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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

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Gangakhed Sugar & Energy Private Ltd (GSEPL) 30 MW Bagasse Based Co-generation Power Project

Version: 09.2

Dated: 13/03/2013

A.2. Description of the project activity:

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Gangakhed Sugar & Energy Private Ltd (GSEPL) has decided to develop an Integrated Cane Processing Plant (ICPP) at Village Vijaynagar – Makhani in Gangakhed Taluka, Parbhani District, Maharashtra, in order to tap the sugarcane potential in the region and also to aid in the sustainable development of the region. As a part of the ICPP, GSEPL has proposed to install a 6000 TCD Sugar Plan, a 60 KLPD Distillery and 30 MW Bagasse Based Cogeneration Plant.

Purpose

The project activity involves setting up of a 30 MW bagasse based Co- generation plant at the ICPP site. The Bagasse based Co – generation plant will utilize the bagasse generated in-house to the fullest potential and the additional fuel requirement for the operation of the plant would be met by procuring the surplus biomass residues available in the region. The power generated will be used to meet the power demand for the sugar plant[1] and the surplus power will be exported to the grid. In the baseline scenario, the power supplied by the project would have been generated by a) the GHG intensive thermal power plants connected to the state grid and b) in a reference plant with lower efficiency as compared to the project plant. As the project activity employs a boiler of higher efficiency and generates additional power as compared to the baseline scenario, it aids in mitigation of GHG emissions.

Sustainable development criteria

The following criteria have been considered for demonstrating sustainable development.

- *Social well being*
- *Economic well being*
- *Environmental well being*
- *Technological well being*

The project activity contributes to the sustainable development in the following way:

1. *Social well being*:

- GSEPL's management will recruit semi skilled & unskilled workers from the nearby villages. Workers being the local labor will help in improving the social status of the villagers. Additionally the project would also create indirect employment opportunities
- Project activity will help to reduce the demand-supply gap in the power deficit state grid.

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[1] The distillery would have its own captive power plant for meeting its energy demand. No power would be exported from the cogeneration plant to the distillery

2. *Economical well being*:
- The project activity will help to create business opportunity for local stakeholders such as farmers, suppliers, manufacturers, contractors etc.
- The procurement of biomass residues would also create an additional source of revenue for the local farmers who otherwise are heavily dependent on economic aid from the Government of Maharashtra due to lack of demand for sugarcane and biomass residues in the region
- Project activity will reduce transmission losses due to generation of decentralized power close to load points, this will further improve the system voltage. This will result in availability of quality power to nearby villages and industrial units.

3. *Environmental well being*
- The project activity would lead to mitigation of greenhouse gas emissions from thermal power plants
- The project activity would also help in avoidance of the release of pollutants like SOx, NOx etc from the thermal power plant in the atmosphere
- The project activity would aid in the conservation of fast depleting reserves of fossil fuel

4. *Technological well being*
- The project is designed as a cleaner energy generation project. The technology employed is a high pressure steam generation (110 ata and 540^{o}C) and high pressure condensing steam turbine for power generation
- The project activity would install 110 ata steam cycle plant with higher efficiency over the lower pressure plants.This electricity generated would substitute the power generation by carbon intensive MSEB grid.

A.3. Project participants:

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Name of Party involved	Private and/or public entity (ies) project participants	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/ No)
India (Host)	Gangakhed Sugar & Energy Private Limited (GSEPL) (Private Entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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Vijaynagar-Makhani Village

A.4.1.1. Host Party(ies):

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India

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

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Maharashtra

A.4.1.3. City/Town/Community etc.:

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Gangakhed Taluka in Parbhani District

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

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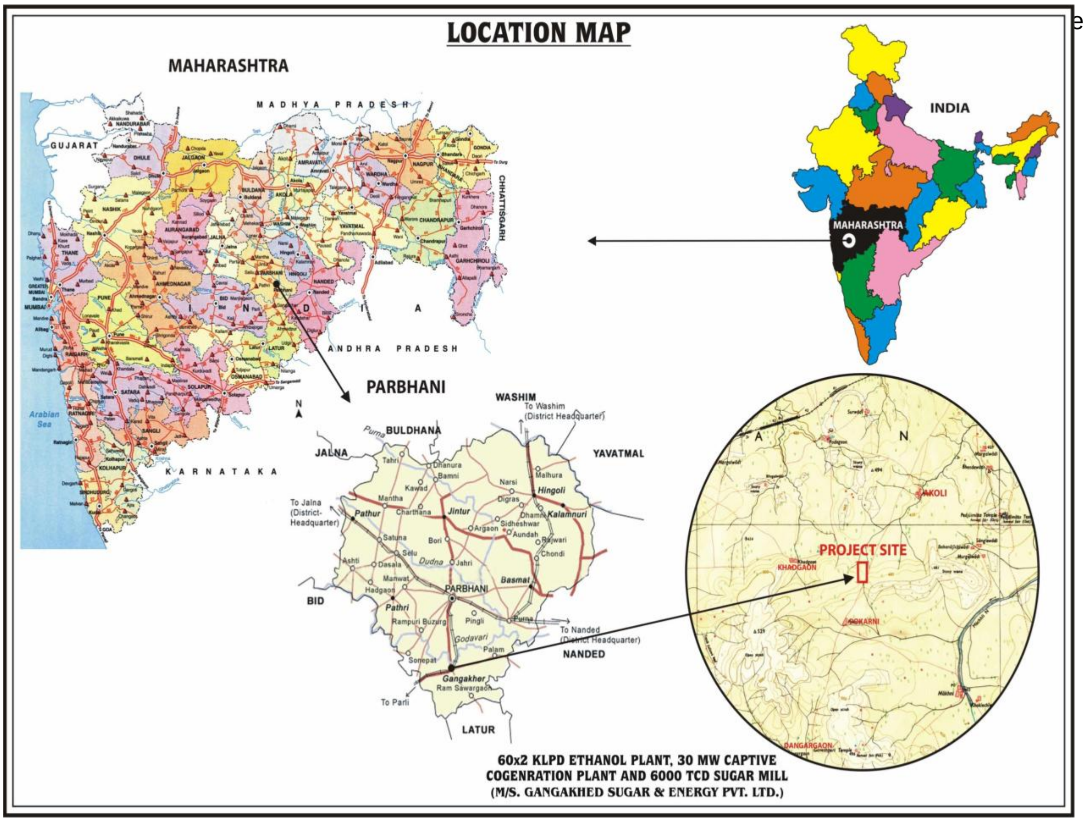
The project activity is located at 56B/9 & 56B/13 (Topo sheet No) in Village Vijaynagar – Makhani Tehsil: Gangakhed, District headquarters Parbhani (Maharashtra). The study area lies near Vijaynagar-Makhani village of Maharashtra. Its coordinates are Latitude 18°54’03” North and longitude 76°42’54” East. The nearest railway station is Gangakhed which is at a distance of 5 Km from site. The nearest National / State Highway, Gangakhed to Lathur (S.H.170) is at a distance of 9 Km.



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

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The project activity is a bagasse based grid connected co-generation power project, which is primarily a renewable energy project. Hence the project activity is categorized under Category 1: Energy industries (renewable - / non-renewable sources) as per the scope of the project activities enlisted in the 'List of Sectoral Scopes' (Version 16, July 07) for accreditation of operational entities.

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

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The plant is designed with all other auxiliary plant systems like bagasse / biomass residue handling system with storage and processing arrangements, ash handling system, water treatment plant, cooling water system and cooling tower, compressed air system and the turbo generator for its successful operation.

Technical specifications of major equipments would be as below:

Boiler:
The Steam generator is designed with the following design parameters:

Parameter	Design Value
Maximum Continuous rating (MCR) (T/hr)	150
Peak capacity of the boiler as percentage of MCR capacity	110
Superheater Outlet Pressure (Kg/Cm^2 (g)	109
Superheater Outlet Temperature (^{0}C)	540^{o}C
Feed Water Inlet Temperature (^{0}C)	210
Excess Air (%)	<30%
Boiler Outlet Flue Gas Temperature	<160
Dust Concentration at Boiler Outlet (mg/NM^3)	50

The design features of the boiler is Bi-drum / single drum, natural circulation, radiant furnace with water cooled membrane walls, Three stage superheater with interstage desuperheater and balanced draft. The boiler shall be top supported and shall be of semi-outdoor type. The boiler shall be capable of a peak generation of 110% of the MCR generation for a period of One (1) Hour in a shift. The operating excess air percentage at the outlet of the boiler shall be less than 30%. The dust concentration in the flue gases leaving the boiler shall not exceed 50 mg/NCum.

Turbine:
The turbo generator shall be a triple extraction cum condensing machine and the rated capacity of the turbine would be 30 MW. The first extraction shall be uncontrolled at 21 ata, the second extraction shall be uncontrolled at 9 ata and the third extraction shall be a controlled extraction at 2.8 ata. The following shall be the salient design parameters. The speed of the turbine is 6800 RPM

Parameters	***Value***	
	Season	***Off - Season***
Steam pressure at the turbine stop valve at boiler (ata)	110	110
Steam flow at the turbine stop valve at boiler MCR (Kg/Hr)	150,000	114,700
Steam temperature at the turbine stop Valve (^{o}C)	538	538
Condenser Operating pressure (ata)	0.07 to 0.09	
Condenser cooling water inlet temperature (^{o}C)	32.0	
Generating voltage (kV)	11.0	
Parallel operation with grid	Required with State EB grid	
Grid Voltage kV	132	
Duty requirements	Continuous 8000 hours	
System Frequency	50± 5%	

Supply to Grid:
The power generated will be supplied to a transformer after meeting the in house power requirement of the sugar plant and co-generation plant for stepping up from 11 KV to 132KV in a plant switch yard. The stepped up power will be supplied to the MSEB grid.

The plant will also be designed with other auxiliary plant systems like Bagasse handling system with storage arrangements, High pressure feed water heaters, Ash handling system, Water treatment plant, Compressed air system, Air conditioning system, Main steam, medium pressure and low pressure steam systems, Fire protection system, Water system which include raw water system, circulating water system, condensate system and the electrical system for its successful operation.

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

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The project would result in a CO_2 emission reduction of **648800** tCO_2 per year during the 10-year crediting period between 2012– 2022. Thus the project activity enables reduction of greenhouse gas emissions of the NEWNE grid as provided in Table 1.

Years	**Estimation of annual emission reductions in tonnes of CO_2e**
2012- 2013	64480
2013- 2014	64480
2014- 2015	64480
2015- 2016	64480
2016- 2017	64480
2017- 2018	64480
2018- 2019	64480
2019- 2020	64480
2020- 2021	64480
2021- 2022	64480
Total estimated reductions (tCO_2e)	644800
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tCO_2e)	64480

A.4.5. Public funding of the project activity:

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No public funding has been availed of for the implementation of 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 electricity and heat generation from biomass residues

Reference -This is an UNFCCC approved consolidated baseline methodology ACM0006 version 12.0.1, EB 66, which is based on the following approved methodologies.

This methodology also refers to the latest approved version of:

- "Tool to determine the remaining lifetime of equipment (Version 1.0)";
- "Tool for the demonstration and assessment of additionality (Version 6.0)";
- "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (Version 1.0);
- "Tool to calculate the emission factor for an electricity system" (Version 2.2.1);
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2);
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 1.0).
- "Project and leakage emissions from road transportation of freight" (Version 1)
- "Emissions from Solid Waste Disposal Sites" (Version 6.0.1)
- "Assessment of the validity of the original/ current baseline and update of the new baseline at the renewal of the crediting period" (Version 3.0.1)

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

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As per the selected methodology, the project activity is applicable to project activities that operate biomass-residue (co-)fired power-and heat plants. The project activity may include the following activities or a combination of these activities

- The installation of new plants at a site where currently no power and heat generation occurs (greenfield projects);
- The installation of new plants at a site where currently power or heat generation occurs. The new plant replaces or is operated next to existing plants (capacity expansion projects);
- The improvement of energy efficiency of existing plants (energy efficiency improvement projects), which can also lead to a capacity expansion, e.g. by retrofitting the existing plant;
- The total or partial replacement of fossil fuels by biomass residues in existing plants or in new plants that would have been built in the absence of the project (fuel switch projects), e.g. by increasing the share of biomass residues use as compared to the baseline, by retrofitting an existing plant to use biomass residues, etc.

The project activity under consideration involves the installation of a new biomass residue fired power and heat plant at a site where currently no power generation occurs (Greenfield power projects) and hence the stipulated applicability criteria is met.

Further, the qualification of the project activity against the applicability criteria stipulated in ACM0006, version 12.0.1 EB 66, as under:

Applicability Criteria	Qualification
No biomass types other than biomass residues are used in the project plant;[2]	The project activity would predominantly use bagasse and other types of biomass residues available in the area such as residues of cotton and tur. Hence this applicability criteria is met.
Fossil fuels may be co-fired in the project plant. However, the amount of fossil fuels co-fired does not exceed 80% of the total fuel fired on an energy basis	Although co-firing of fossil fuel is not envisaged as a part of the project activity, use of fossil fuel, if any would be monitored during the crediting period and would not exceed 80% of the total fuel fired on an energy basis. Hence this applicability criteria is also met.
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 substantial changes (e.g. product change) in this process	The Project activity will not result in any change in the processing capacity or product. Hence this applicability criteria is met
The biomass used by the project facility should not be stored for more than one year.	Maximum portion of the bagasse generated during crushing season (which spans 170 days in a year) at the sugar plant is continuously used by the boilers for generating steam for the sugar manufacturing facility. Some portion of the bagasse generated is stored at the plant premises for use in the non-crushing period. This quantity of bagasse is not stored at the project facility for more than one year. The quantity of bagasse generated during the season is also not sufficient for the operation of the plant during the off-season. Hence GSEPL additionally be procuring surplus biomass residues available in the region for operation during non-season. From the above argument, it can be concluded that biomass will not be stored in the project facility for more than a years time. Hence, this applicability criteria is also met.
The biomass residues used by the project facility are not obtained from chemically processed biomass (e.g. through esterification, fermentation, hydrolysis, pyrolysis, bio- or chemical-degradation, etc.) prior to combustion. Moreover, the preparation of biomass-derived fuel do not involve significant energy quantities, except from transportation or mechanical treatment so as not to cause significant GHG emissions;	The biomass residues planned to be used by the project facility are not obtained from chemically processed biomass. No significant processing is required for the bagasse and other biomass residues consumed in the project activity. Procedure for accounting of emissions arising due to the transportation of biomass procured from outside sources has been outlined in Section B.6. Hence, this applicability criteria is also met.
In the case of fuel switch project activities, the use	The project activity under consideration involves

2 Refuse Derived Fuel (RDF) may be used in the project plant but all carbon in the fuel, including carbon from biogenic sources, shall be considered as fossil fuel.

of biomass residues or the increase in the use of biomass residues as compared to the baseline scenario is technically not possible at the project site without a capital investment in: • The retrofit or replacement of existing heat generators/boilers; or • The installation of new heat generators/boilers; or • A new dedicated biomass residues supply chain established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes); or Equipment for preparation and feeding of biomass residues.	the installation of a new biomass residue fired power and heat plant at a site where currently no power generation occurs. The project is not a fuel switch project activity and hence this criteria is not applicable for the project under consideration.
In the case that biogas is used in power and/or heat generation, this methodology is applicable under the following conditions: • The biogas is generated by anaerobic digestion of wastewater (to be) registered as a CDM project activity and the details of the registered CDM project activity must be included in the PDD. Any CERs from biogas energy generation should be claimed under the proposed project activity registered under this methodology; The biogas is generated by anaerobic digestion of wastewater that is not (and will not) be registered as a CDM project activity. The amount of biogas does not exceed 50% of the total fuel fired on an energy basis.	The project activity does not involve the use of biogas and hence is not applicable to the project activity. The application of the methodology is hence justified.
Finally, the methodology is only applicable if the most plausible baseline scenario, as identified per the “Selection of the baseline scenario and demonstration of additionality” section hereunder, is: • For power generation: Scenarios P2: to P7:, or a combination of any of those scenarios; • For heat generation: Scenarios H2 to H7, or a combination of any of those scenarios; • If some of the heat generated by the project activity is converted to mechanical power through steam turbines, for mechanical power generation: Scenarios M2: to M5:	The baseline scenario identified for the project is Power: P5 and P7 Heat: H5

• In the case of M2 and M3, if the steam turbine(s) are used for methancial power in the project, the turbine(s) used in the baseline shall be at least as efficient as the steam turbine(s) used for methancial power in the project; • In the case of M4 and M5, steam turbine(s) for methancial power are not allowed for the same purpose in the project • For biomass residue use: Scenarios B1 to B8, or any combination of those scenarios. For scenarios B5 to B8, leakage emissions should be accounted for as per the procedures of the methodology.	Biomass: B1 and B4. The heat generated by the project activity is not converted to mechanical power through steam turbines for mechanical power generation hence not applicable As the identified baseline scenarios for Power, Heat and Biomass is permitted, the application of the methodology is justified.

As demonstrated above, the project activity meets all the applicability criteria of the selected approved methodology and hence the application of the methodology is justified.

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

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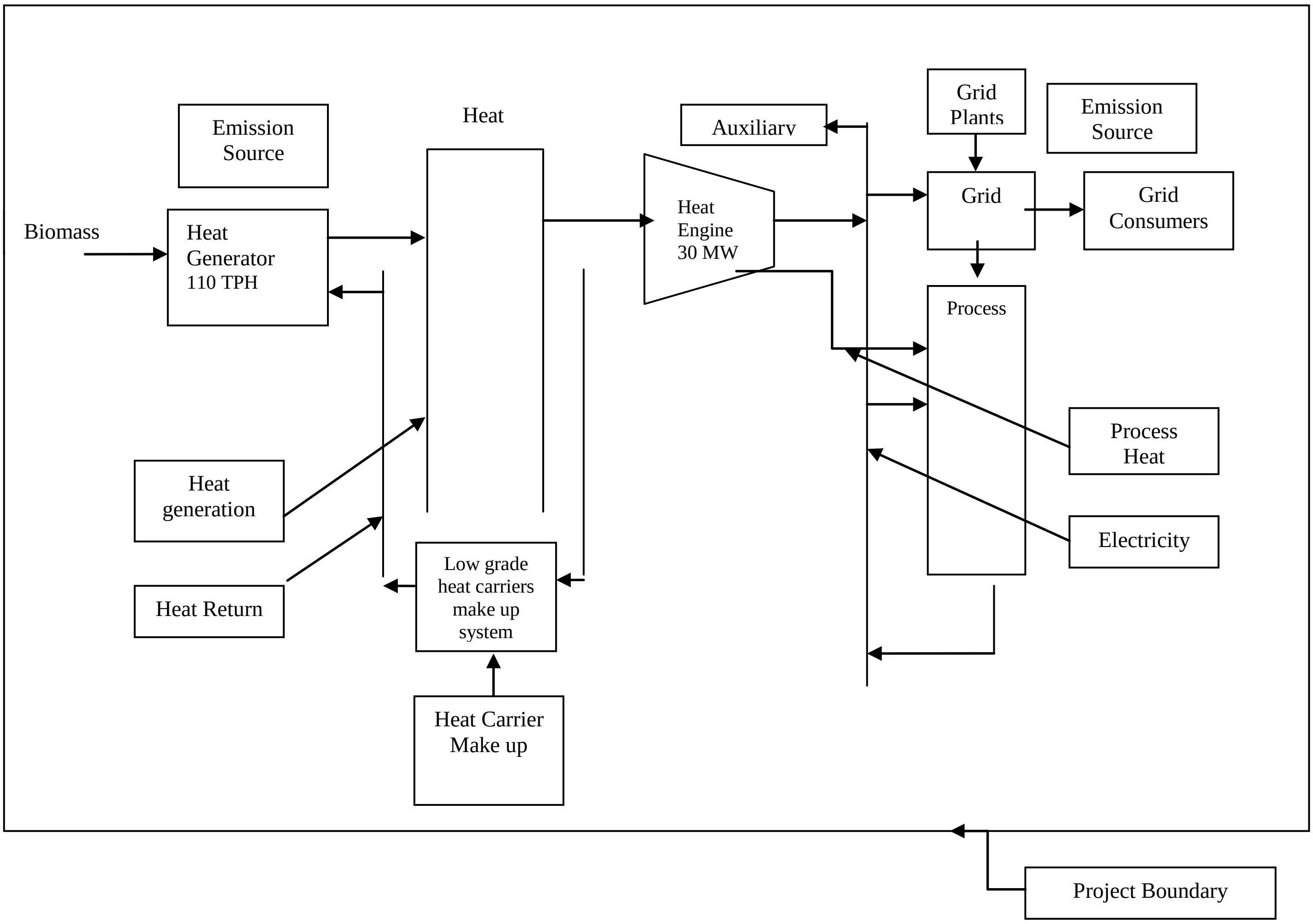
Project Boundary

The spatial extent of the project boundary is defined below:

Elements	Justification for Inclusion/ Exclusion
All plants generating power and/or heat located at the project site, whether fired with biomass	The cogeneration plant which supplies power and heat to the sugar plant has been included within the

residues, fossil fuels or a combination of both;	project boundary.
All power plants connected physically to the electricity system (grid) that the project plant is connected to;	The cogeneration plant, which supplies power to the grid also, has been included within the project boundary.
Where possible, all off-site heat sources that supply heat to the site where the project activity is located (either directly or via a district heating system);	There are no off-site heat sources and hence not included in the project boundary
The means of transportation of biomass residues to the project site;	The means of transportation of biomass residues to the project site have been included.
The site where the biomass residues would have been left for decay or dumped;	The site where the biomass residues would have been left to decay or dumped has also been included.
The wastewater treatment facilities used to treat the wastewater produced from the treatment of biomass residues;	The biomass used in the plant do not undergo any treatment and hence not included in the project boundary
In case biogas is included, the site of the anaerobic digester.	The project does not involve biogas and hence not included in the project boundary

The subsequent sections in the PDD provides the details of the capacity of the heat generators, the type and quantity of fuels estimated to be used in the heat generators, the type and capacity of the heat engines and the direct heat extractions both in the baseline as well as in the project scenario.



The table below illustrates the emissions sources which are included and excluded from the project boundary for determination of both baseline and project emissions.

	Source	Gas		Justification / Explanation
Baseline	Electricity and heat 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
	Uncontrolled burning or decay of surplus biomass residues	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. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources
	On-site fossil	CO_2	Included	May be an important emission source

	fuel consumption	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Off-site transportation of biomass residues	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Combustion of biomass residues for electricity and heat	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Excluded	This emission source is excluded as CH_4 emissions from uncontrolled burning or decay of biomass residues in the baseline scenario are excluded
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small
	Storage of biomass residues	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 residues are stored for not longer than one year, this emission source is assumed to be small
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small
	Wastewater from the treatment of biomass residues	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	Included	This emission source shall be included in cases where the waste water is treated (partly) under anaerobic conditions
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small

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

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Selection of baseline scenario

As per the selected methodology, the baseline scenario and demonstration of additionality should be conducted by applying the following steps:

Step 1: Identification of alternative scenarios

The alternatives to the project activity are being identified in this section separately for power, heat, mechanical power and biomass residue. 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.

Step1a: Define alternative scenarios to the proposed CDM project activity

The project participant has considered alternatives for power generation and biomass residues use in the absence of project activity. The realistic and credible alternatives for co-generation projects would include:

Scenario	**Baseline scenario**	**Applicability**
	Power Generation	
P1	The proposed project activity not undertaken as a CDM project activity.	This can be considered as a credible alternative.
P2	If applicable, the continuation of power generation in existing power plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the starting date of the project activity;	The project activity involves the installation of a new biomass residue fired cogeneration plant at a Greenfield Integrated Cane Processing Complex. As there are no existing power plants at the project site, this alternative is not credible.
P3	If applicable, the continuation of power generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project activity;	The project activity involves the installation of a new biomass residue fired cogeneration plant at a Greenfield Integrated Cane Processing Complex. As there are no existing power plants at the project site, this alternative is not credible.
P4	If applicable, the retrofitting of existing power plants at the project site. The retrofitting may or may not include a change in fuel mix;	The project activity involves the installation of a new biomass residue fired cogeneration plant at a Greenfield Integrated Cane Processing Complex. As there are no existing power plants at the project site, this alternative is not credible.
P5	The installation of new power plants at the project site different from those installed under the project activity	This is a realistic and credible alternative. The project activity is being installed in a sugar plant with demand for both heat and power. In order to meet the energy demand for the sugar plant, the PP could have installed a cogeneration plant. The option of setting up a power only plant is not considered viable as the sugar mill would also have heat requirement and cogeneration plant in such a scenario would be more efficient. The common practice followed by the industry is the establishment of a biomass residue fired boiler with low efficiency. The

		most commonly established boiler is of pressure 45 kg/cm^2. This is a credible scenario. In the absence of CDM, the project the project proponent would also have installed a cogeneration plant involving low efficiency 45 kg/cm^2 boiler to meet the power and heat demand for the sugar plant. The sizing scenarios considered for further evaluation include: Scenario A) Electricity and steam produced in the project scenario and in the reference plant is the same (i.e. 211431 MWh of electricity and 1105 TJ of steam), Scenario B) The size of the reference plant is designed using the steam requirement of the sugar plant, ie a plant of 17 MW capacity producing 1105 TJ of steam and 120684 MWh of electricity). These have been further evaluated in Section B.4 below.
P6	The generation of power in specific off-site plants, excluding the power grid	In the absence of CDM, the project participant would also have followed the common practice of establishing a low efficiency boiler with a pressure of 45 kg/cm^2 ands would have sourced power and heat through its in house cogeneration plant. Hence, the scenario involving the sourcing of energy from a specific off–site plant is not realistic.
P7	The generation of power in the power grid.	In the absence of CDM, the project participant would also have followed the common practice of establishing a low efficiency boiler with a pressure of 45 kg/cm^2. However, as the plant would have had lower efficiency, it would not have been able to generate as much as would be generated in the project plant. This additional power could have been generated in the thermal power plants connected to the grid. Hence, this is a realistic and credible scenario.

Scenario	**Baseline scenario**	**Applicability**
	Heat Generation	
H1	The proposed project activity not	This can be considered as a realistic

	undertaken as a CDM project activity	alternative.
H2	If applicable, the continuation of heat generation in existing plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the project activity	The project activity is a Greenfield project. There are no existing plants at the project site and hence this scenario is not realistic or credible.
H3	If applicable, the continuation of heat generation in existing plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the project activity	The project activity is a Greenfield project. There are no existing plants at the project site and hence this scenario is not realistic or credible.
H4	If applicable, the retrofitting of existing plants at the project site. The retrofitting may or may not include a change in fuel mix	The project activity is a Greenfield project. There are no existing plants at the project site and hence this scenario is not realistic or credible.
H5	The installation of new plants at the project site different from those installed under the project activity;	The common practice followed by the industry is the establishment of a biomass residue fired boiler with low efficiency. The most commonly established boiler is of pressure 45 kg/cm^2. This is a credible scenario. In the absence of CDM, the project the project participant would also have installed a cogeneration plant involving low efficiency 45 kg/cm^2 boiler to meet the power and heat demand for the sugar plant. Hence this scenario is realistic & credible. The capacity of the boiler would have been 120 TPH. The boiler would have operated at a PLF of 90% and would have had a Steam to Fuel Ratio of 2.4. Justification for the above has been provided in Section B.4 of the PDD.
H6	The generation of heat in specific off-site plant.	The common practice followed by the industry is the establishment of a biomass residue fired boiler with low efficiency. The most commonly established boiler is of pressure 45 kg/cm^2. This is a credible scenario. In the absence of CDM, the project the project participant would also have installed an in-house cogeneration plant involving low efficiency 45 kg/cm^2 boiler to

		meet the power and heat demand for the sugar plant. Hence the generation of steam in an offsite plant is not realistic & credible.
H7	The production of heat from district heating.	In the baseline scenario, the project participant would have generated heat in a low efficiency cogeneration plant. Hence this scenario is not realistic.

Scenario	**Baseline scenario**	**Applicability**
	Mechanical Power Generation	
M1	The proposed project activity not undertaken as a CDM project activity	As the project activity does not involve any mechanical power generation this cannot be considered as a realistic alternative.
M2	If applicable, the continuation of mechanical power generation from the same steam turbines in existing plants at the project site	The project activity is a Greenfield project. There are no existing plants at the project site and hence this scenario is not realistic or credible.
M3	The installation of new steam turbines at the project site	The project activity does not involve any mechanical power generated through turbines hence this is not applicable
M4	If applicable, the continuation of mechanical power generation from electrical motors in existing plants at the project site;	The project activity is a Greenfield project. There are no existing plants at the project site and hence this scenario is not realistic or credible.
M5	The installation of new electrical motors at the project site	There is no installation of new electrical motors at the project site hence this is not applicable and realistic

The project activity does not involve the generation of mechanical power. Hence the above conditions are not applicable in the case of the project at hand.

The project activity would involve the utilization of biomass residues such as bagasse, cotton and tur. The realistic and credible scenarios for these biomass residues in the baseline scenario have been identified below.

	Biomass Residues	
B1	The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.	Applicable. The bagasse generated in house would have been a valuable resource and would not have been left to dump or decay. Additionally, the project activity also involves use of procured biomass. The biomass assessment survey has revealed that there is surplus availability of biomass in the region. As there was no other demand for the biomass in the region, it is possible that the biomass would have been dumped or left to

		decay under aerobic conditions. This is applicable only for the types of fuels planned to be procured from outside sources in the project scenario (Cotton stalks, Tur and Bagasse) .
B2	The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to landfills which are deeper than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.	The scenario is not applicable to the bagasse generated in-house. The bagasse generated in house would have been a valuable resource and would not have been left to dump or decay. Additionally, the project activity also involves use of procured biomass, to which this scenario might be applicable. The biomass assessment survey has revealed that there is surplus availability of biomass in the region. As there was no other demand for the biomass in the region, it is possible that the biomass could have been dumped or left to decay under anaerobic conditions. However, for the purpose of conservativeness, it has been assumed that all of the surplus biomass would have decayed aerobically and no anaerobic decay would have happened. Hence this scenario has been ignored. This is applicable only for the different types of fuels planned to be procured from outside sources in the project scenario.
B3	The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes.	This scenario is not applicable to the bagasse generated in house as this bagasse would have been a valuable resource and would not have been left to dump or decay. Additionally, the project activity also involves use of procured biomass, to which this scenario is applicable. The biomass assessment survey has revealed that there is surplus availability of biomass in the region. As there was not other demand for the biomass in the region, it is possible that the biomass would have been burnt in an uncontrollable manner without utilizing it for energy purposes. This is applicable only for the different types of fuels planned to be procured from outside sources in the project scenario.
B4	The biomass residues are used for power or heat generation at the project site in new and/or existing plants	Applicable. The Biomass residues, in the absence of the project activity, would have been utilized in a low efficiency cogeneration plant to generate heat and power. This could be either biomass that is generated in-house

		or procured from outside parties Hence this is a realistic and credible alternative. This is applicable for all the different types of fuels planned to be used in the project activity.
B5	The biomass residues are used for power or heat generation at other sites in new or existing plants.	The biomass assessment study conducted in the region has revealed that the procured biomass in the absence of the project was unutilized and was surplus. Hence this scenario is not realistic. This is applicable for all the different types of fuels procured from outside sources and planned to be used in the project activity.
B6	The biomass residues are used for other energy purposes, such as the generation of bio-fuels.	There is no industrial demand for biomass residues in the area where the project activity is being set up. In the pre-project scenario, the biomass residues to be procured, were not being utilized and is surplus. This has been established through the biomass assessment study conducted in the area. As there was no demand for the biomass in the pre-project scenario, this scenario is not considered realistic. This is applicable for all the different types of fuels planned to be used in the project activity.
B7	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)	There is no industrial demand for biomass residues in the area where the project activity is being set up. In the pre-project scenario, the biomass to be procured, was not being utilized and was surplus. This has been established through the biomass assessment study conducted in the area. The surplus biomass available value has been arrived at after taking into account the consumption for non-energy purposes like use as fertilizer or as feed for livestock in the area. As there was no demand for the biomass in the pre-project scenario, this scenario is also not considered realistic. This is applicable for all the different types of fuels planned to be used in the project activity.
B8	Biomass residues are purchased from a market, or biomass residues retailers, or the primary source of the biomass residues and/or their fate in the absence of the project activity cannot be clearly identified	The project participant has demonstrated that there is surplus quantity of biomass available in the region. Hence in accordance with the applied methodology, this scenario is not assumed to be realistic or credible.

The table below represents a detailed biomass balance for both the reference and the project plants.

Project Scenario

Total Biomass Consumption	360252

Fuel Type	In House		External		Total
	Season	Off Season	Season	Off Season	
Bagasse	211034	57022	0	0	268056
Cotton Stems	0	0	0	46098	46098
Tur Stems	0	0	0	46098	46098
Total					360252

Baseline Scenario

Total Biomass Consumption	304222

Fuel Type	In House		External		Total
	Season	Off Season	Season	Off Season	
Bagasse	179010	89046	0	0	268056
Cotton Stems	0	0	0	18083	18083
Tur Stems	0	0	0	18083	18083
Total					304222

	B1	B4
Bagasse	0	268056
Cotton Stems	28015	18083
Tur Stems	28015	18083

Total Biomass usage in project scenario (B1 + B4)	360252

As per the Biomass Assessment Report carried out for the assessing the surplus availability of biomass residues the report prepared by an independent third party clearly mentions that the annual availability of cotton and tur stems at 75% collection efficiency are 68273 MT and 143127 MT which sums up to 211400 MT. The annual requirement for the project activity is around 92196 MT. Therefore it can be clearly inferred that there is more than double the biomass availability than what is required by the project activity.

Quantity of biomass available (cotton and tur stems) = 211400 MT
Quantity required for the project = 92195 MT

% Surplus = (211400 – 92195)/92195 * 100 = 129.29%

The table below provides the details of the fate of the various types of biomass proposed to be used in the project plant.

Biomass residues category (*k*)	**Biomass residues type**	**Biomass residues source**	**Biomass residues fate in the absence of the project activity**	**Biomass residues use in project scenario**	**Biomass residues quantity (tonnes)**
1	Bagasse	On-site production	Electricity/heatgeneration on-site (B4)	Cogeneration of Power & Heat in (co-fired boiler)	211034
2.	Bagasse	On-site production	Electricity/heatgeneration on-site (B4)	Generation of Power (power only mode)	57022
3.	Cotton Stalks	Off-site from biomass residue retailer	Electricity/heat generation on-site (B4)	Generation of Power (power only mode)	18080
4.	Cotton Stalks	Off-site from biomass residue retailer	Decay under aerobic condition (B1)	Generation of Power (power only mode)	14007
5.	Cotton Stalks	Off-site from biomass residue retailer	Burnt without utilizing for energy purposes (B3)	Generation of Power (power only mode)	14007
6.	Tur Residues	Off-site from biomass residue retailer	Electricity/heat generation on-site (B4)	Generation of Power (power only mode)	18080
7.	Tur Residues	Off-site from biomass residue retailer	Decay under aerobic condition (B1)	Generation of Power (power only mode)	14007
8.	Tur Residues	Off-site from biomass residue retailer	Burnt without utilizing for energy purposes (B3)	Generation of Power (power only mode)	14007
9.	Bagasse	Off-site from biomass	Decay under aerobic condition	Generation of Power (power	0

		residue retailer	(B1)	only mode)	

Outcome of Step 1a:

As per the methodology ACM 0006 version 12.0.1 (EB 66), the plausible baseline alternatives for the project activity are

For Power:

P1: The proposed project activity not undertaken as a CDM project activity;
P5: The installation of new power plants at the project site different from those installed under the project activity
P7: The generation of power in the power grid.

For Heat:

H1: The proposed project activity not undertaken as a CDM project activity;
H5: The installation of new plants at the project site different from those installed under the project activity;
For Biomass:
B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.
B4: The biomass residues are used for power or heat generation at the project site in new and/or existing plants

The baseline scenario identified for the project activity would deliver equal quantum of power and heat as in case of the project activity. The power generated in the project would in the baseline be partially generated in a reference plant and the rest of the power would be generated in the grid. Similarly, the baseline reference plant would generate equivalent quantum of heat as in case of the project plant.

The alternatives identified are consistent with all the mandatory and applicable laws and regulations.
Local laws and regulations don't prevent implementation of the identified alternatives. Hence Outcome of Step 1b is identical to that of Sub-step 1a.

Thus the two possible alternatives for the project include the implementation of a new cogeneration plant with parameters that different from those in the project activity and the implementation of the project without CDM funds.

Based on the steps detailed therein, it can be concluded that Implementation of the project activity without CDM faces barriers and it is not an economically attractive option as well. Hence the implementation of the project without CDM is not a likely scenario. Hence the project participant would have opted for the other alternative: Implementation of a low efficiency cogeneration plant. The same has hence been identified as the baseline scenario for the project activity. The following section provides the details of the assumption and the justification for selecting operating parameters for the baseline plant.

Baseline Reference Plant:

Overview of alternative technologies available

Maharashtra Energy Development Agency (MEDA) is the nodal agency for the promotion of Renewable Energy in the state of Maharashtra. The objectives of MEDA include promotion, development and implementation of Non-conventional renewable and alternative energy devices and technology and evolving suitable alternatives to meet the burgeoning energy demand. As a part of its efforts for promotion of renewable energy, MEDA has identified that the existing boilers installed in the sugar mills in Maharashtra are normally of pressure 21, 32 and 45 kg/cm^2[3].

The project activity is being setup in a sugar plant. The project would deliver heat and power to the sugar plant and the surplus power generated would be sold to the grid. Also, in India, Sugar sector is controlled by the state governments who follow different policies for their respective states (For e.g different state governments prescribe different Minimum Support Prices for sugar, which in turn impacts their operations). Also, the power sector is controlled by the state government and the respective state electricity regulatory commissions decide on the tariffs provided for export of surplus power to the grid from the sugar mills. This too has an impact of the profitability of the sugar mills, which in turn impacts their operations. Hence, the state of Maharashtra can be considered as the relevant geographical area for the project. The data for 21 sugar plants in the state was assessed to understand the efficiency of the boilers employed by them. It may be noted here. The assessment revealed that the technology implemented in these plants involved boilers with pressures of 21 kg/cm^2 or 45 kg/cm^2. Conservatively, the reference plant has been assumed to have a boiler with 45 kg/cm^2 pressure. This is line with the methodological requirement for choosing relevant baseline technological options in a conservative manner.

In order to establish the reference plant parameters, two sizing scenarios were considered for the reference plant: Scenario A) The entire quantity of electricity produced in the project scenario is generated in the low efficiency reference plant, Scenario B) The PP has used the steam requirement of the sugar plant (110 TPH at pressure of 2.80 ata) as the reference point for sizing in Scenario B. Provided below in tabular format is the steam flow parameters during season and off-season for the project plant and the reference plant in both scenarios.

<u>Project Plant Scenario</u>

Steam Flow- During Off-Season for Project Plant

	Flow	Pressure	Temperature	Enthalpy	Power Generation
Parameter	TPH	Ata	Deg C	kJ/kg	KW
At Boiler Outlet	135.00	105.00	538.00	3464.10	-
HP Heater 2	11.93	17.00	324.00	3084.90	1256.63
HP Heater 1	10.25	7.85	240.00	2928.70	1524.40
Deaerator	11.70	3.10	153.00	2766.00	2268.83
Condenser	100.82	0.09	43.00	2580.00	24759.71
Ejector	0.30	-	-	-	0
Maximum Possible Power Generation		(MW)			29.81

[3] http://www.mahaurja.com/PG_Bag_Tech.html

Steam Flow- During Season for Project Plant

Parameter	Flow TPH	Pressure ata	Temperature Deg C	Enthalpy kJ/kg	Power Generation kW
At Boiler Outler	150.00	105.00	538.00	3464.10	-
HP Heater 2	11.93	21.00	325.00	3077.3	1281.81
HP Heater 1	10.25	9.00	230.00	2901.9	1600.71
Sugar Process	110.60	2.80	130.00	2720.50	22845.04
Condenser	15.30	0.07	38.65	2571.00	3795.68
Ejector	0.30	-	-	-	0
Leakage	1.62	-	-	-	0
Generation Capacity		(MW)			29.52

As can be seen from the above tables, the PP has a steam requirement of 110.60 TPH in the sugar plant while during the off-season, the PP intends to maximize the power generation. As there is no steam demand from the sugar plant during off-season, the total steam generation required during the off-season reduces.

<u>Reference Plant Scenarios</u>

Scenario A: Scenario A involves generation of equivalent quantity of power generation in the reference plant as that in the project plant. The reference plant design has been developed by altering the flow at the boiler outlet.

Scenario A: Steam Flow- During season for Reference Plant

	Flow TPH	Pressure ata	Temperature Deg C	Enthalpy kJ/kg	Power Generation kW
At Boiler Outlet	183.41	45.00	420.00	3253.4	0.00
HP Heater 2	0	-	-	-	0
HP Heater 1	3	9.00	230.00	2901.9	292.92
Sugar Process	110.60	2.80	130.00	2720.50	16371.87
Condenser	67.89	0.07	38.65	2571.50	12858.55
Ejector	0.30	-	-	-	0
Leakage	1.62	-	-	-	0
Maximum Possible Power Generation		(MW)			29.52

Scenario A: Steam Flow- During Off Season- Reference Plant

	Flow	Pressure	Temperature	Enthalpy	Power Generation
	TPH	ata	Deg C	kJ/kg	KW
At Boiler Outlet	163.93	45.00	420.00	3253.40	
HP Heater 2	0.00	-	-	-	0.00
HP Heater 1	2.00	7.85	240.00	2928.70	180.39
Deaerator	11.70	3.10	153.00	2766.00	1584.05
Condenser	149.93	0.09	43.00	2580.00	28045.24
Ejector	0.30	-	-	-	-
Maximum Possible Power Generation		(MW)			29.81

Scenario B: In scenario B, the reference plant has been designed assuming that the PP will have an equivalent steam demand in its sugar plant (110 TPH at a pressure of 2.80 ata) in the baseline case as well. However, due to the low efficiency of the boiler, the PP would have been able to generate approximately 17 MW of power. Accordingly, it is assumed that the rated capacity of the turbine in the baseline scenario would have been 17 MW.

The design has been arrived at by altering the low steam at the boiler outlet as compared to Scenario A. The off-season operation has been so designed so that the PP is able to generate 17 MW during off-season as well. Also, as is in the case of the project activity scenario, the steam generation required during the off-season reduces in the baseline scenario as well. The details of the designed reference plant are provided below in tabular format.

Scneario B: Steam Flow During Off-Season for Reference Plant

	Flow	**Pressure**	**Temperature**	**Enthalpy**	**Power Generation**
Parameter	**TPH**	**ata**	**Deg C**	**kJ/kg**	**KW**
At Boiler Outlet	95.00	45.00	420.00	3253.40	
HP Heater 2	0.00	-	-	-	0.00
HP Heater 1	2.00	7.85	240.00	2928.70	180.39
Deaerator	11.70	3.10	153.00	2766.00	1584.05
Condenser	81.00	0.09	43.00	2580.00	15151.50
Ejector	0.30	-	-	-	-
Maximum Possible Power Generation		(MW)			16.92

Scenario B: *Steam Flow- During season for Reference Plant.*

Parameter	Flow TPH	Pressure ata	Temperature Deg C	Enthalpy kJ/kg	Power Generation kW
At Boiler Outlet	117.00	45.00	420.00	3253.4	0.00
HP Heater 2	0	-	-	-	0
HP Heater 1	3	9.00	230.00	2901.9	292.92
Sugar Process	110.60	2.80	130.00	2720.50	16371.87
Condenser	1.48	0.07	38.65	2571.50	280.34
Ejector	0.30	-	-	-	0
Leakage	1.62	-	-	-	0
Maximum Possible Power Generation		(MW)			16.95

As the efficiency of the boiler is lower for the reference plant as compared to the project activity, the steam flow in case of the reference plant is higher for the reference plant. Consequently, the fuel consumption in reference plant would also be higher. A comparison of the financial returns for Scenario A and Scenario B has been undertaken which reveals that the returns in case of Scenario A is much lower (19.25%) as compared to Scenario B (48%). This lower return is due to the fact that the cost of procurement of fuel from outside sources is significantly higher as compared to the electricity generated. Hence the chosen baseline scenario for further evaluation is Scenario B as it is financially more attractive than Scenario A. The returns generated in the chosen baseline scenario, i.e Scenario B has been compared further with the returns generated in the project activity in section B.5.

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):

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As per the decision 17/cp.7 para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in absence of the registered CDM project activity. The applied methodology requires the project participant to apply the latest approved version of the "Tool for the demonstration and assessment of additionality" (Version 06.0.0) in addition to the procedure mentioned in the methodology.

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

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

The identification of the realistic and credible alternatives to the project activity, consistent with the current laws and regulations, has been detailed in Section B.4. The plausible alternatives thus identified for power, biomass and heat are provided below:

Power: P4 and P5- The installation of new power plants at the project site different from those installed under the project activity and the Generation of Power in the power grid.

Heat: H5- Generation of heat using biomass residues

Biomass: B1 and B4- Biomass residues is either dumped and left to decay aerobically or used to generate heat and power

Outcome of Step 1a: Identified realistic and credible alternative scenario(s) to the project activity

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

All the above identified scenarios are in compliance with the applicable legal and regulatory requirements.

Outcome of Step 1b: Identified realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the country and EB decisions on national and/or sectoral policies and regulations.

Step 2: Barrier Analysis

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

Detailed below are ***the proposed CDM project activity:***
The identified barrier that would prevent the implementation of the project activity in the absence of CDM is the *Lack of prevailing practice.*
The project activity involves consumption of biomass for the generation of heat and power. The heat thus generated will be used in the sugar manufacturing process. The power generated would also be used to meet the power demand of the sugar plant and the surplus power is planned to be exported to the grid. The high power generation and export to the grid has been possible due to the employment of a highly efficient technology. The boiler proposed to be implemented as a part of the project activity is a 110 kg/cm^2 pressure boiler which is a first of its kind for the state of Maharashtra, where the project activity has been implemented.

<u>Demonstration that the proposed CDM project activity is a first-of-its-kind project activity</u>

The PP has demonstrated that the proposed CDM project activity is a first-of-its-kind project activity as per "GUIDELINES ON ADDITIONALITY OF FIRST-OF-ITS-KIND PROJECT ACTIVITIES" (Version 02.0).

Identifying the applicable geographical area:

As per the Guidelines on Additionality for First of its Kind project activities, applicable geographical area covers the entire host country as a default. Project participants may provide justification that the applicable geographical area is smaller than the host country for technologies that vary considerably from location to location depending on local conditions. For the project activity, the relevant sectors identified were the renewable energy sector and the sugar sector. A review of the policies concerning these industries indicates that these sectors are governed at a state level and hence varies considerably from state to state in India.

Sugar is one of the 15 items listed under The Essential Commodities Act, 1955. The said Act empowers the state government to control production, supply, distribution, prices etc of sugar. State governments may also chose to provide varying levels of encouragement of the sugar industry by providing rebates and funding options for such projects. As the price of sugar and the Minimum Support Price to be paid to the farmers is controlled by the state government, the state government policies have varying degree of impact on the sugar industry. Consequently, the access to funds, investment choices made by the sector and the return on investment from the sector vary from state to state. Also, the promotion of renewable energy is entrusted to state the level agencies. The state regulatory commissions fix the tariff paid to the sugar companies for generating power from bagasse based plants based on various assumptions like cost of operations, price of fuel, return on equity which is likely to vary from state to state. Hence, making an investment choice would depend on the policies provided in the state. .

As can be seen from the above, the state of both sugar industry as well as the renewable energy industry is governed by the state government's policies. The policies and the conditions in the state of Maharashtra are significantly different from the other sugar producing states in the country. Hence, for the purpose of the analysis, the state of Maharashtra has been considered as the applicable geographical area.

As the industry in general is controlled by the state government and the use and promotion of renewable energy is also managed at a state level, the region for the 'First of its Kind' assessment has been selected as the state where the project activity has been implemented, i.e. Maharashtra.

As per paragraph 2 of the guidance, the project activity involves the implementation of a high pressure boiler and the baseline involves the implementation of a low pressure boiler with lower efficiency. The proposed CDM project falls under the category 2(b) as mentioned in the guidance *"(b) Switch of technology with or without change of energy source (including energy efficiency improvement)"*.

As per paragraph 3 of the guidance, output involves the co-generation of thermal and electrical energy.

The proposed CDM project activity is the first instance of the implementation of the particular technology in the identified geographical region. No other projects, including CDM projects, employ a high efficiency boiler with pressure of 110 kg/cm^2. The prevailing trend in the sector is the setting up of low efficiency boilers, typically 21 kg/ cm^2, 45 kg/ cm^2 or 67 kg/ cm^2 pressure boilers. The proposed technology is different from the prevailing technologies in terms of its superior efficiency by utilizing bagasse/ biomass in a 110 kg/cm^2 pressure boiler for the first time in the identified geographical region.

As per paragraph 5(a) of the guidance, a study of the boiler configurations in the sugar industry in the state of Maharashtra was undertaken. All of the identified plants were compared with the project activity irrespective of whether they were CDM registered or not. The analysis revealed that all of these plants produced steam at a pressure lower than 110 kg/cm^2. No plant was generating power at a pressure of 110 kg/cm^2, as the project activity was able to. Hence, it was concluded that the project is a first of its kind and the conclusion is in line with the applicable guidelines.

As per paragraph 5(b) of the guidance, the project participant has selected a fixed crediting period of 10 years duration with no option of renewal.

Therefore, as per paragraph 6 of the guidance, the project can be concluded to be additional.

Outcome of Step 2a

The identified barrier is lack of prevailing practice.

Sub Step 2b: ***Eliminate alternative scenarios which are prevented by the identified barriers***

The above listed barriers prevent the implementation of the project activity in the absence of CDM. However, these barriers do not prevent the implementation of the identified baseline scenario, i.e., implementation of a reference plant with low efficiency, as it is the most common practice followed by the industry.

Outcome of Step 2b:

The list of alternative scenarios that are not prevented by the prevailing practice barrier

For Power:

P5: The generation of heat in a new cogeneration plant at the project site
P7: The generation of power in the power grid.

For Heat:
H5: The generation of heat in a new cogeneration plant at the project site;

For Biomass:
B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.
B4: The biomass residues are used for power or heat generation at the project site in new and/or existing plants

Thus, the only remaining alternative for the project is the implementation of a baseline reference plant with a lower efficiency.

As per the applied methodology, if there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario. From the above discussion it can be concluded that the baseline for the project would be the implementation of the baseline reference plant with lower efficiency.

Step 3: Investment Analysis

In order to demonstrate the additionality, an Investment Analysis has been conducted between the identified baseline scenario and the project activity scenario without CDM. The list of assumptions used for the investment comparison analysis between the baseline reference plant and the project activity plant has been provided in Appendix A. The reference plant design parameters as been detailed in Section B.4

This step has been implemented following the guidance provided in Step 2 of the latest version of the "Tool for the demonstration and assessment of additionality".

Sub-step 3a: Determine appropriate analysis method

As per paragraph 19 if the "GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS", Version (05, EB 62), *"If the proposed baseline scenario leaves the project participant no other choice* *than to make an investment to supply the same (or substitute) products or services, a benchmark analysis is not appropriate and an investment comparison analysis shall be used. If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate."*

In the proposed CDM project activity, the project participant has identified a reference co-generation plant that would have been set up in the absence of the project activity. Therefore, even in the absence of the proposed CDM project, the project participant would have made an investment to set up the baseline reference plant. Therefore, as per the guidance, benchmark analysis has not been considered appropriate and the project participant has demonstrated additionality through investment comparison analysis.

Sub-step 3b: As the project participant has chosen investment comparison analysis to demonstrate the additionality, Option II under the tool is applicable.

The proposed CDM project activity involves the setting up of a biomass based co-generation plant that would meet the captive thermal and electrical energy requirements at the project site. The project activity also includes a source of revenue through sale of power to the regional grid. Therefore, in the context of decision making and for demonstration of additionality, Internal Rate of Return (IRR) has been used as the financial indicator.

Sub-step 3c: Calculation and comparison of financial indicators

Based on the listed set of the assumptions, the IRR for the project activity works out to be 30.94% while the IRR for the reference plant works out to be 48.86%. Thus, in the absence of CDM, the project participant could have opted to setup the low efficiency reference plant. However, considering the additional revenues that could be generated through the sale of CERs, the PP has decided to proceed ahead with the implementation of the project activity.

Sub-step 3d: Sensitivity analysis

The key parameters which are likely to impact the IRR are a) the Project cost, b) Cost of biomass, NCV of biomass, c) Plant Load Factor and d) Efficiency for the reference plant and the project activity power plant. The result of +/- 10% variation in the project cost on the IRR is provided in tabular format below:

Parameter	IRR of Reference Plant	IRR of Project Plant
10% Increase in Project Cost	44.22%	27.41%
10% Decrease in Project Cost	54.36%	35.25%
10% Decrease in Cost of Biomass	49.80%	32.33%
10% Increase in Cost of Biomass	47.90%	29.51%
100% Decrease in Tariff Escalation	48.79%	30.70%
100% Increase in Tariff Escalation	48.92%	31.18%
10% Decrease in PLF	43.82%	25.93%
10% Increase in PLF	53.73%	35.59%
10% Decrease in NCV of Biomass	47.80%	29.34%
10% Increase in NCV of Biomass	49.71%	32.20%

10% Increase in Steam to Fuel Ratio	54.40%	34.87%
10% Decrease in Steam to Fuel Ratio	41.59%	25.56%

As can be seen from the above table, even with a variation ± 10%, in all the key parameters, the IRR for the project plant remains below that of the reference plant. The only identified case wherein the IRR for the reference falls below that of the project plant is when the steam to fuel ratio for the reference plant reduces to 2.14. However, this scenario is unrealistic. Thus it may be concluded that the project activity is financially less attractive as compared to the reference plant. However, the project participant has decided to proceed ahead with the implementation of the project considering CDM funds.

Outcome of Step 3: As per the sensitivity analysis, it is concluded that the proposed CDM project activity is not the most financially/economically attractive option for the project participant.

Step 4: Common Practice Analysis

This step will justify whether "If similar activities to the proposed project activity are identified, then compare the proposed project activity to the other similar activities and assess whether there are essential distinctions between the proposed project activity and the similar activities".

The common practice analysis has been conducted as per the guidance provided in "GUIDELINES ON COMMON PRACTICE (Annex 12, EB 63).

Step 1: ***Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.***

The proposed CDM project activity is a 30 MW bagasse based cogeneration plant. As per the requirement of step 1, the applicable output range works out to ±50% of the rated output of the project plant (30 MW). The applicable output range, is therefore, 15 MW – 45 MW.

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities shall not be included in this step

Selection of applicable geographical area: For the proposed CDM project activity, the project participant has considered that state of Maharashtra as the applicable geographical area. Sugar is one of the 15 items listed under The Essential Commodities Act, 1955. The said Act empowers the state government to control production, supply, distribution, prices, etc of sugar. Also, the promotion of renewable energy is entrusted to state nodal agencies as well, which in case of Maharashtra is the Maharashtra Energy Development Agency (MEDA). As the industry in general is controlled by the state government and the use and promotion of renewable energy is also managed at a state level, the region for the common practice analysis assessment has been selected as the state where the project activity has been implemented, i.e. Maharashtra.

The list of projects that started commercial operation before the start date of the project includes[4]:

Sr. No.	Name of the Project	Location	Installed Capacity (In MW)	Boiler specification	Date of Commissioning	Remarks
1	M/s. Jawahar SSKL,Kolhapur	Kolhapur	27	45 kg/cm^2 21 kg/cm^2	23.11.2001	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
2	M/s.Kay Pulp & Pap. Mills Ltd.,Satara	Satara	6.00	45 Kg/cm^2	11.1.2002	Boiler(s) of 45 kg/cm2 or lesser pressure have been installed
3	M/s Terna SSK Ltd. Dhoki, Osmanabad	Osmanabad	14.00	45 kg/cm^2	13.12.2002	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
4	M/s Adinath SSK Ltd, Solapur	Solapur	6.00	45 kg/cm^2	01.02.2003	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
5	M/s Jawahar SSSK Kolhapur	Kolhapur	3.00	20 Kg/cm^2	27.8.2004	Boiler(s) of 20 kg/cm2 or lesser pressure have been installed
6	M/s Rajarambapu Patil SSKL (W) Sangli	Sangli	12.00	45 kg/cm^2	11.11.2006	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
7	M/s Kisanveer SSKL Bhuinj (NCNQ)	Satara	2.00	21 kg/cm^2	17.03.2006	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
8	M/s Pandurang SSK, Solapur	Solapur	9.00	67 kg/cm^2	22.06.2006	Set up considering CDM funds[5]
9	M/s Mula SSK,Ahemadnagar	Ahmednagar	16.00	67 kg/cm^2	28.11.2006	Set up considering CDM funds[6]
10	M/s Bhimashankar SSK, Pune	Pune	6.00	45 kg/cm^2	04.01.2007	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
11	M/s Purna SSK, Hingoli (NCNQ)	Hingoli/Parbhani	1.50	21 kg/cm^2	02.02.2007	Boiler(s) of 21kg/cm2 or lesser pressure have been installed
12	M/s.Purti Sakhar Karkh. Ltd. ,Bela,Umred NGP.	Bela Umred	22.00	67 kg/cm^2	18.3.2007	-Set up considering CDM funds
13	M/s Kukdi SSKL, Ahmednagar (NCNQ)	Ahmednagar	2.00	46 kg/cm^2	18.06.2007	Boiler(s) of 46 kg/cm2 or lesser pressure have been installed
14	M/s Dhyaneshwar SSK A'Nagar	Ahmednagar	12.00	66 kg/cm^2	31.07.2007	Set up considering CDM funds
15	M/s Loknete Baburao Patil SSKL Solapur	Solapur	8.00	46 kg/cm^2	14.12.2007	Boiler(s) of 46 kg/cm2 or lesser pressure have been installed

[4] As provided by Office of the Commissioner, Sugar (Maharashtra)

[5] http://cdm.unfccc.int/Projects/DB/BVQI1142341690.23/view

[6] http://cdm.unfccc.int/Projects/Validation/DB/VLZZ10NYTVNGI05O53V73IHNLTM3TY/view.html

16	M/s Vitthalrao Shinde SSK, Solapur	Solapur	10.50	45 kg/cm^2	26.01.2008	Boiler(s) of 45 kg/cm2 or lesser pressure have been installed
17	M/s Vighanahar SSK, Pune (6+12)	Pune	12.00	45 kg/cm^2 + 67 kg/cm^2	23.12.2005	Information not available.
18	Dr B. Ambedkar SSKL Osmanabad	Osmanabad	16.00	45 kg/cm^2	May 2007	Boiler(s) of 45kg/cm2 or lesser pressure have been installed
19	M/s Sharad SSKL Osmanabad	Kolhapur	2.00		15.01.2008	Information not available.
20	M/s Chhatrapati Sahu, Kolhapur	Kolhapur	12.50	67 kg/cm^2	15.03.2008	Set up considering CDM funds[7]
21	M/s Yash Agro Energy Pvt. Ltd. NGP.	Chimur	8.00	86 Kg/cm^2	Commissioned 2008	Set up considering CDM funds[8]

Therefore, $N_{all} = 21$

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}

Within the plants identified in Step 2, all the identified plants apply technologies that are different from the technology applied in the proposed CDM project activity. The list of projects represents facilities that have installed 21 kg/ cm^2, 45 kg/ cm^2 or 67 kg/ cm^2 pressure boilers, which are different from the technology in the proposed project.

Therefore, $N_{diff} = 21$

Step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity

$$\mathbf{F = 1\text{-}21/21 = 1\text{-}1 = 0}$$

The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3.

As F = 0 (<0.2), the proposed project activity is not a common practice in the sector in the applicable area.

[7] http://cdm.unfccc.int/Projects/DB/SGS-UKL1187609119.78/view

[8] http://cdm.unfccc.int/Projects/Validation/DB/QLOXHSC8ION5KEX6A4TNUNW3FURHLY/view.html

A review of the operational sugar plants reveal that the common practice in the region is to set up cogeneration plants with low pressure boilers. The most common configuration is setting up of boilers with 45 kg/cm^2 pressure or lesser. No activities similar to the project activity, ie. High pressure Boilers with 110kg/cm^2 pressure has been observed. Therefore there is no scope of comparison with similar activities. Hence the proposed project activity is additional.

Chronology of events

Provided below is the chronology of events for securing CDM status for the project:

Events related to implementation of project	Date (dd/mm/yy)	Events related to securing CDM status for the project
Board Decision to implement the project considering CDM funds (CDM Consideration and Investment Decision)	04/04/2008	Board Decision to implement the project considering CDM funds
	15/05/2008	Appointment of CDM consultant (Real/ Continuous Action)
Placement of Purchase Order for Turbine &Boiler (Start Date of the project)	11/06/2008	
	17/11/2008	Presentation to the DNA for Host Country Approval
	05/11/2008	Appointment of DOE (Real/Continuous Action)
	18/12/2008	Start of Webhosting of the Project

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Emission Reductions would be calculated using the following formula:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(1)}$$

Where,

ER_y	=	Emissions reductions in year *y* (tCO_2)
BE_y	=	Baseline emissions in year *y* (tCO_2)
PE_y	=	Project emissions in year *y* (tCO_2)
LE_y	=	Leakage emissions in year *y* (tCO_2)

<u>Calculation of Baseline Emissions:</u>

Baseline Emissions are to be calculated using the following formula:

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min(EF_{EG,GR,y}, EF_{EG,FF,y}) + BE_{BR,y} \quad \textbf{(2)}$$

Where,

BE_y	=	Baseline emissions in year *y* (tCO_2)
$EL_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year *y* (MWh)
$EF_{EG,GR,y}$	=	Grid emission factor in year *y* (tCO_2/MWh)
$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year *y* (GJ)
$EF_{FF,y,f}$	=	CO_2 emission factor for fossil fuel type f in year *y* (tCO_2/GJ)
$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity generation in the grid or on-site in year *y* (MWh)
$EF_{EG,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year *y* (tCO_2/MWh)
$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year *y* (tCO2e)
y	=	Year of the crediting period
f	=	Fossil fuel type

The proposed CDM project activity involves the implementation of a biomass based co-generation project at the project site. The project site is a sugar factory and the steam from the co-generation plant is required to meet the process steam requirement of the sugar plant during the season. During the off-season however, the sugar plant is not operational and therefore, there is no process steam requirement. Therefore, the mode of operation of the heat engine is co-generation mode during the season and power only mode during the off-season. Therefore, the approach for estimation of baseline emissions is different for the season and off-season periods. The same have been explained below:

<u>During Season</u>

Step 1: Determine Biomass availability, generation and capacity constraints, efficiencies and power emission factors

Step 1.1. Determine total baseline process heat generation:

The process heat requirement arises for the operation of the 6000 TCD sugar plant. As the capacity of the sugar mill remains the same both in the baseline and in the project activity, the steam demand in the baseline would also be the same as in the project activity.

During the crediting period, the heat consumption would be calculated as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies would be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.[9] The process heat would be calculated net of any parasitic heat used for drying of biomass, i.e, any additional heat that may be consumed for drying of the biomass would also be deducted while determining the process heat generation. The assessment has been based on the assumption that, similar to the project activity, the baseline also involves a single header

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[9] Heat supplied during the project activity to a district heating system shall count as process heat and be included in the process heat.

For ex ante estimation of the heat demand, the data has been sourced from the Detailed Project Report. The total steam demand in the baseline plant is 110.60 TPH with a pressure of 2.80 ata and Temperature of 130 Deg C.

Step 1.2 Determine total baseline electricity generation.

$$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp,y} - EL_{PJ,aux,y} \qquad \textbf{(3)}$$

Where,

$EL_{BL,y}$ = Baseline electricity generation in year *y* (MWh)
$EL_{PJ,gross,y}$ = Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
$EL_{PJ,imp,y}$ = Project electricity imports from the grid in year *y* (MWh)
$EL_{PJ,aux,y}$ = Total auxiliary electricity consumption required for the operation of the power plants at the project site in year *y* (MWh)
y = Year of the crediting period

$EL_{PJ,aux,y}$ would include the all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues and electricity required for the operation of all power or heat generating plants which are located at the project site and included in the project boundary.

Step 1.3: Determine baseline capacity of electricity generation

The total capacity of electricity generation available in the baseline needs to be calculated using the equation below:

$$CAP_{EG,total,y} = LOC_y \cdot \left[\sum_i \left(CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) + \sum_j \left(CAP_{EG,PO,j} \cdot LFC_{EG,PO,j} \right) \right]$$

Where,

$CAP_{EG,total,y}$ = Baseline electricity generation capacity in year *y* (MWh)
$CAP_{EG,CG,i}$ = Baseline electricity generation capacity of heat engine *i* (MW)
$CAP_{EG,PO,j}$ = Baseline electricity generation capacity of heat engine *j* (MW)
$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio)
$LFC_{EG,PO,j}$ = Baseline load factor of heat engine *j* (ratio)
LOC_y = Length of the operational campaign in year *y* (hour)
i = Cogeneration-type heat engine in the baseline scenario
j = Power-only-type heat engine in the baseline scenario
y = Year of the crediting period

The baseline scenario identified for the project activity would include a single Cogeneration type heat engine. No power only type heat engines have been identified. Hence, the above mentioned equation has been modified as per applicability for the project under consideration.

$$CAP_{EG,total,y} = LOC_y \cdot \left[\sum_i \left(CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) \right] \quad (4)$$

Based on the process heat requirement of the plant, the baseline cogeneration electricity capacity has been estimated as 17 MW. The detailed calculations have been provided in the attached Excel Sheet.

Step 1.4 Determine the baseline availability of biomass residues

The project activity involves the use of a high efficiency biomass based boiler while the baseline identified for the project involves the use of a low efficiency 45 kg/cm^2 boiler. The project would involve consumption of bagasse generated in house and also biomass fuel procured from outside sources. All of these biomass sources would be available for consumption in the baseline scenario as well. However, as has been established in the earlier sections, on account of the low efficiency of the boiler, consumption of the entire quantity of procured biomass would not be possible in the baseline scenario.

As per the methodology, the sum of biomass residues used in the baseline for heat generation in all heat generators shall be equal to the total amount of biomass residues which are used under the project activity and for which the baseline scenario is B4.

$BR_{B4,n,y}$ = $HC_{BL,y}$ / [Efficiency of Boiler ($\eta_{BL,HG,BR,h}$) x NCV of Biomass residues ($NCV_{BR,n,y}$)]

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

The PP has assumed the efficiency value as per Option 1, under step 1.5 of the approved methodology ACM0006 version 12.0.1.
As per Option 1, the default value under Option F in the latest approved version of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems" has to be applied.

As per the Table 1: of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems the value of 85% has been assumed as per the value of new coal fired boiler.

The default value for the losses linked to the electricity generator group (i.e. turbine/engine, couplings and electricity generator), $GGL_{default}$, is 5%.

Step 1.6: Determination of the emission factor of on-site electricity generation with fossil fuels

No fossil fuel based generation plant has been identified in the baseline scenario. Hence, this step is n ot relevant for the project activity under consideration.

Step 1.7: Determination of the emission factor of grid electricity generation

The steps to be followed for the determination of the emission factor of grid electricity generation have been detailed in Annex 3.
Step 2: Determine the minimum baseline electricity generation in the grid

The calculation of the minimum amount of electricity that would be generated in the grid in the baseline is based on the assumption that the amount of electricity generated on-site in the baseline cannot be higher than the installed capacity of power generation available in the baseline scenario. Therefore, the following equation should be used:

$$EL_{BL,GR,y} = \max\left(0, EL_{BL,y} - CAP_{EG,total,y}\right) \quad \textbf{(5)}$$

Where:

$EL_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year *y* (MWh)
$EL_{BL,y}$	=	Baseline electricity generation in year *y* (MWh)
$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in year *y* (MWh)
y	=	Year of the crediting period

Step 3: Determine the baseline biomass-based heat and power generation

Step3.1: Determine the baseline biomass-based heat generation

It is assumed that the use of biomass residues for which scenario B4 has been identified as the baseline scenario ($BR_{B4,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. From that assumption, the equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) should be determined.

The amount of heat generated with biomass residues shall be calculated as per the following equations:

$$HG_{BL,BR,y} = \sum_h \sum_n BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h}$$

Subject to,

$\sum_h \sum_n BR_{B4,n,h,y} = \sum_n BR_{B4,n,y}$, i.e. the biomass residues used in each heat generator should not exceed the total amount of biomass residues available.

$\sum_n \left(BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h}\right) \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$, i.e. the heat generation in each heat generator should not exceed the total capacity of the heat generator;

Where:

$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year *y* (GJ)
$BR_{B4,n,h,y}$	=	Quantity of biomass residues of category n used in heat generator h in year *y* with baseline scenario B4 (tonne on dry-basis)
$NCV_{BR,n,y}$	=	Net calorific value of biomass residue of category n in year *y* (GJ/tonne on dry-basis)

$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator *h* (ratio)
$BR_{B4,n,y}$	=	Quantity of biomass residues of category n used in the project activity in year *y* for which the baseline scenario is B4: (tonne on dry-basis)
LOC_y	=	Length of the operational campaign in year *y* (hour)
$CAP_{HG,h}$	=	Baseline capacity of heat generator *h* (GJ/h)
$LFC_{HG,h}$	=	Baseline load factor of heat generator *h* (ratio)
y	=	Year of the crediting period
h	=	Heat generator in the baseline scenario

There is only one biomass residue fired boiler of capacity 45 TPH identified in the baseline scenario which would be used to generate the process steam to meet the demand of the reference plant.

…………………………………………(6)

Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction

There are no biomass based stand alone which have been identified in the baseline scenario. The baseline scenario involves the implementation of a biomass based cogeneration project. Hence, 100% of the heat generated in step 3.1 ($HG_{BL,BR,y}$) would be allocated to the biomass based cogeneration project.

- Calculate the amount of electricity and process heat generation based on the allocation above using the following equations:

$$EL_{BL,BR,CG,y} = \frac{1}{3.6} \cdot \sum_{i} \left(\frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \qquad \textbf{(8)}$$

$$HC_{BL,BR,CG,y} = \sum_{i} \left(\frac{HPR_{BL,i}}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \qquad \textbf{(9)}$$

Where,

$EL_{BL,BR,CG,y}$	=	Baseline biomass-based co-generated electricity in year *y* (MWh)
$\eta_{BL,EG,CG,i}$	=	Baseline electricity generation efficiency of heat engine *i* (MWh/GJ)
$HG_{BL,BR,CG,y,i}$	=	Baseline biomass-based heat used in heat engine *i* in year *y* (GJ)
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat co-generated in year *y* (GJ)
$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine *i* (ratio)
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio)
$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year *y* (GJ)
$HC_{BL,y}$	=	Baseline process heat generation in year *y* (GJ)

LOC_y = Length of the operational campaign in year *y* (hour)
$CAP_{EG,CG,i}$ = Baseline electricity generation capacity of heat engine *i* (MW)
$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio)
i = Cogeneration-type heat engine in the baseline scenario
y = Year of the crediting period

As per the applied methodology, for Case 3.21., if $HG_{BL,BR,y} = \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$, then all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines and would suffice to serve all process heat demand.

In case of the project activity, all the heat generated in the baseline using biomass residue would be used in the cogeneration type heat engine and it would suffice to serve all process heat demand. Hence, Case 3.2.1 is the case applicable for the project activity under consideration.

For such cases, it is assumed that the use of fossil fuels on-site in the baseline scenario would be uncertain (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology, particularly on the relative prices of on-site electricity generation using fossil fuels and the electricity price in the grid. In order to estimate the baseline parameters that result project participants should:

Define $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$ (10)

$EL_{PJ,offset,y} = 0$,

$FF_{BL,HG,y,f} = 0$,

Also, as per the methodology, the next step to be applied would be Step 5.

Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

The PP does not intend to claim emission reductions from uncontrolled burning or decay of biomass.

Step 6: Calculate baseline emissions

The baseline emissions would be calculated using equation No. 2 provided in the preceding section.
Project Emissions

For the purpose of determining GHG emissions of the project activity under consideration, project participants are required include the following emissions sources:

- Emissions from fossil fuel consumption at the project site for the generation of electric power and heat and for auxiliary loads related to the generation of electric power and heat;
- CO_2 emissions from grid-connected fossil fuel power plants in the electricity system for any electricity that is imported from the grid to the project site;

- CO_2 emissions from off-site transportation of biomass residues that are combusted in the project plant;
- If applicable, CH_4 emissions from combustion of biomass residues for electric power and heat generation at the project site;
- If applicable, emissions from anaerobic treatment of wastewater originating from the treatment of the biomass residues prior to their combustion.

Project emissions are calculated as follows:

$$\mathrm{PE_y} = \mathrm{PE_{FF,y}} + PE_{GR1,y} + \mathrm{PE_{TR,y}} \qquad (11)$$

Where,

PE_y	=	Project emissions in year *y* (tCO_2)
$PE_{FF,y}$	=	Emissions during the year y due to fossil fuel consumption at the project site (tCO_2)
$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (tCO_2)
$PE_{TR,y}$	=	Emissions during the year y due to transport of the biomass residues to the project plant (tCO_2)

Determination of PE_{FFy}

The latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" should be used to calculate $PE_{FF,y}$. All combustion processes *j* as described below shall be included:

- Emissions from on-site fossil fuel consumption for the generation of electric power and heat. This includes all fossil fuels used at the project site in heat generators (e.g. boilers) for the generation of electric power and heat; and
- Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power and heat.

Determination of $PE_{GR1,y}$

If electricity is imported from the grid to the project site during year *y*, corresponding emissions should be accounted for as project emissions, as follows:

$$PE_{GR1,y} = EF_{EG,GR,y} \cdot EL_{PJ,imp,y} \qquad \textbf{(12)}$$

Where:

$PE_{GR1,y}$	=	Emissions during the year *y* due to grid electricity imports to the project site (tCO_2)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year *y* (MWh)
$EF_{EG,GR,y}$	=	Grid emission factor in year *y* (tCO_2/MWh)

Determination of $PE_{TR,y}$

Emissions are calculated on the basis of distance and the number of trips (Option 1)

$$PE_{TR,y} = N_y \cdot AVD_y \cdot EF_{km,y} \qquad (13)$$

Where

$PE_{TR,y}$	=	Emissions during the year y due to transport of the biomass residues to the project plant (tCO_2)
N_y	=	Number of truck trips for the transportation of biomass during the year *y*
AVD_y	=	Average round trip distance (from and to) between the biomass residues fuel supply sites and the site of the project plant during the year *y* (km)
$EF_{km,y}$	=	Average CO_2 emission factor for the trucks measured during the year *y* (tCO_2/km)

Leakage Emissions

As per the methodology, the leakage emissions shall be calculated for biomass residues for which the identified baseline scenario is B5, B6, B7 or B8. However, these scenarios are not applicable to biomass residues included in the proposed CDM project activity. Therefore, leakage emissions are zero for the proposed CDM project activity.

During off-season

Step 1: Determine Biomass availability, generation and capacity constraints, efficiencies and power emission factors

Step 1.1. Determine total baseline process heat generation:

As for the calculations during season, the heat generation would be calculated as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies would be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.[10]

Step 1.2 Determine total baseline electricity generation.

Equation (3) as provided above shall be used to calculate the total baseline electricity generation.

Step 1.3: Determine baseline capacity of electricity generation

The baseline capacity of electricity generation shall be calculated as per the procedure mentioned above.

Step 1.4 Determine the baseline availability of biomass residues

The baseline availability of biomass residues shall be determined as per the procedure mentioned above.

"Where the baseline scenario includes the use of biomass residues for the generation of power and/or heat, the amount of biomass residues of category n that would be available in the baseline in year y ($BR_{B4,n,y}$) has to be determined.

Where the whole amount of biomass residues of one particular type and from one particular source would be used in the baseline in clearly identifiable baseline heat generators, the monitored quantities of biomass residues used in the project can be directly allocated to those heat generators in the baseline scenario."

The entire amount of biomass residues identified of each particular type and originating from one particular source (onsite and open market) is used in the single heat generator in the baseline scenario and therefore the biomass residues used in the project activity is directly allocated to the heat generator in the baseline scenario.

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[10] Heat supplied during the project activity to a district heating system shall count as process heat and be included in the process heat.

"Where one of these situations arises, the project participants should specify and justify in the CDM-PDD in a transparent manner how the relevant allocations should be made. The approaches used should be consistent with the identified baseline scenario and reflect the particular situation of the underlying project activity.

- *The sum of biomass residues used in the baseline for power or heat generation in all heat generators shall be equal to the total amount of biomass residues which are used under the project activity and for which the baseline scenario is B4"*

As detailed in the table below, as there is just one heat generator in the baselines scenario, the amount of biomass residues used in the heat generators in the baseline scenario is equal to the total amount of biomass residues which are used in the project activity for which the baseline scenario is B4.

Baseline Scenario

Total Biomass Consumption	304222

Fuel Type	In House		External		Total
	Season	Off Season	Season	Off Season	
Bagasse	179010	89046	0	0	268056
Cotton Stems	0	0	0	18083	18083
Tur Stems	0	0	0	18083	18083

	B1	B4
Bagasse	0	268056
Cotton Stems	28015	18083
Tur Stems	28015	18083

Project Scenario

Total Biomass Consumption	360252

Fuel Type	In House		External		Total
	Season	Off Season	Season	Off Season	
Bagasse	211034	57022	0	0	268056
Cotton Stems	0	0	0	46098	46098
Tur Stems	0	0	0	46098	46098

Therefore

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

The efficiency values as assumed for calculations during the season shall be used for calculations during off-season as well.

Step 1.6: Determination of the emission factor of on-site electricity generation with fossil fuels

No fossil fuel based generation plant has been identified in the baseline scenario. Hence, this step is not relevant for the project activity under consideration.

Step 1.7: Determination of the emission factor of grid electricity generation

The steps to be followed for the determination of the emission factor of grid electricity generation have been detailed in Annex 3.

Step 2: Determine the minimum baseline electricity generation in the grid
Equation (5) as mentioned above shall be used to calculate the minimum baseline electricity generation in the grid.

Step 3: Determine the baseline biomass-based heat and power generation

Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode

The amount of electricity generated shall be computed using the following equations:

$$EL_{BRL,BR,PO,y} = \sum_i HG_{BL,BR,PO,y,j} \cdot \eta_{BL,EG,PO,j} \quad \ldots\ldots(14)$$

Subject to,

$$\sum_i HG_{BL,BR,PO,y,j} \leq HG_{balance,BR,PO,y} \quad \ldots\ldots(15)$$

i.e. the biomass-based heat used in the heat engines should not exceed the biomass-based heat balance;

$$(HG_{BL,BR,PO,y,j} \cdot \eta_{BL,EG,PO,j}) \leq LOC_y \cdot CAP_{EG,PO,j} \cdot LFC_{EG,PO,j} \quad \ldots\ldots(16)$$

, i.e. the electricity generation in each heat engine should not exceed the total capacity of the heat engine.

Where,

$EL_{BL,BR,PO,y}$	=	Baseline biomass-based electricity (power-only) in year *y* (MWh)
$\eta_{BL,EG,PO,j}$	=	Average electric power generation efficiency of heat engine j (MWh/GJ)
$HG_{BL,BR,PO,y,i}$	=	Baseline biomass-based heat used in heat engine *j* in year *y* (GJ)
$HG_{balance,BR,PO,y}$	=	Baseline biomass-based heat balance after cogeneration in year y (GJ)
LOC_y	=	Length of the operational campaign in year *y* (hour)
$CAP_{EG,PO,i}$	=	Baseline electricity generation capacity of heat engine *j* (MW)

$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio)

Further, as per case 3.3.1.,

Case 3.3.1: If $EL_{balance,PO,y} \geq EL_{BL,BR,PO,y}$, the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario. In that case:

- Define $EL_{BL,FF/GR,y} = EL_{balance,PO,y} - EL_{BL,BR,PO,y}$, $EL_{PJ,offset,y} = 0$, $FF_{BL,HG,y,f} = 0$………(17)

The next step after 3.3.1 is step 5 as per the methodology.

Step 1: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

The PP does not intend to claim emission reductions from uncontrolled burning or decay of biomass.

Step 6: Calculate baseline emissions

The baseline emissions would be calculated using equation No. 2 provided in the preceding section.

Project Emissions

The procedure for calculation of project emissions during the off-season shall be as per the procedure followed for project emissions during the season.

Leakage Emissions

As per the methodology, the leakage emissions shall be calculated for biomass residues for which the identified baseline scenario is B5, B6, B7 or B8. However, these scenarios are not applicable to biomass residues included in the proposed CDM project activity. Therefore, leakage emissions are zero for the proposed CDM project activity.

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

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential for CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values has been used
Any comment:	-

Data / Parameter:	Biomass residues consumption in the baseline scenario
Data unit:	Metric Tonnes
Description:	Biomass residues categories and quantities used for the selection of the baseline scenario selection and assessment of additionality
Source of data used:	Reference Plant Design
Value applied:	The types of biomass estimated to be used in the baseline are 1. The Bagasse consumption in the baseline would have been 268056 MT: It would have been procured from in-house sugar plant and would be used in the reference plant for cogeneration of heat and power. In the project scenario as well, the bagasse would be consumed in the project plant 2. The Cotton stalk consumption in the baseline would have been 46094 MT: It would have been procured from outside plant and would have been used in the reference plant for cogeneration of heat and power. In the project scenario as well, the cotton stalks would be consumed in the project plant. 3. The Tur stalk consumption in the baseline would have been 46094 MT: It would have been procured from outside plant and would have been used in the reference plant for cogeneration of heat and power. In the project scenario as well, the tur stalks would be consumed in the project plant
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on the reference plant design which has been detailed in Section B.4.
Any comment:	-

Data / Parameter:	$CAP_{HG,h}$
Data unit:	GJ/h
Description:	$CAP_{HG,h}$ = Baseline capacity of heat generator h (GJ/h)
Source of data:	Reference plant design parameter
Value applied	380.6748 GJ/h
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been sourced from the Reference Plant designed for the project activity. The basis for the reference plant design has been detailed in Section B.4
Any comment:	Calculated based on the generation capacity of the boiler (117 TPH) and the enthalpy of the steam produced (3253.4 kJ/kg)

Data / Parameter:	$CAP_{EG,CG,i}$
Data unit:	MW
Description:	Baseline electricity generation capacity of heat engine i (MW)
Source of data:	Reference plant design parameter

Value applied	17
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been sourced from the Reference Plant designed for the project activity which has transparently been explained in Section B.4 of the PDD.
Any comment:	-

Data / Parameter:	$LFC_{HG,h}$
Data unit:	Ratio
Description:	Baseline load factor of heat generator h (ratio)
Source of data:	Reference plant design parameter
Value applied	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been sourced from the Reference Plant designed for the project activity which has transparently been explained in Section B.4 of the PDD.
Any comment:	-

Data / Parameter:	$HPR_{BL,i}$
Data unit:	Ratio
Description:	Baseline heat-to-power ratio of the heat engine *i* (ratio)
Source of data:	Reference plant design parameter
Value applied	4.08
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been sourced from the Reference Plant designed for the project activity which has transparently been explained in Section B.4 of the PDD.
Any comment:	-

Data / Parameter:	$LFC_{EG,CG,i}$
Data unit:	Ratio
Description:	$LFC_{EG,CG,i}$ = Baseline load factor of heat engine i (ratio)
Source of data:	On-site measurements or reference plant design parameters
Value applied	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been sourced from the Reference Plant designed for the project activity which has transparently been explained in Section B.4 of the PDD.

Any comment:	---

B.6.3. Ex-ante calculation of emission reductions:

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Baseline Emissions (BE_y)

<u>Season</u>

Step 1: Determine Biomass availability, generation and capacity constraints, efficiencies and power emission factors

Step 1.1. Determine total baseline process heat generation:

The amount of process heat that would be generated in the baseline in year *y* is determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators.

For On-Season
As per reference plant design,
Total steam flow rate at boiler outlet = 117 tph
Enthalpy of superheated steam at boiler outlet = 3253.3 kJ/ kg
Total enthalpy at boiler outlet = 1398 TJ
Total enthalpy of feedwater = 191 TJ
Total energy consumption for process ($HC_{BL,y}$) = 1105 TJ

There is no condensate return to the heat generators from the process and no heating is also employed in the plant for drying of biomass. So the amount of process heat generated in the baseline in year y ($HC_{BL,y}$) is determined by the difference of the enthalpy of the process heat supplied to the sugar plant – the enthalpy of the feedwater.
Also, it is assumed that the steam is supplied to the sugar plant through a single header.

Total baseline process heat generation = Total energy consumption of process less the total enthalpy of feed water = 1105 – 191 = 914 TJ

Step 1.2 Determine total baseline electricity generation.
Gross quantity of electricity generated by the project during season in year y = 29.52 MW x 170 days x 24 hours/day x 90% = 108409 MWh
Auxiliary power consumption = 10% x 108409 MWh = 10840.9 MWh
Project grid import = 0 MWh

Therefore total baseline electricity generation is the summation of gross quantity of electricity generated and project import less the auxiliary consumption

Baseline electricity generation, $EL_{BL,y}$ = 97568 MWh

Step 1.3: Determine baseline capacity of electricity generation

As per the assumptions,
Length of the operational campaign (LOC_y) = 170 * 24 hours = 4080 hours

Total capacity of electricity generation available in the baseline
$CAP_{EG,total,y}$ = 16.95 MW x 170 days x 24 hours/ day x 90% = 62223 MWh

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines
As per option 1: Default values using Option F of the latest approved version of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems
Efficiency of boiler = 85%
Losses linked to electricity generator group, GGL default = 5%

Heat to power ratio for the reference Plant = 1/3.6*baseline process heat generation/ $CAP_{EG,total,y}$ * 10 ^ 3 = 1/3.6*914/62223 * 10 ^ 3 = 4.08

Step 1.6: Determine the emission factor of on-site electricity generation with fossil fuels
No fossil fuel consumption is envisaged

Step 1.7: Determination of the emission factor of grid electricity generation

As per details provided in Annex 3, grid emission factor = 0.8049 tCO_2e/ MWh

Step 2: Determine the minimum baseline electricity generation in the grid

The calculation of the minimum amount of electricity that would be generated in the grid in the baseline is based on the assumption that the amount of electricity generated on-site in the baseline cannot be higher than the installed capacity of power generation available in the baseline scenario.

$$EL_{BL,GR,y} = \max\left(0, EL_{BL,y} - CAP_{EG,total,y}\right)$$

$EL_{BL,GR,y}$ = 97568 – 62223 = 35346 MWh

Step 3: Determine the baseline biomass-based heat and power generation

Step 3.1: Determine the baseline biomass-based heat generation

It is assumed that the use of biomass residues for which scenario has been identified as the baseline scenario ($BR_{B4,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. From that assumption, the equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) should be determined.

NCV of biomass available in house = 9.51 GJ/MT
Bagasse consumed (generated in-house) = 179010 MT

$HG_{BL,BR,y}$ = 179010 MT x 9.51 GJ/MT x 85%/1000 = 1447 TJ

$HG_{BL,BR,y}$ is calculated subject to the condition that :

- The biomass residues used in each heat generator should not exceed the total amount of biomass residues available, and:
- $\sum_{n}\left(BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h}\right) \leq LOC_{y} \cdot CAP_{HG,h} \cdot LFC_{HG,h}$
  The heat generation in each heat generator should not exceed the total capacity of the heat generator.
  Therefore min (1447, 1398) TJ

Baseline biomass based heat generation ($HG_{BL,BR,y}$) = 1398 TJ

Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction

Allocate the total biomass-based heat ($HG_{BL,BR,y}$) to the different heat engines ($HG_{BL,BR,CG,y,i}$).

As in the baseline scenario there is a single heat generator therefore:

$HG_{BL,BR,CG,y}$ = 1398 TJ

- The biomass-based heat used in cogeneration mode does not exceed the total biomass-based heat generated and;
- The process heat cogenerated should not exceed the total process heat demand;
- The electricity generation in each heat engine should not exceed the total capacity of the heat engine

Therefore;

Electricity generated by the project, $EL_{BL,BR,CG,y} = \frac{1}{3.6} * \frac{1}{(1+4.08+0.05)} * 1398 * 1000$ = 75658 MWh

In order to satisfy condition 3 stated above;

$EL_{BL,BR,CG,y}$ = min (75658, capacity of heat engine)
Therefore,
$EL_{BL,BR,CG,y}$ = 62223 MWh

Thermal energy generated by the project, $HC_{BL,BR,CG,y} = \frac{4.08}{(1+4.08+0.05)} * 1398$ = 1112 TJ

Now, as per step 3.2.1 of the methodology,

As $HC_{BL,y}$ is not equal to $HC_{BL,BR,CG,y}$ the use of fossil fuels on-site in the baseline scenario would not be uncertain

$EL_{BL,FF/GR,y}$ = 97568 – 35346 – 62223 = 0 MWh

Therefore: Baseline emissions = 35346 x 0.8049 = 28449 tCO_2e

Project emissions (PE_y)

During the season, the biomass utilized will be generated at the project site itself. Moreover, the PP does not envisage any import of electricity from the regional grid or any fossil fuel consumption. Therefore, project emissions during the time = 0 tCO_2e.

Leakage emissions (LE_y)

As per the explanation provided in section B.6.1., **Leakage emissions = 0 tCO_2e.**

<u>Off-season</u>

Baseline Emissions (BE_y)

Step 1: Determine Biomass availability, generation and capacity constraints, efficiencies and power emission factors

Step 1.1. Determine total baseline process heat generation:

As per reference plant design,
Total steam flow rate at boiler outlet = 95 tph
Enthalpy of superheated steam at boiler outlet = 3253.3 kJ/ kg
Total enthalpy generated = 1068 TJ

Total enthalpy of feedwater = 146 TJ
Total enthalpy change during off season = 1068 – 146 = 923 TJ

Total energy consumption for process $HC_{BL,y}$ = 0
As there is no process requirement during off season
Therefore; total baseline process heat generation is 0 TJ

Step 1.2 Determine total baseline electricity generation.
Gross quantity of electricity generated by the project during season in year y = 29.81 MW x 160 days x 24 hours/day x 90% = 103022 MWh
Auxiliary power consumption = 10% x 103022 MWh = 10302.2 MWh
Project grid import = 0 MWh
Baseline electricity generation, $EL_{BL,y}$ = 92720 MWh

Step 1.3: Determine baseline capacity of electricity generation
As per the assumptions,

$CAP_{EG,total,y}$ = 16.92 MW x 160 days x 24 hours/ day x 90% = 58461 MWh

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

$\eta_{BL,EG,PO,j}$ = total actual power generated / balance enthalpy / 1000 = 16.92 * 160 * 24 * 90% / 895 / 1000
Efficiency of power generation = 0.06533 MWh/ GJ

Step 1.7: Determination of the emission factor of grid electricity generation

As per details provided in Annex 3, grid emission factor = 0.8049 tCO_2e/ MWh

Step 2: Determine the minimum baseline electricity generation in the grid

$EL_{BL,GR,y}$ = 92720 – 58461 = 34258 MWh

Step 3: Determine the baseline biomass-based heat and power generation

Step 3.1: Determine the baseline biomass-based heat generation

Total Bagasse consumed (internal) = 89046 MT
Total biomass consumed (external) = 36166 MT

Total energy generated by using biomass residues, $HG_{BL,BR,y}$

$HG_{BL,BR,y}$ = (89046*9.51 + 36166*12.56) * 85% / 1000 = 1106 TJ

Total capacity of heat generator = 1068 TJ

($HG_{BL,BR,y}$) = min (1106,1068) = 1068 TJ

Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode

$HG_{Balance,BR,PO,y} = HG_{BL,BR,y}$

$EL_{Balance,PO,y} = HG_{Balance,BR,PO,y}$ * Average electric power generation efficiency of heat engine * 1000

$EL_{Balance,PO,y} =$ 69784 MWh

Allocating the balance of biomass-based heat ($HG_{balance,BR,PO,y}$) to the different heat engines ($HG_{BL,BR,PO,y,j}$)

$HG_{balance,BR,PO,y} = HG_{BL,BR,PO,y,j}$ as there is a single heat engine

- Biomass-based heat used in the heat engines should not exceed the biomass-based heat balance
- The electricity generation in each heat engine should not exceed the total capacity of the heat engine

$EL_{BL,BR,PO,y}$ = 1068 x 1000 x 0.06533 = 69784 MWh

$EL_{BL,BR,PO,y}$ = 69784 MWh

But capacity of heat engine 58461 MWh

Therefore $EL_{BL,BR,PO,y}$ = min (69784, 58461) MWh = 58461 MWh

As per step 3.3.1. of the methodology,

$EL_{BL,FF/GR,y}$ = 69784 – 58461 = 11323 MWh

Baseline emissions = 34258 x 0.8049 + 11323 x 0.8049 = 36687 tCO_2e

Project emissions (PE_y)

Total biomass procured externally = 92195 MT/ annum
Capacity of trucks = 10 MT
Number of trips made = (92195/10)*2 = 18439/ annum
Average distance for procurement of biomass = 50 km
Average mileage of trucks used for transportation of biomass = 4 km/L
Calorific value of diesel = 43.1 TJ/Gg
Density of diesel = 0.89 gm/ L
Emission factor of diesel = 74.1 tCO_2e/ TJ
Total emissions due to transportation of biomass = 656 tCO_2e/ annum

Further, the proposed CDM project activity does not envisage the consumption of fossil fuels or import of electricity from the NEWNE grid. Therefore, total project emissions during the off-season period = 656 tCO_2e/ annum.

Leakage emissions (LE_y)

As per the explanation provided in section B.6.1., **Leakage emissions = 0 tCO_2e.**

Now,

Total baseline emissions (BE_y) = 28449 + 36687 = 65136 tCO2e/ annum
Total project emissions (PE_y) = 656 tCO2e/ annum
Total leakage emissions (LE_y) = 0 tCO2e/ annum

Total emission reductions (ERy) = 64480 tCO2e/ annum

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

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Year	**Estimation of project activity emissions (tCO_2e)**	**Estimation of baseline emission (tCO_2e)**	**Estimation of leakage (tCO_2e)**	**Estimation of overall emission reductions (tCO_2e)**
2012- 2013	656	65136	0	64480
2013- 2014	656	65136	0	64480
2014- 2015	656	65136	0	64480
2015- 2106	656	65136	0	64480
2016- 2107	656	65136	0	64480
2017- 2018	656	65136	0	64480
2018- 2019	656	65136	0	64480
2019- 2020	656	65136	0	64480
2020- 2021	656	65136	0	64480
2021- 2022	656	65136	0	64480
Total	**6560**	65136**0**	**0**	**644800**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	Biomass residues categories and quantities used in the project activity
Data unit:	a) Biomass residues category (k): 1 Biomass residues type: Bagasse Source: On-site production Fate in the absence of the project activity: Electricity generation on-site (B4) Biomass residues use in the project scenario: Cogeneration of Power & Heat in (co-fired boiler) Quantity (MT/ annum): 211034 b) Biomass residues category (k): 2 Biomass residues type: Bagasse Source: On-site production Fate in the absence of the project activity: Electricity generation on-site (B4) Biomass residues use in the project scenario: Generation of Power

	(power only mode) Quantity (MT/ annum): 57022 c) Biomass residues category (k): 3 Biomass residues type: Cotton Stalks Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Electricity generation on-site (B4) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 18080 d) Biomass residues category (k): 4 Biomass residues type: Cotton Stalks Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Decay under aerobic condition (B1) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 14007 e) Biomass residues category (k): 5 Biomass residues type: Cotton Stalks Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Burnt without utilizing for energy purposes (B3) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 14007 f) Biomass residues category (k): 6 Biomass residues type: Tur residues Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Electricity generation on-site (B4) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 18080 g) Biomass residues category (k): 7 Biomass residues type: Tur residues Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Decay under aerobic condition (B1) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 14007 h) Biomass residues category (k): 8

	Biomass residues type: Tur residues Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Burnt without utilizing for energy purposes (B3) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 14007 i) Biomass residues category (k): 9 Biomass residues type: Bagasse Source: Off-site from biomass residue retailer Fate in the absence of the project activity: Decay under aerobic condition (B1) Biomass residues use in the project scenario: Generation of Power (power only mode) Quantity (MT/ annum): 0
Description:	
Source of data to be used:	On-site measurements
Value of data	a) Biomass residues category (k): 1 Quantity (MT/ annum): 211034 b) Biomass residues category (k): 2 Quantity (MT/ annum): 57022 c) Biomass residues category (k): 3 Quantity (MT/ annum): 18080 d) Biomass residues category (k): 4 Quantity (MT/ annum): 14007 e) Biomass residues category (k): 5 Quantity (MT/ annum): 14007 f) Biomass residues category (k): 6 Quantity (MT/ annum): 18080 g) Biomass residues category (k): 7 Quantity (MT/ annum): 14007 h) Biomass residues category (k): 8 Quantity (MT/ annum): 14007 i) Biomass residues category (k): 9 Quantity (MT/ annum): 0
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: Weight meters would be used. The dry biomass would be determined by adjusting the moisture content. The quantity shall be cross checked with the quantity of electricity and heat generated and fuel purchase receipts (wherever applicable) Monitoring frequency: Continuously Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years

QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	For biomass residues categories for which scenarios B1:, B2: or B3: is deemed a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario
Data unit:	Tonnes
Description:	a) Biomass residues category (k): 4 & 5 Quantity of available cotton stalk in the region: 91031 Quantity of cotton stalk utilized - 22758 Surplus availability – 68273 b) Biomass residues category (k): 7 & 8 Quantity of available tur stalk in the region - 190836 Quantity of tur stalk utilized - 47709 Surplus availability – 143127 c) Biomass residues category (k): 9 Quantity of available bagasse in the region - 151815 Quantity of bagasse utilized - 20837 Surplus availability – 130978
Source of data to be used:	Third party survey
Value of data	-
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$BR_{PJ,n,y}$
Data unit:	Tonnes
Description:	Quantity of biomass residues of category n used in the project activity in year y (tonnes on dry basis)
Source of data to be used:	On-site measurements

Value of data	1) Bagasse (produced in-house) – 268056 MT/ annum 2) Cotton Stalks (purchased from off-site biomass residue retailer) - 46094 MT/ annum 3) Tur residues (purchased from off-site biomass residue retailer) - 46094 MT/ annum 4)Bagasse (purchased from off-site from biomass residue retailer) – 0 MT/ annum
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: Weight meters would be used. The dry biomass would be determined by adjusting the moisture content. The quantity shall be cross checked with the quantity of electricity and heat generated and fuel purchase receipts (wherever applicable) Monitoring frequency: Continuously Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	**$BR_{B4,n,y}$**
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B4
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions	304216
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: Weight meters would be used. The dry biomass would be determined by adjusting the moisture content. The quantity shall be cross checked with the quantity of electricity and heat generated and fuel purchase receipts (wherever applicable) Monitoring frequency: Continuously Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	**$BR_{B1,n,y}$**
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B1

Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions	28014
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: Weight meters would be used. The dry biomass would be determined by adjusting the moisture content. The quantity shall be cross checked with the quantity of electricity and heat generated and fuel purchase receipts (wherever applicable) Monitoring frequency: Continuously Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	**$EF_{CO2,LE}$**
Data unit:	tCO_2/GJ
Description:	CO2 emission factor of the most carbon intensive fuel used in the country.
Source of data used:	IPCC , 2006
Value of data:	101 (Lignite most carbon intensive fuel used in the country)
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC , 2006 Default Values has been used
Any comment:	-

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	Ton/yr
Description:	Quantity of fuel type i combusted in process j during the year y

Source of data to be used:	On-site measurements
Value of data	0
Description of measurement methods and procedures to be applied:	Data Type: Measured Monitoring Procedure: Weight meter will be used. Monitoring Frequency: Continuously Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years

QA/QC procedures to be applied:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	**$BR_{TR,y}$**
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues that has been transported to the project site during the year y (tonnes of dry matter)
Source of data to be used:	On-site measurements
Value of data	92233
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: Weight meter at the plant would be used to monitor the parameter. The quantity of dry biomass would be determined by adjusting the moisture content. The quantity shall be cross checked with the quantity of electricity and heat generated and fuel purchase receipts. Monitoring frequency: Continuously aggregated monthly Calibration Frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance based on purchased quantities and stock changes.
Any comment:	-

Data / Parameter:	**$EF_{km,,y}$**
Data unit:	tCO_2/km
Description:	Average CO_2 emission factor for the trucks during the year *y*
Source of data to be used:	Sample measurements of the fuel type (Diesel), fuel consumption and distance travelled for all truck types will be taken to derive emission factor. For net calorific values and CO_2 emission factors, reliable national default values or IPCC default values shall be used, depending on the reliability and availability of information.
Value of data applied for the purpose of calculating expected emission reductions	0.000711
Description of measurement methods and procedures to be applied:	Monitoring frequency: Annually
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**$EF_{FF,y,f}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for fossil fuel type in year y
Source of data to be used:	IPCC , 2006 default emission factors (country-specific, if available)
Value of data	96.1
Description of measurement methods and procedures to be applied:	Value taken from latest IPCC guidelines.
QA/QC procedures to be applied:	Uncertainty related to the parameter is low and hence no QA/QC procedures are required.
Any comment:	-

Data / Parameter:	**$HC_{BL,y}$**
Data unit:	GJ
Description:	Baseline process heat generation in year y (GJ)
Source of data to be used:	GSEPL records
Value of data	1105000
Description of measurement methods and procedures to be applied:	<u>Data Type:</u> Calculated <u>Monitoring Procedure:</u> This parameter shall be determined as the difference of the enthalpy of the steam supplied to process heat loads in the project activity minus the enthalpy of the feed-water and condensate return to the heat generators. The respective enthalpies shall be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables shall be used to calculate the enthalpy as a function of temperature and pressure <u>Monitoring Frequency:</u> Continuously and aggregated annually <u>Data Archiving:</u> Crediting period + 2 years
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**$EL_{PJ,gross,y}$**
Data unit:	MWh
Description:	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y

Source of data to be used:	On-site measurements
Value of data	211431
Description of measurement methods and procedures to be applied:	Data Type: Measured Monitoring Procedure: Measured using calibrated electricity meters Monitoring frequency: Continuously Calibration frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales and the quantity of fuels fired
Any comment:	-

Data / Parameter:	$\mathbf{EL_{PJ,imp,y}}$
Data unit:	MWh
Description:	Project electricity imports from the grid in year y
Source of data to be used:	On-site measurements
Value of data	0
Description of measurement methods and procedures to be applied:	Data Type: Measured Monitoring Procedure: Measured using calibrated electricity meters Monitoring frequency: Continuously Calibration frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	The consistency of metered electricity generation shall be cross-checked with receipts from electricity purchases
Any comment:	-

Data / Parameter:	$EL_{PJ,aux,y}$
Data unit:	MWh

Description:	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year y.
Source of data to be used:	On-site measurements
Value of data	21143
Monitoring Frequency	Continuously, aggregated monthly
Description of measurement methods and procedures to be applied:	Data Type: Measured Monitoring Procedure: Measured using calibrated electricity meters Monitoring frequency: Continuously Calibration frequency: Yearly Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	The consistency of metered electricity generation shall be cross-checked with receipts from electricity sales and the quantity of fuels fired
Any comment:	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues and electricity required for the operation of all power plants which are located at the project site and included in the project boundary.

Data / Parameter:	**$NCV_{FF,f,y}$**
Data unit:	kcal / Kg
Description:	Net calorific value of fossil fuel type f in year y
Source of data to be used:	Plant records / IPCC default net calorific values (country-specific, if available)
Value of data	5200
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: NABL accredited Laboratories Monitoring Frequency: Once in six months Calibration Procedure: Yearly Data Archiving: Crediting Period + 2 years
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:	**$NCV_{BR,n,y}$**
Data unit:	kcal/kg
Description:	Net calorific value of biomass residue of category n in year y
Source of data to be used:	Plant records

Value of data	Bagasse: 2272 kcal/kg Biomass: 3000 kcal/ kg
Description of measurement methods and procedures to be applied:	Data Type: Measured/ estimated Monitoring Procedure: NABL accredited Laboratories Monitoring Frequency: Once in six months Calibration Procedure: Yearly Data Archiving: Crediting Period + 2 years
QA/QC procedures to be applied:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Any comment:	-

Data / Parameter:	**Moisture Content of the biomass residues**
Data unit:	% Water Content in mass basis in wet biomass residues
Description:	Moisture content of each biomass residue type k
Source of data to be used:	Laboratory test results
Value of data	0%
Description of measurement methods and procedures to be applied:	The moisture content should be monitored for each batch of biomass of homogeneous quality. The weighted average should be calculated for each monitoring period and used in the calculations
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**N_y**
Data unit:	Dimensionless
Description:	Number of truck trips for the transportation of biomass during the year y
Source of data to be used:	On-site measurements

Value of data	18447 per year
Description of measurement methods and procedures to be applied:	Data Type: Estimated Monitoring Procedure: As per the purchase records Monitoring frequency: Continuously, aggregated annually
QA/QC procedures to be applied:	Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years.
Any comment:	-

Data / Parameter:	**AVD_y**
Data unit:	Km
Description:	AVDy = Average round trip distance (from and to) between the biomass residues fuel supply sites and the site of the project plant during the year y (km)
Source of data to be used:	Records by project participants on the origin of the biomass
Value of data	100
Description of measurement methods and procedures to be applied:	Data Type: Estimated Monitoring Procedure: Distance certificate provided by supplier. Monitoring Frequency: Continuously, averaged annually. Data Archiving: Crediting period + 2 years
QA/QC procedures to be applied:	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources
Any comment:	If biomass is supplied from different sites, this parameter should correspond to the mean value of km traveled by trucks that supply the biomass plant

Data / Parameter:	**TL_y**
Data unit:	tonnes of dry matter
Description:	Average truck load of the trucks used during the year y
Source of data to be used:	On-site measurements
Value of data	10
Description of measurement methods and procedures to be applied:	Determined by averaging the weights of each truck carrying biomass to the project plant Monitoring Frequency: Continuously, aggregated annually. Data Archiving: Crediting period + 2 years

QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**LOC_y**
Data unit:	Hour
Description:	Length of the operational campaign in year y
Source of data to be used:	On-site measurements
Value of data	Season – 4080 Off – Season: 3840 Total: 7920
Description of measurement methods and procedures to be applied:	Record and sum the hours of operation of the project activity facilities during year y.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$EF_{Grid,CM,y}$
Data unit:	t CO_2 /MWh
Description:	Emission factor for the NEWNE grid
Source of data to be used:	Calculated as per the formula mentioned in PDD section B.6.1
Value of data	0.8049
Description of measurement methods and procedures to be applied:	This value is calculated using OM and BM values as per Version 2.2.1 of methodological tool to calculate the emission factor for an electricity system.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$EF_{Grid,OM,y}$
Data unit:	tCO_2 /MWh
Description:	Simple operating margin for NEWNE grid of India
Source of data to be	Latest version of the CO_2 baseline database for the Indian Power Sector

used:	published by CEA[11]
Value of data	1.0122[12]
Description of measurement methods and procedures to be applied:	This value would be taken from the 'Simple Operating Margin' (including imports) for NEWNE grid which is calculated and published by CEA in their latest version of the CO_2 baseline database for the Indian Power Sector (viz. National Data)[13]
QA/QC procedures to be applied:	-
Any comment:	It would be prudent to note that CEA would monitor the relevant parameters required to calculate the Simple Operating Margin (including imports) as per relevant equation mentioned in 'Tool to calculate the Emission Factor for an electricity system' and publish the calculated value. PP would be referring to this value for calculating the $EF_{CO2,grid,y}$

Data / Parameter:	$EF_{Grid,BM,y}$
Data unit:	t CO_2 /MWh
Description:	Build margin for NEWNE grid of India
Source of data to be used:	Latest version of the CO_2 baseline database for the Indian Power Sector published by CEA

[11] CEA - Central Electricity Authority under the Ministry of Power, Government of India

[12] Value derived from CEA database Version 04 which was available at the time of uploading the PDD for Global Stakeholder Comments on UNFCCC's website

[13] Available at http://www.cea.nic.in/

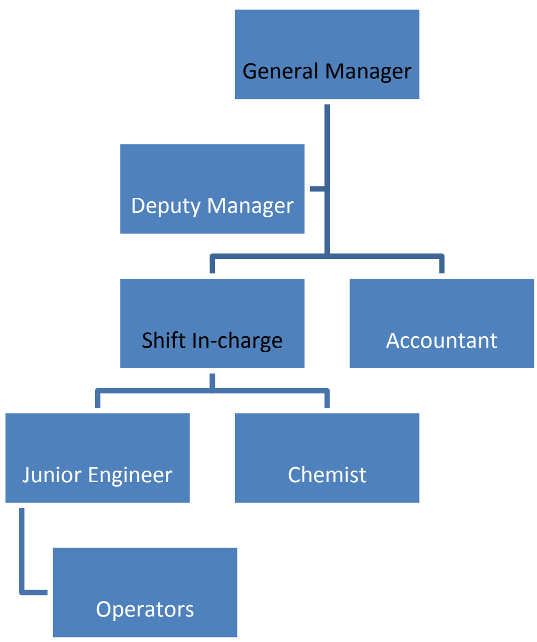
Value of data	0.5977[14]
Description of measurement methods and procedures to be applied:	This value would be taken from the 'Build Margin' (not adjusted for imports) for NEWNE grid which is calculated and published by CEA in their latest version of the CO_2 baseline database for the Indian Power Sector (viz. National Data) .
QA/QC procedures to be applied:	-
Any comment:	It would be prudent to note that CEA would monitor the relevant parameters required to calculate the Build Margin (not adjusted for imports) as per relevant equation mentioned in 'Tool to calculate the Emission Factor for an electricity system' and publish the calculated value. PP would be referring to this value for calculating the $EF_{CO2,grid,y}$

B.7.2. Description of the monitoring plan:

>>

Organization Structure

GSEPL proposes the institution a CDM cell which would be responsible for the monitoring of various parameters listed in Section B.7.1. The structure of the CDM cell is provided below:



[14] Value derived from CEA database Version 04 which was available at the time of uploading the PDD for Global Stakeholder Comments on UNFCCC's website

The General Manager (GM) of the Plant would have the overall responsibility for the implementation of the Monitoring and Verification Protocol. The Shift In-Charge would oversee the day to day implementation of the Monitoring Plan and report the operational performance of the plant to the GM on a daily basis. The Shift In-Charge would also be responsible for overseeing fuel availability for sustained operation of the plant. The Chemist would be responsible for the monitoring of the calorific value of the fuel consumed in the plant. GSEPL would also recruit adequate number of Junior Engineers for the operation and maintenance of the plant and these engineers would report on a daily basis to the Shift-In-charge. The accountant at the plant would be responsible for the maintenance of the records pertaining to invoices submitted to the state utility for the export of power and also for the quantity of fuel procured from outside sources during off-season.

Training:

GSEPL has devised an extensive operational training plan with the objective of acquainting the operators of the following

a) the nature, purpose and limitations of the plant and equipment,
b) the detailed operating instructions on each section and equipment of the plant
c) normal start up and shut down program for the unit and
d) the emergency procedures

The basis for the training shall be the plant's operating and maintenance manual Particulars book, which is compiled from the manufacturers instructions, the contract documents and the drawings,. In addition, the information gathered from the visits to the other operating plants and to the manufacturers works shall also be included in the traning. Supervisors and co-ordination of the training program requires full time attention of a senior executive of the plant and also the consultant's assistance may be taken.

The training program shall include lectures, expositions by experienced plant operators and maintenance personnel, informal discussions and visits to operating plants and manufacturer's works. Exposure to the courses conducted by institutions like Power Plant Training Institute and seminars etc could also be given to the operating and maintenance staff.

The maintenance training program would be based on the requirements of the individual maintenance functions, like mechanical, electrical, instrumentation etc. The engineers and the technicians could also be sent to the manufacturers' works to witness the generation and be associated with the erection of plant and equipment.

Emergency Preparedness

The operational staff's main task is to keep a close watch on a day to day basis on the functioning of the major equipment in the power plant. The operating staff would also document the downtime and operating hours for the major plant equipment along with the reasons for the downtime. The operating staff would summarize the logbook data on a monthly basis and report the same to the General Manager.

Additionally, it will ensure supply of sufficient quantity of critical and essential spares and consumables for the requirement of the machines. These critical and essential spares and consumables shall be stocked at the project site to reduce the machine repair downtime. A complete set of tools and tackles will be maintained at the site at the project site. The site in-charge together with the staff would ensure that periodic maintenance checks are performed on all major components. GSEPL would also maintain spare meters at the site. In case, if any of the meters are found to be providing faulty readings, they will be replaced with the spare meters. The spare meters will also be calibrated on an annual basis.

Internal Audit

GSEPL would also constitute an Internal Audit team which would be lead by the Deputy Manager. The internal auditors would verify the data monitoring, recording and archiving system of the plant. The plant performance during the audit period would also be reviewed including events of forced shutdowns and the reasons for the same. The audit team would also review the actions taken in response to such shutdowns and the adequacy of those actions to prevent future occurrences. GSEPL preparedness for possible emergencies that may arise and the implementation of the emergency preparedness plan would be reviewed. Measures and monitor actions taken against suggested recommendations during previous audits would also be verified as a part of the audit. The findings of the audit would be reported to the plant manager.

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):

>>

Date of completion: 10/01/2012

GSEPL has determined the baseline for the project activity. The entity is a project participant listed in Annex-I where the contact information has also been provided.

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:

>>
11/06/2008

(The date of placement of the purchase order for the major equipment has been considered as the start date for the project)

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

>>
20y-0m

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:

>>
15/11/2012

The crediting period would not commence prior to the registration of the project.

C.2.2.2. Length:

>>
10y-0m

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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On the basis of the environmental conditions at the proposed site and the nature of adjoining area, the project site is considered as core zone and the area lying within 10 km radius from the proposed site was considered to be the buffer zone where some impacts may be observed on physical and biological environment. At the boundary of 10 km radius circle only slight impact may be observed and that too is occasional.

The baseline data for the project site and 10 km radius area were collected in accordance with the requirement of guidelines of MOE&F. Monitoring was done during Winter Season (November 2007 – January 2008). Baseline data collected in reference to the air, water, soil and noise.

The REIA study is prepared for the core zone and area within buffer zone, the following data, through field survey and other sources are: -

- Details of fauna & flora in this region.
- Sensitive places/ historical monuments and sanctuaries.
- Land use pattern within core zone and buffer zone including the cropping pattern.
- Demography and socio-economic analysis based on last available census data for entire study area.
- Relevant meteorological data, from India meteorological department (IMD).

Identification of water bodies, hills, roads etc. and collecting data regarding discharge of streams etc. from existing records, within the study area.

The following instruments were used at the site for environmental baseline data collection work.

1. Respirable dust collector with attachment for gaseous pollutants, Envirotech APM 460.
2. Digital D.O. Meter model – 831 E.
3. WM – 25 (Wind monitoring station)
4. Dry and Wet Bulb Thermometer.
5. Sound Level Meter Model Sl – 4010
6. Anemometer Model AM – 4201

In addition to the above samples collected, the data on land use, vegetation and agricultural crops were also collected by the field team by meeting with a large number of local inhabitants in the study area and different government departments / agencies. This provided an excellent opportunity to the members of the field team for obtaining an intimate feel of the environment of the study area.

Seismicity of Area

Many parts of the Indian subcontinent have historically high Seismicity. Seven catastrophic earthquakes of magnitude greater than 8 (Richter scale) have occurred in the western, northern and eastern parts of India and adjacent countries in the past 100 years. By contrast, peninsular India is relatively less seismic, having suffered only infrequent earthquakes of moderate strength. The main seismogenic belts are associated with the collision plate boundary between the Indian and Eurasian plates. The project area is located in a low seismic risk by national standards.

Water Environment

Surface Water

Godavri River is around 8.5 km from the site in NNE direction. Water requirement of the project is proposed to be fed by Masoli Reservoir, which is 2 km away from the site. The water table in the area is about 6 m below the general ground surface. Dug well and bore wells are the main source of water in the area. The area receives an average annual rainfall of 995.85 mm. Due to the presence of established drainage network and favourable condition the natural recharge conditions are good.

During the survey samples of water within the periphery of 10 km. radius was analyzed.

Ground Water Survey

Dug wells and bore well are the major source of drinking water and for limited irrigation in the buffer zone; almost every village has got hand pumps.
Most of the villages in the study area have bore well and the residents of these villages make use of this water for drinking and other domestic uses. Therefore, bore well samples have been considered for sampling. In all 7 ground water samples were collected from different sources around the plant area within the periphery of 10 Kms. The results for the parameters are compared within standard for drinking water as IS: 10500 ‘’Specification for Drinking Water’’.
The quality of groundwater has been ascertained from the chemical analysis results of water samples collected from. The range of different chemical constituents in the ground water is given below:

Ground Water Quality

Analysis results of ground water reveal the following:-

- pH varies from 7.12 to 7.70
- Total hardness varies from 180.96 to 93.60 mg/l
- Total dissolved solid varies from 180.0 to 228.0 mg/l
- Fluoride varies from 0.29 to 1.43 mg/l

All above parameter values as per IS: 10500 standards are well within the permissible limit.

AMBIENT AIR MONITORING

To study the baseline air quality in the study area, 10 Ambient Air Quality-Monitoring (AAQM stations were selected in the study area in different directions and at varied distances from the proposed plant site keeping in view the guidelines of the Ministry of Environment and Forest, Government of India as shown in the key plan.
To establish the Ambient Air Quality, monitoring station and measurements were monitored for 3 months.
Different parameters were monitored within 10 kms Radius. The Parameters measured are Suspended Particulate Matter, Sulphur Di-Oxide and Oxide of Nitrogen. The ambient air quality monitoring for SPM, SO2, NOx were carried out for 24 hours.

Sampling Programme

As stated earlier the sampling at the above 10 stations was carried out during winter season. The sampling frequency was twice a week for 24 hours for a period of one season.
The stations are selected and located with due consideration to the meteorological conditions of the region. Major air pollutants viz, Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SOx), Nitrogen Dioxide (NOx), representing the basic air pollutants in the region were identified for Ambient Air Quality Monitoring (AAQM). The samples were collected as per the cpcb norms during study period. Gaseous pollutants viz, SO2 and NOx were collected on 8-hour basis three times a day through the respective absorbing media. SPM and RSPM were collected as 24 hours average through Wattman Glass Micro Fiber Filter Paper (GFA grade). The samples for gaseous pollutants as well as for SPM were collected as per the prescribed standard procedures.

PROCEDURE FOR DETERMINING VARIOUS AIR QUALITY PARAMETERS

Parameters	Testing Procedure
SPM & RSPM	Gravimetric Method using Respirable Dust Sampler Envirotech RDS - APM 460 IS: 5182 (Part-IV)
NOx	Absorption in dill NaOH and then estimated calorimetrically with sulphanilamide and N (I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (CPCB Method).
SO2	Absorption in Potassium Tetra Chloromercurate followed by Chlorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS: 5182 Part – II).

Result:-

Suspended Particulate Matter (SPM)

The existing SPM concentration near the project site varied from 82 µg/m3 to 155 µg/m3. In the near by area the SPM ranges from 84 µg/m3 to 161µg/m3.

It is evident from the above discussion that values of SPM concentration at most of the locations was found to be well within the limit prescribed by CPCB.

Respirable Particulate Matter (RPM)

RPM concentration near the existing site varied from 45 µg/m3 to 58 µg/m3. While the RPM concentration at all other locations varied from 38 µg/m3 to 62 µg/m3.

It is evident from the above discussion that average RPM concentration near the project site was found to be well within the limit prescribed by CPCB.

Sulphur Dioxide (SO2)

The SO2 concentration near the Existing Project Site varied from 8 to 11 µg/m3. While the maximum SO2 concentration at all other sampling locations was found to be BDL to 14 µg/m3.

It is evident from the above discussion that the SO2 concentrations were found to be well below the permissible limit of 80 µg/m3 at all the sampling locations.

Oxides of Nitrogen (NOx)

The NOx concentration near the existing Project Site varied from 12 to 17 µg/m3. While the minimum & maximum NOx concentration at all other sampling locations was found to be 8 µg/m3 to 21 µg/m3.

It is evident from the above discussion that the NOx concentrations were found to be well below the permissible limit of 80 µg/m3 at all the sampling locations.

<u>NOISE ENVIRONMENT</u>

Base Line Data

Noise often defined as unwanted sound, interferes with speech communication, causes annoyance, distracts from work, disturb sleep, thus deteriorating quality of human environment. Noise pollution survey has therefore been carried out.

Noise levels were measured near highways, residential areas and other settlements located within 10 km radius around the project site

Noise levels were measured at 6 locations in the study area to establish present scenario.

Noise monitoring data is presented in along with relevant standards given in following Table.

Average NOISE LEVEL
WINTER SEASON (Nov. 2007 to Jan. 2008)

.No	LOCATIONS	NOISE LEVEL Leq dB (A)	
		DAY TIME 06.00 am–10.00 pm	NIGHT TIME 10.00 pm–6.00 am
1.	Plant Site	50	45
2.	Isad	49	44
3.	Dangar Gaon	47	43
4.	Ukhali Khurd	51	45
5.	Khad Gaon	48	43
6.	Akoli	49	44

CPCB Noise Standards

AREA CODE	CATEGORY OF AREA	LIMITS IN Leq. dB (A)	
		DAY TIME 06.00 am–10.00 pm	NIGHT TIME 10.00 pm–6.00 am
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

SOIL ENVIRONMENT

Soil Quality and Characteristics

The information on soils has been collected from various secondary sources and also through primary soil sampling analysis of which is described in this section.

For studying the soil profile of the region, five locations including the project site were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The concentrations of physical and chemical parameters were determined. In addition to the above, information on the availability of water sources at sampling locations were also collected.

The sampling locations have been finalized with the following objectives:

- To determine the baseline soil characteristics of the study area; and
- To determine the impact of industrialization on soil characteristics.

Quality of the soil in the area is shown a marked diversity in nature depending upon the parent rock and climatic conditions prevailing in different parts of the district. The soil in the area has a property of swelling to some extent when wetted and foaming cracks, when it dries up subsequently.

Representative soil samples were collected from six different specified locations within the study area of the plant site. Standard procedures were followed for the sampling and analysis of physico – chemical parameters.

Results:-

The analysis results show that soil is Alkaline, pH value ranging from 7.30 to 7.70 with Organic Matter from 1.24 to 1.29%. Soil texture is mostly Silty Clay.

SOCIO-ECONOMIC ENVIRONMENT

Socio-economic study of an area gives an opportunity to assess the socio-economic conditions of an area. By this study, the changes likely to occur in living and social standards of the study area due to existence of Gangakhed Sugar & Energy Pvt. Ltd. can also be assessed. It can undoubtedly be said that due to the existence of this plant the gross economic production of the area will increase substantially. This plant may provide direct and indirect employment and will improve the infrastructural facilities and standards of living of the area.

An integral part of environmental study, which deals with the total environment, is socio-economic environment incorporating various facts related to socio-economic condition in the area. These includes demographic structure of the area, provision of basic amenities viz., housing, education, health and medical services, occupation, water supply, sanitation, communication, transportation, prevailing diseases, pattern as well as feature of aesthetic significance such as temples, historical monuments, etc. at the baseline level. This would help in visualizing and predicting the likely impact depending upon the nature and magnitude of the project.

The Gangakhed Sugar & Energy Pvt. Ltd. project is proposed to be generated a fair amount of direct, indirect and induced employment in the study region. The local economy is expected to receive a boost due to employee spending and services generated by Gangakhed Sugar & Energy Pvt. Ltd. The overall effect will be improved buying power of employees and thus a higher standard of living viz. better education, improved health and sanitation facilities housing and acquisition of consumer durable. This is envisaged as a major positive benefit.

Migration into the existing area or displacement of existing population is insignificant. This project does not involve any displacement of local people. Employment opportunities will improve in the nearby villages because of this proposed unit and this will provide direct employment opportunity for more than 100 persons. The unit as a responsible corporate citizen will be contributing towards social causes like health, education, and amenities for the surrounding areas.

Housing, transport, water, power supply, medical, educational and other civic amenities are not adversely affected nor appear to get affected in future. On the other hand, there is an ample employment opportunity for the local people due to the presence of GSEPL in this region.

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:

>>

The project does not result in significant environmental impact. The project participant has undertaken the EIA study for the project activity.

SECTION E. Stakeholders' comments

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

>>

Stake holders meeting on "CDM Project at Gangakhed Sugar & Energy Pvt. Ltd" was held on 25/09/2008 at the project site Village Vijaynagar- Makhani, Tal Gangakhed Dist. Parbhani, Maharashtra.

The stakeholders were invited through invitations and notices. The various stakeholders identified were

- Representatives from Village Panchayat
- Farmers
- Employees
- Officials from GSEPL
- Officials from Irrigation Department and Water Works Department
- The Villagers
- Workers

The meeting started with a welcome speech by Mr. Pradeep Kale, General Manager (Project) in Marathi (local language) giving brief idea to all participants regarding the purpose of the meeting. It was followed by an introduction of all the members present. Mr. N. R Sharma, (Chief Agricultural officer) informed all the participant about the project capacity (6000 TCD Sugar Mill, 30 MW Cogeneration plant & 60 KLPD distillery) He then explained the entire process of integrated project right from cane cutting to final product of sugar production and power generation. He informed about the possible benefit to the various stakeholder and society at large due to the project activity at GSEPL and how it would help in developing the region in terms of Education facility, Sanitation facility, Drinking water distribution, Medical facilities, Development of ancillary industries, opportunities for transporters, power availability and thereby improving the economic status of the potential stakeholders. While explaining the social benefits he informed to the stakeholders about the effect on the surrounding environment and how it would be mitigated by adapting to the "Clean Development Mechanism" (CDM).

He gave a brief talk on Climate Change, impacts of Climate Change on the environment and the Clean Development Mechanism. It was followed by a talk on the technology adopted for the project by the technical consultant. Mr Pramod Tikkas representative of Technical Advisor informed the participant to create general awareness about green house gases, sources of there production /GHG emission and possible effect on the environment, global warming and measures to mitigate the same. He informed about how the waste generated in the sugar processing is usefully utilized for power generation and thereby saving of depleting fossil fuel such as coal and oil and protecting the environment by reducing the GHG emission.

The stakeholder showed great interest and raised questions during the brief question- answer session conducted during the meeting; the excerpts of the session are summarized below:

The comments and the queries has been mentioned in the Minutes of the Stakeholder Meeting .

E.2. Summary of the comments received:

>>

The stakeholder's comments were received and recorded in writing in the form of questionnaire.
Some of the queries and the response for the comments are listed below:

1. The Village Sarpanch Mr. Uttamrao Pole raised a query on how the high pressure Boiler will help in reducing the carbon dioxide emission.The representative of the Technical Advisor Mr Pramod Tikkas informed about the boiler configuration (Low pressure 32 to 66 kg/cm^2 & 440 ^{0} C temp)adopted by the co- generators/ Sugar Mills existing in the region. He further explained about how quantity of fuel consumption reduces due to adoption of high-pressure boiler configuration (110 Kg/cm^2 pressure, 540 ^{0}C temp.) for generation of steam and power and thereby the reduction of emission for similar kind of activity.

2. Mr. Rawke employee of GSEPL asked whether CDM project activity is proven to reduce GHG emissions.

   Representative of Technical Advisor replied that there are many CDM project activities registered under the UNFCCC and is well proven globally.

3. The farmers Sh Sambhajirao Pole & Sh Ashok Murkute asked why the project is located in this area and further asked whether the smoke/ash coming out of the boiler will be hazardous to the cane farming.
   Representative of Technical Advisor replied that the project location is decided taking into consideration the ample availability of sugarcane in the region. He further informed that the project has adopted Best Available System and Technology including monitoring instruments and ESP which will monitor the smoke and particulate matter. He informed that the ash produced from the combustion of bagasse would be used as manure and will have no hazardous effect on cane farming.

4. Mr. Vasant Pathak Section officer (Masoli Project) asked whether there will be any contamination of ground water due to project activity and the waste generated during the process.

   Representative of the Technical Advisor Mr. Pramod Tikkas replied that 90% of the waste water generated during the sugar process will be utilized in the boiler, bagasse will be utilized in the boiler as fuel, molasses will be used as fuel in the incinerator, and waste water generated during the process will be treated in the Effluent Treatment Tank. This technology is well accepted and has proven to be one of the best in the treatment of waste water The treated water will be utilized for development of green belt inside and around the project boundary. Thus there will be zero discharge outside the project area. Hence there will be no contamination of water. .

5. Mr. B.K. Chavan (Sr. Agri. Asstt.) GSEPL asked how burning of biomass in the boiler will reduced GHG emission

   Representative of Technical Advisor Mr Pramod Tikkas replied that decaying of biomass in the field produces methane which is the main constituent of green house gases and has got high potential, 21 times potential of CO2 to cause Global warming, hence burning of biomass helps in reducing the GHG emission to a considerable extent..

6. During the meeting one of the farmer asked about how much quantity of coal will be saved against use of bagasse as fuel and further asked how many agricultural pump set will be run on the energy generated by the cogeneration project Representative of the Technical Advisor replied that more than 400 tonnes per day of coal would be saved against the use of waste bagasse and thus would be reducing the GHG emission to that extent. He further replied that the energy generated would be fed into the MSEB grid, which would definitely help in reducing the power crunch in the state.

During the question hour session Mr Pradeep Kale GM (Projects) GSEPL informed about the Tree Plantation event organized during the morning session on Sept 25, 2008. It was well attended by the farmers and various govt. officials in the presence of District Collector as Chief Guest This was the initiative taken by GSEPL as an obligation towards maintaining the surrounding environment from degradation before the start of construction activity at site

At the end of the session, a questionnaire was handed over to all the participant to seek their comments about the project activity, surrounding environment and Clean Development Mechanism adopted by the project

Villagers and other stakeholder appreciated the efforts taken by officials of Gangakhed Sugar & Energy Pvt. Ltd. for arranging the stakeholders meeting and resolving their doubts. Villagers were more excited with the social benefits, education facilities, employment opportunities and improving infrastructure in the vicinity of the plant due to project activity which otherwise would have not foreseen in the near future.

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

>>

GSEPL has received all necessary approvals / clearances / permissions from various local bodies which represent the local stakeholders.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	The Gangakhed Sugar & Energy Private Limited (GSEPL)
Street/P.O.Box:	97, East high Court Road, Ramdaspeth
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URL:	
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Gutte
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding for this project activity including any funding form ANNEX 1 countries.

Annex 3

BASELINE INFORMATION

The latest data available for the financial year 2007-08 has been used for the estimation of the baseline emissions. The Central Electricity Authority (CEA) under the Ministry of Power, Government of India, has estimated the Build Margin and the Simple Operating Margin for the NEWNE grid, the details of which is available on the following website and is detailed below as well:

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

Version 4.0 of the database has been used.

Gross Generation Total (GWh)

	2005-06	2006-07	2007-08
NEWNE	470,037	499,380	531,539

Net Generation Total (GWh)

	2005-06	2006-07	2007-08
NEWNE	437,877	465,361	496,119

20% of Net Generation (GWh)

	2005-06	2006-07	2007-08
NEWNE	87,575	93,072	99,224

Net Generation in Operating Margin (GWh)

	2005-06	2006-07	2007-08
NEWNE	359,271	379,471	401,642

Net Generation in Build Margin (GWh)

	2005-06	2006-07	2007-08
NEWNE	87,764	93,524	100,707

Emission Data

Absolute Emissions Total (tCO_2)

	2005-06	2006-07	2007-08
NEWNE	368,114,047	385,643,080	406,563,416

Absolute Emissions OM (tCO_2)

	2005-06	2006-07	2007-08
NEWNE	368,114,047	385,643,080	406,563,416

Absolute Emissions BM (tCO_2)

	2005-06	2006-07	2007-08
NEWNE	59,023,383	59,042,467	60,193,616

Emission Factor

Simple Operating Margin (tCO_2/MWh) (incl. Imports)

	2005-06	2006-07	2007-08
NEWNE	1.0195	1.0083	0.9992

Build Margin (tCO_2/MWh) (not adjusted for imports)

	2005-06	2006-07	2007-08
NEWNE	0.6725	0.6313	0.5977

In accordance with the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1, EB 63), combined margin CO_2 emission factor for grid connected power generation is calculated stepwise as below:

STEP 1: Identify the relevant electricity systems.
STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3: Select a method to determine the operating margin (OM).
STEP 4: Calculate the operating margin emission factor according to the selected method.
STEP 5: Calculate the build margin (BM) emission factor
STEP 6: Calculate the combined margin (CM) emissions factor.

Step 1: Identifying the relevant electricity system

For the purpose of determining the electricity emission factors, identify the relevant **project electricity system.** As the project electricity system is completely located in the country of India, the tool is applicable to the proposed CDM project activity.

The Indian power system is divided into two independent regional grids, namely NEWNE and Southern grid. Each grid covers several states. Power generation and supply within the regional grid is managed by Regional Load Dispatch Centre (RLDC). The Regional Power Committees (RPCs) provide a common platform for discussion and solution to the regional problems relating to the grid.

Each state in a regional grid meets their demand with their own generation facilities and also with allocation from power plants owned by the central sector such as NTPC and NHPC etc. Specific quotas are allocated to each state from the central sector power plants. Depending on the demand and generation, there are electricity exports and imports between states in the regional grid. There are also electricity transfers between regional grids, and small exchanges in the form of cross-border imports and exports (e.g. from Bhutan). Recently, the Indian regional grids have started to work in synchronous mode, i.e. at same frequency.

Table: States connected to different regional grids

Regional grid	NEWNE Grid				Southern grid
	Northern	**Eastern**	**Western**	**North Eastern**	**Southern**
States	Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand	Bihar, Orissa, West Bengal, Jharkhand and Sikkim	Gujarat, Madhya Pradesh, Maharashtra, Goa and Chattisgarh	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura	Andhra Pradesh, Karnataka, Kerala and Tamil Nadu
Union Territories	Delhi and Chandigarh	Andaman-Nicobar	Daman & Diu, Dadar & Nagar Haveli	-	Pondicherry, Lakshadweep

The NEWNE grid constitutes several states including Maharashtra. These states under the regional grid have their own power generating stations as well as centrally shared power-generating stations. While the power generated by own generating stations is fully owned and consumed through the respective state's grid systems, the power generated by central generating stations is shared by more than one state depending on their allocated share. Presently the share from central generating stations is a small portion of their own generation.

Since the CDM project would be supplying electricity to the NEWNE grid, it is preferable to take NEWNE grid as the project boundary. It also minimizes the effect of inter-state power transactions, which are dynamic and vary widely. Considering free flow of electricity among the member states and the union territory, the entire NEWNE grid is considered as a single entity for estimation of baseline.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).

As per Option I provided in the Step II of the tool, only grid power plants have been included in the calculation of the grid emission factor and off-grid power plants have not been included in the project electricity system

Step 3: Selection of an Operating Margin method

The project participant wishes to use the Simple Operating Margin (OM) method for the estimation of the Operating Margin Emission Factor. The use of the Simple OM method is justified as the share of the low cost/ must run resources constitute less than 50% of the total grid generation. The data pertaining to the total grid generation and the low/cost must run resources have been included in Annex 3. The Ex post option has been chosen where in the Emission Factor would be monitored by the PP during the entire crediting period of ten years.

Step 4: Calculation of the OM according to the Simple OM method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

The data provided by the Central Electricity Authority (CEA), an official data source has been relied upon for the calculation of the OM[15]. The same has been detailed in Annex 3. The latest version of the database, Version 4.0 has been used. The OM calculations have been based upon net electricity generation and fuel consumption of each power plant.

Assumptions

The following assumptions have been made in case of unavailability of data at station level:

Net generation: In case of stations where only gross generation is available, CEA standard values for auxiliary consumption have been applied to calculate the net generation data.

GCV: Default GCV values for some thermal power stations have been used for cases where station specific data was unavailable.

The following assumptions have been in case of unavailability of data at unit level:

Net generation: The data is not monitored at a unit level and hence the following assumptions have been made

1. The auxiliary consumption (in % of gross generation) of the unit was assumed to be equal to that of the respective stations in the following cases:
   - All units of a station fall into the build margin; or
   - All units of a station have the same installed capacity; or
   - The units in the station have different capacities but do not differ with respect the applicable standard auxiliary consumption.
2. In all other cases, standard values for auxiliary consumption adopted by CEA were applied.

Fuel consumption and GCV: Fuel consumption and GCV are generally not measured at unit level. Instead, the specific CO_2 emissions of the relevant units were directly calculated based on heat rates.

Calculation Approach

The Simple OM has been calculated using the following formula:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{co_2,i,y}}{\sum_{m} EG_{m,y}}$$

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

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type i consumed by power plant / unit m in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power plant / unit m in year y (MWh)
M	=	All power plants / units serving the grid in year y except low-cost / must-run power plants / units
I	=	All fossil fuel types combusted in power plant / unit m in year y
Y	=	The three most recent years for which data is available at the time of submission of the PDD to the DOE for validation (for ex ante option)

The Operating Margin calculated works out to 1.0122

$$EF_{Grid,OM,y} = 1.0122\ tCO_2/MWh$$

Where,

$EF_{Grid,OM,y}$ is the operating margin CO_2 emission factor in year y (tCO_2/MWh)

<u>Step 5: Calculate the build margin emission factor</u>

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available and will be calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EFEL,_{m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
M	=	Power units included in the build margin
Y	=	Most recent historical year for which power generation data is available

The build margin thus calculated works out to 0.5977. Therefore,

$$EF_{Grid,BM,y} = 0.5977$$

Step 6: Calculation of the Combined Margin Emission Factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM}$$

Where,

$EF_{grid,CM,y}$ = Combine margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$ = Built margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The default values to be used for projects are

w_{OM}= 0.5 w_{BM}= 0.5

Hence, the Baseline Emission Factor is calculated as below:

$$EF_{Grid,CM,y} = w_{OM} * EF_{Grid,OM,y} + w_{BM} * EF_{Grid,BM,y}$$
$$= 0.5 * 1.0122 + 0.5 * 0.5977$$

$$= 0.8049\ tCO_2/MWh$$

Annex 4

MONITORING INFORMATION

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Appendix A
List of Assumptions for Investment Comparison Analysis

Parameter	Project Plant		Baseline Plant	
Power Plant Parameters				
Power Plant Capacity	30 MW	Detailed Project Report	17 MW	Calculated
Plant Load Factor	90%	Detailed Project Report	90%	Same as project case
No of days of operation in season for Power Plant	170 Days	Detailed Project Report	170 Days	Same as project case
No of days of operation in off season for Power Plant	160 Days	Detailed Project Report	160 Days	Same as project case
Auxiliary Consumption	10.00%	Assumed	10.00%	Same as project case
Sugar Plant Parameters				
Sugar Plant Capacity	6000 TCD	Detailed Project Report	6000 TCD	Same as project case
Bagasse to Cane to Ratio	30%	Detailed Project Report	30%	Same as project case
Gross captive consumption of sugar plant during season	5.4 MW	Detailed Project Report	5.4 MW	Same as project case
Gross captive consumption of sugar plant during off season	0.35 MW	Detailed Project Report	0.35 MW	Same as project case
Steam Requirement during Season	110.60 TPH	Detailed Project Report	110.60 TPH	Same as project case
Steam Related Parameters				
Steam to Fuel Ratio	2.61	Technology Supplier	2.4	Technology Supplier
Pressure of Steam Generated	105 kg/cm^2	Detailed Project Report	45 kg/cm^2	Common Practice
Temperature of Steam Generated	540	Steam Table	420	Steam Table
Project Cost				
Total Project Cost	16976 INR Lakhs	Detailed Project Report	7208 INR Lakhs	Based on CERC Order
% Debt	70%	Detailed Project Report	70%	Same as project case
% Equity	30%	Detailed Project Report	30%	Same as project case
Interest on Long Term Debt	14%	Detailed Project Report	14%	Same as project case
Operational Cost				

O&M Cost (as % of Capex)	4%	Detailed Project Report	4%	Same as project case
Escalation for O&M Cost	5%	Detailed Project Report	5%	Same as project case
Manpower Cost	INR 399 Lakhs	Detailed Project Report	INR 169 Lakhs	Based on Project Case
Escalation for Manpower cost	10%	Detailed Project Report	10%	Same as project case
Fuel Related parameters				
Cost of Inhouse Bagasse	INR 0	Detailed Project Report	INR 0	Same as project case
Cost of Procured Bagasse	INR 2000	Detailed Project Report	INR 2000	Same as project case
Escalation	5%	Detailed Project Report	5%	Same as project case
Calorific Value of Bagasse	2272 kcal/kg	Detailed Project Report	2272 kcal/kg	Same as project case
Calorific Value of Biomass	3000 kcal/kg	Detailed Project Report	3000 kcal/kg	Same as project case
Tariff				
For First ten years of operation	INR 4.00	Detailed Project Report	INR 4.00	Same as project case
For 11^{th} to 20^{th} Year of operation	5%	Assumed	5%	Same as project case
Tax				
Minimum Alternate Tax	11.33%	As per Income Tax Act	11.33%	As per Income Tax Act
Corporate Tax Rate	33.99%	As per Income Tax Act	33.99%	As per Income Tax Act
Tax Holiday	10 Years	As per Income Tax Act	10 Years	As per Income Tax Act
Depreciation (As per Companies Act)				
Land	0%	As per Companies Act	0%	As per Companies Act
Civil Works	3.34%	As per Companies Act	3.34%	As per Companies Act
Plant & Machinery	5.28%	As per Companies Act	5.28%	As per Companies Act
Depreciation (As per IT Act)				
Land	0%	As per Income Tax Act	0%	As per Income Tax Act
Civil Works	10%	As per Income Tax Act	10%	As per Income Tax Act
Plant & Machinery	80%	As per Income Tax Act	80%	As per Income Tax Act
Salvage Value	10%	CERC Notification 09	10%	CERC Notification 09
Savings (HT Tariff (Energy Charges)	INR/kWh 2.15	MSEDCL Tariff Booklet	2.15 INR/kWh	MSEDCL Tariff Booklet
Savings (Demand Charges)	INR 350	MSEDCL Tariff Booklet	INR 350	MSEDCL Tariff Booklet