

Summary of the Feasibility Study for the Co-generation Project at a Rice Mill in Cambodia

(1) Basic Elements for the implementation of the Project

Summary of the proposed project and background of the project proposal

This project involves the construction of a co-generation power plant adjacent to Angkor Kasekam Roongroeung Co., Ltd (AKR), the largest fragrant rice mill in Cambodia located in Angsnul Village of Kandal Province. The electrification rate of Cambodia is only about 20% and its beneficiary is limited to the capital city of Phnom Penh. Therefore, businesses such as AKR have resorted to captive power generation mainly using diesel oil. As a result, AKR face the following problems.

- High prices of petroleum products in Cambodia
- AKR is planning to expand its operation from the current production of 10 tons of rice husk per hour to 30 tons per hour by year 2005.
- It is difficult for AKR that responds to demands of fragrant rice within Cambodia and overseas to manage the large amount of rice husk generated as waste.

In order to solve these problems as well as to contribute to sustainable development of Cambodia, AKR has established a special purpose company, Angkor Bio Cogen (ABC) in August 2004 to proceed with the plan to implement the rice husk power generation project. ABC plans to sell all of its electricity to AKR while AKR plans to sell any surplus electricity to residents in the neighboring village at low price.

The purpose of this project is to develop a technology that is in line with Cambodian national situation, is acceptable to stakeholders and contributes to the reduction of greenhouse gas emissions. In addition, the Project aims to procure adequate funding to introduce the most suitable technology for Cambodia's first rice husk power generation through increasing the possibility of project implementation by obtaining carbon credits

Description of the host country

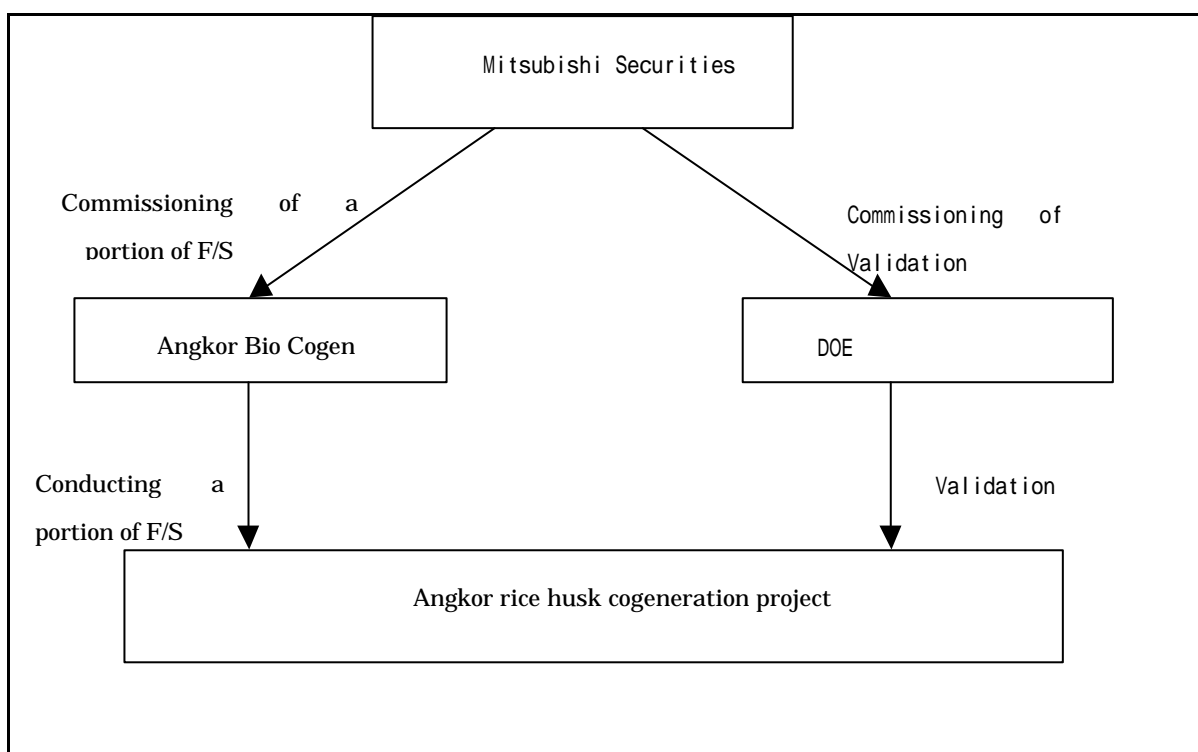
At present, after a long civil-war period, 10 years have passed since Cambodia has laid its hands on redevelopment of the country in peace. The areas capable of accessing grid electricity are still limited to the capital of Phnom Penh and its surroundings while most private households rely on firewood for cooking and oil for lighting. Businesses, such as restaurants and hotels operate on captive power using sources, such as diesel oil. In Cambodia, fragrant rice is its main staple while also an important export item. AKR also exports its rice to overseas, such as Europe. For Cambodia that needs to promote rural electrification for economic development while being responsible for sustainable development as a signatory to Kyoto Protocol, exploration of the use of biomass energy sources has a significant meaning.

CDM/JI approval criteria of the host country, establishment of DNA, CDM policy and status

Cambodia ratified Framework Convention of Climate Change in December 1995, Kyoto Protocol in August 2005 and made CDM sustainability criteria publicly available in December 2004. The sustainability criteria include environmental protection and improvement, improvement of national income and quality of life, transfer of appropriate and applicable technologies including capacity building and economic benefits. This set of criteria is almost complete and awaits formal government approval in the near future. The framework required for CDM project approval, such as the establishment of technical subcommittees under the DNA is already formed. It was confirmed during the interview with the Cambodian Ministry of Environment that the project evaluation can start before the formal government decision on the sustainable development criteria. Cambodian government has high expectation for CDM and this project, when implemented, will be Cambodia's first biomass power generation project.

Implementation framework of the study (domestic, host country, others)

The implementation framework of the study is as follows.



(2) Project planning

Detailed description of the Project

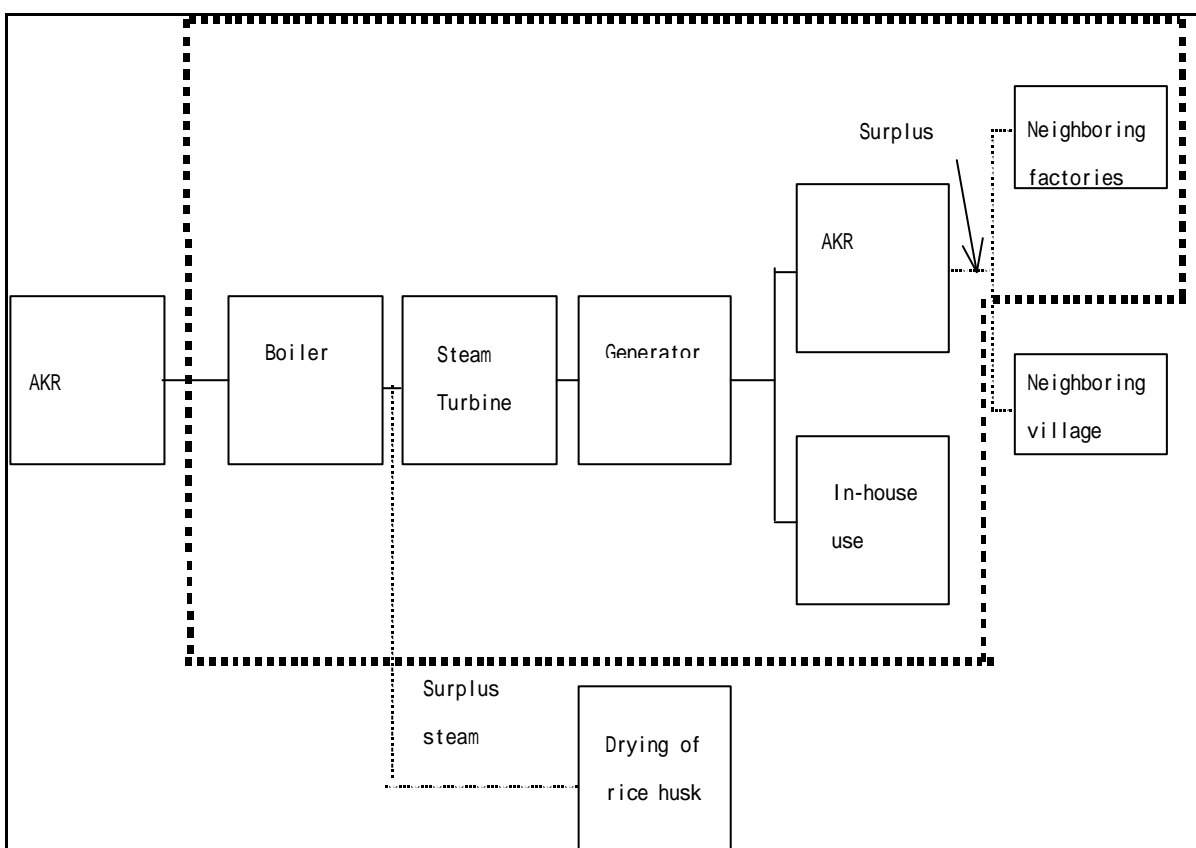
In this Project, a cogeneration power plant with the capacity of 1.5MW will be constructed. All electricity generated will be sold to AKR replacing the diesel oil AKR currently uses for power generation. If the Project is not implemented, the rice husk will continue to be left outdoors emitting methane gas. Therefore, the Project will also avoid the emissions of methane. Additionally, the Project will generate excess steam which will be used to dry rice husk, however, as the rice husk is currently dried naturally, the use of steam will not contribute to the reduction of GHGs. Basic information of the cogeneration plant is as follows.

Generation capacity	1.5Mwe
Electric system	3phases, 400volts
Operating hours	7,920 hours/year
Operation life	25 ~ 30years (when operation is available for 7,000 ~ 8,000 hours/year with proper maintenance)
Electricity generated (gross)	11,880MWh/year (1.5MWe × 7,920 hours/year)
Of which parasitic consumption	1,782MWh/ year
Sales to AKR	10,098MWh/ year

Project boundary, baseline setting, demonstration of additionality

1) Project boundary

The Project boundary is as follows, determined in accordance with the simplified modalities and procedures for small-scale CDM project activities, type I.A for the displacement of diesel oil and type III.E for methane avoidance respectively. Because ABC will sell all of its electricity to AKR, AKR's sales to neighboring villagers is not included in the project boundary.



2) Baseline emissions

Baseline emissions are determined as follows.

a) Baseline emissions for displacement of diesel use at AKR

Option 2 in the Type I.A. (Type I.A.), Simplified modalities and procedures for small-scale CDM project activities was used. The calculation resulted in 9,088tCO₂/year.

b) Baseline emissions for avoidance of methane from stockpiling of rice husk.

Calculation was carried out according to Type III.E, Simplified modalities and procedures for small-scale CDM project activities (Type III.E.). First, methane emissions factor was arrived at 0.0616 and then the baseline emissions were calculated as 33,810tCO₂/year.

3) Demonstration of additionality

The following three baseline scenarios were considered.

1. Stockpiling until natural decomposition
2. Open burning
3. Implementation of the Project without CDM

Scenario 1 is the common practice of rice husk disposal in Cambodia and there is no likelihood for regulations enforcement in this area. Scenario 2 may bring emissions of toxic materials and dangers of fire hazard. As it poses a big impact on the community, it is unlikely to be adopted as a common practice. Therefore, Scenario 1 is the baseline scenario.

Scenario 3 is faced with technological barrier and barrier due to prevailing practice, therefore not the baseline scenario. Additionality of this Project is demonstrated through analysis of these barriers.

GHG emissions reductions by the Project and leakage

1) Project emissions

According to the Volume 3 of 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, biomass is carbon neutral, thus no emissions of CO₂ is accounted for in this Project. However, when emissions of CH₄ and N₂O are calculated according to Type III.E, the amount of project emissions is estimated at 2,917 tCO₂/year.

2) Emissions reduction

Emissions reduction of the Project is as follows.

Year	Baseline emissions		Project emissions	Emission reductions
	CO ₂ emissions from diesel electricity generation (CO ₂ tons)	CH ₄ emissions from rice husk piled at the disposal site (CO ₂ e tons)	CH ₄ and N ₂ O emissions from rice husk fuelled electricity generation (CO ₂ e tons)	Emission reductions (CO ₂ e tons)
2,007	9,088	33,810	2,917	39,981
2,008	9,088	33,810	2,917	39,981
2,009	9,088	33,810	2,917	39,981
2,010	9,088	33,810	2,917	39,981
2,011	9,088	33,810	2,917	39,981
2,012	9,088	33,810	2,917	39,981
2,013	9,088	33,810	2,917	39,981
Total	63,616	236,670	20,419	279,867

Also, in consideration of leakage, it has been made clear that there is adequate of supply of rice husk from neighboring rice mills, therefore, there will be no leakage; i.e., from brick factories that currently use rice husk as fuel switching to using fossil fuel.

Monitoring plan

Monitoring plan has been developed according to Type I.A. and Type III.E. The following items will be monitored.

1. Amount of electricity generated (MWh)
2. Amount of biomass fuel treated (tons)
3. Energy content of biomass fuel (TJ/ton)

There is no monitoring with regards to leakage, as it is not required by Type III.E.

Environment and other indirect impact

Power generation projects with capacity less than 5 MW, including this project, are not subject to Environmental Impact Assessment requirements under Cambodian regulations. It is deemed the Project will not bring negative impacts to the environment.

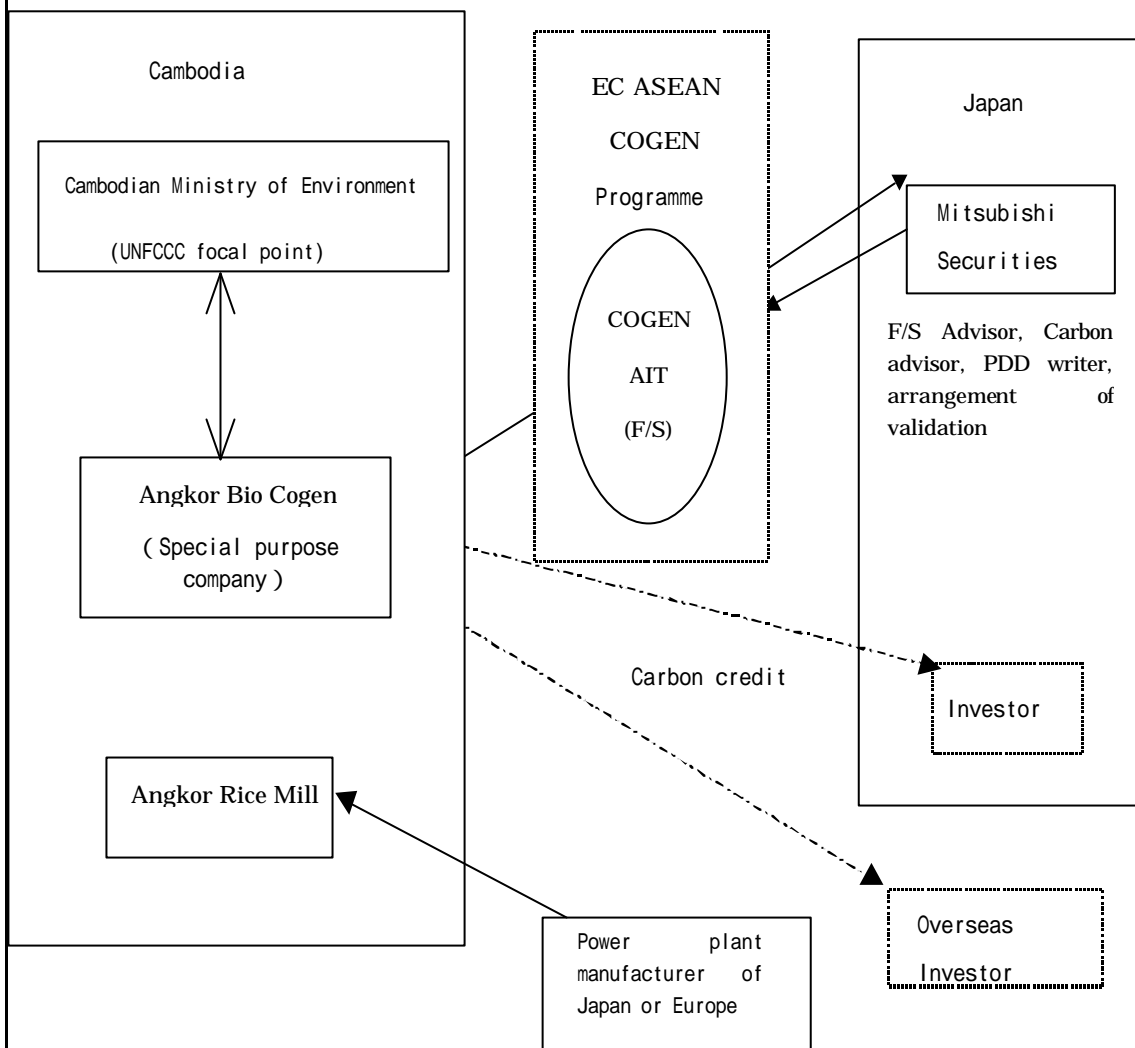
Stakeholder comments

ABC conducted a public hearing session in September 2004 to gather comments from 22 people consisting of workers of the rice mill, Angsnul villagers and other residents around the project site. Every person who attended the session expressed support for the Project.

(3) Towards implementation

Implementation framework (domestic, host country, others)

The implementation framework of the Project is as follows. No specific investors have been determined.



Financial plan

The total initial investment cost is 3.5 million USD. The cost of the boiler and turbine generator expected to be installed for the Project is approximately 2 million USD. The cost incurred for planning and designing is about 259,000 USD. Engineering and installation cost about 518,000 USD.

Cost Benefit Analysis

The benefit compared to cost of this project is as follows.

$$3,463,800 \text{ (USD) } \div 279,867 \text{ (tCO}_2\text{/7years) } = 12.4 \text{ (USD/ tCO}_2\text{) }$$

The cost benefit ratio is not attractive, requiring reconsideration of the initial investment cost.

Plans and issues towards implementation

Even though ABC, as a result of the implementation of this project, will be a pioneer in the renewable energy sector in Cambodia, it will also undertake a high risk in terms of implementing a project in an unknown arena. The country risk of Cambodia must also be taken into consideration when overseas investors are involved. Compared to other Southeast Asian countries, Cambodia's country risk is extremely high. Given such condition, the IRR needed for projects attractive to investors in Cambodia is 25% or higher.

The IRR for this project is 17.9% without revenues from CERs, significantly lower than the 25% threshold needed for attracting investment. One of the main reasons for the Project not attracting investors at this point is low IRR, therefore, ABC has high hopes for the Project to obtain the CDM status to attract investors.

(4)Validation

Validation, outline of the desk review

The DOE selected for the Project, Det Norske Veritas Certification (DNV) conducted the desk review and provided feedback based on the following viewpoints.

- Whether or not the Project meets the requirements of CDM projects as set forth in Article 12 of the Kyoto Protocol as well as the requirements for small-scale CDM projects set forth under Clause 2 of the said Article.
- Whether or not the PDD meets requirements set forth in its each section.
- Clarifications to be made during the site visit.

Process of the review by DOE

Validation is conducted according to the following process. So far, the Project has proceeded to Step

Submission of draft PDD to DOE (17 January 2005)

Receipt of the Customized Protocol, the result of the desk review, from DOE (31 January 2005)

Site visit (2~3 February 2005)

Receipt of the feedback from DOE based on the site visit (February 2005)

Submission of the revised PDD based on Step to DOE (7 February 2005)

Receipt of the Preliminary Validation Report from DOE (outstanding)

Submission of the PDD for public comments by DOE (outstanding)

Visits were made to Cambodian Ministry of Environment (MOE), Ministry of Industry (MIME) and ABC during 2~3 February 2005 with an inspector from DNV, a DOE based in Norway. At MOE,

questions were asked mainly on Cambodia's sustainability criteria for CDM projects and whether the Project meets the criteria. In response, MOE commented that the decision will be made during the formal approval process of the Cambodian government.

At MIME, questions were asked on its renewable energy promotion policy, what MIME requires in CDM projects and other policy related matters. In response, MIME commented that Cambodia has no policy targeted for biomass power generation and like MOE, MIME also requires that CDM projects contribute to Cambodia's sustainable development.

At ABC, questions were asked mainly on the monitoring procedure. Response from ABC was satisfactory. DNV has yet to provide a formal report, however, unofficial comments after the site visit indicate that all clarification points have adequately been explained.