LOGOS

Impact of the Linking Directive for Thailand

Project Synthesis Report

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Foreword

Climate change is a major environmental concern for the entire world, especially for those developing countries with high vulnerability and limited adaptive capacity. The international community has undertaken several initiatives, and CDM (Clean Development Mechanism) under the Kyoto Protocol is one of the initiatives that provide benefits for both developed countries and developing countries. The European Emission Trading Scheme (EU ETS), in particular the Linking Directive, is one more important initiative to enhance successful emissions reduction of greenhouse gases. The Linking Directive also provides an arbitrage opportunity for developing countries to promote country's sustainable development via CDM implementation. However, it is not yet well-known among people in developing countries like Thailand.

In order to promote awareness on such arbitrage opportunities provided by the Linking Directive, Energy Research Institute (ERI) under Chulalongkorn University of Thailand has been appointed from the EU-Thailand Economic Co-operation Small Project Facility to undertake a project titled "Study on Impact of the European Linking Directive 2004/101/EC (so-called CDM Linking Directive) for Thailand". It is expected to enhance meaningful participation of Thailand in the CDM, and also to strengthen the economic partnership between EU and Thailand on trade, investment and related areas.

However, the study would not have been possible without financial support from the EU-Thailand Economic Co-operation Small Project Facility as well as technical support from all project partners namely CEERD (Centre for Energy Environment Resources Development, Thailand) and JIN (Joint Implementation Network Foundation, The Netherlands), and also valuable information supported by several stakeholders. On behalf of Chulalongkorn University, I would like to express our sincere thank to all of those mentioned. I also hope that this report will provide useful information for all stakeholders, especially policy makers in relevant ministries.

Dr. Withaya Yongchareon

Director

Energy Research Institute
Chulalongkorn University

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List of Acronyms and Abbreviations

List of Abbreviations

bbl/d	Barrel per day
Bcf	billion cubic feet
GW	Gigawatt
GWh	Gigawatt hour
Ktoe	1000 toe
kW	Kilowatt
kWh	Kilowatt hour
Mtoe	1000 ktoe
MW	Megawatt
toe	Tonne of oil equivalent
TWh	Terrawatt hour

List of Acronyms

ADB	Asian Development Bank
ARE	Accelerated Rural Electrification
ASEAN	Association of Southeast-Asian Nations
CDM	Clean Development Mechanisms
DEDE	Department of Alternative Energy Development and Efficiency
DNA	Designated National Authority
DOPA	Department Of Provincial Administration
EERF	Energy Efficiency Revolving Fund
EFE	Energy for Environment foundation
EGAT	Electricity Generating Authority of Thailand
ENCON	Energy Conservation and Promotion
EPC	Energy Policy Council
EPPO	Energy Policy and Planning Office
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IEA	International Energy Agency
IGES	Institute for Global Environmental Strategies
IPP	Independent Power Producer
JI	Joint Implementation
MEA	Metropolitan Electricity Authority
MHG	Mini-hydropower Generation
MOE	Ministry of Energy
MSW	Municipal Solid Waste
NCUNFCCC	National Committee on the UNFCCC
NEDO	New and Industrial Energy Development Organization
NEPC	National Energy Policy Council
NGL	Natural Gas Liquids
ONEP	Office of Natural Resources and Environmental Policy Planning
PDD	Project Design Document
PEA	Provincial Electricity Authority
PIN	Project Idea Note

PRET	Promotion of Renewable Energy Technologies
PTT	Petroleum Authority of Thailand
PV	Photovoltaic
RE	Renewable Energy
RPS	Renewable Portfolio Standard
SPP	Small Power Producer
TFC	Total Final Consumption
TPES	Total Primary Energy Supply
UNCTAD	UN Conference on Trade and Development
UNEP Riso	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VSPP	Very Small Power Producers

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Executive Summary

Introduction: Scope of the Report

The Kyoto Protocol defines quantified greenhouse gas (GHG) emission reduction commitments for industrialised countries. These commitments have the shape of national GHG emission budgets (so-called Assigned Amounts), which are expressed as a percentage of a country's GHG emissions level in 1990. During the commitment period 2008-2012, industrialised countries must remain below their assigned amounts.[1] Countries can, however, enlarge their emission budgets by acquiring assigned amount units (AAUs) from other countries through a system of international emissions trading or by participation in investments in GHG emission reduction projects in other industrialised countries or in developing countries, which do not have quantified commitments under the Kyoto Protocol. Such project co-operation among industrialised countries has been defined under the Kyoto Protocol as Joint Implementation (JI), whereas for project co-operation between an industrialised country and a developing country the Clean Development Mechanism (CDM) has been established.[2] The main rationale for these forms of co-operation is that marginal abatement costs differ between countries and that the effect of GHG emission reduction on atmospheric GHG concentrations is the same wherever the abatement action takes place. Through emissions trading, industrialised countries can achieve their commitments in a more cost-effective manner.

The CDM has two objectives. A typical CDM project aims at reducing GHG emissions while at the same time supporting the sustainable development of the developing country which hosts the project (the host country). Ideally, a CDM project would therefore have two chains of supply and demand. On one hand, industrialised countries have a demand for relatively cheap emission reduction credits, whereas, on the other hand, non-Annex I Parties need sustainable (energy) technologies for their sustainable development. Generally speaking, through CDM projects, modern, clean energy technologies are transferred from Annex I to non-Annex I Parties, which replace existing technologies in the host countries. This modernisation of technological equipment in host countries leads to GHG emission reductions, which the non-Annex I hosts can sell to Annex I investors.

For the supervision of CDM transactions, the CDM Executive Board (EB) has been established under the Kyoto Protocol.[3] CDM projects are subject to project validation procedures during the project design phase and to verification during the implementation phase. Once the emission reductions have been verified by a third-party verifier (designated for this task by the EB), the EB has the task of certifying the emission reductions. Once certified, the emission reductions can formally be added to Annex I Parties assigned amounts as Certified Emission Reductions (CERs).

Since the Kyoto Protocol has entered into force on 16 February 2005, a sharp increase in the number of projects submitted for validation and registration has been observed. In addition, the European Linking Directive 2004/101/EC, adopted on 16 September 2004 by the EU Foreign Affairs Ministers as an amendment to the EU Directive on the Emissions Trading Scheme (EU ETS), allows EU installations to purchase emission reduction credits from abroad via JI (as of January 2008) and the CDM (as of January 2005). Hence, the international CDM market is developing itself from two

[1] Industrialised countries are listed in Annex I of the UN Framework Convention on Climate Change, UNFCCC, 1992, and therefore generally referred to as Annex I Parties. Developing countries are generally referred to as non-Annex I Parties.
[2] UNFCCC, 1997, Articles 6 and 12.
[3] It was formally approved by the First Conference of the UNFCCC Parties serving as the Meeting of the Kyoto Protocol Parties (COP-MOP-1, held in Montreal, Canada, December 2005).

directions: one direction focuses on CDM projects for compliance under the Kyoto Protocol and the second direction focuses on CERs to be sold to EU installations with emission caps under the EU ETS.

Despite the high demand in utilizing the CDM and the continuing improvement in CDM rules, many investors and developers still find it difficult to implement projects. One problem directly related to the effectiveness of the CDM implementation is the complexity of the instrument in terms of accounting for the GHG emission reductions (*i.e.* to calculate the GHG emission reductions upfront and monitor these during the project) and assessment of whether and how a project's technology contributes to the host country's sustainable development in general, and medium to long-term energy strategy in particular. Many potential CDM host countries have struggled with the implementation of CDM projects on their territory, due to under-developed institutions, lack of experience among government officials, lack of right information, and lack of coordination among ministries and relevant authorities.

Accordingly, the present study[4], co-financed by the Small projects Facility (SPF) of the EC Delegation to Thailand, aims to assess how Thailand could enhance its position as a CDM host country by focusing its CDM potential and relevant policy measures and programmes, and exploring opportunities for supplying CERs to EU ETS installations through the Linking Directive, while at the same time contributing to Thailand's objectives in terms of sustainable development.

This report presents the findings of the study in three parts. Part I presents a general overview of the CDM state-of-play, background and what the procedure of transferring a Thai CDM project's emission reduction as a CER through the Kyoto Protocol procedures to an EU ETS installation as an EU allowance. Part II presents the strategy for Thailand, including CDM status and related policies, institutional framework, sustainable development criteria, CDM approval process, and CDM potentials in Thailand. Finally, recommendations for the Thai DNA and stakeholders to harness CDM activities, how parties in Thailand can effectively participate in the ETS-CDM project co-operation or successfully enter the EU Linking Directive CDM market are presented in Part III.

[4] "Study on the Impact of the European Directive 2004/101/EC (so-called CDM Linking Directive) for Thailand" was carried out by a consortium of three partners: ERI (Energy Research Institute, Chulalongkorn University, Thailand), CEERD (Centre for Energy Environment Resources and Development, Thailand), and JIN (Joint Implementation Network, the Netherlands).

Part I: CDM State-of-Play

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1. General Overview of the CDM State-of-Play

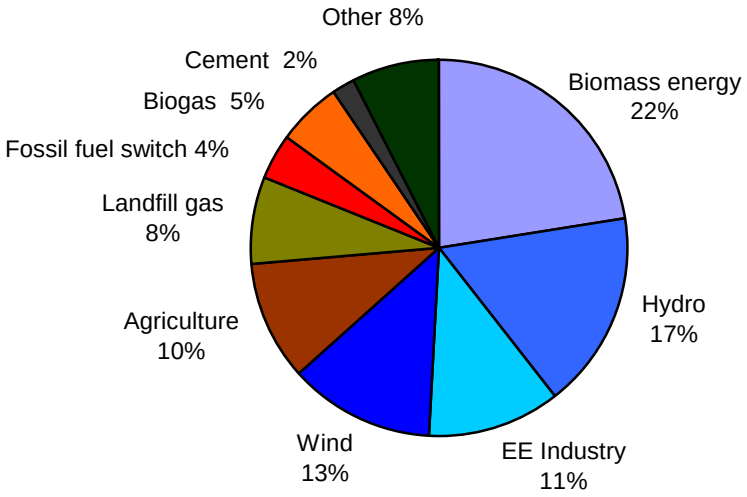
1.1. Trends in CDM Project Types

The CDM portfolio has been growing quite rapidly since the entry-into-force of the Kyoto Protocol in February 2005. As of December 2006, the total number of project plans submitted for validation by an entity designated for this task by the EB (a so-called designated operational entity, DOE) and/or projects registered by the EB (*i.e.* the project has completed the entire project design phase and is ready for delivering CERs) is about 1,400 and the total expected CER generation volume until 2012 is estimated to be over 1.5 billion.[5]

In terms of the number of projects submitted, renewable electricity generation for grids is the most dominant category (*e.g.* biomass, wind energy, biogas, hydropower), followed by projects reducing emissions of fugitive gases, and energy efficiency projects (Figure 1-1). Fugitive gas emission reduction projects mainly take place in landfills where methane is recovered and subsequently flared or used for electricity production. Other examples of fugitive gas reduction are projects that use residues from wood production for co-generation, thereby both preventing piling of wood residues and burning fossil fuels for energy production. Given the high global warming potential (GWP) of methane (over 21 times that of CO_2) fugitive gas recovery projects are rather popular among CDM investors. Moreover, since the CER revenues are generally a substantial part of the financial revenues of a fugitive gas recovery project and given the lack of financial incentives to recover the gases without the value of the CERs, the additionality of the emission reductions of these projects is relatively easy to show, which makes these projects easier to approve within the EB procedures. On the other hand, renewable energy and energy efficiency projects are appealing to project proponents not only because of the emission reductions but also their large auxiliary benefits such as improved regional and/or local economic development, improvement of local air quality, rural electrification, etc. Also, the large number of renewable energy and energy efficiency projects is partly due to the simplified CDM procedures for small-scale projects for these categories.

However, when categorising projects in the CDM market in terms of the CER volumes they expect to generate, it turns out that projects reducing industrial GHGs (*i.e.* N_2O and HFC-23 destruction projects) are truly dominant (with over 40% market share). These gases have very high GWPs (*e.g.,* HFC23 has a GWP of 11,700 times CO_2) and therefore offer huge emission reduction opportunities at relatively low costs with relatively easy additionality assessments (*i.e.* under business as usual industrial operators have no incentive to make similar investment as under the CDM, see also Section 1.4). As shown in Figure 1-1 and 1-2, only a handful of industrial gas reduction projects comprise over 100 million CERs until 2012 (this is further discussed in Section 1.2). Finally, it can be remarked that in terms of the number of projects, there are as many large-scale as small scale projects (a large-scale project being activities with a large GHG emission reduction).[6] Consequently, the large-scale projects taken together have a much larger CER potential than the small-scale projects presently in the pipeline.

[5] "Submitted projects" are defined as projects submitted for validation, shown on the UNFCCC website (http://cdm.unfccc.int/).
[6] For a definition of small and large-scale projects, see http://cdm.unfccc.int/.



Note: The 'other' category includes projects such as HFCs, EE Service, Fugitive, Solar, Coal bed/mine methane, Geothermal N2O, EE Households, A/R, Transport, Energy distribution, PFCs and Tidal.

Figure 1-1. CDM project types (# of projects, December 2006)
Source: Fenhann, 2007.

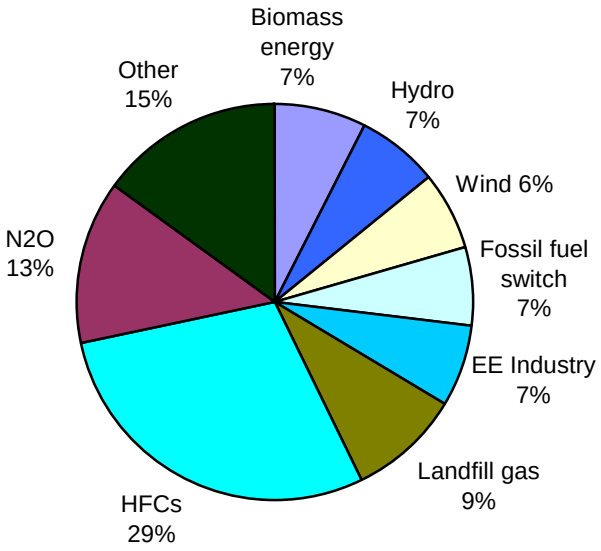


Figure 1-2. Annual CERs from projects submitted by project type (December 2006)
Source: UNFCCC 2006a

1.2. Geographical Distribution of CDM Projects

The geographical distribution of CDM projects over the world has been uneven. As mentioned in Section 1.1., a few industrial gas reduction CDM projects have taken a very large share (around 50%) of the CER market (estimated CERs up to 2012). Since these projects are located in China, India and South Korea, this implies that about half of the CER revenues from the present CDM portfolio of projects under validation or registered will eventually flow to these countries. Although there are still many other projects in the pipeline in other project categories, the money flowing to these industrial gas reduction projects will not be spent on renewable energy, fuel conversion, and energy efficiency CDM projects, which are generally considered to have a stronger contribution to sustainable development in the host countries (*e.g.,* enhanced security of energy supply, poverty alleviation, cleaner local air, *etc*). In other words, with a given demand for CERs, the large share of the industrial gas reduction projects leads to a crowding out of the potential of more sustainable CDM projects and thus limits the geographical distribution of CDM projects.

Consequently, 60% of the presently contracted CERs (*i.e.* expected CERs to be delivered upto 2012 and contracted by CER buyers through a forward contract) will come from China.[7] From projects in India 15% of the CERs have been contracted, with the rest of Asia taking a share of 9%. Latin American projects have been contracted for about 9% of the global CER market, with about half to be generated in Brazil. In this global picture, only 6.5% of the CERs will come from Africa. Interestingly, Nigeria has quite a large share in this percentage based on gas recovery projects which yield intensive emission reductions.

1.3. EU Member States' involvement in the CDM market

The EU as a Party to the Kyoto Protocol has an assigned amount of GHG emissions for the period 2008-2012 of 92% of the emission levels in 1990. Through the burden sharing agreement of 16 June 1998, this 8%-reduction target has been subdivided across the then fifteen EU Member States in the form of differentiated national targets (see Table 1.1). The twelve new Member States of May 2004 and January 2007 do not participate in the burden sharing agreement and have their individual GHG emission reduction targets under the Kyoto Protocol.

Table 1-1. EU burden sharing agreement (reduction below 1990 GHG levels)

Austria	-13
Belgium	-7.5
Denmark	-21
Finland	0
France	0
Germany	-21
Greece	25
Ireland	13
Italy	-6.5
Luxembourg	-28
Netherlands	-6
Portugal	27
Spain	15
Sweden	4
UK	-12.5
EU 15 Kyoto target	**-8**

Source: www.climnet.org/resources/euburden.htm

[7] Based on ERPA analysis, IETA & World Bank, 2006.

In order to comply with their commitments under the burden sharing agreement, several EU Member States have established or have become active in programmes to purchase emission reduction credits through JI and the CDM. For example, Austria, Belgium, Denmark, Finland, Italy, the Netherlands, and the UK manage and/or participate in programmes to purchase JI and CDM credits. Table 1.2 shows the planned purchase of JI and CDM credits of ten EU Member States. Taken together these countries plan to acquire from JI and CDM projects about 550 $MtCO_2$-eq. during the 2008-2012 commitment period (or 110 $MtCO_2$-eq. on average per year) for which they have allocated over € 2.7 billion so far.[8]

Table 1-2. Planned purchases of Kyoto credits by EU member states

	Annual average 2008-2012 ($MtCO_2$-eq.)
Austria	7.0
Belgium	8.4
Denmark	4.4
Finland	2.4
Ireland	3.7
Italy	39.6
Luxembourg	3.0
Netherlands	20.0
Spain	20.0
Sweden	at least 1.0
Total	**109.5**

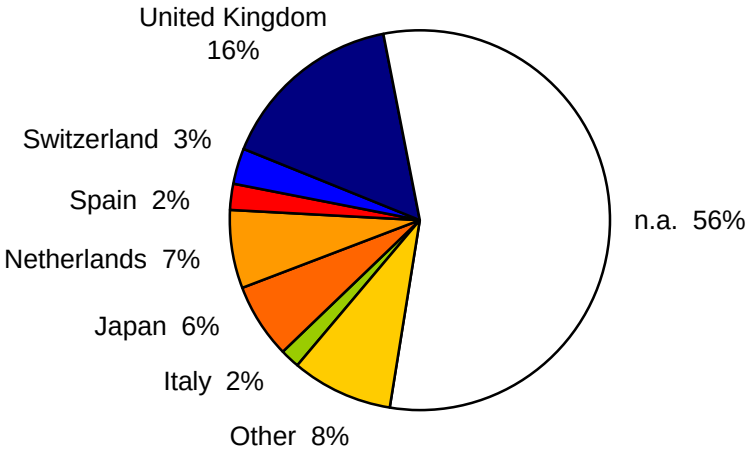
Source: Own calculation based on Salay, 2006

Figure 1.3 shows the shares of several Annex I Parties, including EU Member States, in the international CDM market (in terms of number of projects). It shows that, presently, of the EU Member States, the Netherlands and the UK are involved in most of current projects. Involvement can imply different things though. First, it can imply that the country invests in a CDM project as a buyer of the CERs. This is the case for most of the projects in which the Netherlands Government is involved. Second, it can imply that the country approves many CDM projects on behalf of legal entities that are located within its borders. CERs can only be added to the assigned amount of an Annex I country if that country approves of the project (next to approval of the project by the host country). In many project cases, legal entities develop CDM projects in co-operation with the host country, but without signing an emission reduction purchase agreement (ERPA) with an investor country. For the time being, the host country could decide to keep the emission reductions for itself and sell them as CERs after completion of the project or of a project phase, or it could sell the expected emission reductions through a forward contract to an international legal entity. Since most of these presently operational legal entities are based in the UK (often due to their London Stock Exchange quotation), the UK Government is requested to give approval to the underlying projects. It may well be though that the CERs presently listed under the UK, will eventually be sold to different investors/countries.

Finally, in several cases a CER buyer cannot be identified which may indicate the increasing popularity of developing projects unilaterally, *i.e.* without Annex I participation throughout the CDM project cycle (at least not during the project design stage). Private demand for CERs has largely

[8] Salay, 2006.

increased due to, among others, developments on the EU ETS. In total, private sector demand over 2005-06 was responsible for over 80 percent of the volume transacted.[9]



Note: In some projects, more than one investor country participates.

Figure 1-3. CDM investing countries and programmes

Source: Fenhann, 2007.

Theoretically speaking, there is huge potential surplus of credits during the Kyoto period 2008-2012. In particular, the Russian Federation and Ukraine could meet all other Annex I Parties' current GHG emission reduction requirements. It is estimated that the potential supply would be about three times higher than the current shortfall of assigned amount units of industrialised countries.[10] As explained above, Annex I Parties can enlarge their assigned amounts by purchasing AAUs from other industrialised countries, and by investing in JI and CDM projects.

Within the EU ETS, installations can only increase their amount of emission allowance through the purchase of JI and CDM credits; AAUs are not eligible under the Linking Directive. The size of the demand for JI and CDM credits by EU installations is difficult to predict. During the present phase of the EU ETS (2005-2007), its market price has fallen below € 5/tCO_2, which is lower than the average CDM credit price (even if the CER is traded on the forward market). Nonetheless, for the second period of the EU ETS (2008-2012), higher market prices are expected, based on the fact that the Commission is in a position to tighten the allowances allocated to installations. This expectation is reflected in the present forward market where EU ETS allowance contracts for December 2008 and December 2009 are traded at contract values of between € 16 and € 20 per tCO_2.[11] Given that such prices would be higher than those included in the present forward contracts for CDM credits for the period 2008-2012, this could imply an increased EU private sector demand for JI and CDM credits during this period.

[9] Capoor and Ambrosi, 2006.
[10] see Point Carbon, 2006a.
[11] see www.emissierechten.nl.

1.4. Lessons Learned from CDM: technology transfers, GHG emissions reduction, and methodology fitness

1.4.1. Retroactive Crediting

Officially, CDM emission reductions have been eligible for crediting as of the year 2000, even though the Kyoto Protocol only entered into force in February 2005. Projects which have started after 2000, but before 2005, could therefore retroactively claim emission reduction credits. There has been a clear preference for an early start date of CDM projects in order to alleviate post-2012 uncertainty about the CDM (after all, given the lead time for a project before it can become operational and reduce GHG emissions, a late start of the project would imply less CERs by 2012). Since most CER buyers show no interest for emission reductions in post-2012 (given the present absence of clarity about what a post-Kyoto Protocol climate regime will look like), project proponents tend to generate as many CERs as possible before 2012, which has resulted in a concentration of the starting date of the first crediting period prior to 2008 (see Figure 1-4).

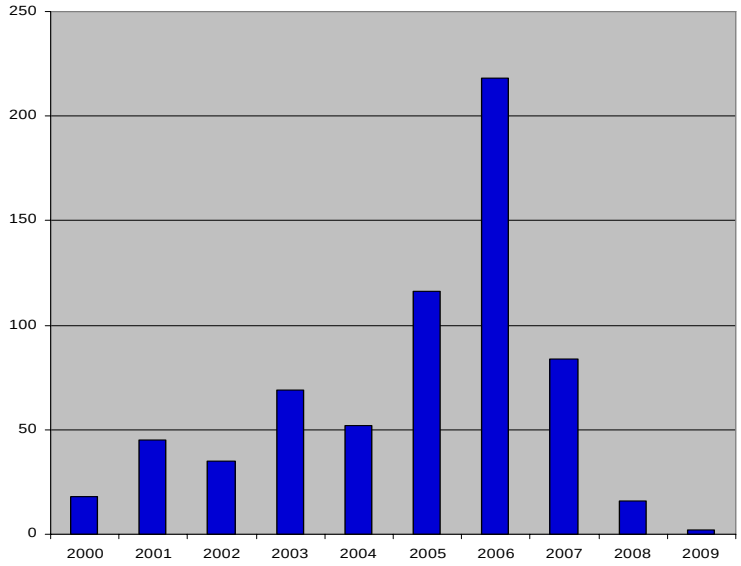


Figure 1-4. Start date of the first crediting period of projects submitted (September 2006)

Source: UNFCCC 2006a

However, it is important to realize that projects with so-called early crediting starting dates face a risk regarding the so-called "retroactive crediting," *i.e.* claiming CERs for emission reductions from projects before they are registered by the EB. At its second meeting in November 2006 the COP-MOP decided that *"project activities that started in the period between 1 January 2000 and 18 November 2004 and have not yet requested registration but have either submitted a new methodology or have requested validation by a DOE (designated operational entity) by 31 December 2005 can request retroactive credits if they are registered by the CDM EB by 31 March 2007 at the latest* (see UNFCCC 2006b)."

Therefore, host countries (such as Thailand) and project proponents should make sure that their projects can meet this deadline and be eligible to claim retroactive CERs.

1.4.2. Relation between choice of project type and baseline complexity….

A CDM project requires a careful accounting procedure to calculate the GHG emission reduction achieved. Through a baseline or reference scenario, it is estimated how many GHG emissions would have been emitted in the absence of the project. The emission reductions are calculated as the difference between the project's actual emissions and the baseline emissions. As a baseline is a hypothetical scenario by definition, *i.e.* the scenario described will be replaced by the project and will thus never exist, the methodologies for baseline determination must make clear that the scenario determined is a reasonable description of the without-project situation, based on the best available knowledge.

Baseline determination thus adds a considerable transaction cost component to the development costs of a CDM project activity. Moreover, during 2003-2004 many baseline methodologies were rejected by the EB, which has made investors and project developers reluctant to develop complex baseline methodologies. The most straightforward way to develop a CDM project is to select an activity for which it is relatively easy to show that it would not have taken place without the CDM component (*i.e.* it is clearly additional) and which baseline scenario is not complex with preferably one or at most two emission streams. Popular CDM projects are those with easy data availability, relatively simple monitoring procedures, and straightforward baseline assessments, so that the EB can quickly process the projects and the achieved emission reductions, such as landfill gas capture, fugitive gas capture, HFC-23 and N_2O removal projects have been quite popular among CDM investors; these activities require a relatively modest investment, but under business-as-usual circumstances there would be little incentive to carry out the investments.[12] On the other hand, projects that generate revenues through products that can be sold on the market, have been more difficult to assess on their additionality since the dividing line between the internal rate of return with and without the GHG emission reduction credits is not always easy to draw. Project examples in this category are: electricity generation through renewable energy sources (in particular hydropower projects in countries with a growing electricity supply shortage) and energy efficiency improvements.

This tendency is reflected in the Figures below (Figures 1-5 and 1-6), which show that, among others, almost one out of four baseline methodologies for energy efficiency projects have been rejected by the EB, whereas five out of six fugitive gas reduction projects were approved. About half of the renewable energy project baseline methodologies have been approved by the EB.

Another complication with effectuating the full potential of the CDM is that projects need a certain minimum scale in terms of GHG emission reduction in order to be able to cover the transaction and investment costs. Although the CDM contains a provision that small-scale projects could have their project design documents drafted in a simplified manner using standardised baseline emission components, still a large number of CDM projects would be too small to benefit from the small-scale CDM simplification. For example, biogas projects at small farms in developing countries or fuel switch investments in buses, or projects that switch to compact fluorescent lights in households can only be set up in programmes or bundles of small projects. For these bundles or projects, one overall baseline and additionality assessment is carried out, with the monitoring taking place through random sample checks. The CDM portfolio presently contains only a small number of such bundles (see also Chapter 2).

[12] Michaelowa and Hayashi, 2006.

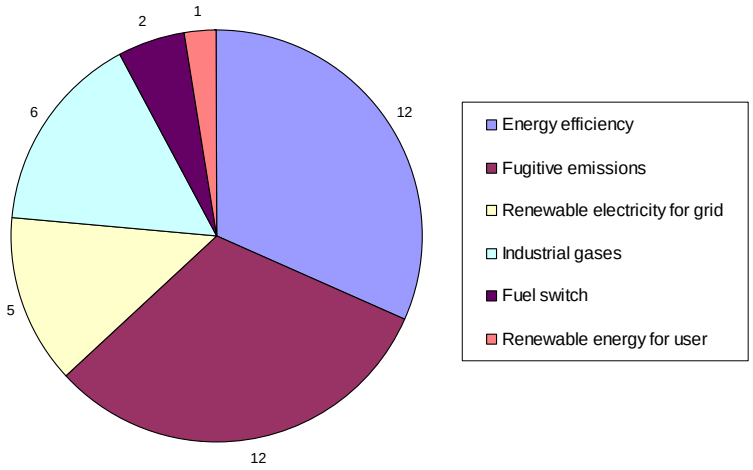


Figure 1-5. Number of baseline methodologies approved by project type (September 2006)
Source: UNFCCC 2006a

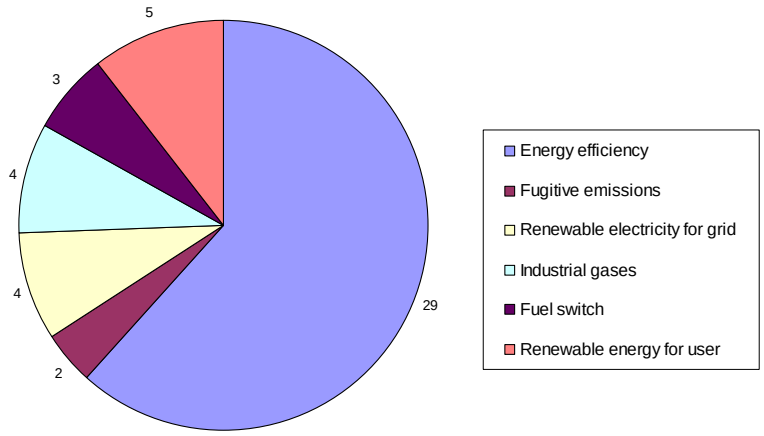


Figure 1-6. Number of baseline methodologies rejected by project type (September 2006)
Source: UNFCCC 2006a

1.4.3. …and the consequences for sustainable development contribution of CDM projects

As explained above, the CDM has a double-aim objective: to reduce GHG emissions to assist Annex I Parties in achieving their Kyoto Protocol commitments and to contribute to sustainable development in non-Annex I Parties. From this definition, a typical CDM project would involve two demand-supply chains: on the one hand, industrialised countries exercise a demand for relatively cheap emission reduction credits from CDM projects to be used for compliance with the Kyoto Protocol commitments; on the other hand, non-Annex I Parties exercise a demand for sustainable technologies that industrialised countries could offer through a CDM project.

Ideally, a CDM project would therefore be based on a clear assessment of the GHG emission reduction potential and a clear assessment of the technology needs in the host country. In such a situation, both demand-supply chains coincide. Actual practice of the CDM, however, has shown that projects are largely initiated by the demand for relatively low-cost CERs (see also Section 1.1).[13] In addition, with a view to the spreading of projects across countries, a rather large concentration of projects in a small number of developing countries can be observed (see also Section 1.2).

These two figures indicate that the CDM may thus far not have been able to clearly utilise its potential to match developing countries' demand for sustainable technologies with technology supply in industrialised countries, *e.g.*, the EU. Therefore, it can be concluded from the above that the CDM potential is determined by three basic factors: *first*, the demand in industrialised countries for relatively cheap GHG credits; the 'fitness' of the project design document with the approval procedures under the EB (baseline and additionality, transaction costs); and the priorities and needs of the host countries in terms of sustainable technology transfer. The above description of the present CDM market has shown that these three 'circles of potential' overlap to a small extent only, which is illustrated in Figure 1-7 below (note that the size of the overlap between the circles is only hypothetical). The overlap among the three circles is the part of the CDM potential that is actually being used.

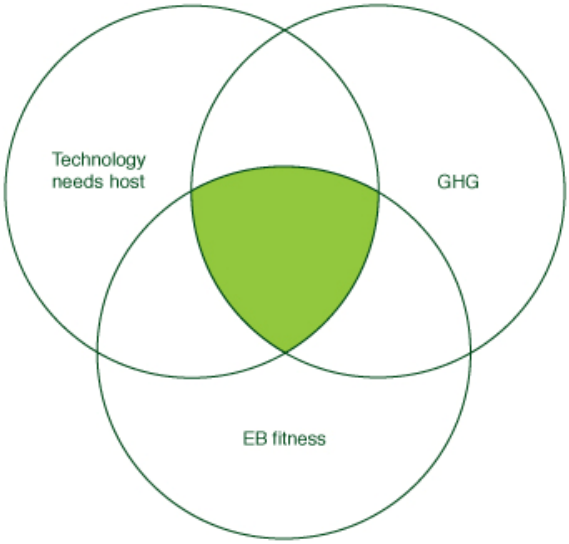


Figure 1-7. Circles determining the CDM potential

When taking a static perspective in terms of the technology needs and the GHG emission reduction potential, it can be seen that the CDM potential would already increase if for all projects in the overlapping area between technology needs of the host and GHG abatement potential, accounting methodologies could be designed. However, from a more dynamic perspective, it could be argued that through innovative concepts, such as programmatic CDM approaches, bundled projects and projects based on sector-level policies, more projects that would be in line with the national technology needs and priorities in the host countries would deliver substantial GHG emission reduction amounts. In other words, the overlap between GHG emission reduction potential and technology needs would become bigger.

[13] Van der Gaast and De Jong, 2007.

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2. Forms of CDM and the Role of the Host Country

2.1. CDM Co-operation and How and When Investor and Host countries Co-operate

2.1.1. Forms of CDM co-operation: bilateral, multilateral and unilateral CDM

The traditional way of developing CDM projects is that an entity from an investor country co-operates on a project with an entity from the host country, under the supervision of both governments. This form of bilateral co-operation was practiced mostly during the pilot phase for the Kyoto flexibility mechanisms, called Activities Implemented Jointly (AIJ, which lasted from 1995 to approximately 2000, although the pilot phase was never formally completed).

In the course of time, also multilateral CDM co-operation gained importance, especially through the activities of the World Bank and the several carbon funds that it established and which have now developed into the World Bank's Carbon Finance Programme.[14] Multilateral CDM funds collect investment money from governments and non-governmental entities that are interested in CERs, and invest this money into CDM projects. The advantage for the CER buying entities participating in multilateral funds is that they do not need to enter into the project preparation and implementation activities themselves but can leave this to the Funds' specialists.

With bilateral and multilateral co-operation, it is common practice that the CER buyers or their representatives (under multilateral co-operation) are involved in the project from the early stages of the activity. For instance, in a bilateral CDM context, an investor country interested in buying CERs explores the possibilities of becoming engaged in CDM projects (*e.g.* through a tender). Project developers subsequently offer project ideas to the investor country from which a number of ideas are selected. These ideas are worked out into full CDM approval and require the approval of the host country. Once approved, the project proposal will have to be validated by a DOE and subsequently registered by the EB. In the context of multilateral CDM, the multilateral fund selects the projects on behalf of the investor country by whom it has been contracted, after which the investor countries themselves approve the project selection made by the fund. Contractual arrangements with the host country participants are subsequently made by the multilateral fund.

In actual practice, however, several CDM projects have not identified CER buyers by the time that the project design is complete and the project registered by the CDM EB. Such cases are referred to as unilateral CDM projects, *i.e.* projects that have been approved by the host country government, implemented, and for which CERs a buyer is sought only upon certification of the emission reductions and/or issuance of the CERs to a buyer (which could take place annually or by the end of the crediting lifetime).

The roots of unilateral CDM can be traced back to the AIJ pilot phase. In 1995, Costa Rica introduced Certifiable Tradeable Offsets (CTOs) for its forest management programme as a unilateral anticipation of an international crediting system. A national umbrella finance fund administered the projects. By selling only a part of all possible reductions as CTOs, the fund could bear the risks of project delay or failure. International investors could simply buy the CTOs and Costa Rica was able to realize projects according to its own economic necessities and political preferences. This particular system highlighted an important window of opportunity for unilateral action.

[14] See http://www.carbonfinance.org

Over 50% of the CDM projects in the present pipeline have only host country approval.[15] Therefore, it can be concluded that many projects are presently developed by host country entities, possibly in co-operation with specialized intermediary parties from abroad who also offer temporary investment capital through loans or equity. Subsequently, these projects are approved by the host country governments and submitted for validation to DOEs. After validation, the projects are submitted to the CDM EB for registration and once this has been completed, the project can go ahead as a CDM activity with eventual delivery of CERs. Somewhere between the start of project implementation and the eventual CER issuance, a CER buyer is to be found. At that point, an agreement is reached with the buyer on the quantity and price of the CERs to be traded from the CDM project.

For some time, it was unclear whether unilateral CDM would be legally possible, given that the *Marrakech Accords* require a written approval of voluntary participation from the DNA of each Party involved in a CDM project. However, the moment at which an investor country would have to provide this approval was not defined. At its 18th meeting, on 25 February 2005, the EB supported the idea of unilateral CDM and *"agreed that the registration of a project activity can take place without an Annex I Party being involved at the stage of registration"*[16]. This basically implies that it has now become possible to set up CDM projects whereby:

- some, or even all equity, comes from host country actors;
- only the approval of the host country DNA is required prior to CDM EB registration;
- CER buyers only become formally involved when the first CERs become available for sale.

Several authors have argued that unilateral CDM would have the benefit that projects are more in line with the host countries' sustainable technology needs.[17] Another benefit could be that unilateral CDM provides developing countries that have not been able to participate in the CDM on a large scale thus far, with an opportunity to also enter the CDM market. Unilateral CDM could open a promising window of opportunities for ambitious businesses and consultants in developing countries to take initiatives to get the CDM machinery really going, without being dependent on procedural involvement by 'competing' experts in industrialised countries.[18]

In addition, transaction costs could be reduced because the experts from the developing countries are most likely not only cheaper, but probably also better informed about the situation in their home countries and may have different risk perceptions so that for them the minimally required internal rate of return may be lower than for a foreign investor. This could largely reduce CDM transaction costs, especially search costs (*i.e.* a local non-Annex I entity would generally be better aware of investment opportunities) and negotiation costs (*i.e.* negotiations would only involve talks about prices and quantities since unilateral CDM projects would have no or considerably less risks in terms of project risk and delivery risks). The potential reduction in transaction costs due to unilateral CDM could also stimulate the development of small-scale CDM projects. Several international CER buyers, such as the Dutch *Rabobank carbon procurement programme*, the German *Kreditanstalt für Wiederaufbau KfW*, and the Dutch *CERUPT programme*, require projects to deliver at least half a million to one million tonnes of CERs by 2012, in order to be able to cover the transactions costs related to project design and implementation.[19]

Finally, unilateral CDM offers CDM project developers in developing countries the possibility to sell CERs at higher prices. After all, when selling CERs upfront through a forward contract, the buyer has

[15] Fennham, 2007.
[16] see: http://cdm.unfccc.int.
[17] Figueres, 2004; Laseur, 2005; Jahn *et al.*, 2004.
[18] Jepma, 2005.
[19] JIN, 2004.

to take into consideration a risk premium because these CERs have not been actually realised. Selling CERs afterwards, *i.e.* once the emission reductions have been realized under the project, would imply supplying risk-free carbon credits on the market. At that point, spot market CERs would have the same low risk profile as EU ETS allowances. This creates arbitrage opportunities for developing country entities, among others through the Linking Directive, by using unilateral CDM.

Generally, however, unilateral CDM is considered to be surrounded by two important disadvantages. First, although developing country entities have the possibility to sell CERs at a later stage without ERPA contracts, and thus can benefit from higher prices, this may also imply a risk for them that the price will be lower by the time of CER issuance than at the time of designing the CDM project. Second and in line with the above argument, there could be a risk that unilateral CDM reduces the potential of transferring state-of-the-art sustainable technologies from industrialised to developing countries (Liu, 2001). Without the agreed purchase of the CERs from a project by an Annex I Party entity at an agreed forward price, it could become more difficult for the host country project participants to attract funding (*e.g.*, loans) from domestic or international financial institutes to purchase an international state-of-the-art technology and/or to acquire spare parts during the project lifetime. Instead, in order to reduce the upfront risks and increase the internal rate of return, the project developers may decide to purchase domestic technologies for the unilateral project, which could be less advanced than the international state-of-the-art and possibly, but not necessarily, produce fewer emission reductions.

2.1.2. Programmes of activities

Programmatic CDM involves the aggregation of a number of relatively small emission reduction activities in developing countries into a larger bundle or programme, which is then prepared and submitted to the CDM Executive Board as a single CDM activity with one set of methodologies for baseline determination and monitoring of the project performance. Given the fact that the development of a CDM project involves several fixed cost items (both for small and large-scale projects), such as project design, validation and verification costs and fees; only the fee for the administration/registration of a project with the CDM Executive Board varies with the size of the GHG emission reduction component. Moreover, the costs related to project design may vary with the size of the projects, as some project-design procedures for small-scale projects are simpler than for large-scale projects.

Due to these relatively large fixed costs, many small activities that have the potential to reduce GHG emissions cannot be implemented, even when taking into consideration the CER revenues, because the costs are too high. The most well known examples of these activities are compact fluorescent lamps that replace incandescent light bulbs, green transport plans and agricultural activities such as biogas installations for farmers. Given the above fixed cost problem, it is not possible to develop a CDM project for each household, car or farm, but in programmatic bundles, the costs can be spread across a large range of activities and compensated by a much larger emission reduction component. It will thus become more attractive to develop these activities under the CDM.

Many renewable energy projects (in particular in rural areas) and energy efficiency improvement projects (in particular in built environment) are small, although their replicability potential is big.[20] Enabling these activities under the CDM in a bundle or programme would thus contribute strongly to sustainable development in the host countries. A clear example of a CDM programme is a series of activities in Nepal with partial support from the Development Assistance Office in the Netherlands

[20] Hayashi, 2006.

and which aims at supplying biogas installations to farmers for electricity and cooking purposes. The programme has been extended and the extension has been registered as a CDM project. The overall programme covers over 200,000 farms.[21] The programme is expected to contribute to sustainable development as it reduces the need for women and children to collect firewood for cooking, whereas less oil needs to be purchased for lighting.

Aggregation under the CDM is not a new phenomenon. The project in Nepal is one example of a bundle of individual small projects. Also, methodological aggregation has been applied through the adoption of baseline methodologies that can be used for a multitude of projects, *e.g.*, baselines that are calculated using (weighted) average GHG emissions for sectors. Moreover, the CDM EB has merged baseline and monitoring methodologies, which have been developed in the course of time, into consolidated methodologies, which can be used for all projects of the same type.

At the policy level, the topic of recognising programmes as stand-alone CDM projects has been surrounded by uncertainties about whether such programmes could also include government policies in developing countries. This uncertainty was based on the question whether a government which would like to improve the energy efficiency in households (*e.g.*, lighting or air-condition), thereby valuing the GHG emission reductions achieved, would be allowed to develop such a policy as a CDM project. At its second session in November 2006, the COP-MOP decided that local/regional/national policy or standards cannot be considered a CDM project. However, COP-MOP-2 decided that project activities under a programme of activities can be registered as a single CDM project, provided that it would comply with the regular CDM modalities and procedures. COP-MOP-2 requested the CDM Executive Board to provide detailed guidance on such Programmes of Activities (PoA).[22]

The guidance document can be summarised as follows:[23]

- PoA is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes
- The physical boundary of a PoA may extend to more than one country
- A PoA can be proposed by both a public or private entity
- The projects under the PoA can not be registered as CDM projects individually
- Each PoA shall apply one approved baseline and monitoring methodology, involving one type of technology or measure applicable to all activities within the programme
- The duration of the PoA shall be defined by the entity at the time of request for registration. During the PoA, new activities can be added to the programme. This implies that the following times periods can apply:
  - each activity within the programme can have a crediting lifetime of 10 years or a 7-year crediting lifetime with two possibilities for renewal up to a maximum of 21 years.
  - during the lifetime of the PoA, new projects activities can be added, about which the PoA co-ordinator must inform the CDM Executive Board.
  - however, the maximum lifetime of the PoA is 30 years, so that a project that joins the PoA after 15 years, can only receive credits for 15 more years instead of 21.
- The emission reductions of each activity within the project shall be monitored as per the registered monitoring plan (which may include random sampling) according to the methodology applied to the registered PoA.

[21] Van der Gaast and De Jong, 2007.
[22] JIN, 2006.
[23] The document can be downloaded from http://cdm.unfccc.int/EB/028/eb28_repan15.pdf.

2.1.3. The CDM project cycle and implications for unilateral CDM

As mentioned above, the development, implementation and completion of a CDM project follows a project cycle with a number of steps, which are in accordance with the *Marrakech Accords*.[24] The first step is the identification of a project by a project developer (either an entity from the host country or from abroad). Under regular bilateral CDM deals potential buyers typically ask for a project idea note (PIN). Once the PIN is accepted by the investor country (in most cases this means short listed from a rather long list of project ideas; for PIN acceptance it is also generally recommended that the host country government has given its approval to the project idea), a project concept note (PCN) is generally asked for which requires more detailed information from the project developer, including a clear calculation of the expected GHG emission reduction and contribution to sustainable development in the host country. Once the envisaged CER buyer has accepted the project, the project participants will sign an emission reduction purchase agreement (ERPA), which is the basic contractual arrangement of the amount of CERs that will be transferred to the buyer once the reductions have been certified. It usually also includes a price for the CERs.

For validation by a DOE and registration of the project by the EB, the PCN needs to be elaborated on into a Project Design Document (PDD), which is the basic format for submitting the project plan to the EB. The role of the host country government could be rather passive during this project development stage, but a project cannot be submitted for registration to the EB without a formal approval by the host country's DNA. For this, the host country DNA must submit a *Letter of Approval* for the project, which does not only confirm the host country's voluntary participation in the activity, but also that it perceives the project to be contributing to the host's sustainable development (which is in accordance with Kyoto Protocol Art.12.2). If any Annex I Party is officially involved as a project participant at this stage, a Letter of Approval from its DNA is required as well.[25] During the validation of a project by a DOE, a public comment period of 30 days is foreseen and the DOE takes comments into consideration.

Subsequently, a CDM project plan accompanied by a Letter of Approval from the DNAs of the participating countries and validated by the DOE can be officially registered by the CDM.[26] For this registration, the project developers need to pay a fee to the EB, which is proportional to the size of the project.[27]

Regularly, usually annually or biannually, the project's generated GHG emission reductions are to be verified by another DOE. Once this is done, the DOE is expected to certify the credits and to request the EB to issue the CERs. Finally, the CDM registry administrator, working under the authority of the EB, forwards the CERs to the account that the CER buyer holds under the EB.[28] From then on, the CERs can be used to assist Annex I Parties (and/or ETS companies, see Chapter 4) in achieving compliance with their emission mitigation commitments.

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[24] UNFCCC, 2001.

[25] The Marrakech Accords require the approval from the DNA "*of each Party involved*" (UNFCCC (2001), Draft decision -/CMP.1 (Article 12), Annex, §40a). Notably, Annex I Party approval cannot be circumvented, but only delayed, see the discussion in Section 2.1.1.

[26] The extent of initial DOE validation fees approximately varies from €5,000 to €30,000, depending on various factors, among which the most important are: the project's complexity, the time needed, and the costs of site visits. Source: personal communications with DOE representatives. Site visits are more likely to be necessary if a project's baseline is based on existing actual or historical emissions (UNFCCC (2001), Draft decision -/CMP.1 (Article 12), Annex, §48a) than if it is based on emissions data of a technology (*ibed.*, §48b) or similar projects (*ibed.*, §48c) .

[27] For the fees, see JIN, 2005.

[28] See UNFCCC (2001), Draft decision -/CMP.1 (Article 12), Annex, §66b.

2.2. Role of Host Country Government in Meeting Domestic Technology Needs through the CDM and CDM Risk Management

2.2.1. Technology needs assessments

As explained in Chapter 1, ideally, a CDM project would be the result of a CER demand from an industrialised country and a clear assessment of the technology needs in the host country. Such a technology needs assessment (TNA) and would result in a list of sustainable energy technologies which would best fulfil the host country's needs and priorities and deliver an optimised contribution to sustainable development in the country. Particularly suitable for the CDM would be those technologies that would not be implementable under business-as-usual circumstances due to all kinds of economic, cultural and institutional barriers. Such technologies would deliver a clearly assessable contribution to sustainable development and are additional to business-as-usual circumstances (see for example Box 2.1).

Box 2-1. Possible priorities and needs for sustainable development in a CDM host countries

A TNA could consist of exploring which of the following energy services would have the highest need/priority in the host country, and, subsequently, what technologies would be most suitable to fulfil these needs/priorities:

- Electricity for industrial appliances, agricultural production, households, both in rural communities and urban communities, and for service sectors;
- Heat delivery for industry, households, and service sectors;
- Energy for cooling purposes (*e.g.,* medicines);
- Efficient design of buildings;
- Energy for cooking;
- Transport; and
- Municipal solid waste management.

However, in actual CDM practice, such extensive and elaborate TNAs hardly take place. Instead, present CDM projects are largely initiated by the demand for relatively low-cost CERs. Even within the UNFCCC context, developing countries hardly feel inclined to carry out such assessments and the UNFCCC Secretariat needs to combine information from the National Communications submitted by countries to come to TNA reports. An important barrier mentioned in the SB-24 report is the lack of funding available in developing countries for TNAs.[29] Moreover, as has been discussed in Chapter 1, actual practice has also shown that project developers largely tend to focus on those projects for which the additionality of the emission reductions is relatively easy to show.

It thus does not come as a surprise that many CDM projects are assessed on their GHG emission reduction potential using a technology or technique that the host country considers not to conflict with its national strategies and that project developers consider to be easier in terms of going through the EB procedures. That is not to say that these CDM projects do not contribute to sustainable development in the host countries, but a TNA could have led to different projects with higher contributions to sustainable development in the host country.

Of the three forms of CDM co-operation described above, unilateral CDM seems to fit best in the concept of assessing technology needs and priorities. Once priority technologies have been identified, local entities would establish and implement a CDM project and sell the credits after the project has delivered CERs. However, this requires that the local partners are able to acquire the technologies on the basis of the net present value of the CERs to be sold in the course of the project (see above). Under bilateral CDM, it would be necessary to find a CER buyer who is also able and willing to deliver the prioritized technology. For instance, a project containing a priority technology may be of a small

[29] UNFCCC (2006).

scale and thus less attractive for potential bilateral or multilateral CDM buying entities that may prefer larger projects with possibly less preferential technologies from the host country perspective.[30]

In the case of unilateral CDM the CER buyer is not involved in the project and thus does not have to care about transaction costs and risks related to project development. As mentioned above, however, unilateral CDM may require different compromises if it turns out that the local or international financial institutes are unwilling to financially support, *e.g.*, through a loan, projects containing technologies with the highest priority for the host country, for instance, as these could be more expensive. In those cases, second-best technologies would need to be included in the unilateral CDM project.

Nonetheless, should a CDM host country decide to use unilateral CDM as its strategy for the reasons mentioned above, the following three aspects would have to be taken into consideration:

- the priority technologies for the host country - to ensure a full contribution to sustainable development and easier approval of the host country DNA.
- the GHG emission reduction potential of projects - to attract interest from foreign (Annex I government or ETS entity) buyers.
- the flexibility of the GHG accounting methodologies (baselines and additionality) in EB.

In finding a balance between these three aspects, research activities, such as the underlying study, could provide considerable research input to make TNAs more feasible for potential CDM host countries.[31]

2.2.2. The role of the host country government in CDM project risk management

The CDM project cycle contains several points of uncertainty which implies risks for the project developers. One risk category is the position of the host country government towards the project. This is also why most CDM buyers under bilateral or multilateral deals want to receive from the host country governments a Letter of No Objection to the project prior to the Letter of Approval.[32] Another risk would be the acceptance of the project during the validation and registration procedures. A final risk during the project design phase would be whether the full financing of the overall project investment will be secured.

During the implementation phase, there are risks related to the performance of projects. For instance, a project's state-of-the-art technology may encounter technical problems during the installation, and operation and management phases. Sometimes, projects may have to be stopped for a few weeks or months, so that the contracted forward CERs will have to be adjusted downwards, which is sometimes even accompanied by clauses for non-delivery. There could also be other risks related to regular foreign direct investments, such as host country political and legal risks.

With a view to the revenue side of the projects, project participants may face risks related to the follow-up of the Kyoto Protocol. For projects that envisage delivering credits beyond 2012 (*i.e.* projects that have chosen a 21-year crediting lifetime for the GHG emission reductions), it is very important that the emission reductions to be achieved then will still be tradable as CERs to countries with commitments. Also the CER price remains uncertain as it largely depends on the eventual demand and supply figures for GHG emission titles during the Kyoto Protocol commitment period 2008-2012: *e.g.*, how large will the Russian surplus of assigned amounts become; will Canada enter the

[30] It should be noted though that presently multilateral funds exist that specifically address specified needs in developing countries, such as the Community Development Carbon Fund of the World Bank.
[31] Moreover, the FP6 project ENTTRANS carries out TNA for five potential CDM host countries: Chile, China, Israel, Kenya, and Thailand; see www.enttrans.org
[32] Laseur, 2005.

CDM market as a substantial buyer; how many CERs do EU Member States need, or their installations, through the Linking Directive?

Through learning by doing, with an increasing number of projects in a host country, these risks could probably already be mitigated to some extent. For instance, specialised institutes could emerge which would be able to assess domestic investment risks and know their way towards the CER buyers, as well as when to sell the CERs. In general, a country that wants the CDM to work throughout its economy is likely to install a DNA that can do a lot more than passively executing its formal responsibility of appraising incoming CDM project proposals. However, having to manage increasing responsibilities obviously puts supplementary strains on the already-limited resource base of most developing countries. Castro and Figueres (2002) have proposed that a DNA should preferably first occupy itself with the prescribed evaluation and approval functions and only later, as experience accumulates, take on the additional responsibilities that are needed for unilateral CDM. Jahn *et al*. (2004) have also emphasized the advantage of previous experiences with AIJ and CDM project development.

In practice, it may well be that a country with little previous experience with CDM project development would prefer bi- or multilateral CDM co-operation. However, if a search for a foreign CER buyer fails, a decision could to be made to proceed unilaterally. Unilateral CDM can in fact also help to relieve certain responsibilities by providing more independence. Local consultants can learn to perform the tasks that are presently mostly executed by experts from the North. In fact, *"[…] it may help non-Annex I Party country participants to get rid of the feeling of being patronized by foreign CDM consultants"* (JIN, 2005). Even though it may be tempting for a developing country to outsource the development of projects under the CDM and to use their own human capacity base towards more pressing matters, it may be equally worthwhile to encourage local consultants in the host countries to learn how to do the work that is now still mostly done by their relatively expensive colleagues from industrialised countries.[33] If host countries acquire the CDM know-how, they may be better prepared to participate in the global effort to mitigate the adverse effects of climate change more actively in the future. This way, the CDM offers a real opportunity to stimulate the sustainable development of developing countries at a level that goes beyond the local development benefits of individual CDM projects. The next Chapter will explore in detail the responsibilities and (possible) roles of the DNAs in CDM host countries and how the DNA set-up could specifically address risk management.

[33] Outsourcing could be directed to a specialized credit procurement entity or carbon fund from abroad. However, as these types of co-operation do not involve ERPA with an Annex I Party buyer, the co-operation could be considered unilateral CDM.

3. DNA Settings in non-Annex I Parties

3.1. Status of DNAs in non-Annex I countries

As of September 2006, 89 host countries had notified the UNFCCC Secretariat of the establishment of a Designated National Authority (DNA) for the CDM.[34] In terms of CDM institutional capacity, the Latin American and Central America region are the most advanced due to their active involvement in the AIJ programmes. 17 Out of 20 non-Annex-I countries in this region have already established DNAs, and most of them are fully functional. Asia can be considered the second most advanced region, represented by the large number of DNA notifications and several CDM 'giants', *e.g.* China and India. However, the region also includes some countries with DNAs at an early stage of development.

In Africa, the number of DNAs has significantly grown since 2005. However, most of them are not in operational condition yet except for South Africa and the Maghreb countries. The regions that lag behind mostly are the Middle East, South-East Europe and the non-Annex I Parties in the former Soviet Union (FSU). Many factors such as uneasiness with the Kyoto Process, political instability, lack of human and financial resources, and low awareness of the CDM in the regions have caused the tardy institutional development.

Focusing on structures, regulatory, and promotional functions, this chapter analyzes different DNA settings and exploits lessons from the experience in the Latin American/Central Americas, Asian, South-Eastern Europe and FSU regions. As a first step, the next section summarises DNA structures that are theoretically possible and which have been implemented in practice in the surveyed regions.

3.2. Structure of DNAs

3.2.1. Theoretical structure of DNAs

Theoretically, there are at least five approaches to develop a DNA structure: i) single government model, ii) two-unit model, iii) inter-ministerial model, iv) foreign direct investment (FDI) piggyback model, and v) outsourcing model. These five approaches are summarized below.

- **Single government model:** One department or ministry undertakes all DNA activities and may invite technical experts upon demand. The DNA Secretariat may also be responsible for marketing and promotion of the CDM.[35] A host country can avoid a blockade through conflict of interests in different ministries that leads to high transaction costs for project proponents.[36] However, other kind of conflicts may arise if a DNA plays both roles of CDM approval and promotion.
- **Two-unit model:** DNA activities are split into two parts. Regulatory functions are assigned to a department responsible for climate change, while promotional functions remain elsewhere in another government department or an independent unit. The DNA may establish an ad-hoc CDM Board with representatives of ministries to conduct the regulatory work. The separation helps to avoid possible conflicts of interest in the process of project formulation and approval.[37]

[34] See for an overview, http://cdm.unfccc.int/DNA
[35] see Lee (ed.), 2004.
[36] see Michaelowa, 2003.
[37] Lee (ed.), 2004.

- **Inter-ministerial model:** All relevant government departments are integrated into a DNA as permanent members. The Ministry of Environment can act as a co-ordinator, but all member departments take part in the approval of projects. A committee to operate this approval could be set up.[38] This model can incorporate a wide variety of expertise. However, conflicts of interest may arise among different departments. If not managed properly, this model could considerably slow down the approval process.
- **FDI-piggyback model:** Most countries have a Foreign Direct Investment (FDI) institutional framework, which typically comprises a promotion office and an approval or implementation office. The FDI framework could thus be adapted for the CDM and be used as a DNA. Relevant technical experts could be sourced by the investment office to assist validate GHG emission reductions.[39] This model may allow a quicker DNA set up, but conflicts of interest are likely to arise if the DNA is also involved in promotional activities.
- **Outsourcing model:** DNA services can be outsourced to an independent agency, which subsequently evaluates and validates projects, and reports to a government agency. Then the government agency would forward the project approval letter to the DOE. This model may increase flexibility in funding options, but rigorous oversight is required to ensure the quality of project approval. Also, conflicts of interest between regulatory and promotional functions may arise if a single agency is in charge of both functions.

3.2.2. Structure of DNAs in the surveyed regions

In the surveyed regions the two-unit DNA model dominates, followed by the single-government department, and the inter-ministerial models. The outsourcing model is not very common and the FDI-piggyback model has not been observed so far in the regions. Since governance structures and responsibilities are different across countries, efficient DNA structures are also likely to vary.[40] As a general remark, however, it is recommended to place a DNA Secretariat in an office that is designated specifically for climate change activities in order to make full use of its expertise. Delegation of Secretariat functions to an independent entity (in case of a two-unit model) or outsourcing of all the relevant functions can be a strategy more flexible in terms of DNA costs for the government. However, it depends on the legal structure and the private sector's perception of the CDM in the country whether such outsourcing is feasible or not.

Early experience in Costa Rica, which was an advanced host country under the AIJ programme, shows that it is imperative to have a single unit responsible for the solicitation and approval of projects. It must have full decision autonomy and professional, permanent staff. Thereby, it can avoid a blockade through conflicting interests of different ministries which could be observed in some Eastern European countries and which affected several AIJ projects in these countries and led to high transaction costs for project developers.[41] However, it should be kept in mind that potential conflicts of interest may arise between the investment promotion and project oversight functions with the single-unit model, where CERs are used as compliance instruments to meet Kyoto targets in Annex I countries.[42] For example, the Peruvian DNA, the National Environmental Council (CONAM: *Consejo Nacional del Ambiente*), has been entrusted with only regulatory functions whereas promotional functions were

[38] Lee (ed.), 2004.
[39] Lee (ed.), 2004.
[40] Ellis *et al*., 2004.
[41] Michaelowa, 2003.
[42] UNDP, 2003.

assigned to the National Environmental Fund (FONAM: *Fondo Nacional del Ambiente-Perú*) to avoid such conflicts of interest.[43] The Ecuadorian DNA also has a two-unit structure for the same reason.[44]

Therefore, countries should have sound understanding of the regulatory and promotional functions of DNAs and make a clear distinction between them to avoid such conflicts. The next sections discuss those functions and summarize lessons learned from the experience in the surveyed regions.

3.3. Regulatory functions of DNAs

According to the *Marrakech Accords*, host country DNAs have to conduct the following functions:[45]

1. Decide on sustainable development criteria;
2. Confirm voluntary participation of the project participants;
3. Confirm sustainable development contribution of the project and issue a letter of approval for the purposes of validation and registration; and
4. Report to the UNFCCC Secretariat on the CDM activities annually.

As per the decisions taken under the *Marrakech Accords*, host country DNAs have the prerogative to decide whether a CDM project contributes to achieving sustainable development in the country or not. Therefore, the host country should develop national criteria and fulfil respective information requirements to ensure a coherent, justifiable and transparent assessment in accordance with the national interpretation of sustainable development (see).[46] The key task of a DNA is to translate the national development needs and priorities into criteria for the evaluation of CDM projects contribution to sustainable development ín the country.

Even though most of the existing DNAs have established sustainable development criteria, few have been able to define concrete methods to assess projects against these criteria, *e.g.*, multi-criteria analyses, or a general system to add weights to each criterion. This situation could create considerable uncertainty for project proponents and interested investors, who do not know clearly a priori whether their project would qualify under the sustainable development criteria set by the host country DNA.[47] With a view to this, further specification and selection of sector-specific national or regional sustainable development criteria may be more practical.[48]

In order to enhance DNAs' capacity to assess sustainable development, it is also important to utilize an existing body which has expertise in sustainable development issues. For example, the Government of Georgia is considering the establishment of a State Commission of Sustainable Development as a high-level decision-making body on the compliance of CDM projects with the sustainability criteria.[49] Such expertise should be well-integrated into a DNA structure.

Next to well-designed and transparent procedures for the assessment of projects' sustainable development contribution, it is also important that DNAs establish clear, transparent and thus efficient national procedures for project approval (*i.e.* confirmation of voluntary participation of the project participants, sustainable development contribution of the project, and issuance of letter of approval). Such as procedure could consist of two main steps: initial screening and final approval of a project. The initial screening can be done by review of a PIN or PCN. It is not intended to assess the accuracy of the information provided but to assess the completeness and adequacy of the information

[43] Chaparro, 2006.
[44] Figueres and Olivas, 2002.
[45] Castro, *et al.*, 2002
[46] Castro, *et al.*, 2002.
[47] Morera, *et al.*, 2003.
[48] Naydenova, 2004; Shvangiradze, 2005; Castro, 2004.
[49] Van Wees and Van Rooijen, 2004.

requested to conduct the final approval process. During the final approval, based on a review of a PDD, the DNA could increase transparency and certainty by applying a standardized timeframe for the project approval procedure (*e.g.* three weeks or 20 working days).

Most countries in the surveyed regions have proposed a two-step approval procedure (screening and final approval). The quick initial feedback, often in the form of a letter of endorsement or no objection, helps project proponents decide whether it would be worthwhile to continue the project preparation process or not at a very early stage. This avoids wasting time and resources to fully develop a project idea that might not be approved at the end (note that several CER buyers recommend project developers to obtain the host country's initial approval of a proposed project during the project idea phase). On the other hand, the Brazilian DNA only considers projects after validation by a DOE, which can be problematic if there are frequent changes in approved GHG accounting methodologies which may lead to the need to revise a PDD after approval and thus the need to start the whole process again.

The majority of DNAs in the surveyed regions mainly use the contribution of the projects to national sustainable development and confirmation of voluntary participation as approval criteria. A few examine the submitted projects for compliance with the CDM formulation rules (for example of the Latin American and Central America region),[50] which is largely left to DOEs at the validation stage. As an example of the formulation rule assessment, the Argentinean DNA requests a technical analysis from an external institution once the initial screening of a project has been finished. The reviewer assesses baseline, additionality, estimated emission reductions, crediting period, monitoring plan, economic feasibility and technical feasibility. The result of these technical assessments will be submitted to the DNA for its final decision on project approval.[51]

One of the key elements for attracting CDM investments is the host country's application of quick and transparent procedures for project approval.[52] The quicker and more transparent the approval process is, the less transaction costs are incurred to project proponents. However, it should be kept in mind that the level of scrutiny in the international registration process has significantly increased since the setup of the Registration and Issuance Team (RIT) in February 2006.[53] Therefore, a host country DNA should contemplate a careful choice of approval criteria and level of scrutiny.

The key question regarding regulatory DNA functions is how to expedite the approval process without losing the quality of approved projects. First of all, the experience in the surveyed regions shows that it is essential to utilize existing expertise within the country on climate change and sustainable development, *e.g.* integrating climate change or sustainable development units into DNA structures. Second, uniform formats for documents required for host country approval greatly increase transparency and expedite the approval process. Third, a two-step approval procedure, with a quick initial feedback and final approval process, can avoid wasting time and resources to fully develop a project idea that might not be approved at the end. This reduces transaction costs both for the DNA and the project proponents. Fourth, transparent guidelines and approval criteria and timeframe must be clearly announced. In particular, sustainable development criteria, including technology transfer requirements, have been a major challenge in project approval. Such criteria tend to be too general to be applied in a specific project case or they are applied in an ad-hoc manner. Sustainable development criteria at a sector level, rather than just a general clause, may help to make the approval process much more transparent and efficient. Lastly, but not least, a host country DNA is

[50] Morera. *et al.*, 2003; Chaparro, 2006.
[51] Chaparro, 2006.
[52] Castro *et al.*, 2002.
[53] As of August 2006 seven projects are put under review due to doubtful additionality determination.

encouraged to build capacity to properly assess additionality and stakeholder consultation elements in its approval process.

3.4. Promotional functions of DNAs

3.4.1. Overview of promotional functions

DNAs may choose to perform promotional functions, which are optional and not mandated by international rules. A non-exhaustive list of promotional functions is given in Table 3-1.

Table 3-1. Promotional DNA functions

Functions	Desired outputs
Information database	• Project portfolio • Partner matching data • Appropriate technologies data • Data CD-ROM
Information dissemination/ training	• Website development • Newsletter • Seminars and training manuals
Policy development support	• Regional networking • Consensus building • Policy documents • Coordination with other programmes promoting sustainable development
Project development support	• Project CDM packaging • Project documents/updates • Standardized methodologies • Baseline data collection • Financial standards
Operational entity support	• Capacity building seminars • Domestic DOEs
Credit sharing support	• Model contracts • Negotiation capacity building
Marketing	• Website hosting • Road-shows • One-stop PIN shop • Participation in carbon fairs • Memoranda of Understanding

Source: Adapted from Michaelowa, 2003.

Expanding the DNA with a role in the identification of potential CDM projects and making this information available to potential investors could help increase the financial viability of a DNA.[54] However, as discussed above, conflicts of interest may arise if the same organisation both promotes projects and must provide host-country approval of these projects. A two-unit model could be an option to avoid such conflicts.

Several DNAs in the Latin American and Central Americas regions have actively performed promotional functions. However, it requires considerable efforts just to establish appropriate project approval criteria, implement an efficient and transparent approval process, and educate all involved stakeholders in the requirements of project review. Once a DNA has demonstrated that it operates effectively, it will be much better positioned to turn to outside donors and investors for additional support for project outreach, identification, and development.[55] For a newly established

[54] Ellis *et al*., 2004.
[55] Findsen, 2005.

host country DNA it is almost impossible to perform all the promotional functions besides regulatory ones and it is not necessary to do so.[56] Georgia and Armenia, for example, have focused first on the institutional setup for the review function, then on the development of sustainable development criteria, and only much later the governments of both countries will become involved in outreach, project pipeline development, and consolidated baseline studies. Several other FSU countries have also recommended that technical assistance activities for DNAs should be kept simple in the first years and implemented in phases. Any assistance should start with helping the countries develop their DNA structures and then focus on activities related to project development and outreach.[57]

3.4.2. Moving forward to proactive DNAs

Promotional functions are optional but essential tools, especially for countries that are not able to easily attract foreign investors. As has been mentioned above, these functions should be designated according to the specific needs and institutional maturity of a host country. This section explores some important promotional functions that host country DNAs may choose to perform in order to make a step forward to become more proactive:

- **Provision of a good website:** As a first step, a DNA is strongly encouraged to develop and maintain its own Internet site. A simple but continuously updated website should feature its DNA structure, approval criteria, description of the approval process, projects approved and key CDM stakeholders in the country. All the information on the website should be available in English. However, a survey on DNA websites found that only a minority of host country DNAs have websites and that most of them are not well structured.[58]

- **Participation in carbon fairs**: A DNA should participate in the two key world carbon fairs: the Carbon Markets Insights and the Carbon Expo.[59] Networking and marketing at carbon fairs are very essential and effective promotional tools for a host country DNA. The World Bank supports DNA participation in the Carbon Expo.

- **Conclusion of Memoranda of Understanding:** Memoranda of Understanding (MoUs) are aimed to establish long-term co-operation in the field of the CDM and could help establish a long-term understanding between a potential CER buyer and the host country. However, it must be noted that the role of MoUs has been decreasing with a maturing CDM market.

- **Co-ordination of project portfolio and partner information:** DNA assistance in partner matching can reduce project search costs. This can be done by developing a project portfolio database with a 'one-stop PIN shop' which offers workable CDM project ideas to potential investors. In addition, such co-ordination could also increase the possibility of bundling potential projects that are considered too small to develop as stand-alone projects, *e.g.* typical small-scale renewable energy projects. If a host country DNA could be a co-ordinating body for project bundling, such projects could become more attractive to investors.

- **Capacity building on CDM formulation rules:** Local project proponents that are not well informed about the CDM run a higher risk of methodology or PDD rejection by DOEs or the EB compared to bi- or multilateral investors with high-quality consultants.[60] In order to make local project proponents more competent, host country DNAs can organize capacity building seminars on the CDM formulation rules.

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[56] Castro *et al*., 2002.
[57] Findsen, 2005.
[58] Gupta and Michaelowa, 2005.
[59] www.pointcarbon.com and www.carbonexpo.com.
[60] Jahn *et al*., 2004.

- **Baseline data collection:** Data gathering for baseline emissions calculation is usually time consuming and incurs high transaction costs. Now that many baseline methodologies have been approved[61] and they provide clear views on data requirements, a host country could analyze its CDM potential and set a priority list for baseline data collection. DNAs can centrally provide some key data, the most important of which are the GHG emission factors related to existing power production capacity in the host country, including the composition of the energy mix in the country, potential power sector expansion plans, recently added power capacity, load factors within the power grid, etc.
- **Establishment of financial standards:** The awareness of the CDM opportunities among financial institutions is very low in most non-Annex I countries, where general practice and concerted actions for financing projects do not exist. Standardised risk assessment procedures are indispensable for potential investors to rate and rank CDM projects and thus dismantle local investment barriers (see).[62] A host country DNA may act together with financial institutions to increase their CDM awareness and establish financial standards in the country.
- **Support of domestic entities' application for DOEs:** Transaction costs associated with DOE services could be lower if domestic project proponents have access to a local DOE.[63] In addition, domestic DOEs can also solve language problems in communication with domestic project proponents. A host country DNA may assist application for DOEs by national entities by holding capacity building seminars or giving advices upon request. However, a country should carefully think whether a local company can fulfil the cumbersome requirements of a DNA and actually gain a foothold in the market.

All these activities require a budget. This could be raised through project submission fees, which host countries have historically been reluctant to introduce. This may be due to the fact that earmarking of fees is not possible. Moreover, countries fear a competitive disadvantage if they charge a project approval fee and other countries do not. So far, only the Philippine and Malaysian DNA charge fees (the Philippine fee of € 150 per approval is purely nominal). In addition, the Thai DNA has proposed a review fee of about € 300 in its draft approval procedure.[64] Also, a host country should consider its CER supply potential when considering the choice of promotional functions and whether to charge a fee. After all, it would not make much sense for a host country with a limited CER supply to have many promotional functions as this may just harm its financial sustainability.

3.5. Lessons learned

Essential questions to make a host country DNA more efficient are: i) how to expedite the approval process while maintaining a high quality of the approved projects, ii) how to attract foreign investors, and iii) how to become financially sustainable?

Regarding the first question, the experience in the surveyed regions has shown the necessity of transparent and consistent approval systems based on the expertise of existing climate change or sustainable development units, uniform formats for necessary documents, a two-step approval procedure, standardised approval timeframe, sector-specific sustainable development criteria, and thorough assessment of additionality and stakeholder consultation elements.

[61] http://cdm.unfccc.int.
[62] Jahn *et al.*, 2004.
[63] Jahn et al., 2004.
[64] ONEP, 2006.

The DNA structure is also an important factor. The single government model can allow quick project approval and may be more suitable when the country lacks financial and human capacity. However, potential conflicts of interest may become a serious concern. The inter-ministerial model is usually perceived as a reason for cumbersome and slow approvals. Outsourcing can be an option to avoid bureaucratic blockage, but its feasibility depends on the country's legal system and the private sector's perception of the CDM and its capacity to deal with CDM issues. The two-unit model appears to be the most favourable DNA structure and has been dominant in the surveyed regions.

Foreign investment plays a core role in the CDM project financing and it is important for a host country to attract such investments. Although promotional functions are not mandatory, they are essential tools for host countries to become more proactive in the international carbon market. The key functions include i) provision of a good website, ii) marketing at carbon fairs, iii) conclusion of MoUs, iv) coordination of project portfolio and partner information, v) capacity building on CDM formulation rules, vi) baseline data collection, vii) establishment of financial standards, and if the country has a significant CDM potential viii) support of domestic entities' application for DOEs. Those functions are to be chosen based on the needs and resource availability of the host country. However, a host county at an early stage of institutional development should keep in mind that operationalization of promotional functions is likely to require extra capacity within the DNA. It is not recommended to expand its activity scope to promotional functions until the host country has established a fully-fledged approval system and an initial project pipeline.

In order to become financially sustainable, a host country DNA first has to strike a balance among the CER supply potential, related project review or approval fees, and choice of DNA functions. Also, it is important to consider a DNA structure which may be able to effectively achieve financial independency. Countries with sufficient financial resources from governments tend to establish their DNAs within the government. Otherwise, provided that the private sector has enough capacity and willingness to take the role, DNA functions can be outsourced to private entities in order to widen the range of financing options.

4. The Linking Directive of the EU

4.1. EU ETS and Linking Directive: Introduction and overview of developments

Origin

The Linking Directive was adopted on 16 September 2004 by the EU Foreign Affairs Ministers as an amendment to the EU ETS Directive (which was adopted in 2003). It was the result of a compromise between the proposal of the European Commission and the European Parliament which the EU Council of Environment ministers had put together on 7 April 2004. The compromise implied that CDM projects could be linked to the EU ETS as of 2005, whereas JI project-based credits could be sold to EU installations as of 2008. The main reason for the difference in treatment of the two mechanisms is that JI project crediting only takes place during the 2008-2012 Kyoto Protocol commitment periods, whereas CDM credits can potentially be certified when generated after 2000.

The linking of JI/CDM to the ETS takes place on the basis of a one-to-one credit conversion rate, which means that one tonne of CO_2-equivalent certified by the CDM EB can be transferred to the EU ETS for the value of one EU ETS allowance (equivalent to one tonne of CO_2). By deciding on a one-to-one conversion rate of JI/CDM credits into EU allowances, the EU Council expressed its confidence in the credibility of the CDM accounting procedures established by the COP-MOP and supervised by the EB.

Originally, the European Commission proposed that the extent to which JI/CDM credits could be used for compliance with EU ETS should be limited to 6% of the total amount of allowances. In other words, an installation with 100 tonnes of allowances but with 110 tonnes of actual emissions could use 6 tonnes of JI/CDM credits and would have to purchase 4 tonnes on the EU market. Eventually, in the Linking Directive, no limitation to the use of CDM credit transfer to the EU ETS was included. Instead, the European Parliament advised that each EU Member State would have to decide on a national cap to the use of the Linking Directive, which would hold for each individual installation in that State. These caps must be included in the National Allocation Plans by Member States for the 2008-2012 period.

Regarding project types, the Linking Directive states that CERs originating from nuclear power plant projects cannot be converted into EU ETS allowances. Forestry-based projects, thus aiming at carbon sequestration credits, are neither eligible CDM projects during the first EU ETS phase, but this could change for the second period if modalities and procedures for the CDM forestry projects will have been completed within the context of the COP-MOP (including approved accounting methodologies for the carbon sequestered through CDM forestry projects). With respect to hydropower-based CDM projects, it was decided in the Linking Directive that projects installing hydropower plants with a capacity of more than 20 MW would need to comply with the criteria laid down in the year 2000 report of the UN World Commission on Dams.[65]

Developments during 2005 – 2006

On 1 January 2005, the trading of EU allowances could start. In January 2005, trading could still only take place via forward contracts as by then the national registries of EU Member States were not yet operational (see for an explanation Section 4.2). ETS spot market trade can only take place when registries are technically connected with each other through the Community Independent Transaction Log (CITL, see Section 4.2). Without such connections, installations could 'promise', through forward or futures contracts to sell allowances for 2005 in December 2005, or at least

[65] World Commission on Dams, 2000.

before the end of April 2006, at an agreed price. In the course of 2005, most of the 25 EU Member States made their EU ETS registries operational.

The development of the market in 2005 was rather hectic. Between January and March 2005, the EU ETS market price (both forward trades for issuance later in 2005 and increasingly also spot market trades) strongly increased due to the sudden cold spell in Europe during March. Energy companies had to switch to coal burning, which increased the emissions of CO2. European utilities immediately reacted through the purchase of extra EU allowances in order to cover their positions.

During the summer of 2005, utility companies in Southern EU Member States (especially Spain) faced problems with their hydropower production plants due to the extremely dry period which lasted for a number of weeks. In order to meet electricity demand, the utilities had to switch to coal, which resulted in a strong increase in CO_2 emission levels and a larger need for extra EU allowance. Consequently, and since utilities quickly reacted on new circumstances by purchasing extra allowances, prices were pushed upwards to a level of almost € 30 per allowance in July 2005.

During the winter of 2006, prices in general, also spot prices, remained high, which was largely due to speculation about the extent to which key utilities would be able to comply with their 2005 caps. Until April 2006 installations had time to submit to the European Commission their CO_2 emissions bookkeeping for 2005. However, during these months it became clear that the actual emissions trading was carried out by a rather small number of installations: around 100, out of the total number of over 10,000 EU installations active in the scheme (of which about 5,000 could actually trade because their governments had made the CO_2 registry operational on time), mainly Danish, UK, Belgium and Dutch power utilities regularly participated in trading deals.[66] Installations in other countries and sectors (such as cement, pulp and paper, steel, chemical industries) participated much less in the emissions trading.

As Section 4.4 will explore in further detail, it is likely that limited familiarity of many installations with the possibilities of emissions trading via forward contracts, spot market transactions and futures has been an important reason for the limited participation in the ETS by installations. Another reason could be that many installations had little incentive to become active as they realised that their CO_2 emissions would remain below their allowances.

The extent to which installations within the EU had long positions (*i.e.* fewer CO_2 emissions than allowances) for 2005 became clear when the reports of EU Member States were published on 15 May 2006 via the CITL. It turned out that all ETS installations taken together had remained 4% below the total ETS allowances level of 2.1 billion tonnes CO_2 emissions for the year 2005. Although the UK and Spain reported deficits (of 36.4 Mt and 9.2 Mt, respectively), Germany (21 Mt), France (19.1 Mt), Czech Republic (15.8 Mt), Finland (11.6 Mt), and Denmark (10.8 Mt) showed long positions of over 10 Mt. Table 4-1 shows an overview of long and short positions during 2005, as reported in May 2006.

[66] Beyers, 2005.

Table 4-1. Overview of long and short positions within EU ETS for the year 2005

Long Positions (in Mtonnes CO_2)		Short Positions (in Mtonnes CO_2)	
Poland	+ 28.1	UK	- 36.4
Germany	+ 20.9	Spain	- 10.8
France	+ 19.1	Italy	- 9.5
Czech Republic	+ 14.5	Ireland	- 3.2
Finland	+ 11.6	Austria	- 1
Denmark	+ 10.8	Greece	- 0.1
Lithuania	+ 6.9		
The Netherlands	+ 6.1		
Slovakia	+ 5.2		
Hungary	+ 4.2		
Estonia	+ 4.1		
Sweden	+ 3.0		
Belgium	+ 3.0		
Latvia	+ 1.2		
Luxembourg	+ 0.6		
Portugal	+ 0.5		
Slovenia	+ 0.4		
Total	**+ 79.3 (4% of total EU ETS allowances)**		

Source: Ellerman, *et al*., 2006.

As a result of the large and unexpected surplus within EU ETS allowances, the prices on the market dropped strongly at the end of April 2006, when the first reports were published, and early May, when the emerging picture of long positions was confirmed. From a largely speculation-driven early April 2006 high of € 31 per allowance, prices landed at a level of slightly above € 10 per allowance by mid-May 2006.

There were a number of reasons why the EU ETS achieved an overall surplus over 2005. First, it was generally felt that the allocations for 2005-2007 have been too generous. Second, the slow economic growth in Europe during 2005 has been reported to have contributed to fewer emissions than anticipated. Third, installations did respond to the commitment to remain below the allowance caps (*e.g*., by adding biomass burning to coal firing in power plants).

For the CDM, the April-May 2006 price correction implies that arbitrage opportunities might have reduced during the 2005-2007 period of the ETS. With CDM credit prices increasing with more emission reductions being certified and offered through spot market transactions, the price differential with EU allowances for 2006-2007 has disappeared. However, market players expect that the prices of EU ETS allowances during the next ETS period of 2008-2012 will become higher given that the forward prices for December 2008 allowances floated between € 16 and € 20 per EU allowance during the second half of 2006. In May 2006, the spread between 2008 forward – 2006 spot market contracts amounted to € 7.5 per tonne, in June the spread decreased to around €6 per allowance, but increased again to over €10 per tonne in December 2006. This spread would offer increased arbitrage opportunities for the CDM during the second EU ETS phase (see also Figure 4-1).

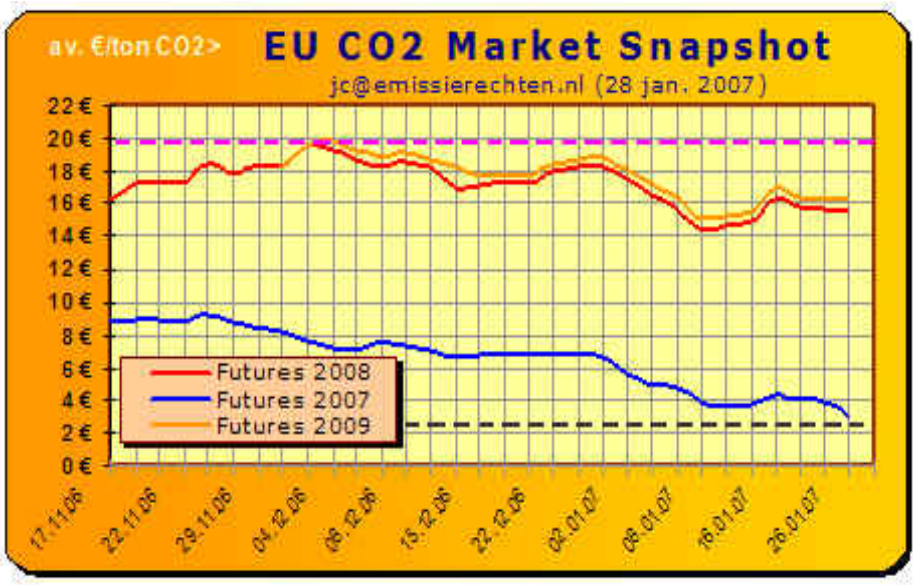

Figure 4-1. Price development on EU ETS market: first-phase futures 2007 vs second-phase 2008/2009 futures (November 2006 – January 2007).

Source: Cozijnsen, 2006.

4.2. The EU ETS and the CDM: Current Status and Prospects

4.2.1. The Process of Transferring CERs to the EU ETS

During 2005, several EU installations have entered into CDM deals with the purpose of using the CERs for compliance with their EU ETS commitments. The credits generated thus far under these projects have the character of forward trading agreements; they will be banked until the installations want and/or can use them.

During 2005-2006, the use of the Linking Directive was hampered by the absence of an International Transaction Log (ITL) to transfer CDM credits from the host country to the GHG account of the EU installation that has invested in the CDM project. For a clearer understanding of this limitation, it is good to explain how such a transfer takes place. Suppose, a Dutch company has been allocated CO_2 emission allowances and wishes to increase these allowances by purchasing CERs. For this purpose, the company invests in a CDM wind power project in, say, Morocco. After having received approval of the project's design document from the Moroccan Government and having been registered by the EB, the project is implemented and delivers GHG emission reductions. Subsequently, these emission reductions need to be certified by a DOE. Once that has been completed, the credits can be issued by the EB as CERs to the investor.

As a first step in the issuance process, the CERs are placed in the pending account of the EB. At this stage, the Board deducts from the amount of CERs a fee of 2% for an adaptation fund to support developing countries vulnerable to the consequences of climate change.[67] Subsequently, the remaining CERs are put in the GHG registry of the investing country (or in the registry of the host country if the CDM activity is unilateral, see below) from where they can be transferred to a company within that country. The latter forms the connection between the Kyoto Protocol's CDM on the one hand (where the governments of the Parties are the end of the CER transfer chain), and the EU ETS on the other hand.

[67] UNFCCC, 1997, Article 12.8.

In order to establish this connection, the ITL foreseen under the Kyoto Protocol will be linked to the EU Community Independent Transactions Log (CITL, see box 4-1). The ITL is presently under construction and is planned to be operational by April 2007 (as per the Decision of the COP-MOP-1 in December 2005[68]). On 15 August 2006, the building of the ITL was awarded by the UNFCCC to the Belgian company Trasys. It will function as a tracking system to enable the trade of all types of GHG emission reduction titles tradable/transferable under the Kyoto Protocol.

A practical problem in this context is that the present absence of the ITL, and perceived uncertainty regarding the date of its becoming operational, complicates the transfer of the CERs from the Moroccan wind power plant in our example to the Dutch installation's CITL account. Until that time, the CERs will stay in the temporary account of the company within the Netherlands CDM registry under the EB. Some EU countries, including the Netherlands, are presently considering interim laws to make it possible for the EU companies to use the CERs in the temporary CDM registry account, but the feasibility of these attempts is uncertain.[69] The status of the ITL is thus extremely important to make the Linking Directive applicable during 2005-2007.

Box 4-1. The Community International Transactions Log

The Community Independent Transactions Log (CITL) has been established as part of the Regulation on the Emissions Trading Registries. The information concerning the CITL can be found at http://europa.eu.int/comm/environment/ets.
The CITL shows when a national registry of a Member States has been opened, as well as when installations and traders open accounts within the registries. Also information is shown about the number of allowances allocated to installations in each Member States under the National Allocation Plans.
The CITL will show on 15 May of each year from 2006 onwards, to what extent each installation is in compliance with its EU ETS allowances. It does not show, however, real-time trading or holding positions of individual installations. The only compliance-related figure that can be seen on the CITL throughout the year is the overall compliance situation of each EU Member State, which is used to prevent countries from overselling EU allowances.

4.2.2. How EU Installations can Generate CERs

CDM projects can be established through the Linking Directive in a number of ways: projects are developed through co-operation between project participants in non-Annex I countries and EU ETS installations; CERs can be generated from a CDM project by a broker and then sold to an EU installation; and projects could be established under carbon funds and/or offered at carbon exchanges. These options are described below.[70]

An installation interested in purchasing CERs for EU ETS compliance could decide to invest in a CDM project by itself. For that the installation would follow the procedures for regular bilateral CDM deals and thus be involved in the project identification, design and implementation. What would be needed in this process, in order to have the project registered as an official CDM project by the CDM EB, is an approval of the project by the host country DNA. An approval of the project by the government of the installation's Member State would only be needed by the time the CERs are due for issuance into the account of the installation through the ITL in combination with the CITL. In December 2005, the Netherlands Government, for example, announced its interim policy to arrange the approval of CDM projects that are contracted by Dutch or other European installations for the purpose of the ETS. The interim policy claims to be very effective in terms of time needed for the approval of the projects; each approval costs € 350.[71]

[68] JIN, 2005.
[69] Author's communication with several government officials.
[70] See Laseur, 2005.
[71] VROM, 2006.

Installations can also contact brokers and ask them to generate CDM credits on their behalf. Presently, there are a number of specialised carbon brokers, such as Natsource, Ecosecurities, Environmental Markets, Carbon Finance, etc.,[72] which have the possibility to set up projects with parties in developing countries and, in some cases, could even provide funding for the project in anticipation of the expected project returns once it is ongoing and delivering CERs. Some of the present operational brokers have a quotation on the stock exchange (*e.g.*, London, Chicago) and have some capital available to provide such pre-funding. With this capital they could enter bilateral deals in which they help entities in the host country prepare their project, purchase the CERs from them, and sell these to CER buyers. This would reduce the risk for CER suppliers in the host countries. Some brokers, such as Ecosecurities, have even developed portfolio systems in which they collect a number of projects, buy the CERs and sell these to buyers. In their portfolio, Ecosecurities purchases the CERs at 30 to 40% of the EU ETS allowance price and sells these CERs at prices of 60 to 90% of the EU prices.[73]

A third option is to purchase CERs for the EU ETS through carbon funds and carbon exchanges. As of April 2006, over US$ 4 billion was dedicated to carbon funds and governmental carbon credit purchase programmes.[74] Although purchasing carbon credits is the key objective of most carbon funds, some initiatives also focus on generating financial returns through the leverage effect that the carbon component of a project creates in terms of attracting extra investment capital. For instance, the European Carbon Fund (ECF) successfully closed at € 142.5 m in January 2006. This was considerably higher than its € 100 m target. Co-sponsored by French *Caisse des Depots* and Belgian-Dutch *Fortis Bank*, the ECF is managed by IXIS Environnement & Infrastructures.

An interesting, innovative initiative which provides further liquidity to the CDM market and offers a good potential to EU ETS installations to purchase CERs is the *ACX-Climex forward CER auction*, which has been organised regularly since 25 November 2005. This initiative has been developed by the *Asia Carbon Exchange* (ACXChange) and *New Values* (Climex) and provides transparent price setting through auctioning forward CERs (although New Values left the initiative in August 2006). Auctions are organised by linking EU ETS-capped companies with CDM project developers in Asia.[75]

Estimates of the annual compliance demand for CERs and JI emission reduction units (ERUs) by EU ETS installations in 2010 range from 45 to 243 Mt CO_2-eq.[76] Because the Linking Directive allows each member state to decide on limits to the use of CERs and ERUs for compliance during 2008-2012, the demand for these credits might be affected by future decisions by the Commission. In addition, the ongoing second NAP assessment of emissions caps on each member state is also a crucial factor. If for the 2008-2012 ETS period relatively loose NAPs were accepted by the European Commission, there would be fairly limited demand for CERs and ERUs by EU installations.[77]

4.2.3. Transposition of the Linking Directive in EU Member States' National Laws

Different EU member states have transposed the Linking Directive in different ways. The Netherlands and Spain have taken a pragmatic approach, while Germany and the UK have been rather strict. As mentioned above, the Netherlands has a quick, cheap and simple approval procedure. Spain does not make any additional restrictions to the ones already given in the Linking Directive and will allow LULUCF projects from 2008. On the other hand, Germany excludes

[72] JIN, 2006a.
[73] Bryan, Garnier&Co, 2006.
[74] JIN, 2006a.
[75] JIN, 2006a.
[76] Sijm *et al.*, 2000; Criqui and Kitous, 2003.
[77] Neuhoff *et al.*, 2006.

unilateral CDM projects and may require a separate full environmental impact assessment (even if a host country does not require it) if the German DNA deems that the environmental impact of the project activity have not been sufficiently addressed. Also, one has to prepare a validated PDD and host country approval in order to ask for German DNA approval. Fees depend on the project size and can reach several thousands of Euros. The UK does not allow non-UK companies to seek approval for their projects in the UK.

Even though different levels of stringency are observed in their approval procedures and limits for compliance use, the transposition laws of the Linking Directive are deemed not to play an effective role for the following reasons. First, entities within the EU ETS can request approval of their CDM/JI projects in another country (except that non-UK companies cannot present their project for approval in the UK) and can therefore make a request for approval in a country which they consider to have the most pragmatic approach, *i.e.* "juridical shopping" (see).[78] Secondly, entities within the EU ETS could swap CERs and ERUs against EUAs in the EU ETS market and then use the swapped EUAs for compliance.[79] This loophole may make the compliance limits ineffective. Of course, such opportunities will be limited if EUA prices are considerably higher than ones for CERs or ERUs.

Consequently, the legislative differences regarding the use of CERs and ERUs for compliance stipulated in the transposition laws are considered to be ineffective. Therefore, the key question for the European private market of CDM/JI is whether the aggregated amount of CERs and ERUs that are allowed to be used for compliance will be binding or not. The next section will have a closer look at the second phase NAPs in order to elaborate the analysis on the compliance limits and government purchase plans for Kyoto credits, another wing of the European carbon market.

4.3. The Linking Directive in the second phase of the EU ETS

It is generally assumed that the second phase NAP will be tighter and broadened to other sectors to help EU Member States reach their targets under Kyoto. At the same time, EU emissions are increasing (+0.3% for the EU-15 in 2004).[80] Moreover, given that the Kyoto Protocol commitment period will start in 2008, the ITL must be operational by then and will also be available for use by EU installations that want to acquire CERs via the Linking Directive. As mentioned above, several EU installations have already become involved in CDM deals, although it is difficult to identify exactly within the present CDM pipeline which projects have already been set up for the purpose of complying with the EU ETS, since the information about the carbon buyer is not always disclosed if the buyer is a private company.[81]

4.3.1. Guidance by the Commission

In 2005, the Commission published "Further guidance on allocation plans for the 2008 to 2012 trading period of the EU Emissions Trading Scheme" in 2005. The paragraph 17 of the document indicates a 6% cut of the total allocation in the second phase of the EU ETS compared to the first phase provided the same share of emission reductions contributed by the scheme, *i.e.* 45% of the total reduction required for the EU to achieve its Kyoto target: If the emissions trading sector were to contribute a proportionate share of the reduction in member states with a gap to close, the second period total allocation in the EU-25 would be about 6% below the first period allocation, resulting in an annual

[78] Van Gehuchten, 2005,
[79] Van Gehuchten, 2005,
[80] GTZ, 2006.
[81] See Fennhan's montly overview of CDM projects, *e.g.*, Fenhann, 2007.

average allocation of 2.063 billion allowances.[82] The Commission's view in 2005 on the ETS second phase allocation is shown in Table 4-2.[83]

Table 4-2. Allocation for the second phase EU ETS based on the Commission's guidance

	First phase cap. annual average ($MtCO_2e$) [a]	First phase EU ETS share (%) [b]	Second phase cap. annual average ($MtCO_2e$) [c]	Change in volume ($MtCO_2e$)	Change in percentage (%)
Austria	33.0	36.0%	24.6	-8.4	-25.4%
Belgium	62.9	42.6%	57.8	-5.1	-8.1%
Cyprus	5.7	62.0%	5.7	0.0	0.0%
Czech Republic	97.6	67.1%	97.6	0.0	0.0%
Denmark	33.5	45.3%	24.9	-8.6	-25.7%
Estonia	19.0	88.6%	19.0	0.0	0.0%
Finland	45.5	53.2%	37.5	-8.0	-17.7%
France	156.5	28.1%	156.5	0.0	0.0%
Germany	499.0	49.0%	483.6	-15.4	-3.1%
Greece	74.4	54.1%	74.4	0.0	0.0%
Hungary	31.3	37.6%	31.3	0.0	0.0%
Ireland	22.3	33.0%	20.1	-2.2	-9.8%
Italy	232.5	40.8%	194.7	-37.8	-16.2%
Latvia	4.6	43.4%	4.6	0.0	0.0%
Lithuania	12.3	71.2%	12.3	0.0	0.0%
Luxembourg	3.4	29.8%	2.8	-0.6	-18.4%
Malta	2.9	n/a	2.9	0.0	0.0%
Netherlands	95.3	44.4%	88.9	-6.4	-6.8%
Poland	239.1	62.3%	239.1	0.0	0.0%
Portugal	38.2	47.0%	35.5	-2.7	-7.1%
Slovakia	30.5	59.0%	30.5	0.0	0.0%
Slovenia	8.8	44.3%	8.4	-0.4	-5.0%
Spain	174.4	43.4%	142.6	-31.8	-18.2%
Sweden	22.9	32.5%	22.9	0.0	0.0%
UK	245.3	37.7%	245.3	0.0	0.0%
Total	**2,190.8**	**45.0%**	**2,063.4**	**-127.5**	**-5.8%**

a: Does not account for changes to the number of installations subsequent to the respective Commission decision, *e.g.* opt-ins or opt-outs of installations. New Entrants Reserves (NERs) are included;
b: Calculated as the first phase cap divided by 2003 national GHG emissions;
c: Calculated by subtracting the contribution of the EU ETS to Kyoto target achievement from the first phase allocation. The same EU ETS share is assumed for the second phase as the first phase. If 2003 national GHG emissions are lower than the Kyoto targets, the second phase allocations are considered to be the same as the first phase. NERs are included.

Source: Own calculation based on European Commission 2005

It remains to be seen though whether the European Commission will tighten its 6%-cut plan based on the verified emissions in 2005. Until the release of verified emissions data on 15 May 2006, the Commission took a stance not to use the 2005 emissions data to consider the second phase allocation plans. This was to avoid perverse incentive for companies under the EU ETS to delay their emission reduction efforts, or even increase their emissions, in order to obtain a higher emissions cap in the second phase. However, the press release in 2006 by the Commission on the 2005

[82] European Commission, 2005.
[83] The "6% cut plan" in the European Commission's guidance in 2005 was based on data of the first phase EU ETS. Therefore, countries not included in the first phase EU ETS, Bulgaria and Romania, are out of the scope.

emission data clearly states that the Commission will consider the 2005 emissions data in its evaluation of the second phase allocations: "*The new 2005 emissions data gives independently assessed installation-level figures for the first time and so provides member states with an excellent factual basis for deciding upon the caps in their forthcoming national allocation plans for the second trading period, when the Kyoto targets have to be met. The plans are subject to approval by the Commission, which will also be making extensive use of the 2005 emissions data*"[84] Considering that the 6%-cut plan was indicated in the Commission's guidance published before the release of 2005 verified emissions data, and combined with the above press release, it can be foreseen that the Commission will put tighter levels than a 6% cut for the second phase allocations.

4.3.2. Allocation Plans specified in the second phase NAPs

Although Member States were supposed to submit their second phase NAPs by 30 June 2006, only Estonia managed to meet this deadline. By December 2006, the process was considerably behind schedule. The allocation plans specified in the second phase NAPs made available during the second half of 2006 are listed in Table 4-3. It should be noted that the second-phase scheme coverage in terms of sectors is different (*i.e.* broader) from the first phase. Therefore, the allocation cap figures between the first and second phases cannot be compared directly.

It can be observed that percentage limits on the use of CERs/ERUs in the proposed NAPs vary in the range of 5% to 50%. This allows potential CER/ERU imports of more than 334 $MtCO_2$-eq. annually on average during 2008-2012. The figure is subject to change based on the further development of the second phase NAPs, especially percentage limits and caps, and amount of reserve allowances set aside by Member States for new entrants during 2008-2012. Note that the cap figures in Table 4-3 are total caps including new entrant reserves. If there are less new entrants into the EU ETS during the second phase than expected, the estimated figure will be slightly lower (a few percentage points at most). It is clear that the estimate of the CER/ERU compliance limit of 334 Mt CO_2-eq. per year is well above the estimated annual compliance demand for EU ETS installations in 2010, which ranges from 45 to 243 $MtCO_2$-eq. It can thus be safely concluded that the CER/ERU compliance limits of the Linking Directive will not be binding in practice.

Table 4-3. Allocation plans stipulated in the second phase NAPs (as of 26 February 2007)

	Second phase cap. annual average 2008-2012 according to NAP 2 ($MtCO_2e$) [a]	Percentage limit on the use of CERs/ERUs for compliance (% of total caps)	The amount of CERs/ERUs allowed to be used for compliance ($MtCO_2e$)
Austria	32.8		20
Belgium	63.3	4 – 24%	
Flanders	39.3	11%	
Walloon	22.6	8%	
Brussels			
Bulgaria	56.3		20
Cyprus			
Czech Republic			33
Denmark			19
Estonia	22.9		
Finland	39.5		4.7

continued next page

[84] European Commission, 2006.

continued from previous page

	Second phase cap. annual average 2008-2012 according to NAP 2 ($MtCO_2e$) [a]	Percentage limit on the use of CERs/ERUs for compliance (% of total caps)	The amount of CERs/ERUs allowed to be used for compliance ($MtCO_2e$)
France	141.6		14.2
Germany	482.0	12%	Germany has requested higher limit (20%)
Greece	75.5	9%	
Hungary			10
Ireland	22.6	34%	
Italy	194.0		9
Latvia	7.7	10%	
Lithuania	16.6	13%	
Luxembourg	4.0	10%	
Malta	3.0		
Netherlands	90.4	10%	
Poland	279.6		25
Portugal	33.9		10
Romania	91.5		10
Slovakia	41.3	7%	
Slovenia	8.3	17.5%	
Spain	152.7		20
Sweden	25.2	10%	
UK	246.0	8%	
Total	**2,127.0**		**334.2**

a: NERs included.
b: "Draft" refers NAPs published for public consultation; "Notified" refers to NAPs notified to the Commission. No NAP has been decided by the Commission yet.

Source: Point Carbon 2006b-n and own research of the second phase NAPs

4.4. European perceptions concerning the EU ETS: Case Study for the Netherlands

4.4.1. Strategies of ETS companies

In the context of this study, a series of interviews have been conducted with intermediaries and EU ETS installations based in the Netherlands on their views and expectations regarding the Linking Directive and the use of CDM credits for EU ETS compliance. It should be noted that it cannot be claimed that the Netherlands forms a representative case for the 27 EU Member States. Nonetheless, the interviews reveal general viewpoints, considerations and perceptions that are basically independent of the country context within which the installations and intermediaries operate. The report below discusses these general emissions trading aspects and EU ETS experiences.

During 2005-2007 approximately 250 Dutch installations participated in the EU ETS (representing approximately 120 companies). The findings discussed below are based on a web-survey sent during June-July 2006 to a sample of 100 Dutch companies in the EU ETS. Even if a company has multiple installations participating in the EU ETS, it received one questionnaire. The remaining 20 companies did not receive a questionnaire, which was due to a lack of contact data. The total response rate was 37%.[85]

[85] See for a detailed analysis, De Wolff, 2006.

The respondents are not equally distributed across the EU ETS sectors. Most of the respondents can be described as utility combustion plants (37%) and the energy intensive industry (26%). Paper and pulp producers represent 20% of the respondents. Oil refineries and iron and steel producers represent respectively 14% and 3% of the respondents to the survey. Of the respondents, 21 companies have an allocated number of EUAs between 100,000 and 500,000. Small installations of less than 100.000 EUAs account for 16% of the respondents. The largest emitters, with more than 2 million EUAs, also had a response rate of 16%.

Before the establishment of the ETS, environmental issues such as pollution permits and legislation were generally the responsibility of the environmental managers within the companies. After the establishment of the ETS, the responsibilities have changed in most of the ETS companies. In only 16% of the responding companies, the environmental manager is responsible for the emissions trading strategy. In 33% of the companies, the Board of Directors has become responsible for the emission trading strategy, which implies that emission trading is seen as a long-term strategic issue. In some cases, the controller or treasurer is responsible for the ETS. 54% of the companies stated that the emission trading strategy has been developed by the companies themselves. In 27% of the cases, companies develop their strategies together with intermediaries. Another 18% of the companies answered that there is no emission trading strategy at all.

The questionnaire distinguishes four different types of emissions trading strategies:

1. The **compliance strategy**, which is a limited strategy as it is only focused on ensuring compliance before the end of the report period in order to pay a fine. The emission strategy is of low priority to this kind of company.
2. The **hedging strategy**. A company trades regularly on the carbon market in order to minimize its price risks, *i.e.* to avoid paying high prices when 'compliance strategy' companies enter the market.
3. The **investment strategy**. Companies actively trade on the carbon market and emission trading is regarded as a core-business.
4. The **project development strategy**, which is characterized by a very active trade on the carbon market and development of CDM/JI projects. Most of the companies with this strategy are power companies with specialized emission trading and CDM departments.

From the 37 respondents, 76% stated that their emission trading strategy can best be described as a compliance strategy. The hedging strategy is pursued by almost 14% of the Dutch companies. Only 3% of the respondents actively invest in CDM projects. Another 8% describes its strategy as an investment strategy. The explanation for the high percentages of compliance strategies pursued by the Dutch companies could be the rather flexible allocations, and lack of knowledge about trading in the first place (see below).

Allowances are increasingly considered commodities. Power companies have extensive experience in commodity trading (gas, electricity, and coal) and have special commodity trading desks. Under the EU ETS, emission allowances are also part of the commodity portfolio of power companies and have become part of their core business. The energy intensive industry, on the other hand, has less experience in commodity trading. The total value of the allowances is such a small part of the balance sheet of these companies that there seems to be no necessity to fully dedicate employees to emissions trading.

It is interesting to see what these strategies will look like in the second ETS period of the EU ETS. The European Commission announced that the allocation of emission allowances will be stricter in the second period, in particular since the second period is considered to be a crucial factor in meeting the Kyoto targets. The survey anticipated this market development by posing the question if companies expected to trade more actively in the second EU ETS period.

Most of the companies – namely 43% – expect to be as active in the second ETS period as they have been so far during the first ETS period. Of these companies, the majority expect that emissions trading will remain a non-core-business between 2008 and 2012. Increased activity is expected by 41% of the Dutch installations. Most of these companies expect to receive fewer allowances. The expected tighter allocation asks for a more active emissions trading strategy. Only 5% expect to be less active, which is mainly caused by the exclusion of small installations in the second period. Almost 11% answered that they have no opinion on this issue.

The power installations have no single route through which they obtain CERs, but a mixture of different routes. Spanish power companies, for example, are becoming active in setting up their own CDM projects through the purchase of electricity firms in the host countries – mainly in Latin America, which investments could be commercially viable in the medium run. The CDM credits function in these cases as a leverage to carry out these investments. Some energy firms also invest to some extent in carbon funds. Others are engaged in direct transactions with CDM project developers.

In their choice of CDM project host countries, EU installations use their network (which could be a bank, see above) and the international contacts of the installation. If they are familiar with business in a particular developing country, it could be more convenient for them to invest in a CDM project in that country (*e.g.*, Spanish utilities in Latin America, British companies are focused on Malaysia and the Philippines; Dutch companies in Indonesia).

Companies which are very active in the CDM market, work with a rating system for projects. Projects are rated according to their characteristics and their relative expected value in comparison with other CDM projects. The most important risk observed by the market participants is the counterpart risk. High credit rating of the counterparty is either a precondition for some buyers, or, in case the credit rating is relatively lower, will result in a price premium in some contracts (Nordseth, 2006). Other important risk factors are volume risk, technology risk, political risk, contract risk, project risk, currency risk, and measurement risk.

It is not always the case that CDM project developers within the EU prefer low risk to higher risk. Some intermediaries prefer to take the project risk and the counterpart risk when they participate in a CDM project. They absorb the risks of a set of CDM projects in a portfolio, trade with an EU installation and sell the CERs which will be generated, in a forward transaction. The companies who buy the stream of CERs in this forward transaction use them for compliance in the period 2008-2012 of the EU ETS.

4.4.2. Companies' Views on the Linking Directive

The second part of the questionnaire largely dealt with the Linking Directive. The Dutch ETS companies appear to have a reasonable knowledge of the Linking Directive. More than 70% of the companies are aware of the possibility of buying CERs from CDM projects to meet their emission targets of EU ETS. Almost 30% are not aware of this possibility.

During the 2008-2012 phase, the Netherlands government will limit the number of CDM and JI emission reduction credits that each installation can acquire for compliance with the ETS, to 8% of its allocated allowances. In the questionnaire, the companies were asked how many CERs they expect to use during the second period of the EU ETS. Almost 60% of the companies expect that they would not use any CERs during the 2008-2012 period. More than 27% of the respondents expect to use less than 6% of their total allowances for credits from CDM projects. Almost 14% expect to use almost the full potential of the 8% cap. There is no relationship between the number of allowances allocated to a company and the expected use of CERs. Most of the companies have between 100,000 and 500,000 allocated allowances.

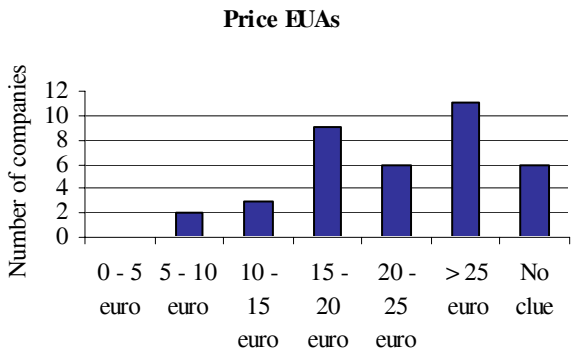

Figure 4-2. Price of EUAs

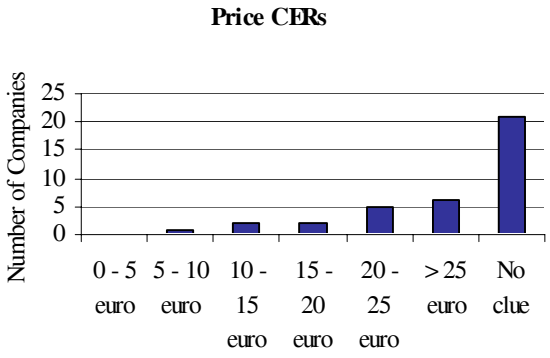

Figure 4-3. Price of CERs

The last part of the questionnaire consists of questions regarding the expected price of EUAs and CERs during 2008-2012. As Figures 4-2 and 4-3 show, most companies expect the EUA price to be higher than € 25 per tonne CO_2-eq. The second largest group expects the price to be between € 15 and 20; this expectation is well in line with the ETS forward market prices of December 2006 (see Figure 4-1). The price expections expressed in the answers are strongly influenced by the lack of knowledge and interest about the CDM market. Twenty-one companies had no clue what the price will be in the second period. The majority of the companies that expected an EUA price above € 25, expect the CER price to be lower than the EUA price.

4.4.3. The Interaction between CERs and EU ETS Allowances: the view of intermediaries

The analysis in this sub-section is based on the results of in-depth personal interviews with Dutch intermediaries, platform exchanges, and power companies who are active participants in the carbon market. An important aspect of the interviews was to what extent these stakeholders see arbitrage opportunities arise from the Linking Directive between CER prices and EUA prices. Table 4-4 summarizes factors that determine, according to these interviewees, the CER price. It is expected that the EU ETS price will influence the CER price. In actual practice, CER deals are in some cases already based on an index price for EUA. The *European Climate Exchange* has an index for EUAs which shows daily prices of EUAs traded in the EU ETS. A potential CER buyer can make a bid of 80% of the EUA index for a stream of CERs. The 20% discount on the CERs compared to the EUA index represents the risk perception of the buyer.[86]

Table 4-4. CER price determinants

Factors	Explanation
EUA price	Floating CER price as % of EUA price
Counterpart creditworthiness	Credit rating of the counterparty
Imposed cap on use of CERs	8% in the Netherlands
Phase of the project cycle	PIN, registered, methodology approved
Delivery contract	Off-take or guaranteed delivery
Payment structure	Up-front or at delivery
Kyoto supply and demand	Potential Hot air from Russia, Ukraine

[86] JIN, 2006a.

The credit rating of the counterparty is an important price determinant of CERs. If the credit worthiness of the counterparty is reasonable, then the risk of default by the project developer is acceptable, which could lead to a CER price. The delivery of CERs can either be structured as an off-take delivery or a guaranteed delivery. With an off-take delivery, the CER buyer is exposed to volume risk; the seller delivers whatever the project generates, without specifying the volumes. With a guaranteed delivery, the project developer is obliged to deliver a specified number of CERs. According to an intermediary: "when a CDM project is monitored, on average 70% of the expected CERs are indeed generated".

Whether the buyer pays up-front or at delivery can also explain a great deal of the price differences between different CER deals. Prices for up-front payment are lower than for payment upon delivery. In general, governments have turned out to be more willing to pay up-front in CDM transactions. Other price determinants of CER prices are the imposed cap on the use of CERs, the phase of the CDM project cycle the particular project is in, and the overall Kyoto Protocol supply and demand. According to an interviewee, "supply and demand of 'Hot Air' (*the surpluses that some countries with economies in transition may be able to supply to the market*) would not account for much, when market participants engage in CDM deals. This boom and bust cycle is not part of the carbon markets until now".

The buyer and the seller negotiate a contract deal that determines how the transaction is structured. One interviewee said: "The buyer wants to reduce uncertainty, but the seller wants to have flexibility in order to receive high revenues for the stream of CERs he expects to generate." An example of certainty for the buyer is that the CDM project is already registered, the delivery is guaranteed, the counterpart has a good credit rating, and the payment is at delivery. If such a deal is negotiated, the CER price is likely to be higher. Therefore, it can be concluded that **there is no single CER price**, every contract is tailor made and every deal unique; **CER prices always depend on the project characteristics and the contract negotiated**.

For the power companies interviewed, the CER and EUA will always be two different commodities as, first, a CER is bankable between the first and the second commitment period of the EU ETS, whereas EUAs cannot be transferred between the two periods (except for French and Polish EUAs). The second difference is that the use of CERs for compliance by EU installations is capped, whereas there is no limitation on the use of EUAs within the EU ETS. The third difference is that a CER can only be used when the ITL is operational. A power company stated that: "a CER will always trade at a discount compared to the EUA. The only exception could be at the end of the first period, because of the bankability of the CERs. There is a possibility that a CER will have a premium to the EU allowance with expiration in December 2008."

Some intermediaries though state that a CER represents the same value as an EU allowance and expect the CER price to fully converge with the EUA price during the second period of the EU ETS. In their view, the value of the CER and EUA is the value of compliance. The intermediaries experience no limitation on the cap of 8% as they provide CERs for compliance to many different EU installations.

As explained in Section 4.1, the spread between EUA December 2007 prices and EUA December 2008 prices was €10 in December 2006. The ETS price developments have reduced arbitrage opportunities through the CDM for the 2005-2007 period (when realizing that the CER prices in October 2006 for guaranteed, low-risk CERs, which are basically the only CERs interested for EU ETS installation during 2005-2007, amounts to €10 to € 15 per tonne). One intermediary stated that: "For this reason it is economically not rational to use the CER in the first period." The only exception can be that the company already contracted 8% of the total allowance in CERs for the second period.

The interviewed persons observe a trend in the CDM market that **host countries take different approaches in developing CDM projects and selling the CERs to Annex I Parties**. Most interviewees agreed that the Chinese focus more on the volume they can generate against a reasonable price. The project developers from India are opportunistic and focus more on the spot price of EUAs in Europe. China wants to increase its market share in the CDM market. It sells the majority of CERs to European companies and the Japanese government. Intermediaries expect that in the future the forward market supply will come from China and Brazil and the supply for the spot market will come from India.

According to the interviewees, the CDM pipeline calculated by the CDM EB[87] seems to be too optimistic in respect to the amount of credits which will be generated from these registered projects. Some intermediaries state that a number of registered projects will be difficult to realize since they face high transaction costs and risks. Therefore, the total amount that will be generated by CDM projects in the period 2008-2012 is highly uncertain. There seems to be a substantial number of potential projects which can be developed in the coming two years. After these two years, the window of opportunities for new CDM projects is closing, because of the post 2012 threshold. This would require a high rate of return on the investment in a CDM project. This scenario could evolve when the EUA price surges in the second period of the EU ETS as a result of the expected shortage of emission allowances. With high EUA prices, more potential CDM projects become economically viable.

The challenge for intermediaries – *i.e.* banks, brokers, project developers, and traders – in the CDM market is to distribute the CERs to EU installations which are not very active in the carbon market and are only focused on their compliance. The interest of these installations in CERs will depend on their potential shortage of emission allowances in the second period of the EU ETS. If the market for 2008-2012 is short – as is expected by all interviewees – these companies will start demanding credits from JI and the CDM. If the allocation for the 2008-2012 period is sufficiently lenient for these installations, however, it is questionable whether they will be interested in CDM and JI activities.

The expectation is that the CDM market will remain the exclusive terrain of relatively few specialized companies from Annex I countries. The total number of allowances must represent a certain value for the company to become active in the CDM market. Smaller companies, instead, will obtain CERs through an intermediary bank, broker, CER auction, or via an exchange. The expectation is that the CDM market will be dominated by 50 to 100 EU companies, mostly power companies, banks, and hedge funds. Specialized brokers and project developers will also remain very active in the CDM market.

[87] http://cdm.unfccc.int

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Part II: Thailand’s Context

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5. Thailand's Policies related to CDM

5.1. Introduction

Balance between economic and social development, while conserving natural resources and the environment, has been the basis for sustainable development in Thailand. The 5-year *National Economic and Social Development Plans* have been used to guide the social and economic development of the country since the 1960s. Sustainable development efforts have been intensified in the 1980s and early 1990s to cope with the deterioration of natural resources and the environment. *The Enhancement and Conservation of Environmental Quality Act*, promulgated in 1992, has substantially strengthened the natural resources and environmental conservation of the country and is a key factor in promoting natural resource conservation and environmental protection in Thailand.

To promote the country's sustainable development, the Act requires preparation of long-term environmental policies and medium-term action plans. Hence, a 20-year (1997-2016) *Policy and Perspective Plan for Enhancement and Conservation of Environmental Quality* (so-called 20-Year Environment Plan) has been issued by the Government. Based on this Plan, a 5-year Environmental Quality Management Plan has been prepared to guide natural resource conservation and environmental protection, which will compliment the 5-year National Economic and Social Development Plans, thus giving equal emphasis to both economic and social development while conserving natural resources and also protecting the country's environment.

The National Economic and Social Development Plans, in general, have been consistent with *Agenda 21* – the important agreement on Environment and Development adopted at Rio de Janeiro in 1992. Though conservation of natural resources and environment has been an integral part of the national plans since the 1980s, natural resource conservation and environmental protection has been insufficient, particularly during the recent years of rapid economic growth. Presently, Thailand is in the process of preparing its 10th National Economic and Social Development Plan, which will emphasize on the principles of "Efficiency Economy".

As a developing country, Thailand must maintain social and economic growth to eradicate poverty and improve the quality of life of its people. Hence, Thailand has adopted the principle of adopting "no-regrets" investment options when selecting GHG mitigation options. Potential mitigation options would include: improvement in energy efficiency, fuel switching, renewable energy development, reforestation, afforestation, and protection of conserved forests.[88]

Since the energy sector is the main source of GHG emissions in Thailand (more than 50% of CO_2 emissions come from the energy sector), and the national energy strategic plan implies a strong challenge to implement GHG mitigation projects, top priority should be given to the implementation of CDM projects in the energy sector; LULUCF or agricultural and forestry CDM projects presently have a lower priority. However, other activities that lead to GHG reduction, *i.e.* N_2O and HFC reduction in industrial processes, would be also acceptable and possibly attractive no-regrets options under the CDM.

5.2. Thailand's Energy Situation

Thailand is located in Southeast Asia and has a land area of 513,115 sq. km. The country is divided into 76 provinces, which are gathered into 5 regions (North, Northeast, East, Central and South).

[88] Saksit Tridech; "Climate Change Treaties and Policy of Thailand", presented at the Regional Workshop on Climate Change: The Changes and Opportunities, held by ERI, 1-2 February 2001.

Geographically, Thailand can be classified into four natural regions. Northern Thailand is dominated by forested mountain ranges divided by four fertile river valleys. Central Thailand is mainly the Chao Praya basin, where the major part of the population and industry, as well as the majority of agricultural production, is based. The North-East is sparsely vegetated and largely infertile. The southern peninsula is dominated by dense tropical forests. The climate is essentially tropical with a wet, warm south-west monsoon from May to September and a drier, cooler monsoon from November to March. Temperatures vary from 20 to 37°C.

The Real GDP was Baht 3,842 billion in 2005 (constant 1988 prices). The population in 2005 was about 62.24 million. Per capita GDP in 2005 at current prices reached Baht 109,658 (US$ 2,673)[89]. Energy Consumption in 2005 was 1.0 toe per person while electricity consumption was 1,942 kWh per person. (table hereafter).

Table 5-1. Thailand basic economic and energy indicators

	1990	1995	2000	2002	2003	2004	2005
GDP (million Baht, 1988 prices)	1,945.4	2,941.7	3,008.4	3,237.6	3,464.7	3,678.5	3,842.5
Population (millions)	55.84	59.4	61.88	62.80	63.08	61.97*	62.24*
GDP per capita (Baht, current prices)	39,104	70,474	79,098	84,846	91,420	100,457	109,658
Energy consumption per capita (toe/person)	0.55	0.77	0.80	0.80	0.90	1.0	1.0
Electricity consumption (kWh/person)	683	1,174	1,421	1,595	1,696	1,856	1,942

Source: ADB (2006); DEDE (2005)

* revised according to DOPA

5.2.1. Energy Strategy for Thailand's Competitiveness

Fossil fuel resources in Thailand are limited and the dependency on imported energy from foreign sources causes a considerable loss of foreign currency. Renewable energy development will help reduce not only the energy supply burden, but also the import of non-renewable energy. In addition, renewable energy will help reduce the environmental impact resulting from fossil fuel based energy development and utilization. In this context, biomass energy development is a promising way to optimize the utilization value of domestic energy resources, bringing economic benefits to concerned local communities.

The target in Thailand is to increase the share of renewable energy in commercial primary energy from 0.5%, or 265 thousand tons of crude oil equivalent (ktoe), in 2002, to 8%, or 6,540 ktoe, by the year 2011.

To reach this target, the government is aware of the following needs:

- Establish the regulation or legal enforcement of the Renewable Portfolio Standard (RPS) for new power plants (5% of generated capacity must be RE based).

[89] The used average exchange rate for 2005 is 41.02 Baht per US Dollar (Bank of Thailand)

- Devise incentive measures encouraging the purchase of power generated by renewable energy, for example, through the provision of tax credits, privileges, and subsidies from the Energy Conservation Promotion Fund.
- Support Research and Development (R&D) on renewable energy sources in which Thailand has a high potential.
- Encourage participation and partnership of the local communities in renewable energy-fuelled power plants.

The responsible agencies in this policy are the Ministry of Energy, the Ministry of Natural Resources and Environment, the Ministry of Science and Technology, the Ministry of Finance, and the Ministry of Industry. They have been called upon to jointly implement every feasible measure to promote, propel and support all kinds of renewable energy development, including expansion of R&D scope of work and support to researchers, so that the outcome of R&D could be practically applied with actual implementation. *Annex A* gives more detailed information on Thailand's overall Energy Strategy for Competitiveness, which includes measures of energy efficiency improvement and enhancement of energy security of supply.

5.2.2. Thailand's Targets for Renewable Power Generation

As stated in the Energy Strategy for Thailand's Competitiveness (published in 2003), it aims to increase the share of renewable energy in commercial primary energy from 0.5 % in the year 2002 to 8% in the year 2011. The target implies a rate of implementation of renewable energy technologies during the present decade that outstrips the usual rate of implementation in Thailand. Further, it implies a capacity of 3,251 MW based on renewable energy to be implemented in year 2011. This shall be achieved by the fulfilment of the Renewable Portfolio Standard (RPS) in combination with incentives for additional implementations. The achievement of the target will imply a substantial increase in the utilisation of biomass, hydro power, solar energy, wind power and municipal solid waste (MSW) as stated in Table 5-2. Table 5-3 shows the renewable energy production targets.[90]

Table 5-2. Capacity targets for implementation of renewable energy for power generation

	Target 2007	**Existing 2006**	**Target Year 2011**		
	[MW]	[MW]	**RPS** [MW]	**Incentives** [MW]	**Total** [MW]
Biomass	162.4	1,977	-	823	2,800
Hydro	18	44	78	34	156
Solar PV	0.2	30	-	25	55
Wind	3	1	1	108	110
MSW	1	4	-	96	100
Biogas	1	5	-	25	30
Total	**185.6**	**2,061**	**79**	**1,111**	**3,251**

Source: MoE (2005)

[90] cp. MoE (2005)

Table 5-3. Energy production targets for implementation of renewable energy for power generation

	Plant factor	Target 2007 [GWh/y]	Existing 2006 [GWh/y]	Year 2011 RPS [GWh/y]	Year 2011 Incentives [GWh/y]	Year 2011 Total [GWh/y]
Biomass	0.45	640.2	7,793.3	-	3,244.3	11,037.6
Hydro	0.35	55.2	134.9	239.1	104.2	478.3
Solar PV	0.13	0.3	32.9	-	27.4	60.2
Wind	0.15	3.9	1.3	1.3	141.9	144.5
MSW	0.60	5.3	21.0	-	504.6	525.6
Biogas	0.60	5.3	26.3	-	131.4	157.7
Total		**710.1**	**8,009.7**	**240.5**	**4,153.8**	**12,403.9**

Source: MoE (2005)

5.2.3. Key Players in the Energy Sector[91]

The main energy key players in Thailand can be separated into institutional players and private players, as follows:

Institutional Players

- **NEPC**

  The National Energy Policy Council (NEPC) was established under the National Energy Policy Council Act, B.E. 2535 (1992). The NEPC acts as the central authoritative body responsible for the formulation of national energy policies, energy management and development plans which will be recommended to the cabinet for approval.

- **Ministry of Energy**

  As a result of a long restructuring process, the Ministry of Energy is now the governing authority in the energy sector of Thailand. It is subdivided in four departments: the Department of Mineral Fuels (DMF), the Department of Energy Businesses (DOEB), the Department of Alternative Energy Development and Efficiency (DEDE) and the Energy Policy and Planning Office (EPPO).

- **EPPO**

  The Energy Policy and Planning Office (EPPO) acts as the co-ordinating and central implementing agency with the direct and indirect involvement of various government agencies, state enterprises and the private sector. EPPO is responsible for the formulation of national energy policies, energy management and development plans.

- **DEDE**

  The Department of Alternative Energy Development and Efficiency (DEDE) is responsible for the implementation of the national policy on energy efficiency, renewable energy, and water

[91] cp. Cogen 3 (2006)

resources. It is also in charge of developing education and training schemes for consultants and energy managers. It launched several programs, including the "30% Subsidy" program, which stimulated investments in energy-saving projects, and it is responsible for the Energy Efficiency Revolving Fund (EERF), which is described in chapter 8.

- **EGAT Public Company Limited**

  The Electricity Generating Authority of Thailand (EGAT) is a state enterprise under the supervision of the Ministry of Energy. Though partly privatized, the state still holds 75% of EGAT's shares. EGAT operates the country's generation and transmission systems. It has long been the largest power producer in Thailand. Its current combined installed capacity is roughly 15,035 megawatts (MW), accounting for about 59 percent of the country's total capacity of 25,647 MW[92]. EGAT supplies as much as 49.1 percent of electric power to meet national demand. Since its establishment as a government agency, EGAT has the right as a controlled monopoly to operate the generation and transmission systems that serve the national electricity demand. The agency builds, owns, and operates several types and sizes of power plants countrywide. Fuel utilization is concentrated mainly on natural gas, lignite, and hydropower. EGAT subsidiaries were established under the government's privatization policy. This was done to enhance private-sector participation in the power business, as well as to reduce the investment burden of EGAT and of the government. There are two EGAT-associated companies: the Electricity Generating Plc and the Ratchburi Electricity Generating Holding Plc. EGAT currently holds about 25 percent and 45 percent of the shares in each of these, respectively.[93]

- **MEA**

  The Metropolitan Electricity Authority (MEA) is responsible for distributing electricity in the Bangkok Metropolitan Region and the surrounding provinces of Nonthaburi, Samutprakan, and part of Pathumthani. About 35 percent of the power transmitted from EGAT is distributed through MEA. In a very small amount, MEA also purchases electricity directly from very small power producers (VSPPs). MEA currently delivers electricity to 2.4 million customers to fulfil the maximum power demand of 6,825 MW.

- **PEA**

  In the same manner as MEA, Provincial Electricity Authority (PEA) operates the distribution of electricity in the other 73 provinces. PEA supplies about 63 percent of the power transmitted from EGAT to consumers in 99 percent of the country[94]. Besides this, the authority also owns small-scale power plants in the areas outside EGAT's service network coverage area. Additionally, PEA also purchases a very small amount of electricity from VSPPs.

Private Players: Energy Producers

- **Independent Power Producers**

  Classifying producers as Independent Power Producers (IPP), small power producers (SPP), or VSPP[95] is based on the maximum electrical power they are allowed to supply to the grid and type of fuel used. An IPP refers to a plant with a capacity larger than 90 MW. Fuel types that IPPs usually use are natural gas and coal. Electricity produced by IPPs is to be sold only to EGAT. Presently, there are seven IPPs with a total installed capacity of 6,677.5 MW. Five of them have

[92] as of June 2006
[93] EGAT (2006)
[94] as of June 2006
[95] IPP=Independent Power Producer; SPP=Small Power Producer; VSPP=Very Small Power Producer

commenced operating and are now supplying power to the grid. The rest are scheduled to begin operation between now and 2009.

- **Small Power Producers (SPP)**

  Similar to IPPs, the SPP scheme was first initiated to encourage the private sector to participate in power generation. The Cabinet first approved the regulations for the purchase of power from SPPs in 1992. The maximum amount of power that an SPP is allowed to supply to the grid is 90 MW, and the electricity must be sold directly to EGAT. In industrial estates, however, SPPs are allowed to sell their generated electricity and heat directly to industrial customers. The use of non-conventional energy or waste or residues from agricultural activities or production processes, and co-generation was the focus of the program. As of September 2006, 97 SPPs with a combined capacity of 4,627 MW are registered[96].

- **Very Small Power Producers (VSPPs)**

  The VSPP scheme was set up with the aim to encourage the use of renewable energy in Thailand. The regulations for VSPPs were first approved in 2002. The electricity capacity supplied to the grid by VSPPs could not exceed 1 MW per year initially, but was expended to 10 MW in 2006, and must be sold to PEA or MEA. Mostly, the plants generate electricity using thermal or cogeneration systems and run on waste and renewables generated on-site or readily available nearby. By June 2005, there was a total of 9.2 MW maximum capacity to be supplied to the grid by VSPPs.

Private Players: Local Suppliers of Sustainable Energy Technology in Thailand

A non-exhaustive list of local suppliers and manufacturers of sustainable energy technologies in Thailand including consultancy agencies and authorities and research institutes can be found in *Annex D*.

5.2.4. Legal Framework

New energy and environmental laws and legislations were enacted in 1992, in response to the high economic growth during the early 1990s. Later, after the economic crisis in the late 1990s new regulations and laws concerning corporate structure and behaviour were introduced. Moreover, as a result of the crisis, legislation was passed to increase public sector performance and governance (including the Ministerial Restructuring Act that has led to establishment of *e.g.* the Ministry of Energy and the Ministry of Natural Resources and Environment). An overview of these laws, regulations and orders can be found in the table below.

Table 5-4. Thai Legal Framework on Energy and Environment Issues

Law/regulation/order	Contents
Thai Constitution (1997)	On natural resources and environment, the new constitution validates the right of: • The communities to conserve natural resources • The people to benefit from a good environment and for project developers to carry out EIA • The people to receive information and participate in the planning of development projects that have an environmental impact

[96] EPPO (2006)

Law/regulation/order	Contents
	• Decentralisation of power to local administrative bodies to manage, maintain and utilise natural resources within their jurisdiction
Energy Conservation and Promotion Act (1992)	Defines the basics for providing financial and logistics support for energy conservation, and for energy efficiency and renewable energy projects. Defines the ENCON programme and ENCON fund.
Environmental Quality Enhancement and Conservation Act (1992)	Establish provincial authorities as responsible for their own natural resources and environmental quality management action plans. These plans are the basis for Government funds. Defines the Environmental Fund.
Ministerial Regulation - Compulsory programme for designated facilities (under the ENCON fund 1995)	Requires designated factories and buildings (> 1 MW elect cap or 20 million MJ heat) to comply with Government regulations to manage energy use, and establish energy conservation targets and plans. Energy conservation includes conversion from fossil fuel to renewable energy fuel.
Regulation for the purchase of power from small power producers (published 1992, revised 1994 and 1998)	Defines the obligations of electricity companies to let SPP's (< 60MW) connect to the grid and purchase power from SPP producing from wind, PV, hydro, biogas and biomass including municipal waste). Pricing not fixed but depends on certain criteria and bids of EGAT/MEA/PEA. June 2003: 1.49 THB + subsidy + capacity payment (for firm capacity). The first round bids included a 5-year tariff subsidy of up to 0.36 THB/kWh – later projects receive 0.15-0.18 THB/kWh.
Law on community forests (1996)	The communities that directly or in-directly own the forests must ensure that their sources of supply are sustained.
Regulation on civil participation (2001)	Regulation requiring the developers of biomass projects to seek the opinions of people living within a 10km radius of a planned plant. If 80% of respondents within 3km support the project then it would qualify for a state subsidy.
Regulation on transportation of organic waste under item 71 of the National Environmental Quality Act 1992	In relation to biogas, it is possible to transport biomass/slaughterhouse waste if the industry complies with a special registration with the Ministry of Industry.
Possession Of Electricity Generator (Announcement 1992)	One who possesses a generator of a total capacity of 200 Kilo-Volt-Ampere or more for electricity production is required to make an application for production of regulated energy to the Department of Alternative Energy Technology and Efficiency.
Regul. regarding EIA of thermal power plants (Environmental Quality Enhancement and Conservation Act 1992)	Thermal power plants with capacity of more than 10 MW are required to prepare an EIA report
Notification of Ministry of Science, Technology and Environment regarding emission limits/air pollution from power plants (1999)	Emission standards for power plants Ambient Air quality standards

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Law/regulation/order	Contents
Regulation regarding waste water standard (under Factory Act 1992)	Standards for effluent standards for industrial plants (including animal food, and slaughterhouse)
Regulation for the purchase of power from the very small renewable energy power producers (2006)	Defines the obligation for an electricity company to let VSREPPs (generator cap. < 10 MW) connect to the grid and to purchase electricity from VSREPPs producing from solar, wind, hydro, biomass and biogas. VSREPPs can sell to the grid on a net settlement basis – excess electricity to the grid will be bought by PEA or MEA at the rate that PEA or MEA buys from EGAT plus a flat rate.

Additionally, several programs have been initiated to promote the use of renewable energy. They consist mainly of individual programs for solar energy, wind energy, biogas, biomass, ethanol and biodiesel and the utilisation of agricultural residues as fuel.

The RPS contains the obligation of power producers that 5% of each new installed capacity have to be RE-based. This standard, in combination with the recent Energy Strategy, which outlines a target for the share of RE energy in the final energy consumption, is a further step towards promoting RETs. Thailand's Energy Strategy is described below. However, the action plans to implement this strategy are still under development.

5.2.5. State of the Energy Sector[97]

The increase in the economic growth rate after the slowdown in 1997 has resulted in a greater use of energy sources such as coal and coke, petroleum products, and natural gas. Due to several external factors, the Thai economy slowed from 6.1% growth in 2004 to 4.5% in 2006, but it is expected to bounce back with a projected real GDP growth for 2006 of 4.6 percent. Longer-term annual growth rates are projected to be in the range of 5-6 percent.

Thailand uses relatively high commercial energy per person: 1.00 tons of oil equivalent (ktoe) per capita for 2005 with a per capita electricity demand of 1,903 kWh. The Energy balance of Thailand for the year 2005 is presented in Table 5-5 next page.

The total primary energy supply has increased from 76,884 ktoe to 103,302 ktoe between 2000 and 2005. Crude oil and petroleum represent the bulk of the primary energy supply (about 40% in 2005), followed by natural gas (about 28% in 2005). In 2005, the total energy demand of Thailand amounted to 62,397 ktoe, rising by 1.85% from the previous year.

The final energy consumption is shared mainly among petroleum (52 %), renewable energy (17%) electricity (17 %), coal and its products (11% percent), and natural gas (3%). By sector, the combined demand from transport and industrial sectors constitute 37.7% and 36.3% while other sectors consumed the remaining share. In that same year, the total energy supply was 103,302 ktoe, rising by 2.79% from year 2004, with net imports of 57,333 ktoe or 51,66% of total energy supply, while the domestic production was 53,640 ktoe or 48,34%.[98].

The primary energy self-sufficiency ratio[99] of Thailand is thus 0.48, which indicates that the domestic production of primary energy is just half of its total primary energy supply.

[97] cp. COGEN 3 (2006)
[98] cp. DEDE (2006)
[99] Primary energy self-sufficiency is defined by IEA as the ratio of total primary energy production over TPES supply

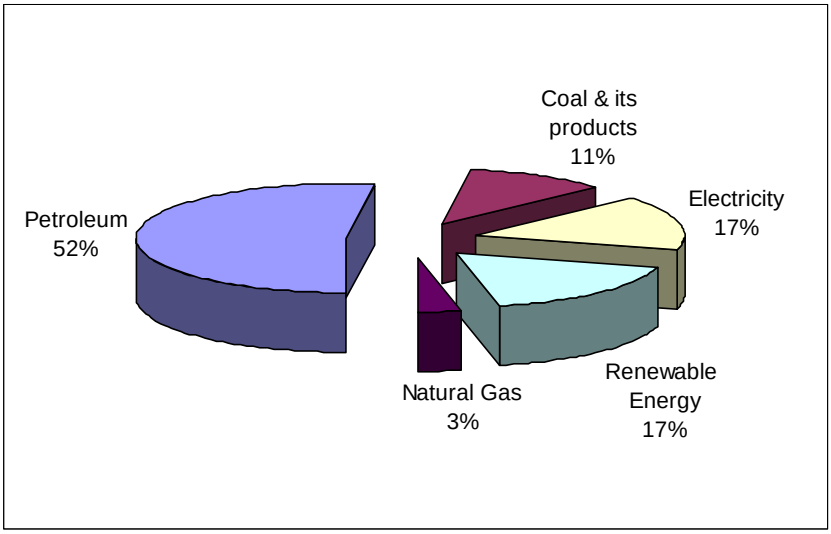
Table 5-5. Energy Balance of Thailand in 2005

Thousand tonnes of oil equivalent

Supply and Consumption	Coal	Crude Oil	Conden-sate	NG	NGL	Petroleum Product	Electricity	Renewable Energy	Total
Production	5,983	5,704	3,156	20,534	-	-	1,285	16,978	53,640
Imports	5,410	41,308	-	8,236	-	1,980	377	22	57,333
Exports	-3	-3,273	-	-	-135	-5,515	-55	-1	-8,982
Stock Changes	67	1,924	-339	-	-8	-333	-	-	1,311
TPES	**11,457**	**45,663**	**2,817**	**28,770**	**-143**	**-3,868**	**1,607**	**16,999**	**103,302**
Petroleum Refineries	-	-45,516	-495	-	-5	36,268	-	-	-9,748
NG Processing Plants	-	-	-	-286	573	2,456	9,979	-1,210	2,743
Power Plants	-4,700	-	-	-20,901	-	-1,967	-	-4,965	-18,799
Other Transformation	-	-	-	-	-	232	-	-	-4,733
Own Use	-	-	-	-5,557	-	-	-343	-	-5,900
Distribution Losses	-	-147	-	-	-	-	-913	-	-1,060
TFC	**6,757**	**0**	**2,322**	**2,026**	**425**	**33,121**	**10,330**	**10,824**	**65,805**
Agriculture	-	-	-	-	-	3,186	21	-	3,207
Mining	-	-	-	-	-	26	99	-	125
Manufacturing	6,757	-	-	1,977	-	3,779	4,748	5,382	22,643
Construction	-	-	-	-	-	152	-	-	152
Residential	-	-	-	-	-	1,309	2,182	5,442	8,933
Commercial	-	-	-	-	-	571	3,275	-	3,846
Transportation	-	-	-	49	-	23,437	5	-	23,491
Non-energy use	-	-	2,322	-	425	661	-	-	3,408
Electricity generated (GWh)	**18,334**	**-**	**-**	**85,703**	**-**	**8,658**	**-**	**5,800**	**118,495**

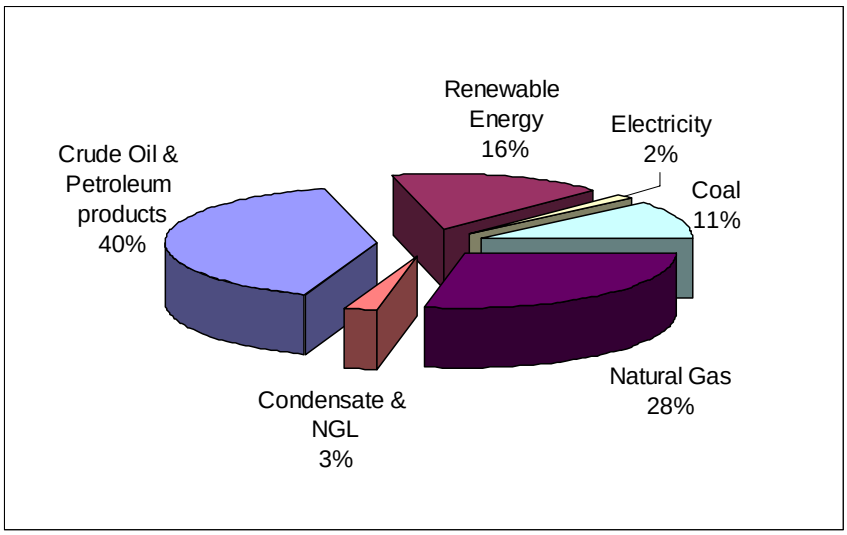
Source: DEDE (2005)

Figure 5-1. Final energy consumption by fuel in Thailand, 2005



Source: DEDE (2005)

Figure 5-2. Energy supply by source in Thailand, 2005



Source: DEDE (2005)

5.2.6. Energy Demand and Supply Projections[100]

Based on a business-as-usual scenario, the final energy demand in 2020 will reach 118 Mtoe, increasing from 49.9 Mtoe in 1999 and posing an overall annual growth of 4.2% during the period. Industry and transport sectors will remain the dominant users as they will account for over 80% of the total final energy demand. The annual energy demand growth of these two sectors will be around 4%, which is similar to the overall energy growth rate. Oil fuel continues to be the main source of energy for final energy use and accounts for more than half of the total final energy demand up to 2020.

Table 5-6. Final Energy Demand from 1980 to 2020

	1980		1999		2020		Growth Rates (%)	
Sectors	**Mtoe**	**Share (%)**	**Mtoe**	**Share (%)**	**Mtoe**	**Share (%)**	**1980-1999**	**1999-2020**
Industry	5.1	32.1	20.7	41.5	49.5	41.8	7.6	4.3
Transport	4.0	25.2	18.2	36.5	46.2	39.0	8.3	4.5
Commercial	0.4	2.5	2.3	4.6	6.8	5.7	10.1	5.3
Residential	6.0	37.7	8.0	16.0	13.4	11.3	1.5	2.5
Others	0.4	2.5	0.7	1.4	2.5	2.1	2.4	6.3
Total	**15.9**	**100.0**	**49.9**	**100.0**	**118.4**	**100.0**	**6.2**	**4.2**
Energy Type								
Coal and coal products	0.1	0.6	3.7	7.4	11.8	10.0	21.4	5.7
Oil and oil products	8.0	50.3	29.2	58.5	69.6	58.8	7.0	4.2
Natural gas	-		1.0	2.0	3.4	2.9	-	5.1
Electricity	1.1	6.9	7.0	14.0	21.7	18.3	10.1	5.5
Renewables	6.7	42.1	9.0	18.0	11.8	10.0	1.6	1.3
Total	**15.9**	**100.0**	**49.9**	**100.0**	**118.4**	**100.0**	**6.2**	**4.2**

Sources: IEA (2001); APERC (2002)

[100] cp. Lefèvre (2004)

In the same scenario, the total primary energy supply will record a 4.0% annual growth between 1999 and 2020, reaching 158.5 Mtoe (Table 5-7). Oil is the main source of energy in the country and will remain so even up to 2020. The growth of coal supply during the forecast period is very high at 7.4% per year, which leads to a doubling of the share of coal in the energy mix of 10% in 1999 to 20% in 2020. Imported electricity is also projected to grow very rapidly: 11.5% per year up to 2020.

Table 5-7. Primary Energy Supply from 1980 to 2020

Energy Type	1980		1999		2020		Growth Rates (%)	
	Mtoe	Share (%)	Mtoe	Share (%)	Mtoe	Share (%)	1980 - 1999	1999 - 2020
Coal	0.5	2.2	7.3	10.4	32.5	20.5	15.5	7.4
Oil and oil products	11.5	50.4	33.9	48.3	73.1	46.1	5.8	3.7
Natural gas	-	-	14.9	21.2	32.0	20.2	12.7	3.7
Hydro	0.1	0.4	0.3	0.4	0.8	0.5	5.1	5.3
New and renewables	10.6	46.5	13.6	19.4	18.3	11.5	1.3	1.4
Electricity	0.1	0.4	0.2	0.3	1.8	1.1	5.5	11.5
Total	**22.7**	**100.0**	**70.2**	**100.0**	**158.5**	**100.0**	**6.1**	**4.0**

Sources: IEA (2001); APERC (2002)

While oil production is expected to decline by 0.7%, oil consumption is projected to increase by 3.7% between 1999 and 2020. The country therefore will continue to rely on imported oil with dependency expected to rise to 95.1%.

Table 5-8. Oil Production and Consumption in Thailand

	1999	2020
Consumption (ktonnes)	33,859	73,117
Production (ktonnes)	4,138	3,560
Net import (>0) and net exports (<0) (ktonnes)	29,721	69,557
Dependency (%)	**87.8**	**95.1**

Source: APERC (2002)

5.2.6.1. Energy Sources Potential[101]

Hydrocarbons

Thailand is a net importer of oil and natural gas, but the government is promoting the use of ethanol to reduce imports of petroleum and the gasoline additive methyl tertiary butyl ether.

In 2005, Thailand produced 306,000 barrels per day (bbl/d) of oil, an increase of about 54,000 bbl/d from the previous year. Of that production, only about 114,000 bbl/d or 38% was crude oil. Most of the remainder was natural gas liquids (NGLs) and lease condensate. Oil consumption in 2005 was 838,000 bbl/d, up from 823,000 bbl/d in 2004. Demand growth in Thailand has decreased since

[101] cp. COGEN 3 (2006)

2003, largely as a result of an increasing substitution of natural gas in electricity generation and an increased use of ethanol in motor fuels[102].

Figure 5-3. Oil Production and Consumption, 1980-2005

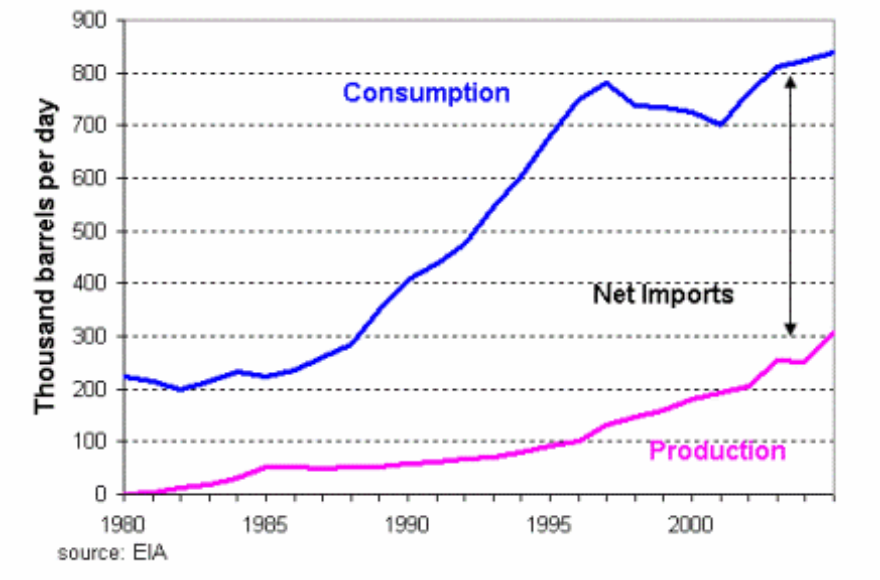


Table 5-9. Petroleum Reserves in Thailand (as of 31.12.2005)

Petroleum Reserves[103]	Proved	Probable	Possible	**Total**
Natural Gas (Bcf)	10,742.89	11,598.18	9,554.99	**31,896.06**
Condensate (MMbbl)	260.54	292.87	157.71	**711.12**
Crude Oil (MMbbl)	192.25	119.26	75.64	**387.15**

Source: Department of Mineral Fuels (2006)

Both the upstream and downstream sectors of the oil industry in Thailand are dominated by PTT, which is the former Petroleum Authority of Thailand. PTT Exploration and Production (PTTEP) is the main upstream subsidiary of PTT while Thai Oil, the country's largest refiner, is also controlled by PTT. Thailand's seven oil refineries have a combined capacity of 1,042,000 barrels per day.[104]

Natural Gas

After its discovery in Thailand in 1980, natural gas has gradually replaced fuel oil and become the main fuel used in power generation with a proportion of around 70%. In 2005, natural gas consumption by power producers, the Electricity Generating Authority of Thailand (EGAT), IPPs, SPPs amounted to approximately 92% of the total gas consumption.[105]

Thailand possesses about 10,743 billion cubic feet (Bcf) of proven natural gas reserves, of which it produced 845 Bcf in 2005. The country consumed 970 Bcf in 2005 (mainly for electricity generation,

[102] EIA (2006)
[103] Bcf = Billion cubic feet; MMbbl = Million barrels
[104] cp. Department of Mineral Fuels (2006)
[105] cp. Department of Mineral Fuels (2006)

see above), including imports from Myanmar. The demand for natural gas is expected to rise at a 5-6 percent annual rate over the next years.

The Gulf of Thailand has been a main supply source of natural gas and most of the natural gas transmission pipeline networks are located there. Because of increasing demand for natural gas, Thailand has been importing gas from Myanmar since 2000. By mid-2003, approximately 70% of Thailand's total natural gas supply came from the Gulf of Thailand while 26% came from Myanmar and the remaining 4% were from onshore gas field.

One of Thailand's most active areas for gas exploration is the Malaysian-Thailand Joint Development Area located in the southern part of the Gulf of Thailand, and governed by the *Malaysia-Thailand Joint Authority*. Two other possible international natural gas pipeline options are presently being studied.

Hydropower

Due to the lack of access to grid electricity of some regions, particularly in the north of Thailand, hydropower plays an important role in the electricity provision in rural areas. As part of the rural electrification program, small hydropower sites have been identified as economically suitable and have brought electricity to 99% of villages in Thailand[106]. Because of its competitive cost, the micro-hydropower system has been widely used in villages.

The scale of current applications covers the following categories:

- Micro-hydropower: up to 200 kW;
- Mini-hydropower: from 200 kW up to 2 MW; and
- Medium and small hydropower: from 2 MW up to 10 MW.

The potential of hydropower in Thailand is estimated at 1,770 TWh per year. The Department of Alternative Energy Development and Efficiency (DEDE) and Provincial Electricity Authority (PEA) have been the main government agencies involved in mini- and micro-hydro development around the country. To date, the total installed capacity in hydro power is around 3,500 MW.

The Mini-hydropower Generation (MHG) pilot project carried out by PEA is a part of the Accelerated Rural Electrification (ARE) project. The MHG is intended to be a simple, standardized design system suitable for operation in remote areas. PEA's policy of MHG development is to install this alternative source of electricity supply to the ARE program instead of only extending the grid system and replacing the current, small diesel generation, wherever it is proved to be feasible under the least -cost calculation.

Renewable energy sources

Thailand is endowed with abundant renewable energy sources, especially biomass, solar, and hydro energy, although, as explained above, it currently heavily relies on fossil fuels which accounted for 82.7% of the total primary energy consumption and 95,1% of the electricity production in 2005. While the utilization of solar energy, wind energy and small-scale hydropower is limited due to high investment costs or limited potential within the country, Thailand's vast biomass potential has only been partially exploited through the use of traditional as well as more advanced conversion technologies for biogas, power generation, and biofuels (see below). Thailand thus has a large potential of renewable energy sources, but their utilization is still considerably low. The estimates of Thailand's RE potential are presented in the Table 5-10.

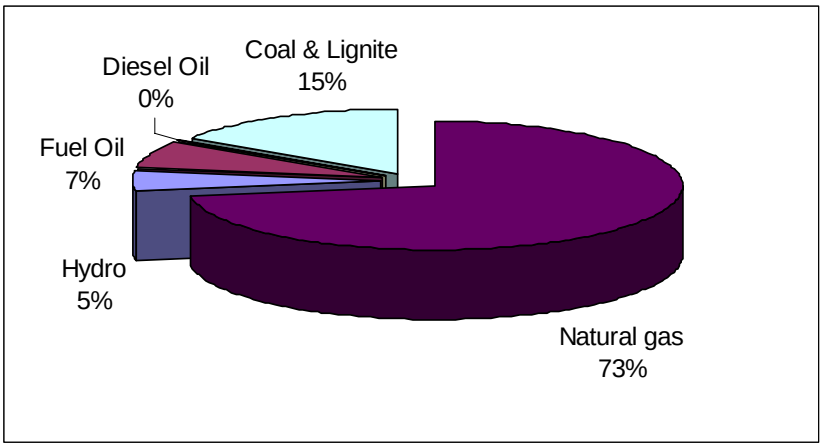
[106] EPPO (2006)

Table 5-10. Estimates of Thailand's RE potential

Renewable Energy	Energy Potential Approximation
Biomass	7,000 MW
Solar	>5,000 MW
Small hydropower	700 MW
Wind	1,600 MW

Source: Greacen, Chris (2005)

Figure 5-4. Energy source for electricity generation in Thailand (2005)



Source: DEDE (2005)

Biomass energy

Thailand has many potential biomass sources, including agricultural and wood residues, wood fuels, new plantations, waste water from livestock farms and industries, and municipal solid waste.

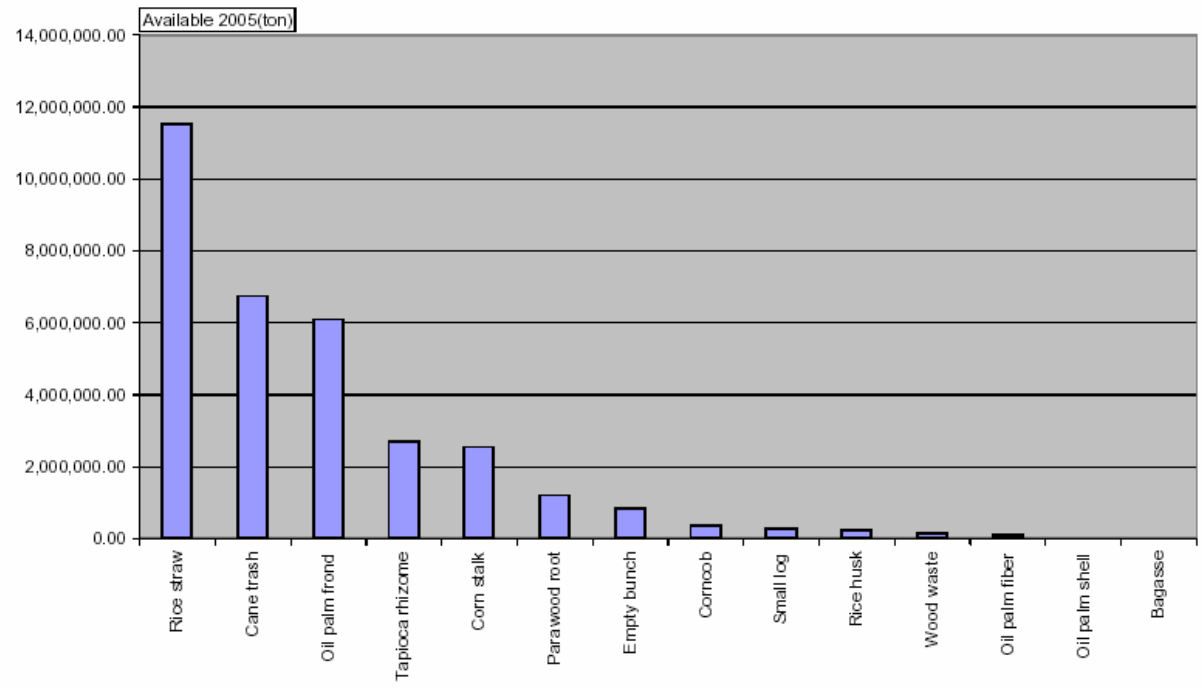


Figure 5-5. Biomass potential residue in Thailand (2005)

Source:: EPPO (Study by EFE, 2005)

Agriculture is a large economic sector in Thailand, accounting for 11% of GDP and employing 60% of the labour force. It generates large amounts of agricultural and wood residues: rice, sugar, palm oil and wood-related industries are the major potential biomass energy sources.

About 32,753 million tons of agricultural and wood residues including rice straw, bagasse from sugar plants, palm oil residues and wood residues, etc. were produced in 2005. Currently, about 0.1 million tons of rice husk are consumed in rural households and 23.25 million tons of bagasse and rice husk are utilized as fuel for industrial heat and power requirements (however, these biomasses are used in boilers with extremely low efficiency -less than 45%- leaving then a huge potential energy sources if boilers could be improved at international standards of 80 to 85% efficiency). Additionally, 38.84 million tons of fuel wood and charcoal are utilized in rural households and mills. Biomass contributes to about one-fifth of the final energy consumption in Thailand but, in general, a lot of biomass is still disposed of through open burning or dumping[107].

5.2.6.2. Electricity Supply and Demand Balancing

Thailand has 26,27 GW of power generation capacity, from which it produced 132,197 GWh of electricity in 2005. Due to the economic crisis and associated declining electricity demand in 1998, EGAT postponed or delayed a number of investment projects. Additionally, EGAT decided to lower its planned generating capacity reserve from 25% to 15%. However, demand growth has recovered in line with Thailand's economic growth over the last five years and in 2004 several prospective new power projects were approved:

- Thai Oil is planning a 1,400 MW gas-fired plant at Sri Racha, adjacent to its existing refinery. It will sell the power generated to EGAT, beginning in 2008.
- EGAT is planning four new 700 MW plants of its own, two near Bangkok, one in Chachoengsao province in the north, and one to be located in the south near Songkla. These new plants are to begin operation by 2009 at the latest.

It is evident that new capacity will be required in the next 5 years as power demand in Thailand is projected to increase by 1,200 – 1,500 MW per year from 2003 – 2012.

5.3. Sustainable Energy Technologies Opportunities

5.3.1. Financial Analysis of Technologies

In the Framework of the DANIDA Project: "Promotion of Renewable Energy Technologies in Thailand" (PRET), a financial analysis has been conducted for each renewable energy technology. Table 5-11 below shows the key financial results for each of the renewable technologies expressed in one unit of output.

The financial results are based on a 20-year cash flow analysis and on the assumption of an increase in the conventional power sales tariff from 2.30 THB/kWh at present to 3.06 THB/kWh in 2024 (fixed prices), without feed-in tariffs added to this sales tariff. Figure 5-6 shows the financial generation cost for renewable technologies compared to the baseline.

The table and figure next page show that the technologies with financial generation costs lower than conventional power generation are biomass backpressure, biomass combined cooling and power and biogas power technologies.

[107] Department of Alternative Energy Development and Efficiency

Table 5-11. Financial data of renewable energy technologies

Electricity Generation Technology	Financial generation cost [THB/kWh]	Financial NPV [Million THB]	FIRR Project [%]	Investment [Million THB]
Municipal solid waste	7.22	-492	-	686.2
Biomass back pressure, 1 MW	0.97	53	13.9%	100.9
Biomass back pressure, 5 MW	0.23	416	20.6%	378.4
Biomass Combined Cooling and Power	2.20	-3	6.8%	208.2
Biomass condensing, 20 MW	2.42	15	7.1%	1513.7
Biomass condensing, 5 MW	3.33	-210	-	328.0
Biomass condensing, 10 MW	3.07	-278	-	555.0
Biomass steam boiler, 7,5 MW	(-)	2	7.8%	36.1
Biogas electricity generation	1.82	34	13.2%	64.1
Biogas steam boiler, 2,5 MW	(-)	16	11.9%	44.1
Mini hydro(200 kW – 6 MW)	2.52	-3	6.8%	185.0
Micro Hydro < 50 kW	2.69	-1	4.9%	3.6
Wind farm, 20 MW	4.15	-432	-	936.0
Solar PV large scale	11.88	-57	-	75.0
Solar PV Residential	15.42	0	-	0.6

Source: MoE, DANIDA-PRET (2005)

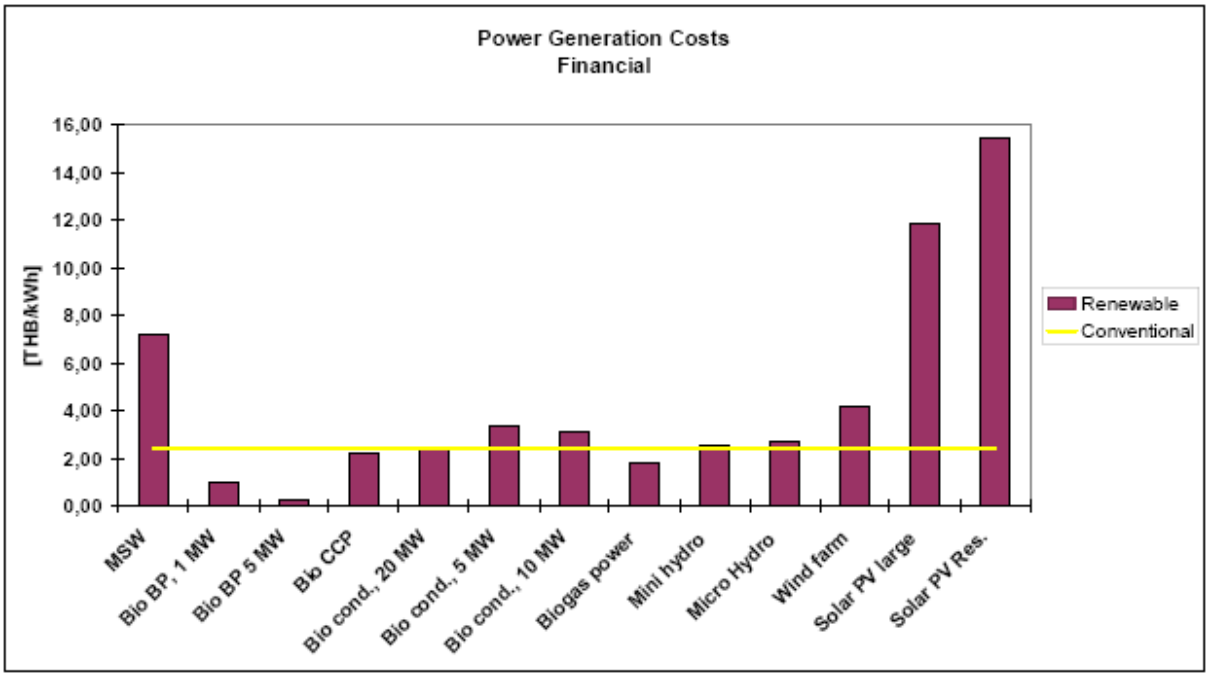


Figure 5-6. Financial power generation costs

Source: MoE, DANIDA-PRET (2005)

5.3.2. Economic Analysis for Technologies

The table below shows economic key results such as economic generation costs and economic net present value found by the DANIDA-PRET project for the renewable technologies expressed in one unit of output.

Table 5-12. Economic data of technologies

Electricity Generation Technology	Economic generation cost [THB/kWh]	Economic NPV of costs [Million THB]	Impact on employment [Man-year/y]	Impact on employment [Man-year/y/GWh]
Municipal solid waste	6.27	692	94	9.0
Biomass back pressure, 1 MW	1.37	343	50	9.0
Biomass back pressure, 5 MW	1.21	1,510	197	7.1
Biomass Combined Cooling and Power	2.54	498	60	3.3
Biomass condensing, 20 MW	2.32	3,300	388	2.9
Biomass condensing, 5 MW	3.18	931	123	4.5
Biomass condensing, 10 MW	2.94	1,719	216	3.9
Biomass steam boiler, 7,5 MW	0.55	269	43	0.9
Biogas electricity generation	1.68	133	17	2.3
Biogas steam boiler, 2,5 MW	0.40	84	21	1.0
Mini hydro(200 kW – 6 MW)	2.02	203	31	3.3
Micro Hydro < 50 kW	2.30	5,8	1.17	4.9
Wind farm, 20 MW	3.67	1,022	93	3.5
Solar PV large scale	11.31	72	5	9.0
Solar PV Residential	14.66	0.56	0.04	10.3

Source: MoE, DANIDA-PRET (2005)

The figure next page, presents graphically the economic generation costs for renewable energy technologies compared to the economic generation costs under the baseline (2.48 THB/KWh).

The economic generation costs are calculated as discounted average generation costs over 20 years in fixed prices. From the figure 5-7 it is obvious that technologies such as Municipal Solid Waste incineration (MSW), Biomass Condensing Power - 5 and 10 MW, Hydro power, Wind farms, Solar PV and Combined Cooling and Power (CCP) - are not viable from a socio-economic point of view. However, CCP is very close with its 2.54 compared with the conventional 2.48 THB/kWh.

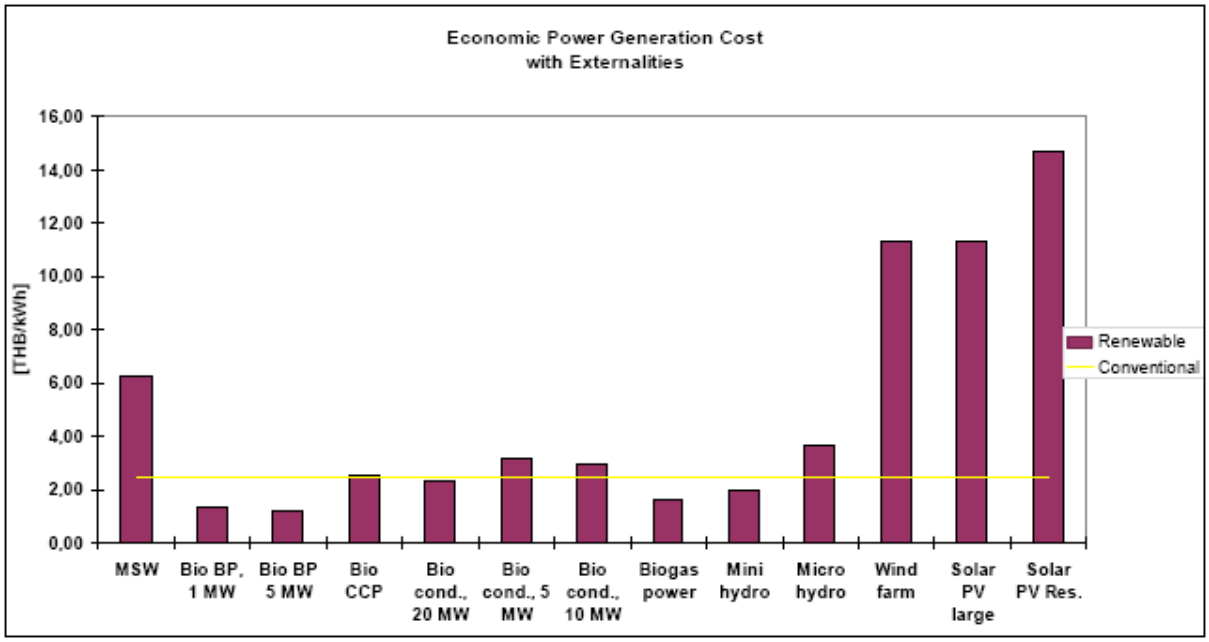


Figure 5-7. Economic power generation cost incl. externalities

Source: MoE, DANIDA-PRET (2005)

5.3.3. Technical Potential for Renewable Energy

Also, the technical potential of renewable energy (RE) has been estimated in the framework of the DANIDA-PRET Project. The table 5-13 next page, shows the full renewable energy potential for Thailand.

As shown in the table, the total technical potential for renewable power in Thailand is estimated to be 60,794 MW, equivalent to 127,616 GWh per year, of which 49,295 MW, or 64,438 GWh per year could come from solar PV plants. It must be noted that the solar PV potential estimate is based on the assumption that only 1 % (5,500 ktoe) out of a total solar potential of 554,000 ktoe is technically available.

The potential for biomass technologies above does not take into account possible energy savings and increased efficiency in energy generation of existing plants through the use of biomass for energy production. The technical potential from the use of bagasse seems to have been big enough to cover 8% of the electricity consumption in Thailand in 2005, if present plants are converted into high-efficient plants.

Excluding the solar PV, the total technical potential of renewable energy is estimated to be 11,499 MW, which is equivalent to a production of 63,178 GWh per year, of which 8,988 MW, or 55,725 GWh per year, can be delivered through biomass technologies. The maximum utilisation of solar energy cannot easily be determined. Instead, a very conservative estimate for the potential has been made (1% utilisation of technical potential, see above) and Solar PV for residential use is not considered.

Table 5-13. Estimated potential for RE resources and corresponding installed capacity and power output

Technology	MW	Fuel, ktoe	Fuel, GWh	Power, GWh
Municipal solid waste	533	1,478	17,187	2,776
Biomass back pressure, 1 MW	113	735	8,548	623
Biomass back pressure 5 MW	182	1,182	13,742	1,002
Biomass Combined Cooling and Power	85	635	7,385	1,578
Biomass condensing, 20 MW	4,241	7,939	92,325	28,418
Biomass condensing, 10 MW	2,535	7,426	86,366	13,991
Biomass condensing, 5 MW	1,833	5,368	62,432	10,114
Biogas electricity generation	251	473	5,502	1,882
Mini hydro (200 kW – 6 MW)	287	78	905	905
Micro Hydro < 50 kW	-	-	-	-
Wind farm, 20 MW	1,438	163	1,890	1,890
Solar PV large scale	49,295	5,541	64,438	64,438
Solar PV Residential	-	-	-	-
Total	**60,794**	**31,017**	**360,733**	**127,616**
Total, excl. Solar	**11,499**	**25,477**	**296,295**	**63,178**
.. of which based on Biomass	**8,988**	**23,284**	**270,798**	**55,725**

Source: MoE, DANIDA-PRET (2005)

5.3.4. National Renewable Energy Supply Curve (economic)

By using the technical implementation potential described in the above sections, together with the economic power production costs, the cost supply curve has been derived for Thailand's electricity sector. The curve from Figure 5-7 next page shows the introduction of renewable power in a sequence starting with the cheaper production and ending with the more expensive production options.

The cost supply curve shows that a number of technologies have lower economic production costs than the conventional power production (2.48 THB/kWh, the horizontal green line). For reference purposes, the economic power production costs of the baseline (conventional power) are also shown without inclusion of externalities (2.11 THB/kWh, the horizontal pink line). It is seen that the RE power production reaches approximately 127,000 GWh, when bringing into play all the renewable energy resources.

It must be noted that the analysis does not take into account such economic factors as long term benefits involving technological developments and the need for general solutions to waste management problems, although such factors may make wind, solar and municipal solid waste systems economically viable.

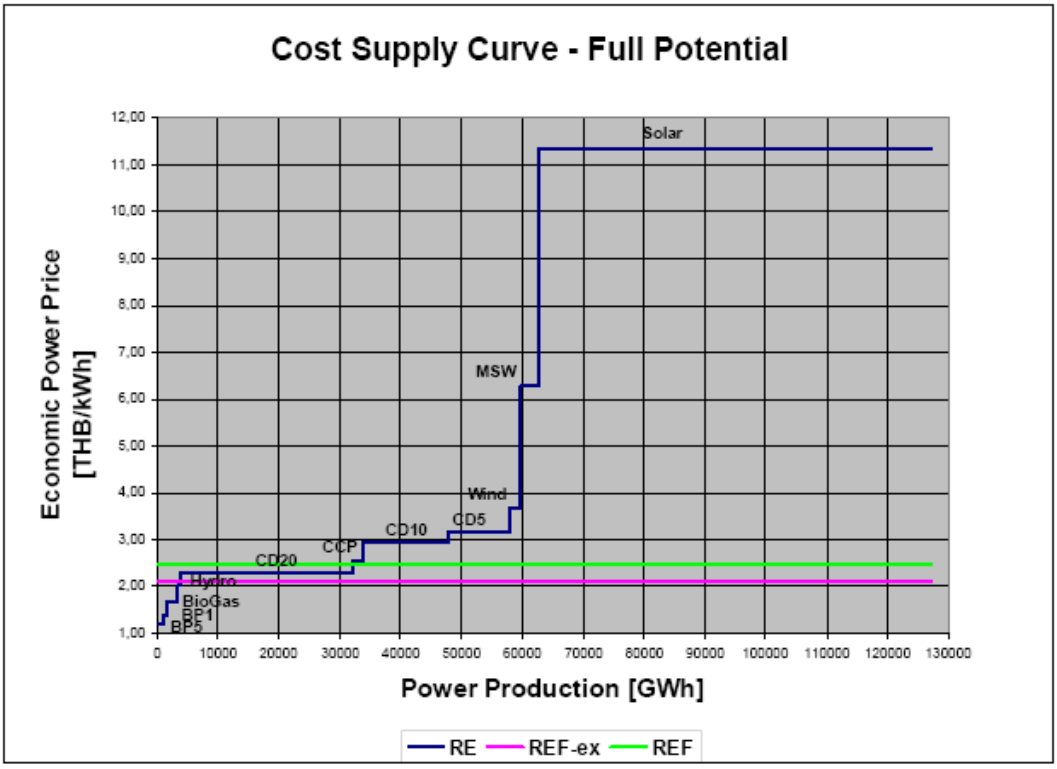


Figure 5-8. Cost supply curve for full exploitation of the RE resources

Source: MoE, DANIDA-PRET (2005)

5.4. Energy Strategies and CDM Opportunities

Thailand's present Climate Change Strategy (as of August 2005) contains a CDM scheme. In line with the strategy's framework, the CDM policy will give priority to stabilizing GHG emissions in the energy sector, both on the supply and demand sides. CDM project development in Thailand therefore will focus particularly on the energy and industrial sectors, especially on those activities involving energy production, transformation, and consumption by power producers and industrial users.

In this context, the energy and waste sectors offer the largest potential for CDM projects in Thailand. CDM priority categories are: fuel switching, waste-to-energy activities, renewable energy, energy efficiency, and energy conservation. Examples of these priority categories in Thailand are shown in the table 5-14 next page.

Even though Thailand's Energy Strategies provide a fairly large potential for energy efficiency and renewable energy development, it remains a challenge to translate this potential into actual CDM projects. To achieve the defined energy targets, tremendous efforts from all concerned parties from both private and government sectors are required. However, the energy implementation plan should be carefully conducted in order to meet the CDM requirements. Too aggressive action plans with specific targets and/or too much pushing forward by the government might reduce the scope for CDM projects as it would make potential CDM projects non-additional.

In addition, the current increase in prices of fuel sources (oil, coal, natural gas), coupled with a high demand for energy, has made it necessary for the country to seek out and use renewable energy sources in order to prevent an energy shortage that would have a negative impact on the country. Income from CDM implementation would therefore encourage the private sector in utilizing renewable energy sources for their activities.

Table 5-14. Projects given high priority in Thailand

Sector	High priority options
Energy Sector	**1. Production of Energy** - Project for the use of bio-energy such as ethanol and bio-diesel, and-biogas from farm and industrial wastewater. - Project for the conversion of agricultural waste into energy. - Project for the use of renewable energy sources such as solar, wind, and small hydro-power systems. **2. Increasing Energy Efficiency** - Project for increasing the efficiency of combustion and steam generation, including the cogeneration system and waste heat recovery. - Project for improving the efficiency of cooling systems. - Project for improving the efficiency of energy usage in buildings. - Project for changing the types of fuel used to produce energy.
Environmental Sector	- Project to convert residential waste into energy. - Project to convert residential wastewater into energy.
Transport sector	- Fuel switching - Project to increase transport efficiency.
Industrial sector	- Other projects that can lead to the reduction of greenhouse gas emissions.

Source: IGES (2006), CEERD-FIHRD (2006)

The CDM project cycle in Thailand is not fully operational yet, but a number of PDDs have been already prepared, and 15 projects of which have been submitted for approval. From such projects in the CDM pipeline, 7 projects have been approved by the Cabinet on 30 January 2007, while the others are expected to be approved soon (see *Annex C)*.

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6. CDM Status

6.1. Thailand and the Kyoto Protocol: Historical Review

Realising the seriousness of climate change as a global threat, Thailand has been contributing to international efforts to address climate change issues, as a Non-Annex I country. Thailand signed the UNFCCC at the United Nations Conference on Environment and Development (UNCED) in June 1992, and ratified the Convention in March 1995. Thailand also signed the Kyoto Protocol in February 1999, and ratified it on 28th August 2002 to reconfirm its stance on the urgent need of the world to combat climate change.

As Non-Annex B party to the Kyoto Protocol, Thailand is eligible for CDM implementation. Hence, Thailand has to set up CDM Institutional Framework and also to decide on a methodology to evaluate the contribution of CDM project activity to the country's sustainable development. At first, Thailand National Focal Point for the UNFCCC and Kyoto Protocol was placed with the Office of Environmental Policy and Planning (OEPP), under MOSTE (Ministry of Science, Technology and Environment). However, since national public administrative reform in October 2002, the MOSTE was split up and MONRE (Ministry of Natural Resources and Environment) was newly established, and the work of climate change as well as CDM was transferred to the "Office of the Permanent Secretary" under MONRE. Until September 2004, MONRE decided to shift the climate change and CDM responsibility to the "Office of Natural Resources and Environmental Policy and Planning (ONEP) under MONRE".

Since the MONRE has been assigned by the Cabinet to be the **DNA for CDM**, the ONEP would perform its role as Thailand's National Focal Point for UNFCCC and the Kyoto Protocol, and also performs its role as the **Secretariat Office of the DNA CDM**.

Accordingly, ONEP reacted by establishing a task force called the "**Climate Change Coordinating Unit**", located in the Office of National Environment Board (NEB). Staff functioning at the Secretariat Office of the DNA CDM are at the Climate Change Coordinating Unit.

The Climate Change Coordinating Unit provides full support to CDM development in Thailand, for instance, drafting a national policy on climate change and CDM; preparing for the establishment of an institutional framework on both climate change and CDM; providing capacity building programs on CDM development to relevant sectors; preparing expert and stakeholder consultation on drafting necessary elements on CDM implementation in the country, including approval procedure and sustainable development criteria for CDM projects.

The Secretary-General of ONEP directly supervises the Climate Change Coordinating Unit and promotes ONEP policy to provide strong cooperation and networking with all stakeholders, *i.e.* relevant ministries (particularly Ministry of Energy, Ministry of Industry, Ministry of Transport, Ministry of Foreign Affairs), academic institutes, non-government organizations (NGOs), private sector, media, and international entities, as well as a complete support for the Thailand's implementation of UNFCCC and the Kyoto Protocol.

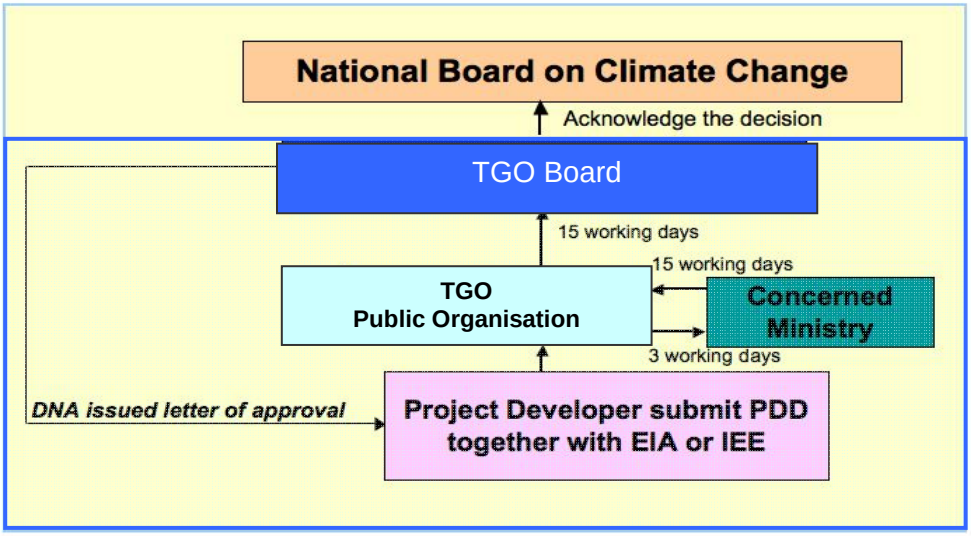
6.2. CDM Institutional Framework and Tentative CDM Approval Procedure

There are several entities, with different roles, relevant to Thailand's CDM institutional framework and current approval procedure: the Cabinet; National Environment Board (NEB); National Committee on the United Nations Framework Convention on Climate Change (NC UNFCCC); Ministry of Natural Resources and Environment (MONRE, as DNA CDM); Relevant Ministries; CDM Expert Group; and Office of Natural Resources and Environmental Policy and Planning (ONEP, as the Secretariat Office of the DNA CDM).

Previously, the Cabinet had decided to give final approval of a CDM project on a case-by-case basis only at the Cabinet level. Hence, the existing CDM project approval procedure would take approximately *60-70 working days*.

This is viewed by the private sector as a discouraging and complicated step. Therefore, *a new organization for greenhouse gas mitigation* namely *Thailand Greenhouse gas Management Organization* (TGO) has been proposed for establishment, and also a new proposal of *a simplified process* drafted by ONEP to shorten a CDM approval procedure is currently on progress. The newly proposed simplified procedure, as shown in figure 6.1, is aimed at enhancing Thailand's competitiveness, yet with efficient measures. It is expected to be implemented by the proposed one-stop-shop and autonomous organization, called TGO, which would act as the **Designated National Authority (DNA)** for CDM projects in Thailand.

Figure 6-1. Draft Simplified CDM Approval

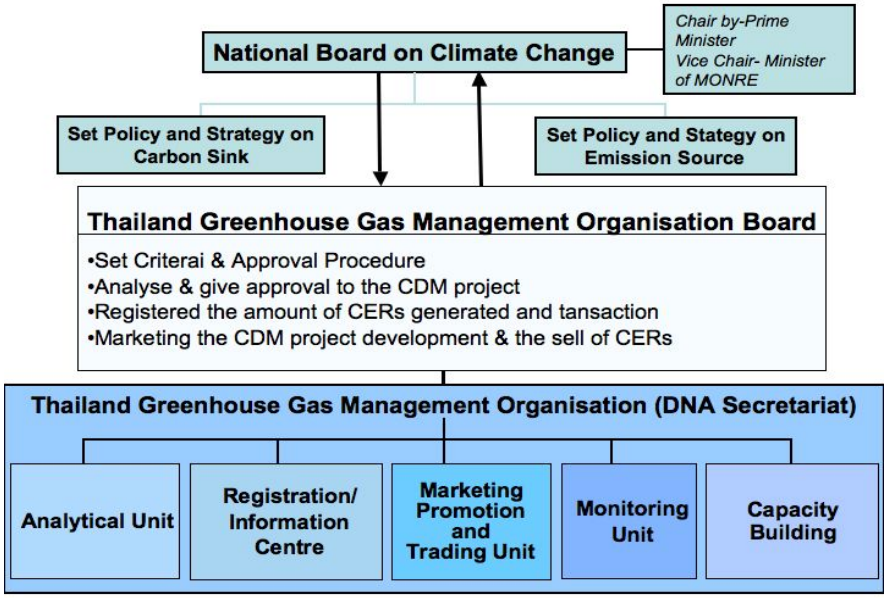


With the new organization, a project developer is expected to submit a Project Design Document (PDD) together with an approved Environmental Impact Assessment (EIA) Report or an Initial Environmental Evaluation (IEE) Report to the TGO. Within *3 working days*, the PDD shall be submitted to the relevant ministry for comments, and send back to the TGO public organization within *15 working days*.

The organization therefore shall prepare a summary of comments and submit them to the TGO Board for review within *15 working days*. After the review by TGO Board, a response (in case of approval), a Letter of Approval (LoA) will be issued to the project proponent and the National Committee on UNFCCC will be notified. This proposed project approval procedure should take approximately *30 working days*.

The new institutional framework, as shown in Figure 6.2, is expected to be attractive for parties to participate in the CDM implementation in Thailand, as well as to stimulate investment and environmental friendly business on greenhouse gas emission reduction in the region.

Figure 6-2. Draft New Institutional Framework on Climate change and CDM



Source: ONEP 2006

6.3. Thailand's Criteria for CDM Implementation

Thailand's criteria for implementing CDM projects are as follows:

- The project must be in line with the relevant ministry's policy and regulations.
- The projects will need to promote the country's goal of sustainable development.
- The projects should create technology transfer and capacity building.
- The projects should give top priority to benefiting local communities.
- Each project must be approved by the Cabinet on a case by case basis (the existing draft procedure), or by TGO (the new draft procedure).
- The government will provide a framework for the trading of CERs.

6.4. Draft CDM Sustainable Development Criteria

In the assessment of the project's contribution to sustainable development, a number of sub-criteria with specific indicators are listed in table 6-4. For each of the sub-criteria, it is indispensable that the project either **improves** one or more of the indicators listed, **does not deteriorate** any of the indicators significantly, or **includes compensatory measures** in case any of the indicators deteriorate.

The overall contribution of the project to sustainable development has to be "positive". It is important to recognize that if a CDM project is not implemented, a business-as-usual or baseline scenario will be implemented.

The baseline scenario will also have an impact on the sustainable development of Thailand. As a consequence, the impact of the CDM project on the sustainable development indicators should be compared to the impact of the baseline scenario on the sustainable development indicators. The project should be approved if it has a more favourable impact on sustainable development than the baseline alternative.

Table 6-1. Draft Guidelines for CDM Sustainable Development at the Local level

Targets	Objectives	Project Review Indicators
Environment	- To preserve the environmental quality in the local community and support greenhouse gases reduction. - To reduce utilization of non-renewable natural resources such as groundwater, non-renewable energy. - To be a systematically managed project, which lasts even after the end of the trading period of CERs.	Reduction of pollution and improvement of environmental quality: - Amount of greenhouse gases released; - Air pollution such as emissions of SO_2, NO_X, and PM10; - Water pollution, discharge of wastewater; - Amount of waste generated; - Amount of chemicals used in soil. Guidelines for maintaining biodiversity and preventing impacts on natural reserves and culturally significant areas. Guidelines for the conservation of groundwater resources. Reduction in usage of non-renewable energy. Promoting concepts of Reduce, Recycle and Reuse. Guidelines in place for reducing potential environmental impacts. Guidelines in place for the management and maintenance even after the end of CER trading period.
Social	- The involvement of local communities is at the heart of a sustainable development project, including avoiding any potential problems that might arise within the project area and/or community. - Project must receive approval from all relevant agencies, both at the local and national levels. - Any benefits achieved by the project should be extended to the local community.	Be in compliance with legal requirements, including the preparation of an IEE report. Communication of project information to the public. Ensuring that benefits are disseminated in the community - health; - education; - enhancement of labor skills; - other benefits.
Economics	- To promote the economy within the project area.	- Years of employment; - Income per household; - Improved quality of living.

Source: www.onep.go.th/cdm/en/cdm_approv.html

6.5. Past and ongoing CDM programs in Thailand

So far, an important focus of CDM programs implemented in Thailand has been on "Capacity Building" in order to create greater public awareness and understanding on both climate change and CDM. Linking issues of "Climate Change and CDM" as a theme for capacity development is

viewed by ONEP to provide more education and information as well as stakeholder participation processes. These programs were designed to fit different target groups continuously.

The capacity building programs based on a stakeholder consultative basis were conducted through various means, for example, seminars, workshops, meetings, publications and website development. The purpose of stakeholder consultation was to identify the needs of stakeholders and how ONEP could address these needs. These include private sector, public sector, academia, NGOs, media and civil society. Stakeholders are also counted as partners to successfully develop CDM capacity in Thailand.

In addition, some more programs have been conducted to provide technical and financial assistance for project identification, preparation, and/or implementation. A few matchmaking programs, aimed at bringing together project developers, investors, and CER buyers, have also been implemented in Thailand.

While the Thai government's budget to support programs is financially limited, international cooperation has played a significant role in closing the gap and supporting the programs implemented in Thailand so far.

The Royal Thai Government (Ministry of Natural Resources and Environment; Ministry of Energy; Ministry of Industry; and Ministry of Transport) has been cooperating with several academic institutions, NGOs, foreign and international agencies to carry out the capacity building programs and other CDM related programs.

6.6. Stakeholders active in Thailand

Concerning Thailand's application on CDM, there are several relevant actors active in the CDM. These include private sector (*i.e.* project developers, consultancies and financial institutions), public sector, academic institutions, non-governmental organizations (NGOs), and the media which tend to be increasing their interest on CDM issues.

Private Sector

Elements of the private sector active in Thailand's CDM include project developers and/or project proponents, consultancies, and financial institutions, including international entities.

- **Project Developers/Proponents**

At present, the private sector has expressed interest in 30–40 CDM projects, while around 15-20 projects are ready for consideration (As of Dec. 2006, 15 projects has been preliminary approved by National Climate Change Committee and proceeded to Cabinet Resolution)[90].

Being continuously organized are a number of capacity building programs on CDM by ONEP and other international entities. Interest in CDM development from the private sector in various types of business, ranging from biomass, biogas, bio-diesel, other renewable energy types, landfill gas, and energy efficiency, has been increasing.

- **Consultancies**

Though a number of energy related consultancies are available, there are limited numbers of experienced CDM consultancies in Thailand. Companies that are interested in contacting these consultancies might not know much about them. A possibility to overcome this barrier could be for

[90] The existing approval procedure was used for this first batch because the Thailand GHG Management Organization is on the process of legal establishment.

ONEP to provide a consultancy list on its official website for interested parties. In addition, ONEP should provide intensive capacity building programs to other local consultancies on PDD making in order to raise the quantity of consultancy supply, a higher quality of consultancy, and competitiveness among them.

- **Financial Institutions**

CDM projects require upfront investments generally obtained from different sources, such as loans, equity, grants, and upfront payments for CER purchase (Michaelowa et al, 2003 cited in IGES, 2006).

Loans can be obtained from financial institutions such as commercial banks, which play a significant role in the Thai financial market. There are approximately 30 commercial banks in Thailand (including Thai and non-Thai registered), which provide services mainly addressing the mobilization of savings in the form of deposits and provision of loans. They are followed in this regard by finance and securities companies (IGES, 2006).

However, there is no evidence that any financial institutions in Thailand directly provide financial loan on CDM projects, except energy conservation projects.

Last year (2005), 6 commercial banks have joined the Revolving Fund Project for Energy Conservation initiated by DEDE (Ministry of Energy), and a additional 5 commercial banks have joined the Revolving Fund Project for Energy Conservation Phase II in 2006. These include *Thai Military Bank* (TMB), *Bangkok Bank*, *Krung Thai Bank*, *Bank of Ayudhya*, *Kasikorn Bank*, *Siam Commercial Bank*, *Siam City Bank*, Small and Medium Enterprise Development Bank of Thailand (so-called *SME Bank*), *Bank Thai*, Export-Import Bank of Thailand (so-called *EXIM Bank*), and *United Overseas (Thai) Bank*.

This Revolving Fund Project will not only encourage and push the investment market for energy conservation, but also enhance the comprehension and experience of the financial institutions in the matter of energy conservation investment and vision on the potential of investment marketing and credit loans for energy conservation. It is hoped that the experience from this project would encourage more financial institutions to be interested in the coming CDM projects.

In addition to the financial institutions described above, there are various international entities providing financial assistance for CDM related activities as summarized in the next section: CDM Financial Issues in Thailand.

Public Sector

Since 2004, ONEP has provided capacity building programs and networking with other concerned Ministries and it could have been stated that the relationship amongst these organizations has been largely improved and strengthened. Apart from the Ministry of Energy, Ministry of Industry, and Ministry of Transport that have direct roles on CDM approval procedure, other authorities have been strongly networking through meetings, seminars, workshops and trainings. These include the Ministry of Foreign Affairs, the Office of National Economic and Social Development Board (NESDB), the Board of Investment (BOI), the Thailand Research Fund (TRF), and academic institutions.

Also, there were a number of CDM seminars and workshops conducted by the Ministry of Energy, and the Ministry of Transport in cooperation with international entities from Denmark and Japan in recent years in order to provide information on CDM feasibility studies and project development to the public and private sectors.

Academic Institutions

There have been an increasing number of publications, research and interest shown from academic institutions in Thailand on Kyoto Protocol implementation and CDM application. These include experts and experienced academic persons from various universities in Thailand, including the Asian Institute of Technology (AIT).

Non-Governmental Organizations

Active non-governmental organizations (NGOs) participating in CDM development in Thailand include:

- Good Governance for Social Development and the Environment Institute (GSEI)
- WWF Thailand
- Thailand Environment Institute (TEI)
- Green World Foundation (GWF)
- Energy for Environment Foundation (E4E)

Media Sector

Media, particularly on the business analysis side of newspapers, occasionally write reports and articles on CDM issues in Thailand. Active media includes Bangkok Post, the Nation, Matichon, Post Today, Bangkok Biz Week, Bangkok Biz News, Matichon Prachachart, Manager, Thairath Newspaper, Environment Thailand Magazine, etc.

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7. Most Promising CDM Project Opportunities in Thailand

Several studies on the CDM potential in Thailand have already been published, of which the most known include the ALGAS study, the national GHG inventory, the national CDM strategy study, and more recently the IGES "CDM country guide for Thailand". All these studies provide a listing of the types of CDM projects with potential in Thailand. The criteria for the selection of these projects include: 1) the importance of current and forecasted GHG emissions, 2) the eligibility of GHG mitigation projects as CDM projects, and 3) the availability of GHG mitigation technologies. Chapter 8 intends to look at the economic feasibility of implementing such projects from a private sector perspective. From the potential CDM projects identified in the above-mentioned studies, chapter 8 aims to determine actual opportunities for private sector investment.

7.1. Overview of the CDM potential in Thailand

More than two-thirds of the total net GHG emissions in Thailand are carbon dioxide emissions (CO_2), with methane accounting for 27%, based on 1998 data (see table 7-1). Carbon dioxide emissions come mainly from the energy sector, which in turn is responsible for half of the 1998 total net GHG emissions. The energy sector's GHG emissions in fact increased both in relative and absolute terms from its 1990 levels (see table 7-2).

Table 7-1. National net GHG emissions, 1990 and 1998

Greenhouse gases*	Emissions in CO_2e, million tons		Percentage of total emissions	
	1990	1998	1990	1998
CO_2	164	204	73	68
CH_4	58	80	25	27
N_2O	3	14	2	5
Total	**225**	**298**	**100**	**100**

* The emissions of other greenhouse gases are negligible compared to total.

Source: ADB, 1998; MONRE, 2002.

Table 7-2. National net GHG emissions by sector, 1990 and 1998

Sector	Emissions in CO_2e, million tons		Percentage of total emissions	
	1990	1998	1990	1998
Energy	79	152	36	51
Industrial Processes	10	12	4	4
Agriculture	54	68	24	23
Land-use Change and Forestry	78	51	35	17
Waste	3	15	1	5
Total	**225**	**298**	**100**	**100**

Sources: ADB, 1998; MONRE, 2002.

Several studies have been conducted to analyze the CDM potential in Thailand in the areas mentioned above, of which the most known include the ALGAS study, the national GHG inventory, the national CDM strategy study, and more recently the IGES "CDM country guide for Thailand".

Potential has been identified in the power generation, transport, industrial, residential, and commercial sectors. While the GHG mitigation potential is technically and theoretically important, not all of the projects are suitable for private sector investment, from the CDM perspective.

7.2. Most promising sectors for private sector investment in CDM projects

Several aspects must be taken into consideration when assessing the attractiveness of a CDM project for a private sector investor. While some directly relate to the basic aspects of a project, some relate to the CDM part of the project.

7.2.1. Power generation

Natural gas for power generation has been extensively used in Thailand, with natural gas representing approximately 70% of the electricity mix in Thailand. Therefore, the emission reduction to be expected from a new power generation plant using natural gas is very limited, and would not compensate for the CDM preparation and transaction cost. In addition, there might some problems proving additionality when most recent capacity additions to the Thai grid have been using natural gas.

The opportunities for CDM projects in power generation would therefore be limited to the introduction of new and more efficient technologies using natural gas, and clean coal technologies.

Concerning **renewable energy**, four types of projects have been identified as having a CDM potential: biomass, biogas, solar and wind. The wind potential in Thailand is known to be very limited, and the use of solar systems for power generation are deemed not attractive for 2 reasons: 1) it is still very expensive compared to other alternatives; and 2) the size of such projects is usually very small, most often below 1 MW, which makes emission reductions insignificant.

Several projects that use **biomass** as fuel for power generation have already been registered as CDM projects by the Executive Board. Table 7-3 below presents a simplified economic analysis for biomass-fired power generation using rice husks. The assumptions are:

- Technology used is biomass condensing 20 MW;
- Electricity generated displaces electricity from the grid at an emission factor of 0.55 tCO2e per MWh;
- Emissions of the project include transportation of fuel to the power plant (average data are used);
- Emission reduction from the project includes avoidance of biomass decay, as per ACM0006[91] "Consolidated methodology for grid-connected electricity generation from biomass residues --- Version 3";
- Price of biomass is assumed at 800 THB/ton;
- Debt/equity ratio 75/25;
- Price of CER: 15 USD;
- Crediting period: 10 years.

[91] This methodology has recently been put on hold for revision. The results presented here must therefore be reconsidered when the new revised methodology is available.

Table 7-3. Economics of biomass power generation

	Unit	Value
Feedstock		Rice husk
Capacity of rice mill	Ton paddy/day	2,700
Feedstock input	Ton/year	193,200
Feedstock price (power plant gate price)	THB/ton	800
Power plant capacity	MW net	20
Plant factor	%	85
Electricity generation	MWh/year	149,000
CERs	t/CO_2e/year	80,000
CER price	USD	15
Investment cost	Million THB	1,200
IRR without CERs	%	10
IRR with CERs	%	13
Plant lifetime	Year	25

Source: Own calculations

Biomass-fired power generation projects are therefore interesting for several reasons:

- The amount of CERs generated allows it to generate significant revenues, and contributes to make the investment feasible and attractive to investors (IRR 13%);
- An approved methodology is already available, reducing the cost of CDM preparation.

However, such projects involve significant risks related to the continuous supply and price of biomass residues. On average, it requires 1 ton of biomass residues per hour and per MW. The availability of biomass residues and their dispersed locations throughout the country put a technical limit to the number of such projects that can be implemented in Thailand.

Among the options to generate power from renewable energy sources, **biogas** is the most successful one in terms on number of CDM projects registered with the Executive Board. There are several potential applications:

- Methane capture from animal farms;
- Methane capture from municipal solid waste;
- Methane capture from municipal landfills; and
- Methane capture from industrial wastewater.

The attractiveness of such projects, from the CDM perspective, comes from the fact that such projects reduce emissions from different sources:

- Avoidance of methane emissions: methane has a global warming power 21 times higher than carbon dioxide. Most of the emission reduction from the project come from this source.
- If the biogas produced is used to generate electricity, additional emission reduction can be credited to the project as displacement of electricity from the grid.

- If the biogas produced is used as fuel for direct combustion in industrial boilers, additional emission reduction come from fossil fuel displacement, as most industrial facilities use heavy fuel oil.

Most importantly pig farms have already installed biogas systems, which make further opportunities fairly limited in Thailand. Concerning methane capture from MSW and landfills, although the potential is important, there are several technical and institutional barriers. The most promising opportunities for biogas systems are found in industrial wastewater. The feasibility of such projects depends directly on the COD (chemical oxygen demand) content of the wastewater, as this parameter is key to determining the amount of biogas that can be produced. Industrial sectors with the most promising potential are tapioca starch industries and crude palm oil mills, due to the high COD content and volume of wastewater generated (above 20,000 mg/l for tapioca starch industries, and above 40,000 mg/l for palm oil mills). As the biogas to be produced can be used to produce electricity or as a substitute to heavy fuel oil, such projects can generate CERs in an amount that would make investment feasible, according to the registered PDDs in this field. Given the importance of the tapioca starch industry and of the important number of palm oil mills in Thailand, projects aiming at producing biogas from industrial wastewater are considered to offer significant opportunities for private sector investment.

The following table gives examples of the number of CERs that could be generated in a tapioca starch factory:

Table 7-4. Examples of CERs generated

Project:	Biogas from industrial wastewater
Industry:	Tapioca starch
Capacity:	200 tons / day
Wastewater volume:	10 m^3 wastewater/ton of starch
COD content:	20,000 mg/l
Electricity generation from biogas:	0.5 MW
Carbon credits:	20,000 tCO_2 / year
Revenues from carbon credits: **(@ 10 USD per CER)**	200,000 USD/year 2 million USD (10 years)

Source: Own calculations

7.2.2. Transport sector

Three areas with CDM potential have been identified: fuel switching, fuel economy improvement, and demand-side management. There is so far no CDM project registered in fuel economy improvement and demand-side management, which means no approved baseline and monitoring methodologies. Such methodologies are extremely difficult –and therefore costly - to develop. With no precedent, and considering the time required to develop such methodologies, and knowing that most carbon buyers would not look at CDM projects beyond 2012, CDM projects in fuel economy improvement and demand-side management are not deemed attractive from a private sector perspective.

In the transport sector, the most attractive CDM projects are found in the production and commercialization of biofuels: biodiesel and bio-ethanol. There is a huge potential for the

production of biofuels in Thailand. The Royal Thai Government has set an ambitious goal for the national production of biodiesel at 8 million l/day in 2010. A few projects, among which PTT is one of the main players, have already been implemented for an accumulated production capacity of 1 million l/day. There are also a few biodiesel production projects that are in the CDM pipeline, but they are all facing problems with the approval of the baseline methodology.

The importance of emission reduction to be expected from such projects depends directly on the baseline methodology and the project's associated leakage. Most new methodologies submitted and under revision include leakages from, among others, the increase in fertilizer utilization and transportation fuel due to the increased demand for crude palm oil (CPO) resulting from the production of biodiesel. Pre-feasibility studies regarding the production of biodiesel show that the financials of the project are extremely sensitive to the price of diesel.

Another important aspect of such projects relate to the distribution channels, as biodiesel or ethanol producers will have to enter into long-term deals with diesel or gasoline distribution companies.

All these barriers make such projects an additional cost from the CDM point of view. Regarding the economic feasibility of biodiesel and ethanol production, investment is deemed attractive to the private sector, as shown in the tables hereafter.

The production of ethanol is based on the fermentation of sugar. In Thailand, tapioca starch industries and sugar industries offer significant opportunities for the production of ethanol. Concerning the production of biodiesel, used cooking oil can be used (one CDM biodiesel project using used cooking oil is currently under development in China), but the most attractive raw material is CPO.

Table 7-5. Economics of ethanol production

	Unit	Value
Production capacity (anhydrous ETOH)	l/day	150,000
Feedstock type		Molasses
Feedstock input	Ton/year	167,600
Price of feedstock	THB/ton	4,000
Selling price of ethanol	THB/l	22
Plant factor	%	75
CERs	t/CO_2e/year	80,700
Crediting period	Year	10
CER price	USD	15
Investment	Million THB	780
IRR without CERs	%	6.5
IRR with CERs	%	11.5
Project life	Year	15

Source: Own calculations

Table 7-6. Economics of biodiesel production

	Unit	Value
Production capacity (biodiesel)	l/day	190,000
Feedstock type		Crude palm oil (CPO)
Feedstock input	Ton/day	173
Price of feedstock	THB/ton	17
Selling price of biodiesel	THB/l	21
Plant factor	%	90
CERs	t/CO_2e/year	125,000
Crediting period	Year	10
CER price	USD	15
Investment	Million THB	700
IRR without CERs	%	13.8
IRR with CERs	%	21.8
Project life	Year	15

Source: Own calculations

7.2.3. Industrial sector

There are basically two types of CDM projects that have interesting potential: industrial processes improvement, and cogeneration.

Several CDM projects have already been registered that deal with **industrial process improvement**. Such projects include improving the clinker-to-cement ration to reduce fuel consumption, HFC-23 reduction projects, N_2O reduction projects, etc. The potential for HFC-23 reduction projects and for N_20 reduction projects is non existent in Thailand, as there are no such industries. On the contrary, reduction of fuel consumption through improvement of the clinker-to-cement ratio could offer significant opportunities in the cement industry in Thailand. However, it is not possible to make general assumptions on the feasibility of such projects, as information is not publicly available.

Cogeneration systems, or combined production of heat and power, are already extensively used in industrial facilities. There two options that would qualify such projects under the CDM:

- In existing cogeneration systems, heavy fuel oil, or alternatively coal, is most commonly used. In such cases, switching to biomass will allow projects to generate CERs.
- In facilities that do not have installed cogeneration systems, emissions would be reduced from displacement of electricity from the grid. But the magnitude of such reduction would not be important unless the installation of the cogeneration system is accompanied by fuel switching, from heavy fuel oil to biomass.

To summarize, cogeneration in industrial facilities is interesting from the CDM perspective only if the fuel used is biomass. Due to the fact that such projects displace both heavy fuel oil and electricity from the grid, projects of a relatively small size could generate a sufficient amount of CERs to make such projects attractive for private sector investment. In addition, depending on the biomass fuel used, avoidance of methane emissions due to biomass decay would also significantly add to the amount of CERs that can be generated.

The only foreseen constraint to the implementation of such projects relates to the availability and secured supply of biomass residues. The table below gives an indicative example of the number of CERs to be expected from a biomass-fired cogeneration system in a factory:

Table 7-7. CDM in biomass fuel switching in industries

Project:	Biomass for cogeneration (steam and power)
Industry:	Any
Fuel substituted:	Heavy fuel oil (HFO)
Fuel consumption:	9 million lHFO/year
Electricity capacity:	2 MW
Carbon credits:	35,000 tCO_2 / year
Revenues from carbon credits: **(@ 10 USD per CER)**	350,000 USD/year 3.5 million USD (10 years)

Source: Own calculations

7.2.4. Residential and commercial sectors

The potential for CDM projects in the residential area mainly include efficient lighting, efficient air conditioning, efficient refrigerators, and efficient building design. The CO_2 emission reduction to be expected from a single project (either a single home, or a single property development project) is extremely low. Therefore, the promotion of energy efficient equipment in residential areas would have a significant GHG emission reduction impact only in the framework of a national program. Such programs would not be financed by private investors, but by the government. As a result, there are no opportunities for private sector investment in CDM projects in the residential sector.

All potential CDM projects identified in the commercial sector relate to installation of higher efficiency equipment (electrical appliances, chillers) and energy efficient building design. In general, commercial buildings have an annual electric demand of less than 10 MW. For example, considering a 20% reduction in electricity consumption in a building with 10 MW annual demand, and assuming 4,000 hours operation, the GHG emission reduction would only be in the magnitude of 4,400 tCO_2e per year. The annual revenues from the selling of CERs would not be sufficient compared to the associated transaction costs to make such projects interesting for the CDM. As a matter of fact, no such CDM projects have been registered at the Executive Board so far.

The replacement of electric chillers by absorption chillers using natural gas would also not constitute an interesting project from the CDM perspective. For example, the replacement of electric chillers by absorption chillers in a commercial building with 2,500 TR (tons of refrigerant), coupled with a cogeneration unit (using natural gas) with 3.9 MW capacity, would generate only 1,400 CERs per year. This is due to the low emission factor of the grid, the fact that commercial buildings operate only for 10-12 hours a day, and the fact that the use of natural gas as fuel emits a significant amount of CO_2.

7.3. Estimate of emission reduction potential

The emission reduction potential of a project depends on three factors:

- The emissions of the baseline scenario;
- The emissions attributed to the CDM project itself;
- The emissions attributed to the leakage, if any.

The table on the next page aims at providing key information on how to estimate the emission reduction potential of a given CDM project type. Providing an accurate estimate is not possible as each project has specific characteristics. The emission reduction estimates provided hereafter are based on approved baseline methodologies and PDDs or current PDDs' methodologies under review, as the case may be.

7.4. Final remarks

The above analysis clearly demonstrates that although the potential for GHG emission mitigation options is important in Thailand, the opportunities for CDM projects financed by the private sector are limited to a certain type of CDM project. Table 7-7, next page, summarizes the main findings of this chapter. It shows that the most important opportunities for private sector investment in CDM projects in Thailand are found in the following areas:

- Biogas production from industrial wastewater, mainly in the tapioca starch industry and in palm oil mills. Such projects generate important amounts of CERs, as the GHG emission reduction occur at several stages of the project: methane avoidance, use of biogas for power generation and/or for HFO substitution.
- Production of biodiesel and ethanol: several projects have already started the CDM preparation process. However, there are still no approved methodologies for biodiesel and ethanol production.
- Cogeneration in industries, using biomass

Table 7-8. Estimate of emission reduction potential per type of CDM project

Sector / Options	Methodology	Description	area/fuel/feedstock	capacity/paramenter	Origin of emission reduction	ER tCO2/y
Power generation						
Biomass	AMS I.D "Grid connected renewable electricity generation"	renewable energy generation units that supply electricity and/or displace electricity from an electricity distribution system	1. The project avoids uncontrolled burning of biomass (fuel: rice husk)	biomass power generation 20 MW,net	CO2 emission from grid electricity	**80,000**
	AMS III.E "Avoidance of methane production from biomass decay through controlled combustion"	biomass decay is prevented through controlled combustion	2. The project avoids biomass decay (fuel: EFB/empty fruit bunch)	biomass power generation 5 MW,net	CO2 emission from grid electricity and avoided CH4 emission from biomass left to decay	**123,000**
	ACM0006 "Consolidated baseline methodology for grid-connected electricity generation from biomass residues"	grid-connected and biomass residue fired electricity generation activities including cogeneration plants				
Biogas from animal farms	AM0006 "GHG emission reductions from manure management systems"	options: anaerobic digestor, methane from the digestion process may be flared, vented or combusted for energy generation	Swine farm/manure (PDD0450 Swine manure treatment project, Indonesia)	collecting from about 300,000 heads	avoided methane emission	**166,000**
	AM0016 ""Greenhouse gas mitigation from improved Animal Waste Management Systems in confined animal feeding operation"			in Thailand, big pig farm 10,000 heads		**5,000 (our study =2,700 tCO2/y)**
Biogas from municipal solid waste	AM0012 "Baseline methodology for biomethanation of municipal solid waste in India, using compliance with MSW rules"	implementation of a biomethanation plant that uses the biogas produced from the processing of MSW to generate electricity	- No PDD available			**no info.**
Biogas from industrial wastewater	AMS III.H "Methane recovery in wastewater treatment"	project activities to recover methane from biogenic organic matter in wastewater				
	AM0013 "Avoided methane emissions from organic waste-water treatement	existing wastewater treatment system is an open lagoon with an aerobic condition; project activity is installation of an anaerobic digestor with biogas extraction capacity at an existing organic wastewater treatment	Crude palm oil mill (45 ton of EFB/day)	45 ton FFB/day, 40,000 mg COD/L, 17,280 kgCOD/day, Operating factor 80%	avoided CH4 emission	**10,000**
			Tapioca starch plant (PDD SIMA Interproduct, Biogas System AFFR, Chachoengsao, Thailandy)	270 ton,starch/day, 20,000 mg COD/L, 44,000 kgCOD/day, Operating 210 day/y	avoided CH4 emission	**20,449**
Transport sector						
Biodiesel	NM142 "Palm methy ester - biodiesel fuel (PME-BDF) production and use for transportaion of Thailand ("B" - case MP20) Note: this methodology is currently under reivew	biodiesel produced from palm oil will be blended with petroleum diesel for transportation use in Thailand	palm oil industry (crude palm oil)	300 tons of biodiesel/d: 90,000 tons of biodiesel/y		**145,044**
Bioethanol	NM0082 "Khon Kaen fuel ethanol project" ("A" - case MP20)	bio-ethanol will be blended with gasoline for transportation use in Thailand	sugar industry (sugar cane molasses)	85,000 liters of ethanol/d: 22,950 kl of ethanol/y		**45,719**
Industrial sector						
Biomass Cogeneration	AMS I.C "Thermal energy for the user"	renewable energy supply thermal energy that displaces fossil fuels (on-site use of electricity and heat)	Palm oil refinery, Malaysia PDD249 uses EFB, mesocarp fiber and palm kernel shell to generate steam and electricity for process use (heat or thermal component depends on site specific requirements, in the case of sugar mill or CPO which used biomass as fuel as usual, this ER component = 0)	main boiler to generate 1) steam 15 ton/h for process 2) steam 3 ton/h to absorption chiller 650 RT and 3) electricity from steam turbine 1.6 MW	CO2 emission from displaced fuel oil (boiler fuel) and from displaced electricity in the baseline (or on-site use)	**35,000**
	AMS I.D "Grid connected renewable electricity generation"	renewable energy generation units that supply electricity and/or displace electricity from an electricity distribution system	electricity components same as "Biomass power generation above"		CO2 emission from grid electricity	

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8. CDM Financial Issues in Thailand

The programs referred to in section 6 above, and several CDM projects currently in the pipeline show that Thai stakeholders have already been somehow familiarized with the CDM concepts. A key factor to ensure and accelerate further development of the CDM market in Thailand now relates to financing aspects, *i.e.* the capacity of Thai players to secure the financial resources needed to undertake CDM projects. The present chapter will now look at this financial dimension.

CDM financial issues in Thailand in this part are notably based on information provided in the IGES report (2006). In addition, a questionnaire has been distributed to Thai stakeholders (financial institutions, bilateral agencies, project developers, and private consultants) in order to have a better idea of these financial issues and their perception by Thai stakeholders.

8.1. Results of the questionnaire

Over a hundred copies of the questionnaire have been distributed to Thai Stakeholders. However, only eleven answers were returned to the project team by the end of the project. The format of the questionnaire has been adapted to address the target groups referred to above. The number of questionnaires returned is as follows:

- Financing institutions (commercial banks): 1 questionnaire returned
- Bilateral agencies: 1 questionnaire returned
- Project developers: 6 questionnaires returned
- Private Consultants: 3 questionnaires returned

A summary of the replies provided regarding these four aspects is provided in the four tables below (table 8-1, 8-2, 8-3, and 8-4). Due to the limited number of replies, the results for each question are presented as a ratio between the number of answers provided and the number of persons who returned the questionnaire. It was deemed that this ratio is more meaningful than a presentation in terms of percentages. Totals may not add up as for some questions a single interviewee provided several answers

The results obtained can broadly be subdivided into: (i) present / envisaged involvement of the organization in CDM projects, (ii) loan process and conditions, (iii) perceived feasibility of development of "pure CDM projects, and (iv) risks and means to overcome them.

Concerning the first point (present / envisaged involvement of the organization in CDM projects) most of the organizations who replied either already have, either plan to undertake CDM projects. This shows that there is already a basic interest in the CDM in Thailand. The most promising sectors are renewable energy and energy efficiency as shown in the table below.

Table 8-1. Present involvement and interest of stakeholders in CDM project

	Financing Institutions	Bilateral Agencies	Project Developers	Private Consultants
Present involvement / interest in CDM project(s)	• Renewable Energy (RE): **1/1**	• RE: **1/1**	• RE: **3/5** • Energy Efficiency and Conservation (EE&C): **1/5**	• RE: **3/3** • EE&C: **1/3** • Waste management: **1/3**

Concerning the second aspect (loan process and conditions), the development of such projects often requires obtaining loans from commercial banks. In this regard, supporting documentation is required which include in particular feasibility studies, environmental studies, and emission reduction purchase agreements (ERPAs), etc.

Different answers were provided with regards to the time needed for approval of such loan requests by financing institutions. The experience of project developers and private consultants indicate that this time ranges from between three months and one year. The reply provided by the financial institution (only one replied) indicate a shorter time (from one to two months), however, it must be mentioned that this institution stated that no loans are provided for "pure" CDM projects (*i.e.* projects which viability is based only or mainly on the expected income from CERs). The size of the loan needed to develop a CDM project varies, based on the size of the project itself. According to the replies received, the loan may range from less than one million US$ to over 25 million US$.

Table 8-2. Loaning conditions for CDM projects in Thailand

	Financing Institutions	Bilateral Agencies	Project Developers	Private Consultants
Time needed for approval of a loan	• 1-2 months	• No answer	• 3-6 months: **1/5** • 7-12 months: **2/5**	• 3-6 months: **2/3** • 7/12 months: **2/3**
Required pre-conditions / documentation to obtain a loan for a CDM project	• Feasibility Study: **1/1** • Environmental study: **1/1**	• Feasibility Study: **1/1** • Emissions Reduction Purchase Agreement (ERPA): **1/1**	• Feasibility Study: **3/5** • Plant Permits: **3/5** • PPA or Energy Conversion Agreement : **2/5** • ERPA: **1/5** • Annual Report of Sponsors: **1/5** • Environmental study: **3/5** • Term sheet for loan: **2/5** • Loan Agreement Document: **2/5**	• Plant Permits: **1/3** • PPA or Energy Conversion Agreement): **1/3** • ERPA: **1/3** • Annual Report of Sponsors: **1/3** • Environmental study: **1/3** • Complete financials of power purchaser: **1/3** • Supplementary guarantee by the Government: **1/3** • Term sheet for loan: **1/3** • Loan Agreement Document: **1/3**
Delaying factors for approval of a loan	• No answer	• No answer	• Project analysis: **1/5** • Obtaining all licenses: **1/5** • Local stakeholders' consultation: **1/5**	• Securing collaterals • Registration of the project by the EB
Size of the loan	• From less than 1 million US$ to more than 25 million US$	• No answer	• < 1 million US$ (construction): **1/5** • < 1 million US$ (operation): **2/5**	• 1- >25 Million US$: **1/3**

There are also different perceptions as regards the feasibility of developing "pure" CDM projects in Thailand (third aspect). On the one hand, it is interesting to note that all the project developers who replied think that such projects cannot be implemented. This perception is also shared by the only financing institution who replied to the questionnaire. On the other hand, the bilateral agency and one private consultant indicated that they believe in the feasibility of such "pure" CDM projects.

Table 8-3. Perceived feasibility of developing "pure CDM projects in Thailand

	Financing Institutions	Bilateral Agencies	Project Developers	Private Consultants
Feasibility of projects which incomes are based mainly / only on CDM	No: **1/1**	Yes: **1/1**	Yes: **0/5** No: **5/5**	Yes: **1/3** No: **1/3**

Whatever the perception concerning the issue referred to above, the Stakeholders generally associate risks with CDM projects in Thailand (fourth aspect). The most common of these risks notably include resource risk and technology performance.

Table 8-4. Risks associated to CDM projects in Thailand and potential options to address them

	Financing Institutions	Bilateral Agencies	Project Developers	Private Consultants
Main types of risks associated with CDM projects	• No answer	• Resource risk: **1/1** • Technology performance: **1/1**	• Construction costs overrun: **2/5** • Construction delays: **1/5** • Resource risk: **1/5** • Technology performance: **1/5** • Currency risk: **1/5**	• Construction delays: **1/3** • Resource risk: **1/3** • Technology performance: **1/3**
Guarantees required to address these risks	• No answer	• Long-term contract with biomass producer: **1/1** • ERPA: **1/1** • A single project should generate at least 10,000 of CERs /year	• Fixed price turnkey Engineering Procurement and Construction Contract: **2/5** • Provision for the payment of liquidated damages by the Contractor: **1/5** • Insurance: **1/5** • Long-term contract with biomass producer: **3/5**	• Insurance: **1/3**

8.2. CDM Project Financing Sources

CDM projects require upfront investments generally obtained from different sources, such as loans, equity, grants, and upfront payments for CER purchase (Michaelowa et al, 2003 cited in IGES, 2006).

Loans can be obtained from financial institutions such as commercial banks, who play the most significant role in the Thai financial market. There are approximately 30 commercial banks in Thailand (including Thai and non-Thai registered), which provide services mainly addressing the mobilization of savings in the form of deposits and provision of loans. They are followed in this regards by finance and securities companies (IGES, 2006). A list of the key financial institutions in Thailand is provided as Annex C to this paper.

A few other potential sources of funding for CDM projects can be envisaged including

- Grants provided by International agencies and organizations (*e.g.* the EU). However considering that CDM projects should not divert regular ODA (Official Development Assistance), such grants should likely be limited to aspects which are not directly related to the project establishment and operation (*e.g*. project preparation through pre-feasibility and feasibility studies).
- Organizations such as Export Credit Agencies can provide guarantees, so that financial institutions will be more willing to provide loans to specific projects.
- Subsidies provided by the Thai Government. At present, there is no specific subsidy aimed at CDM projects. Subsidies related to other types of projects such as renewable energy and energy efficiency could be used. However, an issue here could be to demonstrate that such projects are not part of the baseline itself.
- Funds from international organizations such as the Global Environment Fund.

A list of potential lenders, and fund providers for CDM projects in Thailand is attached as Annex C to this paper.

Additional project revenues, such as revenues from selling CERs could be used to service debts and leverage debt financing, whereas carbon cash flow could help increase debt carrying capacity (Guest et al., 2003 cited in IGES, 2006). The carbon revenues may possibly facilitate in increasing the debt leverage of a project by increasing its debt service coverage ratio (DSCR) level.

Furthermore, in order to improve debt capacity, other options to debt service through the carbon cash flow are provided, which include:

- Pre-paying debt based on forward emission reduction purchase agreement (ERPAs);
- Depositing carbon cash flow directly with banks for credit against debt service, thereby lowering liability on electricity cash flow; and
- Using ERPAs and/or future carbon sales as collateral for loans.

At present however, there is no evidence that the CER purchase agreement can be used to service debts and used as collateral for Thai commercial bank financing due to the unclear and slow CER market development in Thailand (IGES, 2006).

Several options can be considered for project developers to obtain the equity, loans, or initial financing needed for CDM projects. These options, as described hereafter, are not exclusive from each other (they can be combined in the framework of a single project).

- On-balance sheet (or corporate) financing: the debt (loan) that the borrower incurs will show in the borrower's balance sheet. In this case, the criterion for approval of the loan by the financial institution is the financial "good health" of the borrower. Therefore, the more debts/loans the borrower already has, the least likely he is to obtain a new one.

  The size of the company and its proven capacity to generate benefits will therefore be of importance here. For this reason, this type of financing appears to be more adapted for companies already having a well-established, and already profitable core business (*i.e.* in general companies which do not start their activity with the CDM project, and for which this project does not represent the core of their activity). Financial institutions, notably in Thailand, are likely to be more attracted to provide this kind of loan than to provide loans based on a project (project financing).

The other options described hereafter correspond to project financing, the situation where the loan is provided to the project itself.

- Provision of private equity (investors): a Special Purpose Company (SPC) is created to carry out the activity intended under the project (e.g. power generation and sales to the grid). Private investors are then invited to provide equity for the SPC. The private equity thereby constituted can serve to access loans using the principle of corporate financing described above. However, here the risk is shared amongst the different equity investors and the project company (the SPC).

- Off-balance sheet financing: let's consider that a company A wants to develop a CDM project. The company A can establish a SPC and get equity from other companies (private equity investors), on the model described above. In addition, the company can itself provide equity to the project (in addition to equity provided by private equity investors). The benefit for company A is to keep the risk "outside". A is liable only for its share of the total equity of the SPC. In addition, the capacity of a company to obtain further loans is not excessively affected, since the amount of the equity (of the SPC) that the company A provides is limited.

- Cash-flow related lending: in this case the basis for the loan is the expected cash flow (CERs sales, electricity sales to the grid). Indeed this approach will only be accepted by lenders if the future cash flow is secured (ERPAs, PPAs, other agreements on these future incomes of the project will therefore play a crucial role here). In this case, the potential failure of the project will only burdened by the lenders. In addition, convincing private equity investors is not a necessary condition for the project to obtain the needed funds (the loan).

- Non-recourse lending: In this case the funds lent are neither secured by the equity within the project company, nor by other recourse options on a private equity investor's assets outside the SPC. This scheme is not very likely to be applied, as it leaves all risks with the financial institution.

- Limited recourse lending: the security of the loan is limited to the equity within the SPC. The liabilities of the private investors are limited to their equity amount in the project. The risk of the project's failure is thereby spread among the equity investors, but they are not liable to full reimbursement of the loan in case of a failure of the project.

- Full recourse lending: the project investors give full guarantees to the financial institution, that in case of project failure, they will fully reimburse the loan.

There may be other potential means for the project developers to collect the funds needed to start the project. Such means include:

- Closed-end funds: it seems that this option helps to face the risks related to the project performance. The SPC establishes a fund which allows it to cover its need for equity. This fund is a new company whose shares are made public (which allows it to collect the funds needed). The funds collected by the closed-end fund (minus the amount needed to cover the needs of the SPC) are subsequently invested into stocks or bonds, whose return allow remunerating the shareholders of the closed-end fund. Such a structure likely requires assistance from qualified professionals, to appropriately select the investment of the fund (especially if the investments made by the fund do not pertain to the core specialty of the SPC).
- Factoring and leasing of the installations: can be a way to reduce needs for incurring debts/loans and thus smoothen the overall financing process.

Several options are thus available to Thai Stakeholders for financing CDM projects. It nevertheless remains that CDM is still a rather new market with limited concrete experience. Therefore, some risks, real or only perceived, are still associated with CDM. The development of the CDM market in Thailand thus still faces certain barriers. The next section will now describe some of these risks and barriers.

8.3. Risks and barriers for CDM project financing

As referred to in section 7.2.1, the risks and barriers presented here have been identified using questionnaires distributed to project developers, private consultants, a commercial bank, and a bilateral agency supporting CDM in Thailand. The complete results are summarized in Annex F.

As referred to in IGES' 2006 report ("CDM Country Guide for Thailand"), although there are several risks associated with CDM projects, the main risks can be regrouped into project risks, political risks, and market risks.

Firstly, project risks include whether the project meets all the requirements of the CDM and whether the project will generate the emission reduction credits estimated in the project design document (PDD). The questionnaire distributed to the participants has allowed the identification of notable risks related to:

- Construction costs overrun;
- Construction delays;
- Technology performance;
- Resource risk, for example in the case of a renewable energy project using biomass. The non-delivery of the fuel (*e.g.* rice husks) to the power plant, for whatever reason, would result in lower power being actually generated than what was initially expected; thus finally, the amount of CERs from the project would also be reduced.

The questionnaire has also allowed the identification of some options which can help to limit the risks referred to above. Such options notably include:

- Fixed price turnkey Engineering Procurement and Construction (EPC) contracts;
- Long-term contracts between the producer of biomass and the CDM project;
- Insurance.

Secondly, political risks include those concerning the ratification of the Kyoto Protocol by participating governments and national policy towards the CDM. Thailand has ratified the Kyoto protocol, but several parts of the system to fully support the operation of the CDM are still under development and not yet fully established. Therefore Thailand may still hold some political risks vis-à-vis the national policy towards the CDM in the eyes of investors.

Thirdly, market risks include the price of CERs and transaction costs. In addition, the CDM market beyond the year 2012 is still unclear.

These actual or perceived risks constitute barriers to the financing of CDM projects. They furthermore represent typical barriers to the establishment of renewable energy and energy efficiency projects in developing countries. Other financial, technical, and awareness issues are commonly faced when developing such projects which include high capital to O&M cost ratio, high project development-to-investment cost ratio, potential difficulties/uncertainties to guarantee future project cash flow, high transaction costs, perception of risk, etc.

As revealed through the questionnaires distributed to the participants and the various discussions held with Thai stakeholders throughout the project duration, there are diverging views with regards to the viability of conducting "pure" CDM projects (which viability is based only on the CDM revenues) in Thailand. In particular, it appears that "normal" commercial banks are reluctant to provide loans for such "pure" CDM projects which they consider to be too risky. In this regards, considering CDM as a source of additional project revenues (the "icing on the cake" but not the "cake" itself) may offer the advantage of somehow limiting the risks thereby facilitating access to other financing sources.

8.4. Final remarks

As shown in the Section 4 of the present paper, the institutional framework for approval and operation of the CDM is progressively being put in place in Thailand. In parallel, several programs and activities have already been implemented, which have helped create basic awareness and foster interest in the CDM at both government and private sector levels.

Therefore, several Thai financial institutions have already acquired some basic experience in participating in CDM projects. The interest of these institutions for CDM moreover seems to be growing.

Different options can thus be considered for financing CDM projects in Thailand. The selection of particular financing set-ups will vary, depending on the characteristics of the projects and their developers. However, as far as commercial banks are concerned the provision of loans to projects based only on CDM revenues is not yet envisaged.

A key barrier to financing and the rapid development of the CDM in Thailand thus remains the perception of high risks by potential financiers and project developers. This perception of risks relates notably to uncertainties both at the country and project level. Complementary revenues and benefits to the sales of CERs, based for example on incomes from sales of electricity to the grid, offer a means to reduce these risks.

In the mean time, the need for the continuation and extension of the supporting programs already undertaken, especially the programs for capacity building and provision of technical and financial support, remains to support both the private and the public sectors.

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Part III: Recommendations to Harness CDM in Thailand

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9. Recommendations for Thai DNA and Stakeholders to Harness CDM in Thailand: How to successfully enter the EU Linking Directive CDM market ?

As a Non-Annex B party to the Kyoto Protocol, Thailand is eligible for CDM implementation. Hence, Thailand has to set up a CDM Institutional Framework, CDM Approval Procedure, and also to decide on methodology to evaluate the contribution of CDM project activity to the country's sustainable development. At present, though MONRE has been assigned by the Cabinet to be DNA for CDM, and ONEP, as Thailand National Focal Point for UNFCCC and the Kyoto Protocol, performs its role as the Secretariat Office of the DNA CDM, the CDM approval procedure has not been finalized. The existing (draft) CDM project approval procedure would take approximately 60-70 working days and require Cabinet Approval on a case-by-case basis. This has inhibited the growth of CDM investment in Thailand. Therefore, a new public organization namely Thailand Greenhouse Gas Management Organization (TGO) has been proposed for establishment, and a simplified version of the CDM project approval procedure has been also proposed. As of 31st October 2006, the proposed TGO establishment has been approved by the Cabinet and it is on the process of legal establishment. Then, the draft simplified CDM project approval procedure will be proposed for Cabinet approval. The new organization as well as CDM approval procedure is expected to encourage CDM project development in Thailand. Hence, this must be an urgent matter; otherwise, Thailand may lose a number of opportunities for most CDM projects in the pipeline.

9.1. Structure and Functions of Host Country DNA

As described in section 5: DNA Settings in non-Annex I countries, there are theoretically at least five approaches to develop a DNA structure: single government model, two-unit model, inter-ministerial model, foreign direct investment (FDI) piggyback model, and outsourcing model. However, a mix of the different models can be used to achieve the most effective DNA structure. In the case of Thailand, the proposed DNA structure would be considered as a mix of single government model and inter-ministerial model because all activities will be operated at MONRE under the consideration of an ad-hoc inter-ministerial committee. This is expected to balance the conflict of interest and the efficiency of the DNA operation. However, in the future outsourcing of the DNA functions should be considered as well.

Concerning DNA's functions, the host country DNA may perform promotional functions in addition to regulatory functions mandated by the Marrakech Accords, which is an option for moving towards an efficient DNA. However, these functions should be designed according to the specific needs and institutional maturity of the host country.

For countries that are not able to automatically attract foreign investors, the promotional functions may be essential tools. However, it is impossible for a newly established host country DNA to perform all promotional functions in addition to the regulatory functions, and it is not necessary to do so.

Moving towards a proactive DNA can be achieved by developing a database on project portfolio and hosting a one-stop PIN shop, which offers workable CDM project ideas to potential investors. Such coordination could also increase the possibility of a bundling of potential projects. If a host country DNA can be a coordinating body for project bundling, the projects would be much more attractive to investors.

Capacity building on CDM formulation rules as well as data gathering for baseline emissions calculation is usually intensive and incur high transaction costs. DNAs could centrally provide some key data, *e.g.* Grid emission factors for calculation of operating margin and build margin. In addition, the host country DNA may promote CDM awareness among financial institutions and work together with them to establish financial standards in the country.

To be able to perform the complementary work effectively, updating of the knowledge and skills of the staff of the DNA is essential. Registering international publications such as Point Carbon could help. The DNA staff should also be able to attend international fairs such as "Carbon Market Insights" and "Carbon Expo".

In case of Thai DNA, a structural framework of the new established organization, namely Thailand Greenhouse Gas Management Organization or TMO, should also provide framework for performing promotional functions. However, due to the limited number of permanent staff and also limited budget, it is suggested to perform only regulatory functions during the first 1-2 years, and also work closely with relevant ministries. To promote CDM awareness among financial institutions and to work together with them is also necessary for CDM implementation in Thailand.

9.2. Most promising types of CDM projects for Thailand

As mentioned above, CDM projects can be executed in a bilateral, multilateral and unilateral co-operation context. The main difference between bilateral & multilateral CDM on the one hand, and unilateral CDM on the other hand, is that under the first two types the CERs are generally sold to a foreign investor before project implementation (via a forward contract), whereas under unilateral co-operation, the CERs are sold during or after project implementation.

An important advantage of unilateral CDM is that host countries are able to better match CDM projects with their domestic development needs and priorities; under multilateral and bilateral CDM, project choices are largely driven by the CER potential.

However, unilateral CDM is complicated by the capacity requirements that it imposes on the host countries and, as a consequence, that the feasible technologies under unilateral co-operation may be less state-of-the-art than under bilateral and multilateral CDM.

Hence, unilateral CDM appears to be a very promising option for rapid and maximum development of the CDM in Thailand. Bilateral projects remain feasible, but international experience clearly shows the predominance of unilateral projects.

On the technology side, in the framework of the project, a paper has been prepared on the most promising areas for CDM private investment in CDM in Thailand. Based on this paper, and the discussions subsequently held in the framework of the project consultations with Thai private sector, the most promising types of projects include:

- Biogas from industrial wastewater
- Biogas from MSW / Landfill gas
- Biomass for power generation and cogeneration

Concerning the production of biodiesel and ethanol, there is no approved methodology yet. The opportunities related to these types of projects could thus be taken advantage of, but only in the long-term. Further potential opportunities relate to process improvement, in particular those possible in cement factories (improving the cement-to-clinker ratio, to reduce fuel consumption).

9.3. Impact of the EU Linking Directive

Concerning the impact of the Linking Directive for Thailand, it is expected to encourage CDM project development in Thailand. However, the extent to which the Linking Directive will be used by EU installations to purchase CERs is still limited and uncertain. This is because CERs are fundamentally different from EU Allowances and the price development within the EU ETS has been very volatile. It is hoped that CER trade with the EU ETS could be supported though only after 2008 if the Member States' allocation plans create more scarcity on the EU ETS market with higher prices. In addition, the linking of CDM projects to EU ETS activities has been technically impossible due to the present absence of the International Transaction Log, which will trace and track all Kyoto Protocol-based emission reduction titles, and which is a required system for trading CERs on the EU ETS market.

Under the Kyoto Protocol, the CDM market is limited to the transfers of CERs between governments, while under the Linking Directive; EU non-governmental entities can act on the demand side of CERs which broadens the market scope for CDM host countries. As the Linking Directive offers entities in developing countries the possibility to enter a new CDM market, the Thai DNA as well as relevant authorities should consider how can entities in Thailand maximize their benefit from CDM implementation via the Linking Directive? Should Thai entities join CDM activities by only waiting for Annex I countries' investment (so-called bilateral or multilateral cooperation) or should it initiate their own projects, which meet the country's sustainable technology needs, and sell the achieved CERs to the EU ETS market (so-called unilateral cooperation)?

In the both cases of bilateral and multilateral cooperation, it is common practice that the investor or CER buyer is involved in the project from the early stages of the activity. Usually, the government of the CER buyer will sign an emission reduction purchase agreement (ERPA) with the project participants in the host country, during the design phase, to ensure the delivery of CERs at a predetermined price.

While in the case of unilateral cooperation, the project will be developed and implemented by entities in the host country, with the host country government's approval, but the CER buyer as well as a price agreement will be sought only upon certification of the emission reductions.[92]

It is observed that of the CDM projects registered and/or validated, over 70% of the validated projects, but not yet registered, have only host country approval. For the registered projects, this percentage is as much as 50%; therefore, it can be considered that most projects are presently developed by host country entities, possibly in cooperation with specialized intermediary parties from abroad who also offer temporary investment capital through loans or equity.

In addition to the advantage of unilateral CDM in terms of meeting the country's technology needs and priorities, transaction cost could be reduced because the local experts are most likely not only to be much cheaper, but probably also better informed about the situation in their home country and may have different risk perceptions. The potential reduction in transaction costs of unilateral CDM could also stimulate the development of it on a small-scale, but it will meet country's technology needs. Most international CER buyers require a project delivery of at least one million tonnes of CERs by 2012 in order to cover their high transaction costs. The unilateral CDM may offer CDM project developers in developing countries the possibility to sell CERs at higher prices via the spot market rather than selling upfront through a forward contract ERPA.

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[92] At its 18th meeting on 25 February 2005, the CDM EB supported the idea of unilateral CDM and agreed that "the registration of a project activity can take place without an Annex I Party being involved at the stage of registration". CER buyer only becomes formally involved when the first CERs become available for sale.

However, the unilateral CDM is considered to be surrounded by two important disadvantages. First, selling CERs at later stage without ERPA contracts also implies a risk that the price may be lower by the time of the CER issuance than at the time of designing the CDM project. Second, there could be a risk that unilateral CDM reduces the potential of transferring state-of-the-art sustainable technologies from industrialized to developing countries. In addition, without the promise of a purchase of the CERs from Annex I entity at an agreed forwarded price, it could become more difficult for the host country project participants to attract funding from domestic or international financial institutes.

Hence, in order to reduce the upfront risks and increase the internal rate of return, it could be suggested that the project developers may decide to purchase domestic technologies for the unilateral project instead.

As for the aspect of the meeting with country's technology needs, a CDM project would ideally be based on a clear assessment of the GHG emission reduction potential and a clear assessment of the technology needs of the host country.

However, actual practice of the CDM has shown that projects are largely initiated by the demand for relatively low-cost CERs and that a host country CDM approval letter is in several cases mainly a statement of no objection. Hence, CDM projects are mostly driven by CER demand and to a lesser extent by a clear assessment of what a host country mostly needs.

Of the three forms of CDM co-operation, unilateral CDM seems to fit best in the concept of assessing technology needs and priorities. Once priority technologies have been identified, local entities would establish and implement a CDM project and sell the credits after the project has delivered CERs. However, this requires that the local partners are able to acquire the technologies on the basis of the net present value of the CERs to be sold in the course of the project (see above).

Under bilateral CDM, it would be necessary to find a CER buyer who is also able and willing to deliver the prioritized technology. For instance, a project containing a priority technology may be of a small scale and thus less attractive for potential bilateral CDM buying entities that may prefer larger projects with possibly less preferential technologies from the host country perspective. Multilateral CDM funds may take a middle position between leaving the full initiative to the host country and thus the choice for first priority technology options under unilateral CDM and bilateral CDM options with compromises between CER generation potential and meeting the host country's assessed technology needs and priorities.[93]

Concerning risks associated with CDM implementation, learning by doing could probably mitigate the risks to some extent. When an increasing number of projects are developed in the country, specialized institutes will emerge, which will be well able to assess domestic investment risks and know their way towards the CER buyers. However, it is suggested that a considerable capacity building investment would be needed, with an active role of the host country to support the CDM specialists. A country with little or no previous experience in CDM project development is unlikely to use a unilateral CDM as a jump-start to participate in the mechanism, bi- or multilateral cooperation would be preferable.

Considering the delay in the DNA setup in Thailand, the majority of potential CDM projects in the country will have crediting periods exceeding the year 2012. While most of the private buyers show limited interest in post-2012 CERs. On the contrary, several government procurement

[93] It should be noted though that presently multilateral funds exist that specifically address specified needs in developing countries, such as the Community Development Carbon Fund of the World Bank.

programmes (*e.g.* ones under the World Bank carbon funds) have announced the purchase of post-2012 CERs up to a certain amount.

Therefore, although the private sector is likely to be a dominant player in the European market during 2008-2012, Thai CDM projects may be better off seeking buyers who show interest in post-2012 CERs, at least until continuation of the CDM in post-2012 will be confirmed. Such buyers are typically governments and multilateral carbon funds. They usually have streamlined and transparent procedures for project assessment and credit procurement, which is an advantage for countries with a less-mature CDM capacity, like Thailand.

From another perspective, the aggregation of several CDM projects represents a promising option, especially in the view of reducing the high transaction costs usually associated with CDM projects. The concrete rules concerning the process for such aggregation are still under discussion but should be known very soon. In Thailand, the recent voluntary programs for promotion of renewable energy will be eligible. Programs related to energy efficiency will also be very relevant. The past experience of Thailand with the implementation of successful energy efficiency programs is very positive, and could serve as a showcase.

Concerning the aspect of DNA's responsibilities, a certain number of recommendations can be made, notably to avoid blocking good projects. As a whole, it is recommended to establish a quick and transparent approval procedure, to attract investment. A certain balance, between the level of scrutiny and the speed of the approval process, should therefore be targeted.

As shown by the experience in Malaysia, the role of technology transfers should not be "overestimated" for a rapidly industrializing country such as Thailand. Placing a mandatory demonstration of technology transfer as a preliminary condition for projects approval could represent a significant barrier to the rapid development of the CDM in Thailand.

9.4. Conclusions

According to the study of CDM status and most promising CDM projects in Thailand, it is shown that there are of quite low potential for large scale projects. Most potential projects are of small to medium scale; while in line with national energy strategy and most of which would enhance the country's sustainable development. Therefore, Thai DNA should work closely with the Ministry of Energy, via the Energy CDM Working Group, to perform as a coordinating body for project aggregation. Capacity buildings on the progress of methodologies for programmatic CDM approach are also very necessary.

It is recommended that Thai DNA, in collaboration with the Ministry of Energy, Ministry of Industry, and Ministry of Transport, should concentrate on studying the possibility as well as the advantages and disadvantages of development of programmatic CDM in Thailand. It is expected that the programmatic CDM would help overcome various barriers to promoting renewable energy projects in Thailand, both in the Energy Sector and Transport Sector which are the main energy consumers.

Finally, there is an urgent need to make the Thai DNA really operational and create a certain balance between the level of scrutiny and the speed of the approval process. This is because there are a number of Thai projects in the pipeline that must be approved by the DNA by the end of January 2007. Otherwise, Thailand would lose a big opportunity to achieve both technology transfers and revenues from CERs trading, as much as 14 million US$ (Hayashi 2006). I would also send a negative signal towards potential future CDM investors.

In addition, it is recommended that Thai Government should consider CDM as an incentive instrument for sustainable development in Thailand. It should consider those projects in the pipeline as pilot projects for capacity building learning by doing for Thai Stakeholders.

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Annexes

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Annex A: Thailand's Energy Strategy for Competitiveness[108]

1. Introduction

Energy is a factor of the well being of the people and is a production factor of the commercial and industrial sectors. As a result, energy is a prime mover of the country's competitive edge and economic development in the long term.

In order to attain continuous and sustainable economic development, it is essential that energy supplies be adequate and secure, at reasonable prices, and that due consideration be given to the environment so as to enhance the country's competitiveness.

Consideration has been given to the fact that the domestic energy reserves will not be able to adequately accommodate the increasing demand of the country due to its increasing economic growth. Hence, Thailand has to depend largely on imported energy at a considerable cost each year. The high dependency on imported energy will make Thailand at risk of energy supply disruption and volatility of energy prices, apart from a substantial foreign currency loss for the imports of energy.

With a view to strengthening the national energy security and competitiveness, the strategies for Thailand's energy development has been focused on efficient use of energy, acceleration of domestic renewable energy resources development to replace the use of fossil fuel, of which indigenous reserves are limited, and efficient energy management to extend, as long as possible, the supply availability of indigenous energy reserves. Simultaneously, efforts will be made to transform Thailand to be the "Regional Energy Centre", which will be another means to enhance the national energy security and economic development.

According to the Cabinet Resolution on 22nd September 2003: "Energy for Country's Competitiveness"; and the Resolution on 23rd November 2005: "Solution for Energy Crisis", the Ministry of Energy (MOE) has set up the following strategic plans for energy development in Thailand.

2. Strategic Plan for Energy Efficiency

Key target on increasing efficiency of the energy consumption on the demand side is defined as follows:

> *"The long-term target for the increase of energy efficiency is to achieve the energy elasticity, measured by the ratio of the energy usage growth to the economic growth, of 1.0 by the year 2011, and 0.8 by the year 2016"*
>
> *Note*: As of Nov. 2005, revised from the 2003 Strategy, of which 1.0 by the year 2007. The challenge case (optional) for industrial sector was also proposed with 0.85 by the year 2011, and 0.6 by the year 2020.

In order to achieve the targeted energy elasticity reduction, measures have been established focusing on the two major energy intensive sectors, *i.e.* transportation and industrial sectors, which hold a share of 37% and 36% of energy demand respectively.

To increase efficiency of the country's energy consumption, the energy strategic plan for each sector, mainly focused on the two most energy consuming sectors, *i.e.* transportation and industrial sectors, has been set up as described below.

[108] http://www.energy.go.th/en/aboutUs_08strategy.asp

Transportation sector

Since the transportation sector is the biggest energy consuming economic sector in Thailand and normally consumes approximately 37% of the total energy consumption. It is therefore the sector to be focused in term of energy consumption. The following measures are defined:

- changing of transportation mode, from car to track;
- reorganizing of the mass transit system, and develop additional mass transit systems, cargo transport system by train, waterway, and multi-modal system, taking into account urban and rural development;
- promoting energy conservation, *e.g.* smaller engine capacity for city vehicles, etc.;
- implementing tax measures.

However, it has been recognized that the involvement of the Ministry of Transport, especially in restructuring the mass transit system is one of the key successes.

Industrial sector (Target: energy elasticity 0.85 by 2011)

There are three main strategies for the industrial sector.

a. Involve the Ministry of Industry in the restructuring of the industrial sector in terms of competitiveness and investment promotion policies by taking energy aspects into account, *e.g.* considering high energy intensified industry;

b. Issue energy conservation measures, including:
   - legal measures
   - support and contribution
   - knowledge development
   - personnel development;

c. Implementing tax measures to encourage energy conservation.

3. Strategic Plan for Renewable Energy Development: New Options for Thailand

Although fossil fuel resources will remain the major source of energy supply for the next few decades, such energy resources will eventually be depleted. Hence, many countries have paid greater attention to renewable energy development. During the past decade (1990-2000), the average growth rate of renewable energy consumption in Thailand has been approximately of 8% per year while the consumption of energy derived from various types of fossil fuel has grown at a rate of 2% per year.

The objective of renewable energy development is to seek for alternative energy to replace non-renewable energy from fossil fuels. In Thailand, fossil fuel resources are limited and hence are inadequate to satisfy energy demand of the country. Therefore, Thailand has to depend on imported energy from foreign sources, which causes a considerable loss of foreign currency. Renewable energy development will help reduce not only the energy supply burden, but also the import of non-renewable energy. In addition, renewable energy will help reduce environmental impacts as it causes less emission of carbon dioxide. In addition, biomass energy development is a means to optimize the utilization value of domestic energy resources, bringing economic benefits to concerned local communities.

Target: 8% renewable energy share by the year 2011**,** and 10% by the year 2020

To increase the share of renewable energy from 0.5% of the commercial primary energy, or 295 thousand tons of crude oil equivalent (ktoe), in 2003 to 8% of the commercial primary energy, or 6,977 ktoe, by the year 2011.

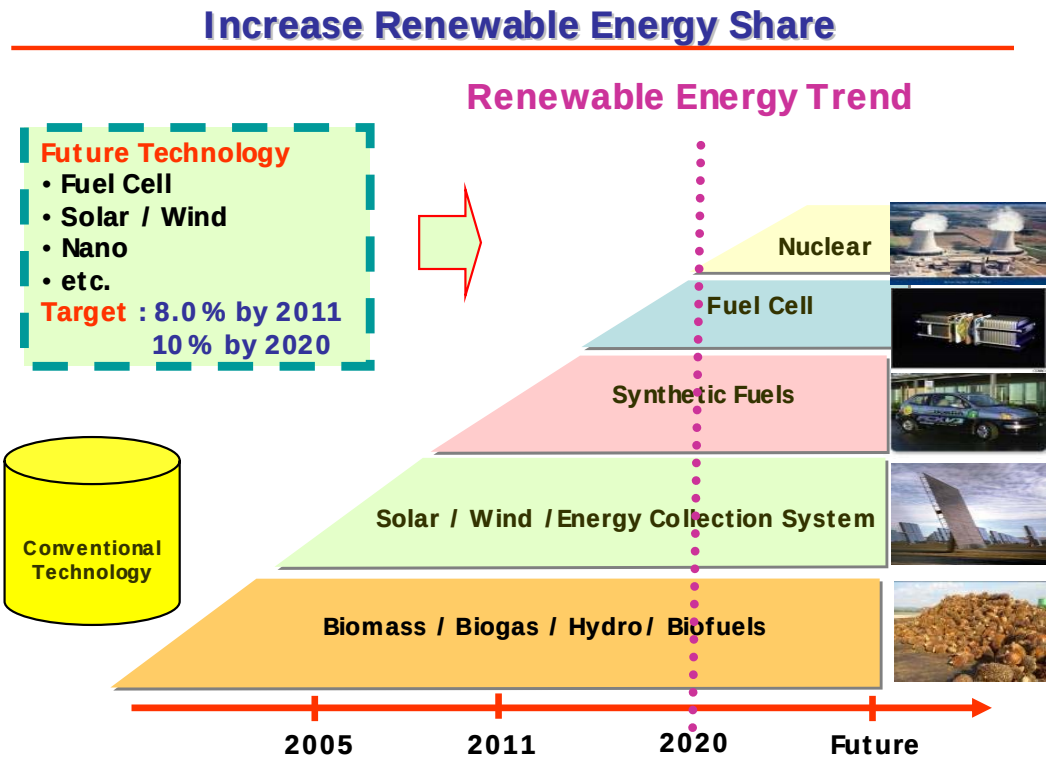
Measures

1. Establish the regulation or legal enforcement on the **Renewable Portfolio Standard** (RPS) for new power plants, *i.e.* 5% of their generation capacity must be generated by renewable energy.
2. Devise **incentive measures** encouraging purchase of power generated by renewable energy, *e.g.* *feed-in tariff*, provision of *tax credit*, *privilege*, and *subsidies* from the Energy Conservation Promotion Fund.
3. Support **Research and Development** (R&D) on renewable energy for which Thailand has high potential, such as solar, micro-hydropower, wind and biomass (agricultural wastes and municipal wastes).
4. Encourage **participation and partnership of the local communities** in renewable energy-fuelled power plants.

Responsible Agencies

The Ministry of Energy, the Ministry of Natural Resources and Environment, the Ministry of Science and Technology, the Ministry of Finance, and the Ministry of Industry are to jointly implement every feasible measure to promote, propel and support all kinds of renewable energy development, including expansion of R&D scope of work and support to researchers so that the outcome of R&D could be practically applied to actual implementation.

Note: The challenge case was also proposed on 23 November 2005 to increase renewable energy share up to 10% by the year 2020, as figure shown below.



Source: MOE 2005 (presentation to Prime Minister on 23 Nov. 2005)

4. Strategic Plan for Energy Security

To ensure the country adequate supply of energy, three main strategies to build on stability of the country's energy reserve have been set up as described below.

Petroleum Supply

- Maintain the R/P (Reserve to Production) level at >10 for the next 20 years
- Execute aggressive policies for the provision of petroleum resources from neighbouring countries such as Indonesia, Myanmar, etc.

Electricity Supply

- Set up an electricity regulatory organization
- Encourage private power plants with existing contract to enter the system in a timely manner
- Maintain generation reserve capacity at no less than 15%
- Execute aggressive policies for the provision of electricity from neighbouring countries such as Myanmar, Lao and southern China

Alternative Energy Development

- Gasohol: increase gasohol production mainly from tapioca flour and sugar industry
- Bio-diesel: collaborate with the Ministry of Agriculture to increase oil palm plantation to increase bio-diesel production
- Mini-Hydro: collaborate with the irrigation department, Ministry of Agriculture, to develop small-sized generator at irrigation reservoir
- Waste to energy: encourage municipal and district administrative authority to cooperate with private firms in developing electricity generation from municipal waste
- Solar Energy: stimulate market mechanism through Renewable Portfolio Standard (RPS), feed-in tariff, tax exemption
- Small Power Producer (SPP): promote the usage of renewable energy resources to generate electricity
- Very Small Power Producer (VSPP): allow electricity generation of maximum 6 MW projects using renewable energy to connect to the distribution grid as the Distributed Generation (DG). The connection requirement is more relaxed than the SPP project.
- R&D: promote latest energy-related innovations both in the energy production system such as 'Solar PV Cell', and in the energy storage system.

To ensure all Thai citizens access to energy at fair rates, strategies to improve capabilities in energy management and integration are as follows:

a. Enhance the potential of energy coordination at regional level so that each province can map out its own energy management direction, ultimately leading to the development of energy-related strategy at the provincial level under the lead of its provincial governor and the national target.

b. Provide support in terms of technical knowledge as well as information for provincial governors and local administrative organizations.

c. Employ a single electricity tariff which has been used for decades.

d. Establish energy regulatory agency.

In addition, to transform Thailand into a regional energy centre is one more strategy for the country adequate supply of energy, and also to strengthen the country's competitive edge.

5. Progress and Action Plan

The energy efficiency and renewable energy strategies presented above will lead to several concerned projects. Governmental organization is expected to take initiatives on most of the projects, whereas private sector will be actually responsible for investment and operating costs on the projects which are financially and technically feasible.

Based on the strategies to increase the efficiency of energy usage in the industrial sector, energy conservation activities have been actively conducted using three key programs, *i.e. designated factory*, *soft loan*, and *tax incentive*. The expected energy conservation target, in ktoe, from each program is illustrated in table A-1 taking into account its past performance together with participation from factories. The amount of energy conserved from each program was evaluated to be about 75 ktoe in 2005.

The results show that the designated energy conservation program provides highest energy saving. It is founded that Thai factories still have considerable potential on energy saving. Most of the 45 ktoe savings in 2005 is contributed from the so called "Value Based Energy Management Program" which requires participation from top management people down to workers in the production line.

It is found that the realization of top management people and their willingness to conduct energy conservation and worker participation play a key role on the success of the program. With the success of the project in the past few years, the MOE would like to continue the program with the saving target set to be accumulated to 1,720 ktoe by the year 2011. Total energy saving in industrial sector with the application of all the programs shown in table A-1 is expected to be accumulated to about 2,250 ktoe by the year 2011.

Table A-1 Energy Conservation Potential in Industrial Sector (unit: ktoe)

Programs	2005	2005 - 2011
Designated factories (legal measure)	45	1,175
Soft loan	20	275
Tax incentive	10	270
Cumulative Total	**75**	**1,720**

Source: DEDE 2005

The target of 8% renewable energy share by the year 2011 and the strategies presented above are used as guidelines in developing a broad top-down action plan.

The plan and target is classified according to renewable energy resources, *i.e*. solar, wind, municipal waste (MSW), biomass, biogas, mini-hydro, and bio-fuel. Expected target in ktoe of each renewable resource is roughly set to achieve the 8% target and shown in table A-2 (overall) and table A-3 (power sector).

Table A-2. Renewable Energy Development Target (unit: ktoe)

Resources	Years	
	2005	2005 - 2011
Solar	3.36	78.37
Wind	1.34	12.09
MSW	6.72	134.36
Biomass	1,718.99	3,676.34
Biogas	14.08	43.19
Mini-hydro	3.93	171.94
Gasohol	43.98	1,097.83
Bio-diesel	10.08	1,762.24
Total RE	**1,802.48**	**6,976.36**
Expected Demand	65,079.31	87,212.50
Target RE (%)	**2.77**	**8.00**

Source: DEDE 2005

It is found that the biomass, gasohol, and bio-diesel are set as the prime targets of the country. Even though Thailand is one of the agricultural product exporting countries, the defined target is still very challenging and difficult to achieve. For example to meet the bio-diesel and gasohol target, it is required to tremendously expand the plantation of palm-oil and cassava. The required land and water resource are still questionable.

Table A-3. Renewable Energy Development Target in Power Sector (unit: MW)

	Target 2007	Existing 2006	Target Year 2011		
	[MW]	[MW]	RPS [MW]	Incentives [MW]	Total [MW]
Biomass	162.4	1,977	-	823	2,800
Hydro	18	44	78	34	156
Solar PV	0.2	30	-	25	55
Wind	3	1	1	108	110
MSW	1	4	-	96	100
Biogas	1	5	-	25	30
Total	**185.6**	**2,061**	**79**	**1,111**	**3,251**

Source: MoE (2005)

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Annex B: Recent capacity building activities related to CDM in Thailand

Capacity building activities on Climate Change and CDM during 2005 – June 2006

Date	Issues	CC	CDM	Target group	Partners
20/1/2005	Introduction to CDM		✓	Relevant organizations (public sector)	• IGES • ONEP
2-3/2/2005	Institutional Capacity Building		✓	Relevant organizations (public sector)	• World Bank
15/2/2005	CDM in Transport Sector		✓	Relevant organizations (public sector); private sector	• Japan MLIT • JTCA • OTP under Thailand's Ministry of Transport
11/3/2005	Climate Change and Sustainable Development	✓	✓	Relevant organizations (public sector) ; Private sector; NGO; Civil society; and Media	• World Bank • Royal Danish Embassy • JBIC • ONEP
15/3/2005	Study to Promote CDM in Transport Sector to Resolve Global Warming Problem: Bio-Diesel as Alternative Fuel		✓	Relevant organizations (public sector)	• Japan MLIT • JTCA • OTP under Thailand's Ministry of Transport
30/3/2005	CDM Capacity Building		✓	Relevant organizations (public sector)	• IGES • ONEP
31/3/2005	Multilateral Environmental Agreements (MEAs): Climate Change and CDM	✓	✓	ONEP staffs and interested people	• ONEP
4-5/4/2005	Capacity Development for CDM		✓	Relevant organizations (public sector); Private sector; Academia; NGO	• AIT • UNEP Risø Centre
18/4/2005	Climate Change and CDM Roadmap	✓	✓	Public sector; Private sector; Academia; NGO	• ONEP
11/5/2005	CDM Forum		✓	Public sector; Private sector; Academia; NGOs	• ERI, Chulalongkorn University
9-10/5/2005	CDM Capacity Building		✓	Relevant organizations (public sector)	• IGES • ONEP

Date	Issues	CC	CDM	Target group	Partners
22/6/2005	First Seminar on Thailand's Preparation for the Second National Communication	✓		Public sector; Academia; NGO; Private Sector	• UNDP • ONEP
23/6/2005	CDM in Energy Sector	✓		Relevant organizations (public sector); Academia; NGO; Private Sector	• AIT • UNEP Risø Centre
28/6/2005	CDM Roadmap		✓	Public sector; Academia; NGO; Private Sector	• TRF • GSEI • ONEP
10/8/2005	CDM Capacity Building		✓	Private sector; Consultants; Relevant organizations (public sector)	• AIT • CEERD
1-2/9/2005	CDM Capacity Building for Government Sector		✓	Relevant organizations (public sector)	• IGES • TEI • ONEP
6-9/9/2005	Baseline and Additionality Tool		✓	Private sector and consultants	• IGES • TEI • ONEP
5/10/2005	Second Seminar on Thailand's Preparation for the Second National Communication	✓		Relevant organizations (public sector); Academia; NGO; Private Sector	• UNDP • ONEP
18/10/2005	CDM Capacity Building		✓	Relevant organizations (public sector)	• DIW, under Ministry of Industry • ONEP • IGES • TEI
26/10/2005	Third Seminar on Thailand's Preparation for the Second National Communication	✓		Relevant organizations (public sector); Academia; NGO; Private Sector	• UNDP • ONEP
9/11/2005	GTZ Experts on CDM		✓	Private sector; public sector; Academia; NGO	• German-Thai Chamber of Commerce
7/12/2005	Electricity Baseline and Capacity Presentation		✓	Relevant organizations (public sector); Private sector; local consultants	• Royal Danish Embassy) • ONEP
16/12/2005	Capacity Building on Climate Change for Local Government Authority	✓		Local Government Authority (public sector)	• Royal Danish Embassy • ONEP
31/1/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Academia; Experts	• ONEP • TEI

Date	Issues	CC	CDM	Target group	Partners
3/2/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Politicians (MPs and Senators)	• ONEP • TEI
17/2/2006	CDM Capacity Building Workshop		✓	Public Sector; NGO	• ONEP • Royal Danish Embassy
24/2/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Private Sector	• ONEP • TEI
27/2/2006	CDM Workshop in Nakorn Ratchasima Province (Northeastern Region)		✓	Local Government Authority; Private Sector	• ONEP • Royal Danish Embassy
6/3/2006	CDM Workshop in Krabi Province (Southern Region)		✓	Local Government Authority; Private Sector	• ONEP • Royal Danish Embassy
8/3/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Media and NGOs	• ONEP • TEI
15/3/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Public sector	• ONEP • TEI
21/4/2006	Thailand's Public Hearing on Climate Change Strategies	✓	✓	Local Government Authority	• ONEP • TEI
24/4/2006	CDM Workshop in Chiangmai Province (Northern Region)		✓	Local Government Authority; Private Sector	• ONEP • Royal Danish Embassy
10/5/2006	Seminar on Public Hearing for CDM Project's Sustainable Development Criteria in Thailand		✓	Public sector; Private sector; NGO; Academia	• ONEP • JGSEE, KMUTT
16/5/2006	CDM Forum on EU CDM Linking Directive		✓	Relevant organizations (public sector)	• EC Delegation to Thailand • ONEP • ERI, CEERD, JIN
22/5/2006	CDM Workshop in Nakorn Ratchasima Province (Northeastern Region)		✓	Local Government Authority; Private Sector	• ONEP • Royal Danish Embassy
31/5/2006 - 1/6/2006	Targeted Capacity Development on CDM		✓	Selected relevant organizations (public sector); Financial sector; Private sector	• Royal Danish Embassy • UNEP Risø Centre • AIT
21/7/2006	CDM Workshop in Nakorn Ratchaburi Province (Central & Western Region)		✓	Local Government Authority; Private Sector	• ONEP • Royal Danish Embassy

Note: Besides those capacity building activities listed in the Table, Ministry of Energy usually merges the CDM issues in various occasions when they organize seminars or workshops concerning Renewable Energy and Energy Efficiency Development. In addition, capacity buildings on CC and CDM are sometimes merged in various websites.

Recent publications relevant to CDM in Thailand since 2005 include:

- "Introduction to the CDM for the Cooperation between Japan and Thailand"
  Publication information: Published in 2005 (1st edition - in Thai and English) by Japan Ministry of Economy Trade and Industry and Thailand's MONRE/ONEP; Prepared and edited by New and Industrial Energy Development Organization (NEDO) with cooperation of Pacific Consultants, and TEI
- "Clean Development Mechanism: CDM Country Guide for THAILAND"
  Publication information: Published in 2006 (1st edition - in English) by Institute for Global Environment (IGES), Japan Ministry of Environment, ONEP, and Biomass One-Stop Clearing House; Edited by IGES
- ONEP's Climate Change and CDM Website
  Publication information, in Thai and English: www.onep.go.th/cdm

Annex C: CDM Pipeline in Thailand

Projects approved by the Cabinet on 30 January 2007 (LoA):

No.	Project Name	Project Developer / Project Design Consultant	CER Buyers	Project Type	Project period / Crediting period (Years)	GHG Reduction per year (ton CO_2 e)	Start Date
1	**Dan Chang Bio-Energy COGEN project (DCBC)**	Dan Chang Bio-Energy Co., Ltd. / ERM-Siam Co. Ltd	Denmark	41 MW Electricity from Biomass (bagasse & leaves)	21 / 10	92,000	1 Jan 2005
2	**Phu Khieo Bio-Energy COGEN project (PKBC)**	Phu Khieo Bio-Energy Co., Ltd. / ERM-Siam Co. Ltd	Denmark	41 MW Electricity from Biomass (bagasse & leaves)	21 / 10	99,000	1 Jan 2005
3	**Korat Waste to Energy project**	Korat Waste to Energy Co., Ltd. / EcoSecurities	Netherlands (IFC)	3 MW Electricity from Starch Industrial waste Water	15 / 7	374,000	15 May 2003
4	**A.T. Biopower Rice Husk Power project**	A.T. Biopower Co., Ltd. / Clean Energy Finance Co., Mitsubishi UFJ Securities Co. Ltd	Japan, Finland	20 MW Electricity from Biomass	25 / 7	70,924	21 Dec 2005
5	**Khon Kaen Sugar Power Plant**	Khon Kaen Sugar Industry Public Co., Ltd.	na	30 MW Electricity from Biomass (bagasse)	20 / na	45,719	na
6	**Ratchaburi Farms Biogas project**	SPM Farm, Veerachai Farm, and Nongbua Farm / ERM UK Ltd	Denmark	3 MW Electricity from pig farm biogas	20 / 10	100,380	1 Jan 2006
7	**Rubber Wood Residue Power Plant in Yala**	Gulf Electric Public Co., Ltd.	na	20.2 MW Electricity from Biomass	25 / na	60,000	na

Projects to be approved:

No.	Project Name	Project Developer	CER Buyers	Project Type	Project period (Years)	GHG Reduction per year (ton CO_2 e)	Start Date
8	**Charoensompong Corporation Rachathewa Landfill Gas to Energy project**	Charoensompong Co., Ltd.	Negotiating	1 MW Electricity from Landfill Gas	15	99,100	1 Jan 2005

9	**Waste Water Treatment with Biogas System in a Starch Plant for Energy and Environment Conservation in Chachoengsao**	Sima Interproduct Co., Ltd.	**Denmark**, 10 years upfront payment at 4.25 USD / ton CO_2 e	Electricity from Industrial Waste Water	20	20,300	1st April 2005
10	**Waste Water Treatment with Biogas System in a Starch Plant for Energy and Environment Conservation in Nakornratchasima**	Sima Interproduct Co., Ltd.	**Denmark**, 10 years upfront payment at 4.25 USD / ton CO_2 e	Electricity from Industrial Waste Water	20	21,500	1 May 2005
11	**Surat Thani Biomass Power Generation project**	Surat Thani Green Energy Co., Ltd.	**Japan**, 8 years upfront payment at 7.5 USD / ton CO_2 e	Electricity from Biomass (Palm)	25	171,774	1 July 2005
12	**Chumporn applied Biogas Technology for Advanced Waste Water Management**	Chumporn Palm Oil Industry Public Co. Ltd.	**Germany**, 10 years upfront payment at 4 EUR / ton CO_2 e	Electricity from Industrial Waste Water	20	30,028	1 Jan 2006
13	**Natural Palm Oil Company Limited – 1 MW Electricity Generation and Biogas Plant**	Natural Palm Oil Co. Ltd.	**Denmark**, 10 years upfront payment at 4.25 USD / ton CO_2 e	1 MW Electricity from Industrial Waste Water	15	14,480	1 Jan 2006
14	**Northern Starch (1987) Co. Ltd. – LPG Fuel Switching**	Northern Starch (1987) Co. Ltd.	**Denmark**, 10 years upfront payment at 4.25 USD / ton CO_2 e	1 MW Electricity from Industrial Waste Water	20	35,420	1 Jan 2006
15	**Surin Electricity Company Limited**	Surin Electric Co. Ltd.	**EU**, 10 years upfront payment at 11.61 USD / ton CO_2 e	10 MW Electricity from Biomass (Bagasse)	20	12,584	15 Jan 2006

Source: ONEP, Feb. 2007

Annex D: List of local relevant SET providers

Category / Origin	Name	Address	Capability / Technology
Academic Institute	Energy Research Institute (ERI) and Faculty of Engineering, Chulalongkorn University	Phyathai Road, Pathumwan, Bangkok 10330	Technical consulting and project development
Academic Institute	Semiconductor Device Research Laboratory (SDRL), Chulalongkorn University	Phyathai Road, Pathumwan, Bangkok 10330	Research on PV cell; materials; systems
Academic Institute	Environmental Research Institute, Chulalongkorn University (ERIC),	Phyathai Road, Pathumwan, Bangkok 10330	Technical consulting on environmental issues
Academic Institute	Institute for Science and Technology Research and Development (ISTR), Chiang Mai University	PO Box 289 Chiang Mai University, Chiang Mai	Review energy and environment situation in livestock farms. Implement appropriate wastewater treatment designs which stimulate increase renewable energy use. Transfer of biogas technology to private sector (farmers)
Academic Institute	Husbandry Department, Faculty of Agriculture, Kasetsart University	50 Paholyothin Road, Jatuchak, Bangkok 10400	Animal science, utilization of biogas from livestock
Academic Institute	The Energy and Environmental Engineering Center, and Faculty of Engineering, Kasetsart University	50 Paholyothin Road, Jatuchak, Bangkok 10400	Research and development, Renewable energy technology; biogas technology; environmental consultant
Academic Institute	Silpakorn University	Sanam Chandra Palace Campus, Nakhon Pathom 73000	Research on solar
Academic Institute	Asian Institute of Technology	PO Box 4 Klong Luang, Pathumthani 12120	Research and dissemination of renewable energy technologies
Academic Institute	King Mongkut's Institute of Technology Latkrabang	Bangkok 10520	Research on PV component
Academic Institute	King Mongkut's University of Technology Thonburi	Ratburana, Bangkok 10140	Research and development: wastewater treatment, landfill gas, biogas, solar energy
Academic Institute	Solar Energy Research and Training Center	Naresuan University, Phitsanulok 65000	Research and dissemination of renewable energy technologies
Academic Institute	Thammasart University	PO Box 22 Thammasart, Rangsit, Pathumthani 12121	Research on PV cell; materials
Consultants	Centre for Energy Environment Resources Development (CEERD) *www.ceerd.net*	SLD Building, 7B Floor, Soi Saladaeng 1, Rama 4 Road, Bangrak, Bangkok 10500	Technical consulting and project development
Consultants	Asia-Pacific Technotrade (Thailand) Ltd.	51/56 Sereephap Building, Soi Wat Buakwan, Thasai, Nonthaburi 11000	Technical consulting and project development

Category / Origin	Name	Address	Capability / Technology
Consultants	AT Biopower	719 KPN Tower, 14th Fl., Rama 9 Road, Bangkapi, Huaykwang, Bangkok 10320	Renewable energy project development
Consultants	AT Tri Co., Ltd.	U.M. Tower, 24th Floor, 9 Ramkhamhaeng Rd, Kwang Suanluang, Bangkok 10250	Renewable energy project development
Consultants	C.M.S. Engineering and Management Co. Ltd.	68/95 Soi 8 Rama II ChomThong, Bangkok 10150	Conduct of feasibility studies and system design on wastewater treatment, sanitary landfill and solid waste treatment
Consultants	Career (Thailand) Co. Ltd.	28 Taharn-bok Road, Borplub, Maung, Nakhon-pathom 73000	Technical consulting and project development
Consultants	Energy Economy Environment Consultants Co. Ltd. (EEEC) *www.eeec.co.th*	SLD Building, 7B Floor, Soi Saladaeng 1, Silom Road, Bangrak, Bangkok 10500	Technical consulting, project development and technology provider
Consultants	Energy-Environment Management	71/6 Sethsiri 2, Samsennai Phayathai, Bangkok 10400	Technical consulting and project development
Consultants	Equitech (Thailand) Ltd. *www.equitech.co.th*	6/15 Ground floor, Somkid Place, No.6 Soi Somkid, Ploenchit Road, Pathumwan, Bangkok 10330	Services in the environmental sector, including carbon market, bio-fuels and forestry sector.
Consultants	Infratech Development Co. Ltd.	19/4 Soi Thonglore 25 Sukumvit 55 Bangkok 10110	Construction company
Consultants	Infratech Engineering Company Limited.	6th Floor, Maneeya Center, 518/5 Ploenchit Road, Lumpini, Patumwan, Bangkok 10330	Biomass energy system components, cogeneration systems, renewable energy, mini-hydro, heat recovery system, solar & wind.
Consultants	Insucon and Services Co. Ltd.	228/16 Sirinthorn Rd, Bangplad, Bangplad District, Bangkok	Construction company
Consultants	Panya Consultants Co. Ltd.	22 Ladprao 35 Ladyao Chatuchak, Bangkok 10900	Design and feasibility study for irrigation and water works
Consultants	Pual Consultants Co. Ltd.	202/12 Soi Pravit and Friends Prachachuen, Ladyao Chatutchak, Bangkok 10900	Conduct of feasibility study
Consultants	System Engineering Co. Ltd.	45 Rajchavithee Phaya Thai Road, Bangkok 10400	Environmental engineering
Consultants	Tara Consultants Co. Ltd.	Ladparo 35/1 Chatuchak, Bangkok 10900	Conduct of feasibility study
Consultants	Team Consulting Engineers Co. Ltd.	2836 Drive-in Center Ladprao 103, Bangkapi, Bangkok 10240	Technical consulting and project development

Category / Origin	Name	Address	Capability / Technology
Consultants	Consultants of Technology	39 Ladprao Soi 124, wangthonglang, Bangkok 10310	Technical consulting and project development
Governmental	Department of Alternative Energy Development and Efficiency (DEDE)	Kasatsuk Bridge, Yodse, Bangkok 10330	Planning and implementation of renewable energy projects
Governmental	Energy Conservation and Renewable Energy Division, Energy Policy and Planning Office (EPPO)	394/14 Samsen Road, Dusit 10300	Planning and funding
Governmental	Department of Industrial Works (DIW)	76/5 Rama IV, Bangkok 10400	
Governmental	Department of Environmental Quality Promotion (DEQP)	49 Rama VI Soi 30 Bangkok 10400	
Governmental	Pollution Control Department	92 Phaholyothin Soi 7 Bangkok 10400	
Governmental	Department of Health	Tiwanond Road, Muang District, Nonthaburi 11000	
Governmental	Electrical and Mechanical Unit, Department of Public Works, Ministry of Interior	2 Larnluang Road, Pomprab, Bangkok 10100	Implementation of projects on solar PV
Governmental	Electricity Generating Authority of Thailand (EGAT)	53 Charan Sanit Wong Road, Bang Kruai, Nonthaburi 11000	Research and demonstration of PV- and wind-powered generating plants
Governmental	Metropolitan Electricity Authority (MEA)	30 Ploenchit Road, Bangkok 10330	Cooperation on the implementation of solar PV rooftop Grid-connected project being implemented by EGAT
Governmental	Provincial Electricity Authority (PEA)	200 Ngarm Wong Wan Road, Chatuchak, Bangkok 10330	Implementation of projects on solar PV
Governmental	Military Hardware Research and Development Unit, Army Force Development Office	Ratchasima Road, Dusit, Bangkok 10300	
Governmental	National Science and Technology Development Agency (NSTDA)	9th Floor Samaggi Ins. Tower, Northpark Project, 2/4 Vibhavadi-Rangsit Rd, Donmuang, Bangkok 10210	Research on solar cells; manufacturing plant
Governmental	Telecommunications Authority of Thailand (TOT)	89 Chaengwatana Road, Toong Song Hong, Donmuang, Bangkok 10210	Implementation of projects on solar PV
Governmental	Thailand Institute of Scientific and Technological Research	196 Phaholyothin Road, Chatuchak, Bangkok 10900	
Manufacturer - Origin: Local	Ban Pong Engineering Co., Ltd *www.bpe-boiler.com*	21 Moo 1, Huapho-Bansing Road, Huapho, Bangphae, Ratchaburi 70160	Boiler Technology/ CHP Technology - Products/Services: Solid fuel boiler, Biomass Boiler, Biomass Power Plant, Sugar Industry, EPC Contractor

Category / Origin	Name	Address	Capability / Technology
Manufacturer - Origin: EU Countries/Local	Bangkok Industrial Boiler Co., Ltd *www.vpe.co.th*	368 Moo 6, Sukhumvit Road, Samrong-Nua, A.Muang, SamutPrakan 10270	Boiler Technology - Products/Services: Boilers, Solid fuel boiler, Biomass boiler
Manufacturer /Supplier - Origin: Multi-National	Boonyium & Associates Ltd.	(1314-1322)39/5 Moo.1 Srinakharin Rd. Suanluang, Prakanong, Bangkok 10250	Boiler Technology - Products/Services: Burner and Steam Boiler
Manufacturer /Supplier	Candoo Enterprise LP	111/76 Soi Srinakornpatana Sukhaphibal 1 Klong Goom Buengkhum, Bangkok 10240	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	Chatchomchuan Co., Ltd.	145 Moo 3 Theparak Road Theparak, Muang Samut Prakan, SamutPrakan 10270	Boiler Technology - Products/Services: Thermal oil,Steam and Hot water boiler
Manufacturer /Supplier	Chong Charoen Charkkol (1991) Co., Ltd	43/2 Moo 9 Suksawad 47 Road, Phra Pradaeng, SamutPrakan 10130	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	City Steam Group Co., Ltd.	21/5 Moo 5 Putthabucha Road Bangmod, Jomthong, Bangkok 10150	Boiler Technology - Products/Services: Steam Boilers & Burner
Manufacturer - Origin: EU Countries	German Engineering & Machinery Co.,Ltd. *german@ger.co.th*	399 Moo 17 Bangna-Trad Km.23 Rd, Bangsaotong District, King Amphur Bangsaotong, SamutPrakan 10540	Boiler Technology - Products/Services: CONVEYING SYSTEM
Manufacturer - Origin: EU Countries	Getabec International Co.,Ltd.	GTB Building, 79/7 Moo 2 , Srinakarin Rd., Nongborn, Pravej, Bangkok 10260	Boiler Technology - Products/Services: Steam boiler, hot water boiler and thermal oil heater and biomass fuel boiler
Manufacturer /Supplier	Hansa International Co., Ltd.	33/29 Ramkhamhaeng Road (Sukapiban 3) Huamark, Bangkapi, Bangkok 10240	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	Hitech Engineering Co., Ltd. *www.hitech-engineering.com*	4/69-71 Rama 2 Road, Bangkhunthian, Bangkok 10150	Boiler Technology - Products/Services: VEGA Steam Boiler
Manufacturer /Supplier - Origin: EU Countries/Local	Jiampattana Energy Partnership	191 M 8, Salakao District, Muang, Suphanburi 72210	CHP Technology - Products/Services: Biogas Engine, gensets
Manufacturer /Supplier	KTS Industry Co.,Ltd	102/52 Moo.4 Sangchuto T.Tamaka A.Tamaka, Kanchanaburi 71120	Boiler Technology - Products/Services:
Manufacturer /Supplier - Origin: Local	LK Boiler Industry Co., Ltd.	95 Moo 15 Kingkeaw Road Ratchateva, Bang Phli, SamutPrakan 10540	Boiler Technology - Products/Services: Thailand Manufacturer - Design - Installation - Service
Manufacturer /Supplier - Origin: Malaysia	Mechmar (Thailand) Ltd.	104 Solid Group Bldg Soi 4, Pattanakarn Road, Suanluang, Bangkok 10250	Boiler Technology - Products/Services: Boilers

Category / Origin	Name	Address	Capability / Technology
Manufacturer /Supplier	Nik Universal Co., Ltd	1184 Sukhumvit Road Paknam, Muang Samut Prakan, SamutPrakan 10270	Boiler Technology - Products/Services: Steam boilers, Thermal oil boilers, Fabrication & Installation
Manufacturer /Service Provider - Origin: Local	P & S Design Co., Ltd.	3/3 M.13, 6.5th km Bangna-Trad Road, Bangkaew, Bangplee, SamutPrakan 10540	CHP Technology/Biogas Technology - Products/Services: Biogas Engine, gensets, Design anaerobic wastewater treatment, biogas plant
Manufacturer /Supplier	P.K. Boiler Co., Ltd.	9/87 Soi PinSuwan, Amphur Moung Samutsakorn 74000	Boiler Technology - Products/Services: Boilers
Manufacturer - Origin: Local	Premier Products Co., Ltd.	2 Soi Premier 2 Srinakarin Rd., Prawate, Bangkok 10250	Biogas Technology - Products/Services: Digestor blanket
Manufacturer /Supplier - Origin: Local/Multi-National	Royal Equipment Co., Ltd. *www.royalequipment.co.th*	88 Phichai Road, Dusit, Bangkok 10300	MSW Management & Handling Technology - Products/Services: Waste handling, sorting, recycl. system, Waste to Energy System
Manufacturer /Supplier	Rung Roj Engineering And Enterprise Co., Ltd	3052 Moo.14 Soi Watdan, Sukumvit 113 A.Muang, SamutPrakan 10270	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	Sang Chai Karnchang	73/37 Soi Jomthong 15 Jomthong Road, Jomthong, Bangkok 10150	Boiler Technology - Products/Services: Boilers
Manufacturer - Origin: India/Japan	Satake (Thailand) Co., Ltd.	133 Moo, Bangkadi Industrial Park, Tivanon Road, Pathumthani 12000	Biomass Gasification Technology - Products/Services: Down-draft biomass gasifier with gas purification system
Manufacturer - Origin: EU Countries	Sepco-Asaia Co., Ltd. *www.sepcoplc.com*	487 2nd Fl. B.S.V. Bldg, Sri-Ayutthaya Road, Phyathai, Ratchathewi, Bangkok 10400	MSW Management & Handling Technology/Biogas Technology - Products/Services: Waste handling, sorting, recycling syst.
Manufacturer /Supplier	Siriporn Mechanic Co., Ltd.	100/790 Moo.6 T.Bangmuang, A.Muang, Samutprakan 10270	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	Somchai Industry Co., Ltd.	45/20 Moo.6 Soi Eakmai 64, Eakchai-Bangbon Road, Bangkhunthian, Bangkok 10150	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier	Steam Master Co., Ltd	31/1 Krungthonburi Rd Klongtonsai, Khlongsan, Bangkok 10600	Boiler Technology - Products/Services: Boilers
Manufacturer /Supplier - Origin: EU Countries/Local	Thai K Boiler Co., Ltd *www.thaikboiler.com*	134 Moo 6 Phatkasem 91 Road Suanluang, Krathum Baen, SamutSakhon 74110	Boiler Technology - Products/Services: Steam boilers, Thermal oil boilers
Manufacturer - Origin: Local	Thammasorn Engineering Co., Ltd.	156/20 Petchburi Road, Rajthevee, Bangkok 10400	MSW Management & Handling Technology - Products/Services: Waste sorting, recycling, screening, separation system, Incinerator, Wastewater treatment

Category / Origin	Name	Address	Capability / Technology
Manufacturer	Zennet Engineering Co., Ltd.	9/136 M.2, Petchkasem Road, Nong Klang Ploo, Nong Khaem, Bangkok 10160	Boiler Technology - Products/Services: Boilers
Representative - Origin: EU Countries	Ansoldo Energia, Representative Office	26/F,252/124 Ratchadapisek Rd. Huaikhwang, Bangkok 10320	Boiler Technology - Products/Services: Boilers
Representative - Origin: EU Countries	BONO ENERGIA *www.bono.it*	Cannon Far East (Thailand Office), 3/1 Soi Ramkhamhaeng 21, Ramkhamhaeng Road, Wangthonglang, Bangkok 10310	CHP Technology - Products/Services: Industrial steam boilers, thermal fluid heaters, water treatment, environmental systems and biomass boilers
Representative - Origin: Japan	Ebara (Thailand) Limited	3rd Fl., ACME Building, 125 Petchburi Road, Rajthevee, Bangkok 10400	MSW Management & Handling Technology - Products/Services: Waste management system, Incinerator, Biomass-Waste Gasification Technology
Representative - Origin: EU Countries	FOSTER WHEELER *www.fwc.com*	Foster Wheeler International Corp. (Thailand Branch), 217 Moo 12, Sukhapiban 8 Road, Tungsuklha, Sriracha, Chonburi 20230	CHP Technology, Boiler Technology - Products/Services: Boilers, HRSG, Engineering and Construction Contractor, Power equipment Supplier
Representative - Origin: USA	GE Energy *www.ge.com*	7th Fl. Capital Tower, All Seasons Place, 87/1 Wireless Road, Lumpini, Pathumwan, Bangkok 10330	CHP Technology - Products/Services: Gas Turbines, Steam Turbine, Turnkey Power Plant, Power Plant Components, Combined Cycle power plant
Representative - Origin: EU Countries	Rolls-Royce International Ltd *www.rolls-royce.com*	900 Tonson Tower, 11th Floor Ploenchit Road, Bangkok 10330	CHP Technology - Products/Services: Gas Turbines, Reciprocating Engines, Control System
Representative - Origin: Japan	Siam Takuma Co., Ltd.	18th Fl. Sin Sathorn Tower, 77/69 Krung Thonburi Rd, Klongsan, Bangkok 10600	Boiler Technology - Products/Services: Boilers, Biomass Power Plant, Oil/Gas Fire Power plant
Representative - Origin: EU Countries	SIEMENS POWER GENERATION *www.siemens.co.th*	Charn Issara Tower II, 32nd Fl., 2922/283 New Petchburi Roady, Bangkapi, Huaykwang, Bangkok 10310	CHP Technology - Products/Services: Gas Turbines, Steam Turbine, Turnkey Power Plants, Power Plant Components, Combined Cycle power plant
Representative - Origin: USA	Thermax Limited	4Th floor Nailert Tower, 2/4 Wireless Road, Lumphini , Pathumwan, Bangkok 10330	Boiler Technology - Products/Services: Solid fuel fired Boilers from 1 tons per hour capacity to 300 tons per hour capacity
Service Provider - Origin: Local	AIR SAVE CO,.LTD	15th Flr. Italthai Tower 2034/71 Nw Phetchaburi Rd. Bangkapi Huaykwang Bangkok 10320	MSW Management & Handling Technology - Products/Services: Consultant
Service Provider - Origin: Local	Better World Green Co., Ltd	2674/1 Moo 2 Soi Drive-in 2, Ladprao Rd., 128/3 Bangkapi, Bangkok 10240	MSW Management & Handling Technology - Products/Services: Waste management

Category / Origin	Name	Address	Capability / Technology
Service Provider	Conquest Co., Ltd.	413/15 Bangrak, Bangkok 10500	Boiler Technology - Products/Services: Boilers
Service Provider	Craftic Co., Ltd.	3725/17 Soi 1 Rama 3 Rd., Bangkolaem, Bangkok 10120	Boiler Technology - Products/Services: Boilers
Service Provider - Origin: Local	Development of Environment and Energy Foundation	12/9 AV3A Building Ladyao, Jatujak, Bangkok 10900	MSW Management & Handling Technology - Products/Services: Consultant
Service Provider - Origin: EU Countries/Korea	Elco Power Systems *www.elcopower.com*	28F Panjathani Tower 127/33 Nonsee Rd. Chongnonsee, Yannawa, Bangkok 10120	CHP Technology - Products/Services: Steam turbines, Biomass energy system, Cogeneration systems, Electrical system, Turnkey Contractor
Service Provider - Origin: Local	Environmental Conservative Service Co., Ltd. *www.eco.co.th*	310/208 Chuanchuen Pattanakan Village, Pattanakan 57, Pravet District, Bangkok 10250	MSW Management & Handling Technology - Products/Services: Waste management
Service Provider	FULL SYSTEM ENGINEERING CO., LTD.	140/545 Moo 9 Bangpai Bangkhae, Bangkok 10160	Boiler Technology - Products/Services: Boilers
Service Provider - Origin: Local	GENCO Co., Ltd	447 Bondstreet Rd. T.Bankpood A. Pakkret, Nonthaburi 11120	MSW Management & Handling Technology - Products/Services: Waste management
Service Provider	HB Energy Co., Ltd.	99/174 Tivanon Road, Pakkred, Nonthaburi 11120	Boiler Technology - Products/Services: Boilers
Service Provider	N.S.R. CENTER CO., LTD.	100/555 Moo 7, Karnjanapisak Rd., Bangkae, Bangkok 10160	Boiler Technology - Products/Services: Water System Machine, Boiler System
Service Provider - Origin: Local	PAPOP Co., Ltd. *www.papop.com*	10/35 Soi Songsangtawan, Ladprao 44 Road, Samsen-Nok, Huaykwang, Bangkok	Biogas Technology - Products/Services: Biogas plant, Anaerobic water treatment plant, Engineering & Construction
Service Provider - Origin: Local	Professional Waste Technology (1999) Co., Ltd	159/33 Sermmite Tower 19th fl. Soi Sukumvit21 Bangkok 10110	MSW Management & Handling Technology - Products/Services: Waste management
Service Provider - Origin: Local	PSP *www.pairoj.co.th*	17/7 Moo 2 Pretkasem T.Aomyai A.Sampan Nakronpathom 73160	MSW Management & Handling Technology - Products/Services: waste management
Service Provider - Origin: Local	Refine Tech Co., Ltd.	47 Moo 7 Soi Suksawat 76 Suksawat Rd. T.Bangjak Prapradang, SamutPrakan 10130	MSW Management & Handling Technology - Products/Services: waste treatment
Service Provider - Origin: Local	S.T.F.E. Co., Ltd.	388 S.P. Building 17th floor Phaholyothin Rd. Samsennai Prayathai, Bangkok	MSW Management & Handling Technology/CHP Technology - Products/Services: Consultant
Service Provider - Origin: Local	SAN. E. 68 Cousulting Engineers Co.,Ltd. *www.SanE68.com*	642/3-7 Wongsawang Bangsue, Bangkok 10800	MSW Management & Handling Technology - Products/Services: Waste management, water treatment and Biogas system

Category / Origin	Name	Address	Capability / Technology
Service Provider - Origin: Local	Thai Shih Hsing Co., Ltd.	171 Moo 6 T.tasai A.Muang SamutSakorn 74000	MSW Management & Handling Technology - Products/Services: waste recycle
Service Provider - Origin: Local	Trend inter trade Co., Ltd	181 Moo 10 Phetkasem Rd. Bangkae, Bangkok 10160	MSW Management & Handling Technology - Products/Services: waste and water treatment
Service Provider - Origin: Local	Waste Management Siam Ltd. *www.wms-thailand.com*	22nd Floor, UBC II Building,591 Sukhumvit Soi33 Khet Wattana, Bangkok 10110	MSW Management & Handling Technology - Products/Services: waste management
Service Provider - Origin: Local	WASTE RECOVERY MANAGEMENT CO.,LTD	47/89 Moo 5 T.tineban A.Muang, SamutPrakan 10280	MSW Management & Handling Technology - Products/Services: Waste management
Supplier	Ab2btrader Ltd	Silom Rd , Saladaeng, Bangkok 10500	Solar water heating systems, solar garden lights, solar outdoor lighting systems
Supplier - Origin: EU Countries	ABB Power Limited	322 Moo.4 Bangpoo Ind. Park, Soi6 Sukumvit Rd. SamutPrakan 10280	CHP Technology - Products/Services: High-Low Voltage Equipments, Plant Automation Control
Supplier	Acmy-Inter Marketing Co. Ltd.	49/1 Sukhumvit 91, Bangchak, Bangkok 10250	Manufacturer and distributor of solar hot water systems
Supplier	American Appliance and Engineering Co. Ltd.	994-1000 New Road, Sampantawong, Bangkok 10100	Importer and distributor of water heaters
Supplier	ARITA ENGINEERING (BKK) CO.,LTD.	82/155 Moo.11, Eakchai 10 Bangkhunthian, Jhomthong, Bangkok 10150	Boiler Technology - Products/Services: Boilers
Supplier - Origin: EU Countries	B.GRIMM POWER ENGINEERING CO.,LTD. *www.bgrimmgroup.com*	33 Soi Lertnava, Krungthep-Kreetha Rd, Huamark, Bangkapi, Bangkok 10240	CHP Technology - Products/Services: Engines, gensets "DEUTZ", Germany, Power Plant Equipments
Supplier	B.P. GENERATOR CO.,LTD.	72/18 M.4, B.P. Bldg, Soi Watthepnimit, Kosumruamjai Road, Donmuang, Bangkok	CHP Technology - Products/Services: Engines, gensets "BERKIN"
Supplier	B.T.EQUIPMENT CO.,LTD.	111/7 Soi Eakmai 5, Sukhumvit Road, Klongtoei, Bangkok	CHP Technology - Products/Services: Engines, gensets "AIRMAN"
Supplier	BANGKOK GENERATOR LTD.,PART.	4/29 M.14, 10.5th Km, Bangna-Trad Rd, Bangplee, SamutPrakan	CHP Technology - Products/Services: Engines, gensets "AIRMAN"
Supplier	BEAM (THAILAND) CO.,LTD.	161/89 Sanpawut Road, Bangna, Prakhanong, Bangkok	CHP Technology - Products/Services: Engines, gensets "BEAM"
Supplier	Bermuda Thai Co. Ltd.	81 Sukapiban 2 Road, Klongkum Bangkapi, Bangkok 10240	Manufacturer and distributor of solar water heater system products.
Supplier	BP Thai Solar Corp. Ltd.	101/47-9 Navanakorn Ind. Estate, Phaholyothin Rd, Klong 1, Klong Luang, Pathumthani 12120	Manufacturer and distributor of solar power generating systems.

Category / Origin	Name	Address	Capability / Technology
Supplier	BUNTANAPHAN ELECTRIC CO.,LTD.	179 Sipraya Road, Bangrak, Bangkok 10500	CHP Technology - Products/Services: Engines, gensets "MAGNETEK"
Supplier - Origin: USA	CE Energy Co., Ltd.	64/121 M.5, Soi Suanpak 35, Chimplee, Talingchan, Bangkok 10170	CHP Technology - Products/Services: Microturbine "Capstone"
Supplier	CHAMNAN WELDING-GENERATOR	27558-9 Soi Choakdee, Praram IV, Klongtoei, Bangkok 10110	CHP Technology - Products/Services: Engines, gensets, sell & leasing
Supplier	Charcoal (Thailand) Co.,Ltd.	264/26 Sukhumvit 71, North Phrakanong , Wattana, Bangkok 10110	Wood Charcoal, Charcoal Briquette
Supplier	CHAROEN KRUNG ENGINEERING CO.,LTD.	83 Navathani Village soi 4, Bangkapi, Bangkok 10240	CHP Technology - Products/Services: Engines, gensets "KOHLER"
Supplier	Chiang Mai Scale Construction	223-6 Moo 1, Chiangmai-Lampoon Road, Nong-hoi, Meung, Chiangmai	
Supplier	CHUCHUENWATANA CO.,LTD.	199 M.2 Soi Boonmee, Sukhapiban 1, Bangkae, Pasicharoen, Bangkok 10160	CHP Technology - Products/Services: Engines, gensets
Supplier - Origin: USA	DALE ELECTRIC POWER SYSTEMS LTD.	40/114-115 Soi Pooncharoen, 16.5th kilometers Bangna-Trad Road, Bangplee, SamutPrakan 10540	CHP Technology - Products/Services: Engines, gensets "DALE", USA.
Supplier	Delta-Vet Co. Ltd.	26 Soi Kwan-pattana 2, Asok-Dindang, Din-Dang, Bangkok 12320	Supplier of pig manure separator (imported from Taiwan)
Supplier	DETCO (THAILAND) LTD.	5 M.13, 7th kilometers Bangna-Trad Road, Bangkaew, Bangplee, SamutPrakan 10280	CHP Technology - Products/Services: Engines, gensets "DETROIL"
Supplier	DIAMOND BROTHERS CO.,LTD.	23/1 Petchkasem 36 Road, Pasichasoen, Bangkok 10160	CHP Technology - Products/Services: Engines, gensets
Supplier - Origin: USA	DIETHELM CO.,LTD.	1696 New Petchburi Road, Bangkapi, Huaykwang Bangkok 10320	CHP Technology - Products/Services: Engines, gensets "CUMMINS, ONAN", USA.
Supplier /Service Provider	Dove Biotech *www.dovebiotech.com*	327/66-67 St' Louis Center, Thoong Vat Don, Sathorn, Bangkok 10120	Biogas Technology - Products/Services: Waste treatment systems, Water filtering and purification systems, Biodiesel production plants, Ethanol Plants, Biodigestion-Bio-Gas Plants
Supplier	DUANG CHOKE ENGINEERING CO.,LTD.	37/156 M. 13 Soi Ratchvinit school, 7.5th kilometer Bangna-Trad Road, Bangplee, SamutPrakan 10540	CHP Technology - Products/Services: Engines, gensets

Category / Origin	Name	Address	Capability / Technology
Supplier	Electrical Production Public Ltd.	Olympia Thai Tower Bldg., 14th Floor, 444 Ratchadapisek, Samsennok, Havey-kwang, Bangkok 10320	
Supplier	ENVIMA (Thailand) Co., Ltd.	1023 TPS Bldg., Pattanakarn Road, Suan Luang, Bangkok 10250	Solar water heating systems, photovoltaic systems, biomass energy systems, hydro energy systems (large), hydro energy systems (small), wind energy systems (small).
Supplier	EURO-THAI ENGINEERING CO., LTD	79/7 Srinakharin Road Nongbon, Praves, Bangkok 10250	Boiler Technology - Products/Services: Boilers
Supplier	Exim Agency and Trading Co., Ltd.	8/24 Ramkamhaeng 118 Rd., Soi Chaiyapruk 8, Sapansung, Bangkok 10240	BBQ Charcoal Briquette Coconut Shell Charcoal Briquette Wood Charcoal Briquette.
Supplier	Forbest Co., Ltd.	809/15 Chan Road Tungwatdon, Sathorn, Bangkok 10120	Boiler Technology - Products/Services: Steam Boiler
Supplier	G.E.C. MARKETING CO.,LTD.	257/3-4 Soi Sukdee, Pattanakarn Road, Klongton, Klongtoei, Bangkok	CHP Technology - Products/Services: Engines, gensets "XENX" with Transformer and AVR Control
Supplier	Grand Technology Co. Ltd.	63 Soi Moonsup, Ramkhamheang Road, Suanluang, Bangkok 10250	Sale and installation of local solar collectors; Import of collectors
Supplier	Heritage Co. Ltd.	13/82 Sukhapiban 1 Rd, Klong lum, Bangkapi, Bangkok 10240	Manufacturer and distributor; "Heritage" solar water heaters
Supplier - Origin: USA	Honeywell Systems (Thailand) Limited.	252/121 Fl.25 MoungThai-Patara2 Bldg. Ratchadapisek Rd., HuayKhwang, Bangkok 10230	Boiler Technology - Products/Services: Boilers, Automatic Control System
Supplier	Industrial Heat and Combustion Co., Ltd.	4/1 Soi 8 Sukumvit Rd., Klongtoey, Bangkok 10110	Boiler Technology - Products/Services: Boilers
Supplier /Service Provider - Origin: EU Countries	International Office of Technical Assistance (Thailand) Limited *www.iotaasia.com*	555 SSP Tower 1, 15th Floor, Soi Sukhumvit 63 (Ekamai) Sukhumvit Road, Klongton-Nua, Wattana, Bangkok 10110	MSW Management & Handling Technology/Biogas Technology - Products/Services: Wastewater treatment, Solid waste management, Gas holder
Supplier - Origin: EU Countries	ITALTHAI INDUSTRIAL CO., LTD.	2013 Italthai Tower New Petchburi Rd. Bangkapi Huaykwang Bangkok 10310	CHP Technology - Products/Services: Engines, gensets
Supplier	Jentrade Co. Ltd.	1128/24 Pracharat I Road, Bangsue, Bangkok 10800	Electrical system installation contractor; solar syst. designer; solar system installation contractor; solar system components manufacturer; electronic control syst. designer

Category / Origin	Name	Address	Capability / Technology
Supplier	K.M. Boiler Industry Co.,Ltd.	98/6 Sooksawad Rd. Prapadang, SamutPrakan 10130	Boiler Technology - Products/Services: Steam Turbine Dealer of HYWARD & Co-generator form England and High Pressure Steam Boiler
Supplier - Origin: Japan	K.Y. Intertrade Co., Ltd. *www.kyi.co.th*	55/17-18 Phyathai Road, Rajthewee, Bangkok 10400	Boiler Technology - Products/Services: MIURA steam boiler
Supplier - Origin: China	KENTFORD MACHINERY CO.,LTD.	3559/47 Praram III Road, Bangklo, Bangkolaem, Bangkok 10120	CHP Technology - Products/Services: Engines, gensets "TEMBER", China
Supplier	Kitti Boiler and Service Partnership	66/12 Soi Eakchai 30, Eakchai Road, Bangkhunthian, Bangkok 10150	Boiler Technology - Products/Services: Boilers
Supplier	Kitti Material Ltd., Part	128/6 Satupradit 6 Road Thungwatdon, Sathorn, Bangkok 10120	Boiler Technology - Products/Services: Boilers
Supplier	Leonics	119/51 Moo-8, Bangna-Trad Rd., Bangna, Bangkok 10260	Solar electric power systems, solar charge controllers, solar water pumping system components.
Supplier - Origin: USA	METRO MACHINERY CO.,LTD. *www.metrocat.com*	1760 Sukhumvit Road (between soi 52-54), Bangchak, Prakhanong, Bangkok 10250	CHP Technology - Products/Services: Engines, gensets "CATERPILLER"
Supplier - Origin: USA	MIN SEN MACHINERY CO.,LTD.	777 SSM Building, Mahachai Road, Wangburapa, Phranakorn, Bangkok	CHP Technology - Products/Services: Engines, gensets "CUMMINS"
Supplier /Service Provider	Mitthai Asia Group partnership	18/8 Pimpasut Namuang Road, Khon Kaen, Khon Kaen 40000	CHP Technology - Products/Services: Biomass energy systems, Gas turbine electric generators, Waste treatment systems, Biomass energy system components, Cogeneration systems, Composting systems
Supplier /Representative - Origin: EU Countries	MTU ASIA (THAILAND) LTD. *www.mtu-online.com*	1000/52-53 PB Tower 14th Fl., Sukimvit 71 Rd., Klongton-nua, Watana, Bangkok 10110	CHP Technology - Products/Services: Engines, gensets "MTU", diesel and gas engine
Supplier - Origin: Multi-National	NAMSANG CHAKKOL CO.,LTD.	33/25 M.7 Petchkasem Road, Nongkangplu, Nongkhaem, Bangkok 10160	CHP Technology - Products/Services: Engines, genset, sell & leasing
Supplier - Origin: Multi-National	NAMSANG ENGINEERING CO.,LTD. *www.namsang.com*	759 Praram 3 Road, Bangpongpang, Yannawa, Bangkok 10120	CHP Technology - Products/Services: Engines, gensets "CUMMINS", "STAMFORD" , "NIPPON SHARYO, CUMMINS, AIRMAN, DENYO"
Supplier	NICHE TECH (THAILAND) CO.,LTD.	662/53-54 Charansanitwong Road, Bangplad, Bangkok	CHP Technology - Products/Services: Engines, gensets "GOODWILL"

Category / Origin	Name	Address	Capability / Technology
Supplier	P & S Continental Trading Co Ltd	620/61 Sathupradit Bang Phongphang Yan Nawa, Bangkok 10120	Boiler Technology - Products/Services: Boilers
Supplier - Origin: Japan	P. SRIYONTR LTD., PART.	729/201 Charansanitwong Road, Bangplad, Bangkok	CHP Technology - Products/Services: Engines, gensets "HONDA"
Supplier	PATTANAYON CHONBURI CO., LTD.	40 Moo 13 Bangna - Trad Rd., Km.8 Bangkeaw, Bangplee, SamutPrakan 10540	CHP Technology - Products/Services: Engines, gensets
Supplier	Phadung Charoen Co., Ltd.	2382 New Phetburi Road Bangkapi, Huaikhwang, Bangkok 10310	Boiler Technology - Products/Services: Boilers
Supplier	Phicor International Co. Ltd.	28th Floor Vanish II Bldg., 1126/2 New Petchburi Road, Makkassan, Patchathevee, Bangkok 10400	
Supplier	Phitsanulok R. P. Service Co., Ltd.	99/26-27 Paongdam Road, Muang District, Phitsanulok 65000	
Supplier	PILLER (THAILAND) CO.,LTD.	51/142 M.7 Viphavadi Rangsit Road, Muang, Pathumthani	CHP Technology - Products/Services: Engines, gensets
Supplier	PO Group Co.,Ltd	52/83-84 Ramkhamhaeng Huamark, Bangkapi, Bangkok 10240	Boiler Technology - Products/Services: Boilers
Supplier	Pranee Phan Co. Ltd.	2159/11 Pranee Phan Bldg, Paholyothin Road, Ladyao, Jatujak, Bangkok 10900	Authorized distributor of "Solahart" solar water heater system; "Stiebel Eltron", and "Solar Lee" water heaters; 150-600 litre capacities
Supplier - Origin: EU Countries	PRASERT ALLIED LTD., PART.	57/1 M.8, Old Railway Road, Samrong-klang, Prapadang, SamutPrakan	CHP Technology - Products/Services: Engines and gensets "VOLVO PENTA
Supplier	PRIME POWER CO.,LTD.	17/3 Pradiphat Road, Samsen-nai, Phyathai, Bangkok	CHP Technology - Products/Services: Engines, gensets
Supplier	S. Paisan Steam Boiler Co., Ltd	309/37 Pattanakarn Road, Pravet, Bangkok 10250	Boiler Technology - Products/Services: Boilers
Supplier	S.C. Boiler Partnership	166/13 Moo.9 Soi 4 Sukumvit Rd. T. Pakkasa A. Muang SamutPrakan 10280	Boiler Technology - Products/Services: Boilers
Supplier	S.K.W. Steels Product Co., Ltd.	44 Mu 9 Soi Thepkranjana, T. Klongmaduae, A. Kratumbaen, Samut Sakhon	Boiler Technology - Products/Services: Boilers
Supplier	S.T.O.T. Co., Ltd.	40 Moo.10 Bangna-Trad Rd. Moo.4.5, Bangna, Bangkok 10260	Boiler Technology - Products/Services: Boilers

Category / Origin	Name	Address	Capability / Technology
Supplier	SAFEGUARD CONTROL SYSTEMS CO.,LTD.	35 C.S. Building, 1st Fl. Room No. 102, Surasak Road, Silom, Bangrak, Bangkok 10500	CHP Technology - Products/Services: Engines, gensets "SAFEGUARD"
Supplier	Scandinavian Pacific Co. Ltd.	51/137 Moo 1, Soi 2, Moo Ban Romsuk Villa 2 Sukhapiban Road, Bangkok 10110	
Supplier	SECO CO.,LTD.	319/50-51 Viphavadi Rangsit Road, Phyathai, Bangkok 10400	CHP Technology - Products/Services: Engines, gensets "AIRMAN"
Supplier - Origin: EU Countries	Siam Control Systems Co., Ltd.	559 Trok watchannai, Charoenrat Road, Bangklo, Bangkolaem, Bangkok 10120	CHP Technology - Products/Services: Engine Control & Synchronization Syst.
Supplier	Siam Solar and Electronics Co. Ltd.	62/16-25 Krungthep-Nothburi Road, Nonthaburi 11000	Installation and distribution of solar PV modules for rural and street lighting, water pumping, battery charging and other electrical appliances; inverters; battery charging controllers and indicators and other solar parts.
Supplier	Siam Triangle Co.,Ltd.	378 Soi Phahonyothin 52, Phahonyothin Rd., Khlongthanon, Saimai, Bangkok 10220	Solar charge controllers, solar electric power systems, DC lighting, Solar cell panels, photovoltaic modules, wind energy system components (small), solar outdoor lighting systems,Solar Traffic Controller
Supplier - Origin: Japan	SINO-THAI Intertrade Co., Ltd	SINO-THAI TOWER, FLOOR 29-30, 32/59-60 SUKHUMVIT 21 RD, Wattana, Bangkok 10110	Boiler Technology - Products/Services: Boilers (fire tube-water tube), hot water generator
Supplier - Origin: Local	SMV Metal Engineering Co., Ltd.	3094 Moo 15, Soi Sukhumvit 107, North Samrong Muang, SamutPrakan 10270	Boiler Technology - Products/Services: Boilers
Supplier	Solar Trading Co. Ltd.	599 Ladyha Rd, Klongsan, Bangkok 10600	
Supplier	Solarnet Co. Ltd.	3rd Floor Narayanaphand Pavilion Bldg., 127 Rajadamri Rd, Lumpini, Pratumwan, Bangkok 10330	Import and distribution of solar water heaters from Australia. All "Edwards" domestic solar hot water syst. (L180, L350H, L440, L600, L305 side pitch frame)
Supplier	Solartron Co. Ltd.	38 Chavanick Bldg., Soi Salanimit Sukhumvit 69, Bangkok	Distributor of solar system in Thailand
Supplier	Solarultra Co. Ltd.	50/11-12 Phaholyothin Road, Bangkhen, Bangkok 10120	Solar water heater manufacturer E39
Supplier	Solocell Intertrader Co. *www.solocellthai.com*	74/4 Pahonyotin 63Rd. Saimai, Bangkok 10220	LED lamps, Solar Street Light, Solar Garden Light, Solar Lighting Syst., Solar Home Syst., Solar Water Pumping Systems, Solar Panel Polycrystaline

Category / Origin	Name	Address	Capability / Technology
Supplier - Origin: EU Countries	SOUER Co., Ltd. *www.souer.co.th*	B.B. House, 99/10 M.5 Ban Klong, Muang, Phitsanulok 65000	CHP Technology - Products/Services: Waukesha gas engines, gensets and cogeneration, Ignition system and Control "Altronic"
Supplier	Spirax Sarco (Thailand) Co., Ltd	9Th Floor J.V.K. Bldg Ramkhamhaeng Road Huamak, Bangkapi, Bangkok 10240	Boiler Technology - Products/Services: Boilers
Supplier - Origin: EU Countries	Standardkessel (Thailand) Co., Ltd.	168 Sukhumvit Rd., Soi 8, Bangkok 10110	Boiler Technology - Products/Services: Boilers
Supplier	Sun Generation Thai *www.solarenergyasia.com*	8/31 Soi Pananchai, Nonggeh, Khao Takiab, Hua Hin, Prachuabkirikhan 77110	Solar Equipment, such as Solar garden Lights, Solar Street lights , Solar Water Heaters and Solar powered Water pumps.
Supplier	T.K.K. ENGINEERING CO.,LTD.	759 Praram 3 Road, Bangpongpang, Yannawa, Bangkok 10120	CHP Technology - Products/Services: Engines, gensets "AIRMAN, STAMFORD", sell and leasing
Supplier - Origin: EU Countries	Thai Burner Industrial Supply Partnership	168 Soi 8, Sukhumvit Road, Klongtoei, Bangkok 10110	Biogas Technology - Products/Services: Oil burner, Biogas-NG burner "Weishaupt"
Supplier	THAI DYNAMAC (1991) CO.,LTD.	98 M.14 Taiban Road, Muang, SamutPrakan 10280	CHP Technology - Products/Services: Engines, gensets "MWM"
Supplier	THAI GENT CO.,LTD.	99/37 Soi Thesabarn Rangrak-Nua, Ladyao, Chatuchak, Bangkok 10900	CHP Technology - Products/Services: Engines, gensets, 5-500 KVA
Supplier - Origin: EU Countries	THAI INTERTELECOM CO.,LTD.	236 Bripat Road, Banbat, Pomprab, Bangkok 10100	CHP Technology - Products/Services: Engines, gensets "PERKIN, VOLVO"
Supplier	THAI MAXWELL ELECTRIC CO.,LTD. *www.thaimaxwell.co.th*	32/7 M.1 Soi Watteinsod, Petchkasem Road, Sampran, Nakhonprathom 73110	CHP Technology - Products/Services: Engines, gensets "MAXWELL"
Supplier	THAI SENG NGUAN MACHINERY CO.,LTD.	64-70 Soi Sukorn 1, Treemit Road, Samphanthawong, Bangkok 10100	CHP Technology - Products/Services: Engines, gensets "T.S.N."
Supplier /Service Provider	Thai Steam Service & Supply Co., Ltd. *www.thaisteam.co.th*	754/31-32 Soi Sukhumvit 101 Sukhumvit Road Bangjak, Prakhanong, Bangkok 10260	Boiler Technology - Products/Services: Boilers
Supplier	THAI SWITCHBOARD AND METAL WORK CO.,LTD.	117 M.6 Suksawad 78 Road, Bangchak, Prapadang, SamutPrakan 10130	CHP Technology - Products/Services: Engines, gensets "TAMCO"
Supplier	THAI-GENERATOR & ENGINEERING CO.,LTD.	119/31 M.8, 15th Fl. Bangnathani Building, B 1 room, 3rd km Bangna-Trad Road, Prakhanong, Bangkok 10200	CHP Technology - Products/Services: Engines, gensets "THAI-GEN"

Category / Origin	Name	Address	Capability / Technology
Supplier	THAIROONGROJ PHISAN CO.,LTD.	21/587-589 M.12, 2nd km Bangna-Trad Road, Phrakhanong, Bangkok 10200	CHP Technology - Products/Services: Engines, gensets
Supplier	THAIYONT ENGINEERING	3706 Praram IV Road, Klongton, Klongtoei, Bangkok 10110	CHP Technology - Products/Services: Engines, gensets
Supplier	THANASIN INDUSTRIAL CO.,LTD.	71/27 Soi Khlomruedi, Chomthong Road, Bangkok 10150	CHP Technology - Products/Services: Engines, gensets "NC"
Supplier	THARIKAN CO.,LTD.	3435 Soi Ladprao 101, Klongchan, Bangkapi, Bangkok 10240	CHP Technology - Products/Services: Engines, gensets "KOHLER"
Supplier - Origin: Local	Therm Engineering Co., Ltd. *www.therm-eng.com*	11/71-72 Moo 4, Chang Akat-uthit Rd, Seekan, Donmuang, Bangkok 10210	CHP Technology, MSW Management & Handling Technology - Products/Services: Engines, gensets "DMC", Waste Burner
Supplier	TRANE INTERNATIONAL Co., Ltd.	13 Krungthonburi 4 Road, Klongsan, Bangkok 10600	CHP Technology - Products/Services: Engines, gensets "GOODWILL, HITACHI"
Supplier	U GEN CO.,LTD.	288/21 Surawong Road, Bangrak, Bangkok	CHP Technology - Products/Services: Engines, gensets "PETBOW"
Supplier	USA Economic Development Co., Ltd.	56/7 Prachachune Road, Thungsonghong, Bengkhen, Bangkok 10900	Manufacturer and distributor of windmill for water pumping and briquetting machine
Supplier /Service Provider - Origin: EU Countries	Wastekleen Thailand *www.wastekleen.com*	Room A10 3rd Fl. Racquet Club, 8 Soi Prachanakadee (Sukhumvit 49) Klong Ton Nua, Wattana, Bangkok 10110	MSW Management & Handling Technology - Products/Services: Composting systems, biomass energy systems, biogas systems for MSW, wastewater biogas systems, aerobic composting systems, biodiesel plants.

Annex E: Directory of potential sources of funding for CDM projects

Organization	Finance type(s)	Technology type(s)
500 PPM emission reduction procurement for retail	Carbon Finance	Energy Efficiency, Bioenergy, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Actis Energy Fund	Private Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Al Tayyar Energy	Private Equities	Bioenergy, Small hydropower, Solar (PV and Thermal), Wind
Aloe Private Equity	Private Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Aon Global Risk Consultants Ltd.	Insurance	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
ASC - Energy Finance	Debt Capital	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Asian Development Bank (ADB)	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
ASN Milieufonds	Public Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
BASF Venture Capital	Private Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Solar (PV and Thermal), Fuel Cells
Blue Hill Partners	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Carboncredits.nl	Carbon Finance	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
CDC Group plc	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
CeCap LLP	Private Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
China Environment Fund	Private Equities	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Climate Investment Partnership	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
CO2e	Other	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Conduit Ventures Fund	Private Equities	Energy Efficiency, Solar (PV and Thermal), Fuel Cells
Consensus	Private Equities	Energy Efficiency, Cleaner Fuels, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Cornell Capital	Other	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells

Organization	Finance type(s)	Technology type(s)
DEG German Investment and Development Company	Debt Capital	Energy Efficiency, Bioenergy, Small hydropower, Wind
Development Bank of the Philippines	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
E+Co	Debt Capital / Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Eksport Kredit Fonden (EKF)	Export Credits	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Energy & Infrastructure Investment SCA	Debt Capital	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Energy Ventures Group (EVG)	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
EnviroTech Financial, Inc	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Envisory GmbH	Debt Capital	Bioenergy, Geothermal, Solar (PV and Thermal), Wind
European Carbon Fund	Carbon Finance	Energy Efficiency, Cleaner Fuels, Geothermal, Solar (PV and Thermal), Wind
European Investment Bank (EIB)	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Export Credits Guarantee Department (ECGD)	Export Credits	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Export Development Corporation (EDC)	Export Credits	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Export Finance and Insurance Corporation (EFIC)	Export Credits	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Export Import Bank of Japan (JEXIM)	Export Credits	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
FMO	Debt Capital / Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Global Environment Fund	Private Equities	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Good Energies Inc.	Private Equities	Solar (PV and Thermal), Wind
IFC Photovoltaic Market Transformation Initiative	Debt Capital	Solar (PV and Thermal)
IFC-Netherlands Carbon (CDM) Facility(INCaF)	Carbon Finance	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Wind
Impax Environmental Markets funds	Public Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
India Renewable Energy Enterprise Development Fund (IREED)	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
International Finance Corp., Environmental Finance Group and Power Department	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Jane Capital Partners LLC	Private Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells

Organization	Finance type(s)	Technology type(s)
Japan Carbon Finance, Ltd.(JCF)	Carbon Finance	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
KfW Carbon Fund	Carbon Finance	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Meridian Finance Group	Debt Capital	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Merryll Lynch New Energy Technology plc.	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Miller Insurance Group	Insurance	Wind
Multilateral Investment Guarantee Agency (MIGA)	Insurance	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
New Alternatives Fund	Public Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
New Energies Invest AG (Bank Sarasin + Cie)	Private Equities	Energy Efficiency, Bioenergy, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
New Energy Fund LP	Public Equities	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
OCM/GFI Power Opportunities Fund	Private Equities	Energy Efficiency
OIKOCREDIT	Microfinance	Solar (PV and Thermal)
Private Energy Market Fund LP (PEMF)	Private Equities	Bioenergy, Wind
Prototype Carbon Fund (PCF)	Carbon Finance	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Rabo Sustainability Fund	Funds of Funds	Energy Efficiency
Rabobank India Finance	Debt Capital	Bioenergy, Small hydropower, Wind
Renewable Energy Equity Fund, Australia	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Renewable Energy for Rural Economic Development Project	Microfinance	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
RNK Capital LLC	Carbon Finance	Energy Efficiency, Cleaner Fuels, Bioenergy, Small hydropower, Wind
	Debt Capital	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Robeco Milieu Technologie	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Royal Sun Alliance UK Office	Insurance	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Svensk Exportkredit (SEK) - Sweden	Export Credits	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
Swedish International Climate Investment Programme (SICLIP)	Carbon Finance	Energy Efficiency, Bioenergy, Wind

Organization	Finance type(s)	Technology type(s)
Swiss Re	Insurance	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
The Finnish CDM/JI Pilot Programme	Carbon Finance	Energy Efficiency, Cleaner Fuels, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
The Global Environment Facility (GEF)	Other	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
The Global Resources Society Fund	Public Equities	Energy Efficiency
Triodos International Fund Management BV	Private Equities	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind, Fuel Cells
Triodos Renewable Energy for Development Fund	Debt Capital	Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
UBS (Lux) Equity Fund Future Energy	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
VENCON MANAGEMENT, INC.	Microfinance	Energy Efficiency, Cleaner Fuels, Bioenergy, Solar (PV and Thermal), Wind, Fuel Cells
Verde Ventures, Conservation International	Debt Capital	Energy Efficiency
Warburg Pincus	Private Equities	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
West LB	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind
World Bank Asia Alternative Energy Programme (ASTAE)	Debt Capital	Energy Efficiency, Bioenergy, Geothermal, Small hydropower, Solar (PV and Thermal), Wind

Source: Sustainable Energy Finance Directory (www.sef-directory.net/search.php)

Commercial Banks registered in Thailand

No.	BANK	IBF LICENSE	ADDRESS
1.	BANGKOK BANK PUBLIC COMPANY LTD. http://www.bangkokbank.com/	Yes	333 Silom Rd., Surawongse, Bangrak, Bangkok 10500Tel. +66 (0) 2231-4333 Fax. +66 (0) 2236-8281-2
2.	KRUNG THAI BANK PUBLIC COMPANY LTD. http://ktb.co.th/	Yes	35 Sukhumvit Rd., North Klongtoey, Bangkok 10110 Tel. +66 (0) 2255-2222 Fax. +66 (0) 2255-9391-6
3.	BANK OF AYUDHYA PUBLIC COMPANY LTD. http://www.bay.co.th/	Yes	1222 Rama III Rd., Bangpongpang, Yannawa, Bangkok 10120 Tel. +66 (0) 2296-2000 Fax. +66 (0) 2683-1484
4.	KASIKORNBANK PUBLIC COMPANY LTD. (name change from THAI FARMERS BANK PUBLIC COMPANY LTD. 8 April 2003) http://www.kasikornbank.com/	Yes	1 Soi Kasikornthai, Ratburana Rd., Ratburana, Bangkok 10140 Tel. +66 (0) 2470-1122, +66 (0) 2470-1199 Fax. +66 (0) 2470-1144 -5
5.	TMB BANK PUBLIC COMPANY LTD. (name change from THE THAI MILITARY BANK PUBLIC COMPANY LTD. 9 May 2005) http://www.tmbbank.com/	Yes	3000 Phaholyothin Rd., Ladyao, Chatuchak, Bangkok 10900 Tel. +66 (0) 2299-1111 Fax. +66 (0) 2299-1784
6.	BANKTHAI PUBLIC COMPANY LTD. http://www.bankthai.co.th/	No	44 North Sathorn Rd., Silom, Bangrak, Bangkok 10500Tel. +66 (0) 2633-9000-3, +66 (0) 2638-8000 Fax. +66 (0) 2633-9026
7.	THE SIAM COMMERCIAL BANK PUBLIC COMPANY LTD. http://www.scb.co.th/	Yes	9 Ratchadaphisek Rd., Ladyao, Chatuchak, Bangkok 10900 Tel. +66 (0) 2544-1111, +66 (0) 2937-7777 Fax. +66 (0) 2937-7454
8.	SIAM CITY BANK PUBLIC COMPANY LTD. http://www.scib.co.th/	Yes	1101 New Petchburi Rd., Makkasun, Rajthevi, Bangkok 10400 Tel. +66 (0) 2208-5000 Fax. +66 (0) 2253-1240
9.	UNITED OVERSEAS BANK (THAI) PUBLIC COMPANY LTD. (name change from BANK OF ASIA PUBLIC COMPANY LTD. 28 November 2005) http://www.uob.co.th/	Yes	191 South Sathorn Rd., Tungmahamek, Sathorn, Bangkok 10120 Tel. +66 (0) 2343-3000 Fax. +66 (0) 2287-2973-4

Specialized Financial Institutions

No.	FINANCIAL INSTITUTIONS	ADDRESS
10.	EXPORT- IMPORT BANK OF THAILAND (EXIM) www.Exim.go.th	1193 Exim Building, Phaholyothin Rd., Samseannai, Phayathai, Bangkok 10400 Tel. +66 (0) 2278-0047, +66 (0) 2271-3700, +66 (0) 2617-2111 Fax. +66 (0) 2271-3281
11.	SMALL AND MEDIUM ENTERPRISE DEVELOPMENT BANK OF THAILAND (SME Bank) http://www.smebank.co.th/ (changed from Small Industrial Finance co.(SIFC))	9th floor Siripinyo Building, 475 Sri Ayuthaya Rd., Rajthevi, Bangkok 10400 Tel. +66 (0) 2201-3700 Fax. +66 (0) 2201-3723-34

Source: Divina Marisa Nidhiprabha, Monaliza Todoc. *Increasing Access to Local Sources of Financing for Renewable Energy Investments and Design of Innovative Financing Instruments: Case Study in the Philippines, Exchanging Experiences with Thailand, and Applicability of European Approaches,* June 2006.

Annex F: Questionnaire – Summary of results

Annex F.1. Questionnaire for financing institutions

I.	Profile of the organization	
1. Type(s) of activities related to CDM:	☐ Promoter of public awareness on CDM:	0/1
	☐ Research and Development:	0/1
	☐ Consulting:	0/1
	☐ Due Diligence:	0/1
	☐ Financing of CDM projects:	1/1
	☐ Provider of credit enhancement and guarantees:	0/1
	☐ Owner of infrastructures applying for CDM:	0/1
	☐ Manager of infrastructures applying for CDM:	0/1
	☐ CDM consulting services (PDD/PIN) :	1/1
	☐ Cooperation with Equity Funds for overall CDM cycle:	1/1
2. What type(s) of CDM projects does your organization support?	☐ Renewable energy-based power generation projects:	1/1
	☐ Energy efficiency projects:	0/1
	☐ Others (please specify) :	0/1
3. Does your organization plan to develop (already develops) CDM projects outside Thailand?	☐ Yes:	0/1
	☐ No:	1/1
4. In the development of how many CDM projects has your organization been already involved (in Thailand and elsewhere)?	☐ 1-5 Projects:	0/1
	☐ 5-10 Projects:	0/1
	☐ Over 10 projects:	0/1
5. Do you (would you) lend to non-Thai organizations interested in developing CDM projects in Thailand?	☐ Yes:	1/1
	☐ No:	0/1
6. What are (would be the criteria) for you to provide loans to such foreign organizations (for the development of CDM projects in Thailand)	☐ Annual turnover (how much?):	0/1
	☐ Annual benefit ratio (how much?):	0/1
	☐ Debt to capital ratio (how much?):	0/1
	☐ Years of operating experience at international level (how much?):	0/1
	☐ Years of specific experience in Thailand (how much?):	0/1
7. What aspects of CDM projects does (would) your organization provide loans/services for?	☐ Construction period plus operation period:	1/1
	☐ Construction period only:	0/1
8. What is (would be) the typical operational period of your loans for CDM projects?	☐ 3-5 years:	0/1
	☐ 5-10 years (not more than 7 years) :	1/1
	☐ 10-14 years:	0/1
	☐ > 14 years:	0/1

II.	Decision criteria / loaning process	
1. What are the documents that you require for you to consider providing a loan for a CDM project	☐ Feasibility Study (technical + economic): *BIG PROJECTS*: 1/1 ☐ Plant Permits: 0/1 ☐ Power Purchase Agreement or Energy Conversion Agreement : 0/1 ☐ Emissions Reduction Purchase Agreement (ERPA) : 0/1 ☐ Annual Report of Sponsors (besides the borrower) : 0/1 ☐ Environmental study: 1/1 ☐ Complete financials of power purchaser: 0/1 ☐ Supplementary guarantee by the Government, in case the Power purchaser is State owned entities: 0/1 ☐ Term sheet for loan: 0/1 ☐ Loan Agreement Document: 0/1 ☐ All of the others: 0/1 ☐ More (please specify) : 0/1	
2. Do you (would you) have these information cross-checked by the internal staff of your organization?	☐ Yes: 0/1 ☐ No: 1/1 *(EXCEPT FOR NEW TECHNOLOGIES SUCH AS ETHANOL PRODUCTION BASED ON KASSAVA)*	
3. What do you expect is the typical time requirement for approval of a loan, assuming the basic supporting documents (as referred to above) are provided?	☐ 1-2 months: 1/1 *(3 WEEKS – 2 MONTHS. FASTER FOR CORPORATE FINANCE)* ☐ 3-6 months: 0/1 ☐ 7-12 months: 0/1 ☐ More than 1 year: 0/1	
Usually, what are the main delaying factors slowing down such approval?	No answer provided	
4. For a CDM project, what currency would you prefer the loan to be denominated in:	<u>Construction</u> (several choices possible) ☐ THB : 0/1 ☐ US $: 0/1 ☐ EURO : 0/1 ☐ Indifferent: 1/1	<u>Operation</u> (several choices possible) ☐ THB : 0/1 ☐ US $: 0/1 ☐ EURO : 0/1 ☐ Indifferent : 1/1
5. What is the approximate <u>smallest</u> size loan you deem commercially viable for a loan for a CDM project?	<u>Construction</u> ☐ Less than 1 million US$ *(5 MILLION BAHT)* 1/1 ☐ 1-5 million US$: 0/1 ☐ 6-10 million US$: 0/1 ☐ 11-25 million US$: 0/1 ☐ Over 25 million US$: 0/1	<u>Operation</u> ☐ Less than 1 million US$: 0/1 ☐ 1-5 million US$: 0/1 ☐ 6-10 million US$: 0/1 ☐ 11-25 million US$: 0/1 ☐ Over 25 million US$: 0/1

II. Decision criteria / loaning process (continued)		
6. What is the approximate <u>largest</u> size loan you deem commercially viable for a loan for a CDM project?	<u>Construction</u> ☐ Less than 1 million US$: 0/1 ☐ 1-5 million US$: 0/1 ☐ 6-10 million US$: 0/1 ☐ 11-25 million US$: 0/1 ☐ Over 25 million US$: 1/1	<u>Operation</u> ☐ Less than 1 million US$: 0/1 ☐ 1-5 million US$: 0/1 ☐ 6-10 million US$: 0/1 ☐ 11-25 million US$: 0/1 ☐ Over 25 million US$: 0/1
7. What criteria would determine the size of a loan you could provide for a CDM project?	☐ Project collateral: 0/1 ☐ Debt service coverage ratio: 0/1 ☐ Debt to capital ratio: *(NO LOAN BASED)* 0/1 ☐ All of the above: *(ON THE CDM ASPECT)* 0/1 ☐ Evaluated on a case by case basis: 0/1	
8. What is the minimum debt service coverage ratio (DSCR) that you would consider as acceptable?	☐ Minimum DSCR of 1.2-1.4: 0/1 ☐ Minimum DSCR of 1.4-1.6: 0/1 ☐ Minimum DSCR of 1.6 – 2.0: 0/1 ☐ Evaluated on a case by case basis: 1/1	
9. What is the minimum debt to capital ratio that that you would consider as acceptable?	☐ Maximum Debt/Project Cost of 90%: 0/1 ☐ Maximum Debt/Project Cost of 80%: 0/1 ☐ Maximum Debt/Project Cost of 70%: 0/1 ☐ Maximum Debt/Project Cost of 60%: 0/1 ☐ Evaluated on a case by case basis: 0/1	
10. What type of project risks do you (would you) take into account when considering providing a loan for a CDM project?	☐ Construction costs overrun: 0/1 ☐ Construction delays (*i.e.* delayed availability of CERs): 0/1 ☐ Resource risk (wind speeds, river flows, biomass supply, etc.): 0/1 ☐ Technology perf. (actual energy savings – emissions avoided, etc., *i.e.* CERs actually generated): 0/1 ☐ Currency risk: 0/1	
11. What complementary guarantees do you require to address these project risks?	☐ Fixed price turnkey Engineering Procurement and Construction Contract (EPC): 0/1 ☐ Provision for the payment of liquidated damages by the Contractor: 0/1 ☐ Insurance: 0/1 ☐ Long-term contract between the biomass producer and the project in case of a biomass-based project: 0/1 ☐ Others (please specify): 0/1	
12. Do you (would you) provide loans for projects which income is solely or mostly based on CERs sales?	☐ Yes: 0/1 ☐ No: 1/1	

- Comments: 1 questionnaire was returned
- Additional comment: "CDM is marginal in the decisions of the Bank to provide loans. Due to high level of uncertainty, CDM is not considered as part of the income when financing the project"

3 other questionnaires to be included once formatted