CHAPTER V

UNDER SUPPORTING FROM CDM

5.1 Introduction

From the financial and economical result in the chapter 4, it showed that both of the financial and economical result can not meet the feasible criteria in the analysis. In this chapter, the additional revenue comes from selling carbon credits under CDM will be counted into the existing model in order to find the final result- whether the project has enough viability that should be moved forward or not by keeping constraints in 4 stipulates as mentioned in chapter 1 to find the best solution for the project investment.

5.2 Generating Process of Carbon Credits

The project activity involves the controlled combustion of municipal solid waste (MSW) to generate electricity in Nontaburi Province, Thailand. The MSW to be used in the project will be carried from the Solid Waste Disposal Center at Nontaburi site (SWDS), which is capable of dealing with 1,000 tons/ day of MSW over its projected 20 year lifespan. The 1,000 tons per day of MSW that the project is to incinerate would otherwise be sold out as by- products or landfilled. The project, therefore, contributes to GHG emission reductions by avoiding methane (CH_4) emission that would have occurred as a result of landfill. It also leads to emission reduction through the displacement of grid electricity. These amounts of emission, which the project can reduce, can be registered under the CDM criteria to receive carbon credit or CERs to use in making transaction with other countries following with emission trading scheme.

5.3 Project Boundary

From the project activity, it can be drawn the boundary of the project as shown in Figure 5-1:

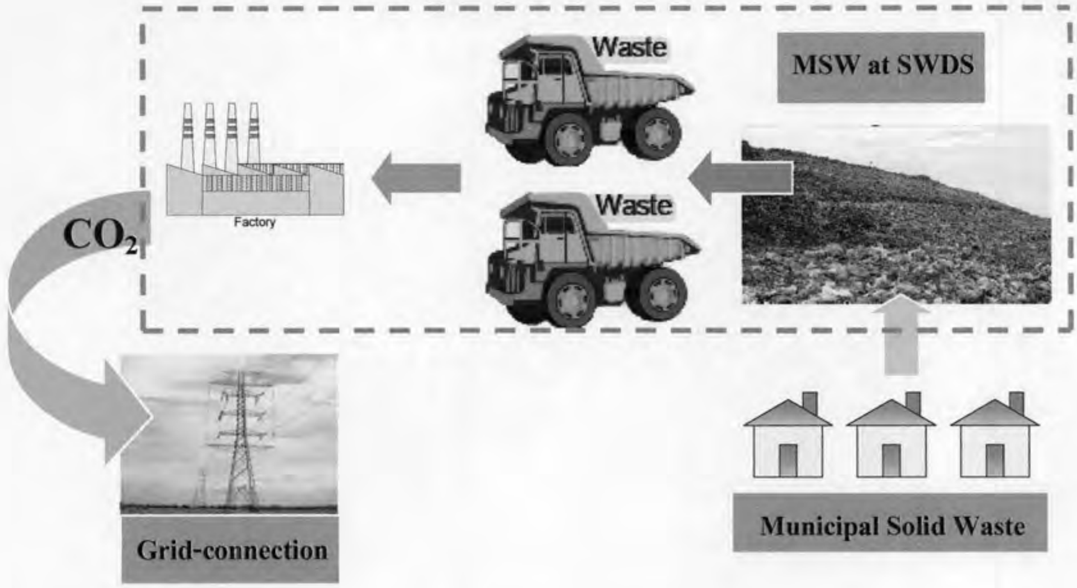

FIGURE 5-1: Project's boundary

5.4 The Methodology used in calculating the amount of emission reduction

As mentioned in the Chapter 1, CDM project should result in "measurable". The concept of measurable reduction is based on a comparison with some defined level of GHG emission. This comparative level, against which the reduction of GHG emissions due to a CDM project are measured, is term a "baseline". The Baseline Methodology being applicable for the project following by ACM0001 is the captured gas is used to produce energy (e.g. electricity/ thermal energy), and emission reductions are claimed for displacing or avoiding energy from other sources.

Since there are no enforce regulatory or contractual requirements for Incineration power plant in Thailand at present, commercial landfill sites emit 100% of produced landfill gas directly into the atmosphere. The selected baseline scenario for the project is the total atmospheric release of methane gas of 1,000 tons of MSW transmitted per day. Emission reductions will be claimed for burning flammable MSW to avoid methane gas that have a chance to be occurred to generate electricity and displacing fossil-fuel-based electricity generation from the grid.

In order to calculate baseline emissions of the project, the amount of methane gas emitted to the atmosphere from 1,000 tons of MSW at disposal site is multiplied by the global warming potential of methane gas. Baseline emissions for displacement of fossil-fuel-based electricity from the grid are calculated multiplying the weighted average emission (tCO_2/ MWh) of the Thai grid by the net amount of electricity (MWh/ yr) exported to the grid by the Project. Finally, total baseline emissions are calculated by summing baseline emissions and subtracting Project emissions (electricity imported from the Thai grid by the Project).

As stipulated by the baseline methodology, the "tool for the demonstration and assessment of additionality" is applied in a conservative and transparent manner to show that CDM assistance is necessary for the project to be implemented.

The following steps from the "tool for the demonstration and assessment of additionality" will be completed below:

STEP 0: Preliminary screening
STEP 1: Identification of alternatives to the project activity consistent with current laws and regulations (This topic will not be mentioned about because the researcher tries to focus only the incineration power plant in order to find the feasibility for the project.)
STEP 2: Investment analysis
STEP 4: Common practice analysis
STEP 5: Impact of CDM registration

STEP 0- Preliminary screening

CDM assistance was taken into consideration since the early stages of project development in Chapter 4. Both of financial and economical analysis revealed that the project would become feasible with additional income generated through CDM assistance.

STEP 2- Investment analysis

In order to determine whether the proposed project is financially attractive without the revenue from the sale of CERs, Option III- "Apply benchmark analysis" is completed below. As mentioned in the tool for the demonstration and assessment of additionality, Project IRR is used to analyze the financial attractiveness of the project.

Project IRR compared to a calculated benchmark value that has been substantiated by an independent expert (referred from a report of Jaroensompong Corporation: Rachathewa Landfill Gas to Energy Project in Thailand). The benchmark is derived from 18 year Thai Government bond which currently yield 4.9% per year. Two kinds of risk premium are added to this bond rate to arrive at a suitable benchmark value for the project. The first kind is the risk of private projects in general as opposed to government lending. The other is the higher risk of the project for being the first of its commercial kind in the country. Experts' opinions vary between 5-7% for the first risk premium between 5-10% for the second risk premium. For the sake of conservatism of the additionality analysis, the low ends of these ranges are selected, resulting in 14.9% (4.9% + 5% + 5%) as the suitable benchmark value for the project.

In Chapter 3, the IRR is compared to the benchmark to examine the financial attractiveness of the project. The project's IRR is estimated to be 0.14%, which is much lower than the project's benchmark of 14.9%. Low IRR, compared to the hurdle rate, indicates that the project is not financially attractive without CDM assistance.

STEP 4- Common Practice analysis

The project will be the first commercial incineration plant to electricity operation in Thailand. There are no regulations requiring such kind of this project, so no other commercial incineration projects have been implemented in Thailand. Project developers are generally reluctant to invest in this untested technology because the high risks do not justify the low returns.

STEP 5- Impact of CDM Registration

The IRR is low to justify implementation of the project. This prompted the project to look for assistance to improve the IRR of the project and reduce investment risk. This expectation of additional revenue from CERs has led the project to look towards implementing the project.

5.5 Estimation of GHG emissions by sources

Following by the Revised 1996 IPCC Guidelines, ACM002 and AMS.I.D, version 11, the emission reduction from this project can be found as shown in calculation sheet below:

The amount of emission reduction in the project can be divided for consideration into 2 parts that are:

1. Reduction of Methane emission from 1,000 tons of waste at solid waste disposal site (the Solid Waste Disposal Center at Nontaburi site)
2. Reduction of CO_2 emissions from displaced fossil fuel used for generation of grid electricity that would otherwise have been produced.

5.5.1 Reduction of Methane emission from Solid Waste Disposal Site

Following in the Revised 1996 IPCC Guidelines, there are number of methods are used in estimating methane emission. In the research, the default methodology from IPCC is adopted to use in calculating the amount of methane generated at the solid waste disposal site.

The default methodology is a mass balance approach that involves estimating the degradable organic carbon (DOC) content of the solid waste, i.e. the organic carbon that is accessible to biochemical decomposition, and using this estimate to calculate the amount of CH_4 that can be generated by the waste. It is the most widely accessible, easy-to-apply methodology for calculating country- specific emissions of CH_4 from SWDSs. It requires the least amount of data available for each country increase. This approach was provided as the default methodology in the IPCC Guidelines (IPCC, 1995).

$$Methane\_emission = (MSW_T \bullet MSF_F \bullet MCF \bullet DOC \bullet DOC_F \bullet F \bullet 16/12 - R) \bullet (1 - OX)$$

Where:

MSW_T = total MSW generated (Gg/ yr)

MSW_F = Fraction of MSW disposed to solid waste disposal sites

MCF = methane correction factor (fraction)

DOC = degradable organic carbon (fraction)

DOC_F = fraction DOC dissimilated

F = fraction of CH_4 in landfill gas (default is 0.5)

R = recovered CH_4 (Gg/ yr)

OX = oxidation factor (fraction- default is 0)

The calculation is shown below:

Calculation Sheet: For 1,000ton Wastes

SOURCE 1: CH_4 Emissions from Solid Waste Disposal
(From Revised 1996 IPCC Guidelines-The reference manual (Volume 3),Waste))

MSW generated per day	1000	ton/day
Percent load to Site	100%	
MSW generated per year	365,000	ton/year

Methane emission	18,136.94	ton CH_4 /year
CH_4 equivalent	21	times of CO_2
CO_2 emission	380,875.81	ton CO_2/ year
USD/ ton CO_2	5	USD
Exchange rate	34	Baht per USD
	64,748,888.08	Baht

$$Methane\_emission = (MSW_T \bullet MSW_F \bullet MCF \bullet DOC \bullet DOC_F \bullet F \bullet 16/12 - R) \bullet (1 - OX)$$

Methane emission (ton CH_4/yr)		18,136.94	
Where:			
MSW_T	: total MSW generated (ton/yr)	365,000	
MSW_F	: fraction of MSW disposed to solid waste disposal sites	100%	
MCF	: methane correction factor (fraction)	0.80	(From default)
DOC	: degradable organic carbon (fraction) (kg C/kg SW)	0.13	(From default)
DOC_F	: fraction DOC dissimilated	0.74	
F	: fraction of CH_4 in landfill gas (IPCC default is 0.5)	0.50	
16/12	: conversion of C to CH_4		
R	: Recovered CH_4 (ton/yr)	0.00	
OX	: oxidation factor (fraction-IPCC default is 0)	0.00	

The IPCC guidelines present the following dafault values for the site condition factors:

Managed sites	MCF	**1.0**
Unmanaged, deep sites ($\geq$5 m)	MCF	**0.8**
Unmanaged, shallow sites (<5 m)	MCF	**0.4**
Unspecified SWDS-default value:	MCF	**0.6**

DOC- Content (fraction) of degradable organic carbon

$$DOC = 0.4 \bullet (A) + 0.17 \bullet (B) + 0.15 \bullet (C) + 0.30 \bullet (D)$$

0.1256	Waste Stream	Percent by weight in wet SW
A	Paper and textiles (%portion in SW)	0.07
B	Garden and park waste, and other (non-food) organic putrescibles (%portion in SW)	0
C	Food waste (%portion in SW)	0.64
D	Wood and straw waste (% portion in SW)	0.01
	sum	0.71

DOC_F-fraction of DOC dissimilated

$$DOC_F = 0.014 \bullet T + 0.28$$

Temperature at site: 33 C 0.742

In calculation, the amount of methane that will be emitted to the atmosphere from 1,000 tons of MSWs is around 18,137 ton CH_4 per year or equals to 380,876 ton CO_2 per year. It is the total emission that will be released to the atmosphere if there is no any proceeding from the project. Comparing against GHG emission reduction due to the CDM project, this emission will be destroyed by passing through the combustion process, and will not have methane left out of this process (assumed that there is no carbon dioxide (CO_2) left from the burning process also). This emission reduction can be claimed for avoiding energy from source and can be claimed to get CER in order to use in making transaction with other countries.

5.5.2 Reduction of CO_2 emissions from displaced fossil fuel used for generation of grid electricity that would otherwise have been produced

Another reduction of emission that the project can do is reduction of CO_2 from displaced fossil fuel used for generation of grid electricity. On site and/ or off site Grid Power Generation Emissions displaced by generation based on the number of wastes brought to incineration process.

5.5.2.1 Baseline Electricity Production

For project activities, the Baseline scenario is electricity delivered to the grid by the project, which would have been generated by the operation of grid-connected power plants, and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below.

The baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps as described in ACM0002/ version 6.

Step 1: Calculate the operating Margin emission factor(s) ($EF_{OM,\ y}$) following with the criteria made by Korat Waste to Energy project in 2007. It is the average emission rate of all power plants by using the equation:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where $F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power source *j* in year(s) *y*, *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including import to the grid, $COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2/ mass or volume unit of fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y* and $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

Step 2: Calculate the Build Margin emission factors ($EF_{BM,\ y}$) as the generation-weighted average emission factor (tCO_2/ MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \bullet COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the method above for plants *m*. By the calculation of $EF_{BM,\ y}$ will base on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either the five power plant that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Step 3: Calculate the baseline emission factor (EF_{y}) as the weighted average of the Operating Margin emission factor ($EF_{OM,\ y}$) and the Build Margin emission factor ($EF_{BM,\ y}$):

$$EF_y = w_{OM} \bullet EF_{OM,y} + w_{BM} \bullet EF_{BM,y}$$

Where the weight w_{OM} and w_{BM}, by default, are 50%, and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Step 1 and 2 above are expressed in tCO_2/ MWh

For the case study, Baseline Grid Power Generation Emissions displaced by renewable generation is based on the number of wastes brought to incineration process. In this project, only electricity displaced from the grid through this waste management generated power is considered. The underlying the facility is grid connected, and does not have its own electricity generators. The carbon emission factor will be quantified according to AMS1D, Version 10 Renewable Energy Projects for Grid as installed electricity capacity is expected to be below 15 MW.

Displaced electricity CO_2 emissions are determined through:

$$E_{CO2\_grid} = EL \bullet EF_y$$

Where:

- EL is the amount of electricity displaced by the electricity generated from wastes carried to incineration process.
- EF_y is the carbon emission factor of the grid as discussed above (tCO_2e/ MWh)

Use of AMS I.D. to determine an appropriate grid CEF sets out two methods to develop such CEF in grids not comprising fuel oil or diesel generation systems:

1. Average of build and operating margin where the operating margin excludes certain technology types.
2. Weighted average emissions of the generation mix.

In this situation, Option 1 was chosen and both the build margin and operating margin were calculated in keeping with AMS.I.D. Version 10 as prescribed in the methodology ACM0002, version 04. Detail spreadsheets can be found in Appendix B.

Operating Margin, Thailand

Operation Margin (OM)			
Year 2004	**Year 2005**	**Year 2006**	**Average**
0.615	0.545	0.550	0.57

<u>TABLE 5-1</u>: Operation Margin for Thailand

Thai Build Margin

Build Margin (BM)
Year 2007
0.444

TABLE 5-2: Build Margin for Thailand

The data used is taken from the Korat Waste to Energy project, Statistical Report Fiscal year 2005, 2006 and from the 2007 Thai Power Development Plan (EGAT PDP, 2007). For more information, please see Appendix B. A weight grid average EF_y for Thai National Grid of **0.5071** tCO_2/ MWh is calculated.

The project installed 12.84 MW of electricity capacity in 20 years of operation.

5.5.2.2 Baseline grid emissions

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Grid CEF	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071
MWh	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351
tCO_2e	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8
	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Grid CEF	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071	0.5071
MWh	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351	90,351
tCO_2e	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8	45,816.8

5.6 Emission Reduction

Following with this formula: $ER = E_{BL} - E_{project}$ Where:

ER: Emission reduction (tCO_2e)

E_{BL}: Baseline emission (tCO_2e)

$E_{project}$: Project Emissions (tCO_2e)

Summary of the estimation of emission reductions:

Year	Estimation of Project Activity emissions (tones of CO_2e)	Estimation of Baseline emissions (tones of CO_2e)	Estimation of emission reductions (tones of CO_2e)
Year 1	-	426,692.88	426,692.88
Year 2	-	426,692.88	426,692.88
Year 3	-	426,692.88	426,692.88

Year 4	-	426,692.88	426,692.88
Year 5	-	426,692.88	426,692.88
Year 6	-	426,692.88	426,692.88
Year 7	-	426,692.88	426,692.88
Year 8	-	426,692.88	426,692.88
Year 9	-	426,692.88	426,692.88
Year 10	-	426,692.88	426,692.88
Year 11	-	426,692.88	426,692.88
Year 12	-	426,692.88	426,692.88
Year 13	-	426,692.88	426,692.88
Year 14	-	426,692.88	426,692.88
Year 15	-	426,692.88	426,692.88
Year 16	-	426,692.88	426,692.88
Year 17	-	426,692.88	426,692.88
Year 18	-	426,692.88	426,692.88
Year 19	-	426,692.88	426,692.88
Year 20	-	426,692.88	426,692.88
Total (tones of CO_2e)	-	8,533,857.68	8,533,857.68

TABLE 5-3: Summary of the estimation of emission reductions (year 1-20)

5.7 Revenue generating from CDM execution

From emission the project can reduce, the tonCO_2 generated in each year will be claimed a CER and will be used for counting as the project's revenue by following with CER price (\$/ tonCO_2) that made with buyers or referred from "spot market".

The emission reduction generated in each year being equal 426,692.88 tons of CO_2 will be multiplied by CER price (for example: 5\$/ ton CO_2) to find the total revenue which the project owner should be received in each year.

CER Price (USD per tCO2)	Total Revenue (USD per annum)	Total Revenue (Baht per annum) (1$ = 34 BHT)
5	2,133,464.42	72,537,790.31

TABLE 5-4: Example of Revenue from the CDM project implementation

However, there are dealing costs the project owner has to pay for before getting CER. As mentioned in Chapter 2, the CDM implementation generates costs which associated with both project preparation and project implementation phase. Both of them will be taken into account and cut out of the CDM revenue.

Table 5-5, 5-6 shows the cost dealing with all CDM activities that the project has to follow:

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 5-5: Expected cost generated from CDM implementation

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 5-6: Expected cost generated from CDM implementation

Although the costs expressed are shown in wide ranges, for such kind of a renewable project, they can be specified by following with data getting from survey (source: CDM consulting company) as shown in table 5-7, 5-8.

CDM Project Preparation Activities	**Small-Scale**
- Project Assessment - Completion of project documentation	£22,667
- Validation	£9,067
- Development of Carbon credits sale agreement	£5,000
- Registration fee	£3,000
Total- Project Development Cost (CDM)	**£39,734**

* Exchange rate: 1£ = 66.1769 Baht

TABLE 5-7: Cost generated from CDM implementation (from survey)

CDM project Implementation Activities	**Estimated Costs**
- Monitoring and verification	£10,000 (per audit)
- Sale of carbon credits	5%

PS: These costs can be changed which depending on timing, contract and agreement

TABLE 5-8: Cost generated from CDM implementation (from survey)

In the table, some of them can be avoided by depending on CDM transaction pattern which investors choose to play. As mentioned, there are 4 patterns that will be used in this research to find the optimum solution of the CDM execution being:

1. The project does not be included CDM criteria in its execution
2. The project is included CDM criteria in scope of work. All activities (documents, metering and all technologies) dealing with CDM, the company will be responsible by themselves (not limited to employ consultant service to help in this implementation), and sell the carbon credit in high price.
3. The project is included CDM criteria in scope of work by the project participants will make an agreement with CER buyer or broker who will pay initial transaction cost for this implementation. By price of the carbon credit, it depends on the agreement which two of them have made. This credit price will relate on project risk and procedures.

4. The last one, the project is included CDM criteria in the process but, in this assumption, the company will negotiate with an Annex-1 country to give them support technology (emission technology) so as to reduce investment cost of the project owner. The amount of methane emission reduced will give to Annex-1 investors to fulfill their legally binding quantitative obligations laid down in the Kyoto Protocol.

Nevertheless, there is only first pattern has already mentioned about. In addition, the rest will not be considered yet.

For the rest of analysis, the crediting period for a proposed CDM project activity is set for maximum seven years which may be renewed at most two times by believing money supporting from CDM can cover through its plant life. Along this assumption, the costs being in preparation phase will be set to pay in 3 times (first and two renews), while the monitoring and verification cost will be set to pay in every year of the plant implementation.

5.8 Financial and Economical results after getting CDM support in each stipulation

Following with the stipulations have left from the first analysis; they will be used to scrutinize to find the outcome of each execution (all of them will stick in the assumptions of BASE CASE).

5.8.1 Condition 2: Investor takes the initiative and pay initial transaction cost

Starting with the first assumption, all activities effecting to the CERs generation, the company will be responsible by themselves. From this assumption, CERs are issued to buyers once CDM emission reductions have been verified and certified. This is the way to reduce risk for Annex I buyers, because CERs are trade on "spot market" but they pay a higher price (it's around 19$/ ton CO_2 in case the project is registered- (source: http://www.thaicdmforum.net/documents/0-Workshop%20Brief%20Background2.pdf). The cost which will be generated from this stipulation is shown in below:

CER Price (USD per tCO_2)	Total Revenue (USD per annum)	Total Revenue (Baht per annum) (1$ = 34 BHT)
19	8,107,164.72	275,643,600.48

TABLE 5-9: Expected Project's revenue from CDM

CDM Project Preparation Activities	Small-Scale
- Project Assessment - Completion of project documentation	£22,667
- Validation	£9,067
- Development of Carbon credits sale agreement	£5,000
- Registration fee	£3,000
Total- Project Development Cost (CDM)	**£39,734**

CDM project Implementation Activities	Estimated Costs
- Monitoring and verification	£10,000 (per audit)
- Sale of carbon credits	5%

TABLE 5-10: Expected CDM expenditures

In summary, net total cost investors have to pay for these CDM activities equals to £49,734 (including monitoring and verification cost in implementation phase) that will be paid in first years and every 7 years; while monitoring cost and sale of carbon credit 5% will be paid in every year. Taking into account, the results of the analysis can be summarized as follows (see Appendix C):

Description	Results
Levelized Production Cost (Baht/kWh)	7.6044
Project NPV (M.Baht)	-374.55
Project Payback Period (Years)	+22 years
EVA (M.Baht)	1,071.82

TABLE 5-11: Result of analysis- condition 2 (70% dividends and bonuses)

In this case, we can see that the EVA rate is quite high. That means, in each year, the return rate that the company offer (70%) to shareholders much higher than they have expected (high expense) until making the project being not feasible. For the sake of conservatism of the analysis, the percent payment on dividends and bonuses should be reduced to make the EVA getting zero (be able to compensate the requirement of shareholders sufficiently- not more than they expected). Then, the results of the analysis can be summarized as follows (see Appendix C):

Description	**Results**
Levelized Production Cost (Baht/kWh)	7.5626
Project NPV (M.Baht)	473.41
Project Payback Period (Years)	13
EVA (M.Baht)	0

TABLE 5-12: Result of analysis- condition 2 (25.5053% dividends and bonuses)

It is the pattern that project owner should do. Besides, the shareholders will be appreciate with money that is returned (as they expected); the project owner will gain high profit as well- "Win- Win situation". However, the researcher try to find out how much minimum CER price can make the condition being feasible. From adjustment, the minimum price that can make the project can be feasible is 12 USD per ton CO_2 (see Appendix C).

Description (12USD/ ton CO_2)	**Results**
Levelized Production Cost (Baht/kWh)	7.4104
Project NPV (M.Baht)	20.51
Project Payback Period (Years)	22
EVA (M.Baht)	0

TABLE 5-13: Result of analysis- condition 2 (12 USD- 25.8038% dividends and bonuses)

5.8.2 Condition 3: Co- operated with CER buyer or broker

To analyze in this condition, the researcher would like to refer the report- "how to strategize CDM opportunities in Thailand", it described about the possible price of CER in various stages of proceeding.

For the project applying in this criterion, the CDM activity is done from the first stage of implementation until project completed by getting support (including CDM transaction cost) from buyer or broker. In transaction, the buyers or brokers can claim to reduce the CER price by reason of the risk which they have to take along in this implementation- quite high.

Comparing these prices to the price that was recommended by authority in EGAT, the CER price should be around US$7-8 per ton CO_2. For the research, US$ 7 per ton CO_2 is chosen to use in this analysis.

By using the stated assumptions, the results of the analysis can be summarized as follows (see Appendix C):

CER Price (USD per tCO2)	Total Revenue (USD per annum)	Total Revenue (Baht per annum) (1$ = 34 BHT)
7	2,986,850.16	101,552,905.44

TABLE 5-14: Expected Project's revenue from CDM

Description	Results
Levelized Production Cost (Baht/kWh)	7.2750
Project NPV (M.Baht)	-937.30
Project Payback Period (Years)	+22 years
EVA (M.Baht)	286.58

TABLE 5-15: Result of analysis- condition 3 (70% dividends and bonuses)

Using the same criteria as the condition 2 do to find the maximum profit that project owner is able to receive. In adjustment, the results of the analysis can be summarized as follows (see Appendix C):

Description	Results
Levelized Production Cost (Baht/kWh)	7.2473
Project NPV (M.Baht)	-399.52
Project Payback Period (Years)	+22 years
EVA (M.Baht)	0

TABLE 5-16: Result of analysis- condition 3 (27.0265% dividends and bonuses)

In the outcome, even though the percent payment is reduced until reached the limited point that can make the EVA result still being positive, the project NPV is still not feasible. In this case, any additional solutions are required.

Nevertheless, if still stick in this criterion (27.0265 percent payment), the CER price that can make the project being feasible is equal to 12 USD per ton CO_2 (see Appendix C). It is quite high, and believing that CER buyer will not give this rate to the project owner, so adjustment in other factors such O&M is recommended.

Description	Results
Levelized Production Cost (Baht/kWh)	7.3106
Project NPV (M.Baht)	53.97
Project Payback Period (Years)	22
EVA (M.Baht)	50.65

TABLE 5-17: Result of analysis- condition 3 (12USD- 27.0265% dividends and bonuses)

5.8.3 Condition 4: Technology support

Following along with the financial model by cutting emission reduction equipment out of the consideration, the results of the analysis can be summarized as follows (see Appendix C):

Description	Results
Levelized Production Cost (Baht/kWh)	6.6216
Project NPV (M.Baht)	-1,137.59
Project Payback Period (Years)	+22 years
EVA (M.Baht)	-18.15

TABLE 5-18: Result of analysis- condition 4 (70% dividends and bonuses)

In this case, the adjustment cannot help to improve the financial condition anymore because, as we known, the results between EVA and project NPV are in opposite manner; it is impossible to improve EVA and make the project NPV being better consequently, so to find other solutions are highly recommended (especially money support).

5.9 Conclusion

From all results that were analyzed, it can be concluded that only condition 2 has high possibility to help investors in both of financial and economical outcomes;

otherwise, it needs any additional support to make the financial and/ or economical result getting better, or better solution as such in the condition 3 (need higher CER price) and condition 4 (not only help in emission technology, but also need more assistance from CER buyer to make the project becomes more feasible).

In the results, the production cost of each condition being higher than in BASE CASE due to the higher of investment cost (including transaction cost from CDM) and including the influence of discount rate or WACC. However, that is not a factor answering whether the project should be invested. In the research, it showed that the higher of production cost will come along with the higher of income (revenue from selling carbon credit); moreover, higher income equals to higher of equity that will affect to the result of WACC also.

Even though, in Base Case, the production cost of the power plant is quite high compared with EGAT and private power plant data being around 2-4 Baht/ kWh-data in 2005 (huge margin compared to the production cost of the project, that is the reason why such the project is hardly to be feasible), if project owner perceive in the revenue coming from the CDM proceeding, it will be able to help in investment of such kind of this project very well.

From experiment, the revenue coming from selling of carbon credit, it can improve the existing revenue in Base Case, which only came from the revenues come from selling electricity, waste disposal charge and sorted MSW sale, being equal to 59% in each year (for condition 2) and 22% in each year (for condition 3). While the expense generated from the CDM transaction is increased only 20% (in condition 2) and 0% in condition 3 respectively, the higher revenue compared with the less expense occurred in the project showed the interesting of revenue that coming from the CDM execution being quite well.

Nevertheless, to do such kind of project by concerning the higher revenue from the CDM execution, it does not mean the higher income can always make the project being feasible, but it needs to be managed and planned in many factors quite well before making the project being feasible and getting satisfaction from shareholders as specified.