RENEWABLE ENERGY DEVELOPMENT STRATEGY IN INDONESIA: CDM FUNDING ALTERNATIVE

Agus Sugiyono
Researcher, Agency for the Assessment and Application of Technology (BPPT)
BPPT Building II, 20th floor, Jl. M.H. Thamrin 8, Jakarta
Fax. 021-316-9765. E-mail : sugiyono@bppt.go.id

Abstract

Renewable energy has advantage than non-renewable energy, i.e. environmentally friendly that has low pollutant emission and support sustainable development. Nevertheless, renewable energy development in Indonesia was not growing fast. Besides renewable energy development has a high investment cost, renewable energy reserve is also not so big comparing with non-renewable energy reserve.

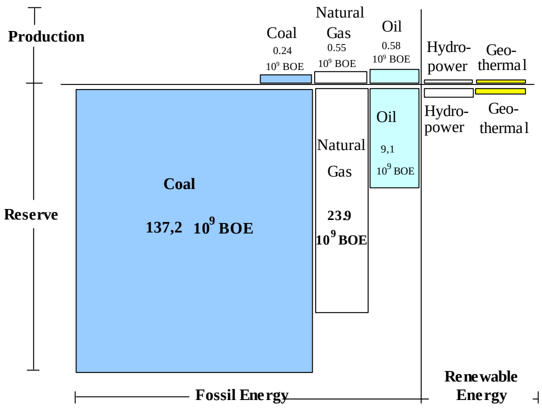
Recently, renewable energy utilization in Indonesia (hydropower and geothermal power plant) is only about 3 % of the total reserve. It is means that there is still a big opportunity to develop renewable energy. With the coming of economic crisis since 1997, the growth of electricity demand is not enough to drive renewable energy development. Therefore, there should be assessed and developed new strategy for renewable energy, such as to develop integrated industrial estate for big hydropower and utilization of non-electricity purpose for geothermal. The other strategy is to sell Greenhouse Gas (GHG) emissions reduction via Clean Development Mechanism (CDM) to reduced investment cost. Under CDM regime developed countries can undertake collaborative project to reduce GHG gases in developing countries. Indonesia has potency to reduce GHG emission about 17.1 million tC along the period 1995-2025 with cost about 0.8 – 7.8 US$/tC using hydropower power plant. While using geothermal power plant is expected about 100.9 million tC will be reduced with cost of 43.9 US$/tC.

Key words: Renewable Energy, Clean Development Mechanism

1. INTRODUCTION

1.1. Energy Resource

Indonesia has a lot of energy resources such as fossil energy (coal, natural gas, and oil) and renewable energy (hydropower, geothermal). Although there is other renewable energy resources such as solar, wind and biomass but it is not significant comparing with the others. The main energy reserve (a part of energy resource that economic to develop) has shown in Figure 1.



Source : Sugiyono (2000)

Figure 1. The Main Energy Reserve and Production in Indonesia (1995)

In 1995 fossil energy dominated energy reserve in Indonesia. The coal reserve located mainly in Kalimantan and Sumatera that estimated about 137.2×10^9 Barrel Oil Equivalent (BOE). The natural gas reserve has estimated about 23.9×10^9 BOE, while the oil reserve has estimated 9.1×10^9 BOE. As a non-renewable energy, reserve to production (R/P) is the main characteristic of the reserve that shown when the reserves will be depleted. R/P for coal is more than 500 years while R/P for natural gas is about 43 years. The oil will be depleted in about 16 years, if there is no new discoveries of reserve.

Renewable energy reserve is shown in difference way. The reserve is indicated by install capacity not by energy unit as in fossil energy reserve. Indonesia has a large hydropower reserve of 75.50 GW, however only 2.9 % of the total hydropower reserve has been utilized. Hydropower reserve is distributed into 1,210 locations. The larger of hydropower reserves are located in Irian Jaya, Kalimantan, and Sumatera regions. These regions have a small-populated area and the electricity demand is too low to justify large-scale hydropower, but have about 80.99 % of the total hydropower reserve. On the other hand, Jawa with the highest population density and energy demand has only 5.60 % of the total hydropower reserve and more than half of its reserve has been already used.

The total geothermal reserve in Indonesia has been estimated about 16.1 GW. Most of the total reserves are located in Jawa and Sumatera. A constraint in the utilization of geothermal is the price of geothermal steam. Therefore, the geothermal that has been used in Indonesia is only 590 MW up to the year 1999 or about 3.7 % of the total geothermal reserve.

Solar energy resource can be estimated from solar radiation (the range of 4.21 kWh/m^{2}day to 5.46 kWh/m^{2}day in Indonesia). Based on the locations, the islands such as Sulawesi, Irian Jaya, Nusa Tenggara, and Maluku have the highest average solar radiation. Since 1988, Indonesia has started to utilize the solar energy through rural electrification program by application of Solar Home System (SHS). More than 10,000 SHS from the target of 1 million have been distributed and installed in households of the remote areas to provide electricity for basic lighting. Wind energy resource can be estimated from wind speed (the range of 1.3 meter/second to 6.3 meter/second in Indonesia). The wind speed that can be utilized as energy source is above 4 meter/second. However, only some areas in Indonesia that has the required wind speed. The economic of wind energy application is not only affected by wind energy potential but also is affected by other factors such as the availability of others energy sources, and initial cost. Utilization of wind for electric generation is still more expensive than other energy sources in Indonesia. Biomass energy that consists of firewood and agricultural wastes can be obtained from home yard, gardens, and forests. Although biomass energy resource in Indonesia is very huge but it is only used as a non-commercial energy for cooking in rural household. In this paper only renewable energy such as hydropower and geothermal energy will be discussed later.

1.2. Environmental Consideration

Fossil energy as a non-renewable resource has no processes of replenishment (once used they are gone forever). While the renewable energy resource has advantage that they will be used in a sustainable manner. Utilization of fossil energy in a form of fuels combustion also has significant impact to the environmental. Air pollution resulting from fuel combustion generates emissions such as suphur dioxide (SO_2), nitrogen oxide (NOx), and particulate matter or dust. These emissions directly related to the human health. Beside that other emissions from fuel combustion is CO_2 that related to the global environmental, i.e.: global warming problem. Table 1 shows environmental impact of emission from fossil energy utilization. Renewable energy utilization such as hydropower and geothermal is not related to the combustion therefore relatively emission free and environmentally friendly. This is the other advantage of renewable energy.

Table 1. Environmental Impact of Emission from Fossil Energy Utilization

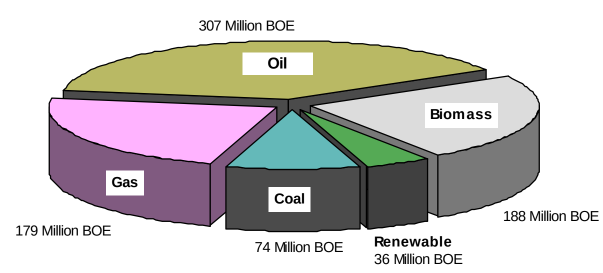
Type of Emissions	Impact to	
	Human Health	Environmental
SO_2	- Problem with respiratory organs - Pneumonia	- acid rain that be able to damage of forest, river, and lake environment - opacity
NO_x	- problem with respiratory organs	- acid rain - depletion of ozone layer that be able to damage forest
Particulate Matter/ Dust	- irritation of eye and larynx - bronchitis and problem with respiratory organs	- opacity
CO_2	No direct impact	- global warming - ecosystem degradation

Source : Princiotta (1991)

2. POWER PLANT FROM RENEWABLE ENERGY

2.1. Primary Energy Supply

Total primary energy supplies in Indonesia reach 784x10^6 BOE for domestic market in 1995 (see Figure 2). Oil at present dominates with 39 % followed by natural gas with 23 % of the domestic market. Biomass has shared about 24 % but has utilized as non-commercial energy in the form of firewood for cooking in rural household. While coal has shared about 9 % and renewable energy has shared only 5 % for domestic energy supply. Fossil energy may be utilized in direct combustion or converted into secondary energy in the refinery or power plant. Renewable energy has only utilized in the form of electricity. Therefore, development of renewable energy has closed relation with development of electricity generation.



Source: BPPT (2000)

Figure 2. Primary Energy Supply (1995)

2.2. Electricity Generation

The electricity generation in Indonesia is supplied by PLN (interconnected system and decentralize), Independent Power Producer (IPP) and auto-generation (captive power). The existence of IPP is the first step for electricity restructuring to create multi seller and multi buyer system. IPP is a private company that produced electricity and sells to PLN. While the captive power is a private company that used their own electricity produced. Up to now there are 309 IPPs proposal with total capacity 98,756 GW. Therefore, the real requirement is only 46 IPPs. The number of private investor that already signed the Power Purchase Agreement (PPA) is 26 with a total capacity of 11.015 GW.

PLN is a main producer with share about 70 % of the total electricity generation in Indonesia. The PLN share has expected more higher in the future followed by decreasing share of captive power. The PLN's installed capacity in Indonesia increase from 4,080 MW in 1984 to 14,895 MW in 1995, or increase in average of 12.4 % per year. While, the auto-generation installed capacity increases from 3,206 MW in 1984 to 6,538 MW in 1995 or increase in average of 6.6 % per year. The electricity production of PLN increases about 14.1 % per year during that time, the production increases from 13.75 TWh to 59.40 TWh.

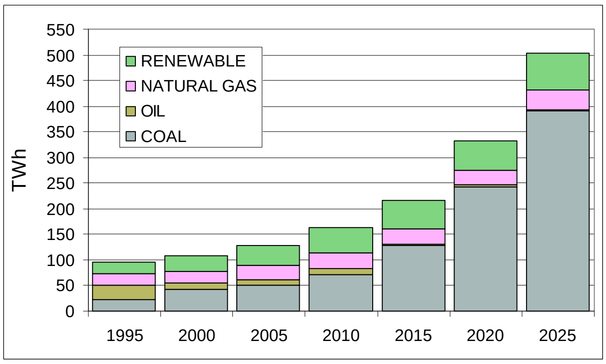
Installed capacity of PLN in 1995 is mainly contributed by steam power plant, it is about 32.3 % of the total installed capacity. Gas combined cycle power plant is the second largest electric generation plant that contributes about 29.6 % of the total installed capacity. The rests of the installed capacity are contributed by hydropower plant (14.6 %), diesel power plant (14.6 %), gas turbine power plant (about 6.7 %), and geothermal power plant (2.0 %).

The economic crisis happened in Indonesia during 1997 to 1998. The crisis hit all of various sectors directly and indirectly. The crisis affected to decrease of ability to buy of the people that would lead to decrease of industrial production sales. But in the economic crisis period, electricity sales by PLN is still increasing. In the period 1991 until 1997 electricity sale grows about 11 % to 16 % per year, but during the economic crisis condition (1997-1998) it only grows about 1 % per year. The crisis also has pushed the government to reschedule IPPs project as indicated in the Presidential Decree no. 39, 1997. On the basis of this decree, the 29 IPPs have been rescheduled. 10 IPPs with total capacity 4720 MW have been continued, 6 IPPs with total capacity 3045 MW have been reviewed and 13 IPPs with total capacity 3215 MW have been postponed. Depreciation of the rupiah currency made electricity prices from IPP become very expensive that made a problem for PLN. Therefore, PLN has made re-negotiation with IPPs to solve the problem.

2.3. Electricity Supply Projection

The growth of electricity demand depends on the growth of Gross Domestic Product (GDP), and population growth. In 1995 the GDP growth about 7 % and in the economic crisis period the GDP will stagnant and expected will gradually recover with the growth of 4 % in 2001 and of 7 % in 2003. The fluctuated of the GDP growth will causes the reduction in the demand of electricity. Taken into account the economic crisis, the electricity demand has been projected with the base year 1995 until 2025. The demand is an input to make electricity supply projection.

Projection of the electricity supply has been performed by optimization method. The MARKAL model is used to make the optimization. In the model, optimization problem was formulated as an energy system network. Based on this network, linear programming matrix is constructed. The model than calculate the least cost or ‘baseline’ strategy of fuel mix for electricity to fulfil the electricity demand. Figure 3 shows projection of electricity supply by fuel mix.



Source : BPPT (2000)

Figure 3. Projection of Electricity Supply by Fuel Mix (Including PLN, IPPs and Captive Power)

The growth rate of the electricity demand in the year 2000 is estimated near zero as a result of the economic recession. Starting at 2010, the economic condition of the country has fully recovered and the electricity demand will increase with an average rate of 7 % per year. In the base year electricity supply has dominated by oil-fired power plant with share 29 % followed by gas turbine power plant and coal fired power plant (each has share of 24 %) and the rest is renewable power plant with share of 23 % (21.8 TWh). The coal-fired power plant is increase by 10 % per annum. In the end of the study period, coal fired power plant has share 78 % of the total electricity supply. The renewable has share of 14 % (71.1 TWh) followed by gas turbine power plant (7 %) and the oil-fired power plant will be phase out in the future.

With the maximizing utilization of renewable energy strategy, i.e.: hydropower plant and geothermal power plant, in the end of study period renewable energy will increase and became 26 % of the total electricity supply (BPPT, 2000). It means that coal-fired power plant has still dominated as electricity supply and the maximum utilization of renewable energy is expected about 130 TWh.

Using least cost optimization, the renewable energy has only growth about 4 % per year from 21.8 TWh in 1995 to 71.1 TWh in 2025. This is because of the unit cost of electricity from renewable energy is remains high than fossil energy. As shown in Table 2 that the unit cost of electricity from renewable is about 4 to 7.1 cent US$/kWh. While the fossil energy has the unit cost of electricity is around or below 4 cent US$/kWh. The renewable energy will be more attractive if the unit cost could be reduced through reducing investment cost.

Table 2. Unit cost of electricity

Type of Power Plant	Unit cost of electricity (cent US$/kWh)		
	1*	2*	3*
Gas Combined Cycle	3.1	3.3	-
Coal Fired	4.1	3.5	-
Oil Steam	4.6	4.2	-
Hydropower	5.3	-	-
Geothermal	7.1	4.3	4.0 – 6.0

Source:
1* BPPT, MARKAL Database (1995), 10 % discount rate
2* Yusgiantoro (2000)
3* World Bank (2001), Large plant, Medium quality resource

3. DEVELOPMENT STRATEGY

Renewable energy resource in Indonesia spread out a long the regions that still have low energy demand. The low and disperse demand of electricity is a main constraint to utilize renewable energy. Under the least cost or “baseline” strategy, development of renewable energy is not attractive as discuss before. There are other strategies and regulation that will push utilization of renewable energy, e.g.: utilize the big unit of power plant, diversification of product such as direct use of geothermal energy for heating, and sell CO_2 emission reduction.

3.1. Integrated Industrial Estate Concept

Large scales renewable energy should be developed integrated with industrial estate that will be used electricity from renewable energy. For example, integrated planning to development hydropower plant in Mamberamo, Papua with capacity near 6 GW. There is no existing transmission line and electricity demand is very low in the region. Therefore, development of hydropower should promote energy intensive industries as a prime mover to drive economic activity in Mamberamo region. The industries that could be a prime mover are aluminum, iron and steel, cooper and nickel industry. A biggest part of energy demand for industries above could be supplied by electricity. If hydroelectric power in Mamberamo will be developed, availability of inexpensive electricity could improve competitiveness of industry product. Using inexpensive electricity could reduced investment, operation, and maintenance cost. Integrated development of hydropower plant and energy intensive industries has expected make Mamberamo region as a center economic growth in Papua.

For funding purpose, except infrastructure that responsible by government, hydroelectric power plant can be funding by investor through venture capital. Whereas, energy intensive industries is funding by foreign investor. With these investment schemes, it is expected not difficult for the government to arrange the budget. The investment will pay back through tax and rent system (Sugiyono, 1999). Although its is attractive concept, due to economic crisis and social-political condition these planning has been postponed.

3.2. Geothermal Energy for Process Heating

Since the utilization of geothermal energy for power plant is expected growing slowly, it may be well to concentrate the possibility utilization of geothermal energy for non-electricity or direct use such as process heating. Utilization of geothermal energy for process heating may be support to the local agriculture and tourism industries. Direct use technologies are built around the extraction of heat from relatively low temperature geothermal resources, generally of less than 150 ^oC. Because geothermal heat is non-transportable (except short distances by fluid pipeline), any applications must generally be sited within 10 km or less from the resource. The possibility utilization of geothermal energy for direct use in industry has shown in Table 3.

Table 3. Possibilities of Low Temperature Process and Application

° C	Process Heating
180	• Evaporation of highly concentrated solutions
	• Refrigeration by ammonia absorption
	• Digestion in paper pulp (Kr2ft)
170	• Heavy water via hydrogen sulphide process
	• Drying of diatomaceous earth
160	• Drying of fish meal
	• Drying of timber
150	• Alumina via Bayer's process
140	• Drying farm products at high rates
	• Canning of food
130	• Evaporation in sugar refining
	• Extraction of salts by evaporation and crystallization
	• Fresh water by distillation
120	• Most multi-effect evaporation. Concentration of saline solution
110	• Drying and curing of light aggregate cement slabs
100	• Drying of organic materials. Seaweed, grass, vegetables, etc.
	• Washing and drying of wool
90	• Drying of stock fish
	• Intense de-icing operations
80	• Space-heating (buildings and greenhouses)
70	• Refrigeration(lower temperature limit)
60	• Animal husbandry
	• Greenhouses by combined space and hotbed heating
50	• Mushroom growing
	• Balneology
40	• Soil warming
	• Swimming pools, biodegradation. fermentations
30	• Warm water for year-round mining in cold climates
	• De-icing
	• Hatching of fish
20	• Fish farming

Source : World Bank (2001)

In agricultural and fishery typically use lower temperature geothermal fluids. Example of geothermal energy utilization in agriculture is greenhousing of plants in Argentina and in fishery is aqua-culture in New Zealand. Geothermal energy may be both cost effective and reliable in industrial applications. Some industries use steam or superheated water. The largest industrial applications are in pulp, paper and wood processing. Examples include timber processing in New Zealand and a vegetable dehydration plant in the United States (World Bank, 2001).

3.3. Autonomy of Provinces and District

In 1999 Government of Indonesia has declare two constitutions regarding the decentralization and deconcentration. Constitution No. 22/1999 deals with autonomy of provinces and districts in Indonesia. Constitution No. 25/1999 regulates financial balance between central and local governments. These constitutions have new regulation on the management and share of natural resources revenue. Its mention that state revenue from natural resource sectors of forestry, general mining, and fishery are divided with 20 % for central government and 80 % for the local government. The state revenue (after tax) from oil is divided with balance of 85 % for the central government and 15 % for the local government. While the state revenue from natural gas is divided of 70 % for the central government and 30 % for the local government. Regarding to the renewable energy development, these regulations have closed relation with geothermal energy. The development of geothermal energy such as exploration and production is much more similar to oil and natural gas industry (Sumotarto, 1999). Therefore, these regulations should be taken into consideration for development of geothermal energy.

4. CDM FUNDING

4.1. GHG Emission and Climate Change

It is now widely recognized that climate change attributable to greenhouse gas (GHG) emissions resulting from human activities is a serious global problem. The GHGs are included six gases, i.e.: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbon (HFC), sulphur hexaflouride (SF_6) and perfluorocarbon (PFC). CO_2 emission is the main contributor that responsible to the climate change. Developed countries are currently the largest emitters of GHGs.

In 1992, the Framework Convention on Climate Change (FCCC) created an international institutional system for dealing with climate change. The convention was opened for signature in 1992 and as of 1998 with 74 countries ratified the treaty. Parties to the FCCC undertook different obligations depending largely on their relative development status. Thirty nine developed countries and countries with economies-in-transition, which are listed in Annex I of the convention (Annex I countries), pledged to adopt policies and measures with the aim of reducing GHG emissions to 1990 levels by the year 2000. While, developing countries (Non-Annex I countries) made no GHG abatement commitment under the FCCC. Like the developed countries, developing countries undertook to prepare national emission inventories and to report to the FCCC on their domestic policies and activities for reducing atmospheric GHG levels.

4.2. The Kyoto Protocol and CDM

The third meeting of the Conference of Parties (CoP) in 1997 has adapted The Kyoto Protocol to the Framework Convention on Climate Change. The protocol establishes binding commitments for the Annex I countries to reduce GHG emissions by at least 5.2 % below 1990 levels during the period 2008-2012. The protocol contains a number of new mechanisms that permit all parties to the convention to implement GHG reduction policies cooperatively with other parties, called flexible mechanisms. There are tree flexible mechanisms, i.e.:

- **Joint Implementation (JI)**. JI consists of a bilateral agreement between two entities to complete a GHG mitigation project. JI projects still can be undertaken between entities in Annex I from industrialized countries. Activities Implemented Jointly (AIJ) is the pilot phase of JI.

- **International Emissions Trading (IET)**. IET refers to the acquisition and the transfer of emission credits or permits between Annex I countries and would begin in 2008. IET implies transferring blocks of emission or emission reductions from one country to another.
- **Clean Development Mechanism (CDM)**. Annex I countries can undertake collaborative projects to reduce emissions or sequester carbon in developing countries under CDM. Both private and public entities are eligible to participate in the CDM. The CDM is more flexible than the others and developing countries such as Indonesia could take merit in this mechanism.

4.3. GHG Inventory and Mitigation Option

Indonesia has been reported GHGs emission inventories to FCCC as presented in the report with title *First National Communication of the Republic of Indonesia* for 1990 - 1994. CO_2 emission is the greatest GHG emissions in Indonesia with share is accounted almost 70 % while the other gases are about 30 %. In 1994 the total GHG emissions in Indonesia are about 470 million tons of CO_2 equivalent. The main sources of GHG emissions are energy sector and forest sector. But the energy sector dominate as GHG emission sources with share about 46 % of the total emission. GHG emission sources in the energy sectors include utilization of fossil fuels at different stages of activities, i.e.: energy production, energy transformation and also the energy combustion at the end-users' plant sites. The value and GHG emission types will depend on the primary energy sources (oil, natural gas, coal, or renewable).

The mitigation option has developed in order to reach a particular level of emission by choosing any of abatement technology option. Technology options for GHG mitigation can be grouped into two categories, i.e. supply side mitigation and demand side mitigation. The supply side mitigation can be divided into more efficient conversion of fossil fuels, switching fossil fuel, and increasing use of renewable energy. The demand side mitigation can be divided into more efficient energy used (demand side management) and the utilization of efficient appliances. These two approaches can work together in one-mitigation application, such as energy efficient lamp, refrigerator, air conditioner and variable speed drives.

Several attributes of renewable energy (hydropower plant and geothermal power plant) have advantage as a technology option for GHG mitigation. Renewable energy can be extracted from the resource without burning as using fossil energy such as coal, gas or oil. Hydropower plant is nearly free from GHG emissions. Geothermal power plant produces only about one-sixth of the CO_2 that a natural gas fuelled power plant produces and none of the N_2O emission.

4.4. Abatement Cost

Cost estimates for GHG reductions range widely depending on the specific location, level of economic and technological development, economic sector and method for measuring emissions. Cost estimates in developed countries, for example, range from US$ 20 to US$ 150 per ton of carbon (tC) saved. Many opportunities for low abatement cost are located in developing countries, so developed countries may be able to obtain GHG abatement at lower cost by investing abroad.

Abatement cost in Indonesia is estimated based on the result of the MARKAL model. From the result of total cost and the total CO_2 emission of energy system at different technologies option can be calculate average abatement cost of CO_2 emission as shown in Table 4. The hydropower can be reduced CO_2 emission about 17.1 million tC along the period 1995-2025 with abatement cost about 0.8 – 7.8 US$/tC. While geothermal power plant can be reduce about 100.9 million tC with cost about 43.9 US$/tC. The Cost of Emissions Reduction Initiatives (CERI) curve for each technology option has shown in Figure 4.

Table 4. Abatement Cost of CO_2 Emission

Mitigation Options	CO_2 Reduction	Additional Cost	Abatement Cost
	10^6 tC 2)	10^6 US$ 3)	US$/tC
Baseline 1)	3,397.3	454,260.0	-
Cogeneration	16.6	-3,939.0	-236.8
New Motor Electric	9.5	-398.8	-41.8
Solar Thermal	0.8	-34.0	-41.6
Compact Flour. Lamp	54.0	-571.4	-10.6
Improve Refrigerator	3.5	-8.0	-2.3
HiTech Refrigerator	4.3	-6.6	-1.5
New Mini Hydro P.P.	7.9	6.0	0.8
New Hydro P.P.	9.2	72.2	7.8
New Gas C. Cycle PP.	1.9	19.0	10.0
Adv. Compct. F. Lamp	22.0	224.5	10.2
Compact Refrigerator	2.7	47.1	17.3
Compact Panel Refrig.	2.1	48.9	22.4
New Biomass P.P.	2.4	62.3	25.4
New Gas Turbine PP.	1.0	29.4	27.0
Geothermal P.P.	100.9	4,429.0	43.9
New HSD Gas Turbine	1.0	212.4	194.7
New Coal PP. 600 MW	1.0	349.2	320.1
New Coal PP 4000 MW	3.0	1,512.0	504.0
Standard Flour. Lamp	1.9	1,088.0	569.9

1) Base on total cost and total CO_2 emission of Indonesia's energy system without mitigation option
2) tC = tons of Carbon
3) Cost calculation base on US$ 1995
4) Source: BPPT, Output MARKAL Model. November 24, 2000

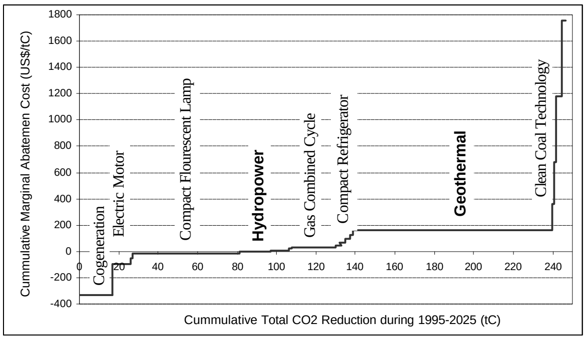


Figure 4. CERI Curve of Abatement Technology Option

4.5. CDM Project Activity

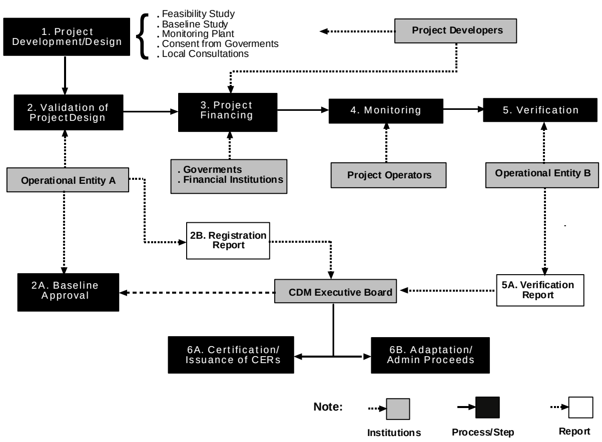
The Kyoto Protocol identifies three specific goals for the CDM, i.e.:

- to assist developing countries achievement sustainable development, decrease local pollution and reduce GHG emission levels.
- to contribute to the attainment of the environmental goals of the convention, and
- to assist Annex I countries in complying with their emissions reduction commitments.

Developing countries view CDM as a new venue for financial assistance, investments towards sustainable development, technology transfer, and promotion of equity.

Under the CDM, developing countries will be able to produce Certified Emissions Reduction (CER) (sometimes called offsets) through projects that reduce GHG emissions below 'baseline' levels. Because it is much cheaper for developing countries to abate GHG emissions, theoretically CDM facilitates cost-effective achievement of any target for GHG reduction. Indonesia has the potential to become as one of CER supplier, besides Mexico, Malaysia, Korea and Brazil. The main CER suppliers will be China and India. The global costs of achieving the Kyoto Protocol targets have estimated about US$ 120 billion if each nation must satisfy its commitments purely through domestic actions. But drop to US$ 54 billion if trading is permitted among Annex I countries and further to US$ 11 billion if CER transfers are permitted and efficiently supplied.

CDM project will pass through a set of stages, beginning with the initial project idea, then proceeding through implementation, and ending with certification of emission reduction. The general steps of the CDM project cycle are shown in Figure 5. The key institutions involved in this regulatory framework would broadly consist of participating parties, brokers, respective governments, monitoring agencies, auditors and verifiers, operational entities, adaptation fund, the Executive Board, the FCCC Secretariat, and the CoP.



Source: Baumert (2000)

Figure 5. CDM Project Activity Cycle

The CDM is a new and untested mechanism for encouraging cooperative multinational efforts to reduce GHG emission. There is still has some matter to debate on, such as how to calculate abatement costs and how to determine the resulting emissions reductions comparing with baseline level. Therefore, many aspects should be taken into consideration carefully before CDM is implemented. The study about implementation of CDM in Indonesia is still in progress that conducted by co-operation of Ministry for the Environmental, BPPT, and other institutions.

5. CONCLUSION

Renewable energy reserve (hydropower and geothermal energy) in Indonesia is expected about 91.6 GW and the utilization is only about 3 % of the total reserve. It is means that there is still a big opportunity to develop renewable energy. But in the economic crisis situation, the growth of electricity demand is not enough to drive renewable energy development. Therefore, there should be assessed and developed a new strategy for renewable energy: such as:

- to develop integrated industrial estate for big hydropower,
- to utilize geothermal energy for non-electricity purpose in industry with process heating, and
- to use financial assistance through CDM.

Renewable energy has advantage than fossil energy because has less GHG emissions. Comparing with baseline along the period 1995-2025, the hydropower will be reduced CO_2 emission about 17.1 million tC with abatement cost about 0.8 – 7.8 US$/tC. While geothermal power plant can be reduce about 100.9 million tC with cost about 43.9 US$/tC. These reductions possibility can be able as an initial idea to create the CDM project. The CDM is a new and untested mechanism for encouraging cooperative multinational efforts to reduce GHG emission. Therefore, many aspects should be taken into consideration carefully before implemented CDM project.

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