4 MW BIOMASS BASED COGENERATION PLANT BY GODREJ AGROVET LTD.

Document Prepared by (Infinite Solutions)

Project Title	4 MW Biomass based cogeneration plant by Godrej Agrovet Ltd.
Version	03
Report ID	1744_MP-1
Date of Issue	29-Sep-2020
Project ID	1744
Monitoring Period	01-Oct-2018 to 30-Jun-2020 (Inclusive of both the dates)
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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Godrej Agrovet Limited (GAVL) has implemented a greenfield renewable biomass-based co-generation project activity in his new palm oil production plant located at Seethanagaram village, District – West Godavari, Andhra Pradesh, India.

The project activity involves the utilization of in-house generated renewable biomass[1] fibre, shell and empty fruit bunches (EFB) in the palm fruit processing facility as a fuel for generating steam which will further be used for generating the electricity and catering the thermal energy requirement.

Thus, project activity generates clean electricity & helps in avoiding the fossil fuel (Coal) usage to meet its captive requirement of heat & electricity and thereby reducing the equivalent GHG emissions from the atmosphere.

The project activity involve installation of 50 TPH Boiler & 4 MW Turbine Generator. As the project activity is co-generation project i.e. generating heat & electricity simultaneously, commissioning[2] date of the project activity is 01-Oct-2018.

Total net electricity generated by the project activity during this monitoring period 01-Oct-2018 to 30-Jun-2020) is 15,569 MWh and 599.22 TJ energy from steam has been given to cater the inhouse requirement.

The total GHG emission reductions or removals generated in this monitoring period (01-Oct-2018 to 30-Jun-2020) is 72,971 tCO_{2e}.

1.2 Sectoral Scope and Project Type

As per simplified modalities and procedures for small scale CDM project activities, the project qualifies under the:

Sectoral Scope	: 01 - Energy industries (renewable-/non-renewable sources)
Type	: I - Renewable Energy Projects
Category	: C. Thermal energy production with or without electricity

Project is neither an AFOLU project nor a grouped project.

1.3 Project Proponent

[1] As the biomass is generated from agro-processing industry, it is a renewable biomass as per definitions in 'Glossary of CDM Terms Ver 07.0.
[2] Commissioning Certificate.

Organization name	Godrej Agrovet Limited
Contact person	Mr. MSMS Kumar
Title	Dy. General Manager - Production & Projects
Address	Ch. Pothepalli, Dwaraka Tirumala Mandal, Andhra Pradesh
Telephone	+91 8829 211128
Email	msms.kumar@godrejagrovet.com

1.4 Other Entities Involved in the Project

Organization name	Infinite Solutions
Role in the Project	Project Consultant
Contact person	Mr. Jimmy Sah
Title	Head - Sustainability
Address	611, Chetak Centre Main, RNT Marg, Indore - 452001, India
Telephone	+91-9644130430
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1.5 Project Start Date

The commissioning date of the project activity is 01-Oct-2018.

Hence, the Project Start date should be the actual commissioning date of the Project as per the para 3.7 of the VERRA project standard version 04.

1.6 Project Crediting Period

The project chooses a renewable crediting period of 10 years. After 10 years, the crediting period will be renewed twice considering project life of 25 years.

Crediting period start date : 01-Oct-2018

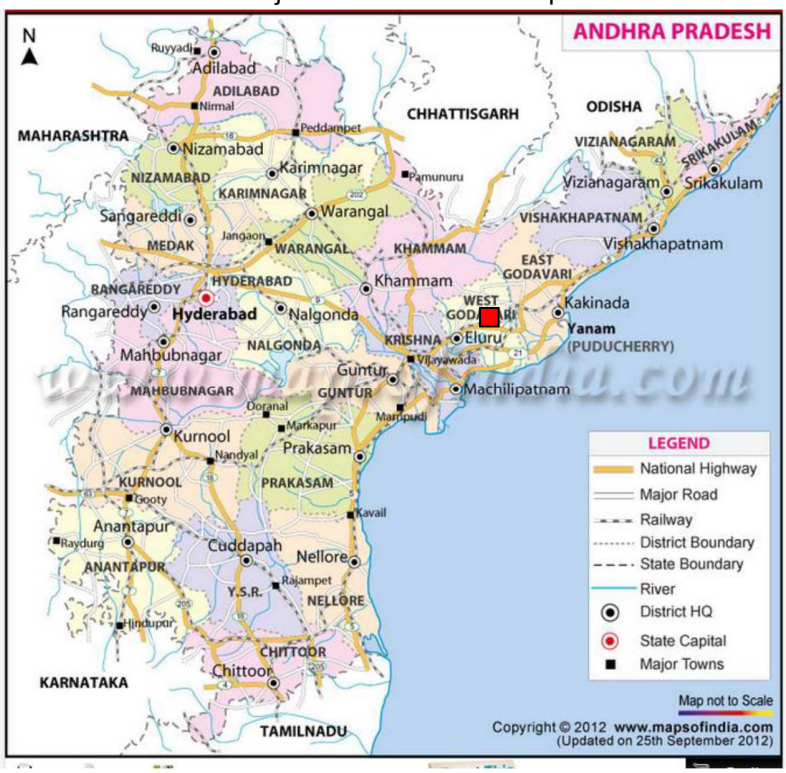
Crediting period end date : 30-Sep-2028

1.7 Project Location

Village : Seethanagaram
District : West Godavari
State : Andhra Pradesh

Country : India
Latitude : 17° 10’ 38” N
Longitude : 81° 41’ 35” E

Plant location from major town/ district headquarter – Eluru – 120 km.



1.8 Title and Reference of Methodology

Type : AMS-I.C
Title : Thermal energy production with or without electricity
Sectoral Scope : 01
Version : 20
EB : 79
Reference:
http://cdm.unfccc.int/methodologies/DB/JSEM51TG3UVKADPA25IPUHXJ85HE8A

In line with the applied methodology, following tools and guidelines are referred in this PD:

- Demonstration of additionality of small-scale project activities, Version 12, EB 99 annex 3
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, Version 3.0, EB 96 annex 5
- Tool to calculate the emission factor for an electricity system, Version 6, EB 97 annex 7

1.9 Participation under other GHG Programs

PP is submitting the undertaking confirming that project has not participated in any other binding and/or non-binding GHG program and any national REC scheme. Hence, there is no double accounting of emission reduction has happened.

Participation under Other GHG Programs:
The project activity has never participated in any other GHG programs.

1.10 Other Forms of Credit

Emission Trading Programs and Other Binding Limits:
The project proponent is not part of any emission trading program. GAVL also does not have any binding GHG emission limits. The net GHG emission reductions from the project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. A letter of this effect from the project proponent has been submitted to the validator.

The project activity has not participated under any other GHG programs. A letter of this effect from the project proponent has been submitted to the validator during validation.

Other Forms of Environmental Credit:
The project activity does not result in creation of any other kind of environmental credits. A letter from the project proponent has been submitted to the validator with an undertaking that the project has not created another form of environmental credit. PP has not participated in REC mechanism. Hence, not eligible to claim REC benefits.

1.11 Sustainable Development

Ministry of Environment & Forests, Government of India has stipulated following indicators for sustainable development in the interim approval guidelines for GHG projects.

1.Social well-being

2.Economic well-being

3.Environmental well-being

4.Technological well-being

Social well-being
The main source of fuel for this plant will be locally available agriculture waste i.e. EFB (renewable biomass). Since the project is located in a village it will assist 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.

Economic well-being
The biomass-based steam generation is an alternative to fossil fuel-based steam generation plants. The project shall create new rural income resulting from the sales of

biomass fuel like agriculture waste. Increased income levels shall contribute to the economic safety and empowerment of the most vulnerable sections of local society.

Environmental well-being
The project is using biomass for steam 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. Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

Technological well-being
The project makes use of efficient environmentally safe technology for steam generation with no Green House Gas (GHG) emission.

In view of the above, the PP has considered that the project activity profoundly contributes to the sustainable development.

2 SAFEGUARDS

2.1 No Net Harm

The project activity has been installed in a Palm oil production plant which involves the utilization of in-house generated renewable biomass i.e. fibre, shell and empty fruit bunches (EFB) in the palm fruit processing facility as a fuel for generating steam.

Thus, the project activity leads to the various environmental and/or socio-economic impacts:
1. Best utilization of in-house generated renewable biomass to generate steam & electricity.
2. Avoids transportation of fuel from outside of the plant.
3. Provides Job opportunities to the locals for Operation & maintenance of biomass-based power generation project.
4. Helps in reducing the GHG emissions equivalent to the quantity of electricity & steam produced from the renewable biomass.

Thus, the project activity is having very positive impact on environment & Socio-economic parameters. There are no negative environmental and/or socio-economic impacts due to the project. Hence, no mitigation action is occupied.

The project activity does not involve any major construction activity. It primarily requires the installation of boiler and turbine within the project premises, interfacing the generators with the State Electricity Board by setting up HT transmission lines and installation of other accessories.

The report on “Developmental Impacts and Sustainable Governance Aspects of Renewable Energy Projects” prepared by MNRE dated September 2013. This report

clearly mentioned that biomass power project activity operations do not result in direct air pollution, noise pollution. Please refer below web link for the same.[3]

Thus, there are no any significant impacts due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

2.2 Local Stakeholder Consultation

Local stakeholder consultation has already done during registration of project activity. The project proponent had organized stakeholders meeting on 5-Dec-2017, in order to take into account the concerns of the nearby villagers regarding the project implementation however there were no major comments or protest raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region.

Also, as a part of continuous feedback from stakeholders, the PP also placed a feedback/complaint register onsite in where the stakeholder can put down his/her complain and the same if found genuine will be addressed immediately.

However, there is no comments received in the current monitoring period.

2.3 AFOLU-Specific Safeguards

This is not applicable to the project activity as for non-AFOLU projects, this section is not required.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity has been successfully commissioned by GAVL and was registered by VCS Board subsequently (Project ID: Ref No. 1744).

The project is a cogeneration unit and had commissioned one 50 TPH biomass-based boiler and a 4 MW turbine generator (TG). The generated steam and electricity are used to meet the captive demand of a greenfield palm oil production unit.

The detailed specifications of boiler and TG are as below:

Table 1: Specification of 50 TPH boiler.

Sr.	Specification	Value	Unit

[3] http://164.100.94.214/sites/default/files/uploads/report-on-developmental-impacts-of-RE.pdf

No.			
1	Type – Pulsating grate bi-drum air cooled boiler	-	-
2	Design steam generation capacity at MCR	50	Tph
3	Steam pressure at MCR	34.65	Kg/cm² (g)
4	Steam temperature	380±5	°C
5	Make and Model -	Thermax / Powermax – 500/1	-
6	Fuel requirement: Fuel 1: 55% Shredded Empty bunch Fiber Fuel 2: 30% palm fibre Fuel 3: 15% palm shell	9.35 Shredded EFB, 5.1 Palm Fiber, 2.55 Palm Shell	Tph
7	Efficiency of boiler	66.8±5	%
8	Feed water temperature to economiser	126	°C

Specification of 4 MW turbine generator:

Sr. No.	Specification	Value	Unit
1	Type – multistage, impulse, nozzle governed back pressure	-	-
2	Design capacity	4	MW
3	Inlet steam pressure	33.38	kg/cm^2
4	Inlet steam temperature	370	°C
5	Specific steam consumption	11125	kg/kWh
6	Make and Model – Triveni Turbine Limited	Triveni Turbine Limited / TST-2030	-
7	Outlet steam pressure at TG	3.5	kg/cm^2
8	Electrical output at AC generator terminal (3 phase, 4 wire system, 0.8 PF)	2500 kW (415 V, 50 Hz)	-

The project activity has been in operation continuously (with outages – forced & planned) since its commissioning. The monthly running hours of the boilers and turbines included in the project activity are being submitted to the verifier. During the present monitoring period i.e. 01-Oct-2018 to 30-June-2020 (Both days included), the project is in normal operation status; there have been no emergencies happened to the monitoring system. There are no events or situation that occurred during the monitoring period which may impact the applicability of the methodology.

However, there were two majors shut downs taken during the current monitoring period which are as follows:

S.No	Months	Reason
1	Mar-2020	Shutdown for routine annual maintenance.
2	Apr-2020	Shutdown for routine annual maintenance.

No Generations has occurred during the shut down period.

Lifetime of the project activity

The main project activity equipment's boiler and turbine are expected to have a lifetime of 25 years[4].

3.2 Deviations

2.3.1 Methodology Deviations

There has been no methodology deviation applied during this monitoring period of the project activity.

2.3.2 Project Description Deviations

There are project description deviations applied during this monitoring period of the project activity which are transparently described under this section of MR.

In line with the Para 3.18.2 of the VCS standard version 4[5], "the deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology, the deviation shall be described and justified in the monitoring report. This shall include a description of when the changes occurred and the reasons for the changes. The deviation shall also be described in all subsequent monitoring reports."

Following are the changes applied since commissioning of the project and this is the first monitoring period. There is no replacement of monitoring equipment's involved during the current monitoring period.

1. In Monitoring Parameter: $EG_{PJ,thermal,y}$ - Net quantity of thermal energy supplied by project

Change: Monitoring Equipment "accuracy class" was corrected in line with the respective equipment calibration certificate.

Reason: a. Steam flow meter/Transmitter: Accuracy class was stated as ±0.5% in the VCS PD, which is corrected as per the equipment calibration certificate i.e. +/- 0.1 of range.

b. Pressure gauges/ Transmitter: Accuracy class was stated as ±1% in the VCS PD, which is corrected as per the equipment calibration certificate i.e. +/- 0.1 of range.

[4] Default values as per Option C of 'Tool to determine and remaining lifetime of the equipment' Version 01, EB 50, Annex 15

[5] https://verra.org/wp-content/uploads/2019/09/VCS_Standard_v4.0.pdf

2. Monitoring Parameter: $B_{biomass,y}$ - Quantity of biomass residues of type k consumed in the boiler in year y (tonnes on dry-basis)

Change: Monitoring Equipment (weighbridge) accuracy class was corrected.

Reason: Accuracy class was mentioned as +/- 1%, corrected to ±0.01% (i.e. 5 kg) in line with the installed equipment details and calibration certificate.

3. Monitoring Parameter: Pressure - Pressure of flowing exhaust steam at the outlet of steam turbine

Change: Monitoring Equipment Accuracy class is corrected.

Reason: "Pressure gauges/ Transmitter" accuracy class was stated as ±1% in the registered PD, which is corrected as per the equipment calibration certificate i.e. +/- 0.1 of range.

4. Monitoring Parameter: M (Moisture content of the biomass residues) - Moisture content of each biomass residues type k

Change: Revision in the "Frequency of monitoring/recording" of the parameter to once in the first year of crediting period.

Reason: It is to be noted that this parameter is not used directly for the emission reduction calculation. Emission reduction are calculated based on the para 38 of the applicable methodology which directly requires, "Net quantity of thermal energy supplied by the project activity during the year y (TJ)" & Amount of electricity supplied by the project activity during the year y; (GWh). These two parameters are calculated based on the direct measurement of steam pressure, temperature & flow and the net electricity supplied.

As per the applicable methodology, "This parameter "Moisture content of the biomass residues" applies in the case where emission reductions are calculated based on biomass energy input. For all cases, ex ante estimates should be provided in the PDD and used during the crediting period." Therefore, PP wishes to revise the Frequency of monitoring/recording of the moisture content "should be monitored for each type of biomass used, once in the first year of the crediting period."

4. Monitoring Parameter: T - Temperature of steam generated

Change: Correction of typographical error under "Description" as "Temperature of steam extracted"

Reason: Correction of typographical error.

The above deviations do not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology,

3.3 Grouped Projects

The project is not a grouped project hence this section is not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$\eta_{BL,cogen/trigen}$
Data unit	%
Description	The total annual average efficiency of the cogeneration plant using coal
Source of data	Default efficiency of new coal fired boiler as per Appendix of the applied methodology and taking steam turbine efficiency of 100% as per Para 40(b)
Value applied	85%
Justification of choice of data or description of measurement methods and procedures applied	Default value as per SSC methodology guidance is used here. Efficiency of a new coal fired boiler = 85% (as per 'Tool to determine the baseline efficiency of thermal or electric energy generation systems', Ver. 01) Efficiency of turbine = 100% (as per Para 29(b) of SSC methodology AMS I.C) Thus, efficiency of cogeneration plant = 85 x 100 = 85%
Purpose of Data	Baseline emission calculation
Comments	NA

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor in year y
Source of data	CEA "CO2 baseline database for the Indian Power Sector, Version 12, May 2017[6]"
Value applied	0.9843
Justification of choice of	Calculated using "Tool to calculate the emission factor for an

[6] http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver12.pdf

data or description of measurement methods and procedures applied	electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO2/MWh
Description	Build Margin CO_2 emission factor in year y
Source of data	CEA "CO2 baseline database for the Indian Power Sector, Version 12, May 2017[7]"
Value applied	0.9083
Justification of choice of data or description of measurement methods and procedures applied	Calculated using "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin emission factor of the Indian grid
Source of data	CEA "CO_2 baseline database for the Indian Power Sector, Version 12, May 2017[8]"
Value applied	0.9462
Justification of choice of data or description of measurement methods and procedures applied	Calculated using "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

[7] http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver12.pdf
[8] http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver12.pdf

4.2 Data and Parameters Monitored

Data / Parameter	$EF_{CO2,i,y}$
Data unit	tCO2/TJ
Description	CO2 emission factor of fossil fuels: coal and diesel
Source of data	Appendix B of CEA "CO2 baseline database for the Indian Power Sector, Version 15[9], May 2019"
Description of measurement methods and procedures to be applied	The database is an official publication of the Government of India for the purpose of CDM baselines. Thus, the value is taken as country specific emission factor of coal and diesel.
Frequency of monitoring/recording	Once in a monitoring period – latest database version is being used
Value monitored	Coal = 95.80 Diesel: 72.6
Monitoring equipment	Default value
QA/QC procedures to be applied	The data is taken from an official publication of the Government of India for the purpose of CDM baselines and is available from authentic source, thus no additional QC is required
Purpose of the data	Calculation of Project Emissions
Calculation method	NA
Comments	NA

Data / Parameter	$EG_{PJ,thermal,y}$
Data unit	TJ
Description	Net quantity of thermal energy supplied by project
Source of data	Calculated parameter. Parameter $EG_{PJ,thermal,y}$ for project activity boiler is calculated from net steam output (ton) and its net enthalpy. Source for net steam output is steam production data log and corresponding enthalpy (at operating temperature) is inferred from steam table with respect to operating pressure and temperature.
Description of measurement methods	Monitoring: This is calculated on the monthly basis. The monthly average value of steam flow meter and pressure gauge is used to

[9] http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver15.pdf

<table>
<tr><td>and procedures to be applied</td><td>calculate enthalpy of the steam supplied using steam table in tonnes/TJ. This value is multiplied with the monthly average of steam generated by project activity boiler Q_{steam}, to calculate enthalpy of steam supplied in a month. The enthalpy of feed water calculated using the measured values of flow meter (1 number) and its temperature (using meter: 1 number) will be subtracted to get $EG_{PJ,thermal,y}$. The sum of $EG_{PJ,thermal}$ of all the months will provide a yearly value.
Data type: Calculated and archived

Archiving Procedure: Electronic</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Monitoring Frequency: Continuous measurement for steam flow and pressure

Recording Frequency: Monthly calculation for enthalpy</td></tr>
<tr><td>Value monitored</td><td>599.22</td></tr>
<tr><td>Monitoring equipment</td><td>Equipment[10] accuracy class
Steam flow meter/Transmitter: ±0.1 of range
<table><tr><td colspan="2">Boiler main steam flow transmitter - 1 (TAG.NO:11-FT-211A)</td></tr><tr><td>Serial No</td><td>Y1TA17589</td></tr><tr><td colspan="2">Boiler main steam flow transmitter - 2 (TAG.NO:11-FT-211B)</td></tr><tr><td>Serial No</td><td>Y1TA17590</td></tr></table>
Pressure gauges/Transmitter : ± 0.1 of range
<table><tr><td colspan="2">Turbine extraction steam pressure transmitter (TAG.NO:PT-140)</td></tr><tr><td>Serial No</td><td>Y1TA16783</td></tr></table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The steam temperature and steam mass flow meters will be calibrated once in three years.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of Baseline Emissions</td></tr>
<tr><td>Calculation method</td><td>Steam generated in a year (ton) x average enthalpy of steam (kJ/kg) / 10^6</td></tr>
<tr><td>Comments</td><td>NA</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$EG_{PJ,electrical,y}$</td></tr>
<tr><td>Data unit</td><td>MWh</td></tr>
<tr><td>Description</td><td>Net electricity supplied by the project activity</td></tr>
</table>

[10] All the monitoring equipment details has been provided under Appendix 1 of the MR.

<table>
<tr><td>Source of data</td><td>Cogen plant log book</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Monitoring: Electricity meter in control room measures the net quantity of electricity supplied by the project activity cogen plant.
Data type: Measured
Archiving procedure: Paper and Electronic
Responsibility: Turbine operator would be responsible for monitoring and checks for regular calibration of electricity meter and Shift In-charge will be responsible for calibration of the electricity meters.
Calibration Frequency: Once in five years</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuous monitoring with monthly recording</td></tr>
<tr><td>Value monitored</td><td>15,569.298</td></tr>
<tr><td>Monitoring equipment</td><td>Electric meter
Accuracy class: 0.2s
<table><tr><td>Equipment Name</td><td>Gross Gen Meter</td></tr><tr><td>S.No</td><td>X0465806</td></tr></table>
<table><tr><td>Equipment Name</td><td>Cogen Auxiliary Meter</td></tr><tr><td>S.No</td><td>1712057761</td></tr></table>
All the monitoring equipment details has been provided under Appendix 1 of the MR.</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Electric meter/s is calibrated once in five years at accredited third-party laboratory</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of Baseline Emissions</td></tr>
<tr><td>Calculation method</td><td>Total generation from the project activity – auxiliary consumption – import from grid (if any used for cogen plant during cogen plant shutdown).
The trivector meter will give net generation directly by doing above calculation.</td></tr>
<tr><td>Comments</td><td>NA</td></tr>
</table>

Data / Parameter	$B_{biomass,y}$
Data unit	Ton
Description	Quantity of biomass residues of type k consumed in the boiler in year y (tonnes on dry-basis)
Source of data	Measured using weighbridge
Description of	Will be monitored ex-post. Adjust for the moisture content in order to

measurement methods and procedures to be applied	determine the quantity of dry biomass. If more than one type of biomass fuel is consumed, each shall be monitored separately. Project activity is utilizing the inhouse-generated renewable biomass: Palm fibre, Nut shell and shredded fibre within the palm fruit processing facility as a fuel. For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, NCV of the processed biomass that is supplied to users with an appropriate sampling frequency. However, same is not used during the current monitoring period.
Frequency of monitoring/recording	Monitoring: The quantity of the biomass consumed will be measured using weigh bridge. Data Type: Measured and archived Archiving Procedure: Electronic Responsibility: Stores in-charge is responsible for maintaining the records of the biomass consumed in project. Stock in charge maintains an inventory recording the opening and closing balance annually. Cross-check: Cross checking the measurements using mass/energy balance.
Value monitored	99,836.91 Tons
Monitoring equipment	Weighbridge Accuracy class: ±0.01% (i.e. 5 kg) Weigh Bridge S.NO | 2717131579 All the monitoring equipment details has been provided under Appendix 1 of the MR
QA/QC procedures to be applied	Weigh bridge used is calibrated by an external agency once in a year.
Purpose of the data	Baseline emissions calculations
Calculation method	Sum of quantities of “Palm fibre, Nut shell and shredded fibre” consumption in a monitoring period The moisture content in order to determine the quantity of dry biomass is determined by reputed laboratory.
Comments	The parameter monitors quantities of all biomass used palm fiber, palm shell and EFB separately

Data / Parameter	$NCV_{k,biomass}$
Data unit	kcal/kg

Description	Net Calorific Value of biomass type k
Source of data	Lab analysis report of NCV
Description of measurement methods and procedures to be applied	Monitoring: The NCV of biomass will be measured once in the first year of the crediting period (3 samples in each quarter) by third party laboratory/ in-house as per national/ international standard. Data Type: Measured and Archived Archiving Procedure: Electronic Recording frequency: once in the first year of the crediting period Responsibility: Chief Chemist will be responsible for getting the lab analysis for the NCV.
Frequency of monitoring/recording	Once in the first year of the crediting period
Value monitored	Avg. NCV of Biomass fuel mix (kcal/kg) (43% SEFB+43% Fibre+14% shell) is 2107 kCal/kg
Monitoring equipment	Calorimetry - third party lab analysis
QA/QC procedures to be applied	Average value obtained using third party analysis using three samples for each measurement every quarter in the first year of operation and will be compared with any public literature if available and IPCC default values. If the measurement results differ significantly from previous measurements or other relevant data sources, additional measurements will be conducted.
Purpose of the data	Baseline emissions calculations
Calculation method	Calorimetry
Comments	The parameter will monitor NCV of all biomass used palm fibre, palm shell and EFB separately

Data / Parameter	Extracted steam Enthalpy
Data unit	kJ/kg
Description	Enthalpy of exhaust steam at the outlet of the steam turbine
Source of data	Plant log books
Description of measurement methods and procedures to be applied	Calculation Procedure: Enthalpy of steam from turbine is calculated from steam tables based on the corresponding values of quantity of steam and pressure. Data type: Calculated Recording Frequency: Daily

	Archiving procedure: Paper and/or Electronic Responsibility: Boiler operator is responsible for monitoring and checks for regular calibration of temperature meter and pressure gauge. The Shift In-charge will be responsible for calibration of the temperature meter and pressure gauge.
Frequency of monitoring/recording	Continuous monitoring with monthly recording
Value monitored	1997
Monitoring equipment	Pressure of steam is measured by pressure gauge and temperature by temperature transducer. Turbine extraction Steam Pressure transmitter (Tag.no:pt-140) Serial No | Y1TA16783 Turbine extraction steam temperature transmitter (Tag.no:TT-141) Serial No | C2T502618 All the monitoring equipment details has been provided under Appendix 1 of the MR
QA/QC procedures to be applied	QA/QC procedures is ensured as the temperature meter and pressure gauge would be calibrated at regular intervals.
Purpose of the data	Baseline emissions calculations
Calculation method	Enthalpy of steam at end of TG – enthalpy of feed water
Comments	NA

Data / Parameter	Pressure
Data unit	kg/cm^2
Description	Pressure of flowing exhaust steam at the outlet of steam turbine
Source of data	Pressure gauge
Description of measurement methods and procedures to be applied	Monitoring: Pressure gauge measures the pressure of the steam at the turbine outlet Data type: Measured and archived Recording Frequency: Hourly Archiving procedure: Paper and Electronic Responsibility: Turbine operator is responsible for monitoring and checks for regular calibration of pressure gauge and Shift In-charge is responsible for calibration of the pressure gauge. Calibration Frequency: Calibration will be carried out once in a year.
Frequency of	Continuous monitoring with monthly recording

monitoring/recording	
Value monitored	2.66
Monitoring equipment	Pressure gauge Accuracy class: +/-0.1% of range Turbine extraction Steam Pressure transmitter (Tag.no:pt-140) Serial No: Y1TA16783 All details provided under Appendix 1 of the MR.
QA/QC procedures to be applied	Pressure gauge will be calibrated once in a year.
Purpose of the data	Baseline emissions calculations
Calculation method	Direct reading from Pressure gauge
Comments	NA

Data / Parameter	$FC_{i,j,y}$
Data unit	MT/year
Description	Quantity of fossil fuel combusted in the project in year y
Source of data	Measured using weigh bridge for coal and level gauge for diesel
Description of measurement methods and procedures to be applied	Monitoring: Type and quantity of fossil fuel combusted in the project activity is measured using electronic weigh bridge (or recorded in challans provided by the supplier and handed over to the plant people by the truck driver). Data Type: Continuously Measured and archived Archiving Procedure: Electronic Responsibility: Plant head with Officer (stores) is responsible for monitoring and checks for regular calibration of weigh bridge
Frequency of monitoring/recording	Continuous measurement with monthly recording/ compilation
Value monitored	Coal = 0 Diesel = 73,129 Lit
Monitoring equipment	Weigh bridge for coal and level guage for diesel Accuracy class: ±1%
QA/QC procedures to be applied	Weigh bridge is calibrated by an external agency once in a year. The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on

	purchased quantities and stock changes.
Purpose of the data	Baseline emissions calculations
Calculation method	Sum of total fuel consumed in boiler
Comments	NA

Data / Parameter	M (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, is measured once in the first year of the crediting period (3 samples in each quarter) by third party laboratory/ in-house as per national/ international standard. 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 will be carried out in dedicated scales. Lab reports from in-house/third party shall be used.
Frequency of monitoring/recording	The moisture content should be monitored for each type of biomass used once in the first year of the crediting period.
Value monitored	Palm Fiber (MT): 30.00% Shell (MT): 15.00% Shredded fiber (MT): 50.00%
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	-

Data / Parameter	T
Data unit	^{0}C
Description	Temperature of steam extracted

Source of data	Plant log book
Description of measurement methods and procedures to be applied	The temperature of steam extracted is measured using temperature gauge on hourly basis, the monthly average value is applied to calculate enthalpy of steam.
Frequency of monitoring/recording	Every hour reading, monthly recording
Value monitored	174.29
Monitoring equipment	Temperature gauge/ Turbine extraction steam temperature transmitter (TAG.NO:TT-141) Serial No: C2T502618 All the monitoring equipment details has been provided under Appendix 1 of the MR
QA/QC procedures to be applied	Calibration of Temperature transducer is done as per the applicable national or international standard or manufacturer's specification or at least once in three years
Purpose of the data	Calculation of baseline emission
Calculation method	Where relevant, provide the calculation method, including any equations, used to establish the data/parameter
Comments	Data will be archived for crediting period +2 years

Data / Parameter	$NCV_{fossil\ fuels}$
Data unit	kcal/kg
Description	Net Calorific Value of fossil fuels
Source of data	Lab analysis report of NCV
Description of measurement methods and procedures to be applied	Monitoring: The NCV of fossil fuel type if used is measured once in the year by third party laboratory/ in-house as per national/ international standard. Data Type: Measured and Archived Archiving Procedure: Electronic Recording frequency: once in the first year of the crediting period Responsibility: Chief Chemist is responsible for getting the lab analysis for the NCV.
Frequency of monitoring/recording	Once in the first year of the crediting period
Value monitored	- (No fossil fuel used (Coal))

Monitoring equipment	Calorimetry – third party lab analysis
QA/QC procedures to be applied	Lab reports from in-house/third party shall be used.
Purpose of the data	Baseline emissions calculations
Calculation method	Calorimetry
Comments	The parameter will monitor NCV of all fossil fuels used separately

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Electricity taken from grid for the cogeneration plant startup/ emergency operations.
Source of data	Cogen plant log book
Description of measurement methods and procedures to be applied	Monitoring: Electricity meter in control room Data type: Measure Archiving procedure: Paper and Electronic Responsibility: Turbine operator is responsible for monitoring and checks for regular calibration of electricity meter and Shift In-charge is responsible for calibration of the electricity meters. Calibration Frequency: Once in five years
Frequency of monitoring/recording	Continuous monitoring with monthly recording
Value monitored	733.036
Monitoring equipment	Electric meter **Equipment Name** | **Import Meter** S.No | 17230314 Accuracy class: 0.2s All the monitoring equipment details has been provided under Appendix 1 of the MR
QA/QC procedures to be applied	Electric meter/s are under the control of State utility and PP has no control over it.
Purpose of the data	Baseline emissions calculations
Calculation method	The trivector meter will give net generation directly by doing above calculation.
Comments	NA

4.3 Monitoring Plan

The Monitoring and Verification procedures define a project-specific standard against which the project's performance and conformance with all relevant criteria will be monitored and verified. It includes:

- Suitable data collection, collation and archiving methods consistent with good practices
- Data interpretation techniques for monitoring and verification of GHG emissions.

These procedures provide for a clear, credible, and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support continuous monitoring of the key performance indicator for the project, i.e. Greenhouse Gas (GHG) emission reductions.

All instruments will be calibrated and marked in accordance with information in Section 4.2 so that the accuracy of measurement can be ensured all the time.

The general monitoring principles are based on:

- Frequency of monitoring
- Minimizing uncertainties and increasing reliability of performance of the project by an emergency preparedness plan
- Reporting and archiving the data used in monitoring and accounting for the emission reduction from the Project
- QA/QC

Frequency of monitoring

The project developer has installed all metering facilities within the plant premises. The measurements are monitored as per the frequency described in above sections, and the values of the parameters are recorded in the automatic reports generated by the PLC (only for parameters: Steam flow, Steam pressure and temperature at boiler, feed water temperature) and in log books. The monitored values will be transferred to the excel spreadsheet on monthly basis to prepare monthly reports. These monthly reports are used by the VCS Coordinator to calculate the reduction in GHG emissions and to generate monthly reports that form a necessary component of the Management Information System.

The VCS Coordinator will be responsible for

- Monitoring the project on a day to day basis,
- Co-coordinating with the Sr. Manager/Manager- projects and other internal and external agencies/authorities for the purpose of smooth operation of the project and accrual of emission reduction.

Emergency preparedness plan

The amount of emission reduction units is proportional to the steam generation using the biomass residues in the Project. Measurement devices having good accuracy and procured from reputed manufacturers have been installed at site for the purpose of monitoring the various parameters of the project. Since the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the

equipment for reproducibility, all instruments will be calibrated as per the planned frequency for ensuring reliability of the system.

In the event that a particular instrument malfunctions or breaks down, all efforts will be made to restore or replace that instrument within short span of time of such eventuality. The data used in calculating the emission reduction for that particular parameter will be taken as zero from the last recorded reading.

This will ensure that the uncertainties in the parameters used for calculating the emission reductions from the project are consistent, verifiable and reliable, and any uncertainty is minimal.

Reporting and archiving
Verification is done on the basis of monthly reports that are prepared by the concerned sections covering all the monitoring parameters.

The VCS coordinator will be responsible for

- Collection and updating of all data in the project monitoring worksheet,
- Generation and distribution of monthly reports to the Management accounting for the actual emission reduction achieved during the month,
- Any specific event affecting emission reduction due to the project during the month

Reporting data on monthly basis for the calculation and estimation of emission reductions.

This data will be checked against initial estimates. If the project is not performing as expected or if there are any negative impacts on the volume of emission reductions obtained, on the basis of the monthly data being monitored, analysis will be carried out to identify where the project is deviating in its generation of emission reductions and the immediate measures will be taken to maintain the expected generation of emission reductions from the operation of this project.
All data will be kept for a minimum of 2 years following last issuance of VCUs or the end of the crediting period, whichever is later, and the storage of this data will be the responsibility of the project proponents.

QA/QC procedures
The quality assurance and quality control over the data monitored will be done by the manager as follows:

- The monitored data will be verified for the completeness and consistency.
- It will be ensured that the plant personnel receive adequate training
- It will be ensured that the equipment's in the project activity undergo periodic maintenance as recommended by the manufacturer.
- It will be ensured that the monitoring instruments are calibrated as per the specified frequency.
- It will be ensured that the there is an adequate storage of the data monitored.

Any non-conformance will be identified and a corrective action will be taken.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per para 38 of AMS I.C. "*For electricity and thermal energy produced in a baseline cogeneration or trigeneration unit, using fossil fuel (case 28(d)), the following equation shall be used to determine baseline emissions*":

$$BE_{cogen/trigen,CO2,y} = \left[\left(\frac{EG_{PJ,thermal,y} + EG_{PJ,electrical,y} \times 3.6}{\eta_{BL,cogen/trigen}}\right)\right] \times EF_{FF,CO2}$$

Where:

$BE_{cogen/trigen,CO2,y}$ = Baseline emissions from electricity and thermal energy displaced by the project activity during the year y (t CO2)

$EG_{PJ,electrical,y}$ = Amount of electricity supplied by the project activity during the year y; (GWh)

3.6 = Conversion factor (TJ/GWh)

$EG_{PJ,thermal,y}$ = Net quantity of thermal energy supplied by the project activity during the year y (TJ)

$EF_{FF,CO2}$ = CO2 emission factor of the fossil fuel that would have been used in the baseline cogeneration plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO2/TJ)

$\eta_{BL,cogen/trigen}$ = Total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel determined as per paragraph 39 or 40

Now,

$\eta_{BL,Cogen}$ = 85% (Default efficiency of new coal fired boiler as per Appendix of the applied methodology)

$EF_{FF,CO2}$ = $EF_{CO2,i,y}$ =95.8 tCO_2/TJ (CO2 emission factor of the fossil fuel (Coal) - as per Central Electricity Authority (CEA) CO_2 Baseline Database for the Indian Power Sector; Ver. 15)

During this monitoring period

$EG_{PJ,thermal,y}$ = 599.22 TJ

$EG_{PJ,electrical,y}$ = 15.569 GWh

Thus,

$BE_{cogen,CO2,y}$ = 73,851 tCO_2 (Rounded Down Value)

Refer the ER sheet for detailed calculations.

5.2 Project Emissions

During the project operation, there are two sources for project emissions;

1. Coal Consumption in Boiler: There was no coal consumption in boiler.

2. Diesel consumption in DG:

$PE_{diesel,y}$ = Quantity of diesel consumed (Lit) X Density of diesel X NCV of diesel X EF of diesel

= 73,129 (L) X 0.83 (kg/L) X 9975 (kJ/kg) X 72.6 (tCO_2/TJ) / 10^9

= 45 tCO_{2e} (Rounded Up Value)

3. $PE_{grid,import,y}$ = ($EC_{PJ,j,y}$) Total Electricity Import (MWh)X (1+TDL) X GEF (tCO_2/MWh)

= 733.036 X (1+20.33%) X 0.9462

= 835 tCO_{2e}(Rounded Up Value)

$EC_{PJ,j,y}$ is measured as electricity taken from grid for the cogeneration plant start-up/ emergency operations. The transmission and distribution losses are calculated using the recent, accurate and reliable data available within the host country.

Total Project Emission:

PE_y = $PE_{fossil\ fuel,y}$ + $PE_{diesel,y}$ + $PE_{grid,import,y}$

= 0 + 45 + 835

= 880 tCO_{2e} (Rounded up Value)

5.3 Leakage

Since the biomass is sourced from the plant itself, thus leakage is zero.

5.4 Net GHG Emission Reductions and Removals

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)
2018 (01-Oct-2018 to 31-Dec-2018)	9,285	129	0	9,156
2019 (01-Jan-2019 to 31-Dec-2019)	52,172	431	0	51,741
2020 (01-Jan-2020 to 30-Jun-2020)	12,394	320	0	12,074
Total	73,851	880	0	72,971

It is to be noted here that as per the estimated emission reduction from the project activity for the current monitoring period is 170,991 tCO_{2e}, whereas actual emission reductions achieved are 72,971 tCO_{2e}, which is approximately – 57.32% lower than the estimated emission reductions. The co-generation generation plant operation depends upon various factors, one of them is process requirement and solely operates on process plant need basis. Hence during the current monitoring period requirement of process steam was less. Therefore, projects activity operated at 50% load only i.e. the cogeneration plant is operated at lower PLF (Plant load factor). This difference in the generation during the current verification period is hence due to certain process requirement conditions and hence acceptable.

APPENDIX 1: < METER CALIBRATION DETAILS >

	BOILER MAIN STEAM FLOW TRANSMITTER - 1 (TAG.NO:11-FT-211A)		
	Equipment Name	**STEAM FLOW TRANSMITTER**	**STEAM FLOW TRANSMITTER**
	Make	YOKOGAWA	YOKOGAWA
	Serial No	Y1TA17589	Y1TA17589
	Accuracy Class	+/- 0.1 of Range	+/- 0.1 of Range
Frequency	Date of Calibration	1-Oct-18	25-Feb-20
Once in 3 years	Due Date	30-Sep-21	24-Feb-23
	BOILER MAIN STEAM FLOW TRANSMITTER -2 (TAG.NO:11-FT-211B)		
	Equipment Name	**STEAM FLOW TRANSMITTER**	**STEAM FLOW TRANSMITTER**
	Make	YOKOGAWA	YOKOGAWA
	Serial No	Y1TA17590	Y1TA17590
	Accuracy Class	+/- 0.1 of Range	+/- 0.1 of Range
Frequency	Date of Calibration	1-Oct-18	25-Feb-20
Once in 3 years	Due Date	30-Sep-21	24-Feb-23

	(Generation) kWh Meter		
	Equipment Name	**Tri vector Meter MWh**	**Tri vector Meter MWh**
	S.No	X0465806	X0465806
	Make	SECURE	SECURE
	Accuracy Class	0.2s	0.2s
Frequency	Date of Calibration/Date of Installation	01-Oct-18	29-Feb-20
Once in 5 years	Due Date	30-Sep-23	28-Feb-25

	TURBINE EXTRACTION STEAM TEMPARATURE TRANSMITTER (TAG.NO:TT-141)		
	Equipment Name	**STEAM TEMP.INDICATOR**	**STEAM TEMP.INDICATOR**
	Make	YOKOGAWA	YOKOGAWA
	Serial No	C2T502618	C2T502618
	Accuracy Class	+/- 0.1 of Range	+/- 0.1 of Range
Frequency	Date of Calibration	1-Oct-18	27-Feb-20
Once in 3 years	Due Date	30-Sep-21	26-Feb-21

	TURBINE EXTRACTION STEAM PRESSURE TRANSMITTER (TAG.NO: PT-140)		
	Equipment Name	**Flow Transmitter**	**Flow Transmitter**
	Make	YOKOGAWA	YOKOGAWA
	Serial No	Y1TA16783	Y1TA16783
	Accuracy Class	+/- 0.1 of Range	+/- 0.1 of Range
Frequency	Date of Calibration	1-Oct-18	27-Feb-20
Once in a year	Due Date	30-Sep-19	26-Feb-21
	Delay in Exhaust Steam Pressure Calibration has been found in Oct 19 (Delay period Oct-19 to Feb 20). Hence, maximum permissible error factor has been applied for the whole month of Oct 19 to Feb 20, to the exhaust pressure meter reading. Please refer sheet "Energy".		

Auxiliary meter Details

	Equipment Name	Cogen Auxiliary Meter	Cogen Auxiliary Meter
	S.No	1712057761	1712057761
	Make	Rishabh	Rishabh
	Accuracy Class	0.2s	0.2s
Frequency	Date of Calibration	01-Oct-18	29-Feb-20
Once in 5 year	Due Date	30-Sep-23	28-Feb-25

Import meter Details

	Equipment Name	Import Meter
	S.No	17230314
	Make	L & T
Frequency	Accuracy Class	0.2s
Once in 5 year	Date of Calibration	25-Nov-17
	Due Date	24-Nov-22

	Biomass quantity			
	Weigh Bridge	2717131579	2717131579	2717131579
	Equipment Name	**2018**	**2018**	**2019**
	Make	METLER	METLER	METLER
	Accuracy Class	5 kg	5 kg	5 kg
Frequency	Date of Calibration	8-Nov-17	20-Oct-18	8-Nov-19
Once in a year	Due Date	7-Nov-18	19-Oct-19	7-Nov-20
	Delay Period (Days)		19	
	Delay in calibration has been found in Oct -19. Hence, maximum permissible error has been applied for the delayed period i.e. for the whole month of Oct & Nov 2019 has been applied in the Biomass quantity. Please refer sheet "Biomass"			