Feature Article

Malaysian Clean Development Mechanism (CDM) Projects**

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INTRODUCTION

Parties of the United Nations Framework Convention on Climate Change are committed to *protect the climate system for the benefit of present and future generations of mankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities*. Since the Kyoto Protocol came into force on February 2005, many non-Annex 1 countries have gained momentum into identifying and developing projects, which can reduce the emission of identified greenhouse gases. Implementation of such projects can make them eligible for certified emission reductions, which can be translated into economic gains. Malaysia to date (31 July 2006) has seven registered projects with the CDM Executive Board. All these seven projects use renewable energy resources from the palm oil mills, replacing fossil fuel.

This accomplishment would not have been possible if not for the determination of Malaysia to play its role in mitigating climate change. The co-ordinated efforts of the various national supporting agencies, Annex 1 country participation and active Malaysian industrialists are highly commendable. *Figure 1* summarizes the various steps in the preparation cycle of a CDM project.

A number of criteria set by the international body must be fulfilled for a project to be approved as a Clean Development Mechanism or CDM project. The most important being the additionality criterion, *i.e* the project must result in the reduction of emissions that would not have occurred in the absence of the project. The emission reduction must be measurable, real and sustainable too. The project must also be developed in compliance with the domestic policies and strategies of the host country and also must uphold its sustainability development policies.

ADVANTAGES OF CDM

The appeal of CDM lies in the fact that it combines an incentive mechanism, in particular, for the project developer, where the final sale of Certified Emission Reduction (CERs) or *carbon credits* represents an additional source of project income. Secondly, the CDM may be a solution for the reduction and diversification of risks, which is likely to interest companies or

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1. Develop a CDM project activity
2. Approval by the host and investing parties
3. Validation and registration of the CDM project activity
4. Monitoring of the CDM project
5. Verification, certification and issuance of CERs
6. Distribution of CERs

Figure 1. CDM project cycle.

Source: Adapted from *CDM Manual 2005 for Project Developers and Policy Makers*. Ministry of the Environment, Japan Global Environment Centre Foundation.

groups faced with domestic greenhouse gas (GHG) emission reduction objectives, particularly in the immediate term, as part of the European Union Emission Trading Scheme (EU ETS). The implementation of CDM projects may also be part of the company's consideration in realizing the environmental strategy in the host country and abroad by enhancing both its global competitiveness and image.

However, on the downside, the development of a CDM project incurs additional costs for the project developer known as *transaction costs*. These costs are related to the formalization and validation of the CDM project, as well as monitoring and verification of the emission reduction. Thus, only projects that can generate significant emission reduction are favoured.

However, it is observed that the transaction cost, initially significant for the first CDM project can be reduced considerably for development of subsequent projects. When more personnel, are trained and as the CDM procedure modalities become more familiar and widespread, the CDM screening for eligibility and profitability may then become a norm of any emission reduction projects provided that the CDM rules and regulations stabilizes as more projects get implemented. It is interesting to note that to date (31 July 2006) a total of 7 994 116 t CO_{2e} CERs have been issued by the Executive Board. This has reassured the various stakeholders of CDM projects that the mechanism is in order and has been successfully implemented too.

MALAYSIAN CDM PROJECTS

The seven Malaysian CDM projects of Malaysia are as summarized in *Table 1*. All of them are small-scale project activities except the project carried out by Lafarge Malaysia Cement Bhd. Technically, there are only four project types as the Seguntor Bioenergy and Kina Biopower are similar in utilizing biomass from palm oil mills to generate electricity and supplying to the grid. The projects at Lumut PGEO Edible Oils, Lahat Datu Edible Oils and Sandakan Edible Oils are all biomass steam and power plants in refineries, which also utilize empty fruit bunches (EFB) from the surrounding palm oil mills. The project at Sahabat Complex will also use EFB but the steam and power are utilized within a bigger integrated manufacturing complex including supplying electricity for residential use. The Lafarge Malaysian Cement Bhd project is a direct displacement of a significant amount of coal with palm kernel shell for heat generation only.

The various projects are as described, illustrating briefly the technical aspects and how these various projects fulfill the global approach to climate change by emission reduction and meeting the essential sustainability, additionality criteria and development strategies adopted by Malaysia.

SAHABAT EMPTY FRUIT BUNCH BIOMASS PROJECT

FELDA Palm Industries will use the waste EFB for electricity and steam generation. The project involves the construction of a 7.5 MW turbine generator equipped with auxiliary facilities such as boilers, water demineralization plant, cooling tower, air pollution control devices and EFB storage yard. Currently, stand-alone diesel generators are owned and operated by the Sahabat Oil Products (SOP refineries) or through FELDA Engineering Services Sdn Bhd (FESS) and Sahabat Bulkers supplying the power generated for industrial and domestic use at the Sahabat Complex.

The main processes and major power consumers, located at the Sahabat Complex, are Sahabat Oil Products and Sahabat Kernel Crushing Plant. Sahabat Bulkers consumes large amounts of electricity only when there is a shipment of crude palm oil.

Sahabat Bulkers was generating electricity for Bandar Sahabat Resort and the staff quarters until July 2001. The electricity generation and distribution was then carried out and managed by FESS. FESS generates its own electricity to supply the Bandar D settlement and Bandar C township. However, owing to an increase in demand from both commercial and domestic customers, FESS, has installed additional two diesel generators of 500 kW each at Sahabat Complex.

The Sahabat Oil Products refinery also requires steam for its operations, which it currently generates through two oil-fired boilers. The maximum steam demand for the refinery is 16 t hr^{-1} at a pressure of 12.5 bar. The steam will be supplied by the power plant and its cost will be charged to the refinery based on its cost of production.

The development of this biomass plant will have a positive effect on the waste disposal problems faced by various mills at Sahabat Complex, diverting waste away from incineration, reducing the stress on composting capacity, and significantly reducing the amount of EFB currently used as mulch. A biomass utilization scheme, such as this, also presents an opportunity to promote alternative waste management strategies.

Other expected benefits from the project include:

- the multiplier effect of this investment is likely to bring additional benefits such as increased employment opportunities, in the area where the project is located. It increases diversity and security of electricity supply;
- it contributes towards a decrease in fuel imports; and
- the project will act as a clean technology demonstration project, encouraging development of biomass facilities throughout Malaysia, which could be replicated across the region.

The proposed activity, with its 7.5 MW installed capacity using additional boilers, will directly reduce GHG emissions from existing and future generation of electricity and steam production that use fossils fuels. Under the baseline scenario for the two components, there would be continued use of diesel generation to provide both electricity and steam to industrial, commercial and residential consumers within the Sahabat complex. The project will displace the use of diesel for electricity and steam generation with a carbon neutral alternative, *i.e.* use of EFB. However, the project will still results in some emissions from the use of diesel generators during annual maintenance period.

BIOMASS ENERGY PLANT – LUMUT, LDEO BIOMASS STEAM AND POWER PLANT AND SEO BIOMASS STEAM AND POWER PLANT

Biomass Energy Plant - Lumut

This project involves the installation of a modern, high efficient 30 t hr^{-1} capacity, 29 Bar(g) biomass-fired cogeneration system to supply steam and electricity to the PGEO palm oil refinery in Sitiawan, Perak, Malaysia.

The project will be implemented in two stages. At the first stage, 15 t hr^{-1} of steam will be generated for the palm oil refinery process consumption and 3 t hr^{-1} will be used to provide cooling through a new absorption chiller system. This new absorption chiller system will replace an existing 650 RT (refrigerant tonne) electrically powered chiller system. The second stage of the project will be optimizing the steam energy by installing steam turbine and generator to supply 2 MW of electricity for the refinery own use.

LDEO Biomass Steam and Power Plant and SEO Biomass Steam and Power Plant

These two projects aim to use EFB as fuel for a modern, high efficient 35 t hr^{-1} capacity, 29 Bar(g) biomass-fired co-generation system to supply steam and electricity to the palm oil refinery. The project will be implemented in two stages where at the first stage 35 t hr^{-1} of steam will be generated for the palm oil refining process. The second stage will be to optimize the steam energy by installing a steam turbine generator to supply up to 5 MW of electricity for the refining process too. The projects shall be respectively sourcing EFBs from the vicinity via fuel purchase agreements.

Emission Reductions

Each of the project activity will be able to reduce emissions in three ways. First is by displacing fuel oil, which is used to generate 15 t hr^{-1} steam. Second and third are by displacing electricity from the national grid by replacing existing chiller system and generating electricity. The energy plant will be sourcing the biomass waste from neighbouring palm oil mills via fuel purchase agreements.

The palm oil refinery is currently operating a fuel oil fired boiler plant to supply steam for the refining process and also purchase power from the electricity grid. The project is to reduce the amount of steam produced from fuel oil and grid generated power and thus reduce GHG emissions, the fuel oil fired boiler plant and the national electricity grid.

Such project type illustrates sustainability in various aspects. These include:

Sustainable development. The use of sustainable renewable energy sources in a highly efficient manner is in line with the country's development policy of renewable energy as a fifth fuel. This will lead to a greater self-sufficiency of fuel for the energy sector. Currently, fuel oil is subsidized and the project will directly lead to reduction of subsidized fuel oil for the refinery and lead to reduction of gas and oil subsidies in the Malaysian power sector, as it will produce its own power and displace conventional power from the grid. Such a project will also lead to technology and knowledge transfer from Denmark to Malaysia to facilitate local manufacturing of high efficient biomass boilers, ensure local employment and reduce foreign expenditures.

Environmental sustainability. Decision to intensify the development of renewable energy as the fifth fuel resource under the country's Fuel Diversification Policy, as stipulated in the objectives of the Third Perspective Plan Outline for 2001-2010 (OPP3) and the Eighth Malaysia Plan including pollution control systems for the flue gas and proper disposal of ash

and wastewater will comply with the local environmental regulations.

Social sustainability. Requires more skilled staff than the existing plant as the capacity is higher due to the additional grid connected electricity generation. The current workforce will be trained to operate the new plant and additional qualified staff will be employed. The project also gives an opportunity to manufacture and sell high efficiency boilers.

Economic sustainability. The fuel source is a sustainable, indigenous resource, which reduces fuel imports thus reducing the foreign exchange. This project will also eliminates the risk of fluctuating oil price enabling a more economic and reliable production.

The GHG emissions from the project activity is additional and would not have occurred without the proposed project activity.

In the absence of the project activity, the most likely scenario would be that the refinery would continue to operate using oil-fired boilers and purchase all the electricity from the grid. There are limited alternatives to oil firing, as the area does not have access to the natural gas distributions grid, which could have been an alternative that would reduce the GHG emissions.

REPLACEMENT OF FOSSIL FUEL BY PALM KERNEL SHELL BIOMASS IN THE PRODUCTION OF PORTLAND CEMENT

Lafarge Malayan Cement Bhd (LMCB) has exclusively developed the technology and skills to substitute a significant percentage of the coal used at its Kanthan and Rawang plants with palm kernel shell.

The manufacture of cement is a high energy intensive activity. The vast proportion of this energy is required to heat the raw materials to a level that brings about the necessary chemical change to create cement clinker. In Malaysia, the heating process is predominantly achieved through the firing of coal although some plants have in recent years also started consuming other fossil fuels such as *e.g.* pet coke.

The substitution of biomass for fossil fuels in the cement manufacturing process in Malaysia provides significant contribution to boost Malaysia's sustainable development plans. LMCB currently sources all of its coal supplies from overseas. The substitution of imported fossil fuel with locally available biomass will not only reduce Malaysia's dependence on imports, but also gives rise to environmental benefits from preserving fossil fuels and utilizing a waste biomass stream.

The decision to substitute fossil fuel with biomass is a positive action to reduce the GHG, carbon dioxide (CO_2) from the cement manufacturing process. This action is also consistent with Lafarge's global target to reduce CO_2 emissions by 20% from 1990 to 2010.

The technology to process and use palm kernel shell has been developed in a partnership with Blue Circle Industries' Technical Centre in Europe based on their experience of combustion of alternative fuels. Knowledge and expertise have been actively transferred in the development of the project by design work in Europe and European expert deployment in Malaysia during design, construction and subsequent follow-up adjustments and performance monitoring. Training of staff and engineers has also been provided during the design and commissioning stage of the project.

SEGUNTOR BIOENERGY AND KINA BIO POWER 11.5 MW EFB POWER PLANT

The purpose of the project activity is to utilize EFB (an abundant waste product of the palm oil milling process), as the primary biomass fuel for power generation with gross generation capacity of 11.5 MW (10 MW net) at Sandakan, Sabah in Malaysia.

The majority of the electricity generated (87%) will be sold to the Sabah Electricity Sdn Bhd (SESB) distribution grid by interconnecting to the 22/11 kV nearby substation under the Small Renewable Energy Programme (SREP) stipulated by the Government of Malaysia, while the balance (13%) will be provided for the project plant in-house (parasitic) consumption.

Four nearby palm oil mills in the vicinity of the project will be the EFB suppliers. Each project activity will produce approximately 92 681 MW hr annually for the electricity supplied to the SESB grid and plant in-house consumption.

The projects will contribute to sustainable development of Malaysia in two areas: production of biomass generated renewable energy - the project activity conforms to the Malaysian Government policy and contributes to sustainable development by providing electricity through biomass power generation without depending on conventional fossil fuel combustion. The electricity generated will be supplied to the SESB grid and displace part of its fossil fuel generated electricity.

Utilization of disposed agricultural waste by utilizing the EFB waste as primary fuel for power generation, the project activity prevents EFB from being left to decay, which would lead to uncontrolled methane emission and putrid odour. In the absence of the project, the likely fate of the EFB at these mills is to leave it to decay in the open air resulting in emitting biogas containing methane, a potential GHG and a potential fire hazard.

The implementation of the project activity is hindered by the following barriers:

Investment Barrier

The equipment cost for grid-connected biomass power plants are significantly higher than that for GHG-intensive conventional fossil fuel power plants which are comparatively lower, increasing their attractiveness in long-term; this is still insufficient to increase project returns to the level attained by conventional plants. In developing countries, like Malaysia, where short-term minimization is important, grid-connected biomass power projects do not represent an attractive course of action.

Although the Malaysian Government has the SREP policy to encourage private entity which generates power from renewable biomass to sell part or all of its output to TNB/SESB, tariff is set at around RM 0.17 kW hr, with renewable power projects enjoying no special tariffs, despite the higher investment costs. The current electricity pricing structure gives comparative advantage to conventional power projects.

The additional revenue from the sale of CERs will increase the project return to a more acceptable level, enabling the implementation of the project. Without this extra source of income, the low return combined with the real and perceived risks involved can make the project unattractive to investors.

Barriers Due to Prevailing Practice

There are currently no regulations for the management of EFB waste except for the general ban on open-air burning as stipulated in 1998 amendments to the Environmental Quality Act of 1974. As there is also no standard technology to manage EFB waste, it is obvious that without incentives in the form of carbon credits, the most likely scenario for EFB waste at the palm oil mills is to leave it to decay in open-air, resulting in uncontrolled emission of GHGs.

Using biomass waste as fuel for electricity generation is not a standard waste management practice in Malaysia,

TABLE 1. CDM PROJECTS OF MALAYSIA

No.	Project title	Host parties	Other parties involved	Activity category	Methodologies used	Amount of reductions	Registration date	Crediting period
1	Biomass Energy Plant - Lumut PGEO Edible Oil Sdn Bhd Lumut Port Industrial Park Block G5	Malaysia authorized participants: ENCO Energy Sdn Bhd	Denmark authorized participant: Royal Danish Ministry of Foreign Affairs	1-Energy industries	Thermal energy for the User	32 545 t CO_{2e} p.a	24-Feb-06	1- Feb- 06 - 31-Jan 12 (Renewable)
2	Replacement of fossil fuel by Palm Kernel Shell Biomass in the production of Portland Cement - Larfarge Malaysia Cement Bhd, Rawang - Kanthan Works Selangor	Malaysia authorized participants: Lafarge Malayan Cement Bhd	France authorized participant: Lafarge S.A.	4-Manufacturing industries	Emissions reduction through partial substitution of fossils fuels with alternative fuels in cement manufacture	61 946 t CO_{2e} p.a	7-Apr-06	1- May- 00 - 30 Apr 10 (Fixed)
3	Sahabat Empty Fruit Bunch Biomass Project Felda Sahabat Lahad Datu, Sabah	Malaysia authorized participants: Felda Palm Industries Sdn Bhd	United Kingdom of Great Britain and Northern Ireland	1-Energy industries	Thermal energy for the user	53 986 t CO_{2e} p.a	23-Apr-06	1- Jan- 06 - 31-May 12 (Renewable)
4	LDEO Biomass Steam and Power Plant in Malaysia LDEO Palm Oil Refinery Lahad Datu, Sabah	Malaysia authorized participants: LDEO Energy Sdn Bhd	Canada authorized participant: Landfill Gas Canada Ltd.	1-Energy industries (renewable-/non-renewable sources), 13-Waste handling and disposal 15-Agriculture.	- Thermal energy for the User - Avoidance of methane production from biomass decay through controlled combustion	208 871 t CO_{2e} p.a	10-Jun-06	1-Jun-06 31-May 13 (Renewable)
5	SEO Biomass Steam and Power Plant in Malaysia SEO Palm Oil Refinery Sandakan, Sabah	Malaysia authorized participants: SEO Energy Sdn Bhd	Canada authorized participant: Landfill Gas Canada Ltd.	1-Energy industries (renewable-/non-renewable sources), 13-Waste handling and disposal 15-Agriculture.	- Thermal energy for the User - Avoidance of methane production from biomass decay through controlled combustion	216 831 t CO_{2e} p.a	10-Jun-06	1-Jun-06 31-May 13 (Renewable)
6	Seguntor Bioenergy 11.5 MW EFB Power Plant	Malaysia authorized participants: Seguntor Bioenergy	Japan authorized participant: Agritech Marketing Co. Ltd. Clean Energy Finance Committee, Mitsubishi UFJ Securities Co. Ltd.	1-Energy industries 13-Waste handling and disposal 15-Agriculture.	- Renewable electricity generation for a grid - Avoidance of methane production from biomass decay through controlled combustion	230 019 t CO_{2e} p.a	21-Jul-06	1-April-08 - 31-Mar 15 (Renewable)
7	Kina Biopower 11.5 MW EFB Power Plant	Malaysia authorized participants: Kina Biopower Sdn Bhd	Japan authorized participant: Agritech Marketing Co. Ltd. Clean Energy Finance Committee, Securities Co. Ltd	1-Energy industries 13-Waste handling and disposal 15-Agriculture.	Generation for a grid. - Avoidance of methane production from biomass decay through controlled combustion	230 019 t CO_{2e} p.a	21-Jul-06	1- Apr-08 - 31-Mar 15 (Renewable)

Source: http://cdm.unfccc.int

even though the SREP is highly promoted recently. The project activity, therefore, is highly unlikely to be the natural choice.

CONCLUSION

The successful registration of these seven CDM Malaysian projects with the Executive Board has been a long and testing period for the various pioneering project proponents in which initial planning and paper work actually started as early as 2001 where between 2001 and 2005, there was much doubt and scepticism as to the implementation of the mechanism until the Kyoto Protocol was finally ratified. Even then, till now the rules and procedures are still being refined and formalized.

The Malaysian industry has the potential to develop CDM projects in various areas but so far the registered CDM projects of Malaysia have been limited to using resources from the palm oil industry as solid fuel. Out of the seven projects, six utilize the EFB for either generation of electricity only or co-generation of steam and power while only one uses palm kernel shell as fuel for heat generation. These initial Malaysian projects indicate that the palm oil industry has vast potential to generate more CERs.

There are many other project types which can be considered by the palm oil industry. These may include harnessing the biogas from treated palm oil mill effluent or utilizing the untreated palm oil mill effluent. With new technologies, the readily available and abundant cellulosic solid biomass has potential to be transformed to alternative renewable energy via the biological, thermal and chemical pathway. These derived alternative fuels can then directly displace the fossil fuel use. Palm oils mills could also consider improving the efficiency of their CHP system which are very CDM related. Either changing altogether or improvements in processes that reduce or eliminate the potency of the liquid effluent; utilization of less fossil fuel source generated power and diesel are all potential CDM projects.

Palm oil refineries and cement manufacturing plants as illustrated by the few Malaysian CDM projects can generate CERs using resources from palm oil mills while other alternatives include fuel switching to natural gas and utilizing less electricity from grid are all potentially viable CDM projects. There are also potential from oleochemical plants implementing CDM projects as part of their process improvements, in particular process that demand high energy and steam. From the plantations, there is potential to develop CDM projects related to reduced use of fertilizers. As the rules and procedures for the forest, afforestation and reforestation for full scale CDM projects are being refined and harmonized, there could possibly be opportunities for the Malaysian oil palm industry to develop projects from the plantation side too.

REFERENCE

http://cdm.unfccc.int. All information of projects are from the respective Project Design Document.