DEMONSTRATION AND MARKET IMPLEMENTATION OF BIO-ENERGY FOR HEAT AND ELECTRICITY IN SOUTHEAST ASIA: FINANCING ISSUES AND CDM POTENTIAL

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ABSTRACT: Associated with the rapid economic growth of the Southeast Asian region in the recent years, electricity demand has been constantly on the rise. Countries in this region are changing their policies to encourage private participation in power production and rational use of indigenous energy sources. With increased access of auto-produced electricity to the national grid, there is a renewed interest to employ efficient technologies for processing and combustion of agro-industrial residues.

For many biomass projects in Southeast Asia, financing has become one of the most important factors for their successful implementation. Project developers, many of which are small to medium size, are finding it difficult to provide the equity needed for the projects, much less to pay for the project costs from their internal funds only. Technologies, equipment and processes that could efficiently use biomass as fuel, are available commercially in abundance, many of which offer viable economic returns. Yet, not many of such projects are being implemented compared to what can be potentially achieved.

This paper examines the potential of implementing bio-energy projects in the Southeast Asian region, the issues involved and the options related to the financing of these projects, and the likelihood of passing them as Clean Development Mechnism projects. Finally, a case study of an actual project in Thailand is presented.

Key words: combined heat and power generation (CHP), bio-energy financing, Clean Development Mechanism (CDM)

1 INTRODUCTION

Biomass is an important renewable source of energy in Southeast Asia. Supply of biomass is available from various sources: forests, wood plantations, agricultural and industrial residues, and even municipal solid wastes. Waste products from wood and agro-industries are the least expensive and most accessible. The availability of the biomass, however, can be restricted by the availability of land for planting, crop patterns and season.

In energy markets where modern technology and competition dictate the use of more efficient and clean fuels, biomass is gaining an increased commercial value. The sugar, rice and oil palm are the three major sectors that have the most potential for bio-energy production in the region. Residues obtained from the harvesting and milling of the agricultural produce can be utilised as fuel for energy generation in the form of both power and heat (cogeneration).

2 BIO-ENERGY POTENTIAL

Cogeneration, also known as combined heat and power generation (CHP), has been widely applied in agro-industries such as sugar mills and palm oil mills, although the technologies traditionally implemented have been outdated and inefficient. As the trend in wood industries shifts toward integrated wood complexes, cogeneration plants are also being implemented increasingly in this sector. Currently, rice husk is emerging as an important fuel source for power generation. If appropriate technologies are implemented, cogeneration cannot only render these agro-industries self-sufficient in energy, but can also help them to earn a profit by exporting excess energy to the national grid or to neighbouring industries. The power generation potential of using bagasse, rice husk and palm oil residues, after satisfying the heat energy required for the mill processing and assuming the use of efficient technologies, is given below:

Table I: Cogeneration potential in Southeast Asia

Country	Crop Product-ion (1,000 tonnes)	Residue production (1,000 tonnes)	Power Generation Potential (GWh/year)
Indonesia	107,000	30,710	14,677
Malaysia	44,000	18,080	7,349
Philippines	32,300	8,636	3,693
Thailand	78,300	21,466	8,833
Vietnam	40,000	9,640	5,267
Total	301,600	88,532	39,819

3 EC–ASEAN COGEN PROGRAMME PHASE III

The EC-ASEAN COGEN Programme is an economic cooperation initiative between the European Commission (EC) and the Association of Southeast Asian Nations (ASEAN). During the second phase of the Programme, 14 Full Scale Demonstration Projects (FSDP) were implemented in ASEAN promoting real

reference projects using proven biomass-based technologies.

COGEN 3 is the third phase of this cooperation programme, coordinated in ASEAN by the Asian Institute of Technology (AIT), Bangkok, Thailand and in Europe by Carlbro International, Sweden. The third phase started its operation in January 2002 and will continue until December 2004. The objective of COGEN 3 is to promote and create business opportunities for the use of cogeneration to generate power and heat using biomass, coal or gas as fuel, through partnerships between ASEAN industries and power producers and European equipment suppliers.

The following are a few of the projects that have been, or are being, implemented in Southeast Asia under the FSDP scheme:

- 41 MW biomass-fired cogeneration system in a sugar mill in Thailand
- 16 MW biomass-fired cogeneration system in a palm oil mill in Malaysia
- 2.5 MW biomass-fired cogeneration system in a rice mill in Thailand
- 1 MW biomass-fired cogeneration system in a wood recycling industry in Singapore.

4 FINANCING ISSUES AND OPTIONS

For many biomass projects in Southeast Asia, financing has become one of the major factors that influence the success of their implementation. Projects that have been soundly conceived technically could be delayed or cancelled because of lack of funds to carry on once the decision to invest had been made. For one, biomass energy projects usually have high initial capital costs compared to conventional technologies. As these projects tend to have small capacities, they could not normally benefit from price reductions due to economies of scale. Another difficulty that developers of biomass projects face is the lack of experience financing institutions have in lending to these types of projects. Added to this is the dearth of cases which could be seen as examples of projects that have been successfully implemented and operated. Because of these, financiers consider biomass projects as very risky and therefore not attractive from the financing point of view.

Despite the above challenges, recent trends have shown that financing of biomass projects are not only possible but could present attractive opportunities for financing institutions. Below are some of the financing routes being used in the financing of biomass projects in Southeast Asia.

4.1 On-balance sheet (corporate finance)

On-balance sheet finance is generally the simplest means of raising finance. It is likely to be used only by strong corporate sponsors. This type of loan is generally easy to arrange if the borrower is considered creditworthy, but repayment periods are normally less than ten years. As the lender does not scrutinize the project documents and contracts rigorously, the up-front expenses and time invested are far less than that for project finance. The structure of the project and the project risk profile would not influence the price of the loan as the corporate borrower accepts all the project risks.

4.2 Project finance

Project finance is a means of raising the funds required for a capital investment project wherein the providers of equity rely primarily on the cash flow of the project for the return on their investment, and the providers of debt for the payment of interest and repayment of the principal borrowed by the project. Projects using the project finance route are developed by borrowing funds based on the creditworthiness of the project alone rather than of the sponsor, through an establishment of a special purpose company.

The banks place more stringent criteria for lending on a project finance basis. This imposes heavy requirements and contractual implications upon the developers of the projects. However, despite these constraints, for many developers, the benefits of using project finance outweigh the disadvantages. The contractual arrangements implicit in project finance effectively transfer many of the risks away from the developer to those better able to manage and control them. Although the up-front expense is greater for the project finance, the overall cost of finance may be lower.

4.3 Self-financing

Self-financing means that the company uses its own internal funds to finance the investment. Usually, this will come from the retained earnings or from existing cash reserves. Where a project is being developed by individuals or a small or new company without reserves, it may be necessary to raise funds from private entities/individuals, either to provide equity or to fund the whole project. Since the cost of equity is normally higher than the cost of debt, self-financing is not the most efficient route to finance a project, except for some circumstances where it is not attractive to leverage the project, or when the project is small enough for the company to pay for the whole project cost from its own funds.

4.4 Other innovative schemes

In order to facilitate financing of biomass energy projects, a number of innovative financing mechanisms have been observed. The table below summarizes the possible financing mechanisms relevant to biomass energy projects and their applicability to the different size ranges of the projects.

Table II: Financing mechanisms for different systems

System	Financing mechanisms/schemes
Small-Scale/ Off-Grid of size <1 MW	Applicable schemes include: ▪ Self-financing ▪ On-balance sheet ▪ Micro-credit ▪ Grant/subsidy ▪ RESCO/ESCO ▪ Leasing ▪ First-cost subsidies and lower import duties ▪ Supplier's credit

	▪ Dealer's credit ▪ Financial bundling
Medium-Scale/ Isolated-Grid/ Grid-Connected of size between 1-15 MW	Applicable schemes include: ▪ On-balance sheet ▪ Venture capital ▪ Project finance (limited recourse) ▪ Corporate guarantee ▪ Grant/subsidy ▪ RESCO/ESCO ▪ Leasing ▪ Supplier's credit ▪ Financial bundling
Large-Scale/ Grid Connected of size >15 MW	Applicable schemes include: ▪ Project finance (limited/non-recourse) ▪ Venture capital ▪ Multilateral agency lending ▪ Export Credit Agencies ▪ Political risk guarantee ▪ Bonds issuance ▪ Supplier's credit

5 CDM POTENTIAL FOR BIOMASS ENERGY PROJECTS

Due to its carbon neutrality, biomass projects have good potential under Clean Development Mechanism (CDM) within the Kyoto Protocol. Likewise, potential for biogas projects are also high, due to methane capture and fuel substitution for energy use. In Southeast Asia, several projects in the pipeline are being developed in Thailand, Malaysia, Indonesia and the Philippines.

By participating as CDM project activities, relevant biomass energy projects could benefit from CDM funds either early on during the project development and implementation or later during the operation of the plant through outright sales of CERs.

The following are examples of biomass and biogas projects that are currently being pursued as CDM activities:

- 22 MW rice husk-fired project by AT Biopower in Thailand
- 34 MW bagasse-fired project by Agrinergy in Thailand
- 3.2 MW Korat waste-to-energy biogas project in Thailand
- 1 MW biogas project by Bumibiopower in Malaysia

6 STATUS OF CDM IN SOUTHEAST ASIA

Except Indonesia and Singapore, other Southeast Asian countries have ratified the Kyoto Protocol and are positive towards CDM. As of 2004, six biomass projects have submitted their methodologies to the CDM executive board. Several other projects are at various stages of development. Few countries have already established their Designated National Authority (DNA), an office assigned to deal with CDM, while others have created interim DNAs. So far, only Malaysia has given conditional approval for their CDM projects. Other countries are in the process of reviewing projects that have requested for approval.

7 CASE STUDY

The following case study is based on an actual project currently being implemented in Thailand under the Full Scale Demonstration Project scheme of COGEN.

7.1 Dan Chang Bio Energy: 41 MW bagasse-fired cogeneration project

Although most of the sugar industries in Thailand already have cogeneration plants, the technologies used in these systems are old and inefficient. With the current efficiency of most of the installed boilers in Thailand, it takes up to 9 kg of bagasse to produce 1 kWh of electricity. These boilers have been designed deliberately with low efficiency in order to burn large quantities of bagasse while producing the amount of steam and/or power needed by the mill. Otherwise, burning bagasse more efficiently could result in a waste disposal problem and its associated cost. Moreover, at the time of implementation of these cogeneration projects, there was no government policy allowing the purchase of electricity from private producers in Thailand.

However, recent developments such as alternative uses of bagasse (for example, as raw material for particle board, medium density fibreboard and paper factories), and the possibility of selling electricity to the grid, have shown that bagasse can actually be a valuable resource which should be managed efficiently.

7.2 Project description

Dan Chang Bio Energy (DC), a special purpose company established by Mitr Phol Sugar Corporation Ltd. (MP), has recently decided to implement a cogeneration project in the existing sugar mill facility of Mitr Phol in Dan Chang, Thailand. The objective of the project is to generate steam and electricity to cover the needs of the sugar mill and to sell excess electricity to the national grid. The fuel sources include bagasse, cane leaves, wood bark and rice husk.

Table III: Summary of the project information

Owner/Developer	Mitr Phol Sugar Corp. Ltd.
Industry:	Sugar
Location:	Dan Chang, Thailand
Existing equipment:	Mitr Phol has an existing cogeneration plant (consisting of several old boilers and turbines), which covers the steam and power requirements of the sugar mill. The old system is able to export from 3 to 5 MW excess electricity to EGAT during the milling operations.
New scheme:	Several existing boilers and turbines will be replaced with two efficient high pressure boilers (2 x 120 tph, 68 bar, 510 ^{o}C) and one efficient extraction condensing turbine (41 MW gross).

Fuel:	Bagasse, cane leaves, wood bark and rice husk
Project status:	Commercial operation is expected in June 2004
Electrical output:	41 MW (gross)
Off-take:	Electricity Generating Authority of Thailand (EGAT), PPA for 21 years on firm basis
Electricity export to EGAT:	25 MW during peak hours 16 MW during off-peak hours

7.3 CO2 emission reduction potential

The electricity generated by the power plant using bagasse and other biomass replaces partly the fossil fuel consumption for electricity production and leads to decreased GHG emissions in Thailand. At the moment, part of the bagasse is used for the existing cogeneration plant, and part of it is used as raw material for particle board and medium density fibreboard. The utilisation of bagasse for electricity production helps to solve the waste problem related to sugar production, enhances the economy in the region, and therefore contributes to sustainable development. The expected GHG emission mitigation potential is 510,236 tons of CO2 equivalent per year (combination of CO2, CH4 and N2O emissions converted into CO2 equivalent, considering the global warming potential). The annual NOx and SOx reductions are calculated to be 1,955 and 4,249 tons, respectively.

7.4 Financing of the project

The total cost of the project was estimated to be THB 2,170 million (40 million Euro). Financing this project proved to be a great challenge to the sponsors who had to face uncharted paths in many ways. Wanting to separate the risks from its core business and to avoid an on-balance sheet treatment of the debt, the sponsors decided to use the Project Finance approach. Because of the strong fundamentals of the project which include, among others, sound Power Purchase Agreements with the sugar mill and the utility, use of proven state-of-the-art technology supplied by a reliable contractor, and the strength/reputation of the sponsors, an agreement with a local bank to provide the loan was reached. The salient points of the loan agreement are provided in the table below.

Table IV: Summary of loan agreement

Project cost:	THB 2,170 mil. (40 mil. Euro)
Equity:	~ 29 %
Debt:	~ 71 %
Bank:	Siam Commercial Bank, Thailand
Interest rate:	MLR before operation, fixed for 1st yr, MLR-1.00% afterwards
Maturity:	11 years (inc. grace period)
Grace period:	2 years
Security arrangements:	• Mortgage of all land, building and equipment to the bank • Assignment of PPA (DC vs. EGAT) • Assignment of Utilities Supply Agreement (DC vs. MP) • Corporate guarantee for the whole portion of the loan (to be released when listed in SET) • All risk insurance for equipment & all assets in the name of the bank.

8 CONCLUSIONS

- The potential of using wood and agro-industrial residues for cogeneration in ASEAN is substantial. Modern and efficient technologies have been developed which can replace obsolete, inefficient equipment.
- Some innovative financing mechanisms have been devised and several funding initiatives exist. These have been useful in helping stimulate investments in industrial projects involving biomass energy. However, the fact remains that in order to create market sustainability, projects should be able to easily obtain financing on a commercial basis, without full corporate guarantee or full recourse to the sponsors. Currently, there is a dearth of examples where this is actually happening.
- The participation of the private sector in the development and implementation of projects is key in the widespread dissemination and acceptance of projects involving biomass energy.
- Biomass projects have good potential to mitigate greenhouse gas emissions which could make them likely candidates for CDM projects.
- The case study succinctly presented a real-life example of the financing issues and options faced by the stakeholders in projects that are currently being implemented in ASEAN. Particularly, this project has shown that, despite the many challenges, raising of funds mainly on the merits of the project cash flow is currently attainable.

9 REFERENCES

[1] Gonzales, A.D. and Carlos, R.M., "Financing Issues and Options for Energy Efficiency, Renewable Energy and Greenhouse Gas Abatement Projects in Asia", The Second World Congress of Environmental and Resource Economists, Monterey, California, USA, 24-27 June 2002.

[2] Gonzales, A.D., Financing Issues and Options for Small-Scale Industrial CDM Projects in Asia, UNDP-FINESSE, December 2001.

[3] Mathias A.J., Electricity Generation from Bagasse In Thailand, World Sugar Co-products 2002 conference. 7-8 October 2002, Bangkok.

[4] Mathias A.J., Emerging Trend in Sugar Mill Cogeneration and Opportunities for the Philippine Sugar Industry, Philsutech 50th Annual Convention, August 26-29, 2003, Bacolod City, Philippines.

[5] www.unfccc.org/cdm