Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	A.T. Biopower Rice Husk Power Project in Pichit, Thailand
Reference number of the project activity	1026
Version number of the monitoring report	01
Completion date of the monitoring report	04/01/2013
Registration date of the project activity	18/06/2007
Monitoring period number and duration of this monitoring period	Monitoring period 05 and duration of this monitoring period 01/01/2012-20/12/2012(first and last days included)
Project participant(s)	• A.T Biopower Co., Ltd • Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. • Gazprom Marketing & Trading Singapore Pte. Ltd.
Host Party(ies)	Thailand
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 1: ACM0006 Version04 "Consolidated methodology for grid-connected electricity generation from biomass residues"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	,68,639 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	69,744 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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This project activity is designed to reduce the Greenhouse gas emission from replacing some amount of the electricity in the national grid system which mostly generated from the fossil fuel. Since the electricity produced from the project activity is generated from rice husk that would be otherwise be burned in the open air or left to decay.

The project involves the construction and operation of new rice husk power plant in Pichit province with approximately 22.5 MW gross generating capacity, 20 MW net. Electricity is sold through a 25-year power purchase agreement (PPA) with the Electricity Generating Authority of Thailand (EGAT).
. The main equipment has been installed provided in Table 1

Table 1: The main equipment installed in the project activity

Main equipment	Supplier	Specification
Boiler	Electrowatt-Ekono (Thailand) Ltd.	Design pressure = 76 barg Design temperature = 485^{o}C Capacity = 91 T/HR
Turbine	Electrowatt-Ekono (Thailand) Ltd.	Condensing turbine Inlet steam pressure 65 bar. A Inlet temperature 480^{o}C Speed (turbine/generator) 4900/1500 rpm Rated output (at generator terminal) 22.5 MW.
Generator	Electrowatt-Ekono (Thailand) Ltd.	Rated current 260 A Rated power factor 0.8 Rated frequency 50 Hz Rated Speed 1500 rpm

A.2. Location of project activity

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Thailand
Pichit province
Bang Moon Nak city/ Horkai sub-district
Physical location: 96 Moo 2, Horkai sub-district of Ampur Bang Moon Nak, Pichit province, Thailand
Geographical location: Latitude: 16^{o} 04' 16.67" N; Longitude: 100^{o} 23' 47.73" E

A.3. Parties and project participant(s)

Party involved **((host) indicates a host Party)**	**Private and/or public entity(ies) project participants (as applicable)**	**Indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Thailand (host)	A.T. Biopower Co., Ltd	No
Japan	Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.	No
United Kingdom of Great Britain and Northern Ireland	Gazprom Marketing & Trading Singapore Pte. Ltd.	No

A.4. Reference of applied methodology

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(a) ACM0006 "Consolidated methodology for grid-connected electricity generation from biomass residues" (Version 04)

The applied methodology refer to UNFCCC website as below;

http://cdm.unfccc.int/methodologies/DB/U3THXNPFFSPP2WO1MFB20DXU1444S5/view.html

A.5. Crediting period of project activity

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Type of crediting period: Renewable crediting period for 7 years.

Starting date and length of the crediting period corresponding to this monitoring period:

Starting date of the crediting period: 21/12/2005
Length of the crediting period: 21/12/2005-20/12/2012(first and last days included)

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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This section will provide the information on the implementation status of the project activity during monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity in the Project standard. Also, the installed technology, technical process and equipment, include diagrams will be provided appropriately.

The technology employed into the project activity is a simple power cycle consisting of boiler, turbine, and generator which can be presented as a diagram below.

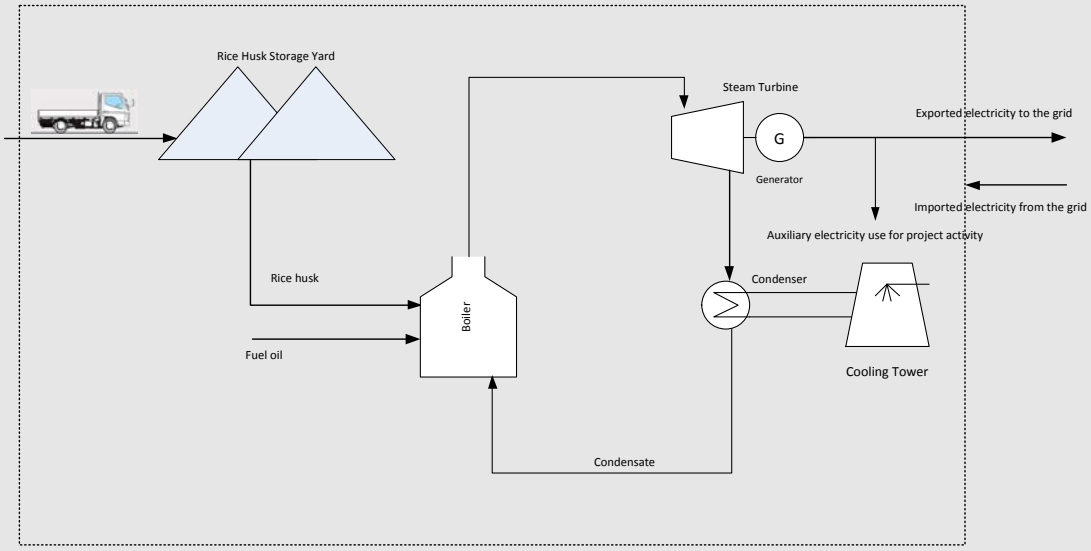

Figure 1: The project activity simple diagram

As per Figure 1, the rice husk is transported from rice mills to the power plant by truck and then stored in the rice husk storage yard preparing to feed to the boiler. Before feeding the rice husk to the boiler, the rice husk are grounded by a grinding machine so that the finely ground rice husk in small fragments will be increased surface areas for combustion, resulting in rapid combustion and at the same time have lighter weight suitable burned during subject to suspension-fired combustion in the furnace while light-weight fly as which occurs in the combustion will be blown away by air pressure.

In details of technical process, after the combustion chamber is started up by using diesel oil reaching a

temperature of 700-800^{o}C; then grounded rice husk will be fed from a service silo while the use of diesel oil is gradually decreased until all rice husk ignite continuously. The combustion system is a suspension-fired combustion, where grounded rice husk from a service silo are fed to a fuel-air mixing system and are compressed by air from a primary air fan. The burner has adjustable vanes to force the fuel-air mixture to circulate for proper combustion in the combustion chamber at temperature around 800-900^{o}C.

The feed water is fed to the boiler to become a hot steam. Hot steam is transferred to a steam turbine where thermal energy of the steam is converted to mechanical energy. In the turbine, a governor is fitted to regulate the steam flow rate and the speed of rotors and the speed or the rotor is reduced by a reduction gear unit to turn to 11.5 KV turbine generator. Then the mechanical energy is converted to electricity
which is transmitted by a generator breaker and a step-up transformer to generate a voltage of 115 KV for subsequent distribution through the transmission line of the Provincial Electricity Authority (PEA).

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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During this monitoring period, there are no any temporary deviations from registered monitoring plan or applied methodology.

B.2.2. Corrections

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During this monitoring period, there are no any corrections to project information or parameters fixed at validation.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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The project activity has requested for changes of monitoring plan since monitoring period two. It has submitted for approval from EB on 03/01/2013 and now waiting for approval.

During this monitoring period, there are no any permanent changes from registered monitoring plan or applied methodology.

B.2.4. Changes to project design of registered project activity

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This section the changes to project design of registered project activity will be indicated. The gross electricity generation has been changed from 22 MWe which is mentioned in registered PDD to 22.5 Mwe according to name plate of generator inspected by DOE. However, this change does not effected to the additionality of the project activity. Hence, the revised PDD is requested.

The revised PDD will be provided after get approval from EB for changes from registered monitoring plan.

B.2.5. Changes to start date of crediting period

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During this monitoring period, there are no any changes to start date of crediting period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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N/A

SECTION C. Description of monitoring system

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The diagram of the monitoring system has been provided in this section according to monitored parameters. Also the description of monitoring system in the project standard will be justified in this section.

The monitored parameters has been measured and monitored according to the diagram below. Firstly, the quantity of rice husk (BF) is measured and recorded when it arrived to the power plant as same as moisture content, the number of truck and the average distance from rice mill to power plant. Also, the sample of rice husk will be taken for heating value measurement according to the method mention in section D. The consumption of diesel oil using in the boiler and onsite transportation are separately measured as shown in the diagram; moreover the heating value of diesel oil is measured follow the measurement method mention in section D. The electricity imported from the national grid and export to the national grid are also measured shown in the diagram. For more detail on each parameter measurement, it is provided in section D.

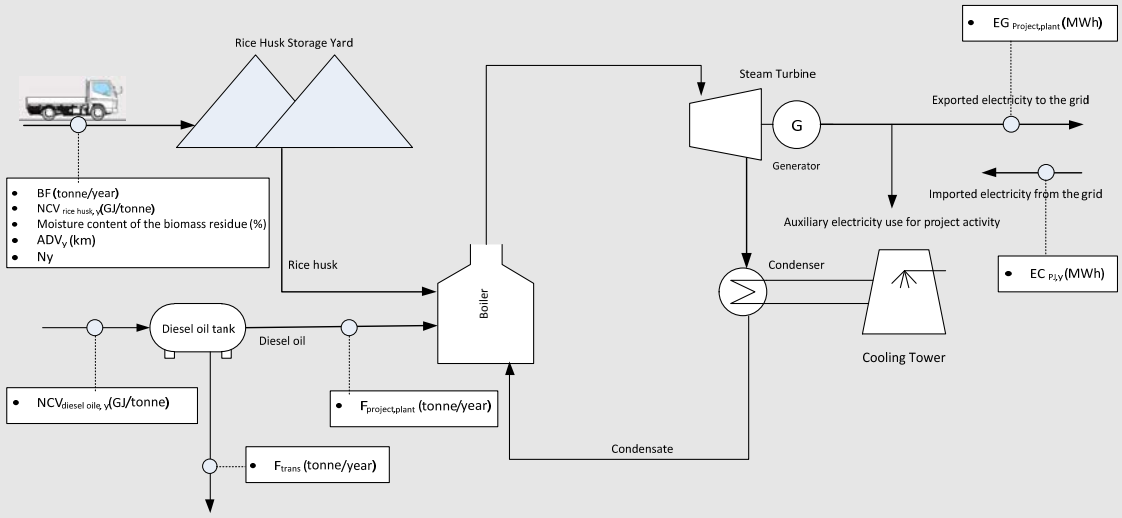

Figure 2: The monitoring system diagram for project activity

In order to monitor emission reduction and any leakage effects generated by the project activity. The information flow has been set up a well-defined management and operational system. This system includes the operation and management of the monitoring plan, which specifies the requirements and procedures for parameters monitoring data recording and data archiving.

The plant manager and operators are responsible for the execution of the monitoring plan. Based on the modern system it intends to use for control and reporting, they collect and archive relevant data in a systematic and reliable way, evaluate them regularly, generate reports, and ensure the availability of pertinent information for verification. For the ease of understanding, ATB outlines the general guidance on performing the monitoring plan in the following areas:

- Establishment of a transparent system for the data monitoring, collection, computation, and recording;
- Development of a protocols that provide routines procedures for electronic based data

monitoring and record keeping processes, which must be fitting for independent auditing;
- Development of an "Equipment Calibration Procedures" booklet, which delineates the frequency and detail of each equipment calibration and maintenance; and
- Production and internal verification of monitoring are reported in a regular basis throughout the verification period.

Apart from internally verification done by the plant manager and ATB's board of directors, an independent verifier, DOE, also periodically audits the monitoring results and its management systems in order to ensure credibility and transparency of the reported emission reductions and other performance indicators of the ATB Project.

To ensure that the operators enable to undertake the tasks as per monitoring plan, internal on-the-job training is provided. The staff training programs are carried out before the initial verification with the supports of technical assistants, professionals and system contractors.

The description of the monitoring system which includes data collection procedure, organization structure, roles and responsibility of personnel, and emergency procedures for the monitoring system are provided in CDM manual which is controlled by ISO9001. The CDM manual can be provided during verification to DOE.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	GWP_{CH4}
Unit:	tCO_2e / tCH_4
Description:	Global warming potential for CH_4
Source of data:	IPCC
Value(s) applied):	21
Purpose of data:	Calculation of baseline emission
Additional comment:	-

Data / Parameter:	EF_{grid}
Unit:	tCO_2 / MWh
Description:	CO_2 emission factor of the grid
Source of data:	Registered PDD
Value(s) applied):	0.51
Purpose of data:	Calculation of baseline emission
Additional comment:	Once upon renewal of a crediting period

Data / Parameter:	EF_{OM}
Unit:	tCO_2 / MWh
Description:	CO_2 Operating margin emission factor of the grid
Source of data:	Registered PDD
Value(s) applied):	0.60
Purpose of data:	Calculation of baseline emission
Additional comment:	Once upon renewal of a crediting period

Data / Parameter:	EF_{BM}
Unit:	tCO_2 / MWh
Description:	CO_2 emission factor of the grid
Source of data:	Registered PDD
Value(s) applied):	0.42
Purpose of data:	Calculation of baseline emission
Additional comment:	Once upon renewal of a crediting period

Data / Parameter:	$COEF_{fuel}$
Unit:	tCO_2/t_{fuel}
Description:	CO_2 emission coefficient of each fossil fuel
Source of data:	EGAT, EPPO
Value(s) applied):	IPCC
Purpose of data:	Calculation of baseline emission
Additional comment:	None

Data / Parameter:	F_{pp}
Unit:	one/yr
Description:	Amount of each fossil fuel consumed by each power source / plant
Source of data:	EGAT, EPPO
Value(s) applied):	Refer to Tables 1 and 2 of Annex 3.
Purpose of data:	Calculation of baseline emission
Additional comment:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.

Data / Parameter:	GEN_{pp}
Unit:	MWh
Description:	Electricity generation of each power source / plant
Source of data:	EGAT, EPPO
Value(s) applied):	Refer to Table 1 of Annex 3.
Purpose of data:	Calculation of baseline emission
Additional comment:	None

Data / Parameter:	Plant name (OM)
Unit:	-
Description:	Identification of power source/plant for the OM
Source of data:	EGAT, EPPO
Value(s) applied):	Refer to Table 1 of Annex 3.
Purpose of data:	Calculation of baseline emission

Additional comment:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.

Data / Parameter:	**Plant name(BM)**
Unit:	-
Description:	Identification of power source / plant for the BM
Source of data:	EGAT, EPPO
Value(s) applied):	Refer to Table 2 of Annex 3.
Purpose of data:	Calculation of baseline emission
Additional comment:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.

Data / Parameter:	**$COEF_{CO2}$**
Unit:	tCO_2/TJ
Description:	CO_2 emission factor of the most carbon intensive fuel in the calculation of the combined margin with methodology ACM0002
Source of data:	IPCC, EGAT
Value(s) applied):	74.1
Purpose of data:	Calculation of baseline emission
Additional comment:	IPCC or EGAT default values will be used where appropriate.

D.2. Data and parameters monitored

Data / Parameter:	BF
Unit:	one / yr
Description:	Quantity of rice husk combusted in the ATB plant
Measured/ Calculated / Default:	Measured
Source of data:	Monthly report at site
Value(s) of monitored parameter:	148,666 (one/yr at dry basis)

Monitoring equipment:	<table><tr><td>Manufacturer</td><td>Commandor</td><td>Commandor</td></tr><tr><td>Serial number</td><td>0000700</td><td>0000701</td></tr><tr><td>Calibration frequency</td><td>Every 2 years</td><td>Every 2 years</td></tr><tr><td>accuracy</td><td>±20 kg.</td><td>±20 kg.</td></tr><tr><td>Calibration year 2010</td><td>29/07/2010</td><td>29/07/2010</td></tr><tr><td>Calibration year 2011</td><td>13/07/2011</td><td>13/07/2011</td></tr><tr><td>Calibration year 2012</td><td>03/07/2012</td><td>03/07/2012</td></tr><tr><td>Validity</td><td>02/07/2013</td><td>02/07/2013</td></tr></table>
Measuring/ Reading/ Recording frequency:	**Measuring –** Measured by a weighting meter each time truck arrived **Reading –** Reading each time that truck arrives. **Recording frequency –** Record each time that truck arrive, aggregated monthly and yearly and archived electronically
Calculation method (if applicable):	BF on dry basis = BF wet basis – (1-%moisture)
QA/QC procedures:	Trucks carrying rice husk is weighted twice, upon entry and exit. Meters at the weighing station is calibrated once in 2 years as per regulation. This will be checked against purchase receipts and inventory data.
Purpose of data:	The amount rice husk combusted is estimated from the amount of rice husk delivered to the project site considering the stocks of biomass at the beginning and end of each year. As per the methodology, an energy balance will be carried out annually, considering the stocks of rice husk at the beginning and end of each year.
Additional comment:	The amount rice husk combusted is estimated from the amount of rice husk delivered to the project site considering the stocks of biomass at the beginning and end of each year. As per the methodology, an energy balance is carried out annually, considering the stocks of rice husk at the beginning and end of each year.

Data / Parameter:	Moisture content of the biomass residue
Unit:	%
Description:	Moisture content of the biomass combusted at ATB plant
Measured/ Calculated / Default:	Measured
Source of data:	Monthly report at site
Value(s) of monitored parameter:	9.76%

Monitoring equipment:	<table><tr><td>Manufacturer</td><td>METTLER TOLEDO</td></tr><tr><td>Serial number</td><td>1126400006</td></tr><tr><td>Calibration frequency</td><td>Yearly</td></tr><tr><td>accuracy</td><td>±3%</td></tr><tr><td>Calibration year 2010</td><td>20/09/2010</td></tr><tr><td>Calibration year 2011</td><td>20/12/2011</td></tr><tr><td>Calibration year 2012</td><td>27/09/2012</td></tr><tr><td>Validity</td><td>26/09/2013</td></tr></table>
Measuring/ Reading/ Recording frequency:	**Measuring –** The measurement has been done for each truck that delivers rice husk to the site by moisture analyser continuously. **Reading –** Each truck that delivers rice husk to the site **Recording frequency** – Each truck that delivers rice husk to the site. Data is to be aggregated monthly and will be archived electronically.
Calculation method (if applicable):	-
QA/QC procedures:	Moisture content of the rice husk is cross checked with the result from the external laboratory with international testing standard at least annually, taking at least three samples for each measurement. The moisture analyzer will be calibrated annually.
Purpose of data:	Calculating baseline emission
Additional comment:	In case of dry biomass, monitoring of this parameter is not necessary. The mean value of moisture content will be weight average with the biomass quantity. The mean value will be calculate on monthly basis.

Data / Parameter:	EF_{CH4}
Unit:	tCH4 / TJ
Description:	CH4 emission factor for the combustion of biomass residues in the project plant
Measured/ Calculated / Default:	Default
Source of data:	Default values, as provided in Table 3.
Value(s) of monitored parameter:	0.0411 tCH_4/TJ
Monitoring equipment:	-

Measuring/ Reading/ Recording frequency:	This parameter is reviewed yearly. Data is kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	IPCC default values will be used where appropriate.
Purpose of data:	Calculation of baseline emission
Additional comment:	From Table 3 of ACM0006 Version 4 , methane emission factor is 30 kg CH_4/TJ and then multiply with conservativeness factors 1.37 to get methane emission factor 0.0411 tCH_4/TJ.

Data / Parameter:	AVD
Unit:	km
Description:	Average return trip distance between biomass fuel supply sites or the origin of the biomass and ATB plant
Measured/ Calculated / Default:	Measured
Source of data:	ATB
Value(s) of monitored parameter:	70
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	**Measuring –** Continuously (each time trucks arrive) **Reading –** Continuously (each time trucks arrive) **Recording frequency -** Eeach time trucks arrive
Calculation method (if applicable):	-
QA/QC procedures:	The consistency of distance records are checked against with maps from the rick husk sources to the site.
Purpose of data:	Calculation of project emission
Additional comment:	The data will be held for a period of 2 years after the end of the crediting period.

Data / Parameter:	N
Unit:	-
Description:	Number of truck trips for the transportation of rice husk
Measured/ Calculated / Default:	Measured
Source of data:	ATB
Value(s) of monitored parameter:	7,469

Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	**Measuring –** Continuously (each time trucks arrive) **Reading –** Continuously (each time trucks arrive) **Recording frequency -** Eeach time trucks arrive
Calculation method (if applicable):	-
QA/QC procedures:	The consistency of the number of truck trips with the quantity of biomass combusted are checked and compared by the relation with previous years.
Purpose of data:	Calculation of project emission
Additional comment:	-

Data / Parameter:	$EF_{km,CO2}$
Unit:	tCO_2 / km
Description:	Average CO_2 emission factor for transportation of rice husk
Measured/ Calculated / Default:	Default
Source of data:	Emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range).
Value(s) of monitored parameter:	1097gCO_2/km
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	This parameter is reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	Cross-check measurement results with emission factors referred to in the literature.
Purpose of data:	Calculation of project emission
Additional comment:	-

Data / Parameter:	**$EF_{CO2,Diesel}$**
Unit:	tCO_2/GJ
Description:	CO_2 emission factor of the diesel
Measured/ Calculated / Default:	Default

Source of data:	Use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice.
Value(s) of monitored parameter:	0.0741 tCO_2/GJ
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	IPCC default values will be used where appropriate.
Purpose of data:	Calculation of project emission
Additional comment:	As local or national data is not available therefore IPCC default emission factor from Table 2.2 Volume 2: Energy has been reported in kg of CO2 per TJ has been used. The basic conversion factor has been used to convert the value to tCO2 per GJ according to Table 1-3 SI Prefixes, Perry's Chemical Engineers' Handbook 7th edition.

Data / Parameter:	$FF_{project, plant}$
Unit:	one / yr
Description:	Onsite fossil fuel consumption for start-up/auxiliary use
Measured/ Calculated / Default:	Measured
Source of data:	On-site measurements
Value(s) of monitored parameter:	82
Monitoring equipment:	**Manufacturer**: Oval **Serial number**: 78043 **Calibration frequency**: 1 year **accuracy**: ±0.25% **Calibration year 2010**: 26/03/2010 **Calibration year 2011**: 20/03/2011 **Calibration year 2012**: 19/03/2012 **Validity**: 18/03/2013
Measuring/ Reading/ Recording frequency:	**Measuring –** Measured continuously **Reading –** Reading continuously **Recording frequency –** Monthly recorded
Calculation method (if applicable):	-

QA/QC procedures:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data:	Calculation of project emission
Additional comment:	The volume of diesel oil from meter will be converted to the weight by multiply with the density of diesel oil.

Data / Parameter:	$FF_{project, site}$
Unit:	one / yr
Description:	Quantity of fossil fuel type *i* combusted at the project site for other purposes that are attributable to the project activity during the year *y.*
Measured/ Calculated / Default:	On site measurement
Source of data:	Monthly report at site
Value(s) of monitored parameter:	150
Monitoring equipment:	**Manufacturer**: TATSUNO **Serial number**: 05010024 **Calibration frequency**: Every 2 years **accuracy**: ± 0.25% **Calibration year 2009**: 03/09/2009 **Calibration year 2012**: 16/02/2012 **Validity**: 15/02/2014
Measuring/ Reading/ Recording frequency:	**Measuring –** Measured continuously **Reading –** Reading continuously **Recording frequency –** Monthly recorded
Calculation method (if applicable):	-
QA/QC procedures:	The amount of fuel consumption will be monitored by fuel meters, which will undergo calibration be calibrated once in 2 years as per regulation. The consistency of the data will be checked against fuel purchase invoices.
Purpose of data:	Calculation of project emission
Additional comment:	Fossil fuel use at site is only diesel.

Data / Parameter:	$EG_{project\ plant}$
Unit:	MWh
Description:	Net quantity of electricity generated from the ATB plant
Measured/ Calculated / Default:	Measured

Source of data:	ATB
Value(s) of monitored parameter:	131,593
Monitoring equipment:	**Manufacturer**: Landis&Gyr **Serial number**: 83448652 **Calibration frequency**: 1 year **accuracy**: ±0.2% **Calibration year 2010**: 09/11/2010 **Calibration year 2011**: 01/12/2011 **Calibration year 2012**: 18/09/2013 **Validity**: 17/09/2013
Measuring/ Reading/ Recording frequency:	**Measuring –** Measured continuously by electricity meters (main meter and backup meter). **Reading –** continuously **Recording frequency –** continuously
Calculation method (if applicable):	-
QA/QC procedures:	The amount of the electricity generated by the Project will be monitored by electricity meters (main meter and backup meter), which will be calibrated in accordance with the strict standards set by EGAT. Cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Purpose of data:	Calculating of baseline emission
Additional comment:	This is electricity export to the grid.

Data / Parameter:	$NCV_{diesel, y}$
Unit:	GJ / tonne
Description:	Net calorific value of diesel oil
Measured/ Calculated / Default:	Default
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice.
Value(s) of monitored parameter:	45.69
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Using reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available). The conservative value will be chosen.

Calculation method (if applicable):	-
QA/QC procedures:	Check consistency of the reliable local or national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information.
Purpose of data:	Calculation of project emission
Additional comment:	For the conversion factor of diesel from Btu/lb to GJ/ton is taken from Table 1-4 Perry's Chemical Engineers' Handbook 7th Edition (1Btu/lb = 2,326 kJ/kg = 2.32 x 10^{-3} GJ/ one.

Data / Parameter:	$NCV_{rice\ husk,\ y}$
Unit:	GJ / tonne
Description:	Net calorific value of rice husk
Measured/ Calculated / Default:	Default
Source of data:	Measurement by the external laboratory.
Value(s) of monitored parameter:	15.32
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Using reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available). The conservative value will be chosen.
Calculation method (if applicable):	-
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from relevant data sources (e.g values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data source, conduct additional measurements.
Purpose of data:	Calculation of project emission
Additional comment:	The testing result will be in unit of kcal/ one and will be converted to GJ/ one with simple conversion factor by multiplied 0.41868 x 10^{-6} as mention in Table 1-3 and Table 1-5 of Perry's Chemical Engineers' Handbook 7th Edition.

Data / Parameter:	$EF_{burning,\ CH4,k,y}$
Unit:	tCH_4 / GJ
Description:	CH4 emission factor for uncontrolled burning of the biomass residue
Measured/ Calculated / Default:	Default
Source of data:	Use referenced and reliable default values (e.g IPCC)

Value(s) of monitored parameter:	3×10^5
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	This parameter will be reviewed yearly. Data will be kept in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	IPCC default values will be used where appropriate
Purpose of data:	Calculation of baseline emission
Additional comment:	Conservativeness factors will also be documented. The basic conversion factor has been used to convert the value to tCO_2 per GJ according to Table 1-3 SI Prefixes, Perry's Chemical Engineers' Handbook 7th edition

Data / Parameter:	$EC_{PJ,y}$
Unit:	MWh
Description:	Onsite electricity import attributable to the project activity
Measured/ Calculated / Default:	Measured
Source of data:	On-site measurement
Value(s) of monitored parameter:	541
Monitoring equipment:	**Manufacturer**: EDMI (MK6E) **Serial number**: 23047080 **Calibration frequency**: 1 year **accuracy**: ± 0.5% **Calibration year 2010**: 13/10/2010 **Calibration year 2011**: 15/02/2011 **Calibration year 2012**: 25/01/2012 **Validity**: 24/01/2013
Measuring/ Reading/ Recording frequency:	**Measuring –** Continuous **Reading -** Continuous **Recording frequency –** Monthly to MR
Calculation method (if applicable):	-

QA/QC procedures:	One-site electricity consumption will be monitored by electricity meter, which will undergo calibration annually by PEA. The consistency of the data will be checked against electricity receipt from PEA.
Purpose of data:	Calculating of project emission
Additional comment:	This parameter is electricity imported from grid for using within the project activity only.

Data / Parameter:	-
Unit:	Tone/yr
Description:	Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region
Measured/ Calculated / Default:	n/a
Source of data:	Survey or statistic
Value(s) of monitored parameter:	81,136
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	This parameter is reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.
Purpose of data:	Calculation of leakage
Additional comment:	-

Data / Parameter:	-
Unit:	Tone/yr
Description:	Quantity of available biomass residues of type k in the region
Measured/ Calculated / Default:	n/a
Source of data:	Survey or statistic
Value(s) of monitored parameter:	2,157,359
Monitoring equipment:	-

Measuring/ Reading/ Recording frequency:	This parameter is reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable):	-
QA/QC procedures:	This involves the use of official data, the Thai national inventory. Quality control of this data is beyond the control of the project operators.
Purpose of data:	Calculation of leakage
Additional comment:	-

D.3. Implementation of sampling plan

>>
There are no any data and parameter monitored described in section D.2 are determined by a sampling approach. Then this section is not applicable for this project activity.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

This section will provided sample calculations for all formulae used and calculation of baseline emission, applying actual values. The electronic spreadsheets to present full calculations will be attached in the monitoring report as annex 1.

In term of baseline emission, the main sources are through the exported electricity to the national grid and CH_4 emission from uncontrolled burning of rice husk.

$$BE = ER_{electricity,y} + BE_{biomass,y}$$

Period	BE	$ER_{electricity,y}$	$BE_{biomass,y}$
	tCO_2e	tCO2e	tCO2e
01/01/2012-20/12/2012	73,265	67,112	6,153

(i) Emission reductions due to displacement of electricity

Emission reduction due to the displacement of electricity are calculated by multiplying the net quantity of increased electricity generated with biomass residues as a result of the project activity (EG_y) with the CO2 baseline emission factor for the electricity displaced due to the project ($EF_{electricity,y}$) as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$$

Period	1. $ER_{electricity,y}$	2. EG_y	3. $EF_{electricity,y}$
	tCO_2e	MWh	tCO_2/MWh
01/01/2012-20/12/2012	67,112	131,593	0.51

(ii) Emission of methane emissions, from uncontrolled burning or aerobic decay of the biomass residues

Baseline emissions are calculated by multiplying the quantity of biomass residues that would not be used in the absence of the project activity with the net calorific value and an appropriate emission factor, as follows:

$$BE_{biomass,y} = GWP_{CH4} \cdot \sum_k BF_{PJ,k,y} \cdot NCV_k \cdot EF_{burning,CH4,k,y}$$

To determine the CH_4 emission factor, the level of conservativeness factor depends on the uncertainty rage of the estimate for the CH_4 emission factor. Appropriate conservativeness factor from Table 5 in ACM0006 Version04 is chosen and multiplied with the estimate for the CH_4 emission factor. The default CH_4 emission factor of 0.0027 tCH_4/t biomass is used, the uncertainty can be deemed to greater than 100%, resulting in a conservativeness factor of 0.73. Thus, in this case an emission factor of 0.001971 tCH_4/t biomass is used. However, the $EF_{burnin,CH4,y}$ is calculated by dividing the CH_4 emission factor with the net calorific value in GJ/t biomass.

Period	$BE_{biomass,y}$	GWP_{CH4}	$BF_{PJ,k,y}$	NCV_k	$EF_{burning,CH4,y}$
	tCO_2e/y	tCO_2e/tCH_4	tons dry	GJ/ton dry	tCH_4/GJ
01/01/2012-20/12/2012	6,153	21	148,666	15.32	0.00012

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>

This section provides the sample calculation for all formulae used and calculation of project emission. The electronic spreadsheets to present full calculations will be attached in the monitoring report as annex 1.

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{biomass,CH4,y}$$

Period	PE_y	PET_y	PEFFy	$PE_{EC,y}$	GWP_{CH4}	$PE_{biomass,CH4,y}$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e/tCH_4	tCO_2/yr
01/01/2012-20/12/2012	3,521	482	789	276	21	94

(i) CO_2 emissions from combustion of fossil fuels for transportation of biomass residues to the project plant (PET_y)

In this project activity, the approach based on distance and vehicle type (option 1) is chosen to determine emission from transportation of biomass residues to project plant. Emissions are calculated on the basic of distance and the number of trips as follows:

$$PET_y = N_y \cdot AVD_y \cdot EF_{km,CO2,y}$$

Period	PET_y	$Ny \times AVD_y$	$EF_{km,CO2,y}$
	tCO_2e	km	tCO_2/km
01/01/2012-20/12/2012	482	438,804	0.001097

(ii) CO_2 emissions from onsite consumption of fossil fuels ($PEFF_y$)

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum_i (FF_{projectplant,i,y} + FF_{projectsite,i,y}) \cdot NCV_i \cdot COEF_i$$

Period	$PEFF_y$	$FF_{project\ plant,\ I,y}$	$FF_{project\ site,\ I,\ y}$	NCV_i	$COEF_i$
	tCO_2e	tone	tone	GJ/tone	tCO2/GJ
01/01/2012-20/12/2012	789	82.46	150.42	45.69	0.0741

(iii) CO_2 emissions from electricity consumption ($PE_{EC,y}$)

CO_2 emissions from onsite electricity consumption ($PE_{EC,y}$) are calculated by multiplying the electricity consumption by an appropriate grid emission factor, as follows:

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y}$$

Period	$PE_{EC,y}$	EC_{Piy}	$EF_{grid,y}$
	tCO_2e	MWh	tCO_2/MWh
01/01/2012-20/12/2012	276	540	0.51

(iv) Methane emissions from combustion of biomass residues

Emissions are calculated as follows:

$$PE_{biomass,CH4,y} = EF_{CH4,BF} \cdot \sum_k BF_k \cdot NCV_k$$

Period	$PE_{biomass,CH4,y}$	$EF_{CH4,BF}$	BF_k	NCV_k
	tCH_4	tCH_4/GJ	ton/yr	GJ/ton
01/01/2012-20/12/2012	94	41.1×10^{-6}	148,666	15.32

The default CH_4 emission factor of 30 kg CH_4/TJ from Table 3 in methodology ACM0006 Version is used, the uncertainty is estimated to be 300%, resulting in a conservativeness factor of 1.37. Thus, in this case a CH_4 emission factor of 41.1 kg CH_4/TJ is used.

E.3. Calculation of leakage

>>

This section provides sample calculation for all formulae used and calculation of leakage, applying actual values.

As identified in the registered PDD, a leakage assessment was carried out as part of monitoring the supply situation for the rice husk. To demonstrate that the use of rice husk by the project does not result in increased fossil fuel consumption elsewhere, a leakage assessment is carried out. Of the three options provided in the baseline methodology, leakage assessment L_2 is used:

"Demonstrate that there is an abundant surplus of the biomass residue in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residue of type k in the region is at least 25% larger than the quantity of biomass residue of type k that is utilized (e.g. for energy generation or as feedstock), including the project plant."

The baseline methodology stipulates that in defining that geographical boundary of the region for the leakage assessment, the usual distances for biomass transport should be taken into account, and the region may cover a radius around the project activity of at least 20 km but no more than 200 km. Due to the large number of rice millers in the region, it is not possible to isolate public data according to distance. Instead, based on the project's planned procurement area, the geographical boundary was defined in line with the registered PDD as Pichit and the surrounding provinces of Kamphaeng Phet, Phitsanulok, Nakhon Sawan, Uthai Thani, Petchabun and Chainart. These provinces cover an area of roundly 100 km in radius.

The percentage of rice husk in surplus will be calculated by the formulas presented below:

$$\text{Percent of rice husk in surplus [RHs] (\%)} = \left(\text{Amount of (available rice husk in the region (tone/yr)} - \text{Amount of rice husk that is utilized (tone/yr)}\right) \times 100\%$$

Leakage 2012 (01/01/2012 – 20/12/2012)

1. Rice Production and Rice Husk Production in 2012

Province	Rice Production (Tonnes) 2012			Production of Rice Husk (tonne)
	Major Rice	Second Rice	Total	
Kamphaeng Phet	707,630.00	696,406.00	1,404,036	322,928.28
Phitsanulok	905,240.00	1,001,796.00	1,907,036	438,618.28
Phichit	913,070.00	783,110.00	1,696,180	390,121.40
Nakhon Sawan	1,207,680.00	907,551.00	2,115,231	486,503.13
Uthai Thani	322,910.00	200,486.00	523,396	120,381.08
Phetchabun	601,760.00	145,845.00	747,605	171,949.15
Chai Nat	506,870.00	479,469.00	986,339	226,857.97
Total	**5,165,160.00**	**4,214,663.00**	**9,379,823.00**	**2,157,359.29**

Source: Office of Agricultural Economics
http://www2.oae.go.th/mis/Forecast/08_DEC2555/Thai/table/tbl_t_01.htm
http://www2.oae.go.th/mis/Forecast/08_DEC2555/Thai/table/tbl_t_02.htm

Based on information from the Office of Agricultural Economics, rice production in the 7 provinces ones d 9,379,823 tonnes, translating to a total rice husk of some 2.16 Million ones in 2012.

Rice Husk Use

The major traditional uses of rice husk were identified as the use in chicken farm, brick plants and cement plants, in additional to rice millers' own consumption for rice milling and parboiling. This demand has been relatively stable as mentioned in the PDD. Another source of rice husk is the use for grid connected power plants. The amount of rice husk used for each proposed was estimated base on official data together with survey result obtained by ATB. This information is summarized below.

A. Rice Milling and Parboiling

The quantity of rice husk consumed by rice millers for rice milling and parboiling is calculated

17.11% of total rice husk. This information is based on interview with the Rise Engineering Supply Company, and Ruam Charn Rice Miller.

B. Chicken farms

According to the information from Office of Agricultural Economics, the chicken populations in the 7 provinces total approximately 11.97 million in 2012.

Chicken population in procurement area

Province	Broiler Chicken 2012	Native Chicken 2012	Total	Rice Husk Demand (tonne)
Kamphaeng Phet	366,345	366,345	732,690	879.23
Phitsanulok	892,194	892,194	1,784,388	2,141.27
Phichit	319,418	319,418	638,836	766.60
Nakhon Sawan	1,384,709	1,384,709	2,769,418	3,323.30
Uthai Thani	482,883	482,883	965,766	1,158.92
Phetchabun	2,116,483	2,116,483	4,232,966	5,079.56
Chai Nat	424,287	424,287	848,574	1,018.29
Total	**5,986,319**	**5,986,319**	**11,972,638**	**14,367.17**

Source: Office of Agricultural Economics
http://www2.oae.go.th/mis/Forecast/08_DEC2555/Thai/table/tbl_t_22.htm
http://www2.oae.go.th/mis/Forecast/08_DEC2555/Thai/table/tbl_t_23.htm

Of these, only broiler farms which use evaporator-controlled system need to use rice husk to lay the floor. For conservative estimation, it is assumed that all broiler farms use the evaporator-controlled system. Therefore, the chicken population requiring rice husk is deemed as 14,367.17 tonne in 2012.
In order to ascertain the amount of rice husk used per chicken, ATB conducted an interview as part of an EIA in 2004. Two farmers, one with a small farm of 10,000 chickens and another with a medium farm of 140,000 chickens, gave figures of 1.21 kg and 0.54 kg rice husk requirement per chicken, respectively. Based on the assumption that the difference reflected small farms tending to use a larger amount of rice husk per chicken, the figure of 1.2 kg per chicken per year was determined to be the appropriate and conservative value to use for the estimation of rice husk used in chicken farms. Thus,

Rice husk used in chicken farms in the Project's procurement area = Total chicken population in the Project's procurement area x Rice husk demand per chicken (t rice husk/chicken/yr)

C. Brick plants

Data on the number of brick plants in the project's procurement area of 7 provinces and their production capacities were obtained from the Department of Industrial Works. The number of brick plant is the same as for year 2005, as provided in PDD, because the Department of Industrial Works has not registered any new brick plants since 2005. In an interview with one major brick supplier, it transpired that the demand for brick in this region has decreased by 5-10%, which accounts for no new brick plants being set up.

Brick plants in procurement area

Province	Number of brick plants	Total Capacity (piece/year)	Rice Husk Demand (tonne)
Kampaeng Phet	17	26,590,000.00	6,647.50
Phitsanulok	24	30,550,000.00	7,637.50
Pichit	4	1,650,000.00	412.50
Nakhon Sawan	17	19,585,000.00	4,896.25
Uthai Thani	14	58,680,000.00	14,670.00
Phetchabun	14	45,315,000.00	11,328.75
Chainart	13	14,990,000.00	3,747.50
Total	**90**	**197,360,000.00**	**49,340.00**

Source: Department of Industrial Work. Latest data available for 2006; accessed on 28 May 2008.

ATB conducted an interview with 4 brick makers in 2004. The brick makers gave rice husk consumption figures of between 0.18 kg and 0.25 kg for production of one piece of brick, with the smaller brick makers requiring more rice husk per piece of brick. For the purpose of a conservative, the 0.25 kg figure was used for the estimation of rice husk used in brick plants. Also for conservatism, it is assumed that all brick plants use rice husk for their energy requirement.

$$\text{Rice husk used in brick plants in the Project's procurement area} = \text{Total bricks produced in the Project's procurement area (bricks/year)} \times \text{Rice husk demand per piece of brick produced (t rice husk/brick)}$$

According to the formula above the rice husk use in brick plants in the project procurement area is around 49,340 tonnes annually.

D. Cement plants

There is one known cement manufacturer in the procurement area that uses rice husk as part of its fuel mix. ATB conducted an interview with the manufacturer in order to obtain the consumption volume of rice husk. Based on the interview, the rice husk use for cement plants was determined to be 10,600 tonne.

E. Grid-connected power plant

There are currently four power plants by the Thai Power Supply Company totaling an approximately 14 MW gross located approximately 100 km from the project site.
Based on ATB's interview with the power company, the total rice husk use for the four plants is approximately 81,136 tonnes per year. Therefore, it is assumed that 81,136 tonnes, are procured from within the project's leakage assessment area.

Rice husk surplus

The following table summarizes that supply and demand situation of rice husk in the 7 provinces – Pichit, Kamphaeng Phet, Phitsanulok, Nakhon Sawan, Uthai Thani, Petchabun and Chainart. – that comprise the project's procurement area.

2. Supply and demand of rice husk in procurement area

	Tonnes
Supply	**2012**
Rice husk production	2,157,359
[A] Total Supply	**2,157,359**

Demand	
Rice milling and parboiling	369,124
Chicken farms	14,367
Brick plants	49,340
Cement plants	10,600
Grid-connected power plants	81,136
ATB Project's fuel requirement	95,153
[B] Total Demand	**619,720**
Surplus [A] – [B]	**1,537,639**
Surplus as defined by ACM0006 ([A]-[B])/[B]	**248%**

It can be seen from the table above that the quantity of available rice husk in the region is approximately 248 in 2012 which is larger than the quantity of rice husk that is used, for all purposes including the ATB plant. This is significantly higher than the 25% threshold given in the baseline methodology. Therefore, the project does not bead to any leakage.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	73,265	3,521	0	69,744

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	68,639	69,744

E.6. Remarks on difference from estimated value in registered PDD

>> The actual emission is a bit higher (+1.6%) than estimated in The PDD, because it has more available of rice husk this year due to the promotion of government.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards

	Emission reductions or GHG removals by sinks (t CO_2e)	n/a	n/a	

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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