FEASIBILITY STUDY OF FUEL SUBSTITUTION AT THE THULHIRIYA TEXTILE MILLS

FINAL REPORT

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Exhibits

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FOREWORD

This feasibility study is part of the Industrial Energy Conservation program (IECP) component of a comprehensive National Energy Demand Management and Conservation Programme (NEDMCP) undertaken by the Energy Efficiency, Demand Management and Conservation (EDMAC) Task Force of the Ministry of Power and Energy of Sri Lanka.

The four-phase IECP was launched by EDMAC in late 1982. Phase 1, Sensitization, was completed in 1983, and Phase 2, which is receiving assistance from the United States Agency for International Development (USAID), has entailed extensive training of plant staff and government officials in energy management for the last 12 months, including on-site training in energy auditing techniques. A major objective of Phase 3 of the IECP is the implementation of specific projects with the potential for significant energy cost savings. A feasibility study is required in those instances when a project would involve large capital expenditure and some degree of uncertainty, but is likely to result -- if technically sound and economically and financially justified -- in significant energy savings. In Phase 4, scheduled for 1985, the IECP will be entirely self-sustaining, with private and government institutions providing energy audit consultancy services, while EDMAC plays a catalytic and policy-oriented role.

The topic of this feasibility study was identified jointly by EDMAC and the Ministry of Textiles on the basis of the oil consumption of the mills and the results of a detailed energy audit undertaken with USAID specialists in March 1984 at the Thulhiriya Textile Mills. Because of its replicability in other plants in Sri Lanka, this study is expected to trigger similar initiatives across industry, which could ultimately help to reduce Sri Lanka's foreign exchange expenditures caused by consumption of imported oil in the industrial and commercial sectors.

This feasibility study is part of the Industrial Energy Conservation component of a comprehensive National Energy Demand Management and Conservation Programme (NEDMCP) undertaken by the Energy Efficiency, Demand Management and Conservation (EDMAC) Task Force of the Ministry of Power and Energy of Sri Lanka.

The topic of the study is the substitution of solid fuels for furnace oil at the Thulhiriya Textile Mills (TTM). The project was identified jointly by EDMAC, the Ministry of Textiles, and TTM's management on the basis of the potential oil savings and the replicability of the findings. All data necessary for the analysis were obtained from the results of the detailed energy audit conducted under the same EDMAC program with USAID consultants in March and April 1984.

TTM, one of the largest spinning, weaving, and finishing cotton mills in South Asia, uses large amounts of steam to finish more than 10 million meters of cloth annually. The steam is produced by three East German-made boilers. Each boiler is rated to produce 6.8 tonnes (metric tons) of steam per hour at a pressure of 13 bar. Although the boilers operate at 84 percent efficiency, the high cost of fuel -- both to TTM and the Sri Lankan economy -- prompted a study of alternative energy sources for generating steam.

In the meantime, TTM considered the installation of a new thermal fluid heater to provide heat at 200°C to 210°C for new polyester fabric stentors. However, this initiative was not brought to the attention of the study team until June, when the draft study was already completed.

Nonetheless, we sought to satisfy TTM management's request that this option be incorporated in the feasibility study of fuel substitution. To this end, we contacted several qualified industry sources to determine whether fuels other than natural gas and light oil could be used in a thermal fluid heater. Based on these discussions, we concluded that thermal fluid heaters cannot run on solid fuels such as coal or wood, even if the fuel is gasified first. Indeed, the low-Btu gas produced from coal or wood gasification has several major drawbacks, including the length and temperature of the flame and possible CO emission inside the working area. Existing thermal fluid heaters are not designed to use dirty low-Btu gas as fuel. Gas cleaning and cooling systems and a large furnace volume would be necessary, and we believe that the cost of such a custom designed system would be prohibitive. If gas from wood is to be used, steam is a better medium than thermal fluid.

We thus recommend the installation of a conventional thermal fluid heater using light oil.

We decided to limit the study to the existing boiler plant and investigate those options that would be best for TTM.

TECHNICAL OPTIONS

On the basis of the boiler audit, we selected six options for improving the cost efficiency of steam generation at TTM. Of these options, three were considered sufficiently attractive to warrant detailed financial and economic analysis. The three options are:

- Option 1: Converting one existing boiler from oil to low Btu wood-gas using a wood gasifier
- Option 2: Replacing one existing boiler with a new, multifuel boiler capable of burning wood and oil
- Option 3: Replacing one existing boiler with a new, multifuel boiler capable of burning coal and oil.

The advantage of option no. 1 is that the resulting gas can be used in the existing boilers with few modifications. The advantage of replacing imported oil with a cheaper, indigenous fuel may be offset in part, however, by the cost of the gasifier and the substantial fuel handling system that would be required.

The two multifuel boilers -- wood/oil and coal/oil -- also have the advantage of replacing expensive, imported oil with fuels that are less expensive for the same energy content. However, multifuel boilers are generally 8-10 percent less efficient than oil-fired boilers. Moreover, the additional equipment required by a multifuel boiler usually results in higher capital, installation, and indirect costs than those for oil-fired boilers. Finally, significant floor space for the boiler is required, as are fuel storage facilities.

Total project costs, including interest during construction, vary from Rs.11.6 million for option no. 1 (of which Rs.6.1 million correspond to the CIF value of the equipment) to Rs.31 million for the multi-fuel boiler using coal and oil (of which Rs.12.3 million are for the equipment) (see Exhibit A). These investment figures are conservative estimates, as they have been based on highest quality equipment imported from the United States and Europe. They also include duties and large provisions for contingency.

Total incremental annual operating costs range from a low Rs.3.3 million for option no. 1 to Rs.5.4 million for option no. 3. These O&M costs are

Exhibit A

Cost and Performance Summary for the Three Options
(Rs. 000)

		Multifuel boiler	
Direct costs	**Wood gasifier**	**Wood/oil**	**Coal/oil**
Equipment	6,127	12,204	12,204
Installation	1,985	6,664	6,664
Contingency	917	3,642	3,642
Total direct costs	**9,029**	**22,510**	**22,510**
Engineering/design	1,180	4,416	4,880
Total project costs, including interest during construction	11,623	30,724	31,251
Additional annual operating and maintenance costs			
Labor	420	344	344
Power	1,700	1,900	1,900
Water and chemicals	N/A	272	272
Spare parts (maintenance)	1,172	2,008	2,008
Other	N/A	900	900
Total O&M	**3,292**	**5,424**	**5,424**
Annual fuel savings (tonnes of oil)	**2,140**	**1,820**	**1,820**

N/A = not applicable.

SOURCE: Hagler, Bailly & Company.

in addition to those for current operation of the existing boilers (see Exhibit A).

Assumptions on steam plant characteristics, energy prices, and financial data are presented in Exhibit B.

Based on extensive discussions with various organizations, the study team established that sufficient quantities of wood (roughly 10,000-12,000 tonnes per year) will be available from Mahaweli clearings between 1986 (beginning of operation) and 1990-1992. To ensure a wood supply for the 1990s, TTM should develop dedicated wood plantations, as recommended and strongly supported by the Sri Lankan government.

The small quantities of coal required (less than 3,000 tonnes annually) will be transported from Trincomalee (where a new coal-fired power plant will be operating by 1989) to Colombo by rail and then to Thulhiriya by truck.

EVALUATING THE TECHNICAL OPTIONS

To evaluate the three technical options, we conducted financial and economic analyses of their expected performance. The financial analyses, conducted from the perspective of TTM, are intended to assist TTM's management in deciding which, if any, of the options to implement. The economic analyses were conducted from the perspective of the Sri Lankan economy and encompassed two separate analyses: an evaluation of the costs and benefits to Sri Lankan society of the options and an analysis of the options' foreign currency requirements. The economic analyses are intended to assist the Sri Lankan government in determining the overall social merit of the options and deciding whether an option with a satisfactory financial performance would also be likely to meet society's criteria.

Findings from the Financial Analyses

To perform the financial analyses, we projected the incremental after-tax cash flows to TTM from each option. These projections were based on the expected technical performance of the options, and incorporated detailed information on the timing and level of the cash outlays required to undertake each project and the subsequent cash returns and expenses associated with project operation. The analyses incorporated relevant provisions of the Sri Lankan tax code and reflected the expected structure and terms of financing for the options.

On the basis of the projected cash flows, we calculated the following measures of financial performance: present value of after-tax cash flows at a discount rate of 20 percent; internal rate of return (i.e., the discount rate at which the present value of project after-tax cash flows equals zero); and the simple payback period (i.e., the length of time required for the cumulative cash flow from a project to become positive). In addition

Exhibit B

Critical Study Assumptions

1. Steam Plant Characteristics

Size: 6.8 tonnes of steam/hour (one boiler)
Pressure: 13 bar design; 9 bar operation
Efficiency on oil: 84 percent
Efficiency on coal: 75 percent
Efficiency on wood: 72 percent
Useful life: 15 years

2. Energy Prices

Market prices (delivered to Thulhiriya)

Oil: Rs.4,922/tonne in 1984, increasing at 2 percent per year in real terms
Coal: Rs.1,625/tonne in 1984, increasing at 1 percent per year in real terms
Wood: Rs.500/tonne in 1984, constant in real terms
Electricity: Rs.2/kWh (total cost), including incremental demand charge of Rs.90/kVA/month in 1984, increasing at 2 percent per year in real terms

Opportunity costs (shadow prices)

Oil: Rs.3,602/tonne in 1984, increasing at 2 percent per year in real terms
Coal: Rs.1,347.5/tonne in 1984, increasing at 1 percent per year in real terms
Wood: Rs.500/tonne between 1984 and 1990 and Rs.700/tonne after 1990
Electricity: Rs.3.5/kWh (total cost) over the period 1984-2000

3. Financial Data

Debt/equity ratio:	80/20
Interest rate:	14%/year
Moratorium on principal repayment:	1 year
Marginal TTM tax rate:	25 percent
Debt repayment period:	10 years
Depreciation:	50 percent during 4 years and 50 percent during 8 years, straight line
Discount rate:	20 percent nominal, after tax (TTM); 10 percent real (economic)

SOURCE: Hagler, Bailly & Company.

to calculating such measures on the basis of expected project performance, we also conducted analyses in which important factors influencing project performance -- namely project capital cost, value of energy savings, and cost of debt financing -- were varied from their expected levels.

A comparison of the three options indicates that the wood gasifier has lower direct costs, lower operation and maintenance costs, and higher annual fuel savings than the two multifuel boilers (see Exhibit A).

The results of the financial analyses, which are based on financial assumptions provided by TTM, indicate that the wood gasifier is the only option that offers positive financial returns (see Exhibit C). The internal rate of return (IRR) for the wood gasification project is 75.8 percent at a debt/equity ratio of 80/20. If the debt/equity ratio falls to 60/40, the internal rate of return decreases to 46.2 percent. If the project is 100 percent debt financed, the internal rate of return jumps to more than 200 percent, which makes the project highly attractive to TTM if it can obtain such financing.

The other variable with the greatest effect on project IRR is the estimation of savings from switching fuels. If, for instance, the projected fuel savings (in rupees) were 10 percent lower than expected for the wood gasifier project financed at 80/20 debt/equity, the IRR of the project would fall to 21.9 percent.

In addition to these two important variables, the gasification project is subject to other risks. For instance, there are some unresolved technical issues with respect to the efficiency and reliability of the gasifier. While the assumptions used in these analyses were deliberately conservative, it is not difficult to imagine a scenario in which slightly lower efficiency and equipment reliability could result in substantially reduced fuel savings. In addition, the analyses assumed that the price of oil would escalate by 2 percent annually in real terms, while the price of wood would not change in real terms. If oil prices were to escalate at a slower rate while wood prices increased more quickly, the financial returns of the project would be adversely affected.

Finally, there is some risk involved in assuming that 11,500 tonnes of wood (45 percent water content) would be consistently available every year for this project at a current cost of Rs.500/tonne. Roughly 40 tonnes per day of wood would be required, a substantial quantity by any standard. It is not clear that this quantity of wood could indeed be delivered to TTM reliably on a regular basis.

Findings from the Economic Analyses

In addition to evaluating the probable financial performance and risks of the three project options, we studied the probable effects of these options from the perspective of the Sri Lankan economy. An important difference

Exhibit C

Financial Performance for the Three Options
(Rs. 000)

	Wood gasifier	Multifuel boiler	
		Wood/oil	Coal/oil
Percentage debt financing	80	80	80
Total financial cost, including interest	11,623	30,724	31,251
Present value of after-tax cash flows (at 20 percent)	5,581	(9,377)	(12,498)
Internal rate of return on after-tax cash flows	75.8	(100±)	(100±)
Quarters to simple payback from initial outlays	12	N/M*	N/M
Quarters to simple payback from beginning of operation	6	N/M	N/M

*N/M = not meaningful because project never breaks even.

SOURCE: Hagler, Bailly & Company.

between the social cost/benefit analysis and the financial analysis is the use of constant or uninflated costs in the former and current or inflated costs in the latter. Also, the effect of taxes is not considered in the social cost/benefit analysis, as tax payments are internal to the Sri Lankan economy.

In our economic analyses, we evaluated the expected costs and benefits to Sri Lankan society of each of the options. This analysis was conducted according to traditional principles of social cost/benefit analysis and accounted for differences in the market perception of the costs and prices of goods and services and their social value to the Sri Lankan economy. To provide a basis for comparing the performance of the options, we calculated such measures as the present value of net social benefits and the ratio of operating period net benefits to development period costs (benefit/cost ratio). In addition, we estimated the foreign currency effects of the options. In general, the projects have a substantial requirement for foreign currency during the project development phase but, by reducing oil imports, have less need of foreign currency during the operating phase. The evaluation measures computed for the foreign currency analysis included the present value of net foreign currency requirements for each project and the ratio of reduction in foreign currency use during operation to the need for foreign currency during development.

On the basis of the social cost/benefit analysis, all three options have negative net social benefits to the Sri Lankan economy (see Exhibit D). The negative values for the wood gasifier, the smallest of the three options, can be explained in part by the fact that the project's financial attractiveness stems mainly from the tax shelters created from the high debt component it uses. Also, while wood fuel is far less expensive than oil on an equivalent energy basis, the additional costs associated with fuel handling -- foreign spare parts and a substantial quantity of electric power for which the opportunity cost is almost double of the market price -- essentially negate the social benefits of wood gasification.

The **foreign currency analysis** indicates that option no. 1 would achieve the highest present value of net displacement in foreign currency requirements at Rs.59 million (present value of net reduction in foreign currency requirements measured in current rupees and discounted at 10 percent) followed by option no. 2 at Rs.17.5 million and option no. 3 at a negative Rs.13.4 million. With regard to the ratio of foreign currency savings during operation to foreign currency needs during development, option no. 1 achieves the highest performance with a ratio of 13.22, followed by option no. 2 at 3.1. Thus, option no. 1 again achieves the highest return per rupee invested (see Exhibit E).

On the basis of the social cost/benefit and foreign currency requirements analysis, we conclude that option no. 1 would likely benefit the Sri Lankan economy more than the other options analyzed.

Exhibit D

Social Cost/Benefit Analysis for the Three Project Options
(Rs. 000)

	Wood gasifier	Multifuel boiler	
		Wood/oil	Coal/oil
Total development period costs	9,331	25,079	25,601
Present value of net social benefits at 10 percent	(8,563)	(28,947)	(43,404)
Quarter in which cumulative net benefits become positive	N/M*	N/M	N/M
Cumulative net benefits for analysis period	(9,299)	(33,385)	(60,186)

*NM = not meaningful because the project does not beak even on a social/economic basis.

SOURCE: Hagler, Bailly & Company.

Exhibit E

Foreign Currency (FC) Analysis for the Three Project Options
(Rs. 000)

	Wood gasifier	Multifuel boiler	
		Wood/oil	Coal/oil
FC required in development period	9,232	24,320	24,713
FC saved in operating period	122,061	75,029	21,035
FC savings/requirements	13.22	3.09	0.85
Present value of FC requirement at 10 percent	-59,498*	-17,491	13,464

*A negative value indicates savings (or generation) of foreign currency.

SOURCE: Hagler, Bailly & Company.

Discussion of Results

The conclusion of the composite financial, economic, and foreign currency analysis is clear: only option no. 1 can be considered by TTM management for possible implementation. The only drawback of this option is its slightly negative social value, which could be improved rather easily by substituting local labor for foreign currency. We analyzed the wood gasifier assuming the use of a virtually automatic fuel handling system. However, if local labor were used for much of the loading, handling, and unloading of fuelwood, the option's social value would become positive because of reduced requirements for electricity, diesel oil, and imported equipment. This decision is left to TTM management.

TTM management raised other issues, however, after their review of the draft report in June 1984:

- The availability of wood
- The absence of local technical and managerial capabilities to procure, install, and operate the proposed system
- The lack of demonstrated operating experience of large industrial gasifiers, especially in the textile industry
- Possible product contamination owing to wood ash disposal.

The availability of wood is unlikely to be the most critical issue, given the small quantities involved. TTM and its parent ministry should immediately approach the Forest Department, the State Timber Corporation, and possibly the Ministry of Industry to develop a wood supply strategy and sign a long-term contract with one of these entities. EDMAC could be of considerable help to TTM in this effort.

Addressing the other three issues would require intensive training of operators and hiring of specialized staff, probably including a number of foreign specialists (who would also be involved in the preparation and evaluation of the tenders) and would thus cost considerable time and money. An alternative solution, more acceptable to TTM management, would be to allow an outside company to procure, own, and operate the system and assume all responsibilities with respect to operation, safety, and performance.

Such "third-party" arrangements are gaining popularity in many countries, including Sri Lanka, and may involve local specialized firms as well as foreign firms. One example in Sri Lanka is the newly established CTC Services Ltd., a subsidiary of Ceylon Tobacco Company. Several specialized American firms are also interested in this kind of venture, and USAID supports them strongly. We thus recommend that TTM contact such third-party firms if they do not wish to implement and manage the project themselves.

Conclusions

Should TTM find the project worth implementing, it can choose between two strategies. The first strategy is to order, own, and operate the system as if it were a conventional factory component. The second strategy is to retain a specialized outside firm to own, operate, and take responsibility for the system. The steps involved in each strategy are shown in Exhibit F. Under the second strategy, TTM would simply agree with the other firm on a steam price; the price would have to be sufficiently low to make the project attractive compared with continued operation on oil, and sufficiently high to ensure an acceptable financial return to the third-party firm. Under such an agreement, the third-party firm could lease the converted boiler to TTM and include the leasing charge in the definition of the steam price. Should the gasifier system encounter problems, TTM could use one of the two remaining oil-fired boilers.

Exhibit F

Thulhiriya's Steam Plant Retrofit to Wood Gasifier: Next Steps

Option 1: TTM Owns and Operates the System

Step 1: Issue an international tender (see Appendices D and E for example of tender document and list of suppliers to contact)

Step 2: Select best bid (with assistance of EDMAC and USAID consultant)

Step 3: Order equipment

Step 4: Install and start up system (during this step, the selected bidder will take full responsibility for commissioning, including training of operators for a sufficient duration, i.e., several months).

Option 2: An Outside Firm Owns and Operates the Gasifier

Step 1: Contact potential firms to review feasibility study (see Appendix E for a list of possible firms)

Step 2: Select firm (in consultation with EDMAC and the Ministry of Textiles)

Step 3: Draw up contractual agreement between TTM and the selected firm.

SOURCE: Hagler, Bailly & Company.

Introduction

The Thulhiriya Textile Mills (TTM), part of the National Textile Corporation of Sri Lanka, began commercial production of cotton yarn and fabrics in 1972.

In connection with the support provided by USAID, a preliminary and a detailed energy audit have been conducted at TTM in March and April 1984. As a result of these audits, the generation, distribution, and use of steam were found to represent opportunities for substantial energy savings. TTM management and the Ministry of Industry subsequently welcomed the opportunity offered by EDMAC and USAID to conduct a detailed study of the feasibility of using wood or coal as a boiler fuel in lieu of expensive and imported oil.

In the following sections, we discuss plant operation, the corporation's financial situation, production, energy use, and the plant's future. These sections provide the context for project options and their evaluation.

PLANT AND PROCESS DESCRIPTION

The Thulhiriya Textile Mills are located in a rural area about 60 kilometers from Colombo. The plant consists of buildings housing the processing department, administrative and sales offices, boilers, electrical distribution systems, the chilled water plant, and other plant services.

The mills produce finished cloth, greige goods, sized beams, and yarn from raw natural (cotton) and synthetic fibers. A plant layout diagram appears in Exhibit 1.

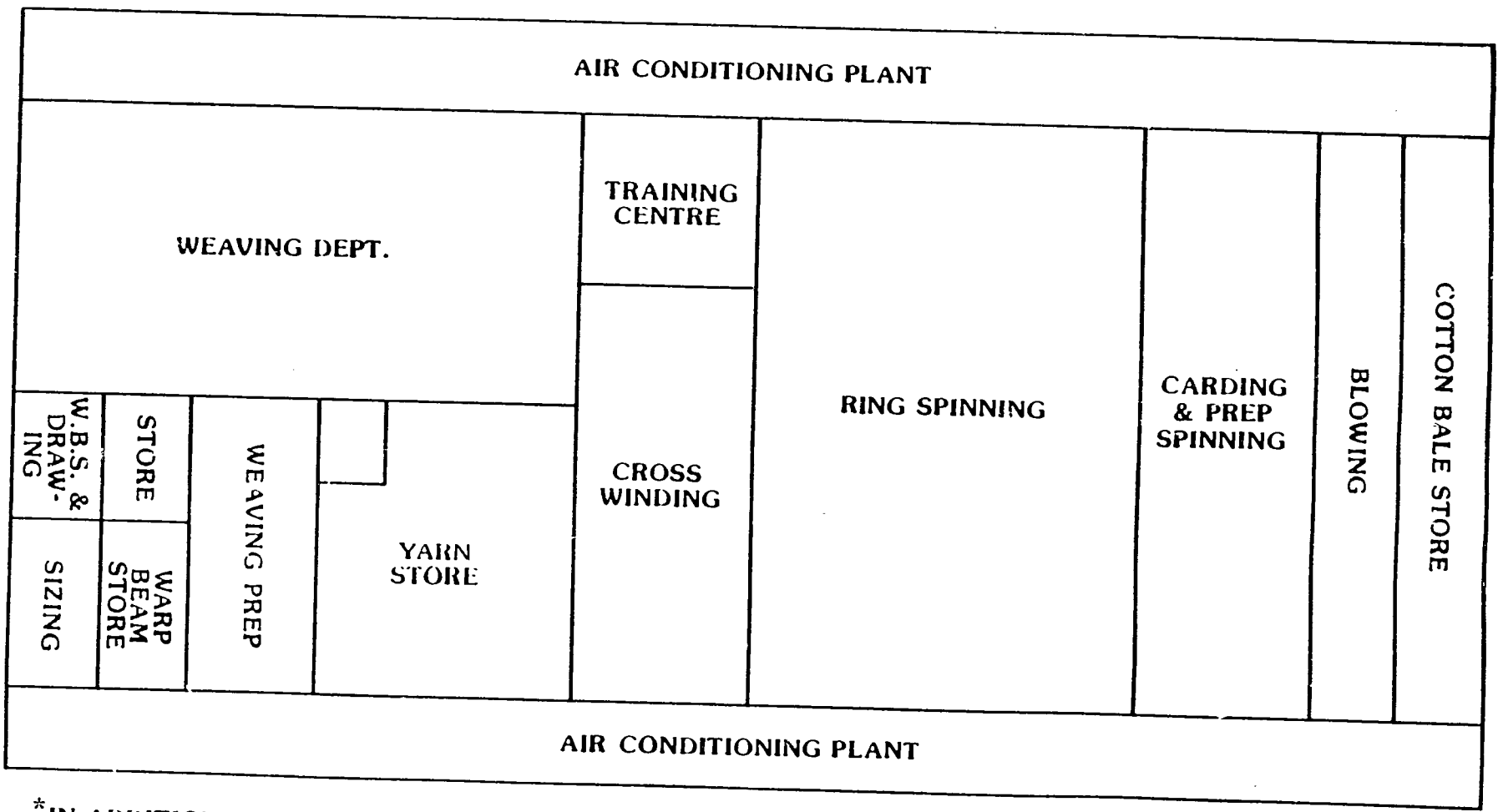
Baled cotton and synthetic fibers are delivered to the incoming storage areas. There, the bales are sorted and classified. In the blow room, the baled fibers are put in one of two blow machines, which "open" the fibers and remove foreign materials. Foreign materials amount to 14 to 15 percent of the raw cotton and about 5 percent of the man-made fiber.

The cleaning and opening process produces a sheet of fibers called a lap. The lap is fed to a carding engine that draws the fibers into a continuous sliver. The sliver can be either combed or carded. These operations, all of which are mechanical in nature, serve to fix the density of the fibers and order them into a parallel arrangement.

Exhibit 1

THULHIRIYA TEXTILE MILLS *

LAYOUT OF MAIN PRODUCTION AREAS



*IN ADDITION THERE IS A FINISHING DEPARTMENT

The combed or carded sliver is then made smaller and tighter by sequential processing on a number of different types of machines, such as the draw frame and fly frame.

The actual thread is produced by ring spinning. The plant's 226 ring spinning machines spin the drawn yarns into the tight threads that are eventually used in the weaving operation.

The thread undergoes a series of operations between the spinning and weaving steps. The warp is produced by winding the spun yarn onto large spindles. The spindles are wound onto large beams, and the beams are sized in the sizing area. This operation involves the application of a sizing material to the yarn to impart additional strength to the threads. The sizing chemical is applied in a heated bath, and the material is dried over a steam heated cylinder. The weft is produced by a number of simple winding operations.

The sized warp and the weft are combined in the weaving department to form the raw (greige) cloth. The loom shed contains 560 automatic looms, producing a cloth in 50-, 62-, and 68-inch widths.

In the finishing department, the woven cloth is inspected and then passed to the shearing/cropping operation, where mechanical blades cut protruberances from the surface of the cloth. The cloth is then passed to the singeing operation, where direct contact with a flame burns off any stray threads and imparts a smooth surface to both sides of the cloth. Next, the cloth is desized by passing it through a heated chemical bath and leaving it in a storage pit for several hours while the chemicals take effect.

The cloth, which is now treated as a rope rather than a continuous sheet, is scoured in a series of J-box scourers. These boxes subject the cloth to temperatures of about 100°C, for approximately 90 minutes, by direct injection of steam.

The scoured rope may then be bleached. Next, it is opened up and dried on a steam heated cylinder dryer. At this point, it may be mercerized and dyed or printed.

Dyeing is performed in one of the eight jigger dyers available. The dyeing process uses a series of hot and cold temperature steps to ensure that the cloth is uniformly permeated with dye, and that the dye has set. The dyed cloth is then washed to remove any residual dye.

The cloth is printed in one of three screen printing machines, and then dried in an integrated dryer. It is further finished by stentering (to set size) and by aging, curing, sanforizing, or calendering. The sequence of operations depends on the requirements of the final product.

The finished rolls of cloth are stored prior to shipment.

PRODUCTION

TTM is engaged in the production of finished textile products, yarn, sized beams, and greige goods. Output for 1982 and 1983 is shown in Exhibit 2, which reflects production sold to customers as well as production used by other departments in the plant.

ENERGY CONSUMPTION AND COSTS

TTM use large amounts of fuel oil and electricity: energy consumption in 1983 was 183,380 gigajoules (GJ), with fuel oil accounting for 58.3 percent of total energy use (about 2,500 tonnes annually) and electricity, the remainder (see Exhibit 3).

Fuel oil is burned in the boiler plant to produce steam at 9 bar. The steam is used almost exclusively in the finishing department for a number of drying, heating, and process steps. Electricity is used primarily to provide motive power for process motors, fans, and other drives. All process equipment within the plant uses electricity as the source of motive power.

The boiler plant consists of three water tube boilers and economizers of East German manufacture. Each boiler is rated to produce 6.8 tonnes of steam per hour at a design pressure of 13 bar. The boiler plant is in very good condition, operating at an overall boiler efficiency estimated to be 84.1 percent. This estimate is based on the results of a recent audit (see Appendices A and B).

ENERGY MONITORING

Fuel oil and electricity use at TTM are monitored on a regular basis and plotted against production figures to identify any variations from expected values. The monitoring is maintained by the Mill manager and the Finishing Department manager.

The lack of installed instrumentation and meters tends to hamper monitoring, however. For instance, fuel oil consumption is measured by insering a dipstick into the fuel tanks. Electricity is metered at incoming service points and at the transformers, but not by department or process machinery. Steam distribution is neither metered nor monitored by section of utilization.

Although TTM management is attempting to measure facility energy consumption in terms of generally accepted norms, it is unable to make valid comparisons in the absence of sufficient metering and monitoring devices.

Exhibit 2

Thulhiriya Textile Mills:
Production, 1982 and 1983

	1982	1983
Spinning (kg)	2,673,844	3,133,281
Winding (kg)	2,800,427	3,544,304
Warping and sizing (meters)	11,082,788	11,972,799
Weaving (meters)	5,289,659	6,604,335
Finishing (meters)	12,610,935	10,805,845

SOURCE: Thulhiriya Textile Mills.

Exhibit 3

Energy Consumption and Costs at the Thulhiriya Textile Mills, 1983

Units	Consumption	Annual cost (Rs.)	Total cost (percent)
Electricity (kWh)	21,261,514	23,175,051	56.6
Peak kVA	5,750	5,454,000	13.3
Fuel oil (gallons)	569,505	12,307,003	30.1
		40,936,053	100.0

Thermal Equivalents

	Annual energy equivalent (GJ)	Marginal energy cost (Rs./GJ)	Total energy (percent)
Electricity	76,541	411.11	41.7
Fuel oil	106,839	115.19	58.3
	183,380		100.0

Formula for converting to GJ:

Electricity = 0.0036 x kWh
Fuel oil = 0.1876 x gallons

SOURCE: Thulhiriya Textile Mills.

TTM management is interested in reducing energy costs at the mill. This interest, which is evidenced by the high priority given by management to energy conservation, takes the place of a formal energy awareness program in the plant.

PLANT ENERGY MANAGEMENT ACTIVITIES AND ORGANIZATION

TTM energy management activities are coordinated by the Deputy Chief Engineer. Mr. Herath can call upon the assistance of about thirty people, including engineers and advisory staff, in his efforts.

Once the project is approved by senior management, the project duties are agreed to by all participants. No one person has responsibility for any ongoing project; rather, the responsibility appears to be shared by all people involved in the project.

TM management is keen to achieve energy savings in the plant. Several projects have been implemented or are under way, including:

- Permanent shutdown of chilled water plant as air conditioning was found not to be necessary
- Cascading of hot process chemicals and liquors to eliminate heating requirements
- Use of ventilation systems only as required
- Most of the low-cost/high-payoff audit recommendations (see Appendix A).

To the extent possible, management has committed resources to energy management and the implementation of conservation opportunities. Despite the apparent lack of formal structure, the plant's energy management activities appear to be succeeding.

REPORT ORGANIZATION

The feasibility study report is organized into four chapters:

Chapter 1: Technical Options
Chapter 2: Cost and Performance
Chapter 3: Financial Analysis
Chapter 4: Economic Analysis.

The four chapters are supported by six appendices:

Appendix A: Energy Audit Report Summary

Appendix B: Detailed Results of Steam System Audit

Appendix C: Future Energy Prices and Availability

Appendix D: Example of Tender Document

Appendix E: List of Equipment Suppliers and "Third-Party" Firms

Appendix F: Detailed Results of Financial/Economic Evaluation.

In this chapter, we first describe the condition of the steam generation and distribution system. Then, we review six technical options -- well-proven as well as new technologies -- for improving the efficiency of steam generation. These options, which were selected on the basis of the boiler audit, are:

- Thermal fluid heaters
- New oil-fired packaged boiler
- Multifuel (wood/oil and coal/oil) stoker boilers
- Gasifier
- Coal-fired stoker boiler
- Multifuel fluidized-bed boiler.

STEAM GENERATION AND DISTRIBUTION SYSTEM

As mentioned earlier, the boiler plant consists of three water tube boilers and economizers of East German manufacture. Each boiler, which includes combustion air preheating, is rated to produced 6.8 tonnes of steam per hour at a pressure of 13 bar. In normal operation, one boiler operates at high fire and a pressure of 9 bar to meet total demand; the other boilers provide back-up. Duty is rotated every 3 months. In a normal work week, the boiler is fired at 0430 Monday morning and operates continuously until all processing is completed at about 0600 the following Sunday morning.

The boiler plant is in good condition, and overall boiler efficiency is estimated to be 84.1 percent, based on measurements made during the energy audit (see Appendices A and B). In these measurements, flue gas was analyzed and water quality, total dissolved solids (TDS) levels, and boiler shell surface temperatures were determined. Although adjustments to fuel/air ratios are made manually, combustion conditions were found to be good throughout the operating range. The boiler operators display considerable skill in maintaining efficiency at such high levels.

The boilers are well insulated, and radiation losses are at a relatively low level. Within the boiler house, there are a few instances of missing insulation and leaks, but the standard of maintenance is generally good.

Much of the instrumentation within the boiler house does not work or has not been calibrated recently. The company should either repair or replace the existing instrumentation. In addition, it should invest in additional instruments to:

- Measure oil flow to individual burners
- Analyze flue gas composition by electrochemical means
- Test boiler water chemistry.

The steam distribution system is in good condition with the exception of the steam traps. Approximately 30 percent of the traps were tested during the audit, and more than 50 percent were found to be malfunctioning. The plant should establish a regular trap testing and maintenance program.

Missing pipework insulation and leaks around the system are minor, but improvements would nonetheless result in savings.

Approximately 16 percent of the steam used for process is returned to the boiler as condensate. The cost of the connections needed to return additional condensate to the boiler -- together with the potential savings -- makes this conservation measure an attractive one. Some of the condensate could also be used for flash steam generation.

ALTERNATIVES FOR MORE EFFICIENT PROCESS HEAT SUPPLY

Below, we discuss six options for reducing the cost of generating/distributing process heat at the Thulhiriya Textile Mills.

Thermal Fluid Heaters — Packaged or Multifuel Types

In a thermal fluid heater, the heat transfer medium is a special mineral oil rather than the water that is used in conventional boilers. The oil always circulates as a liquid and is never vaporized at any part of the cycle. Thus, its boiling point is on the order of 600°C-700°C (see Exhibit 1.a).

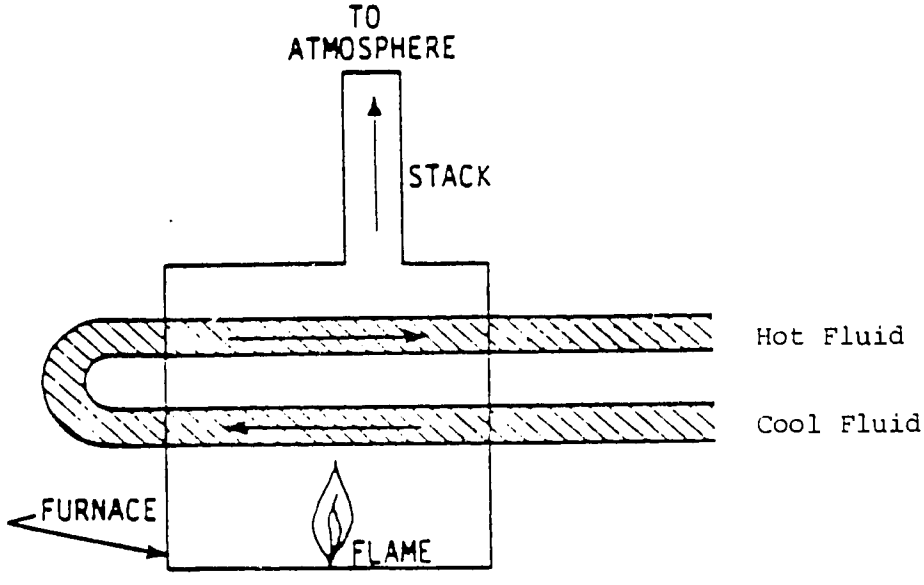
The main advantage of a thermal fluid system is that it allows very high temperatures of the circulating medium to be achieved without a corresponding high pressure, unlike a system using steam. For example, steam at a temperature of 300°C yields a saturation pressure of 85 bar. In the case of mineral oil, the vapor pressure at the same temperature would be about 1.25 bar. Another advantage of using thermal fluid in vulcanization is that a much higher temperature can be used, resulting in faster initial heating times and thus an increase in productivity.

The main disadvantage of thermal fluid heating is that mineral oil costs much more than treated water.

Thermal fluid heaters operate on the same principle as boilers, with one exception. There is nothing that corresponds to a steam drum, because the fluid never vaporizes and the separation of dry saturated vapor from liquid is thus unnecessary. Generally, the overall efficiency of a thermal fluid heater would be a few percentage points higher than that of a boiler

Exhibit 1.a

Thermal Fluid Heater



SOURCE: Hagler, Bailly & Company.

of equivalent heat output because heat transfer on the fluid side is better and tube wall thicknesses are usually lower.

As the TTM boilers already operate at 84.1 percent efficiency, modest efficiency increases are unlikely to justify conversion of the entire steam system. In addition, backup requirements would necessitate an additional heater, which would double the investment cost (in the case of steam, the old boilers can still be used). Consequently, we do not view thermal fluid heaters as a viable alternative to the present TTM boilers. However, the idea of installing a new, small fluid heater to supply heat to the polyester stentors is quite justified.

New Oil-Fired Packaged Boiler

An oil-fired packaged boiler, usually mounted on a skid, has most of the essential services, including boiler feed pumps, oil burner, burner control panel, indicating instruments, oil preheater, and other equipment (see Exhibit 1.b). The burner is fully automatic and self-contained, with integral induced draft fan and electronic control of fuel and air flow. The simpler systems operate on an on-off cycle, shifting between high firing rate and low firing rate. The more sophisticated systems are able to modulate between high and low fire to more precisely match steam demand. However, because the boiler steam drum acts as an accumulator of steam, the simpler type of burner would be quite adequate for the textile mill's purposes.

Burner on-off control is based on burner steam pressure, sensed by means of a pressurestat. The required steam pressure can be set on the burner control panel. In modern packaged boilers, overall efficiencies of better than 80 percent can be achieved at high fire rates, especially using low excess air (LEA) burners.

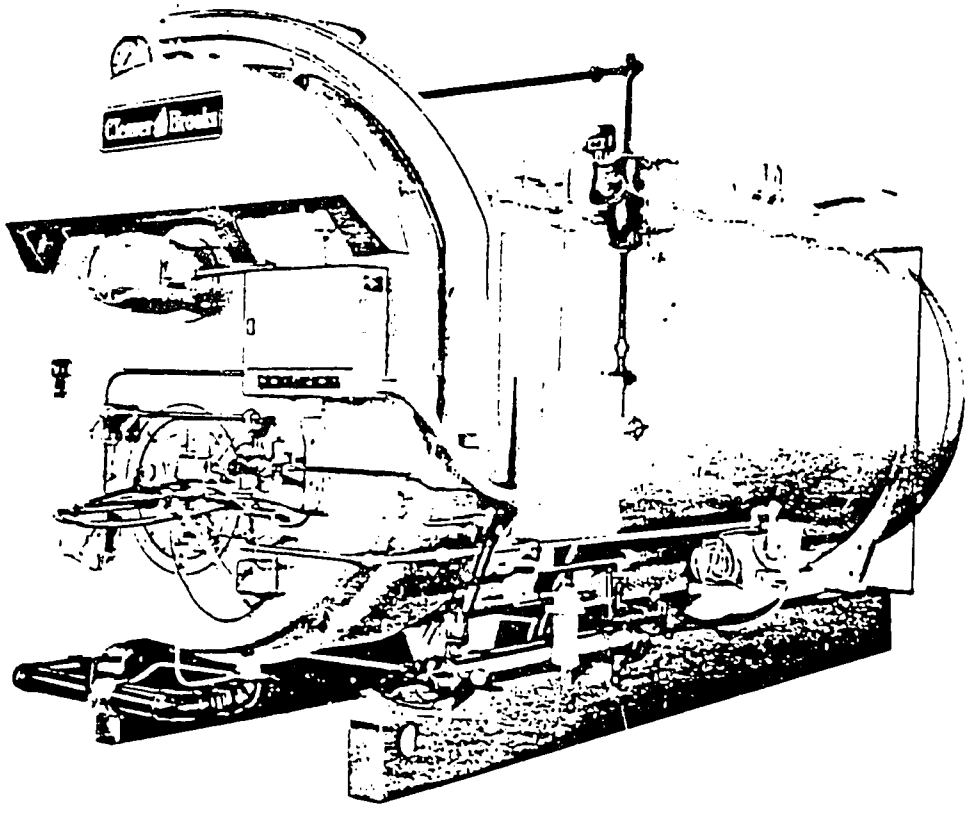
Given the high efficiency of TTM's boilers, however, a packaged boiler is unlikely to offer any significant fuel savings. If the boiler operating improvements suggested in the audit are implemented, the efficiency of the boilers should increase slightly, making it even more difficult for a packaged boiler to offer fuel savings.

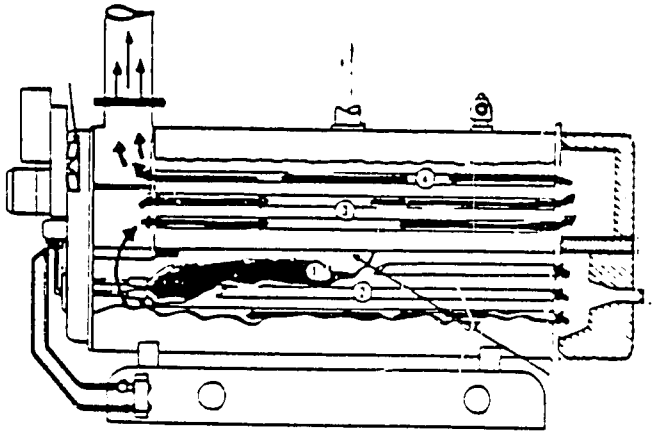
Multifuel Stoker Boiler

Because oil-fired boilers require the use of expensive imported fuel, Thulhiriya management might consider a boiler that can operate on a number of fuels. The candidate multifuel stoker boiler must be able to operate on solid fuels such as coal or wood as well as on oil when solid fuels are not available. The ability to replace expensive, imported oil with domestic wood fuel could make the multifuel boiler attractive from both a financial and a socioeconomic point of view.

Exhibit 1.b

Oil-Fired Packaged Boiler





SOURCE: Cleaver-Brooks.

There are two types of solid fuel-fired boilers, those that require the fuel in particulate form and those that can use large pieces such as logs. In the former case, fuel can be conveyed by pneumatic feed systems from the storage area directly into the boiler. Screw conveyor-type feed systems are also used for this purpose. Reasonably good automatic fuel feeding can be achieved with this type of system, because continuous flow is possible. However, equipment to chip or grind the solid fuel may also be required.

In the multifuel boiler that can use large-sized fuel, an additional under-floor fire grate and furnace must be provided. Some boilers of the packaged, skid-mounted type, however, can accept wood up to a certain size. The furnace must usually be constructed beforehand and lined with firebrick before the boiler is installed.

The efficiency of multifuel boilers is usually 8 to 10 percentage points less than that of oil-fired boilers. In oil-fired boilers, there is a high component of indirect heat from the flame that is effective in heat transfer. In multifuel boilers, the radiant heat component is generally not as effective because of lower flame temperatures and larger furnace sizes. Most of the heat transfer takes place in the convection mode. Thus, multifuel boilers in general need a greater heat transfer surface to obtain good efficiency. Package-type multifuel boilers fired on wood are likely to have a lower efficiency than boilers with under-floor furnaces and water preheaters. When firing fuels such as coal in a finely pulverized state, however, the multifuel boiler's flame temperatures can reach those of an oil-fired boiler, and boiler efficiency is likely to be higher.

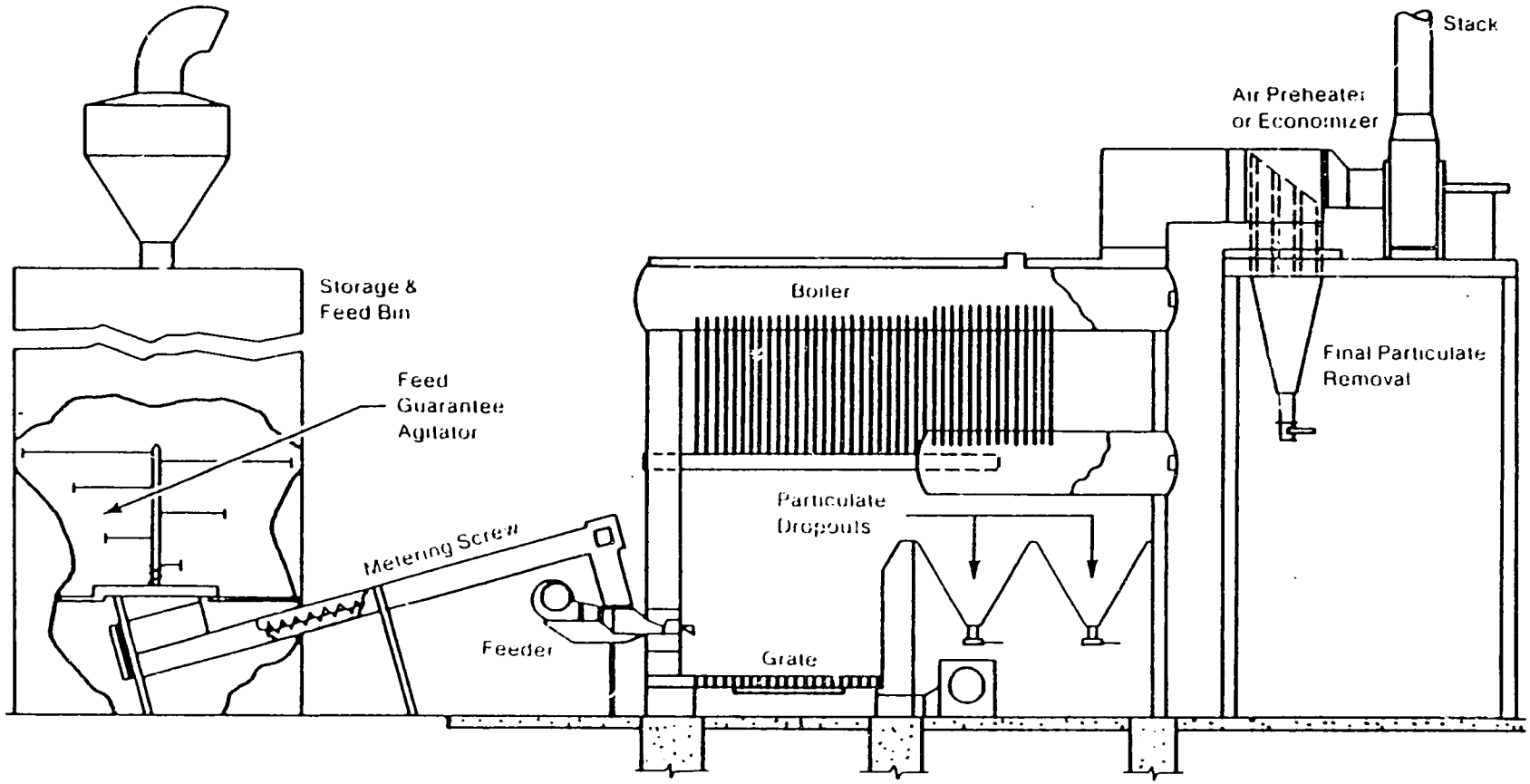
Automatic fuel-feed systems can be installed even for boilers that burn large pieces of wood. However, manual feeding is more common in installations in developing countries for small sizes (i.e., below 20 tonnes of steam/hour). Multifuel boilers also require an additional forced or induced draft when operating on solid fuel alone. When operating on oil, the fan in the packaged burner is capable of handling the required air flow. When operating on solid fuel, the burner is usually swung out of the way, which necessitates another means of air flow.

Because of the additional equipment required by a multifuel boiler, the capital, installation, and indirect costs are higher. A significantly larger floor space is required for this boiler. In addition, a large storage area is required when a solid fuel boiler is used, because solid fuels tend to be bulky in relation to their calorific value and require above-ground storage. Furnace oil can be conveniently stored in underground fuel tanks. In the case of coal and particulate fuels, additional handling and day storage equipment is also necessary (see Exhibit 1.c).

A multifuel boiler also needs a water treatment plant of the same size as that required by an equivalent packaged boiler.

Exhibit 1.c

Automatic Stoker Direct Combustion Solid Fuel Boiler



SOURCE: Solar Energy Research Institute.

Operation and maintenance costs are likely to be higher than for a packaged boiler, for several reasons:

- Boiler electricity demand is higher
- Labor requirements (especially in manual feeding) are greater
- More cleaning of interior surfaces is required, owing to greater contamination when burning solid fuels.

Gasifier

Another option available to TTM management might be to gasify a solid fuel and use the fuel gas in a boiler or in diesel engines to generate power.

The advantage of gasification is that the resulting gas can be used in existing oil-fired boilers with few modifications. In an installation where oil-fired packaged boilers have a reasonable thermal efficiency but direct conversion to solid fuel is not feasible, the gasification option is worth considering. In such a case, the gasifier with associated fuel handling and storage and new burners capable of handling fuel gas would be the only additional expenditures.

Given the high thermal efficiencies of the TTM boilers, the gasification option is worth investigating. A wood gasifier would have the advantage of replacing much of the imported oil used at Thulhiriya. (See Exhibits 1.d.1 and 1.d.2 for possible configurations.)

Coal-Fired Boiler

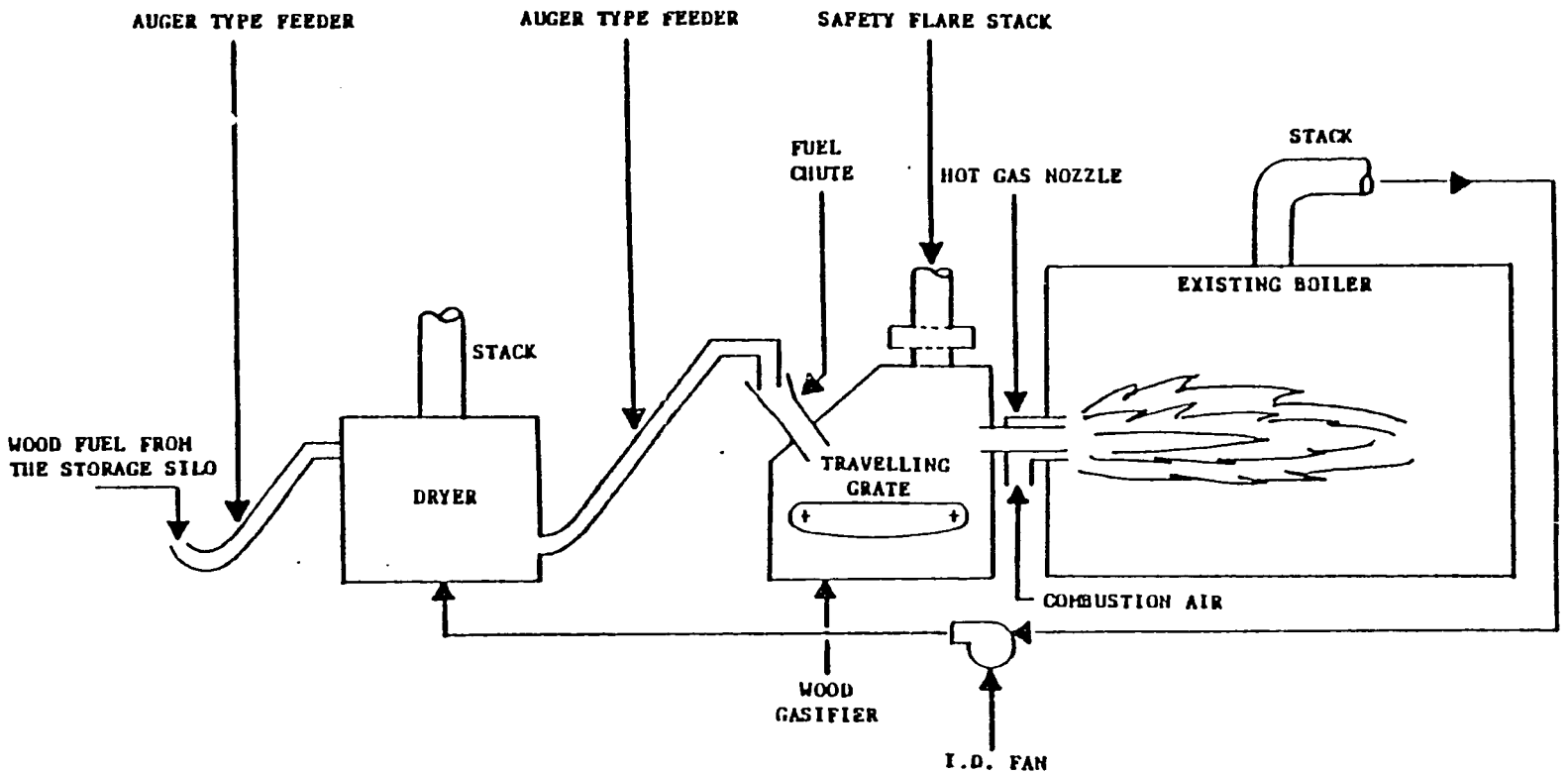
Another option in the case of TTM would be to fit a coal-burning boiler. Coal can be burned either as lumps or in pulverized form. Most large power stations and other large boilers now use pulverized coal because of ease of handling and higher combustion efficiencies. However, in a smaller plant, the use of pulverized coal would increase the capital cost too much. The major characteristics of the different fuels are listed in Exhibit 1.e.

With respect to the different types of stoker, the chain and traveling grate alternative would appear to be the best because of its ability to handle different types of solid fuels. Also, it has the advantage of continuous clearing, which reduces the possibility of ash and slag build-up.

When coal is used, considerable expense is incurred in fitting a suitable handling plant. A fairly substantial stockpile may have to be maintained because coal is an imported fuel and there are no major distributors at the present time in Sri Lanka.

Exhibit 1.d.1

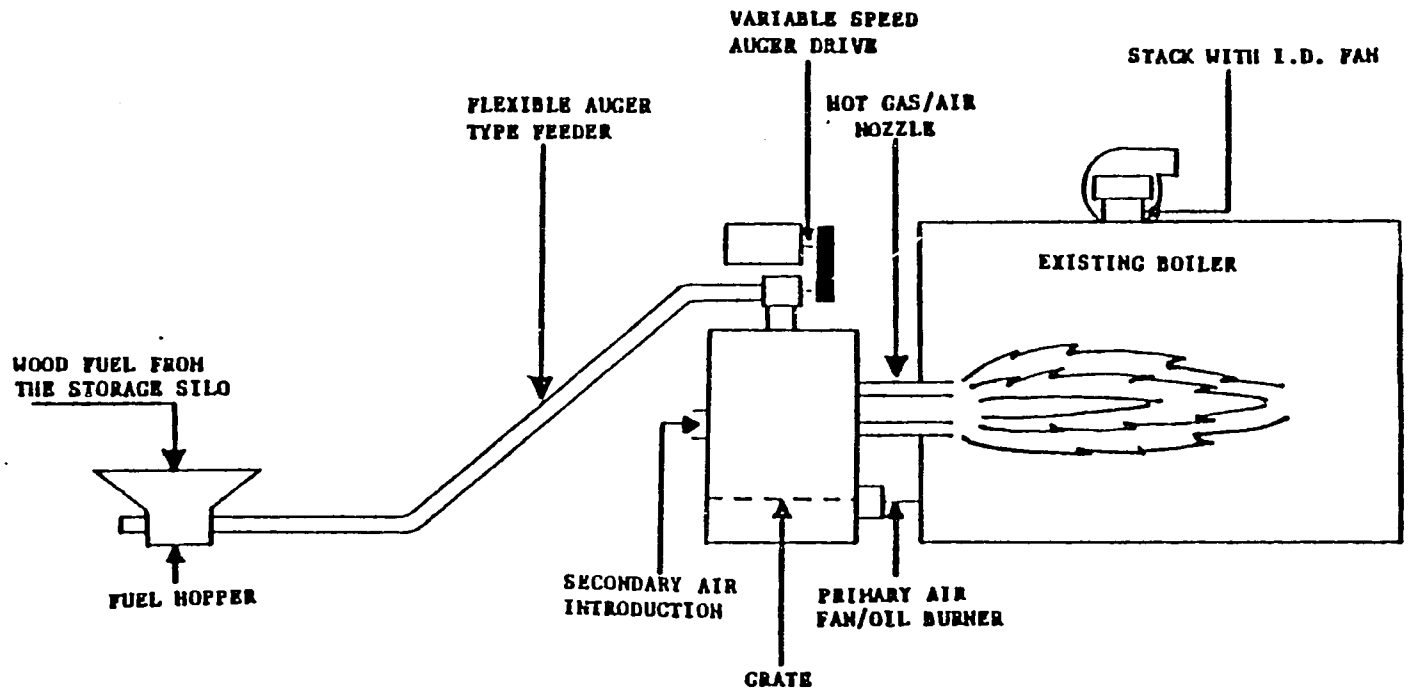
Gasifier/Burner Boiler Retrofit System - Type A



SOURCE: Manufacturer.

Exhibit 1.d.2

Gasifier/Burner Boiler Retrofit System - Type B



SOURCE: Manufacturer.

Coal-Fired Boilers: Types and Major Characteristics

Type			Characteristics		
				Range of steam generation	
Category	Subcategory	Type	Types of coals	Tonnes of steam/hour	Heat release (Mcal/hour)
Stoker boilers	Spreader	Stationary and dumping grate	All except anthracite	Up to 200, but usually under 50	1,200/m^2
		Traveling grate	All except strongly caking bituminous		2,000/m^2
		Vibrating grate	All except strongly caking bituminous		1,100/m^2
	Underfeed	Horizontal-feed (single and double retort)	Caking coals	10-15	825-1,150/m^2
		Gravity-feed (multiple retort)		Up to 250	1,400-1,650/m^2
	Water-cooled vibrating grate		Wide range of bituminous and lignite coals, even those with high free-swelling index	Up to (100-150)*	1,100/m^2
	Chain grate and traveling grate		Almost any solid fuel	Up to (100-125)*	1,400/m^2
Pulverized-coal boilers		Bin system	Almost any, but a given pulverizer can only operate efficiently on a narrow range of coals	Up to 2,000	Not applicable
		Direct-firing			
Cyclone furnace		One-wall firing	Coals with slag viscosity below 250 poise at 1,427°C, volatile matter higher than 15 percent, and low ratios of sulfur/iron		4,000-7,500 Mcal/m^3
		Opposed firing			

*Estimate.

SOURCE: Hagler, Bailly & Company.

Moreover, because coal produces undesirable substances in the flue gas, gas cleaning systems must also be installed. These systems may be either baghouses or electrostatic precipitators.

It is unlikely, however, that the replacement of efficient oil-fired boilers by coal-fired boilers can be justified on either a financial or a socioeconomic basis.

Fluidized-Bed Boilers

A new and different type of boiler has achieved much prominence over the last 20 years. The major distinguishing feature in this type of boiler is the fact that fuel/air mixing and combustion take place within a bed of particulates in combustible matter, usually silica (sand), limestone, or coal ash. The heating surfaces are usually immersed in the bed. The flue gas released from the bed undergoes several heat exchanges to permit further heat absorption into the water and steam before discharge through the stack (see Exhibit 1.f).

Fluidized-bed combustion offers several advantages over conventional combustion techniques:

1. The ability to use a wide range of fuels, including those of low calorific value and those that are hard to ignite. The high degree of turbulent contact between air and fuel particles owing to the fluidization of the bed material, as well as the high (sometimes incandescent) temperature of the bed material, promote ignition of the fuel.

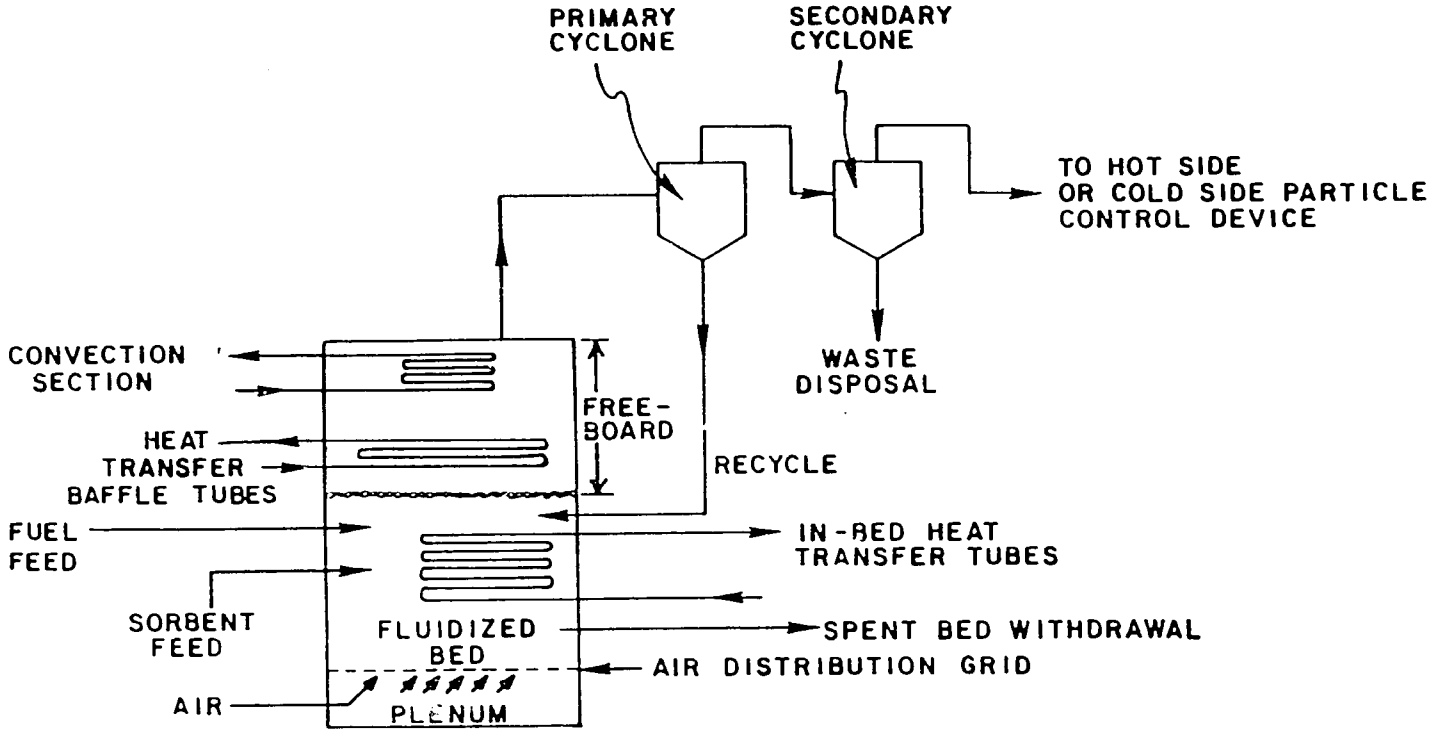
2. The ability to retain sulfur in the bed by the use of limestone (in the case of high-sulfur fuels). This characteristic is extremely useful because cleaning is carried out by cheap, in-bed methods, precluding the need for external electrostatic precipitators or other similar devices.

3. The ability to maintain bed temperatures at less than 1,000°C while still achieving high combustion efficiency. At this temperature, problems from the fusion of ash or the formation of bonded or sintered deposits do not arise.

4. Very high heat transfer coefficients between the bed and immersed heating surfaces. Both hot gas and bed material in a state of fluidization are in contact with immersed heating surfaces, which accounts for the high coefficient and partly explains why combustion zone temperatures are lower than in other non-fluidized high-intensity combustion systems.

Exhibit 1.f

Typical Industrial Fluidized Bed Boiler



SOURCE: Manufacturer.

5. The absence of moving parts in the combustion zone, which leads to greater durability and lower maintenance costs.

6. Maintenance of high efficiency at high turndown ratios. Unlike conventional boilers, high efficiency can be maintained at low firing rates because bed characteristics do not change very much with reduced air and fuel inflow. Where a low firing rate is required, the depth of fuel on the bed is simply reduced, which reduces the firing rate.

7. Little or no fouling of immersed heat transfer surfaces, owing to the constant scouring action of the bed material in a state of fluidization.

The most modern type of fluidized-bed boiler designed for coal/solid fuel firing is now able to burn coal with a combustion efficiency of 94 to 96 percent and an overall efficiency of 80 to 85 percent. Since there is no fouling of surfaces, this efficiency level can be maintained easily over long periods of time.

Nonetheless, we do not believe that the multifuel fluidized-bed boiler option would be superior to the wood/oil and coal/oil multifuel boiler options discussed above, especially because of the small size involved.

SELECTION OF MOST ATTRACTIVE OPTIONS

The thermal fluid heater option was rejected because first cost considerations showed that such a dramatic system change would be far too costly, as new backup (the old boilers cannot be used any longer) would be required.

The packaged oil-fired boiler was rejected because of the high efficiency of the existing boilers. It is unlikely that a packaged boiler could save enough fuel (if any) to be justified on either economic or social cost/benefit grounds.

The multifuel boilers (wood/oil and coal/oil) were both considered worth exploring on the basis of similar analyses carried out in Sri Lanka (preliminary studies were available from several companies, including Ceylon Tobacco Company and the Sri Lanka Paper Corporation).

The gasifier option was also considered worthy of further investigation, since the boiler unit itself is very efficient.

The multifuel fluidized-bed boiler was rejected because it was believed that the wood/oil and coal/oil multifuel boilers were superior options for such a small size (about 6-7 tonnes of steam/hour, maximum demand).

We therefore retained three options that warranted further investigation:

- Option 1: new wood gasifier
- Option 2: new multifuel (wood/oil) boiler
- Option 3: new multifuel (coal/oil) boiler.

In the next chapter, we present our assumptions on investment costs, operation and maintenance costs, and performances for each option. These assumptions were used in our detailed financial and economic evaluations (Chapters 3 and 4).

2 COST AND PERFORMANCE ASSUMPTIONS

In this chapter, we present the assumptions used in estimating system capital and O&M costs and benefits (i.e., energy cost savings plus indirect benefits) for each of the three options retained for analysis:

- Option no. 1: New wood gasifier
- Option no. 2: New multifuel (wood/oil) boiler, burning wood primarily
- Option no. 3: New multifuel (coal/oil) boiler burning coal primarily.

Other assumptions regarding fuel prices are presented in Appendix C and other general financial/economic assumptions in Chapters 3 and 4.

OPTION 1: NEW WOOD GASIFIER

Capital Costs

The key components of the cost of retrofitting a current oil-fired boiler with a wood gasifier include design and engineering costs, the capital cost of the burner and the fuel handling and storage areas, and the cost of installing the equipment and bringing it into operation. Industrial costs, which are usually associated with down time and production interruptions, are assumed to be negligible in this case because of the multiple boilers available at TTM (see Exhibit 2.a).

The total installed cost of the wood gasifier and accompanying fuel storage and handling system is estimated at Rs.10.2 million. The largest margin for variation in these estimates lies in the cost for the fuel handling and storage system, as fuel handling equipment can range from wheelbarrows and shovels to intricate, intricate automatic conveyors and metering silos. We made a slightly conservative estimate of total fuel handling and storage costs in this case.

The disbursement schedule for the investment covers a six-quarter development period (see Exhibit 2.b). The disbursement schedule incorporates the effect of inflation on the cash flows experienced in later periods. The length of the development period is rather conservative; the gasifier may become operational more quickly (some manufacturers claim that they can install and start up their system in less than one quarter, for a total project implementation period of three quarters).

Exhibit 2.a

Investment Estimate for Option 1: Wood Gasifier Boiler Retrofit
(Rs.000)

	Total	Foreign	Local
Boiler retrofit			
Burner (400 hp, FOB)[1]	2,818	2,818	0
Shipping and insurance[2]	338	338	0
Cost, CIF Sri Lanka	3,156	3,156	0
Tariff (17.5%)	552	0	552
Total	**3,708**	**3,156**	**552**
Fuel handling and storage[3]			
Storage facilities, including silo	980	980	0
Conveyors	368	368	0
Front-end loader	490	490	0
Shipping and insurance	221	221	0
Tariff (17.5%)	360	0	360
Total	**2,419**	**2,059**	**360**
Installation[4]			
Burner	1,105	553	552
Fuel handling and storage	720	360	360
Tariff (17.5%)	160	0	160
Total	**1,985**	**913**	**1,072**
Contingency[5]	811	608	203
Tariff on contingency	106	0	106
	917	608	309
Total direct costs	9,029	6,736	2,293
Engineering and design[6]	1,180	826	354
Indirect costs[7]	0	0	0
GRAND TOTAL	**10,209**	**7,562**	**2,647**
Working capital[8]	510		

[1]Burner cost estimated from discussions with U.S. manufacturers of gasification equipment. Gasifiers from non-U.S. sources may be less expensive in some cases (e.g., from Brazil).
[2]Shipping and insurance are estimated at 12 percent of burner FOB cost.
[3]Fuel handling and storage costs are extremely variable, depending on specific location and the cost of labor relative to capital. This estimate may be slightly conservative in Sri Lanka.
[4]Installation costs are estimated at 35 percent of equipment costs, net of tariff. Installation costs are assumed to be split 50/50 foreign/local.
[5]A contingency of 11.5 percent of the direct costs, net of tariff, is included, assuming 75 percent from foreign sources.
[6]Engineering and design costs are estimated at 15 percent of direct costs, net of tariff, with 70 percent coming from foreign sources.
[7]Because the Thulhiriya Textile Mills plant has three boilers, we assumed that one boiler can be retrofitted without incurring any indirect costs such as down time.
[8]Additional working capital requirements are estimated at 5 percent of total investment costs.

SOURCE: Hagler, Bailly & Company.

Exhibit 2.b

Schedule of Disbursements for Option 1*
(Rs.000)

Engineering and design cost

	3Q 1984	4Q 1984	1Q 1985	2Q 1985	3Q 1985	4Q 1985	Total
Percent	20	20	20	20	10	10	100
Real	236	236	236	236	118	118	1,180
Current**	236	242	248	254	130	133	1,243

Direct capital cost

	3Q 1984	4Q 1984	1Q 1985	2Q 1985	3Q 1985	4Q 1985	Total
Percent	10	20	20	20	20	10	100
Real	902	1,806	1,806	1,806	1,806	902	9,028
Current*	902	1,860	1,896	1,943	1,992	1,015	9,598

*May vary with supplier.
**Assumes 10-percent annual inflation rate.

SOURCE: Hagler, Bailly & Company.

Operation and Maintenance Costs

Operation and maintenance (O&M) costs include the additional labor, power, chemicals, water, and spare parts that must be included in the financial and economic analysis of the project.

Maintenance

Maintenance costs are estimated at 10 percent of installed capital costs per year. Installed capital costs are roughly Rs.10.2 million for the boiler retrofit, so maintenance costs are estimated at Rs.1.02 million per year, or Rs.255,000 per quarter. By the first quarter of 1986, general inflation will have increased maintenance costs to Rs.1.17 million annually, or Rs.293,000 per quarter.

Labor

On the margin, the installation of the wood gasifier will increase the labor requirements in the Thulhiriya Textile Mills. An additional boiler operator per shift will be required at a cost of Rs.90,000 annually. A supervisor/manager to oversee operations will add an additional Rs.60,000, and three additional fuel handling personnel per shift will increase labor requirements another Rs.216,000 annually. Total labor requirements are estimated at Rs.366,000 per year, or Rs.91,500 per quarter. By the start of operations in the first quarter of 1986, general inflation will have increased the labor requirements to Rs.420,000 annually, or Rs.105,000 per quarter.

Power

Power requirements for the proposed wood gasification project include electricity requirements for the burner, wood chipper, conveyors, and agitation in the storage silo. The front-end loader is assumed to require 75 liters of diesel fuel per day of operation (22,500 liters annually, or Rs.150,000).

Power requirements for the burner include a 40-kW fan that operates 85 percent of the 7,200 annual hours of plant operation. The 25-kW agitator in the storage silo operates the full year, or 8,760 hours. The power requirements for the chipper and the conveyors are estimated to total 50 kW, but operate only 3,600 hours per operating year. Total electricity consumption would therefore be 643,800 kWh annually. At Rs.2 per kWh, annual electricity consumption would be Rs.1,287,600. On a quarterly basis, roughly Rs.360,000 would be required for power requirements, including both diesel and electricity.

Both diesel and electricity prices are assumed to increase at 2 percent real rates above the 10-percent general inflation rate. By the first quarter

of 1986, the period in which operations are scheduled to begin, the cost of power will have escalated approximately 18 percent. Instead of Rs.360,000 per quarter, Rs.425,000 per quarter would be required for power.

For the social cost/benefit analysis, we allotted 70 percent of the electricity expenditures to foreign sources, and 90 percent of the diesel purchases. On a weighted average, 72 percent of the power requirements were attributed to foreign sources. In both the financial and social cost/benefit analyses, power requirements can be found under the category "other operating period costs", which allows the impact of real increases in prices to be kept separate from other O&M expenditures.

Other O&M

On the margin, no additional O&M expenses are required. Chemical and water costs would be incurred regardless of the decision to retrofit or change boilers.

A summary of the operating and maintenance requirements for option 1, the boiler retrofit with a wood gasifier, is shown in Exhibit 2.c.

Energy Savings

TTM fuel consumption in 1983 was 569,505 imperial gallons, or roughly 2,518 tonnes of oil. Although TTM has three 6.8 tonnes/hr boilers, only one boiler must usually be operating, usually at 50 to 75 percent of rated capacity. On average, one boiler operates 300 days per year at 68 percent of rated capacity. Steam demand variations, however, require that a second boiler be used roughly 12 days every year.

The proposed wood gasifier is rated at 6.26 tonnes/hr of steam capacity based on the audit results, after implementation of the proposed "housekeeping" measures and will be able to fully meet the steam demand on most typical operating days. However, the use of wet wood in the gasifier will derate the boiler. The extent of derating depends on the water content of the wood that is being gasified. Although wood logs are available with a 45 percent water content, water content at the burner -- after chipping, conveying, and storage -- is likely to be much closer to 35 percent. At this moisture level, boiler derating should not exceed 15 percent.

Based on the size and reliability of the proposed gasifier, as well as the rather consistent 300-day annual operation of the mills, we estimate that 85 percent of TTM's current oil consumption can be saved by installing the wood gasifier. The balance (15 percent) will still be met by oil. Thus, the 2,518 tonnes of oil consumed annually would be reduced by 2,140 tonnes, or 535 tonnes of oil per quarter.

Exhibit 2.c

Summary of O&M Requirements for Option 1
(Boiler Retrofit, Wood Gasifier)
(Rs.000)

O&M category	Annual expense*	Quarterly expense*
Maintenance	1,172	293
Labor	420	105
Chemicals	N/A	N/A
Water	N/A	N/A
Power	1,700	425
Total	**3,292**	**823**

*Expenses in first quarter 1986. Total O&M is roughly 28 percent of direct capital costs annually.

N/A = not applicable.

SOURCE: Hagler, Bailly & Company.

The amount of wood necessary to replace the 2,140 tonnes of oil depends on the oil's heat content and the amount burned, the efficiency of the oil boilers, and the heat content of the wood and efficiency of the wood gasifier. The oil-fired boilers are 84.1 percent efficient with a calorific value of 10,500 K/kg. The calorific value of the wood, as well as the efficiency of the boiler, depends on the water content of the wood (see Exhibit 2.d). Based on these figures, we conservatively estimate that 11,500 tonnes of wood with 45-percent water content must be purchased annually to replace the 2,140 tonnes of oil. TTM would then burn 11,500 tonnes of wood and 378 tonnes of oil annually.

OPTION 2: NEW MULTIFUEL WOOD/OIL BOILER

This new multi-fuel boiler, sized at 15,000 lb/hour maximum steam demand (MSD), was assumed to be a conventional grate stoker boiler with associated handling and storage facilities.

Investment Cost

Total investment cost for this option is estimated at Rs.26.9 million (Rs.1,793/lb/hour or U.S. $71.70/lb/hour), based on a series of price quotations reviewed in Sri Lanka and other quotations received from U.S. and European manufacturers. Of this Rs.26.9 million, Rs.4.42 million -- 16.4 percent -- are designated as engineering and design costs. A detailed cost breakdown is shown in Exhibit 2.e. The schedule for capital disbursements covers six quarters (see Exhibit 2.f).

Operation and Maintenance

Operation and maintenance costs considered here are those costs above the O&M costs of the existing oil-fired boilers. They consist of any additional labor, power, chemicals, water, electricity, and spare parts that are required. We estimated the O&M costs as of third quarter 1984; however, in our financial analysis, these values were escalated to reflect expected inflation.

Labor. Solid fuel-fired boilers need more manpower than oil-fired boilers because of the more complex combustion and storage, handling, loading, and ash handling systems. In this case, an additional qualified boiler operator would be needed at Rs.2,500 per month and an additional fuel loader/operator at Rs.2,000 per month. Because the plant operates three shifts, corresponding additional expenditures would be Rs.22,500 and Rs.18,000 per quarter, respectively. In addition, one manager will be required to supervise multifuel boiler operation, fuel purchasing (wood), and fuel handling and storage (Rs.5,250/month x 3 months = Rs.15,750) and one additional maintenance technician per shift will be needed (at a cost of Rs.2,250 per month x 3 months x 3 shifts, or Rs.20,250 per quarter).

Exhibit 2.d

Fuel Requirements for Wood Gasifier

Water content (percent)	Calorific value (K/kg)	Boiler efficiency (percent)	Annual wood requirements (tonnes)[1]
45	2,300	67.0	12,290
40	2,570	67.8	10,860
35	2,840	68.6	9,725[2]
30	3,110	69.3	8,785
25	3,380	70.0	8,010
Oven dry	4,728	72.0	5,570

[1]Based on replacing 2,140 tonnes of oil annually (10,500 K/kg) in boilers that are 84.1 percent efficient.

[2]The gasifier is assumed to use 9,725 tonnes of wood with a 35-percent water content annually, but the amount of 45-percent water content wood that must be purchased is (0.65/0.55)(9,725) = 11,500 tonnes, or 2,875 tonnes per quarter.

SOURCE: Hagler, Bailly & Company.

Exhibit 2.e

Capital Outlays for Options 2 and 3

Cost element	Wood/oil multifuel boiler*
Equipment	
Boiler	6,895
Water treatment	622
Fuel handling and storage	2,935
Stack	876
Other	876
Total	12,204
Installation	
Boiler	4,134
Building	700
Foundation	876
Other	954
Total	6,664
Contingency on boiler system	3,642
Engineering/design for boiler system	4;416**
Total cost for boiler system	26,926

*In real Rs.(000).

**Includes system start-up and testing costs. Engineering and design costs for option 3 (coal/oil boiler) are estimated to be Rs.4.88 million, the only difference between capital outlays for options 2 and 3.

SOURCE: Hagler, Bailly & Company.

Notes to Exhibit 2.e

OPTION 2

Equipment

Comprising:

- 1 multi-fuel boiler
- 1 evaporator system
- 1 economizer
- Valves and accessories comprising 3 steam safety valves, all isolating, drain, and vent valves as required
- Firing equipment for solid fuel
- Vibrating grate stoker, complete.

or:

- Chain grate stoker, complete.
- In all cases with necessary hoppers, lighting systems, primary and secondary air distributions systems, etc.

plus:

- The option of fitting a pneumatic conveyor system for particulate fuels such as sawdust, chipped wood, and dried coir dust. Manual feed of solid fuels instead of mechanical feeding arrangements would be acceptable in Dutch oven type M/F boilers with underground furnaces.
- Solid fuel handling and storage system comprising conveying systems from storage locations to boiler.

Installation

Building: A single-story concrete-floored building with provisions for underground furnace where necessary. Floor area to be approximately 1,500 square feet.

Foundation: Reinforced concrete foundation for placement of boiler and accessories.

Boiler Installation

For hire of cranes and lifting equipment, to construct underground furnace, additional parts required, etc.

Exhibit 2.f

Schedule of Disbursements, Option 2
(Rs.000)*

Engineering and design cost

	3Q 1984	4Q 1984	1Q 1985	2Q 1985	3Q 1985	4Q 1985	Total
Percent	7.8	14.3	14.3	19.0	14.3	30.4	100.0
Real	344	630	630	840	630	1,342	4,416
Current	344	646	661	903	694	1,510	4,758

Direct capital cost

	3Q 1984	4Q 1984	1Q 1985	2Q 1985	3Q 1985	4Q 1985	Total
Percent	28.3	25.6	23.5	14.6	6.2	1.9	100.0
Real	6,371	5,754	5,290	3,287	1,387	421	22,510
Current	6,371	5,898	5,555	3,533	1,526	474	23,357

*For option 3 (coal/oil multifuel boiler), the only difference is a slightly higher engineering/ design cost of Rs.4.88 million in real terms, or Rs.5.29 million in current terms.

SOURCE: Hagler, Bailly & Company.

Total additional labor cost comes to Rs.76,500 per quarter (as of the third quarter of 1984; by the time the new boiler begins operation in the first quarter of 1986, we estimate that this value will have escalated to Rs.86,000).

Power. Additional power will be needed for fuel handling and the induced draft fan on the boiler. We assumed that 110 kW will be needed (80 kW for wood handling and 45 kW for the fan). At Rs.2/kWh (including incremental demand charge), total additional electricity costs are estimated at Rs.396,000 per quarter (1,800 hr/quarter). By the beginning of operation, this value will have escalated to Rs.475,000.

Chemicals and water increase only moderately, because of the greater heating area. We have estimated additional costs at Rs.60,000/quarter. Again, with escalation, the value would be about Rs.68,000 at the beginning of operation.

Electricity requirements are 250,000 kWh per quarter at a price of Rs.2/kWh, or Rs.5000,000 (escalated to Rs.576,000 by the beginning of operations).

Spare parts. The cost of additional spare parts is assumed to be 6 percent of initial capital cost per year or about Rs.502,000 per quarter at the beginning of operations (see Exhibit 2.g).

Fuel Savings

The proposed new multifuel boiler would run primarily on wood, but could also use oil if there were any problem with wood supply (e.g., wood handling breakdown, delay in delivery). For the purpose of the analysis, we assumed that the multifuel boiler would operate 85 percent of the time on wood and 15 percent of the time on oil. As the multifuel boiler could not operate the full year, however, we assumed that 15 percent of the plant's steam demand would be met using the existing boilers. Consequently, the multifuel boiler would save 15 percent less oil than the wood gasifier, or 455 tonnes per quarter. Wood requirements at 45-percent water content would be 1,740 tonnes per quarter.

OPTION 3: NEW MULTIFUEL BOILER BURNING COAL AND OIL

This new multifuel boiler option is similar to option no. 2, as we assumed that the same system could be used to burn wood pellets and coal, depending on local availability and prices.

Exhibit 2.g

Summary of O&M Requirements for Options 2 and 3
(Multifuel Boilers)
(Rs.000)

Operating and maintenance expense for first operating period (1Q 1986):	
Labor	86
Electricity	475
Water and chemicals	68
Spare parts	502
Other	225
Total	**1,346**

SOURCE: Hagler, Bailly & Company.

Investment Costs

Total investment cost for the coal option is estimated at Rs.27.4 million, or slightly higher than option no. 2, of which Rs.4.9 million are earmarked for engineering and design (see Exhibit 2.e for detailed breakdown). Compared with the wood option, fuel handling and storage are cheaper but overall boiler cost is higher because of particulate (baghouse) and ash removal requirements.

Operation and Maintenace Costs

Identical to option no. 2 (see Exhibit 2.g).

Fuel Savings

Based on an 85/15 split for coal and oil firing, with 85 percent of the plant's steam demand being met by the coal/oil boiler, quarterly coal consumption would be 635 tonnes and quarterly oil consumption would be reduced by 455 tonnes.

3 FINANCIAL ANALYSIS

In this chapter, we present our financial analysis of the three options for improving energy efficiency at the Thulhiriya Textile Mills:

1. New wood gasifier
2. New multifuel (wood/oil) boiler
3. New coal-fired boiler (stoker or fluidized-bed).

The purpose of the analysis is to evaluate the probable financial effect on TTM of undertaking any of the three options and thereby assist Thulhiriya's management in deciding on implementation. In addition, the analysis is intended to assist in designing an appropriate financial structure for a project and in acquiring necessary external financing.

In undertaking the financial analysis, we projected the incremental cash flows to TTM from undertaking a project. Our projections are based on the expected technical performance of the project and incorporate detailed information on the timing and level of the cash outlays required and the subsequent cash returns and expenses associated with project operation. We conducted the financial analysis in current rupees and thus incorporated expected general inflation in the economy (at 10 percent annually) and real changes in the price levels of specific commodities (e.g., oil prices are expected to grow at a real rate of 2 percent annually or approximately 12 percent in nominal terms). Our analyses are made on a quarterly basis over a period beginning in the third quarter of 1984 and extending for 10 years through the second quarter of 1994. They incorporate relevant provisions of the Sri Lankan tax code and reflect institutional considerations regarding the availability and cost of debt financing.

To evaluate the expected financial performance of a project, we calculated conventional measures of performance, including the present value of after-tax cash flows (at a discount rate of 20 percent), the internal rate of return (i.e., the discount rate at which the present value of project after-tax cash flows equals zero), and the simple payback period (i.e., the length of time required for the cumulative cash flows associated with a project to become positive).

In addition to analyzing the expected financial effect of a project on TTM, we also considered the current financial performance and condition of TTM as a basis for understanding its likely ability to finance the project.

In the following sections, we first discuss the financial and tax circumstances of the Thulhiriya Textile Mills. Next, we review the financial structure and financing requirements for each of the three project options.

Finaliy, we present the results of our analyses of project performance, including sensitivity analyses on such parameters as the value of energy savings, project capital cost, and interest rate on project debt.

FINANCIAL STRUCTURE AND PROJECT PERFORMANCE

On the basis of our review of TTM's financial condition and discussions with TTM financial officials and representatives of Sri Lankan financial institutions, we determined that TTM should be able to achieve a relatively high degree of debt financing in undertaking an energy efficiency project. Accordingly, for our analyses, we assumed that projects would be financed with 80 percent debt and 20 percent cash equity. It is possible that the debt fraction of project financing could be higher than 80 percent; indeed, TTM may be able to obtain essentially 100 percent debt financing for a high quality energy efficiency project. In analyzing a project's financing requirements, we scheduled the equity contributions and debt funding so that the project maintains a 80 percent debt/20 percent equity structure throughout the development period to the beginning of project operation.

From our discussions with financial institutions, we determined that TTM should be able to obtain credit at an interest rate of 14 percent, with a repayment period of up to 8 years following the beginning of project operation. It is also probable that TTM will be able to obtain a moratorium on principal repayment during the first year of project operation. Accordingly, in our analyses, we used debt terms of a 14-percent interest rate, a 1-year principal payment moratorium, and an 8-year debt repayment period. Interest is accrued and paid during construction and the first year of project operation. Allowance for interest payments during the development period is included in the estimation of a project's total financing requirements.

The development period outlays and financing requirements for each of the three project options are summarized in Exhibit 3.a. The account "Engineering/Design Cost" includes the project design and engineering expenses and the startup expenses that are incurred during the beginning of a project's operation. We assumed that all of these costs could be expensed for tax purposes and accordingly would create a tax credit during the development period (i.e., we assumed that TTM would be taxed at a 25 percent rate on marginal income and have sufficient income tax liability elsewhere to allow full, current deduction of the development period expenses and any operating period losses). Project capital cost includes the cost of purchasing and installing the capital equipment and facility improvements required for a project. We assumed that 50 percent of these outlays could be depreciated over an 8-year period and the remaining 50 percent over a 4-year period. No capital outlays were expensed for tax purposes. All interest charges during project development were expensed.

Total project cost, excluding development period interest, varies from a low of Rs.10.8 million for option no. 1 (wood gasifier) to a high of Rs.28.6

Exhibit 3.a

Thulhiriya Textile Mills: Development Period Outlays and Financing Requirements for the Three Project Options (in current Rs.000)

	Project options*		
	Option 1	Option 2	Option 3
Development begins	3Q 1984	3Q 1984	3Q 1984
Operations begin	1Q 1986	1Q 1986	1Q 1986
Engineering/design cost	1,2431**	4,758	5,285
Capital cost	9,598	23,357	23,357
Total direct cost	10,841	28,115	28,642
Development period interest	782	2,610	2,610
Total development period financing required	11,623	30,725	31,252
Debt required	9,298	24,580	25,002
Equity contributed	2,325	6,145	6,250

*Option 1 = boiler retrofit with wood gasifier.
Option 2 = new multifuel boiler burning wood and oil.
Option 3 = new multifuel boiler burning wood and coal.
**Very conservative. The gasifier system can be operating in the third quarter of 1985.

NOTE: Totals may not agree with the sum of components owing to rounding error.

SOURCE: Hagler, Bailly & Company.

million for option no. 3 (multifuel boiler, coal/oil). Development period interest follows a similar pattern, ranging from a low of Rs.782 thousand for option no. 1 to Rs.2.6 million for options nos. 2 and 3. Project debt is 80 percent of total development period outlays and varies from Rs.9.3 million for option no. 1 to Rs.25.0 million for option no. 3. The required equity contribution at the 20 percent equity structure varies from Rs.2.3 million to Rs.6.3 million (for a more detailed delineation of the development period outlays and analysis of financing requirements by quarter, see the Development Period Financial Summary for each of the project options in Appendix E).

FINANCIAL ANALYSIS OF PROJECT PERFORMANCE

We undertook a detailed cash flow analysis for each of the three project options (see Exhibit 3.b). Of the three options, only option no. 1 -- wood gasifier boiler retrofit -- exhibits positive financial returns. The wood gasifier boiler retrofit had an internal rate of return (IRR) of 75.8 percent, while the internal rates of return for option no. 2 and no. 3 were negative. Consequently, only option no. 1 will be discussed further.

The cumulative cash flows for option no. 1 become positive in the second quarter of 1987, 12 quarters after the beginning of cash outlays and **in the sixth quarter of operation.** The present value of the after-tax cash flows, when discounted at 20 percent, was Rs.5.6 million. In no operating quarter was the cash flow for option no. 1 negative. The cumulative cash flow for the analysis period reached Rs.20.3 million.

In addition to the base or expected case analysis, we carried out a sensitivity analysis of the key variable affecting the financial performance of option no. 1. In the analysis, we changed such parameters as the value of energy saved (plus and minus 10 percent), project capital costs (plus and minus 10 percent), and the interest rate on debt (plus and minus 2 points).

The results indicate that variations in the expected energy savings for option no. 1 have the greatest effect on the project's internal rate of return (see Exhibit 3.c). If the value of the energy saved is 10 percent less than expected, the internal rate of return will decrease to 31.0 percent. The energy savings would be lower if, for instance, the performance of the gasifier was below expectations, the cost of wood was higher than that used in the analyses, or oil prices did not escalate at the anticipated real rate of 2 percent annually. On the other hand, if energy savings were 10 percent greater than expected, the project's IRR would increase to 115.7 percent. On the other hand, the project's financial performance is not very sensitive to slight fluctuations in either direct capital costs or debt interest rates.

Although these analyses assume financing at 80 percent debt, 20 percent equity, we studied the financial attractiveness of the project at lower debt levels. At 60/40 debt/equity, the base case internal rate of return

Exhibit 3.b

Thulhiriya Textile Mills: Financial Performance
for the Three Project Options
(in current Rs.000)

	Project options*		
	Option 1	Option 2	Option 3
Development begins	3Q 1984	3Q 1984	3Q 1984
Operations begin	1Q 1986	1Q 1986	1Q 1986
Last analysis period	2Q 1994	2Q 1994	2Q 1994
Total development period outlay (includes interest during development)	11,623	30,724	31,251
Present value of after-tax cash flow at 20%	5,581	(9,377)	(12,489)
Internal rate of return on after-tax cash flow (%)	75.8	(100+)	(100+)
Quarter in which cumulative cash flow becomes positive	2Q 1987	None	None
Number of quarters from beginning of outlays to simple payback	12	N/M	N/M
Cumulative cash flow for analysis period	20,337	(16,742)	(25,927)
Number of operating period quarters with negative cash flow	0	34 of 34	34 of 34
After-tax cash flow in: 4Q 1986	406	(201)	(355)
2Q 1989	502	(497)	(726)
4Q 1991	793	(306)	(628)
2Q 1994	1,271	(209)	(660)

*Option 1 = boiler retrofit with wood gasifier.
Option 2 = new multifuel boiler burning wood and oil.
Option 3 = new multifuel boiler burning wood and coal.

N/M = not meaningful.

SOURCE: Hagler, Bailly & Company.

Exhibit 3.c

Sensitivity Analysis for Option 1,
Boiler Retrofit with Wood Gasifier
(Internal rate of return, %)

	Less than expected	Greater than expected
Energy savings (+/- 10%)	31.0	115.7
Direct development costs (+/- 10%)	86.1	67.1
Interest rates (+/- 2 points)	80.1	71.4

Base case internal rate of return: 75.8 percent.

SOURCE: Hagler, Bailly & Company.

of the project falls from 75.8 percent to 46.2 percent. If, for the 60/40 debt/equity case, the energy savings were 10 percent less than expected, the IRR of the project would fall to 21.9 percent.

The sensitivity of the IRR to the project's leverage is not unexpected. As long as the after-tax cost of debt is lower than the project's IRR, increased borrowing will naturally raise the internal rate of return. At high debt/equity levels and a 1-year moratorium on the debt principal, it is possible to obtain very quick paybacks because only the interest payments need be covered by the cash savings of the project.

As a result of these analyses, we recommend that TTM management consider the installation of a wood gasifier to replace the oil-fired burners currently being used.

4 ECONOMIC ANALYSIS

In addition to evaluating the probable financial performance of the three options for improving energy efficiency at TTM, we also evaluated the probable effects of the three options from the perspective of the Sri Lankan economy. This evaluation encompassed two analyses: an evaluation of the costs and benefits to Sri Lankan society of undertaking the efficiency improvements and an analysis of the options' foreign currency requirements.

Evaluating projects by a social cost/benefit analysis is important for understanding the general economy-wide effects of a project (as opposed to the financial effects on TTM). In undertaking the social cost/benefit analysis, we considered only the real economic costs and benefits to Sri Lanka and, as a result, did not account for such items as tax and tariff payments (which are only transfer payments within the Sri Lankan economy and do not represent a real cost of using a productive resource). In addition, it is possible that the cost to the economy of using a productive resource differs from the cost to a firm. For example, if the labor required for an efficiency project is supplied from a pool of previously unemployed people, then the cost to the economy of using that labor, as measured by the production value in an alternative application (i.e., unemployment), may be considerably less than the price paid by a firm in using the labor.

Another price for which the social value is usually different from the firm's price is the price of capital, or the cost of deferring current consumption in return for (presumed) increases in future income and consumption. In a financial analysis, the price of capital is accounted for in the interest cost of debt and the firm's required return on equity. However, in a social cost/benefit analysis, the appropriate measure of the cost of deferring current consumption is the social discount rate, which for many societies is less than the private price of capital. As a result of these differences, the social cost/benefit evaluation of a project may differ significantly from the firm's financial evaluation of that project.

The foreign currency effects of an energy efficiency improvement project are also important. If a project has a large net requirement for foreign currency, implementation of the project may contribute to a deterioration in the country's terms of trade with other countries. Such a deterioration will increase the quantity of a country's own goods and services that must be exchanged in importing a fixed quantity of goods and services from other countries and will generally reduce the value of goods and services that may be produced and purchased by an economy on a current basis.

In contrast, if a project is a large net generator of foreign currency (i.e., if it increases exports or reduces import requirements), it will generally

improve the terms of trade and lead to a higher value of production and consumption in the economy. Energy efficiency projects often have a beneficial effect on foreign currency requirements because such projects often reduce the consumption of imported oil or substitute consumption of a locally available energy resource (e.g., wood) for imported oil. Again, because of the difference in perspective and analytic methods, the evaluation of the foreign currency effects of competing projects may differ from their financial evaluation.

To illustrate the importance and potential use of the social cost/benefit and foreign currency requirements analyses, consider the following example. Because the results of a social cost/benefit and foreign currency requirements analysis may differ from those of a financial analysis, a country may find that one project preferred by a firm is less advantageous from the social perspective than another project. In this case, the country might wish to subsidize the return provided by the more socially advantageous project to induce the firm to adopt that project instead of pursuing the more financially lucrative project.

In the following sections, we present our social cost/benefit analyses of the five options for improving energy efficiency and then review the foreign currency requirements of each option.

SOCIAL COST/BENEFIT ANALYSIS

An important difference between the social cost/benefit analysis and the financial analysis is that we used constant or uninflated values (as of mid-1984) in the former and current or inflated values in the latter. Accordingly, the values for specific accounts are not strictly comparable except in 1984. Numerically, constant and current values differ in that all current values have a general inflation rate of 10 percent. Certain account values are assumed to have real growth rates other from zero (i.e., the current values for these accounts will grow at a rate other than 10 percent). These accounts and their real growth rates are: oil, 2 percent; coal, 1 percent; and electricity, 2 percent.

As appropriate, in undertaking the social cost/benefit analysis, we substituted social values for the market or posted values that were used in the financial analysis. The following adjustments were applied to estimate the social values:

- **Imported oil.** The incremental value of imported oil to the Sri Lankan economy depends on whether the oil reduces or increases consumption of residual oil, which is currently in excess supply from domestic refining and must be exported. Thus, the social value of imported oil (Rs.3,602 per tonne, fourth quarter 1984) is approximately 25 percent less than the current posted price (Rs.4,922 per tonne, fourth quarter 1984).

- **Wood.** Based on discussions with the Forestry Department and the State Timber Corporation, it appears that more wood will be available from Mahaweli clearings than the market can absorb, at least until 1990. Because the quantities are large and cannot be stored for more than 6-8 months, industrial users are prime candidates for this fuel. We thus considered the opportunity cost of fuelwood to industry to be the cost of removal from the site, loading, transportation, unloading, and preparation. Based on the above discussions, this total cost is about Rs.500/tonne. After 1990, this opportunity cost will equal the cost of producing fuel wood (eucalyptus or Ipil-Ipil) from plantations plus delivery and preparation. This cost is currently assumed to be Rs.700/tonne for delivery at Thulhiriya.

- **Coal.** The opportunity cost of coal is the border price (U.S. $50/tonne) plus the cost of unloading and transportation (U.S. $5/tonne) on the average). Consequently, the shadow price of coal is Rs.1,347.5/tonne (85 percent of market).

- **Electricity.** To estimate the social value of electricity, we separated its cost by foreign and domestic content (70 percent foreign/30 percent domestic). The social value of the foreign content was set at its purchase price, and the social value of the domestic content was valued at 90 percent of its purchase price. As a result, the social value of electricity was 97 percent of its purchase price.

- **Other imported goods and services.** Other imported goods and services were valued at their purchase price less any tariff.

- **Other domestically provided goods and services.** Other domestically provided goods and services (e.g., labor) were valued at 90 percent of the local price.

- **Price of capital.** A real social discount rate of 10 percent was used in the analysis.

On the basis of our social cost/benefit analysis, we found that all three options had negative present values of net social benefits (see Exhibit 4.a). Option no. 1, the wood gasifier, had the highest present value of net social benefit -- Rs.-8.6 million. The multifuel boilers, wood/oil and coal/oil, had present values of net social benefits of Rs.-28.9 million and Rs.-43.4 million, respectively.

The negative values for the wood gasifier can be explained in part by the fact that the project's financial attractiveness stems mainly from the tax shelters that it provides at high debt/equity ratios. In the social

Exhibit 4.a

Thulhiriya Textile Mills: Social Cost/
Benefit Analysis for the Three Project Options
(in current Rs.000, mid-1984)

	Project options*		
	Option 1	Option 2	Option 3
Development begins	3Q 1984	3Q 1984	3Q 1984
Operations begin	1Q 1986	1Q 1986	1Q 1986
Last analysis period	2Q 1994	2Q 1994	2Q 1994
Total development period costs	9,331	25,079	25,601
Total operating period benefits	32	(8,306)	(34,585)
Present value of net social benefits at 10%	(8,563)	(28,947)	(43,404)
Operating period net benefits/ development period net costs	0	(0.33)	(1.35)
Quarter in which cumulative net benefits become positive	N/M	N/M	N/M
Cumulative net benefits for analysis period	(9,299)	(33,385)	(60,186)
Net benefits in: 4Q 1986	63	(228)	(518)
2Q 1989	21	(238)	(828)
4Q 1991	(28)	(252)	(1,245)
1Q 1994	(87)	(268)	(1,802)

*Option 1 = boiler retrofit with wood gasifier.
Option 2 = new multifuel boiler burning wood and oil.
Option 3 = new multifuel boiler burning wood and coal.

N/M = not meaningful.

SOURCE: Hagler, Bailly & Company.

cost/benefit analysis, taxes and similar transfer payments internal to the Sri Lankan economy are not considered.

The high efficiency of the existing oil-fired boilers means that less oil can be saved than would be possible with less efficient equipment. While the wood fuel is far less expensive than oil on an equivalent energy basis, the additional costs associated with fuel handling -- foreign spare parts and a substantial quantity of electric power (shadow price being about double of market price) -- essentially negate the social benefits of the wood gasifier. As a result of these factors, together with the high foreign component of the equipment and the installation costs, negative net social benefits could not be avoided under the assumptions used in these analyses.

In the cases of the wood gasifier and the multifuel boilers, labor can be substituted for equipment and electricity requirements in the fuel handling and storage areas of the project. Valuing labor at 90 percent of its local cost is conservative; if labor were obtained from the ranks of the unemployed, its social marginal cost might be zero. A further investigation of the substitution of labor for capital and its effect on the financial and social attractiveness of the projects may be warranted, and it is clear that several possibilities exist to make the net present social value positive.

FOREIGN CURRENCY REQUIREMENTS ANALYSIS

To analyze the foreign currency effects of each project, we first estimated the foreign currency content of each project's cash flow account. These values are summarized in Exhibit 4.b. Next, we used these values, together with the cash accounts from the financial analysis, to develop foreign currency use/displacement accounts for each of the project options. Like the financial analysis, the foreign currency requirements analysis was conducted in current rupees (i.e., including the effects of general inflation). Accordingly, the foreign currency use/displacement values reflect the actual monetary flows that would be expected if a project were undertaken.

On the basis of this analysis, we found that the wood gasifier and the multifuel wood/oil boiler are net generators of foreign currency (see Exhibit 4.c). The coal/oil multifuel boiler is a net user of foreign currency. These results are not unexpected. In the case of the gasifier and wood/oil multifuel boiler, imported oil is being replaced by a domestic fuel. In the case of the coal/oil multifuel boiler, both fuels come from foreign sources.

Option no. 1 achieves the highest present value (at a discount rate of 10 percent) of net reduction in foreign currency requirements (Rs.59.5 million), followed by option no. 2 at a net reduction of Rs.17.5 million. Option no. 3 increases foreign currency requirements by Rs.13.4 million.

Exhibit 4.b

Thulhiriya Textile Mills: Foreign Currency Content of Specific Accounts for the Three Project Options (Foreign content in percent)

Account	Project options*		
	Option 1	Option 2	Option 3
Engineering/design cost	75.0	75.0	75.0
Capital cost	80.0	80.0	80.0
Operating and maintenance expense	60.0	60.0	60.0
Oil saved	90.0	90.0	90.0
Energy consumed in place of oil (if relevant)	Wood	Wood	Coal
Energy produced (if relevant)	N/R	N/R	N/R

*Option 1 = boiler retrofit with wood gasifier.
Option 2 = new multifuel boiler burning wood and oil.
Option 3 = new multifuel boiler burning wood and coal.

N/R = not relevant.

SOURCE: Hagler, Bailly & Company.

Exhibit 4.c

Thulhiriya Textile Mills: Foreign Currency Requirements Analysis for the Three Project Options (in current Rs.000)*

	Project options**		
	Option 1	Option 2	Option 3
Development begins	3Q 1984	3Q 1984	3Q 1984
Operations begin	1Q 1986	1Q 1986	1Q 1986
Last analysis period	2Q 1994	2Q 1994	2Q 1994
Foreign currency required in development period	9,232	24,320	25,601
Foreign currency required in operating period	(122,061)	(75,029)	(34,585)
Present value of foreign currency requirement at 10%	(59,498)	(17,491)	(13,464)
Quarter in which cumulative foreign currency requirement becomes negative	1Q 1987	2Q 1990	N/M
Cumulative foreign currency requirement for analysis period	(112,830)	(50,710)	(3,678)
Foreign currency use in: 4Q 1986	(2,197)	(1,036)	51
2Q 1989	(3,062)	(1,753)	(347)
4Q 1991	(4,226)	(2,739)	(920)
2Q 1994	(5,782)	(4,076)	(1,721)

*Values include general inflation at 10% p.a.); positive values indicate use of foreign currency; negative values indicate generation of foreign currency.

**Option 1 = boiler retrofit with wood gasifier.
Option 2 = new multifuel boiler burning wood and oil.
Option 3 = new multifuel boiler burning wood and coal.

N/M = not meaningful.

SOURCE: Hagler, Bailly & Company.

Appendix A ENERGY AUDIT REPORT SUMMARY

Reliance Energy Services

EXECUTIVE SUMMARY

This report details energy cost savings at Thulhiriya Textile Mills identified during an energy audit training program. The audit training program was jointly sponsored by EDMAC and USAID and completed in March, 1984.

The potential savings identified in this report represent Rs 2.24 million per year based upon first quarter 1984 marginal costs. This is equivalent to an overall energy use reduction of 9.1% when compared to 1983.

The savings can be categorized in two distinct areas. One area is housekeeping measures or alternatively measures that have simple paybacks under one year.

The second area is capital intensive measures or those measures with simple paybacks in excess of one year.

Savings due to housekeeping represent some RS 1.38 million or 6.5% of 1983 usage. These items are usually easy to implement and it is understood from discussions held with plant management in May, 1984 that they have taken steps to implement or have already implemented these items.

Capital intensive measures can save a further Rs 0.86 million but require a capital investment of Rs5.44 million. The payback periods for all of these items is in excess of four years, some have very much greater paybacks. These measures should be considered with respect to any other capital measures that the company may be planning to improve productivity or modernization before any definite decision is made to implement.

The training program began with a classroom session, lasting two days. The purpose of this session was to instruct course participants in the use of portable instrumentation, and in the data collection and test procedures. During the ten days of site work, the engineers were responsible for testing the wide range of equipment within the plant, including the boiler and ancillary equipment, dryers, process equipment, motors and ventilation systems.

Reliance Energy Services

EXHIBIT I

SUMMARY OF MEASURES

ITEM	Energy Saved GJ*	Cost Saved Rs.	% Savings GJ	% Savings Rs.	Implementation Cost/Rs.	Simple Payback ('
Housekeeping Measures						
Steam Pipe Insulation	151	17,446	0.9	0.8	15,000	0.9
Steam Leaks	1,402	161,496	8.4	7.2	40,000	0.3
Steam Traps	933	107,472	5.6	4.8	42,000	0.4
Condensate Recovery	7,032	810,016	41.9	36.0	100,000	0.1
J-Box Temp Control	1,824	210,107	10.9	9.4	150,000	0.7
Printer Improvements	615	70,842	3.7	3.2	20,000	0.3
Total House-keeping	11,957	1,377,379	71.4	61.4	367,000	0.3
Capital Inten-sive Measures						
Stenter Heat Recovery	2,456	282,907	14.6	12.6	1,250,000	4.4
Replace MG Sets	257	105,616	1.5	4.7	1,050,000	9.9
Load Management	217 KVA	234,360	-	10.5	1,125,000	4.8
Printer Heat Recovery	1,785	205,614	10.6	9.2	1,875,000	9.1
Flash Steam Recovery	314	36,170	1.9	1.6	150,000	4.1
Total Capital Intensive Measures	4,812	864,667	28.6	38.6	5,440,000	6.3
Total All Measures	16,769	2,242,046	100.0	100.0	5,817,000	2.6

*GJ = 10^9 x Joules

The balance of the training program consisted of the analysis of the collected data, formulation of energy conservation strategies, and calculation of the savings possible by implementation of the recommended measures.

The energy savings can be achieved by implementation of the projects identified during the course of the audit and data analysis sessions. These projects range from the repair of such obvious sources of waste as steam leaks, to heat cascading and recovery projects involving some capital expense.

In order to identify the areas where improvement in energy utilization are possible, the plant was analyzed in the following manner:

A visual inspection of the plant was conducted to familiarize the auditors with the basic layout of the plant, and to identify the most obvious sources of waste. This was followed by the collection of readily available energy related data.

This Preliminary Energy Audit (PEA) included collection of the following types of information:

- energy use by fuel type and source delivered
- energy costs
- inventory of major energy consuming equipment in the plant
- operating schedules for the major departments in the plant
- details on currently practiced energy management programs
- information on energy conservation projects being considered, underway, or previously implemented

The PEA data was used to develop a plan for the instrumented testing of major energy consuming process equipment. This equipment was then tested to determine the level of energy waste and the amount of energy that could be usefully recovered.

To ensure full audit coverage of the plant, the plant was divided into a number of discrete areas. Each team of audit engineers was responsible for conducting tests on equipment in each of the areas. The areas were:

- o blowing and carding departments
- o ring spinning department
- o sizing and weaving department
- o finishing department
- o boiler plant and steam distribution and condensate return systems
- o electrical distribution and motors
- o lighting and environmental system
- o compressed air systems

These areas comprise the major process and service functions within the plant.

Analysis of the data collected enabled the identification of the potential for energy conservation available. This was followed by the formulation of strategies to achieve the energy savings. Each strategy was then further analyzed to estimate the implementation cost required to achieve the savings. The analysis of the implementation and cost savings enable the development of an energy conservation action plan.

The major findings and recommendations of this study are as follows:

- o Thulhiriya Textile Mills is engaged in the production of finished textile products, yarn, sized beams and greige goods. The plant operates on a three-shift per day basis (although some departments and processes operate on a two-shift per day basis), six days per week, exclusive of holidays. The plant is in operation for a total of about 300 days per year.

- A number of steam and condensate leaks were identified. These should be repaired immediately. In addition, some pipework insulation was found to be missing or damaged; this should be replaced.

- The steam distribution and condensate return systems were found to be in generally good condition. About half of the steam traps tested were found to be inoperative and passing live steam. These traps should be repaired or replaced, and a regular steam trap maintenance program instituted.

- Numerous steam leaks were found in the sizing room. These should be repaired immediately. In addition, there is an opportunity for energy savings by installation of a pocket ventilation system, using sizer exhaust air heat recovery, to improve the drying efficiency of the sizing machines.

- The J-box scour range was found to be overheated. The installation of thermostatically controlled steam valves is recommended.

- Recovery of heat in exhaust air from the stenters and printers is recommended. The exhaust air can be used to preheat incoming air and reduce steam requirements for drying. In addition, the volume of exhaust air from the printers was found to be excessive, and should be reduced. Flash steam can be recovered from stenter condensate and used to provide at least part of the requirement of the steam ager.

- Electricity consumption has been reduced by about 35% by shutting down the chilled water plant.

- Plant power factor is maintained at 99% by an automatic capacitor bank located at the incoming service; no further

- Electricity is used to provide motive power for motors and accounts for approximately 42% of the total energy consumed on site. Fuel oil is used to raise steam in the boiler plant for process heating and drying, and accounts for approximately 58% of the energy consumed on site. Small amounts of diesel fuel and petrol are also used.

- Electricity accounts for approximately 70% of the annual energy cost expenditure; fuel oil accounts for the balance.

- The plant has established an energy management program, which is headed by the Deputy Chief Engineer. The program has identified a number of areas where energy use could be reduced, and these projects have been implemented. A more formal program is required, however, especially in the area of energy use monitoring, and the establishment of energy use targets by process area.

- The boiler plant was found to be operating very efficiently, especially considering the lack of automatic controls and instrumentation. Boiler efficiency was calculated to be 84.1%. Improvements can be made in the maintenace of boiler water total dissolved solids (TDS) levels, by purchase and use of a conductivity meter. Little improvement to the boiler plant can be made economically by changes in burners, etc. Opportunity exists to reduce overall steam production costs by fuel substitution. This item is the subject of a feasibility study which was conducted in parallel to the audit as part of IECP Phase II.

- According to measurements taken during the audit, only about 16% of the steam from the boiler is returned as condensate. Management believes this is not typical, condensate return normally being around 40-50%. A number of areas have been identified where condensate is being lost. It is recommended that this loss be eliminated by return of condensate to the boiler.

improvement to the power factor is required. Peak electric demand can be controlled somewhat by shedding non-essential loads when the peak is approached. This would be accomplished by use of an automatic load controller, interfaced with the utility electric meter.

- Lighting levels were found to be significantly lower than recommended standards. Delamping in many areas have accomplished this. As the lighting levels appear to be adequate for production purposes, no further improvements are recommended.

- A number of motor generator sets are used to drive large motors. Since these are relatively inefficient replacement by thyristor rectifiers can further reduce electricity consumption and demand.

As a first step in implementing the measures identified, a three phase action plan has been developed. This plan has been developed based on the relative savings and costs associated with each energy conservation measure, and is shown in Exhibit 2.

Phase I of the program includes those items which are relatively low in cost, and have payback periods of less than one year. Because of the rapid return on investment, these items should be implemented immediately. Projects included in Phase II and Phase III have higher capital investments associated with them, and the payback periods range from four to ten years. Because of the longer payback periods, these projects should be considered for implementation within the framework of future capital programs that the management may be considering for productivity amd modernization.

EXHIBIT 2

IMPLEMENTATION ACTION PLAN

Phase I

- Repair all steam leaks
- Insulate pipework
- Institute a steam trap maintenance program
- Return condensate to the boiler
- Reduce exhaust from printers
- Fit temperature control to J-box

Phase II

- Fit flash steam recovery system to stenters
- Fit automatic load management system
- Heat recovery from stenters

Phase III

- Heat recovery from printers
- Replace motor generator sets

Boiler Plant

The boiler plant consists of three watertube boilers and economizers of East German manufacture. The boilers also include combustion air preheating. The boilers are each rated to produce 6.8 tonnes of steam per hour at a pressure of 13 bar. In normal operation, one boiler operates at high fire and a pressure of 9 bar to meet demand. The other boilers are under maintenance. Duty is rotated every 3 months. In a normal week, the boiler is fired at 0430 Monday morning and continues operation until all processing is completed at about 0600 Sunday morning.

The boilers are fitted with rotary cup burners and fire 1000 second Redwood Number 1 fuel oil. The burners are in a good state of repair, with little sign of leakage. Inspection of the burners not in use showed that the rotary cups are beginning to wear; at present, measured combustion conditions indicate that this is not adversely impacting burner performance. Combustion does not appear to come to completion within the combustion chamber, but continues through the economizer, which means that some of the heat available for preheating feedwater is lost in the flue gases. However, the temperature at the economizer exit was around 200°C, which is relatively low when the length of the flues and height of the chimney are considered. It is very likely that the exhaust gas temperature has fallen below acid dewpoint and sulfuric acid may be condensing on the inside of the chimney. It is recommended that this be investigated further. If sulfuric acid is being formed, the chimney mortar and cement will suffer from acid corrosion, with associated deterioration of the chimney structure.

Because of the high combustion efficiency, it is not recommended that an automatic oxygen trim system be fitted to the burners. It is unlikely that improvements would justify the expense.

The boiler plant is in very good condition, operating at high efficiency. The overall boiler efficiency is estimated to be 84.1 percent, based on measurements made during the audit. The measurements taken include flue gas analysis, water quality, and total dissolved solids (TDS) levels, and surface temperatures of the boiler shell. Adjustments to air/fuel ratios are made manually, and despite this, combustion conditions were found to be good throughout the operating range. The boiler operators should be commended for their skill in maintaining efficiency at such high levels.

One area that should be improved is boiler blowdown. On several occasions, the TDS level in the boiler water was checked and found to vary significantly. On first testing, the TDS level was found to be 4,400 ppm. This level is too high and could lead to scale formation on the heat transfer surfaces. Upon checking the TDS level 2 days later, it was found to be 250 ppm. The boiler operator had blown down the boiler for an extended period, reducing the TDS level significantly. To control the TDS level to a level of 3,000 ppm, it is recommended that a suitable water analysis kit, capable of measuring TDS, be purchased and the boiler operators be trained in its use.

The boilers are well insulated, and radiation losses are at a relatively low level. Within the boiler house, there are some minor areas of missing insulation and leaks, but in general, the standard of maintenance is good.

Feedwater to the boiler is supplied from a deaerator that is operated at 105°C. This temperature is considered satisfactory for removal of dissolved oxygen. Makeup water is supplied from a demineralization plant. Based on measurements made during the audit, condensate return was estimated to be about 16 percent, which was quite low, and there is scope for improvement. Management estimates that condensate return normally is on the order of 40-50 percent. The boiler house has provision for supplying feedwater using either steam or electric pumps. The relative economics at this time indicate that it is correct to use the electric pumps to feed the boilers.

Instrumentation within the boiler house could be improved to enable the operators to continue their fine efforts. Much of the original instrumentation does not work or has not been recently calibrated. It is recommended that the company upgrade the existing instrumentation by either repair or direct replacement.

Exhibits B.1, B.2, and B.3 summarize the results of boiler combustion tests, estimate of boiler radiation losses, and boiler efficiency calculations.

Exhibit B.1

Boiler Combustion Tests

Boiler no.: 1 of 3
Date of test: 3/22/84
Fuel fired: 1000 sec. fuel oil

Test results	Before economizer	After economizer
Firing rate	Medium	Medium
CO_2 in flue gases (percent)	12.67	13.5
O_2 in flue gases (percent)	4.25	3.4
Flue gas temperature (^oC)	320	203
Ambient air temperature (^oC)	37	37
Smoke number	5	3
Losses due to flue gases (percent)	19.6	15.4
Combustion efficiency (percent)	80.4	84.6

Measurements/readings from:

Measurement	Instrument
Percent CO_2 in flue gases	Fyrite
Percent CO_2 in flue gases	Fyrite
Flue gas temperature	Electronic thermometer
Ambient air temperature	Mercury-in-glass thermometer
Smoke number	Truespot smoke pump
Losses due to flue gases	Bacharach combustion slide rule

Exhibit B.2

Estimate of Boiler Radiation Losses

Radiation losses from the boiler can be estimated using the following data:

Data:

Boiler surface temperature	= 48.2°C
Surface area of sidewalls	= 16.72 m^2 x 2
Surface area of front and back	= 9.93 m^2 x 2
Surface area of top	= 7.43 m^2 x 2
Heat transfer coefficients sides, front, and back	= 12.79 $W/m^2/°C$
Top	= 14.8 $W/m^2/°C$
Ambient air temperature	= 37°C
Conversion of watts to joules	= 3.6
Operating hours	= 7,200/year
Heat losses	= h x area x dt
Side walls	= 12.79 x 16.72 x 2 x (48.2 - 37)
	= 4,790 watts
Front and back	= 12.79 x 9.93 x 2 x (48.2 - 37)
	= 2,845 watts
Top	= 14.8 x 7.43 x 2 x (48.2 - 37)
	= 2,463 watts
Total losses/year	= $\frac{10,098 \times 7,200}{1,000} \times 0.0036$
	= 262 GJ
Boiler input	= 106,839
Percentage radiation loss	= $\frac{262}{106,839} \times 100$
	= 0.2 percent.

Exhibit B.3

Boiler Efficiency Calculations

Efficiency = 100 - total losses (percent).

Losses:

Flue gas loss	=	15.4 percent	See Exhibit B.1
Blowdown loss	=	0.3 percent	
Radiation loss	=	0.2 percent	See Exhibit B.2
Total losses	=	15.9 percent	
Efficiency	=	100 - 15.9	84.1 percent.

Appendix C ENERGY AVAILABILITY AND PRICES 1984-2000

Sri Lanka's domestic energy resources consist mostly of hydropower and fuelwood. Other resources include agricultural and agroindustrial biomass residues, geothermal energy, and peat, but none is currently used on a significant scale. Prospects for discovering sources of hydrocarbons are believed to be limited. Two factors are likely to have a major effect on future energy supply and demand in the industrial sector: (1) the probable availability of imported steam coal, and (2) the development of wood plantations to offset the depletion of natural fuelwood sources.

In this appendix, we summarize the results of a literature survey and extensive discussions with Sri Lankan officials with respect to the future availability and prices of petroleum products, coal, peat, fuelwood other renewable resources, and electricity.

1. **Petroleum products.** Ceylon Petroleum Corporation (CPC) imports and refines approximately 50,000 bpd of 32-33 degree API crudes from the Middle East (mostly Saudi Arabia, Iran, and Iraq, through a contract with Caltec) to produce about 2 million tons of refined products, of which 42 percent is furnace oil.

   The basic problem facing CPC is the rapidly growing demand for light fractions (LPG, gasoline, kerosene, aviation fuel, and diesels) and the decreasing demand for furnace oil resulting from industrial fuel oil conservation and switching (e.g., as in the cement industry). In addition, the bleak prospects for the SFMC fertilizer complex, which is the largest national user of furnace oil and naphtha, are likely to exacerbate this imbalance. As a result, CPC is left with two options:

   - Export more heavy fractions of naphtha
   - Install a hydrocracker.

   The first option is the least cost option for the short term, provided that the products will find a market at a reasonable price. If SFMC is going to cease operation, up to 400,000 tonnes of fuel oil and naphtha will have to be exported, a 100 percent increase from 1983 levels. These exports would bring in up to Rs.2,000 million in foreign exchange revenues, which could be used to purchase the light refined products needed to meet additional demand.

The cost of the second option was estimated at U.S. $150 million (1981), and is probably close to $200 million now (Rs 5,000 million). As of spring 1984, this option's prospects were unclear.

The price of heavy furnace oil to industry is not expected to increase from its current price of Rs.4,900/tonne at least until the end of 1985. The latest world oil market studies project an oil glut until 1986. Consequently, furnace oil prices will increase after early 1986 at an average annual rate of 2 percent in real terms.*

2. **Coal.** Although Sri Lanka was a relatively large user of coal even 30 years ago, current coal consumption (28,000 tonnes in 1982) represents less than 1 percent of total net energy supply and about 1 percent of net commercial energy supply.

Future plans, however, call for a reversal of this trend, with consumption reaching 40,000 tonnes in 1984 and jumping to 400,000 tonnes in 1990 when the coal-fired power plant at Trincomalee is commissioned. By 2000, preliminary estimates indicate that coal imports could be anywhere between 2 and 4 million tonnes annually. Although the imports will be mainly steam coal for electric power plants, up to 10-15 percent could be used by industry in:

1. existing boilers originally designed for coal
2. new coal-designed or multifuel boilers
3. some direct burning applications (e.g., bricks, foundries).

Based on recent discussions with possible suppliers, the coal available in Sri Lanka is expected to have the following characteristics:

- Calorific value, as such: 6,400 - 6,600 kcal/kg
- Moisture content: 6-10 percent
- Volatile matter: 27-30 pecent
- Ash: 10-20 percent
- Sulfur (for power plants): less than 1 percent

*Based on studies performed by the Energy Coordinating Team in 1983 and 1984.

- Sulfur (for cement): less than 2 percent
- Sulfur (other): less than 3 percent.

Current delivered prices are around U.S. $55-60/tonne or Rs.1,375-1,500/tonne at KCW (Kankesanturai Cement Works). Because of the larger quantity needed for the power plant, Trincomalee CIF real prices by 1990 should be U.S. $45-$50 (1984 constant dollars).

Based on discussions with several Sri Lankan officials and embassy officials in Sri Lanka (Australia, Indonesia, India) and on the latest international coal studies, it appears that the price of steam coal (bituminous and subbituminous) is not likely to increase significantly in the future. A real rate of increase of 1 percent per annum has been selected to reflect the price competition with furnace oil (which will increase at 2 percent per annum) and take into account the magnitude of world coal reserves relative to oil reserves.

ELECTRICITY

Electricity demand is projected to increase from 2,076 kWh (50 percent hydro) in 1982 to 4,373 kWh in 1990 (9.7 percent per annum) and to almost 10,000 kWh in the year 2000. Total installed capacity is projected to increase from 592 MW (of which 40 percent will be hydro) to about 800-850 MW in early 1985 (of which 612 MW will be hydro), 1,200-1,300 MW in 1990 (947 MW hydro), and between 2,500 and 3,000 MW in 200 (50-60 percent hydro).

High voltage industrial electricity consumption is not expected to increase significantly in the 1980s, as no new major industrial projects will be coming on line and some large users may be phased out (e.g., SFMC, Steel Corporation).

In the 1990s, it is likely that this demand segment will grow slowly, being served by hydro and coal-based loads. In contrast, low and medium voltage industrial electricity is likely to increase dramatically over the 1995-2000 period, as small and medium-sized businesses develop. Growth is estimated at more than 20 percent per annum.

As demand in other sectors (households, commerce, and railroads) is also expected to increase sharply over the same period, there may be years when peak conservation turbines will be needed to meet demand. In particular, there may be constraints on supply between 1988 to 1990, until the 120-MW Trincomalee coal-fired power plant comes on line.

Tariffs

Compared with the current average total cost of Rs.1.8-1.9/kWh (including demand and fuel adjustment charges) in industry, future electricity rates are likely to be higher in real terms, given the long-term marginal development costs of between Rs.3-4/kWh (in 1984 rupees) and growth in repayment of the capital intensive capacity expansion program. For the purposes of this study, it was assumed that average industrial electricity prices will increase at 2 percent per annum in real terms, reflecting both the increasing cost of oil used at the margin and the repayment of the foreign exchange part of the generation expansion program.

FUELWOOD

Fuelwood is currently the most widely used source of energy in Sri Lanka. In 1982, total fuelwood consumption was estimated at approximately 5 million tonnes or 55 percent (in fuel oil equivalent) of total gross energy supply. Demand in 1990 is projected to be about the same. However, supply characteristics will be drastically different. In 1980, 56 percent of all fuelwood supply originated from denudation of forests, 29 percent from rubber and other crop residues, and the balance (15 percent) from the natural regeneration of forests. While 400,000-750,000 acres will be cleared under the Accelerated Mahaweli Development Program, somewhat alleviating the problem, denudation of forests cannot continue at the past pace. Current government programs undertaken with assistance from USAID and the Asian Development Bank call for extensive reforestation through fuelwood plantations. USAID and ADB will finance approximately 100,000 acres of fuelwood plantation, for a potential of 1.5 million tonnes annually, starting in the 1990s.

The prime objective of this reforestation effort is to provide a future fuel supply to households. To ensure long-term availability to both households and industry, a much more aggressive program would be required.*

In any case, long-term availability of fuelwood for industry can only be ensured by captive plantations.

Prices

Current market prices for fuelwood originating mostly from Mahawali clearings are between Rs.20 and 70/cubic meter onsite (Rs.60-210/tonne); delivered prices vary between Rs.500 and Rs.650/tonne.

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*A 1979 U.S. AID study estimated that about 650,000 acres of fuelwood plantations would be needed, plus 10,000 acres annually thereafter to allow for the effects of population growth.

Based on preliminary estimates, this range of prices is likely to hold for dedicated fuelwood plantations, on an annualized basis. For the purposes of this study, fuelwood was assumed to be available at Rs.500/tonne (U.S. $20) at the plant site. This price corresponds roughly to Rs.1,670/tonne of oil equivalent. The low end of the price range was selected because of the proximity of the Thulhiriya Textile Mills to fuelwood supplies.

Appendix D TENDER DOCUMENTS

THULHIRIYA TEXTILE MILLS
THULHIRIYA, SRI LANKA

TENDER FOR THE SUPPLY OF A COMPLETE WOOD GASIFICATION SYSTEM (15 MILLION BTU/HR OUTPUT)*

TENDER NO. _____

CLOSING AND OPENING OF TENDERS: _____
AT THE OFFICE OF THE CHAIRMAN,
THULHIRIYA TEXTILE MILLS,
THULHIRIYA, SRI LANKA

*This document is adapted from tender documents used by the Ceylon Electricity Board and is presented here only as an example to provide guidelines to Thulhiriya Textile Mills in establishing their own request for bids.

THULHIRIYA TEXTILE MILLS
GENERAL CONDITIONS OF TENDER

Scope of Work

Supply and delivery of material to the Thulhiriya Textile Mills, Thulhiriya, Sri Lanka.

The Thulhiriya Textile Mills will open letters of credit for payment of 90 percent CIF value on shipment and balance 10 percent on delivery of materials to the factory at Thulhiriya. Customs duty and business turnover tax at the port of Colombo will be paid by the Thulhiriya Textile Mills and should not be included in the contract sum.

1. Receipt of Tenders

Tenders shall be submitted as per annexed schedule of prices in duplicate. The original and duplicate copy of the tender should be placed in separate envelopes marked "Original" and "Duplicate." Both envelopes should be enclosed in one securely sealed cover that should be marked as described on Page 1 of the document on the top left-hand corner and shall be receivable by the Chairman, Tender Board, Thulhiriya Textile Mills, Thulhiriya, Sri Lanka.

2. Closing of Tenders

Tenders sealed, enclosed, marked, and addressed as aforesaid should be sent under registered cover to reach the Chairman, Tender Board, not later than _____ as indicated on Page 1 of this document. If local representatives are submitting tenders on behalf of manufacturers and/or principals abroad, they or their agents can deposit such tenders in the Tender Box provided for this purpose at the Thulhiriya Textile Mills, Thulhiriya (see Page 1).

Tenders sealed, marked, and addressed as aforesaid may also be handed over to the Chairman, Tender Board, or to the officer deputed by him to receive such tenders at the Thulhiriya Textile Mills before the closing time for tenders. In such an event, the sealed cover should bear the name and address of the party who has submitted the tender.

3. Opening of Tenders

Tenders will be opened immediately after the closing of tenders at the _____.

Tenderers or their duly authorized representatives may be present at the opening of tenders. The officer who opens the tenders will read out or cause to be read out to those present the quoted price as indicated in the offer.

Technical data, specifications, or similar particulars will not be divulged. Any tender received after the closing time will be rejected. Any tenderer, if he so

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wishes, may scrutinize the duplicate or any tender that has been submitted, only with regard to the prices quoted, by prior appointment with the Chairman, Tender Board.

4. Local Agent to Hold Power of Attorney

a. Local agents representing principals abroad will not be considered unless they hold the power of attorney from the principals empowering the agent to offer on their behalf, to enter into a valid agreement on behalf of the principals to fulfill all the terms and conditions of the contract, in the event of the tender being awarded.

b. Nomination of agent(s) after the tender has been submitted shall not be valid.

5. Bid Security

Each tender shall be accompanied by a bid security in the form of a bank draft/ certified check or a bank guarantee confirmed by a bank operating in Sri Lanka and payable to the Thulhiriya Textile Mills equivalent in value to Sri Lanka Rs._____ or five percent (5%) of the total tendered price, whichever is lower. **Failure to submit bid security at the time of opening of the tender will result in the tender being rejected.** Checks submitted as bid security will be credited to the Thulhiriya Textile Mills, subject to a refund in terms of Paragraph 2 of Clause 5.

The bid security shall be valid for one hundred twenty (120) days from the date of opening of tenders. Bid securities from unsuccessful tenderers will be returned to them, while the bid securities of the successful tenderers will be returned to them after receipt of the performance bond referred to in Clause 10.

6. Schedule of Prices

a. Tenders shall be in the prescribed form of schedule of prices. Prices shall be quoted F.O.B./unit conference line ocean freight prevailing at the time of tender supported by this document shall be indicated separately. Item here refers to items given in the column under description. All agents, commissions, discounts, etc., should be disclosed in the appropriate column in the schedule of prices. **Offers not in the prescribed form are liable for rejection.**

b. Prices quoted in the currency of the country of origin should be entered in the schedule of prices.

c. Tenderers shall provide, in the prescribed form of schedule, the name and address of local agents in Sri Lanka, if any.

d. Any guarantees offered by manufacturers of the goods should also be indicated while making the offer.

7. Clearing of Materials and Transport to SLTC Stores

The successful tenderer shall be responsible for the **expeditious** clearing of materials from the harbor and handing over same to the Thulhiriya Textile Mills, Thulhiriya. If the tenderer is not agreeable for clearing of materials from the harbor and delivery to stores, **the offer will be rejected.** In the event of the goods being diverted to other destinations from _____, payment for such transport will be made at accepted mileage rates. Proof that the local agent or representative can undertake the above work should be given explicitly with the tender documents.

The successful tenderer should send through courier service a duplicate set of shipping documents to his local agent or representative to allow him to obtain a bank guarantee and to clear the goods without rent or container charges for delays. The Chief Engineer, Contracts and Supplies, will arrange to sign all such guarantees on presentation of the necessary documents. The tenderer should not await the receipt of original documents through the bank to arrange clearing of materials, as all assistance will be provided for clearing materials on a guarantee in the event of delays in the receipt of original documents. The successful tenderer must clear the materials **within three (3) working days** from the date of discharge of cargo at the port.

7.1 Insurance

The tenderer/local agent should insure all materials for the full CIF value against all insurable risks or damage from whatsoever cause with the Insurance Corporation of Sri Lanka or the National Insurance Corporation of Sri Lanka from the port of shipment to the Thulhiriya Textile Mills, Thulhiriya. Insurance policies should be obtained in the name of the Managing Director, Thulhiriya Textile Mills, and the cost of insurance follow-up should be included in the appropriate column on the schedule of prices.

If the above information is not supplied with the tender, the tender is liable for rejection.

8. Minimum Validity Period of Offer

a. All offers shall be good for acceptance for a minimum period of ninety (90) days from the closing date for tenders.

b. All F.O.B. prices included in the schedule of prices, Clause 6 above, shall be firm and shall not be subject to any price variation within the validity period of offer specified in (a) above.

c. Any variation in freight resulting from a change in conference line rates will be settled.

Tenders that do not comply with requirements (a) and (b) above will be rejected.

9. Evaluation of Tenders

a. The prices quoted in currencies of the country of origin of the goods shall be converted to local currency at the official middle exchange rate of the Central Bank of Sri Lanka prevailing on the day of opening of tenders.

b. The tenders shall be evaluated at cost per item, including commissions and cost of clearing from port and delivery to stores.

c. An amount of one percent (1%) per week over the quoted F.O.B. price in the schedule of prices shall be added for the evaluation purposes when the indicated delivery period is exceeding required delivery indicated in Clause 11.

10. Performance Bond

The supplier/principal/agent shall deposit within fourteen (14) working days of receipt of the letter of award a performance bond supported by a guarantee from a reputed bank in the country of the supplier/principal/agent and confirmed by a bank operating in Sri Lanka corresponding to five percent (5%) of the amount of contract. However, the type of such bond of guarantee (whether certified check, bank bond, bank guarantee, surety bond, irrevocable letter of credit, or otherwise) shall be at the option of the supplier/principal/agent. The letter of credit will be opened after the deposit of the performance bond. The performance bond shall be in favor of the General Manager, Thulhiriya Textile Mills, Thulhiriya, and shall be valid for a period not less than ninety (90) days from the actual date of the anticipated final shipment. The supplier/principal must on his own account instruct his bank to cable the General Manager, Thulhiriya Textile Mills, the date, amount, and validity period of the performance bond deposited to expedite opening of letters of credit.

In the event of default on the part of the supplier/principal resulting from breach of agreement or relevant conditions hereto, the General Manager may by written notice terminate the right of supplier/principal to proceed with any or all remaining deliveries and collect the performance bond without resource.

11. Delivery of Goods

The total quantity shall be ready for shipment within twelve (12) weeks of opening of letters of credit. Tenderers who cannot comply with this delivery schedule shall state specifically when delivery could be made.

12. **Mode of Payment**

a. **Foreign cost.** Payment will be made by means of a letter of credit opened in favor of the successful tenderer. Such letter of credit will provide for payment to be made as indicated below against shipping documents that will include clean on-board freight prepaid bills of lading, signed invoices, certificate of origin, certificate of inspection, warranty, and a certificate of quality and quantity from an inspector as per Clause 16.

b. A letter of credit will be opened for the foreign cost to be paid in two installments, as follows:

First installment of ninety percent (90%) of the F.O.B. or CIF cost, as the case may be, of each shipment, to be paid on presentation of shipping documents, etc., as stated in (i) above.

The balance ten percent (10%) of F.O.B. or CIF cost to be paid on issue of a certificate by the General Manager, Thulhiriya Textile Mills, to the relevant bank, after the goods have been satisfactorily delivered to the Thulhiriya Textile Mills's stores.

13. **Details to Accompany Tender**

All tenders should contain adequate particulars with respect to the items offered.

a. Country of origin and name of manufacturer.

b. Test certificates (in English), including type tests.

c. Manufacturers' leaflets, illustrations, and full particulars of the items offered (in English).

d. Schedule of prices called for in tender document Clause 6 duly completed.

e. Variations and/or deviations in specifications, if any.

f. Six (6) copies of signed "pro forma" invoices indicating the F.O.B. prices and freight charges separately. Documents confirming ocean freight indicated and obtainable from steamer agents/shipping lines should be annexed.

g. Documents for proof of ability referred to in Clause 21.

h. Relevant guarantees of the manufacturers should be submitted.

14. **Power to Accept or Reject Offers**

a. The contract shall be awarded to the tenderers whose offer complies to the Board's specifications, satisfies the requirements of the Board, and is most

advantageous to the Thulhiriya Textile Mills with price and other factors being considered. In making its selection, the duly appointed tender board will not be bound to make the award to the tenderer submitting the tender with the lowest indicated cost.

b. The tender board reserves the right to reject any or all tenders without adducing any reasons. The Board may accept any or all items of the offers and reserves the right to increase or decrease the quantity of goods to be contracted for at prices indicated in the schedule of prices and subject to the conditions in Clause 6(b) and (c).

c. The notice of acceptance of tender will be sent by registered post to the successful tenderer at the address given by him in the tender document as soon as possible after the decision of the tender board. Intimation of the acceptance of tender may be made by telex/cable if circumstances so require, and such intimation should be considered as sufficient notice of acceptance until receipt of notice of acceptance as above.

15. Packing

In addition to specific packing required as per specification, if any, the tendered price shall include the cost of all necessary packing, including cases, materials, and labor. Export packing must be done in the best possible manner to withstand rough handling in transit. Packages must be suitable for export to and storage in the tropics. The tenderer will be held responsible for the items so packed so as to ensure against damages in transit to Colombo. Small packages subject to pilferage and being misplaced should be sent in containers.

16. Inspection of Materials

a. The materials shall be inspected prior to shipment by an independent competent authority of recognized status and competence acceptable to the Thulhiriya Textile Mills for the purpose of obtaining the certificate of quality and quantity. Any expense incurred shall be borne by the contractor. The Thulhiriya Textile Mills also reserves the right to reject any testing authority and appoint its own inspector for this purpose. An inspector/panel of inspectors/inspecting authority is herein referred to as the inspector.

b. Inspection fees of any additional inspectors appointed by the Thulhiriya Textile Mills will be met by the Thulhiriya Textile Mills.

17. Shipping Advice

When goods are ready for shipment, the tenderer shall send to the General Manager a cable/telex stating the name of the ship and the number of packages being dispatched and shall send by air mail or preferably courier service within two (2)

days after bill of lading the advance copies of following shipping documents when goods are shipped:

a. Two copies of invoice

b. Two copies of freight prepaid bill of lading

c. One certificate of origin

d. Two copies of packing particulars, including the list of items, weight, and measurement of each package

e. Certificate of quantity and quality.

Tenderers are requested to furnish the following details along with their tender:

a. Number of packages
b. Dimensions of packages
c. Description of the packing
d. Probable date of shipment
e. The port/ports from which the goods will be shipped.

18. Delivery Within Agreed Period and Damages for Delay

a. Should the tenderer anticipate at any time during the execution of the order that he will be unable to deliver the items within the time specified in his tender, he shall at once give notice accordingly in writing to the General Manager, Thulhiriya Textile Mills, explaining the cause for the delay. In the case of delay, the General Manager shall have the option of either granting an extension or terminating the award, ruling the case as default of contract. If the extension is granted, the tenderer shall effect shipment within the extended period, but will, in addition to any other liabilities incurred by him under this contract, be subject to a deduction from the tendered sum and/or the amount covered by the performance bond for liquidated damages hereto (and not as a penalty) of one-tenth of one percent (0.1%) of the value of each item not shipped for each and every complete day that may lapse between the contracted date of shipment and actual date of shipment.

b. In the case of acceptance of extension of delivery, the principal/supplier shall extend the period of validity of the performance bond referred to under Clause 10.

Contract Not To Be Sublet

No tenderer shall assign or sublet his obligations to supply the items tendered for and accepted without the written authority of the General Manager. If any part of his obligation has been assigned or sublet by the tenderer with written authority,

100

he shall nevertheless be held responsible for the due performance of the part assigned or sublet.

20. Force Majeure

The tenderer shall not be responsible for delay or non-performance of his contractual obligations to sell, and the Thulhiriya Textile Mills shall not be held responsible for delay or non-performance of its contractual obligations to purchase all or any part of the supplies, caused by war, blockade, embargo, insurrection, mobilization, act of God, governmental direction or intervention of civil, naval, or military authorities or other agencies of government, riots, civil commotions, warlike conditions, labor troubles (including strikes), sabotage, prolonged failure or other epidemics, quarantine, fire, flood, windflood, typhoon, hurricanes, tidal waves, landslides, lightning, and explosion.

21. Proof of Ability

Tenderers shall submit documents and/or other evidence of their ability to carry out the contract while forwarding their offer. Factors such as experience, plant facilities, nature of business, capital invested or authorized, turnover, availability of raw materials, guaranteed time of delivery, and other relevant matters will be considered when evaluating offers.

22. Patent Rights Claims

The tenderers shall indemnify the Thulhiriya Textile Mills against any and all claims arising on account of patent rights or royalties, whether from manufacturers or others, from the use by the Thulhiriya Textile Mills of patented or royalty goods supplied.

23. Arbitration

If, during the continuance of this contract or at any time after the termination thereof, any differences or disputes shall arise between the parties hereto in regard to the interpretation of any of the provisions herein contained or any other matter or thing relating to this contract (other than difference or dispute in respect of which a decision of the Chairman, Thulhiriya Textile Mills, is declared to be final and binding on the parties hereto), such difference or dispute shall be forthwith referred to two arbitrators for arbitration in Sri Lanka, one to be appointed by each party, with liberty to the arbitrators in case of difference or their failing to reach an agreement to appoint an umpire. In the event of the two parties failing to agree on the appointment of an umpire, he will be nominated by the International Chamber of Commerce, and the award made by the two arbitrators or the umpire, as the case may be, shall be final and conclusive and binding on the parties hereto.

If either party in difference fails or neglects to appoint an arbitrator within the space of thirty (30) days after notice in writing to do so has been given by the other party, or shall appoint an arbitrator who shall refuse to act, the arbitrator appointed by the other party shall make a general decision alone, and the making of any award in such reference shall be a condition to any right of action against any of the parties hereto in respect of such difference.

The decision of a majority of the arbitrators shall be final and binding upon the parties to the contract, and the expenditure of the arbitration shall be paid as the arbitrators may determine.

24. The tenders and any contract resulting therefrom shall be governed and abide by Sri Lanka law.

25. Tenderers must be acquainted fully with the conditions of the tender. No plea of lack of information or insufficient information will be entertained at any time.

26. Offers will be liable for rejection of tenderers have not purchased official tender documents and if all the conditions laid down hereto have not been strictly fulfilled.

27. Any further information can be had on application to the Chief Engineer, Contracts and Supplies, Thulhiriya Textile Mills, _____
_____
_____.

I agree to abide by the above conditions of tender and therefore submit my offer in the attached schedule.

_____

Signature of Tenderer and Seal

Date:_____

APPENDIX 1
THULHIRIYA TEXTILE MILLS — FORM OF TENDER

The Chairman
Tender Board
Thulhiriya Textile Mills

_____

_____

(I/We), having examined the Conditions of Tender, the Bill of Quantities, and all other documents pertaining to this work/supply, do hereby offer and undertake to carry out the work/supply to the satisfaction of the General Manager, Thulhiriya Textile Mills, strictly in accordance with Conditions of Tender, at the prices and within the delivery period set forth in the accompanying Bill of Quantities pertaining to Tender No. _____. And, in consideration of the trouble and expense incurred by Thulhiriya Textile Mills in preparing the contract documents and in examining and considering the tender, (I/we) further undertake that this tender shall not be withdrawn by (me/us) before the expiration of three (3) calendar months from the date of closing, but shall remain binding on (me/us) and may be accepted at any time before such expiration.

And, (I/we) further undertake, in the event of this tender being accepted, to deposit in cash five percent (5%) of the tendered amount as security with the General Manager, Thulhiriya Textile Mills, or to furnish a bank guarantee as per tender conditions in the said sum, confirmed by a bank operating in Sri Lanka, in favor of the General Manager, Thulhiriya Textile Mills, for the due performance of the contract and for the payment of all claims to which the Thulhiriya Textile Mills may be entitled, and to execute an agreement in the prescribed form duly stamped by (me/us) at (my/our) expense in accordance with the Stamp Duty Ordinance, and to complete the work to the entire satisfaction of the General Manager, Thulhiriya Textile Mills.

And, (I/we) further agree, in the event of (my/our) failing mto make such deposit or execute such bond and/or execute such agreement within two (2) weeks of (my/our) being called upon to make such deposit or execute such bond and/or to execute such agreement, that the Thulhiriya Textile Mills has the right to recover from (me/us) the full amount of damages sustained by the Thulhiriya Textile Mills as a result of (my/our) so declining or failing, and confiscate the security deposit.

(I/We) understand that the Thulhiriya Textile Mills is not bound to accept the lowest or any tender it receives.

_____ _____

Signature of Tenderer

Date:_____

Tenderer's Name:_____

Address:_____

Witness:_____

Signature: 1._____ 2._____

Name:_____ _____

Address:_____ _____

APPENDIX 2
FORM OF BANK GUARANTEE

_____, 198_

Thulhiriya Textile Mills

Dear Sirs:

At the request of our constituent, _____, of _____ _____(hereinafter referred to as "the Contractor"), we, the undersigned, _____ _____, a banking corporation duly incorporated in _____ _____ and having its head office at _____and carrying on business at _____ in the Island of the Republic of Sri Lanka, do hereby undertake and promise to pay to you on demand at Colombo in Sri Lanka currency such sums not exceeding in the aggregate Rupees _____ (Rs._____) as may be demanded by you from time to time hereunder, provided every such demand is made in writing under the hand of the General Manager or the Chief Executive Officer or your Board or any person purporting to act under the authority of the General Manager or the Chief Executive Officer.

Notwithstanding anything to the contrary herein contained, these presents shall be valid only up to and including the _____ day of _____, 198___, and shall not thereafter be of any force or avail in law except in respect of any demand made by you before 2 p.m. on the _____ day of _____, 198___, provided, however, that in case we shall have before 2 p.m. on the said _____ day of _____, 198___, extended the period of validity up to any date subsequent to the said _____ day of _____, 198___, the provisions of this clause shall stand amended and read as if the date of which these presents is so extended and originally been inserted wherever in this clause the said _____ day of _____, 198___ occurs, and these presents shall have force accordingly. Such period of validity may similarly be extended from time to time so as to keep these presents in full force up to such extended date or dates.

A demand addressed to us under the hand of your General Manager or the Chief Executive Officer or other officer of your Board acting as aforesaid shall be sufficient and conclusive proof that we are liable to pay to you the sum demanded hereunder.

APPENDIX 3
SPECIFICATION FOR SUPPLY OF COMPLETE WOOD GASIFICATION SYSTEM (DRAFT)

Introduction

A gasification system able to convert wood from Sri Lanka jungle clearings and rubber wood into low-Btu gas suitable for use in an existing boiler (details about boiler to be provided by Thulhiriya management), including equipment for storing, loading, and preparing firewood, as well as instrumentation, is required for use at the Thulhiriya Textile Mills, Thulhiriya, Sri Lanka. The feasibility study prepared by EDMAC provides the necessary background for the project. Bidders should prepare their proposal in two parts: hardware and technical assistance.

Hardware

The wood gasifier should be rated at not less than the output necessary to produce 6.3 tonnes of steam per hour in one existing boiler rated at 6.8 tonnes of steam per hour for an operating pressure of 9-10 bar.

The fuelwood may have a moisture content of 35-45 percent. If the gasifier cannot directly use wood with such a moisture content level, the bidder should include drying equipment in his proposal. If a chipper or a specific sawmill is required, it should also be included in the proposal.

The wood handling system should be sized for up to 4 tonnes of green wood/hour, to run an average 2.5 tonnes/hour. The wood storage area should be covered with a roof and able to store up to 1 month's wood consumption or 1,000 tonnes, which corresponds to approximately 1,500 cubic meters (50 x 10 x 3).

The gasification system should emit no carbon monoxide and should be fitted with a proper ash removal and handling system to avoid any contamination of the environment. Textile manufacturing and finishing must be protected from any possibility of dust contamination. Relevant references should be provided.

Technical Assistance

The bidder should include in his proposal a description of the training activities he will undertake before, during, and after the commissioning of the complete system. The duration of on-site training should not be less than 3 months.

SUPPLIERS OF HEAT GASIFIERS SUITABLE TO TTM

Advanced Energy Applications, Inc.
1380 Mor Avenue
Los Altos, CA 94022
USA

C.H.H. Technology, Inc.
Route 1
Warsaw, VA 22572
USA

Forest Fuels Manufacturing, Inc.
P.O. Box 547 — Water Street
Marlborough, NH 03455
USA

MARELCO, Inc.
3900 Mt. Vernon Avenue
P.O. Box 5084
Alexandria, VA 22305
USA

Northamerican Gasifier Company (NGC)
Sales and Manufacturing
Suite 200
106 K Street
Sacramento, CA 95814
USA

Sur-Lite Corporation
8124 Allport Avenue
Santa Fe Springs, CA 90670
USA

Vyncke (Belgium)
Gentsesteenweg 224
b 8/30 harelbeke
BELGIUM

Omnifuel Gasification Systems
Suite 401
3284 Yonge Street
Toronto, ON M4N 3M7
CANADA

Creusot Loire (France)
15, Rue Pasquier
75008 Paris
FRANCE

Pillard (France)
B.P. nr. 56
13268 Marseille
Cedex 8
FRANCE

Imbert Energie Technik (Germany)
GmbH & Co KG
Bonnerstrasse 49
5354 Weilerswist
Fernruf (02254) 4061
GERMANY

Biomass Energy Consultants & Engineers (Netherlands)
Piesmanweg 27
P.O. Box 498
7600 AL Almeto
THE NETHERLANDS

Wellman Mechanical Engineering Limited (England)
Gasification Division
Roberts house
Cornwall Road
Smethwick
Warley, West Midlands B66 2IU
UNITED KINGDOM

"THIRD-PARTY" FIRMS

Catalyst Energy Development Corporation
110 Wall Street
New York, NY 10005
USA

Hydra-Co Enterprises, Inc.
Suite 1225
One Lincoln Center
Syracuse, NY 13202
USA

CTC Services Limited
P.O. Box 2035
29, Morton Place
Colombo 7
SRI LANKA

Appendix F DETAILED RESULTS

CONSERVATION PROJECT FINANCIAL/ECONOMIC EVALUATION

THULHIRIYA TEXTILE MILLS

Prepared for:
K.M. RANDERIA
NATIONAL TEXTILE CORPORATION
THULHIRIYA SRI LANKA

Prepared by:
EDMAC
Ministry of Power and Energy
50, Sir Chittampalam A. Gardiner Mawatha
Colombo -02, Sri Lanka

MAY 14, 1984

ACKNOWLEDGEMENT

This feasibility study was conducted under a joint program of the Sri Lanka Ministry of Power and Energy and the United States Agency for International Development. The analyses for the study were performed using a conservation project financial evaluation model developed by Hagler, Bailly & Company under contract to the Office of Energy, Bureau for Science and Technology, U.S. AID. For information on the model, contact:

Pamela Baldwin, Project Officer
Energy Policy Development and Conservation Project
S&T/EY--USAID
Washington, D.C. USA 20523
(703) 235-8918

or

Hagler, Bailly & Company
2301 M Street NW
Washington, DC USA 20037
(202) 463-7575
Telex: 710-822-1150

TABLE OF CONTENTS

LIST OF ABBREVIATIONS USED IN THIS REPORT:

CAP: Capital
DVL: Development
ENG: Engineering
IND: Indirect
PRD: Period
RQRD: Required
Q: Quantity
OPER & MAINT: Operating & Maintenance

SUMMARY PROJECT INFORMATION

Project Name: THULHIRIYA TEXTILE MILLS

Project Location: THULHIRIYA SRI LANKA

Company: NATIONAL TEXTILE CORPORATION

Company Contact: K.M. RANDERIA, GENERAL MANAGER

Telephone: 580074

Project Description:

THE THULHIRIYA UNIT OF THE NATIONAL TEXTILE CORPORATION OF SRI LANKA CURRENTLY USES OIL-FIRED BOILERS TO MEET STEAM REQUIREMENTS. IN THIS ANALYSIS THE OPTION OF RETROFITTING ONE OF THE BOILERS WITH A WOOD GASIFIER IS INVESTIGATED.

Start of Project Development: 3q/1984

Start of Project Operation: 1q/1986

SUMMARY RESULTS OF FINANCIAL ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

DEVELOPMENT PERIOD COSTS
TOTAL DIRECT CAPITAL COST: 10841
TOTAL DIRECT DVL PERIOD COST (includes interest): 11623
TOTAL INDIRECT DVL PERIOD COST: 0

FINANCIAL STRUCTURE
DEBT FRACTION: 80.0%
TOTAL DEBT REQUIRED: 9299
TOTAL EQUITY CONTRIBUTED: 2325

DEBT TERMS
DEVELOPMENT PRD INTEREST RATE: 14.0%
OPERATING PERIOD INTEREST RATE: 14.0%
OPERATING PERIOD DEBT TERM: 32 QUARTERS
DEBT MORATORIUM PERIOD: 3 QUARTERS

MARGINAL TAX RATE: 25.0%

FINANCIAL PERFORMANCE

TARGET AFTER TAX RETURN ON EQUITY: 20.0%
PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 3531
INTERNAL RATE OF RETURN: 75.8%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 2q/1987.

DEVELOPMENT PERIOD FINANCIAL SUMMARY
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985
ENG/DESIGN COST	236	242	248	254	130	133
DIRECT CAPITAL COST	902	1850	1896	1943	1992	1015
DVL PRD INTEREST AT 14.0%	0	32	91	154	220	285
TOTAL FINANCING RQRD	1138	2124	2235	2351	2342	1433
EQUITY CONTRIBUTED	228	425	447	470	468	287
DEBT REQUIRED	910	1699	1788	1881	1873	1147
CUMULATIVE EQUITY	228	652	1099	1570	2038	2325
CUMULATIVE DEBT	910	2609	4398	6278	8152	9299
CUMULATIVE CAPITAL	1138	3262	5497	7848	10190	11623
DVL COST EXPENSED	236	242	248	254	130	133
DVL COST DEPRECIATED	902	1850	1896	1943	1992	1015
INDIRECT DVL COST	0	0	0	0	0	0
CUMULATIVE IND COST	0	0	0	0	0	0

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	535	535	535	535
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	5.81	5.97	6.15	6.32
VALUE ENERGY SAVED	0	0	0	0	0	0	3107	3197	3288	3383
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	0	0	0	0	0	0	3107	3197	3288	3383
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	0	0	0	0	0	0	2875	2875	2875	2875
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.59	0.60	0.62
VALUE ENERGY USED	0	0	0	0	0	0	1653	1693	1734	1776
DVL PRD EXPENSE	236	242	248	254	130	133	0	0	0	0
DVL PRD INTEREST	0	32	91	154	220	285	325	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	398	408	417	427
OTHER OPER PRD COST	0	0	0	0	0	0	425	437	450	463
OPER PRD INTEREST	0	0	0	0	0	0	0	325	325	325
DEPRECIATION	0	0	0	0	0	0	450	450	450	450
TOTAL COST	236	274	339	408	350	418	3251	3313	3376	3441
TAXABLE INCOME	-236	-274	-339	-408	-350	-418	-144	-117	-88	-58
INCOME TAX	-59	-68	-85	-102	-87	-105	-36	-29	-22	-15
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	0	0	0	0	0	0	0	0	0	0
EQUITY CONTRIBUTED	228	425	447	470	468	287	0	0	0	0
TOTAL AFTER TAX OUTLAYS	228	425	447	470	468	287	0	0	0	0
AFTER-TAX CASH FLOW	-169	-356	-362	-368	-381	-182	342	362	384	406
CUMULATIVE CASH FLOW	-169	-525	-887	-1255	-1636	-1818	-1477	-1114	-730	-324

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	6.50	6.69	6.88	7.08	7.29	7.49	7.71	7.93	8.16	8.39
VALUE ENERGY SAVED	3480	3580	3683	3789	3898	4010	4125	4244	4366	4491
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	3480	3580	3683	3789	3898	4010	4125	4244	4366	4491
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	0.63	0.65	0.66	0.68	0.70	0.71	0.73	0.75	0.77	0.78
VALUE ENERGY USED	1818	1862	1907	1953	2000	2049	2098	2149	2200	2253
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIREC. DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	438	448	459	470	482	493	505	517	530	543
OTHER OPER PRD COST	476	490	504	518	533	548	564	580	597	614
OPER PRD INTEREST	325	320	314	308	302	295	288	281	274	267
DEPRECIATION	450	450	450	450	450	450	450	450	450	450
TOTAL COST	3508	3570	3634	3699	3766	3835	3905	3977	4051	4127
TAXABLE INCOME	-27	10	49	90	131	175	220	266	314	364
INCOME TAX	-7	3	12	22	33	44	55	67	79	91
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	162	168	174	180	186	193	199	206	214	221
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	162	168	174	180	186	193	199	206	214	221
AFTER-TAX CASH FLOW	267	290	313	337	362	388	415	443	472	502
CUMULATIVE CASH FLOW	-57	233	546	883	1245	1634	2049	2492	2964	3467

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	8.64	8.88	9.14	9.40	9.67	9.95	10.24	10.53	10.83	11.14
VALUE ENERGY SAVED	4620	4753	4885	5030	5174	5323	5476	5633	5795	5962
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	4620	4753	4889	5030	5174	5323	5476	5633	5795	5962
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	0.80	0.82	0.84	0.86	0.88	0.90	0.93	0.95	0.97	0.99
VALUE ENERGY USED	2308	2363	2420	2479	2538	2600	2662	2727	2792	2860
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	556	569	583	597	611	626	641	656	672	688
OTHER OPER PRD COST	632	650	669	688	708	728	749	771	793	815
OPER PRD INTEREST	259	251	243	234	225	216	206	197	186	176
DEPRECIATION	450	450	150	150	150	150	150	150	150	150
TOTAL COST	4204	4283	4064	4147	4232	4320	4409	4500	4594	4689
TAXABLE INCOME	416	470	825	882	942	1004	1067	1133	1202	1273
INCOME TAX	104	117	206	221	235	251	267	283	300	318
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	229	237	245	254	263	272	281	291	301	312
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	229	237	245	254	263	272	281	291	301	312
AFTER-TAX CASH FLOW	533	565	524	558	594	631	669	709	750	793
CUMULATIVE CASH FLOW	4000	4565	5089	5647	6241	6872	7541	8250	9000	9793

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	11.46	11.79	12.13	12.48	12.84	13.21	13.59	13.98	14.38	14.79
VALUE ENERGY SAVED	6133	6309	6491	6677	6869	7067	7270	7479	7694	7915
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	6133	6309	6491	6677	6869	7067	7270	7479	7694	7915
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	1.02	1.04	1.07	1.09	1.12	1.15	1.18	1.20	1.23	1.26
VALUE ENERGY USED	2929	2999	3072	3146	3221	3299	3379	3460	3544	3629
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	705	722	739	757	776	794	813	833	853	874
OTHER OPER PRD COST	839	863	888	913	940	967	994	1023	1052	1083
OPER PRD INTEREST	165	154	142	130	117	104	91	77	63	48
DEPRECIATION	150	150	150	150	150	150	150	150	0	0
TOTAL COST	4787	4888	4991	5096	5204	5314	5427	5543	5512	5633
TAXABLE INCOME	1346	1422	1500	1581	1665	1752	1842	1935	2182	2281
INCOME TAX	336	355	375	395	416	438	461	484	545	570
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	323	334	346	358	370	383	397	411	425	440
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	323	334	346	358	370	383	397	411	425	440
AFTER-TAX CASH FLOW	837	882	929	978	1029	1081	1135	1191	1211	1271
CUMULATIVE CASH FLOW	10629	11511	12441	13419	14447	15528	16663	17854	19066	20337

SUMMARY RESULTS OF SENSITIVITY ANALYSIS
THULHIRIYA TEXTILE MILLS

BASE OR EXPECTED CASE

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 5581
INTERNAL RATE OF RETURN: 75.8%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 2q/1987.

ENERGY SAVINGS/SALES 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 10181
INTERNAL RATE OF RETURN: 115.7%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 4q/1986.

ENERGY SAVINGS/SALES 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 981
INTERNAL RATE OF RETURN: 31%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 1q/1990.

DIRECT DEVELOPMENT COSTS 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 5011
INTERNAL RATE OF RETURN: 67.1%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 3q/1987.

DIRECT DEVELOPMENT COSTS 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 6151
INTERNAL RATE OF RETURN: 86.1%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 1q/1987.

INTEREST RATES 2 POINTS HIGHER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 5186
INTERNAL RATE OF RETURN: 71.4%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 2q/1987.

INTEREST RATES 2 POINTS LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: 5959
INTERNAL RATE OF RETURN: 80.1%
CUMULATIVE CASH FLOW BECOMES POSITIVE IN 1q/1987.

SUMMARY RESULTS OF SOCIAL VALUE AND
FOREIGN CURRENCY REQUIREMENTS ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

SOCIAL DISCOUNT RATE: 10.0%

SOCIAL VALUE RESULTS

TOTAL DEVELOPMENT PERIOD COST: 9331

TOTAL NET BENEFITS IN OPERATING PERIOD: 32

PRESENT VALUE OF NET BENEFIT STREAM AT
10.0%: -8563

FOREIGN CURRENCY REQUIREMENTS RESULTS

FOREIGN CURRENCY REQUIRED IN DEVELOPMENT PERIOD: 9232

FOREIGN CURRENCY REQUIRED IN OPERATING PERIOD:-122061

PRESENT VALUE OF FOREIGN CURRENCY REQUIREMENT AT
10.0%: -59498

(Positive values mean the project is a net user of foreign currency; Negative values mean the project is a net generator of foreign currency.)

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	535	535	535	535
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	4.24	4.26	4.28	4.30
VALUE ENERGY SAVED	0	0	0	0	0	0	2268	2280	2291	2302
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	0	0	0	0	0	0	2268	2280	2291	2302
PROJECT COSTS										
ENERGY USED (MT WOOD)	0	0	0	0	0	0	2875	2875	2875	2875
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.53	0.54	0.54
VALUE ENERGY USED	0	0	0	0	0	0	1515	1528	1541	1555
ENG/DESIGN COST	236	242	248	254	130	133	0	0	0	0
DIRECT CAP COST	902	1571	1571	1571	1571	902	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	304	304	304	304
OTHER OPER PRD CST	0	0	0	0	0	0	375	377	378	380
TOTAL COST	1138	1813	1819	1825	1701	1035	2194	2209	2224	2239
NET BENEFIT STREAM	-1138	-1813	-1819	-1825	-1701	-1035	75	71	67	63
CUMULATIVE NET BENEFITS	-1138	-2951	-4770	-6595	-8296	-9331	-9256	-9186	-9118	-9055

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	4.32	4.35	4.37	4.39	4.41	4.43	4.46	4.48	4.50	4.52
VALUE ENERGY SAVED	2314	2325	2337	2348	2360	2372	2384	2395	2407	2419
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2314	2325	2337	2348	2360	2372	2384	2395	2407	2419
PROJECT COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	0.55	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59
VALUE ENERGY USED	1568	1582	1595	1609	1623	1637	1651	1665	1680	1694
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	304	304	304	304	304	304	304	304	304	304
OTHER OPER PRD CST	382	384	386	388	390	392	394	396	398	400
TOTAL COST	2254	2270	2285	2301	2317	2333	2349	2365	2381	2398
NET BENEFIT STREAM	59	55	51	47	43	39	35	30	26	21
CUMULATIVE NET BENEFITS	-8996	-8940	-8889	-8841	-8798	-8759	-8725	-8695	-8669	-8648

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	4.54	4.57	4.59	4.61	4.64	4.66	4.68	4.70	4.73	4.75
VALUE ENERGY SAVED	2431	2443	2455	2468	2480	2492	2504	2517	2529	2542
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2431	2443	2455	2468	2480	2492	2504	2517	2529	2542
PROJECT COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	0.59	0.60	0.60	0.61	0.62	0.62	0.63	0.63	0.64	0.64
VALUE ENERGY USED	1709	1724	1739	1754	1769	1784	1799	1815	1831	1847
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT CVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	304	304	304	304	304	304	304	304	304	304
OTHER OPER PRD CST	402	404	406	408	410	412	414	416	418	420
TOTAL COST	2415	2431	2448	2465	2482	2500	2517	2535	2553	2570
NET BENEFIT STREAM	17	12	7	2	-3	-8	-13	-18	-23	-28
CUMULATIVE NET BENEFITS	-8631	-8619	-8612	-8610	-8612	-8620	-8632	-8650	-8673	-8702

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	535	535	535	535	535	535	535	535	535	535
PRICE ENERGY SAVED	4.77	4.80	4.82	4.85	4.87	4.89	4.92	4.94	4.97	4.99
VALUE ENERGY SAVED	2555	2567	2580	2593	2606	2619	2632	2645	2658	2671
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2555	2567	2580	2593	2606	2619	2632	2645	2658	2671
PROJECT COSTS										
ENERGY USED (MT WOOD)	2875	2875	2875	2875	2875	2875	2875	2875	2875	2875
PRICE ENERGY USED	0.65	0.65	0.66	0.66	0.67	0.68	0.68	0.69	0.69	0.70
VALUE ENERGY USED	1862	1879	1895	1911	1928	1944	1961	1978	1995	2012
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	304	304	304	304	304	304	304	304	304	304
OTHER OPER PRD CST	422	424	426	428	430	433	435	437	439	441
TOTAL COST	2588	2607	2625	2643	2662	2681	2700	2719	2738	2758
NET BENEFIT STREAM	-34	-39	-45	-51	-56	-62	-68	-74	-80	-87
CUMULATIVE NET BENEFITS	-8736	-8775	-8820	-8871	-8927	-8989	-9058	-9132	-9212	-9299

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
VALUE ENERGY SAVED	0	0	0	0	0	0	-2797	-2877	-2960	-3045
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	177	182	186	191	98	100	0	0	0	0
DIRECT CAP COST	722	1480	1517	1554	1594	812	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	239	245	250	256
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	0	0	0	0	0	0	306	315	324	333
INTEREST PAYMENTS	0	25	73	122	175	227	258	258	258	258
NET FOREIGN CURRENCY REQUIRED	899	1687	1775	1867	1866	1138	-1993	-2059	-2127	-2197
CUMULATIVE FOREIGN CURRENCY REQUIRED	899	2585	4361	6228	8094	9232	7239	5180	3053	856

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
VALUE ENERGY SAVED	-3132	-3222	-3315	-3410	-3508	-3609	-3713	-3819	-3929	-4042
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	263	269	276	282	289	296	303	310	318	326
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	343	353	363	373	384	395	406	418	430	442
INTEREST PAYMENTS	258	254	249	244	239	234	229	223	218	212
NET FOREIGN CURRENCY REQUIRED	-2268	-2347	-2427	-2510	-2596	-2684	-2774	-2868	-2964	-3062
CUMULATIVE FOREIGN CURRENCY REQUIRED	-1412	-3759	-6186	-8696	-11292	-13975	-16750	-19617	-22581	-25643

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
VALUE ENERGY SAVED	-4158	-4278	-4400	-4527	-4657	-4791	-4928	-5070	-5216	-5366
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	333	341	350	358	367	376	385	394	403	413
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	455	468	481	495	510	524	539	555	571	587
INTEREST PAYMENTS	206	199	193	186	179	171	164	156	148	140
NET FOREIGN CURRENCY REQUIRED	-3164	-3269	-3377	-3488	-3602	-3720	-3841	-3965	-4094	-4226
CUMULATIVE FOREIGN CURRENCY REQUIRED	-28807	-32076	-35453	-38940	-42542	-46262	-50102	-54068	-58161	-62387

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
VALUE ENERGY SAVED	-5520	-5679	-5842	-6010	-6182	-6360	-6543	-6731	-6924	-7123
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	423	433	444	454	465	477	488	500	512	524
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	604	621	639	658	676	696	716	736	758	779
INTEREST PAYMENTS	131	122	113	103	93	83	72	61	50	38
NET FOREIGN CURRENCY REQUIRED	-4362	-4502	-4646	-4794	-4947	-5105	-5267	-5433	-5605	-5782
CUMULATIVE FOREIGN CURRENCY REQUIRED	-66749	-71251	-75897	-80692	-85639	-90743	-96010	-101443	-107048	-112830

CONSERVATION PROJECT FINANCIAL/ECONOMIC EVALUATION

THULHIRIYA TEXTILE MILLS

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LIST OF ABBREVIATIONS USED IN THIS REPORT:

CAP: Capital
DVL: Development
ENG: Engineering
IND: Indirect
PRD: Period
RQRD: Required
Q: Quantity
OPER & MAINT: Operating & Maintenance

SUMMARY PROJECT INFORMATION

Project Name: THULHIRIYA TEXTILE MILLS

Project Location: THURHIRIYA SRI LANKA

Company: NATIONAL TEXTILE CORPORATION

Company Contact: K.M. RANDERIA, GENERAL MANAGER

Telephone: 580074

Project Description:

THE THULHIRIYA UNIT OF THE NATIONAL TEXTILE CORPORATION CURRENTLY USES OIL-FIRED BOILERS TO MEET STEAM REQUIREMENTS. IN THIS ANALYSIS THE OPTION OF REPLACING A BOILER WITH A MULTI-FUEL BOILER USING WOOD AND OIL IS INVESTIGATED.

Start of Project Development: 3q/1984

Start of Project Operation: 1q/1986

SUMMARY RESULTS OF FINANCIAL ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

DEVELOPMENT PERIOD COSTS
TOTAL DIRECT CAPITAL COST: 28115
TOTAL DIRECT DVL PERIOD COST (includes interest): 30724
TOTAL INDIRECT DVL PERIOD COST: 0

FINANCIAL STRUCTURE
DEBT FRACTION: 80.0%
TOTAL DEBT REQUIRED: 24580
TOTAL EQUITY CONTRIBUTED: 6145

DEBT TERMS
DEVELOPMENT PRD INTEREST RATE: 14.0%
OPERATING PERIOD INTEREST RATE: 14.0%
OPERATING PERIOD DEBT TERM: 32 QUARTERS
DEBT MORATORIUM PERIOD: 3 QUARTERS

MARGINAL TAX RATE: 25.0%

FINANCIAL PERFORMANCE

TARGET AFTER TAX RETURN ON EQUITY: 20.0%
PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -9377
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DEVELOPMENT PERIOD FINANCIAL SUMMARY
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985
ENG/DESIGN COST	344	646	661	903	694	1510
DIRECT CAPITAL COST	6371	5898	5555	3533	1526	474
DVL PRD INTEREST AT 14.0%	0	188	377	561	701	783
TOTAL FINANCING REQD	6715	6732	6593	4997	2921	2767
EQUITY CONTRIBUTED	1343	1346	1319	999	584	553
DEBT REQUIRED	5372	5386	5274	3998	2337	2213
CUMULATIVE EQUITY	1343	2689	4008	5007	5592	6145
CUMULATIVE DEBT	5372	10758	16032	20029	22366	24580
CUMULATIVE CAPITAL	6715	13447	20040	25037	27958	30724
DVL COST EXPENSED	344	646	661	903	694	1510
DVL COST DEPRECIATED	6371	5898	5555	3533	1526	474
INDIRECT DVL COST	0	0	0	0	0	0
CUMULATIVE IND COST	0	0	0	0	0	0

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	3a/1984	4a/1984	1a/1985	2a/1985	3a/1985	4a/1985	1a/1986	2a/1986	3a/1986	4a/1986
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	455	455	455	455
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	5.81	5.97	6.15	6.32
VALUE ENERGY SAVED	0	0	0	0	0	0	2643	2719	2797	2877
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	0	0	0	0	0	0	2643	2719	2797	2877
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	0	0	0	0	0	0	1740	1740	1740	1740
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.59	0.60	0.62
VALUE ENERGY USED	0	0	0	0	0	0	1001	1025	1049	1075
DVL PRD EXPENSE	344	546	661	903	694	1510	0	0	0	0
DVL PRD INTEREST	0	188	377	561	701	783	860	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	6
OPER & MAINT EXPENSE	0	0	0	0	0	0	1346	1381	1417	1454
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	0	0	0	0	0	0	0	860	860	860
DEPRECIATION	0	0	0	0	0	0	730	730	730	730
TOTAL COST	344	834	1038	1464	1395	2293	3937	3996	4056	4118
TAXABLE INCOME	-344	-834	-1038	-1464	-1395	-2293	-1294	-1277	-1260	-1241
INCOME TAX	-86	-209	-259	-366	-349	-573	-324	-319	-315	-310
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	0	0	0	0	0	0	0	0	0	0
EQUITY CONTRIBUTED	1343	1346	1319	999	584	553	0	0	0	0
TOTAL AFTER TAX OUTLAYS	1343	1346	1319	999	584	553	0	0	0	0
AFTER-TAX CASH FLOW	-1257	-1138	-1059	-633	-235	20	-241	-228	-215	-201
CUMULATIVE CASH FLOW	-1257	-2395	-3454	-4087	-4323	-4303	-4544	-4772	-4986	-5188

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	6.50	6.69	6.88	7.08	7.29	7.49	7.71	7.93	8.16	8.39
VALUE ENERGY SAVED	2960	3045	3132	3222	3315	3410	3508	3609	3713	3819
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	2960	3045	3132	3222	3315	3410	3508	3609	3713	3819
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	0.63	0.65	0.66	0.68	0.70	0.71	0.73	0.75	0.77	0.78
VALUE ENERGY USED	1101	1127	1154	1182	1211	1240	1270	1300	1332	1364
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1491	1530	1570	1611	1652	1695	1739	1785	1831	1878
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	860	845	830	814	797	780	762	744	724	705
DEPRECIATION	730	730	730	730	730	730	730	730	730	730
TOTAL COST	4182	4232	4284	4336	4390	4445	4501	4558	4617	4677
TAXABLE INCOME	-1222	-1188	-1151	-1114	-1075	-1035	-993	-949	-904	-857
INCOME TAX	-306	-297	-288	-278	-269	-259	-248	-237	-225	-214
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	429	444	459	475	492	509	527	545	565	584
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	429	444	459	475	492	509	527	545	565	584
AFTER-TAX CASH FLOW	-616	-604	-593	-581	-568	-555	-542	-528	-513	-497
CUMULATIVE CASH FLOW	-5803	-6408	-7001	-7581	-8150	-8705	-9247	-9774	-10287	-10784

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	8.64	8.88	9.14	9.40	9.67	9.95	10.24	10.53	10.83	11.14
VALUE ENERGY SAVED	3929	4042	4158	4278	4401	4527	4657	4791	4929	5070
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	3929	4042	4158	4278	4401	4527	4657	4791	4929	5070
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	0.80	0.82	0.84	0.86	0.88	0.90	0.93	0.95	0.97	0.99
VALUE ENERGY USED	1397	1430	1465	1500	1536	1573	1611	1650	1690	1731
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1927	1977	2029	2081	2135	2191	2248	2306	2366	2427
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	684	663	641	619	595	571	546	520	492	465
DEPRECIATION	730	730	730	730	730	730	730	730	730	730
TOTAL COST	4738	4801	4865	4930	4997	5065	5135	5206	5278	5353
TAXABLE INCOME	-809	-759	-706	-652	-595	-538	-477	-415	-350	-282
INCOME TAX	-202	-190	-177	-163	-149	-134	-119	-104	-87	-71
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	605	626	648	670	694	718	743	769	796	824
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	505	626	648	670	694	718	743	769	795	824
AFTER-TAX CASH FLOW	-481	-465	-448	-430	-411	-392	-371	-351	-329	-305
CUMULATIVE CASH FLOW	-11266	-11731	-12179	-12608	-13019	-13411	-13782	-14133	-14462	-14768

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	11.46	11.79	12.13	12.48	12.84	13.21	13.59	13.98	14.38	14.79
VALUE ENERGY SAVED	5216	5366	5520	5679	5842	6010	6183	6360	6543	6731
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	5216	5366	5520	5679	5842	6010	6183	6360	6543	6731
BEFORE TAX COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	1.02	1.04	1.07	1.09	1.12	1.15	1.18	1.20	1.23	1.26
VALUE ENERGY USED	1772	1815	1859	1904	1950	1997	2045	2094	2145	2196
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	2490	2555	2622	2690	2759	2831	2905	2980	3057	3137
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	436	406	375	343	310	276	240	204	166	126
DEPRECIATION	730	730	730	730	730	730	730	730	0	0
TOTAL COST	5429	5506	5586	5667	5749	5834	5920	6008	5368	5462
TAXABLE INCOME	-213	-140	-65	12	93	176	263	352	1175	1271
INCOME TAX	-53	-35	-16	3	23	44	66	88	294	318
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	853	883	914	946	979	1013	1049	1085	1123	1163
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	853	883	914	946	979	1013	1049	1085	1123	1163
AFTER-TAX CASH FLOW	-283	-258	-233	-207	-179	-151	-122	-91	-242	-309
CUMULATIVE CASH FLOW	-15050	-15309	-15542	-15748	-15928	-16079	-16200	-16291	-16533	-16842

SUMMARY RESULTS OF SENSITIVITY ANALYSIS
THULHIRIYA TEXTILE MILLS

BASE OR EXPECTED CASE

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -9377
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

ENERGY SAVINGS/SALES 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -5465
INTERNAL RATE OF RETURN: -16.2%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

ENERGY SAVINGS/SALES 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -13289
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DIRECT DEVELOPMENT COSTS 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -10925
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DIRECT DEVELOPMENT COSTS 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -7829
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

INTEREST RATES 2 POINTS HIGHER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -10456
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

INTEREST RATES 2 POINTS LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -8345
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

SUMMARY RESULTS OF SOCIAL VALUE AND
FOREIGN CURRENCY REQUIREMENTS ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

SOCIAL DISCOUNT RATE: 10.0%

SOCIAL VALUE RESULTS

TOTAL DEVELOPMENT PERIOD COST: 25079

TOTAL NET BENEFITS IN OPERATING PERIOD: -8306

PRESENT VALUE OF NET BENEFIT STREAM AT
10.0%: -28947

FOREIGN CURRENCY REQUIREMENTS RESULTS

FOREIGN CURRENCY REQUIRED IN DEVELOPMENT PERIOD: 24320

FOREIGN CURRENCY REQUIRED IN OPERATING PERIOD: -75029

PRESENT VALUE OF FOREIGN CURRENCY REQUIREMENT AT
10.0%: -17491

(Positive values mean the project is a net user of foreign currency; Negative values mean the project is a net generator of foreign currency.)

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	455	455	455	455
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	4.24	4.26	4.28	4.30
VALUE ENERGY SAVED	0	0	0	0	0	0	1929	1939	1948	1958
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	0	0	0	0	0	0	1929	1939	1949	1958
PROJECT COSTS										
ENERGY USED (MT WOOD)	0	0	0	0	0	0	1740	1740	1740	1740
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.53	0.54	0.54
VALUE ENERGY USED	0	0	0	0	0	0	917	925	933	941
ENG/DESIGN COST	344	646	661	903	694	1510	0	0	0	0
DIRECT CAP COST	5543	5131	4833	3074	1328	412	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	1238	1240	1243	1245
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	5887	5777	5494	3977	2022	1922	2155	2165	2176	2186
NET BENEFIT STREAM	-5887	-5777	-5494	-3977	-2022	-1922	-226	-227	-227	-228
CUMULATIVE NET BENEFITS	-5887	-11664	-17158	-21135	-23157	-25079	-25305	-25531	-25759	-25987

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.32	4.35	4.37	4.39	4.41	4.43	4.46	4.48	4.50	4.52
VALUE ENERGY SAVED	1968	1978	1987	1997	2007	2017	2027	2037	2047	2057
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	1968	1978	1987	1997	2007	2017	2027	2037	2047	2057
PROJECT COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	0.55	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59
VALUE ENERGY USED	949	957	966	974	982	991	999	1008	1017	1025
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1248	1250	1253	1255	1258	1260	1263	1265	1268	1270
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	2197	2208	2218	2229	2240	2251	2262	2273	2285	2296
NET BENEFIT STREAM	-229	-230	-231	-232	-233	-234	-235	-236	-237	-238
CUMULATIVE NET BENEFITS	-26216	-26446	-26677	-26910	-27143	-27377	-27612	-27848	-28085	-28324

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.54	4.57	4.59	4.61	4.64	4.66	4.68	4.70	4.73	4.75
VALUE ENERGY SAVED	2068	2078	2088	2099	2109	2119	2130	2141	2151	2162
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2068	2078	2088	2099	2109	2119	2130	2141	2151	2162
PROJECT COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	0.59	0.60	0.60	0.61	0.62	0.62	0.63	0.63	0.64	0.64
VALUE ENERGY USED	1034	1043	1052	1061	1071	1080	1089	1098	1108	1118
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT OVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1273	1276	1278	1281	1283	1286	1288	1291	1293	1296
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	2307	2319	2330	2342	2354	2366	2377	2389	2401	2414
NET BENEFIT STREAM	-240	-241	-242	-243	-245	-246	-247	-249	-250	-252
CUMULATIVE NET BENEFITS	-28563	-28804	-29046	-29290	-29535	-29781	-30028	-30277	-30527	-30779

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.77	4.80	4.82	4.85	4.87	4.89	4.92	4.94	4.97	4.99
VALUE ENERGY SAVED	2173	2183	2194	2205	2216	2227	2238	2249	2260	2272
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2173	2183	2194	2205	2216	2227	2238	2249	2260	2272
PROJECT COSTS										
ENERGY USED (MT WOOD)	1740	1740	1740	1740	1740	1740	1740	1740	1740	1740
PRICE ENERGY USED	0.65	0.65	0.66	0.66	0.67	0.68	0.68	0.69	0.69	0.70
VALUE ENERGY USED	1127	1137	1147	1157	1167	1177	1187	1197	1207	1218
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1299	1301	1304	1306	1309	1312	1314	1317	1319	1322
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	2426	2438	2451	2463	2476	2488	2501	2514	2527	2540
NET BENEFIT STREAM	-253	-255	-256	-258	-260	-261	-263	-265	-267	-268
CUMULATIVE NET BENEFITS	-31032	-31287	-31543	-31801	-32061	-32322	-32585	-32850	-33117	-33385

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
VALUE ENERGY SAVED	0	0	0	0	0	0	-2378	-2447	-2517	-2589
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	258	485	496	677	521	1133	0	0	0	0
DIRECT CAP COST	5097	4718	4444	2826	1221	379	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	808	829	850	872
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	0	149	298	444	555	620	681	681	681	681
NET FOREIGN CURRENCY REQUIRED	5355	5352	5238	3948	2296	2131	-890	-937	-986	-1036
CUMULATIVE FOREIGN CURRENCY REQUIRED	5355	10707	15944	19892	22188	24320	23430	22493	21507	20470

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
VALUE ENERGY SAVED	-2664	-2740	-2819	-2900	-2983	-3069	-3157	-3248	-3341	-3437
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	895	918	942	966	991	1017	1044	1071	1099	1127
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	681	669	657	644	631	617	603	589	573	559
NET FOREIGN CURRENCY REQUIRED	-1088	-1153	-1220	-1290	-1361	-1435	-1511	-1589	-1669	-1753
CUMULATIVE FOREIGN CURRENCY REQUIRED	19382	18229	17009	15719	14358	12923	11413	9824	8154	6402

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
VALUE ENERGY SAVED	-3536	-3638	-3742	-3850	-3961	-4074	-4192	-4312	-4436	-4563
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1156	1186	1217	1249	1281	1314	1349	1384	1420	1456
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	542	525	508	490	471	452	432	411	390	368
NET FOREIGN CURRENCY REQUIRED	-1838	-1927	-2018	-2112	-2208	-2308	-2411	-2517	-2626	-2739
CUMULATIVE FOREIGN CURRENCY REQUIRED	4564	2637	619	-1492	-3701	-6009	-8420	-10937	-13563	-16302

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
VALUE ENERGY SAVED	-4694	-4829	-4968	-5111	-5258	-5409	-5564	-5724	-5889	-6058
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1494	1533	1573	1614	1656	1699	1743	1788	1834	1882
ENERGY CONSUMED	0	0	0	0	0	0	0	0	0	0
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	345	321	297	272	245	218	190	161	131	100
NET FOREIGN CURRENCY REQUIRED	-2855	-2975	-3098	-3226	-3357	-3492	-3631	-3775	-3923	-4076
CUMULATIVE FOREIGN CURRENCY REQUIRED	-19157	-22132	-25231	-28456	-31813	-35305	-38936	-42711	-46634	-50710

CONSERVATION PROJECT FINANCIAL/ECONOMIC EVALUATION

THULHIRIYA TEXTILE MILLS

Prepared for:
K.M. RANDERIA
NATIONAL TEXTILE CORPORATION
THURHIRIYA SRI LANKA

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MAY 13, 1984

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LIST OF ABBREVIATIONS USED IN THIS REPORT:

CAP: Capital
DVL: Development
ENG: Engineering
IND: Indirect
PRD: Period
RQRD: Required
Q: Quantity
OPER & MAINT: Operating & Maintenance

SUMMARY PROJECT INFORMATION

Project Name: THULHIRIYA TEXTILE MILLS

Project Location: THURHIRIYA SRI LANKA

Company: NATIONAL TEXTILE CORPORATION

Company Contact: K.M. RANDERIA, GENERAL MANAGER

Telephone: 580074

Project Description:

THE THULHIRIYA UNIT OF THE NATIONAL TEXTILE CORPORATION CURRENTLY USES OIL-FIRED BOILERS TO MEET STEAM REQUIREMENTS. IN THIS ANALYSIS THE OPTION OF REPLACING ONE OF THE BOILERS WITH A MULTI-FUELED BOILER USING COAL AND OIL IS INVESTIGATED.

Start of Project Development: 3q/1984

Start of Project Operation: 1q/1986

SUMMARY RESULTS OF FINANCIAL ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

DEVELOPMENT PERIOD COSTS
TOTAL DIRECT CAPITAL COST: 28642
TOTAL DIRECT DVL PERIOD COST (includes interest): 31251
TOTAL INDIRECT DVL PERIOD COST: 0

FINANCIAL STRUCTURE
DEBT FRACTION: 80.0%
TOTAL DEBT REQUIRED: 25001
TOTAL EQUITY CONTRIBUTED: 6250

DEBT TERMS
DEVELOPMENT PRD INTEREST RATE: 14.0%
OPERATING PERIOD INTEREST RATE: 14.0%
OPERATING PERIOD DEBT TERM: 32 QUARTERS
DEBT MORATORIUM PERIOD: 3 QUARTERS

MARGINAL TAX RATE: 25.0%

FINANCIAL PERFORMANCE

TARGET AFTER TAX RETURN ON EQUITY: 20.0%
PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -12489
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DEVELOPMENT PERIOD FINANCIAL SUMMARY
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985
ENG/DESIGN COST	344	646	661	903	694	2037
DIRECT CAPITAL COST	6371	5898	5555	3533	1526	474
DVL PRD INTEREST AT 14.0%	0	188	377	561	701	783
TOTAL FINANCING RQRD	6715	6732	6593	4997	2921	3294
EQUITY CONTRIBUTED	1343	1346	1319	999	584	659
DEBT REQUIRED	5372	5386	5274	3998	2337	2635
CUMULATIVE EQUITY	1343	2689	4008	5007	5592	6250
CUMULATIVE DEBT	5372	10758	16032	20029	22366	25001
CUMULATIVE CAPITAL	6715	13447	20040	25037	27958	31251
DVL COST EXPENSED	344	646	661	903	694	2037
DVL COST DEPRECIATED	6371	5898	5555	3533	1526	474
INDIRECT DVL COST	0	0	0	0	0	0
CUMULATIVE IND COST	0	0	0	0	0	0

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS. (000)

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	455	455	455	455
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	5.81	5.97	6.15	6.32
VALUE ENERGY SAVED	0	0	0	0	0	0	2643	2719	2797	2877
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	0	0	0	0	0	0	2643	2719	2797	2877
BEFORE TAX COSTS										
ENERGY USED (MT COAL)	0	0	0	0	0	0	635	635	635	635
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	1.84	1.89	1.94	1.99
VALUE ENERGY USED	0	0	0	0	0	0	1170	[illegible]	1233	1266
DVL PRD EXPENSE	344	646	661	993	694	2037	0	0	0	0
DVL PRD INTEREST	0	188	377	561	701	783	875	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	1346	1381	1417	1454
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	0	0	0	0	0	0	0	875	875	875
DEPRECIATION	0	0	0	0	0	0	730	730	730	730
TOTAL COST	344	834	1038	1464	1395	2820	4121	4187	4255	4324
TAXABLE INCOME	-344	-834	-1038	-1464	-1395	-2820	-1479	-1469	-1458	-1447
INCOME TAX	-86	-209	-259	-366	-349	-705	-370	-367	-365	-362
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	0	0	0	0	0	0	0	0	0	0
EQUITY CONTRIBUTED	1343	1346	1319	999	584	659	0	0	0	0
TOTAL AFTER TAX OUTLAYS	1343	1346	1319	999	584	659	0	0	0	0
AFTER-TAX CASH FLOW	-1257	-1138	-1059	-633	-235	46	-379	-372	-364	-355
CUMULATIVE CASH FLOW	-1257	-2395	-3454	-4087	-4323	-4277	-4656	-5027	-5391	-5746

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	6.50	6.69	6.88	7.08	7.29	7.49	7.71	7.93	8.16	8.39
VALUE ENERGY SAVED	2960	3045	3132	3222	3315	3410	3508	3609	3713	3819
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	2960	3045	3132	3222	3315	3410	3508	3609	3713	3819
BEFORE TAX COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	2.05	2.10	2.16	2.21	2.27	2.33	2.39	2.46	2.52	2.59
VALUE ENERGY USED	1299	1333	1369	1405	1442	1480	1519	1559	1601	1643
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1491	1530	1570	1611	1652	1695	1739	1785	1831	1878
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	875	860	844	828	811	793	775	756	737	717
DEPRECIATION	730	730	730	730	730	730	730	730	730	730
TOTAL COST	4395	4453	4512	4573	4635	4699	4764	4830	4898	4968
TAXABLE INCOME	-1436	-1408	-1380	-1351	-1320	-1288	-1255	-1221	-1186	-1149
INCOME TAX	-359	-352	-345	-338	-330	-322	-314	-305	-296	-287
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	436	451	467	483	500	518	536	555	574	594
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	436	451	467	483	500	518	536	555	574	594
AFTER-TAX CASH FLOW	-783	-778	-772	-767	-761	-754	-748	-741	-733	-726
CUMULATIVE CASH FLOW	-6529	-7307	-8079	-8846	-9606	-10360	-11108	-11849	-12582	-13308

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	8.64	8.88	9.14	9.40	9.67	9.95	10.24	10.53	10.83	11.14
VALUE ENERGY SAVED	3929	4042	4158	4278	4401	4527	4657	4791	4929	5070
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	3929	4042	4158	4278	4401	4527	4657	4791	4929	5070
BEFORE TAX COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	2.66	2.73	2.80	2.87	2.95	3.03	3.11	3.19	3.27	3.36
VALUE ENERGY USED	1686	1731	1777	1824	1872	1921	1972	2024	2078	2133
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1927	1977	2029	2081	2135	2191	2248	2306	2366	2427
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	696	674	652	629	605	581	555	529	501	473
DEPRECIATION	730	730	730	730	730	730	730	730	730	730
TOTAL COST	5039	5113	5187	5264	5342	5423	5505	5589	5675	5763
TAXABLE INCOME	-1110	-1070	-1029	-986	-942	-895	-847	-798	-746	-692
INCOME TAX	-278	-268	-257	-247	-235	-224	-212	-199	-186	-173
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	615	637	659	682	706	731	756	783	810	838
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	615	637	659	682	706	731	756	783	810	838
AFTER-TAX CASH FLOW	-718	-710	-701	-692	-682	-672	-662	-651	-640	-628
CUMULATIVE CASH FLOW	-14026	-14735	-15436	-16128	-16810	-17482	-18144	-18795	-19434	-20062

FINANCIAL ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS
All Monetary Values In: RS.(000)

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT REVENUES										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	11.46	11.79	12.13	12.48	12.84	13.21	13.59	13.98	14.38	14.79
VALUE ENERGY SAVED	5216	5366	5520	5679	5842	6010	6183	6360	6543	6731
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUE	5216	5366	5520	5679	5842	6010	6183	6360	6543	6731
BEFORE TAX COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	3.45	3.54	3.63	3.73	3.83	3.93	4.03	4.14	4.25	4.36
VALUE ENERGY USED	2189	2247	2306	2367	2430	2494	2560	2628	2697	2768
DVL PRD EXPENSE	0	0	0	0	0	0	0	0	0	0
DVL PRD INTEREST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	2490	2555	2622	2690	2759	2831	2905	2980	3057	3137
OTHER OPER PRD COST	0	0	0	0	0	0	0	0	0	0
OPER PRD INTEREST	443	413	382	349	315	281	245	207	169	129
DEPRECIATION	730	730	730	730	730	730	730	730	0	0
TOTAL COST	5853	5945	6039	6136	6235	6336	6439	6545	5923	6034
TAXABLE INCOME	-637	-579	-519	-457	-393	-326	-256	-184	620	697
INCOME TAX	-159	-145	-130	-114	-98	-81	-64	-46	155	174
AFTER TAX OUTLAYS										
DEBT PRINCIPAL	868	898	929	962	996	1031	1067	1104	1143	1183
EQUITY CONTRIBUTED	0	0	0	0	0	0	0	0	0	0
TOTAL AFTER TAX OUTLAYS	868	898	929	962	996	1031	1067	1104	1143	1183
AFTER-TAX CASH FLOW	-615	-602	-589	-575	-560	-545	-529	-512	-678	-660
CUMULATIVE CASH FLOW	-20677	-21280	-21869	-22443	-23004	-23548	-24077	-24590	-25267	-25927

SUMMARY RESULTS OF SENSITIVITY ANALYSIS
THULHIRIYA TEXTILE MILLS

BASE OR EXPECTED CASE

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -12489
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

ENERGY SAVINGS/SALES 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -8577
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

ENERGY SAVINGS/SALES 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -16401
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DIRECT DEVELOPMENT COSTS 10% GREATER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -14058
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

DIRECT DEVELOPMENT COSTS 10% LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -10919
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

INTEREST RATES 2 POINTS HIGHER THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -13583
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

INTEREST RATES 2 POINTS LESS THAN EXPECTED

PRESENT VALUE OF AFTER TAX CASH FLOW
AT 20.0%: -11442
INTERNAL RATE OF RETURN IS LESS THAN NEGATIVE 100%
CUMULATIVE CASH FLOW DOES NOT BECOME POSITIVE.

SUMMARY RESULTS OF SOCIAL VALUE AND
FOREIGN CURRENCY REQUIREMENTS ANALYSIS

THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)

PROJECT SCHEDULE
DEVELOPMENT STARTS: 3q/1984
OPERATIONS START: 1q/1986
LAST TIME PERIOD IN ANALYSIS: 2q/1994

SOCIAL DISCOUNT RATE: 10.0%

SOCIAL VALUE RESULTS

TOTAL DEVELOPMENT PERIOD COST: 25601

TOTAL NET BENEFITS IN OPERATING PERIOD: -34585

PRESENT VALUE OF NET BENEFIT STREAM AT
10.0%: -43404

FOREIGN CURRENCY REQUIREMENTS RESULTS

FOREIGN CURRENCY REQUIRED IN DEVELOPMENT PERIOD: 24713

FOREIGN CURRENCY REQUIRED IN OPERATING PERIOD: -21035

PRESENT VALUE OF FOREIGN CURRENCY REQUIREMENT AT
10.0%: 13464

(Positive values mean the project is a net user of foreign currency; Negative values mean the project is a net generator of foreign currency.)

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	0	0	0	0	0	0	455	455	455	455
PRICE ENERGY SAVED	0.00	0.00	0.00	0.00	0.00	0.00	4.25	4.27	4.29	4.31
VALUE ENERGY SAVED	0	0	0	0	0	0	1934	1943	1953	1963
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	0	0	0	0	0	0	1934	1943	1953	1963
PROJECT COSTS										
ENERGY USED (MT COAL)	0	0	0	0	0	0	635	635	635	635
PRICE ENERGY USED	0.00	0.00	0.00	0.00	0.00	0.00	1.84	1.85	1.85	1.86
VALUE ENERGY USED	0	0	0	0	0	0	1170	1173	1176	1179
ENG/DESIGN COST	344	646	661	903	694	2037	0	0	0	0
DIRECT CAP COST	5543	5131	4855	3047	1328	412	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	1205	1236	1268	1301
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	5887	5777	5516	3950	2022	2449	2375	2410	2445	2480
NET BENEFIT STREAM	-5887	-5777	-5516	-3950	-2022	-2449	-442	-466	-492	-518
CUMULATIVE NET BENEFITS	-5887	-11664	-17180	-21130	-23152	-25601	-26043	-26509	-27000	-27518

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.33	4.36	4.38	4.40	4.42	4.44	4.47	4.49	4.51	4.53
VALUE ENERGY SAVED	1972	1982	1992	2002	2012	2022	2032	2042	2052	2062
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	1972	1982	1992	2002	2012	2022	2032	2042	2052	2062
PROJECT COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	1.86	1.87	1.87	1.88	1.88	1.88	1.89	1.89	1.90	1.90
VALUE ENERGY USED	1182	1185	1188	1191	1194	1197	1200	1203	1206	1209
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1335	1370	1405	1442	1479	1518	1557	1598	1639	1682
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	2517	2555	2593	2633	2673	2715	2757	2800	2845	2890
NET BENEFIT STREAM	-545	-573	-601	-631	-661	-693	-725	-758	-793	-828
CUMULATIVE NET BENEFITS	-28063	-28635	-29237	-29867	-30529	-31221	-31946	-32705	-33498	-34326

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.56	4.58	4.60	4.62	4.65	4.67	4.69	4.72	4.74	4.76
VALUE ENERGY SAVED	2073	2083	2093	2104	2114	2124	2135	2146	2156	2167
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2073	2083	2093	2104	2114	2124	2135	2146	2156	2167
PROJECT COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	1.91	1.91	1.92	1.92	1.93	1.93	1.94	1.94	1.95	1.95
VALUE ENERGY USED	1212	1215	1218	1221	1224	1227	1230	1233	1236	1239
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1725	1770	1816	1863	1912	1961	2012	2065	2118	2173
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	2937	2985	3034	3084	3136	3188	3242	3298	3354	3412
NET BENEFIT STREAM	-865	-902	-941	-981	-1022	-1064	-1107	-1152	-1198	-1245
CUMULATIVE NET BENEFITS	-35190	-36092	-37033	-38014	-39035	-40099	-41207	-42359	-43557	-44802

SOCIAL VALUE ANALYSIS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Taxes And Interest Not Considered In This Analysis

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
PROJECT BENEFITS										
ENERGY SAVED (MT OIL)	455	455	455	455	455	455	455	455	455	455
PRICE ENERGY SAVED	4.79	4.81	4.83	4.86	4.88	4.91	4.93	4.95	4.98	5.00
VALUE ENERGY SAVED	2178	2189	2199	2210	2221	2232	2243	2255	2266	2277
ENERGY SOLD ()	0	0	0	0	0	0	0	0	0	0
PRICE ENERGY SOLD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	2178	2189	2199	2210	2221	2232	2243	2255	2266	2277
PROJECT COSTS										
ENERGY USED (MT COAL)	635	635	635	635	635	635	635	635	635	635
PRICE ENERGY USED	1.96	1.96	1.97	1.97	1.98	1.98	1.99	1.99	2.00	2.00
VALUE ENERGY USED	1242	1245	1248	1252	1255	1258	1261	1264	1267	1270
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	2230	2287	2347	2408	2470	2535	2600	2668	2737	2808
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
TOTAL COST	3472	3533	3595	3659	3725	3792	3861	3932	4004	4079
NET BENEFIT STREAM	-1294	-1344	-1396	-1449	-1504	-1560	-1618	-1678	-1739	-1802
CUMULATIVE NET BENEFITS	-46096	-47441	-48837	-50286	-51790	-53350	-54968	-56645	-58384	-60186

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1984	4q/1984	1q/1985	2q/1985	3q/1985	4q/1985	1q/1986	2q/1986	3q/1986	4q/1986
VALUE ENERGY SAVED	0	0	0	0	0	0	-2378	-2447	-2517	-2589
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	258	485	496	677	521	1528	0	0	0	0
DIRECT CAP COST	5097	4718	4444	2826	1221	379	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	0	0	0	0	0	0	808	829	850	872
ENERGY CONSUMED	0	0	0	0	0	0	995	1021	1048	1076
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	0	149	298	444	554	619	692	692	692	692
NET FOREIGN CURRENCY REQUIRED	5355	5352	5237	3947	2296	2526	116	95	73	51
CUMULATIVE FOREIGN CURRENCY REQUIRED	5355	10706	15944	19891	22187	24713	24829	24924	24997	25047

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1987	2q/1987	3q/1987	4q/1987	1q/1988	2q/1988	3q/1988	4q/1988	1q/1989	2q/1989
VALUE ENERGY SAVED	-2664	-2740	-2819	-2900	-2983	-3069	-3157	-3248	-3341	-3437
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	895	918	942	966	991	1017	1044	1071	1099	1127
ENERGY CONSUMED	1104	1133	1163	1194	1226	1258	1291	1325	1360	1396
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	692	680	667	654	641	627	613	598	583	567
NET FOREIGN CURRENCY REQUIRED	27	-9	-46	-85	-125	-167	-210	-254	-300	-347
CUMULATIVE FOREIGN CURRENCY REQUIRED	25074	25065	25019	24934	24809	24642	24432	24178	23879	23532

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	3q/1989	4q/1989	1q/1990	2q/1990	3q/1990	4q/1990	1q/1991	2q/1991	3q/1991	4q/1991
VALUE ENERGY SAVED	-3536	-3638	-3742	-3850	-3961	-4074	-4192	-4312	-4436	-4563
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1156	1186	1217	1249	1281	1314	1349	1384	1420	1456
ENERGY CONSUMED	1433	1471	1510	1550	1591	1633	1676	1721	1766	1813
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	550	533	516	497	479	459	439	418	396	374
NET FOREIGN CURRENCY REQUIRED	-396	-447	-499	-554	-610	-668	-728	-790	-854	-920
CUMULATIVE FOREIGN CURRENCY REQUIRED	23135	22688	22189	21635	21026	20358	19630	18840	17986	17066

FOREIGN CURRENCY REQUIREMENTS BY TIME PERIOD
THULHIRIYA TEXTILE MILLS

All Monetary Values In: RS.(000)
Positive Values Indicate Use Of Foreign Currency
Negative Values Indicate Generation Of Foreign Currency

TIME PERIOD	1q/1992	2q/1992	3q/1992	4q/1992	1q/1993	2q/1993	3q/1993	4q/1993	1q/1994	2q/1994
VALUE ENERGY SAVED	-4694	-4829	-4968	-5111	-5258	-5409	-5564	-5724	-5889	-6058
VALUE ENERGY SOLD	0	0	0	0	0	0	0	0	0	0
ENG/DESIGN COST	0	0	0	0	0	0	0	0	0	0
DIRECT CAP COST	0	0	0	0	0	0	0	0	0	0
INDIRECT DVL COST	0	0	0	0	0	0	0	0	0	0
OPER & MAINT EXPENSE	1494	1533	1573	1614	1656	1699	1743	1788	1834	1882
ENERGY CONSUMED	1861	1910	1960	2012	2065	2120	2176	2233	2292	2353
OTHER OPER PRD CST	0	0	0	0	0	0	0	0	0	0
INTEREST PAYMENTS	351	327	302	276	249	222	193	164	133	102
NET FOREIGN CURRENCY REQUIRED	-989	-1060	-1133	-1209	-1287	-1368	-1452	-1539	-1629	-1721
CUMULATIVE FOREIGN CURRENCY REQUIRED	16077	15017	13884	12675	11388	10019	8567	7028	5399	3678