PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Biomass Based Thermal Energy Generation By Bhani Agro India Pvt Ltd

Version 1.0

Date 06/07/2022

First CoU Issuance Period: 1 Years, 1 Months

Crediting Period: 09/11/2020 to 31/12/2021

Universal Carbon Registry	**PROJECT CONCEPT NOTE**

BASIC INFORMATION

Title of the project activity	**Biomass Based Thermal EnergyGeneration By Bhani Agro India Pvt Ltd,**
Scale of the project activity	Small Scale
Completion date of the PCN	06/07/2022
Project participants	Project Proponent: Bhani Agro India Pvt Ltd Aggregator: Ozone Envirotech Private limited
Host Party	India
Applied methodologies and standardized baselines	**CDM UNFCCC Methodology** **AMS-I.C**.: Thermal energy production with or without electricity (Ver.21.0)
Sectoral scopes	01 Energy industries (Renewable/NonRenewable Sources)
Estimated total amount of average GHG emission reductions per year	32526 CoUs (32526 tCO_{2eq})

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The project **Biomass Based Thermal Energy Generation By Bhani Agro India Pvt Ltd** is located at Malhipur Road, Village: Wazirpur, District: Bahraich State: Uttar Pradesh, Country: India.

The details of the registered project are as follows:

Purpose of the project activity:
The project activity meets the in house demand of steam of Bhani Agro India Pvt Ltd (BAIPL) a rice mill manufacturing facility, and involves the installation of a 14 TPH biomass (rice husk) based boiler. The primary technology for the project activity involves direct combustion of biomass in the boiler to generate thermal energy. During combustion chemical energy contained in the biomass is converted into thermal energy, which is utilized for steam/hot air generation. The boiler of 14 TPH capacity has outlet parameters of 10.54 kg/cm^2 (pressure) and 180 ºC (temperature). The boiler was first steam tested on 09/11/2020 which is considered as the commissioning date of the project activity.

BAIPL was incorporated in 04/05/2018 with the objective of operating a rice milling facility that processes paddy from nearby fields. The commercial operations of this plant commenced in 2020. The raw material for the products manufactured at BAIPL are procured directly from farmers and from the open market. The main purpose of rice milling is to remove the hulls and bran from harvested, dried rough rice/paddy and to produce a milled, polished, or white rice.

The project activity is thus the thermal energy production using renewable energy sources that displaces fossil fuel use (coal) and avoids GHG emissions (CO_2). In the pre-project scenario, the process demand of steam would have been met by a coal fired boiler. The project results in reductions of CO_2 emissions that are real, measurable and give long-term benefits to the mitigation of climate change.

Assured supply of biomass fuel and other barriers to biomass boiler implementation

The project activity could have used coal instead of biomass. In India, the continuous and uninterrupted supply of fossil fuel (coal and furnace oil-FO) from nearby depots does not require BAIPL to deploy manpower and is the cheaper alternative. On the other hand, rice husk being an agricultural produce is dependent on the vagaries of the nature, has to be sourced from a large number of suppliers and is seasonal in nature. Getting assured supply of biomass is dependent on many uncontrolled parameters thereby increasing the risk of shutdown for the project activity.

Considering the criticality of supply of steam, BAIPL would have ideally used a coal fired boiler for their in house activities at the manufacturing unit. This source of fossil fuel derived steam is more reliable, well proven, easier to operate and is subject to minimal breakdown as opposed to a biomass based boiler. Although fossil fuel based energy generation sources are more reliable but are carbon intensive and lead to emissions of greenhouse gases (GHGs) in the atmosphere, the project proponent being an environment conscious organization, decided to implement a 14 TPH biomass (rice husk) based boiler in light of concerns on global warming caused due to accumulation of greenhouse gases. The rice husk based boiler helps avoid and mitigates GHG emissions that would have been generated from the coal fired boiler. The project activity has the following ongoing technological and operational risks:

- The ash generated after combustion of rice husk contains high percentage of silica which leads to rapid erosion of the equipments. Due to high silica content and the shape of rice husk, equipments like ID fan, cone portion of air preheater and top portion of the stack get eroded which leads to high maintenance cost, frequent breakdown and increased downtime. Presence of silica in rice husk ash also corrodes boiler tubes which require frequent maintenance of the boiler. Further, in rice husk fired boilers, escape of fluidized media along with flue gas is a common problem. To compensate this and to maintain fluidized bed thickness, fluidizing media is required to be added at regular intervals. This leads to variation in the air requirement;
- The fuel flow control with respect to the steam output is difficult in biomass fired boilers.
- The steam requirements in the Rice Industry is a continuous processes, any disruption in supply leads to heavy production losses and BAIPL would be incurring huge financial burden.
- The problems with biomass (rice husk) are further aggravated due to the higher level of moisture and at times presence of impurities added. Many a times, the rice husk procured is mixed with impurities such as dust particle, stones and pebbles, and other biomass such as leaves, straw etc. The impurities present can damage the machinery and also provide incorrect estimates of the biomass requirement for steam generation. In addition to this the effective cost of biomass is also increased affecting project's viability. The moisture content of rice husk may vary depending upon the season and also during transportation. In the monsoons, the moisture content will be comparatively more as compared to the other seasons. While transportation of fuel, precautions will have to be taken against unpredictable rainfall, and other weather conditions to ensure availability of biomass with least moisture levels. The presence of moisture (more than normal) would not only affect the net calorific value of biomass but also result in increased effective cost of it. This creates problems during combustion and also affects the economic viability of the project activity and as there is no structured market for biomass, BAIPL would have to depend on what ever is available and may have to face these problems. The perceived technological and operating risks of project activity has lead to events of boiler breakdown and the revenue from the sale of UCR carbon credits would help in covering these technological and operational ongoing risks.
- There is a lot of manpower and logistical efforts required from the project proponent in collection and transportation of the biomass residues (rice husk) from various locations to the project site as there is a lack of a structured and established market is Uttar Pradesh

- BAIPL has to spend on additional resources to make sure the availability of the biomass to the project activity is regular and uninterrupted. Other than this, due to seasonal availability of biomass residues, BAIPL spends on arrangements for storage of biomass residues at the project site that has entail investment in land and its management. Formal markets for such products do not exist and it is not possible to execute a long-term contracts for stable procurement of biomass fuel for such steam generation projects.
- The bulk density of biomass is very low and as such transportation cost is much higher compared to conventional fossil fuels. To ensure a continuous and regular supply, a biomass management program has been prepared by the project proponent.
- There has to be further precautions taken by the project proponent to store the fuel from adverse weather conditions.
- An in-house facility has been setup to check the quality of biomass and to take immediate necessary action with respect to the storage of rice husk. Rice husk has low specific gravity which requires proper handling and storage procedures at the project site, requiring a larger stocking area.

The use of biomass for on-site energy faces a significant supply chain barrier. The supply chain for rice husk is highly variable according to local conditions but is, in most cases, informal and erratic. Energy security from biomass is very poor on the long-term due to the uncertainty of the market but also at the short- and immediate term due to the informality of the market and the relative unreliability of suppliers. There is no steady supply of biomass, nor a steady cost. This barrier represents a major risk for industrial facilities, for whom energy security is paramount to continued production, which is the major line of business. Several studies have identified that the security of fuel is a more important factor than the simple economics of the fuel price for industrial energy users (Asian Institute of Technology, 2005; Evald, 2005).

Projects using biomass for captive energy generation in India are generally considered to have a high risk of discontinuation, since the price of biomass as well as the unreliability of the supply chain favour a switch to coal fired energy generation in most cases (source: https://newclimate.org/wp-content/uploads/2017/05/vulnerability-of-cdm.pdf, May 2017).

The sale of voluntary carbon credits and revenue from the same will increase the financial attractiveness for the continued use of biomass at captive energy industries across India. From the above paragraphs, it is clear that the project activity has and continues to face barriers, but in spite of that, BAIPL decided to implement this project and revenue from the sale of UCR carbon credits would help mitigate the above barriers and showcase de-carbonizing efforts such as fossil fuel switch to biomass, is profitable and desirable as a necessary tool to fight global warming and climate change.

A.2 Do no harm or Impact test of the project activity>>

Thereare social, environmental, economic and technological benefits which contribute to sustainable development.

- **Social benefits:**
- The project activity contributes to employment generation in the local area for both skilled & unskilled people for operation and maintenance of the equipments.
- It has created steady higher value jobs and skilled workers at the facility. The project activity is contributing to the national energy security by reducing consumption of fossil fuels.
- The technology being used in the project is proven and safe for steam generation. An increase in such kind of projects shall enable all the technology suppliers to continuously innovate and modernize on the technology front. The local people will know the technological advancement and will help in capacity building.

- **Environmental benefits:**
- The project activity is a renewable energy project, which utilizes b i o m a s s as a fuel for steam generation, a move that is voluntary and not mandated under current environmental laws of India. Since this project activity generates green energy in the form of steam, it has positively contributed towards the reduction in (demand) use of finite natural resources like coal and oil, minimizing depletion and in turn increasing its availability to other important purposes. Therefore, this project activity helps to environment sustainability by reducing GHG emission in the atmosphere.
- Avoids global and local environmental pollution, leading to reduction of GHG emissions.
- The rice husks generated in rice mills in the region are generally in excess and hence gets disposed in unplanned ways including dumping into nearby rivers. As a result of such disposal and due to natural decay in the absence of the project activity, the rice husks used in the project would have emitted methane.

- **Economic benefits:**
- The project activity creates employment opportunities during the project stage and operation and maintenance of the boiler.
- The project activity helps in conservation of fast depleting natural resources like coal and oil thereby contributing to the economic well being of country as a whole.
- The increase in demand of rice husk exerted by the project has had a local effect on its price and generates additional revenue for the rice millers, which in turn benefits the local farmers, as this is paddy-growing area. The project activity results in saving the coal and allowing it to be diverted to other needy section of the economy.

A.3. Location of project activity >>

Country: India
Site: Malhipur Road,
Village: Wazirpur
District: Bahraich
State: Uttar Pradesh (U.P.)
Latitude: 27° 37' 23.88" N
Longitude: 81° 39' 13.968" E


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A.4. Technologies/measures >>

The ministry of Environment and forests (MoEF),Government of India, under the environment impact Assessment Notification has listed a set of industrial activities in Schedule of the notification which for setting up new projects or modernization /expansion will require environmental clearance and will have to conduct an Environmental Impact Assessment(EIA) study. BAIPL project activity does not require EIA to be conducted as the activity is not included in schedule I.

The project activity is the installation of a biomass (rice husk) fired boiler for steam generation. The generated steam is utilized for meeting the process requirement. In the baseline scenario the steam was generated through a coal based boiler, to meet BAIPL's process requirement. The project activity has replaced coal based boiler with rice husk based boiler for steam generation thus the project activity is environment friendly and leads to GHG emission reduction.

The CO2 emission due to the combustion of rice husk/bagasse is neutralized by the photosynthesis process of paddy crops. Hence, it "recycles" atmospheric carbon and does not add to the greenhouse effect. And also the rice husk/bagasse contains negligible quantities of nitrogen and sulphur, hence the other green house gas from the combustion of rice husk/bagasse can be neglected. The coal being a carbon intensive fuel leads to GHG emissions hence implementation of the project activity leads to GHG emission reductions.

No transfer of technology is involved to host country because technology is available within India from reputed manufactures.

Specification	Value
Capacity of Boiler	14 TPH
Temperature	180 ^{0}C
Number of Boilers	1
Pressure	10.54 kg/cm^2
Feed Material	Rice Husk approx 81 TPD
Enthalpy of Steam**	2.777 MJ/kg
Operation days/annum	330 days/yr, 24hrs/day
Enthalpy of water @80 ^{0}C*	0.335 MJ/kg
Boiler Rating	14*(2.777-0.335)/3.6 = 9.50 $MW_{thermal}$
NCV Rice Husk	3314 kcal/kg
Moisture Content Rice Husk	7.03%
NCV Coal	6823 kcal/kg
Feed Water Temp	80 ^{0}C

*https://www.peacesoftware.de/einigewerte/wasser_dampf_e.html

** https://www.peacesoftware.de/einigewerte/calc_dampf.php7

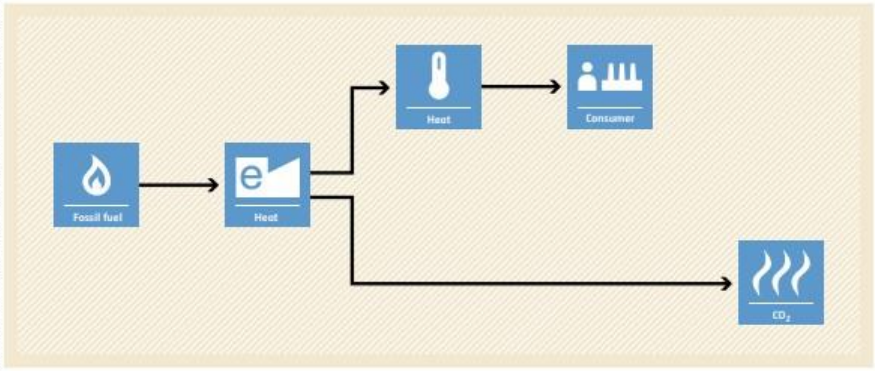
A.5. Parties and project participants >>

Project activity does not involve any public funding from Annex I Party, which leads to the diversion of the official development assistance.

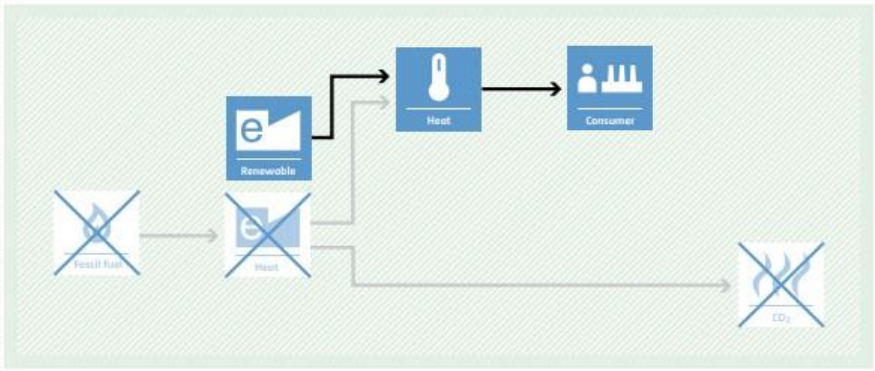
Party (Host)	Participants/Aggregator
India	Project Proponent: Bhani Agro India Pvt Ltd Aggregator: Ozone Envirotech Private Limited Email: ozone.env@gmail.com Phone 8558800447

A.6. Baseline Emissions>>

BASELINE SCENARIO
Energy generation (thermal heat and / or electricity) by more-carbon-intensive technologies based on fossil fuel. In case of retrofits or capacity addition, operation of existing renewable power units without retrofit and capacity addition.



PROJECT SCENARIO
Energy generation by installation of new renewable energy generation units, by retrofitting or replacement of existing renewable energy generation units as well as by switch from fossil fuel to biomass in modified existing facilities.



The approved baseline methodology has been referred from the indicative simplified baseline and monitoring methodologies for selected small-scale UNFCCC CDM project activity categories.

The applicable methodology and simplified modalities and procedures for small scale CDM project activities, states that "*For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced. IPCC default values for emission coefficients may be used*"

Emission coefficient of fuel used in the baseline scenario
In absence of the project activity, the probable baseline scenario would have been steam generation using fossil fuel (coal). Thus to determine emission co-efficient BAIPL has used emission factor for coal as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories for GHG emissions which is 96.1 tCO2 /TJ.

Emission coefficient of fuel used in the project activity
The fuel used in the project activity is the biomass residues (rice husk), which is a carbon neutral fuel and therefore the emission coefficient (tC/TJ) is zero.

A.7. Debundling>>
This project is not a debundled component of a larger registered carbon offset project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines >>

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)

TYPE I - **Renewable Energy Projects**

CATEGORY- ***AMS-I.C.: Thermal energy production with or without electricity (Ver. 21.0)***

This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.

B.2. Applicability of methodologies and standardized baselines >>

The project activity is thermal energy generation project using a biomass (rice husk) based boiler that displaces equivalent amount of thermal energy that would have been generated by a fossil fuel based boiler. Since the project activity utilises rice husk for the generation of thermal energy by displacing fossil fuel (coal), it meets the primary applicability criteria of the methodology.
The thermal generation capacity of project activity is 9.50 $MW_{thermal}$ which is less than the threshold of 45$MW_{thermal}$ asper the applied methodology.
The biomass used by the project plant is not stored for more than one year.
The project activity is neither a co-generation nor co-firing system, therefore this condition is not applicable in the case of BAIPL project activity.
Biomass generated steam is used for captive use.
The project activity replaces the fossil fuel based thermal energy generation. There was no renewable energy based system prior to the project activity.
Thermal energy generation capacity are determined by taking the difference between enthalpy of total output leaving the project equipment and the total enthalpy of input entering the project equipment.
The installed biomass boiler generates steam to meet the demand of steam recipient plant and displace fully the use of fossil fuel based boilers. The project technology utilizes appropriate treatment systems to ensure exhaust gas and discharged water in compliance with national environmental regulations. Note that fossil fuel (i.e. furnace oil, coal, gas, etc) cannot be used for biomass fired boilers due to its specialized design of combustion chamber. The service level (e.g. temperature, pressure) of supplied steam in case of utilizing different types of renewable biomass residues is ensured by qualified boiler operators and is monitored by steam flow meter at recipient plant. The project activity will thus reduce Green house gas (GHG) emissions associated with the combustion of fuel oil in baseline boilers. The project activity claims emission reduction for the thermal energy production by renewable energy technologies (biomass boilers) that displace the use of fossil fuel based boilers. This is in line with the applied methodology AMS I.C requirements.

B.3. Applicability of double counting emission reductions >>

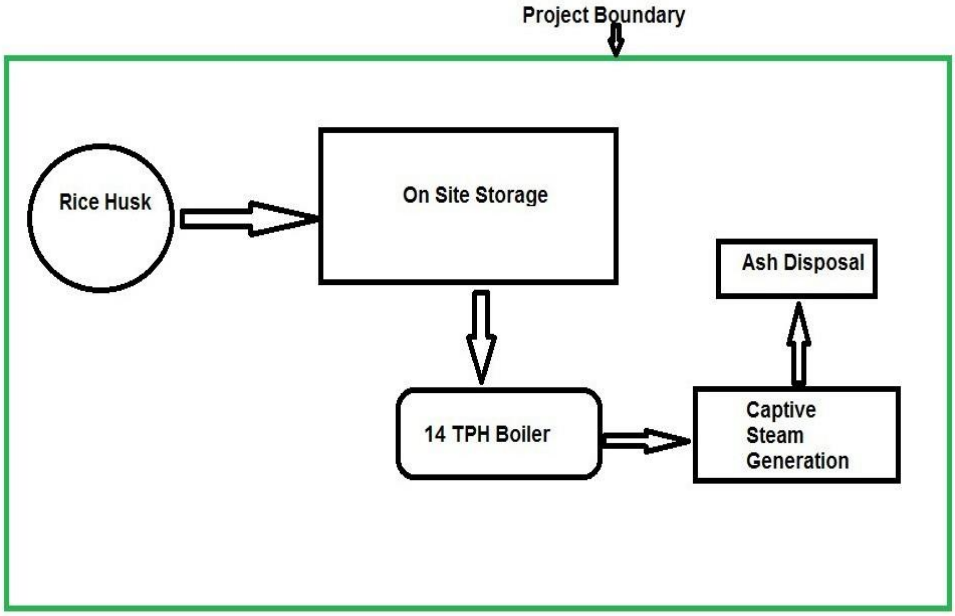
The biomass boiler is constructed by the project proponent within the rice mill. The biomass boiler has a unique IDs (UP/8164), which is visible on the unit. The Monitoring Report has the details and will be provided to the UCR verifier during the verification process.

The project has never applied for carbon credits under any other GHG program or for the 2020-2021 vintage years and hence there is no double counting of the credits.

B.4. Project boundary, sources and greenhouse gases (GHGs)>>

The project boundary includes the physical, geographical site(s) of:

- Site of the renewable energy generation.
- Biomass based boiler, which starts from the biomass storage to the point of steam supply
- Biomass storage facility



Leakage Emissions is not applicable as the project activity does not use technology or equipment transferred from another activity.

There is no registered or an application to register another small-scale carbon project activity with the same project participants in the same project category within 1 km of the project boundary, hence the project activity is not a debundled component of a large scale project.

	Source	GHG	Included?	Justification/Explanation
Baseline	Co2 Emissions from fossil fuel in boilers for heat	CO_2	**Included**	Major source of GHG emissions
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Emissions from Biomass Project Activity	CO_2	**Included**	Biomass emissions excluded for simplification. This is conservative. Emissions from coal co-fired is considered as a source of GHG emissions
	Emissions from Coal co-fired in Project Activity	CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

B.5. Establishment and description of baseline scenario >>

The baseline scenario identified at the PCN stage of the project activity is:

- Renewable energy technologies that displace technologies using fossil fuels, wherein the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced.

Emission Reductions (ER_y) The emission reduction due to the project activity is calculated as the difference between the baseline emissions and the sum of the project emissions and the leakage:

$$\mathbf{ERy = BE_y - (PE_y + LE_y)}$$

$\boldsymbol{BE_y}$= Baseline emissions in year y (t CO_{2e})

As mentioned in the methodology AMS I.C, for steam produced using fossil fuels the baseline emissions are calculated as follows:

$$\boldsymbol{BE_y} = \mathbf{(HG_y * EF_{CO2}) / \eta_{th}}$$

Where:

HGy = The net quantity of heat supplied by the project activity during the year in TJ. It is calculated as product of quantity of steam generated and net enthalpy of steam. The net enthalpy of steam is calculated as difference of enthalpy of steam and enthalpy of feedwater. The enthalpy of steam is calculated from steam pressure and steam temperature..

EF_{CO2} = The CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO2/TJ), obtained from reliable local or national data if available, otherwise,IPCC default emission factors are used.

η_{th} – The efficiency of the boiler using fossil fuel that would have been used in the absence of the project activity (Table 1 below).

PEy = Project activity emissions. The GHG emissions due to the combustion of biomass is neutralized by the sequestration done during the growth of the biomass, thereby making it a carbon neutral fuel. Further the rice husk and bagasse contains negligible quantities of nitrogen and sulphur, the other green house gas from the combustion of biomass can be considered as negligible. Therefore essentially the Project Emissions would be the GHG emissions due to the co-firing of coal in the project activity within the project boundary.

LE_y = Leakage emissions. Leakages is to be considered if the energy generating equipment is transferred from another activity or if the existing is transferred to another activity. There is no transfer of energy generating equipment or existing equipment to another activity. Further, emissions arising during the transportation of rice husk to the site, is negligible since the biomass is sourced locally within a radius of less than 200 kms, hence considered as negligible.

EF_{CO2}	=	96.1 tCO2/TJ IPCC 2006 guidelines for National Greenhouse Gas inventories got stationary combustion

Table 1. Default baseline efficiency values for different technologies as per AMS IC Methodology

Technology of the energy generation system	Default efficiency
New natural gas fired boiler (w/o condenser)	92%
New oil fired boiler	90%
Old natural gas fired boiler (w/o condenser)	87%
New coal fired boiler	85%
Old oil fired boiler	85%
Old coal fired boiler	80.00%

Specification	Value
Capacity of Boiler	14 TPH
Temperature	180 ^{0}C
Number of Boilers	1
Pressure	10.54 kg/cm^2
Feed Material	Rice Husk approx 81 TPD
Enthalpy of Steam**	2.777 MJ/kg
Operation days/annum	330 days/yr
Enthalpy of water @80 ^{0}C*	0.335 MJ/kg
NCV Rice Husk	3314 kcal/kg
Moisture Content Rice Husk	7.03%
NCV Coal	6823 kcal/kg
Feed Water Temp	80 ^{0}C
No. Of working hours/day	24

*https://www.peacesoftware.de/einigewerte/wasser_dampf_e.html

** https://www.peacesoftware.de/einigewerte/calc_dampf.php7

(HG_y= Qty. Of steam generated * (Enthalpy of steam -enthalpy of water)

= 110880 * 2.442MJ

= 270.769Tj

$BE_y = (HG_y * EF_{CO2}) / \eta_{th}$

= (270.769 * 96.1)/0.80

= 32526

$ERy = BE_y - (PE_y + LE_y)$

= 32526-(0+0) =32526

Hence estimated reduction per annuam =32526 tcou/year

B.6. Prior History>>

The project activity has not applied to any other GHG program for generation or issuance of carbon offsets or credits.

B.7. Changes to start date of crediting period >>

There is no change in the start date of crediting period (09/11/2020).

B.8. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN monitoring plan and applied methodology

B.9. Monitoring period number and duration>>

First Issuance Period: 1 years, 1 months
First CoU Issuance Period: 1 Years, 1 Months
Crediting Period: 09/11/2020 to 31/12/2021

B.8. MonitoringPlan>>

According to the approved methodology AMS-I.C – Thermal energy production with or without electricity (Version 21), the following parameters will be monitored:

Parameters	Description
$Q_{S,y}$	Quantity of steam supplied per year measured at recipient's end
$T_{steam,y}$	Temperature of steam at the recipient's end
$P_{steam,y}$	Pressure of steam
$E_{steam,y}$	Enthalpy of the saturated steam supplied to the recipient
$T_{Feedwater}$	Temperature of boiler feed water
$E_{Feedwater}$	Enthalpy of feed water
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year y
$B_{Biomass,y}$	Net quantity of biomass consumed in year y (on dry basis)
$MC_{biomass}$	Moisture content of the biomass
EF_{CO2}	The CO_2 emission factor of the coal (fossil fuel) that would have been used in the baseline plant.

The monitoring and recording of the required parameters is carried out by trained personnel who are managed by the Biomass Boiler Project Managers. All measurements will use calibrated measurement equipment that are maintained regularly and checked for its functioning which will meet the minimum requirement of the methodology. All indicators of importance for controlling and reporting of projects performance have been incorporated in the monitoring plan (Monitoring Report

during verification) as well as indicated in the planned formal set of monitoring protocol and work instructions.

Data/Parameter	Date of commissioning of biomass boiler
Data unit	Date as per boiler test report.
Description	Actual date of commissioning of the project device
Source of data Value(s) applied	Monitoring Report As and when commissioned
Measurement methods and procedures	The construction processes are maintained from its initiation to completion dates for the biogas unit. Thus the start date of each of the unit installed is recorded in the monitoring report.
Monitoring frequency	As and when commissioned and fixed and recorded in the monitoring report
Purpose of data	To estimate baseline emissions

Data/Parameter	$Q_{biomass}$
Data unit	MT
Description	The quantity of rice husk and bagasse used to generate steam in the boiler
Source of data Value(s) applied	Plant records and log books receipts
Measurement methods and procedures	Monitoring: The quantity of biomass fed into the boiler is controlled. Data type: Measured Responsibility: Boiler Operator
Monitoring frequency	Daily
QA/QC	The amount of biomass used can be cross checked by the purchase orders and stock inventory for rice husk

Data/Parameter	S_P
Data unit	Kg/cm2 boiler
Description	Pressure of the steam at the outlet of the biomass boiler
Source	The steam pressure would be measured using pressure gauge. This parameter is used to calculate the Net Enthalpy of steam.
Measurement methods and procedures	Monitoring: Log book Data type: Monitored
Monitoring frequency	Daily/Hourly
QA/QC	The parameter is monitored and logged in log sheets. Based on the logged data, a report consisting of the parameter are prepared by Shift in charge in hard copy and are forwarded to manager on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months.

Data/Parameter	$T_{feedwater}$
Data unit	^{0}C
Description	The temperature of feed water
Source of data Value(s) applied	Plant Log Sheets
Measurement methods and procedures	Feed water temperature is measured in the plant premises by using temperature gauge. This parameter is used to calculate the Net Enthalpy of steam. Monitoring: Log book Data type: Monitored
Monitoring frequency	Daily
QA/QC	The parameter is monitored and logged in log sheets. Based on the logged data, a report consisting of the parameter are prepared by Shift in charge in hard copy and are forwarded to manager on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months.
Data/Parameter	h_f
Data unit	Kj/kg
Description	Feed water enthalpy
Source of data Value(s) applied	Plant Log Sheets
Measurement methods and procedures	Type: Calculated Data type: Monitored
Monitoring frequency	Daily
QA/QC	The parameter is monitored and logged in log sheets. Based on the logged data, a report consisting of the parameter are prepared by Shift in charge in hard copy and are forwarded to manager on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months.

Data/Parameter	h_g
Data unit	Kj/kg
Description	Steam enthalpy
Source of data Value(s) applied	Plant Log Sheets
Measurement methods and procedures	Type: Calculated Data type: Monitored
Monitoring frequency	Daily
QA/QC	The parameter is is calculated from the monitored steam pressure. Based on the logged data, a report consisting of the parameter are prepared by Shift in charge in hard copy and are forwarded to manager on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months.