20 MW CAPACITY BIOMASS BASED POWER PROJECT OF M/S. SHALIVAHANA GREEN ENERGY LIMITED

Document Prepared by Infinite Solutions

Project Title	**20 MW Capacity Biomass based Power Project of M/s. SHALIVAHANA GREEN ENERGY LIMITED**
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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The project activity consists of 20 MW biomass-based power Plant at Nimdha (V), Dhenkanal District, Orissa State. The project activity has been essentially conceived to generate GHG emission free electricity by making use of available biomass at the project site to supply the electricity to the grid. The project being a renewable energy project leads to sustainable development through efficient utilization of available natural resources and generation of additional employment for the local stakeholders.

The project activity is generation of electricity by utilizing surplus biomass residues like paddy stalks, ground nut shell, stalks of red grams, mung, til, maize etc. agro industrial waste (rice husk) and woody biomass (juliflora & casuarina twigs, etc) from agricultural/waste lands, which are available in the project region and exporting the generated electricity to the grid system owned by Orissa Power Transmission Corporation Limited (OPTCL), a state utility which is part of grid.

As the project activities utilize naturally available Biomass project for power generation and do not use any fossil fuels, the project contributes for reduction of greenhouse gases, which would have, otherwise, been generated by the operation of grid-connected power plants and/or by addition of new generation sources.

Project Name	Capacity	Location	Commissioning Date
Shalivahana Green Energy Limited (SGEL)	20 MW	Orissa	19/12/2011

Objective of the Project

The installations of the project activities have been carried out with a motive of generation of electricity from environmentally benign source of energy. The project activity comprises of biomass plant. The details of the investor along with the unique identification of the Plant have been provided in Section A.4.2.

Nature of the Project

The basic technology involved in the project is is generating electricity using biomass (agricultural residues) with a 90 TPH biomass fired boiler (BFBC) using a 23 MW turbine whose capacity will be governed at 20MW. On an annual average basis, the project exports around 124.57 GWh to the OPTCL grid, which is belongs to eastern grid, which is a part of the NEWNE grid[1]. Considering auxiliary power consumption of 10 % the plant is expected to operate at an annual average plant load factor of 80%.

[1] NEWNE grid is now known as INDIAN grid

The PP of SGEL has entered into a long-term Power Purchase Agreement (PPA) with state utility for a period of 20 years from the date of implementation of project.

Scenario existing prior to the implementation of project activity:
The scenario existing prior to the implementation of the project activity, is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

Baseline Scenario:
As per the applicable methodology, a Greenfield power plant is defined as "a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity".

As the project activity falls under the definition of a Greenfield power plant, the baseline scenario as per paragraph 24 of Section 5.2.1 of applied methodology is the following:

If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

Hence, pre-project scenario and baseline scenario are the same.

Contribution to GHG emissions reduction
The project activity harnesses wind energy to generate and supply electricity to the Indian grid. The Project displaces fossil fuel-based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel-based power plants in regional electricity grid, thereby leading to reduction in emission of greenhouse gases associated with fossil fuel-based electricity generation.

As a result, GHG emission reductions by project is estimated to be approximately 104,744 tCO2e per year and total GHG emission reductions of 626,971 tCO2e for the crediting period, thereon displacing 746,395 MWh/year amount of electricity from the gird.

The project is already registered with UNFCCC CDM (UN ref. no. 5905[2]) on 18 Jul 2012 with fixed crediting period 18 Jul 12 - 17 Jul 22.

GHG emission reduction by the Project in this monitoring period

[2] https://cdm.unfccc.int/Projects/DB/DNV-CUK1331900319.3/view

The monitoring period is from 18 Jul 12 - 17 Jul 18. The total GHG emission reductions or removals generated in this monitoring period are 626,972 tCO2.

1.2 Sectoral Scope and Project Type

The bundled project will generate renewable electricity from WEGs. The generated electricity will be exported to the grid. Therefore, in accordance with Appendix B2 of the simplified modalities and procedures for small scale CDM project activities the applicable methodology is ACM0018. Grid connected renewable electricity generation. The relevant type and category are shown below:

Sectoral Scope : 01 – Energy Industries (renewable / non-renewable sources)
Project Type : I - Renewable Energy Projects
Category : I.D. Grid connected renewable electricity generation
Reference : ACM0018/Version 01.3.0, EB 63

The project is not a grouped project activity.

1.3 Project Proponent

Organization name	Shalivahana Green Energy Limited
Contact person	Mr. M. Komaraiah
Title	Managing Director
Address	7 th Floor, Minerva Complex, 94 S D Road, Secunderabad - 500 003
Telephone	+91-40-67666000
Email	komaraiah@shalivahanagroup.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, 12/2 RNT Marg, Indore- 452001
Telephone	+91-9644130430
Email	jimmy@infisolutions.org

1.5 Project Start Date

Project Start Date: 19 Dec 11
The project start date is the date when the project was commissioned.

1.6 Project Crediting Period

CDM registration date: 18/07/2012
VCS Crediting Period Start date: 19/12/2011 (Date of commissioning)
VCS Crediting Period End date: 18/12/2021
This is a CDM registered project having Fixed crediting period. Hence, considered fixed crediting period.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

As the estimated annual average GHG emission reductions or removal per year is 86,353 tCO2e which is less than 300,000 tonnes of CO2e per year, thus the project falls in the category of Project.

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	76,516
Year 2	87,446
Year 3	87,446
Year 4	87,446
Year 5	87,446
Year 6	87,446
Year 7	87,446
Year 8	87,446
Year 9	87,446
Year 10	87,446
Total estimated ERs	863,530
Total number of crediting years	10
Average annual ERs	86,353

1.8 Description of the Project Activity

Not Applicable as project is registered under CDM.

1.9 Project Location

SGEL has established the Hydel power plant in at Nimdha (V), Dhenkanal District, Orissa State and the details of physical location of each sub project in the project activity are furnished below.

Shalivahana Green Energy Limited (SGEL)				
Sl. No.	**Latitude & Longitude**	**Village & Tehsil**	**District**	**State**

1.	10.87356 N & 77.49728 E	Nimdha village	Dhenkanal	Orissa

Project Location

1.10 Conditions Prior to Project Initiation

As the project is a Greenfield project, the scenario existing prior to the implementation of the project activity, is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" which is described step wise in CDM registered PDD.

Please refer CDM registered PDD. The web link for the same is mentioned below:
https://cdm.unfccc.int/Projects/DB/DNV-CUK1331900319.3/view

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

This is CDM registered project (UN Ref ID: 5905).
https://cdm.unfccc.int/Projects/DB/DNV-CUK1331900319.3/view

Project complies with all relevant local, regional and national laws, statutes and regulatory frameworks and meets all local laws and regulation of India. All necessary NOCs, commissioning certificates, loan approval documents have been submitted to DOE during CDM validation.

The relevant national laws and regulations pertaining to generation of energy in India are:

• Electricity Act 2003
• National Electricity Policy 2005
• Tariff Policy 2006

The Project activity conforms to all the applicable laws and regulations in India:

- Power generation by biomass projects is not a legal requirement or a mandatory option.
- There are state and sectoral policies, framed primarily to encourage Biomass based power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.

- The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation.

- There is no legal requirement on the choice of a particular technology for power generation

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The Project is owned by Shalivahana Green Energy Limited. Further the Ownership is demonstrated through Commissioning certificates for WTGs in the name of individual Project Owner's.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project is registered under CDM mechanism, project no. 5905.

Project Proponent will be submitting undertaking that they will not claim same emission reductions of the project from CDM and VCS for the same monitoring period.

Also, it is to be noted that the project proponent has no compliance or national cap to meet. However, Project Proponent will be submitting undertaking that emission reductions from the VCS monitoring period would not be used for any compliance with emission trading program to meet binding limits if any in future or voluntary REC trade mechanism on GHG emissions.

So, that there will not be any double accounting of emission reduction.

1.12.3 Other Forms of Environmental Credit

The Project is registered with as CDM project, no. 5905. The Project Proponent has submitted undertaking for not availing other forms of environmental credit for the same monitoring period under consideration.

Project Proponent will be submitting undertaking that they will not claim same emission reductions of the project from CDM and VCS for the same monitoring period.

Also, it is to be noted that the project proponent has no compliance or national cap to meet. However, Project Proponent will be submitting undertaking that emission reductions from the VCS monitoring period would not be used for any compliance with emission trading program to meet binding limits if any in future or voluntary REC trade mechanism on GHG emissions.

So, that there will not be any double accounting of emission reduction.

1.12.4 Participation under Other GHG Programs

The project is registered under CDM mechanism, project ID 5905. Project Proponent has submitted undertaking that they will not participate in other GHG programs for the same monitoring period.

Project Proponent will be submitting undertaking that they will not claim same emission reductions of the project from CDM and VCS for the same monitoring period.

Also, it is to be noted that the project proponent has no compliance or national cap to meet. However, Project Proponent will be submitting undertaking that emission reductions from the VCS monitoring period would not be used for any compliance with emission trading program to meet binding limits if any in future or voluntary REC trade mechanism on GHG emissions.

So, that there will not be any double accounting of emission reduction.

1.12.5 Projects Rejected by Other GHG Programs

The Project is not rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project does not fall under AFOLU category or Grouped, hence not applicable

Leakage Management

Project does not involve any leakage emissions other than methodology requirement for wind power project. Hence there are no any extra Leakage Management Plan and risk mitigation measures are required.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description

Sustainable Development

Ministry of Environment and Forests, Govt. of India has stipulated the social wellbeing, economic wellbeing, environmental wellbeing and technological wellbeing as the four indicators for sustainable development for Clean Development Mechanism (CDM) projects.

Social well being

The project activity generates clean power, without emitting any GHGs during its operations. Hence, it leads to a cleaner environment, reducing the adverse impacts of GHG emissions on the people. It reduces a part of the electricity deficit being faced in the region and also improves infrastructural development in the areas around the project activities.

Environmental well being

The project activities are environment friendly clean electricity generation with no significant impact on the environment. There is no pollution as electricity is produced from a clean source of energy, i.e. biomass. This would help in conservation of fast depleting fossil fuels and make it available for other dependent processes. Further, there is no treated effluent.

Economic well being

The project activities contribute to an investment which would increase the economic activity of the local area. The generated electricity is fed into the Grid through the local grid which would improve the grid frequency and availability of electricity to the local consumers. This will provide new opportunities for the industries to set up in the area thereby improving local employment and leading to overall development.

Technological well being

The project activities employ the best available technology and it lead to the promotion of wind technology into the region, demonstrating the success of wind based renewable energy generation, which is fed into the nearest sub-station (part of the Indian Grid), thus increasing energy availability and improving quality of power under the service area of the substation.

Further Information

There are no information or incidents that will have bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Not Applicable as project is registered under CDM.

2.2 Applicability of Methodology

Not Applicable as project is registered under CDM.

2.3 Project Boundary

Not Applicable as project is registered under CDM.

2.4 Baseline Scenario

Not Applicable as project is registered under CDM.

2.5 Additionality

Not Applicable as project is registered under CDM.

2.6 Methodology Deviations

There is no methodological deviation neither pursued nor pursing for the project activity since commissioning and registration.

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Not Applicable as project is registered under CDM.

3.2 Project Emissions

Not Applicable as project is registered under CDM.

3.3 Leakage

Not Applicable as project is registered under CDM.

3.4 Estimated Net GHG Emission Reductions and Removals

Not Applicable as project is registered under CDM.

4 MONITORING

4.1 Data and Parameters Available at Validation

Not Applicable as project is registered under CDM.

4.2 Data and Parameters Monitored

Not Applicable as project is registered under CDM.

4.3 Monitoring Plan

Not Applicable as project is registered under CDM.

5 SAFEGUARDS

5.1 No Net Harm

Not Applicable as project is registered under CDM.

5.2 Environmental Impact

Not Applicable as project is registered under CDM.

5.3 Local Stakeholder Consultation

Not Applicable as project is registered under CDM.

5.4 Public Comments

Not Applicable as project is registered under CDM.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	GWP_{CH4}
Data unit	tCO2e/tCH4
Description	Global warming potential for CH4
Source of data	IPCC http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
Description of measurement methods and procedures applied	The power will be recorded at the plant using meter to be installed in the control room in the plant.
Frequency of monitoring/recording	-
Value applied:	21
Monitoring equipment	Not Applicable
QA/QC procedures applied	--

Data / Parameter	$EF_{CO2,Coal}$
Data unit	tCO2/TJ
Description	CO2 Emission factor of coal
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
Description of measurement methods and procedures applied	The CO2 Emission factor of coal is available in 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Frequency of monitoring/recording	-
Value applied:	99.7
Monitoring equipment	-
QA/QC procedures applied	-

Data / Parameter	$EF_{CO2,Diesel}$
Data unit	tCO2/GJ
Description	CO2 Emission factor of Diesel
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
Description of measurement methods and procedures applied	The IPCC 95% confidence interval upper value of Diesel has been taken for this parameter.
Frequency of monitoring/recording	
Value applied:	0.0748
Monitoring equipment	-
QA/QC procedures applied	IPCC 2006 values have been used for diesel and any future revision of the IPCC Guidelines should be taken into account and review the appropriateness of the data annually

Data / Parameter	**NCV^{Diesel}**
Data unit	GJ/ton
Description	Net calorific value of diesel
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
Description of measurement methods and procedures applied	Net calorific value of diesel has been considered from the IPCC's Default Net calorific values, upper limits of the 95% confidence Intervals
Frequency of monitoring/recording	-
Value applied:	43.3
Monitoring equipment	-
QA/QC procedures applied	-

Data / Parameter	**$TDL_{j,y}$**

Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	As defined in “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.
Description of measurement methods and procedures applied	It is default value as prescribed in tool as the Scenario A applies for the project activity. The distribution losses can be based on references from utilities, network operators or other official documentation.
Frequency of monitoring/recording	-
Value applied:	20
Monitoring equipment	-
QA/QC procedures applied	-

Data / Parameter	ρ^{Diesel}
Data unit	kg/Litre
Description	Density of Diesel
Source of data	Society of Indian Automobile Manufacturers http://www.siamindia.com/scripts/Diesel.aspx
Description of measurement methods and procedures applied	The upper most value has been considered from the Society of Indian Automobile Manufacturers
Frequency of monitoring/recording	--
Value applied:	0.845
Monitoring equipment	---
QA/QC procedures applied	---

Data / Parameter	Biomass residues categories and quantities used in the project activity
Data unit	Quantity (tonnes on dry-basis).

Description	Along the crediting period, if new categories of biomass residues (i.e. new types, new sources, with different fate) are used in the project activity if these new categories are of the type B1:, B2: or B3:, the baseline scenario for those types of biomass residues would be assessed using the procedures outlined in the guidance provided in the procedure for the selection of the baseline scenario and demonstration of additionality.
Source of data	On-site measurements
Description of measurement methods and procedures applied	Measured
Frequency of monitoring/recording	Daily
Value applied:	929,403
Monitoring equipment	Type: Weigh bridge, Calibration frequency: Annually
QA/QC procedures applied	Actual amount of biomass consumed is quantified based on the weigh bridge records of biomass received in the plant and cross checked against the financial records of the project developer. Actual specific consumption of fuel is calculated based on actual fuel consumed and gross electricity generated. The calorific value of the biomass is analysed periodically in-house or through outside recognized laboratory. The weigh bridge is calibrated according to manufacturer's instructions, but at least once in every 3 years to ensure the accuracy of measurement.

Data / Parameter	$EG_{PJ,gross,y}$
Data unit	MWh
Description	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y*
Source of data	On-site measurements at plant premises
Description of measurement methods and procedures applied	844,912
Frequency of	Data monitored continuously, recorded daily and aggregated monthly

monitoring/recording	
Value applied:	
Monitoring equipment	
QA/QC procedures applied	The meter will be calibrated once in a year as per National Standards. The consistency of metered electricity generation will be cross-checked with receipts from electricity sales, auxiliary (in-house) electricity consumption.

Data / Parameter	$EG_{PJ,aux,y}$
Data unit	MWh
Description	Total auxiliary electricity consumption required for the operation of the power plant at the project site
Source of data	On-site measurements
Description of measurement methods and procedures applied	The auxiliary electricity consumption will be measured using calibrated energy meter of accuracy class 0.2 which is installed in the control room/MCC
Frequency of monitoring/recording	Data monitored continuously, recorded daily and aggregated monthly.
Value applied:	73,888
Monitoring equipment	
QA/QC procedures applied	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.)

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Net quantity of electricity generated in the power plant year y
Source of data	Joint meter readings (JMR) of Main meter & Check meter installed at grid interface of OSEB and Monthly bills
Description of measurement methods and procedures applied	The net quantity of electricity generated readings will be measured using Main meter and Check meter (accuracy class 0.2). Considered conservative value of the measured reading and

	computed value by difference of Gross generation and Auxiliary electricity consumption.
Frequency of monitoring/recording	Measured continuously using calibrated meters (Main meter and Check meter) by grid officials, recorded monthly and aggregated annually.
Value applied:	768,807
Monitoring equipment	
QA/QC procedures applied	The meters will be calibrated as per PPA/OSEB norms or at least once in a year as per National standards.

Data / Parameter	$EC_{PJ,j,.y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project in year y (Import from grid system)
Source of data	Joint meter readings (JMR) of Main meter & Check meter installed at grid interface of OSEB and Monthly bills
Description of measurement methods and procedures applied	The electricity import measured using Main meter and Check meter (accuracy class 0.2).
Frequency of monitoring/recording	Measured continuously using calibrated meters (Main meter and Check meter) by grid officials, recorded monthly and aggregated annually.
Value applied:	2,217
Monitoring equipment	-
QA/QC procedures applied	The meters will be calibrated as per PPA/OSEB norms or at least once in a year as per National standards.

Data / Parameter	NCVn,y
Data unit	kcal/kg
Description	Net calorific value of biomass residues of category n in year y
Source of data	Periodic fuel calorific value test reports
Description of measurement methods and procedures applied	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Frequency of monitoring/recording	At least every six months, taking at least three samples for each measurement
Value applied:	3,129
Monitoring equipment	

QA/QC procedures applied	Consistency of the measurements shall be checked 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

Data / Parameter	$EF_{BR,n,y}$
Data unit	tCH4/GJ
Description	CH4 emission factor for uncontrolled burning of the biomass residues category n during the year y
Source of data	Conduct measurements or use reference default values
Description of measurement methods and procedures applied	To determine the CH4 emission factor, project participants may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 t CH4 per ton of biomass as default value for the product of NCV_k and $F_{burning,CH4,k,y}$
Frequency of monitoring/recording	-
Value applied:	0.0000411
Monitoring equipment	
QA/QC procedures applied	To determine the CH4 emission factor, project participants may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 tCH4 per ton of biomass as default value for the product of NCVk and $EF_{burning,CH4,k,y}$

Data / Parameter	Moisture content of the biomass residues
Data unit	% Water content
Description	Moisture content of each biomass residues type k
Source of data	On-site measurements
Description of measurement methods and procedures applied	Moisture content of biomass would be analyzed by using drying pan and weighing scale
Frequency of monitoring/recording	The moisture content shall be monitored for each batch of biomass of homogeneous quality. The weighted average shall be calculated for each monitoring period and used in the

	calculations
Value applied:	0.115
Monitoring equipment	-
QA/QC procedures applied	-

Data / Parameter	N_y
Data unit	---
Description	Number of truck trips for the transportation of biomass
Source of data	On-site measurements
Description of measurement methods and procedures applied	Number of trucks would be monitored continuously, recorded daily and aggregated monthly
Frequency of monitoring/recording	
Value applied:	12,734
Monitoring equipment	Site Records
QA/QC procedures applied	Consistency of the number of truck trips shall be checked with the quantity of biomass combusted and biomass purchase receipts

Data / Parameter	AVD_y
Data unit	Km
Description	Average round trip distance (from and to) between biomass fuel supply sites and the project site
Source of data	Records by project participants on the origin of the biomass
Description of measurement methods and procedures applied	Truck trip distances would be monitored continuously and aggregated monthly.
Frequency of monitoring/recording	-
Value applied:	100+100
Monitoring equipment	
QA/QC procedures applied	Consistency of distance records provided by the truckers by comparing recorded distances shall be checked with other

	information from other sources (e.g. maps).

Data / Parameter	$EF_{km,y}$
Data unit	tCO2/km
Description	Average CO2 emission factor for the trucks during the year y
Source of data	IPCC 2006 default values & local data if available
Description of measurement methods and procedures applied	Based on the formulae depicted in above section B.6.1 i.e. $EF_{km,,y}$ = ($NCV_{Diesel\ y}$ × $EF_{CO2\ diesel}$ × Density $_{diesel}$)/ (Avg. Mileage of truck × 10^6) Values of the data used: - NCV of diesel = 43.3 TJ/Gg - IPCC 2006 default CO2 emission factor of diesel = 74.8 tCO2/TJ - Fuel consumption for diesel vehicles = 4.5 km/liter. - Density of diesel = 0.845 kg/liter Monitoring frequency: At least annually
Frequency of monitoring/recording	
Value applied:	0.00060818
Monitoring equipment	
QA/QC procedures applied	Cross-check measurement results with emission factors referred to in the literature

Data / Parameter	TL_y
Data unit	Tones
Description	Average truck load of the trucks used for transportation of biomass
Source of data	On-site measurements
Description of measurement methods and procedures applied	Determined by averaging the weights of each truck carrying biomass to the project plant.
Frequency of monitoring/recording	Data monitored continuously and aggregated monthly.
Value applied:	10
Monitoring equipment	On-site measurements
QA/QC procedures	-

applied	

Data / Parameter	$FC_{coal,y}$
Data unit	Tonnes
Description	Quantity of coal combusted in boiler during the year y
Source of data	On site measurement at weigh bridge of plant & Plant Records
Description of measurement methods and procedures applied	The quantity of coal will be measured continuously using weighbridge, which is installed at the plant. The trucks carrying coal weighted by a calibrated weighbridge twice upon entry and exit to arrive net quantity of fuel procured. Accuracy = ±10 kg
Frequency of monitoring/recording	Data monitored continuously recorded daily and aggregated monthly
Value applied:	36,289
Monitoring equipment	On-site measurements
QA/QC procedures applied	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes

Data / Parameter	$FC_{diesel,y}$
Data unit	Litre
Description	Quantity of diesel used in the DG set during the year y
Source of data	Plant log book
Description of measurement methods and procedures applied	The quantity will be measured and monitored through dedicated log book for diesel consumption in DG set. The log book will have details of total quantity of diesel used in DG set. A dip stick is used for the same purpose. No accuracy level needed as no instrument is involved
Frequency of monitoring/recording	The recorded data can be cross checked against the diesel purchase receipts
Value applied:	0
Monitoring equipment	On-site measurements
QA/QC procedures applied	Considered zero for ex- ante calculations, however the measured values would be used for ex- post project emission calculations

Data / Parameter	$NCV_{i,y}$

Data unit	kcal/kg
Description	Net calorific value of the fossil fuel type i (i.e., coal and diesel) in year y
Source of data	For coal: measurements are carried out at third party lab. For diesel: IPCC default value
Description of measurement methods and procedures applied	Measurements shall be carried out at reputed laboratories and according to relevant international standards.
Frequency of monitoring/recording	In case of measurements: At least every six months, taking at least three samples for each measurement In case of other data sources: Review the appropriateness of the data annually
Value applied:	3,215 NCV of biomass = 95% of GCV = 3,384 x 95% = 3,215 kcal/kg
Monitoring equipment	-
QA/QC procedures applied	Check consistency of measurements and local/national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.

Data / Parameter	$EF_{CH4,BF}$
Data unit	tCH4/GJ
Description	CH4 emission factor for the combustion of biomass residues in the project plant
Source of data	On-site measurements or default values, as provided
Description of measurement methods and procedures applied	The CH_4 emission factor may be determined based on a stack gas analysis using calibrated analyzers
Frequency of monitoring/recording	At least quarterly, taking at least three samples per measurement
Value applied:	0.0000411
Monitoring equipment	
QA/QC procedures 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

6.2 Baseline Emissions

As per description earlier under this document:

$$BE_{EL,y} = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

$$EG_{PJ,y} = EG_{PJ,gross,y} - EG_{PJ,aux,y}$$

Where,

$BE_{EL,y}$ = Baseline emissions due to generation of electricity in year *y* (tCO_2)

$EG_{PJ,y}$ = Net quantity of electricity generated in the power plant year y (MWh)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid-connected electricity generation in year *y* (tCO_2/MWh)

$$EG_{PJ,y} = EG_{PJ,gross,y} - EG_{PJ,aux,y}$$
$$BE_{EL,y} = EG_{PJ,y} * EF_{grid,CM,y}$$

Table-1: Baseline emissions due to generation

Year	Gross Generation	Auxiliary consumption	Import consumption	Net Electricity export to Grid	Combined margin CO2	Baseline Emissions
	MWh	MWh	MWh	MWh	tCO2/MWh	tCO2e
18/7/2012 to 31/12/2012	102,641	8,264	248	94,129	0.84	79,068
2013	134,116	9,616	288	124,212	0.84	104,338
2014	123,121	10,851	326	111,944	0.84	94,033
2015	132,184	11,754	353	120,077	0.84	100,865
2016	121,165	15,102	453	105,610	0.84	88,712
2018	140,125	10,015	300	129,810	0.84	109,040
1/1/2018 to 17/7/2018	91,560	8,286	249	83,025	0.84	69,741
	844,912	73,888	2,217	768,807	-	645,798

Baseline emissions due to uncontrolled burning or decay of biomass residues under aerobic conditions:

$$BE_{BR,y} = GWP_{CH4} \cdot \sum BR_{n,B1/B3,y} \cdot 0.001971$$

$BE_{BR,y}$ = Baseline emissions due to uncontrolled burning or decay of biomass residues in year y (tCO2).

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2/tCH_4).

$BR_{n,B1/B3,y}$ = Amount of biomass residues category n used in the project plant(s) included in the project boundary in year *y* for which B1 or B3 has been identified as the most plausible baseline scenario (tones on dry-basis)

Since the biomass baseline for the project activity is B1 or B3, $\sum BR_{n,B1/B3,y}$ is the total amount of biomass residues used in the project plant in year y.

Table 2: Baseline emissions due to uncontrolled burning or decay of biomass

Year	Amount biomass residues used	Global Warming Potential of methane	Baseline Emissions $BE_{BR,y}$
	tonnes	tCO_2/tCH_4	tCO_2
18/7/2012 to 31/12/2012	112,905	21	4,673
2013	147,528	21	6,106
2014	135,433	21	5,606
2015	145,402	21	6,018
2016	133,282	21	5,517
2018	154,138	21	6,380
1/1/2018 to 17/7/2018	100,716	21	4,169
Total	**929,403**		**38,469**

The baseline emissions for the project activity are:

$$BE_y = BE_{EL,y} + BE_{BR,y}$$

Table 3: Baseline emissions

Year	$BE_{EL,y}$	$BE_{BR,y}$	Baseline Emissions
	tCO2	tCO2	tCO2
18/7/2012 to 31/12/2012	79,068	4,673	83,742
2013	104,338	6,106	110,444
2014	94,033	5,606	99,639
2015	100,865	6,018	106,883
2016	88,712	5,517	94,229
2017	109,040	6,380	115,420
1/1/2018 to 17/7/2018	69,741	4,169	73,910
	645,798	38,469	684,267

6.3 Project Emissions

The Project Emissions for the project activity are

$$PE_y = PE_{FF,Y} + PE_{TR,y} + PE_{BR,y} + PE_{EC,y}$$

Emissions due to use of fossil fuel combustion:

Project emissions due to use of coal combustion in the Boiler and diesel combustion in DG set at the project site are calculated by using the following formula.
Where,

$$PE_{FF,y} = FC_{coal,y} \times COEF_{coal,y} + FC_{diesel,y} \times COEF_{diesel,y}$$

$PE_{FF,y}$ = Project emissions during the year y due to fossil fuel combustion in the project plant

$FC_{coal,y}$ = Quantity of fuel coal combusted in process j during the year y (mass or volume unit/yr);

$COEF_{coal,y}$ = CO2 emission coefficient of fuel coal in year y (tCO2/mass or volume unit)

Where $COEF_{coal,y} = NCV_{coal,y} \times EF_{CO2,coal,y}$

$COEF_{coal,y}$ = 13.46 (GJ/ton) x 0.0997 (tCO2/GJ)

$FC_{diesel,y}$ = Quantity of fuel diesel combusted in process j during the year y (mass or volume unit/yr);

$COEF_{diesel,y}$ = CO2 emission coefficient of fuel diesel in year y (tCO2/mass or volume unit)

Where,

$COEF_{diesel,y} = NCV_{diesel,y} \times EF_{CO2,diesel,y}$

$COEF_{diesel,y}$ = 43.3 (GJ/ton) x 0.0748 (tCO2/GJ)

Project emissions due to use of coal combustion at the project site are calculated assuming 10% of coal (on energy basis) would be used in the plant.

Project emissions due to coal:

$PE_{FF,coaly} = FC_{coal,,y} \times NCV_{coal,y} \times EF_{CO2,coal,y}$

Table-4: Project emissions due to fossil fuel (coal) combustion

Year	Coal Consumption	GCV for Coal	NCV of coal	Emission factor coal	Project Emissions
	tonnes	**kcal/kg**	**GJ/ton**	**tCO_2/GJ**	**tCO_2**
18/7/2012 to 31/12/2012	2,772	3,384	13.460	0.0997	3,720
2013	6,746	3,384	13.460	0.0997	9,053
2014	7,701	3,384	13.460	0.0997	10,334
2015	7,001	3,384	13.460	0.0997	9,395
2016	6,010	3,384	13.460	0.0997	8,065
2017	3,320	3,384	13.460	0.0997	4,455
1/1/2018 to 17/7/2018	2,739	3,384	13.460	0.0997	3,676
Total	**69,289**				**90,244**

Project emissions due to Diesel:

$PEFF_{diesel,y} = FC_{diesel,,y} \times NCV_{diesel,y} \times EF_{CO2,diesel,y}$

Table-5: Project emissions due to fossil fuel (diesel) combustion

Year	Diesel consumption	Diesel consumption	NCV of diesel	Emission factor diesel	Project Emissions diesel
	litres	kg	GJ/ton	tCO_2/GJ	tCO_2
18/7/2012 to 31/12/2012	0	0	43.3	0.0748	0
2013	0	0	43.3	0.0748	0
2014	0	0	43.3	0.0748	0
2015	0	0	43.3	0.0748	0
2016	0	0	43.3	0.0748	0
2017	0	0	43.3	0.0748	0
1/1/2018 to 17/7/2018	0	0	43.3	0.0748	0

Project emissions due to coal & Diesel:

$$PE_{FF,Y} = PE_{FF,coaly} + PE_{FFdiesel,y}$$

Table 6: Project emissions due to fossil fuel combustion:

Year	Project Emissions coal	Project Emissions diesel	Project Emissions $PE^{FF,y}$
	tCO_2	tCO_2	tonnes
18/7/2012 to 31/12/2012	3,720	0	3,720
2013	9,053	0	9,053
2014	10,334	0	10,334
2015	9,395	0	9,395
2016	8,065	0	8,065
2017	4,455	0	4,455
1/1/2018 to 17/7/2018	3,676	0	3,676
Total	48,698	**0**	48,698

Project emissions in year y due to transport of biomass residues to project plant ($PE_{TR,y}$)

$$PE_{TR,y} = \frac{BR_{TR,y}}{TL_y} * AVDy * EF_{km,y}$$

Table 7: Project emissions due to biomass residues transportation

Year	Quantity of Biomass residues transported	Average round trip distance	Average truck load	Emission factor for trucks	Off-site transport Emissions $PE_{TR,y}$
	tonnes	km	tons	tCO2/km	tCO2
18/7/2012 to 31/12/2012	112,905	200	10	0.00060818	1373
2013	147,528	200	10	0.00060818	1794
2014	135,433	200	10	0.00060818	1647
2015	145,402	200	10	0.00060818	1769
2016	133,282	200	10	0.00060818	1621
2017	154,138	200	10	0.00060818	1875
1/1/2018 to 17/7/2018	100,716	200	10	0.00060818	1225
Total					11,305

Project emissions from the combustion of biomass residues ($PE_{BR,y}$)

$$PE_{BR,y} = GWP_{CH4} * EF_{CH4,BR} * \sum_{n} BR_{PJ,n,y} * NCV_{n,y}$$

CH_4 emission factor for combustion of biomass residues in the project plant would be determined based on stack gas analysis using calibrated analyzers. In the absence of such data default values are used for ex-ante calculations.

Table 8: Project emissions from combustion of biomass residues

Year	Amount biomass residues used	Global Warming Potential of methane	CH_4 emission factor for combustion biomass	Average NCV of biomass	Project Emissions $PE_{BR,y}$
	tonnes	tCO_2/tCH_4	tCH_4/GJ	GJ/ton	tCO_2
18/7/2012 to 31/12/2012	112,905	21	0.0000411	13.102	1277
2013	147,528	21	0.0000411	13.102	1668
2014	135,433	21	0.0000411	13.102	1532
2015	145,402	21	0.0000411	13.102	1644
2016	133,282	21	0.0000411	13.102	1507

2017	154,138	21	0.0000411	13.102	1743
1/1/2018 to 17/7/2018	100,716	21	0.0000411	13.102	1139
Total					10,510

Project Emissions from electricity consumption ($PE_{EC,y}$):

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

Table: 9. Project emissions from electricity consumption

	Quantity of electricity consumed (Import)	Grid CO_2 Emission factor	Average T&D Losses	Project Emissions $PE_{EC,y}$
	MWh	tCO_2/MWh	%	tCO_2
18/7/2012 to 31/12/2012	248	0.84	18	246
2013	288	0.84	18	286
2014	326	0.84	18	323
2015	353	0.84	18	350
2016	453	0.84	18	449
2017	300	0.84	18	298
1/1/2018 to 17/7/2018	249	0.84	18	246
Total				0

Total Project emissions are:

$$PE_y \; PE_{FF,y} + PE_{TR,y} + PE_{BR,y} + PE_{EC,y}$$

Table 10-Total Project Emissions

Year	$PE^{FF,y}$	$PE^{TR,y}$	$PE^{BR,y}$	$PE^{EC,y}$	Project Emissions PE_y
	tCO_2	tCO_2	tCO_2	tCO_2	tCO_2
18/7/2012 to 31/12/2012	3,720	1373	1277	246	6,616
2013	9,053	1794	1668	286	12,801
2014	10,334	1647	1532	323	13,836
2015	9,395	1769	1644	350	13,158
2016	8,065	1621	1507	449	11,642
2017	4,455	1875	1743	298	8,371
1/1/2018 to 17/7/2018	3,676	1225	1139	246	6,286
Total	90,244	9,221	8,573	2,197	72,710

6.4 Leakage

The project activity is generating electricity using surplus biomass residues; hence, according to Indicative simplified baseline and monitoring methodologies for selected CDM project activity categories: “General guidance on leakage in biomass project activities” (Version 03), the leakage source applicable is ‘Competing use of biomass’. This is accomplished by the biomass survey report furnished to DOE and explained in section B.4 of this report.

The surplus availability of each type of biomass residue in the project region is in the range of 69.2% to 149.5% larger than the quantity of biomass residues of that type which is utilized in the region including the project plant. Hence, the leakage of the project activity is zero.

LEy = 0

6.5 Net GHG Emission Reductions and Removals

The total emission reduction achieved in current monitoring period is

ERy = BEy – PEy – LEy
ERy = 684,267 - 72,710 - 0 tCO2

Hence, total emission reductions for the project activity in current monitoring period

= 611,557 tCO2

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)
18/7/2012 to 31/12/2012	83,742	6,616	0	77,126
2013	110,444	12,801	0	97,643
2014	99,639	13,836	0	85,803
2015	106,883	13,158	0	93,725
2016	94,229	11,642	0	82,587
2017	115,420	8,371	0	107,049
1/1/2018 to 17/7/2018	73,910	6,286	0	67,624
Total	626,972	72,710	0	611,557

Further, the comparison for estimated emission reductions as per validated VCS PD and actual observed are detailed below. The emission reductions are lower than the estimated value.

Parameters	tCO2e
Estimated Annual Emission Reduction per year	87,446
Emission Reductions for the monitoring period (2191 days)	611,557
Emission reductions achieved in monitoring period	524,915
Percentage of variation when compared with estimated ERs	-16.5%

The variation in the Emission Reductions are 16.5 % less due to break downs in the operation during the monitoring period.