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

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Annexes

Appendices

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 0~~5~~64

18~~6~~/06/2008

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):

>>
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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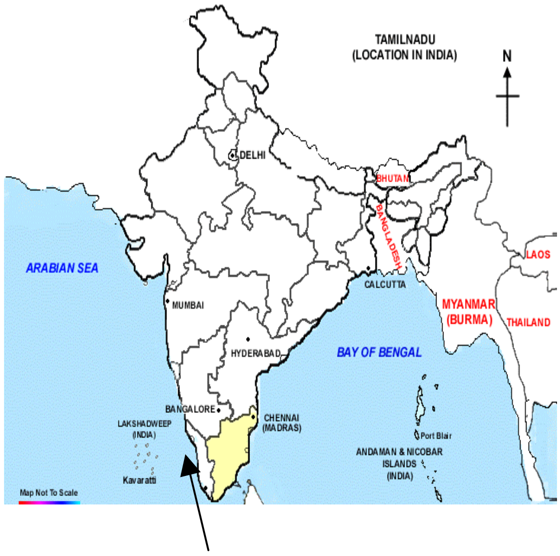
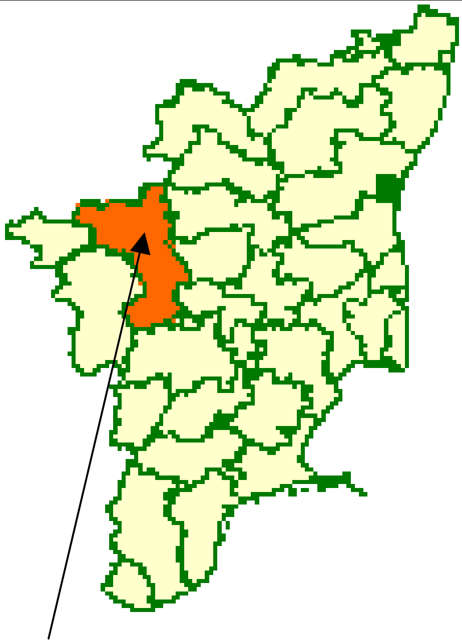
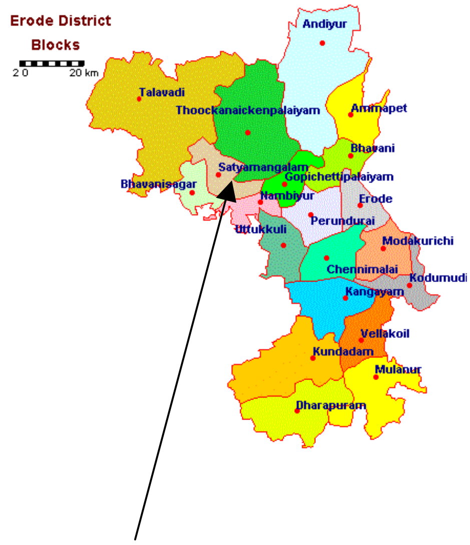
The 20 MW cogeneration plant is located at BASL's sugar factory at Alathukombai village of Sathyamangalam taluk, Erode District in the state of Tamil Nadu. The project activity is located at Latitude 11.3°N and Longitude 77.17°E. The nearest railway station is at Erode (around 45 kms) and the nearest airport at Coimbatore (around 60 kms). 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. 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 significant lifetime to continue operating.

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.

Since the project activity involves advanced cogeneration configuration, the Operation and Maintenance (O&M) personnel need to be trained for the proper operation of the plant. BASL has arranged to provide periodic training to its O&M personnel regarding the power plant and its control systems[1].

[1] Copies of proof of training are being submitted to the DOE

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
April 2008 – March 2009	80,793
Apr 2009 - Mar 2010	80,793
Apr 2010 - Mar 2011	80,793
Apr 2011 - Mar 2012	80,793
Apr 2012 - Mar 2013	80,793
Apr 2013 – Mar 2014	80,793
Apr 2014 - Mar 2015	80,793
Apr 2015 - Mar 2016	80,793
Apr 2016 - Mar 2017	80,793
Apr 2017 - Mar 2018	80,793
Total estimated reductions (tCO_2e)	807,930
Total number of crediting years	10
Average of estimated reductions over the crediting period (Tonnes of CO_2e)	**80,793**

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 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” version 03.*

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 version 04 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).	Biomass residues 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	Energy consumption is not involved in the preparation of biomass residues.
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. 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 spatial extent of the project boundary encompasses:

- The power plant at the project site
- The means for transportation of biomass residues to project site
- All power plants connected to the electricity grid

The spatial extent of the project boundary is depicted in the figure below:

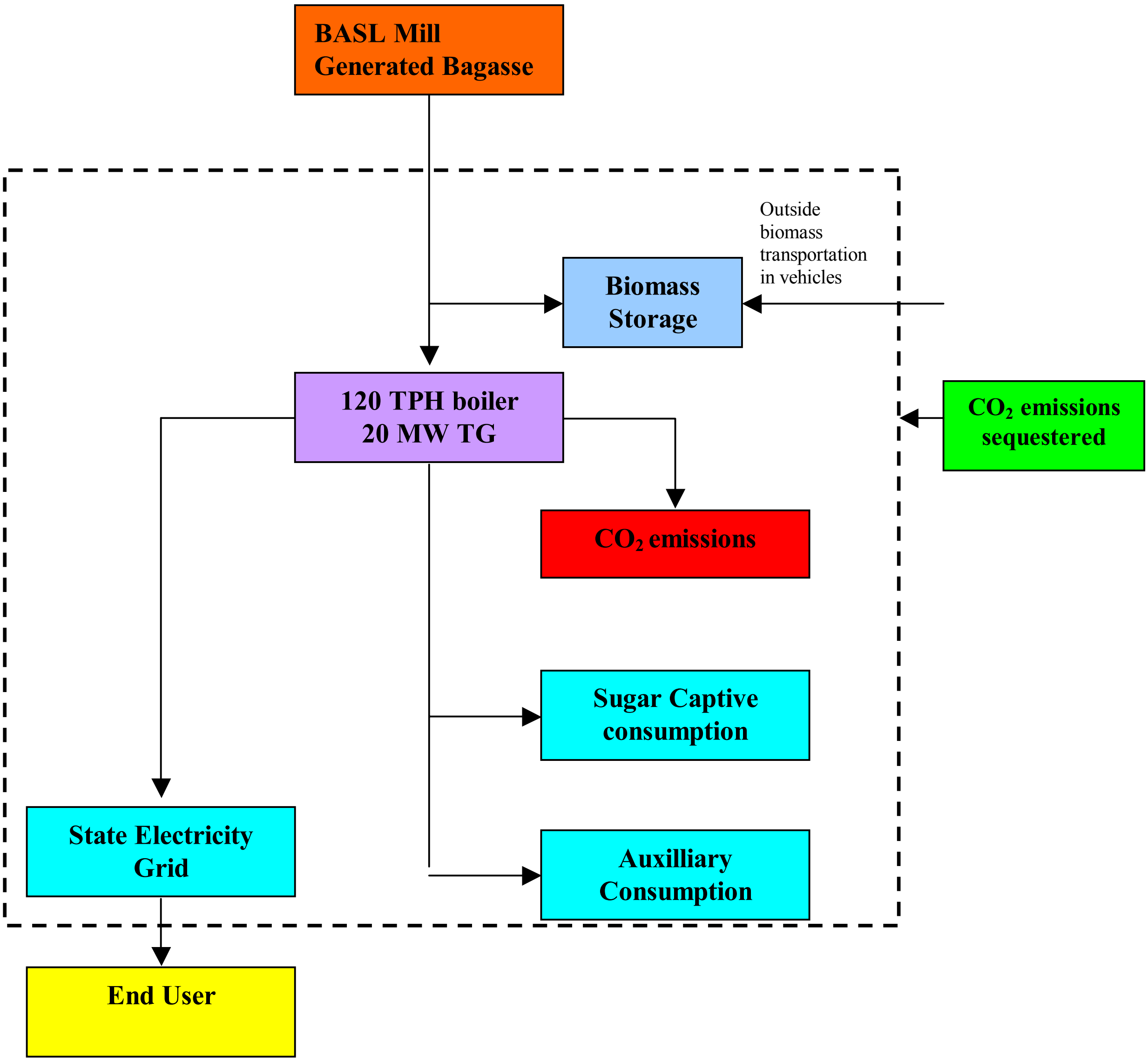

Figure B.1: Project boundary

Emission sources included in the project boundary:

The project participants have included in the project boundary, GHG emissions sources from the project activity and emission sources in the baseline, as prescribed by the methodology ACM0006. The project boundary includes the following emission sources:

	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 in Onsite boilers	CO_2	Excluded	Heat generation is using biomass as fuel.
		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 combustion 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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As prescribed by ACM0006 version 04, project participants have determined the baseline scenario and demonstrated additionality using the "Tool for the demonstration and assessment of additionality" (version 03) shown in Figure B.2 of section B.5 below.

As per ACM0006, project participants have determined the most plausible baseline scenario among all realistic and credible alternatives separately regarding:

- How power would be generated in the absence of the CDM project activity
- What would happen to the biomass in the absence of the project activity
- In case of cogeneration projects: how heat would be generated in the absence of the project activity

IDENTIFICATION OF THE MOST PLAUSIBLE BASELINE SCENARIO

The various alternatives to the project activity are being identified in this section separately for power, heat and biomass. The main criteria for identifying the alternatives are that they should be able to deliver services and output equivalent to that of the project activity.

Alternatives available for power generation:

P1 The proposed project activity not undertaken as a CDM project activity

This is a possible alternative scenario for the power generated in the project activity

P2 The proposed project activity (installation of a power plant), fired with the same type of biomass residues but with a lower efficiency of electrical generation (e.g. an efficiency that is common practice in the relevant industry sector)

This is a possible alternative to the power generated in the project activity. However, it may not be a credible alternative since the existing cogeneration plant itself is of lower efficiency than the project plant. There is no necessity to install a new low efficiency plant when the existing plant can continue its operation at a similar efficiency. Therefore, this alternative is not considered further.

P3 The generation of power in an existing captive power plant, using only fossil fuels
This is not an alternative to power generation since there is no fossil fuel based power plant at the site. Therefore, this alternative is not considered further.

P4 The generation of power in the grid
This is a possible alternative scenario for the power generated in the project plant. The entire quantity of power generated in the project activity or part of it could be generated in the grid. However, the option of 100% of power generation of project plant to be generated in the grid is not a credible option since captive cogeneration is an essential aspect in sugar mills for economical operation. However, the incremental power generation between the project plant and other power generation alternatives would be generated in the grid. Therefore option P4 will not be stand alone alternative, rather, it would be combined with other alternatives.

P5 The continuation of power generation in an existing biomass residue fired power plant, fired with the same type of biomass residues as in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant
This is a possible alternative scenario for the power generated in the project activity. In this case, since the quantity of power generation would be smaller than the project plant, the incremental electricity generation would have been generated in the grid (Option P4).

P6 The continuation of power generation in an existing biomass residue fired power plant, fired with the same type of biomass residues as in the project activity and, at the end of the lifetime of the existing plant, replacement of that plant by a similar new plant.
This is a possible alternative scenario for the power generated in the project activity. However, at the end of the lifetime of the existing plant, higher efficiency technology (similar to the project activity) would have penetrated the sector to a good extent. BASL would rather implement the higher efficiency technology than a similar new plant. Therefore, this alternative is not considered further.

Alternatives available for heat (process steam) generation:
H1 The proposed project activity not undertaken as a CDM project activity

This is a possible alterative to the heat generated in the project activity

H2 The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass residues but with a different efficiency of heat generation (e.g. an efficiency that is common practice in the relevant industry sector)
This is a possible alterative to the heat generated in the project activity. However this may not be a credible alternative since there is already a biomass residue fired cogeneration plant with a lower efficiency existing at the project site. BASL would rather continue operating the existing plant than install a new plant of similar efficiency at high cost. Therefore, this alternative is not considered further.

H3 The generation of heat in an existing captive cogeneration plant, using only fossil fuels
This is a not a credible alterative to the heat generated in the project activity as there are no fossil fuel based captive cogeneration plant in the project site.

H4 The generation of heat in boilers using the same type of biomass residues
This is a possible alterative to the heat generated in the project activity. However, it is not a realistic alternative since cogeneration of heat and power is the established norm in sugar industries. Combustion of biomass residues in heat only boilers is an inefficient method compared to cogeneration and therefore cogeneration of power is an inherent and necessary component of any modern sugar mill from efficiency and economic point of view. Therefore, this alternative is not considered further.

H5 The continuation of heat generation in an existing biomass residue fired cogeneration plant, fired with the same type of biomass residues as in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant.
This is a possible alterative to the heat generated in the project activity.

H6 The generation of heat in boilers using fossil fuels
This is a possible alterative to the heat generated in the project activity. However, it is not a realistic alternative since cogeneration of heat and power from biomass residues is the established norm in sugar industries. Combustion of fossil fuels in heat only boilers is an inefficient and uneconomic method compared to biomass cogeneration and therefore cogeneration of power is an inherent and necessary

component of any modern sugar mill from efficiency and economic point of view. Therefore, this alternative is not considered further.

H7 The use of heat from external sources, such as district heat

This is a possible alterative to the heat generated in the project activity. However, it is not a realistic alternative since cogeneration of heat and power from biomass residues is the established norm in sugar industries. Use of heat from external sources is an uneconomic method compared to biomass cogeneration and therefore cogeneration of power is an inherent and necessary component of any modern sugar mill from efficiency and economic point of view. Therefore, this alternative is not considered further.

H8 Other heat generation technologies (e.g. heat pumps or solar energy)

This is a possible alterative to the heat generated in the project activity. However, it is not a realistic alternative since cogeneration of heat and power from biomass residues is the established norm in sugar industries. Heat generation from other technologies is an uneconomic method compared to biomass cogeneration and therefore cogeneration of power is an inherent and necessary component of any modern sugar mill from efficiency and economic point of view. Therefore, this alternative is not considered further.

Alternatives available for biomass:

B1 The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.

This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B2 The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B3 The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes.
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B4 The biomass residues are used for heat and/or electricity generation at the project site
This is a possible alternative scenario for the biomass used in the project activity.

B5 The biomass residues are used for power generation, including cogeneration, in other existing or new grid-connected power plant
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B6 The biomass residues are used for heat generation in other existing or new boilers at other sites
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B7 The biomass residues are used for other energy purposes, such as the generation of biofuels
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case also) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

B8 The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in the pulp and paper industry)
This is a possible alternative scenario for the biomass used in the project activity. However, it may not be a realistic alternative since biomass residue fired cogeneration is an established norm in sugar mills from an efficiency and economic point of view. BASL would require the biomass residues for combustion in a cogeneration plant to meet its energy requirements. Only the surplus biomass residues (that are not used in the project activity case also) can be used for other purposes. BASL would not have any surplus bagasse. Therefore, this alternative is not considered further.

List of plausible alternative scenarios to the project activity:

- ***Identified credible alternatives for power generation are P1, P4 and P5.***
- ***Identified credible alternatives for heat generation are H1 and H5***
- ***Identified credible alternative for biomass residues is B4.***

Realistic and credible combinations of the alternatives for power, heat and biomass residues identified above are considered as plausible alternatives to the project activity and are listed below. These alternatives are in line with the combinations (scenarios) listed in ACM0006 version 04.

Baseline Alternative 1 (BA1):
Combination of P1, H1 and B4.

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

Under this alternative, BASL had the option to install a high pressure cogeneration system to replace the existing low pressure system without undertaking it as a CDM project activity. There was no restriction on BASL to export surplus power.

Baseline Alternative 2 (BA2):
Combination of P4, P5, H5 and B4.
The continuation of power and heat generation in the existing cogeneration plant using the same type of biomass residues as in the project activity and without any retrofits. This alternative corresponds to scenario 14 of ACM0006 version 04.

- Continuation of the existing low pressure cogeneration system and replacement with a high pressure cogeneration system at the end of its lifetime. BASL had the option to continue operating the low pressure system.
- The existing low pressure system had sufficient capacity to meet the captive power and steam requirements of the sugar plant

- There would be no surplus power for export

The description of scenario 14 as per ACM0006 version 04 and justification of how this baseline alternative falls under this scenario is provided below:

- The project activity involves the improvement of energy efficiency of an existing biomass residue fired power plant by retrofit or replacement of the existing biomass residue fired power plant.
  The project involves the improvement of energy efficiency of the existing bagasse based cogeneration plant by the replacement of the low pressure cogeneration system with high pressure cogeneration system
- The retrofit or replacement increases the power generation capacity, while the thermal firing capacity is maintained.
  The replacement increases the power generation capacity from 4.5 MW to 20 MW, whereas the total quantity of biomass residues (in heat equivalent) fired remains the same.
- In the absence of the project activity, the existing power plant would continue to operate without significant changes, until it would need to be replaced at the end of its technical lifetime.
  In the absence of the project activity, the existing low pressure system would have continued to operate without any significant changes until it would need to be replaced at the end of its technical lifetime. **The existing cogeneration plant was inspected by Chartered Engineer to assess its remaining useful lifetime. As per the assessment[2], the minimum lifetime of the plant was expected to be till year 2019. This is within the crediting period of the project activity.**
- The same type and quantity of biomass residues as in the project plant would be used.
  In the absence of the project activity, the existing low pressure power plant would have used the same type and quantity of biomass residues as the fuel. This is because of the low efficiency of the low pressure system
- Consequently, the power generated by the project plant would in the absence of the project activity be generated (a) in the same plant (without project implementation) and – since power generation is larger due to the energy efficiency improvements – (b) partly in power plants in the grid.
  In the absence of the project activity, the power generated by the 20 MW project plant would partly be generated in the existing 4.5 MW plant and the remaining (15.5 MW) in the grid.

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[2] **Life assessment certificates submitted to the DOE.**

- In case of cogeneration plants, the heat generated by the project plant would in the absence of the project activity be generated in the same plant (the heat generated per biomass input is smaller or the same after the implementation of the project activity).
  In the absence of the project activity, the heat generated by the project plant would be generated in the existing (pre-project) plant. The efficiency of the project plant is same as that of the pre-project system.

Thus, the BA2 clearly falls under scenario 14 of ACM0006 version 04.

As per ACM0006, the step 3 (barrier analysis) of the "Tool for the demonstration and assessment of additionality" version 03 is used to determine the most plausible baseline scenario among the above two alternatives.

Barrier analysis of the alternatives:
An analysis of the barriers facing the baseline alternatives is provided in section B.5. The analysis demonstrates that the alternative 1 (BA1) faces technological and other barriers that would prohibit its implementation. These barriers and other barriers do not prevent the baseline alternative 2 (BA2) from occurring. Thus, BA2 is selected as the most plausible baseline scenario.

Most plausible baseline scenario for the project activity:
Baseline Alternative 2 (BA2):
Combination of P4, P5, H5 and B4.
The continuation of power and heat generation in the existing cogeneration plant using the same type of biomass residues as in the project activity and without any retrofits. This alternative corresponds to scenario 14 of ACM0006 version 04.

- Continuation of the existing low pressure cogeneration system and replacement with a high pressure cogeneration system at the end of its lifetime. BASL had the option to continue operating the low pressure system.
- The existing low pressure system had sufficient capacity to meet the captive power and steam requirements of the sugar plant
- There would be no surplus power for export

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): >>

In order to demonstrate that the CDM project activity reduces anthropogenic GHG emissions that would have occurred in the absence of the project activity, it is necessary to prove that:

- The implementation of the project activity is not the baseline scenario, (i.e., under normal circumstances, there would be no power capacity expansion and thereby BASL would not export additional power to the grid).

ACM0006 version 04 prescribes the use of the "Tool for the demonstration and assessment of additionality" (Figure B.2 below) for the above purpose, which is applied to the project activity.

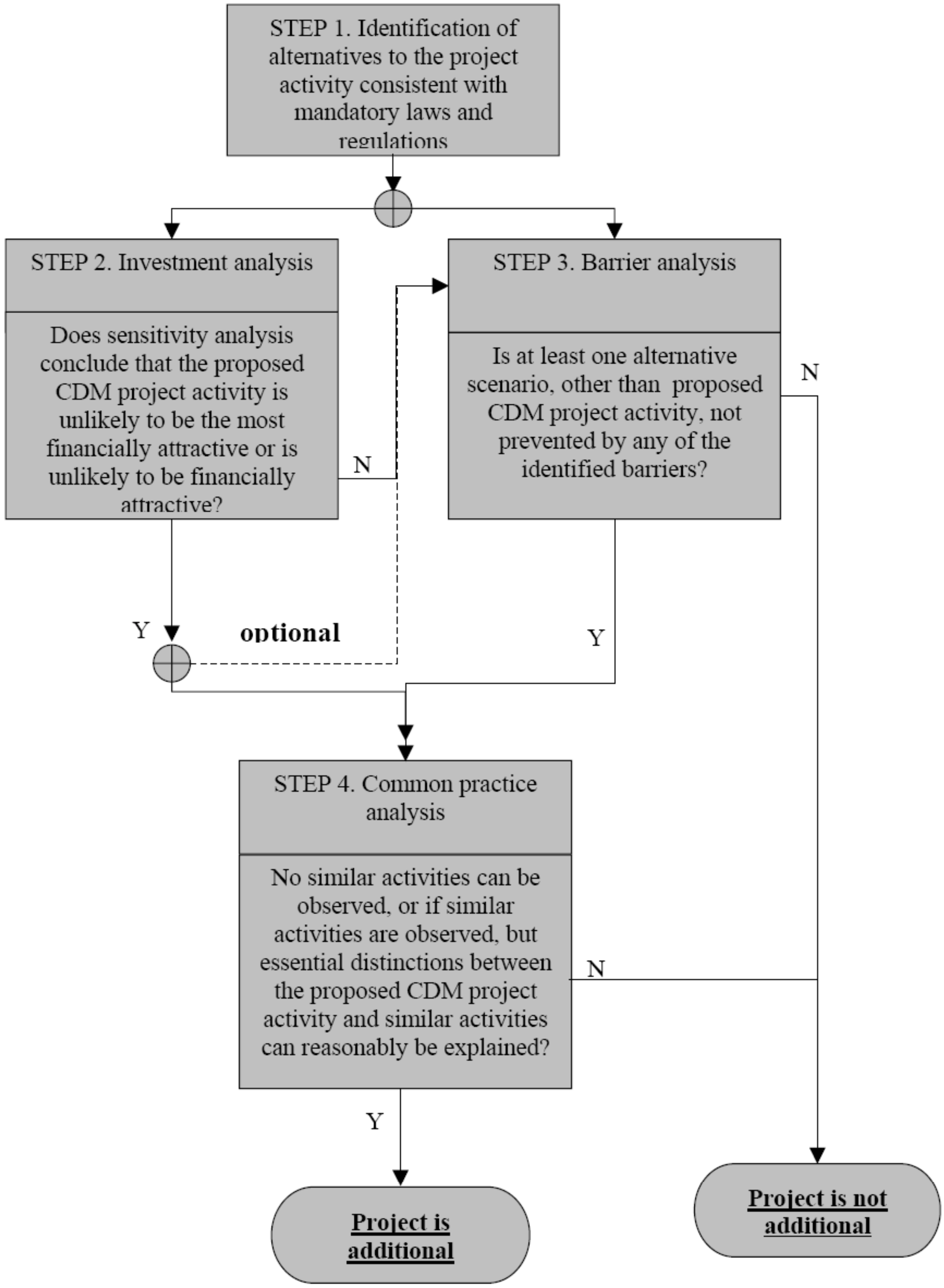

Figure B.2: "Tool for the demonstration and assessment of additionality"

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

Project participants have determined the most plausible baseline scenario among all realistic and credible alternatives separately regarding:

- How power would be generated in the absence of the CDM project activity
- What would happen to the biomass in the absence of the project activity
- In case of cogeneration projects: how heat would be generated in the absence of the project activity

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 1a. Define alternatives to the project activity

Realistic and credible combinations of the alternatives for power, heat and biomass residues identified above are considered as plausible alternatives to the project activity and are listed below. These alternatives are in line with the combinations (scenarios) listed in ACM0006 version 04.

Baseline Alternative 1 (BA1):

Combination of P1, H1 and B4.

- 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 Alternative 2 (BA2):

Combination of P4, P5, H5 and B4.

The continuation of power and heat generation in the existing cogeneration plant using the same type of biomass residues as in the project activity and without any retrofits. This alternative corresponds to scenario 14 of ACM0006 version 04.

- Continuation of the existing low pressure cogeneration system and replacement with a high pressure cogeneration system at the end of its lifetime. BASL had the option to continue operating the low pressure system.
- The existing low pressure system had sufficient capacity to meet the captive power and steam requirements of the sugar plant
- There would be no surplus power for export

Sub-step 1b: Consistency with mandatory laws and regulations:

Both the above two alternatives are consistent with applicable laws and regulations:

- The applicable regulations do not restrict BASL to continue steam and power generation using the lower efficiency pre-project system or in a high efficiency system
- The applicable regulations do not restrict BASL to continue steam and power generation from bagasse or other biomass.
- The applicable regulations do not restrict BASL the export or non-export of surplus power to the grid

The next step is to proceed with either Step 2 or Step 3. Step 3 (Barrier analysis) has been selected as the next step.

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

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

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

- **Other barriers:** BASL was apprehensive in approving the investment proposal for the project activity due to two risk factors: Climatic and Policy risks

All the above barriers are further elaborated below:

Technological barriers:

The most plausible alternative to the project activity is to have continued with the low pressure cogeneration configuration operating with low efficiency. The project activity involved the replacement of the low pressure system with a high-pressure co-generation technology (87 ata). The high pressure system had a very low market penetration and meant a major technological leap for BASL. The lack of success stories on the performance of high pressure technology and the lack of skilled manpower to operate such systems posed as major barriers to BASL and are described below:

- **Performance uncertainties – Risk of technology failure or underperformance:**

The basic principle used in a low pressure cogeneration system and a high pressure system is the same – the Rankine cycle. However, the design, construction and operation of a high pressure system are more complicated and significantly different than that of a low pressure system. As the operating pressure increases, the monitoring and control of water/steam parameters is of critical importance. Even minor fluctuations in water/steam properties could cause dramatic effects on the performance and life of the boiler and TG. The boiler materials have to be designed to withstand the thermal stress expected as a result of high temperature and pressure differentials.

The high pressure (87 ata) cogeneration technology is relatively new to the Indian sugar mills and is not established in the country/region. In the year 2001, during conceptualisation of the project activity, the high pressure (87 ata) configuration was not prevailing in the region. BASL's 20 MW cogeneration plant at Sathyamangalam was the first of its kind[3] and the only project in the state of TamilNadu to have this high pressure technology. As a result of this lack of successful high pressure systems in the region, BASL was

[3] Ministry of Non-Conventional Energy Sources (MNES) data

apprehensive about the performance uncertainties with respect to efficiencies of major equipment, life and trouble-free plant operation.

Any performance loss or frequent maintenance shutdowns would correspondingly reduce the power and steam output. BASL was wary that such a situation would not only impact the energy sale revenue but also affect the primary manufacturing process (The sugar plant depends on the cogeneration system for its power and steam requirements. In case the high pressure cogeneration system has to be shutdown, the sugar plant would also be shut down resulting in huge financial loss). Thus BASL was apprehensive of implementing a technology that not only risks the economic feasibility of the project activity but also that of the primary business.

BASL is the first company in Tamil Nadu to take up the risk in overcoming the technology barrier by adopting 87 ata pressure configuration for its cogeneration system.

- **Lack of trained manpower:**

The operation and maintenance of a high pressure system is radically different from that of a low pressure system. It requires skilled manpower trained and experienced in such systems. Whereas the operation of a low pressure system is simple and easy, a high pressure system involves multiple controls and complicated start-up, operation and maintenance procedures to be followed. Unlike in low pressure captive systems, the grid connected high pressure system involves simultaneous control of the power system (TG) and the boiler systems that require close co-ordination between the operating personnel. Some of the critical aspects in operation of a high pressure system are as follows:

- Frequent monitoring and control of the water properties
- Frequent monitoring and control of steam quantity and properties
- Proper monitoring and maintenance of the pressure parts and heat exchange components
- Frequent monitoring of the grid parameters (frequency, voltage) and parallel operation with the grid

The low prevalence of high pressure systems in the region also meant a limited availability of skilled manpower to operate such systems. The trained manpower capable of handling a high-pressure cogeneration system was not readily available to BASL. Though the equipment suppliers provided a preliminary training to the O&M team, BASL was apprehensive of this lack of experienced and trained manpower that could transform into unscheduled shutdowns, performance loss or degradation of equipment life.

This risk envisaged by BASL has unfortunately been materialised after the implementation of the project activity. During the year 2004, BASL faced frequent failure of boiler tubes[4] due to which the operation of the plant was disturbed. The plant had to be stopped for the inspection and rectification of the problem. The problem was analysed by the equipment suppliers and identified to be caused due to improper operation of the plant. The O&M team was instructed on the proper operation of the system to ensure smooth operation of the plant.

Other barriers – Policy and Climatic barrier:

The project activity faced a 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 lakhs against the continuation of the low pressure system with minimum retrofits. BASL was apprehensive of the project's high sensitivity to fuel availability and the power policy atmosphere.

- **Climatic risks:**

The fuel availability of the project activity directly depended on the rainfall in the region. The rainfall in the region and therefore the cane production and bagasse availability are of fluctuating nature[5]. BASL was apprehensive that this fluctuation could impact the viability of the project activity.

It may be noted that BASL's apprehension materialised in the three years subsequent to implementation of the project activity. In these years (2003, 2004 and 2005), 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 clearly demonstrates the climatic risk borne by BASL in implementing this project activity.

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[4] Communications between BASL and the equipment supplier

[5] Refer Annex 5 for details

- **Policy risks:**

The project revenues depended directly on the power purchase tariff offered by TNEB. The tariff policy in the state was dynamic and liable to change. As per the tariff policy[6] applicable during the project conceptualization the tariff applicable to the project was dependent on the High Tension (HT) industrial tariff. Any revision in the HT industrial tariff would also impact the purchase tariff from the project. BASL had no background in selling power to the grid and was wary of this dynamism in the purchase tariff. However, BASL's management took the 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.

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.

***Technological barrier**:*

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.

Climatic risks:

The BA2 would not require any additional investment and therefore the impact of climatic vagaries would not be a significant factor to its implementation.

Policy risks:

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[6] TNEB tariff policy dated 11.1.2000

Since there would be no power export to grid in the alternative scenario, barriers associated with power purchase agreements; electricity policies etc would not prevent the implementation of the baseline alternative 2 (BA2).

The next step as per Figure B.2 is Step 4: Common practice analysis

STEP 4 - COMMON PRACTICE ANALYSIS

Sub-step (4a): 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 high pressure cogeneration pressure of 87 ata was not prevailing (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, BASL's interest towards environmental friendly operation and the prospect of CDM revenues 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*[7]
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	*13*
Sugar mills in private sector with power export	*8*[8]
Sugar Mills with similar or better configuration as of BASL in State	*None*[9]

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

[7] As per data from Tamil Nadu Co-operative Sugar Federation Limited

[8] Ministry of Non-conventional Energy Sources (MNES) data on commissioned biomass power plants

[9] MNES annual reports

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.

Since all the criteria of the "Tool for the demonstration and assessment of additionality" are satisfied, the project may be considered additional.

CDM Consideration and background of the project activity:

Date~~S.No~~	Event
September 2000	**BASL learns about the concept of CDM from their engineering consultant during the feasibility assessment of the project activity. This is reflected in their Detailed Project Report[10]. The project proposal was approved for implementation by the BASL Board of Directors, against the risks envisaged, keeping in view the CDM benefits[11].**
December 2000	**With the objective of taking the project forward in the CDM process, BASL's representative attended a seminar on carbon trading[12], organized by CII[13], USAID and WII.**
March 2001	**Purchase orders were placed for the project equipments.**
August 2002	**Project was commissioned.**
March 2003	**CDM Consultant was appointed[14]. By this time, the institutional framework for CDM was established in the country, though the Designated National Authority (DNA) was formed only in November 2003.**
December 2003	**DOE appointed for Validation. Refer work order receipt letter from DOE.**
January 2004	**PDD was submitted to DNA for approval.**

[10] Extract from DPR submitted to DOE

[11] Extract from Minutes of the Board Meeting submitted to DOE

[12] Seminar invitation and delegate pass submitted to DOE

[13] CII – Confederation of Indian Industries, USAID – United States Agency for International Development, WII – Winrock International India

[14] Copy of contract with consultant is submitted to DOE

May 2004	**Host Country Approval was obtained[15].**
April 2006	**Validation was commenced using ACM0006 version 02. Till such time, a suitable CDM methodology was not available.**
May 2007	**PDD re-webhosted for Validation using ACM0006 version 04.**

[15] **This was later renewed as per the latest host country approval format, which is submitted to the UNFCCC**

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. This section elaborates on the formula used to calculate the project emissions, baseline emissions, leakage and net emission reductions based on ACM0006 version 04.

As defined in section B.4 and B.5 above, the baseline alternative 2 is the most likely baseline scenario which is a combination of options P4, P5, H5 and B4. This corresponds to scenario 14 of ACM0006 version 04 and therefore, for this project activity, the formula applicable to baseline scenario 14 would be used.

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:

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

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*):

Out of the two options provided by ACM0006, option 1 has been selected for the calculation of this source of project emissions.

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

Where:

BFk,y	is the quantity of biomass type k, 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:

$$PEFF_y = \sum_i (FF_{projectplant,i,y} + FF_{projectsite,i,y}) x NCV_i x EF_{co_2,FF,i}$$

where,

$PEFF_y$	is the project emission from fossil fuel co-firing during the year y in tons of CO_2,
$FF_{projectplanti,y}$	is the quantity of fuel type *i* combusted in the project activity during the year y in a volume or mass unit.

$FF_{projectsite,i,y}$	is the quantity of fuel type *i* combusted due to the project activity in the site during the year y in a volume or mass unit. Fossil fuel combustion in standby DG sets during start-up or maintenance activities would only be part of this parameter. Only that fossil fuel consumption attributable to the energy efficiency improvement would be included in this parameter.
$EF_{CO2,FF,i}$	is the CO_2 emission factor of the fossil fuel type 'i' in tCO_2/GJ
NCV_i	is the calorific value of the fossil fuel in GJ per mass unit.

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

Any electricity consumption at the project site attributable to the project activity, excluding that of the power plant auxiliary[16] equipments, would be part of this parameter. The possible scenario of electricity consumption as a result of the project activity is the use of captive DG power during project plant maintenance. However, since the captive diesel consumption would be monitored as part of the "Carbon dioxide emissions from on-site consumption of fossil fuels ($PEFF_y$)", this need not be again included in this parameter. Since all electricity consumption scenarios are already accounted, this parameter need not be monitored separately.

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 $\varepsilon_{el,pre\ project}$ (or $\varepsilon_{el,baseline\ plant}$) 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. For calculating this, three years data vintage is used as required by ACM0006.

$\varepsilon_{el,project\ plant,y}$ -is average net energy efficiency of electricity generation in the project plant, expressed in MWhel/MWhbiomass calculated as below:

$$\varepsilon_{el,projectplant} = \frac{EG_{projectplant,y}}{\sum_k NCV_k . BF_{k.y} + \sum_i NCV_i . FF_{projectplant,i,y}}$$

Where,

NCV_k is the net calorific value of biomass residue type k in GJ/ton

$BF_{k,y}$ is the quantity of biomass residue type k combusted in the project plant in year y

NCV_i is the net calorific value of fossil fuel type i in GJ/ton

[16] Auxiliary consumption would be deducted from gross energy generation. Only the net generation is considered

$FF_{project\ plant,i,y}$ is the quantity of fossil fuel type i combusted in the project plant during year y

Determination of electricity baseline emission factor (EF_y):

ACM0006 recommends that if 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)

$EF_{OM,\ y}$ 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

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in calculating baseline emissions.

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:

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

For calculations, local values of NCV_i and $EFCO_{2i}$ from Central Electricity Authority (CEA) reports 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. CEA data for years 2004-05, 2005-06 and 2006-07 are used for the calculations. Refer Annex 3 for details.

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.

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 ACM0002. 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). The combined margin emission factor as per CEA database is shown below:

$EF_{OM,y}$ = 1.003 tCO_2/MWh

$EF_{BM,y}$ = 0.705 tCO_2/MWh

$EF_{CM,y}$ = 0.85 tCO_2/MWh

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. For detailed calculations of thermal efficiency, refer excel sheet enclosed as appendix to this PDD.

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 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. $ER_{heat,y} = 0$.
$BE_{biomass}$	Baseline emissions due to biomass decay. This parameter is excluded from the project boundary and therefore is equal to zero. $BE_{biomass} = 0$.
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 (Refer section B.6.1.3 and B.6.1.4 above), 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. The three most recent historical years have been be used to determine the average efficiency. As per guidelines of ACM0006 version 04.
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 applied :	Measure the quantity of fuels fired and the electricity generation during a representative time period and divide the quantity of fuels fired. The three most recent historical years have been be used to determine the average efficiency. As per guidelines of ACM0006 version 04.

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:	0.85
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project participants have chosen to calculate this value on a ex-ante basis once in the beginning of the project activity. This will not be updated annually. Calculated as per ACM0002 guidelines using data from CEA/IPCC. Refer annex 3 for details.
Any comment:	More details in Annexure 3

B.6.3 Ex-ante calculation of emission reductions:

>>

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. Monitoring procedures are clearly defined in section B.7.1. No uncertainties in this parameter.
2	$FF_{projectsite,y}$	Quantity of fossil fuel used	T/yr	0	Will be measured if used. Envisaged only during emergencies. Fossil fuel combustion in standby DG sets during start-up or maintenance activities would only be part of this parameter. Only that fossil fuel consumption attributable to the energy efficiency improvement would be included in this parameter. Uncertainties for this parameter are addressed above.
3	NCV	Calorific Value	TJ/T coal	0.020784	Average calorific value of coal used in grid connected power plants based on CEA data. No uncertainties in this parameter.
4	$EF_{CO2,FF,i}$	CO_2 emission factor	tCO_2/TJ	0	IPCC default value for the specific fuel used would be adopted. No uncertainties in this parameter.
5	$PEFF_y$ ((1+2)*3*4)	CO_2 emissions from coal	tCO_2/yr	0	Methodology formula.

Emissions due to combustion of fossil fuels for transportation of biomass:					
6	BF_y	Quantity of biomass bought and transported from outside	T/yr	0	Only expected during bagasse shortage. No uncertainties in this parameter.
7	TL_y	Average truck load of the trucks used	T	10	Average rated tonnage of trucks used. No uncertainties in this parameter.
8	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. No uncertainties in this parameter.
9		Truck fuel economy for 10 tonne truck	Kms/litre of fuel	4	Data from local truck operator.
10		Truck fuel economy	Litres/000'kms	250	Based on above data (1000/4 = 250)
11		Density of diesel	Kg/litre of fuel	0.85	Bureau of Energy Efficiency reference material
11		Fuel consumption per 1000 kilometer for 10 tonne truck	kg/000'kms	212.5	Based on above parameters (250 X 0.85 = 212.5). No uncertainties in this parameter.
12		CO_2 emission factor	$kgCO_2$/kg fuel	3.16	IPCC 2006 guidelines default value for diesel.
13	$EF_{km,CO2}$ (11*12)	Average CO_2 emission factor of the trucks	$kgCO_2$/km	0.6478	Methodology formula. Refer section B.6.1.1 above.
14	PET_y ((6*8*13) / (7))	CO_2 emissions from diesel	tCO_2	0	Methodology formula. Refer section B.6.1.1 above.
15	PE_y (5+14)	Total Project Emissions	tCO_2	0	Methodology formula. Refer section B.6.1.1 above.

Emission reductions due to displacement of electricity:

Determination of EGy:					
S.No	**Notation**	**Parameter**	**Unit**	**Value**	**Comments**
1	EGpre-project,y	Generation from the pre-project 4.5 MW, 32 Kg/cm2 system in year 2001 and 2002	MWhe	39,284.07	Actual values recorded by BASL. As per consolidated monthwise energy and mass balance calculated based on daily cogeneration report. Refer copies of above documents.
2	EGproject plant,y	Generation from the 20 MW, 87 Kg/cm2 system	MWhe	119,106	Estimated based on the fuel availability and actual observed efficiency.
3	BFpre-project,y	Fuel Consumption (Old 4.5 MW system) in year 2001 and 2002	T	474,753.28	Actual values recorded by BASL. As per consolidated monthwise energy and mass balance for the years calculated based on daily cogeneration report. Refer copies of above documents.
4	$\sum BF_{pre\text{-}project,k,y} \cdot NCV_{,k,y}$	Fuel Consumption in heat equivalent in year 2001 and 2002	MWh	992,946.5	Based on NCV of 1800 kcal/kg for bagasse
5	BFproject plant,y	Fuel Consumption (New 20 MW system)	T	291,000	Based on 250 days operation at 4000 Tonnes cane crushed per day and 29% bagasse on cane.
6	$\sum BF_{project\ plant,k,y} \cdot NCV_{,k,y}$	Fuel Consumption in heat equivalent	MWh	609,070	Based on NCV of 1800 kcal/kg for

					bagasse
7	$\varepsilon_{el, pre-project}$ (1/4)	Pre-project efficiency	MWhe/ MWhth	0.0395	Maximum efficiency achieved during the pre-project years. Refer excel sheet.
8	$\varepsilon_{el, project plant,y}$ (2/6)	Project plant efficiency	MWhe/ MWhth	0.1956	Expected efficiency of project plant. This is also the actual efficiency obtained post project implementation and therefore no uncertainties.
9	EGy (2* (1- (7/8)))	Incremental Energy generation from the project activity	MWh	95,051	ACM0006 formula. Refer section. Refer section B.6.1.2 above.

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	0.85
12	$ER_{el,y}$ (10*11)	Electricity emission reduction	tCO_2/yr	80,793

Net Emission reductions

S.No	Notation	Parameter	Unit	Value
1	$ER_{el,y}$	Electricity emission reductions	tCO_2/yr	80,793
2	PE_y	Project emissions	tCO_2/yr	0
3	ER_y (1-2)	Emission reductions	tCO_2/yr	80,793

There are no uncertainties in the estimation of emission reductions as all the critical values used are based on actual data.

For detailed calculations, please refer excel sheets enclosed as appendix to this PDD.

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

>>

Sr. No.	Operating Years	Electricity Emission reductions (tonnes of CO_2) $ER_{el,y}$	Project Emissions (tonnes of CO_2) PE_y	Leakage Emissions (tonnes of CO_2) L_y	Emission Reductions (tonnes of CO_2) ER_y
1.	2008-09	80,793	0	0	80,793
2.	2009-10	80,793	0	0	80,793
3.	2010-11	80,793	0	0	80,793
4.	2011-12	80,793	0	0	80,793
5.	2012-13	80,793	0	0	80,793
6.	2013-14	80,793	0	0	80,793
7.	2014-15	80,793	0	0	80,793
8.	2015-16	80,793	0	0	80,793
9.	2016-17	80,793	0	0	80,793
10.	2017-18	80,793	0	0	80,793
	2008-2018	**807,930**	**0**	**0**	**807,930**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$BF_{k,y}$**
Data unit:	Tonnes
Description:	Quantity of biomass type *k* combusted in the project plant during year y
Source of data to be used:	ACM0006 recommends "on-site measurements using weight or volume meters". Bagasse generated in-house is monitored based on on-site measurement of parameters in weight and volume meters as described below in "Description of measurement methods". Recorded in log books.
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:	"Bagasse combusted = Bagasse generated + Opening stock - Closing stock in bagasse yard" Bagasse generated = Cane crush + Water added – Juice produced Cane crush is monitored by weigh bridge. Water added and juice produced is monitored through flow meters. The above method of monitoring is an approved method of monitoring for sugar industries and is used in preparing the Monthly and Annual manufacturing reports (RT 7c and 8c) that are submitted to the Government of India. Frequency of monitoring: Daily
QA/QC procedures to be applied:	Monitored bagasse data would be cross-checked with RT 8c and 7c reports of the plant. Annual bagasse balance would be prepared to cross-check recorded data. Conflict of interest: No conflict of interest in conservative data monitoring. Overestimation of emission reductions is likely if the quantity of biomass consumed is recorded as less than actually consumed since project plant efficiency would increase. There is no other benefit to the promoter by doing so. Further any such mis-recording can be identified in the annual mass balance or comparison with historic efficiency.
Any comment:	-

Data / Parameter:	***Moisture content of the biomass residues***
Data unit:	% water content

Description:	Moisture content of each biomass residue type k
Source of data to be used:	Lab chemist log book
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50% (for Bagasse)
Description of measurement methods and procedures to be applied:	Weights method – The weight of bagasse with moisture and without moisture (after drying in oven) is measured to arrive at the moisture content Frequency of monitoring: Daily
QA/QC procedures to be applied:	Equipments used like mass balances would be calibrated periodically. Conflict of interest: No conflict of interest in conservative data monitoring. Overestimation of emission reductions is likely if the moisture content of biomass consumed is recorded as more than actually consumed since project plant efficiency would increase. There is no other benefit to the promoter by doing so. Further any such mis-recording can be identified in the annual mass balance or comparison with historic data.
Any comment:	-

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:	Records by BASL on the origin of the biomass – Will be recorded in biomass purchase log books based on information provided by truck operators.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100
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 and the project activity. Frequency of monitoring: Continuously
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.

	No potential conflict of interest in conservative data monitoring since truck operators would not provide a lower distance as it will reduce their revenue.
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:	Measured in BASL weigh bridge and recorded in log book
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:	Determined by averaging the weights of each truck carrying biomass to the project plant Frequency of monitoring: Continuously, aggregated annually
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:	Sample measurements of the fuel type, fuel consumption and distance traveled for all truck types. Calculate CO_2 emissions from fuel consumption by multiplying with appropriate net calorific values and CO_2 emission factors. For net calorific values and CO_2 emission factors, reliable national default values or, if not available, (country-specific) IPCC default values would be used.
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:	-
QA/QC procedures to be applied:	Cross-check measurement results with literature
Any comment:	Average CO_2 emission factor for transportation of biomass with trucks

Data / Parameter:	$EF_{CO2,FF,i}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for fossil fuel type i
Source of data to be used:	Measurement results – Third party reports
Value of data applied for the purpose of calculating expected emission reductions in section B.5	- (Actual value would be monitored based on type of fossil fuel used)
Description of measurement methods and procedures to be applied:	Analysis of samples of specific fossil fuel used would be conducted at reputed laboratories once in six months whenever fossil fuel is used.
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:	$FF_{project\ plant\ i,y}$
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 boiler fuel log books
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 BASL weigh bridge before their unloading into the project site. [Fuel combusted = Opening stock - Closing stock + Fuel purchase if any for the day] Recording Frequency: Daily Proportion of data to be monitored: 100%
QA/QC procedures to be applied:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock exchanges. No potential conflict of interest in conservative data monitoring as no other type of benefit is available for recording a lower quantity of fossil fuel consumption than actually consumed.

Any comment:	

Data / Parameter:	$\mathbf{FF}_{\text{project site i,y}}$
Data unit:	Tonnes
Description:	Onsite fossil fuel consumption of type 'i' used in the project site apart from co-firing as a result of the project activity. Only that fossil fuel consumption attributable to the energy efficiency improvement would be included in this parameter.
Source of data to be used:	BASL fuel consumption log books
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 in volume or weight meters. Monitoring frequency: Continuously.
QA/QC procedures to be applied:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock exchanges. No potential conflict of interest in conservative data monitoring as no other type of benefit is available for recording a lower quantity of fossil fuel consumption than actually consumed.
Any comment:	

Data / Parameter:	$\mathbf{EG}_{\text{project plant,y}}$
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant during the year y
Source of data to be used:	BASL energy meter log books
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:	The data will be recorded in log books on a daily basis based on energy meters of BASL. Monitoring frequency: Continuously
QA/QC procedures to be applied:	The consistency of the recorded net electricity generation will be cross-checked with receipts from energy sales and the quantity of fuel fired (e.g. check whether the electricity generation divided by the quantity of fuel fired results in a

	reasonable efficiency that is comparable to previous years) No potential conflict of interest in conservative data recording.
Any comment:	-

Data / Parameter:	**$NCV_{i,FF}$**
Data unit:	GJ/ton
Description:	Calorific value of fossil fuel
Source of data to be used:	Analysis report of reputed laboratory
Value of data applied for the purpose of calculating expected emission reductions in section B.5	- (Actual value would be monitored based on type of fossil fuel used)
Description of measurement methods and procedures to be applied:	Determined by a certified laboratory Monitoring frequency: Once in six months
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. No potential conflict of interest in conservative data recording.
Any comment:	The value will be determined when fossil fuel is used.

Data / Parameter:	**$NCV_{i,BF}$**
Data unit:	GJ/ton of dry matter
Description:	Net calorific value of biomass residue type *k*
Source of data to be used:	Analysis report of reputed laboratory
Value of data applied for the purpose of calculating expected emission reductions in section B.5	7.5 for bagasse (1800 kcal/kg)
Description of measurement methods and procedures to be applied:	Determined by a certified laboratory Monitoring frequency: Once in six months
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. No potential conflict of interest in conservative data recording.
Any comment:	

Data / Parameter:	**$BF_{k,y}$ (outside biomass)**
Data unit:	Tonnes of dry matter
Description:	Quantity of biomass type *k* purchased from outside and combusted in the project plant during year y
Source of data to be used:	ACM0006 recommends "on-site measurements using weight or volume meters". Biomass purchased is monitored based on on-site measurement of parameters using weigh bridges. Recorded in log books.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 (Outside biomass purchase expected only during emergencies like drought. Since this is not likely to occur in normal years, this parameter is considered as zero for the estimation.)
Description of measurement methods and procedures to be applied:	Purchased biomass will be monitored in weigh bridges of BASL and recorded electronically. Frequency of monitoring: Continuously
QA/QC procedures to be applied:	Weigh bridges would be calibrated annually. Annual fuel balance would be prepared to cross-check recorded data. Conflict of interest: No conflict of interest in conservative data monitoring. Overestimation of emission reductions is likely if the quantity of biomass consumed is recorded as less than actually consumed since project plant efficiency would increase. There is no other benefit to the promoter by doing so. Further any such mis-recording can be identified in the annual mass balance or comparison with historic efficiency.
Any comment:	This data is used for the calculation of project emissions as a result of outside biomass transportation.

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

B.7.2 Description of the monitoring plan:

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Bannari Amman Sugars Limited will incorporate a special team for implementing the monitoring procedures as described in section 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:

18~~6~~/06~~1~~/2008

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

M/s. Bannari Amman Sugars Limited

1212, Trichy Road

Coimbatore

Tamilnadu - 641018

The entity is a project participant listed in annex 1 to this document

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:

>>

05/03/2001

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:

>>
01/04/2008 or on Registration with UNFCCC whichever is later

C.2.2.2. Length:

>>
10 years 0 months

SECTION D. Environmental impacts

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

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A rapid 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 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

The Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forests (MoEF) is not applicable as the project activity does not fall under its purview.

SECTION E. Stakeholders' comments

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

>>

BASL organised a formal meeting to appraise the local stakeholders about the project activity and receive their comments. BASL sent (through mail) formal invitations to individual stakeholders well in advance of the consultation meeting indicating the date, time and venue. The following stakeholders were identified:

- Local panchayat/residents
- Local farmers/cane growers' associations
- Local Non Governmental Organisations (NGOs)
- Tamil Nadu Electricity Board (TNEB)
- Tamil Nadu Pollution Control Board (TNPCB)

The stakeholder meeting was conducted on 04.09.2003 at the sugar plant conference hall and was attended by the local stakeholders. BASL representatives appraised the stakeholders about the various aspects of the project activity. Doubts raised by stakeholders were clarified by BASL. The stakeholders discussed on the project activity and provided their views on it. BASL collected written comments of the project activity from the stakeholders.

E.2. Summary of the comments received:

>>

All the stakeholders in the meeting provided positive comments on the project activity and appreciated BASL for implementing the project activity. The stakeholders were glad that the project is contributing to reducing environmental pollution. Further, BASL has obtained clearances from TNPCB and TNEB for the implementation of the project activity. No negative comments were received from any of the stakeholders. The query raised by the *Head-Village Panchayat* and the clarification provided by BASL are provided below:

Query: *"How is the air pollution in the area reduced by the project activity?"*

BASL response: *"In the old low pressure cogeneration set up, rotary air valves (RAV) were present to reduce the particulate matter escaping from the flue gas. These RAVs cannot control fine particles and as a result lot of dust particles and unburnts escaped with flue gas and settled as deposits in the near by* *areas. However, in the new project activity, latest Electro Static Precipitators (ESPs) are installed. The ESPs collect even fine particles from the flue gas and drastically reduces solid particles in the out going flue gas"*

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

>>

Since all the stakeholder comments were positive and no negative comments were received, no corrective action was undertaken as no negative comments were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bannari Amman Sugars Limited
Street/P.O.Box:	1212, Trichy Road
Building:	Bannari Amman Sugars Limited
City:	Coimbatore
State/Region:	Tamilnadu
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URL:	www.bannari.com
Represented by:	
Title:	Vice President (Finance)
Salutation:	Mr.
Last Name:	R
Middle Name:	
First Name:	Murugesan
Department:	Finance
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	rmurugesan@bannari.com

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 (based on 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 (0.85 tCO_2/MWh) has been considered for this project activity.

CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE

VERSION	**3.0**
DATE	**15 December 2007**
BASELINE METHODOLOGY	**ACM0002**

EMISSION FACTORS

Weighted Average Emission Rate (tCO2/MWh) (excl. Imports)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
North	0.72	0.73	0.74	0.71	0.71	0.71	0.72
East	1.09	1.06	1.11	1.10	1.08	1.08	1.03
South	0.73	0.75	0.82	0.84	0.78	0.74	0.72
West	0.90	0.92	0.90	0.90	0.92	0.87	0.85
North-East	0.42	0.41	0.40	0.43	0.32	0.33	0.39
India	0.82	0.83	0.85	0.85	0.84	0.82	0.80

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

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
North	0.98	0.98	1.00	0.99	0.97	0.99	0.99
East	1.22	1.22	1.20	1.23	1.20	1.16	1.13
South	1.02	1.00	1.01	1.00	1.00	1.01	1.00
West	0.98	1.01	0.98	0.99	1.01	0.99	0.99
North-East	0.74	0.71	0.74	0.74	0.71	0.70	0.69
India	1.02	1.02	1.02	1.03	1.03	1.02	1.01

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

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
North					0.53	0.60	0.63
East					0.90	0.97	0.93
South					0.70	0.71	0.71
West					0.77	0.63	0.59
North-East					0.15	0.15	0.23
India					0.69	0.68	0.68

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

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
North	0.76	0.76	0.77	0.76	0.75	0.80	0.81
East	1.06	1.06	1.05	1.07	1.05	1.06	1.03
South	0.86	0.85	0.86	0.85	0.85	0.86	0.85
West	0.87	0.89	0.88	0.88	0.89	0.81	0.79
North-East	0.44	0.43	0.44	0.44	0.43	0.42	0.46
India	0.86	0.86	0.86	0.86	0.86	0.85	0.85

Annex 4

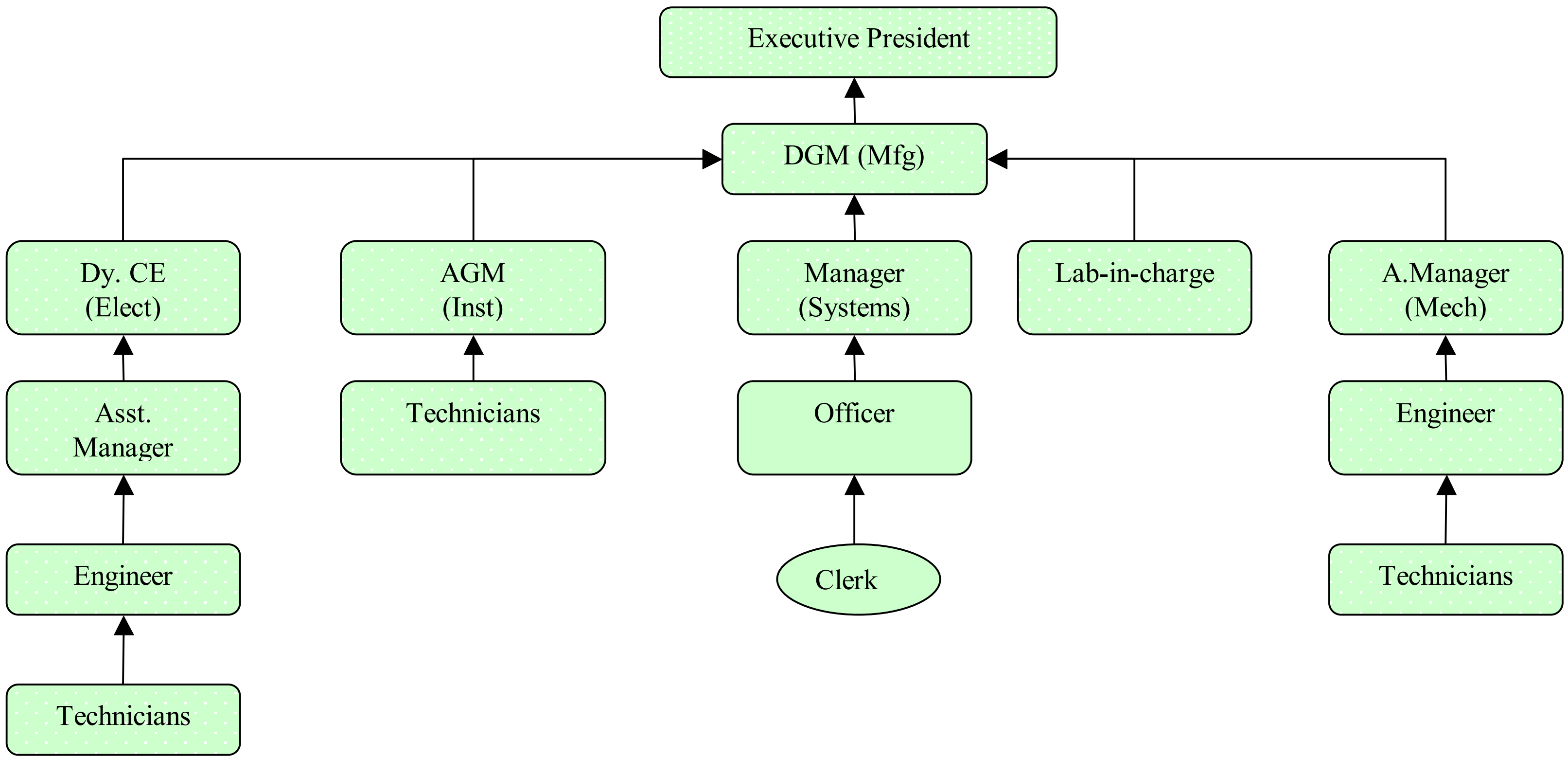
MONITORING INFORMATION

This section elaborates on the monitoring plan to be followed by the project promoters:

CDM TEAM:

The CDM team comprises of personnel from the Engineering, Electrical, Instrumentation, Laboratory and Systems departments. The personnel in the team perform the dual functions of power plant O&M and compliance with CDM procedures. The organization structure of the CDM team is given in Figure 1.

Organization structure showing the CDM Team



Parameters to be monitored and detailed monitoring procedures:

$EG_{Project\ Plant,gross}$ - Gross energy generation of the project plant (MWh)	
Monitoring methods and procedures	This data will be measured continuously in BASL energy meters. The Technician (Electrical) will record the generation data on a daily basis in log books.
QA/QC procedures	A monthly energy balance will be prepared to cross-check the recorded generation data with other parameters. In case the deviation in recorded data is beyond the allowable limits for the energy meter used, the meter will be calibrated/rectified at the earliest. For the period of error, data would be adjusted as described under "Data uncertainties and adjustments". Periodic calibration and maintenance of the energy meter will be arranged by the Electrical department.
Reporting	The Shift Electrical Engineer (SEE) will review and approve the log books on a daily basis and record the data in computer in the form of Daily Cogen Report. The daily report would be reviewed by the Assistant Manager (AM) and forwarded to the Dy.CE (Elec) and DGM (Manufacturing). On a monthly basis, a compilation of all the energy parameters recorded for the month would be prepared by the AM and submitted to the Dy.CE and DGM (Mfg).
Data archiving	The Dy.CE (Elec) would verify the daily and monthly energy report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in meter • When meter is dismantled for O&M or calibration • When data is not recorded or records are lost

	• Delay in calibrating the energy meter – In some years, the period between two calibrations may be more than one year due to unavoidable circumstances like extended crushing season of the sugar plant due to which the cogeneration plant cannot be stopped for maintenance. During the above circumstances, the lower value between the below two would be adopted for emission reduction calculations: • Gross generation = Captive consumption + Energy exported + Auxiliary consumption • Gross generation = Heat equivalent of biomass fired X Efficiency of the system calculated with latest reliable data • When the period between two calibrations is more than a year, no adjustments need to be done if the meter error during calibration is within limits. If meter error during calibration is above limits by "x%", then "x%" may be deducted from the monitored data for the non-calibrated period for calculating CERs. As far as possible, the calibration and maintenance of the meters would be scheduled when the plant is under shutdown to avoid any data uncertainties.

$EG_{project\ plant,aux}$ - Auxiliary consumption (MWh)	
Monitoring methods and procedures	This data will be measured continuously in BASL energy meters. The Technician (Electrical) will record the consumption data on a daily basis in log books.
QA/QC procedures	A monthly energy balance will be prepared to cross-check the recorded consumption data with other parameters. In case the deviation in recorded data is beyond the allowable limits for the energy meter used, the meter will be

	calibrated/rectified at the earliest. For the period of error, data would be adjusted as described under "Data uncertainties and adjustments". Periodic calibration and maintenance of the energy meter will be arranged by the Electrical department.
Reporting	The Shift Electrical Engineer (SEE) will review and approve the log books on a daily basis and record the data in computer in the form of Daily Cogen Report. The daily report would be reviewed by the Assitant Manager (AM) and forwarded to the Dy.CE (Elec) and DGM (Mfg). On a monthly basis, a compilation of all the energy parameters recorded for the month would be prepared by the AM and submitted to the Dy.CE and DGM (Mfg).
Data archiving	The Dy.CE (Elec) would verify the daily and monthly energy report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in meter • When meter is dismantled for O&M or calibration • When data is not recorded or records are lost • Delay in calibrating the energy meter – In some years, the period between two calibrations may be more than one year due to unavoidable circumstances like extended crushing season of the sugar plant due to which the cogeneration plant cannot be stopped for maintenance. During the above circumstances, the lower value between the below two would be adopted for emission reduction calculations:

	• Auxiliary consumption = Gross generation -Captive consumption - Energy exported • Auxiliary consumption = Gross generation X % Auxiliary consumption calculated based on most recent reliable data available • When the period between two calibrations is more than a year, no adjustments need to be done if the meter error during calibration is within limits. If meter error during calibration is above limits by "x%", then "x%" may be deducted from the monitored data for the non-calibrated period for calculating CERs. As far as possible, the calibration and maintenance of the meters would be scheduled when the plant is under shutdown to avoid any data uncertainties.

$EG_{Project\ Plant,\ Net}$ - Net energy generation (MWh)	
Monitoring methods and procedures	This data will be measured as the difference between gross generation and auxiliary consumption measured in BASL energy meters.
QA/QC procedures	Since this data is based on monitored Gross generation and auxiliary consumption data, separate QA/QC procedures are not necessary.
Reporting	The Shift Electrical Engineer (SEE) will review and approve the log books on a daily basis and record the data in computer in the form of Daily Cogen Report. The daily report would be reviewed by the Assistant Manager (AM) and forwarded to the Dy.CE (Elec) and DGM (Mfg). On a monthly basis, a compilation of all the

	energy parameters recorded for the month would be prepared by the AM and submitted to the Dy.CE and DGM (Mfg).
Data archiving	The Dy.CE (Elec) would verify the daily and monthly energy report and archive it.
Data uncertainties and adjustments	Since this data is based on monitored Gross generation and auxiliary consumption data, separate procedures for data adjustments are not necessary.

Captive energy consumption of factory (MWh) – The methodology does not necessitate monitoring of this parameter. However, it is monitored for reference purposes.	
Monitoring methods and procedures	This data will be measured continuously in BASL energy meters. The Technician (Electrical) will record the consumption data on a daily basis in log books.
QA/QC procedures	A monthly energy balance will be prepared to cross-check the recorded consumption data with other parameters. In case the deviation in recorded data is beyond the allowable limits for the energy meter used, the meter will be calibrated/rectified at the earliest. For the period of error, data would be adjusted as described under "Data uncertainties and adjustments". Periodic calibration and maintenance of the energy meter will be arranged by the Electrical department.
Reporting	The Shift Electrical Engineer (SEE) will review and approve the log books on a daily basis and record the data in computer in the form of Daily Cogen Report. The daily report would be reviewed by the Assistant Manager (AM) and forwarded to the Dy.CE (Elec) and

	DGM (Mfg). On a monthly basis, a compilation of all the energy parameters recorded for the month would be prepared by the AM and submitted to the Dy.CE and DGM (Mfg).
Data archiving	The Dy.CE (Elec) would verify the daily and monthly energy report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in meter • When meter is dismantled for O&M or calibration • When data is not recorded or records are lost During the above circumstances, the lower value between the below two would be adopted for emission reduction calculations: • Captive consumption = Gross generation -Auxiliary consumption - Energy exported • Captive consumption = Cane crushed X Specific power consumption for crushing calculated based on most recent reliable data available

$EG_{Project\ Plant,\ export}$ - Energy exported (MWh) - The methodology does not necessitate monitoring of this parameter. However, it is monitored for reference purposes.	
Monitoring methods and procedures	This data will be measured continuously in KPTCL/CESCOM energy meters located at the switchyard/sub-station. The energy exported would be recorded by KPTCL/CESCOM personnel in the presence of BASL personnel (SEE) on a monthly basis in the Joint meter reading" log book. The Technician (Electrical) also records this data in log books on a daily basis.

QA/QC procedures	The recorded data would be cross-checked with a check meter installed along with the main energy meter. In case the deviation in recorded data is beyond the allowable limits for the energy meters used, the meter will be calibrated/rectified at the earliest. For the period of error, data would be adjusted as described under "Data uncertainties and adjustments".
Reporting	The Shift Electrical Engineer (SEE) will review and approve the log books on a daily basis and record the data in computer in the form of Daily Cogen Report. The daily report would be reviewed by the Assistant Manager (AM) and forwarded to the Dy.CE (Elec) and DGM (Mfg). On a monthly basis, a compilation of all the energy parameters recorded for the month would be prepared by the AM and submitted to the Dy.CE and DGM (Mfg).
Data archiving	The Dy.CE (Elec) would verify the daily and monthly energy report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in main meter or check meter • When meter is dismantled for O&M or calibration Since there are two meters installed, during any of the above problems in one meter, the other meter would still be working and therefore the recorded data of the other meter will be used for the error period.

Biomass combusted (captive bagasse) – in Tonnes	
Monitoring methods and procedures	This data will be measured as follows: *"Bagasse combusted = Bagasse generated + Opening*

	stock - Closing stock in bagasse yard" This data is recorded on a daily basis by Technicians – Mechanical in log books. During most crushing season days, the entire quantity of bagasse generated would be directly fed to the boiler. However, during some days, bagasse may partly go to or be taken from the bagasse yard. *Bagasse generated = Cane crush + Water added – Juice* Cane crush is monitored by weigh bridge. Water added and juice are monitored through flow meters. *The above method of monitoring is an approved method of monitoring for sugar industries and is used in preparing the Monthly and Annual manufacturing reports (RT 7c and 8c) that are submitted to the Government of India.*
QA/QC procedures	Monitored bagasse data would be cross-checked with RT 8c and 7c reports of the plant. Annual bagasse balance would be prepared to cross-check recorded data. For the period of error, data would be adjusted as described under "Data uncertainties and adjustments".
Reporting	Bagasse data recorded by Technicians would be reviewed and input to the computer by the Engineer – Mech. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Engineer and submitted to the Assistant Manager (AM) and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in monitored values

	• Monitored data missing During any of the above scenarios, bagasse quantity would be computed as follows: Bagasse consumed = Gross energy generation / Efficiency calculated using latest reliable data

Biomass combusted (outside biomass) – in Tonnes	
Monitoring methods and procedures	This data will be measured as follows: *"Biomass combusted = Biomass purchased + Opening stock - Closing stock in biomass yard"* This data is recorded on a daily basis by Technicians – Mechanical in log books. Biomass purchased is monitored by weigh bridge. The type of biomass would also be recorded.
QA/QC procedures	Monitored biomass data may be cross-checked with biomass purchase invoices. Calibration of weigh bridge would be done annually. For the period of any error, data would be adjusted as described under "Data uncertainties and adjustments".
Reporting	Biomass data recorded by Technicians would be reviewed and input to the computer by the Engineer – Mechanical. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Engineer and submitted to the Assistant Manager (AM) and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in monitored values

	• Monitored data missing During any of the above scenarios, biomass quantity would be computed as follows: Biomass consumed = Gross energy generation / Efficiency calculated using latest reliable data

Moisture content of biomass	
Monitoring methods and procedures	This data will be measured for each type of biomass on a monthly basis by the Lab-in-Charge (LIC) using the "weights method" (Weighing the sample before and after drying in an oven). The LIC records the data in log books.
QA/QC procedures	Mass balance used in the measurement process is calibrated annually.
Reporting	Biomass data recorded by LIC would be reviewed and input to the computer by the Engineer – Mechanical. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Engineer and submitted to the AM and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • Monitored data missing • Monitoring not done During any of the above scenarios, moisture content would be computed as follows: The least moisture content measured historically for the type of biomass would be considered for that period.

Net Calorific Value of biomass	
Monitoring methods and procedures	This data will be monitored for each type of biomass on a quarterly basis by a third party analysis. The Lab-in-Charge (LIC) will be responsible for collecting samples and arranging the analysis.
QA/QC procedures	Not applicable
Reporting	Calorific value data recorded by LIC would be reviewed and input to the computer by the Engineer - Mechanical. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Engineer and submitted to the AM (Mech) and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are not likely.

Fossil fuel combusted (co-fired) in the project plant	
Monitoring methods and procedures	This data will be measured as follows: *"Fossil fuel combusted = Fuel purchased + Opening stock - Closing stock in fuel storage"* This data is recorded on a daily basis by Technicians – Mechanical in log books. Fossil fuel purchased is monitored by weigh bridge.
QA/QC procedures	Monitored fossil fuel data may be cross-checked with purchase invoices. Calibration of weigh bridge would be done annually.
Reporting	Fossil fuel data recorded by Technicians would be reviewed and input to the computer by the Engineer. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the

	Engineer and submitted to the AM and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in monitored values • Monitored data missing During any of the above scenarios, the entire quantity of fossil fuel purchased in a particular monitoring period would be considered as combusted in the project plant.

Fossil fuel consumption at the project site	
Monitoring methods and procedures	Fossil fuel combustion in standby DG sets during start-up or maintenance activities will only be included in this parameter. This data will be measured in volume measurements as and when supplied to the DG sets. This data is recorded on a daily basis by Technicians – Engineering in log books. Fossil fuel purchased is monitored by weigh bridge.
QA/QC procedures	Monitored fossil fuel data may be cross-checked with purchase invoices. Calibration of weigh bridge would be done annually.
Reporting	Fossil fuel data recorded by Technicians would be reviewed and input to the computer by the Engineer. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Engineer and submitted to the AM and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.

Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • During error in monitored values • Monitored data missing During any of the above scenarios, the entire quantity of fossil fuel purchased in a particular monitoring period would be considered as combusted in the project plant.

Net Calorific Value of fossil fuel	
Monitoring methods and procedures	This data will be monitored on a quarterly basis by a third party analysis. The Lab-in-Charge (LIC) will be responsible for collecting samples and arranging the analysis.
QA/QC procedures	Not applicable
Reporting	Calorific value data recorded by LIC would be reviewed and input to the computer by the Engineer. On a monthly basis, a compilation of all the Energy-CDM parameters recorded for the month would be prepared by the Enginner and submitted to the AM and DGM (Mfg).
Data archiving	The AM would verify the monthly energy-CDM report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are not likely.

Distance from biomass sites	
Monitoring methods and procedures	This data will be measured in truck odometers by the truck operators and recorded by the systems department clerk at the weigh bridge. This data is recorded on a continuous basis by the clerk in log books.

QA/QC procedures	Consistency of distance records provided by the truckers will be checked by comparing recorded distances with information from other sources
Reporting	Distance data recorded by clerk would be reviewed and input to the computer by the Officer – Systems. On a monthly basis, a compilation of CDM parameters recorded for the month would be prepared by the Officer and submitted to the Manager – Systems.
Data archiving	The Manager-Systems would verify the monthly CDM report and forward it to the DGM (Mfg) for his review and archiving.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • Data missing If data is missing for a particular truck load of biomass, the farthest distance recorded in the past would be assumed.

Truck load	
Monitoring methods and procedures	This data will be measured in BASL weigh bridge and recorded by the systems department clerk at the weigh bridge. This data is recorded on a continuous basis by the clerk in log books.
QA/QC procedures	Weigh bridge would be calibrated annually
Reporting	Truck load data recorded by clerk would be reviewed and input to the computer by the Officer – Systems. On a monthly basis, a compilation of CDM parameters recorded for the month would be prepared by the Officer and submitted to the Manager – Systems.
Data archiving	The Manager-Systems would verify the monthly CDM

	report and forward it to the DGM (Mfg) for his review and archiving.
Data uncertainties and adjustments	For this parameter, data uncertainties are likely during the following scenarios: • Data missing If data is missing for a particular truck load of biomass, the maximum load recorded in the past would be assumed.

Truck mileage	
Monitoring methods and procedures	This data will be monitored by the transportation operators. Declaration from the biomass transportation operators would be obtained by the stores department on an annual basis for a sample of the trucks used.
QA/QC procedures	Check consistency of measurements and local / national data
Reporting	Truck mileage data obtained would be reviewed by the Systems department Manager and provided to the DGM (Mfg).
Data archiving	The DGM would verify the report and archive it.
Data uncertainties and adjustments	For this parameter, data uncertainties are not likely.

Procedures for project performance reviews before data is submitted for internal audit or external verification:

The DGM (Mfg) assisted by the Dy.CE (Electrical) and AM (Mech) would do the project performance review every month based on the monthly energy reports. A comparison of the daily fuel consumption and energy generation data will be done using MS-Excel. This would reveal the performance of the project activity which would be compared against the expected performance levels. Any discrepancy or deviations would be inspected and traced back to original records and corrective action for that parameter as per the CDM Manual would be done.

Procedures for internal audit and Management review:

An internal audit of the project activity would be done on a half yearly basis during the management review meeting (MRM). The review (audit) team would include at least one technical person and an accounts person. The team would audit the project for the below aspects among other things:

- Are the monitoring of CDM parameters done in line with the CDM PDD and CDM Manual
- Is the documentation of monitored CDM parameters done properly
- Are equipments calibrated and maintained as scheduled
- Is the quantity of CERs generated inline with that projected in the CDM PDD? If not, what are the reasons for deviation?
- Are necessary corrective actions being taken to address deviations?
- Check the authenticity of data monitored and recorded by random cross-checking with other sources.

The audit team would submit their observations to the DGM (Mfg) for his review and necessary action. The DGM (Mfg) would instruct the CDM Team to take the required corrective action if any suggested by the audit team.

Procedures for corrective actions for better future monitoring and reporting:

Errors or anomalies in the monitoring and reporting would be identified by the DGM (Mfg) while reviewing the monthly CDM reports. A comparison of these reports would reveal any data errors or missing data or other anomalies. Errors or deviations will also be identified during the half yearly review/internal audits. The DGM would take up these matters during the monthly CDM Team meeting (that normally would happen a few days after monthly CDM reports are prepared and submitted). The root cause of these errors would be discussed and appropriate action would be taken for better future monitoring and reporting. The corrective actions may include:

- Training of monitoring personnel where required
- Replacement or repair of equipment

Procedures for training of monitoring personnel:

- An initial training would be provided by the CDM consultant to all the monitoring personnel identified. Detailed monitoring procedures for each of the CDM parameters would be elaborated.
- Subsequent to the training program, the consultant would witness the actual monitoring on site and help with any difficulties faced by the personnel.
- The DGM would closely inspect the monitoring activities till the mechanism works smoothly.
- Any new person joining the team would be trained on the job by the person being replaced.

Functions of the CDM Team:

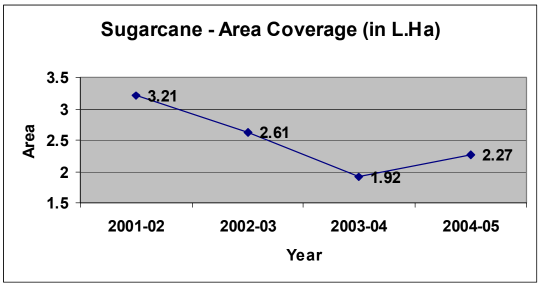
- Monitor parameters for calculating emission reductions generated by the project activity
- Maintain records of relevant data for verification of CERs.
- Ensure accuracy of data by proper maintenance and calibration of monitoring equipment.
- Operate the power plant in compliance with the CDM Project Design Document
- Take all preventive measures to ensure plant availability at all times.

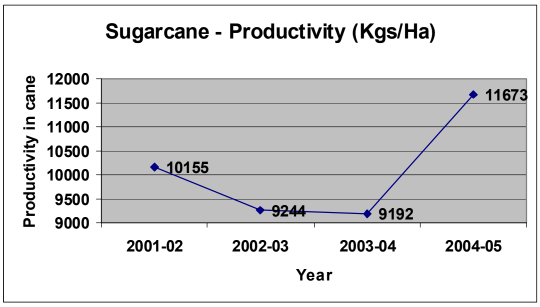
CDM Team meeting:

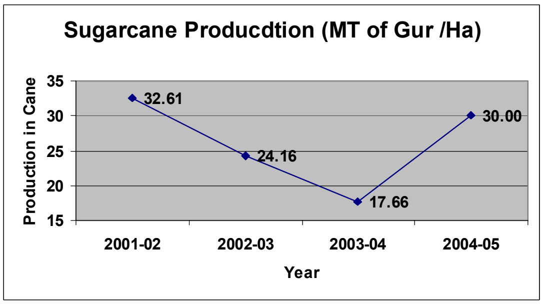
The team meets once a month to review the CDM performance of the plant. Any particular concerns are discussed and appropriate action is taken.

Annex 5

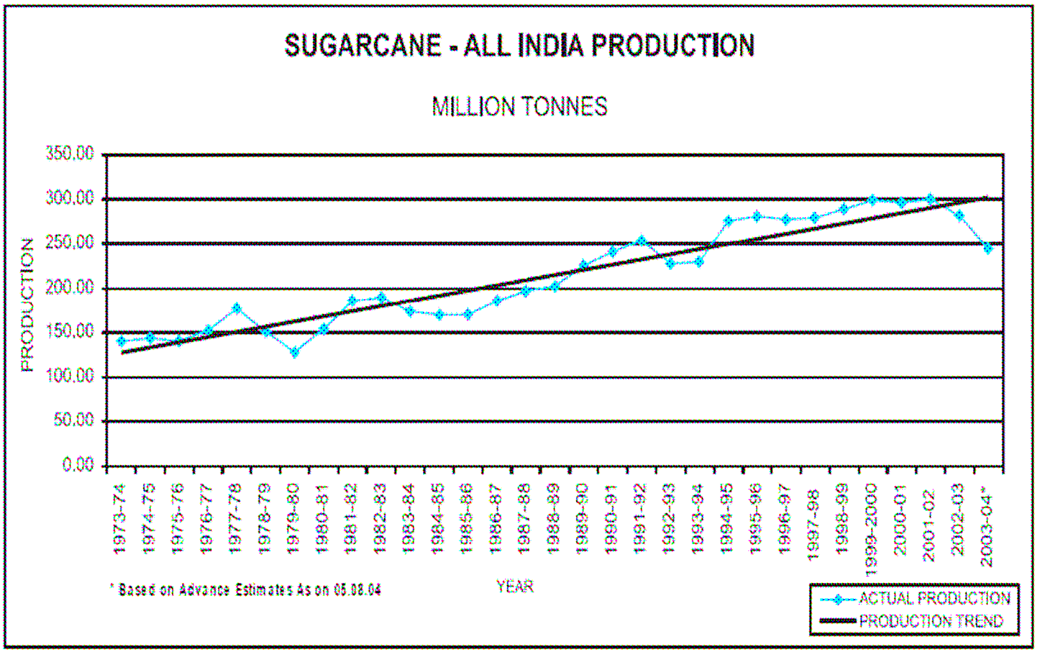
Sugarcane cultivation and production in Tamilnadu and India







For Tamil Nadu, Source: www.agricoop.nic.in/RabiCampaing05_06/ RabiCamp05_06/Tamil%20Nadu.ppt



Source: Reports of "The Commission For Agricultural Costs and Prices During 1999-2000" – www.agricoop.nic.in

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

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:

1. Construction phase
2. 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.