**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-PDD)**
**Version 03 - in effect as of: 28 July 2006**

**CONTENTS**



**Annexes**

## SECTION A. General description of project activity

### A.1. Title of the project activity:

>>

Grid-connected Biomass Power Plant at Takli District of Nakhon Sawan Province in Thailand.
Version No. 02
Date: 30/12/2012

### A.2. Description of the project activity:

>>

A 60 MW Grid-connected Biomass Power Plant at Takli, Nakhon Sawan is a biomass residues cogeneration project to be implemented by Kaset Thai Bio Power Co., Ltd. (KTBP), located in Takli district of Nakhon Sawan province at the middle part of Thailand. KTBP biomass power plant is one of several factories under Thai Identity Sugar Group (TIS), which is situated near by other 3factories. Environment Pulp and Paper Co., Ltd. (EPPCO), Ekarat Pattana Co., Ltd. (EPC) and Kaset Thai Industry Sugar Co., Ltd. (KTIS).

**Prior to the project activity:**
The project activity is a Greenfield project. KTBP will also obtain the bagasse from other sugar mills. The total bagasse consumption at KTBP will be around 571230 tonnes per annum.

The proposed project (KTBP) involves installation of the new bagasse based cogeneration power plant consist of one travelling grate stoker 60 MW rate output turbine generator with 240 tonnes/hr and one boiler delivering steam at 105 kg/cm² and 540 C° by Shin Nippon Machinery Co. LTD., which will burn bagasse from the nearby sugar factories to produce steam and electricity to be contributed to adjacent sugar factory of KTIS (roughly at 11.8% in crushing process, 23.5% in re-melting process and 2.5% in off-season) and other factories as EPPCO (on-season: 5.9% in, off-season: 4.2% in) and EPC (on-season: 3.5%, off-season: 2.5%). The surplus power supply 30 MW in average will be sold to the Electricity Generating Authority of Thailand (EGAT) under the non-firmed Small Power Producer (SPP) scheme. In the absence of the project activity the same power would have been generated from the fossil fuel based power plant in the grid which would have resulted in the emission of Greenhouse gas emissions into the atmosphere. Thus, the proposed project will reduce 96,035 $tCO_2e$ annually, as aim to promote a global level of greenhouse gases reduction and enhance a sustainable development of CDM project in Thailand in additional.

**Sustainable development benefits of the project**

The proposed project intends to use an agriculture wastes or by-product in the area to generate the environmental friendly and renewable energy, as the activity will directly and indirectly contribute to sustainable development in several ways:

**Environmental dimension**
The project activity will reduce an emission of $CO_2$, by replacing an equivalent amount of grid by electricity from renewable resources and also not dumped, left on fields, or burnt the bagasse in an uncontrolled manner, as it can be caused the air pollution from dust. However, the bagasse under this

project will be burned in a boiler that is much more efficient and environmentally friendly than the traditional ones. More than that, bagasse ashes of the biomass power plant will be distributed to local farmers to be used as soil conditioner in sugar fields.

**Social dimension**

This project leads to an increase in local economics activities and employment opportunities for local people. The proposed project will create jobs for a great number of people in the area. There will be employment more than 100 workers during the construction and approximately 80 employees during the operation and maintenance of the power plant. Moreover, the generated electricity from the proposed project which send to nation grid will be contributed the security and stability of the surrounding community.

**Economics dimension**

Construction of the 60 MW biomass power plant will create cash flow in the region in selling construction materials, equipment and tools for the plant, and from transportation services in the construction and operation period. The employee of the project can handle the job in operation period for at least 15-20 years as the project's lifetime.

Therefore, the project is in line of policies of the National Strategy for Sustainable Development of Thailand; the policy of the Department of Alternative Energy Development and Efficiency (DEDE) under the Ministry of Energy of Thailand (MoE), the priority list for Thailand's CDM projects, according to the Thailand Greenhouse Gas Management Organization (TGO). The project contributes to raise the share of renewable usage. The project complies with the sustainability criteria applied by the National DNA of Thailand (TGO).

## A.3. Project participants:

>>

| Name of Party involved (*) (host indicates a host Party) | Private and/or Public entity(ies) Project participants(*) (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participants (Yes/No) |
|---|---|---|
| Thailand (Host) | Kaset Thai Bio Power Co., Ltd. (KTBP) – Private Entity | No |
| (*) In accordance with the CDM modalities and procedures, at the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required. | | |

## A.4. Technical description of the project activity:

### A.4.1. Location of the project activity:

>>

#### A.4.1.1. Host Party(ies):

>>

Thailand

#### A.4.1.2. Region/State/Province etc.:

>>
Nakhon Sawan Provice

**A.4.1.3. City/Town/Community etc.:**

>>
Takli District

**A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):**

>>
The proposed project lies in Tambon Nong Pho, Takli District, Nakhon Sawan Provice at coordinates: 15.375684, 100.234859 (+15° 22' 32.46" N, +100° 14' 5.49"E).

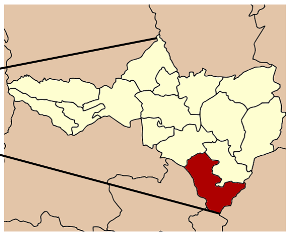
| | | |
|---|---|---|
|  Thailand |  Takli District, Nakhon Sawan Province | KTBP Location, KTIS, EPPCO, and EPC |
| | | |


**Figure 1**. Location of the project activity

### A.4.2. Category(ies) of project activity:

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*Sectoral Scope 01: Energy industries (renewable/non-renewable sources).*

### A.4.3. Technology to be employed by the project activity:

>>

The proposed project (KTBP) involves installation of the new bagasse based cogeneration power plant consist of one travelling grate stoker 60 MW rate output turbine generator with boiler steam generation capacity of 240 tonnes/hr and one boiler delivering steam at 105 kg/cm² and 540 C° by Shin Nippon Machinery Co. LTD., which will burn bagasse from the nearby sugar factories to produce steam and electricity to be contributed to adjacent sugar factory of KTIS (roughly at 11.8% in crushing process, 23.5% in re-melting process and 2.5% in off-season) and other factories as EPPCO (on-season: 5.9% in, off-season: 4.2% in) and EPC (on-season: 3.5%, off-season: 2.5%). The surplus power supply 30 MW in average will be sold to the Electricity Generating Authority of Thailand (EGAT) under the non-firmed Small Power Producer (SPP) scheme.

**Prior to the project activity:**

The project activity is a Greenfield project. KTBP will obtain the bagasse from other sugar mills. The total bagasse consumption at KTBP will be around 571230 tonnes per annum.

The technology employed in this project is a travelling gate stoker 60 MW rate output turbine generator with 240 tonnes/hr boiler delivering steam at 105 kg/cm² and 540 C° by Shin Nippon Machinery Co. LTD., as the specification shown in Table1.

The steam turbine will also provide low pressure 2.0 bar process steam to the raw sugar boiling house and 1.0 bar (a) steam to the sugar refinery via the steam transformer.

**Table 1**. Technical specification of new high pressure boiler, turbine and generator

| Parameter | Boiler | Turbine |
|---|---|---|
| Type | Travelling grate stoker type | Horizontal, impulse, multi-stage mu1ti-valve, axial flow, condensing, extraction & Non-geared ( Down exhaust type) |
| Power Capacity (MW) | | 60 |
| Steam Flow on /off-season (tonnes/h) | 240 | 240/229.4 |
| Operation Pressure (kg/cm²g) | 105 | 103 |
| Efficiency at MCR | 88% | - |
| Temperature (°C) | 540±5 | 535 |
| Fuel Consumption (tonnes/hr) | 76 | |

### A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>

**Table 2**. Estimated emission reductions through the crediting period

| **Year** | **Annual estimation of emission reductions (tonnes of $CO_2$e)** |
|---|---|
| 2013 | 96,035 |
| 2014 | 96,035 |
| 2015 | 96,035 |
| 2016 | 96,035 |
| 2017 | 96,035 |
| 2018 | 96,035 |
| 2019 | 96,035 |
| 2020 | 96,035 |
| 2021 | 96,035 |
| 2022 | 96,035 |
| **Total estimated emission reductions (tonnes of CO2e)** | 96,035**0** |
| **Total number of crediting years** | **10** |
| **Annual average over the crediting period of estimated reductions** (tonnes of $CO_2$ e) | 96,035 |

### A.4.5. Public funding of the project activity:

>>
Public funding from Annex I countries and diversion of ODA is not involved in this project.

## SECTION B. Application of a baseline and monitoring methodology

### B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

>>
The project activity follows the following methodology:
Methodology number is ACM0006 "Consolidated methodology for electricity and heat generation from biomass residues" with version 12.1.1 (EB 69), valid from 02 Mar 12 onwards.

In accordance with the ACM0006 following tools/methodologies are used in this project activity:
-Tool: for the demonstration and assessment of additionality, Version 06.0.0
-Tool to calculate the emission factor for an electricity system, Version 02.2.1
-Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 01
-Project and leakage emissions from road transportation of freight, Version 01.0.0

### B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

*The methodology is applicable to project activities that operate biomass-residue (co-)fired power-and-heat plants.*

The project is a cogeneration biomass residues fired based plant, which the biomass residues derived from sugar cane crushing process. This project activity will supply power to nation grid and both power and heat to nearby sugar factory

According to the methodology, the project activity may include:

*The installation of new plants at a site where currently no power and heat generation occurs (greenfield project);*

The project activity involved the installation of a new biomass based cogeneration which operated as independent power plant, the biomass residues supplied by biomass residues finding from an affiliate factories nearby or a market.

*The installation of new plants at a site where currently power or heat generation occurs. The new plant replaces or is operated next to existing plants (capacity expansion projects);*

The project activity is constructed at a site where currently no power or heat generation occurs. Thus, this is not applicable.

*The improvement of energy efficiency of existing plants (energy efficiency improvement projects), which can also lead to a capacity expansion, e.g. by retrofitting the existing plant;*

The project activity is a Greenfield plant. Thus, the applicability condition is not applicable.

*The total or partial replacement of fossil fuels by biomass in existing plants or in new plants that would have been built in the absence of the project (fuel switch projects), e.g. by increasing the share of biomass use as compared to the baseline, by retrofitting an existing plant to use biomass, etc.*

The project does not involve replacement of fossil fuels by biomass. Thus, the applicability condition is not applicable for the project activity.

In addition, the project activity meets the consolidated condition as follows:

1. *No biomass types other than biomass residues are used in the project plant*
   The project will be used only bagasse as a biomass residues fuel.

2. *Fossil fuels may be co-fired in the project plant. However, the amount of fossil fuels co-fired does not exceed 80% of the total fuel fired on an energy basis;*
   There will be no fossil fuel used in the project activity.

3. For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project does not result in an increase of the processing capacity of raw in put (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process;

   The implementation of the project activity does not result in an increase in the processing capacity of the raw input or other changes in the sugar manufacturing process since the sugar cane is an independent process based on sugar cane production and managed by separate entity (KTIS)

4. The biomass residues used by the project facility are not stored for more than one year;

   The biomass residues used by the project facility will not be stored for more than one year. The rest small quantities of the biomass residues may be held over from one season to the next season and used as the start up fuel of the nearby plant. However, the length of this process is not longer than 6 months.

5. The biomass residues used by the project facility are not obtained from chemically processed biomass (e.g. through esterification, fermentation, hydrolysis, pyrolysis, bio- or chemical degradation, etc.) prior to combustion. Moreover, the preparation of biomass-derived fuel do not involve significant energy quantities, except from transportation or mechanical treatment so as not to cause significant GHG emissions;
   The biomass residues used by the project facility are directly conveyed to the boilers, the bagasse is only transfer from storage yard to boiler without chemical treatment or involved significant energy quantities.

6. *In the case of fuel switch project activities, the use of biomass or the increase in the use of biomass as compared to the baseline scenario is technically not possible at the project site without a capital investment in:*

- *The retrofit or replacement of existing heat generators/boilers; 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); or*
- *Equipment for preparation and feeding of biomass.*

The project activity does not involve fuel switch majors. Thus , the applicability condition does not applies to the project.

7. *In the case that biogas is used in power and/or heat generation, this methodology is applicable under the following conditions:*

   *The biogas is generated by anaerobic digestion of wastewaster (to be) registered as a CDM project activity and the details of the registered CDM project activity must be included in the PDD. Any CERs from biogas energy generation should be claimed under the proposed project activity registered under this methodology;*

   *The biogas is generated by anaerobic digestion of wastewater that is not (and will not) be registered as a CDM project activity. The amount of biogas does not exceed 50% of the total fuel fired on an energy basis.*

   The project activity does not involve biogas used in power and heat generation. Thus, the applicability condition does not applies to the project activity.

8. *In the case of biomass from dedicated plantations:*

   *(a) The cultivated land can be clearly identified and used only for dedicated energy biomass plantations;*

*(b) The CDM project activity does not lead to a shift of pre-project activities outside the project boundary, i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project;*

*(c) The plantations are established:*

(i) *On land which was, at the start of the project implementation, classified as degraded or degrading; or*

(ii) *On a land area that is included in the project boundary of one or several registered A/R CDM project activities;*

*(d) The plantations are not established on organic soil (notably peatlands);*

*(e) The land area of the dedicated plantations will be planted by direct planting and/or seeding;*

*(f) After harvest, regeneration will occur either by direct planting, seeding or natural sprouting;*

*(g) Grazing will not occur within the plantation;*

*(h) No irrigation is undertaken for the biomass plantations;*

*(i) The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the CDM project activity would have not been used for any other agricultural or forestry activity;*

*(j) Only perennial plantations are eligible.*[1]

The project activity does not involve dedicated plantation.

In addition, the methodology is applicable to the project activity, since the baseline scenario has been identified in the section B4 of the PDD.

**B.3. Description of the sources and gases included in the project boundary:**

>>

*As per the methodology ACM0006, the spatial extent of the project boundary encompasses:*

- *All plants generating power and/or heat located at the project site, whether fired with biomassfossil fuels or a combination of both;*
- *All power plants connected physically to the electricity system (grid) that the project plant is connected to;*
- *Where possible, all off-site heat sources that supply heat to the site where the CDM project activity is located (either directly or via a district heatingsystem);*

[1] Project proponents can apply for revision of the methodology to include annual plantations, providing evidence that annual plantations would not result in depletion of the soil carbon.

- *The means of transportation of biomass to the project site;*
- *If the feedstock is biomass residues, the site where the biomass residues would have been left for decay or dumped;*
- *If the feedstock is biomass produced in dedicated plantations: the geographic boundaries of the dedicated plantations;*
- *The wastewater treatment facilities used to treat the wastewater produced from the treatment of biomass;*
- In case biogas is included, the site of the anaerobic digester.

The spatial extent of the project boundary encompasses:

- The power plant at the project site;
- All power plants connected physically to the electricity system that the CDM project power plant is connected to
- The means of transportation of biomass residues to the project site (trucks)
- The site where the biomass residues would have been left for decay or dumped.

Thus, the project site consist of KTBP and EPPCO, EPC & KTIS. So, the power plant installed at the EPPCO, EPC & KTIS is included in the project boundary

For the purpose of determining GHG emissions of the project activity, the following emissions sources are included in project boundary:

- CO2 emissions from on-site electricity consumption.
- Off-site transportation of biomass residues which is the main part of bagasse would come from nearby factories, actually transport via convey as normal practice in any sugar mill. However, the rest bagasse, which coming from other sources has been included in the project boundary.

For the purpose of determining the baseline, the following emission sources are included:

- CO2 emissions from electricity system (the main equipments are boiler, turbine generator, condenser, water treatment plant, transformers, transmission line and etc.), included national grid.

Although the project activities also generate steam, there is no significant change in the amount of steam generated for the sugar factory, and it is already generated with biomass residues. The steam generation is, therefore, not included in the emission reduction.

The table bellow illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

**Table 3: Emission sources included or excluded from the project boundary**

| | Source | Gas | | Justification / Explanation |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Baseline** | 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 |
| | Heat generation | $CO_2$ | Excluded | No emission reductions are claimed for heat generated by the project activity as the heat under baseline is derived from the biomass residues. |
| | | $CH_4$ | 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 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | Excluded | Excluded for simplification. This is conservative. |
| | | $N_2O$ | 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. |
| | Off-site transportation 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 and heat | $CO_2$ | Excluded | It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | Excluded | Exclude, because this emission source is excluded because CH4 emissions from uncontrolled burning or decay of biomass residues in the baseline scenario are not occurred. |
| | | $N_2O$ | 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 emissions 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 not linger than one year, this emission source is assumed to be very small. |
| | | $N_2O$ | Excluded | Excluded for simplification. This emission source is assumed to be very small. |
| | Wastewater from the treatment of biomass residues | $CO_2$ | Excluded | It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector. |

| | | | | |
|---|---|---|---|---|
| | | $CH_4$ | Excluded | This emission source shall be included in case where the waste water is treated (partly) under anaerobic condition. |
| | | $N_2O$ | Excluded | Excluded for simplification. This emission source is assumed to be very small. |

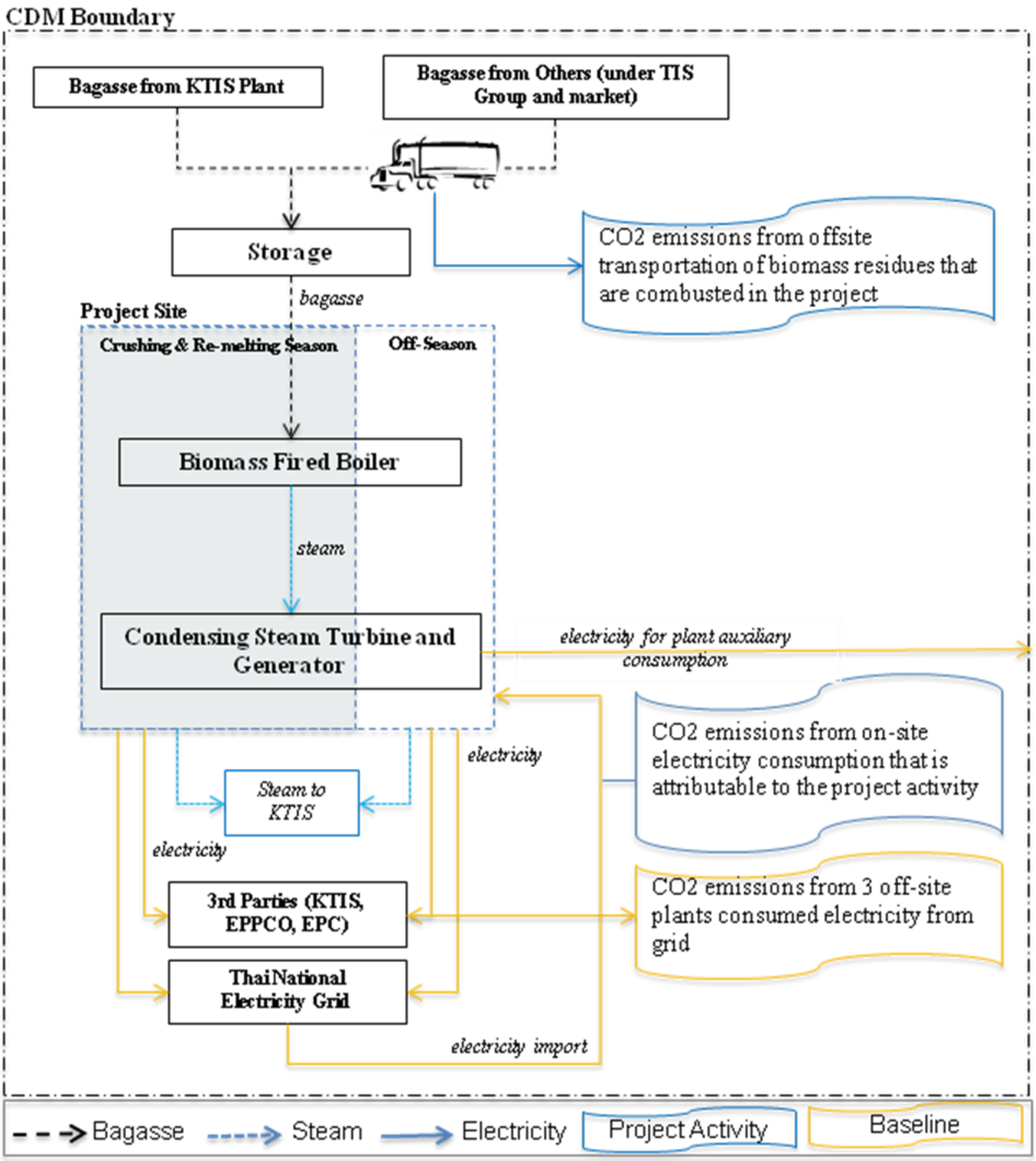


**Figure 2:** Project Boundary

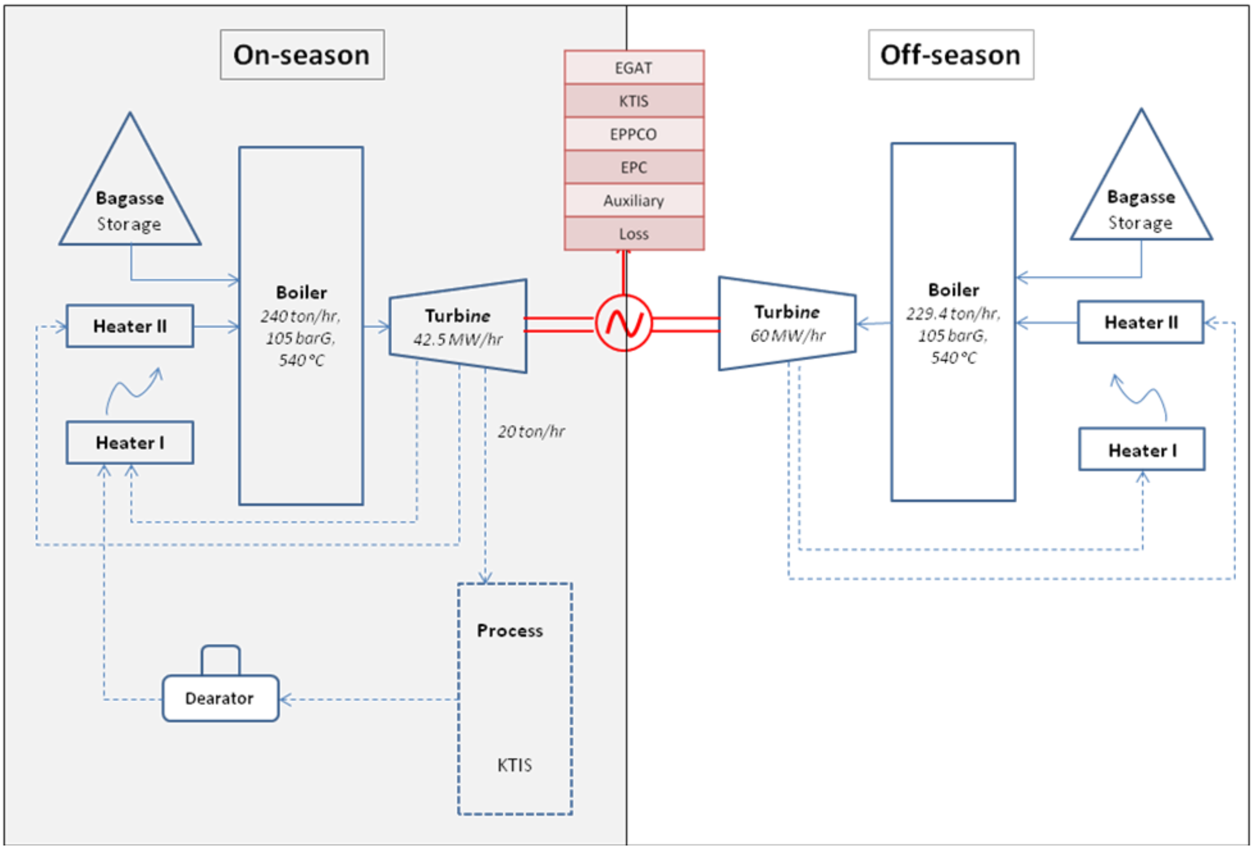


**Figure 3:** Schematic diagram of the project activity and baseline scenario

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

>>

As per ACM0006, The baseline scenario is defined using the "Tool for the demonstration and assessment of additionality" version 06.0.0.

The selection of the baseline scenario and demonstration of additionality should be conducted as the following steps:

***Step 1: Identification of alternative scenarios***

***Sub-step 1a: Define alternative scenarios to the proposed CDM project activity***

The realistic and credible alternatives should be separately determined regarding:

• How electric **power** would be generated in the absence of the CDM project activity; and

• How **heat** would be generated in the absence of the CDM project activity;

• What would happen to the **biomass residues** in the absence of the project activity?

The considered **power** baseline scenarios are as follow:

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

This may be an alternative baseline scenario. As per the project activity faces with the investment barriers as explain in section B.5 and would not have an incentive without CDM consideration.

P2: If applicable,2 the continuation of power generation in existing power plants at the project site. The existing plants would operate at the same conditions (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 starting date of the project activity;

The project activity is a new Greenfield project activity. Thus, it has been excluded as a plausible baseline scenario.

P3: If applicable,2 the continuation of power generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project activity;

The project activity is a new Greenfield project activity. Thus, it has been excluded from consideration as a plausible scenario.
P4: If applicable,2 the retrofitting of existing power plants at the project site. The retrofitting may or may not include a change in fuel mix;

The project activity is a new Greenfield project activity. Thus, it has been excluded from consideration as a plausible scenario.
P5: The installation of new power plants at the project site different from those installed under the project activity;

This may be a credible baseline, because there is no power plant at the project site, as the project is the new plant construction.

P6: The generation of power in specific off-site plants, excluding the power grid;

Specific off-site plants, excluding the power grid, are not feasible in the project area. P6 is eliminated.
P7: The generation of power in the power grid

This may be a credible baseline. The generation of power in new grid connected plants as the power from the project activity will be fed in to grid (expected to displace power from national grid).

The considered **heat** generation baseline scenarios are as follow:

H1: The proposed project activity not undertaken as a CDM project activity;

This may be an alternative baseline scenario, but without CDM consideration the project activity may faces with investment barrier which have been discussed in section B.5 of the PDD.

H2: If applicable the continuation of heat generation in existing plants at the project site. The existing plants would operate at the same conditions (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;

Excluded, because of the project is a newly constructed plant.

H3: If applicable, the continuation of heat generation in existing plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the project activity;

Excluded, because the project is a  new plant construction.

H4: If applicable, the retrofitting of existing plants at the project site. The retrofitting may or may not include a change in fuel mix;

Excluded, because of the project is the new plant construction.

H5: The installation of new plants at the project site different from those installed under the project activity;

In the absence of the proposed project, the existing boilers would continue to work. Base on the same justification as provided for P5 above, H5 is eliminated.
H6: The generation of heat in specific off-site plants;

The project is to provide heat to KITS and the maximum heat supplied in terms of steam is 160t/h. In the absence of the project activity the 160TPH heat will be generated from the existing boiler of KTIS. Thus, it is a plausible baseline scenario.
H7: The production of heat from district heating.

There is no current trend that shows the production of heat from district heating system can be done at the project site and in the region. Thus, the same is excluded.

Therefore the plausible and credible baseline scenarios for heat generation are H1 and H5.

The considered **biomass** baseline scenarios are as follow:

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;

The bagasses available at the sources are surplus in nature. This can be plausible baseline scenario.

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 or left to decay on fields;

In Thailand, the Municipality solid waste and household waste are only being collected and processed in the landfill and  the landfill does not receive the waste from agricultural and forestry sector. Furthermore, if the biomass residues are left to decay under clearly anaerobic conditions, they should be covered with sand or soil, and certain investment will be required. It is not practiced in the country. Thus, considering

that no mandatory regulations or laws have ever request the biomass residues to be treated in landfill, hence this alternative scenario is not plausible for further consideration.
B3: The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes;

The bagasses available at the sources are surplus in nature. This can be plausible baseline scenario.
B4: The biomass residues are used for power or heat generation at the project site in new and/or existing plants;

This is the proposed project activity and hence the scenario is realistic and available to the project participants. Therefore, B4 is identified as an alternative scenario whereby it accompanies scenarios P1 and H1.
B5: The biomass residues are used for power or heat generation at other sites in new and/or existing plants;

The biomass residues are readily available to the project from the vicinity of the proposed project location and this is demonstrated through the procedure defined in ACM006 and detailed below. Therefore, this scenario is not realistic because there is an abundant surplus of biomass in the region.
B6: The biomass residues are used for other energy purposes, such as the generation of bio fuels;

At present, there is no case available in Thailand where biomass is being used as the feedstock of biofuel and it cannot be industrialized in the current scenario. Hence, B6 is excluded.
Thus, this has been excluded as a plausible scenario.

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

There is pulp and paper plants are there in the nearby region who requires bagasse for non –energy purposes. Thus, the plausible scenario is excluded.

B8: Biomass residues are purchased from a market, or biomass residues retailers, or the primary source of the biomass residues and/or their fate in the absence of the project activity cannot be clearly identified.

The biomass residues are readily available to the project from the vicinity of the proposed project location and this is demonstrated through the procedure defined in ACM006 and detailed below. Therefore, this scenario is not realistic because there is an abundant surplus of biomass in the region.
**Table 4:** Biomass residues categories from the project boundary

| 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 (tones) |
|---|---|---|---|---|---|
| 1 | Bagasse | Off-site from biomass residues retailer | nidentified (B1 or B4) | Electricity generation on-site (biomass-only boiler) | 571,230 |

**Outcome of Step 1a:** From the above, the results can be summarized as follows:

- For power: P1, P7 is the plausible scenarios;
- For heat: H1 or H5 is the plausible scenario;
- For biomass: B4 is the plausible scenario.

| Alternative combination | Power | Heat | Biomass | Description |
|---|---|---|---|---|
| 1 | P1 | H1 | B4 | The project activity not undertaken as CDM activity and biomass is used at the existing facility.. |
| 2 | P7 | H6 | B4 | In the absence of the proposed project activity, the equivalent power would have been supplied by the grid; the equivalent heat would be generated at KTIS existing bagasse based boiler or some other site; the biomass residues would have been dumped or left to decay mainly under aerobic conditions or burnt in an uncontrolled manner without utilizing it for energy purposes. |

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

The objective of this step is to determine whether the alternatives listed in outcome of step 1a are in compliance with all mandatory applicable legal and regulatory requirements.
All of the alternative combinations that pass Step 1a are in compliance with all Thailand government applicable laws and regulations. The proposed project activity not undertaken as a CDM project activity is not the only alternative among them.

**Outcome of Step 1b:**

In conclusion, the list of alternative scenarios to the project activity that are in compliance with current laws and regulations in Thailand are:
(a) **P1**, **H1** and **B4 (the proposed project activity undertaken without CDM)**
(b) **P7, H6** and **B4**

**Step 2: Investment analysis**

As analysis in the section B.5 indicates that the proposed project activity is not financially attractive without the CDM revenues. It can be concluded that in the absence of CDM income, the proposed project is not financially attractive to the project owner. Hence scenario P1, H1 and B4 is eliminated.
In conclusion, the plausible alternative scenarios for the proposed project are:
• For power generation: Scenario P7;
• For heat generation: Scenario H6;
• For biomass residue use: Scenario B4

**Step 3: Barrier analysis**

***This is not applied.***

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

>>
As the section B.4 result, which identified the baseline scenario under the "tool for the demonstration and assessment of additionality", version 06.0.0 (EB65) and ACM0006 version 12.1.0. (EB69). This section was demonstrated that there are more than one alternative, one of which is the proposed project activity undertaken without being registered as a CDM project activity (Alternative 1). According to the tool, then proceed to Step 3.

**Step 2: Investment Analysis**

According to ACM0006 (Version 12.1.1), project participants should identify the most plausible baseline scenario and demonstration additionality using the latest approved version of the "tool for the demonstration and assessment of additionality" (Version 06.0.0), the investment analysis is conducted in the following steps:
Here in Thailand, the insufficient financial returns that proposed project would have to confront in the absence of carbon credits is the most important barrier that prevent the private investors from determining on power plant project.

***Sub Step 2a: Determine appropriate analysis method***

The "tool for the demonstration and assessment of additionality" (Version 06.0.0) recommends three analysis methods: simple cost analysis, investment comparison analysis and benchmark analysis. The proposed project produces economic benefits through the sales of electricity other than CDM related income; therefore, the simple cost analysis can not be taken. The investment comparison analysis is not applicable to the proposed project because the alternative of the proposed project is outside the direct control of the PP.

As per Annex 05 of EB 62, the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest. In the project activity the baseline scenario is the generation of equivalent amount of electricity from the grid connected power plants.

The baseline scenario is outside the direct control of the PP. Hence, the benchmark analysis is chosen and the Post Tax Equity IRR is used as the financial indicator to assess the financial viability of the project activity.

***Sub step 2b: Option III – Benchmark analysis***

The PP has calculated the Benchmark Required/Expected returns on equity using the standard, popular paradigm, the Capital Asset Pricing Model (CAPM). This model postulates a linear relationship between an asset's 'beta', a measure of systematic risk, and expected return.

Cost of Equity: The cost of equity has been determined based upon the Capital Asset Pricing Model (CAPM)

$$CoE = r_f + \beta(ERP)$$

Where:
CoE = cost of equity
$r_f$ = risk free rate
ERP = equity risk premium for the market
β =Beta or systematic risk for this type of equity investment coefficient reflecting the volatility (risk) of the stock relative to the market

Yield to Maturity (YTM) is considered as the yield on the Thailand BMA Government Yield Curve for the period of 20 years corresponding to the time period of financial assessment. This works out 3.87% for the project activity as on 30/07/2010 at the time of investment decision[2].

Capital Asset Pricing Model (CAPM) provides the framework for computing risk premium. Risk premium, or market risk premium as it is commonly known as is the difference between the market return and the risk free return (YTM on Government Securities). As required by CAPM, market Index representing a widely diversified portfolio which is SET 50 Total Return Index (Set 50 TRI) has been selected to compute the market return. The base value of SET 50 TRI index is considered as 1000 as on 02/01/2002. The return on SET 50 TRI index has been computed from 02/01/2002 till 30/07/2010 the at the time of investment decision date for the project activity. This return works out to 18.09% for the project activity.

Based on the market return arrived at as explained above and the risk free return, the market risk premium works out to be 14.22% for the project activity.

The risk of the project type has been computed using Beta. Beta has been computed by regressing the returns of the Industry Group and Sector Indices Resources which represent the Stocks in Energy Sector with the returns of the SET 50 TRI Index

The cost of equity is obtained by adding the risk premium reflecting the risk of the project type to the government bond rates which works out to 19.23%.

***Sub step 2c: Calculation and comparison of financial indicators:***
The calculation of the equity IRR is based on the project cash inflows from sale of electricity to grid and third party and steam to adjacent third party, the project cash outflows related to cost of operation and maintenance of the plant, fuel cost, etc., which minus any interest and debt repayments. All these costs are in line with industry standards. Detail and data parameters used for the analysis are given in Table 6.

**Table 6**: IRR calculation key parameters

| **Assumption** | **Value** | **Unit** | **Source** |
|---|---|---|---|
| Plant operation | 240 | days/year | FSR |
| Working days during Crushing | 150 | days/year | FSR |

[2] http://www.thaibma.or.th/yieldcurve/YieldTTM.aspx

| | | | |
|---|---|---|---|
| Working days during Remelting | 45 | days/year | FSR |
| Working days during Off-season | 45 | days/year | FSR |
| Plant Load Factor | 80% | | FSR |
| Fuel Consumption at On-season (Full Capacity) | 60,153.78 | kg/hr | FSR |
| Fuel Consumption at Off-season | 57,496.98 | kg/hr | FSR |
| Electricity Exported to the grid | 136 | GWh | FSR |
| Tariff | 2.58 | BHT/kWh | Provincial Electricity Authority (PEA) of Thailand |
| Tariff pricing subsidy | 0.30 | BHT/kWh | Index Mundi Website[3] |
| Total Investment | 2,270,000,000 | BHT | FSR |
| Operation and maintenance expenses | 102,150,000 | BHT/year | FSR |
| Tax rate | 30% | | Thailand Revenue[4] |
| Total Emission Reduction ($CO_2$) | 96,035 | $tCO_2$ e/year | ER calculation sheet |
| Project life time | 20 | Years | Feasibility Study Report |
| CER price | 14.0 | Euro/$tCO_2$e | 1 yr historical data average before the management decision date [5] |
| Exchange rate | 40.33 | BHT/ Euro | 3 Months Average Rate before the management decision date[6] |
| Credit period | 10 | Years | ERTA |

Post Tax Equity IRR for the given project activity comes out to be 14.72% against the benchmark value of 19.23%. Thus, it is evident that the project is not financially attractive.

***Sub step 2d: Sensitivity Analysis:***

The robustness of the conclusion drawn above, namely that the project is not financially attractive, has been tested by subjecting critical assumptions to reasonable variation. As required by Annex 05 of EB 62, only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. PPs have identified the total revenue from the project activity is dependent on the Plant Load Factor & Steam Revenue & Tariff and Project Cost, O&M Costs & Fuel Cost constitute more than 20% of the project costs. These three

[3] http://www.indexmundi.com/commodities/?commodity=coal-australian&months=120

[4] http://www.rd.go.th/publish/6044.0.html

[5] http://www.eex.com/en/Market%20Data/Trading%20Data/Emission%20Rights/EU%20Emission%20Allowances%20%7C%20Spot/EU%20Emission%20Allowances%20Chart%20%7C%20Spot/spot-eua-chart/2011-07-01/0/0/1y

[6] http://www.bot.or.th/english/statistics/financialmarkets/exchangerate/_layouts/Application/ExchangeRate/ExchangeRateAgo.aspx#s

factors have been subjected to a 10% variation on either side and the results of the sensitivity analysis so conducted are given in the following tables.

**Table 7:** Sensitivity Analysis

| Factors | -10% | 0% | +10% |
|---|---|---|---|
| Plant Load Factor | 11.82% | 14.72% | 17.56% |
| Project Cost | 17.71% | 14.72% | 12.17% |
| Fuel Cost | 15.53% | 14.72% | 13.90% |
| Steam Cost | 14.05% | 14.72% | 15.38% |
| Tariff | 11.75% | 14.72% | 17.56% |
| O&M Cost | 15.41% | 14.72% | 14.03% |
| Benchmark | 19.23% | | |

**Outcome of Step 2:** After the sensitivity analysis it is concluded that: the proposed CDM project activity is unlikely to be the financially/economically attractive, and then proceed to Step 4 (Common practice analysis).

**Step 4: Common Practice Analysis**

There are 3 other large scale grid based bagasse cogeneration plants that are registered as the CDM project as they are all face with the financial investment return (Table 5) –Dan Change and Phu Khieo undertaken by the Mitr Phol Group. Khon Kaen Sugar Power Plant undertaken by Khon Kean Sugar Industry Public Co., Ltd, which registered in July 2007. The current project which was passed the process of CDM project approval of Thailand by Thailand Greenhouse Gas Management Organization (TGO)[7] and still on the process of DOE consideration is Surin Electricity Company Limited. As the statistic of the TGO and Energy Policy and Planning Office (EPPO)[8], Ministry of Energy, Royal Thai Government shown that almost large scale power plant need the subsidy, adder or support cost from outsider.

**Table 8:** Biomass-based (bagasse) power plant in Thailand

| Projects | Fuel | Installed Capacity | Status |
|---|---|---|---|
| Dan Chang Bio-Energy Cogeneration Project (DCBC) | Bagasse | 48 | Registered as CDM Project |
| Phu Khieo Bio-Energy Cogeneration Project (PKBC) | Bagasse | 56.9 | Registered as CDM Project |

[7] Lis of the CDM Projects which are currently being analyzed by Thailand by Thailand Greenhouse Gas Management Organization (Public Organization) (TGO). http://www.tgo.or.th/english/index.php?option=com_content&view=section&id=6&Itemid=56

[8] Energy Statistic of Thailand 2010. The Energy Policy and Planning Office (EPPO), Ministry of Energy. http://www.eppo.go.th/info/YearBook/EnergyStatisticsofTHAILAND2010.pdf

| | | | |
|---|---|---|---|
| Khon Kaen Sugar Power Plant | Bagasse | 30 | Registered as CDM Project |
| Surin Electricity Company Limited | Bagasse | 30 | Applying for CDM Project |

**Table 9:** Project Timeline

| Date | Event/Activity |
|---|---|
| 15 July 2010 | Feasibility Study on 60 MW power plant with and without CDM |
| 13 August 2010 | Board gets a preliminary proposal from 3rd party, gets a complete financial and technical proposal, then made decision to do the biomass power plant project with CDM |
| 26 August 2010 | KTBP Company's Registration |
| 29 August 2010 | Letter of Intent (Turbine Generator) |
| 01 October 2010 | Signed contract for plant & machinery design and installation |
| 02 October 2010 | Land rent contract |
| 20 October 2010 | Board approved on CDM project |
| 20 October 2010 | The first time meeting of EIA participants |
| 01 November 2010 | Sales agreement turbine generator |
| 15 November 2010 | Signed contract for boiler, cooling tower, waste water treatment equipment and ESP |
| 28 December 2010 | The first time of KTBP board meeting |
| 17 January 2011 | The second time meeting of EIA participants |
| 19 January 2011 | Purchase order turbine generator |
| 27 January 2011 | Applied for permission to build factory license |
| 09 February 2011 | Prior consideration intimation to DNA & UNFCCC |
| 02 May 2011 | The approval of factory |
| 04 August 2011 | ERPA signed |
| 24 August 2011 | EIA approved |
| 25 November 2011 | BOI approved |

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

>>

As the base line analysis of section B.4, the baseline scenario of the proposed project is the combination of P7, H1, B1 and B8. Thus, according to the methodology ACM0006 (Version 12.1.1), the emission reductions of this project during the year *y* will be calculated following:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where:

$ER_y$ = Emissions reductions in year y ($tCO_2$)
$BE_y$ = Baseline emissions in year y ($tCO_2$)
$PE_y$ = Project emissions in year y ($tCO_2$)
$LE_y$ = Leakage emissions in year y ($tCO_2$)

**Baseline Emissions**

In the baseline scenario power would have been generated from the grid and heat would be generated in the existing bagasse based boiler of KTIS and the biomass residues would have been dumped or left to decay mainly under aerobic conditions or burnt in an uncontrolled manner without utilizing it for energy purposes. Based on conservative assumptions, baseline emissions are calculated as follows:

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min\left(EF_{EG,GR,y}, EF_{EG,FF,y}\right) + BE_{BR,y} \quad (2)$$

Where:

$BE_y$ = Baseline emissions in year y ($tCO_2$)
$EL_{BL,GR,y}$ = Baseline minimum electricity generation in the grid in year y (MWh)
$EF_{EG,GR,y}$ = Grid emission factor in year y ($tCO_2$/MWh)
$FF_{BL,HG,y,f}$ = Baseline fossil fuel demand for process heat in year y (GJ)
$EF_{FF,y,f}$ = CO2 emission factor for fossil fuel type f in year y ($tCO_2$/GJ)
$EL_{BL,FF/GR,y}$ = Baseline uncertain electricity generation in the grid or on-site in year y (MWh)
$EF_{EG,FF,y}$ = CO2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y ($tCO_2$/MWh)
$BE_{BR,y}$ = Baseline emissions due to disposal of biomass residues in year y ($tCO_2e$)
y = Year of the crediting period
f = Fossil fuel type

**Baseline Scenario**

| Power | Heat | Biomass | Descriptions |
|---|---|---|---|
| P7 | H6 | B4 or B1 or B3 | In the absence of the proposed project activity, the equivalent power would have been supplied by the grid; the equivalent heat would be generated at KTIS existing bagasse based boiler; the biomass residues would have been dumped or left to decay mainly under aerobic conditions or burnt in an uncontrolled manner without utilizing it for energy purposes. |

**Step 1: Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors;**

***Step 1.1: Determine total baseline process heat generation***

In the absence of project activity the heat will be generated at the KTIS in the existing bagasse based boiler at the KTIS. HCBL,y is determined as 17,81,950GJ.

***Step 1.2: Baseline electricity generation***

The amount of electricity that would be generated in the baseline in year *y* is calculated as follows:

$$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp,y} - EL_{PJ,aux,y} \qquad \textbf{(1)}$$

Where:

| | | |
|---|---|---|
| $EL_{BL,y}$ | = | Baseline electricity generation in year *y* (MWh) |
| $EL_{PJ,gross,y}$ | = | 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) |
| $EL_{PJ,imp,y}$ | = | Project electricity imports from the grid in year *y* (MWh) |
| $EL_{PJ,aux,y}$ | = | Total auxiliary electricity consumption required for the operation of the power plants at the project site in year *y* (MWh) |
| y | = | Year of the crediting period |

$EL_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass(e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power or heat generating 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.).

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

According to the FSR, $EL_{PJ,gross,y}$ = 263,700MWh and $EL_{PJ,aux,y}$ = 26,370MWh. ELPJ,imp,y is ex-ante estimated as zero and will be monitored in the crediting periods. Hence, ELBL,y =263,700 + 0 – 26,370=237,330MWh

***Step 1.3: Baseline capacity of electricity generation***

equation below. The heat engines *i* and *j* should be obtained from the baseline scenario identified using the "Selection of the baseline scenario and demonstration of additionality" and the load factors should take into account seasonal operational constraints as well as other technical constraints in the system (e.g. availability of heat to drive heat engines).

$$CAP_{EG,total,y} = LOC_y \cdot \left[ \sum_i \left( CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) + \sum_j \left( CAP_{EG,PO,j} \cdot LFC_{EG,PO,j} \right) \right] \qquad \textbf{(2)}$$

Where:

| | | |
|---|---|---|
| $CAP_{EG,total,y}$ | = | Baseline electricity generation capacity in year *y* (MWh) |
| $CAP_{EG,CG,i}$ | = | Baseline electricity generation capacity of heat engine *i* (MW) |
| $CAP_{EG,PO,j}$ | = | Baseline electricity generation capacity of heat engine *j* (MW) |

$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio)

$LFC_{EG,PO,j}$ = Baseline load factor of heat engine *j* (ratio)

$LOC_y$ = Length of the operational campaign in year *y* (hour)

I = Cogeneration-type heat engine in the baseline scenario

j = Power-only-type heat engine in the baseline scenario

y = Year of the crediting period

***Step 1.4: Baseline availability of biomass residues***

Since, this project had only one type of the biomass residue. Then the fate of the biomass residue of the proposed project fall in to (b) B1; dumping, leaving to decay or burning that not leaved longer than one year. The KTIS and RP sugar mill, both mills will not leaved the biomass residue longer than one year. The KTIS could be supported 500,000 tons per year of the bagasse to the proposed project and raised 71,230 tons would be derived from RP sugar mill, which located in the same province. The distance takes approximately 60 kilometers from the proposed project.

| **Biomass residues category (*k*)** | **Biomass residues type** | **Biomass residues source** | **Biomass residues fate in the absence of the CDM project activity** | **Biomass residues use in project scenario** | **Biomass residues quantity (tonnes)** |
|---|---|---|---|---|---|
| 1 | Bagasse | Off-site from an identified KTIS | Electricity generation on-site (**Error! Reference source not found.**) | Electricity generation on-site (biomass-only boiler) | 392,376 |
| 2 | Bagasse | Off-site from an identified RPI | Electricity generation on-site (**Error! Reference source not found.**) | Electricity generation on-site (biomass-only boiler) | 45,384 |

***Step 1.5: Determine efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines.***

For this project, Option 1- Default values will be chosen to calculate the efficiencies of heat generators, i.e. use Option F in the latest approved version of the "*Tool to determine the baseline efficiency of thermal or electric energy generation systems*".
According to the tool option F, use 85% of new coal fired boiler for heat generators of this project activity in baseline scenario.

***Step 1.6: Determine the emission factor of on-site electricity generation with fossil fuels***

There is no fossil fuel based power generation was identified as the part of the baseline scenario, Thus, make $EF_{EG,FF,y} = EF_{EG,GR,y}$.

***Step 1.7: Determine the emission factor of grid electricity generation***
Determination of the emission factor of grid electricity generation as the "Tool to calculate the emission factor for an electricity system" version 02.2.1, this tool provides procedures to determine the following parameters:

| Parameter | SI Unit | Description |
|---|---|---|
| $EF_{grid,CM,y}$ | $tCO_2/MWh$ | Combined margin $CO_2$ emission factor for the project electricity system in year y |
| $EF_{grid,BM,y}$ | $tCO_2/MWh$ | Build margin $CO_2$ emission factor for the project electricity system in year y |
| $EF_{grid,OM,y}$ | $tCO_2/MWh$ | Operating margin $CO_2$ emission factor for the project electricity system in year y |

However, the emission factor is calculated in a transparent and conservative manner by the Thailand Greenhouse Gas Management Organization (TGO), which is the Designed National Authority (DNA) for the Clean Development Mechanism of Thailand. TGO has set up a working group to study on the emission factor for an electricity system in Thailand in 2010 and published a report under a title of "The Study of emission factor for an electricity generation of Thailand in year 2010".(http://www.tgo.or.th/english/download/publication/GEF/2010/GEFReport_EN.pdf) using version 02.2.1 of the "Tool to calculate the emission factor for an electricity system" that was clarification in (Annex 3) of the PDD.

**Step 2: Determine the minimum baseline electricity generation in the grid;**
In case of absence project, the electricity would be generated from grid only, then the minimum amount of electricity generation could be calculated from the following equation:

$$EL_{BL,GR,y} = \max\left(0, EL_{BL,y} - CAP_{EG,total,y}\right) \qquad (13)$$

Where:
ELBL,GR,y = Baseline minimum electricity generation in the grid in year *y* (MWh)
ELBL,y = Baseline electricity generation in year *y* (MWh)
CAPEG,total,y = Baseline electricity generation capacity in year *y* (MWh)
y = Year of the crediting period
As aforesaid, the baseline electricity generation capacity in year y $CAP_{EG,total,y}$ is set to be zero, Hence $EL_{BL,GR,y} = EL_{BL,y}$

**Step 3: Determine the baseline biomass-based heat and power generation;**

***Step 3.1: Determine the baseline biomass-based heat generation***

It is assumed that the use of biomass residues for which scenario B.4: has been identified as the baseline scenario (BRB4,n,y) would be prioritized over the use of any fossil fuels in the baseline. From that assumption, the equivalent amount of heat that would be generated with biomass residues (HGBL,BR,y) should be determined.

- Calculate the amount of heat generated with biomass residues based on the allocation rules established in the CDM-PDDusing the following equations:

$$HG_{BL,BR,y} = \sum_h \sum_n \left( BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h} \right)$$

Subject to,

$\sum_h \sum_n BR_{B4,n,h,y} = \sum_n BR_{B4,n,y}$ , i.e. the biomass residues used in each heat generator should not exceed the total amount of biomass residues available.

$\sum_n \left( BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h} \right) \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$ , i.e. the heat generation in each heat generator should not exceed the total capacity of the heat generator;

Where:

| | | |
|---|---|---|
| $HG_{BL,BR,y}$ | = | Baseline biomass-based heat generation in year *y* (GJ) |
| $BR_{B4,n,h,y}$ | = | Quantity of biomass residues of category n used in heat generator h in year *y* with baseline scenario B4 (tonne on dry-basis) |
| $NCV_{BR,n,y}$ | = | Net calorific value of biomass residue of category n in year *y* (GJ/tonne on dry-basis) |
| $\eta_{BL,HG,BR,h}$ | = | Baseline biomass-based heat generation efficiency of heat generator *h* (ratio) |
| $BR_{B4,n,y}$ | = | Quantity of biomass residues of category n used in the CDM project activity in year *y* for which the baseline scenario is B4 (tonne on dry-basis) |
| $LOC_y$ | = | Length of the operational campaign in year *y* (hour) |
| $CAP_{HG,h}$ | = | Baseline capacity of heat generator *h* (GJ/h) |
| $LFC_{HG,h}$ | = | Baseline load factor of heat generator *h* (ratio) |
| y | = | Year of the crediting period |
| h | = | Heat generator in the baseline scenario |

$$\sum_n \left( BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h} \right) \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$$

***Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction.***

- Calculate the amount of electricity and process heat generation based on the allocation above using the following equations:

$$EL_{BL,BR,CG,y} = \frac{1}{3.6} \cdot \sum_{i} \left( \frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \quad \textbf{(3)}$$

$$HC_{BL,BR,CG,y} = \sum_{i} \left( \frac{HPR_{BL,i}}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \quad \textbf{(4)}$$

Subject to,

$\sum_{i} HG_{BL,BR,CG,y,i} \leq HG_{BL,BR,y}$, i.e. the biomass-based heat used in cogeneration mode should not exceed the total biomass-based heat generated;

The next st As indicated above, the cogeneration in Step 4.1 is not the project case and thus HGBL,BR,CG,y=0.

Baseline process heat demand is totally met via direct heat extraction from biomass-fired boilers.

ep to be followed depends on the outcomes of the calculations above. Four cases are possible:

**Case 3.2.1**:If $HG_{BL,BR,y} = \sum_{i} HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$, then all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines and would suffice to serve all process heat demand. It is assumed then that the use of fossil fuels on-site in the baseline scenario would be uncertain (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology, particularly on the relative prices of on-site electricity generation using fossil fuels and the electricity price in the grid. In order to estimate the baseline parameters that result project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, $EL_{PJ,offset,y} = 0$, $FF_{BL,HG,y,f} = 0$, and,
- Thus, $EL_{BL,FF/GR-}$=0
- Proceed to Step 5:Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

As the proposed project is the new travelling grate stoker type boiler 240 TPH 105 bars at Maximum Continuous Rating biomass based cogeneration power plant. There is no baseline biomass-based cogeneration, and then the amount of electricity and process heat generation calculation are not required.

**Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues;**

The calculation of baseline emissions due to uncontrolled burning or decay of biomass residues is not included. Because, the biomass would be not burned as it against the nation regulation of Thailand and it would not leave to decay longer than one year.

**Step 6: Calculate baseline emissions**

The baseline emission of the proposed project is not included the emission from fossil fuel, burning and disposal of biomass residues. The emission baseline would be calculated from the electricity generated from grid only. The calculation based on equation (2) above and the results are show in the emission reduction calculation sheet.

**Project Emissions**

The emission of the proposed project activity would not include the emission from fossil fuel consumption, the $CO_2$ from grid-connected fossil fuel power plants in the electricity system as there are not any electricity that is imported from the grid to the project site;

The project emissions are calculated by the following formula:

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y} \quad (37)$$

Where:
PEy = Project emissions in year *y* (tCO2)
PEFF,y = Emissions during the year y due to fossil fuel consumption at the project site (tCO2)
PEGR1,y = Emissions during the year y due to grid electricity imports to the project site (tCO2)
PEGR2,y = Emissions due to a reduction in electricity generation at the project site as compared to the baseline scenario in year *y* (tCO2)
PETR,y = Emissions during the year y due to transport of the biomass residues to the project plant (tCO2)
PEBR,y = Emissions from the combustion of biomass residues during the year *y* (tCO2e)
PEWW,y = Emissions from wastewater generated from the treatment of biomass residues in year *y* (tCO2e)
PEBG2,y = Emissions from the production of biogas in year *y* (tCO2e)

***Determination of PEFFy***

There are no emissions due to fossil fuel consumption at the project site, then ***PEFFy*** =0

***Determination of PEGR1,y***

As the proposed project is a new power plant which now not imported electricity from the grid to the project site, then this parameter will be set to zero in this stage (***PEGR1,y*** =0). Anyway, if the power fluctuations occurred the proposed project would import from the grid. The calculation as follows:

$$PE_{GR1,y} = EF_{EG,GR,y} \cdot EL_{PJ,imp,y} \quad (38)$$

Where:

$PE_{GR1,y}$ = Emissions during the year *y* due to grid electricity imports to the project site (tCO2)
$EL_{PJ,imp,y}$ = Project electricity imports from the grid in year *y* (MWh)
$EF_{EG,GR,y}$ = Grid emission factor in year *y* (tCO2/MWh)

***Determination of PEGR2,y***
The amount of electricity generated on-site in the baseline not exceeds the amount of electricity generated in the project scenario, then the ***PEG2,y*** should be unaccounted as project emissions (as no electricity generated on-site in the baseline).

***Determination of PETR,y***
The most part of biomass residues of this project are generated from nearby sugar factory, then it assumed no CO2 emissions. However, the remained biomass need to transport from off-site source, the CO2 emissions resulting from transportation of the biomass residues to the project plant are derived under "Project and leakage emissions from road transportation of freight" tool, version 01.0.0 (EB 63 Report Annex 10) with Option B. The equation is as follows:

$$\left.\begin{matrix} PE_{TR,m} \\ LE_{TR,m} \end{matrix}\right\} = \sum_{f} D_{f.m} \cdot FR_{f,m} \cdot EF_{CO2.f} \cdot 10^{-6} \qquad (40)$$

***Determination of PEBR,y***
The emissions from the combustion of biomass residues not to be included in the project scenario, then ***PEBR,y*** =0.

**Leakage**
The emission from biomass residue transportations are already considered in the emission reduction of project activity already. Thus emissions due to leakage are zero ( $LE_y = 0$ ).

**B.6.2. Data and parameters that are available at validation:**
*(Copy this table for each data and parameter)*

| **Data / Parameter:** | Biomass residues categories and quantities used for the selection of the baseline scenario selection and assessment of additionality |
|---|---|
| Data unit: | - Type (bagasse)<br>- Source (obtained from an identified biomass residues producer, obtained from a biomass residues market)<br>- Fate in the absence of the project activity (scenarios B);<br>- Use in the project scenario (scenarios P);<br>- Quantity (tonnes on dry-basis) |
| Description: | The proposed project intend to buy the bagasse from off-site an identified nearby sugar mill, which would be dumped fate in the absence of the project activity and bought from an identified off-site sugar mill with unidentified fate |
| Source of data used: | On-site assessment of biomass residues categories and quantities |

| | | | | | | |
|---|---|---|---|---|---|---|
| Value applied: | **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 (tones)** |
| | 1 | Bagasse | Off-site from an identified sugar mill | Unidentified (B8) | Electricity generation on-site (biomass-only boiler) | 571,230 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | - | | | | | |
| Any comment: | This parameter is related to the procedure for the selection of the baseline scenario selection and assessment of additionality | | | | | |

| **Data / Parameter:** | $CAP_{HG,h}$ |
|---|---|
| Data unit: | GJ/h |
| Description: | CAPHG,h = Baseline capacity of heat generator h (GJ/h) |
| Source of data used: | On-site measurements and design parameters |
| Value applied: | Boiler No.1 = 216 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | This parameter reflects the design maximum heat generation capacity (in GJ/h) of the baseline heat generator h. It is based on the installed capacity of the heat generator. This parameter was determined from nameplate capacity guaranteed by the manufacturer and compared with performance tests of the boilers |
| Any comment: | -- |

| **Data / Parameter:** | $CAP_{EG,CG,i}$ $CAP_{EG,PO,j}$ |
|---|---|
| Data unit: | MW |
| Description: | CAPEG,CG,i = Baseline electricity generation capacity of heat engine i (MW) CAPEG,PO,j = Baseline electricity generation capacity of heat engine j (MW) |
| Source of data used: | On-site measurements and design parameters |
| Value applied: | Turbine Generator No.1 = 60 |
| Justification of the choice of data or description of measurement methods | This parameter reflects the design maximum electricity generation capacity (in MW) of the baseline heat engines *i* and *j*. It is based on the installed capacity of the heat engines. This parameter was determined from nameplate capacity guaranteed by the manufacturer and compared with performance tests of the |

| | |
|---|---|
| and procedures actually applied : | turbo-generators |
| Any comment: | -- |

| **Data / Parameter:** | $LFC_{HG,h}$ |
|---|---|
| Data unit: | Ratio |
| Description: | LFCHG,h = Baseline load factor of heat generator h (ratio) |
| Source of data used: | On-site measurements or reference plant design parameters |
| Value applied: | Boiler No.1 = 80 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | This parameter should reflect the maximum load factor (i.e. the ratio between the .actual electricity generation. of the heat engine and its .design maximum electricity generation. along one year of operation) of the baseline heat engine *i* or *j*. The actual electricity generation of the heat engine should be determined taking into account downtime due to maintenance, seasonal operational patterns, and any other technical constraints. Project participants should document transparently and justify in the CDM-PDD how this parameter was determined |
| Any comment: | -- |

| **Data / Parameter:** | $EF_{EG,GR,y}$ |
|---|---|
| Data unit: | $tCO_2$/MWh |
| Description: | Grid emission factor in year y |
| Source of data used: | Thailand Greenhouse Gas Management Organization (TGO) |
| Value applied: | 0.5113 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | |
| Any comment: | the emission factor is calculated in a transparent and conservative manner by the Thailand Greenhouse Gas Management Organization (TGO), which is the Designed National Authority (DNA) for the Clean Development Mechanism of Thailand. TGO has set up a working group to study on the emission factor for an electricity system in Thailand in 2010 and published a report under a title of “The Study of emission factor for an electricity generation of Thailand in year |

| **Data / Parameter:** | $NCV_{BR,n,y}$ |
|---|---|
| Data unit: | GJ/tonne on dry-basis |
| Description: | Net calorific value of biomass residue (bagasse) of category *n* in year *y* |
| Source of data used: | Bolier Specification of K.T.S.Industry Co.,LTD (TAMAKA Thailand) |

| | |
|---|---|
| Value applied: | 1,750 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | This value could be derived from laboratory result analysis of reliable source. |
| Any comment: | Technology provider specified the information as fuel bagasse based condition. |

| **Data / Parameter:** | $EF_{CO2,LE}$ |
|---|---|
| Data unit: | tCO2/GJ |
| Description: | CO2 emission factor of the most carbon intensive fossil fuel used in the country |
| Source of data used: | 2006 IPCC defaults: Volume 2, Chapter 2 (Table 2.3) -- Diesel Oil Natural |
| Value applied: | 74.100 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | According to methodology ACM0006, this data shall be determined by conducting sample measurements or choosing emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range). The latter option is taken in this project.<br>This value used here is IPCC default value for the US heavy Duty Diesel Vehicle in uncontrolled condition (the highest emission level) which is conservative. |
| Any comment: | The value should be updated according to latest IPCC version. |

| **Data / Parameter:** | $EF_{CO2,f}$ |
|---|---|
| Data unit: | gCO2/t km |
| Description: | Default CO2 emission factor for freight transportation activity *f* |
| Value applied: | **Vehicle class** / **Emission factor (g CO2 / t km)**:<br>Light vehicles: 245<br>Heavy vehicles: 129 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Applicable to Option B. The default CO2 emission factors take into account emissions generated by loaded outbound trips and empty return trips. The default emission factors have been obtained from two sources. For light vehicles, the emission factor was obtained from empirical data from European vehicles. For heavy vehicles, the emission factor has been derived based on custom design transient speed-time-gradient drive cycle (adapted from the international FIGE cycle), vehicle dimensional data, mathematical analysis of loading scenarios, and dynamic modeling based on engine power profiles, which, in turn, are a function of gross vehicle mass (GVM), load factor, speed/acceleration profiles and road gradient. The following assumptions on key parameters have been made: an average driving speed of 30 km/h, an average gradient of 1%, and a load factor attained when biomass is transported were assumed |
| Any comment: | - |

**B.6.3. Ex-ante calculation of emission reductions:**

>>

Emission reductions are calculated based on the following set of equations as stated in the methodology (assuming a typical 150-day crushing season, 45-day in remelting season and 45-day in fixed or off season).

**Baseline Emissions**

In the baseline scenario power and heat of this project could be generated by the project activity exports electricity to the grid, as the project activity intended to use the biomass to generate the power and heat, then exports electricity to the national grid and 3rd parties under project boundary, which purchased electricity from grid in the baseline and no electricity would be produced at the project site in the baseline. Based on conservative assumptions, baseline emissions are calculated as follows:

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min\left(EF_{EG,GR,y}, EF_{EG,FF,y}\right) + BE_{BR,y} \quad (2)$$

Where:

$BE_y$ = Baseline emissions in year y ($tCO_2$)

$EL_{BL,GR,y}$ = Baseline minimum electricity generation in the grid in year y (MWh)

$EF_{EG,GR,y}$ = Grid emission factor in year y ($tCO_2$/MWh)

$FF_{BL,HG,y,f}$ = Baseline fossil fuel demand for process heat in year y (GJ)

$EF_{FF,y,f}$ = CO2 emission factor for fossil fuel type f in year y ($tCO_2$/GJ)

$EL_{BL,FF/GR,y}$ = Baseline uncertain electricity generation in the grid or on-site in year y (MWh)

$EF_{EG,FF,y}$ = CO2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y ($tCO_2$/MWh)

$BE_{BR,y}$ = Baseline emissions due to disposal of biomass residues in year y ($tCO_2e$)

y = Year of the crediting period

f = Fossil fuel type

**Step 1: Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors;**

***Step 1.1: Determine total baseline process heat generation***

| **Base data** | Value | Unit |
|---|---|---|
| Steam rate | 200 | TPH |
| Enthalpy of output steam @ 20 and 350C | 3134.43 | KJ/kg |
| Enthalpy of feed water @ $90^0$ C | 377 | KJ/kg |
| | | |
| Plantrun days | 240 | per annum |
| Annual Heat | 3176559.36 | GJ/ annum |

| | | |
|---|---|---|
| output ($HC_{BL,y}$) | | |

***Step 1.2: Baseline electricity generation***

According to the FSR, $EL_{PJ,gross,y}$ = 263,700MWh and $EL_{PJ,aux,y}$ = 26,370MWh. ELPJ,imp,y is ex-ante estimated as zero and will be monitored in the crediting periods. Hence, $EL_{BL,y}$ =210,960 + 0 – 21,096=189864MWh

***Step 1.3: Baseline capacity of electricity generation***

The total capacity of electricity generation available in the baseline should be calculated using the equation below:

$$CAP_{EG,total,y} = LOC_{,y} \cdot \left[ \sum_i \left( CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) + \sum_j \left( CAP_{EG,PO,j} \cdot LFC_{EG,PO,j} \right) \right]$$

For electricity generation, baseline scenario P7, i.e. the generation of power in the power grid, is identified for the proposed project. No any heat engine is identified from the scenario. Hence $CAP_{EG,total,y}$ = 0.

***Step 1.4: Baseline availability of biomass residues***

The amount of biomass residues (bagasse only on a dry basis) that would be available in the baseline in year *y* (BRB8,p,y = 571,230 tonnes) is such that the sum of biomass residues used in the baseline for power or heat generation is equal to the total amount of biomass residues which are used under the project activity. See in EIA report for specific details.

***Step 1.5: Determine efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines.***

Following the "Tool to determine the baseline efficiency of thermal or electric energy generation systems", version 01.The efficiencies of heat generators and heat engines should be calculated using one of the following options:

**Option 1: Default values.** Use Option F in the latest approved version of the .Tool to determine the baseline efficiency of thermal or electric energy generation systems. The default value for the losses linked to the electricity generator group (i.e. turbine/engine, couplings and electricity generator), *default GGL* , is 5%.Thus, the project activity is the new power plant, then the default efficiency would be considered.
Default value is 85%.

***Step 1.6: Determine on-site electricity emission factor***

The proposed project has identified power grid as baseline and no fossil fuel based power generation was identified as part of the baseline scenario. As per the methodology, $EF_{EG,FF,y}$= EF $_{EG,GR,y}$.=0.5113 $tCO_{2e}$/MWh

***Step 1.7: Determination of the emission factor of grid electricity generation***

Determination of the emission factor of grid electricity generation as the “Tool to calculate the emission factor for an electricity system” version 02.2.1, this tool provides procedures to determine the following parameters:

| Parameter | SI Unit | Description |
|---|---|---|
| $EF_{grid,CM,y}$ | $tCO_2/MWh$ | Combined margin $CO_2$ emission factor for the project electricity system in year y |
| $EF_{grid,BM,y}$ | $tCO_2/MWh$ | Build margin $CO_2$ emission factor for the project electricity system in year y |
| $EF_{grid,OM,y}$ | $tCO_2/MWh$ | Operating margin $CO_2$ emission factor for the project electricity system in year y |

However, the emission factor is calculated in a transparent and conservative manner by the Thailand Greenhouse Gas Management Organization (TGO), which is the Designed National Authority (DNA) for the Clean Development Mechanism of Thailand. TGO has set up a working group to study on the emission factor for an electricity system in Thailand in 2010 and published a report under a title of “The Study of emission factor for an electricity generation of Thailand in year 2010”.(http://www.tgo.or.th/english/download/publication/GEF/2010/GEFReport_EN.pdf) using version 02.2.1 of the “Tool to calculate the emission factor for an electricity system” that was clarification in (Annex 3) of the PDD. The value is 0.5113 $tCO_{2e}/MWh$

**Step 2: Determine the minimum baseline electricity generation in the grid;**

The minimum amount of electricity that would be generated in the grid in the baseline is given by:

$EL_{BL,GR,y} = \max(0, EL_{BL,y} - CAP_{EG,total,y})$ = $EL_{BL,y}$ =189,864MWh MWh/y

**Step 3: Determine the baseline biomass-based heat and power generation;**

***Step 3.1: Determine the baseline biomass-based heat generation***

The baseline scenario of the proposed project is not used biomass to generate heat just leave to decay (not B4). There is no biomass-based cogeneration in the baseline.

***Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction.***

As the proposed project is the new travelling grate stoker type boiler 240 tonnes/hr 105 kg/cm²g at Maximum Continuous Rating biomass based cogeneration power plant. There is no baseline biomass-based cogeneration, and then the amount of electricity and process heat generation calculation are not required.

***Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode***

| | | |
|---|---|---|
| BRB4,n,h,y | 437760 | T/annum |
| NCVBR,n,y | 9.510592 | GJ/tonne |
| $\eta_{BL,HG,BR,h}$ | 85.00% | % |
| HGBL,BR,y | 3538853.241 | GJ/annum |

**Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation;**

| | | |
|---|---|---|
| No fossil fuel based cogeneration in the baseline. | | |
| $HPR_{BL,i}$ | Ratio | 4.45 |
| $GGL_{default}$ | Ratio | 0.5 |
| $HG_{BL,BR,CG,y,i}$ | GJ/annum | 0 |
| $HG_{BL,BR,y}$ | GJ/annum | 0 |
| $EL_{BL,BR,CG,y}$ | MWh | 0 |
| HCBL,y | GJ/annum | 0 |

- Define $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, $EL_{PJ,offset,y}$ = 0, $FF_{BL,HG,y,f}$ = 0, and,

$EL_{BL,FF/GR,y}$=189,864MWh-189,864MWh-0MWh=-0MWh

**Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues;**

The calculation of baseline emissions due to uncontrolled burning or decay of biomass residues is not included. Because, the biomass would be not burned as it against the nation regulation of Thailand and it would not leave to decay longer than one year.

**Step 6: Calculate baseline emissions**

The baseline emissions of the proposed project are obtained as:

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min\left(EF_{EG,GR,y}, EF_{EG,FF,y}\right) + BE_{BR,y}$$

= 189,864*0.5113 = 97,077($tCO_2$)/y

**Project Emissions**

The emission of the proposed project activity would not include the emission from fossil fuel consumption, the $CO_2$ from grid-connected fossil fuel power plants in the electricity system as there are not any electricity that is imported from the grid to the project site;

The project emissions are calculated by the following formula:

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y}$$ = 1,042.00 (tCO2)/y

Where:

PEFF,y = 0 (tCO2)

PEGR1,y = 0 (tCO2) (approximately very low or close to 0 in this period)

PEGR2,y = 0 (tCO2)

PEBR,y = 0 (tCO2e) (there are neither baseline nor project emissions due to uncontrolled burning or decay of biomass residues)

PEWW,y = 0 (tCO2e) (there is not wastewater originated from the treatment of the biomass that is treated under anaerobic conditions and where methane from the waste water is not captured and flared or combusted)
PEBG2,y = 0 (tCO2e) (there is neither current nor future production of biogas)

***Determination of PEFFy***
There are no emissions due to fossil fuel consumption at the project site, then ***PEFFy*** =0
***Determination of PEGR1,y***
As the proposed project is a new power plant which now not imported electricity from the grid to the project site, then this parameter will be set to zero in this stage (***PEGR1,y*** =0). Anyway, if the power fluctuations occurred the proposed project would import from the grid. The calculation as follows:

$$PE_{GR1,y} = EF_{EG,GR,y} \cdot EL_{PJ,imp,y} = 0 \text{ tCO2}$$

***Determination of PEGR2,y***
As no electricity generated on-site in the baseline, then the ***PEG2,y*** should be unaccounted as project emissions.
***PEG2,y*** = 0
***Determination of PETR,y***
The most part of biomass residues of this project are generated from nearby sugar factory, then it assumed no CO2 emissions. However, the remained biomass need to transport from off-site source, the CO2 emissions resulting from transportation of the biomass residues to the project plant are derived under "Project and leakage emissions from road transportation of freight" tool, version 01.0.0 (EB 63 Report Annex 10) with Option B: Using conservative default values; This option relies on conservative default emission factors to estimate project or leakage emissions from road transportation of freight. The equation is as follows:

$$\left.\begin{matrix} PE_{TR,m} \\ LE_{TR,m} \end{matrix}\right\} = \sum_{f} D_{f,m} \cdot FR_{f,m} \cdot EF_{CO2.f} \cdot 10^{-6}$$
Or

**Table 10**. the freight transportation activities under the project activity

| Activity No | Freight type | Weight (tonnes) | Origin | Destination | Road distance (km) | Vehicle Class |
|---|---|---|---|---|---|---|
| 2 | Sugar cane bagasse | 45,384 | RS | KTBP | 60 | Light |

***Determination of PEBR,y***
The emissions from the combustion of biomass residues not to be included in the project scenario, then ***PEBR,y*** =0.

**Leakage**

As the baseline scenarios for biomass residues of this project are B1 and B8, then the leakage emissions of the proposed project would be calculated based on the following equation:

$$LE_y = 0$$

### B.6.4 Summary of the ex-ante estimation of emission reductions:

| **Year** | **Estimation of project activity emissions ($tCO_2$ e)** | **Estimation of baseline emissions ($tCO_2$ e)** | **Estimation of Leakage ($tCO_2e$)** | **Estimation of Overall Emission Reduction ($tCO_2$ e)** |
|---|---|---|---|---|
| Year 1 | 30,990 | 1,042 | - | 96,035 |
| Year 2 | 97,077 | 1,042 | - | 96,035 |
| Year 3 | 97,077 | 1,042 | - | 96,035 |
| Year 4 | 97,077 | 1,042 | - | 96,035 |
| Year 5 | 97,077 | 1,042 | - | 96,035 |
| Year 6 | 97,077 | 1,042 | - | 96,035 |
| Year 7 | 97,077 | 1,042 | - | 96,035 |
| Year 8 | 97,077 | 1,042 | - | 96,035 |
| Year 9 | 97,077 | 1,042 | - | 96,035 |
| Year10 | 97,077 | 1,042 | - | 96,035 |
| Total (tonnes of CO2e) | **904,687** | **10,420** | **0** | 960,350 |

>>

## B.7. Application of the monitoring methodology and description of the monitoring plan:

### B.7.1 Data and parameters monitored:

| **Data / Parameter:** | Biomass residues categories and quantities used in the project activity |
|---|---|
| Data unit: | - Type<br>- Source<br>- Fate<br>- Use in the project scenario<br>- Quantity |
| Description: | See in table 10 |
| Source of data to be used: | On-site measurements |

<table>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><th>Biomass residues category (k)</th><th>Biomass residues type</th><th>Biomass residues source</th><th>Biomass residues fate in the absence of the project activity</th><th>Biomass residues use in project scenario</th><th>Biomass residues quantity (tones)</th></tr>
<tr><td>1</td><td>Bagasse</td><td>Off-site from an identified sugar mill</td><td>Unidentified (B8)</td><td>Electricity generation on-site (biomass-only boiler)</td><td>571,230</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Weight meters are used and values are adjusted for the moisture content in order to determine the quantity of dry biomass</td></tr>
<tr><td>Monitoring frequency:</td><td>Data monitored continuously and aggregated as appropriate, to calculate emissions reductions</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>Measurements are crosschecked with an annual energy balance that is based on purchased quantities and stock changes</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

| **Data / Parameter:** | For biomass residues categories for which scenarios B1:, B2: or B3: is deemed a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario |
|---|---|
| Data unit: | Tonnes |
| Description: | - Quantity of available biomass residues of type n in the region<br>- Quantity of biomass residues of type n that are utilized in the defined geographical region<br>- 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 to be used: | Surveys or statistics |
| Measurement procedures (if any): | - |
| Description of measurement methods and procedures to be applied: | Weight meters are used and values are adjusted for the moisture content in order to determine the quantity of dry biomass |
| 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 to be applied: | - |
| Any comment: | - |

| **Data / Parameter:** | BRPJ,n,y |
|---|---|

| | |
|---|---|
| Data unit: | Tonnes on dry-basis |
| Description: | BRPJ,n,y = Quantity of biomass residues of category n used in the project activity in year *y* (tonnes on dry-basis) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes |
| Any comment: | The biomass residue quantities used should be monitored separately for (a) each type of biomass residue and each source ( produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.) |

| **Data / Parameter:** | BRB1/B3,n,y |
|---|---|
| Data unit: | Tones on dry-basis |
| Description: | BRB1/B3,n,y = Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B1: or B3: (tonnes on dry basis) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes |
| Any comment: | - |

| **Data / Parameter:** | BRB5/B8,n,y |
|---|---|
| Data unit: | tones of dry matter |
| Description: | BRB5/B8,n,y = Quantity of biomass residues of category n used in the project activity in year y , for which the baseline scenario is B5:, B6:, B7: or B8: (tonnes on dry-basis) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes |
| Any comment: | - |

| **Data / Parameter:** | BRTR,y |
|---|---|
| Data unit: | tones on dry basis |
| Description: | BRTR,y = Quantity of biomass residues that has been transported to the |

| | |
|---|---|
| | project site during the year y (tonnes of dry matter) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Use weight or volume meters. If volume meters are used convert to mass units using the density of each category of biomass residues. Adjust for the moisture content in order to determine the quantity of dry biomass |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes |
| Any comment: | - |

| **Data / Parameter:** | Df,m |
|---|---|
| Data unit: | Kilometer |
| Description: | Return trip road distance between the origin and destination of freight transportation activity *f* in monitoring period *m* |
| Source of data to be used: | Records of vehicle operator or records by project participants |
| Measurement procedures (if any) | Determined once for each freight transportation activity *f* for a reference trip using the vehicle odometer or any other appropriate sources (e.g. on-line sources) |
| Monitoring frequency: | To be updated whenever the road distance changes |
| QA/QC procedures to be applied: | - |
| Any comment: | Applicable to Option B |

| **Data / Parameter:** | FRf,m |
|---|---|
| Data unit: | tones |
| Description: | Total mass of freight transported in freight transportation activity *f* in monitoring period *m* |
| Source of data to be used: | Records by project participants or records by truck operators |
| Measurement procedures (if any) | - |
| Monitoring frequency: | Continuously |
| QA/QC procedures to be applied: | - |
| Any comment: | Applicable to Option B |

| **Data / Parameter:** | EFCO2,LE |
|---|---|
| Data unit: | tCO2/GJ |
| Description: | EFCO2,LE = CO2 emission factor of the most carbon intensive fossil fuel used in the country (tCO2/GJ) |
| Source of data to be used: | Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication / GHG inventory. If available, use national default values for the CO2 emission factor. Otherwise, IPCC default |

| | |
|---|---|
| Measurement procedures (if any) | - |
| Monitoring frequency: | Annually |
| QA/QC procedures to be applied: | - |
| Any comment: | --- |

| | |
|---|---|
| **Data / Parameter:** | ELPJ,gross,y |
| Data unit: | MWh |
| Description: | ELPJ,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) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Use calibrated electricity meters |
| Monitoring frequency: | Data monitored continuously and aggregated as appropriate, to calculate emissions reductions |
| QA/QC procedures to be applied: | 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) |
| Any comment: | - |

| | |
|---|---|
| **Data / Parameter:** | ELPJ,imp,y |
| Data unit: | MWh |
| Description: | ELPJ,imp,y = Project electricity imports from the grid in year y (MWh) |
| Source of data to be used: | On-site measurements |
| Description of measurement methods and procedures to be applied: | Use calibrated electricity meters |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | The consistency of metered electricity generation should be cross-checked with receipts from electricity purchases |
| Any comment: | - |

| | |
|---|---|
| **Data / Parameter:** | ELPJ,aux,y |
| Data unit: | MWh |
| Description: | ELPJ,aux,y = Total auxiliary electricity consumption required for the operation of the power plants at the project site in year y (MWh) |
| Source of data to be used: | On-site measurements |
| Description of measurement methods | Calibrated electricity meters are used |

| | |
|---|---|
| and procedures to be applied: | |
| Monitoring frequency: | Data monitored continuously and aggregated annually, to calculate emissions reductions |
| QA/QC procedures to be applied: | The consistency of metered electricity generation should be cross-checked with receipts from electricity sales and the quantity of fuels fired (check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years) |
| Any comment: | EGPJ,aux,y shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (for mechanical treatment of the biomass, conveyor belts, driers) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (for pumps, fans, cooling towers, instrumentation and control) |

| **Data / Parameter:** | NCVBR,n,y |
|---|---|
| Data unit: | GJ/tones of dry matter |
| Description: | NCVBR,n,y = Net calorific value of biomass residue of category n in year y (GJ/tonne on dry-basis) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | 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 to be applied: | Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass |
| Any comment: | - |

| **Data / Parameter:** | Moisture content of the biomass residues |
|---|---|
| Data unit: | % Water content in mass basis in wet biomass residues |
| Description: | Moisture content of each biomass residues type *k* |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | - |
| Monitoring frequency: | The moisture content should be monitored for each batch of biomass of homogeneous quality. The weighted average should be calculated for each monitoring period and used in the calculations |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

| Data / Parameter: | $LOC_y$ |
|---|---|
| Data unit: | Hour |
| Description: | LOCy = Length of the operational campaign in year y (hour) |
| Source of data to be used: | On-site measurements |
| Measurement procedures (if any) | Record and sum the hours of operation of the project activity facilities during year *y*. |
| Monitoring frequency: | - |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

### B.7.2. Description of the monitoring plan:

>>

In order to determine the emission reductions the following parameters are monitored:
Electricity exported to and imported from the grid,

Quantity of bagasse consumption and corresponding net calorific values besides the moisture content of biomass consumed.

To ensure high quality data from the plant, a systematic, detailed and complete monitoring plan must be implemented.

The Monitoring equipment will be installed and samples will be taken by qualified companies and trained personnel following the highest technical standard. The project developer will be responsible for the monitoring over the complete crediting period and will employ and train technicians in the operation and readings of all monitoring equipment. The collected data will be stored in a systematic and transparent manner, in a reliable way, checked for plausibility, evaluated on a regular basis, and made available in a monitoring report for verification. All data will be stored electronically.

Calibration of monitoring equipment will be carried out according to international standards and guidelines of the manufacturers.

In dealing with possible monitoring data adjustments and missing data allowing redundant reconstruction of data in case of monitoring problems the following procedures have been identified:

- Monitoring data adjustment: All measure meters will be calibrated either according to appropriate industrial standard or as per manufacturer's recommendation. Where required related meters will be calibrated by an accredited entity.

- Redundant reconstruction of data in case of monitoring problem: For the data that will be measured continually and recorded per day, the missing data or big error of the data will be taken from the average between one day before and one day after. For the data that will be measured and recorded weekly, the missing data will be taken from the lowest of that month.

The monitoring team will be composed of a team leader of the monitoring plan on-site and monitoring engineers on site. An external CDM monitoring Manager will receive the data on a regular basis and

guide and check the monitoring activity. The CDM Project Manager (at the responsible CDM consultant) will have the overall responsibility for the accuracy and systematic monitoring procedure and reporting of monitoring date for verification.

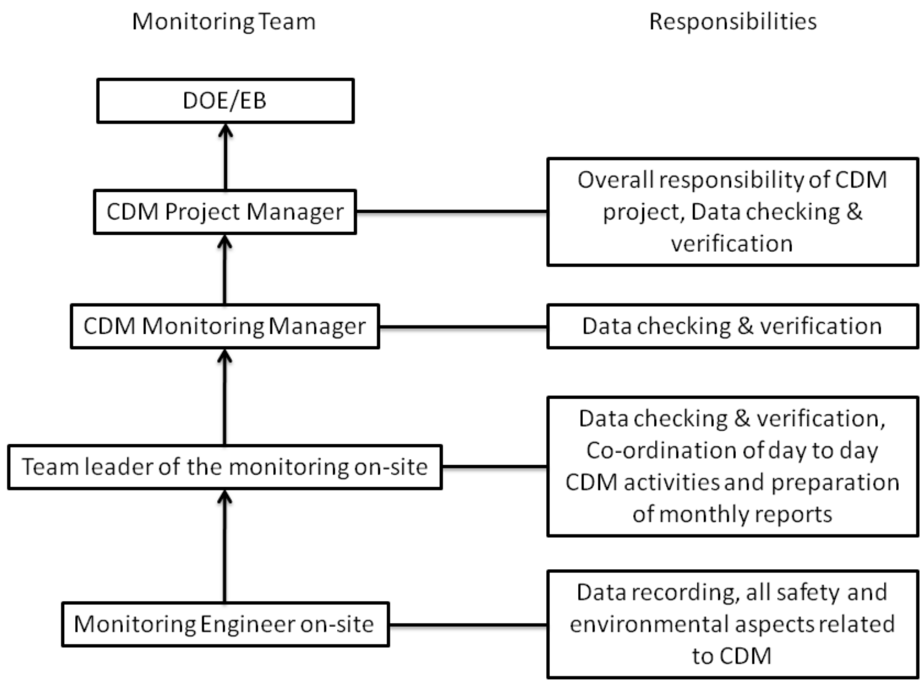


**Figure 5.** Operating Monitoring Structure

The monitoring engineers on-site are responsible to:
1. Maintain the monitoring devices
2. Record the required monitoring data
3. Sending the monitoring data to team leader of monitoring plan on-site
4. Managing the power plant operating in each shift

The team leader of monitoring plan onsite is responsible for:
1. Daily summary of the monitoring data
2. Monthly summary of the monitoring data
3. Storage the monitoring data
4. Sending the monitoring data to CDM monitoring manager
5. Ensuring a proper and timely calibration, 6. Supervise the entire power plant operating (function as a supervisor)

The CDM monitoring manager is responsible for:
1. Cross check all the monitoring data
2. Supervise about the monitoring structure
3. Control the monitoring working process
4. Handling the monitoring data to CDM project manager.

The CDM project manager is responsible for :
1. Cross check the monitoring data provided by CDM monitoring manager
2. Writing the monitoring report
3. Communication with DOE/EB

Data monitored and required for verification and issuance will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

**B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):**

>>
Date of completion of the application of baseline and monitoring methodology: 29.02.2012

Persons responsible for the application of the baseline and monitoring methodology:

1. Mrs. Sureeporn Sringam
Q.C.A.Asia Ltd.
68 Patan Road, Patan Sub-district, Muang Chiang Mai District,
Chiang Mai Province 50300, Thailand
Phone: +66 (0) 52 000 350, +66 (0) 84 222 8457.
E-mail: su@quality-carbon.com

PNP Quality Carbon, Ltd. provides carbon advisory services for CDM projects and is not a project participant listed in Annex 1.

## SECTION C. Duration of the project activity / crediting period

### C.1. Duration of the project activity:

#### C.1.1. Starting date of the project activity:

>>
29/10/2010 (date of signed the letter of intent of Turbine Generator with the Shin Nippon Machinery Co. LTD.,)

#### C.1.2. Expected operational lifetime of the project activity:

>>
20 Years (based on expected operating lifetime of cogeneration system, as recommended by the system supplier)

**C.2. Choice of the crediting period and related information:**

**C.2.1. Renewable crediting period:**

**C.2.1.1. Starting date of the first crediting period:**

>>
Not Applicable

**C.2.1.2. Length of the first crediting period:**

>>
Not Applicable

**C.2.2. Fixed crediting period:**

**C.2.2.1. Starting date:**

>>
01/01/2013 or the registry date of the project activity under the CDM-UNFCCC, whichever is later.

**C.2.2.2. Length:**

>>
10 years

## SECTION D. Environmental impacts

>>

**D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

>>
Thailand's Designated National Authority (TGO – Thailand Greenhouse Gas Management Organisation) and Government of Thailand requires an Initial Environmental Evaluation (IEE) for small project and Environmental Impact Assessment (EIA) for large scale project in order to grant its approval to CDM projects. Documentation of this Environmental Impact Assessment of the proposed project activity has been conducted will be submitted to the DNA along with this PDD. A summary of this report can be found in Annex 4 of this document

**Environmental Impact**

In Thailand an Environmental Impact Assessment (EIA) is required per environmental regulation for this project as a power generation project larger than 15 MW[9]. Since the project uses biomass residue from sugar mill and water for steam generation, it does not produce significant environmental impacts. Main

[9] "The Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (NEQA 1992)"; http://www.pcd.go.th/info_serv/en_reg_envi.html

concern is related with particulate matter from bagasse and ash; however, pollutants will be eliminated at the emission sources.

**Air quality**
At the construction and operation phases, the main effect concern in the dust and small particle from construction and ash from operation activities. Since fuel for boiler is bagasse, which is considered as $CO_2$ neutral, $SO_2$ is negligible, based on bagasse properties and $NO_X$ will be minimized by operational control. Particulate matter from fly ash will be treated by Electrostatic Precipitator (ESP). As a result, stack emissions will be under control within standard value as per Notification of the Ministry of Science, Technology and Environmental. The percentage of ash from bagasse analysis compared with other biomass residue such as rick husk is relatively low.[10]

Scattering particulates matter in the plant area will be resolved. Dust from bagasse storage area will be eliminated by water sprayed at the storage boundary. Bagasse /Ash handling and storage system were designed to prevent dust dispersion. The ash could be utilised for brick production, also distributed as mineral fertilizer for mixing with cultivation soil; suitable seal container will be used to protect ash spilling out during transportation. In case the ash is still not utilised, it will be treated by mixing with soil to prevent spilling out to the atmosphere and land filling in the plant area. It could be utilised later for cultivation soil or landfill.

**Water quality**
The plant will be operated with zero water discharge. The water from steam condensate will be recycled to the boiler plant. Output water from demineralization plant will be neutralized before discharge to the internal well for internal usage such as water spray for tree planting and dust reduction.

**Soil and Underground water impact**

Output ash and disposed water are non-toxic and could be utilised. Ash is disposed in a landfill without toxic contamination to soil and underground water[11]. Bagasse ash can also be given to farmers to be utilised as soil conditioner. Lubricants leakage is minimal and could be protected with good practice.

**Noise pollution**
Plant layout design and installation are carried out concerning noise minimization. Noise level at the plant boundary is guaranteed below the set standards.

---

[10] Environment Impact Assessment of Kaset Thai Bio Power 60 MW bagasse based cogeneration by TOP-CLASS CONSULTANT CO., LTD.

[11] "Possible effects of rice husk ash to soil after bagasse ash application to soil in Thailand" Napat Jakrawatana, School of Energy and Environment, Naresuan University Phayao, Thailand

**D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

>>

The environmental impacts are not considered to be significant by the project participant or the host party.

The proposed project does not require an Environmental Impact Assessment (EIA) under Thai Law.

## SECTION E. Stakeholders' comments

>>

**E.1. Brief description how comments by local stakeholders have been invited and compiled:**

>>

The stakeholder comments process was conduct on September of 2011, through an interview, group meeting and questionnaire, where the local stakeholders, authorities and universities were contacted and people had the opportunity to express their opinions. The local stakeholder consist of 2 parts

The following entities were involved in the process:

1. public participation meeting of household level, which settle within a radius of 7 kilometers around the project site, cover 17 villages of 4 sub-districts of Nakorn Sawan and 4 villages of Chainat province.
2. public participation meeting of 7 groups of stakeholder 5 kilometers around the project who had a direct impact from the project activities such as local government office, educational institute, NGOs, mass media and villager.

This study applied the accidental sampling for stakeholder's selection. The meetings are arranged to 2 times. The first time, the stakeholders were expressed and gave an opinion on the proposed project, boundary of environment impact study and possible impacts. The second time, they were comment on the environment impact study report and preventive measures to avoid a negative impacts.

The stakeholders were asked the following set of questions through the survey:

- Environmental impact on physical resources as soil, surface-underground water quality, air and noised pollution.
- Environmental impact on ecological resources such as forest-conservative area, agriculture area, local terrestrial and aquatic animal.
- Human use values such as plantation and agriculture, local industry, transportation, traveling and general economic situation.
-Quality of life as health and sanitation, safety, carrier and employment, income, scenery and local cultures.

Additionally, all comments and doubts from the stakeholders were received and clarified.

**E.2. Summary of the comments received:**

>>

The comments received by local stakeholders group two (institutes) indicated that 76.2% of them agree with the project activities. They suggested the proposed project to consider a preventative measure on

pollution as the first priority and the responsibility when the negative impact proved as the second, followed with should to provide the chance to the local labour to employ at the project.

Almost 90% of the second group (the village headman or village leader) assent to take the advantages from employment opportunities of local labour follows with the economic expansion and improving of public utilities and consumer goods. However, more than 80% concerned in the pollution from small particle of dust and ash, road damaged and the quality of water resources change response to the project activities.
In conclusion more than 80% agree to develop the biomass power plant project and no one disagree with the project. The remaining voted (20 %) skip to express.

**E.3. Report on how due account was taken of any comments received:**

>>
Most of them concerned in the air pollutions, but if the project had a good practices and responsibility the problem can be smoothly solved.

## Annex 1

### CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | Kaset Thai Bio Power Co. Ltd., |
| Street/P.O.Box: | 1/1 Moo 14 Tambon Nong Pho |
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| Represented by: | Apichart Noochprayoon |
| Title: | Mr. |
| Salutation: | |
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# Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

No Public Funding involved in the Project Activity

## Annex 3

## BASELINE INFORMATION

**Grid Emission of Thailand**

***Step1: Identification of the connected electricity system***

In Thailand, the electricity transmission line system is considered as a single grid system due to the transmission lines are networked all of the country area. Electricity Generating Authority of Thailand (EGAT) regulate electricity generation and main transmission system, meanwhile Metropolitan Electricity Authority (MEA) is responsible for electricity distribution system in Bangkok and vicinity area, and Provincial Electricity Authority (PEA) is responsible for electricity distribution system in the rest of country.

***Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)***

**Option I:** Only grid power plants are included in the calculation.

***Step 3: Select a method to determine the operating margin (OM)***

According to Thailand's data, the Simple OM method (ex ante option) is the most appropriate method that requires the latest 3 years data including the quantity of electricity generation, fuel types and fuel consumption of each fuel type. In this study, used the electricity statistic data in the years 2008 – 2010. The operating margin emission factor can be calculated by the equation (1), follows with the Simple OM (option B).

***Step 4: Calculate the operating margin emission factor according to the selected method***

The result calculation is as below table

| Year | CO2Emission (tCO2) | Grid Consumption (GWh) | OM Emission Factor(tCO2/MWh) |
|---|---|---|---|
| 2010 | 88,452,088 | 152,603.73 | 0.5796 |
| 2009 | 82,178,673 | 136,193.80 | 0.6034 |
| 2008 | 84,083,369 | 136,116.14 | 0.6177 |
| Summary | 254,714,130 | 424,913.67 | 0.5994 |

***Step 5: Calculate the build margin (BM) emission factor***

The group of power units is used for calculating the build margin (BM) emission factor which can be determined following with the option 1 (ex ante) and condition (b). This table shown the group of power units that supply electricity to the grid most recently which is the date when the power unit starts to supply electricity to the grid) and their annual quantity of electricity generation comprise larger than or equal to 20% of total annual electricity generation (in year 2010).

Table X Quantity of electricity was generated by the most recently built power plants

| | Power Unit | Grid Generation* (GWh) | COD |
|---|---|---|---|
| 1 | North Bangkok Power Plant (Unit 01) | 1,584.22 | 19-Nov-10 |

| | | | |
|---|---|---|---|
| 2 | Bangpakong Power Plant (Unit 05) | 4,643.22 | 16-Sep-09 |
| 3 | Phu Kieaw Bio Power Project 2 | 79.46 | 15-Sep-09 |
| 4 | Dan Chang Bio Power Project 2 | 76.75 | 15-Sep-09 |
| 5 | South Bangkok Power Plant (Unit 03) | 4,431.92 | 1-Mar-09 |
| 6 | Chana Power Plant (Unit 01) | 5,090.02 | 15-Jul-08 |
| 7 | Ratchaburi Power Company Limited (RPCL) (Unit 1&2) | 7,124.72 | 1-Jul-08 |
| 8 | Gulf Power Generation Co., Ltd. (Unit 1&2) | 9,903.93 | 1-Mar-08 |
| | Summary | 32,934.25 | |
| | Percentage as of 2010 Grid Generation ( 160,190.96 GWh) | 20.56 | |

*Electricity Statistic Annual Report 2010, Electricity Generating Authority of Thailand

Table X Fuel consumptions of the most recently built power plants as listed in Table 6 and result calculation of the build margin emission factor

| Fuel type | Fuel Consumption | | CO2 Emission ($kgCO_2$/Unit) | CO2Emission ($tCO_2$) | Grid Consumption (GWh) | BM Emission Factor ($tCO_2$/MWh) |
|---|---|---|---|---|---|---|
| | **Unit** | **Volume** | | | | |
| **Total** | | | | **13,933,412** | **32,934.25** | **0.4231** |
| Natural Gas | scf. | 251,512,881,819 | 0.0554 | 13,930,292 | | |
| Lignite | ton | | 951.7230 | | | |
| Bituminous | ton | | 2,360.1150 | | | |
| Bunker | liter | | 3.0026 | | | |
| Diesel | liter | 1,179,772 | 2.6441 | 3,119 | | |

***Step 6 : Calculate the combined margin emissions factor***

The CM emission factors that were calculated by the equation (2) follow with the Methodological Tool (Version 02.2.1) "Tool to calculate the emission factor for an electricity system" are shown in Table XX

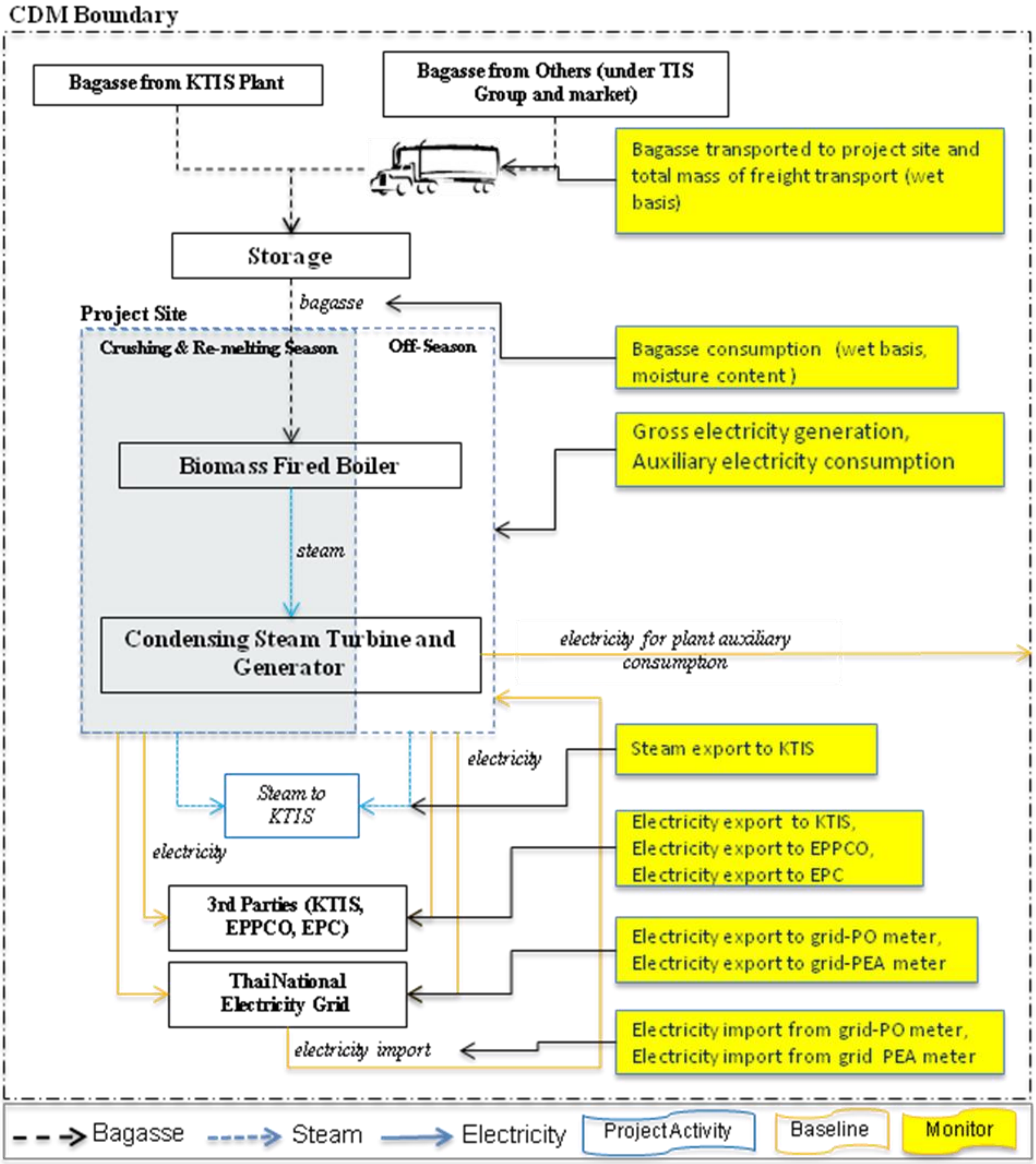
| CDM project type | Emission Factor (tCO2/MWh) | | |
|---|---|---|---|
| | **OM,gridEF** | **BM,gridEF** | **CM,gridEF** |
| General project | 0.6003 | 0.4231 | **0.5117** |
| Wind and solar power generation project | 0.6003 | 0.4231 | 0.5560 |

The CM emission factor of general CDM project is 0.5117 $tCO_2$/MWh

# Annex 4

## MONITORING INFORMATION

**Figure of monitoring point and the CDM project boundary**

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