PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	A.T. Biopower Rice Husk Power Project in Pichit, Thailand
Version number of the PDD	03 After TR comments 02 After onsite validation 01 (Submit to UNFCCC for notification for renewal)
Completion date of the PDD	26/03/2014
Project participant(s)	A.T. Biopower Co., Ltd
Host Party(ies)	Thailand
Sectoral scope and selected methodology(ies)	Sectoral scope: 1 ACM0018 “Electricity generation from biomass residues in power-only plants”
Estimated amount of annual average GHG emission reductions	54,506 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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A description of the project activity in accordance with applicable provisions related to the description of project activity is provided in this section as well as the estimate of annual average and total GHG emission reduction from the chosen crediting period.

The project activity "A.T. Biopower Rice Husk Power Project in Pichit, Thailand" has been registered as a CDM project since 18/06/2007 (UNFCCC Reference Number 1026)[1]. The first 7 year-renewal crediting period started on 21/12/2005 and expired on 20/12/2012. The project proponents are applying for second crediting period from 21/12/2012 to 20/12/2019.

In general, the project activity is defined as a power-only plant which is a power plant applying all heat engines of the power plant produce only power and do not co-generate heat, and the thermal energy produced in equipment of the power plant is only used in heat engines and not for other processes. The project activity involves the installation of 22.5 MWe biomass power plant which is located in Pichit province, Thailand and 20 MWe net is sold to the national grind to replace the fossil base electricity in the grid system.

The biomass residues, rice husk, used as main fuel fed to the boiler generating heat and the heat is carried out by steam to the header and then is use in condensing turbine to generate the electricity sold to the grid. There are some amount of electricity generated is used for station service. In case of power plant shut down, the electricity from the national grid is requested for station service. However, the full description of the technologies and measure, project boundary and baseline scenario are to be provided in sections A.3, B.3 and B.4 below.

As electricity from the project activity is generated from renewable energy and it is replaces the fossil base electricity in the grid system, the estimate of annual average GHG emission reduction for the chosen crediting period (second crediting period from 21/12/2012 to 20/12/2019) is 54,506 tCO_2 and the total estimated of GHG emission for the second crediting period is 381,544 tCO_2.

Not only GHG emission will be reduced from the project activity, the sustainable development is contributed to the host country as follows:

- Save the fossil fuels used in the power sector, and correspondingly reduce SO_2 and NO_x emission;
- Reduce the wastage of biomass which are currently being dumped and burnt;
- Stimulate the renewable energy industry in Thailand, including domestic manufacturing;
- Create local employments during the operation.

[1] http://cdm.unfccc.int/Projects/DB/DNV-CUK1174909241.2/view

A.2. Location of project activity

A.2.1. Host Party(ies)

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Thailand

A.2.2. Region/State/Province etc.

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Pichit province

A.2.3. City/Town/Community etc.

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Hor-Krai sub-district

Bang-Moon-Nak district

A.2.4. Physical/Geographical location

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The project activity is located at 96 Moo 2 Hor-Krai sub-district, Bang-Moon-Nak district and Pichit province. The region is in the Lower North of Thailand and approximately 320 kilometres from Bangkok.

Geographical coordinate of the project activity:

Latitude : 16^{o} 04’ 16.58” N

Longitude : 100^{o} 23’ 48.36” E

Figure 1: The location of project activity

Source: Google map (last access 31/05/2012)

A.3. Technologies and/or measures

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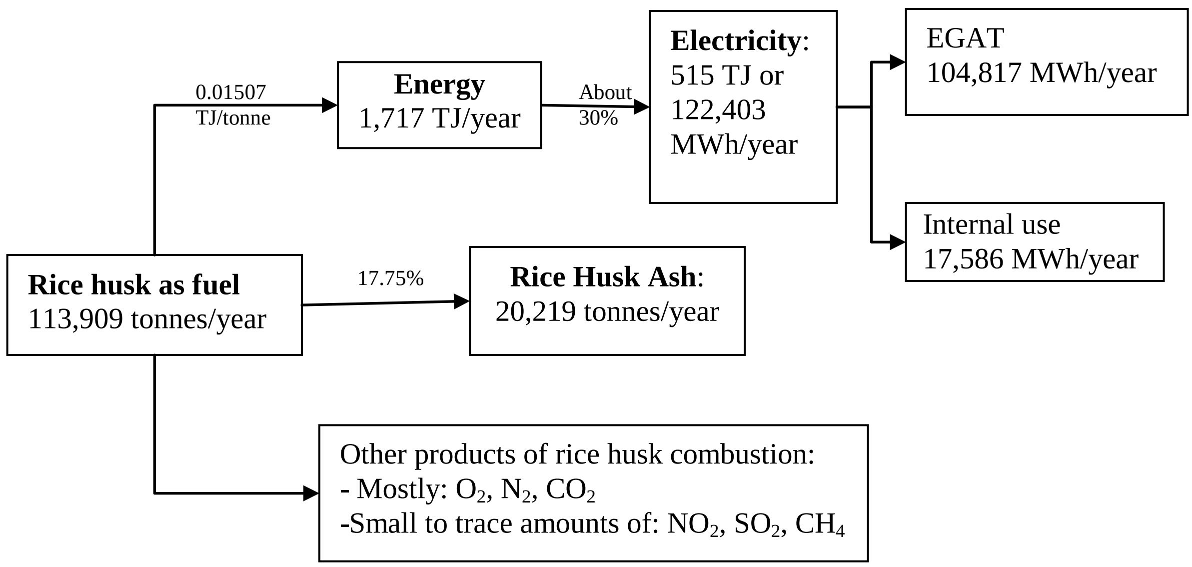
In this section, the description of technologies and measures to be employed and/or implemented by the project activity including a list of the facilities, systems and equipment that will be installed and/or modified by the project activity is included.

(a) The project involves the construction and operation of new rice husk power plant in Pichit province with gross generating capacity of generator at 22.5 MWe. The plant operates using suspension-fired boilers, design to burn ground rice husk in suspension. 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 bar Design temperature = 485^{o}C Capacity = 91 T/HR
Turbine	Electrowatt-Ekono (Thailand) Ltd.	Condensing turbine Inlet steam pressure 65 bar 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 capacity 22.5 MW Rated Voltage 6.6 kV Rated current 260 A Rated power factor 0.8 Rated frequency 50 Hz Rated Speed 1500 rpm

(b) Base on project operation on 2008-20012, energy and mass flow and balance of the system and equipment included in the project activity has been simulated as in the diagram below:



(c) There is no any modified and/or installed new system and equipment under the project activity and their relation.

A.4. Parties and project participants

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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	A.T. Biopower Co., Ltd	No
Japan	Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.	No

A.5. Public funding of project activity

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No public funding from Annex I countries is involved in the project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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The selected methodology for second crediting period is:
ACM0018 "Electricity generation from biomass residues in power-only plants" (Version 3.0)

Tools referenced in this methodology:
"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 02);
"Emissions from solid waste disposal sites" (Version 06.0.1);
"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01);
"Tool to calculate the emission factor for an electricity system" (Version 04.0);
"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1)
"Project and leakage emissions from road transportation of freight" (Version 01.0.0)

The selected methodology and tools referenced in this methodology can refer to the UNFCCC CDM website is http://cdm.unfccc.int/methodologies/DB/DAZTTA5JRVU3J4W4PEFMT4ZOQW0DFM.

B.2. Applicability of methodology

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The project activity is power-only generation project and applied ACM0006 version 4, which allowed both co-generation and none co-generation project activity, during the time of registration. However, based on the ACM006 version 10 EB52 Annex08 onwards, the applicability of methodology was restricted to power and heat projects. The power-only projects were excluded from this methodology (Refer to latest version of ACM0006 Consolidated methodology for electricity and heat generation from biomass version 12.1.1 EB69 Annex17 valid from 02/03/2012 onwards, history of the document, page 87/89) and applied with a new consolidated methodology ACM0018 Version 03.0"Electricity generation

from biomass residues in power-only plants”. Therefore, applicable methodology for project activity in the renewal crediting period is ACM0018 Version 03.0.

Referring all approved methodologies provided in the UNFCCC CDM website, the project activity met the applicability of ACM0018 “Electricity generation from biomass residues in power-only plants” (Version 03.0) as justified in Table 2.

Table 2: The justification of methodology applicability - ACM0018 (Version 03.0)

No	Applicable condition	Justification	Applicability (Yes/No)
1	This methodology is applicable to project activity that generates electricity in biomass-residue (co-)fired power-only plants, optionally combining with electricity generation using solar thermal technology.	The project activity is operating a power-only plant to generate power and do not co-generate heat and the thermal energy	Yes
2	The project activity may include the following activities or, where applicable combinations of these activities: a) The installation of new biomass residue (co-)fired power-only plants at a site where currently no power generation occurs (greenfield power project)	a) The project activity is built a new power-only plant by firing biomass residues, where currently no power generating occurs on site (greenfield power project)	Yes
	b) The installation of new biomass residues (co-)fired power-only plants, which replace or are operated next to existing power-only plants fired with fossil fuels and/or biomass residues (power capacity expansion project)	b) The power plant is the Greenfield project and not related to power capacity expansion project. This option is not applicable for project activity.	No
	c) The improvement of energy efficiency of existing biomass residues (co-)fired power-only plants (energy efficiency improvement projects), which can also lead to a capacity expansion, for example by retrofitting the existing plant	c) The project activity related to installation of new power-only plant. This option is not applicable for project activity.	No
	d) The total or partial replacement of fossil fuels by biomass residues in an existing power only plant or in a new power-only plant that would have been built in the absence of the project (fuel switch project), e.g by increasing the share of biomass residues use as compared to the baseline, by retrofitting and existing plant to use biomass residues, etc.	d) The project is Greenfield project and not related to replacement of fossil fuels by biomass residues. This option is not applicable for project activity.	No

	e) The installation of biomass residues (co-)fired power-only plants which include solar thermal power generation by sharing the power generation equipment between the biomass and solar components at a site where currently no power generation using solar thermal technology occurs (either as Greenfield or power capacity expansion project).	e) The project is rice husks power plant only not include solar thermal generation. This option is not applicable for project activity.	No
3	The biomass residues used in the project activity may be produced on-site (e.g if the project activity is based on the operation of a power plant located in an (agro-) industrial plant generating the biomass residues), or they can be obtained off-site from the nearby area, specific suppliers or purchased from a market.	The biomass residues are obtained off-site from the field and identified rice mills at nearby area.	Yes

Not only the applicability above, but methodology is also applicable under the following conditions which are justified in Table 3.

Table 3: The justification of applicable condition - ACM0018 (Version 03.0)

No	Applicable condition	Justification	Applicability (Yes/No)
1	No other biomass type than biomass residues, as defined above, are used in the project plant.	The project activity is only use rice husk biomass residues.	Yes
2	Fossil fuel may be co-fired in the project plant. However, the amount of fossil fuels co-fired shall not excess 80% of the total fuel fired on an energy basis.	Only small amount of diesel oil will be used for boiler start-up which would not exceed 80% of the total fuel fired on an energy basis.	Yes
3	For project that use biomass residues from a production process (e.g production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g product change) in this process.	The biomass residue used in the project activity is supplied from rice production process. The implementation of the project will not result in an increase of the processing capacity of rice to the rice mill	Yes

4	The biomass residues used by the project facility should not be stored for more than one year.	The storage time of the biomass residue will not be stored for more than one year.	Yes
5	Projects that chemically process the biomass residues prior to combustion (e.g by means of esterification, fermentation and gasification) are not eligible under this methodology. The biomass residues can however be processed physically such as by means of drying pelletization and briquetting.	The project does not chemically process the biomass before combustion.	No
6	No power and heat plant operates at the project site during the crediting period	The project activity is the only power-only plant located and operated at the project site during the crediting period.	Yes
7	If any heat is generated for purposes other than power generation (e.g. heat which is produced in boilers or extracted from the header to feed thermal loads in the process) during the crediting period or was generated prior to the implementation of the project activity, by any on-site or off-site heat generation equipment connected to the project site, the following conditions should apply: (a) The implementation of the project activity does not influence directly or indirectly the operation of the heat generation equipment, i.e. the heat generation equipment would operate in the same manner in the absence of the project activity; (b) The heat generation equipment does not influence directly or indirectly the operation of the project plant (e.g. not fuels are diverted from the heat generation equipment to the project plant); and (c) The amount of fuel used in the heat generation equipment can be monitored and clearly differentiated from any fuel used in the project activity.	The project activity is a power-only plant which any heat is generated for only purposes power generation. Therefore, this condition is not applicable.	No
8	In the case of fuel switch project activity, the use of biomass residues or the increase in the use of biomass residues as compared to the baseline scenario is technically not possible at the project site without a capital investment in:	The project activity is not a case of fuel switch project activity, and then this applicable condition is not applied to this project activity.	No

	• The retrofit or replacement of existing heat generators/boiler; or • The installation of new heat generators/boilers; or • A new dedicated biomass residues supply chain established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes); • Equipment for preparation and feeding of biomass residues.		

However, the methodology is only applicable if the most plausible baseline scenario, as identified per the "Procedure for the selection of the baseline scenario and demonstration of additionality" section hereunder, is:

- For power generation: Scenarios P2 to P7, or a combination of any of those scenarios;
- For biomass use: Scenarios B1 to B8, or a combination of any of those scenarios. However note that for scenarios B5 to B8, leakage emissions should be accounted for as per the procedures of the methodology.

According to Section B.4 Establishment and description of baseline scenario, for the power generation the Scenario P5 is the most plausible baseline scenario while Scenario B1is the most plausible baseline scenario for biomass use.

In conclusion of the applicability, the project activity satisfies that the project activity meets the applicability condition of the ACM0018 "Electricity generation from biomass residues in power-only plants" (Version 03.0)

B.3. Project boundary

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According to Guidelines for completing the project design document form EB66 Annex 8, present a flow diagram of the project boundary, physically delineating the project activity, based on the description provided in section A.3 above is provided, including in the flow diagram the equipment, systems and flows of mass and energy described in that section. In particular, indicate in the diagram the emission sources and GHGs included in the project boundary and the data and parameters to be monitored are described.

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.

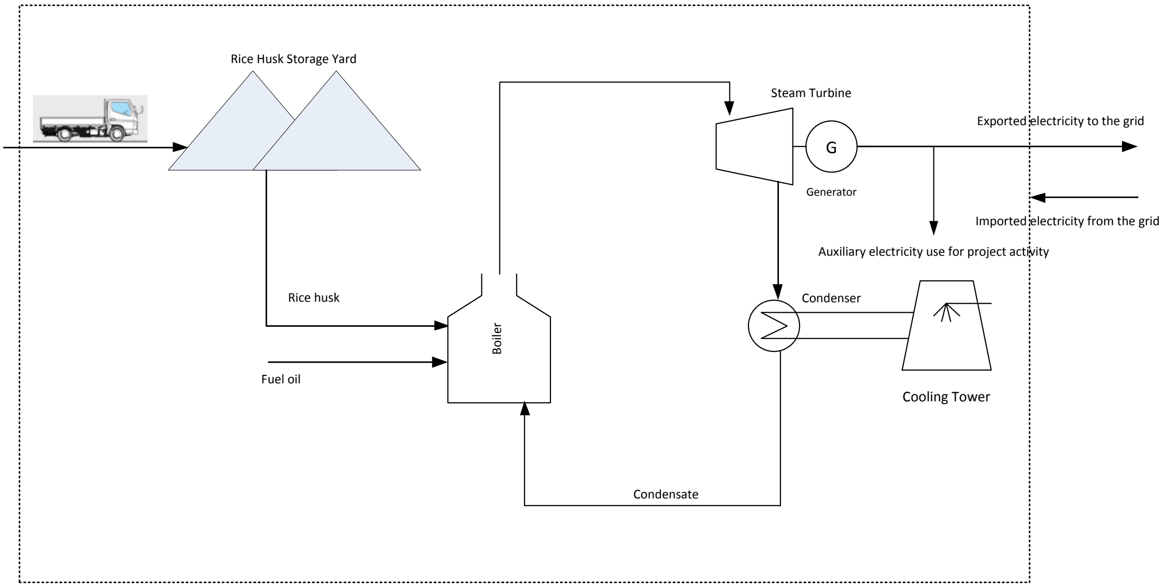

Figure 2: A flow diagram of the project activity boundary

As per Figure 2, 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 rich 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 generators. Then the mechanical energy is converted to electricity this 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).

Table 4: Overview on emissions sources included in or excluded from the project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.

	Uncontrolled burning or decay of surplus biomass residues	CO_2	Excluded	It is assumed that CO2 emission from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	Since case B1 has been identified as the most likely baseline scenario, the CH4 emission from uncontrolled burning or decay of surplus biomass residues has been included.
		N_2O	Excluded	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources.
Project Activity	On-site fossil fuel consumption	CO_2	Included	May be an important emission source.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	On-site and off-site transportation and processing of biomass residues	CO_2	Included	May be an important emission source.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Combustion of biomass residues for electricity	CO_2	Included	It is assumed that CO2 emission from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	Since the CH4 emission from uncontrolled burning or decay of surplus biomass residues has been included in the baseline scenario, this emission source must be included.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Storage of biomass residues	CO_2	Excluded	It is assumed that CO2 emission from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Excluded	Excluded for simplification. Since biomass residues are stored for not longer than one year, this emission source is assumed to be small.
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small.
	Waste water from the treatment of biomass residues	CO_2	Excluded	It is assumed that CO2 emission from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.

		CH_4	Excluded	Excluded since there is no wastewater from the treatment of biomass residues.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.

B.4. Establishment and description of baseline scenario

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This section explains how the baseline scenario is established in accordance with the selected methodology and applicable provisions for establishment and description of baseline scenario in the project standard. There is no change for the baseline in using biomass for generation of electricity[2]. According to procedure for the selection of the baseline scenario and demonstration of additionality, ACM0018 (Version 03.0), the baseline scenario is conducted by applying the following steps:

Step 1: Identification of alternative scenarios

This step serves to identify all alternative scenarios to the proposed CDM project activity that can be the baseline scenario through the following sub-steps:

Step 1a: Define alternative scenario to the proposed CDM project activity

This step will identify all alternative scenarios that are available to the project participants and that provide output or services with comparable quality, properties and application area as the proposed CDM project activity.

In doing so, alternative scenarios should be separately determined regarding:

- How electricity would be generated in the absence of the CDM project activity; and
- What would happen to the biomass residues in the absence of the project activity.

The alternative scenarios for electricity power should include, *inter alia*

P1: The proposed project activity not undertaken as a CDM project activity;

P2: If applicable[3], the continuation of power generation in existing power-only plants fired with biomass residues, or fossil fuels, or a combination of both, at the project site. The existing power-only plants would operate at the same condition (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the project activity;

P3: If applicable[2], the continuation of power generation in existing power-only plants fired with biomass residues, or fossil fuels, or a combination of both, at the project site. The existing power-only plants would operate with different conditions from those observed in the most recent three year prior to the project activity;

P4: If applicable[2], the retrofitting of existing power-only plant fired with biomass residues, or fossil fuels, or a combination of both, at the project site. The retrofitting may or may not include a change in fuel mix;

P5: The generation of power in the grid;

P6: The installation of new power-only plants fired with biomass residues, or fossil fuels, or a combination of both, at the project site, using the same amount or less biomass residues than under scenario P1, both with and without solar thermal power generation, if applicable[4];

[2] Confirmed with Thailand DNA. (Dr. Chaiwat)

[3] This alternative is only applicable if there are existing power plants operating at the project site.

[4] This alternative is only applicable if there are existing power plants operating at the project site.

P7: The installation of new power-only plants fired with biomass residues, or fossil fuels, or a combination of both, at the project site, using more biomass residues than under scenario P1, both with and without solar thermal power generation, if applicable[3];

P8: If applicable[3], the installation of new solar thermal power-only plant without biomass utilisation.

Scenario P2, P3 and P4, this alternative is only applicable if there are existing power plants operating at the project site, are immediately rejected as a plausible alternative because there are no such plants within the immediate vicinity of the project site.

In addition, since the project activity is the establishment of a Greenfield power plant and supplies electricity only to the grid, then the alternatives considered for power generation should include only the scenarios P1 and P5 according to the procedure for the selection of the baseline scenario and demonstration of additionality, ACM0018 (Version 03.0) page 14/66. In this case, it can be considered that the electricity delivered by the project activity would have otherwise been generated by the operation of existing or new grid-connected power plants, established either by the project participants or by third parties. Therefore, the scenario P6, P7 and P8 is immediately rejected as a plausible alternative.

In conclusion, the remaining plausible scenarios are alternative P1 and P5 for electricity power.

For the use of biomass residues, the alternative scenarios for biomass residues should include, *inter alia*

B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields;

B2: the biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to landfills which are deeper than 5 meters. This does not apply to biomass residues that are stock-piled[5] or left to decay on fields;

B3: The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes;

B4: The biomass residues are used for electricity generation in power-only plant configuration at the project site in new and/or existing power plants;

B5: the biomass residues are used for power and/or heat generation in other existing or new power plants at other sites;

B6: The biomass residues are used for other energy purposes, such as the generations of bio-fuels;

B7: The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in process (e.g in the pulp and pare industry);

B8: The primary source of the biomass residues and/or their fate in the absence of the project activity cannot be clearly identified[6].

The project activity mainly uses rice husks as the fuel to generate the power. According to methodology ACM0018 (Version 03.0), the analysis of the quantities of which biomass residues categories are used in the project activity should be taken, which has been presented in

Table 5.

[5] Further work is undertaken to investigate to which extent and in which cases methane emissions may occur from stock-piling biomass residues. Subject to further insights on this issue, the methodology may be revised.

[6] For example, this scenario can be used if biomass residues are purchased from a market, or biomass residues retailers, or if processes biomass is purchased from biomass processing plants which are not included in the project boundary.

Table 5: Biomass residues categories

Biomass residues category (k)	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario	Biomass residues quantity (tonnes)
3	Rice husk	Off-site from an identified rice mill	Dumping and decay of residues on fields (B1)	Electricity generation on-site (P5)	Corresponds to the quantity of each category of biomass residues (tonnes)
4	Rice husk	Off-site from a biomass residues retailer	Burnt in an uncontrolled manner (B3)	Electricity generation on-site (P5)	Corresponds to the quantity of each category of biomass residues (tonnes)

For biomass residues categories for which scenarios B1:, B2: and B3: is deemed to be a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario. Towards this end, for each biomass residues category, one of the following procedures should be applied:

(a) Demonstrate that there is an abundant surplus of the type of biomass residue in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of that type of biomass residues available in the region in at least 25% larger than the quantity of biomass residues of the type which is utilized in the region.
(b) Demonstrate for the sites from where biomass residues are sourced that the biomass residues have not been collected or utilized but dumped and left to decay, land-filled or burnt without energy generation prior to their use under the project activity this approach is only applicable to biomass residues categories for which project participants can clearly identify the site from where the biomass residues are sourced.

The scenarios B1:, B2:,B3: can only be regarded as a plausible baseline scenario for a certain category of biomass residues, if the project participants can demonstrate that at least one of the two approaches (a) or (b) are fulfilled. Otherwise, the baseline scenario for this particular biomass residues category should be considered as B8:, and a leakage penalty will be applied when calculating leakage emissions.

According to above paragraph, option (a) was selected. For this purpose, demonstrate that the quantity of that type of biomass residues available in the region in at least 25% larger than the quantity of biomass residues of the type which is utilized in the region.

As the project is applying for renewal of crediting period, therefore demonstration of leakage as per identified in the registered PDD section B.4.2, was conducted with updated information from year 2012 as below.

As identified in the baseline methodology, the main potential source of leakage for biomass power generation projects is an increase in emissions from fossil fuel combustion due to the diversion of biomass from other uses to the project plant as a result of the project activity.

To demonstrate that the use of rice husk (biomass residue of type *k*) by the Project does not result in increased fossil fuel consumption elsewhere, a leakage assessment is carried out as part of the monitoring the supply situation for the rice husk. 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 the 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 20km but no more than 200km. Due to the large number of biomass fuel supply sites 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 as Pichit and the surrounding provinces of Chainart, Nakhon Sawan, Uthai Thani, Kamphaeng Phet, Phitsanulok and Petchabun. These provinces cover an area of roughly 100km in radius.

The percentage of rice husk in surplus has been calculated by the formulas presented below:

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

Rice Production in 2012

Province	Rice Production (Tonnes) 2012			Production of Rice Husk (tonne)
	Major Rice	Second Rice	Total	
Kamphaeng Phet	895,773.00	696,406.00	1,592,179	366,201.17
Phitsanulok	912,405.00	1,001,796.00	1,914,201	440,266.23
Phichit	1,106,662.00	783,110.00	1,889,772	434,647.56
Nakhon Sawan	1,405,702.00	907,551.00	2,313,253	532,048.19
Uthai Thani	378,609.00	200,486.00	579,095	133,191.85
Phetchabun	646,946.00	145,845.00	792,791	182,341.93
Chai Nat	519,376.00	516,744.00	1,036,120	238,307.60
Total	**5,865,473.00**	**4,251,938.00**	**10,117,411.00**	**2,327,004.53**

Source: Office of Agricultural Economics
http://www.oae.go.th/download/prcai/DryCrop/majorrice.pdf
http://www.oae.go.th/download/prcai/DryCrop/secondrice.pdf

Based on information from the Office of Agricultural Economics, rice production in the 7 provinces totalled 10,117,411 tonnes, translating to a total rice husk of some 2.33 Million tonnes in 2012[7].

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 registered 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.

[7] http://www.env.msu.ac.th/en/attachments/426_fulltext.pdf

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 9.99 million in 2012.

Chicken population in procurement area

Province	Broiler Chicken 2012	Native Chicken 2012	Total	Rice Husk Demand (tonne)
Kamphaeng Phet	366,345	702,480	1,068,825	1,293.28
Phitsanulok	892,194	570,741	1,462,935	1,770.15
Phichit	319,418	683,008	1,002,426	1,212.94
Nakhon Sawan	1,384,709	388,630	1,773,339	2,145.74
Uthai Thani	482,883	492,907	975,790	1,180.71
Phetchabun	2,116,483	837,841	2,954,324	3,574.73
Chai Nat	424,287	331,792	756,079	914.86
Total	**5,986,319**	**4,007,399**	**9,993,718**	**12,092.40**

Source: Office of Agricultural Economics
http://www.oae.go.th/download/prcai/livestock/broiler.pdf
http://www.oae.go.th/download/prcai/livestock/nativechicken.pdf

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 12,092.40 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 1.21 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 74 plants. 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 Installed Capacity (piece/year)	Rice Husk Demand (tonne)
Kampaeng Phet	28	7,986,600	1,996.65
Phitsanulok	3	2,960,000	740.00
Pichit	4	1,650,000.00	412.50
Nakhon Sawan	16	21,111,500	5,277.88
Uthai Thani	1	200,000	50.00
Phetchabun	17	18,503,300	4,625.83
Chainart	5	21,920,000	5,480.00
Total	**74**	**74,331,400.00**	**18,582.85**

Source: Department of Industrial Work. Confirmed by have telephone call with Department of Industrial Works.

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.

Rice husk used in brick plants in the Project's procurement area	=	Total bricks produced in the Project's procurement area (bricks/year)	x	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 18,582 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 totalling 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.

Province	No. of Power Plant	Rice Husk Demand (tonne)	
Kampaeng Phet	1	39,058.00	Thai Seri Generating Co.,Ltd. Capacity 6.0 MW
Phitsanulok		-	
Pichit	1	6,510.00	Jitsermthai Rice Mill Co.,Ltd. Capacity 1.0 MW
Nakhon Sawan		-	
Uthai Thani		-	
Phetchabun		-	
Chainart	2	35,568.00	Biomass Power Co.,Ltd. Capacity 6.0 MW and Energy for Cons/Env Co.,Ltd. Capacity 1.0 MW
Total	**4**	**81,136.00**	

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.

Supply and demand of rice husk in procurement area

	Tonnes
Supply	**2012**
Rice husk production	2,327,005
[A] Total Supply	**2,327,005**
Demand	
Rice milling and parboiling	398,150
Chicken farms	12,092
Brick plants	18,583
Cement plants	10,600
Grid-connected power plants	81,136
ATB Project's fuel requirement	148,655
[B] Total Demand	**669,217**
Surplus [A] - [B]	**1,657,787**
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 lead to any leakage.

Outcome of Step 1a:

As per Step 1a, it is identified that for **power generation** the realistic and creditable alternative include **P1** and **P5** and for the **use of biomass residues**, the realistic and creditable alternative include **B1,** and **B3.**

Sub-step 1b: Consistency with mandatory applicable laws and regulation

The objective of this sub-step is to determine whether the alternatives listed in outcome of sub-step 1a are in compliance with all mandatory applicable legal and regulatory requirements.

Both alternatives for power generation and used of biomass residues which is outcome of step 1a demonstrated above are in compliance with mandatory applicable legal and regulatory.

Outcome of Step 1b:

As per Step 1a, it is identified that for **power generation** the realistic and creditable alternative include **P1** and **P5** and for the **use of biomass residues**, the realistic and creditable alternative include **B1** and **B3.**

Step 2: Barrier analysis

This step serves to identify barriers and to assess which alternatives are prevented by these barriers. Apply the following sub-steps:

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

Establish a complete list of realistic and credible barriers that may prevent alternative scenarios to occur. Such realistic and credible barriers may include:

- Investment barriers, other than insufficient financial returns as analyzed in Step 3, inter alia:
    - For alternative undertaken and operated by private entities: Similar activities have only been implemented with grants or other non-commercial finance terms. Similar activities are defined as activities that rely on a broadly similar technology or practices, are of a similar scale, take place in a comparable environment with respect to regulatory framework and are undertaken in the relevant geographical area, as defined in Sub-step 1a above.
    - No private capital is available from domestic or international capital markets due to real or perceived risks associated with investment in the country where the project activity is to be implemented, as demonstrated by the credit rating of the country or other country investment reports of reputed origin.
- Technological barriers, inter alia:
    - Skilled and/or properly trained labor to operate and maintain the technology is not available in the relevant geographical area, which leads to an unacceptably high risk of equipment disrepair, malfunctioning or other underperformance;
    - Lack of infrastructure for implementation and logistics for maintenance of the technology (e.g. natural gas cannot be used because of the lack of a gas transmission and distribution network);
    - Risk of technological failure: the process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed CDM project activity, as demonstrated by relevant scientific literature or technology manufacturer information;
    - The particular technology used in the proposed project activity is not available in the relevant geographical area.
- Lack of prevailing practice:
    - The alternative is the "first of its kind"
- Other barriers, preferably specified in the underlying methodology as examples.

Outcome of Step 2a:

There are investment and technological barriers that prevent the implementation of the proposed project activity not undertaken as a CDM project activity. Discussion of barrier is in section B.5.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

Identify which alternative scenarios are prevented by at least one of the barriers listed in Sub-step 2a, and eliminate those alternative scenarios from further consideration. All alternative scenarios shall be compared to the same set of barriers. The assessment of the significance of barriers should take into account the level of access to and availability of information, technologies and skilled labour in the specific context of the industry where the project type is located. For example, project located in sectors with small and medium sized enterprises may not have the same means to overcome technologies barriers as projects in a sector where typically large or international companies operate.

Base on outcome of Sub-step 2a; (P1) the proposed project activity not undertaken as a CDM project activity is prevented by investment and technology barriers. Assessment of barriers is discussed in section B.5.

Outcome of Step 2b:

Table 6 the list of outcome of Step 2b

	Power generation	Used of biomass residues	Barriers
Project activity	P1: the proposed project activity not undertaken as a CDM project activity.	B4:The biomass residues are used for electricity generation in power-only plant configuration at the project site in new and/or existing power plants:	Investment and technological barriers
Baseline scenarios	P5: the generation of power in the grid.	B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields. B3: The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposed.	No barrier

There are still several alternative scenarios remaining, but which do not include the proposed project activity undertaken without being registered as a CDM project activity. The CDM alleviates the identified barriers that prevent the proposed project activity from occurring, project participants may choose to either:

Option 1: Go to Step 3 (investment analysis); or
Option 2: Identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario, and proceed to Step 4.

The Option 2 is chosen, and then the common practice analysis is proceeding.

Step 4: Common practice analysis

The project is applying for renewal of crediting period, therefore the additionality remains the same as the registered PDD demonstrated as Step 4a and 4b in section B.5.

B.5. Demonstration of additionality
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The project is applied for renewal of crediting period; therefore the additionality is not updated with regard to the methodology ACM0018 version 3. The additionality remains the same as the registered PDD that demonstrated as below

Step 0. Preliminary screening based on the starting date of the project activity

Under this step, it is necessary for project participants who wish to have the crediting period starting prior to the registration of their project activity to:

(a) Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration; and

(b) Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.

As stated in Section C.1.1., the starting date of the project activity is 5 January, 2004, which is the date on which construction work for the Pichit plant started. Further, while it is only required for a project to have submitted a new methodology or requested validation by a DOE, the Project fulfils both of these conditions. A new methodology application was first submitted in connection with this Project in April 2003, and a request for validation was made to Det Norske Veritas[8] in early 2003.

In the case of this Project, it is clear that the incentive from the CDM was seriously considered prior to the decision to proceed with the project activity. ATB commissioned MUS (formerly MS), its CDM consultant, in 2002 for the production of the CDM-PDD and has consulted with the Thai government regarding the CDM approval process from an early stage. A previous version of the Project's CDM-PDD was formally released in February 2003. The project participants only decided to start construction when the baseline and monitoring methodologies submitted for the Project was approved (as AM0004, now consolidated under ACM0006), with ATB issuing a Notice to Proceed on December 24, 2004. Most importantly, the Project would not have been possible without its major equity investor CEPCO, which, due to its interest in the CDM, only decided to participate in the Project after the methodology approval.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity

The identification of alternatives to the project activity is carried out as part of the baseline scenario identification in Section B.4. As a result, the alternatives to the project activity have been narrowed down to the following three scenarios.

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[8] DNV was accredited as DOE in April 2004

- P1 The proposed project activity not undertaken as a CDM project activity
- P2 The proposed project activity (installation of a power plant), fired with the same type of biomass but with a lower electrical energy efficiency (e.g. an efficiency that is common practice in the relevant industry sector)
- P4 The generation of power in existing and/or new grid-connected power plants

For each of the three scenarios, the biomass baseline is B1: The biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes

Sub-step 1b. Enforcement of applicable laws and regulations

All three power generation alternatives identified will meet Thailand’s legal and regulatory requirements. For the rice husk, there is currently no regulation dictating the disposal method of agricultural waste. The identified alternatives to the project activity are therefore in compliance with all applicable legal and regulatory requirements.

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

<u>Alternative P1: The proposed project activity not undertaken as a CDM project activity</u>

Of the typical barriers delineated in the methodology, the Project faces investment and technological barriers most acutely, which together prevent it from being implemented on a BAU basis.

The Project plans to procure its rice husk fuel from 30 biomass fuel supply sites. ATB expects these 30 millers will produce enough rice husks to meet the Project’s fuel requirement. However, this fuel supply arrangement is different to usual practice where a rice husk power plant has a core supplier to supply most if not all of its fuel requirements. This significantly increases the risk in the eyes of investors.

In terms of technology, the Project represents the first case of applying suspension-fired technology to rice husk in Thailand. While the technology itself has a proven track record of combusting rice husk for power generation, it is by no means guaranteed that the technology will not encounter unforeseen problems when it is applied to Thai rice husk with their particular characteristics. In addition, nobody in Thailand having previous experience with the technology, the Project entails a comprehensive program to train local employees for operation and maintenance.

Notwithstanding the incentives provided by EPPO subsidies and the SPP program which guarantees purchase of most of the electricity generated, it remains difficult to develop environmentally friendly electricity generation projects in Thailand. For the Pichit Project in particular, a major investment barrier has been the perceived high risk of the Project when investors evaluate it. The Project differs from any of a small number of undertakings hitherto seen in Thailand for rice husk power generation. Other projects have a large rice mill as a core project sponsor and rely on it for the supply of all or nearly all of the rice husk to be used at their plants. In contrast, the Project sources its rice husk from a great number of smaller mills. ATB itself does not see anything inherently risky about not having a core rice husk supplier, and is confident that, even in the unlikely event that supply becomes tight, the good-will it has cultivated with biomass fuel supply sites and agreements it will enter into with many of them will ensure uninterrupted supply. However, accustomed to seeing a core fuel supplier in similar projects and wary of new ideas, investors have not been convinced. They are worried that future popularity of rice husk power generation may boost demand for rice husk, prompting independent biomass fuel supply sites to raise prices in a mercantile manner. Furthermore, investors fear that when the supply and demand balance

becomes tight, the availability of rice husk for ATB's plant may be at risk, as there is no guarantee that the biomass fuel supply sites will honour the contracts with ATB. From investors' vantage point, the behaviour of independent biomass fuel supply sites will be in sharp contrast to that of the core suppliers whose long-term interest in the success of the power generation project he is closely involved in will restrain his demands for price increases and maintain his rice husk supply commitment. It is pertinent to note that investor's concerns about fuel supply are related to the latter half of the Project's life of 25 years. Few anticipate a shortage of rice husk supply during the first 7 years which constitute the crediting period for this PDD.

These concerns, coupled with investors' aversion to an unfamiliar technology, have led to a higher perceived risk for the Project than its real risk as judged by ATB. Perceived risk, however, exerts strong influence on investor appetite. Despite ATB's enthusiasm and the worthiness of the undertaking, it was not possible to attract enough investors to the Project on a BAU basis.

From investors' vantage point, the risk is the Project's use of an innovative technology unproven in Thailand. One key feature of the Project, which aims to minimise the environmental impacts caused by power generation, is its plans to reduce as much as possible the disposal of rice husk ash (RHA) by selling it to cement manufacturers as a replacement for clinker. The production of ash of a quality acceptable to cement manufacturers has meant the use for the first time in Thailand of a state-of-the-art technology (suspension-fired boiler), unlike a small number of rice husk power plants in the country which use a more conventional combustion technology such as a stoker boiler. This pioneering feature of the Project adds to the perceived risk.

In the eyes of investors, the redeeming feature of the Project is its CDM potential. Not only will the sale of CERs enhance the Project's revenues to, at least partially, offset its high (perceived) risk, an equally important incentive for investors is the higher status associated with CDM designation. The Project will publicly highlight its participants' environmental commitment. When registered with the CDM Executive Board, the Project will be one of the first CDM projects in Thailand. Indeed, the industrial and major equity investor CEPCO only decided to participate in the Project after the approval of the baseline methodology AM0004 (now consolidated under ACM0006), which was submitted in connection with this Project.

As is the case for the Project, this barrier can only be overcome with the assistance of CDM, which will allow a project to attract CDM investors willing to take a higher risk in return for CERs.

The only remaining realistic and credible alternative to the Project is therefore the generation of power in existing and/or new grid-connected power plants (P4). The baseline scenario is therefore the generation of power in existing and/or new grid-connected power plants (P4) for the power generation component of the project activity and the uncontrolled disposal of rice husk (B1) for the biomass utilization component of the project activity. This is consistent with Scenario 2 that is given in the baseline methodology ACM0006:

"The project activity involves the installation of a new power plant at a site where currently no power generation occurs. The power generated by the project plant is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes…"

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

The barriers identified in Sub-step 3a do not affect the alternative to the project, which is the generation of power in existing and / or new grid-connected power plants and the uncontrolled disposal of rice husk. The alternative to the Project is essentially the continuation of current practice, and the investment and technological barriers involved in a pioneering project such as ATB's will not affect or prevent the continued implementation of current practice.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

There are currently nine power plants in Thailand that use rice husk as fuel. Of these, four power plants are single-fuel plants that use only rice husk, and five power plants are multi-fuel plants. But for one of these plants, all power plants are owned by / attached to rice mills or other food processing plants such as sugar mills. In this respect, these projects are entirely different to the Project, which does not have a major supplier, as elaborated in B.3. The other, remaining project is a much smaller plant (6MW) and is a non-firm power producer. This is also vastly different to the Project.

Sub-step 4b. Discuss any similar options that are occurring

As per sub-step 4a, there are no similar options that are occurring.

Step 5. Impact of CDM registration

As briefly mentioned in Step 3, the industrial and major equity investor CEPCO only decided to participate in the Project once they were confident of the Project's chances of CDM approval, after the approval of the baseline methodology submitted in connection with the Project (AM0004, subsequently consolidated as ACM0006). CEPCO made clear from the beginning that their interest in the Project was contingent on the Project's CDM status. Under business-as-usual, it would have not been possible to attract the interest of CEPCO, without whose equity investment the Project would not have been implemented.

The Project is clearly not the baseline scenario. With a few exceptions, rice mills in Thailand are too small to use the rice husk they produce for electricity generation. The Project will collect unused rice husk from these mills and utilize it as fuel for its power plant. Without the Project, the surplus rice husk at these mills would continue to be either dumped or burned in the open air or in simple incinerators. The Project will reduce GHG emissions by displacing grid electricity by carbon-neutral biomass power generation. As illustrated in Section B.6.3, the Project results in a reduction of emissions totalling an estimated 541,044 tCO2 during the initial crediting period. Based on the foregoing assessments, the Project fulfils the criteria for additionality stipulated in Paragraph 43 of the CDM modalities and procedures.
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B.6. Emission reductions
B.6.1. Explanation of methodological choices
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According to the consolidated methodology ACM0018 "Electricity generation from biomass residues in power-only plant" (Version 03.0) the baseline emissions, project emissions, leakage and emission reduction are calculated as follows:

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y = Emission reductions during year y (tCO_2)
BE_y = Baseline emission during year y (tCO_2)
PE_y = Project emission during year y (tCO_2)
LE_y = Leakage emissions during year y (tCO_2)

Baseline Emission

Baseline emission may, where applicable, include the following emission sources:

- CO_2 emission from fossil fuel power plants at the project site;
- CO_2 emission from grid-connected fossil fuel power plants in the electricity system;
- CH_4 emission from anaerobic decay of biomass residues and/or CH_4 emissions from uncontrolled burning of biomass residues without utilizing them for energy purposes.

Baseline emissions are calculated as follows:

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

Where:

BE_y = Baseline emission during year y (tCO_2)
$BE_{EL,y}$ = Baseline emission due to generation of electricity in year y (tCO_2)
$BE_{BR,y}$ = Baseline emission due to uncontrolled burning or decay of biomass residues in year y (tCO_2e)

Baseline emissions are determined through the following steps:

Step 1: Determination of $BE_{EL,y}$

Baseline emissions from electricity generation are calculated based on the net quantity of electricity generation at the project site under the project scenario ($EG_{PJ,y}$) and a baseline emission factor ($EF_{BL,EL,y}$) which expresses the weighted average CO_2 intensity of electricity generation in the baseline as follows:

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

Where:

$BE_{EL,y}$ = Baseline emission due to generation of electricity in year y (tCO_2)
$EG_{PJ,y}$ = Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year (MWh)
$EF_{BL,EL,y}$ = Emission factor for electricity generation in the baseline in year y (tCO_2/MWh)

For this methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the project activity and are therefore not accounted for.

Step 1.1: Determination of $EG_{PJ,y}$

The net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary ($EG_{PJ,y}$) is determined as the difference between the gross electricity generation at the project site ($EG_{PJ,gross,y}$) and the auxiliary electricity consumption required for the operation of the power plant at the project site ($EG_{PJ,aux,y}$), as follows:

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

Where:

$EG_{PJ,y}$ = Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year (MWh)

$EG_{PJ,gross,y}$ = Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh)

$EG_{PJ,aux,y}$ = Total auxiliary electricity consumption required for the operation of the power plants at the project site (MWh)

$EG_{PJ,aux,y}$ shall include all electricity required on-site for the operation of equipment related to the preparation, processing, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting process, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc)

Step 1.2: Determination of $EF_{BL,EL,y}$

The electricity generated under the project activity could be generated in the baseline in there difference ways, depending on the baseline scenario and the particular situation of the project activity:

- **Use of biomass residue at the project site.** Electricity could be generated with biomass residues in power plant at the project site. This applies, for example, if
  (a) The project activity is a replacement of an existing biomass residues fired power plant;
  (b) The project activity is a capacity expansion of an existing biomass residues fired power plant by installing a new biomass residues fired power plant that is operated next to the existing plant;
  (c) The project activity is a fuel switch project activity where some biomass residues have already been used prior to the implementation of the project activity.

AND/OR

- **Use of fossil fuels at the project site.** Electricity could be generated with fossil fuels in power plants at the project site. This applies, for example, if
  (a) The project activity is a fuel switch from fossil fuels to biomass residues;
  (b) In the baseline, a fossil fuel power plant would continue to operate at the project site in parallel with a new biomass residues power plant;

AND/OR

- **Power generation in the electricity grid.** Electricity could be generated by power plants in the electricity grid. This applies, for example, if
  (a) The project activity exports all electricity to the grid and no electricity would be produced at the project site in the baseline.
  (b) The project activity results in an increase of the quantity of electricity produced by power plant included in the project boundary and this increased electricity is exported to the grid or would in the baseline be purchased from the grid.

As in the establishment and description of baseline scenario (Section B.4.), the alternative P5 is established as the baseline scenario. Belong to the option (a) of the particular situation of **Power generation in the electricity grid**: The project activity export all electricity to the grid and no electricity would be produced at the project site in the baseline.

Therefore, the determination of $EF_{BL,EL,y}$ applies as:

$$EF_{BL,EL,y} = \frac{EG_{BL,FF,y} \cdot EF_{BL,FF,y} + EG_{BL,grid,y} \cdot EF_{grid,CM,y} + EG_{BL,FF/grid,y} \cdot MIN(EF_{BL,FF,y}; EF_{grid,CM,y})}{EG_{BL,BR,y} + EG_{BL,FF,y} + EG_{BL,grid,y} + EG_{BL,FF/grid,y}}$$

Where:

$EF_{BL,EL,y}$ = Emission factor for electricity generation in the baseline in year y (tCO_2/MWh)
$EG_{BL,BR,y}$ = Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year y (MWh)
$EG_{BL,FF,y}$ = Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year y (MWh)
$EG_{BL,grid,y}$ = Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year y (MWh)
$EG_{BL,FF/grid,y}$ = Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year y (MWh)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid-connected electricity generation in year y (tCO_2/MWh)
$EF_{BL,FF,y}$ = CO_2 emission factor for electricity generation with fossil fuels in power plant(s) at the project site in the baseline in year y (tCO_2/MWh)

In the following, first the amounts of electricity generated from the various sources in the baseline ($EG_{BL,BR,y}$, $EG_{BL,grid,y}$, $EG_{BL,FF,y}$ and $EG_{BL,FF/grid,y}$) are determined, taking into account the project configuration and the baseline scenario. Therefore, different cases have to be considered. Then the emission factors ($EF_{grid,CM,y}$ and $EF_{BL,FF,y}$) are determined.

Step 1.3: Determination of $EG_{BL,BR,y}$

The amount of electricity that would be generated with biomass residues in power-only plants operated at project site in the baseline ($EG_{BL,BR,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

Case 1: No power generation with biomass residues in the baseline. If Scenario B4 does not apply to any biomass residue category (i.e. if no biomass residues would be used for electricity generation in power-only plants in the baseline), then: $EG_{BL,BR,y} = 0$.

Case 2: Power generation with biomass residues in the baseline. If Scenario B4 applies to all or parts of the biomass residues fired in the power plant(s) included in the project boundary (i.e. if all or parts of the biomass residues would be used in the baseline for electricity generation in power-only plants included in the baseline boundary), then $EG_{BL,BR,y}$ is calculated as per equation (6) in ACM0018 (Version 03.0) page 28/66.

According to the analysis of baseline scenario in Section B.4, the project is a newly built power-only project, then **No power generation with biomass residues in the baseline** $EG_{BL,BR,y} = 0$.

Step 1.4: Determination of $EG_{BL,FF,y}$

The minimum of electricity that would be generated with fossil fuels at the project site in the baseline in year y ($EG_{BL,FF,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

Case 1: No use of fossil fuels in the baseline. This case applies if no fossil fuel would be used for electricity generation in the baseline scenario at the project site. In this case, $EG_{BL,FF,y} = 0$.

Case 2: No connection to the electricity grid. This case applies if all power plants included in the project boundary are off-grid power plants. In this case, the electricity generated by the project can only displace on-site electricity generation with fossil fuel and/or biomass residues ($EG_{PJ,y} = EG_{BL,FF,y} + EG_{BL,BR,y}$). Accordingly, $EG_{BL,FF,y}$ is calculated as per equation (12) in ACM0018 (Version 03.0) page 34/66.

Case 3: Grid connection and historical use of fossil fuels. This case applies if:
(a) Al least one power plant included in the project boundary is not an off-grid plant;
(b) Fossil fuels were used for power generation at the project site at any point in time during the most recent three calendar years prior to the implementation of the project activity; and
(c) The baseline scenario is the continued use of fossil fuels for power generation at the project site either in existing or new (co-fired) power plant(s) at the project site which is/are (co-)fired with fossil fuels.

Case 4: Grid connection, no historical use of fossil fuels, and construction of a new power plant (co-)fired with fossil fuels in the baseline scenario.
This case applies if:
(a) Al least one power plant included in the project boundary is not an off-grid plant;
(b) No fossil fuels were used for power generation at the project site during the most recent three year prior to the implementation of the project activity; and
(c) The baseline scenario is the construction of new power plant(s) at the project site which it/are (co-)fired with fossil fuels.

As described in Section B.4, the baseline scenario, the project is a newly built power-only project. No fossil fuel would be used for electricity generation in the baseline scenario at the project site. Therefore, **Case 1: No use of fossil fuels in the baseline** is applied and $EG_{BL,FF,y} = 0$.

Step 1.5: Determination of $EG_{BL,grid,y}$

The minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline ($EG_{BL,grid,y}$) should, in accordance with the baseline scenario, be determined as follows:

Case 1: No connection to the electricity grid. If all power plants included in the project boundary are off-grid power plants, then the project does not displace grid electricity and $EG_{BL,grid,y} = 0$.

Case 2: No electricity generation at the project site in the baseline. If no power plants would be operated at the project site in the baseline, then all electricity generated by the project displaces grid electricity and $EG_{BL,grid,y} = EG_{PJ,y}$.

Case 3: Use of only biomass residues for electricity generation at the project site in the baseline. If only biomass residues and no fossil fuels would be used for electricity generation at the project site in the baseline, then the electricity generated by the project displaces grid electricity and electricity generated with biomass residues ($EG_{PJ,y} = EG_{BL,grid,y} + EG_{BL,BR,y}$). Accordingly, $EG_{BL,grid,y}$ is calculated as per equation (15) in ACM0018 (Version 03.0) page 37/66.

Case 4: Use of only fossil for electricity generation at the project site in the baseline. If only fossil fuel and no biomass residues would be used for electricity generation at the project site in the baseline, then the electricity generated by the project can displace grid electricity and electricity generated with fossil fuels at the project site. $EG_{BL,grid,y}$ represents the amount of electricity that could not be generated in on-site power plant using fossil fuels and would have to be supplied by the grid. This applies to the amount of electricity generated in the project activity that exceeds the maximum amount of electricity that could be generated with fossil fuels at the project site in the baseline ($EG_{BL,MAX,FF}$). Accordingly, $EG_{BL,grid,y}$ is calculated as per equation (16) in ACM0018 (Version 03.0) page 38/66.

Case 5: Use of fossil and biomass residues for electricity generation at the project site in the baseline. If biomass residues and fossil fuels would be used for electricity generation at the project site in the baseline, then the electricity generated by the project can displace grid electricity that exceeds the maximum amount of electricity generation that could be generated by co-firing fossil fuels and biomass residues in plants at the project site in the baseline ($EG_{BL,MAX,FF/BR}$). Accordingly, $EG_{BL,grid,y}$ is calculated as per equation (17), (18) or (19) depending on **(a) Use of all biomass residues in co-fired heat generator** or **(b) Use of all biomass residues in biomass residues only heat generator** or **Use of biomass residues in both biomass residues only heat generator and co-fired heat generator** in ACM0018 (Version 03.0) page 38/66.

Since there are no power plants would be operated at the project site in the baseline for this project activity, then **Case 2: No electricity generation at the project site in the baseline** is applied.

Step 1.6: Determination of $EG_{BL,FF/grid,y}$

$EG_{BL,FF/grid,y}$ represents the amount of electricity that could be generated in the baseline in the grid or at the project site using fossil fuels. $EG_{BL,FF/grid,y}$ corresponds to the remainder of electricity generation, i.e. the amount that exceeds the minimum amount of electricity that would be generated by power plants in the electricity grid ($EG_{BL,grid,y}$), the minimum amount of electricity that could be generated with fossil fuels at the project site ($EG_{BL,FF,y}$), and the amount of electricity that would be generated with biomass residues at the project site ($EG_{BL,BR,y}$). Accordingly, $EG_{BL,FF/grid,y}$ is calculated as follows:

$$EG_{BL,FF/grid,y} = EG_{PJ,y} - EG_{BL,BR,y} - EG_{BL,FF,y} - EG_{BL,grid,y}$$

Where:

$EG_{BL,FF/grid,y}$ = Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year (MWh)

$EG_{PJ,y}$ = Electricity generated in power plants included in the project boundary in year y (MWh)

$EG_{BL,BR,y}$ = Amount of electricity that would be generated with biomass residues in power only plants operated at the project site in the baseline in year y (MWh)

$EG_{BL,FF,y}$ = Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year y (MWh)

$EG_{BL,grid,y}$ = Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year y (MWh)

Step 1.7: Determination of $EF_{BL,FF,y}$

$EF_{BL,FF,y}$ should be determined using option A or option B below. If fossil fuel power plants were operated at the project site prior to the implementation of the project activity, either option A or option B can be used to determine $EF_{BL,FF,y}$. For new power plants that would be constructed at the project site in the baseline scenario, Option B should be used.

Option A: Determine $EF_{BL,FF,y}$ as per the procedure described under "Scenario B: Electricity consumption from on off-grid captive power plant" in the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", using data from the three calendar year prior to the implementation of the project activity.

Option B: Determine a default emission factor for $EF_{BL,FF,y}$ based on a default efficiency of the power plant that would be operated at the project site in the baseline and a default CO2 emission factor for the fossil fuel types that would be used, as per equation (24) in ACM0018 (Version 03.0) page 43/66.

Since there are no any fossil fuel power plants were operated at the project site prior to the implementation of the project activity, the determination of $EF_{BL,FF,y}$ in this project activity case has not been applied.

Step 8: Determination of $EF_{grid,CM,y}$

$EF_{grid,CM,y}$ should be determined as the combined margin CO_2 emission factor for grid connected power generation in year y, calculated using the latest approved version of the "Tool to calculate the emission factor for an electricity system"

Step 2: Determination of baseline emission due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$)

The calculation of baseline emission due to uncontrolled burning or decay of biomass residues is optional and project participants can decide whether to include these emission sources or not. If project participants wish to include these emission sources, the procedure below should be followed, and emission from combustion of biomass residues under the project activity should be also be determined. Otherwise, this section does not need to be applied and project emissions do not need to include emissions from combustion of biomass residues under the project activity.

Baseline emissions due to uncontrolled burning or decay of biomass residues are only determined for those categories of biomass residues for which B1, B2 or B3 has been identified as the most plausible baseline scenario, as summarized in

Table 5 in the PDD. The guidance for the determination of $BR_{BL,n,p,y}$ should be considered in determining the quantities of biomass residues for each biomass residue category.

The emissions are determined separately for biomass residues categories for which scenario B1 and B3 (aerobic decay or uncontrolled burning) apply, and for biomass residues categories for which scenario B2 (anaerobic decay) apply:

$$BE_{BR,y} = BE_{BR,B1/B3,y} + BE_{BR,B2,y}$$

Where:

$BE_{BR,y}$ = Baseline emissions due to uncontrolled burning or decay of biomass residues in year y (tCO_2)
$BE_{BR,B1/B3,y}$ = Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (tCO_2)
$BE_{BR,B2,y}$ = Baseline emissions due to anaerobic decay of biomass residues in year y (tCO_2)

Since in this project activity, the biomass residues categories for which scenario B2 (anaerobic decay) is not apply. Therefore, only Step 2.1 is determined.

Step 2.1: Determination of $BE_{BR,B1/B3,y}$

For the biomass residues categories, as described in the biomass residues categories table, for which the most likely baseline scenario is either that the biomass residues would be dumped or left to decay under mainly aerobic condition (B1), or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios (aerobic decay and uncontrolled burning), that the biomass residues would be burnt in an uncontrolled manner.

Baseline emissions are calculated by multiplying the quantity of biomass residues with the net calorific value and an appropriate emission factor, as follows:

$$BE_{BR,B1/B3,y} = GWP_{CH4} \cdot \sum_{n} BR_{n,B1/B3,y} \cdot NCV_{n,y} \cdot EF_{BR,n,y}$$

Where:

$BE_{BR,B1/B3,y}$ = Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year y (tCO_2)
GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2/tCH_4)
$BR_{n,B1/B3,y}$ = Amount of biomass residues category n used in the project plant included in the project boundary in year y for which B1 or B3 has been identified as the most plausible baseline scenario (tonnes on dry-basis)
$NCV_{n,y}$ = Net calorific value of the biomass residues category n in year y (GJ/tonnes on dry-basis)
$EF_{BR,n,y}$ = CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y (tCH_4/GJ)
N = Categories of biomass residues

To determine the CH_4 emission factor, project participant may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 tCH4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$[9].

The uncertainty of the CH_4 emission factor ($EF_{BR,n,y}$) is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emission reductions, a conservativeness factor must be applied to the CH_4 emissions factor. The level of the conservativeness factor depends on the uncertainty range of the estimate for the CH_4 emissions factor. The appropriate conservativeness factor from Table 4 in the methodology shall be chosen and multiplied with the estimate for the CH_4 emission factor. For example, if the default CH_4 emission factor of 0.0027 tCH_4/t biomass is used, the

[9] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

uncertainty can be deemed to be 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 should be used.

Project emission

Project emissions as calculated as follows:

$$PE_y = PE_{FF,y} + PE_{EL,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y}$$

Where:

PE_y = Project emissions during year y (tCO_2e)
$PE_{FF,y}$ = Emissions during the year y due to fossil fuel consumption (tCO_2)
$PE_{EL,y}$ = Emissions during the year y due to electricity use off-site for the processing of biomass residues (tCO_2)
$PE_{TR,y}$ = Emissions during the year y due to transport of the biomass residues to the project plant (tCO_2)
$PE_{BR,y}$ = Emissions from the combustion of biomass residues during the year y (tCO_2e)
$PE_{WW,y}$ = Emissions from waste water generated from the treatment of biomass residues in year y (tCO_2y)

According to project activity description in Section B.4, there is no electricity use off-site for the processing of biomass and waste water generated from the treatment of biomass residues. Then, $PE_{EL,y}$ and $PE_{WW,y}$ can be excluded.

Therefore, the Project emissions as calculated as follows:

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

Determination of $PE_{FF,y}$

The following emission sources should be included in determining $PE_{FF,y}$

- Emissions from on-site fossil fuel consumption for the generation of electricity power. This includes all fossil fuels used at the project site in heat generation (e.g boilers) for the generation of electric power; and
- Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electricity power. This includes fossil fuels required for the operation of auxiliary equipment related to the power plant (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.) which are not accounted in the first bullet; and
- Fossil fuels required for the operation of equipment related to the on-site or off-site preparation, storage, processing and transportation of fuels and biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, dries, pelletization, shredding, briquetting processes, etc.).
- If any fossilized or non-biodegradable material are used in the processing of biomass residues and incorporated in the processed biomass residues (e.g. binders) then emissions arising from those materials should be accounted for when the processed biomass residues are combusted. For that purpose those materials should be deemed as fossil fuels, if net calorific values, carbon content and/or emissions factors of those materials are available they could be used, otherwise the net calorific values, carbon content and/or emissions factors of the most carbon intensive fossil fuel available in the country should be used.

The latest approved version of the **"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"** should be used to calculate $PE_{FF,y}$, All combustion processes j as described in the two bullets above should be included.

Determination of $PE_{EL,y}$

Emissions should be included that result from the generation of electric power plant required for the operation of equipment related to the off-site preparation, processing, stored and transportation of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.). The latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01 EB39 Annex7 should be used to calculated $PE_{EL,y}$. Note that the electric power used on-site for the purposes described above are already accounted as part of $EG_{PJ,aux,y}$. $PE_{EL,y}$ should account thus only for the off-site use of electricity.

In this project activity, there is no electricity use off-site for the processing of biomass residues as described above. Then, the $PE_{EL,y}$ is able to be excluded.

$$PE_{EL,y} = \underset{(MWh/yr)}{EC_{PJ,y}} * \underset{(tCO_2/MWh)}{EF_{EL,y}} * (1+TDL_{j,y})$$

Where,

$PE_{EL,y}$ = Emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,y}$ = Quantity of electricity consumed by the project electricity consumption (MWh)

$EF_{EL,y}$ = Grid Carbon Emission Factor (tCO_2/MWh)\

$TDL_{,}$ = Average technical transmission and distribution losses for providing electricity to source in year y (5.8%)

CO_2 emission factor: 0.5113 tCO_2/MWh

Determination of $PE_{TR,y}$

In case where the biomass residues are not generated directly at the project site, project participant shall determine CO_2 emissions resulting from transportation of the biomass residues to the project plant using the latest version of the tool **"Project and leakage emissions from road transportation of freight"**. $PE_{TR,m}$ in the tool corresponds to the parameter $PE_{TR,y}$ in this methodology and the monitoring period m is one year.

Determination of $PE_{BR,y}$

If project proponents chose to included emissions due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$) in the calculation of baseline emissions, then emissions from the combustion of biomass residues have also to be included in the project scenario. Otherwise, this emissions source need not be included. Corresponding emissions are calculated as follows:

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

Where:

$PE_{BR,y}$ = Emissions from the combustion of biomass residues during the year (tCO_2)
GWP_{CH4} = Global Warming Potential for methane valid for the relevant commitment period (tCO_2/tCH_4)
$EF_{CH4,BR}$ = CH_4 emission factor for the combustion of biomass residues in the project plant (tCH_4/GJ)
$BR_{PJ,n,y}$ = Quantity of biomass residues of category n used in power plant which are located at the project site and included in the project boundary in year y (tonnes on dry-basis/yr)
$NCV_{n,y}$ = Net calorific value of the biomass residues category n in year y (GJ/tonnes on dry-basis)

To determine the CH_4 emission factor, project participants may conduct measurements at the plant site or use IPCC default values, as provided in Table 5 in the methodology. The uncertainty of the CH_4 emission factor is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emissions reduction, a conservativeness factor must be applied to the CH_4 emissions factor. The level of conservativeness factor depends on the uncertainty rage of the estimate for the CH_4 emission factor. Project participants shall select the appropriate conservativeness factor from Table 6 in methodology and shall multiply the estimate for the CH_4 emission factor with the conservativeness factor.

For example, where the default CH_4 emissions factor of 30 kg/TJ from Table 5 in methodology 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/TJ should be used.

Determination of $PE_{WW,CH4,y}$

This emission source should be estimated in case where waste water originating from the treatment of the biomass is (partly) treated under anaerobic conditions and where methane from the waste water is not captured and flared or combusted. Project emissions from waste water are estimated as per equation (29) ACM0018 (Version 03.0) page 49/66.

Since the project has no waste water originating from the treatment of the biomass is treated under anaerobic condition, this emission source should not be included.

Leakage

The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity. Changes in carbon stock in the LULUCF sector are expected to be insignificant since this methodology is limited to biomass residues, as defined in the applicability conditions above. The baseline scenarios for biomass residues for which this potential leakage is relevant are B5:, B6:, B7: and B8:.

The actual leakage emissions in each of these cases may differ significantly and depend on the specific situation of each project activity. For that reason, a simplified approach is used in this methodology: it is assumed that an equivalent amount of fossil fuels, on energy basis, would be used if biomass residues are diverted from other users, no matter what the use of biomass residues would be in the baseline scenario.

Therefore, for the categories of biomass residues whose baseline scenario has been identified as B5:, B6:, B7: or B8:, project participants shall calculate leakage emissions as follows:

$$LE_y = EF_{CO2,LE} \cdot \sum_n BR_{PJ,n,y} \cdot NCV_{n,y}$$

Where:

LE_y	= Leakage emissions in year y (tCO_2/yr)
$EF_{CO2,LE}$	= CO_2 emission factor of the most carbon intensive fossil fuel used in the country (tCO_2/GJ)
$BR_{PJ,n,y}$	= Quantity of biomass residues of category n used in power plant which are located at the project site and included in the project boundary in year y (tonnes on dry-basis/yr)
$NCV_{n,y}$	= Net calorific value of the biomass residues category n in year y (GJ/ton of dry matter)
N	= Categories of biomass residues for which B5:,B6:, B7: or B8: has been identified as the baseline scenario.

The determination of $BR_{PJ,n,y}$ shall be based on the monitored amounts of biomass residues used in power plants included in the project boundary.

In the case that negative overall emission reductions arise in a year through application of the leakage emissions, CERs are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emissions reductions from the year concerned. For example, if negative emissions reductions of 30 tCO_2 occur in the year t and positive emissions reductions of 100 tCO_2 occur in the year t+1, only 70 CERs are issued for the year t+1.

B.6.2. Data and parameters fixed ex ante

In addition to the parameters and procedures described herein, all monitoring provisions contained in the tools referred to in this methodology also apply.

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global warming potential for methane valid for the relevant commitment period
Source of data	IPCC
Value(s) applied	21 for period of 21/12/2012 – 31/12/2012 25 for period of 01/01/2013 – 20/12/2019
Choice of data or Measurement methods and procedures	Recommended default value according to the latest version of IPCC or any international recommendation.
Purpose of data	(i) Calculation of baseline emissions; and (ii) Calculation of project emissions.
Additional comment	n/a

Data / Parameter	Biomass residues categories and quantities used for the selection of the baseline scenario selection and assessment of additionality.
Unit	- Type : Rice husk - source obtained from an identified biomass residues producer, - Fate in the absence of the project activity Scenario B1 and B3 - Use in the project scenario Scenario P5 - Quantity (tonnes on dry-basis)
Description	<table><tr><td>Biomass residues category (k)</td><td>Biomass residues type</td><td>Biomass residues source</td><td>Biomass residues fate in the absence of the project activity</td><td>Biomass residues use in project scenario</td><td>Biomass residues quantity (tonnes)</td></tr><tr><td>1</td><td>Rice husk</td><td>off-site from an identifie d rice mill</td><td>Dumping and decay of residues on fields (B1) Burnt in an uncontrolle d manner (B3)</td><td>Electricity generatio n on-site (P5)</td><td>Correspond s to the quantity of each biomass residues (tonnes)</td></tr></table>
Source of data	On-site assessment of biomass residues categories and quantities
Value(s) applied	113,909 (Average from the first crediting period)
Choice of data or Measurement methods and procedures	The quantities rice husk of the baseline scenario selection was determined based on energy balance conducted by the project participant. The detail of calculation method is indicated in section A.3
Purpose of data	Categorise the biomass residues used for the selection of the baseline scenario selection and assessment of additionality.
Additional comment	This parameter will be monitored during the crediting period.

Data / Parameter	$EF_{CO2,f}$
Unit	gCO_2/t km
Description	Default CO_2 emission factor for freight transportation activity f
Source of data	Methodological Tool "Project and leakage emissions from road transportation of freight" (Version 01.0.0)
Value(s) applied	Vehicle class: Light vehicles – Emission factor (gCO_2/t km): 245; Heavy vehicles – 129
Choice of data or Measurement methods and procedures	Default
Purpose of data	Calculation of project emissions
Additional comment	Applicable to Option B "Project and leakage emissions from road transportation of freight" (Version 01.0.0)

Vehicle class	Emission factor (gCO_2/t km)
Light vehicles	245
Heavy vehicles	129

Data / Parameter	$EF_{CO2,gird,CM,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid electricity in year *y*
Source of data	Calculated
Value(s) applied	0.5113
Choice of data or Measurement methods and procedures	The Grid Emission Factor of Thai National Grid is calculated using the latest version 04.0 of "Tool to calculate the emission factor for an electricity system", EB 75
Purpose of data	Used for baseline and project emission estimations
Additional comment	This value is used for the entire crediting period.

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2e/MWh
Description	Operating Margin Emission Factor
Source of data	Calculated
Value(s) applied	0.6
Choice of data or Measurement methods and procedures	The Grid Emission Factor of Thai National Grid is calculated using the latest version 04.0 of "Tool to calculate the emission factor for an electricity system", EB 75.
Purpose of data	Used for baseline and project emission estimations
Additional comment	This value is used for the entire crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2e/MWh
Description	Build Margin Emission Factor
Source of data	Calculated
Value(s) applied	0.42
Choice of data or Measurement methods and procedures	The Grid Emission Factor of Thai National Grid is calculated using the latest version 04.0 of "Tool to calculate the emission factor for an electricity system", EB 75.
Purpose of data	Used for baseline and project emission estimations
Additional comment	This value is used for the entire crediting period.

Data / Parameter	$\mathbf{TDL_{j,y}}$
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data	Reliable data available from DEDE
Value(s) applied	5.8%
Measurement methods and procedures	$TDL_{j,y}$ has been chosen form DEDE under Ministry of Energy that is the recent, accurate and reliable data available within host country.
Monitoring frequency	In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	Used for project emission calculation
Additional comment	This value will be applied for entire of crediting period.

B.6.3. Ex ante calculation of emission reductions

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Providing a transparent ex ante calculation of baseline emissions, project emissions (or, where applicable, direct calculation of emission reduction) and leakage expected during the crediting period, applying all relevant equations provided in the methodology. For data or parameters available before registration, use values contained in the table in section B.6.2 above.

For data/parameters not available before registration and monitored during the crediting period, use estimates contained in the table in section B.7.1 below.

Also the sample calculation for each equation used, substituting the values used in the equations are provided.

1. Baseline emission calculation

Baseline emission may, where applicable, include the following emission sources:

- CO_2 emission from fossil fuel power plants at the project site;
- CO_2 emission from grid-connected fossil fuel power plants in the electricity system;
- CH_4 emission from anaerobic decay of biomass residues and/or CH_4 emissions from uncontrolled burning of biomass residues without utilizing them for energy purposes.

Baseline emissions are calculated as follows:

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

Where :

BE_y = Baseline emissions during year y (tCO2)

$BE_{EL,y}$ = Baseline emissions due to generation of electricity in year y (tCO2)

$BE_{BR,y}$ = Baseline emissions due to uncontrolled burning or decay of biomass

Parameter	21/12/12-31/12/12	2013-2018 (each year)	01/01/19-20/12/19	Unit
$BE_{EL,y}$	1,615	53,593	51,978	tCO_2
$BE_{BR,y}$	142	5,612	5,443	tCO_{2e}
BEy	1,757	59,205	57,421	tCO_2

Baseline emissions are determined through the following steps:

Step 1: Determination of $BE_{EL,y}$

Baseline emissions from electricity generation are calculated based on the net quantity of electricity generation at the project site under the project scenario ($EG_{PJ,y}$) and a baseline emission factor ($EF_{BL,EL,y}$) which expresses the weighted average CO_2 intensity of electricity generation in the baseline as follows:

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

Where :

$BE_{EL,y}$ = Baseline emissions due to generation of electricity in year y (tCO2)

$EG_{PJ,y}$ = Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh)

$EF_{BL,EL,y}$ = Emission factor for electricity generation in the baseline in year y (tCO2/MWh)

Parameter	Value	Unit
$EG_{PJ,y}$	104,817	MWh
$EF_{BL,EL,y}$	0.5113	tCO_2/MWh
$BE_{EL,y}$	53,593	tCO_2

For this methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the project activity and are therefore not accounted for.

Step 1.1: Determination of $EG_{PJ,y}$

The net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary ($EG_{PJ,y}$) is determined as the difference between the gross electricity generation at the project site ($EG_{PJ,gross,y}$) and the auxiliary electricity consumption required for the operation of the power plant at the project site ($EG_{PJ,aux,y}$), as follows:

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

Where:

$EG_{PJ,y}$	=	Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh)
$EG_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y (MWh)
$EG_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plants at the project site (MWh)

$EG_{PJ,aux,y}$ shall include all electricity required on-site for the operation of equipment related to the preparation, processing, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting process, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc)

Parameter	Value	Unit
$EG_{PJ,gross,y}$	122,403	MWh
$EG_{PJ,aux,y}$	17,586	MWh
$EG_{PJ,y}$	104,817	MWh

Step 1.2: Determination of $EF_{BL,EL,y}$

The electricity generated under the project activity could be generated in the baseline in there difference ways, depending on the baseline scenario and the particular situation of the project activity:

- **Power generation in the electricity grid.** Electricity could be generated by power plants in the electricity grid. This applies, for example, if
  (a) The project activity exports all electricity to the grid and no electricity would be produced at the project site in the baseline.
  (b) The project activity results in an increase of the quantity of electricity produced by power plant included in the project boundary and this increased electricity is exported to the grid or would in the baseline be purchased from the grid.

As in the establishment and description of baseline scenario (Section B.4.), the alternative P5 is established as the baseline scenario. Belong to the option (a) of the particular situation of **Power generation in the electricity grid**: The project activity export all electricity to the grid and no electricity would be produced at the project site in the baseline.

Therefore, the determination of $EF_{BL,EL,y}$ applies as:

$$EF_{BL,EL,y} = \frac{EG_{BL,FF,y} \cdot EF_{BL,FF,y} + EG_{BL,grid,y} \cdot EF_{grid,CM,y} + EG_{BL,FF/grid,y} \cdot MIN(EF_{BL,FF,y}; EF_{grid,CM,y})}{EG_{BL,BR,y} + EG_{BL,FF,y} + EG_{BL,grid,y} + EG_{BL,FF/grid,y}}$$

Where :

$EF_{BL,EL,y}$	=	Emission factor for electricity generation in the baseline in year *y* (t CO_2/MWh)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh)

$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh)
$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh)
$EG_{BL,FF/grid,y}$	=	Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year *y* (MWh)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid-connected electricity generation in year *y* (t CO_2/MWh)
$EF_{BL,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels in power plant(s) at the project site in the baseline in year *y* (t CO_2/MWh)

Step 1.3: Determination of $EG_{BL,BR,y}$

The amount of electricity that would be generated with biomass residues in power-only plants operated at project site in the baseline ($EG_{BL,BR,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

According to the analysis of baseline scenario in Section B.4, the project is a newly built power-only project, then **No power generation with biomass residues in the baseline** $EG_{BL,BR,y} = 0$.

Step 1.4: Determination of $EG_{BL,FF,y}$

The minimum of electricity that would be generated with fossil fuels at the project site in the baseline in year y ($EG_{BL,FF,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

According to no fossil fuel would be used for electricity generation in the baseline scenario at the project site, **Case 2: No connection to the electricity grid** is applied.

Step 1.5: Determination of $EG_{BL,grid,y}$

The minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline ($EG_{BL,grid,y}$) should, in accordance with the baseline scenario, be determined as follows:

Since there are no power plants would be operated at the project site in the baseline for this project activity, then **Case 2: No electricity generation at the project site in the baseline** is applied.

Step 1.6: Determination of $EG_{BL,FF/grid,y}$

$EG_{BL,FF/grid,y}$ represents the amount of electricity that could be generated in the baseline in the grid or at the project site using fossil fuels. $EG_{BL,FF/grid,y}$ corresponds to the remainder of electricity generation, i.e. the amount that exceeds the minimum amount of electricity that would be generated by power plants in the electricity grid ($EG_{BL,grid,y}$), the minimum amount of electricity that could be generated with fossil fuels at the project site ($EG_{BL,FF,y}$), and the amount of electricity that would be generated with biomass residues at the project site ($EG_{BL,BR,y}$). Accordingly, $EG_{BL,FF/grid,y}$ is calculated as follows:

$$EG_{BL,FF/grid,y} = EG_{PJ,y} - EG_{BL,BR,y} - EG_{BL,FF,y} - EG_{BL,grid,y}$$

Where :

$EG_{BL,ff/grid,y}$	=	Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year *y* (MWh)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh)
$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh)
$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh)

Step 1.7: Determination of $EF_{BL,FF,y}$

$EF_{BL,FF,y}$ should be determined using option A or option B below. If fossil fuel power plants were operated at the project site prior to the implementation of the project activity, either option A or option B can be used to determine $EF_{BL,FF,y}$. For new power plants that would be constructed at the project site in the baseline scenario, Option B should be used.

Option A: Determine $EF_{BL,FF,y}$ as per the procedure described under "Scenario B: Electricity consumption from on off-grid captive power plant" in the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", using data from the three calendar year prior to the implementation of the project activity.

Option B: Determine a default emission factor for $EF_{BL,FF,y}$ based on a default efficiency of the power plant that would be operated at the project site in the baseline and a default CO2 emission factor for the fossil fuel types that would be used, as per equation (24) in ACM0018 (Version 03.0) page 43/66.

Since there are no any fossil fuel power plants were operated at the project site prior to the implementation of the project activity, the determination of $EF_{BL,FF,y}$ in this project activity case has not been applied.

Step 8: Determination of $EF_{grid, CM,y}$

$EF_{grid,CM,y}$ should be determined as the combined margin CO_2 emission factor for grid connected power generation in year y, calculated using the latest approved version of the "Tool to calculate the emission factor for an electricity system". According to the latest DNA publication of National grid emission, The $EF_{grid, CM,y}$ = 0.5113 tCO_2/MWh.

According to the determination of parameters above, the $EF_{BL,EL,y}$ is calculated as below;

Parameter	Value	Unit
$EG_{BL,FF,y}$	0.00	MWh
$EF_{BL,FF,y}$	0.00	tCO2/MWh
$EG_{BL,grid,y}$	104817.36	MWh
$EF_{grid,CM,y}$	0.5113	tCO2/MWh
$EG_{BL,FF/grid,y}$	0.00	MWh
$EG_{BL,BR,y}$	0.00	MWh
$EF_{BL,EL,y}$	0.5113	tCO2/MWh

Step 2: Determination of baseline emission due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$)

The calculation of baseline emission due to uncontrolled burning or decay of biomass residues is optional and project participants can decide whether to include these emission sources or not. If project participants wish to include these emission sources, the procedure below should be followed, and emission from combustion of biomass residues under the project activity should be also be determined. Otherwise, this section does not need to be applied and project emissions do not need to include emissions from combustion of biomass residues under the project activity.

Baseline emissions due to uncontrolled burning or decay of biomass residues are only determined for those categories of biomass residues for which B1, B2 or B3 has been identified as the most plausible baseline scenario, as summarized in

Table 5 in the PDD. The guidance for the determination of $BR_{BL,n,p,y}$ should be considered in determining the quantities of biomass residues for each biomass residue category.

The emissions are determined separately for biomass residues categories for which scenario B1 and B3 (aerobic decay or uncontrolled burning) apply, and for biomass residues categories for which scenario B2 (anaerobic decay) apply:

$$BE_{BR,y} = BE_{BR,B1/B3,y} + BE_{BR,B2,y}$$

Where :

$BE_{BR,y}$	=	Baseline emissions due to uncontrolled burning or decay of biomass residues in year *y* (t CO_2)
$BE_{BR,B1/B3,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year *y* (t CO_2)
$BE_{BR,B2,y}$	=	Baseline emissions due to anaerobic decay of biomass residues in year *y* (t CO_2)

According to the project activity description in Section B.4, the baseline emissions due to aerobic decay or uncontrolled burning of biomass residues is only applied.

Step 2.1: Determination of $BE_{BR,B1/B3,y}$

For the biomass residues categories, as described in the biomass residues categories table, for which the most likely baseline scenario is either that the biomass residues would be dumped or left to decay under mainly aerobic condition (B1), or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios (aerobic decay and uncontrolled burning), that the biomass residues would be burnt in an uncontrolled manner.

Baseline emissions are calculated by multiplying the quantity of biomass residues with the net calorific value and an appropriate emission factor, as follows:

$$BE_{BR,B1/B3,y} = GWP_{CH4} \cdot \sum_{n} BR_{n,B1/B3,y} \cdot NCV_{n,y} \cdot EF_{BR,n,y}$$

Where:

$BE_{BR,B1/B3,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year *y* ($t\ CO_2$)
GWP_{CH4}	=	Global warming potential of methane valid for the commitment period ($t\ CO_2/t\ CH_4$)
$BR_{n,B1/B3,y}$	=	Amount of biomass residues category *n* used in the project plant(s) included in the project boundary in year *y* for which B1 or B3 has been identified as the most plausible baseline scenario (tonnes on dry-basis)
$NCV_{n,y}$	=	Net calorific value of the biomass residues category *n* in year *y* (GJ/tonnes on dry-basis)
$EF_{BR,n,y}$	=	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year *y* ($t\ CH_4/GJ$)
n	=	Categories of biomass residues

Parameter	Value	Unit	Description
GWP_{CH4}	21	tCO2/tCH4	Global Warming Potential of methane until 2012
	25	tCO2/tCH4	Global Warming Potential of methane after 2012
$BR_{n,B1/B3,y}$	113,909	tonnes on dry basis	Amount of biomass residues category n used in the project plant included in the project boundary for which B1 or B3 has been identified as baseline scenario
$NCV_{n,y}$	14.39	GJ/tonnes on dry basis	Net calorific value of the biomass residues category n
$EF_{BR,n,y}$	0.000137	tCH4/GJ	CH4 emission factor for uncontrolled burning of the biomass residues category n
$BE_{BR,B1/B3,y}$	4,714	tCO2	Baseline emissions due to uncontrolled burning of biomass residues per year (until 2012)
	5,612	tCO2	Baseline emissions due to uncontrolled burning of biomass residues per year (after 2012)

To determine the CH_4 emission factor, project participant may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 tCH4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$[10].

The uncertainty of the CH_4 emission factor ($EF_{BR,n,y}$) is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emission reductions, a conservativeness factor must be applied to the CH_4 emissions factor. The level of the conservativeness factor depends on the uncertainty range of the estimate for the CH_4 emissions factor. The appropriate conservativeness factor from Table 4 in the methodology shall be chosen and multiplied with the estimate for the CH_4

[10] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

emission factor. For example, if the default CH_4 emission factor of 0.0027 tCH_4/t biomass is used, the uncertainty can be deemed to be greater than 100%, resulting in a conservativeness factor of 0.73. Thus, in this case an emission factor of 0.001971 t CH_4/t biomass should be used.

According to the baseline emissions calculation described above, the total baseline emission can be estimated annually as 59,201 tCO_2.

Project emissions

$$PE_y = PE_{FF,y} + PE_{EL,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y}$$

Where :

PE_y	=	Project emissions during year *y* (t CO_2e)
$PE_{FF,y}$	=	Emissions during the year *y* due to fossil fuel consumption (t CO_2)
$PE_{EL,y}$	=	Emissions during the year *y* due to electricity use off-site for the processing of biomass residues (t CO_2)
$PE_{TR,y}$	=	Emissions during the year *y* due to transport of the biomass residues to the project plant (t CO_2)
$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year *y* (t CO_2e)
$PE_{WW,y}$	=	Emissions from waste water generated from the treatment of biomass residues in year *y* (t CO_2e)

There is no electricity use off-site for the processing of waste water generated from the treatment of biomass residues. Then, $PE_{WW,y}$ can be excluded.

Therefore, the Project emissions as calculated as follows:

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

Parameter	21/12/12-31/12/12	2013-2018 (each year)	01/01/19-20/12/19	Unit
$PE_{FF,y}$	39	1,292	1,253	tCO_2
$PE_{EL,y}$	10	337	327	tCO_2
$PE_{TR,y}$	42	1,383	1,341	tCO_2
$PE_{BR,y}$	43	1,684	1,633	tCO_2
$PE_{WW,y}$	-	-	-	tCO_2
PE_y	133	4,696	4,554	tCO_2

Determination of $PE_{FF,y}$

The following emission sources should be included in determining $PE_{FF,y}$

- Emissions from on-site fossil fuel consumption for the generation of electricity power. This includes all fossil fuels used at the project site in heat generation (e.g boilers) for the generation of electric power; and

- Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electricity power. This includes fossil fuels required for the operation of auxiliary equipment related to the power plant (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.) which are not accounted in the first bullet; and
- Fossil fuels required for the operation of equipment related to the on-site or off-site preparation, storage, processing and transportation of fuels and biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, dries, pelletization, shredding, briquetting processes, etc.).
- If any fossilized or non-biodegradable material are used in the processing of biomass residues and incorporated in the processed biomass residues (e.g. binders) then emissions arising from those materials should be accounted for when the processed biomass residues are combusted. For that purpose those materials should be deemed as fossil fuels, if net calorific values, carbon content and/or emissions factors of those materials are available they could be used, otherwise the net calorific values, carbon content and/or emissions factors of the most carbon intensive fossil fuel available in the country should be used.

The latest approved version of the **"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"** should be used to calculate $PE_{FF,y}$, All combustion processes j as described in the two bullets above should be included.

$$PE_{FF,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Where :

$PE_{FF,y}$	=	Emissions during the year *y* due to fossil fuel consumption (t CO_2)
$FC_{i,j,y}$	=	The quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$CO_{EF,i,y}$	=	The CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)

Parameter	Value	Unit
$FC_{i,j,y}$	382.74	tonne/yr
$COEF_{i,y}$	3.3742	tCO2/t diesel
$PE_{FF,i,y}$	1,292	tCO2/yr

Determination of $PE_{EL,y}$

Emissions should be included that result from the generation of electric power plant required for the operation of equipment related to the off-site preparation, processing, stored and transportation of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.). The latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" should be used to calculated $PE_{EL,y}$. Note that the electric power used on-site for the purposes described above are already accounted as part of $EG_{PJ,aux,y.}$ $PE_{EL,y}$ should account thus only for the off-site use of electricity.

The emissions associated with electricity consumption in the project activity assume to be zero for ex-ante calculation. As the electricity to be consumed are electricity generated from the project activity (i.e. renewable).

In case project activity consumes electricity from the grid, project emission will be calculated as follow:

$$PE_{EL,y} = \underset{(MWh/yr)}{EC_{PJ,j,y}} * \underset{(tCO_2/MWh)}{EF_{EL,j,y}} * (1+TDL_{j,y})$$

Where,

$PE_{EL,y}$ = Emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption (MWh)

$EF_{EL,j,y}$ = Grid Carbon Emission Factor (tCO_2/MWh)

$TDL_{j,y,}$ = Average technical transmission and distribution losses for providing electricity to source in year y (5.8%)

CO_2 emission factor: 0.5113 tCO_2/MWh

For ex post calculation, the electricity export to the grid and import to use in ATB from the grid will be monitored by individual meter as separated parameter.

Parameter	Value	Unit
$EC_{PJ,y}$	621.27	MWh
$EF_{EL,y}$	0.5113	tCO2/MWh
$TDL_{j,y}$	5.8	%

Determination of $PE_{TR,y}$

In case where the biomass residues are not generated directly at the project site, project participant shall determine CO_2 emissions resulting from transportation of the biomass residues to the project plant using option B of the latest version of the tool **"Project and leakage emissions from road transportation of freight"**. $PE_{TR,y}$ in the tool corresponds to the parameter $PE_{TR,y}$ in this methodology and the monitoring period m is one year.

$$PE_{TR,m} = \sum_{f} D_{f,m} \cdot FR_{f,m} \cdot EF_{CO2,f} \cdot 10^{-6}$$

Where :

$PE_{TR,y}$ = Emissions during the year *y* due to transport of the biomass residues to the project plant (t CO_2)

$D_{f,m}$ = Return trip road distance between the origin and destination of freight transportation activity (km)

$FR_{f,m}$ = Total mass of freight transported in freight transportation activity (tonne)

$EF_{CO2,f}$ = Default CO2 emission factor for freight transportation activity (gCO2/t)

Parameter	Value	Unit
$D_{f,m}$	94.09	km
$FR_{f,m}$	113,909	t
$EF_{CO2,f}$	129.00	gCO2/t km
$PE_{TR,m}$	1,383	tCO2

Determination of $PE_{BR,y}$

If project proponents chose to included emissions due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$) in the calculation of baseline emissions, then emissions from the combustion of biomass residues have also to be included in the project scenario. Otherwise, this emissions source need not be included. Corresponding emissions are calculated as follows:

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

Where :

$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year *y* (t CO2)
GWP_{CH4}	=	Global Warming Potential for methane valid for the relevant commitment period (t CO2/t CH4)
$EF_{CH4,BR}$	=	CH4 emission factor for the combustion of biomass residues in the project plant (t CH4/GJ)
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category *n* used in power plants which are located at the project site and included in the project boundary in year *y* (tonnes on dry-basis/yr)
$NCV_{n,y}$	=	Net calorific value of the biomass residues category *n* in year *y* (GJ/tonnes on dry-basis)

Parameter	Value	Unit	Definition
GWP_{CH4}	21	tCO2/tCH4	Global Warming Potential of methane until 2012
	25	tCO2/tCH4	Global Warming Potential of methane from 2013
$EF_{CH4,BR}$	0.0000411	tCH4/GJ	CH4 emission factor for the combustion of biomass residues in the project plant
$BR_{PJ,n,y}$	113,909	tonnes on dry-basis	Quantity of biomass residues of category n used in power plant which located at the project site
$NCV_{n,y}$	14.39	GJ/tonnes ondry-basis	Net calorific value of the biomass residues category n
$PE_{BR,y}$	1,415	tCO2	Emisisons from the combustion of biomass residues per year (until 2012)
	1,684	tCO2	Emisisons from the combustion of biomass residues per year (after 2012)

To determine the CH_4 emission factor, project participants may conduct measurements at the plant site or use IPCC default values, as provided in Table 5 in the methodology. The uncertainty of the CH_4 emission factor is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emissions reduction, a conservativeness factor must be applied to the CH_4 emissions factor. The level of conservativeness factor depends on the uncertainty rage of the estimate for the CH_4 emission factor. Project participants shall select the appropriate conservativeness factor from Table 6 in methodology and shall multiply the estimate for the CH_4 emission factor with the conservativeness factor.

For example, where the default CH_4 emissions factor of 30 kg/TJ from Table 5 in methodology 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/TJ should be used.

Determination of $PE_{WW,CH4,y}$

This emission source should be estimated in case where waste water originating from the treatment of the biomass is (partly) treated under anaerobic conditions and where methane from the waste water is not captured and flared or combusted. Project emissions from waste water are estimated as per equation (29) ACM0018 (Version 03.0) page 49/66.

Since the project has no waste water originating from the treatment of the biomass is treated under anaerobic condition, this emission source should not be included.

According to the project emissions calculation described above, the total project emission can be estimated annually as 4,695 tCO_2.

B.6.4. Summary of ex ante estimates of emission reductions

It is estimated that project activity will generate emission reductions for about 494,410 tCO2e per year over second 7 year crediting period from 21/12/2012 to 20/12/2019.

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
21/12/2012 - 31/12/2012	1,757	133	0	1,624
01/01/2013-31/12/2013	59,205	4,696	0	54,509
01/01/2014-31/12/2014	59,205	4,696	0	54,509
01/01/2015-31/12/2015	59,205	4,696	0	54,509
01/01/2016-31/12/2016	59,205	4,696	0	54,509
01/01/2017-31/12/2017	59,205	4,696	0	54,509
01/01/2018-31/12/2018	59,205	4,696	0	54,509
01/01/2019-20/12/2019	57,421	4,554	0	52,866
Total	414,408	32,864	0	381,544
Total number of crediting years	7			
Annual average over the crediting period	59,201	4,695	0	54,506

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	Biomass residues categories and quantities used in the project activity
Unit	• Type (Rice husks); • Source (Off-site) • Fate in the absence of the project activity (Scenario B1,B3); • Use in the project scenario (Scenario P5); • Quantity (tonnes on dry-basis)
Description	see table below
Source of data	On-site measurement
Value(s) applied	113,909 t/y (Average from the first crediting period)
Measurement methods and procedures	Use weighbridge. Adjust for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	This parameter will be measured by a weighbridge (each time trucks arrive). Data is to be aggregated monthly and yearly and will be archived electronically. The figure will be adjusted with the accuracy of ±20 kg for project emission and -20 kg for baseline emission when the calibration of equipment is delayed. The archived data will be kept during the crediting period and two years after the end of the crediting period.
QA/QC procedures	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes
Purpose of data	(i) Calculation of baseline emissions; (ii) Calculation of project emissions
Additional comment	The amount of biomass residues 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 verification period 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 verification period.

Description:

Biomass residues category (k)	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario	Biomass residues quantity (tonnes)
3,4	Rice husk	off-site from an identifie d rice mill	Dumping and decay of residues on fields (B1) Burnt in an uncontrolle d manner (B3)	Electricity generatio n on-site (P5)	Correspond s to the quantity of each biomass residues (tonnes)

Data / Parameter	$BR_{PJ,n,y}$
Unit	Tonnes on dry-basis
Description	Quantity of biomass residues of category n used in power plants which are located at the project site and included in the project boundary in year y
Source of data	On-site measurement
Value(s) applied	113,909 t/y (Average from the first crediting period)
Measurement methods and procedures	Use weighbridge. Adjust for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	This parameter will be measured by a weighbridge (each time trucks arrive). Data is to be aggregated monthly and yearly and will be archived electronically. The figure will be adjusted with the accuracy of ±20 kg for project emission when the calibration of equipment is delayed. The archived data will be kept during the crediting period and two years after the end of the crediting period.
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 emissions
Additional comment	The biomass residue quantities used should be monitored separately for (a) each type of biomass residue (e.g) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.)

Data / Parameter	$BR_{n,B1/B3,y}$
Unit	Tonnes on dry-basis
Description	Amount of biomass residues category n used in the project plant included in the project boundary in year y for which B1 or B3 has been identified as the most plausible baseline scenario
Source of data	On-site measurements
Value(s) applied	113,909 t/y (Average from the first crediting period)
Measurement methods and procedures	Use weighbridge. Adjust for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	This parameter will be measured by a weighbridge (each time trucks arrive). Data is to be aggregated monthly and yearly and will be archived electronically. The figure will be adjusted with the accuracy of -20 kg for baseline emission when the calibration of equipment is delayed. The archived data will be kept during the crediting period and two years after the end of the crediting period.
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 baseline emissions
Additional comment	The biomass residue quantities used should be monitored separately for (a) each type of biomass residue (e.g) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.)

Data / Parameter	For biomass residues categories for which scenarios B1:, B2: or B3: is deemed a plausible baseline alternative, project participant shall demonstrate that this is a realistic and credible alternative scenario
Unit	Tonnes
Description	• Quantity of available biomass residues of type n in the region • Quantity of biomass residues of type n that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region • Availability of a surplus of biomass residues type n (which cannot be sold or utilized) at the ultimate supplier to the project and a representative sample of other suppliers in the defined geographical region
Source of data	Surveys or statistics
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	At the validation stage for biomass residues categories identified ex-ante, and always that new biomass residues categories are included during the crediting period.
QA/QC procedures	-
Purpose of data	-
Additional comment	-

Data / Parameter	$EG_{PJ,gross,y}$
Unit	MWh
Description	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year y
Source of data	On-site measurements
Value(s) applied	122,402 MWh/y (Average from the first crediting period)
Measurement methods and procedures	Use calibrated electricity meters
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reduction. The figure will be adjusted with the accuracy of ±0.2% when the calibration of equipment is delayed.
QA/QC procedures	The consistency of metered electricity generation should be 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	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{PJ,aux,y}$
Unit	MWh
Description	Total auxiliary electricity consumption required for the operation of the power plants at the project site
Source of data	Calculated
Value(s) applied	17,585.60 MWh/y (Average from the first crediting period)
Measurement methods and procedures	$EG_{PJ,aux,y}$ will be calculated from Gross Electricity generation ($EG_{PJ,gross,y}$) and Net Electricity generation to grid ($EG_{project\ plant}$) as the following expression ; $EG_{PJ,aux,y} = EG_{PJ,gross,y} – EG_{project\ plant}$ Where; $EG_{PJ,gross,y}$ = Gross quantity of electricity generated from ATB plant $EG_{project\ plant}$ = Net quantity of electricity generated from the ATB plant
Monitoring frequency	Calculation will be done base on monthly basis
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.). During shutdown of the power plant, electricity import from grid will be used for auxiliary consumption.

Data / Parameter	$EG_{project\ plant}$
Unit	MWh
Description	Net quantity of electricity generated from the ATB plant
Source of data	On-site measurements
Value(s) applied	104,817.36 MWh/y (Average from the first crediting period)
Measurement methods and procedures	Use calibrated electricity meters
Monitoring frequency	This parameter will be measured continuously by electricity meter. 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.
QA/QC procedures	The amount of the electricity generated by the project will be monitored by electricity meter, which will be calibrated in accordance with the 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	Calculation of baseline emissions
Additional comment	This is electricity export to the grid

Data / Parameter	$EC_{PJ,y}$
Unit	MWh
Description	On-site electricity imported attributable to the project activity
Source of data	On-site measurements
Value(s) applied	621.27 MWh/y (Average from the first crediting period)
Measurement methods and procedures	Use electricity meters, PEA meter
Monitoring frequency	Continuously measure, Monthly record, and Yearly aggregate for emission calculation
QA/QC procedures	On-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	Calculation of project emissions
Additional comment	This parameter is electricity imported from grid for using within the project activity only.

Data / Parameter	$NCV_{n,y}$
Unit	GJ/tonnes on dry-basis
Description	Net calorific value of biomass residues of category n in year y
Source of data	On-site measurement
Value(s) applied	14.39 GJ/t per year (Average from the first crediting period)
Measurement methods and procedures	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV on dry-basis
Monitoring frequency	At least every six months, taking at least three samples for each measurement
QA/QC procedures	Check the consistency of the measurement by comparing the measurement results with measurements from previous year, relevant data source (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Purpose of data	(i) Calculation of baseline emissions (ii) Calculation of project emissions
Additional comment	-

Data / Parameter	$EF_{BR,n,y}$
Unit	tCH_4/GJ
Description	CH_4 emission factor for uncontrolled burning of the biomass residues category n during the year y
Source of data	Conduct measurement or use reference default values
Value(s) applied	0.00013 tCH_4/GJ per year (Average from the first crediting period)
Measurement methods and procedures	To determine the CH_4 emission factor, project participants may undertake measurement or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 t CH_4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	Moisture content of the biomass residues
Unit	% Water content
Description	Moisture content of each biomass residues type k
Source of data	On-site measurements
Value(s) applied	12.61% per year (Average from the first crediting period)
Measurement methods and procedures	To measure moisture content, the measurement will be done for each truck that delivers rice husk to the site by moisture analyser. Data is kept electronically during the crediting period and two year after the end of the crediting period.
Monitoring frequency	The parameter will be measured each time truck arrive The figure will be adjusted with the accuracy of -3% for project emission and +3 % for baseline emission when the calibration of equipment is delayed.
QA/QC procedures	Moisture content of the rice husk will be 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 at least annually.
Purpose of data	(i) Calculation of baseline emission (ii)Calculation of project emission
Additional comment	In case of dry biomass, monitoring of this parameter is not necessary

Data / Parameter	$EF_{CH4,BR}$
Unit	tCH_4/GJ
Description	CH_4 emission factor for the combustion of biomass residues in the project plant
Source of data	On-site measurement of default values, as provided in Table 5 in ACM0018 (Version 03.0)
Value(s) applied	0.0000411 tCH_4/GJ
Measurement methods and procedures	To determine the CH_4 emission factor, project participants may undertake measurement or use referenced default values. In the absence of more accurate information, it is recommended to 30 kg/TJ from Table 5 in ACM0018 (Version 03.0). 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/TJ should be used which can converted to 0.0000411 t CH_4/GJ
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of project emission
Additional comment	-

Data / Parameter	$D_{f,m}$
Unit	Kilometre
Description	Return trip road distance between the original and destination of freight transportation activity f in monitoring period m
Source of data	Records of vehicle operator or records by project participants
Value(s) applied	94.09 km/y (Average from the first crediting period)
Measurement methods and procedures	Determined once for each freight transportation activity f for a reference trip using the vehicle odometer or any other appropriate source (e.g on-line sources)
Monitoring frequency	To be update whenever the road distance changes
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	Applicable to Option B in Methodological Tool “Project and leakage emissions from road transportation of freight”

Data / Parameter	$FR_{f,m}$
Unit	Tonnes
Description	Total mass of freight transported in freight transportation activity f in monitoring period m
Source of data	Records by project participants or records by truck operators
Value(s) applied	113,909 t/y (Average from the first crediting period)
Measurement methods and procedures	Use weighbridge. Adjust for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	This parameter will be measured by a weighbridge (each time trucks arrive). Data is to be aggregated monthly and yearly and will be archived electronically. The figure will be adjusted with the accuracy of ±20 kg when the calibration of equipment is delayed. The archived data will be kept during the crediting period and two years after the end of the crediting period.
eQA/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 emissions
Additional comment	The biomass residue quantities used should be monitored separately for (a) each type of biomass residue (e.g) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.) In additional, type of vehicles: Light and Heavy will be monitor based on EB70 Annex23 Methodological tool: Project and leakage emissions from transportation of freight Version 01.1.0 para19.

Data / Parameter	$FC_{i,j,y}$
Unit	Tonne/yr
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	On-site measurements
Value(s) applied	382.74 t/y (Average from the first crediting period)
Measurement methods and procedures	Used calibrated flow meters
Monitoring frequency	This parameter will be measured continuously. Data is to be aggregated monthly and yearly and will be archived electronically. The figure will be adjusted with the accuracy of $\pm$0.25% when the calibration of equipment is delayed. The archived data will be kept during the crediting period and two years after the end of the crediting period.
QA/QC procedures	To consistency of metered fuel consumption quantities should be cross-checked by purchased quantities and stock changes.
Purpose of data	Calculation of project emissions
Additional comment	The project emission shall be caused by the onsite transportation of biomass is calculated based $PE_{FC,j,}y = \sum FC_{i,j,y}$ x $COEF_{i,y}$ where combustion process j is comprised of “Diesel consumption for startup process” and “Diesel consumption for onsite transportation”. Both process j are utilized same type of diesel i provided by the contract supplier.

Data / Parameter	$p_{i,y}$
Unit	Mass unit/volume unit
Description	Weighted average density of fuel type i in year y
Source of data	The following data sources may be used if the relevant condition apply: **Data source** — **Conditions for using the data source** a) Values provided by the fuel supplier in invoices — This is the preferred source b) Measurements by the project participants — If a) is not available c) Regional or national default value — If a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
Value(s) applied	0.85 kg/m^3
Measurement methods and procedures	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	The density of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	It is need to convert unit from volume to mass.

Data / Parameter	$NCV_{i,y}$
Unit	GJ/ton
Description	Weighted average net calorific value of fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** a) Values provided by the fuel supplier in invoices — This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the project participants — If a) is not available c) Regional or national default — If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of 2006 IPCC Guidelines on National GHG inventory — If a) is not available
Value(s) applied	45.54 GJ/t per year (Average from the first crediting period)
Measurement methods and procedures	For a) and b): Measurement should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the value under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emission
Additional comment	Applicable where Option B in Methodological tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

<table>
<tr><td>Data / Parameter</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Unit</td><td>tCO_2/GJ</td></tr>
<tr><td>Description</td><td>Weighted average CO_2 emission factor of fuel type i in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>e) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>f) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>g) Regional or national default</td><td>If a) is not available

These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>h) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of 2006 IPCC Guidelines on National GHG inventory</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>0.0741 tCO2/GJ</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurement should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emission</td></tr>
<tr><td>Additional comment</td><td>Applicable where Option B in Methodological tool “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurement for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.</td></tr>
</table>

B.7.2. Sampling plan

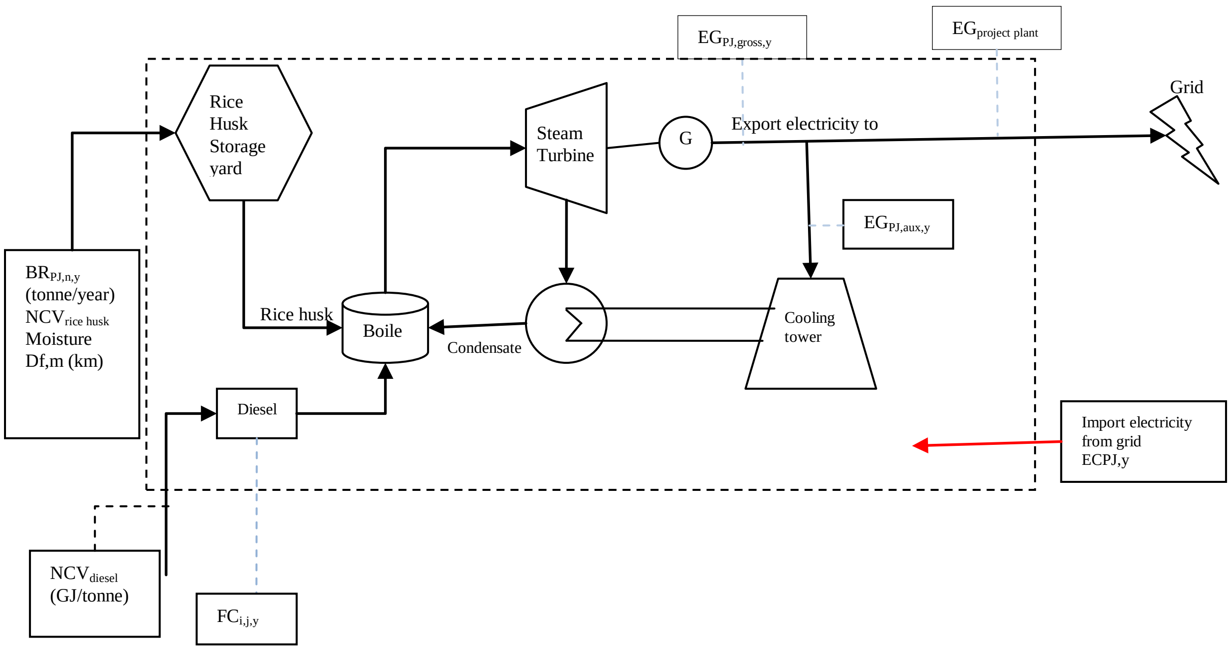
>>

There is no data and parameters in Section B.7.1 above are to be determined by a sampling approach, then this section is not applied.

B.7.3. Other elements of monitoring plan

>>

Monitoring diagram of the project activity shown as below:



In order to monitor emission reductions and any leakage effects generated by the Project, ATB will 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 power plant manager, supervisor and operators will be responsible for the execution of the monitoring plan. Based on the modern system it intends to use for control and reporting, they will 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 will outline 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;

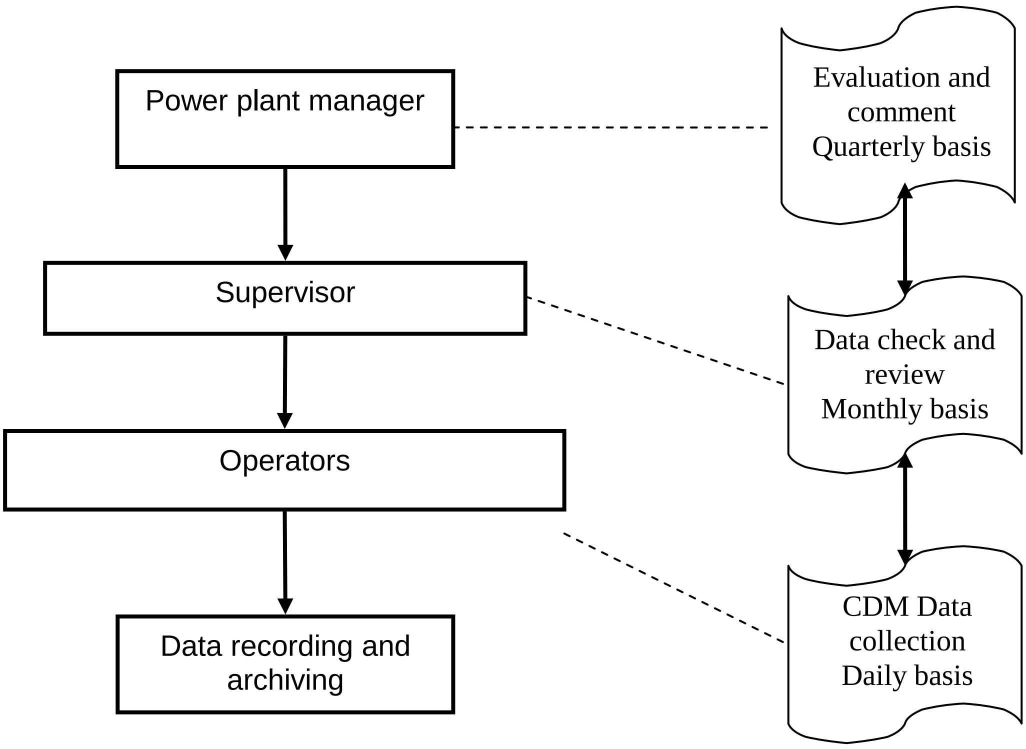
- Development of an "Equipment Calibration Procedures" booklet, which delineates the frequency and detail of each equipment calibration and maintenance; and

- Production and internal verification of monitoring reports 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, will also periodically audit 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 will be provided. The staff training programmes will be carried out before the initial verification with the supports of technical assistants, professionals and system contractors.

The gathered monitoring data will be digitally stored in a recorder. At regular intervals, data will be electronically archived. All data will be kept for at least two years following the end of the crediting period or the last issuance of CERs (whatever is the later). For all monitoring supervision, maintenance, data storage, data handling and plausibility check measures will be elaborated by ATB for their monitoring and management staff. In case of data loss the archived can be used also in case of malfunction of monitoring equipment the average of archived data from the 90 days of pre and 90 days of post events data will be used. The lowest data will be used for baseline emissions and the highest data will be used for project emissions



SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity
>>
05/01/2004

C.1.2. Expected operational lifetime of project activity
>>
Minimum 25 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period
>>
Renewable crediting period

C.2.2. Start date of crediting period
>>
21/12/2012

C.2.3. Length of crediting period
>>
7 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
The controlled combustion of rice husk burning in a modern facility such as ATB's eliminates serious environmental consequences that arise from the usual methods of rice husk disposal, i.e. dumping or open-air burning. The following picture illustrates the environmental hazard caused by open-air burning of rice husk.

Other points noted for ATB's plants are as follows:

- SO_2 emissions will be minimal. NO_x emissions will be kept within the standards prescribed by the Ministry of Science, Technology and Environment and the Ministry of Industry. To ensure observance of the standards, a continuous air emission monitoring system (CEMS) will be installed.

- Particulates and fly ash will be captured in an electrostatic precipitator for controlled removal. Preliminary air dispersion simulations suggest that the maximum concentrations of solid particulate emitted by the plant will be less than 20% of the national standard.

- Wastewater will not be permitted to leave the plant site. Instead, it will be first treated and then evaporated from an evaporating pond.

- Ash will be disposed of safely. If the 25,400 tonnes/yr of RHA expected from the project cannot be sold, provision has been made to bury the ash on-site, thereby preventing it from escaping into the atmosphere or entering the local waterways via runoff.

- The large size of the site combined with tree plantings at each plant will buffer ambient noise.

- EPC and O&M contractors will be required to guarantee that the plant will follow World Bank environmental guidelines for thermal power plants, in addition to Thailand's NEB regulations.

D.2. Environmental impact assessment

>>

According to Thai regulations, an Environmental Impact Assessment is required for the proposed plant. The assessment and mitigation plan for any impacts must be approved by the Office of Environmental Policy and Planning (OEPP) and National Environmental Board (NEB).

In September 2001, ATB submitted it's completed EIA for the Pichit site, whose English summary is attached as Reference File I. The EIA was approved by the National Environmental Board (NEB) on 20 November 2002. Approval of the Project's EIA signifies conformity to all the Thai environmental standards specified in the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535.

As part of EIA compliance, ATB will submit to the OEPP regular semi-annual EIA reports, which will include the following:

- Results of continuous monitoring of air emission from the stack
- Ambient air quality
- Noise level at monitoring points in the neighbourhood
- Water quality at the holding pond
- Occupational health and safety
- Record of accidents

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

ATB has held numerous meetings with local stakeholders. Appendix C lists 24 principal meetings held for the Pichit site.

Local stakeholder comments are also sought in formal surveys. Opinion surveys were conducted amongst 20 community leaders and 150 villagers, in accordance with the methodology described in Reference File II. Such a comprehensive stakeholder consultation process is not mandated under Thai law.

E.2. Summary of comments received

>>

The opinion survey results were very positive for the Project, with as many as 87% of the respondents expressing agreement, while only 2.7% disagreed. Details are provided in Reference File II.

Thai law requires that 50% of respondents agree to a project as part of an EIA assessment. However, in order to be eligible for the EPPO-SPP program, it is required that 67% approval is obtained. A public hearing conducted specifically for this purpose found 89% of respondents in favor of the Project. This figure is well over both the EPPO and EIA requirements.

E.3. Report on consideration of comments received
>>

G.3.1 Environmental Protection Guarantee Fund
ATB is establishing an Environmental Protection Guarantee Fund to ensure that financial resources are available to pay for damages in the unlikely event that environmental degradation occurs as a result of the operations of its plants.

During plant operation, the Fund earmarks annually a sum of 1 million baht (about US$25,000). Please refer to Appendix D for details.

A careful process has been developed to monitor the fund, meetings, actions, and public participation proceedings. These records will be available for inspection.

The monitoring procedure is summarized in the following table.

Performance Evaluation for:	**Documentation**	**Comments:**
Environmental well-being & compliance	- Meeting minutes of Fund Committee meetings	Committee meetings will be held on a regularly scheduled basis, with details to be finalized at the start of construction.
Environmental well-being & compliance	- Independent 3rd party assessments	Technical expert assessments by an independent third party will support the Committee's work in monitoring environmental impact.
Environmental well-being & compliance	- Fund's bank statements	If local communities are compensated for environmental non-compliance, the Fund's bank will record drawdowns from the Fund.
Community resident satisfaction	- Resident comment logs	Residents within the community will be encouraged to voice concerns with the local government, who will be responsible for bringing them to the Committee. The Committee will maintain a record of residents' comments.

SECTION F. Approval and authorization
>>
The letter of approval from Thai DNA has been issued since 30/01/2007.

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Appendix 1: Contact information of project participants

Organization name	A.T. Biopower Co., Ltd. (Project participant)
Street/P.O. Box	719 Rama 9 Road
Building	KPN Tower, 14th Floor
City	Bangkapi,Huaykwang, Bangkok
State/Region	
Postcode	10320
Country	Thailand
Telephone	+66 2717 0445-8
Fax	+66 2717 0449
E-mail	
Website	www.atbiopower.co.th
Contact person	
Title	
Salutation	Mr.
Last name	Vichaisornchayakarn
Middle name	
First name	Tanawat
Department	
Mobile	+66 81 8295885
Direct fax	
Direct tel.	
Personal e-mail	tanawat@atbiopower.co.th

Organization name	Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.
Street/P.O. Box	5/F., Toyosu Front, 3-2-20, Toyosu
Building	Toyosu Front
City	Koto-ku
State/Region	Tokyo
Postcode	135-0061
Country	Japan
Telephone	+81 3 6213 6278
Fax	+81 3 6213 6175
E-mail	
Website	
Contact person	
Title	
Salutation	Mr.
Last name	Kurokawa
Middle name	
First name	Ayato
Department	
Mobile	
Direct fax	+81 3 6213 6175
Direct tel.	+81 3 6213 6278
Personal e-mail	Kurokawa-ayato@sc.mufg.jp

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Appendix 2: Affirmation regarding public funding

The financial plans for the Project does not involve ODA from Annex I countries.

Appendix 3: Applicability of selected methodology

The applicability of selected methodology is completely described in Section B.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

The baseline information for calculation of CM emission factor of the Thailand National Grid is shown in the Summary Report of "The study of emission factor for electricity generation of Thailand in year 2010" which is developed and published by Thai DNA "Thailand Greenhouse Gas Management Organization (Public Organization) as link below:

http://www.tgo.or.th/index.php?option=com_content&view=article&id=349:thailand-grid-emission-2010-report&catid=62:tgo-research&Itemid=29

Appendix 5: Further background information on monitoring plan

The background information on monitoring plan has been identified in Section B.7.

Appendix 6: Summary of post registration changes

Corrections

>> This section the corrections to project design of registered project activity have been indicated. The corrections are summarized and approved by the executive board on 06/08/2013 with reference number PRC-1026-001 (http://cdm.unfccc.int/PRCContainer/DB/prcp196697172/view).
The correction items are;

1. Rated power capacity of steam turbine

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. This is the typographic error of project information which not affect to the design of project activity.

2. Project Participants

The Mitsubishi UFJ Securities Co., Ltd. was changed the name to Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. The MOC Annex 2 in change authorized signatory, name or contact detail was web-hosted on 27/01/2011. Chubu Electricity Power Co., Ltd withdraws from the project activity. The voluntary withdrawal letter was signed and valid as of 12/04/2011. After that, Gazprom Marketing & Trading Singapore Pte. Ltd is added to the list as the Project Participant Party.
Furthermore, on 13/11/2013[11] the MOC is updated again which Gazprom Marketing & Trading Singapore Pte. Ltd is withdrawn from the project participant list of the project activity.

3. Fossil fuel combusted at the project site for other purpose

As the registered PDD mentioned that heavy fuel oil and diesel will be used in the project activity. But in the project implementation only diesel is used at the project site for other purpose. Also the heavy fuel oil has never been used for emission calculation. Hence the correction is made to the registered PDD by removed the information of heavy fuel oil which is not related to project activity. The revised PDD and the calculation spreadsheet were revised by applying the NCV of diesel (43.0 x 10^{-3} TJ/t) to reflect the real implementation. In addition. The fossil fuel consumption in start up operations per time has been changed from 500-600 litres of fuel oil in the registered PDD to 10,000 litres of diesel and will be started up 10 times per year.

4. Editorial correction in registered PDD

In the registered PDD, the word "rice mill and rice miller" are used to describe source of rice husk. Then these words are changed to "biomass fuel supply sites", which is the same wording in the methodology.

The version number of PDD and the completion date of the revised PDD as 28/11/2012 with version 5.1 are updated base on the approval from EB for Requested change of the project activity on 06/08/2013.

[11] Date of submission of the MoC and the Annex2 of MoC are on 13/11/2013. However the Annex2 of MoC is valid from 18/11/2013 and the MoC is valid from 21/11/2013 (Further details : http://cdm.unfccc.int/Projects/DB/DNV-CUK1174909241.2/view)

Permanent changes from registered monitoring plan or applied methodology

>>
During the first crediting period, it has permanent changes from registered monitoring plan.
The permanent changes from registered monitoring plan or applied methodology are summarized and approved by the executive board on 06/08/2013 with reference number PRC-1026-001 (http://cdm.unfccc.int/PRCContainer/DB/prcp196697172/view). The parameters are detailed below;

1. The moisture content of biomass residue is added as monitoring parameters.

2. On-site electricity imported attributable to the project activity is added as monitoring parameters.

3. The net calorific values (NCV) of rice husk and diesel oil are revised to be measured at least every six months, taking at least three samples for each measurement.

4. The NCV of residual oil is removed and not required for monitoring as it has never been and will not be used in the project activity

5. The calibration frequency of the weight meter for quantity of rice husk combusted in the ATB plant measurement in the revised PDD is specified to once in two years and the energy balance for cross checking is revised to conduct annually.

6. The fossil fuel consumption for on-site transportation of rice husk is revised to calibrate the fuel meter to once in two years. Then the data will be cross checked with fuel purchase invoice.

7. An average return trip distance between biomass fuel supply sites or the origin of the biomass and ATB plant is revised by stating that this parameter will be recorded when the supplier agree to provide the rice husk to site and will be checked against with maps from rice husk source to site.

8. Source of methane emission factor for combustion of rice husk at ATB plant is revised to comply with applied methodology by using from default value as provided in Table 4 of the methodology.

9. The average CO_2 emission factor for transportation of rice husk is revised source of data by applying an alternative choice from the methodology provided. The emission factor is selected an applicable for rice husk types used from literature in a conservative manner. Then the data will be cross checked with emission factor referred to in the literature.

10. The CO_2 emission factor of diesel is revised to comply with methodology. Source of data is revised to select a reliable local or national data where available. Where such is not available, the IPCC default value can be applied. If there are deemed to reasonably represent local circumstances, the most conservative manner will be chose.

11. The net quantity of electricity generated from ATB plant is revised to comply with methodology. This parameter will be cross checked data with receipts from electricity sales and 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) 12. The on-site fossil fuel consumption of diesel for start up/auxiliary use is revised the documentation evidence for cross checking from fuel purchase invoices in the registered PDD to an energy balance to comply with applied methodology.

12. The amount of fossil fuel consumed by each power source, CO_2 emission coefficient of fossil fuel, electricity generation of power source, power source for OM, power source for BM from the section B.7.1 in the registered PDD were moved to section B.6.2 because they will be revised once upon renewal of a crediting period.

13. The revision of the registered monitoring plan is in accordance with the approved methodology ACM0006 version 4 and national regulation. In addition, the calibration frequency of each parameter is

added for transparency. This revision improved the accuracy of information provided and consistency in the registered PDD and the monitoring plan.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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