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:

A.T. Biopower Rice Husk Power Project in Pichit, Thailand (the Project)

Version 05.1 (Post registration changes : Permanent change from the registered monitoring plan or applied methodology and Correction)
Date 28/11/2012

A.2. Description of the project activity:

A.2.1 Purpose of the Project activity

The Project is designed to use for electricity generation rice husk that would otherwise be burned in the open air or left to decay.

It involves the construction and operation of a new rice husk power plant in Pichit province, central Thailand, with 22.5 MW gross generating capacity, 20 MW net. Electricity will be sold through a 25-year power purchase agreement (PPA) with the Electricity Generating Authority of Thailand (EGAT).

The plant is one of five similar rice husk power plants currently being planned by A.T. Biopower (ATB). Although originally presented as a single CDM project, this has now been separated into two or more projects with Pichit being the first, to make the Project more manageable in terms of financing and implementation.

A.2.2 Contribution to the sustainable development of the host country

The Project will assist Thailand's sustainable growth by providing electricity through biomass power production without relying on fossil fuel combustion.

According to the Power Development Plan (PDP) by the Electricity Generating Authority of Thailand (EGAT)[2], Thailand's demand for electricity will double from 126,811 GWh in 2004 to 265,788 GWh in 2015. Against this backdrop, securing steady supply sources of electricity is a matter of vital importance for the Thai economy.

Biomass fuels, especially rice husk and bagasse, represent particularly rich energy resources for Thailand. These renewable energy sources currently fuel less than 1% of Thailand's electricity generation, which is dominated by natural gas, lignite and imported fuel oil.

[2] EGAT Power Development Plan (PDD) 2004.

Recognizing the potential contribution of renewable energy to the Thai energy mix, the government has placed great importance on supporting environmentally friendly, indigenous, and renewable sources of energy. It is noteworthy that Thailand's National CDM Strategy[3] released by the Office of National Resources and Environmental Policy and Planning, places biomass renewable energy at the top of the list of promising CDM project areas for Thailand. In addition to providing renewable energy, the Project will have an added contribution to Thailand's sustainable development in that it will improve the disposal of a major source of agricultural waste.

A.2.3 Project plans

A.2.3.1 Electricity sales

The main channel for EGAT's purchases of renewable energy is the *Small Power Producer Program*[4]. Standardized power purchase agreements (PPAs) with EGAT under the SPP Program run from 6 to 25 years. ATB has applied for a 25-year firm agreement with a contracted capacity of 20 MW, whereby EGAT guarantees minimum purchase of 80% of the contracted capacity.

Given ATB's plan to operate the plant for 24 hours a day, 346 days a year, the minimum amount of electricity sales to EGAT will be 132,864MWh/yr:

20 MW × 24 hr × 346 day × 80 % = 132,864 MWh/yr

It is expected that the plant will internally consume about 10% of the electricity it produces. Taking this into consideration, exporting the above amount to EGAT requires ATB to generate 147,627MWh/yr of electricity:

(132,864MWh/yr)/(1 - 0.1) = 147,627MWh/yr

A.2.3.2 Sale of rice husk ash to cement manufacturers

Rice husk to be used as fuel by the Project will yield about 25,659 tonnes/yr of ash. Rice husk ash (RHA) produced in properly controlled facilities such as the Pichit plant is a non-crystalline silica ash suitable as a substitute for clinker. When RHA is used in lieu of the same amount of Portland cement, it would effectively displace GHG emission-intensive cement manufacturing process. Much research has been conducted on RHA's role as a strengthening admixture for cement.

ATB has entered into discussions with well-established Thai cement manufacturers for the sale of RHA. Although this will lead to both process- and energy-related emission reductions in cement manufacturing, the Project will not claim CERs for these reductions.

It is noted that a small number of rice husk power generation projects hitherto seen in Thailand have all procured their fuel entirely is mostly from one large core supplier. ATB's plans to purchase rice husk

[3] National Clean Development Mechanism Strategy Study for the Kingdom of Thailand 2002, p.7

[4] A Small Power Producer (SPP) can be any private, government or state enterprise that generates electricity either (a) from non-conventional sources such as wind, solar and mini-hydro energy or fuels such as waste, residues or biomass, or (b) from conventional sources provided they also produce steam through cogeneration.

from a large number of smaller suppliers set the Project apart from other undertakings for rice husk power generation.

A.2.3.3 Rice husk availability and procurement

Rice has always been Thailand's flagship agricultural product, with Thailand being the world's largest exporter of rice. Production is relatively stable. From 1981 to 2005, the average yearly production was about 23 million metric tons a year, with a general increase of about 1 to 2% per year[5]. In the 2004/05 crop year, 27 million tonnes were produced, and in 2005/06, some 29 million tonnes were produced.

Central Thailand, the location of the Pichit plant and fuel supply, is a rich alluvial plain with an extensive network of irrigation canals. Most farmers in the region enjoy three rice harvests a year. As further discussed in B.2, ATB considers its fuel supply area to be the seven provinces[6], comprising Pichit province where the plant is located, plus six surrounding provinces within an economical transport distance, about 100 km. These provinces have annually produced around 5 million tonnes of paddy in recent years, amounting to about 20% of the nation's total. As delineated in Section B.4.2, there is an abundant supply of rice husk in the region.

ATB has entered into 8-year fuel supply agreements with about 30 biomass fuel supply sites, principally within 80 km of the proposed plant. Rice husk will be delivered primarily by small local truckers.

It is noted a small number of rice husk power generation hitherto seen in Thailand have all procured their fuel entirely or mostly from one large core supplier. ATB's plans to purchase rice husk from a large number of smaller suppliers set the Project apart from undertakings for rice husk power generation.

A.2.3.4 Financial plans

The Project cost is estimated at US$36 million. This includes the cost of an EPC contract as well as the cost of land, interest during construction, project development fees, financing fees, and contingencies.

The Project has been granted a 5-year subsidy for SPPs from the Ministry of Energy's Energy Policy and Planning Office (EPPO), formerly National Energy Policy Office (NEPO). This subsidy is incorporated into the financial projections.

ATB's financial plan includes 55% debt and 45% common equity and subordinated debt. The equity investors noted in A.3 will provide the common equity. The interest of the major investor CEPCO is expressly tied to the Project's designation as a CDM project and was conveyed to ATB only after the CDM methodology submitted for the Project was approved.

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[5] Office of Agricultural Economics, Ministry of Agriculture and Cooperatives.

[6] Thailand has 78 provinces.

A.3. Project participants:

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

A.4. 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.:

Pichit.

A.4.1.3. City/Town/Community etc:

Ampur Bang-moon-nak, Tambon Hor-krai.

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

The Project site is located at 96 Moo 2 Horkai Sub-District of Ampur Bang-moon-nak. The region, in the Lower North of Thailand, is the rice hub of Thailand and is some 320 kilometers from Bangkok. The Project area has abundant rice husk, provides convenient access to transportation arteries and is close to the 115kV transmission line of the Provincial Electricity Authority.

The plant is located on a 34 hectare site. About half the site is used for plant buildings, equipment, and storage facilities. The rest is used as buffer zones and green space. The front of the plant is adjacent to Highway No.1313 and the Nan River while there is a small pool at the back side of the plant called "Lah

Rod Fai" which adjoins the northern route railway. At the left and right sides are surrounded by vast area of rice fields.

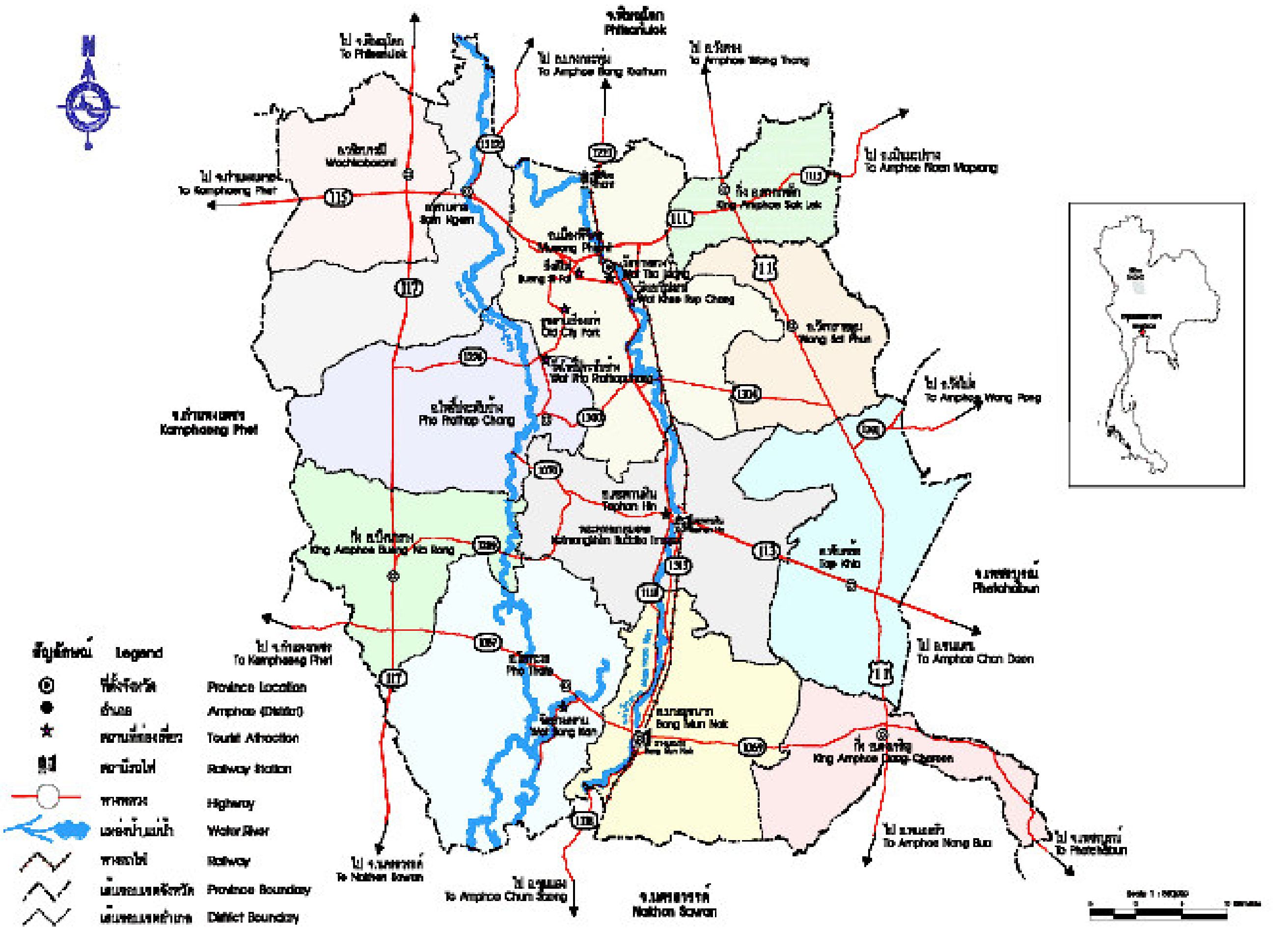


Figure 1: Map of Pichit Province

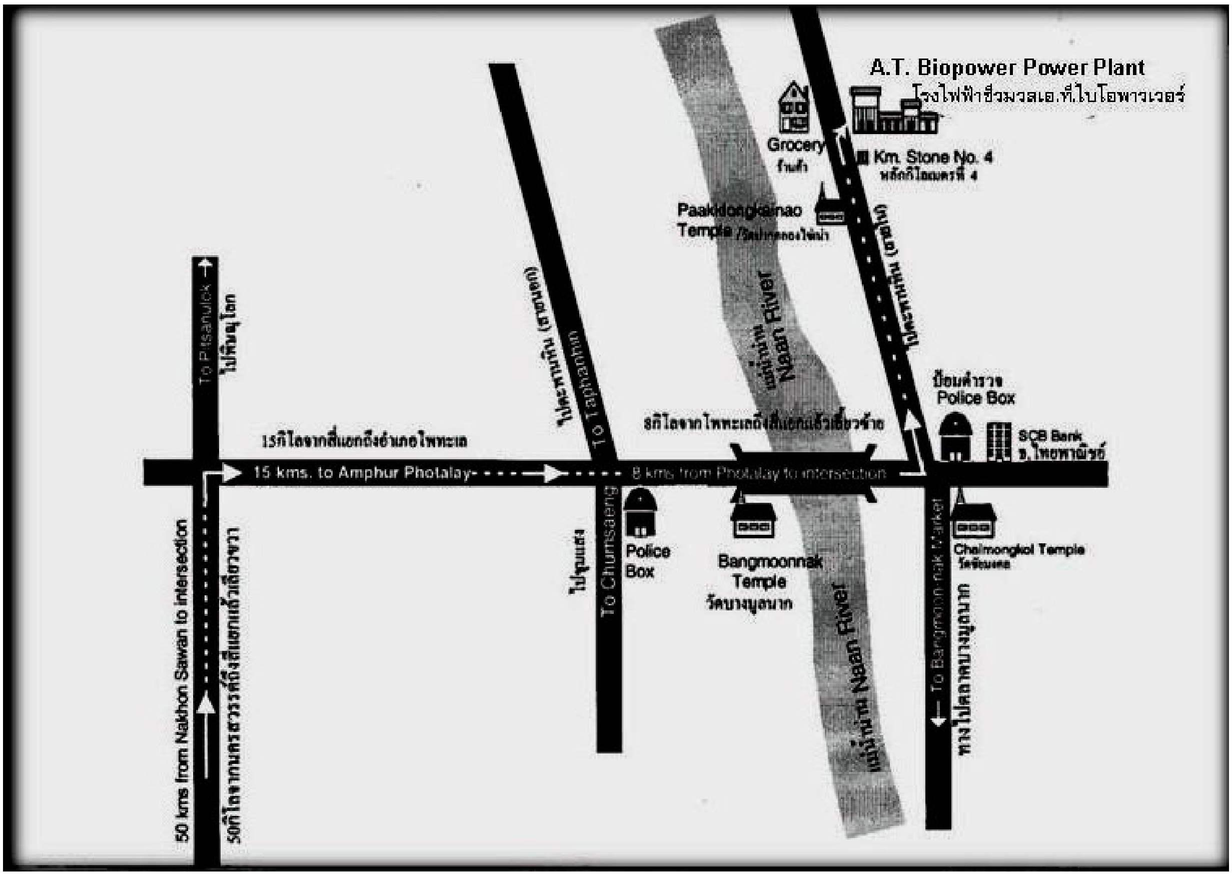


Figure 2: Simplified local map showing Project site

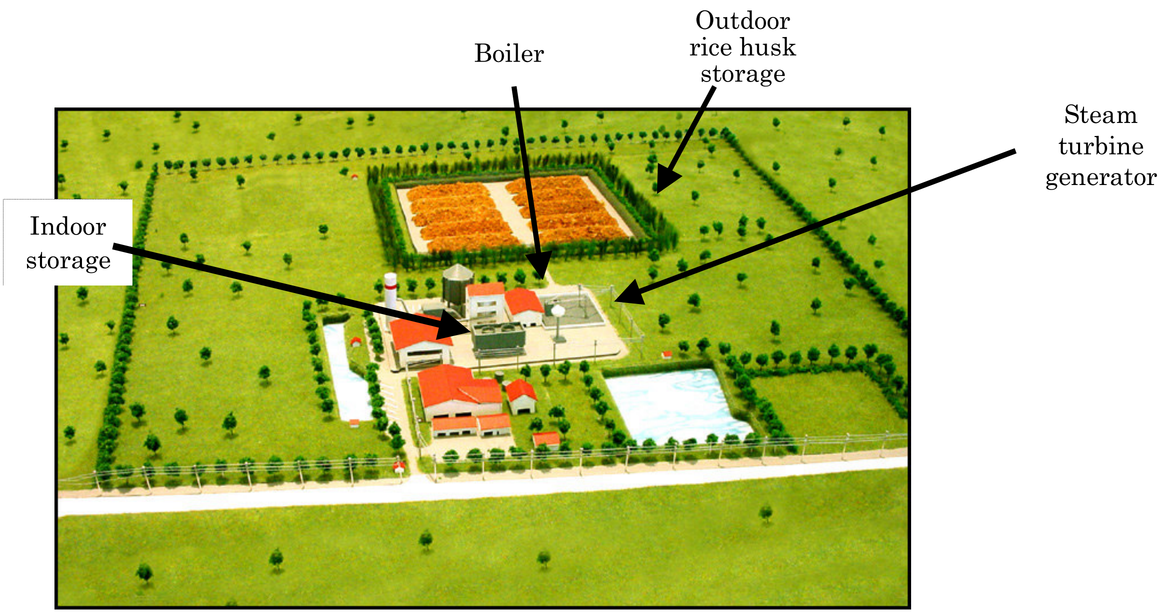


Figure 3: Image of Pichit Plant Site

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

The Project fits under Sectoral Scope 1: Energy industries (renewable sources).

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

A.4.3.1 Technology to be employed

The plant will operate using suspension-fired boilers, designed to burn ground rice husk in suspension. This particular boiler technology was adopted due to their ability to produce high quality ash product, which will be suitable as a substitute ingredient for cement. This will eliminate the environmental issue of ash disposal while at the same time reduce GHG emissions from cement manufacturing. As the first example to use this state-of-the-art technology in Thailand, the Project represents an important case of technology transfer. A small number of rice husk power plants hitherto constructed in Thailand all use more conventional combustion technology such as a stoker boiler.

The main equipment has been installed provided in **Table 1**

Table 1: The main equipment installed in the project activity

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

The Pichit plant has been constructed by Poyry Energy Limited (formerly Electrowatt-Ekono (Thailand) Ltd.) as EPC contractor, with McBurney Corp. (McB) as combustion technology provider.

Poyry will be required to guarantee equipment performance, net power output, fuel consumption rates, reliability, availability, and emissions. Under the EPC contract, the construction cost and completion date will be guaranteed on a lump sum, fixed-price, date-certain basis.

Chubu Electric Power Thailand Ltd. (CEPT), the Thai subsidiary of CEPCO whose main activity is power plant operation and maintenance (O&M), will operate the plant under an O&M contract.

A.4.3.2 Training as a way for technology transfer

Under ATB's general guidance, the O&M contractor will staff the plant with Thai staff (including the Site Manager), contributing to technology transfer of this state-of-the-art combustion and power generation technology. Whenever possible, preference will be given to recruiting suitably qualified staff from local communities. This will greatly enhance the well being of the communities surrounding the power plant.

ATB places particular emphasis on staff training, providing all staff members with basic training consisting of:

- Basic safety
- Basic plant knowledge
- Basic rice husk fuel fired technology
- Environmental awareness
- Supervisory training (where applicable)

In addition, classroom sessions will be held on job-specific subjects. This training will cover the following areas:

- Plant and steam cycle overview
- Boiler design and operation
- Turbine design and operation
- Fuel handling equipment and operation
- Ash handling equipment and operation
- Water treatment and water chemistry
- Power plant HV reticulation
- Power plant control philosophy

The most important training will be on-the-job training. This will include:

- Start up
- Shut down
- Emergency Response

All the training will be supplemented by comprehensive Operations and Maintenance Manuals that will be supplied by EWE. Staff members will also be trained through work instructions for all key activities. These work instructions will be developed during the mobilization phase, the period of time running up to power plant commissioning and the start of operation.

A.4.3.3 Energy balance and related analysis

Thorough laboratory tests conducted by ATB show the following characteristics for the rice husk to be used as fuel:

Ultimate Analysis:

Carbon	37.13%
Hydrogen	4.12%
Oxygen	31.60%
Nitrogen	0.36%
Sulphur	0.05%
Ash	17.75%
Moisture	9.00%
Total:	100.00%

Calorific Value: 13,607 kJ/kg → 0.013607 TJ/tonne

As described in A.2.3.1, ATB expects to produce approximately 147,627 MWh of electricity annually, of which 132,864 MWh will be exported to EGAT, with the remaining 14,763 MWh consumed internally at the plant. In terms of energy, the amount of electricity produced at the Pichit plant will equal 531 TJ/yr:

147,627 MWh/yr x 3,600 MJ/MWh x (1 TJ/1millionMJ) = 531 TJ/yr

ATB's feasibility study indicates that the plant will convert approximately 30% of the heat generated in its boiler to electrical power. Therefore, the boiler needs to provide 1,770 TJ/yr of heat (energy) in order for the plant to generate the planned amount of electricity:

(531 TJ/yr) ÷ 0.3 = 1,770 TJ/yr

Since the expected efficiency for the plant's boiler is 90%, the rice husk to be combusted at the ATB plant must contain the following amount of energy:

(1,770 TJ/yr) / (0.9) = 1,967 TJ/yr

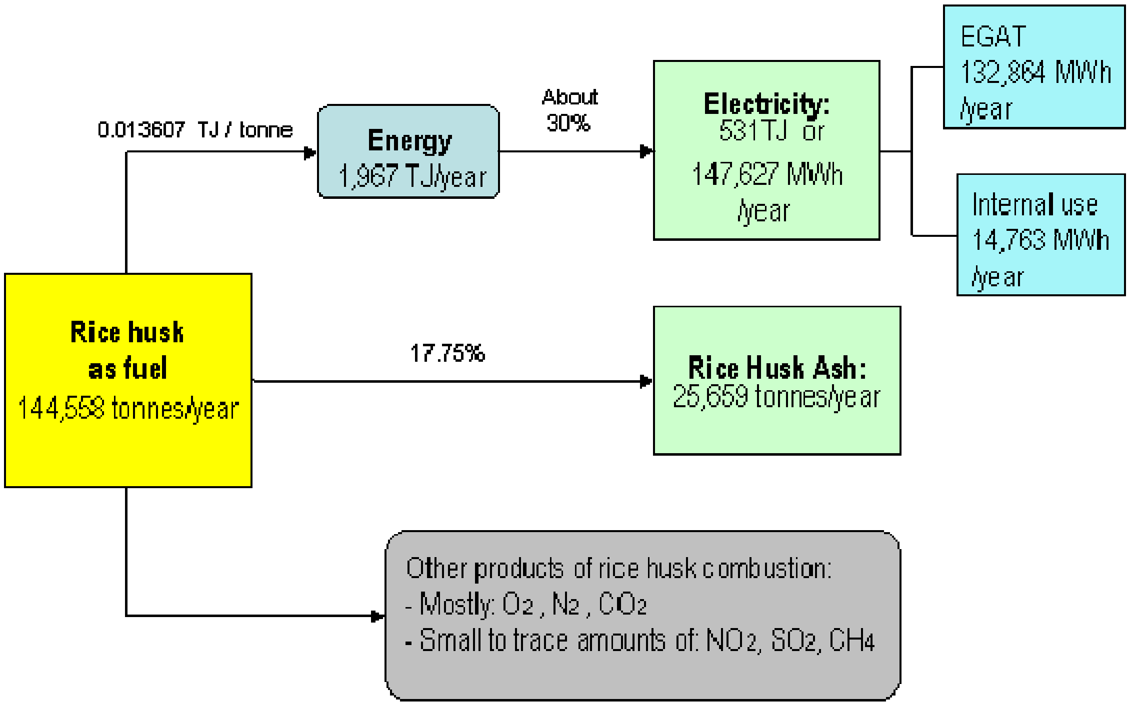
Based on the calorific value of 0.013607 TJ/tonne for the rice husk to be used as fuel, the quantity of rice husk needed to produce the required amount of energy is approximately 144,558 tonnes/yr:

(1,967 TJ/yr) / (0.013607 TJ/tonne) = 144,558 tonnes/yr

Given the ash content of 17.75%, the combustion of the above amount of rice husk will result in ash of 25,659 tonnes/year in volume.

144,558 tonnes/year x 17.75% = 25,659 tonnes/year

The relationships are summarized in the following diagram:



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

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year 1	70,508
Year 2	70,508
Year 3	70,508
Year 4	70,508
Year 5	70,508
Year 6	70,508
Year 7	70,508
Total estimated reductions (tonnes of CO_2e)	493,556
Total number of crediting years	7 years (renewable)
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	70,508

A.4.5. Public funding of the project activity:

The financial plans for the Project involve public funding from an Annex I country in that one of ATB's shareholders, FINNFUND, is a Finnish government-owned institution. However, the fund is not ODA and therefore the issue of diversion of ODA is irrelevant.

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 approved consolidated baseline and monitoring methodology ACM0006 (Version 04) – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues" is applied to the project activity.

The tool used for demonstrating and assessing the additionality of the project activity is "Tool for the demonstration and assessment of additionality (Version 02)".

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

The approved consolidated baseline methodology ACM0006 is based on several individually approved methodologies, including AM0004, which was prepared specifically in connection with the Project. The Project meets all of the applicability conditions listed in ACM0006, as summarised below.

- The project must involve grid-connected biomass residue electricity generation.

The Project will use rice husk, an abundant agricultural waste, to fuel its power plant. The power plant will be installed at a site where no power generation currently occurs (i.e. a greenfield power project). The power will be exported to EGAT's grid.

- No other biomass types other than biomass residues, defined as a by-product, residue or waste stream from agriculture, forestry and related industries, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired).

The Project will not involve the use of biomass that is not a biomass residue. Some small amounts of fossil fuel will be used during start-up, however, the fuel will remain predominantly biomass residue.

- For projects that use biomass residues from a production process, the implementation of the project shall not result in an increase of the processing capacity of raw input or in other substantial changes in this process.

The rice husk will be sourced from various biomass fuel supply sites. The rice husk procurement plan for the Project is based on current production levels and availability at the rice mills, and does not depend on an increase in processing capacity. Therefore, there shall be no increase of processing capacity of raw input or other substantial changes in the rice milling process on the account of the Project.

- The biomass residues used by the project facility should not be stored for more than one year.

The rice husk will not be stored for more than one year. The storage facility for the Project can only hold at most 3 months' worth of rice husk supply.

- No significant energy quantities, except from transportation of the biomass, are required to prepare the biomass residues for fuel combustion.

No significant energy quantities are required to prepare the rice husk for fuel combustion. Unlike some other biomass fuels with higher moisture content, rice husk is a relatively dry fuel that does not require pre-treatment such as dewatering.

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

As per the baseline methodology, the following emission sources are included.

	Source	Gas		Justification / Explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	For simplification. This is conservative.
		N_2O	Excluded	For simplification. This is conservative.
	Uncontrolled burning or decay of surplus rice husk	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	B1 is the most likely baseline scenario.
		N_2O	Excluded	For simplification. This is conservative.
Project	On-site fossil fuel and electricity consumption due to the project activity (stationary and mobile)[7]	CO_2	Included	Main emission source.
		CH_4	Excluded	For simplification. This emission source is assumed to be very small.
		N_2O	Excluded	For simplification. This emission source is assumed to be very small.
	Off-site transportation of rice husk	CO_2	Included	Main emission source.
		CH_4	Excluded	For simplification. This emission source is assumed to be very small.
		N_2O	Excluded	For simplification. This emission source is assumed to be very small.
	Combustion of rice husk for electricity generation	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included	Consistent with inclusion of CH_4 emission for uncontrolled disposal of rice husk in baseline.
		N_2O	Excluded	For simplification. This emission source is assumed to be very small.
	Rice husk storage	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector.

		CH_4	Excluded	Excluded for simplification. Since biomass is stored for not longer than one year, this emission source is assumed to be small.
		N_2O	Excluded	For simplification. This emission source is assumed to be very small.

The spatial extent of the project boundary encompasses the power plant at the project site, the means for transportation of biomass to the project site (e.g. vehicles), and all power plants connected physically to EGAT's electricity system, the system that the Project is connected to. This is in line with the default definition of the boundary given in the baseline methodology ACM0002, which is used for determining the emissions associated with grid electricity generation. It is noted that the EGAT's electricity system is a national one, which cannot be further isolated into smaller grids.

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

The baseline methodology ACM0006 is applied to the project activity following the steps below.

- Identification of the baseline scenario. This follows the steps provided in ACM0006, together with Steps 2 and/or 3 of the "tool for the demonstration and assessment of additionality"[8], (additionality tool). The latter is detailed in Section B.5.
- Leakage assessment.
- Demonstration of additionality. This is detailed in Section B.5.
- Emission reduction estimation. This is described in Section B.6.3.

B.4.1. Identification of the baseline scenario

According to ACM0006, the first step is to identify all realistic and credible alternatives to the CDM project activity. Realistic and credible alternatives are to be separately determined regarding:

- how power would be generated in the absence of the project activity; and
- what would happen to the biomass in the absence of the project activity.

For power generation, in the context of this Project, the potential alternatives include:

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

P2 The proposed project activity (installation of a power plant), fired with the same type of biomass residue but with a lower electrical energy efficiency (e.g. an efficiency that is common practice in the relevant industry sector)

P3 The generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels

P4 The generation of power in existing and/or new grid-connected power plants

[8] At the time of preparing this PDD, Version 2 was the latest version available.

P5 The continuation of power generation in an existing power plant, fired with the same type of biomass residue as in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant

Scenario P3, the generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels is immediately rejected as a plausible alternative. There are no such plants within the immediate vicinity of the Project site.

Likewise, the continuation of rice husk-fired power generation in an existing power plant, Scenario 5, is not a realistic and credible alternative. There are no existing rice husk-based power plants in the immediate vicinity. Indeed, there are no such plants in the entire Pichit province, and only a handful exists in the entire country.

Therefore, the two remaining plausible scenarios are P1, P2 and P4 – the proposed project activity not undertaken as a CDM project activity, the proposed project activity with a lower electrical efficiency not undertaken as a CDM project activity, and the generation of power in existing and/or new grid-connected power plants. In order to select the more plausible of the three, further assessment is carried out in Step 3 of the additionality tool, in Section B.5 below.

For the use of biomass (rice husk), the potential alternatives include:

B1 The biomass residue is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes
B2 The biomass residue is used for heat and/or electricity generation at the project site
B3 The biomass residue is used for power generation, including cogeneration, in other existing or new grid-connected power plants
B4 The biomass residue is used for heat generation in other existing or new boilers at other sites
B5 The biomass residue is used for other energy purposes such as the generation of biofuels
B6 The biomass residue is used for non-energy purposes

Scenario B2, the use of rice husk at the ATB site, is ruled out as a plausible scenario. The Project is a greenfield power project. Furthermore, unlike power plants located next to or within a biomass fuel suppy sites's plant site, the Project will not be located next to a supplier.

Scenarios B4 and B6, the use of rice husk in other existing or new boilers at other sites and the use of rice husk for non-energy purposes, respectively, are also not plausible scenarios. The uses of rice husk for energy purposes, mainly for the millers' own energy needs, and other minor uses such as chicken bedding, have relatively stable demand against rice husk supply. The Project's procurement plan involves only the surplus rice husk that is remaining after the fulfilling the traditional demands. Therefore, in the absence of the Project, this rice husk will continue to be in surplus.

Unlike the uses of rice husk for millers' on-site energy purposes and other traditional uses, for which demand is stable, it is possible that under BAU, the surplus rice husk will be used for grid-connected power plants, i.e. Scenario B3. However, the use of biomass in other existing or new grid-connected power plants is not a plausible scenario. The Project procurement plan has always been based on using the rice husk which is not being used by existing power plants. The rice husk used in other power plants does not form part of the Project's potential supply (see leakage assessment below). In terms of new

power plants, there are plans for a new grid-connected power plant 100km away. However, given the large pool of rice husk available in the region, and the Project's unusual plan to procure rice husk from dozens of small biomass fuel supply sites, it is unlikely that the rice husk the Project uses will, under BAU, be used for grid-connected power plants.

Lastly, the use of rice husk for other energy purposes such as the generation of biofuels is not a realistic scenario. Rice husk is not a source of biofuel, and no other energy uses are known.

Therefore, the only remaining credible alternative for rice husk use is Scenario B1, the disposal through uncontrolled burning or dumping, without utilising it for energy purposes. This is the predominant current practice for unwanted rice husk.

B.4.2. Leakage assessment

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

To demonstrate that the use of rice husk (biomass residue of type *k*) by the Project does not result in increased fossil fuel consumption elsewhere, a leakage assessment is carried out as part of the monitoring the supply situation for the rice husk. Of the three options provided in the baseline methodology, leakage assessment L_2 is used:

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

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

Rice husk production

Based on information from the Office of Agricultural Economics, the total rice production in the seven provinces totalled nearly 6 million tonnes in 2003, translating to a total rice husk production of some 1.35 million tonnes.

Table B-1: Rice and rice husk production in procurement area[9]

Province	Production of major rice (t)	Production of second rice (t)	Total production of rice (t)	Production of rice husk (t)[10]
Uthai Thani	222,657	138,705	361,362	83,113
Kampaeng Phet	520,546	314,494	835,040	192,059
Pichit	524,784	495,863	1,020,647	234,749
Chainart	558,692	470,407	1,029,099	236,693
Nakhon Sawan	882,868	509,562	1,392,430	320,259
Phetchabun	425,269	7,840	433,109	99,615
Phitsanulok	378,530	401,972	780,502	179,515
Total	3,513,346	2,338,843	5,852,189	1,346,003

Rice husk uses

The major traditional uses of rice husk were identified as the use in chicken farms, brick plants and cement plants, in addition to rice millers' own consumption for rice milling and parboiling. This demand, as mentioned earlier, has been relatively stable. Another source of rice husk use is the use for grid-connected power plants. The amount of rice husk used for each purpose was estimated based on official data together with survey results obtained by ATB. This information is summarised below.

A. Rice milling and parboiling

The quantity of rice husk consumed by rice millers for rice milling and parboiling is calculated as 266,629t, based on an estimated consumption of 19.8%[11] of total rice husk.

B. Chicken farms

According to the Department of Livestock Development, the chicken population in the seven provinces total approximately 19 million.

Table B-2: Chicken population in procurement area[12]

Province	Broiler chicken	Native chicken	Total
Uthai Thani	978,680	202,086	1,180,766
Kampaeng Phet	638,816	735,601	1,374,417
Pichit	1,068,672	808,087	1,876,759
Chainart	1,216,249	297,624	1,513,873
Nakhon Sawan	3,728,360	1,395,543	5,123,903
Phetchabun	5,170,840	1,135,175	6,306,015

[9] Agricultural Statistics of Thailand 2004, Office of Agricultural Economics. Latest data available for 2003.

[10] Based on estimated 0.23 tonnes rice husk for every tonne of rice.

[11] Based on interviews with the Rise Engineering Supply Company, and Ruam Charn Rice Miller.

[12] Department of Livestock Development, http://www.dld.go.th/ (last accessed February 2006). Latest data available for 2005.

Phitsanulok	461,692	1,231,280	1,692,972
Total	**13,263,309**	5,805,396	19,068,705

Of these, only broiler farms which use evaporator-controlled systems need to use rice husk to lay a floor. For a conservative estimation, it is assumed that all broiler farms use the evaporator-controlled system. Therefore, the chicken population requiring rice husk is deemed as 13,263,309.

In order to ascertain the amount of rice husk used per chicken, ATB conducted an interview as part of an EIA in 2004. Two farmers, one with a small farm of 10,000 chicken and another with a medium farm of 140,000 chicken, gave figures of 1.21kg and 0.54kg rice husk requirement per chicken, respectively. Based on the assumption that the difference reflected small farms tending to use a larger amount of rice husk per chicken, the figure of 1.21kg per chicken per year was determined to be the appropriate and conservative value to use for the estimation of rice husk used in chicken farms. Thus,

Rice husk used in chicken farms in the Project's procurement area	=	Total chicken population in the Project's procurement area	x	Rice husk demand per chicken (t rice husk/chicken/yr)
	=	13,263,309	x	0.00121
	=	16,170 t		

C. Brick plants

Data on the number of brick plants in the Project's procurement area of seven provinces and their production capacities were obtained from the Department of Industrial Works.

Table B-3: Brick plants in procurement area[13]

Province	Number of brick plants	Total Capacity (piece/year)
Uthai Thani	14	58,680,000
Kampaeng Phet	17	26,590,000
Pichit	4	1,650,000
Chainart	13	14,990,000
Nakhon Sawan	17	19,585,000
Phetchabun	14	45,315,500
Phitsanulok	24	30,550,000
Total	103	197,360,500

ATB conducted an interview with 4 brick makers in 2004. The brick makers gave rice husk consumption figures of between 0.18kg and 0.25kg for the production of one piece of brick, with the smaller brick makers requiring more rice husk per piece of brick. For the purpose of a conservative, the 0.25kg figure

[13] Department of Industrial Works. Latest data available for 2004.

was used for the estimation of rice husk used in brick plants. Also for conservatism, it is assumed that all brick plants use rice husk for their energy requirement.

Rice husk used in brick plants in the Project's procurement area	=	Total bricks produced in the Project's procurement area (bricks/year)	x	Rice husk demand per piece of brick produced (t rice husk/brick)
	=	197,360,500	x	0.00025
	=	49,340 t		

D. Cement plants

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

E. Grid-connected power plants

There are currently four power plants by the Thai Power Supply Company totalling approximately $61MW_{gross}$ located approximately 350km from the Project site. Although the power plants fall outside of the leakage assessment area, for conservatism, it is assumed that 25% of their rice husk needs is sourced from within this boundary. This assumption is very conservative in that not only are the plants located outside of what would normally be considered an economic transport distance, but also as, apart from the smallest 3MW plant, all plants are associated with a rice and saw milling company, which acts as the major supplier.

Based on ATB's interview with the power company, the total rice husk use for the four plants is approximately 325,000 tonnes per year. Therefore, for the purpose of this assessment, it is assumed that 81,250 tonnes are procured from within the Project's leakage assessment area.

Rice husk surplus

The following table summarises the supply and demand situation of rice husk in the seven provinces – Pichit, Uthai Thani, Kampaeng Phet, Chainart, Nakhon Sawan, Phetchabun and Phitsanulok – that comprise the Project's procurement area.

Table B-4: Supply and demand of rice husk in procurement area

	Tonnage
Supply	
Rice husk production	1,346,003
[A] Total Supply	**1,346,003**
Demand	
Rice milling and parboiling	266,629
Chicken farms	16,170
Brick plants	49,340
Cement plants	10,600
Grid-connected power plants	81,250
ATB Project's fuel requirement	144,558
[B] Total Demand	**568,547**
Surplus as defined by ACM0006 ([A]-[B])/[B]	**137%**

It can be seen from the table that the quantity of available rice husk in the region is approximately 137% larger than the quantity of rice husk that is used, for all purposes including the ATB plant. This is significantly higher than the 25% threshold given in the baseline methodology. Therefore, the Project does not lead to any leakage.

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):

In order to establish the additionality of the Project, the "Tool for the demonstration and assessment of additionality" is applied, in line with the baseline methodology ACM0006. Steps 0, 1, 3, 4 and 5 are described below.

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

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

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

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

As stated in Section C.1.1., the starting date of the project activity is 5 January, 2004, which is the date on which construction work for the Pichit plant started. Further, while it is only required for a project to have submitted a new methodology or requested validation by a DOE, the Project fulfils both of these

conditions. A new methodology application was first submitted in connection with this Project in April 2003, and a request for validation was made to Det Norske Veritas[14] in early 2003.

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

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

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

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

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

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

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

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

Step 3. Barrier analysis

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

[14] DNV was accredited as DOE in April 2004

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

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

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

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

Notwithstanding the incentives provided by EPPO subsidies and the SPP program which guarantees purchase of most of the electricity generated, it remains difficult to develop environmentally friendly electricity generation projects in Thailand. For the Pichit Project in particular, a major investment barrier has been the perceived high risk of the Project when investors evaluate it. The Project differs from any of a small number of undertakings hitherto seen in Thailand for rice husk power generation. Other projects have a large rice mill as a core project sponsor and rely on it for the supply of all or nearly all of the rice husk to be used at their plants. In contrast, the Project sources its rice husk from a great number of smaller mills. ATB itself does not see anything inherently risky about not having a core rice husk supplier, and is confident that, even in the unlikely event that supply becomes tight, the good-will it has cultivated with biomass fuel supply sites and agreements it will enter into with many of them will ensure uninterrupted supply. However, accustomed to seeing a core fuel supplier in similar projects and wary of new ideas, investors have not been convinced. They are worried that future popularity of rice husk power generation may boost demand for rice husk, prompting independent biomass fuel supply sites to raise prices in a mercantile manner. Furthermore, investors fear that when the supply and demand balance becomes tight, the availability of rice husk for ATB's plant may be at risk, as there is no guarantee that the biomass fuel supply sites will honour the contracts with ATB. From investors' vantage point, the behaviour of independent biomass fuel supply sites will be in sharp contrast to that of the core suppliers whose long-term interest in the success of the power generation project he is closely involved in will restrain his demands for price increases and maintain his rice husk supply commitment. It is pertinent to note that investor's concerns about fuel supply are related to the latter half of the Project's life of 25 years. Few anticipate a shortage of rice husk supply during the first 7 years which constitute the crediting period for this PDD.

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

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

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

Alternative P2: The proposed project activity with a lower electrical energy efficiency

This type of project activity will face a lesser barrier than that faced by the proposed Project, when compared purely on the basis of project returns. Using equipment with a lower efficiency implies a reduction in the equipment cost, which will have a positive – in some cases significant – impact on the projected returns. However, the increase in project returns alone will not be sufficient for a project of this type to overcome all of the barriers it faces. The fundamental barrier, which is the perceived and real risk in the eyes of the investors' of not having a principle fuel supplier, remains.

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

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

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

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

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

Step 4. Common practice analysis

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

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

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

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

Step 5. Impact of CDM registration

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

The Project is clearly not the baseline scenario. With a few exceptions, rice mills in Thailand are too small to use the rice husk they produce for electricity generation. The Project will collect unused rice husk from these mills and utilize it as fuel for its power plant. Without the Project, the surplus rice husk at these mills would continue to be either dumped or burned in the open air or in simple incinerators. The Project will reduce GHG emissions by displacing grid electricity by carbon-neutral biomass power generation. As illustrated in Section B.6.3, the Project results in a reduction of emissions totalling an estimated 541,044 tCO2 during the initial crediting period. Based on the foregoing assessments, the Project fulfils the criteria for additionality stipulated in Paragraph 43 of the CDM modalities and procedures.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

B.6.1.1 Project emissions

CO_2 emissions from combustion of fossil fuels for transportation of biomass residues to the project plant

The baseline methodology ACM0006 allows two different approaches to determine emissions; an approach based on distance and vehicle type or on fuel consumption. Here, the distance approach is used.

Emission due to off-site transportation	=	Number of truck trips in a year	x	Average return trip distance to supply site	x	CO_2 emission factor for trucks
(tCO_2)				(km)		(tCO_2/km)

CO_2 emissions from on-site consumption of fossil fuels

The project consumes fossil fuels on-site for two purposes. One is the use of diesel oil in the boiler as start-up / auxiliary fuel. The other is for on-site transportation of rice husk using diesel-fuelled dump trucks and bulldozers. These will be calculated as:

For fossil fuel use in the boiler:

Emission due to combustion of start-up / auxiliary fuel (tCO_2e/yr)	=	Emission factor for each fuel *i* (tCO_2e/TJ)	x	Fuel consumption in energy equivalent for each fuel *i* (TJ/yr)

CO_2 emissions from on-site electricity consumption

Emission due to on-site electricity consumption (tCO_2e/yr)	=	On-site electricity consumption that imported from the grid by the Project (MWh/yr)	x	CO_2 emission factor for grid electricity (tCO_2/MWh)

For ex-ante, electricity consumption from grid is assume to be zero as the source will be come from the ATB power plant which is the renewable biomass power plant.

CH_4 emissions from combustion of biomass residues

Emission due to combustion of biomass at ATB plant (tCO_2e/yr)	=	Heat value of rice husk used by Project (TJ/yr)	x	Methane emission factor for rice husk combustion (tCH_4/TJ)	x	Approved GWP of CH_4 (tCO_2e/tCH_4)

An appropriate conservativeness factor will be applied to the IPCC default methane emission factor, as stipulated in the baseline methodology.

B.6.1.2 Baseline emissions

CO_2 emissions for grid electricity generation

The emissions associated with electricity generation from plants connected to the grid are calculated as:

Emission due to displacement of electricity (tCO_2/yr)	=	Net quantity of increased electricity generation by the Project (MWh/yr)	x	CO_2 emission factor for displaced electricity (tCO_2/MWh)

where, as described in B.6.3., the CO_2 emission factor for displaced electricity determined *ex ante* is 0.51tCO_2/MWh.

CH_4 emissions for uncontrolled disposal (burning) of rice husk

Emission due to uncontrolled disposal of rice husk (tCO_2e/yr)	=	Approved GWP of CH_4 (tCO_2e/tCH_4)	x	Quantity of rice husk used in the ATB plant (t/yr)	x	Net calorific value of rice husk (TJ/t)	x	CH_4 emission factor for uncontrolled burning of rice husk (tCH_4/TJ)

An appropriate conservativeness factor will be applied to the IPCC default methane emission factor, as stipulated in the baseline methodology.

B.6.1.3 Leakage

As delineated in Section B.4.2., the leakage effects due to the project activity shall be calculated as follows:

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

If the RH_s is equal to or greater than 25%, the Project does not lead to any leakage. Otherwise, leakage effect will be quantified as:

Leakage emission (tCO_2e/yr)	=	CO_2 emission factor of the most carbon intensive fuel (tCO_2/TJ)	x	Σ	Amount of rice husk used as fuel in the project plant (tonne/yr)	x	Net calorific value of rice husk (TJ/tonne)

B.6.1.4 Emission Reductions

The emission reduction for a given year is calculated as:

Emission Reduction	=	Baseline emission due to displacement of grid electricity	+	Baseline emission due to uncontrolled disposal of rice husk	–	Project emission due to off-site transportation	–	Project emission due to on-site consumption of fossil fuels	–	Project emission due to on-site combustion of biomass	–	Project emission due to on-site electricity consumption

Should the Project's use of rice husk is deemed to contribute to leakage, as a result of on-going monitoring described in B.7.1, any leakage effect will be quantified and subtracted from the above emission reductions.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential for CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice as per ACM0006.
Any comment:	None

Data / Parameter:	**EF_{grid}**
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Source of data used:	EGAT, EPPO, TGO
Value applied:	0.51 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002 and once upon renewal of a crediting period.
Any comment:	This parameter is calculated as weighted sum of the OM and BM emission.

Data / Parameter:	**EF_{OM}**

Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid
Source of data used:	EGAT, EPPO, TGO
Value applied:	0.60 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002 and once upon renewal of a crediting period
Any comment:	None

Data / Parameter:	**EF_{BM}**
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid
Source of data used:	EGAT, EPPO, TGO
Value applied:	0.42 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002 and once upon renewal of a crediting period
Any comment:	None

Data / Parameter:	**$COEF_{fuel}$**
Data unit:	tCO_2/t_{fuel}
Description:	CO_2 emission coefficient of each fossil fuel
Source of data used:	EGAT, EPPO
Value applied:	IPCC
Justification of the choice of data or description of measurement methods and procedures actually applied :	Refer to Table 3 of Annex 3.
Any comment:	None.

Data / Parameter:	**F_{pp}**
Data unit:	tonne/yr
Description:	Amount of each fossil fuel consumed by each power source / plant
Source of data used:	EGAT, EPPO
Value applied:	Refer to Tables 1 and 2 of Annex 3.
Justification of the	Once upon renewal of a crediting period.

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.

Data / Parameter:	**GEN_{pp}**
Data unit:	MWh
Description:	Electricity generation of each power source / plant
Source of data used:	EGAT, EPPO
Value applied:	Refer to Table 1 of Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Once upon renewal of a crediting period.
Any comment:	None

Data / Parameter:	**Plant name (OM)**
Data unit:	-
Description:	Identification of power source/plant for the OM
Source of data used:	EGAT, EPPO
Value applied:	Refer to Table 1 of Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Once upon renewal of a crediting period.
Any comment:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.

Data / Parameter:	**Plant name(BM)**
Data unit:	-
Description:	Identification of power source / plant for the BM
Source of data used:	EGAT, EPPO
Value applied:	Refer to Table 2 of Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Once upon renewal of a crediting period.

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

Data / Parameter:	**$COEF_{CO2}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of the most carbon intensive fuel in the calculation of the combined margin with methodology ACM0002
Source of data used:	IPCC, EGAT
Value applied:	74.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Once upon renewal of a crediting period.
Any comment:	IPCC or EGAT default values will be used where appropriate.

B.6.3 Ex-ante calculation of emission reductions:

In line with Section B.3, project emissions include the following gases and sources.

- CO_2 from off-site transportation of rice husk
- CO_2 from on-site fossil fuel consumption, both stationary and mobile
- CH_4 from the incomplete combustion of rice husk for electricity generation
- **CO_2 emissions from electricity consumption**

Baseline emissions include the following.

- CO_2 from grid electricity generation (displacement of grid electricity)
- CH_4 from the uncontrolled burning of rice husk

B.6.3.1. CO_2 emissions from combustion of fossil fuels for transportation of biomass to the project plant (project emissions)

As the rice husk is not generated directly at the ATB site, it is necessary to determine CO_2 emissions associated with off-site transportation. The baseline methodology ACM0006 allows two different approaches to determine emissions; an approach based on distance and vehicle type or on fuel consumption. Here, the distance approach is used.

Emission due to off-site transportation (tCO_2)	=	Number of truck trips in a year	x	Average return trip distance to supply site (km)	x	CO_2 emission factor for trucks (tCO_2/km)

It is estimated that by using 15 tonne trucks, some 9,638 trips will be required in a year to transport the Project's requirement of 144,558 tonnes of rice husk. Using the estimated average return trip distance of 120km,

Emission due to off-site transportation (tCO_2)	=	9,638	x	120	x	$1,097 \times 10^{-6}$
	=	1,269 tCO_2				

B.6.3.2. CO_2 emissions from on-site consumption of fossil fuels (project emissions)

The project consumes fossil fuels on-site for two purposes. One is the use of diesel oil in the boiler as start-up / auxiliary fuel. The other is for on-site transportation of rice husk using diesel-fuelled dump trucks and bulldozers.

In start-up operations, 10,000 litres of diesel oil will be used several times a year[15]. Assuming conservatively as many as ten start-up operations a year, the total diesel oil consumption for this purpose will amount to about 100,000 litres or 84.39 t[16].

The IPCC carbon emission factor for diesel oil, 74,100 $kgCO_2/TJ$, and NCV, 43 TJ/kt, were used to determine the CO_2 emissions:

Fuel consumption in energy equivalent (TJ/yr)	=	Diesel oil consumption (t/yr)	x	Net calorific value of diesel oil (TJ/t)	x	Emission factor (tCO_2/TJ)
	=	84.39	x	$43. \times 10^{-3}$	x	$74,100 \times 10^{-3}$
	=	268.89	tCO_2/yr			

Diesel oil is also required to increase the efficiency of combustion when rice husk is extremely wet in the rainy season. However, with the precaution to cover rice husk with tarpaulin, such occasions are expected to be infrequent and short. Fossil fuel used for this purpose, heavily dependent of the weather, cannot be projected in advance. Due to the current high prices of fossil fuel, the Project expects its use of diesel oil to be small in quantity.

Nevertheless, the Project's diesel oil usage, be it for start-up, in the rainy season, or for any other purpose, will be accurately monitored and incorporated in the CER calculation as project emissions, using the emission factor calculated above.

As for the fuel consumption related to the on-site transportation of rice husk, it is also not possible to project the amount of fuel that will be consumed. Emissions from this source will be accounted for *ex post*.

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15 Confirmation from ATB's Power Plant Manager.

16 Assuming density of diesel oil = 0.8439kg/l (Table A3.8 Page 181 of the Energy Statistics Manual of OECD/IEA, 2004)

B.6.3.3. CH_4 emissions from combustion of biomass (project emissions)

As described in A.4.3.3, ATB's boiler will burn 144,558 tonnes of rice husk a year with a calorific value of 1,967 TJ, releasing CH_4 from the incomplete combustion process.

ACM0006 gives a default value of 30 $kgCH_4/TJ$ for the combustion of biomass residues and a conservativeness factor of 1.37. The resultant CH_4 emission factor is therefore 41.1 $kgCH_4/TJ$. Then,

Emission due to combustion of biomass at ATB plant (tCO_2e/yr)	=	Heat value of rice husk used by Project (TJ/yr)	x	Methane emission factor for rice husk combustion (tCH_4/TJ)	x	Approved GWP of CH_4 (tCO_2e/tCH_4)
	=	1,967	x	0.0411	x	21
	=	1,697	tCO_2e/yr			

The total estimated project emission for the Project is 3,235 tCO_2 per year.

B.6.3.4. CO_2 emissions from electricity consumption (project emissions)

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

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

B.6.3.5. CO_2 emissions for grid electricity generation (baseline emissions)

The emissions associated with electricity generation from plants connected to the grid are calculated as:

Emission due to displacement of electricity (tCO_2/yr)	=	Net quantity of electricity generation by the Project (MWh/yr)	x	CO_2 emission factor for displaced electricity (tCO_2/MWh)

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

Step 1: Determination of grid CO_2 emission factor (baseline emissions)

For the Project, the baseline scenario fits under Scenario 2. It also has a power generating capacity of more than 15MW. The baseline methodology stipulates that under these circumstances, the grid CO_2emission factor is to be calculated as the combined margin (CM) using the method provided in the

baseline methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Under ACM0002, the baseline emission factor is calculated as the CM, consisting of the combination of the operating margin (OM) and build margin (BM) emission factors, as detailed below.

Step 1.1: Calculation of the operating margin emission factor

The baseline methodology offers four options for the calculation of the OM: (a) Simple OM, (b) Simple adjusted OM, (c) Dispatch Data Analysis OM or (d) Average OM. Calculation using the Dispatch Data Analysis OM method, while being the first methodological choice, is not feasible as no dispatch data is publicly available for the Thai grid. Since EGAT's low-cost / must-run resources constitute less than 50% of the total grid generation, option (a), the Simple OM method, was chosen.

The Simple OM emission factor is calculated as the generation weighted average emissions per electricity unit of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$\text{Simple OM emission factor } (tCO_2/MWh) = \frac{\sum \text{Amount of fuel } i \text{ consumed by relevant power sources } j \text{ (unit fuel/yr)} \times \text{CO}_2 \text{ emission factor for fuel } i \text{ } (tCO_2/\text{unit fuel})}{\sum \text{Electricity delivered to the grid by power source } j \text{ (MWh)}}$$

where

$$\text{CO}_2 \text{ emission factor for fuel } i \text{ } (tCO_2/\text{unit fuel}) = \text{Net calorific value of fuel } i \text{ (TJ/unit fuel)} \times \text{CO}_2 \text{ emission factor of the fuel i } (CO_2/TJ)$$

The above calculations were conducted for all fuel types using the fuel consumption data from EGAT's Power Development Plan (see Annex 3 for baseline data)[17]. An illustration of the calculation is given using EGAT data for lignite in 2003 and IPCC emission factor values.

Firstly, the CO_2 emission factor is calculated:

$$\text{CO}_2 \text{ emission factor for lignite} = \text{Net calorific value of lignite (TJ/t)} \times \text{CO}_2 \text{ emission factor of lignite } (tCO_2/TJ)$$

$$= 11.9 \times 10^{-3} \times 27.6$$

$$= 1.2 \quad tCO_2/t$$

[17] Power Development Plan 2004, EGAT. The most recent available grid data (actual) is for 2003.

Multiplying this with the fuel consumption of lignite:

CO_2 emissions from lignite	=	Amount of lignite consumed by grid plants (t/yr)	x	CO_2 emission factor for lignite (tCO_2/t)
	=	16,220,000	x	1.2
	=	19,494,818	tCO_2/yr	

The total grid emissions for 2003 calculated in the same way was 64,653,234tCO_2. According to EGAT, the total electricity generated by the grid in 2003, including imports and excluding low-cost/must-run resources, was 107,898GWh. Then, the Simple OM emission factor for 2003 is:

$$\text{Simple OM emission factor} = \frac{64{,}653{,}234}{107{,}898{,}000}$$

$$= 0.60\ tCO_2/MWh$$

The 3-year average Simple OM emission factor is summarised below.

Year	**Simple OM emission factor (tCO_2/MWh)**
2001	0.62
2002	0.57
2003	0.60
Average	**0.60**

Since there was sufficient grid data to compute a 3-year average, the Simple OM emission factor is set *ex ante* as 0.60tCO_2/MWh.

Step 1.2: Calculation of the build margin emission factor

The build margin is calculated as the generation-weighted average emission factor of a sample of power plants. The sample group consists of either:

(a) the five power plants that have been built most recently, or
(b) the power plants whose capacity additions in the electricity system comprise 20% of the system generation (in MWh) that have been built most recently.

From these two options, the sample group that comprises the larger annual generation is to be chosen. In the case of the Thai grid, the latter represents a larger amount of generation.

EGAT does not make publicly available generation data on individual plants. Therefore, data from the Department of Alternative Energy Development and Efficiency (DEDE) was used. The following table details the grid data for the recent power plant capacity additions that comprise 20% for the system generation.

Table E-1: Build margin sample plants

Plant name	Commissioning date	Fuel type
EPEC (CC)	25 March 2003	Natural gas, diesel
Glow (CC)	31 January 2003	Natural gas, diesel
Ratchaburi (CC)	18 April 2002, 1 November 2002	Natural gas, diesel
Small power producers (collective)	After 28 October 2000	Renewable
Small power producers (collective)	After 28 October 2000	Natural gas
Ratchaburi (Thermal)	22 October 2000	Natural gas, fuel oil, diesel

Repeating the calculations as described in Step 1.2 for the five identified plants, the resultant BM emission factor was 0.42 tCO_2/MWh.

For the data vintage, option 1, the *ex ante* calculation was chosen.

Step 1.3: Calculation of the baseline emission factor

The CM emission factor is the weighted average of the OM and BM emission factors, where the default weightings are 50% each. As the emission factors were calculated as 0.60tCO_2/MWh and 0.42tCO_2/MWh, for the OM and BM respectively, the resultant combined margin CO_2 emission factor is 0.51tCO_2/MWh.

Step 2: Determination of incremental electricity generation

The Project's baseline scenario fits under Scenario 2. According to the baseline methodology, for such project activities, the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) simply corresponds to the net quantity of electricity generation in the project plant.

It is estimated that the Project will generate some 132,864MWh of electricity annually to supply to the grid.

Thus, the baseline emission associated with grid electricity generation is calculated as:

Emission due to displacement of electricity (tCO_2/yr)	=	Electricity exported by Project (MWh/yr)	x	Combined margin CO_2 emission factor (tCO_2/MWh)
	=	132,864	x	0.51
	=	67,760	tCO_2/yr	

B.6.3.6. CH_4 emissions for uncontrolled disposal (burning) of rice husk

As detailed in B.2, anthropogenic sources of rice husk would have been disposed of in an uncontrolled manner in the absence of the project activity. The Project is therefore directly responsible for reducing the methane emissions associated with uncontrolled disposal.

This is quantified according to the baseline methodology as:

Emission due to uncontrolled disposal of rice husk (tCO_2e/yr)	=	Approved GWP of CH_4 (tCO_2e/tCH_4)	x	Quantity of rice husk used in the ATB plant (t/yr)	x	Net calorific value of rice husk (TJ/t)	x	CH_4 emission factor for uncontrolled burning of rice husk (tCH_4/TJ)

Taking the default value of 0.0027 tCH_4/t rice husk for the product of the net calorific value and methane emission factor and using the conservativeness factor of 0.73 provided in the baseline methodology, the appropriate CH_4 emission factor is0.001971 tCH_4/t rice husk. Described in A.4.3.3, ATB will burn 144,558t of rice husk a year with a calorific value of 0.013607TJ/t. Therefore,

Emission due to uncontrolled disposal of rice husk	=	21	x	144,558	x	0.001971
	=	5,983	tCO_2e/yr			

The total estimated baseline emission is 73,743 tCO_2e per year.

The estimated emission reduction in a given year is 70,508 tCO_2e (73,743 minus 3,235).

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

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of emission reduction (tCO_2e)
2006	3,235	73,743	0	70,508
2007	3,235	73,743	0	70, 508
2008	3,235	73,743	0	70, 508
2009	3,235	73,743	0	70, 508
2010	3,235	73,743	0	70, 508
2011	3,235	73,743	0	70, 508
2012	3,235	73,743	0	70, 508
Total (tCO_2e)	22,645	516,201	0	493,556

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**BF**

Data unit:	tonne/yr
Description:	Quantity of rice husk combusted in the ATB plant
Source of data to be used:	ATB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	144,558 tonne/yr
Description of measurement methods and procedures to be applied:	The amount of rice husk deliver to the project site will be measured by weighting meter (each time trucks arrive). Data is to be aggregated monthly and yearly and will be archived electronically. The archived data will be kept during the crediting period and two years after the end of the crediting period. Quantity of rice husk on dry basis in the ATB plant (BF) will be calculated base on the moisture content in the rice husk by the following expression; BF on dry basis = (BF wet basis) *(1- moisture content)
QA/QC procedures to be applied:	Trucks carrying rice husk will be weight twice, upon entry and exit. Meters at the weighing station will be calibrated once in 2 years as per regulation. This will be checked against purchase receipts and inventory data.
Any comment:	The amount rice husk combusted is estimated from the amount of rice husk delivered to the project site considering the stocks of biomass at the beginning and end of each year. As per the methodology, an energy balance will be carried out annually, considering the stocks of rice husk at the beginning and end of each year.

Data / Parameter:	**Moisture content of the biomass residue**
Data unit:	% of water content
Description:	Moisture content of the biomass combusted at ATB plant
Source of data to be used:	On- site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	15% the conservative value
Description of measurement methods and procedures to be applied:	To measure moisture content, the measurement will be done for each truck that delivers rice husk to the site by moisture analyzer . Data is kept electronically during the crediting period and two year after the end of the crediting period.
QA/QC procedures to be applied:	Moisture content of the rice husk will be cross checked with the result from the external laboratory with international testing standard at least annually, taking at least three samples for each measurement. The moisture analyzer will be calibrated annually.

Any comment:	In case of dry biomass, monitoring of this parameter is not necessary. The mean value of moisture content will be weight average with the biomass quantity. The mean value will be calculate on monthly basis.

Data / Parameter:	**EF_{CH4}**
Data unit:	tCH_4/TJ
Description:	CH_4 emission factor for the combustion of biomass residues in the project plant
Source of data to be used:	Default values, as provided in Table 3.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0411 tCH_4/TJ
Description of measurement methods and procedures to be applied:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	IPCC default values will be used where appropriate.
Any comment:	From Table 3 of ACM0006 Version 4 , methane emission factor is 30 kg CH_4/TJ and then multiply with conservativeness factors 1.37 to get methane emission factor 0.0411 tCH_4/TJ.

Data / Parameter:	**AVD**
Data unit:	Km
Description:	Average return trip distance between biomass fuel supply sites or the origin of the biomass and ATB plant
Source of data to be used:	ATB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	120 km
Description of measurement methods and procedures to be applied:	This parameter will be recorded for each truck that delivers rice husk to the site. This will be taken from the transport measurement when the supplier agree to provide the rice husk to the site.
QA/QC procedures to be applied:	The consistency of distance records will be checked against with maps from the rick husk sources to the site.
Any comment:	The data will be held for a period of 2 years after the end of the crediting period.

Data / Parameter:	**N**
Data unit:	-

Description:	Number of truck trips for the transportation of rice husk
Source of data to be used:	ATB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	9,638
Description of measurement methods and procedures to be applied:	This parameter will be recorded continuously (each time trucks arrive). Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	The consistency of the number of truck trips with the quantity of biomass combusted will be checked and compared by the relation with previous years.
Any comment:	

Data / Parameter:	$EF_{km, CO2}$
Data unit:	tCO_2/km
Description:	Average CO_2 emission factor for transportation of rice husk
Source of data to be used:	Emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1097gCO_2/km
Description of measurement methods and procedures to be applied:	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	Cross-check measurement results with emission factors referred to in the literature.
Any comment:	

Data / Parameter:	$EF_{CO2,Diesel}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the diesel
Source of data to be used:	Use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice.
Value of data applied for the purpose of calculating expected emission reductions in	0.0741 tCO_2/GJ

section B.5	
Description of measurement methods and procedures to be applied:	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	IPCC default values will be used where appropriate.
Any comment:	As local or national data is not available therefore IPCC default emission factor from Table 2.2 Volume 2: Energy has been reported in kg of CO2 per TJ has been used. The basic conversion factor has been used to convert the value to tCO2 per GJ according to Table 1-3 SI Prefixes, Perry's Chemical Engineers' Handbook 7th edition.

Data / Parameter:	$\mathbf{FF_{project\ plant}}$
Data unit:	tonne/yr
Description:	On-site fossil fuel consumption of diesel for start-up/auxiliary use
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	84.39 tonne/yr
Description of measurement methods and procedures to be applied:	This parameter will be measured continuously by volume meter. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes..
Any comment:	The volume of diesel oil from meter will be converted to the weight by multiply with the density of diesel oil.

Data / Parameter:	$\mathbf{FF_{project\ site,i,y}}$
Data unit:	tonne/yr
Description:	Quantity of fossil fuel type *i* combusted at the project site for other purposes that are attributable to the project activity during the year *y*.
Source of data to be used:	On site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	

Description of measurement methods and procedures to be applied:	This parameter will be measured continuously by volume meter. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	The amount of fuel consumption will be monitored by fuel meters, which will undergo calibration be calibrated once in 2 years as per regulation. The consistency of the data will be checked against fuel purchase invoices.
Any comment:	Fossil fuel use at site is only diesel.

Data / Parameter:	**$EG_{project\ plant}$**
Data unit:	MWh
Description:	Net quantity of electricity generated from the ATB plant
Source of data to be used:	ATB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	132,864 MWh
Description of measurement methods and procedures to be applied:	This parameter will be measured continuously by electricity meters (main meter and backup meter). Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	The amount of the electricity generated by the Project will be monitored by electricity meters (main meter and backup meter), which will be calibrated in accordance with the strict standards set by EGAT. cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Any comment:	This is electricity export to the grid.

Data / Parameter:	**$NCV_{diesel,y}$**
Data unit:	GJ/tonne
Description:	Net calorific value of diesel
Source of data to be used:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice..
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Diesel: 43 GJ/tonne
Description of measurement methods	In case of conduct measurements shall be carried out at reputed laboratories and according to relevant international standards.

and procedures to be applied:	In case of measurements: At least every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually.”
QA/QC procedures to be applied:	Check consistency of the reliable local or national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information.
Any comment:	For the conversion factor of diesel from Btu/lb to GJ/ton is taken from Table 1-4 Perry’s Chemical Engineers’ Handbook 7th Edition (1Btu/lb = 2,326 kJ/kg = 2.32 x 10^{-3} GJ/tonne.

Data / Parameter:	**$NCV_{rice\ husk,y}$**
Data unit:	GJ/tonne
Description:	Net calorific value of rice husk
Source of data to be used:	Measurement by the external laboratory.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Rice husk: 13.607 GJ/tonne (on dry basis)
Description of measurement methods and procedures to be applied:	The NCV of rice husk will be carried out at reputed laboratories and according to relevant international standards.base on dry basis at least every six months, taking at least three samples for each measurement. Data will be kept in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	Check the consistency of the measurements by comparing the measurement results with measurements from relevant data sources (e.g values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data source, conduct additional measurements.
Any comment:	The testing result will be in unit of kcal/tonne and will be converted to GJ/tonne with simple conversion factor by multiplied 0.41868 x 10^{-6} as mention in Table 1-3 and Table 1-5 of Perry’s Chemical Engineers’ Handbook 7th Edition.

Data / Parameter:	**$EF_{burning,\ CH4,k,y}$**
Data unit:	tCH_4/GJ
Description:	CH_4 emission factor for uncontrolled burning of the biomass residue.
Source of data to be used:	Use referenced and reliable default values (e.g IPCC)
Value of data applied for the purpose of calculating expected	3 x 10^5 tCH_4/GJ

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	This parameter will be reviewed yearly. Data will be kept in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	IPCC default values will be used where appropriate.
Any comment:	Conservativeness factors will also be documented. The basic conversion factor has been used to convert the value to tCO_2 per GJ according to Table 1-3 SI Prefixes, Perry's Chemical Engineers' Handbook 7^{th} edition

Data / Parameter:	**$EC_{PJ,y}$**
Data unit:	MWh
Description:	On-site electricity imported attributable to the project activity
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Use electricity meters, PEA meter, continuously measure and Monthly record and aggregate yearly for emission calculation.
QA/QC procedures to be applied:	One-site electricity consumption will be monitored by electricity meter, which will undergo calibration annually by PEA. The consistency of the data will be checked against electricity receipt from PEA.
Any comment:	This parameter is electricity imported from grid for using within the project activity only..

Data / Parameter:	**-**
Data unit:	tonne/yr
Description:	Quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region
Source of data to be used:	Surveys or statistics
Value of data applied for the purpose of calculating expected	81,250 tonne/yr

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	This involves the use of official data released by EGAT and EPPO. Quality control of this data is beyond the control of the project operators.
Any comment:	

Data / Parameter:	**-**
Data unit:	tonne/yr
Description:	Quantity of available biomass residues of type *k* in the region
Source of data to be used:	Surveys or statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,346,003 tonne/yr
Description of measurement methods and procedures to be applied:	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	This involves the use of official data, the Thai national inventory. Quality control of this data is beyond the control of the project operators.
Any comment:	

B.7.2 Description of the monitoring plan:

In order to monitor emission reductions and any leakage effects generated by the Project, ATB will set up a well-defined management and operational system. This system includes the operation and management of the monitoring plan, which specifies the requirements and procedures for parameters monitoring, data recording and data archiving.

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

- Establishment of a transparent system for the data monitoring, collection, computation, and recording;

- Development of a protocols that provide routines procedures for electronic based data monitoring and record keeping processes, which must be fitting for independent auditing;

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

- Production and internal verification of monitoring reports in a regular basis throughout the verification period.

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

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

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: 25/01/2007

Clean Energy Finance Committee, Mitsubishi UFJ Securities Co., Ltd.
Mitsubishi Building, 2-5-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Tel: +81-3-6213-6860 Fax: +81-3-6213-6175
Email: hatano-junji@sc.mufg.jp; ktochikawa@cefconsulting.com

Mitsubishi UFJ Securities is the CDM advisor to the Project. It is a project participant listed in Annex 1.

Date of completion of PDD (Permanent change from the registered monitoring plan or applied methodology and Change to the project design of a registered project activity) : 28/11/2012

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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:

05/01/2004

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

Minimum of 25 years.

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

The renewable crediting period is chosen.

C.2.1. Renewable crediting period

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

21/12/2005

C.2.1.2. Length of the first crediting period:

Seven (7) years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

This section is intentionally left blank.

C.2.2.2. Length:

This section is intentionally left blank.

SECTION D. Environmental impacts

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

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

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

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

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

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

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

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

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

D.2. 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:

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

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

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

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

SECTION E. Stakeholders' comments

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

ATB has held numerous meetings with local stakeholders. There are 24 principal meetings held for the Pichit site.

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

E.2. Summary of the comments received:

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

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

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

G.3.1 Environmental Protection Guarantee Fund

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

During plant operation, the Fund earmarks annually a sum of 1 million baht (about US$25,000).

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

The monitoring procedure is summarized in the following table.

Performance Evaluation for:	Documentation	Comments:
Environmental well-being & compliance	- Meeting minutes of Fund Committee meetings	Committee meetings will be held on a regularly scheduled basis, with details to be finalized at the start of construction.
Environmental well-being & compliance	- Independent 3rd party assessments	Technical expert assessments by an independent third party will support the Committee's work in monitoring environmental impact.
Environmental	- Fund's bank	If local communities are compensated for

well-being & compliance	statements	environmental non-compliance, the Fund's bank will record drawdowns from the Fund.
Community resident satisfaction	- Resident comment logs	Residents within the community will be encouraged to voice concerns with the local government, who will be responsible for bringing them to the Committee. The Committee will maintain a record of residents' comments.

G.3.2 Socio-economic contribution to local communities

ATB intends to make certain that its power plants will substantially contribute to the well being of the local communities.

Many locals have become stakeholders in the Pichit Project. Biomass fuel supply sites and truckers, many of whom are residents in communities in the vicinity of the power plant sites, have entered into fuel supply and fuel transport agreements. Other local residents have been involved during plant construction as construction workers and civil work subcontractors, and during plant operation as skilled and unskilled operations and maintenance personnel. In addition, local communities have expressed strong support for ATB's plans to make low cost steam available for paddy drying, as this helps farmers achieve better margins for their crop.

The list of specific local economic development impacts include;

- Creation of construction and power plant operation jobs (All contractors and suppliers to the project are mandated to give preference to local labour);

- Training and professional development (Training in equipment operation and computers; internet access will also be available for workers);

- Increased employment opportunities in rural areas (People may choose to work locally, instead of moving to urban centres for employment);

- Increased economic activity is expected in the local communities around the plant site to meet transportation, housing, and catering needs, etc.;

- Increased prices for rice paddy (Since the Project requires large quantities of rice husk, the newly created market will likely drive up prices paid to rice traders, as well as to farmers).

G.3.3 Community Development Fund

To contribute to the local communities' social development, ATB is establishing the Community Development Fund in addition to the Environmental Protection Guarantee Fund mentioned above. The fund earmarks 1 million baht (about US$ 25,000) annually. The annual endowment is not contingent on the Project's financial performance.

Run by a committee composed of local leaders, ATB representatives and 3rd party advisors, the fund's mandate will be to design, organize, and run projects focusing on education for the youth, cultural life, and the environment.

ATB's discussions with local communities have revealed some common goals:

- Increase the number of young people continuing onto higher education (high school completion, technical college, etc.) through merit and need-based scholarships;

- Improve education experience at primary and secondary levels through donations and endowments to local schools;

- Increase computer literacy through factory-based and/or school-based computer facilities and workshops;

- Promote greater awareness and understanding of environmentally sustainable farming and irrigation techniques.

The fund will positively impact social development at community level, through streamlined, focused activities.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Grid information

The following is based on the most recent publicly available information.

Data for Simple OM calculation:

Table 1: EGAT's grid generation and fuel consumption data for 2001-2003[18]

Type of fuel		2001	2002	2003
Hydroelectric	GWh (low-cost/must-run)	6,311	6,481	7,742
	GWh (Imported from Laos)	2,885	2,807	2,438
Natural Gas	GWh	70,280	76,689	83,500
	MMSCFD	1,681	1,632	1,895
Heavy Oil	GWh	3,146	2,062	2,150
	Mlitres	783	521	533
Diesel Oil	GWh	155	258	45
	Mlitres	46	67	12
Lignite	GWh	17,307	16,890	17,134
	Mtons	15.24	15.2	16.22
Imported Coal	GWh	2,475	2,541	2,526
	Mtons	0.99	1.054	1.084
Renewable Energy	GWh (low-cost/must-run)	597	648	1,103
EGAT-TNB	GWh (Imported from Malaysia)	9	13	105
Total	GWh	**103,165**	**108,389**	**116,743**

[18] Power Development Plans for 2002 – 2004, EGAT

Table 2: Generation and fuel consumption data for recently built plants[19]

Plant name	Commissioning Date	Fuel type	Capacity (MW)	Generation (GWh)	Efficiency	Fuel Consumption	CO_2 emission (tCO_2)
EPEC	25-Mar-03	Natural Gas	350.0	1,922	7,083	14,363	805,764
Grow	31-Jan-03	Natural Gas	713.0	4,298	6,850	31,062	1,742,578
Ratchaburi	18-Apr-02, 1-Nov-02	Natural Gas	2,175.0	12,315	7,262	94,355	5,293,316
SPP (collective)	after 28-Oct-00	Renewable	192.0	1,236	-	0	0
SPP (collective)	after 28-Oct-00	Natural Gas	210.0	1,352	-	9,386	526,555
Ratchaburi	22-Oct-00	Natural Gas	1,512.0	3,451	10,110	36,810	2,065,041
Total			-	24,574[20]	-	185,977	10,433,254

Table 3: Other input variables

Source	Variable	Value	Reference[21]
Grid electricity generation	Net calorific value	(TJ/kt) Natural gas = 48.00 Heavy oil = 40.40 (residual fuel oil) Diesel oil = 43.00 Lignite = 11.90 Imported Coal = 26.70	Volume 2 Table 1-2
	CO_2 emission factor	(tCO_2/TJ) Natural gas = 56,100 Heavy oil = 77,400 (residual fuel oil) Diesel oil = 74,100 Lignite = 101,000 Imported Coal = 98,300 (anthracite)	Volume 2 Table 2.2
	Grid fuel consumption	Refer to table above	EGAT PDP
	Grid electricity generation	Refer to table above	EGAT PDP
	Electricity exported by project	132,864 MWh/yr	Calculated
Open air burning of surplus	CH_4 emission factor	0.0027 t CH_4/t biomass	ACM0006

[19] Department of Alternative Energy Development and Efficiency, www.dede.go.th/dede/ (last accessed February 2006) and Energy Policy and Planning Office, www.eppo.go.th/ (last accessed February 2006)

[20] The total generation was 116,743 GWh for 2003, the latest year for which data is publicly available. 20% of 116,743 GWh is 23,349 GWh.

[21] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, unless otherwise stated; to be updated to the latest information available at time of verification

biomass	Conservativeness factor	0.73	ACM0006
	Biomass used by project	144,558 t/yr	Calculated
	CH_4 emission factor	30 $kgCH_4/TJ$	ACM0006
	Conservativeness factor	1.37 For maximum uncertainty range of over 100	ACM0006
Transportation emission	CO_2 emission factor	1097gCO_2/km (US heavy duty diesel vehicles, uncontrolled – this is most conservative)	Table 1-32, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual
	Truck capacity	15 t	ATB data
	Return trip distance	120 km (average)	ATB data

Other data:

GWP CH_4	21
GWP N_2O	310
Mass conversion factor (tCO_2/tC)	44/12
Mass conversion factor (tCH_4/tC)	16/12

In converting volume-based fuel consumption to mass-based, the following densities were used:

Heavy oil = 0.89kg/m^3
Heavy oil densities are between 0.9 and 1.0 kg/m^3 at 15ºC. For a conservative calculation of baseline emissions, the lower limit was used, adjusted for higher temperatures (30ºC). For consistency, project emissions for on-site fuel use were calculated using the same value.

Diesel oil = 0.85kg/m^3

Annex 4

MONITORING INFORMATION

The monitoring plan is a working document that identifies the key Project performance indicators and sets out the procedures for tracking, monitoring, calculating and verifying the impacts of the Project, in particular with respect to the emission reductions of the Project.

For the purpose of determining GHG emission reductions of the project activity, the following project and baseline emissions sources shall be monitored:-

Project emissions

- CO_2 emissions from off-site transportation of rice husk that is combusted in the project plant;
- CO_2 emissions from on-site fuel consumption of fossil fuels for rice husk transportation use in the project site;
- CO_2 emissions from on-site fuel consumption of fossil fuels for Start-up/Auxiliary fuel use in the project site; and
- CH_4 emissions from combustion of rice husk for electricity generation.
- CO_2 emission from on-site electricity consumption.

Baseline emissions

- CH_4 emissions from uncontrolled burning of surplus rice husk; and
- CO_2 emissions from fossil fuel fired power plants connected to the power grid.

The following monitoring parameters, which are the key information for calculating the Project's emission reductions, will be monitored and recorded in a regular basis and in an orderly manner. They include:-

1. Quantity of rice husk combusted in the Project plant

The project includes a system for monitoring the amount of rice husk combusted (tonne/yr) As the amount of rice husk combusted is almost equivalent to the amount of rice husk delivered to the site. In order to estimate rice husk combusted more accurately, the amount of rice husk combusted is estimated from the amount of rice husk delivered to the project site considering the stocks of biomass at the beginning and end of each year. Then the rice husk inventory at the initial and final stage each year must be monitored and verified.

The plant is equipped with the scale system of truck weight to measure the delivered rice husk. The measured data will be automatically archived to the attached computer system with relevant data including the date of delivery, weight of delivered rice husk and identification of rice husk supplied site from which the husk is sourced. These archived data are controlled and managed not only for CDM monitoring use but also for operational and maintenance management use.

Once rice husk is delivered to the site, it is piled at the storage yard neighbouring to the plant in the regular manner with constant height and width, so the rice husk inventory at the storage yard can be estimated easily by ATB Pichit Staff. ATB Pichit staff will also remain the condition of storage yard on a picture as evidence.

These collected information are inputted into the Excel spreadsheet by ATB Pichit staff. ATB Pichit staff can estimate accurately the quantity of rice husk combusted in the Project plant annually with using its Excel spreadsheet.

2. Net calorific value of rice husk,

The Net calorific value (NCV) of rice husk will be measured at least every six months, taking at least three samples for each measurement. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of crediting period. Moreover, the NCV of rice husk will be measured according to national approved standards and procedures through a qualified laboratory. The testing result of rice husk might be resulted in unit of kcal/tonne and it will be converted to GJ/ton with a simple conversion factor by multiplied with 0.41868×10^{-6} which refer to Table 1-3 and 1-5 of Perry's Chemical Engineer's Handbook 7th Edition. For the conversion factor of diesel and residual oil from Btu/lb to GJ/ton is taken Table 1-4 of Perry's Chemical Engineer's Handbook 7th Edition (1 Btu/lb = 2,326 kJ/kg = 2.32×10^{3} GJ/ton.)

3. Net calorific value of diesel oil

The Net calorific value of diesel oil will be used either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available). The conservative value will be chosen.

4. Moisture content of the biomass residue

To measure moisture content, the measurement will be done for each truck that delivers rice husk to the site by moisture analyser. Data is kept electronically during the crediting period and two year after the end of the crediting period. The mean value of moisture content will be weight average with the biomass quantity.

5. On-site electricity imported attributable to the project activity

The on-site electricity consumption will be monitored by the electricity meter (PEA meter). The imported electricity will be continuously monitoring and recording by controlling system and summarized as monthly recorded. The meter will be read in unit of kWh due to the unit used in methodology the reading unit – kWh -- will be converted to MWh by a simple conversion factor dividing by 10^{3} according to Table 1-3 of Perry's Chemical Engineer's Handbook 7th Edition.

6. Methane emission factor for combustion of rice husk at ATB plant

This parameter will refer to the latest IPCC guidelines at the time of verification and it will be reviewed yearly. The data will be kept in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

7. AVD

The amount of aggregated off-site transportation distance (km/yr) of rice husk will be monitored and verified through the receipts of rice husk acceptance. The plant is equipped with the scale system of truck weight to measure the delivered rice husk. Once truck arrived at the project site, specific information including date of arrival, biomass fuel supply sites of transportation origin, truck scale and so on are inspected and archived automatically on the attached computer. The data is collected by ATB Pichit staff and controlled using Excel spreadsheets for verification use. But it is true that the data is controlled not only for CDM monitoring use but also for operational and maintenance management use.

The distance between each biomass fuel supply sites or the origin of the biomass and project site can be estimated accurately using map or actual truck driving meter in advance.

Therefore by aggregating these data, the ATB Pichit staff can estimate accurately total amounts of off-site transportation distance between biomass fuel supply sites or origin of the biomass and project site during the process of initial or periodic verification.

8. **Number of truck trips for the transportation of rice husk**

This parameter will be recorded continuously (each time trucks arrive). Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period. The consistency of the number of truck trips with the quantity of biomass combusted will be checked and compared by the relation with previous year.

9. Average CO_2 emission factor for transportation of rice husk

The latest version of IPCC guidelines at the time of verification will be applied and it will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

10. On-site fuel consumption of fossil fuel used for rice husk transportation

The amount of diesel oil (tonne/yr) used inside the Project site for rice husk transportation will be monitored and verified through the measurement system installed at the outlet of oil tank. The volume of diesel oil from meter will be converted to the weight by multiply with the density of diesel oil.

This collected data is also managed not only for monitoring use but also for operational and maintenance use. And it is controlled using Excel spreadsheets at the project site for monitoring use. Therefore by aggregating these data, the ATB Pichit staff can calculate accurately total amount of on-site fuel

consumption of fossil fuel used for rice husk transportation in the project site during the process of initial or periodic verification.

11. CO_2 emission factor for diesel

The latest IPCC guidelines at the time of verification will be applied. This parameter will be reviewed yearly and data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period**.**

12. On-site fuel consumption of fossil fuel used for boiler start-up

The plant consumes diesel oil for plant start-up and also auxiliary use at burner combustion. The amount of diesel oil (tonne/yr) used for it will be monitored and verified through the measurement system installed at the outlet of oil tank. The volume of diesel oil from meter will be converted to the weight by multiply with the density of diesel oil.

This collected data is also managed not only for monitoring use but also for operational and maintenance use. And it is controlled using Excel spreadsheets at the project site for monitoring use. Therefore by aggregating these data, the ATB Pichit staff can calculate accurately total amount of on-site fuel consumption of fossil fuel used for boiler start-up and auxiliary during the process of initial or periodic verification.

13. Amount of electricity exported to power grid

The electricity exported to power grid (MWh/yr) is monitored continuously and verified by ATB and EGAT. The main exported meter and backup meter locates at the substation neighbouring to the plant.

This collected data is also managed not only for monitoring use but also for operational and maintenance use. And it is controlled using Excel spreadsheets for monitoring use.

14. Power grid emission factor

Since the rice husk power generation capacity (22.5 MW) is more than 15MW, grid emission factor is calculated as a combined margin (CM), which is average of operating margin (OM) and build margin (BM). Operating margin (t-CO_2/MWh) will be calculated with using both the amount of electricity generated (MWh/yr) according to generating type and fuel consumptions (tonne/yr or cubic meters/yr) on according to generation type. Those data will be acquired through data book disclosed by Electricity Generating Authority of Thailand (EGAT) and will be reviewed by project participant per crediting period. Build margin (t-CO_2/MWh) will be estimated using the data of commissioning (month/year), capacity (MW) and up-to-date generated power (MWh) for past five years and it is also updated per crediting period with the available information from Thailand Greenhouse Gas Organization (TGO).

15. Default values

All default values or other default values used in the spreadsheets "Baseline Emissions", "Leakage Emissions" and "Project Activity Emissions" to calculate the GHG emissions, will be annually verified in

the respective source data and the emissions determined using always the most recent default values available. All default values used in the GHG emissions calculation in the Project are given below, and those are reviewed by ATB head office staff;

- Baseline CH_4 emission factor for uncontrolled burning of rice husk (t-CH_4/TJ), which is used by multiplying conservative factor (0.73).
- Emission factor per fuel for grid generating power (t-CO_2/TJ), which is used to estimate power grid emission factor.
- Average emission factor for the trucks (t-CO_2/km), which is used to estimate off-site rice husk transportation emissions.
- Diesel oil calorific value (TJ/t), which is referenced by some data book disclosed by PTT, Thailand's only fully-integrated gas company or other Thai agencies.
- Diesel oil emission factor (t-CO_2/TJ), which is used to estimate on-site rice husk transportation emissions and on-site boiler start-up/auxiliary use emissions.
- CH_4 emission factor for the combustion of rice husk in the project plant (t-CH_4/TJ), which is used by multiplying conservative factor (1.37).

16. Rice husk leakage estimation

The main potential source of leakage for this project activity is an increase in emission from fossil fuel combustion due to diversion of rice husk from other uses to the Project plant as a result of the project activity. The following option is used to demonstrate that the rice husk used in the Project site does not increase fossil fuel consumption elsewhere. It is required to demonstrate that there is an abundant surplus of the rice husk in the region of the project activity, which is not utilized. For this purpose, ATB needs to demonstrate that the quantity of available rice husk in the region (tonne/yr) is at least 25% larger than the rice husk that is utilized (tonne/yr), including Project plant quantitatively. Those data are collected through national inventory and will be reviewed by ATB head office staff per verification period. And in the Project, the region, in which leakage should be considered, will cover a radius around Project site of less than 200km defined in the ACM0006.