CHAPTER II

LITERATURE REVIEW

2.1 Introduction

One major issue that researcher must consider is the arrangement of the principles, concepts and scientific term used during discussion. This chapter is to review literatures which were done and have some content being able to use in this research.

2.2 Principle Clean Development Mechanism (CDM)

Many studies of CDM and waste management have been done previously, and the whole studies are very useful as guidance for this research. For principle of CDM has been reviewed from **Baseline Methodologies for Clean Development Mechanism Projects**, UNEP RisØ Center, **CDM Guide for Thailand**, Institute for Global Environment Strategies, and **Carbon transaction Costs and Project viability**, A Climate Change Project Office Guide. This item has an intention to introduce the basic principle of CDM. These literatures contain complete information of the basic principles of CDM. Hence almost literature reviews for this item will refer to these stuffs as shown in following paragraph.

2.3 Overview of the Clean Development Mechanism

The CDM is one of three mechanisms in the Kyoto Protocol where Annex-1 countries with a specific responsibility to reduce a set amount of greenhouse gas (GHG) emissions by 2012 and assist non-Annex 1 countries to implement project activities to reduce or absorb at least one of six GHGs. Non-Annex1 countries are signatories and ratifiers to the Kyoto Protocol. The reduced amount of GHGs becomes credites called "Certified Emission Reductions (CERs)", which Annex-1 can use to help their emission reduction targets under the protocol.

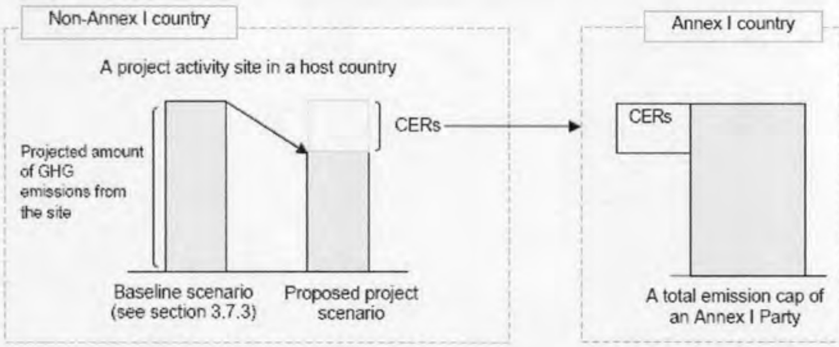

FIGURE 2-1: Diagram of how the CDM functions

(Source: the CDM country Guide for Thailand, p.43)

2.4 CDM Project Criteria and Eligible CDM Projects

As mentioned, CDM is a project-based mechanism. An important objective of the CDM is to assist developing countries achieve sustainable development. The responsibility for evaluating the sustainable development contribution of proposed CDM project activities rest with the host. Therefore, in addition to other global CDM criteria, CDM project activities should also satisfy criteria for a sustainable development contribution as defined by the host country's government.

The three global CDM criteria as outlined in Paragraph 5, Article 12 of the Kyoto Protocol are:

1. The participation of country governments of respective partners in the CDM is voluntary.
2. The projects result in real, measurable, and long term benefits related to mitigation of climate change.
3. The reduction in GHG emissions from the CDM projects should be additional to any that would occur in the absence of the CDM (This is referred to as the additionality criterion).

"Mitigation of climate change" in criterion 2 refers to reducing the increases in greenhouse gases (GHGs) concentration in the atmosphere, which are the cause of long term changes in the climate, and to stabilizing the GHG concentration in the atmosphere. The reduction in concentration of GHGs in the atmosphere can be achieved through reduction of GHG emissions or absorption of GHGs from atmosphere and storing them in a medium. The latter is referred to as sequestration.

Project activities that result in reducing emissions of one or more of the six GHGs are eligible for CDM. These project activities may reduce GHGs from energy use and production (fuel combustion and fugitive emissions from fuel), industrial processes, use of solvents and other products, the agriculture sector, and waste management. Projects that sequester (store) carbon in biomass, through afforestation and reforestation activities, are also eligible under CDM. The following types of GHG mitigation or sequestration projects and activities can be eligible for CDM:

- Renewable energy technologies
- Energy efficiency improvements- supply side and/ or demand side
- Fuel switching (e.g., coal to natural gas or coal to sustainable biomass)
- Combined heat and power (CHP)
- Capture and destruction of methane emissions (e.g. from landfill sites, oil, gas and coal mining)
- Emissions reduction from such industrial processes as manufacture of cement
- Capture and destruction of GHGs other than methane (N_2O, HFC, PFCs and SF_6)
- Emission reductions in the transport sector
- Emission reductions in the agricultural sector
- Afforestation and reforestation
- Modernization of existing industrial units/ equipment using less GHG intensive- practices/ technologies (retrofitting)
- Expansion of existing plants using less GHG intensive- practices/ technologies (Brownfield projects)
- New construction using less GHG- intensive practices/ technologies (Greenfield projects)

Criterion 3 states that the proposed CDM project activity should not only result in reduction (sequestration) of GHG, but in reductions beyond those that would have occurred in the absence of the CDM project activity. Even in the absence of CDM, an economy is likely to witness a move towards more efficient energy use and increased renewable energy use. These activities also result in GHG emissions reductions. Therefore, for a project to be an eligible CDM project, the GHG reductions should be greater than or additional to the GHG reductions that are expected to occur in any case. This is also the aspect alluded to by "real" in criterion 2.

"Measurable" reduction implies that a proposed CDM project should result in reductions that can be physically verified.

"Long term benefits" of reduction imply that CDM should result in adoption of practices/ technologies that result in a long term trend toward lowering of GHG emissions in the economy. The CDM projects should affect the way energy is produced and/ or consumed in the host country economy or should affect a shift towards less carbon intensive energy sources.

While reviewing the above listed categories for eligible CDM projects that use particular processes/ technologies, it is important to underscore that these must be processes or technologies that are not expected to be used in similar projects in the normal course in the economy. For example, though wind energy projects result in zero GHG production, they can not be eligible for CDM if wind energy projects are already common in a host country and the proposed CDM project is similar to existing wind projects. In such case, one would expect that the proposed wind energy project would have been implemented even in the absence of CDM. But, if the proposed CDM project is being implemented in, say, a low wind area where in the past no similar projects were implemented, reductions from the proposed project might then be considered additional.

2.5 Baseline and its Context in CDM

As mentioned, CDM projects should result in "measurable" reductions in GHG. Since CDM projects would result in non-negative reductions of GHG emissions, the concept of "measurable" reduction is based on a comparison with some defined level of GHG emissions. This comparative level, against which the reduction of GHG emissions due to a CDM project are measured, is termed a "baseline". The Marrakech Accord defines the baseline for a CDM project activity as "the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity". Therefore, the baseline is emissions that would have occurred in the absence of CDM project activity. The proposed CDM project will result in reduction of GHG emissions only if the GHG emissions from the proposed CDM projects are lower than the baseline.

The scenario defining likely activities/ sources of GHG emissions in the absence of a CDM project activity is commonly referred to as the baseline scenario. The term baseline refers to the level or quantity of GHG emissions of an activity or source of emission in the baseline scenario. For example, consider a proposed CDM project for methane gas capture and flaring from municipal solid waste (MSW) disposal landfill site. Disposal of MSW in landfills results in emission of methane, which is a GHG. In the absence of the CDM project, no action is expected to be taken either to reduce the methane from the MSW landfill site or to capture the methane generated. Therefore, the baseline scenario represents the level of methane generated from MSW disposal in the landfill without the measures for its capture. The baseline for the project is the quantity of methane generated at the MSW disposal in the landfill site.

As defined in Section 2.4, a key criterion for CDM project activities is that emission reduction (sequestration) from CDM project should be additional to any that would occur in the absence of CDM project activities. The baseline scenario helps establish whether the proposed CDM project activity would have been implemented in the absence of CDM and, hence is a test of project's *additionality*. The baseline provides the basis for determining whether GHG emissions (sequestration) from the proposed project are lower (or greater) than the emission (sequestration) in the absence of the project; that is, whether the CDM project reductions are additional. The baseline scenario and the baseline are thus the bases for testing whether the CDM project activity meets the additionality criterion.

2.6 Baselines- Key Elements and Concepts

The baseline, as discussed above, is the level or quantity of emissions in the baseline scenario as a projection of activities in the future that are likely to occur in the absence of the proposed CDM activities. Thus the baseline and the baseline scenario are hypothetical in nature and depend on a number of factors, such as demand for services of the type produced by proposed CDM project, availability of various resources to implement the activity, environmental and other policies relevant to the project activity, etc. Therefore, there is a possibility of multiple baselines for given proposed CDM project due to the subjectivity involved in interpreting the trends of various factors that influence decisions in the choice of alternatives to the proposed CDM project. To narrow down these subjectivities and provide a common understanding of important aspects to be taken into account while establishing baselines, the modalities and procedures fro CDM, in the Marrakech Accord, give guidelines for establishing the baseline. These guidelines highlight the key concepts for establishing baselines.

2.6.1 Key Concepts for Baselines

This section presents the important concepts related to establishing baselines based on the guideline in Marrakech Accord

- A baseline should be defined on a project-specific basis. It should be prepared taking into account relevant national and/ or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector.
- A baseline should cover emissions of all the gases, from all sectors and source categories within the project boundary.
- The project boundary should encompass all anthropogenic emissions by sources of greenhouse gases: (i) under the control of project participants; (ii) that are significant; and, (iii) that are reasonably attributable to the CDM project activity.
- Reductions in anthropogenic emissions by sources within the project boundary, measured from the baseline emissions, should be adjusted for *leakage*.
- Leakage is defines as the net change in anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which are measurable and attribute to the CDM project activity.
- Choices of approach, assumptions, methodology, parameters, data sources, key factors and additionality for developing a baseline should

be transparent and should result in a conservative estimate of baseline emissions taking account of uncertainties.

- The baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host country.
- The baseline should be defined in a way that CERs cannot be earned for decreases in activity levels outside the project boundary or due to force majeure.
- Three baseline approaches have been recommended for choosing a baseline methodology. The project participants should select the most appropriate of the three approaches to develop the baseline methodology for their project.
- Project participants shall select a crediting period for a proposed project activity from one of the following alternative approaches: (a) maximum of seven years which may be renewed at most two times, provided that, for each renewable, a designated operational entity determines and informs the CDM-EB that the original project baseline is still valid or has been updated taking account of new data where applicable; or, (b) a maximum of ten years with no option for renewal.
- All information used by project participants to determine additionality, to describe the baseline methodology and its application, and to support an environmental impact assessment for the project must be made public and shall not be considered as proprietary or confidential.

Project proponents should establish the baseline for proposed CDM project using these guidelines. The method/ process for establishing the baseline (i.e., the baseline methodology) have to be approved by the CDM-EB prior to its use for establishing a baseline.

2.6.2 Establishing Baselines- The key Elements of a Baseline Methodology

The baseline methodology describes the procedure/ formulae/ algorithm to establish the baseline and assess additionality of the proposed CDM project. The

Marrakech Accord guidelines for establishing baselines suggest that in the process of establishing a baseline, the project boundary, the baseline scenario, and leakage from implementation of proposed CDM project activity should be established. Therefore, a baseline methodology is a description of the process of establishing a project boundary, identifying the baseline scenario, steps to prove additionality, step for estimating emissions and steps for identifying and establishing leakage. The six key elements of a baseline methodology are presented in detail below.

1. Applicability of the baseline methodology

Applicability of baseline methodology defines the conditions under which the baseline methodology can be used to establish a project specific baseline. The conditions provide the context within which the methodology is applied. Further, a baseline is project specific. However, the methodology used to develop the baseline for a project may be usable for other projects of similar nature. For example, a baseline methodology developed for landfill gas capture CDM project in a country could be applicable to similar projects in other countries. Each methodology, as it exists, is developed with a specific proposed CDM project in mind. These projects address very specific measures for reducing GHGs, and operate in given sectoral conditions/ characteristics under a given set of policies/ regulations. Some or all of these factors affect the baseline scenario and, hence, the baseline. These conditions define the circumstances under which the baseline methodology can be used. Some of the conditions can be parameterized and included in the formulae; such conditions do not restrict the application of the methodology. For example, in the case of the methane capture and flaring project discussed above, the project is established in a country where there are no regulations for capturing and flaring methane. If the baseline emission estimation includes a parameter to represent the fraction of methane to be captured in the baseline as required by law, then the baseline methodology can also be used in countries where there are regulations for capturing and flaring methane. On the other hand, if such a parameter is not included, then the methodology is applicable only to countries where there are no regulations for capturing and flaring methane.

Another important constraining factor could be availability of data for use of a baseline methodology. If the data used in the methodology to estimate emissions, baseline, project or leakage are not available in the case of a project, then the methodology is not applicable to that project. The substitution of different sources or types of data for what was stated in the original methodology implies modification of the methodology, which is not permitted.

Description of these applicability conditions helps the evaluation of the baseline methodology. Table 2-1 presents examples of applicability conditions described in baseline methodologies already approved by the CDM Executive Board.

Methodology	Applicability Conditions
AM0001[7] Incineration of HFC 23 Waste Streams	• The methodology is applicable to any HCFC production facility producing HFC 23 (CHF_3) waste streams that is based in a non-Annex I country. • It is applicable only if there are no regulations restricting the HFC 23 emissions from HCFC production facilities in the country.
AM0002: Greenhouse Gas Emission Reductions through Landfill Gas Capture and Flaring, where the Baseline is established by a Public Concession Contract	This methodology is applicable to landfill gas capture and flaring project activities where: • There exists a contractual agreement that makes the operator responsible for all aspects of the landfill design, construction, operation, maintenance and monitoring; • The contract was awarded through a competitive bidding process; • The contract stipulates the amount of landfill gas (expressed in cubic meters) to be collected and flared annually by the landfill operator; • The stipulated amount of landfill gas to be flared reflects performance among the top 20% in the previous five years for landfills operating under similar social, economic, environmental and technological circumstances; and, • No generation of electricity using captured landfill gas occurs or is planned.
AM0003: Simplified Financial Analysis for Landfill Gas Capture Projects	This methodology is applicable to landfill gas capture project activities where: • The captured gas is flared; or, • The captured gas is used to generate electricity, but no emission reductions are claimed for displacing or avoiding electricity generation by other sources. • It is applicable only where there are only two plausible alternatives, a business-as-usual scenario (with minor changes and modifications) and the technology used in the proposed project. In other words, the methodology is inapplicable where a plausible alternative is a substantial change in practice or technology different from the proposed technology.
AM0004: Grid-connected Biomass Power Generation that avoids Uncontrolled Burning of Biomass	This methodology is applicable to biomass-fired power generation project activities displacing grid electricity that: • Use biomass that would otherwise be dumped or burned in an uncontrolled manner; • Have access to an abundant supply of biomass that is unutilized and is too dispersed to be used for grid electricity generation in the baseline scenario; • Have a negligible impact on plans for construction of new power plants; • Are not to be connected to a grid with suppressed demand; • Have a negligible impact on the average grid emissions factor; and, • Where the grid average carbon emission factor (CEF) is lower (and therefore more conservative as the baseline) than the CEF of the most likely operating margin candidate.

TABLE 2-1: Examples of Applicability Conditions of Approved Baseline Methodologies

2. The baseline scenario

The baseline scenario describes the activities that would have been implemented in absence of the proposed CDM project. The guidance on baseline, discussed in section 2.6.1, suggests that identification of baseline scenario should capture the likely changes in the project sector/ economy due to the national and sectoral policies. For example, selection of baselines for energy efficiency and renewable CDM projects in countries where improvement of energy efficiency and promotion of renewable energy are already part of national energy policy could be different from that in countries where such policies either do not exist or may not be implemented. Moreover, economic and demographic parameters selected in the methodology should be consistent with that provided in national and sectoral policy documents.

3. Baseline approaches

Three baseline approaches, described below, have been recommended by the Marrakech Accord in the guidelines for establishing baselines.

1. The first approach involves existing actual or historical emissions (hereafter "Approach A"). This is applicable to cases where the analysis of the baseline scenario indicates that the most likely activities implemented in absence of the proposed CDM project is the continuation of existing activities. To continue with the Landfill CDM project example, recall that the current practice in the host country is zero collection of methane generated from MSW disposed at the landfills. The analysis of the situation indicates that though there are other options available for curtailing emissions from a landfill (e.g., treatment of organic waste before disposal in a landfill or systems for methane collection at the landfill), the most likely scenario is continuation of present practice. The baseline approach to be used in such a case is Approach A.
2. The second approach (hereafter, "Approach B") is based on emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment. This approach is applicable to situations, where economic analysis is undertaken to identify most attractive option among various options, which includes the CDM project activity. The emissions from the economically most attractive alternative are the baseline. For the landfill CDM project example, say the alternatives available are: continuation of the current

practice, i.e., zero collection of methane generated from landfill; treatment of organic waste before disposal to landfill (methane emissions from landfill are from decay of organic matter); and, a collection system for landfill methane. Suppose the analysis of the situation indicates that treatment of organic waste before disposal at the landfill site is the economically most attractive alternative. Then, the baseline scenario is treatment of organic waste before its disposal to landfill and the baseline approach is Approach B. In this example, the baseline is the terms of emissions from the landfill under the condition that organic waste disposed at the site is pre-treated.

3. The third approach is based on the average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 percent of their category (hereafter "Approach C"). To continue with the landfill CDM project, say there are four alternatives can be clearly demonstrated as economically most attractive. The baseline scenario then is based on analysis of alternatives implemented during the last five years. The baseline is the average emission of the options most commonly used in the previous five years and whose performance is among the top 20 percent.

The three are akin to options available for implementing a project. Project proponents choose either to continue with an existing commonly used process/ technology or to adopt a newer option available in the market that has come to be preferred over more commonly used option in recent years. If more than one new option is available, the proponents choose the most economical option that meets all the regulatory requirements. But in absence of adequate information or differences among various new options, any of the options from the basket of new options could be chosen.

Note that these are the approaches to develop a baseline. The formulae or algorithm to estimate emissions under the baseline scenario should be consistent with the baseline approach. For example, it is proposed to replace a boiler that provides steam at a facility under a CDM project. If the chosen baseline approach is Approach

A, then the baseline emission from use of the existing boiler. If Approach B is chosen, then the formulae for estimating baseline emission will be for the boiler type that is most economical. For approach C, the formulae for estimating baseline emissions will be the average emissions of the types of boiler used by recent projects of similar kind in the last five years.

4. Baselines

The baseline is the emission in absence of proposed CDM project. Baseline describes the formulae for estimating the emissions in the identified baseline scenario for the proposed CDM project. It also includes the description of source of data for parameters/ variables.

5. Project additionality

Additionality is the key element of the baseline methodology. There are two components of additionality that should be satisfied by a proposed CDM project.

1. The project emissions (sequestration) are less (greater) than the baseline emissions (sequestration).
2. The proposed projects should not be a baseline option.

A methodology should include steps to analyze the additionality of the project. The CDM-EB has prepared a consolidated tool for assessing additionality (discussed later). The tool suggests the following steps for assessment of additionality:

1. Identification of alternatives to the project activity.
2. Investment analysis to determine that the proposed project activity is not the most economically or financially attractive option.
3. Barrier analysis
4. Common practice analysis
5. Impact of registration of project as a CDM project on the investment and other barriers faced by the project.

The CDM-EB suggested tool for assessment of additionality is not mandatory. Project proponebts can develop their own process for establishing the additionality of a proposed CDM project.

6. Leakage

The term leakage refers to emissions occurring outside the "project boundary" that are directly attributable to the proposed CDM project activity and are measurable. For example, emissions due to transportation of biomass fuel to the proposed CDM biomass power project site are a project leakage. The project boundary for the project is the physical site of the power plant. Therefore, the transport related emissions are outside the project boundary. Transportation of biomass fuel is a direct consequence of the biomass power plant and, therefore, is attributable to the project. It is necessary to identify possible leakage in emissions in the baseline methodology. If the leakage is measurable and significant, methods (i.e., equations or formulas) to estimate the leakage should be presented in the baseline methodology.

2.7 Additionality Assessment

Additionality is one of the complex issues of CDM modalities and procedures. Additionality has been interpreted in many different ways. The CDM-EB, in its 16th meeting, made clarifications on elements of additionality and approved a consolidated tool to assess additionality. Based on clarifications of the CDM-EB there are two elements of additionality that should be satisfied by a CDM project.

1. The project emissions (sequestrations) are less (greater) than the baseline emissions (sequestrations).
2. The proposed project should not be a baseline option, i.e., compared to the identified alternative baseline scenarios, the proposed CDM project is the least likely.

The consolidated tool essentially provides guidance on assessing the additionality component mentioned in (2) above. The CDM-EB has clearly stated that use of the tool is not mandatory. Project proponents can develop their own methodology for assessing additionality of the proposed project, but it is essential that such a methodology provide steps to prove the above two aspects of additionality. In this topic the various steps involved in the assessment of additionality based on CDM-EB recommended tool will be shown. The various steps and the sections where these are discussed are shown in Figure 2-2. The endeavor is to highlight the important elements of additionality assessment using the tool. The underlying philosophy of this tool is that a proposed CDM project activity is a baseline scenario unless otherwise proven.

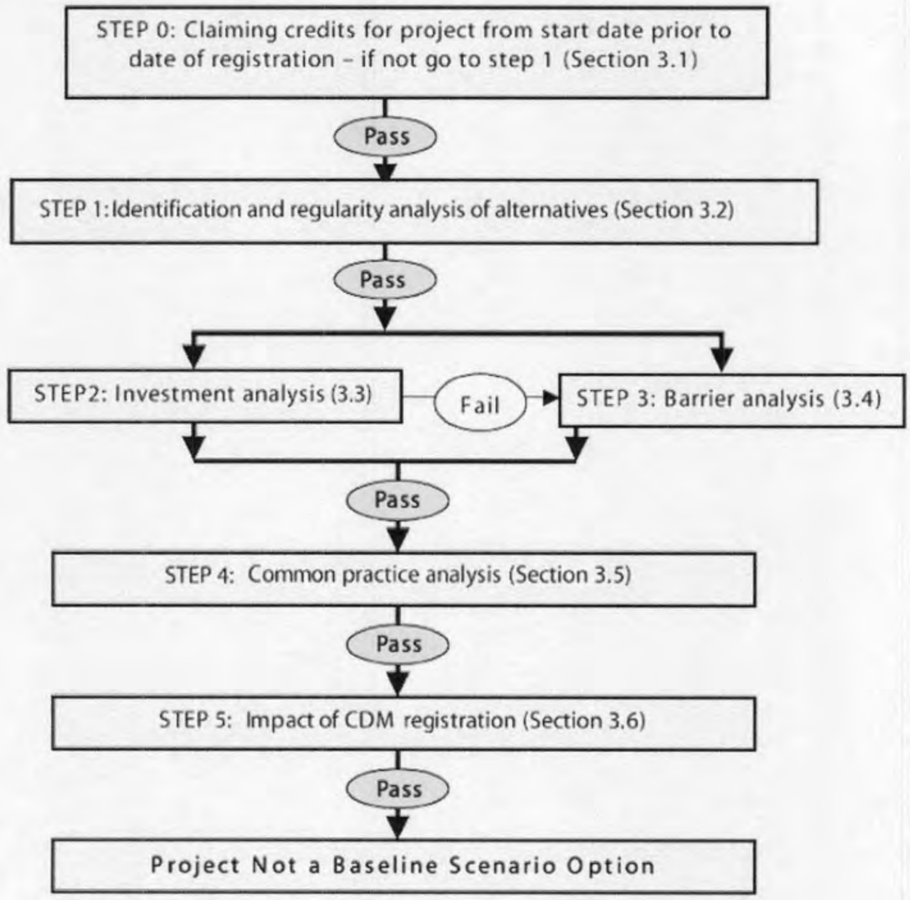

FIGURE 2-2: Steps for assessment of additionality

2.7.1 Claiming Credits from a Start Date Prior to the Date of Registration-Step 0

This step (hereafter, Step 0) is undertaken only if the project proponents want to claim credits from a start date (say, 1st January 2004, when the project became operational) prior to the registration date of the project (say, 1st July 2005). This facility is available only for those projects that register before 31st December 2005. Such projects should prove that

- The starting date of the project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity (first CDM project was registered on 18 November 2004).

- The incentive provided by the CDM was seriously considered in the decision to process with the project activity. This evidence should be based on (preferably official) documentation clearly showing that the CDM incentive played a role at or before the time of decision making.

2.7.2 Identification of Alternatives to the Project Activity Consistent with Current Laws and Regulations- Step 1

This step requires defining and identifying realistic and credible alternatives to the project activities that can be the baseline scenario. The following steps define the process through which baseline scenarios can be identified.

Sub-Step (1a). Define alternatives to the project activity:

A list of realistic and credible alternative(s) available to the project participants that can provide outputs or services comparable with the proposed CDM project activity is identified. The identified alternatives include:

- The proposed project activity assuming, to begin with, that it is a plausible baseline alternative,
- All other plausible and credible alternatives to the project that deliver similar outputs and services in a comparable service area, and
- Continuation of the current situation (no project activity or other alternatives undertaken), if it is relevant.

Sub-Step (1b). Compliance with applicable laws and regulations:

The alternative(s) identified in sub-step (1a) above should be in compliance with all applicable legal and regulatory requirements. Some or all of these laws and regulations might have objectives other than GHG reductions (e.g., to mitigate local air pollution). Only those national and local policies should be considered that have a legally-binding status. An alternative that does not comply with applicable regulations and legislation can be considered only if it is clearly demonstrated that non-compliance is widespread. This can be demonstrated through examination of current practice in the country or region in which the law or regulation applies. If it cannot be shown that the noncompliance is widespread, then the alternative is eliminated from list of identified alternatives for further consideration.

The proposed CDM project activity, other than the proposed project, that is in compliance with all regulations, the proposed CDM project could be additional.

To prove that the proposed CDM project is not a preferred project over the other alternatives that are compliance with all regulations, an analysis is undertaken using either the investment analysis method or the barrier analysis.

2.7.3 Investment Analysis- Step 2

This step is used to determine whether or not the project activity is economically or financially less attractive than other alternatives. The revenue from sale of CERs should not be included in economic or financial analysis of the proposed CDM project. The following steps define the process for conducting the investment analysis:

Sub-Step (2a). Identification of the appropriate analysis method:

The investment analysis could be based on following analysis options:

- Simple cost analysis (Option I) - This option is used if the proposed CDM project activity generates no financial or economic benefits other than CDM related income.
- Investment comparison analysis (Option II) – This option is used if the investment in plausible alternatives are of comparable scale to the proposed CDM project activity.
- Benchmark analysis (Option III) – This option is used if neither of the above two options are applicable.

Sub-Step (2b). Apply the appropriate investment analysis method:

Option I: Simple cost analysis

All the costs associated with the CDM project activity are documented to confirm that the revenues from the activity are either nil or negligible, other than those from sale of GHG emissions reduction. For example, a landfill gas capture and flaring project, where landfill gas capture and flaring is not mandated by law, does not result in any revenue earnings. The only revenue from such project is from sale of CERs generated after the project is registered as a CDM project. For such projects a simple cost analysis can be used.

Option II: investment comparison analysis

This method uses financial indicators such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/ kWh or levelized cost of delivered heat in $/ GJ) to undertake the analysis. The first step in the analysis is to identify the most suitable financial indicator for the project type and the decision context. For example, if the proposed project is a 400 MW power plant using natural gas and the alternative is installation of a coal fired power plant of similar capacity, then an investment analysis is the most appropriate method of comparison.

Option III: benchmark analysis

This method is used on comparison of the estimates of financial indicators for the proposed CDM project with an identified benchmark value. The first step is to identify a financial indicator such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/ kWh or levelized cost of delivered heat in $/GJ). The second step is to identify a benchmark value corresponding to the chosen financial indicator. For example, if the financial indicator chosen is IRR on equity, then the required rate of return (RRR) on equity could be the corresponding benchmark. The benchmark should represent standard returns in the market, considering the specific risk of the project type and not the subjective profitability expectation or risk profile of a particular project developer. Benchmarks can be used on.

- Government bond rates, increased by a suitable risk premium to reflect private investment and/ or the project type, as substantiated by an independent (financial) expert, or
- Estimates of the cost of financing and required return on capital (e.g., commercial lending rates and guarantees required for the country and

the type of project concerned) based on bankers views and private equity investors/ funds' required return on comparable projects.

Sub-Step (2c). Calculation and comparison of financial indicators:

If option II is chosen in step 2a, then the identified financial indicator is estimated for the proposed CDM project activity and other alternatives. The proposed CDM project is additional if the following two conditions are satisfied.

(i) The proposed CDM project is not financially the most attractive alternative. This can be proven by showing that at least one of the alternatives, other than the CDM project activity, has a better value of the financial indicator (.g. higher IRR), than the proposed CDM project.

(ii) Emissions of all the alternatives, that are financially better than the proposed CDM project, are greater than the proposed CDM project activity.

If benchmark analysis (option III) in Step 2a is chosen, then the suitable financial indicator for the proposed CDM project activity alone is estimated. The proposed CDM project activity is considered as financially unattractive if the value of the financial indicator is less than the benchmark value (e.g., lower than IRR).

All the relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/ fiscal incentive, etc.) should be included in estimating the financial indicator. Non-market cost and benefits in the case of public investors can be included.

Sub-Step (2d). : Sensitivity Analysis

To test the robustness of the conclusion arrived at in Sub-step 2c, a sensitivity analysis is necessary. The sensitivity analysis of the financial assessment is done by varying the critical assumptions within a range of plausible values. If the conclusion unambiguously demonstrates that the project activity in unlikely to be the financially most attractive or is unlikely to be financially attractive, then the proposed project could be additional. The next step then for assessing additionality is Common practice Analysis.

If the sensitivity analysis does not unambiguously prove that project in unlikely to be financially attractive, then the project is considered additional only if the barrier analysis indicates that the proposed project activity faces barriers.

2.7.4 Barrier Analysis- Step 3

Analysis of barriers is undertaken to determine whether the proposed project activity faces barriers that: (a) prevent a widespread implementation of the proposed CDM activity; and (b) do not prevent a widespread implementation of at least one of the other alternatives. The following sub-steps can be used for barrier analysis:

Sub-Step (3a). : Identification of barriers:

This step identifies the barriers that prevent the proposed project activity from being implemented if the project were not registered as a CDM activity. Such barriers may include:

- Investment barriers, other than the economic/ financial barriers, for example:
  - Real and/ or perceived risks, associated with the technology or process, are too high to attract investment.
  - Funding is not available for innovative projects.
- Technological barriers, for example:
  - Skilled and/ or properly trained labor to operate and maintain the technology is not available, which could either lead to equipment disrepair and malfunctioning or higher cost of maintenance and operation.
- Barriers due to prevailing practice, for example:
  - Developers lack familiarity with the technology and are reluctant to use them.
  - The project is the "first of a kind".
- Other barriers, for example:

- Management lacks experience using the state-of-the-art technology, so that the project receives low priority by management.

The evidence provide for demonstrating existence of barriers should be documented and should be transparent. Further, the documented evidence should be interpreted conservatively.

Sub-Step (3b). : Analysis of impact of barriers, identified in Sub-step 3a, on other alternatives:

The impact of the barriers identified in Sub-step 3a on the other alternatives is analyzed in this step. The analysis is undertaken to assess whether these barriers prevent widespread implementation of at least one of the alternatives. If the barriers also affect other alternatives, then the analysis should assess whether the impact on the other alternatives is less strong.

It should be noted if wide implementation of an alternative is unlikely due to the identified barriers, then it should not be considered as a baseline alternative and dropped from list of alternatives for further analysis.

A proposed CDM project is additional only if, both Sub-step 3a and 3b are satisfied. If it is proven that the project face barriers which do not affect other alternatives, at least as strongly, then the next step in the additionality assessment is Step 4, Common Practice Analysis.

2.7.5 Common Practice Analysis- Step 4

This step is an analysis of the extent of diffusion of the proposed CDM project type (e.g. technology or practice) in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3). The following sub-steps can be used to identify and discuss the existing common practices:

Sub-Step (4a). : Analysis of prevalence of activities similar to the proposed CDM project:

This sub-step analyses the prevalence of activities similar to the proposed project activity that have been implemented previously or are currently being implemented. Activities are considered similar if:

(i) They are in the same country and/ or rely on broadly similar technology:

(ii) They are of similar scale; and

(iii) They are implemented in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.

The project proponents should provide quantitative information on similar activities wherever it is relevant.

Sub-Step (4b). : Analysis of already implemented similar activities:

It is difficult to justify that a proposed CDM project activity is financially unattractive (Step 2) or faces barriers (Step 3) if similar activities are widely implemented. If this is the case, then for the proposed project to be additional there should exist conditions that differentiate the proposed project from the existing similar activities. These sub-step analyses widely implemented similar activities to identify whether there exist any essential distinctions in the proposed CDM project activities. The essential distinctions could be financial factors (e.g., subsidies or other financial flows) or policy environment, the barriers to the proposed CDM project, etc. For example, if 20% of the sugar industry has implemented cogeneration using higher efficiency boilers, then a proposed CDM project for cogeneration in a sugar unit using a high efficiency boiler is unlikely to be additional even if it is demonstrated to be financially non-viable. Say, the analysis of implemented cogeneration projects indicates that all the existing projects were installed under a government scheme to promote cogeneration, benefits of which are not available to the proposed CDM project. In this case, the proposed CDM project could be additional. If similar project activities exist with no essential differences then the proposed CDM project activity is not additional. If they have differences, the proposed project could be additional and the final step in assessment of additionality – the impact of CDM registration (Step 5, described in Section 3.6) – is implemented.

2.7.6 Impact of CDM Registration- Step 5

The final step in assessment of additionality is analysis of the impact of registering the proposed project under CDM. The analysis presents the impact of benefits and incentives derived from the CDM on the economic and financial hurdles (Step 2) or other identified barriers (Step 3) faced by the proposed CDM project. The benefits and incentives can be of various types, such as:

- The financial benefit of the revenue obtained by selling the GHG emissions reductions.
- The implementation of proposed project as CDM attracts new players who are not exposed to the same barriers, or can accept a lower IRR (for instance because they have access to cheaper capital).
- The implementation of proposed project as CDM attracts new players who bring the capacity to implement a new technology, thus remove barriers related to unfamiliarity.
- The CER revenues provide either a better foreign exchange loan or reduce the exchange rate risk affecting expected revenues and attractiveness of the project to investors.

If the analysis clearly demonstrates that registration of project as CDM will help address the difficulties in implementing the project activity, then the proposed CDM project activity is not the baseline scenario and is additional. Else, the proposed CDM project activity is not additional.

2.8 How to get CERs?

From the "**CDM Country Guide for Thailand, 2006**" report, it explicated the procedures, which project proponents need to go through, with the purpose of achieving in the international requirement and in order to get CERs as a result.

The detail in the report clarified that, in December 2001, negotiators worked out the detailed modalities and procedures of the international climate change policy regime, including the rules and regulations of the CDM. The CDM Executive Board was established as the UNFCC secretariat to oversee the CDM process. In order to be registered as a CDM project activity, project proponents need to go through the steps detailed in figure 2-3.

1. Planning a CDM project activity	**Project participants** should consider that: (a) the planned project activity will assist the host country's sustainable development, (b) the planned project activity is additional, and (c) the planned project boundary is eligible
2. Preparing the project design document (PDD)	**Project participants** should: (a) Download the standard PDD form from the UNFCC website and complete it according to the guidelines provided by the CDM EB.
3. Getting approval from each party involved	**Project participants** should: (a) Learn about the approving process of concerned Parties and all the requirements from designated national authorities (DNAs), and (b) Obtain the written approval of voluntary participation from the DNAs
4. Validation and registration	**Project participants** should: (a) Have the validation done by a designated operational. (b) Pay a registration fee to the CDM EB The ***DOE*** will submit all necessary documents to the CDM EB and request project registration.
5. Monitoring a CDM project activity	**Project participants** should: (a) Monitor according to the monitoring plan and report to the operational entity.
6. Verification and certification	**The operational entity** should: (a) Verify the monitoring results and certify the exact amount of GHG emissions reduction resulting from the project activity, and (b) Report the result to the CDM EB.
7. Issuance of CERs	**The CDM EB** will: (a) Issue a certified amount of CERs within 15 days after receiving a request for issuance, and (b) Deduct a "share of proceeds" from the issued CERs.

FIGURE 2-3: Overview of Project cycle

In the entire steps, following by theirs activity, all of them can be classified in two phases in order to make it is easy to understand:

- Project Preparation Phase
- Project Operational Phase

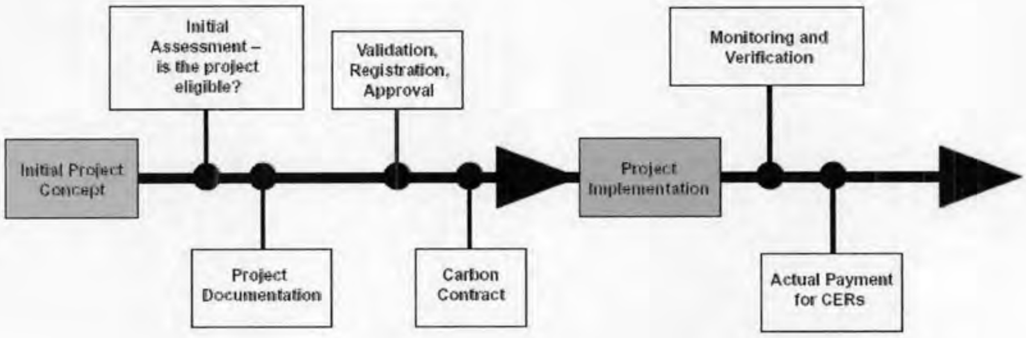

FIGURE 2-4: A Big picture of CDM

(Source: www.dti.gov.uk/ccpo/business.htm)

2.8.1 Project Preparation Phase

(Source: www.dti.gov.uk/ccpo/business.htm)

Initial assessment: Before developing a project as a CDM activity, project developers are advised to conduct preliminary due diligence to ensure that the project being considered would be eligible under international guidelines and that meets conventional project development and implementation criteria.

Prepare documentation: Project developers need to develop a Project Design Document (PDD). This generally represents the largest upfront cost item due to the detailed analyses required and the fact that the PDD needs to contain all of the information that will be used to evaluate the project.

Obtain host government approval: Once the PDD is complete, the project proponent will need a letter of approval issued by the relevant host country authority for the transfer of the carbon credits. In the case of CDM, the Designated National Authority (DNA) or CDM office will issue the letter of approval.

Validate project design: The PDD needs to be reviewed and approved (validated) by an independent third party accredited by appropriate authorities. For CDM projects, the PDD is validated by a Designated Operational Entity (accredited by the CDM Executive Board, (EB)).

Prepare a carbon credits sales agreement: The development of the Emission Reduction Purchase Agreement (ERPA) involves legal and contractual costs related to drafting of the contract, risk management and negotiations. Following the preparation of the PDD, developing the ERPA is likely to be the largest cost item project developers will incur.

Registration: For CDM projects, the CDM Executive Board (EB) will charge a registration fee which, in its current form, has to be paid when the project is registered and depends on the volume of emission reduction. Eventually, the registration fee will represent a percentage of the amount of CERs.

2.8.2 Project Operational Phase

(Source: www.dti.gov.uk/ccpo/business.htm

Monitoring and Verification: Monitoring and verification of emission reductions has to be carried out regularly. For the CDM projects the verification is undertaken by Designated Operational Entity.

Sale of carbon credits: The sale of carbon credits could be done directly to the buyer or through an intermediary such as a broker or the consultants that helped prepare the project. In the latter case a fee is usually paid and can be based on a certain percentage of the value of the sale.

Adaptation of funds: CDM projects in all but the least developed countries are subject to a levy worth 2% of the value of the credits, payable into an adaptation fund to assist countries to adapt to the impacts of climate change.

Host nation fees: Some countries have considered imposing fees on the sale of carbon credits to fund certain activities (e.g., operational Designated Authority offices), but no country has yet required these.

2.9 Transaction Cost

From the description of project life cycle, the CDM implementation as shown generates costs which associated with both project preparation phase and project implementation phase.

CDM Project Preparation Activities	Large-Scale	Small-Scale
- Project Assessment	£5,000-£15,000	£3,000-£4,000
- Completion of project documentation	£15,000-£54,000	£6,000-£12,500
- Validation	£4,000-£18,000	£3,500-£5,500
- Development of Carbon credits sale agreement	£3,000-£35,000	£1,500-£5,000
- Registration fee	£6,000-£18,000	£3,000
Total- Project Development Cost (CDM)	**£33,000-£140,000**	**£17,000-£30,000**

TABLE 2-2: Estimated transaction costs for developing a standard CDM project (Source: EcoSecurities 2004)

In the table 2-2, it presents indicative transaction costs for CDM projects. Costs are expressed in ranges because they are not exact and will depend on several factors, including the type project, the size of the project, location, and the cost of consultants and intermediaries involved. Cost estimates are also included for small-scale projects, and these are lower because the CDM EB has established streamlined procedures for these projects.

The authorities managing climate change projects have instituted several important elements in the project preparation phase to reduce carbon transaction costs and thus minimize the impact of these costs on smaller projects.

2.9.1 Small-scale project (SSC) procedures and cost implications (Source: www.dti.gov.uk/ccpo/business.htm)

To reduce the transaction costs associated with preparing CDM projects, the CDM EB has approved streamlined procedures and standardized baselines for small-scale projects, which are defined as:

- Renewable energy projects with an installed capacity under 15 MW
- Energy efficiency projects that reduce energy consumption by up to 15 GWh per year
- Activities that emit less than 15,000 tonnes of CO_2 equivalent per year.

From the context above, it shown only the cost associated with project preparation phase. For the other one, it is the costs dealing with project operation phase shown in table 2-3 below.

CDM project Implementation Activities	**Estimated Costs**	**Comments**
- Monitoring and verification	£3,000- £10,000 (per audit)	-Yearly or every two years
- Sale of carbon credits	5%- 20%	-Yearly; only if an intermediary is involved
- "Share of proceeds": registration	N/a	-Will eventually replace current registration fees; will be based on percentage of CERs
- Adaptation fee	2%	-Applies only to CDM projects. Does not apply to CDM projects in the least developed countries and will probably not apply to small-scale projects

TABLE 2-3: Estimated transaction costs for implementation a standard CDM project (Source: EcoSecurities 2004)

It presents indicative CDM project implementation transaction costs for the various cost elements outlined above.

2.10 Capital Investment Analysis and Project Assessment

In the research, there are many contents mentioned about the project investment analysis of the incineration power plant. So following with **Capital Investment Analysis and Project Assessment Report**, Michael Boehlje and Cole Ehmke, **Economic Value Added**, Craig Savarese, **EGAT training report**, Stern Stewart & Co. in 2004, all of them have been contained the necessary information that will be used in making a decision for the project investment. Hence the literature reviews for the item will refer to these stuffs as shown.

Capital investment decisions that involve the purchase of items such land, machinery buildings, or equipment are among the most important decisions undertaken by the business manager. These decisions typically involve the commitment of large sums of money, and they will affect the business over a number of years. Furthermore, the funds to purchase a capital item must be paid out immediately, whereas the income or benefits grow over time.

Because the benefits are based on future events and the ability to foresee the future is imperfect, you should make a considerable effort to evaluate investment alternatives as thoroughly as possible. The most important task of investment analysis is gathering the appropriate data, then an otherwise thorough and complete analysis will be misleading.

Selecting investments that will improve the financial performance of the business involves two fundamental tasks: 1) economic profitability analysis and 2) financial feasibility analysis. However, an investment may not be financially feasible: that is, the cash flows may be insufficient to make the required principal and interest payments. So you should complete both analyses before you make a final decision to accept or reject a particular project.

Completing a thorough investment analysis may seem complicated and difficult. But the reward of a soundly based decision will be worth the effort invested to learn the process and collect the necessary information.

2.11 Financial Analysis

The purpose of the project financial analysis is to determine whether the proposed cash flow is likely to make the activity financially viable during the activity operating period (contribute to the long run profits). Although various techniques can be used to evaluate alternative investments, including the payback period and internal rate of return, the most commonly accept technique is net present value, otherwise known as "discounted cash flow."

2.11.1 Time Value of Money

The basic concept of a net present value procedure is that a dollar in hand today is worth more than a dollar to be received sometime in the future. A dollar is worth more today than tomorrow because today's dollar can be invested and can generate earnings. In addition, the uncertainty of receiving a dollar in the future and inflation make a future dollar less valuable than if it were received today.

The procedure for accounting for the delay in receiving funds or the income given up is to discount, or penalize, future cash flows. The longer you must wait to receive them, the more heavily you must discount them. This discounting procedure converts the cash flows that occur over a period of future years into a single current so that alternative investments can be compared on the basis of that single value. This conversion of flows over time into account the opportunity cost having money tied up in the investment.

2.11.2 Net Present Value

Using these concepts of time value of money, you can determine the net present value (NPV) for a particular investment as the sum of the annual cash flows discounted for any delay in receiving them, minus the investment outlay.

In mathematical notation this set of computation can be summarized as:

$$N = \sum_{n=1}^{K} \frac{I_n}{(1+d)^n} - o$$

When N denotes net present value; n denotes the time period, with K indicating the last period an inflow is expected; Σ denotes a summation of all n periods; I_n denotes the net cash inflow in period n; d the rate of discount; and O the cash outlay required to purchase the capital asset.

There are six steps to complete this net present value analysis procedure:

Step1: Choose an appropriate discount rate to reflect the time value of money

Step2: Calculate the net present value of the cash outlay required to purchase the asset

Step3: Calculate the benefits or annual net cash flow for each year from the investment over its useful life.

Step4: Calculate the present value of the annual net cash flows.

Step5: Compute the net present value.

Step6: Accept or reject the investment.

STEP1: Choose an appropriate discount rate to reflect the time value of money

You use the discount rate to adjust future flows of income back to their present value. The discount rate you choose essentially indicates the minimum acceptable rate of return for an investment; it represents the "cutoff criterion" in judging whether or not an investment returns at least the cost of the debt and equity funds that must be committed or acquired by the business to obtain the asset.

How should you determine the combination of debt and equity funds used to finance an investment? In long run, the funds you used to acquire any capital item will come from both debt (borrowed funds) and equity (your financial contribution to the business) sources. Therefore, you should base the cost of capital on the combination of debt and equity capital used in the "long term" to finance the operation, not the specific combination of debt and equity that you may use to finance a particular purchase. Even though you may use a high proportion of debt to finance current investments, using this debt now will reduce your business's ability to use credit in the financing of the future investments.

This objective is to evaluate investment alternatives based on the long- run optimal capital structure of the business- the capital structure or combination of debt and equity that you expect to maintain over a number of years. To determine the long-run cost of capital (based on this optimal capital structure) for the business, you must weight the cost of debt funds and the cost of equity funds by the long- run proportions of debt and equity that will be used to finance the business. This results in a weight cost of capital that can be summarized as:

$$d = K_e W_e (1-t) + K_d W_d (1-t)$$

Where **d** is the discount rate, $\mathbf{K_e}$ is the cost of equity funds (rate of return on equity capital), $\mathbf{W_e}$ is the proportion of equity funds used in your business, $\mathbf{K_d}$ is the cost of debt funds (interest), **t** is the marginal tax rate, and $\mathbf{W_d}$ is the proportion of debt funds in your business.

The purpose of the weighted cost of capital formula is to obtain a discount rate that accurately reflected the long- run direct cost of debt funds and the opportunity cost of equity that will be used in the firm. Note that the cost of equity funds is best estimated as the opportunity cost (income foregone) of committing equity to this particular investment compared to other investment.

Because the cash flows that you will discount will be computed on an after-tax basis to reflect all costs and cash flows, you should compute the discount rate on an after- tax basis as well. So you multiply the cost of equity (**K_e**) times one minus the marginal tax rate (**1-t**) to adjust it to an after- tax rate. Also note that because interest (the cost of debt funds) is tax deductible, thus reducing the tax liability of the business, the true cost of debt is the rate of interest on debt funds minus the tax savings. Equivalently, the true after- tax cost of debt can be calculated as the interest rate (**K_d**) times one minus the marginal tax rate (**1-t**).

STEP2: Calculate the present value of the cash outlay required to purchase the asset

In most cases, the present value of the cash outlay will be equal to the purchase price of the asset because all the capital must be committed at the time the purchase is made. In some cases, however, an additional capital outlay will occur in future years in order; for example, to replace equipment that wears out before the end of the useful life of a building or facility. In this situation, you must discount these future capital outlays to present and add then to the initial outlay.

STEP3: Calculate the benefits or annual net cash flow for each year of the investment's useful life

As suggested by the term "discounted cash flow," the benefits to be included are the increased net cash flows that result from a particular investment. You should calculate these cash flows on an after- tax basis. Because depreciation is not a cash flow but only an accounting entry to allocate the cost of a capital item over its useful life, it does not enter directly in the computation of annual net cash flows. Instead, depreciation enters the calculations only as it influences the tax liability or the tax savings of a particular investment. In addition, since the discount rate reflects current expectations of inflation because the data used in the calculation come from current market rates, the estimation of future cash income and cash expenses should also reflect expected price increases for inputs and outputs. You can compute the annual net cash flow for an investment using the following format:

"*Cash Revenue – Cash Expenses + Terminal Value – Income Taxes = Annual Net Cash Flow*"

You would calculate cash revenue for a particular investment as product sales from that particular investment times the expected prices, whereas cash expenses would included the cash cost of the inputs used in production. Note that interest on debt used to finance the investment is not included as a cash expense because it has already been included in the computation of the cost of capital (step 1).

You compute income taxes as:

"*Cash Revenue – Cash Expenses – Depreciation = Net Income*"

Then,

"*Net Income x Marginal Tax Rate = Taxes*"

The marginal tax rate reflected the additional taxes that will be paid on income generated by the particular investment. Note that depreciation enters in this computation of the tax liability. As shown above, the additional tax liability will reduce the net cash flow from a particular investment.

You should include the terminal value, also known as "salvage value," of a particular machine or a piece of equipment as a positive cash flow in the last year if it is to be sold or traded on a new item. The salvage value is part of the cash benefit stream that will be received if the capital item is sold. Or if it is traded for a new capital item, as is often the case with machinery, the salvage value reflects the reduced cash outlay that will be incurred to purchase the new machine.

After you compute the annual net cash flow for each year of the project, you have produced a series of annual net cash flows.

STEP4: Calculate the present value of the annual net cash flows

In step 3, you calculated the annual net cash flow stream for the entire useful life of the asset. Now you want to convert this stream into a single figure that represents the current or present value of such a stream of income over time. As has been suggested earlier, you can determine the present value of income that will be received sometime in the future by multiplying the annual income times the discount factor for the appropriate discount rate and year. By multiplying the annual net cash flow for each year times the discount factor and then summing the discounted annual net cash flows, you can obtain a single present value.

STEP5: Compute the net present value

You simply compute net present value as the present value of the net cash flows obtained in Step 4 minus the present value of the cash outlay to purchase the investment of Step 2.

"*Present value of net cash flows – Present value of cash = Net present value*"

STEP6: Accept or reject the investment

The criterion for accepting or rejecting an investment is simple if the alternatives are mutually exclusive: accept an investment if it has a positive net present value or reject that investment if it has a negative net present value.

2.12 Economical Analysis

"It is well accepted that generally accepted accounting principles (GAAP) are not adequate for measuring shareholder value performance. GAAP policies can obscure true profitability, mis-state investment and inadvertently misrepresent a business's underlying economics. Operating profit ignores the cost of equity capital. People will manage the things against which they are judged, which makes performance measurement an underpinning of all financial practices. Economic profit is a financial measure that links performance to shareholder wealth creation. It provides a solid foundation for linking financial management practices to company performance, and is basis against which employees can apply shareholder value principles in their daily activities." [**Economic Value Added** by Craig Savarese/ P.4]

For this concept, the researcher perceives the important of economic profit, and be aware of the significance of this measurement because recent management trends have emphasized the importance of shareholder wealth creation as the goal of any business enterprise. The ability of a business to create shareholder wealth is increasingly seen as the key indicator of management and business performance. So the information, reference and data getting from **Economic Value Added** by Craig Savarese and the **EGAT training report** done by Stern Stewart & Co. in 2004 will be gathered to use in making this research.

Nevertheless, the researcher does not claim that economic profit is the best measurement that can answer in all expectation from investors, but, in term of shareholder wealth creation, it is the most popular shareholder value- based performance measure.

2.13 Defining Economic Profit

From **"Economic Value Added" by Craig Savarese**, Economic profit, often referred to as economic value added (or EVA), can be described as the "after-tax operating profit remaining after deducting a charge for the capital employed in the business".

Economic profit = Net operating profit after tax- (Capital employed x Cost of Capital)

The term "net operating profit after tax" (NOPAT) is a measure of operating profit. Capital employed is simply a measure of a business's investment, similar to net operating assets, and the cost of capital is financing cost similar, but not identical, to borrowing costs:

Economic profit uses the same principles as return on investment: to measure a business's operating profit relative to the investment in the business. However, it measures the actual return relative to a baseline return level defined by the cost of capital. The cost of capital is the minimum return required in order to create shareholder wealth. It defines the minimum level of NOPAT required to generate positive economic profit. As a dollar measure, it calculates not only whether or not a business is creating value, but also how much value it is creating.

There are therefore three elements in a business's economic profit equation: 1) net operating profit after tax; 2) capital employed; and 3) cost of capital.

2.13.1 Net operating profit after tax

NOPAT is a measure of a business's operating profit. It is derived from a company's financial accounts, and is similar to the reported profit after tax. It differs in two significant ways though: it excludes financing cost; and it reclassifies certain expenses and revenue. These reclassifications are called "adjustments" (which are summarized in Table 5.1) and include items such as depreciation and adjustments for acquisitions. With such adjustment it gives a more representative measure of a business's true operating profit. A simple formula comparison of operating profit and NOPAT is shown in Table 2-4.

NOPAT	***Capital employed***
Operating revenue	Current assets
(Operating expenses)	Non-current assets
Adjustments	Total assets
(Taxes)	
Net operating profit after tax	(Non-borrowing liabilities)
	Adjustments
	Capital employed

TABLE 2-4: NOPAT and capital employed

In Table 2-4, the elements of NOPAT and capital employed have been presented as straightforward extensions of a profit and loss account and balance sheets.

Financial statement Profit and loss	***Economic profit*** NOPAT
Operating revenue	Operating revenue
Operating expenses	- Operating expenses
Interest expense	-
	+/- Adjustments
Taxes	- Taxes
After-tax operating profit	= Net operating profit after tax

TABLE 2-5: Operating profit and NOPAT

2.13.2 Capital employed

Capital employed is a measure of a business's investment. It is also derived from a company's financial accounts, and is similar to the reported net assets, but differs in two ways as well: borrowings are not deducted from total assets, and adjustments are made to certain asset and liability accounts. This gives a better estimate of the investment made in a business. Consequently, it is a more appropriate basis against which to access whether operating profits are adequate given the level of investment in the business. A simple formula comparison between accounting and economic profit is shown in Table 2-6.

Financial statement Balance sheets		***Economic profit*** Capital employed
Current assets		Current assets
Non-current assets	+	Non-current assets
Total assets	=	Total assets
Borrowings	-	
Non-borrowing liabilities	-	Non-borrowing liabilities
	+/-	Adjustments
Net assets/ Shareholders equity	=	Capital employed

TABLE 2-6: Accounting and economic profit

In summary, economic profit measurement is constructed with financial accounts as a starting point and then asks the question: How and in what ways might generally accepted accounting principles or other factors distort the underlying business performance?

2.13.3 Cost of Capital

The cost of capital is a business's true financing cost. It includes the cost of borrowing, interest, and a cost for shareholder funds. This cost is not recorded in the profit and loss accounts but is just as important in accessing a company's performance. The cost of capital defines the minimum return that a company must achieve over time in order to create shareholder wealth. A simplified cost of capital formula is:

Cost of Capital=Cost of equity x (Equity/Market value) + Cost of debt x (1-Tax rate) x Debt/Market value

The cost of debt is the lender's required return. Lenders determine an interest cost based on, among other things, prevailing interest rates and creditworthiness. This is the same for a business as it is for an individual obtaining home or car financing. It is computed after tax because interest expense is a tax-deductible business cost.

The cost of equity is the shareholder's required return. Shareholder's assign this required return based on the perceived risk associated with investing in a company, just as lenders do for borrowing. It is formally computed using the Capital Asset Pricing Model (CAPM). Simply, CAPM estimates the cost of equity by measuring a company historical share return volatility relative to a benchmark (its beta), the general level of interest rates and a factor that measures share market risk, the equity risk premium. The general form of the CAPM formula is:

Cost of equity = Risk free rate + (Beta x Equity risk premium)

The risk free rate and equity risk premium are the same for all companies in a country at any specific point in time. Therefore, broadly speaking the cost of equity differences across companies depends primarily on differences in beta. The higher the risk, the higher the beta, the higher the cost of equity.

The cost of equity and the cost of debt are weighted in respect to their proportions of a company's market value to determine the cost of capital.

2.14 Specific terms and meaning in Power Plant

Another thing that is inevitable is the specific terminologies dealing with the power plant. In the research, there are some parts mentioned about the name of electricity generated from each stage in the power plant. Following by **the presentation report**, Power plant and Energy Resources Technology Department-EGAT, it keeps the specific words that should be known before moving forward. In figure 2-5, electricity is the process of converting non-electrical energy to electricity.

For electric utilities, it is the first process in the delivery of electricity to consumers. The other processes, electric power transmission and electricity distribution, are normally carried out by the electrical power industry. Electricity is most often generated by electromechanical generators, primarily driven by heat engines. The electricity sent out from the generator is called "gross power", while before the power will be distributed to consumers through power transmission and electricity distribution, some of them will be subtracted to be reprocessed in order to use in the power plant facilities called this part as "auxiliary power", and the rest will be called as "Net power" being the electricity which will be sent to end users by passing through the nation grid- connection.

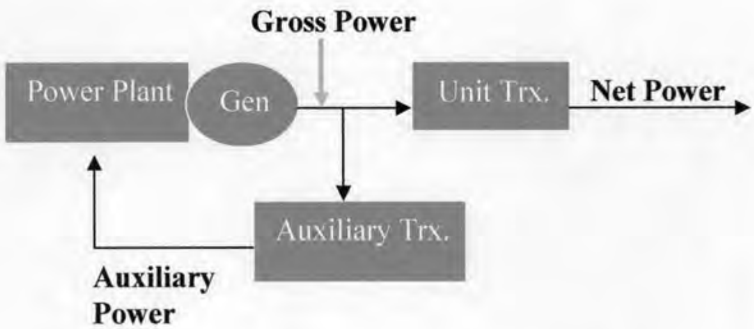

FIGURE 2-5: Power Plant Diagram

2.15 Literatures, which relate to the research study

As refer to the report of **EGAT feasibility study of waste management in Nontaburi province (2005)**, the report based on the process of waste management in Nontaburi province including the amount of waste which was carried into site in each day, geography and compositions of waste. This report is very useful for the research because the report contains the necessary information which is required for fulfillment in this research.

Another useful guidance is the one of **Somrat (2006)** whose report based on Thailand's Potential and Technology of Waste Gasification for Power Generation. The report based on the preliminary assessment of the feasibility of using waste-to-energy system with wastes available in Thailand. This report clarifies the advantage and disadvantage of each available technology in Thailand and capacity (Megawatt) that each technology can generate in order to support the idea of this research.

Another useful guidance is one of **Asian Institute of Technology (AIT-2006).** It is a report on the third workshop on "Target Capacity Development on Clean Development Mechanism (TCD-CDM)" which based on background of CDM, CDM project cycle and an example of carbon emission procurement: Danish CDM Programme. Moreover, it includes financial analysis of CDM projects and exercise on CDM investment. That can make clearly understanding in CDM procedure and can be used as a prototype in calculating carbon emission in the targeted project. Furthermore, the CDM country Guide for Thailand as one report edited by **Institute for Global Environment Strategies 1st Edition** enabled to support in the CDM activities very well.

Another one is the one of **UNFCCC website**. It contains many approved methodologies dealing with CDM activities to find the most appropriate methodology for using in calculation emission reduction of methane at site. For this website the appropriate approved methodology that will be applied to this research is **AMSIII.G./Version 4 (2006)** -it is about avoidance of methane production from biomass decay through controlled combustion, and **AMSIII.G./ Version 10 (2006)** – it is about landfill Methane Recovery.

Another one is the one of **Obayashi Corporation (2004)** whom report explained about feasibility study on CDM/JI LFG to electricity project in Nontaburi, Thailand. Some parts of this report can be used to support this research; particularly prerequisites used for the economic efficiency assessment that will be used for calculation the financial condition.

Another one is the one of **Revised 1996 IPCC Guidelines for National Greenhouse Gas: Reference manual (Chapter 5, 6)**; the report is a guideline for giving more information about GHG from source of waste. In this chapter, it was categorized a number of methods have been used to estimate CH_4 emission from solid waste disposal sites. One of them will be adopted in order to support this research.

The last is the **Regulations for the purchase of power from Small Power Producers (SPP): Electricity Generating Authority of Thailand (EGAT), Metropolitan Electricity Authority (MEA), and Provincial Electricity Authority**

(PEA); the report is a guideline for the pattern in calculation of the project revenue coming from selling electricity of the small power producers such kind of the MSW incineration project. The pattern in calculation will be adopted as one input in the project analysis.