DETAILED PROJECT REPORT
ON
BIO MASS GASIFIER FOR 250 kWth THERMAL APPLICATION REPLACING COAL
(JORHAT TEA CLUSTER)






ENERGY IS LIFE
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Bureau of Energy Efficiency

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BIO MASS GASIFIER FOR 250 kWth THERMAL APPLICATION REPLACING COAL

JORHAT TEA CLUSTER

BEE, 2010

Detailed Project Report on Biomass gasifier for 250 kWth thermal application replacing coal, Jorhat Tea Cluster, Assam (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PCRA/JTC/ SAG/** ____

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Petroleum Conservation Research Association

Guwahati

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List of Abbreviation

BEE	Bureau of Energy Efficiency
MSME	Micro Small and Medium Enterprises
DPR	Detailed Project Report
GHG	Green House Gases
CDM	Clean Development Mechanism
DSCR	Debt Service Coverage Ratio
NPV	Net Present Value
IRR	Internal Rate of Return
ROI	Return on Investment
SCM	Standard Cubic Meter
MNRE	Ministry of New and Renewable Energy
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industrial Development Bank of India

EXECUTIVE SUMMARY

Petroleum Conservation Research Association (PCRA) is the executing BEE _ SME program for Jorhat Tea Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Jorhat cluster is one of the largest tea clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures/technologies, so as to facilitate maximum replication in other tea clusters in India. The main energy forms used in the cluster units are grid electricity, Natural gas, coal, and Diesel oil mainly to provide power during off – grid period.

The tea factories of Jorhat Cluster uses either Natural Gas or Coal as the source for thermal energy requirement, and for electrical energy requirement, grid power is used. In case of failure in the power supply from the grid, DG sets fuelled by diesel oil is used to meet the requirement of electrical energy in the tea factories.

During the audit period, it was found that most of the tea factories have their own plantation of tea. These plantations are source of good quantifiable solid woody biomass as fallout from the tea bushes, which are presently not being utilised properly despite the fact that the cost of energy for these tea factories is high and is maintaining a rising trend. This proposed technology is intended towards optimal utilisation of the biomass resource available in the tea gardens attached with the tea factories for fulfilment of the thermal energy requirement, which is presently being fulfilled by coal in typical tea factories using coal as the thermal energy source.

This DPR highlights the study conducted for optimum utilisation of the biomass through biomass gasification, possible Energy saving and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios and schedule of Project Implementation.

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

S. No	Particular	Unit	Value
1	Project cost	` in lakh	17.18
2	Coal Saving	Tonne/annum	256.87
3	Biomass requirement	Tonne/Annum	342
4	Monetary benefit	` in Lakh /annum	5.57
5	Simple payback period	Yrs	3.70
6	NPV	` in Lakh	4.36
7	IRR	%age	17.37
8	ROI	%age	24.22
9	DSCR	Ratio	1.40
10	Annual CO_2 reduction	tonnes / Annum	468.12
	Process down time	Days	NIL

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible solution for Jorhat Tea Cluster.

ABOUT BEE'S SME PROGRAM

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

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

Activity 1: Energy use and technology audit

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

Activity 2: Capacity building of stake holders in cluster on energy efficiency

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

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1. INTRODUCTION

1.1. Briefing about Jorhat Tea Cluster

1.1.1. About Jorhat Tea Cluster

This SME cluster chosen for BEE's SME cluster development program comprises of the tea factories located in the erstwhile undivided Jorhat district of upper Assam that is presently comprised of Jorhat and Golaghat districts. The Jorhat Tea Cluster has about 150 tea factories. Majority of these tea factories have their own plantations, while the tea factories not having their own plantations depends on the tea gardens that does not have tea factories. The tea factories having their own plantation are owned either by group companies like APPL, Williamson & Magor, etc or by families having ownership through inheritance. These tea factories were mostly established during pre – independence period. Whereas the tea factories which does not have their own plantation were established after the late 80's and are owned by first generation entrepreneurs.

Existing Production Process:

The tea factories under Jorhat Tea cluster produces mainly produces CTC (Cut, tear and curl) and Orthodox type of tea. For the production of CTC type of tea the green tea leaves are shredded and then cut, tear and curled in the CTC (cutting, tearing and curling) machine. Whereas for the production of orthodox tea the green tea leaves are twisted through continuous circular motion of the rollers of the rolling machine. But for both these types of tea being manufactured in this cluster, the tea leaves are dried in dryers to remove the moisture before the made tea is finally sorted and packed. The drying process is the most energy intensive and to carry out the drying, the tea factories of this cluster use either coal or natural gas as fuel.

The pictorial representation of the tea manufacturing process that is being presently followed in Jorhat Tea Cluster is depicted in Annexure 1.

Withering:

The green tea leaves plucked from the garden are first withered to remove the surface moisture and partially the internal moisture. Withering promotes the dissipation of heat generated due to continuous respiration. The withering process which takes about 10 hours on an average, reduces the moisture content of green leaves to 55% in case of orthodox tea and to 70% in case of CTC tea production.

In Jorhat tea Cluster two types of withering process is being adopted by the tea factories. The first is the "Open Trough Withering" and second is the "Enclosed Trough Withering". In the first case, the area over the withering trough is kept open and the air from the withering fan passes from the bottom of the withering trough and released to the environment through the tea leaves. In the second case, the area over the withering trough is enclosed and the air from the withering fan is released to the environment through a single outlet after being passed through the tea leaves.

CTC:

In this process the withered tea leaves are shredded in the rotor – vane and then cut torn and curled in the CTC machine. During this process the enzymes of the tea leaves are released in the rotor – vane and the curling of the tea leaves initiates the fermentation process. Most of the juice that comes out of the tea leaves during shredding in the rotor – vane is evaporated due to friction in the CTC machine, for which the moisture content in the tea leaves after CTC is reduced from 70 % to 55 %.

Rolling:

This process after withering is adopted by tea factories to produce orthodox type of tea. The chemical compounds of the tea leaves are released to initiate oxidation in the fermentation process. Rolling twist the leaves and at the same time, breaks the leaf to release enzymes for oxidation.

Fermentation:

This is the least energy intensive step in the entire tea manufacturing process. During the fermentation process the tea leaves are left for oxidation, to which there occurs notable chemical as well as physical change. The color of the tea leaves is changed to reddish brown. The flavor and liquor of the tea leaves is attained in this stage.

Drying:

The fermented tea particles are dried or fired to arrest the fermentation and to reduce the moisture to about 3%. Clean and odorless hot air is passed through the fermented tea particles in dryers. The temperature of the hot air varies between 900 – 1600C depending on the type of dryer. Drying or firing is a thermal energy intensive operation that also consumes electrical energy to drive blowers and dryers. Drying is a critical process that decides the final product quality of black tea. Two types of dryers are used in the tea industry: - Endless Chain type (ECP) dryer or Fluidized Bed Dryer (FBD).

In the ECP dryer, tea particles are spread over continuously moving chain – type trays through which hot air flows. The trays move from top to bottom while the hot air is blown from the bottom. The temperature of hot air is about 900. The ECP dryer has an advantage to dry both leafy grades and powered grades. In the VFBD, tea particles are pneumatically fluidized by hot air at 140 – 1600C. Uniform drying is ensured in VFBD and better quality tea could be produced. This is also more energy efficient method compared to ECP dryers with less mechanical controls.

1.2. Energy Performance in Existing Situation

1.2.1. Energy Consumption Profile

For the purpose of tea processing, both electrical as well as thermal energy are required. In the tea factories of Jorhat Tea Cluster, the electrical energy requirement is fulfilled by electrical power available through grid whereas the main source of thermal energy is either coal or Natural Gas. The summary of the annual energy consumption in different production capacities of the tea factories of this cluster that uses coal as the thermal energy source as revealed during the energy audit is given in Table – 1 below;

Table 1: Annual Energy Consumption by Tea factories using coal

Parameter	Unit	Up to 500 MT of made tea	500 – 1500 MT of made tea	Above 1500 MT of made tea
Annual electrical energy consumption	kWh	221197.4	688252.8	862896.8
Annual coal consumption	MT	390.64	1107.21	1457.63
Annual HSD consumption	KL	27.66	88.69	136.43
Total Annual Energy consumption	MCal	2, 034, 504	5, 869, 315	7, 923, 604
Total Annual Energy consumption in one unit of the different capacity	Kloe	222.5	646.1	866.6
Average annual Made Tea production	MT	450	1000	1900

And the summary of the annual energy consumption of the tea factories of this cluster that uses NG as the thermal energy source is given in Table – 2 below;

Table 2: Annual Energy Consumption by Tea factories using Natural Gas

Parameter	Unit	Up to 500 MT of made tea	500 – 1500 MT of made tea	Above 1500 MT of made tea
Annual electrical energy consumption	kWh	234896.8	656332.6	805998.7
Annual NG consumption	Scum	216602	431594.8	629896.2
Annual HSD consumption	KL	30	92	145
Total Annual Energy consumption	MCal	2, 581, 390	5, 627, 756	8, 190, 163
Total Annual Energy consumption in one unit of the different capacity	Kloe	258.1	562.8	819.0
Average annual Made Tea production	MT	480	960	2100

1.2.2. Average Annual Production

Tea factories are agro based industries, and the operation of the tea factories depends on the availability of the tea leaves in the tea gardens. The tea factories depends on either their own in – house production of green tea leaves or on green tea leaves plucked from tea gardens without factories or both. The peak production season for tea factories in Jorhat Cluster starts with the beginning of spring, i.e., from the month of March – April and lasts till the end of autumn or beginning of winter, i.e., till the month of October – November. During this period most of the tea factories run on round the clock basis as the green tea leaves cannot be stored. The tea factories remain non – operational for about two to three months in a year between the months of December to March.

The average tea production in the tea factories of Jorhat Cluster where Energy Audit was carried out is 1002 tones of made tea per annum.

1.2.3. Specific Fuel Consumption & Specific Electricity Consumption

Similar to any other type of industry, the specific energy consumption in the tea factories of this cluster also depends on the scale of production, which has been evaluated during the energy audit. Thus keeping this into consideration, the tea factories of this cluster is broadly divided into three groups and the specific energy consumption is evaluated separately.

In this context it is noteworthy to mention that bifurcation of the tea factories base on production is specific to this report only and there is no official notification by any authorized bodies in this regard.

The specific energy consumption by the tea factories is given in Table – 3 below;

Table 3: Specific Energy Consumption by Tea Factories

Type of tea factory	kWh/ kg of made tea	Kgs of coal/ kg of made tea	Liters of HSD/ kg of made tea	Scum of NG/ kg of made tea
Large tea factory	0.55	0.72	0.07	0.32
Medium tea factory	0.65	0.82	0.08	0.39
Small tea factory	0.85	1.02	0.09	0.51

1.3. Existing sources of energy in present situation

The tea factories in the Jorhat Tea Cluster use electricity from grid to meet their electrical energy requirement. For the purpose of meeting the thermal energy requirement the tea factories uses either coal or natural gas. The detailed energy status of this cluster is detailed as below;

1.3.1. Details of the existing electrical energy source

All the tea factories utilize electricity from the ASEB grid to meet the electrical energy requirement. Although grid power is available but power cut is frequent and grid availability on an average is only 70%. Hence the gardens have to rely on in – house generating sets (DG) running mostly on Diesel. The average per unit cost of electricity for gardens is `5.00 and `11.00 for grid and self generation (DG set) respectively. Therefore, the cost of per unit of electrical energy on an average for the cluster works out to be.

Table 4: Average per unit cost of Electrical Power

Per Unit Cost Of Electrical Energy	
Grid Availability	70%
DG Power	30%
Average cost of grid power	` 5.5 per unit
Average cost of DG	` 12 per unit
Total Unit Cost	5.5 *0.7 + 12 * 0.3 = `7.45/ kWh

The average unit cost of electricity for the cluster is `7.45/ kWh, which is quite high. Therefore, any technology intended towards replacement of the existing source of electrical energy, so that the cost incurred towards procurement of electrical energy will be acceptable to the industry.

1.3.2. Details of the existing thermal energy source

To meet the thermal energy requirement for drying and withering, the factories in this cluster mainly use coal or Natural Gas.

Coal: The coal required by these factories is bought from the coal fields located in upper Assam; the coal supplied to cluster has a calorific value of 4500 kcal per kg of coal on an average. The average price of coal that is being supplied to these tea factories is `4.50 per kg of coal. Considering that 1 kWth is equivalent to 860 kCal, the average kWth of thermal energy generated from 1 kg of coal is 5.25 kWth of thermal energy. Though the availability of coal is not a problem for the cluster but the quality is an issue since most of the suppliers of coal do not give any certificate of quality and calorific value of the coal. And also coal available comes from different coalfields; therefore, the uniformity of size and calorific value of coal differs every time new load of coal comes. Due to this reason it is difficult to maintain standard operating practice of coal used in the factories.

Need for alternative source of energy: The high cost of energy, both electrical and thermal forms a major cost component for the tea factories of this cluster. So there is a need to replace the present non – renewable source of energy with renewable source, which has a lower operating cost, thus making the cost of energy cheaper for the cluster. As the tea factories are plantation based industries and also this industry being labor intensive, with the workers residing within the vicinity of the tea factories, biomass is easily available. Hence, utilization of the available biomass through gasification process can be a potentially good source of cheap alternative renewable energy source to fulfill both the thermal energy requirement of the tea factories as replacement of coal.

1.4. Baseline establishment for existing technology

Biomass under the existing situation is not being utilized and the woody biomass generated in the tea garden attached with the tea factories gets degraded in the tea garden itself. The thermal energy that is being required by the tea factories for the process requirement is being met through burning of coal in the coal heater. The baseline for evaluation of the present yearly coal cost is as tabulated in Table 5 below;

Table 5: Baseline parameters determining the yearly coal pricing

S. No.	Particulars	Unit	Value
1	Capacity of Withering Turf	kg/ Hour	225
2	Heat required to process1 kg of made tea	kCal/kg	950
3	Heat required to process made tea per hour	kCal/Hour	213750
4	Total Heat required per hour	kCal/Hour	1079001
5	Price of coal	`/ kg	4.5
6	Average operating efficiency of thermal system with coal as the source	%	19.81
7	Existing hourly requirement of coal to generate 250 kWth of thermal energy for process requirement	Kg/ hour	240
8	Hours of operation of the tea factory	Hours/ Day	12
9	Number of days of operation of the tea factory	Days/ Year	300
10	Total Hours of operation of the tea factory	Hours/ Year	3600
11	Yearly Requirement of coal	Kg/ year	863200
12	Existing cost being incurred towards Coal for thermal energy requirement	`/ year	3884402

1.5. Barriers in adoption of Biomass gasification system for power generation

1.5.1. Technological barrier

Due to absence of any scientifically designed operator training program, the operation and maintenance protocols for optimum utilization of thermal energy equipment are not followed. Though the thermal energy requirement is highest during the drying process of tea and the acceptability for fuel efficient air heater is expected to have a high acceptability, yet there is lack of technological intervention in this regard.

Majority of the unit's entrepreneurs in Jorhat tea cluster do not have any in – depth technical expertise and knowledge on energy efficiency, and are dependent on local technology suppliers or service companies, who normally rely on established and commonly used technology. The lack of technical know – how has made it difficult for the factory owners to identify the most effective technical measures.

Most of units in Jorhat tea cluster have been established several years ago when energy efficiency was not important issue for the operation of a plant. They are operating with outdated technology and low – end technologies.

As majority of the entrepreneurs in cluster are not aware of the energy losses in the plant, there may be a strong feeling that the energy efficiency initiatives in manufacturing facility can have a cascading effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced/ retrofitted equipment falls below design values.

There is a strong feeling in the tea factory entrepreneurs that, energy efficiency initiatives are difficult and the drive to save energy will affect the quality of made tea and thus will lead to business loss. These can however be overcome by motivating them to attend the awareness programs and use the detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

1.5.2. Financial barrier

- The cost of new technology is high. There is inadequate data on return on investment from energy saving alone. This creates barriers to financial decision making for acquisition of new technology.
- Banks, although willing to lend to the sector are unable to take decisions about lending in the absence of information about techno economic feasibility of energy saving equipment.

1.5.3. Skilled manpower

- The persons working in the tea factories of Jorhat Cluster generally belongs to a particular tribe working for generations in tea factories and they normally lead an isolated life. For this, though the persons are skilled with regard to the operation of the machineries, but innovations as well as consciousness regarding energy conservations lacks amongst the workforce. This is one of the lacunae of the Jorhat Tea Cluster.
- Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness amongst workforce. These programs should be organized with equipment suppliers.

1.5.4. Barrier specific towards adoption of this technology

- Though biomass are available in the tea estates, but these resource is un organized as in the existing situation there is no utilization of these resources. But this barrier can be overcome by properly organizing the biomass resource by creating economic value for the same.
- This technology can be optimally implemented in the tea factories having its own plantation as these tea factories have good availability of woody biomass.

2. PROPOSED EQUIPMENT FOR RENEWABLE POWER GENERATION

2.1. Description of technology

This is relatively a new technology for conversion of solid biomass into energy. Solid biomass in this context refers to woody biomass, rice husk, bamboo dust, etc. But solid biomass in the context of preparation of this report refers to woody biomass, because of its easy availability within the vicinity of the tea factories. Solid biomass containing carbon, hydrogen, and oxygen molecules are generally low quality fuel which on complete combustion produces carbon dioxide and water vapor. But in this technology the solid biomass is combusted under controlled condition to produce high quality combustible gaseous fuel. The combustible gaseous mixture thus obtained after controlled combustion of the solid biomass, normally called "PRODUCER GAS" is a low Btu, low pressure gas that can be combusted for thermal application for the tea factories as a replacement of coal. The proposed System will save 250 kWth of thermal energy with 95 kg of biomass consumption per hour. And this gas produced will be used for direct heating with energy efficient Burner. The system will also incorporate an energy efficient burner to combust gas produced.

2.1.1. Detailed description of the Technology

The gasification process technology is based on production of a highly combustible Producer Gas by controlled reactions of Biomass viz., woody biomass available in tea gardens, with air and water vapor. The Producer Gas having a calorific value of 1000 kcal/ m^3 that will be produced from this proposed system will be utilized for thermal application for the tea factories as a replacement of coal. The gasification of the biomass can be done mainly by two processes – Updraft process and Downdraft process. In the Updraft process the solid biomass fuel having moisture content not exceeding 20% and 25 mm size is fed from the top, while the air and steam is fed from the bottom, and moves upward against the downward movement of the biomass fuel. Whereas in the Downdraft process air is introduced into a downward direction following packed bed of solid biomass and the gas is drawn off at the bottom.

The solid fuel for getting converted into combustible gases has to pass through drying, pyrolysis, combustion and reduction zones. Tar and oil produced in the pyrolysis zone are cracked and reduced to non – condensable gaseous products in the combustion zone before leaving the gasifier. The chemistry of the gasification process that takes place in the different zones is detailed as below;

Drying Zone: The first stage of gasification is drying. Usually air dried biomass contains moisture in the range of 13 – 15%. The moisture content of biomass in the upper most layer is removed by evaporation using the radiation from the oxidation zone. The temperature in this zone remains less than 1200 C.

Pyrolysis Zone: The process by which the biomass looses its volatiles in the presence of controlled air and gets converted into Char is called pyrolysis. At temperature above 2000 C biomass starts losing its volatiles. Liberation of volatiles continues as the biomass travels almost until it reaches the oxidation zone. Once the temperature of the biomass reaches 4000 C, a self sustained exothermic reaction takes place in which the natural structure of biomass brakes down. The products of pyrolysis process are char, water, methanol, CO, H2, and considerable quantity of heavy hydrocarbons.

Combustion Zone: The temperature ranges between 9000 C – 12000 C. the outer layer of char burns to provide heat and products of combustion for further reaction. The organic vapor and tar formed in the pyrolysis zone are forced to pass through this zone to crack them through the process of oxidation. The principal reaction that take place are;

$$C + O_2 \longrightarrow CO_2$$

$$H_2 + \tfrac{1}{2} O_2 \longrightarrow H_2O$$

$$C + H_2O \longrightarrow CO_2 + H_2$$

Reduction Zone: The product of oxidation zone then passes through the reduction zone. Reduction is packed with a bed of charcoal. The charcoal is initially supplied from external sources. Later it is in the continuous process of being consumed by the reduction reaction and being simultaneously replenished by the char produced in the pyrolysis zone, the temperature in this zone is maintained at 9000 C – 6000 C. The principal reactions are;

$$CO_2 + C \longrightarrow 2CO$$

$$CO_2 + H_2 \longrightarrow CO + H_2O$$

$$C + 2\,H_2O \longrightarrow CH_4$$

A number of chain chemical reaction are believed to take place in the gas generator from top to bottom ensuring following reactions to take place.

<u>Exothermic Reaction</u>

$$C + O_2 \longrightarrow CO_2$$

<u>Endothermic Reaction</u>

$$CO_2 + C \longrightarrow 2CO$$

$$CO_2 + H_2 \longrightarrow CO + H_2O$$

<u>Methenation Reaction</u>

$$C + 2\,H_2O \longrightarrow CH_4$$

<u>Composition of Gas:</u>

CO	=	19 %	H_2	=	18%	N_2	=	50%
CH_4	=	03%	CO_2	=	10%			

2.1.2. Equipment Specification

The detailed equipment specification for this proposed 250 kWth capacity biomass gasification plant for thermal application as replacement of coal to meet the thermal energy requirement in tea factories through utilization of the available biomass resource in the tea gardens attached with the tea factories is given in Annexure 3.

2.1.3. Suitability or Integration with Existing Equipment

Presently solid biomass that is available in the tea gardens attached with the tea factories are being wasted and at the same time the tea factories are incurring expenditure for availing coal to meet the thermal energy requirement for the process. This proposed technology will help utilize the available biomass resource to generate thermal energy for fulfillment of the process requirement thereby reducing the burden of cost incurred towards availing coal without affecting the process. The system is proposed to consume biomass at the rate of 95kg/hour to produce 250kWth thermal energy. The system will also incorporate an energy efficient burner to combust gas produced.

2.1.4. Superiority over existing system

The superiority of biomass gasification are enumerated as below:

- Converts a traditional low quality fuel inconvenient to use into a high quality combustible gaseous fuel with associated convenience. Such conversion takes place with high efficiency.
- Almost all environmental pollution associated with biomass use can be eliminated.
- The operating efficiency of the thermal system improves as the Producer Gas produced due to gasification can be used by more efficient direct heating mode instead of indirect heating mode as is being practiced presently in the typical tea factories using coal as thermal energy source.
- Both initial investment and also the cost of Energy produced is the lowest amongst all known renewable energy alternatives

2.1.5. Availability of the technology

Biomass gasification is an established technology and can be available from any MNRE approved vendors.

2.1.6. Service Provider

The details of the service providers are given in Annexure 7

2.1.7. Terms and conditions in sales of equipment

The suppliers have already extended standard warrantee conditions for exchange, replace or repair against manufacturing defects for a period of 12 months after the date of commissioning. Promoters will have to promptly notify the supplier in writing of obvious defects or deficiencies after detection thereof. Replaced parts shall become the property of the supplier upon request of the supplier.

Supplier is not liable or defects or deficiencies which are resulting from the following reasons, as long as they are not resulting from a default of Supplier: Improper, unsuitable or negligent use, handling and/or operation of the system by promoters or by third parties; use of spare parts other than Genuine Parts; normal wear and tear; use of unsuitable consumables (such as, fuel, oil cooling liquid or any other consumables), particularly the use of consumables not conciliated in the operation manuals; improper building ground; chemical, electro- chemical or electric influences.

All conditions associated with this system are standard in nature. No special clause is incorporated. The conditions are very common in most of the plant & machinery sales.

2.1.8. Process down time

The installation and commissioning of the Biomass gasifier will require 15 days and this can be installed without disturbing the tea manufacturing process. Thus installation and commissioning of this technology can be done at the time of the year when the gardens are not in operation and there is no process down time during implementation.

2.2. Life cycle assessment and risks analysis

As revealed from the literature of the equipment supplier, the minimum life of the gasification plant can be considered as 15 years

2.3. Suitable unit for implementation of proposed technology

Of the tea factories where energy audit was carried out, 15 tea factories uses coal to meet the thermal energy requirement. This 15 tea factory, where energy audit was carried out is suitable for implementation of this technology.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

The economic benefits as stated above are calculated for a single Biomass gasifier having an installed capacity to generate 250 kWth thermal power and operational for 3600 hours per year.

3.1. Technical benefit

3.1.1. Fuel Saving Per Year

This technology is suitable for implementation in tea factories that uses coal as the source for thermal energy, so there will be saving in only coal and not Natural Gas due to the adoption of this technology. As being evaluated in Table 5 above, the coal saving due to adoption of this technology is estimated to be 256.86 tonne of coal per annum.

Table 6: Fuel savings (Increment in energy due to Energy Efficient Burner)

S. No.	Particulars	Unit	Value	
			Present	Proposed
1	Capacity of Withering Turf	kg/ Hour	225	225
2	Heat required to process1 kg of made tea	kCal/kg	950	950
3	Heat required to process made tea per hour	kCal/Hour	213750	213750
4	Total Heat required per hour	kCal/Hour	1079001	972918
5	Average operating efficiency of thermal system (coal as source)	%	19.81	21.97
6	Existing hourly requirement of coal	Kg/ hour	240	216
7	Yearly Requirement of coal	Kg/ year	863200	778334
8	Existing cost incurred towards Coal for thermal energy requirement	`/ year	3884402	3502503

Table 7: Fuel savings (Gasification)

S. No.	Particulars	Unit	Value
1	Total amount of heat Produced	kWth	250
2	Total amount of heat Produced	kCal/hour	215000
3	Calorific Value of Coal	kCal/kg	4500
4	Savings of coal per hour	kg/hour	48
5	Average operating hours (12 x 300 days)	hours	3600
6	Annual savings of coal	kg/Annum	172800
7	Cost of coal	`/kg	4.5
8	Savings in Rupees	`	777600

3.1.2. Electricity saving through generation

As this proposed technology is intended towards fulfillment of thermal energy requirement, so there will be no electricity saving due to the adoption of this technology.

3.2. Operational Cost of the Biomass Gasifier

The operational cost of this proposed biomass gasifier involves only the cost of solid biomass. The consumption of woody biomass by the gasification system to generate 250 kWth of thermal power will be 250 kg per hour. Based on this the yearly operational cost is as enumerated in below;

Table 8: Operational Cost of Biomass gasifier

Rate of Solid Bio mass, ` / kg	Consumption of woody biomass, kg/ hour	Yearly Quantity required, kg/ year	Total operational cost, ` / year
1.75	95	342000	598500

3.3. Monetary Benefits

The monetary benefits from the proposed technology is as detailed below;

Table 9: Monetary Benefits

S. No.	Particulars	Unit	Value
1	Coal savings due to implementation of EE burner	kg/year	84866
2	Coal savings due to implementation of Gasifier	kg/year	172800
3	*Total Coal Savings*	*kg/year*	*257666*
4	*Biomass required*	*kg/year*	*342000*
5	Cost of Biomass	`/kg	1.75
6	*Cost of Biomass*	*`/Year*	*598500*
7	Cost of coal	`/kg	4.5
8	*Cost of coal*	*`/Year*	*1159498*
9	*Annual Monetary Savings*	*`/Year*	*560998*

3.4. Social benefits

3.4.1. Improvement in working environment

The installation of the biomass gasifier will give economic value to the solid biomass generated in the households of the workers of the tea factory, which are presently being regarded as waste. This will help in the workers economically which in turn will bring more attachment of the workers towards their employer.

3.4.2. Improvement in workers skill

Technical skills of persons will definitely be improved. As the training will be provided by equipment suppliers which improve the technical skills of manpower required for operating of the equipment and also the technology implementation will create awareness among the workforce about energy efficiency and energy saving.

3.5. Environmental benefits

3.5.1. Reduction in effluent generation

There is no effluent generation in tea factories, for which this does not arise.

3.5.2. Reduction in GHG emission

It is estimated that the proposed technology will generate thermal energy required for the process by eliminating 256866 kg of coal per year having an average calorific value of 4500 kcal per kg through gasification of the biomass generated in the tea gardens associated with the tea factories. The reduction in emission of CO_2 due to the adoption of this technology in a single typical tea factory is 465.12 Tons/ annum.

4. IMPLEMENTATION OF THE BIOMASS GASIFIER

4.1. Cost of technology

The capital expenditure that will be required for the installation and commissioning of this technology is tabulated in Table 6 below;

Table 10: Cost for implementation of the technology

S. No.	Particulars	Unit	Value
1	Plant & Machinery	` (in Lacs)	13.50
2	Supervision of installation and commissioning/ training	` (in Lacs)	0.50
3	Civil Work required to be done by the tea factories	` (in Lacs)	2.50
4	Miscellaneous charges (Contingencies @10% Capital investment)	` (in Lacs)	0.68
5	Total cost	` (in Lacs)	17.18

4.2. Arrangements of funds

4.2.1. Financial Assistance

For the Implementation of this project in Tea factory financial assistance is being provided both by Ministry of Micro, Small and Medium Enterprises, Government of India and MNRE, Government of India. The amount of financial assistance provided by each of these two ministries is a discussed below;

- ***Assistance from Ministry of Micro, Small and Medium Enterprises, Government of India:*** This ministry of Government of India provides a capital subsidy of 25% of the total project cost. The capital subsidy from the Ministry of Micro, Small and Medium Enterprises works out to be `453750.
- ***Central Financial Assistance from MNRE, Government of India:*** This being a renewable project, so this project is eligible for financial assistance from Ministry of New and Renewable Energy. As per the scheme of MNRE, ` 2.00 lakh is available as Central Financial Assistance (CFA) for producing 300 kWth of thermal power with gasifier system.
- As this proposed system will produce 250 kWth of thermal power with a biomass gasification system, the tea factories implementing this technology are eligible for a CFA of `1.33 lakh from MNRE.

Financial Assistance considered:

- From the above discussion in paragraph 4.2.1 a and 4.2.1 b above, it is found that the subsidy from the Ministry of Micro, Small and Medium Enterprises is higher than that from the

Ministry of New and Renewable Energy, so the financial assistance from the Ministry of Micro, Small and Medium Enterprises is considered.

- Thus the financial assistance that will be received by the tea factories after implementation of this technology is `453750.

4.2.2. Entrepreneur's contribution

The entrepreneur requires contributing 25% of the total capital investment and this amount to `4.29 lakh.

4.2.3. Loan amount.

The balance capital requirement of 75% will be arranged by means of loans refinanced by Small Industries Development Bank of India through any of the scheduled commercial banks. Thus the loan amount will be `12.88 lakh.

4.2.4. Terms & conditions of loan

The terms and conditions of the loan with regard to the financial aspect of the loan are;

- Interest rate of the loan is @ 10% per annum on a reducing balance basis, which is SIDBI's interest rate for energy efficient projects.
- Repayment period is taken as 5 years excluding the initial moratorium period of 6 months.
- Depreciation is provided as per the rates provided in the companies act

4.3. Financial indicators

The financial indicators for this proposed technology is calculated on the following basis;

- For calculating the financial indicators, the subsidy from this Ministry is not taken into consideration.
- To arrive at a more competitive evaluation, the rise in the energy price is not taken into consideration, as monetary value of the savings is directly proportional to the energy price.
- The cost of maintenance and operation is taken as 2% of the capital cost of the biomass gasifier with a yearly increase @5%.

4.3.1. Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The project is expected to achieve monthly savings of ` 5.61 lakhs based on the assumptions as mentioned above.

Considering the above assumptions, the net cash accrual starts with ` 2.88 lakh in the first year of operation and to ` 13.75 lakh at the end of eighth year of operation.

4.3.2. Simple payback period

The estimated payback period is about 3.06 years or about 37 months.

4.3.3. Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ` 4.36 lakh.

4.3.4. Internal rate of return (IRR)

The after tax IRR of the project works out to be 17.37%.

4.3.5. Return on investment (ROI)

The average return on investment of the project activity works out at 24.22%.

4.4. Sensitivity analysis

Sensitivity analysis is carried out in the following two scenarios;

Optimistic Scenario: Under this scenario the financial projections are evaluated on the basis of 5% increase in the fuel savings.

Pessimistic Scenario: Under this scenario the financial projections are evaluated on the basis of 5% decrease in the fuel savings.

The result of the sensitivity analysis is as given below;

Table 11: Sensitivity Analysis

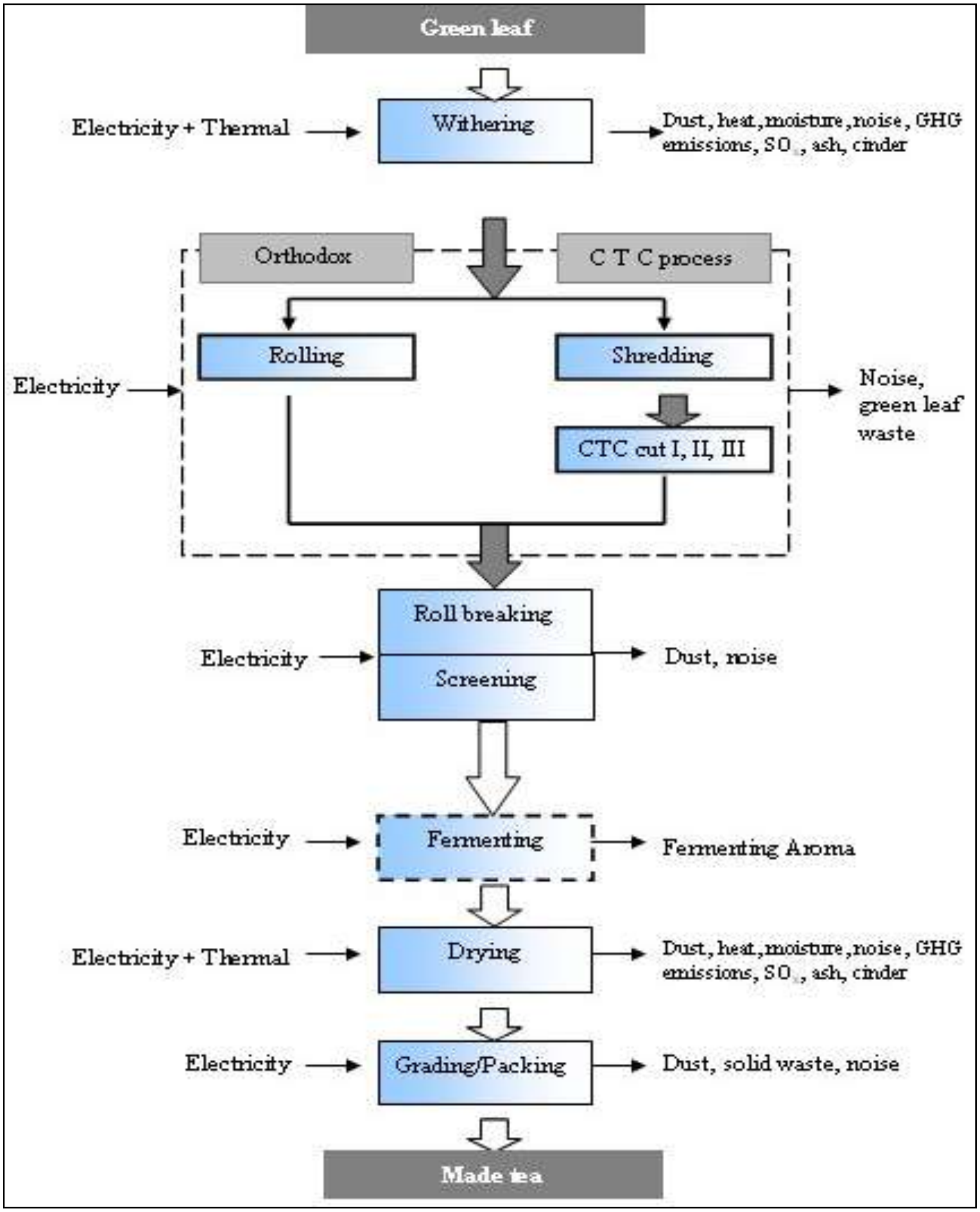
Particulars	IRR	NPV ` lacs	ROI	DSCR
Normal	17.37 %	4.36	24.22%	1.40
5% increase in savings	20.92 %	6.58	24.89%	1.54
5% decrease in savings	13.70 %	2.14	23.37%	1.26

4.5. Procurement and Implementation Schedule

The procurement and implementation schedule is given in Annexure 6.

Annexure

Annexure 1: Process Flow Diagram



Annexure 2: Energy audit data used for baseline establishment

S. No.	Particulars	Unit	Value
1	Capacity of Withering Turf	kg/ Hour	225
2	Heat required to process1 kg of made tea	kCal/kg	950
3	Heat required to process made tea per hour	kCal/Hour	213750
4	Total Heat required per hour	kCal/Hour	1079001
5	Price of coal	`/ kg	4.5
6	Average operating efficiency of thermal system with coal as the source	%	19.81
7	Existing hourly requirement of coal to generate 250 kWth of thermal energy for process requirement	Kg/ hour	240
8	Hours of operation of the tea factory	Hours/ Day	12
9	Number of days of operation of the tea factory	Days/ Year	300
10	Total Hours of operation of the tea factory	Hours/ Year	3600
11	Yearly Requirement of coal	Kg/ year	863200
12	Existing cost being incurred towards Coal for thermal energy requirement	`/ year	3884402

Annexure 3: Detailed technology assessment report

S. No.	Parameter	Value
1	Mode	250 kWth thermal energy generation in 100% Gas Mode
2	Gasifier Type	Open Type throat less Down Draft gasifier
3	Rated Gas Flow	500 Nm3
4	Average Calorific Value	1000 kCal/ m3
5	Gasification Temperature	900 – 10000 C
6	Ash removed	Continuous & through water seal
7	Start Up	Through blower and external power
8	Biomass charging	Continuous through feeding hopper
9	Rated Hourly Consumption	250 kg of woody biomass per hour
10	Typical Conversion efficiency	75 %
11	Turn Down Ratio	1 : 0.35
12	Material of construction	The gasifier reactor is made of M. S. / SS/ Ceramic & refractory lining and depending on the process requirement and maintaining a minimum shell life of 15 years

<u>Gas Burner Constitutes of:</u>

1) Gas filter,

2) On/off AUDCO Gas valve,

3) Input pressure gauge (0-1.0Kg/cm^2),

4) PRV (0-45 m^3/hr.) flow rate,

5) Output pressure gauge (0-300 mili bar),

6) High pressure Hose pipe from gas train assembly to Burner input Controller.

Annexure 4: Drawings for proposed electrical & civil works

Only Civil construction will be required for the installation of the gasifier system, which is specific to tea factory.

Annexure 5: Detailed Financial Analysis

Name of the Technology	BIO MASS GASIFICATION		
Rated Capacity	250 kWth thermal for coal replacement		
Details	**Unit**	**Value**	**Basis**
Installed Capacity	kWth thermal	250	Feasibility study
No of working days	Days	300	Feasibility study
No of Hours per day	Hours	12	Feasibility study
Proposed Investment			
Gasification System	`(in Lakh)	13.50	Feasibility study
Civil Work	`(in Lakh)	2.50	Feasibility study
Erection & Commissioning	`(in Lakh)	0.50	Feasibility study
Misc. Cost (Contingencies @10%)	`(in Lakh)	0.68	Feasibility study
Total Investment	`(in Lakh)	17.18	Feasibility study
Financing pattern			
Own Funds (Equity)	`(in Lakh)	4.29	Feasibility Study
Loan Funds (Term Loan)	`(in Lakh)	12.88	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10	SIDBI Lending rate
Estimation of Cost			
O & M Costs	% on Plant & Equip	2.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Coal saving	Tonne / Year	257.67	Feasibility study
Cost	`/Tonne	4500	Feasibility study
Biomass requirement	Tonne / Year	342	Feasibility study
Cost	`/Tonne	1750	Feasibility study
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax Rules

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	12.88	0.90	11.98	1.49
2	11.98	1.80	10.18	1.12
3	10.18	2.40	7.78	0.91
4	7.78	2.60	5.18	0.67
5	5.18	3.20	1.98	0.38
6	1.98	1.98	0.00	0.06
		12.88		

WDV Depreciation **`(in lakh)**

Particulars / years	1	2
Plant and Machinery		
Cost	17.18	3.44
Depreciation	13.74	2.75
WDV	3.44	0.69

Projected Profitability **`(in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Electricity savings	5.61	5.61	5.61	5.61	5.61	5.61	5.61	5.61
Total Revenue (A)	5.61	5.61	5.61	5.61	5.61	5.61	5.61	5.61
Expenses								
O & M Expenses	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
Total Expenses (B)	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
PBDIT (A)-(B)	5.27	5.25	5.23	5.21	5.19	5.17	5.15	5.13
Interest	1.49	1.12	0.91	0.67	0.38	0.06	0.00	0.00
PBDT	3.78	4.13	4.32	4.55	4.81	5.11	5.15	5.13
Depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PBT	2.87	3.23	3.42	3.64	3.90	4.20	4.24	4.22
Income tax	0.00	0.47	1.47	1.55	1.64	1.74	1.75	1.74
Profit after tax (PAT)	2.87	2.76	1.95	2.09	2.27	2.47	2.49	2.48

Computation of Tax **`(in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	2.87	3.23	3.42	3.64	3.90	4.20	4.24	4.22
Add: Book depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Less: WDV depreciation	13.74	2.75	-	-	-	-	-	-
Taxable profit	(9.96)	1.39	4.32	4.55	4.81	5.11	5.15	5.13
Income Tax	-	0.47	1.47	1.55	1.64	1.74	1.75	1.74

Projected Balance Sheet **`(in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Share Capital (D)	4.29	4.29	4.29	4.29	4.29	4.29	4.29	4.29
Reserves & Surplus (E)	2.87	5.63	7.57	9.67	11.94	14.40	16.89	19.37
Term Loans (F)	11.98	10.18	7.78	5.18	1.98	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	19.15	20.10	19.65	19.14	18.21	18.70	21.19	23.67

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	17.18	17.18	17.18	17.18	17.18	17.18	17.18	17.18
Less Accumulated Depreciation	0.91	1.81	2.72	3.63	4.53	5.44	6.35	7.25
Net Fixed Assets	16.27	15.36	14.45	13.55	12.64	11.73	10.83	9.92
Cash & Bank Balance	2.88	4.74	5.19	5.59	5.57	6.96	10.36	13.75
TOTAL ASSETS	19.15	20.10	19.65	19.14	18.21	18.70	21.19	23.67
Net Worth	7.17	9.92	11.87	13.96	16.23	18.70	21.19	23.66
Debt Equity Ratio	2.79	2.37	1.81	1.21	0.46	0.00	0.00	0.00

Projected Cash Flow **`(in lakh)**

Particulars / Years	0	1	2	3	4	5	6	7	8
Sources									
Share Capital	4.29	-	-	-	-	-	-	-	-
Term Loan	12.88								
Profit After tax		2.87	2.76	1.95	2.09	2.27	2.47	2.49	2.48
Depreciation		0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Total Sources	17.18	3.78	3.66	2.85	3.00	3.18	3.37	3.40	3.38

Application									
Capital Expenditure	17.18								
Repayment Of Loan	-	0.90	1.80	2.40	2.60	3.20	1.98	0.00	0.00
Total Application	17.18	0.90	1.80	2.40	2.60	3.20	1.98	0.00	0.00
Net Surplus	-	2.88	1.86	0.45	0.40	- 0.02	1.39	3.40	3.38
Add: Opening Balance	-	-	2.88	4.74	5.19	5.59	5.57	6.96	10.36
Closing Balance	-	2.88	4.74	5.19	5.59	5.57	6.96	10.36	13.75

IRR **` (in lakh)**

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		2.87	2.76	1.95	2.09	2.27	2.47	2.49	2.48
Depreciation		0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Interest on Term Loan		1.49	1.12	0.91	0.67	0.38	0.06	-	-
Cash outflow	(17.18)	-	-	-	-	-	-	-	-
Net Cash flow	(17.18)	5.27	4.78	3.76	3.67	3.56	3.44	3.40	3.38
IRR	17.37%								
NPV	4.36								

Break Even Point **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
O & M Expenses (75%)	0.26	0.27	0.28	0.30	0.31	0.33	0.35	0.36
Sub Total(G)	0.26	0.27	0.28	0.30	0.31	0.33	0.35	0.36
Fixed Expenses								
O & M Expenses (25%)	0.09	0.09	0.09	0.10	0.10	0.11	0.12	0.12
Interest on Term Loan	1.49	1.12	0.91	0.67	0.38	0.06	0.00	0.00
Depreciation (H)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Sub Total (I)	2.48	2.11	1.91	1.67	1.39	1.08	1.02	1.03
Sales (J)	5.61	5.61	5.61	5.61	5.61	5.61	5.61	5.61
Contribution (K)	5.35	5.34	5.33	5.31	5.30	5.28	5.26	5.25
Break Even Point (L= G/I)%	46.35%	39.58%	35.87%	31.49%	26.29%	20.44%	19.41%	19.58%
Cash Break Even {(I)-(H)}%	29.41%	22.59%	18.84%	14.42%	9.17%	3.27%	2.19%	2.30%
Break Even Sales (J)*(L)	2.60	2.22	2.01	1.77	1.47	1.15	1.09	1.10

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

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	2.87	3.23	3.42	3.64	3.90	4.20	4.24	4.22	29.72
Net Worth	7.17	9.92	11.87	13.96	16.23	18.70	21.19	23.66	122.69
									24.22%

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

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	2.87	2.76	1.95	2.09	2.27	2.47	2.49	2.48	14.40
Depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	5.44
Interest on Term Loan	1.49	1.12	0.91	0.67	0.38	0.06	0.00	0.00	4.62
Total (M)	5.27	4.78	3.76	3.67	3.56	3.44	3.40	3.38	24.47

DEBT

Interest on Term Loan	1.49	1.12	0.91	0.67	0.38	0.06	0.00	0.00	4.62
Repayment of Term Loan	0.90	1.80	2.40	2.60	3.20	1.98	0.00	0.00	12.88
Total (N)	2.39	2.92	3.31	3.27	3.58	2.04	0.00	0.00	17.50
DSCR (M/N)	2.21	1.64	1.14	1.12	0.99	1.68	0.00	0.00	1.40
Average DSCR	1.40								

Annexure 6: Procurement and implementation schedule

Activity No.	Activity Details	Days														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Civil works															
2.	Fitment of Equipments															
3.	Trial Operation															
4.	Training to staff															

The equipment for this technology will be delivered at the site of the tea factory after 3 months of receipt of confirmed order by the tea factory. During the period between placement of order and delivery of the equipments, the necessary site preparation will have to be done by the concerned tea factory. After the arrival of the equipment the installation and commissioning will take 15 days time, the break – up of which is as detailed;

- On the selected site necessary civil foundation and construction work will be carried out by the supplier in co – ordination with the factory personals. This is estimated to take 6 days.
- The fitment of equipments will take 9 days after the partial completion of the civil works.
- After completion of the installation, the equipment supplier will commission the equipment and as per the terms and conditions of MNRE, the equipment supplier will give a trial run for 3 days.
- Training to the staff will be provided simultaneously till completion of the trial run.

Annexure 7: Details of technology service providers

S. No.	Name of Service Provider	Address	Contact Person and No.
1	M/s BIOGEN Industries, Local Service Provider of M/s Rishipooja Energy and Engineering Company, Gorakhpur	Guwahati, Assam	Mr. Anupam Phukan Cell No. 09401596446
2	M/s G. P. Green Energy Systems (P) Limited	Salt Lake, Kolkata	Mr. J. Mukherjee No. (033) 23580114 M/s Radiant Energy Services, Guwahati, Cell No. 9707025343

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

RISHIPOOJA

RISHIPOOJA ENERGY & ENGINEERING COMPANY
M.G. College Road, Gorakhpur - 273001 (UP)
Tele Fax : 0551-220797
Mobile : 9415212901, 9236817707, 9336429290, 9415321903
Phone : (Off.) 0551-3293147, 2202797
E-mail : urjagen@hotmail.com, urjagen@gmail.com
Web Site : www.urjagen.co.in
(Mfg. Of Urja Biomass Gasifier)

Ref. No. :RP/PG/Office/10-11/AK-1119

Date : 28-07-2011

TO,
BONTI CONSULTANTS
GUWAHATI

Subject : Quotation for "Urja" Biomass Gasifier Based THERMAL ENERGY System in 100% Gas Mode.

Dear Sir,

With reference to the above subject, we are pleased to submit our most competitive offer for your kind consideration and early order please.

S.No.	Particulars	Rate
01.	Supply of "Urja"Biomass Gasifier based 250 Kw Generation system Model "Urja" 250 T consisting of:	
	a) "Urja" Biomass Gasifier [Model"Urja" 250 T] suitable for producing extremely clean gas	RS. 13,50,000.00
	b) Supervision of installation & commissioning / Training	RS. 50,000.00
	Total	RS. 14,00,000.00

Terms & Conditions: As enclosed in **Annexure - 1**

Company Profile : As enclosed in **Annexure - 2**

Thanking you, and assuring you of our best attention & services.
With warms regards,
Cordially,

for Rishipooja Energy & Engineering Company

Magnum Automation Systems

A.T. Road, P.O.Lahoal-786010, Dist. Dibrugarh,(Assam).

Phone: +919957574040
Email:info.magnumauto@gmail.com

Buyer's name,
M/s XYZ,
………………………………,
………………………………,

Our Ref No: MAS/….
Dated: 29th June, 2011.

Dear Sir,

Subject: Quotation for the 1) **NG400 of UNIGAS** make for your ***Super Endless Chain Pressure Drier/ Combination FBD drier*** such as *4M Tempest*, of 170-200 Kg DMT/hour.

Reference: Your query No. ………..,

Thanks for the query to us and as required, we are appending below the rates of the ECM noted above, for placement of your Order.

1) To being the cost of the ***EE Automatic N.Gas Burner model NG 400*** for your Drier (model……….   ) with the Controller configuration programmed to match the requisite *thermal energy* via Process Air flow rate for Drier's rated throughput.

VFD Model No: **NG400 TN** of *UNIGAS CIB*, Italy Make, marketed in NE India by our firm, having rated Power of **120 kW** (thermal) .

The EE N.Gas Burner will be fitted on a 10mm MS mounting plate duly lagged from inside for thermal insulation ,together with the requisite 1) gas filter, 2)on/off AUDCO Gas valve, 3) input pressure gauge(*0-1.0Kg/cm²*), 4) PRV(*0-45 m³/hr.*) flow rate , 5)Output pressure gauge(*0-300 millibar*), 6) high pressure Hose pipe from gas train assembly to Burner input Controller, all assembled in such fashion that it is possible to connect the original conventional Burner, in 30 minutes, should it be required, as per AGCL's rules & regulations.

Rate: ₹ **2,03,792.00**
Sales tax (VAT extra): 5%.
Installation & Commissioning at your factory: ₹ ***10977.00.***

TERMS & Conditions of our Offer:

1) Our QUOTATION **is valid for 4 weeks** from its date & thereafter our written extension will be required.

2) **ADVANCE**: **80% of the basic price with order,** and **balance against Proforma Invoice prior** to delivery.

3) Mode of Payment: a) by direct deposit in our account No.**31652358055**, IFSC Code: **SBIN0000071** with SBI, **Dibrugarh**, through any **SBI *cbs* branch**.

Magnum Automation Systems
A.T. Road, P.O.Lahoal-786010, Dist. Dibrugarh,(Assam).
Phone: +919957574040
Email:info.magnumauto@gmail.com

b) By *transfer through* **NIFT**.
c) By an a/c Payee Cheque.

4) **Delivery**: within *3-4 weeks of receipt of Commercial Purchase order* along with Advance.

5) The Customer must place the order in writing especially for EC Products, as the Document may be required for Subsidy claims by BEE, New Delhi.

6) The out state Customer must submit C-Form with the Order.

7) The Electrical equipment supplied must be run within the rated Voltage/Loading range-otherwise the **manufacturer's warranty** will not be enforceable. In the case of **PNG**, the client should ascertain that the fuel supplied is at the right pressure, calorific value, is free from unnatural high %age of Moisture, and other impurities, etc. A *constant Voltage transformer of 1.0 kVA* will be required to be installed, if the factory electrical system voltage is NOT stabilized/regulated.

8) **The delivery date** promised/mentioned is subject to the ***"Force majeure Clause"*** due to unforeseen circumstances or conditions beyond our Control or within our jurisdiction.

9) **Delivery/transport**: The Client will arrange for the transport of Goods to the place of installation in proper condition with all care necessary for fragile goods.

10) The machine will be ***under our AMC for 12 months from the date of commissioning***, and handing over to you.

11) We are one of the **BEE's Approved manufacturer/supplier for this Burner**, and you are free to communicate any problem that you may face from us to **BEE** and/or **ASDA, Guwahati**. Our rates are duly approved by the BEE, New Delhi.

We do hope you will favour us with your valued Order, and it will be our endeavour to give you Excellent products and Services.

Thanking You,

Yours faithfully,
For Magnum Automation Systems,

Jasbir Singh.
Cert.E.A.

Magnum Automation Systems
A.T. Road, P.O.Lahoal-786010, Dist. Dibrugarh,(Assam).
Phone: +919957574040
Email:info.magnumauto@gmail.com

Buyer's name,
M/s XYZ,
.................................,
.................................,

Our Ref No: MAS/....
Dated: 29th June, 2011.

Dear Sir,

Subject: Quotation for the 1) **NG400 of UNIGAS make** for your ***Super Endless Chain Pressure Drier/*** **Combination FBD drier** such as *4M Tempest* , of 170-200 Kg DMT/hour.

Reference: Your query No. ....,

Thanks for the query to us and as required, we are appending below the rates of the ECM noted above, for placement of your Order.

1) To being the cost of the ***EE Automatic N.Gas Burner model NG 400*** for your Drier (model..........) with the Controller configuration programmed to match the requisite *thermal energy* via Process Air flow rate for Drier's rated throughput.

VFD Model No: **NG400 TN** of *UNIGAS CIB*, Italy Make, marketed in NE India by our firm, having rated Power of **420 kW** (thermal) .

The EE N.Gas Burner will be fitted on a 10mm MS mounting plate duly lagged from inside for thermal insulation ,together with the requisite 1) gas filter, 2)on/off AUDCO Gas valve, 3) input pressure gauge(*0-1.0Kg/cm²*), 4) PRV(*0-45 m³/hr.)* flow rate , 5)Output pressure gauge(*0-300 millibar*), 6) high pressure Hose pipe from gas train assembly to Burner input Controller, all assembled in such fashion that it is possible to connect the original conventional Burner, in 30 minutes, should it be required, as per AGCL's rules & regulations.

Rate: ₹ **2,03,792.00**
Sales tax (VAT extra): 5%.
Installation & Commissioning at your factory: ₹ ***10977.00.***

TERMS & Conditions of our Offer:

1) Our QUOTATION **is valid for 4 weeks** from its date & thereafter our written extension will be required.

2) **ADVANCE**: **80% of the basic price with order**, and **balance against Proforma Invoice prior** to delivery.

3) Mode of Payment: a) by direct deposit in our account No.**31652358055**; IFSC Code: **SBIN0000071** with SBI, **Dibrugarh**, through any **SBI *cbs* branch**.

Magnum Automation Systems

A.T. Road, P.O.Lahoal 786010, Dist. Dibrugarh,(Assam).

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We do hope you will favour us with your valued Order, and it will be our endeavour to give you Excellent products and Services.

Thanking You,

Yours faithfully,
For Magnum Automation Systems,

Jasbir Singh.
Cert.EA.

Bureau of Energy Efficiency (BEE)
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Websites: www.bee-india.nic.in, www.energymanagertraining.com

Petroleum Conservation & Research Association
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C-5, Keshava Building, Bandra-Kurla Complex; Mumbai – 400051
Website: www.pcra.org

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Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com