PROJECT INFORMATION DOCUMENT (PID)
CONCEPT STAGE

Project Name	Thailand: TSM Bio Energy Wastewater Management and Methane Capture for Electricity Project
Region	East Asia and Pacific
Sector	Environment and Rural Development
Project ID	P110095
Borrower	N/A
Implementing Agency	TSM Bio Energy Co., Ltd
Environment Category	[ ] A [X] B [ ] C [ ] FI [ ] TBD (to be determined)
Date PID Prepared **Date PID Updated**	April 2, 2009
Date of Appraisal Authorization	
Date of Board Approval	Not applicable.

1. Key Development Issues and Rationale for Bank Involvement

Climate change. Climate change is now recognized as a global threat, with its impacts anticipated to be wide-ranging, affecting agriculture and food security, rise in sea level, increasing intensity of natural disasters, species extinction and spread of diseases, among others. The World Bank, as a trustee of various carbon finance facilities, is leading the efforts in mitigating climate change via market-based initiatives. Through its Carbon Finance Unit, the Bank has been helping catalyze markets for greenhouse gas (GHG) emission reduction under the Clean Development Mechanism (CDM) of the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC). A vital element of the Bank's effort is ensuring that developing countries and economies in transition play a key role in the emerging carbon market for GHG emission reductions by promoting carbon markets that reduce transaction costs, supports sustainable development and reaches and benefits the poor communities of the developing world.

Thailand is one of the signatories of the UNFCCC which ratified the Kyoto Protocol on August 28, 2002. Since then, the country became an active participant of the CDM having processed and approved 41 projects ranging from livestock waste to waste heat power generation project. A number of emission reduction purchase agreements (ERPA) have been signed by Thai project sponsors.

Due to high prices and unstable supply of imported petroleum products, Thailand has actively pursues an energy plan which aims to have energy independence through aggressive exploration and development of clean and renewable indigenous energy sources. It joined the growing number of countries that are taking significant measures to promote the use of biofuels through the passage of the cabinet resolution on 9 December 2003. The resolution approved the strategy for gasohol promotion. A target was set to increase the use of ethanol to 1 million liters per day by the year 2006 to replace the additive, Methyl Tertiary Butyl Ether (MTBE), in octane 95 gasoline and to increase the

use of ethanol to 3 million liters by 2011 to replace MTBE in octane 95 gasoline and also replace 10% of the oil content in octane 91 gasoline. Currently, the production of ethanol is anticipated to grow to approximately 2.4 million liters per day.

Investment costs and market/regulatory uncertainty constitute a major hurdle for investors of renewable energy. The Regulations for the Purchase of Power from Very Small Power Producers (for the Generation Using Renewable Energy), provides incentives in terms of additional revenue for very small power producer (VSPP) who generate less than 10 MW of electricity to be supplied to the national grid. Despite these incentives, the potential high cost of generation is the main barrier for investments in the sector. Carbon Finance has been shown to increase the bankability of projects, by adding as additional revenue stream in hard currency, which reduces the risks of commercial lending.

The wastewater produced from ethanol processing contains very high quantities of organic waste (on average around 14,000 mg/L of Chemical Oxygen Demand: COD)[1] and is one of the most significant polluters in agriculture or food industries. Managing such high concentrations of wastewater is one of the largest environmental challenges in ethanol processing. Systems which treat wastewater using a series of open lagoons remain the most widely practiced treatment technology in Thailand because of its simplicity to operate and low capital costs. The technology is sensitive operationally to overloading especially during the rainy season, requires very large tracts of land and has environmental risks related to groundwater contamination and nuisance odors. In some cases, poorly designed and operated industrial lagoon systems in Thailand have caused chronic pollution issues and public outcry.

In addition to the challenges in wastewater treatment it is estimated that the ethanol processing industry in Thailand would produce 60 million tons of carbon dioxide equivalent (tCO_2-e) in greenhouse gas emissions in 2010. This is due to the wastewater which degrades in open lagoons and waterways producing methane, a greenhouse gas 21 times more potent than carbon dioxide. Additionally, these industries also typically rely in part on fossil fuel for their boilers and for electricity consumption which further contributes to greenhouse gas emissions. There are 25 planned ethanol production facilities. There are 7 operating ethanol production facilities in Thailand, of which 4 are from molasses and 3 are tapioca based. This project could be replicated by other factory in Thailand. Out of the 7 operating plant there is only one plant that has adopted biogas system and apply for CDM, others adopted open anaerobic lagoon.

The proposed project would purchase the carbon emission reduction credits for the operation of an improved wastewater treatment plant that recovers methane and renewable energy facilities and reduce greenhouse gas emissions.

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[1] DETERMINATION OF BIODEGRADATION RATES FOR ETHANOL PRODUCTION WASTEWATER, 2003, TIMOTHY ELLIS, FROM HTTP://WWW.CCEE.IASTATE.EDU/RESEARCH/PROJECTS/PROJECTID/-456381360

Project's consistency with the Country Development Partnership on Environment (CDP-E 2008-2011). World Bank's support for this project is fully consistent with the objectives[2] of the CPD-E 2008-2011 to develop Carbon Finance projects given due focus to energy, waste, industry, and forestry sectors, including mangrove and capacity building activities. Carbon finance and its growing market could be a significant source of foreign denominated income and investment for developing and implementing clean technologies by the private sector in Thailand.

2. Proposed Objectives

The project development objective is to contribute to the reduction of greenhouse gas emissions through the capture of methane from an improved wastewater management system of an ethanol plant and the displacement of fossil fuel from the national electricity grid with the captured methane.

3. Preliminary Description

The project will involve the upgrading of an existing wastewater treatment system of an ethanol plant, the Thai Sugar Ethanol (TSE), which produces 100 m^3 of fuel grade ethanol per day using molasses as a feedstock. The TSE generates approximately 1,100 m^3/day of spent wash of which goes through evaporation process to reduce the volume to approximately 600 m^3. The wastewater then transported to open anaerobic lagoons, the baseline method of treating wastewater.

The project will only involve the upgrading of anaerobic open lagoon system into modified covered lagoon system to capture the methane and use it to feed into the national grid, in the process, displacing fossil fuels.

The project has the following components:

(a) **Component 1: Improvement of the Waste Management System**. This component will involve the improvement in treating and managing liquid wastes (approximately 600 cubic meter per day) and sludge generated by the ethanol plant. It will consist of the following facilities and activities: (i) construction and operation of two modified cover lagoon digester system, each with a capacity of 25,000 m^3, using polyethylene cover and HDPE lining to prevent groundwater seepage and contamination; (ii) construction of a pond to store water, including rain water, that will be used to mix the pre-treated wastewater to correct the potassium content to allow methagenic bacterial activities; (iii) construction of holding pond that will temporarily contain the wastewater prior to treatment; (iv) construction of polishing pond that stores the treated wastewater prior to application in the field as liquid fertilizer; (v) land application of treated wastewater as liquid fertilizer; and (vi) composting of sludge from concentrated wastewater with mud press for use as organic fertilizer.

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[2] 2008-2011 Thailand Country Development Partnership on Environment, Paragraph 22.

(b) **Component 2: Electricity Generation and Transmission Facility.** This component will involve the capture of methane for electricity, which will be sold to the Provincial Electricity Authority of Thailand under the VSPP. The biogas contains 55% methane and will be used as fuel to generate electricity for the provincial grid. The project will install the electricity generation facility of 2 MW. On a daily basis the facility is expected to generate 27,000 kw of electricity. There is existing transmission facility to connect to the provincial grid sub-station. However, the transmission facility will require upgrading.

(c) **Component 3: Carbon Finance Transaction**. This component would involve the purchase of the carbon emission reduction by the World Bank. The purchase will be performance-based or based on the delivery of the emission reduction after an independent verification by a UNFCCC-accredited entity. The price of the emission reduction will be negotiated and agreed by the project sponsor and the World Bank and will be reflected in the Emission Reduction Purchase Agreement signed by the both parties. It is estimated that the GHG emission reduction from the project would be approximately 101,000 $tC0_2$-equivalent per year.

Alternative Project Technologies. The project is based on a consideration of alternatives that led to the implementation of a technology that reduces greenhouse gas emissions and not on a "business as usual" scenario.

- ***Anaerobic open lagoon system***. This is the current practice at the ethanol plant and also the traditional mode of wastewater treatment among distilleries and sugar mills in Thailand. This is a relatively cheap method that meets the national standards for biochemical oxygen demand, but emits/liberates a significant amount of methane into the atmosphere. It also emits a foul odor coming from the decomposing organic matter that has health impacts on the workers and the neighboring communities.

- ***Modified covered lagoon system***. The project would construct a modern wastewater treatment and biogas collection system as an alternative to the original design of a series of lagoons. The chosen system avoids the large emissions of methane found in open lagoon systems; reduces odors and groundwater risks; and can be used as a source of renewable energy.

- ***Composting***. This proposed option will mix wastewater from ethanol production with other agricultural waste product for composting. The composting facility will produce organic fertilizer without investing in wastewater treatment technology. The capital investment for this option is lower than modified cover lagoon system, but it would not produce the needed energy. Furthermore, the composting plant cannot operate during the monsoon season; the wastewater will need to be stored during the monsoon. This is a potential risk to the environment.

- ***Evaporation of wastewater and recycling.*** The ethanol plant is already adopting evaporation of spent wash to reduce the volume that will be transported for treatment at the project site. The treated wastewater will be used as liquid fertilizer in the land owned by the project sponsor while the sludge will be composted and sold to farmers and private individuals.

Design Alternatives. During project preparation, several design alternatives are being considered in the light of their benefits and costs. The project sponsor and designer team has decided that modified covered lagoon is the best option. The system is one of the most efficient systems. It is suitable for wastewater with high concentration of COD. The digester will be designed with control equipment as well as mixing system to prevent sludge accumulation at the bottom. The system is simple to operation and has high efficiency. The volume of the digester is very large; it is suitable for wastewater with high concentration, toxicity and bacteria. The system is simple to operate compared to other high rate systems.

4. Safeguards Policies that Might Apply

Safeguard Policies Triggered by the Project	Yes	No	TBD
Environmental Assessment (OP/BP 4.01)	[X]	[ ]	
Natural Habitats (OP/BP 4.04)	[ ]	[X]	
Pest Management (OP 4.09)	[ ]	[X]	
Physical Cultural Resources (OP/BP 4.11)	[ ]	[X]	
Involuntary Resettlement (OP/BP 4.12)	[]	[X]	
Indigenous Peoples (OP/BP 4.10)	[ ]	[X]	
Forests (OP/BP 4.36)	[ ]	[X]	
Safety of Dams (OP/BP 4.37)	[ ]	[X]	
Projects in Disputed Areas (OP/BP 7.60)*	[ ]	[X]	
Projects on International Waterways (OP/BP 7.50)	[ ]	[X]	
Piloting the Use of Borrower Systems to Address Environmental and Social Issues in Bank-Supported Projects (OP/BP 4.00)	[ ]	[X]	

5. Tentative Financing

Source		($m.)
Recipient: TSM Bio Energy Co., Ltd		40
Carbon Finance		15 (approx)
	Total	65 (approx)

* *By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas*

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