CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

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"20MW Bagasse based Cogeneration power project" at Bannari Amman Sugars Limited Sathyamangalam, Tamil Nadu

Version 02

16/05/2007

A.2. Description of the project activity:

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Purpose

The project activity aims to improve the efficiency of power generation from biomass residues and export the resulting surplus electricity to the State Electricity Grid.

The project activity has been implemented in one of the sugar factories of M/s. Bannari Amman Sugars Limited (BASL) situated at Sathyamangalam, Erode District, Tamil Nadu. BASL is a part of the Bannari Amman Group, a leading industrial conglomerate engaged in the manufacturing of sugar, industrial alcohols, granites, power generation and distribution. Prior to implementation of the project activity, BASL was generating steam and power from its mill generated bagasse, through two low pressure boilers and two turbo generator (TG) sets. The generated steam and power were utilized to meet the captive energy requirements of the sugar factory.

BASL has replaced the low pressure system with a new 20 MW high pressure cogeneration plant ("project activity") in order to improve the energy efficiency and increase power generation thereby facilitating the export of electricity to the TamilNadu Electricity Board (TNEB) grid, which is part of the southern regional grid of India. By exporting renewable electricity to the grid, the project activity displaces fossil fuel intensive electricity from the grid connected power plants and results in emission reductions.

Project's contribution to sustainable development

Social well-being

The project activity helps to bridge the gap of electricity demand and supply at local and national level. The location of the project activity in rural setting contributes towards poverty alleviation by generating both direct and indirect employment. The project activity generates additional income for BASL, enabling the allocation of funds to continue its social welfare measures like health camps, infrastructure development, dissemination of latest agricultural techniques etc.

Economic well-being

The project activity being situated at a remote part of the grid serves as a decentralized grid power source. The improved power quality has a direct positive impact on the region's economic growth through better productivity and quality of life. The revenues from sale of electricity would provide sufficient funds for BASL to expand its sugar crushing capacity, leading to higher cane demand that would boost local employment and improve the income level of farmers in the region.

Environmental well-being

The CO_2 emissions of the combustion process due to burning of bagasse are consumed by the sugarcane plant during its growth, representing a cyclic process, thereby leading to zero net CO_2 emission. The export of surplus electricity to the grid reduces the emission of environmentally harmful gases including GHGs from fossil fuel power plants.

Technological well-being

The project activity uses the most efficient and environment friendly technology of cogeneration available in the renewable energy sector at the time of its implementation. The successful demonstration of the high pressure (87 ata and 515ºC) cogeneration technology helps to accelerate the conversion from lesser steam parameters (32 or 44 ata) prevalent in the country to high efficiency high pressure systems.

A.3. Project participants:

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Name of Party involved (*) (host indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant
India (Host Country)	Bannari Amman Sugars Limited – Private Entity	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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Tamil Nadu

A.4.1.3. City/Town/Community etc:

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Alathukombai Village, Sathyamangalam Taluk, Erode District

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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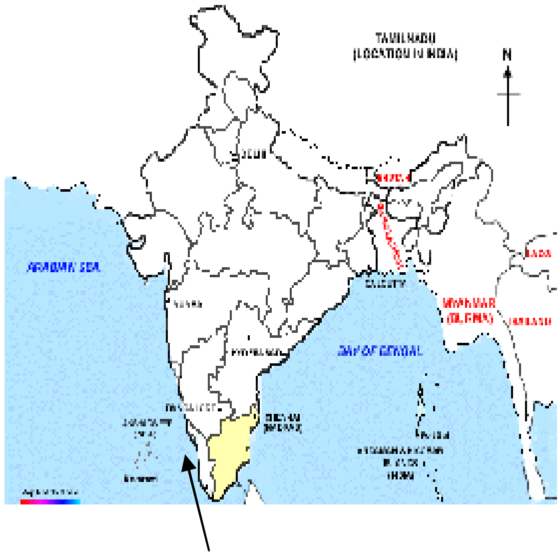
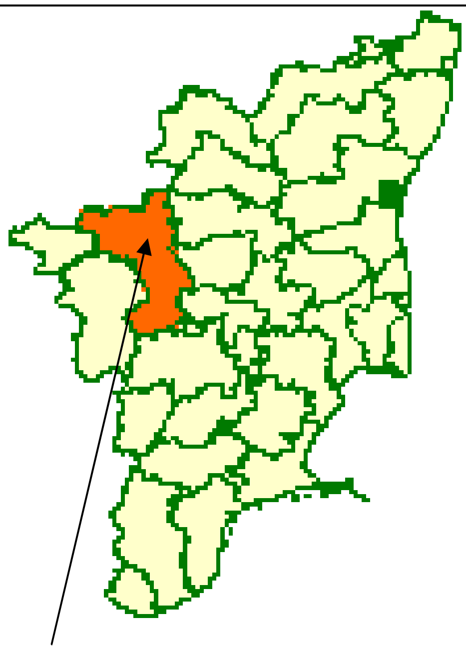
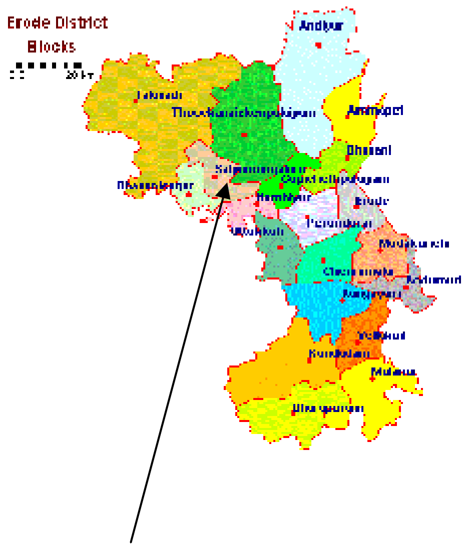
The 20 MW cogeneration plant is located adjacent to BASL's sugar factory at Alathukombai village of Sathyamangalam taluk (11.3°N 77.17°E), Erode District in the state of Tamil Nadu and has been operating since 1986. The nearest railway station is Erode. TNEB electrical sub-station for power export of 20 MVA is situated very near to this project, approximately two kilometres to where the surplus power is exported. Other requirements of the cogeneration project including water requirement, infrastructure facilities are also available at the site.



Tamil Nadu, India



Erode District, Tamil Nadu



Sathyamangalam, Erode District

A.4.2. Category(ies) of project activity:

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The project activity generates electricity from bagasse, which is a renewable fuel and therefore can be categorized under **"Category 1: Energy industries (renewable / non-renewable sources)"** as prescribed in the latest 'List of Sectoral Scopes' available at UNFCCC website.

A.4.3. Technology to be employed by the project activity:

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The cogeneration plant consists of a high pressure boiler; a suitable collaterally operating TG set and associated auxiliary equipment. The boiler is designed to generate 120 TPH steam at 87 ata pressure and 515ºC temperature using bagasse as the main fuel. The high pressure configuration has a better efficiency than the low pressure system, resulting in the generation of higher quantity of steam at a higher enthalpy for the same quantity of biomass input. The inlet feed water will be at 170 ºC with the feed water heated in high pressure feed water heaters. The TG set is rated for a nominal output of 20 MW with inlet steam parameters of 87 ata and 515ºC. The steam-power ratio has increased to around 5.4 kg/kWh as compared to 10 kg/kWh in the pre-project scenario. The turbo-generator is of double extraction cum condensing type capable of operating during off-season when there is no process steam requirement. Surplus bagasse during season will be stored for operation in the off-season period.

- The boiler and turbo Generators are fully automated to improve the operational efficiency. All the steam turbine driven mills are replaced with DC drives and all Induced Draft (ID), Forced Draft (FD), Secondary Air (SA) fans and boiler feed pumps are with Variable Frequency Drives (VFD) drives for energy conservation. Pressure regulating and De-superheating System (PRDS) system with automation is introduced to ensure continuous working of mill during grid failure. To reduce blow-down, water quality is maintained at the required parameter and make-up water is used from Reverse Osmosis (RO) plant. As the TG is of extraction cum condensing type, the steam during sugar mill stoppages need not be let out, which would in turn reduce the specific steam consumption.
- The auxiliary plant systems include:
- Fuel (bagasse / biomass) handling system
- Ash handling system

- Cooling water system
- Raw water and de-mineralized (DM) water system
- Instrument air system, electrical system and EHV transmission system

The cogeneration plant generates a total power of 20 MW during season and off-season. After meeting steam and power requirements of sugar plant, cogeneration plant auxiliaries and BASL's adjacent granite factory, about 13.0 MW of surplus power during season and 17.5 MW during off-season are being exported to TNEB grid. The power generated in the TG set will be at 11 KV level, stepped down to 415V for feeding the plant equipments and stepped up to 110 KV for paralleling with the TNEB grid at the electrical sub-station, which is situated approximately two kilometres from the plant. Considering the overall electrical energy efficiency in the pre-project and project scenarios, the net quantity of increased electrical energy generation as a result of the project activity during the 10-year crediting period would be around 950.50 Million kWhs.

The project activity involves complete replacement of the existing low pressure biomass cogeneration system with a new high pressure system. The high pressure configuration is more efficient, and therefore, the electricity generated from a certain quantity of biomass is higher than in the low pressure system; the average annual generation prior to the project activity was around 24.8 Million kWhs and increased to 119.1 Million kWhs after implementing the project activity. The incremental electricity generated is exported to the TNEB grid resulting in the displacement of an equivalent generation from sources connected to the grid.

The TNEB grid is interlinked with other state grids in southern India with significant quantity of energy exchanges and therefore, the electricity exported by the project activity to the TNEB grid may be considered to displace equivalent electricity from the southern regional grid. The electricity generation mix of southern regional grid is GHG emission intensive; the emission factor representing present and future grid mix is calculated to be 0.86 tCO2 per MWh (Refer Annex 3). Thus, the project activity, by exporting 950.5 Million kWhs of electricity to the southern regional grid, is expected to reduce GHG emissions of 817,430 tons over a ten year period.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Year	Annual estimation of emission reductions in tonnes of CO_2e
2007-08	81,743
2008-09	81,743
2009-10	81,743
2010-11	81,743
2011-12	81,743
2012-13	81,743
2013-14	81,743
2014-15	81,743
2015-16	81,743
2016-17	81,743
Total estimated reductions (tCO_2e)	817,430
Total number of crediting years	10
Average of estimated reductions over the crediting period (Tonnes of CO_2e)	**81,743**

A.4.5. Public funding of the project activity:

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No public funding is available for the project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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Title: Consolidated baseline methodology for grid-connected electricity generation from biomass residues (ACM0006) Version 04

Reference: This consolidated baseline methodology (ACM0006) is based on elements from the following methodologies:

- AM0004: "Grid-connected Biomass Power-Generation that avoids uncontrolled burning of biomass which is based on the A.T Bio power Rice Husk Power Project in Thailand."
- AM0015: "Bagasse-based cogeneration connected to an electricity grid based on the proposal submitted by Vale do Rosario Bagasse Cogeneration, Brazil."
- NM0050: "Ratchasima SPP Expansion Project in Thailand."
- NM0081: "Trupan biomass cogeneration project in Chile."
- NM0098: "Nobrecel fossil to biomass fuel switch project in Brazil"

This methodology also refers to the ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources") and the latest version of the *"Tool for the demonstration and assessment of additionality"*.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The project activity generates electricity from the combustion of bagasse, a renewable biomass residue from the sugar mill, and feeds surplus electricity to the grid. All the applicability criteria of ACM0006 have been met by the project activity as described under:

Conditions of ACM0006	Applicability to project activity
Applicable to grid connected and biomass residue fired electricity generation project activities	Bagasse fired in the project activity is a biomass residue. The project activity is connected to the TNEB grid to which it exports surplus electricity
Involves the improvement of energy efficiency of an existing power generation plant	The project involves the energy efficiency improvement of a power plant by replacing with a high efficiency power plant
May be based on the operation of a power generation unit located in an agro-industrial plant generating the biomass residues	Based on the efficiency improvement of a power generation unit located in a sugar plant
Biomass residues are defined as *biomass* that is a by-product, residue or waste stream from agriculture, forestry and related industries. This shall not include municipal waste or other wastes that contain fossilized and/or non-biodegradable material.	Bagasse used in the project activity is a residue from agriculture related industry (sugar plant)
No other biomass types than *biomass residues*, as defined above, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired).	Bagasse will be used as the predominant fuel, however, some amount of coal may be co-fired during drought or other emergency situations
For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other	The project activity uses the residue (bagasse) from sugar manufacturing. The production process is independent of the project activity and has not resulted in increase of the sugar plant crushing capacity.

substantial changes (e.g. product change) in this process.	
The biomass used by the project facility should not be stored for more than one year.	Bagasse is not stored on the site for more than one year.
No significant energy quantities, except from transportation of the biomass, are required to prepare the biomass residues for fuel combustion	The preparation of bagasse doesn't involve significant energy consumption. Some quantity of energy may be used for biomass transportation from outside during unavailability of bagasse.
The methodology is only applicable for the 17 combinations of project activities and baseline scenarios identified in the methodology.	Project activity fits in scenario 14.

For the project activity, Scenario 14 – Energy Efficiency Projects has been used since the project involves improving the energy efficiency by replacing the existing boiler and turbine configuration. The replacement increases the power generation capacity while the thermal biomass firing capacity is maintained. In the absence of the project activity, the existing power plant had sufficient lifetime to continue operating till the end of the 10 year crediting period. In the absence of the project activity, the same type and quantity of biomass residues as in the project plant would be used in the existing power plant. For details, refer Section B.4 below.

B.3. Description of the sources and gases included in the project boundary

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The following emission sources are included for determining the GHG emissions of the project activity:

- CO_2 emissions from on-site fossil fuel and electricity consumption that is attributable to the project activity. This includes fossil fuels co-fired in the project plant, fossil fuels used for on-site transportation or fossil fuels or electricity used for the preparation of the biomass residues, e.g., the operation of shredders or other equipment, as well as any other sources that are attributable to the project activity; and
- CO_2 emissions from off-site transportation of biomass residues that are combusted in the project plant.

For the purpose of determining the baseline, project participants have included the following emission sources:

- CO_2 emissions from fossil fuel fired power plants connected to the electricity system; and
- CO_2 emissions from fossil fuel based heat generation that is displaced through the project activity.

Methane emissions are excluded from both project and baseline emissions,

The spatial extent of the project activity includes:

- Fuel storage and processing area
- Boiler, TG set and all other power generating equipments, captive consumption units, steam consuming equipments and auxiliary equipments.
- The means for transportation of biomass residues to the project site
- All grid connected power plants of the southern regional grid.

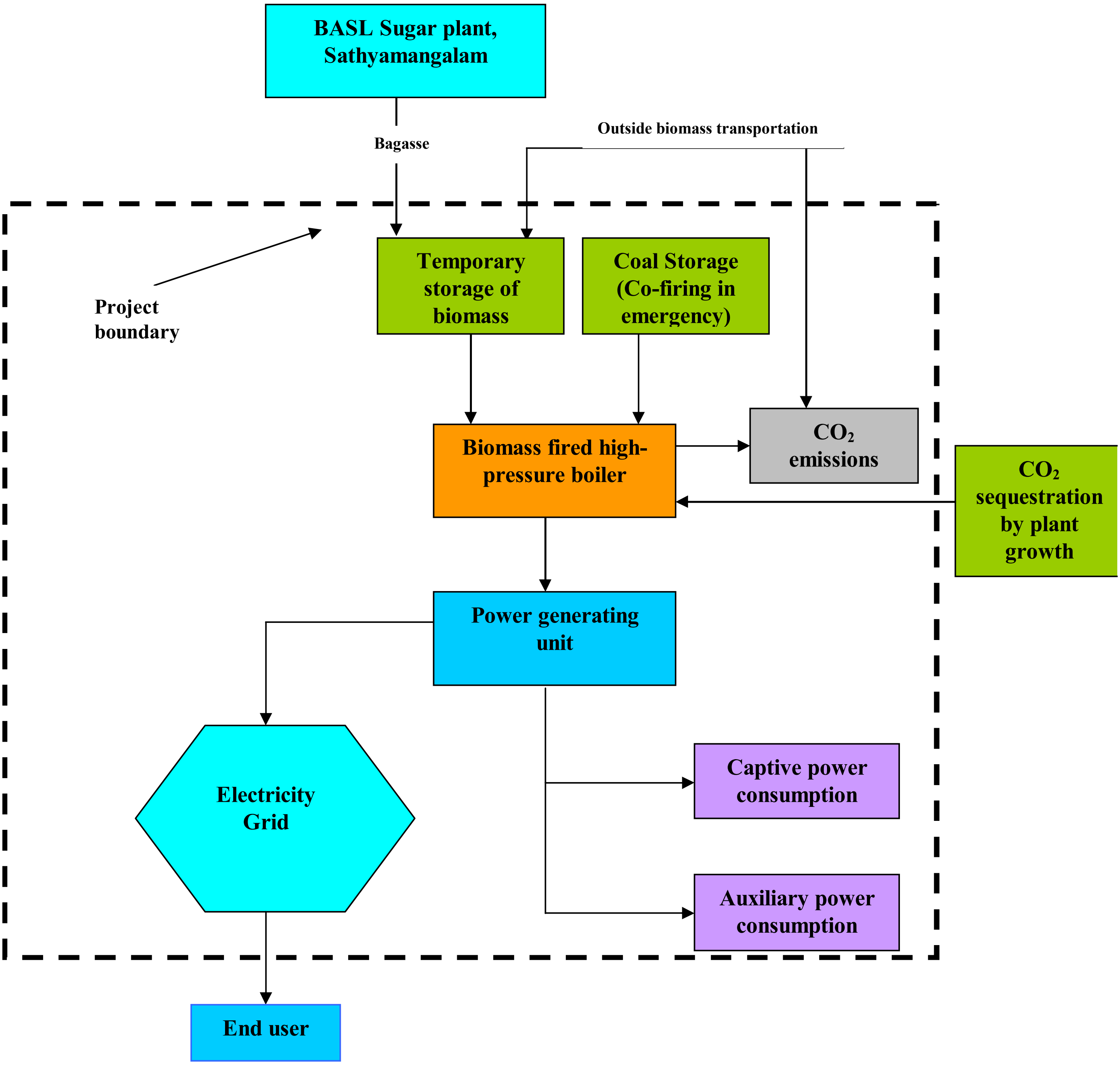

Fig B.1: Project boundary of BASL's project activity, Sathyamangalam

Following table illustrates which emission sources are included and which are excluded from the project boundary:

	Source	Gas		Justification/Explanation
Baseline Scenario	Grid Electricity Generation	CO_2	Included	Main Emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Heat Generation	CO_2	Included	Important emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Decay or uncontrolled burning of surplus biomass	CO_2	Excluded	No surplus biomass
		CH_4	Excluded	No surplus biomass
		N_2O	Excluded	No surplus biomass
Project Scenario	Onsite fossil fuel and electricity consumption due to the project activity	CO_2	Included	Important emission source.
		CH_4	Excluded	Excluded for simplification. This quantity is very small.
		N_2O	Excluded	Excluded for simplification. This quantity is very small.
	Offsite transportation of biomass	CO_2	Included	An important emission source.
		CH_4	Excluded	Excluded for simplification. This quantity is very small.

		N_2O	Excluded	Excluded for simplification. This quantity is very small.
	Combustion of biomass for electricity and/or heat generation	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Excluded	This emission source must be included only if CH4 emissions from uncontrolled burning or decay of biomass in the baseline scenario are included.
		N_2O	Excluded	Excluded for simplification. This quantity is very small.
	Biomass storage	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Excluded	Excluded for simplification. Since biomass is stored for not longer than one year, this emission source is assumed to be small.
		N_2O	Excluded	Excluded for simplification. This quantity is very small.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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In the absence of the CDM project activity, BASL had the following baseline options:

Baseline option 1 (BA1):

- Implementation of the project activity not undertaken as a CDM project activity
- Installation of a high pressure cogeneration system
- The existing low pressure system would be de-commissioned and scrapped

- The surplus power after meeting the captive requirements of the sugar mill would be exported to the grid

Baseline option 2 (BA2):

- Continuation of the existing low pressure cogeneration system and replacement with a high pressure cogeneration system at the end of its lifetime
- The captive power and steam requirements of the sugar plant would be met by the system
- There would no surplus power for export

Determination of the most plausible baseline scenario:

As defined in the consolidated methodology ACM0006, the realistic and credible alternatives have been separately determined for power generation, heat generation and biomass. Steps 3 (Barrier analysis) of the "tool for the assessment and demonstration of additionality" is used to analyse the above two options and determine the most plausible baseline alternatives:

Alternatives for power generation: How power would have been generated in the absence of the project activity?

1. As per baseline option BA1 above, the proposed project activity not undertaken as a CDM project activity is a likely baseline option (Option P1 as per ACM0006).
2. As per baseline option BA2 above, power would be partly generated at the existing power plant fired with the same type of biomass as the project activity (Option P5 of ACM0006) and partly in grid connected power plants (Option P4 of ACM0006)

Identification of most likely baseline power generation scenario using barrier analysis:

The first option (P1 - implementation of the project activity not undertaken as a CDM project activity) cannot be a baseline alternative since it faces prohibitive barriers (Refer Section B.5) to its implementation. There are no legal and regulatory requirements for implementation of the high pressure system. At the time of implementation of the project activity, only three cogeneration plants with equivalent pressure and temperature configuration were in existence in the country. In the absence of sufficient expertise and successful high pressure projects, it is very likely that BASL would not have opted for implementation of the high pressure system without the CDM incentive.

In the second option (combination of P4 and P5), the project proponent would use a lower energy efficient cogeneration plant compared to the project activity, which would result in consumption of more bagasse in order to generate equivalent steam and power for in-house utilization or captive consumption only. Though this alternative does not entail surplus power generation and export to an electricity grid, it is in compliance with all applicable legal and regulatory requirements and could be the baseline. In India, all the sugar mills have their own cogeneration units, most of them operating with low-pressure boiler configuration of below 45 kg/cm^2 (Maximum are in the range of 21 kg/cm^2 to 45 kg/cm^2) to cater to the in house steam and power requirements. This scenario (present situation of sugar mills) is considered as "Business As Usual" case for the Indian sugar industry, where in, bagasse is used at lower efficiency levels to meet the internal power requirements of sugar mills. Prior to the 20MW cogeneration plant, the sugar mill was equipped with two boilers, a 40 TPH and 30 TPH with parameters 32 kg/cm^2 and 380^0 Centigrade and two turbines of capacities 1.5MW and 3.0MW were existent to meet the energy requirements of the sugar mill and had sufficient lifetime to continue operating till the end of the crediting period. This option does not face any of the barriers as that of Option 1 and could be a likely baseline scenario.

A summary of the barrier analysis for the above two alternatives are provided below:

Barriers	**Options**	
	P1	**P4 and P5**
Investment	Yes	No
Technological	Yes	No
Common practice	Yes	No
Institutional	No	No

The most likely baseline power generation option is a combination of Option P4 and P5.

Alternative for steam generation: How heat would be generated in the absence of the project activity?

1. As per baseline option BA1 above, the proposed project activity not undertaken as a CDM project activity is a likely baseline option (Option H1 as per ACM0006).

2. As per baseline option BA2 above, heat would be generated at the existing cogeneration power plant fired with the same type of biomass as the project activity (Option H5 of ACM0006)

Identification of most likely baseline heat generation scenario using barrier analysis:

The first option (H1 - implementation of the project activity not undertaken as a CDM project activity) cannot be a baseline alternative since it faces prohibitive barriers (Refer Section B.5) to its implementation. There are no legal and regulatory requirements for implementation of the high pressure cogeneration system.

In the second option (H5), the process heat requirement of the sugar factory would continue to be met by steam from the exhaust of the backpressure turbines of the low pressure cogeneration system. The low pressure cogeneration system would have continued to operate without any problems till the end of the crediting period and the factory would have continued to meet its heat requirement from the system. There is no policy or regulation enforcing the replacement of the low pressure system with a high pressure system. BASL could have continued heat generation in the low pressure system. There are no barriers preventing this option and therefore it is a likely baseline option.

A summary of the barrier analysis for the above two alternatives are provided below:

Barriers	**Options**	
	H1	**H5**
Investment	Yes	No
Technological	Yes	No
Common practice	Yes	No
Institutional	No	No

The most likely baseline heat generation option is H5.

Alternatives for use of biomass: What would happen to the biomass in the absence of the project activity?

1. As per baseline option BA1 above, the biomass would be used for heat and electricity generation in a high pressure cogeneration system at the project site (Option B4 as per ACM0006)
2. As per baseline option BA2 above, the biomass would be used for heat and electricity generation in the existing low pressure cogeneration system at the project site (Option B4 as per ACM0006)

Identification of most likely baseline biomass scenario using barrier analysis:

The first option (implementation of the project activity not undertaken as a CDM project activity) cannot be a baseline alternative since it faces prohibitive barriers (Refer Section B.5) to its implementation. There are no legal and regulatory requirements for implementation of the high pressure cogeneration system.

In the second option, bagasse would have been used to generate heat and power (required for captive consumption only) at the project site in the existing low pressure boiler and turbine configuration. This alternative does not face any barriers and is in compliance with all regulatory requirements and could be a likely baseline scenario.

However, it may be noted that in both of the options, the biomass is consumed at the project site (Option B4).

Most plausible baseline scenario for the project activity:

The above analysis shows that the most likely baseline scenario is the "Baseline option 2" described above in this section, which is a combination of:

Options P4 and P5 for power generation

Options H5 for heat generation

Option B4 for biomass residues

The above combination of baseline scenarios for power, heat and biomass is applicable under scenario 14 of ACM0006.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

BASL's project activity generates clean electricity using CO_2 neutral bagasse as fuel and the surplus electricity from the project activity is supplied to the southern regional grid. In the business as usual (BAU) scenario, BASL would have continued with their low pressure cogeneration plant with no power export to grid, which is demonstrated using the latest UNFCCC "Tool for the demonstration and assessment of additionality" as prescribed by ACM0006. The equivalent quantity of electricity would be generated from power sources in the grid. Considering the existing grid generation mix and the recent capacity additions, fossil fuel based power plants are likely to dominate the generation mix with a CO_2 emission factor of 0.86 kg CO_2/kWh. Therefore, it may be stated that the implementation of the CDM project activity reduces GHG emissions that would otherwise occur in the CO_2 intensive grid sources.

Demonstration and Assessment of Additionality:

B.5.1 Step 0: Preliminary Screening based on the starting date of the project activity

The procurement and project construction began in March 2001 i.e. after January 2000 and prior to the Registration of the first CDM project activity (18 November 2004). The lack of closest fit methodology has delayed the project's Validation before December 2005 and therefore, the project may claim CERs generated after its Registration with UNFCCC. However, BASL would provide documentary evidence for:

- Consideration of the CDM in the decision to proceed with the project activity
- Starting date of the project activity

This clears the preliminary screening criteria of UNFCCC for registration of eligible project activity as a CDM project.

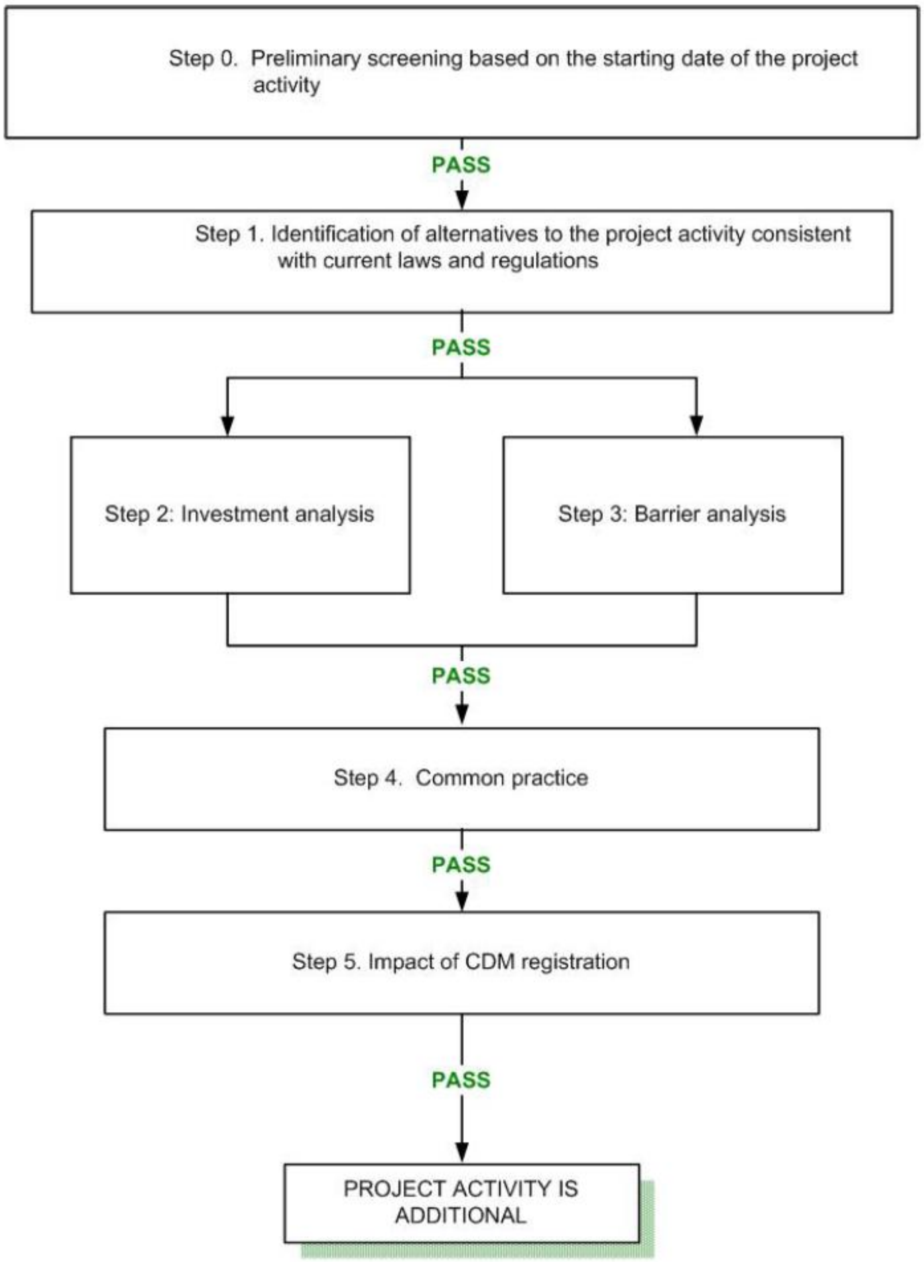

Fig B.2 Flowchart for demonstrating additionality of the project

B.5.2 Step 1 - Identification of alternatives to the project activity consistent with current laws and regulations

The sub-steps include:

A. Sub-step 1a. Define alternatives to the project activity

B. Sub-step 1b. Enforcement of applicable laws and regulations

In sub-step 1a and 1b, BASL is required to identify realistic and credible alternative(s) that were available to BASL or similar project developers that provide output or services comparable with the project activity. These alternatives are required to be in compliance with all applicable legal and regulatory requirements.

Sub-step 1.a: Define alternatives to the project activity

Considering the analysis in section B.4 above, the likely alternatives to the project activity are:

1. The project activity not undertaken as a CDM project activity

2. A combination of:

- Option P4 and P5: Continuation of power generation at the existing power plant (old boiler with lower efficiency) fired with the same type of biomass as the project activity and partly in existing and/or new grid connected power plants.
- Option B4: Use of biomass to generate heat and power at the project site.
- Option H5: Continuation of heat generation from bagasse at the project site.
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- Sub-step1.b. Enforcement of applicable laws and regulations
- Both the above options satisfy all applicable laws and regulations of the country.
- Option 1:
- The implementation of the project activity (utilising the bagasse for efficient power generation) not undertaken as a CDM project activity is not restricted by any applicable law or legislation.
- Option 2:
- There is no law or legislation that restricts the continuation of power generation in existing low pressure system fired with the same type of biomass as the project activity and partly in existing/new grid connected power plants.

- There is no law or legislation that restricts using the biomass to generate heat and power at the project site.
- There is no law or legislation that restricts heat generation from bagasse at the project site.

Therefore, all the alternatives satisfy the applicable laws and legislations.

The next step for additionality justification as per the Fig B.2 is either

- Investment analysis (Step 2) OR
- Barrier analysis (Step 3)

BASL proceeds to establish project additionality by conducting barrier analysis as under:

B.3.3 Step 3: Barrier Analysis

BASL is required to determine whether the project activity faces barriers that:

- Prevent the implementation of this type of project activity; and
- Do not prevent the implementation of at least one of the alternatives

The above study has been done by means of the following sub-steps:

Sub-step 3.a: Identification of barriers that would prevent the implementation of the project activity

The potential for bagasse based cogeneration in the Indian sugar industry is estimated by the Ministry of Non-Conventional Energy Sources (MNES) as 3500 MW of which Tamil Nadu has a potential of 350 MW. As early as 1995, several awareness campaigns and sponsored programs have been conducted to encourage sugar mills to tap their surplus power potential. However, the presence of several associated barriers; mainly climatic, policy, technological and prevailing practice; have prevented the widespread implementation of this concept.

BASL has moved forward and implemented a high pressure cogeneration system to export power to the grid despite the above barriers that are discussed in the subsequent section. The major barriers faced by BASL are:

- **Investment barrier:** BASL was apprehensive in approving the investment proposal for the project activity due to two risk factors in the financial returns: Climatic and Policy risks

- **Technological barrier:** Being one of the first of its kind in the region, the lack of trained manpower and the absence of successful high pressure configurations were a deterrent to the project activity

- **Other barriers**

All the above barriers are further elaborated below:

(i) Investment barrier:

The project activity faced a major barrier in investment approval from the BASL board. The Indian sugar industry is characterised by frequent fluctuations attributed to various factors such as sugar cane output, market forces, political scenario and governmental controls. The new high-pressure cogeneration system required a very high investment of around INR 5880.5 lakhs against the continuation of the low pressure system with minimum retrofits. Though the project would provide a marginal return on the investment under normal circumstances, it is not sufficient to cover the risk of investment on a project which is highly sensitive to fuel availability and the power policy atmosphere.

In the three years subsequent to implementation of the project activity, the region supplying sugarcane to the factory was adversely affected by drought. As a result, cane crushing and therefore fuel availability for the project plant reduced by a large extent; bagasse generation in 2003, 2004 and 2005 has been 2.45, 0.24 and 1.015 lakh tonnes respectively against 2.91 lakh tonnes prior to the project implementation. This has severely affected the project profitability and clearly demonstrates the investment risk borne by BASL in implementing this project activity.

BASL has no background in selling power to the grid and also happens to be only the second sugar industry in the country in implementing 87-ata cogeneration system. BASL's management took decision to pursue the project activity in the midst of the uncertainties involved, considering the revenues from carbon credits generated by the project under CDM.

Hence, BASL has borne a financial risk and taken a pro-active approach by showing confidence in the Kyoto Protocol and therefore the CDM system. Besides the direct financing risk, BASL is also shouldering the additional transaction costs related to the preparation of project documents, supporting CDM initiatives and also developing and maintaining M&V protocol to fulfil CDM requirements.

(ii) Technological Barrier

The typical alternative to the project activity is to have continued with the low or medium pressure cogeneration configuration. Although very few bagasse based cogeneration power plants are designed with above mentioned high pressure and temperature parameters in India. In India, four plants with 87 ata pressure and 515ºC temperature configuration have been commissioned at the time of implementation of the project activity and BASL 's 20 MW cogeneration plant at Sathyamangalam is the first of its kind and the only project in the state of TamilNadu to have this high pressure technology. The project activity uses a technology, which has low market share and less penetration. Low penetrated technology is related to efficiencies of major equipments, trouble-free plant operation, availability of spares, availability of skilled manpower to operate the plant continuously *etc*. BASL is the first company in TamilNadu to take up the risk in overcoming the technology barrier by adopting 87 ata pressure configuration and STG of double extraction cum condensing type.

The technological barriers become even more significant considering the renewable energy potential in TamilNadu using bagasse as fuel. Success of the CDM project will provide a trigger for replication in the other sugar mills thus further reducing the GHG emission to the atmosphere.

(iii) Other Barriers

Despite several years of experience in sugar production, BASL had to overcome a few barriers in order to implement the project activity.

As the region surrounding the sugar plant is significantly dominated by agriculture, the personnel in the plant had to be trained to handle the high pressure configuration cogeneration plant and therefore an extra effort by BASL management was taken to train the technical personnel in order to operate an advanced technology plant.

BASL for long have been involved in business of sugar production and rural economics and had to therefore transform (overcome barrier) and develop expertise to deal with the economics of electricity generation, distribution and dealing with power sector economics, bureaucracy *etc.*

BASL has signed Power Purchase Agreement (PPA) with TNEB. For their earnings, the project depends on the payment from TNEB against the sale of electricity to the grid. It is known that condition of state electricity boards in India is not very healthy and it is likely that, there would be problems with cash flows of BASL. BASL had to take this risk and face this institutional barrier on which they have limited or no control. This situation makes CDM funds even more critical for BASL.

It is estimated that, of the total project proponents who get approval from central/state electricity authority to establish bagasse/biomass based power project in India, only a few are successful in commissioning of the plant due to some of the above mentioned barriers. The data on the 'Common Practice Analysis' of the bagasse-based cogeneration suggests that the barriers discussed are strong enough to hinder growth of the sector.

The project activity is additional as it over comes the above barriers by taking up risk of implementing power project, which is not core business of sugar industry.

Additionality test for Regulatory/Legal requirements

Government of India passed the Electricity Act, 2003 to reform and regulate the generation, transmission and distribution of electricity. The Act sets obligations for the distribution companies to source at least 10% of the total installed generation capacity from non-conventional energy sources. The fulfilment of this obligation will be binding upon state electricity boards to purchase power from projects of renewable energy type by providing higher purchase tariffs and other incentives to encourage renewable energy promoters. Though these obligations are not yet enforced, TNEB has already achieved this target as a result of the tremendous growth of wind energy in the state and hence, there is no such binding on TNEB to encourage further renewable energy projects.

There are no other national or state policies necessitating sugar mills to implement high pressure cogeneration systems and export power to the grid. BASL has taken a proactive step, above the regulatory requirements, to develop a technically advanced cogeneration project in Tamil Nadu.

Sub-step(3b). Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (except the proposed project activity already considered in step 3a):

The most likely alternative in the baseline scenario is the continuation of the low pressure cogeneration system at the project site. This alternative doesn't entail any huge capital outlay as required by the project activity. BASL would have met the minor expenditures of maintenance and retrofits of the low pressure system without any difficulty.

The low pressure technology is a common practice in Indian sugar industry and BASL has the necessary expertise, skilled manpower and other resources to operate the plant without any significant risks associated with the 87-ata system.

The continuation of the low pressure system would not require capacity building or training exercise as required by the project activity. Since, power is not exported; the associated risks of energy pricing and policy are not involved.

As discussed above, the barriers facing the project activity do not prevent the wide spread implementation of the alternative in the sugar industry.

B.3.3 Step 4: Common Practice Analysis

Sub-step 4.a: Analyse other activities similar to the project activity

In 2001, when BASL decided to implement the project activity, most sugar mills in Tamil Nadu were using their entire bagasse in low pressure cogeneration to meet their captive energy requirements and did not export power to the grid. The maximum cogeneration pressure prevailing was 67 kg/cm^2 (Table B1). Thus, the common practice in the similar project sector, socio-economic environment, geographic conditions and technological circumstances was the utilisation of bagasse in low pressure boilers for in-house consumption, which would have been the case with BASL's sugar factory. However, the prospect of CDM revenue has encouraged BASL to install the first 87-ata high pressure cogeneration system in Tamil Nadu.

Table B1: Common Practice Analysis for BASL project activity

Total number of Sugar Mills in TN	*38*
Cooperative Sugar Mills	*16*
Sugar Mills under private sector	*19*
Sugar Mills under public sector	*3*
Sugar Mills with co-generation and export of power to grid	*16*
Sugar Mills with similar or better configuration as of BASL in State	*None*
Total cogeneration potential in Tamil Nadu	*350 MW*
Cogeneration capacity installed as on 2001	*93.5 MW*
Source: (MNES Annual report 2001-02)	

Sub-step (4b): Discuss any similar options that are occurring

The analysis in sub-step 4a above shows that similar project activities are not widely observed and not commonly carried out in the region and that the project activity is the first of its kind in the region. Therefore it may be stated that the project activity is not a common practice.

B.3.4 Impact of CDM registration (Step 5)

The approval and registration of the project activity as a CDM project will facilitate carbon credits for the project activity and improve its sustainability by offsetting part of the risks faced by the project activity. As mentioned in Step 0, before implementation of the project activity BASL considered all the barriers discussed above. Each of them especially investment, institutional and technological barrier could result in project failure resulting in huge financial losses. BASL's management discussed various aspects of project activity implementation in the Board of Director's Meeting. Finally, BASL's management took the decision to invest in the CDM project activity despite the project risks, after computing the carbon financing and by securing the finance partially from bank funding and partially through internal accruals. Unfortunately, the investment risk foreseen by BASL has been realised; the region has been affected by severe drought in the three years subsequent to the project activity installation, affecting its profitability.

- The realization of carbon credits by BASL in the coming years will help the sustainable operation of the project by offsetting the losses incurred to a certain extent. The continued operation of the plant will encourage other promoters to adopt high efficiency cogeneration and further contribute to sustainable development of the region.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no sufficient financial assistance, policy initiatives, or other incentives exist locally to foster its development in India and, without the carbon financing for the project activity, BASL would not have taken the investment risks in order to implement the project activity. Further CDM fund will provide additional coverage to the risk due to institutional barriers and technical problems related to the operation of the project activity, resulting in untimely shut downs of plant and its associated loss of production.

Further with CDM project activity registration many more sugar manufacturing industries in India would take up similar initiatives under CDM by overcoming the barriers to project activity implementation resulting in higher quantum of anthropogenic greenhouse gas emissions reductions.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The emission reductions are mainly from the incremental energy generation using the same quantity of biomass that would have been combusted in the baseline scenario (low pressure cogeneration plant). The incremental energy is exported to the grid and displaces equivalent CO_2 emission from grid connected power plants.

B.6.1.1 Project Emissions:

With reference to ACM0006, it is required to account CO_2 emissions from the combustion of fossil fuels used by the project activity (during unavailability of bagasse / drought / any other unforeseen circumstances), from transportation of biomass from other sites to the project activity, CO_2 emissions from electricity consumption and CH_4 emissions from biomass combustion if included in the project boundary. Such emissions are calculated by using the below equations:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y}$$

Where:

PET_y	CO_2 emissions during the year y due to transportation of the biomass residues to the project plant (tCO_2/yr)
$PEFF_y$	CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr)
$PE_{EC,y}$	CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr)
GWP_{CH4}	Global Warming Potential for methane valid for the relevant commitment period
$PE_{Biomass,CH4,y}$	CH_4 emissions from the combustion of biomass residues during the year y (tCH_4/yr)

Carbon dioxide emissions from transportation of biomass to the project site (*PETy*):

$$PET_y = \frac{\sum BF_{i,y}}{TL_y} \times AVD_y \times EF_{Km,CO_2}$$

Where:

BFi,y	is the quantity of biomass type i, transported from other sites and used as fuel in the project plant during the year *y* in a volume or mass unit,
TLy	is the average truck load of the trucks used measured in tons of biomass,
AVDy	is the average return trip distance between the biomass fuel supply sites and the site of the project plant in kilometers (km), and
EF_{Km,CO_2}	is the average CO_2 emission factor for the trucks measured in tCO_2/km

Carbon dioxide emissions from on-site consumption of fossil fuels ($PEFF_y$)

The proper and efficient operation of the biomass residue fired power plant may require using some fossil fuels, e.g. for start-ups or for stabilising combustion (when the moisture content in biomass residue is too high) or for the preparation or on-site transportation of the biomass residues. In addition, any other fuel consumption at the project site that is attributable to the project activity should be taken into account (e.g. for mechanical preparation of the biomass residues).

CO_2 emissions from combustion of respective fossil fuels are calculated as follows:

$$PEFF_y = \sum (FF_{project\ plant,i,y} + FF_{project\ site,i,y})\,x\,NCV_i\,x\,EF_{CO2,FF,i} \qquad \text{.......(1)}$$

Where:

$FF_{project\ plant,i,y}$	Quantity of fossil fuel type *i* combusted in the biomass residue fired power plant during the year *y* (mass unit per year)
$FF_{project\ site,i,y}$	Quantity of fossil fuel type *i* combusted at the project site for other purposes that that are attributable to the project activity during the year *y* (mass unit per year)
NCV_i	Net calorific value of fossil fuel type *i* (GJ /mass unit)
$EF_{CO2,i}$	CO_2 emission factor for fossil fuel type *i* (tCO_2/GJ)

Carbon Dioxide emissions from electricity consumption ($PE_{EC,y}$)

Any electricity consumption at the project site excluding that of the power plant auxiliary[1] equipments would be monitored. Corresponding project emissions would be calculated as follows:

$$PE_{EC,y} = EC_{PJ,y} \times EF_{grid,y}$$

Where,

$PE_{EC,y}$	is CO_2 emissions from on-site electricity consumption attributable to the project activity (tCO_2/yr)
$EC_{PJ,y}$	is on-site electricity consumption attributable to the project activity during the year y (MWh)
$EF_{grid,y}$	is CO_2 emission factor for grid electricity during the year y (tCO_2/MWh)

Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)

These emissions are not included in the project boundary and are neglected both in project emissions and baseline emissions.

B.6.1.2 Emission reductions due to displacement of electricity:

Emission reductions due to the displacement of electricity is calculated by multiplying the net quantity of increased electricity generated with biomass residues as a result of the project activity (EG_y) with the CO_2 baseline emission factor for the electricity displaced due to the project ($EF_{electricity,y}$), as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$$

Where:

$ER_{electricity,y}$	Emission reductions due to displacement of electricity during the year y (tCO_2/yr)
EG_y	Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y (MWh)
$EF_{electricity,y}$	CO_2 emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)

Determination of EG_y:

Where scenario 14 applies, *EGy* is determined based on the net efficiency of electricity generation in the project plant prior to project implementation $\varepsilon_{el,pre\ project}$ and the net efficiency of electricity generation in the project plant after project implementation $\varepsilon_{el,project\ plant,y}$, as follows:

$$EG_y = EG_{projectplant,y} \times \left(1 - \frac{\in_{el,preproject}}{\in_{el,project\ plant,y}}\right)$$

Where:

EG_y	- is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$	- is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$\varepsilon_{el,pre\ project}$	- is the net efficiency of electricity generation in the project plant prior to project implementation, expressed in MWhel/MWhbiomass
$\varepsilon_{el,project\ plant,y}$	-is average net energy efficiency of electricity generation in the project plant, expressed in MWhel/MWhbiomass.

Determination of electricity baseline emission factor (EF_y):

As the power generation capacity of the biomass power plant is more than 15 MW, $EF_{electricity,y}$ should be calculated as a combined margin (CM), following the guidance in the section "Baselines" in the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002). The emission factor is determined in the following three steps:

As prescribed by ACM0002, combined margin emission factor of the grid is calculated as follows:

$$\mathbf{BEF_y = w_{OM}.EF_{OM,\,y} + w_{BM}.EF_{BM\,,\,y}}$$

Where,

w_{OM} Weight of the operating margin emission factor (0.5 default value as per ACM0002)

[1] Auxiliary consumption would be deducted from gross energy generation. Only the net generation is considered in calculating baseline emissions.

$EF_{OM,y}$	Operating margin emission factor calculated as per ACM0002
w_{BM}	Weight of the build margin emission factor (0.5 default value as per ACM0002)
$EF_{BM,y}$	Build margin emission factor calculated as per ACM0002
BEF_y	Combined margin baseline emission factor of the grid

Operating margin (OM):

ACM0002 provides four options for calculating OM. Option (a) "Simple OM" has been adopted here and the formula for calculating same is described below:

$$EF_{OM,y} = \sum_{i,j} F_{i,j,y} \, x \, COEF_{i,j} / \sum_{j} GEN_{j,y}$$

where,

$F_{i,j,y}$	Is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*
j	Refers to the power sources delivering electricity to the grid, excluding low-operating cost and must-run power plants, and including imports from the grid
$COEF_{i,j\,y}$	Is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and
$GEN_{j,y}$	Is the electricity (MWh) delivered to the grid by source *j*

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_{i,} \, x \, EF_{CO2} xOXIDi$$

For calculations, local values of NCV_i and $EFCO_{2i}$ have been used. The *ex-ante* data vintage of 3-year average, based on the most recent statistics available at the time of PDD submission has been used for the calculation.

Build Margin:

The build margin is calculated as the weighted average emissions of recent capacity additions to the reference grid, based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The PDD has adopted *ex-ante* option for build margin calculation.

$$EF_{BM,y} = \sum_{i,m} F_{i,m,y} \, x \, COEF_{i,m} / \sum_{j} GEN_{m,y}$$

where,

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ - Are analogous to the variables described for the OM method above for plants m.

The sample group m consists of,

- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Further, power plant capacity additions registered as CDM project activities have been excluded from the sample group m of South India Regional grid mix.

Central Electricity Authority (CEA) of India has published a CO_2 baseline database for the regional grids of India. The database includes operating margin, build margin and combined margin emission factors for the regional grids calculated in accordance with the above formula as prescribed by ACM0006. For this project activity, the combined margin baseline emission factor value for the southern regional grid has been directly adopted from the CEA database (Refer Annex 3 for details).

B.6.1.3 Emission reductions due to displacement of heat:

In the case of cogeneration plants, project participants shall determine the emission reductions or increases due to displacement of heat ($ER_{heat,y}$). In scenario 14, heat and electricity in the absence of the project activity is generated in a low pressure low efficiency cogeneration plant, i.e. the efficiency of electricity generation is lower than in the project plant. The efficiency of heat generation, i.e. the heat generated per quantity of biomass residue fired, may differ between the project plant and the plant(s) in the baseline scenario. This implies that the project implementation may result in lower quantity of heat generation compared to the baseline scenario. This may result in additional heat generation from other sources resulting in GHG emissions. As described in ACM0006, to address this substitution effect, project participants may either

(a) demonstrate that the thermal efficiency in the project plant is larger or similar compared with the thermal efficiency of the plant considered in the baseline scenario (i.e., $\varepsilon_{th,project\ plant} \geq \varepsilon_{th,baseline\ plant(s)}$) and then assume $ER_{heat,y} = 0$

or, if this is not the case,

(b) account for any increases in CO_2 emissions,

In the project activity case, (a) is true (i.e., the efficiency of heat generation in the project plant is higher than that of the baseline plants). Therefore, it is assumed that $ER_{heat,y} = 0$ for this project activity.

B.6.1.4: Leakage:

ACM0006 states "The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion due to diversion of biomass from other uses to the project plant as a result of the project activity. Where the most likely baseline scenario is the use of the biomass for energy generation (scenarios 1, 4, 6, 8, 9, 11, 12, 13 and 14), the diversion of biomass to the project activity is already considered in the calculation of baseline reductions. In this case, leakage effects do not need to be addressed." The project activity falls under scenario 14 of ACM0006 and therefore does not require addressing leakage. There is no leakage of emission reductions for this project activity.

B.6.1.5: Net Emission reductions

The project activity mainly reduces CO_2 emissions through substitution of power and heat generation with fossil fuels by energy generation with biomass residues. The emission reduction ER_y by the project activity during a given year y is the difference between the emission reductions through substitution of electricity generation with fossil fuels ($ER_{electricity,y}$), the emission reductions through substitution of heat generation with fossil fuels ($ER_{heat,y}$), project emissions (PE_y), emissions due to leakage (L_y) as follows:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

Where:

ER_y	Emissions reductions of the project activity during the year y (tCO_2/yr)
$ER_{electricity,y}$	Emission reductions due to displacement of electricity during the year y (tCO_2/yr)
$ER_{heat,y}$	Emission reductions due to displacement of heat during the year y (tCO_2/yr). This parameter is equal to zero since efficiency of heat generation in the project scenario is higher than the baseline scenario.

$BE_{biomass}$	Baseline emissions due to biomass decay. This parameter is excluded from the project boundary and therefore is equal to zero.
PE_y	Project emissions during the year y (tCO_2/yr)
L_y	Leakage emissions during the year y (tCO_2/yr). For scenario 14, leakage need not be separately estimated and therefore Ly = 0.

Since $ER_{heat,y} = 0$, $BE_{biomass,y}$ and $L_y = 0$ for this project activity, the above equation reduces to:

$$ER_y = ER_{electricity,y} - PE_y$$

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$\varepsilon_{el,existing\ plant(s)}$
Data unit:	MWhe/MWhbiomass
Description:	Average net efficiency of electricity generation in the existing power / cogeneration plant(s) fired with the same type of biomass residue at the project site
Source of data used:	On-site measurements
Value applied:	0.0395
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measure the quantity of fuels fired and the electricity generation during a representative time period and divide the quantity of fuels fired. In case of turbines with heat extraction, the efficiency should be determined over a time period that reasonably represents the different operation modes. The three most recent historical years should preferably be used to determine the average efficiency, where such data is available and where this time period is reasonably representative.
Any comment:	-

Data / Parameter:	$\varepsilon_{th,existing\ plant(s}$
Data unit:	MWhth/MWhbiomass
Description:	Average net efficiency of heat generation in the existing power / cogeneration plant(s) fired with the same type of biomass residue at the project site
Source of data used:	On-site measurements
Value applied:	0.64
Justification of the choice of data or description of measurement methods and procedures actually	Measure the quantity of fuels fired and the electricity generation during a representative time period and divide the quantity of fuels fired. In case of turbines with heat extraction, the efficiency should be determined over a time period that reasonably represents the different operation modes. The three most recent historical years should preferably be used to determine the average

applied :	efficiency, where such data is available and where this time period is reasonably representative.
Any comment:	-

Data / Parameter:	$EF_{electricity}$
Data unit:	tCO_2/MWh
Description:	Combined margin baseline emission factor of the southern regional grid
Source of data used:	CEA/IPCC
Value applied:	0.86
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as per guidelines provided in ACM0002
Any comment:	More details in Annexure 3

B.6.3 Ex-ante calculation of emission reductions:

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The following tables show the calculation of emission reductions using the formula mentioned in section B.6.1.

Project emissions:

Emissions due to combustion of fossil fuels in the project activity:					
S.No	**Notation**	**Parameter**	**Unit**	**Value**	**Comments**
1	$FF_{project\ plant,y}$	Quantity of fossil fuel used	T/yr	0	Will be measured if used. Envisaged only during emergencies.
2	$FF_{projectsite,y}$	Quantity of fossil fuel used	T/yr	0	Will be measured if used. Envisaged only during emergencies.
3	NCV	Calorific Value	TJ/T coal	0.020784	Average calorific value of coal used in grid connected power plants based on CEA data.
4	EF_{CO2}	CO2 emission factor	tCO_2/TJ	96.1	IPCC default value
5	OXID	Oxidation factor		0.98	IPCC default value
6	COEF	CO2 emission	tCO_2/T coal	1.957	Methodology formula

	(3*4*5)	factor			
7	$PEFF_y$ ((1+2)*3*4)	CO2 emissions from coal	tCO_2/yr	0	Methodology formula

Emissions due to combustion of fossil fuels for transportation of biomass:					
8	BF_y	Quantity of biomass bought and transported from outside	T/yr	0	Only expected during bagasse shortage
9	TL_y	Average truck load of the trucks used	T	10	Average rated tonnage of trucks used
10	AVD_y	Average return trip distance between the biomass fuel supply sites and the project plant	kms	100	Conservative assumption. ACM0006 prescribes a minimum value of 20 kms.
11		Fuel consumption per 1000 kilometer	kg/000'kms	205	Based on truck mileage of 4 kms/litre diesel
12		CO2 emission factor	kgCO2/kg fuel	3.16	IPCC default value
13	$EF_{km,CO2}$ (10*11)	Average CO2 emission factor of the trucks	kgCO2/km	0.6478	Methodology formula
14	PET_y ((8*10*11) / (9))	CO2 emissions from diesel	tCO2	0	Methodology formula
15	PE_y (7+14)	Total Project Emissions	tCO2	0	Methodology formula

Leakage:
As per ACM0006, for project activities under scenario 14, leakage is already considered in the baseline calculations and need not be separately addressed.

Emission reductions due to displacement of electricity:

Determination of EGy:					
S.No	**Notation**	**Parameter**	**Unit**	**Pre-project**	**Post project**
1	EGpre-project,y	Generation from the pre-project 4.5 MW, 32 Kg/cm2	MWhe	39,284.07	0.00

		system in year 2001 and 2002			
2	EGproject plant,y	Generation from the 20 MW, 87 Kg/cm2 system	MWhe	-	119,106
3	BFpre-project,y	Fuel Consumption (Old 4.5 MW system) in year 2001 and 2002	T	474,753.28	0.00
4	BFpre-project,y	Fuel Consumption in heat equivalent in year 2001 and 2002	MWh	992,946.5	0.00
5	BFproject plant,y	Fuel Consumption (New 20 MW system)	T	-	291,000
6	BFproject plant,y	Fuel Consumption in heat equivalent	MWh	-	609,070
7	$\varepsilon_{el, pre-project}$ (1/4)	Pre-project efficiency	-	0.0395	
8	$\varepsilon_{el, project plant,y}$ (2/6)	Project plant efficiency	-	-	0.1956
9	EGy (2* (1- (7/8)))	Incremental Energy generation from the project activity	MWh	-	95,051

S.No	Notation	Parameter	Unit	Value
10	EG_y	Incremental Energy generation from the project activity	MWhe/yr	95,051
11	$EF_{electricity}$	Baseline emission factor for grid	tCO_2/MWh	0.86
12	$ER_{el,y}$ (10*11)	Electricity emission reduction	tCO_2/yr	81,743

Net Emission reductions

S.No	Notation	Parameter	Unit	Value
1	$ERel_y$	Electricity emission reductions	tCO_2/yr	81,743
2	$ER_{heat,y}$	Heat emission reductions	tCO_2/yr	0
3	$BE_{biomass,y}$	Baseline emissions from biomass methane emissions	tCO_2/yr	0
4	PE_y	Project emissions	tCO_2/yr	0
5	L_y	Leakage	tCO_2/yr	0
6	ER_y (1+2+3-4-5)	Emission reductions	tCO_2/yr	81,743

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Sr. No.	Operating Years	Baseline Emission Factor (tonnes of CO_2 / MWh) EFy	Incremental electricity generation (MWh) EGy	Electricity Emission reductions (tonnes of CO_2) BEy	Project Emissions (tonnes of CO_2) PEy	Emission Reductions (tonnes of CO_2)
1.	2007-08	0.86	95,051	81,743	0	81,743
2.	2008-09	0.86	95,051	81,743	0	81,743
3.	2009-10	0.86	95,051	81,743	0	81,743
4.	2010-11	0.86	95,051	81,743	0	81,743
5.	2011-12	0.86	95,051	81,743	0	81,743
6.	2012-13	0.86	95,051	81,743	0	81,743
7.	2013-14	0.86	95,051	81,743	0	81,743
8.	2014-15	0.86	95,051	81,743	0	81,743
9.	2015-16	0.86	95,051	81,743	0	81,743
10.	2016-17	0.86	95,051	81,743	0	81,743
	2007-2017		**950,510**	**81,743**	**0**	**81,743**

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**AVD_y**
Data unit:	Kilometres (Kms)
Description:	Average return trip distance between biomass fuel supply sites and the project site
Source of data to be used:	Truck operator
Value of data applied	100

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The truck operator will provide the distance travelled by the truck between the fuel supply site
QA/QC procedures to be applied:	Consistency of distance records provided by the truckers will be checked by comparing recorded distances with information from other sources
Any comment:	This data is used to calculate project emissions from biomass transportation

Data / Parameter:	**TL_y**
Data unit:	Tonnes
Description:	Average truck load of the trucks used for transportation of biomass
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10
Description of measurement methods and procedures to be applied:	Average carrying capacity of trucks
QA/QC procedures to be applied:	Weigh bridges used for measuring the truck loads will be calibrated periodically
Any comment:	This data is used to calculate project emissions from biomass transportation

Data / Parameter:	**$EF_{km, CO2}$**
Data unit:	t CO_2/km
Description:	Average CO_2 emission factor for transportation of biomass with trucks
Source of data to be used:	IPCC and Truck operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6478
Description of measurement methods and procedures to be applied:	Declaration from the truck operators

QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	Local or national data will be used. Default values from the IPCC will be used alternatively and chosen in a conservative manner.

Data / Parameter:	**$FF_{project\ plant\ i,y}$**
Data unit:	Tonnes
Description:	Onsite fossil fuel consumption of type 'i' for co-firing in the project plant
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The quantity of fossil fuel is measured at the weigh bridge before their unloading into the project site.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities will be checked with purchase receipts
Any comment:	

Data / Parameter:	**$FF_{project\ site\ i,y}$**
Data unit:	Tonnes
Description:	Onsite fossil fuel consumption of type 'i' used in the project site apart from co-firing
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The quantity of fossil fuel is measured at the weigh bridge before their unloading into the project site.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities will be checked with purchase receipts
Any comment:	

Data / Parameter:	**$NCV_{i,FF}$**
Data unit:	Kcal/kg
Description:	Calorific value of fossil fuel
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	The NCV is determined in calibrated calorimeters of a certified agency
QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	The value will be determined when fossil fuel is used

Data / Parameter:	**$EG_{project\ plant,y}$**
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant during the year y
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	119,106
Description of measurement methods and procedures to be applied:	Calibrated energy meters of BASL Frequency: Daily in BASL meters
QA/QC procedures to be applied:	The consistency of metered net electricity generation will be cross-checked with receipts from sales (if available) and the quantity of biomass fired (e.g. check whether the electricity generation divided by the quantity of biomass fired results in a reasonable efficiency that is comparable to previous years)
Any comment:	

Data / Parameter:	**$BF_{i,y}$**
Data unit:	Tonnes

Description:	Quantity of biomass type *i* combusted in the project plant during year y
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	291,000
Description of measurement methods and procedures to be applied:	Monthly and annual mass and energy balance in the sugar plant supported by RT 8C forms submitted to the Government of India
QA/QC procedures to be applied:	Any direct measurements with mass or volume meters at the plant site will be cross-checked with annual energy balance that is based on fuel generated in-house, purchased quantities and stock exchanges
Any comment:	

Data / Parameter:	***Moisture content of the biomass residues***
Data unit:	% water content
Description:	Moisture content of each biomass residue
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50% (Bagasse)
Description of measurement methods and procedures to be applied:	It is monitored continuously where the mean values are calculated at least annually
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**$NCV_{i,BF}$**

Data unit:	Kcal/kg
Description:	Net calorific value of biomass
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,800
Description of measurement methods and procedures to be applied:	The NCV is determined in calibrated calorimeters of BASL
QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	

Data / Parameter:	$\varepsilon_{el,project\ plant,y}$
Data unit:	MWh electricity per MWh heat input
Description:	Average net energy efficiency of electricity generation in the project plant
Source of data to be used:	BASL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1956
Description of measurement methods and procedures to be applied:	Calculated using formula provided in ACM0006 based on estimated electricity generation and fuel consumption
QA/QC procedures to be applied:	Check consistency with manufacturer's information or the efficiency of comparable plants.
Any comment:	

Other parameters specified in ACM0006 are not applicable to this project activity.

B.7.2 Description of the monitoring plan:

>>

Bannari Amman Sugars Limited will incorporate a special team for implementing the monitoring procedures as described in sections B6.2 and B7.1. The team will comprise of relevant personnel from various departments, who will be assigned the task of monitoring and recording specific CDM parameters relevant to their department. The monitored values will be periodically cross-checked by the respective department heads and sent to the CDM team head for compilation and analysis. Any deviation of monitored values from estimated values will be investigated and appropriate action would be taken. The monitored values would be recorded and stored in paper and electronically for verification. Elaborate monitoring information is provided in Annexure 4.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

B.8.1 Date of completing the final draft of this baseline section:

16/05/2007

B.8.2 Name of person/entity determining the baseline:

M/s. Bannari Amman Sugars Limited

Unit I – Alathukombai Village

Sathyamangalam – 638 401

Tamil Nadu, India

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

27/03/2001

C.1.2. Expected operational lifetime of the project activity:

>>

20 years 0 months

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
Not Applicable

C.2.1.2. Length of the first crediting period:

>>
Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/09/2007 or on Registration with UNFCCC whichever is later

C.2.2.2. Length:

>>
10 years 0 months

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

A detailed assessment of Environmental Impact due to the project activity has been carried out and the report is available as Enclosure – I. The cogeneration power plant uses environmentally sustainable grown bagasse as fuel, which leads to zero net GHG emissions. The GHG emissions of the combustion process, mainly CO_2, will be consumed by sugar cane plant species, representing a cyclic process. Since, the bagasse contains only negligible quantities of other elements like Nitrogen, Sulphur etc. release of other GHG are considered as negligible. The bagasse contains 50% moisture & this will keep the temperatures at steam generator burners low enough not to produce nitrogen oxides.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

A host party regulation requires BASL to obtain environmental clearance in the form of "No Objection Certificate" from the TamilNadu Pollution Control Board (TNPCB). The other condition is that the site of the project has to be approved from the environmental angle and that the Environmental Management Plans (EMPs) are to be prepared and submitted to the pollution control board. The assessment of environmental impacts due to the project activity has been carried out to understand if there are any significant environmental impacts and a management plan has been prepared to minimise adverse environmental impact. The study indicates that the impact of the project is not significant.

The following documents were obtained from the TamilNadu (State) Pollution Control Board (TNPCB) for the project activity (20 MW bagasse based cogeneration plant) towards environmental clearance:

- Consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 (Central Act 14 of 1981) as amended

- Consent under Section 25/26 of the Water (Prevention and Control of Pollution) Act, 1974 (Central Act 6 of 1974) as amended

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

Identification of Stakeholders

Bannari Amman Sugars Limited (BASL) established the project activity (20 MW bagasse based cogeneration plant) at their sugar factory premises during August 2002. The project activity uses mill-generated bagasse as fuel and some amount of coal is co fired, when there is inadequate availability of bagasse. The GHG emissions of the combustion process, mainly CO_2, are sequestered by sugar cane / plant species, representing a cyclic process. So the project activity leads to zero net GHG on-site emissions.

The stakeholders identified for the project activity are as under.

- Elected body of representatives administering the local area (village Panchayat)
- TamilNadu Electricity Board (TNEB)
- TamilNadu Pollution Control Board (TNPCB)
- Non Governmental Organizations (NGO's)
- Consultants
- Equipment manufacturers / suppliers

Stakeholders list includes the government and non-government parties, which are involved in the project activity at various stages. BASL communicated to the relevant stakeholders to provide their comments on the project activity for which the stakeholders have responded with their comments. BASL has recorded these comments and will produce it during the time of Validation. BASL also has obtained necessary clearances from the government for setting up the project activity.

E.2. Summary of the comments received:

>>

Stakeholders Involvement

Local population

The consent / permission of the village Panchayat / local elected body of representatives is required to set up the project activity. BASL has already obtained the consent and documented their approval for the project activity. Local population comprises the local people in and around the project area. The role of the local people is as a beneficiary of the project activity. They supply raw material i.e. sugar cane for sugar mills and biomass for cogeneration. In addition to this, it also includes local manpower working at the plant site. Since, the project activity provides good direct and indirect employment opportunities, the local populace encouraged the project activity.

The project activity has not displaced any local population. Since, the distance between the electrical substation for power evacuation and the plant is only 2 Km, installation of transmission lines did not create any inconvenience to the local population. Thus, the project activity has not caused any adverse social impacts on local population rather has helped in improving their quality of life.

TamilNadu Pollution Control Board (TNPCB)

The project activity has received No Objection Certificate (NOC) from the TNPCB and Consent for operating the plant under Section 21 of the Air (Prevention and Control of Pollution) Act 1981 as amended. TNPCB in their consent has prescribed stack heights for the cogeneration plant boiler. TNPCB has also prescribed standards of environmental compliance for the stack emissions from the cogeneration plant. BASL would have to periodically monitor the stack emissions to ensure compliance with standards.

The project activity has also received consent to operate for the discharge of sewage trade effluent under Section 25/26 of the Water (Prevention and Control of Pollution) At 1974 (Central Act 6 of 1974) as amended. The TNPCB has laid out special conditions to be followed by the project activity for effluent discharge to ensure compliance with environmental standards. TNPCB has also laid out maximum daily effluent discharge limits for the cogeneration plant effluents. The water requirement for the project activity is met through river infiltration wells and stored in the raw water tank.

TamilNadu Electricity Board (TNEB)

As a buyer of the power, the TNEB is a major stakeholder in the project activity. They hold the key to the commercial success of the project activity. TNEB has cleared the project activity and BASL has signed Power Purchase Agreement (PPA) with TNEB.

The TNEB and BASL have signed an agreement for parallel operation and supply/ purchase of surplus power from BASL, Sathyamangalam on 24th April 2002. The TNEB shall draw power and therefore pay under the Section 43 of the Electricity (Supply) Act, 1948. The sugar mill agreed that a deduction of 2% be made from the total energy exported to the grid towards line losses. As per the agreement, the sugar mill is permitted to wheel the bagasse-based power to its subsidiary company situated within a radius of 25 km from the sugar mill by paying wheeling charges of 2%.

Project Consultants

Project consultants were involved in the project activity to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, supervision of project implementation, Successful commissioning and trial runs.

Equipment suppliers

Equipment suppliers supplied the equipments as per the specifications finalized for the project activity and were responsible for successful erection & commissioning of the same at the site and for performance.

Stakeholder's Comments

BASL has received the necessary approvals and consents from various authorities prior to project implementation. The approvals include those from TNPCB, TNEB, Panchayat (Public and local people around Sathyamangalam). All the comments from stakeholders were positive, encouraging the development of project activity and no negative comments were received.

E.3. Report on how due account was taken of any comments received:

>>

The comments and important clauses mentioned in the project documents like Detailed Project Report (DPR), environmental clearances; local clearances etc were considered while preparing the CDM project design document. No corrective action was undertaken as no negative comments were received. The PDD will be published at the validator's website for public comments, as per the UNFCCC requirement.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bannari Amman Sugars Limited
Street/P.O.Box:	Unit-I, Alathukombai Village
Building:	Engineers' Office Building
City:	Sathyamangalam Taluk, Erode District
State/Region:	Tamilnadu
Postfix/ZIP:	638401
Country:	India
Telephone:	91-4295-220387, 220363, 220414-418,
FAX:	91-4295-220695, 222362 (Fax)
E-Mail:	bassathy@bannari.com
URL:	www.bannari.com
Represented by:	
Title:	Executive President
Salutation:	Mr.
Last Name:	P
Middle Name:	
First Name:	Dharmalingam
Department:	Administration
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding for this project.

Annex 3

BASELINE INFORMATION

The Central Electricity Authority (CEA) has published the baseline emission factors database for the various electricity grids in India. The emission factors have been calculated based on UNFCCC guidelines (ACM0002). For further details on the calculation methods and data used, please refer the following web-link:

http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

In the CEA database, the simple operating margin, build margin and combined margin emission factors of the regional electricity grids have been provided separately for two cases; Including electricity imports and Excluding electricity imports from other regional grids. Since, emission factors excluding imports are lower, the same has been considered as a conservative approach. The combined margin emission factor for the southern regional grid (0.86 tCO_2/MWh) has been considered for this project activity.

CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE

VERSION	**1.1**
DATE	**21 Dec 2006**
BASELINE METHODOLOGY	**ACM0002 / Ver 06**

EMISSION FACTORS

Simple Operating Margin (tCO2/MWh) (excl. Imports)

	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.98	0.98	1.00	0.99	0.97
East	1.22	1.22	1.20	1.23	1.20
South	1.02	1.00	1.00	1.01	1.00
West	0.98	1.01	0.98	0.99	1.01
North-East	0.67	0.66	0.68	0.62	0.66
India	1.02	1.02	1.02	1.03	1.03

Build Margin (tCO2/MWh) (excl. Imports)

	2000-01	2001-02	2002-03	2003-04	2004-05
North					0.53
East					0.90
South					0.72
West					0.78
North-East					0.10
India					0.70

Combined Margin (tCO2/MWh)

(excl. Imports)

	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.76	0.76	0.77	0.76	0.75
East	1.06	1.06	1.05	1.07	1.05
South	0.87	0.86	0.86	0.86	0.86
West	0.88	0.89	0.88	0.88	0.90
North-East	0.39	0.38	0.39	0.36	0.38
India	0.86	0.86	0.86	0.86	0.86

Annex 4

MONITORING INFORMATION

MONITORING PLAN

Description of the Monitoring Plan

The Monitoring and Verification (M&V) plan defines a project-specific requirement against which the project's performance (i.e. GHG reductions) and conformance with all relevant criteria will be monitored and verified. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical / efficiency / performance parameters. It also allows scope for review, scrutinize and benchmark all this information against reports pertaining to M & V protocols.

As per ACM0006 methodology, some parameters that require monitoring are described below:

Bagasse Requirement and Utilization
Availability of Bagasse
The major fuel being used by the cogeneration power plant is bagasse, saved by the sugar producing unit of BASL. The bagasse generated by the sugar mill is being supplied to cogeneration plant. Hence, production of electricity is mainly dependent on the bagasse produced at the sugar mill. The receipt of bagasse to cogeneration plant mainly depends on the following parameters. • Total cane crushed by the sugar mill • Variety / fiber content of the sugar cane crushed • In-house bagasse consumption by sugar mill The supplementary fuel in relatively smaller measure used in this cogeneration plant is cane trash.
Quantity of the Bagasse fuel used in the boiler
The total amount of saved bagasse received from the sugar unit will be based on the total sugar cane crushing, bagasse generated and use for internal consumption. The bagasse from the sugar mill is conveyed to the boiler by a combination of belt and chain slat conveyors. The system has the provision of returning the excess bagasse to the storage yard and also has the provision of back-feeding the bagasse from the storage yard to the boiler. There are 3 different bagasse paths as given below:

- Feeding the bagasse to the cogeneration steam generator directly from the sugar mill
- Feeding the bagasse to the cogeneration steam generator from the storage yard
- Storing the bagasse in the covered storage yard in case of cogeneration steam generator not operating

The handling of cane trash if used in the boiler during off-season operation, will be through the same handling system as used for bagasse.

The bagasse generated at the sugar mill is quantified by using the mass-balance equation. The inputs to the sugar mill are sugar cane and water for imbibition, which are measured and recorded and the output from the mill are juice and bagasse. The juice is weighed and recorded and the weight of bagasse generated is calculated as the balance quantity i.e. Sugar cane + Imbibition water = Cane juice + Bagasse. This value is recorded on a daily basis. Of this 5% of bagasse is used for vacuum filtration as bagacillo and conveying losses. The remaining quantity of bagasse is used for steam generation purposes.

Since it is mandatory for sugar industries to submit yearly performance record (RT-8C form), which also includes above parameters, to the government, these figures are to be crosschecked from this record.

The biomass (cane trash) used in the boiler is measured by weighing the load in the weighbridge and monitoring manually in the yard. The control of cane trash is done manually and the data is entered in the logbook on a daily basis.

In case any fossil fuel is purchased this would become evident from the audit report. In this case, the net calorific value (NCV) and the CO_2 emission factor of the fossil fuel will be required to estimate the project emissions.

Bagasse used in the boiler

The main fuel used for the power generation is bagasse, which is supplemented with small quantities of cane trash. The properties of the bagasse fuels like ultimate analysis, calorific value, ash composition etc. are already established and will be consistent in the region. However, various properties of bagasse fuels are monitored by taking samples at random from the fuel lots from the processed fuel so that in case of any drastic change in the properties, corrective actions can be taken. Bagasse emerging from the sugar mill is sampled once in 4 hours for its moisture % and sugar % and from this analysis the gross and net calorific values are calculated using the formulas:

Gross Calorific Value: GCV = 4600 – 12S – 46W Net Calorific Value: NCV = 4600 – 12S – 48.5W Where, W is the Moisture % Bagasse and S – Sugar % Bagasse The measurement of fuel properties like ultimate analysis, calorific value etc. will be done at reputed laboratories as per international practices and data or documents will be kept open for verifiers. The data will also be computerized and monitored through management information system of the DCS.
Operational Parameters of the Cogeneration Unit
Total Power Generated
The total power generated by the power project is being measured in the plant premises to the best accuracy and is recorded, monitored on a continuous basis through DCS. All measurement devices are microprocessor based with best accuracy, which have been procured from reputed manufacturers. All instruments are calibrated at regular intervals. All instruments carry tag plates, which indicate the date of calibration and the date of next calibration. The parameter will substantiate the smooth operations of the cogeneration. During verification the total power generated would be verified as compared to the power exported to the grid. All the parameters are also recorded manually and in the DCS and can be retrieved when necessary.
Power consumed by the plant auxiliaries
The project developer has installed all metering and check metering facilities within the plant premises as well as in the grid substation where exported power is connected to the grid. The measurement will be recorded and monitored on a continuous basis by both TNEB and the project developer through DCS. In addition to the records maintained by the promoter, TNEB also monitors the actual power exported to the grid and certify the same. All measurement devices are microprocessor based with best accuracy and procured from reputed manufacturers. All instruments will be calibrated at regular intervals. All instruments carry tag plates, which indicate the date of calibration and the date of next calibration.
Power Exported to grid
The total power exported by the power project would be recorded, monitored on a continuous basis. During verification the total power generated and auxiliary power consumed by the cogeneration plant would be verified as compared to the power exported to the grid. All the parameters are monitored regularly and retrieved when necessary.

All the above parameters / factors will demonstrate the performance of the project at any point of time.

The following major project parameters which affects the emission claims need to be verified, based on the available operating data is as under:

- Cane crushing by the BASL sugar unit
- Quantity of bagasse available
- Type and quantity of biomass fuels used in the boiler
- Total generation of power and captive & auxiliary power requirements.
- Power exported to the grid

Appendices

Appendix A

Abbreviations

BASL	Bannari Amman Sugars Limited
CC	Climate Change
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
CMIE	Centre for Monitoring Indian Economy
CO	Carbon mono-oxide
CO_2	Carbon di-oxide
CPU	Central Power Units
DCS	Distributed Control System
DPR	Detailed Project Report
DM	De-Mineralised
EGEAS	Electric Generation Expansion Analysis System
EPS	Electric Power Survey
ESP	Electro Static Precipitator
EIA	Environmental Impact Assessment
FD	Forced Draft
FYP	Five Year Plan
GHG	Greenhouse Gas
GOI	Government of India
GWh	Gega Watt hour
HP	High Pressure
HV	High Voltage
ID	Induced Draft
IPCC	Intra-governmental Panel for Climate Change
IPP	Independent Power Producers
IREDA	Indian Renewable Energy Development Agency

ISPLAN	Integrated System Plan
KP	Kyoto Protocol
Km	Kilo meters
KV	Kilo Voltage
KW	Kilo Watt
KWh	Kilo Watt hour
NCES	Non-Conventional Energy Sources
LP	Low Pressure
1 Lakh	1,00,000
MkWh	Million Kilo Watt hour
MU	Million units
MNES	Ministry of Non-conventional Energy Sources
MoP	Ministry of Power
MoU	Memorandum of Understanding
MSW	Municipal Solid Waste
MT	Metric Ton
MW	Mega Watt
NCE	Non Conventional Energy
NEDA	Non conventional Energy Development Agency
Nox	Nitrogen Oxides
NTPC	National Thermal Power Corporation
NOC	No Objection Certificate
p.a	Per annum
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PIN	Project Idea Note
PRDS	Pressure regulating and de-superheating station
REP	Renewable Energy Projects
SA	Secondary Air

SEB	State Electricity Board
SO_2	Sulphur Di-oxide
SPM	Solid Particulate Matter
STG	Steam Turbine Generator
TCD	Tones of Crushing per Day
TDS	Total Dissolved Solids
TERI	Tata Energy Research Institute
TJ	Trillion Joules
TNEB	Tamilnadu Electricity Board
TNPCB	Tamilnadu Pollution Control Board
TPH	Tones Per Hour
UNFCCC	United Nations Framework Convention on Climate Change

Appendix B

Reference List

Sr.No	Particulars of the references
	Kyoto protocol / UNFCCC Related
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2.	Website of United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
	Project Related
3.	Detailed Project Report on 20 MW Non-Conventional renewable Sources bagasse Cogeneration Power Plant at BASL, Sathyamangalam
4.	Various project related information / documents / data received from BASL.
	Baseline Related
5.	Website of Center for Monitoring Indian Economy (CMIE) Pvt. Ltd., Mumbai, India – www.cmie.com
6.	Website of Central Electricity Authority (CEA), Ministry of Power, Govt. of India - www.cea.nic.in
7.	Website of Ministry of Power (MoP), Govt. of India www.powermin.nic.in
8.	Website of Ministry Non-Conventional Energy Sources (MNES), Govt. of India – www.mnes.nic.in

9.	Website of Indian Renewable Energy Development Agency (IREDA), www.ireda.nic.in
10.	Official website of Government of Tamilnadu http://www.tn.gov.in
11.	Infraline web site. http://www.infraline.org
12.	South India Sugar Manufacturer's Assosiation (SISMA)
13.	www.indianelectricity.com

Enclosures

Enclosure I

Report on Environmental Impact

The environmental impacts can be either categorized as primary or secondary impacts. Primary impacts are those that can be attributed directly to the project itself while secondary impacts are those, which are induced indirectly because of the development activity which may be triggered by the primary impact. The secondary impacts typically include the associated investment and changed patterns of social and economic activity by the project activity.

The impact of the project on the environment can occur at two stages:

3. Construction phase
4. Operational phase

The project activity concerned has been set up adjacent to the existing sugar manufacturing unit at Sathyamangalam.

Impacts during construction phase

The impacts during construction phase due to the construction of the 20 MW bagasse based cogeneration plant are listed as given here:

Air quality impacts:

- Due to particulate emissions from site clearing
- Due to particulate emissions from quarrying operations offsite
- Due to vehicular emissions from transportation of raw materials such as cement, sand, gravel etc
- Due to particulate emissions from construction activities such as pre-casting, fabrication, welding etc

Noise level increase:

- From earth moving equipments used for site clearing
- From quarrying operations offsite
- From transportation of raw materials such as cement, sand, gravel etc
- From construction activities onsite

Land and soil impacts:

- From change/ replacement of existing land-use by site clearing
- From soil erosion due to removal of vegetation
- From solid wastes disposed on land from construction activities

Water environment impacts

- From consumption of water for construction purposes

Impacts on ecology

- Removal of vegetation at the site

Impacts on socioeconomic environment

- Employment opportunities to local people

The above represents a broad range of environmental impacts that would have occurred during the construction phase of the cogeneration plant.

It should be noted that the impacts due to construction activities are mostly short-term and cease to exist beyond the construction phase.

Impacts during operational phase

The operational phase involves power generation from bagasse. The cogeneration plant feeds surplus power to the grid and indirectly prevents the pollutants otherwise let out into the atmosphere from the thermal power plants (coal, gas and diesel based) of the State grid. Also bagasse being a biomass – renewable fuel does not add any net CO_2 to the atmosphere as the carbon gets recycled during cane growth. Alternative methods of bagasse disposal being currently practiced in sugar plants includes inefficient burning of bagasse in boilers or letting it to decompose, which would lead to more dust and GHG emissions when compared to the present project activity. The impacts during operational phase of the cogeneration plant are as given here:

Air quality impacts:

The cogeneration plant discharges the following pollutants into the air:

- Suspended Particulate Matter (SPM) from fly ash in the flue gas
- Oxides of Nitrogen (NOx) in the flue gas
- Carbon dioxide (CO_2)

The ash content in bagasse is less than 2%. As the pollution control regulations limit the particulate matter emissions from bagasse fired steam generators to 150 mg/ Nm^3, electrostatic precipitators (ESP's) are used in the cogeneration plant to contain the dust emission from the plant to less than 150mg/Nm^3 during bagasse firing.

The fly ash collected from the ESP hoppers and air heater hoppers and the ash collected from the furnace bottom hoppers are used as landfill during the seasonal operation of the plant when bagasse is the main fuel. Considering the high potash content in the bagasse, the ash is used as manure.

As there is no sulphur in bagasse, SO2 emissions do not occur. The temperatures encountered in the steam generators while burning high moisture bagasse are low enough not to produce nitrogen oxides. Carbon dioxide produced by firing bagasse is absorbed by sugar cane plantation and hence recycled.
To reduce to ground level air contaminants, a 77 m stack is used for baggase-fired boiler. This has helped in faster dispersion of air pollutants into the atmosphere thus reducing the impact on the project surroundings.

During off-season the biomass (cane trash) is transported from nearby cane fields to the project site. However considering 3 truck trips per day for transporting 18 tons/day of cane trash from 50 Km distance, the air emissions are very negligible.

The air emissions i.e. SO2, NOx, CO and SPM emissions released from the stacks attached to the boiler of the cogeneration plant are being monitored as per the Section 21 of the Air (Prevention & Control of) Pollution Act 1981.

Noise level increase:
The sound pressure level generated by the noise sources decrease with increasing distance from the source due to wave divergence. Sound attenuation occurs due to atmospheric effects and its interaction with

objects in the transmission path. As Satyamangalam has lot of trees & greenery the noise levels get attenuated significantly.

In a cogeneration plant, noise level increase is primarily from:

- Cogeneration plant operation
- Transportation of vehicles carrying the biomass i.e. cane trash to the cogeneration power plant.

The rotating equipment of the cogeneration plant is designed to operate with a total noise level which will not exceed 85 – 90 db (A) as per the requirement of the Occupational Health and Safety Administration (OSHA) standards. The rotating equipment is provided with silencers wherever required to meet the noise pollution regulations. As per OSHA, the damage risk criteria enforced to reduce hearing loss stipulates that the noise level upto 90 dBA is acceptable for 8 working hours per day.
The vehicular transport of biomass from nearby cane fields to the cogeneration plant includes only 3 truck trips per day and hence the impact is negligible.

The green belt has been provided around the plant area for noise attenuation. Also the workers are instructed to wear ear masks to reduce noise level impacts.

Water quality impacts:

The effluents generated from the project activity are being treated in the effluent treatment plant to ensure that there is no environmental deterioration.
The wastewater generated from the project activity are as given below:

- Effluent from DM plant: Hydrochloric acid and sodium hydroxide are used as regenerants in the DM water plant for boilers and the acid and alkali effluent are neutralized in an epoxy line neutralizing pits. Generally these effluents are self-neutralizing however, provisions are made such that the effluents are completely neutralized by addition of acid/ alkali. The effluent will then be pumped into the effluent treatment ponds which are a part of the effluent disposal system
- Chlorine in the condenser cooling water is about 0.2 ppm and this value would not result in chemical pollution and meets the national standards for liquid effluent

- The effluent from boiler: The blow down water generated from the boiler would have high pH and temperature from the pollution viewpoint. The effluent is generated at 1.22 TPH having a high pH of 9.8 – 10.3 and temperature of 100 deg C and is disposed into the trench and then through sugar plant effluent ponds
- Sewage from various buildings in the plant are conveyed through separate drains into the septic tank

Wastewater treatment plant has been provided for the adequate treatment of the cogeneration plant effluents. The wastewater is treated to suit its use for irrigation purposes.
The characteristics of effluents from the cogeneration plant are maintained so as to meet the requirements of TNPCB and minimum national standards from thermal power plants.

Ecological impacts:

There are no ecological impacts as the wastewater from the cogeneration plant are treated appropriately before final disposal.
Also as trees have been planted around the plant, it gives a cool atmosphere in the operational area and providse as a barrier for air emissions and noise level increase.

Land and soil impacts:

The solid wastes generated from the cogeneration plant are the dry fly ash and wet bottom ash from Grate. Considering the high potash content in the ash generated from bagasse firing, the same is being used as manure in nearby cane fields. Also since the filter press mud from the sugar plant also has good land nutrient value, ash is mixed with press mud and the same is sold to farmers for use in cane fields.

Socio-economic impacts

The cogeneration plant has contributed to socio economic growth in the following ways;

- Generating employment to 50 technical experts in various fields like mechanical, electrical, electronics, instrumentation, chemical engineering etc
- Feeding of surplus power to the grid thereby bridging the gap between demand and supply in a power deficit State

- Offering environmentally friendly solution for additional power generation without using fossil fuels
- Improving financial position of the sugar plant
- Reducing the fuel transportation costs
- Reducing the transmission losses
- Self reliance of power in rural areas

Environmental Management Plan (EMP)

The EMP is to mitigate and manage the various impacts arising from construction and operational phases of the cogeneration power plant.

Construction phase

Air environment

The following mitigative measures were undertaken during construction phase

- Spraying of water at regular intervals to control fugitive dust emissions from construction activities
- Closing materials in trucks with tarpaulin during transportation of raw materials to the site to prevent dust emissions
- Regular and periodic emission check for transportation vehicles
- Use of personal protective equipment (PPE) like goggles and nose masks to reduce impact of dust emissions during construction activities

Noise environment

- Periodic noise control checks on transportation vehicles
- Provision of ear plugs, work rotation, adequate training

Operational phase

Air environment

- Regular and periodic emission check for transportation vehicles
- Use of personal protective equipment (PPE) like goggles and nose masks to reduce impact of dust emissions
- Periodic monitoring of boiler stack emissions

Noise environment

- Periodic noise control checks on vehicles
- Provision of ear plugs, work rotation, adequate training
- Incorporation of noise control measures at source
- Sound proofing/ glass paneling of critical operating stations
- Regular noise level monitoring at the plant and surrounding area
- Plantation of green belt which acts as a attenuator of noise

Land and soil environment

- Improving the soil quality and plantation of suitable tolerant species in the study area.

Water environment

- Treatment of cogeneration plant effluents in the effluent treatment plant
- Periodic monitoring of water quality parameters

Ecological environment

- Plantation of greenbelt

Socioeconomic Environment

- Training to cane growers and farmers in order to improve productivity

Post project monitoring

- The effluent characteristics are being monitored so as to meet the requirements of the TamilNadu Pollution Control Board under the Section 25/26 of the Water (Prevention & Control of) Pollution Act 1974 and the minimum national standards (MINAS) for effluent from thermal power plants
- Air quality monitoring so as to meet the requirements of the TamilNadu Pollution Control Board under the Section 21 of the Air (Prevention & Control of) Pollution Act 1971
- The air quality parameters being monitored from the stack emissions are SPM and SO_2. A laboratory attached to the cogeneration plant is equipped with necessary instruments for carrying out air quality monitoring.