1. Country and Sector Background

According to Thailand’s Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC), more than half of the country’s greenhouse gas (GHG) emissions are from the energy sector. Thailand is not self-sufficient in energy and the potential for certain forms of renewable energy such as hydropower are hindered by environmental and social constraints. While Thailand has emphasized diversification of its energy sources, the country relies heavily on imports to meet much of its primary energy demand, including oil, natural gas and coal.

Thailand views renewable energy as an important option in mitigating GHG emissions as the impacts of climate change threaten many of country’s development gains of the last several decades. While the potential for some renewable energy sources such as hydropower are difficult to pursue, there is significant untapped potential for other renewable energies such as biogas produced from livestock waste.

The rapidly growing livestock sector in Thailand plays an important role in the economy, but a number of practices and activities employed in the sector result in adverse environmental impacts, threats to human health, and significant sources of the country’s GHG emissions. Methane from pigs represents the largest source of such livestock GHG emissions in Thailand and the number of pigs in the country is expected to more than double between 2000 and 2020. The contribution of livestock to global GHG emissions was echoed by a recent publication1 by the Food and Agriculture Organization of the United Nations which stated that livestock account for about 37 percent of global anthropogenic emissions of methane and 65 percent of global anthropogenic emissions of nitrous oxide, another highly potent GHG2.

---

2 GHGs differ in their ability to trap heat in the atmosphere. CO₂ has the least ability to trap gases, while
Thailand ratified the Kyoto Protocol under the UNFCCC in August 2002. The treaty entered into force in February 2005 and Thailand has demonstrated a strong interest in participation in the emerging market for certified emission reductions (CERs) of GHGs which is reflected in the growing portfolio of CDM projects in the country. This Carbon Finance Operation (CFO) will result in CERs from the collection and combustion of methane and electricity generation at 10 medium and large pig farms in Thailand. See Table 1 for details. The CERs will be sold to the World Bank-managed Community Development Carbon Fund (CDCF). This CFO is expected to play an important role in demonstrating the use of market mechanisms such as the CDM to scale-up renewable energy projects through improved livestock waste management while reducing GHG emission as well as generating CERs.

2. Objective

The project development objectives are to (a) reduce methane emissions from improved livestock waste management practices through a carbon finance transaction between the World Bank and the project sponsor and (b) serve as a demonstration for other livestock producers. The project aims to improve livestock waste management practices and take advantage of the captured renewable energy in the form of biogas at participating farms.

3. Rationale for Bank involvement

The World Bank has been a pioneer in the carbon market under the Kyoto Protocol, helping to develop policy, regulatory, fiscal, and financial instruments across sectors and countries to generate incentives to reduce GHGs. Over the past decade, the World Bank has managed 12 Carbon Funds including the CDCF established in 2003. These Carbon Funds do not finance projects, but contract to purchase CERs in a commercial transaction, with annual or periodic payments following verification by a third party auditor. These transactions have provided an additional revenue stream to reduce financial risks and to leverage new private and public investment into projects that reduce GHG emissions.

Support for client countries to address the objectives of international environmental conventions such as the Kyoto Protocol is an identified priority in the World Bank’s Environment Strategy and was reaffirmed in the 2005 Environment Strategy for the East Asia and Pacific Region (EAP). The World Bank has supported Thailand’s environmental sustainability objectives for many years, and is also associated with a major program of environmental cooperation including Analytical and Advisory Activities. The objective of this CFO is consistent with the Country Partnership Strategy for Thailand (25077-TH, January 22, 2003) which supports one pillar of Thailand's National Development Agenda – protection of natural resources and the environment.

SF₆ has the greatest. Each molecule of methane traps 21 times more heat than a single molecule of CO₂ while a single molecule of N₂O traps 310.

³The Kyoto Protocol commits Annex I (industrialized) countries to reduce their collective GHG emissions by about 5 percent below their 1990 levels on average during the period from 2008-2012. In fulfilling these commitments, Annex I countries can achieve some of their emission reductions through several means including the Clean Development Mechanism (CDM) which provides a financial incentive to companies or entities in Non-Annex I (developing) countries to undertake projects that lead to reductions of GHG emissions. The resulting emission reductions can then be sold to entities in Annex I countries to offset some of their commitments under the Kyoto Protocol.
This CFO is directly supporting the Water Quality Theme of the first phase of the Country Development Partnership – Environment (CDP–E) which, successfully completed in 2007, outlined the partnership framework that the Royal Thai Government has been working with the World Bank. The first phase of the CDP–E focused on five major themes namely, air quality, water quality, solid waste management, global environment commitment, and institutional and regulatory framework. This project is also included in the second phase of the CDP–E which is under preparation.

The CERs will provide not only a revenue stream, but a market-based incentive to the participating farmers to support and improve their livestock waste management practices. The CDCF also requires the development of Community Benefit Plan (CBP) that promotes the World Bank’s mission of reducing poverty as well as encouraging economically and socially sustainable development.

The World Bank as a trustee of various Carbon Funds has undertaken a pioneering role in developing the CDM market in Thailand, including awareness raising, capacity building and an emerging portfolio of CDM projects. The World Bank has played a key role in the development of other programs that seek to improve conditions in the livestock sector in Thailand e.g. the Livestock Waste Management in East Asia (LWMEA) project. This CFO will help accomplish some of the goals set under the LWMEA project by facilitating the transfer of technology and capacity building to operate new systems and by providing an opportunity to participating farms to take advantage of the financial incentives from the sale of CERs to implement improved solid waste management systems.

4. Description

This CFO was initiated by the Department of Livestock Development (DLD) and the Advance Energy Plus Co., Ltd. (AEP) in 2006 as part of a replication strategy for LWMEA project. The farms participating in this CFO are dispersed in two provinces which are the largest pig producing provinces in Thailand but the amount of CERs achieved at individual participating farms is relatively modest (see Table 1). To meet the CDCF’s requirements for minimum CERs, the farms have been “bundled” for project administration, technical standardization, and CER transactions. This CFO is composed of three project components which are described below.

**Component A: Construction of Livestock Waste Management Facilities.** This CDM project proposes to use Channel Digester Plus (CDP) technology to produce biogas for electricity generation at all participating farms. GHG emission reductions (ERs) will be achieved from the offset of baseline livestock waste management (open anaerobic lagoon) emissions plus offsetting carbon dioxide emissions from the combustion of fossil

---

4 In 2006, the Bank approved a Global Environment Facility (GEF) grant of US$ 7 million to support the improvement of livestock waste management for Thailand, China and Vietnam under the International Water window. The LWMEA supports a comprehensive approach to reduce the major negative environmental and health impacts of rapidly increasing concentrated livestock production on water bodies and the people of East Asia. Its global environment objective is to reduce livestock-induced, land-based pollution and environmental degradation of the South China Sea where the three countries are a part of.

5 The CDP system is a modified MC-UASB design established by the Energy Research and Development Institute (ERDI) at Chiang Mai University in Thailand. This institute has been responsible for the development and implementation of over 200 successful MC-UASB systems at medium and large pig farms in Thailand since 2004.
fuels to produce the equivalent level of electricity. The principle fuel used for base load electricity generation in Thailand is natural gas which provides the basis to calculate these carbon offsets. Table 1 shows the project’s annual average pig population and the estimated ERs by farm. The total ERs are estimated to be 57,993 ton of CO₂ equivalent per year (tCO₂e/year).

Table 1: Participating Farms

<table>
<thead>
<tr>
<th>Pig Farm</th>
<th>Project Location</th>
<th>Annual Average Pig Population</th>
<th>Estimated ERs (tCO₂e/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District</td>
<td>Province</td>
<td></td>
</tr>
<tr>
<td>1 A.P.</td>
<td>Photharam</td>
<td>Ratchaburi</td>
<td>6,795</td>
</tr>
<tr>
<td>2 Jung</td>
<td>Paktor</td>
<td>Ratchaburi</td>
<td>12,940</td>
</tr>
<tr>
<td>3 Kanchana</td>
<td>Photharam</td>
<td>Ratchaburi</td>
<td>15,220</td>
</tr>
<tr>
<td>4 Kanchana Hybrid</td>
<td>Photharam</td>
<td>Ratchaburi</td>
<td>17,385</td>
</tr>
<tr>
<td>5 K.O.S.</td>
<td>Paktor</td>
<td>Ratchaburi</td>
<td>6,927</td>
</tr>
<tr>
<td>6 Maneerat</td>
<td>Chombueng</td>
<td>Ratchaburi</td>
<td>9,994</td>
</tr>
<tr>
<td>7 Supparuek</td>
<td>Chombueng</td>
<td>Ratchaburi</td>
<td>30,802</td>
</tr>
<tr>
<td>8 V. Tai</td>
<td>Chombueng</td>
<td>Ratchaburi</td>
<td>6,912</td>
</tr>
<tr>
<td>9 Wanchai</td>
<td>Chombueng</td>
<td>Ratchaburi</td>
<td>19,203</td>
</tr>
<tr>
<td>10 Phanusumporn</td>
<td>Koh Chan</td>
<td>Chonburi</td>
<td>5,011</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>131,187</td>
</tr>
</tbody>
</table>

Component activities would include (a) construction of physical facilities i.e. channel digester, electricity generation, on-farm electricity transmission lines, flaring pipes, sludge storage tank and drying beds, and series of ponds; (b) installation of monitoring equipment and devices; and (c) farmer training. Detailed project technical description is provided in Annex 1 of the CFAM. A complete technical description of these activities and the subsequent ERs are included in the Project Design Document (PDD).

**Component B: Carbon Finance Transaction.** This Component will facilitate the purchase of the CERs. The CDM enables the creation, issuance, and sale of CERs from projects undertaken in developing countries that reduce emissions of GHGs. This CFO will facilitate the transaction of the bundled CERs from the participating farms between the AEP and the World Bank-managed CDCF, the terms and conditions of which will be agreed in the Emission Reduction Purchase Agreement (ERPA) to be signed by the two parties. The purchase will be a performance-based contract under which payments are triggered by successful registration with the UNFCCC and verification of the reduction of GHG emissions by an independent, accredited international entity, Designated Operational Entity (DOE)\(^6\) under CDM rules. The quantity of CERs to be contracted, the length of time over which the purchase will be made, and the price to be paid will be agreed between the World Bank and AEP during ERPA negotiations. In addition, as part of its responsibilities, the CDCF will ensure registration of the project with the CDM Executive Board. The Project Design Document (PDD) as well as the Monitoring Plan

---
\(^6\) All DOEs have to be accredited by the CDM Executive Board, and have either of three functions: 1) to validate and subsequently request registration of a proposed CDM project activity; and 2) to verify preparation of a registered CDM project, or 3) to certify the amount of emission reductions generated and to request the Executive Board to issue CERs.
which contain details of how the CDCF will monitor the outcomes for the CFO is attached as part of the Carbon Finance Assessment Memorandum (CFAM) package.

**Component C: Community Benefit Plan.** To meet the CDCF’s requirements, this CFO will support activities to improve the quality of life in selected poor communities living around the participating farms through a CBP. The CBP will be funded from a premium separate from the payments for the CERs and the value of the premium will be agreed during negotiations of the ERPA and recorded in the final signed ERPA. The aim of the CBP is to ensure that the poor communities will benefit from a development initiative; and they get to identify the benefits. The design of the CBP was based on consultation with residents of poor communities near the participating farms and will address the needs of up to four communities at different times, during the duration of the CBP. Moo 10 in Chonburi province has been selected as the first community that will benefit from the CBP based on a set of selection criteria agreed among AEP, DLD and the World Bank team. Specific component activities for the first community were proposed by the selected community through a consultation process and agreed with the World Bank. These would include (a) street light; (b) drinking water; (c) scholarship; (d) mosquito spray machine; (e) community shop; and (f) capacity building.

Specific activities for future communities will be developed during the implementation stage of this CFO and are likely to be similar in design and scope. For consistency, selection of other benefiting communities will follow the same screening approach and the agreed criteria used for the selection of Moo 10 including:

- defined as a village with a population no less than 500;
- community residents live under provincial poverty line established by National Economic and Social Development Board or its equivalent, or limited access to economic infrastructure and/or social services;
- located within participating provinces;
- willingness of 80 percent or more of the population in the community to participate and share cost with CDCF grant in cash and/or in kind; and
- decision jointly made by AEP and DLD/PMO.

5. Financing

The financing plan is based on total project costs for all farms which will be jointly financed by the Thai government, Global Environment Facility (GEF), M$_2$M, participating farms and local banks: (a) DLD will co-finance the technical design costs for each participating farm, some training for participating farmers and project management expenses; (b) Energy Policy and Planning Office (EPPO) of the Ministry of Energy, Thailand, is expected to provide an Energy Conservation Fund to cover some of the costs of technical design and partial construction cost in the form of a financial subsidy; (c) GEF will finance about 15 percent of the total costs; (d) A total of about US$0.7 million from M$_2$M will be used to support the purchase of electricity generators

---

7 M$_2$M is “Methane-to-Markets”, a multi-national partnership focused on reducing global methane emissions from agriculture, coal mines, landfills, and oil and natural gas systems with a secretariat based in Washington D.C. of the United States of America.
for participating farms; and (e) Participating farmers will cover the remaining costs with their equity contribution and loans from local banks. The financing plans for each participating farm are included in individual mini-PIPs and are summarized in Annex 3 of the CFAM. Activities under Community Benefit Plan component will be jointly financed by CDCF, AEP and benefiting community members in cash and/or in kind.

6. Implementation

There are three institutional requirements for clearing a project through the CDM Executive Board i.e. (a) validation that the project as designed is consistent with approved methodologies, workable, and may be registered; (b) verification that the project as implemented is consistent with the approved design; and (c) certification that CERs have been generated as designed and may therefore be “certified.” The PDD and validation report together with the Letter of Approval from the Host Country (Thailand) and the purchasing country will be submitted to the UNFCCC for project registration which is expected to be completed by the end of March 2009. Verification and certification of emission reductions will take place after the project is commissioned.

Given the current average number of pigs at each farm and the total number of pigs for this CFO, the CDM approved small scale methodology AMS III. D version 14, “Methane recovery in animal manure management systems” and approved small scale methodology AMS I. D version 13, “Grid connected renewable electricity generation” with the pig weight adjustment apply. Under these methodologies, emission reductions are subject to periodic ex-post monitoring, to determine whether the reductions have been achieved in compliance with applicable CDM rules and procedures and specific terms of the ERPA.

AEP, DLD, and ERDI are involved in the proposed project. Their respective roles and responsibilities are described below. To specify responsibilities, a Memorandum of Understanding between DLD and AEP was signed on December 14, 2007.

- **AEP**, serving as the project sponsor representing participating farms, has overall responsibility for project preparation and implementation. Specifically, AEP will (a) sign an ERPA with the World Bank and make CER revenue payments to the participating farmers; (b) cooperate with the World Bank in the due diligence aspects of the project including safeguards, validation, registration, verification, and CER issuance; (c) prepare an Initial Environmental Evaluation (IEE); (d) assist the farmers in using appropriate technology and procurement of works and equipment as required; (e) cooperate with DLD and the World Bank to monitor the implementation of the improved waste treatment and electricity generation; (f) coordinate farmers and collect data for verification and training; and (g) implement the CBP in consultation with the selected communities.

- **DLD**, established on May 5, 1942 and as the implementing agency for the LWMEA project, serves as a project supervisor for this project. DLD is the main government agency responsible for research and development of technology in livestock production and has been working with other government agencies, international organizations such as the World Bank and the Food and Agriculture Organization of the United Nations, and the pig farmers to promote improved livestock waste management practices. DLD is the implementing agency for the ongoing GEF-funded LWMEA project and will provide technical advice and
guidance to AEP and ensure that the participating farmers’ interests are respected during the course of project preparation and implementation. DLD will also make sure that the requirements and procedures under the LWMEA project are closely followed.

- **ERDI**, acting on EPPO’s behalf, (a) reviews and endorses technical design of livestock waste management systems to be adopted on participating farms; and (b) provides financial support from the Energy Conservation Fund to partially cover cost of installing the new livestock waste management and electricity generation facilities.

The farms will transfer their ownership of the CERs to AEP who has signed individual agreements with all participating farms to act on their behalf and oversee the collective sale of CERs. AEP will then distribute shares of revenue among the participating farms. AEP will keep a portion of the CER revenue for its role in developing and assembling the CER transactions.

### 7. Sustainability

The biogas collection and electricity generation systems to be employed in this CFO are based on mature and proven technologies that are cost-effective, environmentally sustainable, and widely used in many developed countries. However, in Thailand these technologies and their application are largely unknown. In addition, the required investment is relatively large for the participating farms, but the return on investment is also significant. AEP is well aware of the technical and financial risks associated with the project and is working closely with the DLD to develop project implementation capacity building plans based on the experience accumulated from various national biogas development programs and the GEF-financed LWMEA project. To a large extent, the project’s long-term sustainability is to be ensured through the strengthening of policy frameworks. Such policy frameworks have been in development under the LWMEA project, with which this project is integrated closely.

### 8. Lessons learned from past operations in the country/sector

This project is built on previous World Bank experiences including the LWMEA project. Project preparation has also benefited from the experience and consultations with other World Bank task teams developing similar livestock waste Carbon Finance projects in the East Asia and other regions.

### 9. Safeguard Policies (including public consultation)

This project triggers the World Bank’s [Environmental Assessment](#) policy (OP/BP 4.01) and was designated a Category B as the potential negative environmental impacts of the project are site-specific and manageable with the proposed mitigation measures. Table below lists the applicable World Bank’s safeguard policies.
Table: Safeguard Policies

<table>
<thead>
<tr>
<th>Safeguard Policies Triggered by the Project</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Assessment (OP/BP/GP 4.01)</td>
<td>[X]</td>
<td></td>
</tr>
<tr>
<td>Natural Habitats (OP/BP 4.04)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Pest Management (OP 4.09)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Cultural Property (OPN 11.03, being revised as OP 4.11)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Involuntary Resettlement (OP/BP 4.12)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Indigenous Peoples (OD 4.20, being revised as OP 4.10)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Forests (OP/BP 4.36)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Safety of Dams (OP/BP 4.37)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Projects in Disputed Areas (OP/BP/GP 7.60)</td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>Projects on International Waterways (OP/BP/GP 7.50)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

Overall, this project will contribute to reducing environmental impacts associated with the current pig farm operations (methane and odor generation from the open lagoons). No major negative environmental impacts of the project are envisaged. Potential negative impacts during construction of the waste management facilities may include vegetation clearance and inappropriate transportation and disposal of earth excavation and temporary disturbance due to dust, noise, wastes, and other construction-related activities. These concerns however will be short term and localized and can be mitigated through good construction practices and specific requirements to be included in construction contracts. Potential negative impacts during operation are not anticipated if the treatment facilities are operated and maintained properly. This will be ensured through the application of good farm operation and management practices which are being developed for the LWMEA project as well as training of the farm owners and operators that will be provided during the implementation of the project. Close monitoring of the safeguards performance (safety, noise, dust, odor, and waste disposal) will be conducted at the following units: (a) biogas generation and storage; (b) electricity generation; (c) processing and storage of digested sludge; and (d) application of digested sludge.

Preparation and submission of an Initial Environmental Evaluation (IEE) to the Thailand Greenhouse Gas Management Organization (Public Organization)\(^8\) is required as part of the Letter of Approval process. The IEE was prepared by AEP with assistance from an independent environmental specialist and in close consultation with the farm owners, the technical design consultant, and the World Bank environmental specialist in the Bangkok office. The IEE describes (a) the existing environmental situation; (b) environmental assessment of each participating farm; and (c) proposed monitoring and mitigation measures. The World Bank has reviewed the draft IEE and provided specific comments for improvement. The final IEE in Thai language was disclosed on June 13, 2008 to the general public in Thailand at the World Bank’s Office in Bangkok and at the InfoShop at the World Bank in Washington D.C. The final IEE in English will also be disclosed at InfoShop at the World Bank in Washington D.C once it is available. The Project Information Document (PID) and ISDS were disclosed on June 16, 2008 at the InfoShop at the World Bank in Washington D.C.

---

\(^8\) By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties’ claims on the disputed areas

\(^8\) Thailand Greenhouse Gas Management Organization (Public Organization) serves as the Designated National Authority (DNA) in Thailand for the Kyoto Protocol.
Potential negative impacts of the CBP component are not expected. It is confirmed that activities to be implemented during the first two years will not involve any infrastructure works. Given the selection criteria and small budget (US$52,000 per year maximum), similar activities are expected for the following years for other communities to be selected. AEP will send a confirmation on this assumption before approving the CBP for the following years.

10. List of Factual Technical Documents:

Community Profile and Priorities Report, December 2007
Initial Environmental Evaluation Report, June 2008
Environmental Management Plan, June 2008
Subsidiary Agreement on the Transfer of Rights to Emission Reductions, December 2007
Mini-Project Implementation Plans, May 2008
Methane to Market Partnership Project Network Project Proposal, April 2008
ISDS, May 2008
Livestock Waste Management in East Asia Project Appraisal Document, February 2006
Memorandum of Understanding between Department of Livestock Development and Advance Energy Plus Co., Ltd.

11. Contact Point:

Task Manager: Weiguo Zhou
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433
Telephone: 202-458-4052

12. For information on project related documents contact:

The Infoshop
The World Bank
1818 H. Street, N.W.
Washington, D.C. 20433
Telephone: (202) 458-5454
Fax: (202) 522-1500
Web: http://www.worldbank.org/infoshop

Note: This is information on an evolving project. Certain components may not necessarily be included in the final project.