



**Verified Carbon
Standard**

JILIN LIAOYUAN 50MW LEVEL BIOMASS COGENERATION PROJECT

Document Prepared by Beijing Ruifang Information Technology Co., Ltd.

Project Title	Jilin Liaoyuan 50MW Level Biomass Cogeneration Project
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Jilin Liaoyuan 50MW Level Biomass Cogeneration Project (hereafter referred to as the Project) is located in Liaoyuan City, Jilin province. The project utilizes local surplus biomass residues (mainly as maize stalk) for generating heat and electricity.

The installed capacity is 30MW. The project has installed one straw-fired boiler imported from Denmark BWE Company, which is a world leading company in biomass boilers production. The project has also installed a set of turbine and generator, which are produced domestically. The expected annual net generation of 190.2 GWh will be exported to the Northeast China Power Grid (NEPG) and supply 0.75 million GJ of heat to Longshan Industrial Development Zone per year.

The GHG emission reductions are from two components. Firstly, the project activity substituted electricity generation of NEPG dominated by fossil fuel power plants. Secondly, the project activity used biomass residues, which will reduce CH₄ emissions because the biomass is dumped or left to decay or burned in an uncontrolled manner in the absence of the project. No emission reduction will be claimed due to the heat replacement as per registered PDD and the accepted revised PDD. The estimated annual GHG emission reductions are 190,139 tCO_{2e}.

The project started construction on 28/06/2006. The project started commissioning on 30/11/2007.

This monitoring period is from 25/09/2013 to 29/11/2017 (1527days). The project operated normally during this monitoring period and the emission reductions are 806,163tCO₂.

1.2 Sectoral Scope and Project Type

Sectoral scope 1: energy industries (Renewable sources)

This project is not a grouped project.

1.3 Project Proponent

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Title	Manager
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1.4 Other Entities Involved in the Project

Organization name	Beijing Ruifang Information Technology Co., Ltd.
Role in the Project	Project participant
Contact person	Teng Haipeng
Title	Manager
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1.5 Project Start Date

30/11/2007 (project started commissioning, which means that the project started to generate GHG emissions)

1.6 Project Crediting Period

This project was registered under CDM on 09/03/2010 and the first crediting period is 09/03/2010 to 08/03/2017, which is renewable. Therefore, the total crediting period is from 09/03/2010 to 08/03/2031.

The project was registered under VCS and the first crediting period is from 30/11/2007 to 29/11/2017, which could be renewed twice. According to the rules of VCS, the total crediting period is from 30/11/2007 to 08/03/2031.

1.7 Project Location

The project site is located in Longshan Industrial Development Zone, which is 10 kilometers from the central area of Liaoyuan City. The Project has geographical coordinates with east longitude of 125°15'23" and north latitude of 42°55'24". Geographical location of the project is shown in Figure 1 and Figure 2



Figure 1. Location of Jilin province in China



Figure 2. Location of the project in Jilin province

1.8 Title and Reference of Methodology

The approved baseline and monitoring methodology applied in the project activity is ACM0006 (Version 06.2) – “Consolidated methodology for grid-connected electricity generation from biomass residues”.

In line with the application of the ACM0006 methodology the project refers to the following tools and methodology:

- Combined tool to identify the baseline scenario and demonstrate additionality (Version 02.2).
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 1).
- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion (Version 2).

1.9 Participation under other GHG Programs

This project has been registered as a CDM project on 09/03/2010, and the registration number is 2563. It has been issued carbon credits under CDM mechanism with monitoring period from 09/03/2010 to 24/09/2013.

The emission reductions from 25/09/2013 to 29/11/2017 has not been and will not be counted or claimed under other GHG programs.

The project has not claimed any other forms of environment credit.

1.10 Other Forms of Credit

This project has been registered as a CDM project on 09/03/2010, and the registration number is 2563. It has been issued carbon credits under CDM mechanism with monitoring period from 09/03/2010 to 24/09/2013.

The emission reductions from 25/09/2013 to 29/11/2017 has not been and will not be counted or claimed under other GHG programs.

The project has not claimed any other forms of environment credit.

1.11 Sustainable Development

The project will contribute to the sustainable development in the region as list in following aspects:

- By using maize stalk as fuels for power generation, saving the amount of coal use and making the straws utilization in high efficiency, which will assist China in stimulating and accelerating the commercialization of grid-connected renewable energy technologies and markets in China.
- The ash as by-product of straws burning can be used as ash fertilizer, which will amount to over 21,420 tons in one year.
- The project will improve the livelihoods of local people by creating employment opportunities and promoting the local tourism industry.
- The project will facilitate the local relevant industry such as straw purchase, straw transport and straw storage.
- The project will reduce GHG emissions compared to a business-as-usual scenario.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Statement Report was completed by the project owner and approved by Jilin Environmental Protection Bureau in January of 2006.

According to the Environmental Impact Statement Report, the environmental impacts arising from the Project are analyzed respectively for the construction phase and the operation phase.

Construction Phase

Noise

Noises generated during the construction period are mainly from construction machines. Measures such as making reasonable arrangement of construction machines, setting up noise screen, employing low noise equipment conducive to environmental protection, avoiding concrete mixing and construction during night and so on will be taken to minimize the impact of noises on the external environment.

Dust

Excavation and backfilling of earth, loading and unloading of raw materials, and transportation of vehicles during construction of the Project might generate dust and tail gas at the construction site and the surrounding area. Measures such as reasonable laying out storage space, covering powdered materials and so on will be taken to reduce the impact of dust on the surrounding area. Dust will automatically disappear after completion of the construction. The vehicles are operating on a discontinuous basis, and time during which pollutants are discharged is relatively short and the quantity of pollutant discharged relatively small. Moreover, since the exhaust stacks are relatively low, diffusion scope of tail gas is not large, and thus impact on the surrounding area is relatively small.

Waste water

Waste water generated during construction of the Project is mainly the residential waste water and part of the production waste water (43t/d). After the sedimentation of the construction waste water, the supernatant fluid will be used for farm irrigation, and the sludge will be set to the city landfill site for disposal.

Solid waste

Solid waste generated during construction of the Project is mainly building garbage, discarded earth and residential garbage. Building garbage and discarded earth will be cover with tarpaulin and collectively transported to designated places for landfill treatment. Residential garbage will be collected at the designated places and regularly cleared.

Ecological environment and city landscape

There is no wildwood and endangered species alongside the construction site, therefore, construction of the Project will not have long-term and destructive impact on the surrounding vegetation. Animals inhabiting in the area under evaluation of the Project are mainly small wild animals such as birds, snakes and rats, which have a relatively loose requirement on the growth environment and adapt well to human influence. These animals will migrate during construction and can return after completion of the construction. Construction of the Project will not disturb their normal life.

The Project will be constructed as a new industrial park. Multi-levelled artificial buildings will enhance the diversity of the landscape, which can form a multi-space landscape with stereoscopic effects.

Although the landscape is different from the previous one featured by natural agricultural ecology, it satisfies the planning of the development zone, and its impact on the ecological landscape is acceptable.

Operation phase

Waste gas

Air pollutants emitted during construction of the Project are largely flue gas, SO₂ and NO_x. Since Sulphur content of the straw is low and cyclone plus bag-type two-step dust extractor as well as low-nitrogen combustion system are employed, waste gas emissions from the Project are far lower than the requirement of Emission Standard of Air Pollutants for Thermal Power Plants (GB13223-2003). After being dedusted, flue gas of the Project will be emitted passing a 120 m high chimney with an inner diameter of 4.0 m, which reduces the impacts of unorganized low-altitude emissions resulting from combusting straw on the environment and contributes to the improvement of regional environmental status.

Noise

Measures such as employing low-noise equipment, adopting noise damping, sound isolation and damping measures, establishing noise isolation belt, and reinforcing planting work within the plant area and so on will be taken by the Project to reduce the impacts of noises on the working staff and the surrounding environment. Forecast of the noises within the plant area of the Project satisfies the limit requirement of standard III listed in the Standard of noise at boundary of industrial enterprises, and the noises during the operation will not have significantly harmful impacts on the acoustical environment quality of the surrounding area.

Waste water

Various types of waste water of the Project will be treated based on the principles of separating clean water from dirty water and multi-usage of the water, and reused after the treatment. Residential waste water, acid-alkali wastewater, general industrial waste water and the like industrial waste water will be reused as ash-eliminating water, replenished water for recycled water and rinsing water. Only a small amount of waste water (2.65 m³/h) will be sent to Liaoyuan Sewage Disposal Plant for uniform treatment via the sewage pipe network of the development zone.

Solid waste

Ash resulting from combustion of fuels by the Project will be used as fertilizers in the farmland of the Project location, which not only reduces the burden on farmers, but also achieves the integrated utilization of ash. Residential garbage generation by the Project will be disposed by the environmental sanitation agencies and has little impact on the environment.

According to the results of EIA and the reply from the Environmental Protection Bureau, the impacts on the environment are not significant.

The project does not bring negative environmental and socio-economic impacts.

2.2 Local Stakeholder Consultation

In Nov 2006, assisted by the local government, to investigate the impacts on local ecological environment, the project owner carried out a survey of the local residents who might be affected by the project activities by delivering and collecting questionnaire.

Two staff delivered the questionnaires to the residents within Liaoyuan county randomly, especially the people living closed to the project site and the four storage sites, 50 questionnaires were delivered, and the whole process of the delivery and collection of the questionnaires are completed until the middle of Nov 2006.

Comments received through the survey are summarized as follows. The government of Liaoyuan County issued a support letter for the Project which is available for DNA and DOE. It can be seen that respondents are adequately representative in terms of gender, age and educational level, and their attitudes towards the impacts of the Project can be a comprehensive reflection of the attitudes of the residents possibly affected by the Project. Of the 46 respondents:

- 45 respondents (97.83%) support the construction of the Project and 1 respondent (2.17%) left blank.

- Respondents consider that positive impacts possibly caused by the construction of the Project include increased income (91.30%), increased employment opportunities (89.13%), improved living standards (84.78%) and reduction of air pollutants emission from decay and uncontrolled burning of biomass residues (73.91%).

- Respondents generally believe that construction of the Project will be conducive to the environmental protection and income increase for the farmers, a few respondents are concerned that implementation of the Project might cause an increase of fuel price (10.87%), increase of environmental pollution (8.70%), increase of waste water (6.52%) and increase of noise (2.17%).

The public investigation shows that the government and authorities at all levels support the project construction actively, confirm its social and environmental benefits, and wish the construction could be started early and accelerated. The project probably will lead to some concerns, but all concerns can be explained or solved in a reasonable way.

Besides, a grievance book was put in the office of the company. Anyone who have comments on the project could write on the book. And the phone number of the office is known for local people. Therefore, local stakeholders could also leave comments by the phone.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity is to collect and utilize biomass residues (mainly as maize stalks) to generate electricity and heat.

The project made good use of biomass residues as fuels and installed a 130t/h water-cooling librated boiler with high temperature and high pressure made in China authorized by Denmark BWE Company, one 30MW steam turbine and one suited generator have been applied in the project.

Table 1. Main equipment adopted by the project

Parameters	Unit	Value
Boiler		
Type	/	HG-130/9.2-S.JG1
boiler maximum continuous rating	t/h	130
Superheated Steam pressure	Mpa	9.2
Superheated Steam temperature	°C	540
Boiler feed-water temperature	°C	210
Boiler Efficiency	%	≥92
Boiler Exhaust Temperature	°C	130
Boiler Dirt-discharge Rate	%	2
Expected lifetime (industry standard)	years	30
Manufacturer		BWE boiler made by Harbin Boiler Group Co., Ltd.
Steam turbine		
Model	/	C30-8.83/0.981
Rated Output	MW	30
Rated Rotation Speed	r/min	3000
Rated Flow of main steam	t/h	110
Rated Pressure of main steam	MPa	8.83
Rated Temperature of main steam	°C	535

Efficiency	%	81%
Expected lifetime (industry standard)	years	30
Manufacturer		Qingdao Jieneng Steam Turbine Group Co., Ltd
Generator		
Model	/	QF-30-2
Rated Output	MW	30
Rated Voltage	kV	6.3
Rated Electric Current	A	3437
Rated Rotation Speed	r/min	3000
Efficiency	%	≥97.6
Expected lifetime (industry standard)	Years	30

The total installed capacity of the proposed project is 30MW and the estimated net generation of electricity in approved accepted revised PDD is 190.2 GWh per year and supply 0.75 million GJ of heat to Longshan Industrial Development Zone per year.

The electricity output was transmitted through transformer at the site connected to Jilin Provincial Power Grid that is an integral part of Northeast China Power Grid (NEPG).

According to the registered PDD, the project owner will not claim GHG emission reductions from displacing heat that would otherwise been produced within Longshan Industrial Development Zone.

The detailed technical process is in diagram below.

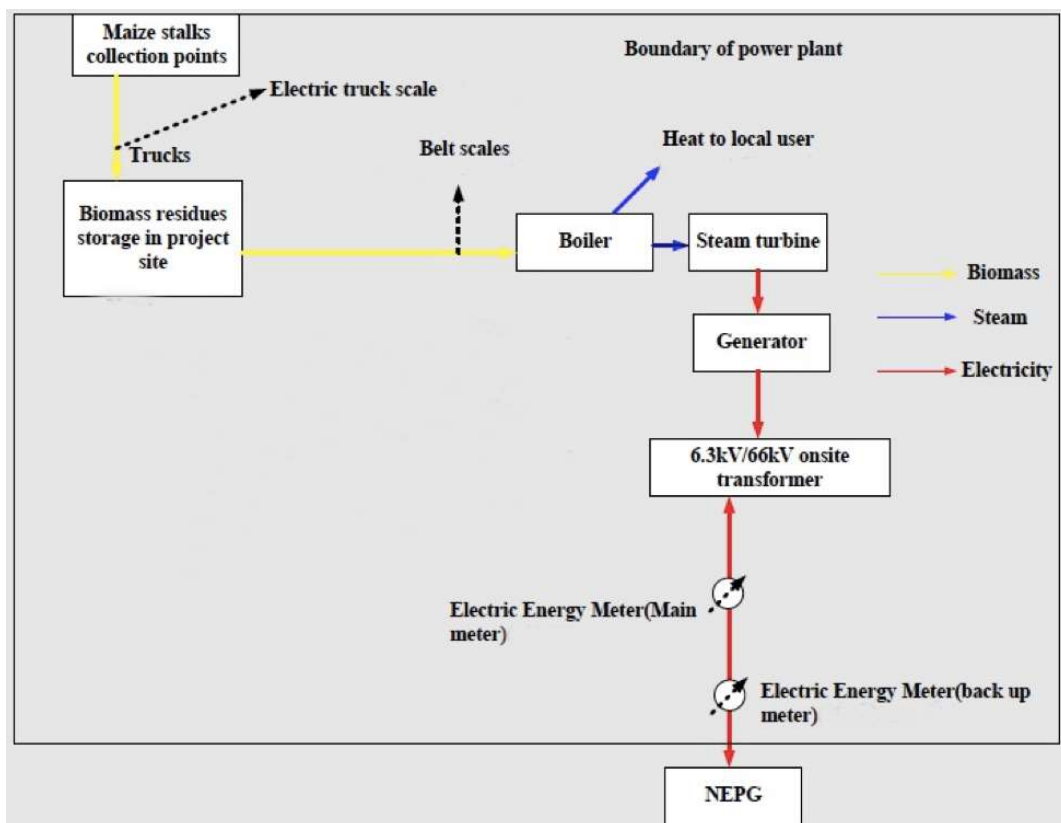


Figure 3. Technical process

3.2 Deviations

2.2.1 Methodology Deviations

There is no methodology deviation in this monitoring period.

2.2.2 Project Description Deviations

There are some project description deviations in this monitoring period.

- 1) The scale of weight meter is extended from 30t to 50t. And belt scales are used to monitor the biomass consumption.

In the registered PDD, the project owner planned to use SCS-30t-QC to monitor the biomass weight. However, after the project operated, the project owner chose SCS-50t-QC to monitor the biomass transported into plant. The scale is extended and more convenient to monitor.

The project owner chose belt scale of HY2105 and 6001B to monitor the biomass feeding into boiler. Belt scale is easier to monitor the biomass feeding into boiler than truck scale. The accuracy

of SCS-50t-QC, HY2105 and 6001B all class III. This will not influence the data accuracy because these meters are calibrated according to national standards.

2) The monitoring equipment for biomass moisture is different with those in PDD.

The moisture is monitored by electronic blast oven and electronic balance. While in the registered PDD, it was planned to be monitored by moisture analyzer (HMT2). Compared with moisture analyzer (HMT2), electronic blast oven and electronic balance are more common and both of them are calibrated by qualified third party according to national standards. Therefore, this would not influence the data accuracy.

3) The NCV of biomass is monitored by the project owner.

As the project requires to monitor the NCV of biomass at least every six months, the project owner decided to buy the calorimeter to monitor the NCV. The calorimeter was calibrated by qualified third party each year to assure its accuracy of 0.1%. This will not influence the data accuracy.

3.3 Grouped Projects

Not applicable as this is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP _{CH4}
Data unit	tCO ₂ e/tCH ₄
Description	Global Warming Potential for CH ₄
Source of data	IPCC default value
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	F _{i,j,y}
Data unit	Mtons, Mm ³

Description	the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y
Source of data	China Energy Statistical Yearbook (2000~2005)
Value applied	Annex 3 of registered PDD
Justification of choice of data or description of measurement methods and procedures applied	Official statistical data
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	NCV _i
Data unit	TJ/ mass or volume unit of a fuel
Description	the net calorific value (energy content) per mass or volume unit of a fuel i
Source of data	China Energy Statistical Yearbook (2005)
Value applied	Annex 3 of registered PDD
Justification of choice of data or description of measurement methods and procedures applied	Official statistical data
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	EF _{CO₂,i}
Data unit	tCO ₂ /GJ
Description	CO ₂ emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Annex 3 of registered PDD
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	EGy
Data unit	MWh
Description	Net electricity generated and delivered to the North-East China grid in year y
Source of data	China Energy Statistical Yearbook (2000 – 2005)
Value applied	Annex 3 of registered PDD
Justification of choice of data or description of measurement methods and procedures applied	Official statistical data
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	BTCA
Data unit	g/kWh
Description	fuel consumption for best technology commercially available
Source of data	China's statistical data http://www.ccchina.gov.cn
Value applied	320
Justification of choice of data or description of measurement methods and procedures applied	According to China's statistical data, the standard coal consumption for fuel-fired power generation in 2000 is 350g/kWh. And if various measures aimed at improving energy efficiency could be carried out, the value of 350g/kWh is expected to reduce to 320g/kWh by 2010. Therefore, the value of $EF_{BTCA_fire\ y}$ is conservative.
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

Data / Parameter	CAP_{fire-y}
Data unit	MW
Description	installed capacity of fuel-fired power in year y within the northeast china grid
Source of data	China Electric Power Yearbook
Value applied	Annex 3 of the registered PDD
Justification of choice of data or description of	Official statistical data

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/
Data / Parameter	CAP _y
Data unit	MW
Description	Total installed capacity of various power in year y within the northeast china grid
Source of data	China Electric Power Yearbook
Value applied	Annex 3 of the registered PDD
Justification of choice of data or description of measurement methods and procedures applied	Official statistical data
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	/

4.2 Data and Parameters Monitored

Data / Parameter	EG _{project plant,y}
Data unit	MWh/year
Description	Net electricity generated in the project plant during the year y
Source of data	Measured by electricity meter
Description of measurement methods and procedures to be applied	It is measured by the electricity meter continuously and recorded monthly. A backup meter is also installed. The meters are calibrated annually to ensure its accuracy.
Frequency of monitoring/recording	Measured continuously and recorded Monthly.
Value monitored	792588.720 The monthly data is shown in table 2 of section 5.
Monitoring equipment	Identify equipment used to monitor the data/parameter including type, accuracy class, and serial number of equipment, as appropriate. The information of electricity meters is shown in following table

	Meter	Model	SN	Accuracy	Calibration date	Validity
	Main meter	ZMD402CT44	93982941	0.2S	13/03/2013	12/03/2014
					07/03/2014	06/03/2015
					02/03/2015	01/03/2016
					26/02/2016	25/02/2017
					20/02/2017	19/02/2018
	Backup meter	ZMD402CT44	93982942	0.2S	13/03/2013	12/03/2014
					07/03/2014	06/03/2015
					02/03/2015	01/03/2016
					26/02/2016	25/02/2017
					20/02/2017	19/02/2018
QA/QC procedures to be applied	The meters are calibrated by national standard. The meter records are crosschecked with the sales receipts.					
Purpose of the data	Calculation of baseline emissions					
Calculation method	The total electricity data will be used for baseline emission calculation					
Comments	/					

Data / Parameter	EC _{PJ,y}
Data unit	MWh/year
Description	On-site electricity consumption attributable to the project activity during the year y
Source of data	Measured by electricity meter
Description of measurement methods and procedures to be applied	It is measured by the electricity meter continuously and recorded monthly. A backup meter is also installed. The meters are calibrated annually to ensure its accuracy.
Frequency of monitoring/recording	Measured continuously and recorded Monthly. The monthly data is shown in table 8 of section 5.
Value monitored	350.280

Monitoring equipment	The information of electricity meters is shown in following table					
	Meter	Model	SN	Accuracy	Calibration date	Validity
	Main meter	ZMD402CT44	93982941	0.2S	13/03/2013	12/03/2014
					07/03/2014	06/03/2015
					02/03/2015	01/03/2016
					26/02/2016	25/02/2017
					20/02/2017	19/02/2018
	Backup meter	ZMD402CT44	93982942	0.2S	13/03/2013	12/03/2014
					07/03/2014	06/03/2015
					02/03/2015	01/03/2016
					26/02/2016	25/02/2017
					20/02/2017	19/02/2018
QA/QC procedures to be applied	The meters are calibrated by national standard. The meter records are crosschecked with the sales receipts.					
Purpose of the data	Calculation of project emissions					
Calculation method	The total electricity data will be used for project emission calculation					
Comments	/					

Data / Parameter	EG _{PJ,y}
Data unit	MWh/year
Description	Electricity consumption at the biomass residue storage sites.
Source of data	Measured by electricity meter
Description of measurement methods and procedures to be applied	It is measured by the electricity meter continuously and recorded monthly.
Frequency of monitoring/recording	Measured continuously and recorded Monthly.
Value monitored	0
Monitoring equipment	The 3 biomass residue storage sites have been closed since 19/04/2010, no monitoring equipment was re-installed since then. If new biomass residue storage site(s) are built, the new electricity meter(s) installed will also be calibrated annually.

QA/QC procedures to be applied	The meters are calibrated by national standard. The meter records are crosschecked with the sales receipts.
Purpose of the data	Calculation of project emissions
Calculation method	The total electricity data will be used for project emission calculation
Comments	/

Data / Parameter	TDL _y
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to the Northeast China Power Grid in year y.
Source of data	Default value in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" quoted by ACM0006 version 06.2.
Description of measurement methods and procedures to be applied	/
Frequency of monitoring/recording	/
Value monitored	20%
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	BF _{T,k,y}
Data unit	tons of dry maize stalks
Description	Quantity of biomass residue type k that has been transported to the project site during the year y where k are the types of biomass residues used in the project plant in year y. (k=maize stalks)
Source of data	Measured by weight meter

Description of measurement methods and procedures to be applied	Measured when the truck entered into the Project site and recorded, adjust for the moisture content in order to determine the quantity of dry biomass, and monthly cumulated value will be used for emission reduction calculation.																																									
Frequency of monitoring/recording	Measured continuously and recorded Monthly.																																									
Value monitored	795,503.05 The monthly data is shown in table 5 of section 5.																																									
Monitoring equipment	The information of weight meters is shown in following table: <table><tr><td></td><td>installed Position s</td><td></td><td>Type</td><td>Accu racy</td><td>Serial No.</td><td>Calibration date</td><td>valid date</td></tr><tr><td rowspan="9">Weight Meter</td><td rowspan="9">Weight house at the entrance of the power plant</td><td rowspan="9">To monitor the quantity of maize stalks transported to the project site</td><td rowspan="9">SCS-50t-QC</td><td rowspan="9">Class III</td><td rowspan="9">212</td><td>12/06/2013</td><td>11/12/2013</td></tr><tr><td>09/12/2013</td><td>08/06/2014</td></tr><tr><td>03/06/2014</td><td>02/12/2014</td></tr><tr><td>25/11/2014</td><td>24/05/2015</td></tr><tr><td>19/05/2015</td><td>18/11/2015</td></tr><tr><td>13/11/2015</td><td>12/05/2016</td></tr><tr><td>08/05/2016</td><td>07/11/2016</td></tr><tr><td>04/11/2016</td><td>03/05/2017</td></tr><tr><td>28/04/2017</td><td>27/10/2017</td></tr><tr><td>23/10/2017</td><td>22/04/2018</td></tr></table>									installed Position s		Type	Accu racy	Serial No.	Calibration date	valid date	Weight Meter	Weight house at the entrance of the power plant	To monitor the quantity of maize stalks transported to the project site	SCS-50t-QC	Class III	212	12/06/2013	11/12/2013	09/12/2013	08/06/2014	03/06/2014	02/12/2014	25/11/2014	24/05/2015	19/05/2015	18/11/2015	13/11/2015	12/05/2016	08/05/2016	07/11/2016	04/11/2016	03/05/2017	28/04/2017	27/10/2017	23/10/2017	22/04/2018
	installed Position s		Type	Accu racy	Serial No.	Calibration date	valid date																																			
Weight Meter	Weight house at the entrance of the power plant	To monitor the quantity of maize stalks transported to the project site	SCS-50t-QC	Class III	212	12/06/2013	11/12/2013																																			
						09/12/2013	08/06/2014																																			
						03/06/2014	02/12/2014																																			
						25/11/2014	24/05/2015																																			
						19/05/2015	18/11/2015																																			
						13/11/2015	12/05/2016																																			
						08/05/2016	07/11/2016																																			
						04/11/2016	03/05/2017																																			
						28/04/2017	27/10/2017																																			
23/10/2017	22/04/2018																																									
QA/QC procedures to be applied	The weight meter is calibrated by national standard. The records are crosschecked with energy balance based on stock change record. The yearly energy efficiency based on maize consumption in the monitoring period is shown as follows: <table><tr><td>Year</td><td>Efficiency (%)</td></tr><tr><td>2013</td><td>22%</td></tr><tr><td>2014</td><td>21%</td></tr><tr><td>2015</td><td>20%</td></tr><tr><td>2016</td><td>22%</td></tr><tr><td>2017</td><td>21%</td></tr></table>								Year	Efficiency (%)	2013	22%	2014	21%	2015	20%	2016	22%	2017	21%																						
Year	Efficiency (%)																																									
2013	22%																																									
2014	21%																																									
2015	20%																																									
2016	22%																																									
2017	21%																																									
Purpose of the data	Calculation of project emissions																																									
Calculation method	/																																									
Comments	/																																									

Data / Parameter

 $BF_{k,y}$

Data unit	tons of dry maize stalks																																																																																						
Description	Quantity of biomass residue type k combusted in the project plant during the year y (k=maize stalks)																																																																																						
Source of data	Measured by belt scale																																																																																						
Description of measurement methods and procedures to be applied	It is measured by the belt scale continuously and recorded monthly. Adjust for the moisture content in order to determine the quantity of dry biomass.																																																																																						
Frequency of monitoring/recording	Measured continuously and recorded Monthly.																																																																																						
Value monitored	790,188.71 The monthly data is shown in table 3 of section 5.																																																																																						
Monitoring equipment	The information of belt scales are shown in following table: <table><tr><th></th><th>installed Position s</th><th></th><th>Type</th><th>Accu racy</th><th>Serial No.</th><th>Calibration date</th><th>valid date</th></tr><tr><td rowspan="10">Belt scale 1</td><td rowspan="10">In front of the boiler</td><td rowspan="10">To monitor the quantity of maize stalks combusted in the project plant</td><td rowspan="10">HY2105</td><td rowspan="10">Class III</td><td rowspan="10">81218</td><td>13/06/2013</td><td>12/12/2013</td></tr><tr><td>09/12/2013</td><td>08/06/2014</td></tr><tr><td>03/06/2014</td><td>02/12/2014</td></tr><tr><td>25/11/2014</td><td>24/05/2015</td></tr><tr><td>19/05/2015</td><td>18/11/2015</td></tr><tr><td>13/11/2015</td><td>12/05/2016</td></tr><tr><td>08/05/2016</td><td>07/11/2016</td></tr><tr><td>04/11/2016</td><td>03/05/2017</td></tr><tr><td>28/04/2017</td><td>27/10/2017</td></tr><tr><td>23/10/2017</td><td>22/04/2018</td></tr><tr><td rowspan="10">Belt scale 2</td><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10">HY2105</td><td rowspan="10"></td><td rowspan="10">090325</td><td>13/06/2013</td><td>12/12/2013</td></tr><tr><td>09/12/2013</td><td>08/06/2014</td></tr><tr><td>03/06/2014</td><td>02/12/2014</td></tr><tr><td>25/11/2014</td><td>24/05/2015</td></tr><tr><td>19/05/2015</td><td>18/11/2015</td></tr><tr><td>13/11/2015</td><td>12/05/2016</td></tr><tr><td>08/05/2016</td><td>07/11/2016</td></tr><tr><td>04/11/2016</td><td>03/05/2017</td></tr><tr><td>28/04/2017</td><td>27/10/2017</td></tr><tr><td>23/10/2017</td><td>22/04/2018</td></tr><tr><td rowspan="10">Belt scale 3</td><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10">6001B</td><td rowspan="10"></td><td rowspan="10">6B23262 163X088 8</td><td>13/06/2013</td><td>12/12/2013</td></tr><tr><td>09/12/2013</td><td>08/06/2014</td></tr><tr><td>03/06/2014</td><td>02/12/2014</td></tr><tr><td>25/11/2014</td><td>24/05/2015</td></tr><tr><td>19/05/2015</td><td>18/11/2015</td></tr><tr><td>13/11/2015</td><td>12/05/2016</td></tr><tr><td>08/05/2016</td><td>07/11/2016</td></tr><tr><td>04/11/2016</td><td>03/05/2017</td></tr><tr><td>28/04/2017</td><td>27/10/2017</td></tr><tr><td>23/10/2017</td><td>22/04/2018</td></tr></table>		installed Position s		Type	Accu racy	Serial No.	Calibration date	valid date	Belt scale 1	In front of the boiler	To monitor the quantity of maize stalks combusted in the project plant	HY2105	Class III	81218	13/06/2013	12/12/2013	09/12/2013	08/06/2014	03/06/2014	02/12/2014	25/11/2014	24/05/2015	19/05/2015	18/11/2015	13/11/2015	12/05/2016	08/05/2016	07/11/2016	04/11/2016	03/05/2017	28/04/2017	27/10/2017	23/10/2017	22/04/2018	Belt scale 2			HY2105		090325	13/06/2013	12/12/2013	09/12/2013	08/06/2014	03/06/2014	02/12/2014	25/11/2014	24/05/2015	19/05/2015	18/11/2015	13/11/2015	12/05/2016	08/05/2016	07/11/2016	04/11/2016	03/05/2017	28/04/2017	27/10/2017	23/10/2017	22/04/2018	Belt scale 3			6001B		6B23262 163X088 8	13/06/2013	12/12/2013	09/12/2013	08/06/2014	03/06/2014	02/12/2014	25/11/2014	24/05/2015	19/05/2015	18/11/2015	13/11/2015	12/05/2016	08/05/2016	07/11/2016	04/11/2016	03/05/2017	28/04/2017	27/10/2017	23/10/2017	22/04/2018
	installed Position s		Type	Accu racy	Serial No.	Calibration date	valid date																																																																																
Belt scale 1	In front of the boiler	To monitor the quantity of maize stalks combusted in the project plant	HY2105	Class III	81218	13/06/2013	12/12/2013																																																																																
						09/12/2013	08/06/2014																																																																																
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						23/10/2017	22/04/2018																																																																																
Belt scale 2			HY2105		090325	13/06/2013	12/12/2013																																																																																
						09/12/2013	08/06/2014																																																																																
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						28/04/2017	27/10/2017																																																																																
						23/10/2017	22/04/2018																																																																																
QA/QC procedures to be applied	The belt scales are calibrated by national standard. The combustion records are crosschecked with energy balance based on purchased quantities and stock change record. The yearly energy efficiency based on maize consumption in the monitoring period is shown as follows:																																																																																						

	Year	Efficiency (%)
	2013	22%
	2014	21%
	2015	20%
	2016	22%
	2017	21%
Purpose of the data	Calculation of project emissions	
Calculation method	The total electricity data will be used for project emission calculation	
Comments	/	

Data / Parameter	Moisture content of the biomass residues					
Data unit	%					
Description	Moisture content of maize stalks					
Source of data	Measured in the chemical laboratory of the power plant					
Description of measurement methods and procedures to be applied	The biomass was sampled continuously and the moisture content of them was monitored by electric blast oven and electronic balance in the chemical laboratory of the power plant when they are transported to the plant and storage stations, and then inspected their values with national standard GB/T211-2007. Moisture content of maize stalks of every truck arrived in the power plant has been monitored. And then the monthly simple mean value of biomass is worked out.					
Frequency of monitoring/recording	Measured when every truck arrived, and monthly simple mean value has been applied in the ER calculation.					
Value monitored	The average value is 28.65% and the monitoring value of each time can be seen in table 7 of section 5.					
Monitoring equipment	The information of metering equipment is shown in following table:					
	Type	Accuracy	Serial No.	Calibration date	valid date	
Electric oven	DHG-9145A	0.02	0900466	30/08/2013	29/08/2014	
				27/08/2014	25/08/2015	
				21/08/2015	20/08/2016	
				17/08/2016	16/08/2017	
				14/08/2017	13/08/2018	
Electronic balance	TE4101-L	Class III	24390302	27/08/2013	26/08/2014	
				27/08/2014	25/08/2015	
				21/08/2015	20/08/2016	
				17/08/2016	16/08/2017	
				14/08/2017	13/08/2018	

QA/QC procedures to be applied	The monitoring equipment are calibrated by national standard. The records are crosschecked with energy balance based on stock change record. The yearly energy efficiency based on maize consumption in the monitoring period is shown as follows: <table border="1"> <thead> <tr> <th>Year</th><th>Efficiency (%)</th></tr> </thead> <tbody> <tr> <td>2013</td><td>22%</td></tr> <tr> <td>2014</td><td>21%</td></tr> <tr> <td>2015</td><td>20%</td></tr> <tr> <td>2016</td><td>22%</td></tr> <tr> <td>2017</td><td>21%</td></tr> </tbody> </table>	Year	Efficiency (%)	2013	22%	2014	21%	2015	20%	2016	22%	2017	21%
Year	Efficiency (%)												
2013	22%												
2014	21%												
2015	20%												
2016	22%												
2017	21%												
Purpose of the data	Calculation of project emissions												
Calculation method	/												
Comments	/												

Data / Parameter	EF _{CH₄,BF}
Data unit	tCH ₄ /GJ
Description	CH ₄ emission factor for the combustion of biomass residues in the project plant.
Source of data	Default value coming from Tables 4 and 5 of the baseline methodology.
Description of measurement methods and procedures to be applied	According to the IPCC 2006 default value provided in table 3 of ACM0006, the CH ₄ emission factor of combustion of biomass in agriculture is 0.03tCH ₄ /TJ. Considering a conservativeness factor of 1.37, the CH ₄ emission factor is taken as 0.0000411 tCH ₄ /GJ.
Frequency of monitoring/recording	/
Value monitored	0.0000411
Monitoring equipment	/
QA/QC procedures to be applied	Default value as provided in Table 4 of the baseline methodology multiplied by the maximum conservativeness factor provided in Table 5 of the baseline methodology will be used during the first crediting period
Purpose of the data	Calculation of project emissions
Calculation method	/

Comments	/				
Data / Parameter	NCV _k				
Data unit	GJ / ton of dry matter (k=maize stalks)				
Description	Net Calorific Value of maize stalks				
Source of data	Default value coming from Tables 4 and 5 of the baseline methodology.				
Description of measurement methods and procedures to be applied	Measurements shall be carried out at reputed laboratories and according to relevant international standards at least every six months, taking at least three samples for each measurement. Measure the NCV based on dry biomass.				
Frequency of monitoring/recording	At least once half a year.				
Value monitored	The average value is 16.861 and the monitoring data of each time can be seen in table 7 of section 5.				
Monitoring equipment	The NCV is measured by calorimeter, which is calibrated by national standards.				
	Model	Serial No.	Accuracy	Calibration date	Valid date
	SDACM4000	1000009	0.1%	03/03/2013	02/03/2014
				26/02/2014	25/02/2015
				13/02/2015	12/02/2016
				02/02/2016	01/02/2017
23/01/2017				22/01/2018	
QA/QC procedures to be applied	PO has checked consistency of measurements and local/national data with default values by the IPCC. There is little difference from IPCC default values				
Purpose of the data	Calculation of project emissions				
Calculation method	/				
Comments	/				

Data / Parameter	AVD _y
Data unit	km
Description	Average return trip distance (from and to) between biomass fuel supply sites and the project site
Source of data	Records by project participants
Description of measurement methods and	Distance travelled by trucks will be continuously monitored and recorded. For conservativeness, 100km is used for calculation.

procedures to be applied	
Frequency of monitoring/recording	Recording distance when every truck arrived at project site
Value monitored	The actual transportation distance from biomass collection site to the power plant is less than 50km. For conservativeness, 100km is used for calculation.
Monitoring equipment	/
QA/QC procedures to be applied	PO has checked consistency of distance records provided by the truckers by comparing recorded distances with maps for QA/QC.
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	TLy							
Data unit	tons							
Description	Average load of the trucks used for transportation of biomass							
Source of data	On-site continuous measurement, aggregated annually							
Description of measurement methods and procedures to be applied	All the trucks will be weighed by a weigh bridge, which is expected to be purchased before the project become operational. The measures to operate the bridge and the accuracy will be according to the description in the user's manual provided by the suppliers. Therefore, TLy will be determined by averaging the weights of each truck carrying biomass to the project plant. Data will be archived 2 years following the end of the crediting period.							
Frequency of monitoring/recording	Each time when the trucks arrive at the project site.							
Value monitored	The weighted average value is 14.14 The monthly data is shown in table 5 of section 5.							
Monitoring equipment		installed Position s		Type	Accu racy	Serial No.	Calibration date	valid date
	Weight Meter	Weight house at the entrance of the power plant	To monitor the quantity of maize stalks transported to the project site	SCS-50t-QC	Class III	212	12/06/2013	11/12/2013
							09/12/2013	08/06/2014
							03/06/2014	02/12/2014
							25/11/2014	24/05/2015
							19/05/2015	18/11/2015
							13/11/2015	12/05/2016
							08/05/2016	07/11/2016
							04/11/2016	03/05/2017
							28/04/2017	27/10/2017
23/10/2017	22/04/2018							

QA/QC procedures to be applied	The weight meter is calibrated according to national standards.
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	EF _{km,CO2,y}
Data unit	tCO ₂ /km
Description	Average CO ₂ Emission Factor for transportation of biomass with Trucks.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Description of measurement methods and procedures to be applied	IPCC default value
Frequency of monitoring/recording	Shall be updated according to IPCC latest version
Value monitored	0.001011
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	FF _{project,plant,y}
Data unit	tons
Description	Quantity of fossil fuel type i combusted in the project plant during the year y.
Source of data	On-site measurements
Description of measurement methods and	The boiler does not need any diesel for start-ups, so no monitoring equipment has been settled to monitor FF _{project plant,i,y} in the initial design stage. FF _{project plant,i,y} is 0.

procedures to be applied	
Frequency of monitoring/recording	Measured continuously
Value monitored	0
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	FF _{project site,i,y}				
Data unit	Mass/year				
Description	Quantity of diesel combusted at the project plant for other purposes that are attributable to the project activity during the year y.				
Source of data	On-site measurements				
Description of measurement methods and procedures to be applied	Monitored Continuously and calculated monthly. The volumes of diesel are converted into weight using a conservative 0.88 ton/m³ specific gravity value				
Frequency of monitoring/recording	Measured continuously and monthly recorded				
Value monitored	712.53 The monthly data is shown in table 5 of section 5.				
Monitoring equipment	It is monitored by flow meter. The meter information is as follows:				
	Model	Serial No.	Accuracy	Calibration date	Valid date
	LC11-A	46	0.5	12/08/2013	11/08/2014
				07/08/2014	06/08/2015
				03/08/2015	02/08/2016
				29/07/2016	28/07/2017
			24/07/2017	23/07/2018	
QA/QC procedures to be applied	It is crosschecked with stock change and purchase records.				

Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	EF _{CO2,FF,i}
Data unit	tCO ₂ /GJ
Description	CO ₂ emission factor for fossil fuel type i
Source of data	Default value
Description of measurement methods and procedures to be applied	The upper limit of the uncertainty at a 95% confidence interval of IPCC default values as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories is used and this is conservative.
Frequency of monitoring/recording	Measured continuously and monthly recorded
Value monitored	0.0748
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	NCV _{i,y}
Data unit	GJ/ton
Description	Net calorie value of diesel in year y
Source of data	China energy statistics 2018
Description of measurement methods and procedures to be applied	China energy statistics 2018
Frequency of monitoring/recording	Based on the latest version

Value monitored	42.652
Monitoring equipment	/
QA/QC procedures to be applied	Check consistency of data with IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guideline. 42.652 is in the range of IPCC lower value (41.4) and upper value (43.3).
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	$EF_{\text{burning,CH}_4,k,y}$
Data unit	tCH ₄ /GJ
Description	CH ₄ emission factor for uncontrolled burning of the biomass residue type k during the year y
Source of data	2006 IPCC
Description of measurement methods and procedures to be applied	$NCV_k * EF_{\text{burning,CH}_4,k,y} = 0.0027 * 0.73 = 0.001971$ According to the IPCC default value provided in table 5 of ACM0006, the CH ₄ emission factor of combustion of biomass in power plant is 0.0027 tCH ₄ /t. Considering a conservativeness factor of 0.73, the CH ₄ emission factor in this PDD is taken as 0.001971 tCH ₄ /TJ.
Frequency of monitoring/recording	Based on the latest version
Value monitored	0.001971
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of project emissions
Calculation method	/
Comments	/

Data / Parameter	Quantity of biomass residues that are utilized
Data unit	Tons
Description	Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region, k=maize stalks.

Source of data	Statistics from local governments					
Description of measurement methods and procedures to be applied	Statistics from local governments					
Frequency of monitoring/recording	Annually					
Value monitored						
		Year 2013	year 2014	2015	2016	2017(01/01/2017-29/11/2017)
	Unit: 10 ⁴ ton	maize stalks	maize stalks	maize stalks	maize stalks	maize stalks
	Biomass utilized out of the project	46.90	45.12	46.79	43.85	44.62
	Biomass utilized by the project in whole year y	23.09	27.45	27.63	26.94	25.17
	Total biomass utilized, including the project	69.99	72.57	74.42	70.79	69.79
Monitoring equipment	/					
QA/QC procedures to be applied	/					
Purpose of the data	Calculation of leakage emissions					
Calculation method	/					
Comments	/					

Data / Parameter	Quantity of biomass residues in the region																							
Data unit	Tons																							
Description	Quantity of biomass residues of type k in the region, k=maize stalks.																							
Source of data	Statistics from local governments																							
Description of measurement methods and procedures to be applied	Statistics from local governments																							
Frequency of monitoring/recording	Annually																							
Value monitored	<table><tr><td></td><td>Year 2013 (wet basis)</td><td>Year 2014 (wet basis)</td><td>Year 2015 (wet basis)</td><td>Year 2016 (wet basis)</td><td>Year 2017 (wet basis)</td></tr><tr><td></td><td>Maize stalks</td><td>Maize stalks</td><td>Maize stalks</td><td>Maize stalks</td><td>Maize stalks</td></tr><tr><td>Available Biomass in the region (10⁴t)</td><td>168.90</td><td>170.10</td><td>172.47</td><td>174.23</td><td>175.91</td></tr></table>							Year 2013 (wet basis)	Year 2014 (wet basis)	Year 2015 (wet basis)	Year 2016 (wet basis)	Year 2017 (wet basis)		Maize stalks	Maize stalks	Maize stalks	Maize stalks	Maize stalks	Available Biomass in the region (10 ⁴ t)	168.90	170.10	172.47	174.23	175.91
	Year 2013 (wet basis)	Year 2014 (wet basis)	Year 2015 (wet basis)	Year 2016 (wet basis)	Year 2017 (wet basis)																			
	Maize stalks	Maize stalks	Maize stalks	Maize stalks	Maize stalks																			
Available Biomass in the region (10 ⁴ t)	168.90	170.10	172.47	174.23	175.91																			
Monitoring equipment	/																							
QA/QC procedures to be applied	/																							
Purpose of the data	Calculation of leakage emissions																							
Calculation method	/																							
Comments	/																							

Data / Parameter	EF _{CO2,LE}
Data unit	tCO ₂ e/GJ
Description	CO ₂ emission factor of the most carbon intensive fuel used in the country
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories: "workbook", Chapter 1, table 1-2.
Description of measurement methods and	/

procedures to be applied	
Frequency of monitoring/recording	update according to IPCC guidelines.
Value monitored	0.092708 (coal) $25.8\text{tC/TJ} * 44/12\text{tCO}_2/\text{tC} * 0.001\text{TJ/GJ} * 0.98 = 0.092708 \text{ tCO}_2/\text{GJ}$
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of leakage emissions
Calculation method	/
Comments	/

4.3 Monitoring Plan

1. Monitoring structure

The monitoring structure is shown by Figure 4 and implemented by the project owner.

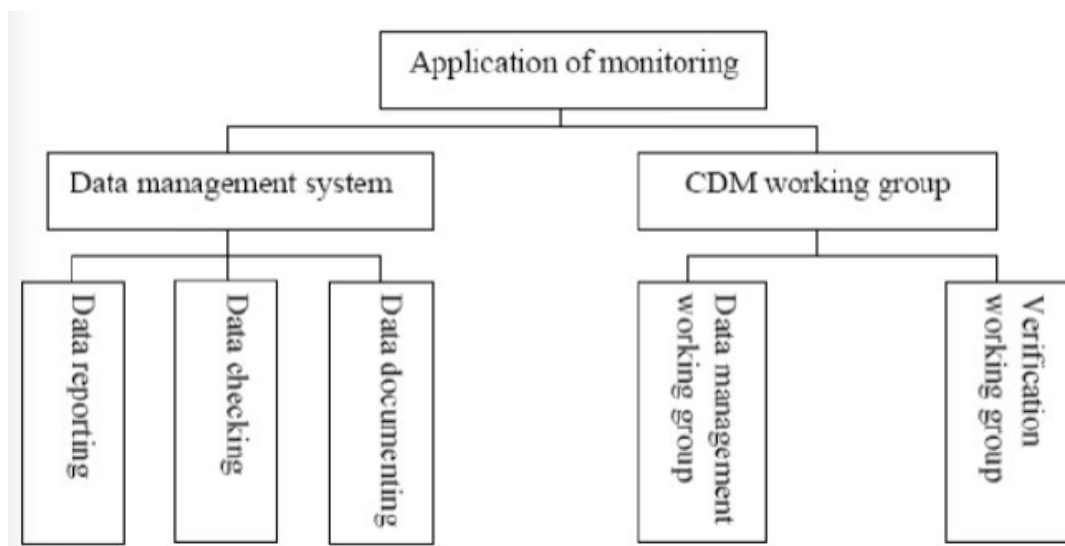


Figure 4. Monitoring structure

The personal responsibilities of the project are:

Operating manager of the plant: Overall management of power plant operation and in charge of collecting monitoring data as requested by the monitoring plan.

Biomass purchase department manager: Biomass collection and summarizing the data collected at the collection stations in terms of types, amount, and transportation record, etc of straws. Ensuring the biomass onsite will not be stored over half a year.

2. Installation of meters

The installation of meters is shown below:

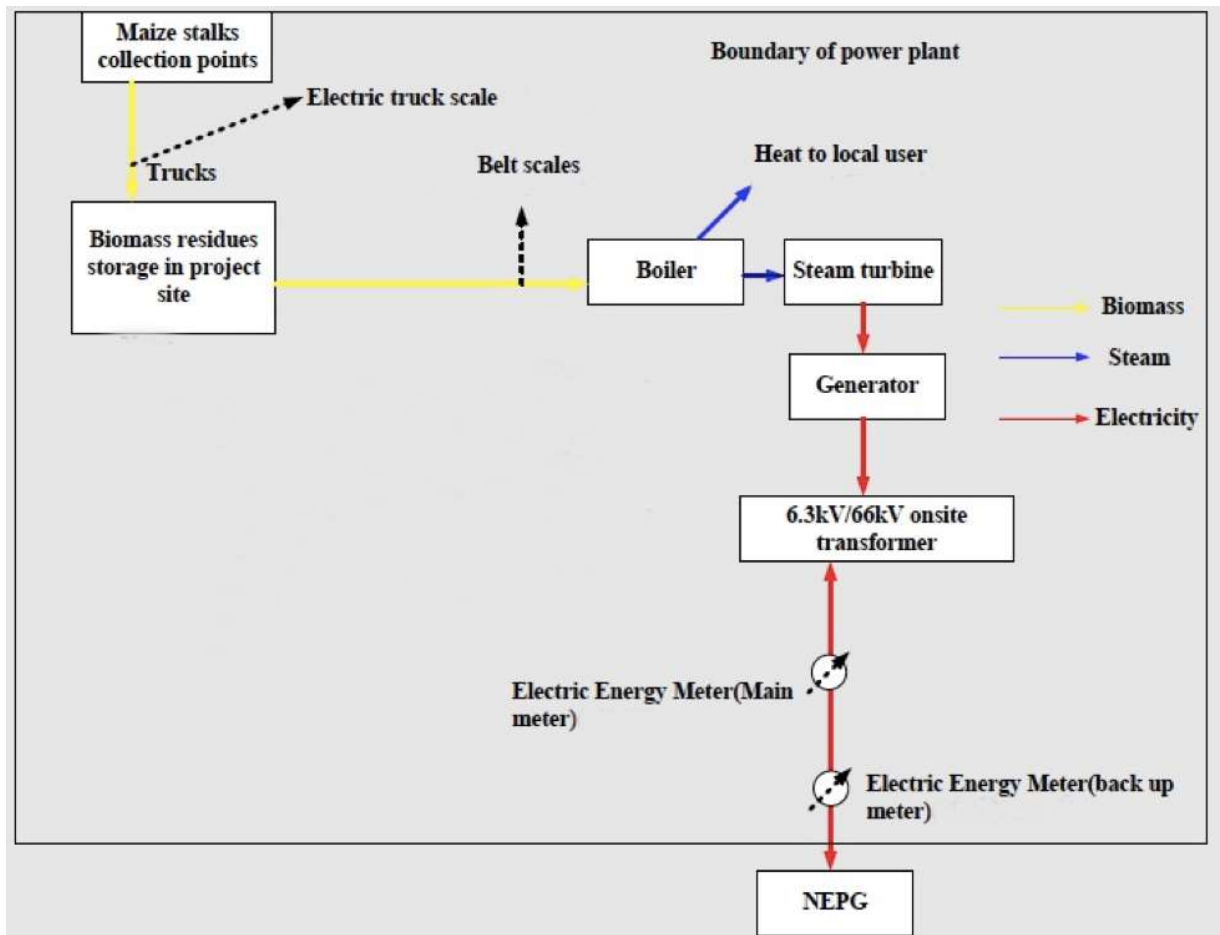


Figure 5. Installation of meters

3. Calibration

The electricity energy meters, flow meter, electric blast oven and electronic balance of the Project will be calibrated once a year by qualified third parties. Weight meter and belt scales will be calibrated twice a year by qualified third parties. And such calibration will be carried out in line with national norms.

4. Data Management System

The data will be recorded automatically if possible. Otherwise, they will be written down. The monitoring data such as all kinds of tables for different monitoring parameters, reports and other documents are processed and stored in the plant office by operating manager and biomass purchase department manager.

All the electronic and paper documents relevant with the project must be archived for more than two years since the end of the crediting period.

5. QA/QC

All the monitoring equipment are calibrated according to national standards.

6. Emergency procedures

If emergency accident occurred in the monitoring system, the data handling and reporting manager would report to project manager immediately and record the monitored data when the accident occurred and settled. And the emission reduction during this period would be estimated on conservative measures. If conservative measures were not available, the emission reduction should not be claimed during the failure period.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Quantify the baseline emissions and/or removals, providing sufficient information to allow the reader to reproduce the calculation. Attach electronic spreadsheets as an appendix or separate file to facilitate the verification of the results.

Based on the description of the methodology, the emission reductions by the project activity during a given year y can be calculated as follows:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

Where:

ER_y are emissions reductions of the project activity during the year y (tCO₂ e/yr)

$ER_{electricity,y}$ are the emission reductions due to displacement of electricity during the year y (tCO₂e/yr)

$ER_{heat,y}$ are emission reductions due to displacement of heat during the year y (tCO₂ e/yr).

$BE_{biomass,y}$ are Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year y (tCO₂ e/yr)

PE_y are Project emissions during the year y (tCO₂ e/yr)

L_y are Leakage emissions during the year y (tCO₂ e/yr)

According to equation 8 of the registered PDD, the project owner will not claim the emission reductions from displacing heat. Therefore, $ER_{heat,y}=0$

$$ER_y = ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

a) Baseline Emission due to displacement of electricity ($ER_{electricity,y}$)

Where:

$ER_{electricity,y}$ are the emission reductions due to displacement of electricity during the year y (tCO₂e/yr)

$EG_{project plant,y}$ are the net quantity of electricity generation of the project activity during the year y in MWh,

$EF_{electricity,y}$ is the CO₂ emission factor for the electricity displaced due to the project activity during the year y (CO₂e/ MWh).

Table 2. Emission reductions due to displacement of electricity ($ER_{electricity,y}$)

Period	$EG_{project plant,y}$ (MWh)	$EF_{electricity,y}$ (tCO ₂ e/MWh)	$ER_{electricity,y}$ (tCO ₂ e)
25/09/2013-30/09/2013	2,378.880	0.996	2369

01/10/2013-31/10/2013	16,152.360	0.996	16088
01/11/2013-30/11/2013	11,789.400	0.996	11742
01/12/2013-31/12/2013	16,423.680	0.996	16358
Total in 2013	46,744.320		46557
01/01/2014-31/01/2014	12,621.000	0.996	12571
01/02/2014-28/02/2014	15,861.720	0.996	15798
01/03/2014-31/03/2014	15,716.400	0.996	15654
01/04/2014-30/04/2014	16,017.120	0.996	15953
01/05/2014-31/05/2014	17,417.400	0.996	17348
01/06/2014-30/06/2014	15,046.920	0.996	14987
01/07/2014-31/07/2014	14,883.120	0.996	14824
01/08/2014-31/08/2014	16,109.520	0.996	16045
01/09/2014-30/09/2014	18,100.320	0.996	18028
01/10/2014-31/10/2014	15,340.080	0.996	15279
01/11/2014-30/11/2014	18,170.880	0.996	18098
01/12/2014-31/12/2014	12,837.720	0.996	12786
Total in 2014	188,122.200		187370
01/01/2015-31/01/2015	11,995.200	0.996	11947
01/02/2015-28/02/2015	15,332.520	0.996	15271
01/03/2015-31/03/2015	10,983.840	0.996	10940
01/04/2015-30/04/2015	19,691.280	0.996	19613
01/05/2015-31/05/2015	15,466.080	0.996	15404
01/06/2015-30/06/2015	15,203.160	0.996	15142
01/07/2015-31/07/2015	16,671.480	0.996	16605
01/08/2015-31/08/2015	15,165.360	0.996	15105
01/09/2015-30/09/2015	17,213.280	0.996	17144
01/10/2015-31/10/2015	18,453.960	0.996	18380
01/11/2015-30/11/2015	15,510.600	0.996	15449
01/12/2015-31/12/2015	17,637.480	0.996	17567
Total in 2015	189,324.240		188567
01/01/2016-31/01/2016	13,088.880	0.996	13037
01/02/2016-28/02/2016	8,009.400	0.996	7977
01/03/2016-31/03/2016	19,844.160	0.996	19765
01/04/2016-30/04/2016	16,332.120	0.996	16267
01/05/2016-31/05/2016	16,645.440	0.996	16579
01/06/2016-30/06/2016	15,195.600	0.996	15135
01/07/2016-31/07/2016	15,024.240	0.996	14964
01/08/2016-31/08/2016	18,035.640	0.996	17963
01/09/2016-30/09/2016	15,901.200	0.996	15838
01/10/2016-31/10/2016	19,060.440	0.996	18984
01/11/2016-30/11/2016	13,573.560	0.996	13519

01/12/2016-31/12/2016	19,960.080	0.996	19880
Total in 2016	190,670.760		189908
01/01/2017-31/01/2017	14,306.880	0.996	14250
01/02/2017-28/02/2017	11,476.920	0.996	11431
01/03/2017-31/03/2017	16,639.560	0.996	16573
01/04/2017-30/04/2017	16,486.680	0.996	16421
01/05/2017-31/05/2017	16,802.520	0.996	16735
01/06/2017-30/06/2017	21,015.960	0.996	20932
01/07/2017-31/07/2017	12,090.960	0.996	12043
01/08/2017-31/08/2017	15,176.280	0.996	15116
01/09/2017-30/09/2017	17,898.720	0.996	17827
01/10/2017-31/10/2017	19,405.680	0.996	19328
01/11/2017-29/11/2017	16,427.040	0.996	16361
Total in 2017	177,727.200		177016
Total	792,588.720		789418

- b) Baseline emissions due to nature decay or burning of anthropogenic sources of biomass ($BE_{\text{biomass},y}$)

$$BE_{\text{biomass},y} = GWP_{\text{CH}_4} * \sum_k BF_{PJ,k,y} * NCV_k * EF_{\text{burning,CH}_4,k,y}$$

Where:

$BE_{\text{Biomass},y}$ is baseline emissions due to natural decay or burning of anthropogenic sources of biomass residue during the year y (tCO₂e/year) ,

GWP_{CH_4} is the Global Warning Potential for methane valid for the relevant commitment period (25CO₂/tCH₄),

NCV_k is the net calorific value of the biomass residue type k in GJ/ton,

$BF_{PJ,k,y}$ is the incremental quantity of biomass type k used as a result of the project activity in the project plant during the year y (ton),

$EF_{\text{burning,CH}_4,k,y}$ is CH₄ emission factor for uncontrolled burning of the biomass residue type k during year y (tCH₄/GJ)

$$NCV_k * EF_{\text{burning,CH}_4,k,y} = 0.001971 \text{ tCH}_4/\text{ton}$$

Table 3. Baseline emissions due to nature decay or burning of anthropogenic sources of biomass ($BE_{biomass,y}$)

Period	BF _{k,y} (ton) (dry base)	NCV _k *EF _{burning,CH₄,k} (tCH ₄ /ton)	GWP _{CH₄} (tCO ₂ e/tCH ₄)	BE _{biomass,y} (tCO ₂ e)
25/09/2013-30/09/2013	3,707.80	0.001971	25	183
01/10/2013-31/10/2013	14,580.37	0.001971	25	718
01/11/2013-30/11/2013	11,242.00	0.001971	25	554
01/12/2013-31/12/2013	16,635.20	0.001971	25	820
Total in 2013	46,165.38			2275
01/01/2014-31/01/2014	13,132.67	0.001971	25	647
01/02/2014-28/02/2014	14,360.13	0.001971	25	708
01/03/2014-31/03/2014	20,624.08	0.001971	25	1016
01/04/2014-30/04/2014	18,656.56	0.001971	25	919
01/05/2014-31/05/2014	19,611.15	0.001971	25	966
01/06/2014-30/06/2014	16,222.44	0.001971	25	799
01/07/2014-31/07/2014	16,858.26	0.001971	25	831
01/08/2014-31/08/2014	15,578.95	0.001971	25	768
01/09/2014-30/09/2014	14,919.38	0.001971	25	735
01/10/2014-31/10/2014	10,876.43	0.001971	25	536
01/11/2014-30/11/2014	14,596.14	0.001971	25	719
01/12/2014-31/12/2014	11,495.47	0.001971	25	566
Total in 2014	186,931.66			9211
01/01/2015-31/01/2015	15,260.32	0.001971	25	752
01/02/2015-28/02/2015	15,709.50	0.001971	25	774
01/03/2015-31/03/2015	14,343.35	0.001971	25	707
01/04/2015-30/04/2015	19,236.43	0.001971	25	948
01/05/2015-31/05/2015	17,338.56	0.001971	25	854
01/06/2015-30/06/2015	16,905.73	0.001971	25	833
01/07/2015-31/07/2015	20,307.77	0.001971	25	1001
01/08/2015-31/08/2015	15,331.56	0.001971	25	755
01/09/2015-30/09/2015	16,256.23	0.001971	25	801
01/10/2015-31/10/2015	13,659.36	0.001971	25	673
01/11/2015-30/11/2015	11,639.76	0.001971	25	574
01/12/2015-31/12/2015	16,028.38	0.001971	25	790
Total in 2015	192,016.96			9462
01/01/2016-31/01/2016	13,950.89	0.001971	25	687
01/02/2016-28/02/2016	6,972.56	0.001971	25	344
01/03/2016-31/03/2016	20,210.34	0.001971	25	996
01/04/2016-30/04/2016	17,760.40	0.001971	25	875
01/05/2016-31/05/2016	18,983.42	0.001971	25	935

01/06/2016-30/06/2016	17,602.63	0.001971	25	867
01/07/2016-31/07/2016	17,624.37	0.001971	25	868
01/08/2016-31/08/2016	16,727.04	0.001971	25	824
01/09/2016-30/09/2016	15,055.52	0.001971	25	742
01/10/2016-31/10/2016	14,838.03	0.001971	25	731
01/11/2016-30/11/2016	11,185.86	0.001971	25	551
01/12/2016-31/12/2016	12,962.81	0.001971	25	639
Total in 2016	183,873.86			9060
01/01/2017-31/01/2017	15,827.73	0.001971	25	780
01/02/2017-28/02/2017	12,046.88	0.001971	25	594
01/03/2017-31/03/2017	19,960.87	0.001971	25	984
01/04/2017-30/04/2017	21,827.47	0.001971	25	1076
01/05/2017-31/05/2017	18,084.96	0.001971	25	891
01/06/2017-30/06/2017	21,595.97	0.001971	25	1064
01/07/2017-31/07/2017	12,175.53	0.001971	25	600
01/08/2017-31/08/2017	20,213.95	0.001971	25	996
01/09/2017-30/09/2017	14,814.71	0.001971	25	730
01/10/2017-31/10/2017	13,046.01	0.001971	25	643
01/11/2017-29/11/2017	11,606.77	0.001971	25	572
Total in 2017	181,200.85			8929
Total	790,188.71			38937

5.2 Project Emissions

$$PE_y = PET_y + PEFF_y + PE_{biomass,y} + PE_{EC,y}$$

Where:

PE_y are Project CO₂ emissions during the year y (tCO₂)

PET_y are Project emission during the year y due to transportation of the biomass to the project (tCO₂)

$PEFF_y$ are the CO₂ emissions during the year y due to fossil fuels co-fired by the generation facility or other fossil fuels consumption at the project site that is attributable to the project activity (tCO₂e/year),

$PE_{EC,y}$ are the CO₂ emissions during the year y due to electricity consumption at the proposed project that is attributable to the project activity (tCO₂e/year) .

GWP_{CH_4} is the global warming potential for methane valid for the relevant commitment period,

$PE_{Biomass,CH_4,y}$ is the CH₄ emissions from the combustion of biomass during the year y (tCH₄/year).

Table 4. Project Emissions (PE_y)

Period	PET _y (tCO ₂ e)	PEFF _y (tCO ₂ e)	PE _{biomass,CH₄,y} (tCO ₂ e)	PE _{EC,y} (tCO ₂ e)	PE _y (tCO ₂ e)
25/09/2013-30/09/2013	19	7	62	0	89
01/10/2013-31/10/2013	92	42	245	0	379
01/11/2013-30/11/2013	83	48	189	18	338
01/12/2013-31/12/2013	127	51	279	0	458
Total in 2013	321	149	775	18	1264
01/01/2014-31/01/2014	85	42	220	0	348
01/02/2014-28/02/2014	77	53	249	19	400
01/03/2014-31/03/2014	174	65	358	0	598
01/04/2014-30/04/2014	120	52	324	19	516
01/05/2014-31/05/2014	166	51	341	0	558
01/06/2014-30/06/2014	103	57	282	20	462
01/07/2014-31/07/2014	110	46	298	0	454
01/08/2014-31/08/2014	113	38	275	0	426
01/09/2014-30/09/2014	90	35	263	22	411

01/10/2014-31/10/2014	58	31	192	0	282
01/11/2014-30/11/2014	90	31	258	0	379
01/12/2014-31/12/2014	90	34	207	15	346
Total in 2014	1276	536	3267	95	5180
01/01/2015-31/01/2015	98	31	274	0	404
01/02/2015-28/02/2015	84	30	282	0	397
01/03/2015-31/03/2015	86	39	258	19	403
01/04/2015-30/04/2015	214	43	346	0	604
01/05/2015-31/05/2015	105	49	312	0	466
01/06/2015-30/06/2015	122	55	300	20	497
01/07/2015-31/07/2015	157	43	360	0	561
01/08/2015-31/08/2015	112	54	272	20	459
01/09/2015-30/09/2015	92	98	288	0	479
01/10/2015-31/10/2015	105	52	242	0	400
01/11/2015-30/11/2015	84	51	206	20	362

01/12/2015-31/12/2015	139	57	280	19	496
Total in 2015	1399	604	3420	98	5528
01/01/2016-31/01/2016	110	46	244	0	400
01/02/2016-28/02/2016	60	38	122	14	234
01/03/2016-31/03/2016	212	35	353	0	601
01/04/2016-30/04/2016	160	31	310	19	521
01/05/2016-31/05/2016	149	31	332	0	512
01/06/2016-30/06/2016	151	34	313	15	514
01/07/2016-31/07/2016	136	31	314	0	481
01/08/2016-31/08/2016	90	30	298	0	418
01/09/2016-30/09/2016	96	39	268	20	423
01/10/2016-31/10/2016	88	42	264	0	395
01/11/2016-30/11/2016	69	48	199	21	338
01/12/2016-31/12/2016	110	54	219	0	384
Total in 2016	1431	459	3236	89	5221
01/01/2017-31/01/2017	92	42	268	0	403

01/02/2017-28/02/2017	111	54	204	14	382
01/03/2017-31/03/2017	129	94	338	20	582
01/04/2017-30/04/2017	139	52	369	0	561
01/05/2017-31/05/2017	110	50	306	20	487
01/06/2017-30/06/2017	158	56	367	0	582
01/07/2017-31/07/2017	83	46	207	21	356
01/08/2017-31/08/2017	146	37	343	0	526
01/09/2017-30/09/2017	115	34	252	21	423
01/10/2017-31/10/2017	84	31	222	0	337
01/11/2017-29/11/2017	88	30	197	21	336
Total in 2017	1255	526	3071	117	4975
Total	5682	2273	13769	419	22168

- a) Carbon dioxide emissions from combustion of fossil fuels for transportation of maize stalks (PET_y)

$$PET_y = \frac{\sum_k BF_{T,k,y}}{TL_y} AVD_y * EF_{km,CO_2,y}$$

Where:

PET_y are CO₂ emissions during the year y due to transport of biomass residues to the project plant (tCO₂e/year).

AVD_y is the average round trip distance from and to between the biomass residue fuel supply sites and the site of the project plant during the year y (km).

EF_{km,CO₂,y} is the average CO₂ emission factor for the trucks measured in t CO₂e/km.

BF_{T,k,y} is the quantity of biomass residue type k that has been transported to the project site during the year y (ton of dry matter).

TL_y is the average truck load of the trucks used (ton) during the year y

Table 5. Carbon dioxide emissions from combustion of fossil fuels for transportation of maize stalks (PET_y)

Period	$\sum BF_{T,k,y}$ (tons, wet base)	Moisture(%)	$\sum BF_{T,k,y}$ (tons, dry base)	TL _y (tons)	AVD _y (km)	EF _{km,CO₂} (tCO ₂ e/km)	PET _y (tCO ₂ e)
25/09/2013-30/09/2013	3,972.78	20.03%	3,177.03	16.79	100	0.001011	19
01/10/2013-31/10/2013	18,839.68	21.25%	14,836.25	16.32	100	0.001011	92
01/11/2013-30/11/2013	14,689.00	22.13%	11,438.32	13.94	100	0.001011	83
01/12/2013-31/12/2013	20,416.50	19.69%	16,396.49	13.07	100	0.001011	127
Total in 2013	57,917.96		45,848.10				321
01/01/2014-31/01/2014	20,740.55	37.68%	12,925.51	15.32	100	0.001011	85
01/02/2014-28/02/2014	18,586.95	22.76%	14,356.56	18.75	100	0.001011	77
01/03/2014-31/03/2014	26,517.61	21.93%	20,702.30	12.05	100	0.001011	174
01/04/2014-30/04/2014	25,917.43	29.10%	18,375.46	15.45	100	0.001011	120
01/05/2014-31/05/2014	29,896.39	36.07%	19,112.76	11.64	100	0.001011	166

01/06/2014-30/06/2014	25,185.42	35.13%	16,337.78	16.11	100	0.001011	103
01/07/2014-31/07/2014	24,757.27	33.31%	16,510.62	15.24	100	0.001011	110
01/08/2014-31/08/2014	24,364.11	34.81%	15,882.96	14.27	100	0.001011	113
01/09/2014-30/09/2014	22,280.23	30.06%	15,582.79	17.50	100	0.001011	90
01/10/2014-31/10/2014	17,596.87	38.77%	10,774.56	18.74	100	0.001011	58
01/11/2014-30/11/2014	20,989.72	32.66%	14,134.48	15.82	100	0.001011	90
01/12/2014-31/12/2014	16,977.03	30.06%	11,873.73	13.32	100	0.001011	90
Total in 2014	273,809.58		186,569.53				1276
01/01/2015-31/01/2015	19,781.62	21.03%	15,621.55	16.04	100	0.001011	98
01/02/2015-28/02/2015	23,916.78	36.18%	15,263.69	18.32	100	0.001011	84
01/03/2015-31/03/2015	17,689.73	22.07%	13,785.61	16.23	100	0.001011	86
01/04/2015-30/04/2015	29,804.20	34.23%	19,602.22	9.26	100	0.001011	214
01/05/2015-31/05/2015	25,153.63	30.63%	17,449.07	16.73	100	0.001011	105
01/06/2015-30/06/2015	24,116.97	28.37%	17,274.99	14.36	100	0.001011	122
01/07/2015-31/07/2015	26,089.36	21.45%	20,493.19	13.17	100	0.001011	157
01/08/2015-31/08/2015	24,997.62	37.90%	15,523.52	14.02	100	0.001011	112

01/09/2015-30/09/2015	24,600.66	33.68%	16,315.16	18.01	100	0.001011	92
01/10/2015-31/10/2015	21,193.49	35.68%	13,631.65	13.07	100	0.001011	105
01/11/2015-30/11/2015	17,977.03	33.26%	11,997.87	14.43	100	0.001011	84
01/12/2015-31/12/2015	21,781.62	28.50%	15,573.86	11.36	100	0.001011	139
Total in 2015	277,102.71		192,532.37				1399
01/01/2016-31/01/2016	22,146.74	37.63%	13,812.92	12.72	100	0.001011	110
01/02/2016-28/02/2016	10,792.51	32.73%	7,260.12	12.30	100	0.001011	60
01/03/2016-31/03/2016	30,090.76	31.74%	20,539.95	9.79	100	0.001011	212
01/04/2016-30/04/2016	26,443.58	33.55%	17,571.76	11.10	100	0.001011	160
01/05/2016-31/05/2016	27,606.23	28.59%	19,713.61	13.36	100	0.001011	149
01/06/2016-30/06/2016	24,808.29	26.17%	18,315.96	12.26	100	0.001011	151
01/07/2016-31/07/2016	23,237.98	21.40%	18,265.05	13.56	100	0.001011	136
01/08/2016-31/08/2016	24,837.21	34.95%	16,156.61	18.24	100	0.001011	90
01/09/2016-30/09/2016	19,938.56	22.18%	15,516.19	16.37	100	0.001011	96
01/10/2016-31/10/2016	22,397.30	31.64%	15,310.79	17.51	100	0.001011	88
01/11/2016-30/11/2016	18,265.04	40.42%	10,882.31	15.87	100	0.001011	69

01/12/2016-31/12/2016	22,200.50	40.84%	13,133.82	12.05	100	0.001011	110
Total in 2016	272,764.70		186,479.09				1431
01/01/2017-31/01/2017	22,376.70	26.11%	16,534.14	18.11	100	0.001011	92
01/02/2017-28/02/2017	17,895.30	31.99%	12,170.59	11.13	100	0.001011	111
01/03/2017-31/03/2017	25,377.36	21.68%	19,875.55	15.53	100	0.001011	129
01/04/2017-30/04/2017	27,733.52	20.60%	22,020.41	15.99	100	0.001011	139
01/05/2017-31/05/2017	26,988.02	31.19%	18,570.46	17.04	100	0.001011	110
01/06/2017-30/06/2017	30,173.46	27.84%	21,773.17	13.91	100	0.001011	158
01/07/2017-31/07/2017	19,478.36	38.45%	11,988.93	14.67	100	0.001011	83
01/08/2017-31/08/2017	25,073.74	21.62%	19,652.80	13.64	100	0.001011	146
01/09/2017-30/09/2017	19,809.42	20.72%	15,704.91	13.75	100	0.001011	115
01/10/2017-31/10/2017	21,601.07	37.71%	13,455.31	16.21	100	0.001011	84
01/11/2017-29/11/2017	19,265.04	36.01%	12,327.70	14.23	100	0.001011	88
Total in 2017	255,771.99	28.54%	184,073.97				1255
Total in this monitoring period	1,137,366.94	28.65%	795,503.05				5,682

b) Carbon dioxide emissions from on-site consumption of fossil fuels (PEFFy)

$$PEFF_y = \sum_{i,j} FF_{j,i,y} * COEF_{i,y}$$

$$COEF_{i,y} = NCV_{i,y} * EF_{CO2,FF,i}$$

Where:

$FF_{j,i,y}$ is the quantity of fuel type i combusted in process j during the year y (mass or volume unit /yr).

$COEF_{i,y}$ is the CO₂ emission coefficient of fossil fuel type i in year y (tCO₂/mass or volume unit of fossil fuel);

i the fuel types combusted in process j during the year y, which is diesel for this project.

$NCV_{i,y}$ weighted average net calorific value of fossil fuel type i in year y (GJ/mass or volume unit), which is 42.652GJ/ton for diesel.

$EF_{CO2,FF,i}$ CO₂ emission factor for the fossil fuel type i(tCO₂/GJ), which can be estimated at 0.0748 tCO₂/GJ for diesel

Table 6. Carbon dioxide emissions from on-site consumption of fossil fuels (PEFF_y)

Period	FF _{project plant,i,y} (liter)	FF _{project site,i,y} (liter)	density of diesel (kg/liter diesel)	FF _{project plant,i,y+FF project site,i,y} (tons, from plant daily logs)	FF _{project plant,i,y+FF project site,i,y} (tons, from diesel purchasing invoice and stock change)	Higher value between pdl and the diesel purchasing and stock change	NCV _{diesel,y} (GJ/ton)	EF _{CO2,FF,diesel} (tCO ₂ /GJ)	PEFF _y (tCO _{2e})
25/09/2013-30/09/2013		2663.66		2.344	2.344	2.344	42.652	0.0748	7
01/10/2013-31/10/2013		15027.07		13.224	13.224	13.224	42.652	0.0748	42
01/11/2013-30/11/2013		16975.78		14.939	14.940	14.940	42.652	0.0748	48
01/12/2013-31/12/2013		18282.64		16.089	16.089	16.089	42.652	0.0748	51
Total in 2013	0	52949.15	0.88	46.596	46.597	46.597			149
01/01/2014-31/01/2014		14929.79		13.138	13.139	13.139	42.652	0.0748	42
01/02/2014-28/02/2014		18947.82		16.674	16.674	16.674	42.652	0.0748	53
01/03/2014-31/03/2014		23255.97		20.465	20.466	20.466	42.652	0.0748	65

01/04/2014-30/04/2014	18644.45	16.407	16.408	16.408	42.652	0.0748	52
01/05/2014-31/05/2014	18152.02	15.974	15.974	15.974	42.652	0.0748	51
01/06/2014-30/06/2014	20405.04	17.956	17.957	17.957	42.652	0.0748	57
01/07/2014-31/07/2014	16441.54	14.469	14.469	14.469	42.652	0.0748	46
01/08/2014-31/08/2014	13369.13	11.765	11.766	11.766	42.652	0.0748	38
01/09/2014-30/09/2014	12373.40	10.889	10.889	10.889	42.652	0.0748	35
01/10/2014-31/10/2014	11196.35	9.853	9.854	9.854	42.652	0.0748	31
01/11/2014-30/11/2014	10886.54	9.580	9.580	9.580	42.652	0.0748	31
01/12/2014-31/12/2014	12131.17	10.675	10.676	10.676	42.652	0.0748	34
Total in 2014	190733.22	167.845	167.852	167.852			536
01/01/2015-31/01/2015	10956.01	9.641	9.641	9.641	42.652	0.0748	31
01/02/2015-28/02/2015	10608.78	9.336	9.336	9.336	42.652	0.0748	30
01/03/2015-31/03/2015	14068.09	12.380	12.380	12.380	42.652	0.0748	39
01/04/2015-30/04/2015	15361.01	13.518	13.518	13.518	42.652	0.0748	43
01/05/2015-31/05/2015	17353.02	15.271	15.271	15.271	42.652	0.0748	49
01/06/2015-30/06/2015	19711.15	17.346	17.346	17.346	42.652	0.0748	55
01/07/2015-31/07/2015	15261.56	13.430	13.431	13.431	42.652	0.0748	43
01/08/2015-31/08/2015	19368.89	17.045	17.045	17.045	42.652	0.0748	54
01/09/2015-30/09/2015	35039.44	30.835	30.835	30.835	42.652	0.0748	98
01/10/2015-31/10/2015	18681.38	16.440	16.440	16.440	42.652	0.0748	52
01/11/2015-30/11/2015	18187.97	16.005	16.006	16.006	42.652	0.0748	51
01/12/2015-31/12/2015	20445.45	17.992	17.993	17.993	42.652	0.0748	57
Total in 2015	215042.75	189.239	189.242	189.242			604
01/01/2016-31/01/2016	16474.09	14.497	14.498	14.498	42.652	0.0748	46
01/02/2016-28/02/2016	13395.61	11.788	11.789	11.789	42.652	0.0748	38
01/03/2016-31/03/2016	12397.90	10.910	10.910	10.910	42.652	0.0748	35
01/04/2016-30/04/2016	11218.52	9.872	9.873	9.873	42.652	0.0748	31

01/05/2016-31/05/2016	10908.10	9.599	9.599	9.599	42.652	0.0748	31
01/06/2016-30/06/2016	12155.19	10.697	10.697	10.697	42.652	0.0748	34
01/07/2016-31/07/2016	10977.71	9.660	9.661	9.661	42.652	0.0748	31
01/08/2016-31/08/2016	10629.79	9.354	9.355	9.355	42.652	0.0748	30
01/09/2016-30/09/2016	13845.67	12.184	12.184	12.184	42.652	0.0748	39
01/10/2016-31/10/2016	15118.15	13.304	13.305	13.305	42.652	0.0748	42
01/11/2016-30/11/2016	17078.66	15.029	15.030	15.030	42.652	0.0748	48
01/12/2016-31/12/2016	19399.51	17.072	17.072	17.072	42.652	0.0748	54
Total in 2016	163598.90	143.97	143.97	143.97			459
01/01/2017-31/01/2017	15020.27	13.218	13.218	13.218	42.652	0.0748	42
01/02/2017-28/02/2017	19062.65	16.775	16.775	16.775	42.652	0.0748	54
01/03/2017-31/03/2017	33469.64	29.453	29.454	29.454	42.652	0.0748	94
01/04/2017-30/04/2017	18386.02	16.180	16.180	16.180	42.652	0.0748	52
01/05/2017-31/05/2017	17900.41	15.752	15.753	15.753	42.652	0.0748	50
01/06/2017-30/06/2017	20122.20	17.708	17.708	17.708	42.652	0.0748	56
01/07/2017-31/07/2017	16213.63	14.268	14.268	14.268	42.652	0.0748	46
01/08/2017-31/08/2017	13183.82	11.602	11.603	11.603	42.652	0.0748	37
01/09/2017-30/09/2017	12201.89	10.738	10.738	10.738	42.652	0.0748	34
01/10/2017-31/10/2017	11041.15	9.716	9.717	9.717	42.652	0.0748	31
01/11/2017-29/11/2017	10735.65	9.447	9.448	9.448	42.652	0.0748	30
Total in 2017	187337.33	164.86	164.86	164.86			526
Total	/	809661.35	/	712.50	712.53	712.53	2273

c) Methane emissions from combustion of maize stalks ($PE_{Biomass,CH_4,y}$)

$$PE_{Biomass,CH_4,y} = EF_{CH_4,BF} * \sum_k BF_{k,y} * NCV_k$$

Where:

$PE_{Biomass,CH_4,y}$ are methane emissions from combustion of maize stalks (tCO₂e/year),

$BF_{k,y}$ is the quantity of maize stalks used as fuel in the project plant during the year y in tons in

dry matter (ton),
 NCV_k is the net calorific value of the maize stalks in TJ per tons
 $EF_{CH_4,BF}$ is the CH_4 emission factor for controlled burning of the maize stalks in tCH_4/TJ .

Table 7. Methane emissions from combustion of maize stalks ($PE_{Biomass,CH_4,y}$)

Period	BFk,y(ton) (wet base)	Moisture (%)	BFk,y(ton) (dry base)	NCVk(GJ/ton) (dry base)	$EF_{CH_4,BF}(tCH_4/GJ)$	GWP (tCO_2e/CH_4)	$PE_{biomass,CH_4,y}(tCO_2e)$
25/09/2013-30/09/2013	4,636.49	20.03%	3,707.80	16.334	0.0000411	25	62
01/10/2013-31/10/2013	18,514.76	21.25%	14,580.37	16.334	0.0000411	25	245
01/11/2013-30/11/2013	14,436.88	22.13%	11,242.00	16.334	0.0000411	25	189
01/12/2013-31/12/2013	20,713.74	19.69%	16,635.20	16.334	0.0000411	25	279
Total in 2013	58,301.87		46,165.38				775
01/01/2014-31/01/2014	21,072.96	37.68%	13,132.67	16.334	0.0000411	25	220
01/02/2014-28/02/2014	18,591.57	22.76%	14,360.13	16.905	0.0000411	25	249
01/03/2014-31/03/2014	26,417.42	21.93%	20,624.08	16.905	0.0000411	25	358
01/04/2014-30/04/2014	26,313.91	29.10%	18,656.56	16.905	0.0000411	25	324
01/05/2014-31/05/2014	30,675.97	36.07%	19,611.15	16.905	0.0000411	25	341
01/06/2014-30/06/2014	25,007.61	35.13%	16,222.44	16.905	0.0000411	25	282
01/07/2014-31/07/2014	25,278.54	33.31%	16,858.26	17.179	0.0000411	25	298
01/08/2014-31/08/2014	23,897.76	34.81%	15,578.95	17.179	0.0000411	25	275

01/09/2014-30/09/2014	21,331.69	30.06%	14,919.38	17.179	0.0000411	25	263
01/10/2014-31/10/2014	17,763.24	38.77%	10,876.43	17.179	0.0000411	25	192
01/11/2014-30/11/2014	21,675.29	32.66%	14,596.14	17.179	0.0000411	25	258
01/12/2014-31/12/2014	16,436.19	30.06%	11,495.47	17.501	0.0000411	25	207
Total in 2014	274,462.15		186,931.66				3267
01/01/2015-31/01/2015	19,324.20	21.03%	15,260.32	17.501	0.0000411	25	274
01/02/2015-28/02/2015	24,615.33	36.18%	15,709.50	17.501	0.0000411	25	282
01/03/2015-31/03/2015	18,405.43	22.07%	14,343.35	17.501	0.0000411	25	258
01/04/2015-30/04/2015	29,248.03	34.23%	19,236.43	17.501	0.0000411	25	346
01/05/2015-31/05/2015	24,994.32	30.63%	17,338.56	17.501	0.0000411	25	312
01/06/2015-30/06/2015	23,601.47	28.37%	16,905.73	17.246	0.0000411	25	300
01/07/2015-31/07/2015	25,853.30	21.45%	20,307.77	17.246	0.0000411	25	360
01/08/2015-31/08/2015	24,688.50	37.90%	15,331.56	17.246	0.0000411	25	272
01/09/2015-30/09/2015	24,511.81	33.68%	16,256.23	17.246	0.0000411	25	288
01/10/2015-31/10/2015	21,236.57	35.68%	13,659.36	17.246	0.0000411	25	242
01/11/2015-30/11/2015	17,440.46	33.26%	11,639.76	17.246	0.0000411	25	206

01/12/2015-31/12/2015	22,417.32	28.50%	16,028.38	17.003	0.0000411	25	280
Total in 2015	276,336.74		192,016.96				3420
01/01/2016-31/01/2016	22,367.95	37.63%	13,950.89	17.003	0.0000411	25	244
01/02/2016-28/02/2016	10,365.03	32.73%	6,972.56	17.003	0.0000411	25	122
01/03/2016-31/03/2016	29,607.88	31.74%	20,210.34	17.003	0.0000411	25	353
01/04/2016-30/04/2016	26,727.47	33.55%	17,760.40	17.003	0.0000411	25	310
01/05/2016-31/05/2016	26,583.70	28.59%	18,983.42	17.003	0.0000411	25	332
01/06/2016-30/06/2016	23,842.11	26.17%	17,602.63	17.325	0.0000411	25	313
01/07/2016-31/07/2016	22,422.86	21.40%	17,624.37	17.325	0.0000411	25	314
01/08/2016-31/08/2016	25,714.12	34.95%	16,727.04	17.325	0.0000411	25	298
01/09/2016-30/09/2016	19,346.59	22.18%	15,055.52	17.325	0.0000411	25	268
01/10/2016-31/10/2016	21,705.72	31.64%	14,838.03	17.325	0.0000411	25	264
01/11/2016-30/11/2016	18,774.53	40.42%	11,185.86	17.325	0.0000411	25	199
01/12/2016-31/12/2016	21,911.44	40.84%	12,962.81	16.461	0.0000411	25	219
Total in 2016	269,369.40		183,873.86				3236
01/01/2017-31/01/2017	21,420.67	26.11%	15,827.73	16.461	0.0000411	25	268

01/02/2017-28/02/2017	17,713.40	31.99%	12,046.88	16.461	0.0000411	25	204
01/03/2017-31/03/2017	25,486.30	21.68%	19,960.87	16.461	0.0000411	25	338
01/04/2017-30/04/2017	27,490.52	20.60%	21,827.47	16.461	0.0000411	25	369
01/05/2017-31/05/2017	26,282.46	31.19%	18,084.96	16.461	0.0000411	25	306
01/06/2017-30/06/2017	29,927.89	27.84%	21,595.97	16.526	0.0000411	25	367
01/07/2017-31/07/2017	19,781.52	38.45%	12,175.53	16.526	0.0000411	25	207
01/08/2017-31/08/2017	25,789.68	21.62%	20,213.95	16.526	0.0000411	25	343
01/09/2017-30/09/2017	18,686.57	20.72%	14,814.71	16.526	0.0000411	25	252
01/10/2017-31/10/2017	20,943.98	37.71%	13,046.01	16.526	0.0000411	25	222
01/11/2017-29/11/2017	18,138.41	36.01%	11,606.77	16.526	0.0000411	25	197
Total in 2017	251,661.40		181,200.85				3071
Total	1,130,131.56		790,188.71				13,769

d) Carbon dioxide emissions from electricity consumption ($PE_{EC,y}$)

$$PE_{EC,y} = (EC_{PJ,y} + EG_{PJ,y}) \times EF_{grid,y} \times (1 + TDL_y)$$

Where:

$PE_{EC,y}$ is the project emissions from electricity consumption by the project activity during the year y (tCO₂e/year).

$EC_{PJ,y}$ is the quantity of electricity consumed by the project activity during the year y (MWh)

$EG_{PJ,y}$ is the quantity of electricity consumption at the biomass residue storage sites (MWh)

$EF_{grid,y}$ is the emission factor for the grid in year y (tCO₂e/ MWh)

TDL_y is the average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site. According to the tool, default value of 20% is implemented for the proposed project.

Table 8. Carbon dioxide emissions from electricity consumption ($PE_{EC,y}$)

Period	Electricity consumed (MWh)	$EF_{grid,y}$ (tCO ₂ e/MWh)	TDL_y	$PE_{EC,y}$ (tCO ₂ e)
25/09/2013-30/09/2013	0.000	0.996	20%	0
01/10/2013-31/10/2013	0.000	0.996	20%	0
01/11/2013-30/11/2013	15.120	0.996	20%	18
01/12/2013-31/12/2013	0.000	0.996	20%	0
Total in 2013	15.120			18
01/01/2014-31/01/2014	0.000	0.996	20%	0
01/02/2014-28/02/2014	15.960	0.996	20%	19
01/03/2014-31/03/2014	0.000	0.996	20%	0
01/04/2014-30/04/2014	15.960	0.996	20%	19
01/05/2014-31/05/2014	0.000	0.996	20%	0
01/06/2014-30/06/2014	16.800	0.996	20%	20
01/07/2014-31/07/2014	0.000	0.996	20%	0
01/08/2014-31/08/2014	0.000	0.996	20%	0
01/09/2014-30/09/2014	18.480	0.996	20%	22
01/10/2014-31/10/2014	0.000	0.996	20%	0
01/11/2014-30/11/2014	0.000	0.996	20%	0
01/12/2014-31/12/2014	12.600	0.996	20%	15
Total in 2014	79.800			95
01/01/2015-31/01/2015	0.000	0.996	20%	0
01/02/2015-28/02/2015	0.000	0.996	20%	0
01/03/2015-31/03/2015	15.960	0.996	20%	19
01/04/2015-30/04/2015	0.000	0.996	20%	0
01/05/2015-31/05/2015	0.000	0.996	20%	0
01/06/2015-30/06/2015	16.800	0.996	20%	20
01/07/2015-31/07/2015	0.000	0.996	20%	0
01/08/2015-31/08/2015	16.800	0.996	20%	20
01/09/2015-30/09/2015	0.000	0.996	20%	0
01/10/2015-31/10/2015	0.000	0.996	20%	0
01/11/2015-30/11/2015	16.800	0.996	20%	20
01/12/2015-31/12/2015	15.960	0.996	20%	19
Total in 2015	82.320			98

01/01/2016-31/01/2016	0.000	0.996	20%	0
01/02/2016-28/02/2016	11.760	0.996	20%	14
01/03/2016-31/03/2016	0.000	0.996	20%	0
01/04/2016-30/04/2016	15.960	0.996	20%	19
01/05/2016-31/05/2016	0.000	0.996	20%	0
01/06/2016-30/06/2016	12.600	0.996	20%	15
01/07/2016-31/07/2016	0.000	0.996	20%	0
01/08/2016-31/08/2016	0.000	0.996	20%	0
01/09/2016-30/09/2016	16.800	0.996	20%	20
01/10/2016-31/10/2016	0.000	0.996	20%	0
01/11/2016-30/11/2016	17.640	0.996	20%	21
01/12/2016-31/12/2016	0.000	0.996	20%	0
Total in 2016	74.760			89
01/01/2017-31/01/2017	0.000	0.996	20%	0
01/02/2017-28/02/2017	11.760	0.996	20%	14
01/03/2017-31/03/2017	16.800	0.996	20%	20
01/04/2017-30/04/2017	0.000	0.996	20%	0
01/05/2017-31/05/2017	16.800	0.996	20%	20
01/06/2017-30/06/2017	0.000	0.996	20%	0
01/07/2017-31/07/2017	17.640	0.996	20%	21
01/08/2017-31/08/2017	0.000	0.996	20%	0
01/09/2017-30/09/2017	17.640	0.996	20%	21
01/10/2017-31/10/2017	0.000	0.996	20%	0
01/11/2017-29/11/2017	17.640	0.996	20%	21
Total in 2017	98.280			117
Total	350.280			419

5.3 Leakage

A survey of the biomass supply/demand situation in the area has been arranged annually. The result is shown below:

Table 9. Biomass used and available biomass in the region of the project activity

	Year 2013	year 2014	2015	2016	2017(01/01/2017- 29/11/2017)
Unit: 10 ⁴ ton	maize stalks	maize stalks	maize stalks	maize stalks	maize stalks

Available Biomass in the region	168.90	170.10	172.47	174.23	175.91
Biomass utilized out of the project	46.90	45.12	46.79	43.85	44.62
Biomass utilized by the project in whole year y	23.09	27.45	27.63	26.94	25.17
Total biomass utilized, including the project	69.99	72.57	74.42	70.79	69.79
Available Biomass/Total biomass utilized	241%	234%	232%	246%	252%
Available Biomass/Total biomass utilized -100%	141%	134%	132%	146%	152%
Abundant surplus? (More than 25%)	Yes	Yes	Yes	Yes	Yes

From the above-mentioned background, it was known that the biomass supply is far more than the demand by the project. The conclusion is the biomass supply to the project during the monitoring period was sufficient and did not lead to the displacement of the current use of biomass as a fuel.

And, because the biomass residues collection range is with 50 km which was defined in PDD, leakage for the project is considered zero, according to ACM0006 version6.2.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
25/09/2013-31/12/2013	48831	1264	0.0	47567
01/01/2014-31/12/2014	196575	5180	0.0	191395
01/01/2015-31/12/2015	198024	5528	0.0	192496

01/01/2016-31/12/2016	198961	5221	0.0	193740
01/01/2017-31/12/2017	185940	4975	0.0	180965
Total in this monitoring period	828331	22168	0.0	806163

The ER in the registered PD is 190139tCO₂/yr. This monitoring period covers 1527days, and the ex-ante ER for this monitoring period is $190139/365 \times 1527 = 795,458 \text{tCO}_2$. The actual ER in this monitoring period is 806,163 tCO₂, which is 1.3% larger than the ex-ante estimated ER. This will not influence the additionality of the project.