5MW BIOMASS BASED COGENERATION PROJECT AT SAINSONS

Document Prepared by PA Research & Consultants Pvt. Ltd.

Project Title	5MW biomass based cogeneration project at Sainsons
Version	04
Report ID	MP01
Date of Issue	17/05/2021
Project ID	1547
Monitoring Period	01-January-2017 to 30-September-2020
Prepared By	PA Research & Consultants Pvt. Ltd.
Contact	317, Vardhman Star Mall Sector- 19, Faridabad- 121002 Haryana, India Ph: +91 129 4013677 E: info@pars-consultants.com W: www.pars-consultants.com

CONTENTS

1 PROJECT DETAILS 3

1.1 Summary Description of the Implementation Status of the Project 3

1.2 Sectoral Scope and Project Type 4

1.3 Project Proponent 4

1.4 Other Entities Involved in the Project 5

1.5 Project Start Date 5

1.6 Project Crediting Period 5

1.7 Project Location 5

1.8 Title and Reference of Methodology 6

1.9 Participation under other GHG Programs 6

1.10 Other Forms of Credit 6

1.11 Sustainable Development 6

2 SAFEGUARDS 7

2.3 AFOLU-Specific Safeguards 7

3 IMPLEMENTATION STATUS 8

3.1 Implementation Status of the Project Activity 8

3.2 Deviations 8

3.3 Grouped Projects 8

4 DATA AND PARAMETERS 8

4.1 Data and Parameters Available at Validation 8

4.2 Data and Parameters Monitored 12

4.3 Monitoring Plan 23

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS 23

5.1 Baseline Emissions 23

5.2 Project Emissions 28

5.3 Leakage 29

5.4 Net GHG Emission Reductions and Removals 29

APPENDIX I: CALIBRATION DETAILS 31

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity is anchored by Sainsons Paper Industries Limited (SPIL), a leading supplier and manufacturer of craft paper. The project site is in Kurukshetra, a district of Haryana state of India. The project uses biomass residue, i.e., rice husk to generate electricity. The project was a cogeneration unit with 50 TPH boiler and 5 MW turbine. The primary objective of the Project is to generate process steam and electricity for the increase capacity of the paper production plant and to reduce dependency on grid electricity which is primarily based on fossil fuels.

SPIL increased its production capacity from 150 MT/day to 225 MT/day. Thus, demand of process steam and electricity also increased from 2717 GJ/day and 114 MWH to 4,017 GJ/day and 170 MWH respectively. To fulfill this additional requirement, the cogeneration plant of 50TPH boiler and 5MW extraction-cum-condensing steam turbine with alternator was set. Major equipment of the power project comprises of 50 tonne per hour (TPH) capacity single drum travel grate type boiler. The average inflow of extraction steam is 30 tonne per hour, which is used for process steam requirement in the paper machine section. In pre project scenario the heat and power requirements were met using low-pressure boiler with 3 MW turbine (running at 90% load), wherein the remaining power is imported from grid.

The detailed specifications of Boiler and TG for the project are as below:

BOILER	
Type	Air Fluidized bed combustion (AFBC) Boiler
Pressure	65 kg/cm^2(g)
Temperature	490±5°C
Capacity	50 TPH
Fuel	Fuel firing option: Rice Husk and Coal
Efficiency	The efficiency for Rice husk 80%
Operational lifetime	20 years

TURBINE	
Type	Multistage, extraction-cum-condensing, Horizontal, Impulse type
Capacity	5 MW
Inlet steam pressure	63 kg/cm^2
Temperature	485±5°C
Gear Box Output speed	1,500 RPM

ALTERNATOR	
Rating	5 MW
Speed	1,500 RPM

Frequency	50 Hz

The 5MW turbine was successfully commissioned on 01/01/2017. the installation replaced the electricity which would have been imported from the Indian grid. During the current monitoring period i.e. from 01/01/2017 to 30/09/2020, the project has achieved 67,151 tCO_2e emission reduction by replacing grid electricity equivalent to 81,880 MWh.

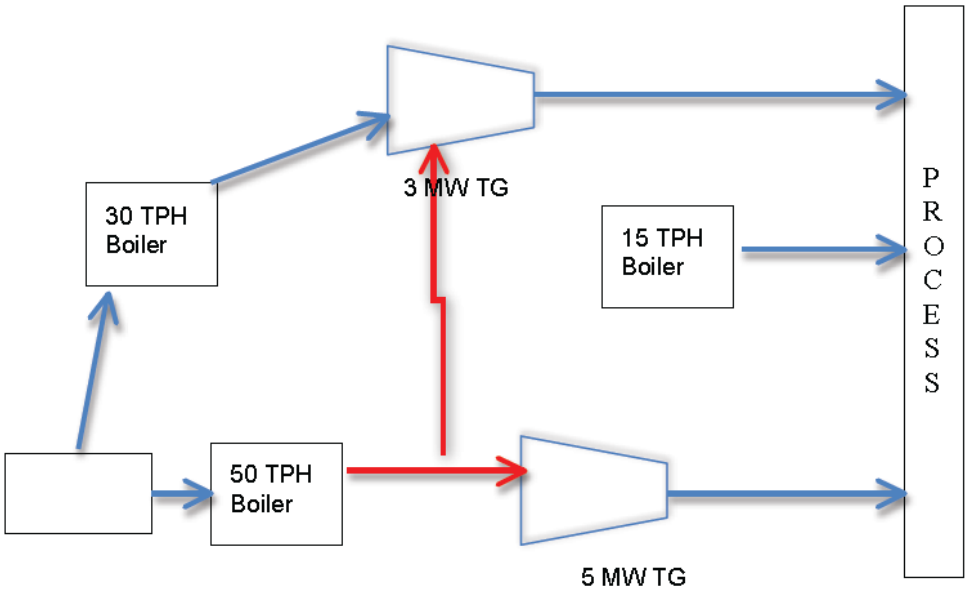

Fig. Project Scenario

1.2 Sectoral Scope and Project Type

Sectoral scope-01, Energy Industries (Renewable /non-renewable sources)

Project Type- Renewable energy

Grouped Project- The proposed project activity is not a grouped project.

1.3 Project Proponent

Organization name	Sainsons Paper Industries Limited
Contact person	Mr. H K Saini
Title	Director
Address	Plot no. 5, Vill-Bakhli (pehowa), Kurukshetra, Haryana
Telephone	--
Email	info@sainsons.net

Organization name	PA Research & Consultants Pvt. Ltd.
Contact person	Mr. Phool Chand
Title	Director
Address	317, Vardhman Star Mall, Mathura Road, Sector-19, Faridabad-121002
Telephone	+91 129 4013677
Email	info@pars-consultants.com

1.4 Other Entities Involved in the Project

N/a

1.5 Project Start Date

The project started on 01- January-2017, which corresponds to the date of commissioning of the 5MW turbine.

1.6 Project Crediting Period

Crediting Period Start Date: 1/01/2017

VCS Project Crediting Period: 10 years. This may be renewed at most twice.

1st crediting period: 01/01/2017 – 31-12-2026

The start date of the project activity was expected to start from 01/10/2016. However, the actual start date of the project is 01/01/2017. So, the start of monitoring period has been taken from 01/01/2017.

1.7 Project Location

The proposed project activity is located in Bakhli village, Pehowa Tehshil, Kurukshetra district of Haryana state of India. The Project site is well connected by district and village roads to the nearest town. The nearest railway station is Kurukshetra Junction is 30 Km away. The geographic co-ordinate of project site is provided below:

Latitude: 30° 00’ 09”

Longitude: 76° 31’ 51.44”

1.8 Title and Reference of Methodology

Title: "Consolidated methodology for electricity and heat generation from biomass residues", ACM 0006, Version: 12.1.1, EB 69

https://cdm.unfccc.int/filestorage/o/w/AL5ZOX4YCPJBM10IRGSN3DUF7E2WQT.pdf/Consolidated%20methodology%20for%20electricity%20and%20heat%20generation%20from%20biomass%20residues.pdf?t=RHI8cWt2MGZwfDDsnxUXRygCs7iC0A4UK643

The following tool have been used for the project activity under consideration –

- "Tool for demonstration and assessment of additionality", Version 7.0.0

  https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf

- "Tool to calculate the emission factor for an electricity system", Version 5.0

  https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", Version 02

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

- "Project and leakage emissions from transportation of freight"; Version 1.1

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

1.9 Participation under other GHG Programs

The project activity has not been registered, or seeking registration under any other GHG programs. The project has not participated under any other GHG program.

1.10 Other Forms of Credit

Emission trading programs: The project activity is voluntary initiative and it is not to meet any local laws or regulatory compliances. An undertaking has been submitted that PP shall not claim for GHG emission reduction credits for the given crediting period under any other emission-trading program or GHG binding limits.

Other Forms of Environmental Credit: PP declares that emission reductions generated from the project activity is not double counted (i.e. issuance of other form of environmental credit like under CDM) for the particular crediting period, which is being claimed under VCS mechanism. PP has submitted an undertaking to the VVB that they shall not claim for GHG emission reduction credits for the given period under any other emission-trading program.

1.11 Sustainable Development

Government of India has stipulated following indicators for sustainable development in the interim approval guidelines1 for CDM projects.

1. Social well-being
2. Economic well-being
3. Environmental well-being
4. Technological well-being

1. Social well-being:

The main source for this cogeneration plant is locally available agriculture waste i.e. renewable biomass. The economy of the local people improves by selling biomass to the power plant. Since the project is located in a village it assists in alleviation of poverty to certain extent by generating both direct and indirect employment in the area of skilled/unskilled jobs for regular operation and maintenance of the power plant.

2. Economic well-being:

The biomass-based cogeneration is an alternative to fossil fuel-based cogeneration plants and the decentralized power generation reduces the transmission and distribution losses. The project creates new rural income resulting from the sales of biomass fuel like agriculture waste. Increased income levels contribute to the economic safety and empowerment of the most vulnerable sections of local society.

3. Environmental well-being:

The project is using biomass for heat/power generation. There is no net GHG emission from this project activity. Combustion of biomass in the proposed project does not result in net increase in GHG emissions of CO_2. In the absence of the project activity the biomass would have been decayed in the land and would emit CH4. Hence, the project activity is also reducing CH4 emission in the atmosphere.

Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

4. Technological well-being:

The project makes use of efficient environmentally safe technology for heat/power generation with no Green House Gas (GHG) emission.

2 SAFEGUARDS

2.1 No Net Harm

As the source of electricity generation is biomass residue, i.e., rice husk residue and there is no net GHG emission from the project activity and in the absence of the project the biomass would have decayed in land to generate CH_4. Hence there is no net harm.

2.2 Local Stakeholder Consultation

As no serious breakdown or other changes happened after the commissioning, furthermore no concern raised during current monitoring period by any stakeholder, hence requirement of another stakeholder meeting was not necessary.

2.3 AFOLU-Specific Safeguards

The project activity is not an AFOLU project activity. Thus, this section is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity was commissioned on 1st January 2017. The project activity is operational since with normal O&M and there have been no instances, which may impact monitoring and emission reduction calculation for the project activity. However, the plant remained shut down for the following period of time:

- 3 days shutdown from 02/05/2018 to 04/05/2018 due to paper mill association strike.
- Shutdown from 18/06/2019 to 27/06/2019 due to Effluent treatment plant upgradation.
- Shutdown from 23/03/2020 to 14/04/2020 as government guideline during lockdown due to COVID-19 pandemic.

3.2 Deviations

2.3.1 Methodology Deviations

No deviation in the methodology has been applied to the project activity during the monitoring period.

2.3.2 Project Description Deviations

The project was not commissioned during registration of the project activity, the start date of crediting period was considered as expected commissioning date i.e. 01/10/2016 and crediting period from 01/10/2016 to 30/09/2026, however the actual commissioning further delayed and project commissioned on 01/01/2017, hence the actual crediting period starts from 01/01/2017 and crediting period is revised as 01/01/2017 to 31/12/2026, which is appropriate.

3.3 Grouped Projects

The project activity is not a group project

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Biomass categories and quantities used for the selection of the baseline scenario selection and assessment of additionality
Data unit	- Type (i.e., bagasse, rice husks, empty fruit bunches, tree bark etc.); - Source (e.g., produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, dedicated plantations etc.);

	- Fate in the absence of the project activity (scenarios B); - Use in the project scenario (scenarios P and H); - Quantity (tonnes on dry-basis)
Description	The biomass quantities provided in the VCS PD were determined ex- ante internally.
Source of data	On-site assessment of biomass residues categories and quantities according to project characteristics.
Value applied	108,000 (tonnes of Rice husk)
Justification of choice of data or description of measurement methods and procedures applied	This is the expected use of rice husk that is used in the project and that which fate in the absence of the project activity. The calculation is done on the basis of the new cogeneration plant and the estimation of ex-ante of the biomass types and quantities.
Purpose of Data	Calculation of baseline emission
Comments	--

Data / Parameter	$HC_{BR, CG/PO,x,i/j}$ ($HC_{BR,CG,x,1}$, $HC_{BR,CG,x,2}$)
Data unit	GJ
Description	Quantity of process heat extracted from the heat engine i/j in year x (GJ)
Source of data	On-site measurements as per design conditions of plant
Value applied	$HC_{BR, CG, x,1}$= 605 (3 years average) $HC_{BR, CG, x,2}$= 300 (3 years average)
Justification of choice of data or description of measurement methods and procedures applied	This parameter is calculated according to Case 1 of the Step 1.5 for the calculation of baseline emissions of the methodology ACM0006 Version 12.1.1: For heat engines with a minimum three years operational history prior to the start date of crediting period, the heat-to-power ratio should be determined as per the design conditions of the plant, for the configuration identified as baseline scenario.
Purpose of Data	Baseline emission calculation
Comments	Value is fixed ex-ante

Data / Parameter	$EL_{BR, CG/PO,x,i/j}$
Data unit	MWh
Description	Quantity of electricity generated in heat engine i/j in year x (MWh)
Source of data	Design parameter of turbine

Value applied	23,760
Justification of choice of data or description of measurement methods and procedures applied	This parameter is calculated according to Case 1 of the Step 1.5 for the calculation of baseline emissions of the methodology ACM0006 Version 12.1.1: For heat engines with a minimum three years operational history prior to the start date of crediting period, the heat-to-power ratio should be determined as per the design conditions of the plant, for the configuration identified as baseline scenario.
Purpose of Data	Baseline emission calculation
Comments	Value is fixed ex-ante

Data / Parameter	$CAP_{HG,h}$
Data unit	GJ/hour
Description	Baseline capacity of heat generator h (GJ/h)
Source of data	Baseline plant design parameters
Value applied	271.7
Justification of choice of data or description of measurement methods and procedures applied	This parameter reflects the design maximum heat generation capacity (in GJ/h) of the baseline heat generation h.
Purpose of Data	Baseline emission calculation
Comments	Value is fixed ex-ante

Data / Parameter	$CAP_{EG,CG,i}$
Data unit	MW
Description	Baseline electricity generation capacity of heat engine i (MW) (Cogeneration Mode)
Source of data	Plant record
Value applied	3
Justification of choice of data or description of measurement methods and procedures applied	This parameter is the design maximum electricity generation capacity (in MW) of the baseline heat engines (Turbine). This is based on the installed capacity of the heat engine.
Purpose of Data	Calculation of project emissions
Comments	Value is fixed ex-ante

Data / Parameter	$LFC_{HG,h}$
Data unit	Ratio
Description	Baseline load factor of heat generator h (ratio)
Source of data	On-site measurements
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	As per methodology, this parameter should reflect the maximum load factor. PP has chosen the maximum value possible i.e., 1. Hence conservative.
Purpose of Data	Calculation of project emissions
Comments	Value is fixed ex-ante

Data / Parameter	$HPR_{BL,i}$
Data unit	Ratio
Description	Baseline heat-to-power ratio of the heat engine i (ratio)
Source of data	On-site measurements or reference plant design parameters
Value applied	12.1
Justification of choice of data or description of measurement methods and procedures applied	The values have been calculated according to Step 1.5 of baseline emission calculation of the methodology ACM0006 based in reference plant parameters.
Purpose of Data	Calculation of project emissions
Comments	Value is fixed ex-ante

Data / Parameter	$LFC_{EG,CG,i}$
Data unit	Ratio
Description	Baseline load factor of heat engine i (ratio) (cogeneration Mode)
Source of data	Based on 3 years historical data
Value applied	0.8
Justification of choice of data or description of measurement methods and procedures applied	This parameter reflects the maximum load factor (i.e., the ratio between the “actual electricity generation" of the heat engine and its “design maximum electricity generation") of the baseline heat engine. Last 3 years data has been used
Purpose of Data	--
Comments	Value is fixed ex-ante

Data / Parameter	$EF_{EG,GR,y}$
Data unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y.
Source of data	Baseline CO_2 Emission Database, Version 11.0
Value applied	0.9613
Justification of choice of data or description of measurement methods and procedures applied	The emission factors in the CO_2 database of CEA are compiled specifically for application by grid-connected projects. The emission factors are consistent with Tool to calculate emission factor for an electricity system (Version 5.0)
Purpose of Data	Calculation of baseline emissions
Comments	Fixed ex-ante for entire crediting period

4.2 Data and Parameters Monitored

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	Onsite measurement
Description of measurement methods and procedures to be applied	The quantity of Rice Husk measured at the entrance-using weighbridge. Dry weight of all biomass residues subsequently determined using the biomass moisture content of the corresponding biomass type in internal laboratory and cross checked with test in third party laboratory.
Frequency of monitoring/recording	On each delivery and monthly aggregation
Value monitored	409,378.10
Monitoring equipment	Weighbridge Please refer Appendix for weighbridge details and calibrations.
QA/QC procedures to be applied	The weighbridge calibrated annually.
Purpose of the data	Calculation of project emissions
Calculation method	The moisture content in order to determine the quantity of dry biomass is determined by reputed laboratory. Data monitored continuously and aggregated as appropriate, to calculate

	emissions reductions. The weight meters have been made in installations using international standards.
Comments	--

Data / Parameter	$BR_{B4, n,y}$
Data unit	Tonne
Description	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)
Source of data	Plant record
Description of measurement methods and procedures to be applied	Calculated ex ante as per the step 1.4 of baseline emission Calculation
Frequency of monitoring/recording	Monthly
Value monitored	409,378.10
Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of the data	--
Calculation method	--
Comments	--

Data / Parameter	$EF_{ff,y}$
Data unit	tCO_2/GJ
Description	CO_2 emission factor for fossil fuel type f in year y (t CO_2/GJ)
Source of data	For the proposed project activity, the selected source is Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. To ensure conservativeness, the Project Proponent uses the values at the upper limit of the uncertainty at a 95% confidence interval.
Description of measurement methods	The Project Proponent uses IPCC default values

and procedures to be applied	
Frequency of monitoring/recording	The Project Proponent reviews the appropriateness of the data annually.
Value monitored	0.0748 (Diesel)
Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of the data	Calculation of project emissions
Calculation method	--
Comments	--

Data / Parameter	$HC_{BL,y}$
Data unit	GJ
Description	Baseline process heat generation in year y (GJ)
Source of data	Plant record
Description of measurement methods and procedures to be applied	The value is calculated based on steam generated, temperature and pressure.
Frequency of monitoring/recording	Determined ex-ante according to project configuration.
Value monitored	2017: 661,442 2018: 765,979 2019: 827,572 2020 (Jan-Sept): 651,248
Monitoring equipment	Calculated
QA/QC procedures to be applied	NA
Purpose of the data	To check energy balance
Calculation method	This parameter determined as the difference of the enthalpy of the generated in the project activity minus the enthalpy of the feedwater, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables has been used to calculate the enthalpy as a function of temperature and pressure.

Comments	--

Data / Parameter	$EL_{Gross,y}$
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 (MWh)
Source of data	Plant record
Description of measurement methods and procedures to be applied	Calibrated electricity meters, Data is monitored continuously and aggregated as appropriate, to calculate emissions reductions. The proportion of data to be monitored is 100% and the data is archived electronically. The metering system is calibrated according to the manufacturer specifications.
Frequency of monitoring/recording	Continuous monitoring, monthly recording
Value monitored	195,276
Monitoring equipment	Energy meter Serial No: XC548932 Please refer appendix for meter details and calibration
QA/QC procedures to be applied	The energy meter is calibrated annually or as per industry standard/manufacturer specification.
Purpose of the data	Calculation of baseline emissions
Calculation method	--
Comments	--

Data / Parameter	$EL_{PJ,aux}$
Data unit	MWh
Description	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year y (MWh)
Source of data	Plant record
Description of measurement methods and procedures to be applied	The auxiliary consumption is monitored using trivector energy meter. The metering system is calibrated according to the manufacturer specifications.

Frequency of monitoring/recording	Continuous, monthly recording
Value monitored	24,296
Monitoring equipment	Energy meter Serial No: 34163030581 Please refer appendix for meter details and calibration
QA/QC procedures to be applied	The energy meter is calibrated annually or as per industry standard/manufacturer specification
Purpose of the data	Calculation of baseline emissions
Calculation method	--
Comments	--

Data / Parameter	$NCV_{BR,n,y}$
Data unit	GJ/Tonne
Description	Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis)
Source of data	Onsite measurement
Description of measurement methods and procedures to be applied	Measurements carried out at reputed laboratories and according to relevant international standards. Measure the NCV on dry-basis.
Frequency of monitoring/recording	At least every six months, taking at least three samples for each measurement.
Value monitored	2017: 13.149 2018: 13.167 2019: 13.298 2020 (Jan-Sept): 13.100
Monitoring equipment	Not applicable
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.
Purpose of the data	To check the energy balance

Calculation method	--
Comments	--

Data / Parameter	$h_{LOW,y}$ $h_{HIGH,y}$
Data unit	GJ/Tonne
Description	$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes) $h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)
Source of data	Plant Record
Description of measurement methods and procedures to be applied	The specific enthalpies should be determined based on 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
Frequency of monitoring/recording	Determined ex-ante according to project configuration.
Value monitored	
Monitoring equipment	Not applicable
QA/QC procedures to be applied	--
Purpose of the data	--
Calculation method	The process heat demand side refers to where heat is finally used for heating purposes by end-users and the heat generator side refers to where heat is generated
Comments	--

	2017	2018	2019	2020 (Jan-Sept)
$h_{LOW,y}$	653.278	653.278	653.278	653.278
$h_{high,y}$	3,300.887	3,311.33	3,305.678	3,304.447

Data / Parameter	Moisture content of the biomass residues
Data unit	%
Description	Moisture content of each biomass residues type k

Source of data	Onsite measurement
Description of measurement methods and procedures to be applied	The biomass residue moisture content is monitored and registered by taking periodic samples from each biomass type flow to the power boiler. Humidity content is calculated by evaporating the water of the samples and measuring the weight before and after the water has been evaporated. This process is carried out in dedicated scales.
Frequency of monitoring/recording	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
Value monitored	
Monitoring equipment	Not applicable. Moisture content is measured locally, in reputed laboratories.
QA/QC procedures to be applied	--
Purpose of the data	To calculate dry basis weight of biomass
Calculation method	--
Comments	--

	2017	2018	2019	2020 (Jan-Sept)
Moisture Content	12.89%	12.40	12.15	11.94

Data / Parameter	LOC_y
Data unit	Hour
Description	Length of the operational campaign in year y (hour)
Source of data	Plant record
Description of measurement methods and procedures to be applied	Record and sum the hours of operation of the project activity facilities during year y.
Frequency of monitoring/recording	Continuous, monthly recording
Value monitored	

	2017	2018	2019	2020 (Jan-Sept)
Operating hours	8,239.50	8,430.00	8,289.00	5,871.00

Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of the data	Calculation of baseline emissions and project emissions
Calculation method	This estimation is based on the total available hours per month in a year, considering maintenance outages both for internal and external reasons. As a result, the yearly operating plan considers 30 days of the power plant outage in a year.
Comments	--

Data / Parameter	$FC_{i,j,y}$
Data unit	Mass or volume unit per year (L/yr.)
Description	Quantity of fuel type i combusted in process j during the year y.
Source of data	Plant record/logbook
Description of measurement methods and procedures to be applied	On-site fossil fuel consumption is calculated in this case.
Frequency of monitoring/recording	Continuously, monthly aggregation
Value monitored	
Monitoring equipment	Volume measurement
QA/QC procedures to be applied	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the emission reduction project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of the data	Calculation of project emissions
Calculation method	Diesel consumption in the power boiler: The consumption is determined by recording the purchases of diesel and the stock

	2017	2018	2019	2020 (Jan-Sept)
Diesel consumed	249	271	321	173

	differences in the diesel tank level. Diesel consumption of the front loaders: The calculation is similar to the one described above.
Comments	--

Data / Parameter	$NCV_{i,y}$
Data unit	GJ per mass or volume unit (e.g., GJ/m^3, GJ/ton)
Description	Average net calorific value of fuel type i in year y.
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Description of measurement methods and procedures to be applied	option d) (IPCC default values) in this case
Frequency of monitoring/recording	Any future revision of the IPCC Guidelines should be taken into account
Value monitored	Diesel: 43.3 GJ/ton
Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of the data	Calculation of project emissions
Calculation method	--
Comments	--

Data / Parameter	$\rho_{i,y}$
Data unit	Weighted average density of fuel type i in year y (Diesel)
Description	Weighted average net calorific value of fuel type i in year y.
Source of data	Bureau of Energy Efficiency, India Standard Value Ch-01.qxd (beeindia.gov.in)
Description of measurement methods and procedures to be applied	Not applicable, since the Project Proponent use data in line with national standard.
Frequency of monitoring/recording	Any future revision of the IPCC Guidelines should be taken into account.
Value monitored	Diesel: 0.87 kg/l

Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of the data	Calculation of project emissions
Calculation method	--
Comments	--

Data / Parameter	$EF_{CO2,i}$
Data unit	tCO_2/TJ
Description	Weighted average CO_2 emission factor of fuel type i in year y.
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG inventories
Description of measurement methods and procedures to be applied	option d) IPCC default values chosen
Frequency of monitoring/recording	Any future revision of the IPCC Guidelines should be taken into account.
Value monitored	0.0748
Monitoring equipment	---
QA/QC procedures to be applied	--
Purpose of the data	Calculation of project emissions
Calculation method	--
Comments	--

Data / Parameter	$D_{f,m}$
Data unit	Kilometer
Description	Return Distance between the origin and destination of freight transportation activity f in monitoring period m.
Source of data	Records of vehicle operator and/or records by project participants.

Description of measurement methods and procedures to be applied	Determined once for each freight transportation activity f for a reference trip using the vehicle odometer or any other appropriate sources (e.g., on-line sources).
Frequency of monitoring/recording	To be updated whenever the road distance changes.
Value monitored	100
Monitoring equipment	--
QA/QC procedures to be applied	All the suppliers are within the range of 50 KMs.
Purpose of the data	Calculation of project emissions
Calculation method	NA
Comments	--

Data / Parameter	$FR_{f,m}$
Data unit	Tonnes
Description	Total mass of freight transported in freight transportation activity f in monitoring period m
Source of data	Plant logbook
Description of measurement methods and procedures to be applied	The quantity of biomass transported measured using weighbridge installed at site on each delivery and record is maintained in log-book.
Frequency of monitoring/recording	On each delivery
Value monitored	468,486.072
Monitoring equipment	Weighbridge Please refer to appendix for details and calibrations.
QA/QC procedures to be applied	The weighbridge calibrated on annual basis.
Purpose of the data	Calculation of project emissions
Calculation method	Biomass residues from third parties are measured (weighted) using dedicated weighbridges at the entrance of the biomass power plant.
Comments	--

4.3 Monitoring Plan

The purpose of the monitoring plan is to build an internal standard and guidance for using exact and conservative data in emission reduction calculation.

This monitoring plan is developed in accordance with the modalities and procedures for small-scale CDM project activities and in line with the guidance provided in the applied methodology. The monitoring plan implemented by the project proponents, describes about overall monitoring organization, Internal reporting procedure for data collection and archiving, Calibration of measurement equipment, training procedures and internal audit procedures.

Data and parameters, which monitored under this monitoring plan as sited in 4.2 are measured and strictly monitored at the project site by means of accurately calibrated instruments.

The monitoring plan structure and the roles of the different member in the monitoring plan are explained below.

Internal reporting procedure: Technicians and operators are responsible for recording of the relevant data on plant logbooks. Shift in-charges are also responsible of QA/QC of data recorded and maintenance of logbooks and other records.

These daily records in plant logbooks are consolidated in the form of monthly GHG report by plant supervisor and is submitted to plant manager for review. The Management, who represents the overall responsibility on the project activity, is able, with this operational structure, to monitor the development of the project activity and make the relevant amendments to the process.

Director <-----Plant Manager <------ Shift In charge <------Operator

Data Collection and Archiving:

The monthly data of electricity generation, steam generation, electricity and steam consumption in process plant, fuel consumption are collected in both logbook and electronic form. However, the data in electronic form is archived throughout the lifetime of the project. The team at the site maintain the electricity records regularly. Other data variables that are most directly related to the emission reductions are collected and archived electronically. The archived data are kept for 2 years beyond the Crediting Period.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Step 1 Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors in the baseline

Step 1.1: Determine total baseline process heat generation

The amount of process heat that would be generated in the baseline in the year 2017,2018, 2019 and 2020 (January to September) ($HC_{BL,y}$) 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. The respective enthalpies have been determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam table has been used to calculate the enthalpy as a function of temperature and pressure.

Period	01/01/2017-31/12/2017	01/01/2018-31/12/2018	01/01/2019-31/12/2019	01/01/2020-30/09/2020
$HC_{BL,y}$ = Total baseline process heat generation.	661,442	765,979	827,572	651,248

Step 1.2: Determine total baseline electricity generation

According to ACM0006, the amount of electricity that would be generated in the baseline in year y is calculated as follows:

$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp\ y} - EL_{PJ,aux,y}$

As there was no electricity imported from the grid $EL_{PJ,imp,y}$ was zero.

Period	$EL_{PJ,gross,y}$ (MWh)	$EL_{PJ,aux,y}$ (MWh)	$EL_{BL,y}$ (MWh)
01/01/2017-31/12/2017	53,381	5,759	47,622
01/01/2018-31/12/2018	52,210	5,964	46,245
01/01/2019-31/12/2019	54,040	6,355	47,686
01/01/2020-30/09/2020	35,645	6,218	29,427

Step 1.3: Determine baseline capacity of electricity generation

The total capacity of electricity generation available in the baseline has been calculated using the equation below. The heat engines i and j obtained from the baseline scenario identified using the "Selection of the baseline scenario and demonstration of additionality".

$CAP_{EG,total,y} = LOC_y * \sum CAP_{EG,CG,i} * LFC_{EG,CG,i}$

Period	$CAP_{EG,total,y}$ (MWh)
01/01/2017-31/12/2017	23,760
01/01/2018-31/12/2018	23,760
01/01/2019-31/12/2019	23,760
01/01/2020-30/09/2020	17,820

Step 1.4: Determine the baseline availability of biomass residues

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

The determination of this parameter is based on the monitored amounts of biomass residues used for power and/or heat generation in the project.

Period	$BR_{B4,n,y}$ (Tonnes)
01/01/2017-31/12/2017	107,396.584
01/01/2018-31/12/2018	112,667.071
01/01/2019-31/12/2019	110,276.264
01/01/2020-30/09/2020	79,038.176

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

The values under this step are ex-ante and hence the values are same as in the registered PD.

Therefore, $HP_{RBL,CG}$ =12.1.

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

As no fossil fuel based power generation was identified as part of the baseline scenario, therefore, as per ACM0006, $EF_{EG,FF,y} = EF_{EG,GR,y}$.

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

The value is fixed ex-ante.

$EF_{EG,GR,y}$ = 0.9613 tCO_2/MWh

Kindly refer to registered PD for detailed calculation.

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:

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

Data	Value	Source
$EL_{BL,2017}$ = Baseline electricity generation in the year 2017 (MWh)	47,622	See step 1.2
$EL_{BL,2018}$ = Baseline electricity generation in the year 2018 (MWh)	46,245	See step 1.2
$EL_{BL,2019}$ = Baseline electricity generation in the year 2019 (MWh)	47,686	See step 1.2
$EL_{BL,2020\ (Jan\text{-}Sept)}$ = Baseline electricity generation in the year 2020 (Jan-Sept) (MWh)	29,427	See step 1.2
$CAP_{EG,total,2017}$ = Baseline electricity generation capacity in the year 2017 (MWh)	23,760	See step 1.3
$CAP_{EG,total,2018}$ = Baseline electricity generation capacity in the year 2018 (MWh)	23,760	See step 1.3
$CAP_{EG,total,2019}$ = Baseline electricity generation capacity in the year 2019 (MWh)	23,760	See step 1.3
$CAP_{EG,total,2020\ (Jan\text{-}Sept)}$ = Baseline electricity generation capacity in the year 2017 (Jan-Sept) (MWh)	17,820	See step 1.3

$EL_{BR,GR,2017}$ = Baseline minimum electricity generation in grid in the year 2017 (MWh)	23,862	Calculated
$EL_{BR,GR,2018}$ = Baseline minimum electricity generation in grid in the year 2018 (MWh)	22,485	Calculated
$EL_{BR,GR,2019}$ = Baseline minimum electricity generation in grid in the year 2019	23,926	Calculated
$EL_{BR,GR,2020\ (Jan\text{-}Sept)}$ = Baseline minimum electricity generation in grid in the year 2020 (Jan-Sept) (MWh)	11,607	Calculated

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 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.

As per this step all biomass based heat was used and there still remains process heat demand to be met. This process heat demand would be met by using recovery boiler there would be no provision that heat demand would be met by using fossil fuels in the baseline. Therefore step 4 is not applicable and this is conservative from emission reduction point of view.

The equivalent amount of heat energy that would be generated with biomass residues ($HG_{BL,BR,y}$) is determined as:

Parameter	Value (GJ)
$HG_{bl,BR,2017}$	1,411,327.473
$HG_{bl,BR,2018}$	1,482,810.050
$HG_{bl,BR,2019}$	1,466,901.393
$HG_{bl,BR,2020\ (Jan\text{-}sept}$	1,035,560.194

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

According to the methodology (ACM006, v.12.1), this step is optional and the project proponent can decide whether to include it or not.

The PP has decided not to apply this section.

Step 6: Calculate baseline emissions

$BE_y = EL_{BL,GR,y} * EF_{EG,GR,y}$

Period	Baseline Electricity generation (MWh)	Baseline electricity generation capacity (MWh)	Baseline minimum electricity generation in the grid (MWh)	Emission factor (tCO_2e/MWh)	Total baseline emission (tCO_2e)
	$EL_{BL,2017/2018/2019/2020(Jan-Sept)}$	$CAP_{EG,total,2017/2018/2019/2020(Jan-sept)}$	$EL_{BL,GR,2017/2018/2019/2020(Jan-Sept)}$	$EF_{CM,grid}$	BE_y
01/01/2017-31/12/2017	47,622	23,760	23,862	0.9613	22,938
01/01/2018-31/12/2018	46,245	23,760	22,485	0.9613	21,615
01/01/2019-31/12/2019	47,686	23,760	23,926	0.9613	22,999
01/01/2020-30/09/2020	29,427	17,820	11,607	0.9613	11,157

5.2 Project Emissions

For the purpose of determining GHG emissions of the project activity, project participant should include the following emissions sources:

$PE_y = PE_{FF,y} + PE_{GR\ 1,\ y} + PE_{GR2,\ y} + PE_{TR,y} + PE_{BR,y} + P_{WW,y} + PE_{BG2\ ,\ y} + PE_{BC,\ y}$

Of the above parameters $PE_{GR1,\ y}$, $PE_{GR2,\ y}$, $PE_{BR,y}$, $PE_{WW,y}$,$PE_{BG2\ ,\ y}$, $PE_{BC,\ y}$ are not considered in the project emission as per the registered PD.

1. $PE_{FF,y}$ = Project Emissions due to fossil fuel consumption at the project site.

Project Emission due to fossil fuel consumption at the project site $PE_{FF,y}$			
Period	Total diesel burnt (L)	Emission factor (tCO_2e/L)	Project emission ($tCO2e$)
01/01/2017-31/12/2017	249	0.0748	18.6252

01/01/2018-31/12/2018	271	0.0748	20.2708
01/01/2019-31/12/2019	321	0.0748	24.0108
01/01/2020-30/09/2020	173	0.0748	12.9404
	1,014		**75.8472**

2. $PE_{TR,y}$ = Project Emission due to transport of the biomass residues to the project plant.

Period	Biomass procured (Tonnes)	Return trip distance (km)	CO_2 Emission factor ($gCO_2e/km/t$)	$PE_{TR,Y}$ (tCO_2e)
01/01/2017-31/12/2017	123,726.70	100	245	3,032
01/01/2018-31/12/2018	128,759.13	100	245	3,155
01/01/2019-31/12/2019	125,899.86	100	245	3,085
01/01/2020-30/09/2020	90,100.39	100	245	2,208
	468,486.072	**400**		**11,480.00**

5.3 Leakage

As per registered PD, the most likely baseline scenario is that the biomass residues are dumped or left to decay without utilizing them for energy purposes, the leakage of the project activity is zero.

5.4 Net GHG Emission Reductions and Removals

The net GHG emission reduction calculated as per equation below

$ER_y = BE_y - PE_y - LE_y$

Where,

BE_y = Baseline emissions (tCO_{2e})

PE_y = Project emissions (tCO_{2e})

LE_y = Leakage emissions (tCO_{2e})

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2017	22,938	3,051	0	19,887
2018	21,615	3,176	0	18,439
2019	22,999	3,110	0	19,889
2020 (Jan-Sept)	11,157	2,221	0	8,936
Total	78,709	11,558	0	67,151

Emission reduction during the monitoring period that (01/01/2017 to 30/09/2020) is = 67,151 tCO_2e

The emission reduction achieved during the current monitoring period, i.e., from 1st January 2017 to 30th September 2020 is 37.05% lower than the ex-ante estimation for the same period. This may be due to the lower production during the current monitoring period.

APPENDIX I: CALIBRATION DETAILS

Stem temperature transmitter Range: 0-1200°C Resolution: 0.1°C Accuracy: ±0.2% Make: Yokogava Type: K type Serial No.: C2S101681	**DATE OF CALIBRATION:** 01/10/2016, 30/09/2017, 29/09/2018, 28/09/2019, 26/09/2020
Stem temperature indicator with sensor Range: 0-1200°C Resolution: 0.01°C Accuracy: ±0.05% Make: Yokogava Type: K type Serial No.: T1L619073	**DATE OF CALIBRATION:** 01/10/2016, 30/09/2017, 29/09/2018, 28/09/2019, 26/09/2020
Feed water temperature gauge Range: 0-300°C Resolution: 5°C Accuracy: ±1% Make: General Serial No.: BG19013237	**DATE OF CALIBRATION:** 01/10/2016, 30/09/2017, 29/09/2018, 28/09/2019, 26/09/2020
Pressure Gauge (Steam) Range: 0-160kg/cm^2 Resolution: 5 kg/cm^2 Make: General Serial No.: 13121260	**DATE OF CALIBRATION:** 01/10/2016, 30/09/2017, 29/09/2018, 28/09/2019, 26/09/2020
Stem flow totalizer Range: 0-60 TPH Resolution: 0.01 TPH Make: Masibus Model No.: 1006 Serial No: 10118151	**DATE OF CALIBRATION:** 01/10/2016, 30/09/2017, 29/09/2018, 28/09/2019, 26/09/2020
Energy meter Make: Schneider Electric Accuracy: 0.2s Model: EM6436 Serial No.: 34163030581	**DATE OF CALIBRATION:** 12/12/2016, 26/12/2017, 04/12/2018, 18/12/2019

Delay in calibration have been observed from 12/12/2017 to 25/12/2017 and 04/12/2019 to 17/12/2019, hence taking a conservative approach error is applied for whole month of Dec 2017 and Dec 2019.	
Energy meter Make: Secure meter Accuracy: 0.2s Model: E3M024 Serial No.: XC548932	**DATE OF CALIBRATION:** 12/12/2016, 26/12/2017, 04/12/2018, 18/12/2019
Delay in calibration have been observed from 12/12/2017 to 25/12/2017 and 04/12/2019 to 17/12/2019, hence taking a conservative approach error is applied for whole month of Dec 2017 and Dec 2019.	
Weighbridge Make: Multi Weigh India Pvt. Ltd. Serial No.: IND/2003/294	**DATE OF CALIBRATION:** 16/02/2017, 09/06/2018, 07/02/2019, 13/02/2020