3.5	138.17	138.2	2731	2731	0	1.11	0.00	0.95	0
2	4.5	3.5	147.18	138.2	2742.8	2731	13.57	1.11	15.08	0.95	14.32
3	5.5	3.5	154.71	138.2	2751.5	2731	23.57	1.11	26.19	0.95	24.88
4	6.5	3.5	161.21	138.2	2758.7	2731	31.85	1.11	35.39	0.95	33.62
5	7.5	3.5	166.95	138.2	2764.8	2731	38.87	1.11	43.19	0.95	41.03
6	8.5	3.5	172.12	138.2	2770	2731	44.85	1.11	49.83	0.95	47.34
7	9.5	3.5	176.82	138.2	2774.4	2731	49.91	1.11	55.46	0.95	52.68
8	10.5	3.5	181.5	138.2	2778.2	2731	54.28	1.11	60.31	0.95	57.30



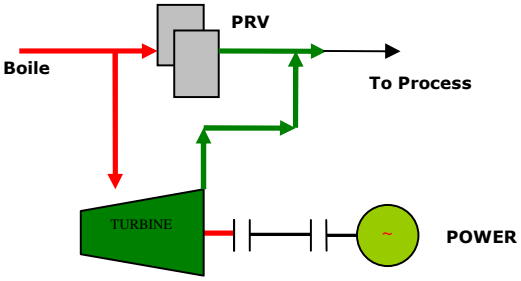


P1	IN-LET STEAM PRESSURE
P2	OUT-LET STEAM PRESSURE
T1	IN-LET STEAM TEMP
T2	OUT-LET STEAM TEMP
H1	IN-LET STEAM ENTHALPY
H2	OUT-LET STEAM ENTHALPY
W	WORK OUT-PUT = (H1-H2) +*C*
Q	Flow rate = 4000/3600 kg/sec
P	Power = W x Q
η	Turbine Efficiency
P_o	Actual Power = P x n
C	*Work done by kinetic and potential energy*

Annexure 4 Drawings of proposed equipment



NO POWER GENERATED



FREE POWER

Annexure 5 Detailed financial calculations & analysis

Assumption

Name of the Technology	***Energy Conservation Turbine***		
Rated Capacity	***60 KW***		
Details	***Unit***	***Value***	***Basis***
Installed Capacity	kW	60	
No of working days	Days	350	
Capacity Utilization Factor	%	90	
Proposed Investment			
Plant & Machinery	₹ (in lakh)	39.00	
Erection & Commissioning	₹ (in lakh)	2.50	
Investment without IDC	₹ (in lakh)	41.50	
Interest During Implementation	₹ (in lakh)	0.00	
Total Investment	₹ (in lakh)	41.50	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	10.38	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	31.13	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4.00	Feasibility Study
Annual Escalation	%	5.00	Feasibility Study
Estimation of Revenue			
Power Saving	KWh	453600	
Cost	₹/KWh	5.6	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

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

Years	***Opening Balance***	***Repayment***	***Closing Balance***	***Interest***
1	31.13	2.70	28.43	2.80
2	28.43	5.40	23.03	2.60
3	23.03	5.80	17.23	2.08
4	17.23	6.40	10.83	1.46
5	10.83	6.90	3.93	0.79
6	3.93	3.93	0.00	0.12
		31.13		

WDV Depreciation

Particulars / years	***1***	***2***
Plant and Machinery		
Cost	41.50	8.30
Depreciation	33.20	6.64
WDV	8.30	1.66

Projected Profitability

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Revenue through Savings								
Fuel savings	25.40	25.40	25.40	25.40	25.40	25.40	25.40	25.40
Total Revenue (A)	25.40	25.40	25.40	25.40	25.40	25.40	25.40	25.40
Expenses								
O & M Expenses	1.66	1.74	1.83	1.92	2.02	2.12	2.22	2.34
Total Expenses (B)	1.66	1.74	1.83	1.92	2.02	2.12	2.22	2.34
PBDIT (A)-(B)	23.74	23.66	23.57	23.48	23.38	23.28	23.18	23.07
Interest	2.80	2.60	2.05	1.44	0.78	0.12	0.00	0.00
PBDT	20.94	21.06	21.53	22.04	22.61	23.17	23.18	23.07
Depreciation	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
PBT	18.75	18.87	19.34	19.85	20.42	20.98	20.99	20.87
Income tax	-	4.90	7.32	7.49	7.68	7.87	7.88	7.84
Profit after tax (PAT)	18.75	13.97	12.02	12.36	12.73	13.10	13.11	13.03

Computation of Tax

₹(In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit before tax	18.75	18.87	19.34	19.85	20.42	20.98	20.99	20.87
Add: Book depreciation	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Less: WDV depreciation	33.20	6.64	-	-	-	-	-	-
Taxable profit	(12.26)	14.42	21.53	22.04	22.61	23.17	23.18	23.07
Income Tax	-	4.90	7.32	7.49	7.68	7.87	7.88	7.84

Projected Balance Sheet

₹(In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Liabilities								
Share Capital (D)	10.38	10.38	10.38	10.38	10.38	10.38	10.38	10.38
Reserves & Surplus (E)	18.75	32.72	44.74	57.10	69.83	82.93	96.04	109.07
Term Loans (F)	28.43	23.03	17.23	10.83	3.93	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	57.55	66.12	72.34	78.30	84.13	93.30	106.41	119.44

Assets								
Gross Fixed Assets	41.50	41.50	41.50	41.50	41.50	41.50	41.50	41.50
Less: Accm. Depreciation	2.19	4.38	6.57	8.76	10.96	13.15	15.34	17.53
Net Fixed Assets	39.31	37.12	34.93	32.74	30.54	28.35	26.16	23.97
Cash & Bank Balance	18.24	29.00	37.41	45.56	53.58	64.95	80.25	95.47
Total Assets	57.55	66.12	72.34	78.30	84.13	93.30	106.41	119.44
Net Worth	29.12	43.09	55.11	67.47	80.20	93.30	106.41	119.45
Dept equity ratio	2.74	2.22	1.66	1.04	0.38	0.00	0.00	0.00

Projected Cash Flow:

₹(In lakh)

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Sources									
Share Capital	10.38	-	-	-	-	-	-	-	-
Term Loan	31.13								
Profit After tax		18.75	13.97	12.02	12.36	12.73	13.10	13.11	13.03
Depreciation		2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Total Sources	41.50	20.94	16.16	14.21	14.55	14.92	15.29	15.30	15.23
Application									
Capital Expenditure	41.50								
Repayment of Loan	-	2.70	5.40	5.80	6.40	6.90	3.93	0.00	0.00
Total Application	41.50	2.70	5.40	5.80	6.40	6.90	3.93	0.00	0.00
Net Surplus	-	18.24	10.76	8.41	8.15	8.02	11.36	15.30	15.23
Add: Opening Balance	-	-	18.24	29.00	37.41	45.56	53.58	64.95	80.25
Closing Balance	-	18.24	29.00	37.41	45.56	53.58	64.95	80.25	95.47

Calculation of Internal Rate of Return

₹(In lakh)

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		18.75	13.97	12.00	12.36	12.73	13.10	13.11	13.03
Depreciation		2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Interest on Term Loan		2.80	2.60	2.08	1.46	0.79	0.12	0.00	0.00
Salvage/Realizable value					-	-	-	-	-
Cash outflow	(41.50)	-	-	-	-	-	-	-	-
Net Cash flow	(41.50)	23.74	18.76	16.25	15.99	15.70	15.41	15.30	15.23
IRR	43.28%								

NPV	52.12

Break Even Point

₹(In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	1.25	1.31	1.37	1.44	1.51	1.59	1.67	1.75
Sub Total (G)	1.25	1.31	1.37	1.44	1.51	1.59	1.67	1.75
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.42	0.44	0.46	0.48	0.50	0.53	0.56	0.58
Interest on Term Loan	2.80	2.60	2.05	1.44	0.78	0.12	0.00	0.00
Depreciation *(H)*	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Sub Total (I)	5.41	5.22	4.69	4.11	3.47	2.84	2.75	2.78
Sales (J)	25.40	25.40	25.40	25.40	25.40	25.40	25.40	25.40
Contribution (K)	24.16	24.09	24.03	23.96	23.89	23.81	23.73	23.65
Break Even Point (L= G/I)	22.38%	21.68%	19.53%	17.15%	14.54%	11.91%	11.58%	11.73%
Cash Break Even {(I)-(H)}	13.31%	12.59%	10.41%	8.01%	5.36%	2.71%	2.34%	2.47%
Break Even Sales (J)*(L)	5.69	5.51	4.96	4.36	3.69	3.03	2.94	2.98

Return on Investment

₹(In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	18.75	18.87	19.34	19.85	20.42	20.98	20.99	20.87	160.06
Net Worth	29.12	43.09	55.11	67.47	80.20	93.30	106.41	119.45	594.16
									26.94%

Debt Service Coverage Ratio

₹(In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	18.75	13.97	12.02	12.36	12.73	13.10	13.11	13.03	82.93
Depreciation	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	13.15
Interest on Term Loan	2.80	2.60	2.05	1.44	0.78	0.12	0.00	0.00	9.77
Total(M)	23.74	18.76	16.25	15.99	15.70	15.41	15.30	15.23	105.85

Debt

Interest on Term Loan	2.80	2.60	2.05	1.44	0.78	0.12	0.00	0.00	9.77
Repayment of Term Loan	2.70	5.40	5.80	6.40	6.90	3.93	0.00	0.00	31.13
Total (N)	5.50	8.00	7.85	7.84	7.68	4.05	0.00	0.00	40.90
Average DSCR (M/N)	2.59								

Annexure 6 Procurement and Implementation plan schedule

***Project Implementation Schedule* – ECT**

S. No.	Activities	weeks							
		1	2	3	4	5	6	7/8	9/10
1	Placement of order								
2	Delivery of the Turbine & Alternator								
3	Steam lines and header modification and Commissioning								
4	Trial runs								

The process down time is considered for one week

Process down Time

S. No.	Activities	days							
		1	2	3	4	5	6	7/8	9/10
1	Modification of steam lines and steam header								
2	Erection and Commissioning								
3	Trial runs								
4	Modification of steam lines and steam header								

Annexure 7 Details of equipment and service providers

Equipment details	*Source of technology*	*Service/technology providers*
Energy Conservation Turbine	Indigenous	**Oorja Energy Engineering Services Pvt Ltd** 8-2-467/4/A/A, 2nd floor Road No.1, Banjara Hills Hyderabad, AP- 500 034 E-mail: madhu@oorja-energy.com Mobile:+91 9000332828 Telefax:+91 40 69995103 Website: www.oorja-energy.com

Annexure 8 Quotations or Techno-commercial bids for proposed equipment

Oorja energy engineering

Oorja Energy Engg Services Hyd Pvt. Ltd.
8-2-467/4/A/A, 2nd Floor, Road No. 1, Banjara Hills
Hyderabad (AP) 500034. Tel: 91-40-69995103
Email: info@oorja-energy.com

Date: 26/10/2010

M/s.Zenith Energy Consultants Pvt Ltd
My Home Plaza, Masab Tank,
Hyderabad.500 028

Kind Attn: Mr. Krishna

Dear Sir,

Sub: Requirement of Energy Conservation Turbine - Reg.

Based on the discussions we had with you and further to the telecon had with you, we are pleased to submit our offer as per the following specifications

Inlet Flow: 4 TPH
Inlet Pressure: 10.5 kg/cm^2, dry saturated
Outlet Flow: 4 TPH
Outlet Pressure: 3.5 kg/cm^2
Output – 60kW
Cost: Rs. 39 Lakhs Ex-our works packed for turbine, gear box, alternator & alternator panel. Taxes & duties extra.

The cooling tower has to be arranged by client.

Thanking You

Giridhar Komanduri

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