Advanced Materials Research Vols. 726-731 (2013) pp 3189-3199
Online available since 2013/Aug/16 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.726-731.3189

The Application of Clean Development Mechanism as a Driver for Renewable Energy Projects in Malaysia

SumianiYusoff, Loh, T., S.,

Department of Civil Engineering, University of Malaya,, Malaysia.

Email:sumiani@um.edu.my, titusloh@gmail.com

Keywords: Renewable Energy, Sustainable Development, Clean Development Mechanism (CDM), Malaysia

Abstract. The issue of climate change has long been attributed to the extensive amountof carbon emission through the utilization of fossil fuel as our primary energy source. As this source reaches depletion, the search for alternative and renewable energy options has received much attention on a global scale. The two-pronged approach of renewable energy projects—reducing global greenhouse gas emissions through substitution of fossil fuels and prolonging the lifespan of non-renewable energy—is deemed as the key to our endeavour for sustainable development. The Clean Development Mechanism under the Kyoto Protocol can act as a tool to provide the financial and technological thrust necessary for effective implementation of renewable energy projects in developing nations. Malaysia, in all its potential, currently utilizes less than 1% of its potential renewable energy capacity—despite its recent political and economical advancements in this respect. This paper will assess the untapped potential of renewable energy and status of the CDM in Malaysia, and discuss how the CDM can act as a driver for renewable energy projects in developing nationsincluding Malaysia.

Introduction

Rapid modernization in recent decades has caused tremendous repercussions, with critical issues such as natural resource depletion and extensive environmental damage reaching suffocating levels. The world today battles daily with the adverse effects birthed from the paradigm of industrialization—summed up in a term commonly known as global warming.

In light of these growing concerns, the Kyoto Protocol was ratified in 1997, where participating industrialized nations agreed to reduce their total greenhouse gas emissions by 5.2% in reference to the year 1990. As one of the three 'Flexibility Mechanisms', the Clean Development Mechanism (CDM) gives Annex 1 countries an option to achieve their targets by proposing emission-reduction projects in partnering developing nations. The holistic approach of the CDM has been well received, causing the number of registered projects to escalate in recent years. Since the first CDM project in 2004, the total number of projects registered has increased to over 2200 as of May 2010, with expected Certified Emission Reductions (CERs) of over 1.79 billion CERs, or 1.79 billion tons of CO_2 emission reductions, until the end of 2012 (UNFCCC, 2010).

Under the CDM, renewable energy projects have drawn intense focus from project proponents, as its dual benefits of reducing carbon emission and relieving the strain on fossil fuel reserves are highly desirable on a global front. Renewable energy projects currently make up 47.6% of the total projects hosted in Latin America, 64% of projects in Asia, and 36% of projects in Africa—each representingthe majority in their respective regions (Fenhann, 2010).

However, renewable energy projects only constitute 21.3% of the total CDM projects in Malaysia, which is a relatively low number considering the vast potential the nation possesses for renewable energy options such as biomass, solar and hydropower. With the country's natural gas reserves only expected to last for the next 50-60 years and oil only for the next 20 years (Jaafar*et al.,* 2001), there is a pressing need for energy alternatives on both a local and global plane.

This paper is structured to assess the untapped potential and recent policy advancements of renewable energy in Malaysia. The current trends of the CDM in terms of project registration will be reviewed;and finally, issues and implications on how the CDM can drive the development of renewable energy in Malaysia will be discussed.

Overview of renewable energy in Malaysia

Like most nations, Malaysia has been and continues to be highly dependent on fossil fuels as a primary source of energy. The nation's primary energy demand was projected to grow at 3.5% per year from 56Mtoe in 2002 to 147Mtoe in 2030 mainly due to the increase in demand for coal, oil and gas (APEC, 2006).Table 1 shows the electricity generation mix in Malaysia for selected years:

Table 1: Electricity Generation Mix in Malaysia (%) (1990-2030) (Source: APERC Analysis, 2005)

	1990	2002	2010	2020	2030
Oil	50	9	1	1	0
Gas	20	74	56	48	45
Coal	12	6	36	45	50
Hydro	17	11	7	6	4
Others	0	0	1	1	1

Analysis shows that the heavy dependence on fossil fuels will prolong even till the year 2030, considering no drastic changes occur. It is worth noting that the contribution of renewable energy in the current mix is scarce despite its huge potential in Malaysia. Besides hydroelectricity, the contribution of biomass energy has steadily increased; while the harnessing of solar energy has been confined to sporadic projects of heating systems and rural electrification. The table below shows the current installed renewable energy capacity:

Table 2: Currently Installed Renewable Energy Capacity in Malaysia(Source: Hasan, 2009)

Category	Mini-hydro	Biomass & biogas	Solar PV	Wind	Total
Grid-connected (MW)	23.8	32	1	-	56.8
Off-grid (MW)	-	447	6.1	0.2	453.3
Total	**23.8**	**479**	**0.2**	**7.1**	**510.1**

As Malaysia seeks to realise its "Vision 2020" industrialization objectives, an expanding consumption of energy was deemed crucial and necessary—with little or no concern for issues such as efficiency and cleaner energy. In response to this, the Malaysian government has actively sought alternatives to lessen the nation's dependence on fossil fuels. Notable efforts include the launching of the Small Renewable Energy Power Programme (SREP) in 2001; which aimed at intensifying the development of renewable energy as the fifth fuel resource under the country's Fuel Diversification Policy—in line with the objectives of the Third Outline Perspective Plan (OPP3) for 2001-2010. Under the 8th Malaysia Plan (8MP 2001-2005), the government had changed the Four Fuel Policy to the Five Fuel Policy with the addition of renewable energy as the fifth source in 1999 (Jamaludin, 2009). This policy was implemented in hope of generating 5% (600MW) of the country's electricity using renewable sources by 2005; however, despite various fiscal incentives, only 2 plants of 12MW total capacity have been officially commissioned (Hasan, 2009).

Recently, the SREP gained momentum with concerns about increasing oil prices looming. Under the 9th Malaysia Plan (2006-2010), a new SREP target of 350MW electricity generation capacity was set to replace the previous target, giving it more feasibility amidst the obvious barriers (Hasan, 2009).

2.1 Renewable energy potential in Malaysia

Malaysia, being entirely equatorial, is blessed with an ambient temperature that remains uniformly high throughout the year—between 27-33^{o}C. Most locations have a relative humidity of 80-88%, rising to nearly 90% in the highland areas and never falling below 60% (Australian Business Council, 2005). Such favourable climate conditions have laid the foundation for possible expansion in renewable energy alternatives—appropriate weather for crop production as a source of biomass energy;consistent rainfall volume ideal for hydropower; and daily exposure to sunshine for solar power initiatives. Table 3 shows a comparison between the renewable energy potential and the current installed capacity in Malaysia:

Table 3: Comparison of currently installed and potential capacity of renewable energy in Malaysia
(Sources: Balce,Tjaroko& Zamora, 2003; Hasan, 2009)

	Installed Capacity (MW)	**Potential Capacity (MW)**
Hydropower	2225 (as of year 2000)	22 000
Mini-Hydro	23.8	500
Biomass/Biogas	479	1300 (Palm Oil Waste)
Solar	6.2	6500
Wind	0.2	(low wind speed – low potential)
Municipal Solid Waste	-	400

Based on the table above, less than 1% of the total renewable energy potential is currently being fully harnessed. There is much room for improvement; and with the uprising of awareness for cleaner energy, the development of biomass and solar energy will play a crucial role in substituting fossil fuel as a primary energy source.

2.1.1 Biomass energy

There is a tremendous amount of biomass and agricultural waste resource available for immediate utilization. Table 4 shows the current and potential energy productivity from biomass sources:

Table 4: Estimation of energy productivity from biomass sources (Source: Lim,Zainal,Abdul Quadir&Abdullah,1999)

Crops/ Activities	Energy Productivity (boe/ha/yr)	Current Annual Amount Used for Energy Purposes (million boe)	Current Annual Energy Potential of Unutilised Biomass (million boe)
Oil Palms	88.7	Fruit shells 23.609 Fruit fibres 13.630 Effluents 0.022	Pruned fronds 77.665 EFB 11.444 Effluents 2.928 Replanting wastes 12.94
Rubber trees	29.5	Wood 4.967	Wood 3.707 Effluents 0.210
Paddy plants	11.54	-	Risk husks 1.025 Rice straws 2.541
Coconut trees	28.21	Fronds 1.578 Shells 0.785	Fronds 0.164
Cocoa trees	80.33		Pruning wastes 16.850 Pod husks 0.085 Replanting wastes 0.630
Sugarcane	54.9	Bagasse 0.421	Leaves and tops 0.298
Logging	-	-	Residues 19.060
Timber processing	-	Sawdust & waste 3.733	Tree bark & Sawdust 1.0

As of 2009, there are a total of 10 licensed biomass and biogas projects under the SREP, producing a total energy capacity of 74MW (Hasan, 2009). Palm oil mill waste has been placed in the spotlight for exploitation in recent times, due to the sheer volume of biomass waste produced from this industry. Countless research studies (Yusoff, 2004; Yusoff, and Hansen, 2005; Shuit, Tan, Lee andKamaruddin, 2009) have shown the feasibility of palm oil as a sustainable option for biomass energy production. Involved parties must take full advantage of this abundant resource for future energy options.

2.1.2 Solar energy

The solar radiation in Malaysia is high even by world standards. With an average daily solar radiation of 4500kWh per square metre and an average daily sunshine duration of about 12 hours, a photovoltaic (PV) system in Kuala Lumpur receives 30% more energy than an equivalent system in Germany (Australian Business Council, 2005). However, solar PV applications in Malaysia are limited to (1) stand-alone PV systems, especially for rural electrification and (2) minor applications such as telecommunication, street and garden lighting, and autonomous energy for parking ticket machines (Australian Business Council, 2005).

At present, the prices of PV components are extremely high, coming to RM28/Wp for each PV system. Due to this, Malaysia does not have any local PV manufacturer—all PV modules are imported from foreign countries such as Germany and Japan—making PV systems an unattractive option (Jamaludin, 2009).

In a recent 5-year On-Grid PV installation system plan, the Malaysian Photovoltaic Industry Association (MPiA) presented a proposal with the following targets:

Table 5: 5-year On-Grid PV installation plan by MPiA(Source: MPiA, 2009)

Period	Target PV Installation (MW)
Year 2011-2012	60
Year 2013-2015	140
TOTAL	**200**

Currently, the largest solar installations are solar water heating systems in hotels, small food and beverage industries and upper middle class urban homes, and it is estimated that there are roughly 10 000 units of domestic hot water systems installed as of now (KeTTHA, 2010). Nevertheless, several efforts have been put into motion to encourage the development of PV systems, with TenagaNasionalBerhad (TNB) undertaking a research project on Photovoltaic Grid Connected Roof Solar energy, funded by a budget of over RM500 000 (KeTTHA, 2010).

In order to reduce the cost of PV systems, the Malaysian Energy Centre launched the Malaysia Building Integrated Photovoltaic (MBIPV) project to incorporate grid-connected systems aesthetically into building architecture and envelope. The MBIPV project is expected to induce the growth of BIPV installations by 330% from the current status of 470-2000kW, with a unit cost reduction of about 20% by the year 2010 (Southeast Asia Renewable Energy Newsletter, 2007). Regardless of these efforts, PV system application remains largely underused.

General status of CDM projects

The Clean Development Mechanism (CDM) was established under the Kyoto Protocol with two objectives – (1) to reduce Greenhouse Gas (GHG) emission levels and (2) concurrently contribute to the sustainable development of the host nation. The CDM has received much acclaim for its alleged win-win approach—shown by the rapid increase of proposed projects since the first was registered in the year 2004. Figure 1 shows the global overview of CDM projects as of January 2010:

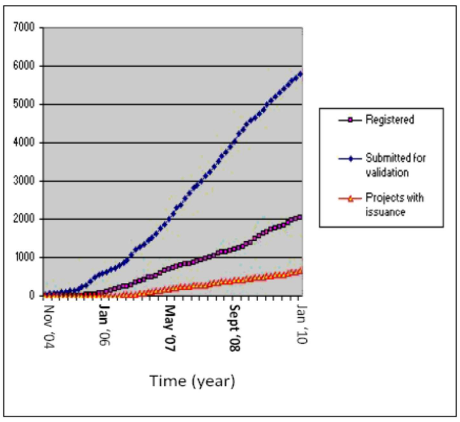


Figure 1: Global overview of CDM projects (Source: Fenhann, 2010)

The two-pronged approach of renewable energy projects—reducing global GHG emissions through substitution of fossil fuels and prolonging the lifespan of non-renewable energy sources—is crucial and highly desirable in our attempts to progress sustainably. The total number of projects considered as renewable, such as biomass energy, geothermal, hydro, solar, tidal, and wind, is

1117—around 56.3% of projects currently registered (Fenhann, 2010). The figure below shows the number of projects in Asia by type:

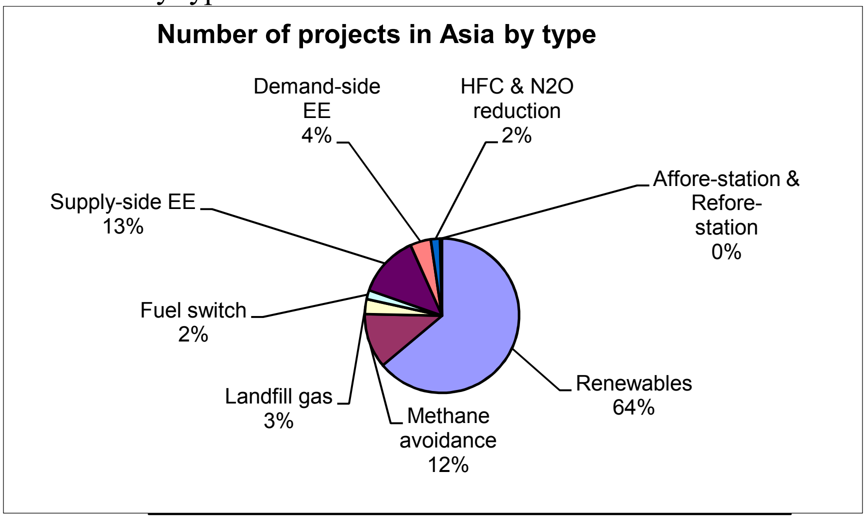


Figure 2: Number of projects in Asia by type (Source: Fenhann, 2010)

The number of renewable projects registered in the Asian region is particularly high; however, the renewable projects in Malaysia only comprise 21.3% of the total CDM projects.

3.1 Status of CDM projects in Malaysia

CDM project implementation in Malaysia has seen a rapid increase in the past 2 years. 41 of the 79 accepted CDM projects were registered in 2009 alone. Table 6 shows the current status of CDM projects in Malaysia:

Table 6: Current status of CDM projects in Malaysia (Source: Fenhann, 2010)

	At Validation	Requesting Registration	Registered
Number of Projects	46	3	79

Malaysia has developed a national criterion for approving CDM projects that are submitted to the Designated National Authorities (DNA). This criteria includes indicators to ensure each project contributes successfully in terms of sustainable development and technology transfer from the Annex 1 Party involved (CDM for Energy Sector, 2010).

Most registered projects involve the palm oil industry, where various methodologies for efficient utilization and management of palm oil mill waste have been introduced by Annex 1 proponents. Despite many projects incorporating minor elements of biomass energy technology within their project boundaries, a majority of them are primarily registered under the category of 'Methane Avoidance' instead of 'Renewables'—due to the focus of their targets. The table below shows the number of projects by type:

Table 7: Total number of CDM projects by type (Source: Fenhann, 2010)

Project Type	Awaiting Registration	Registered
Energy Efficiency	0	4
Landfill Gas	3	5
Methane Avoidance	23	52
Hydro	3	1
Biomass Energy	20	17
TOTAL	**49**	**79**

The amount of CDM projects awaiting registration is steadily increasing at an encouraging rate; however, we can observe that no projects relating to solar energy use are being considered by project proponents—regardless of the vast potential and recent advancements of solar energy utilization as discussed earlier.

3.2 The potential of CDM in Malaysia

The Ministry of Energy, Green Technology and Water, in collaboration with the Malaysia Energy Sector (PTM) maintain a transparent front in regards to the CDM through the establishment of the Clean Development Mechanism for Energy Sector web page.Initiatives such as these—on the part of the government—have paved the way for many opportunities of collaboration between Annex 1 proponent nations. Table 8 provides an overview of the expected potential of CER revenues and the corresponding amount of electricity that can be installed from renewable energy projects:

Table 8: Overview of expected potential of CER revenue and electricity generation for CDM projects(Source: CDM for Energy Sector, 2010)

Project type	CERs per year in 2010	MW electricity
Biogas POME + animal manure	5,900,000	190 MW
Landfill gas	3,700,000	45 MW
Reduction of gas flaring from oil production	4,600,000	N/A
Mini hydro	70,000	25 MW
Biomass CHP	380,000	90 MW
Other projects*	3,150,000	N/A
Total	**17,800,000**	**350 MW**

The results in the table were based on a preliminary assessment of the potential in the energy sector alone. According to the CDM for Energy Sector, the realization of this potential will depend upon the removal of other existing barriers for these project types (CDM for Energy Sector, 2010).

Barriers of implementation for renewable energy projects

4.1 Financial barrier

The high initial cost of implementation is arguably the greatest hindrance preventing renewable energy projects from developing more rapidly. Relevant parties prefer to pursue the status quo of using fossil fuels as the costs are significantly lower as compared to any renewable energy technology. For example, in the context of solar energy, photovoltaic generated electricity costs as much as twenty times the cost of electricity generated by conventional plants (Sopian, Othman, Yatim, Daud, 2005). Without the aid of any special financial incentives, the option of renewable energy will continue to be economically unattractive.

4.2 Technology barrier

Innovation sectors in developing nations, including energy, generally struggle with a lack of research and development in terms of technology. Technologically renowned nations such as Germany and Japan, especially in the field of environmental advancements, are in relevant positions to establish substantial renewable energy efforts as a viable replacement for fossil fuels. Due to the lack of resources, it is difficult for developing nations to make large initial investments into technologies that provide a relatively lengthy rate of return.

4.3 Market barrier

The Australian Business Council for Sustainable Energy noted a market barrier that may have stifled the development of renewable energy specifically in Malaysia. According to their observations, equipment used in the generation, transmission and distribution of electricity attracts import duties of up to 45% and sales tax of 10%, thus imposing high import duties towards renewable energy technology. Such barriers will further brood complacency towards renewable energy initiatives, as relevant parties find little necessity to step out of the convenience of fossil fuel utilization.

The CDM as a driver for renewable energy projects

Since the inception of the Kyoto Protocol in 1997, the course of global development involved an increased awareness of environmental concerns and slowly diverted towards the path of sustainable development. Under the protocol, countries with emission reduction commitments were offered several other means to meet their targets—besides reduction through national measures—through the 'Flexibility Mechanisms'; namely Emissions Trading (ET), Joint Implementation (JI), and finally the Clean Development Mechanism (CDM). The introduction of these three trade-like mechanisms consequently created a market which is now commonly known as the Carbon Market—where carbon emission soon became a priceless commodity. Carbon finance began growing as a support for projects to purchase GHG emission reductions, also known as 'carbon credits' or emission reduction units (Lloyd, Subbarao, 2009).

Under the CDM, CERs are issued to each Annex 1 project proponent for every ton of CO_2 emission reduced through the respective projects. The CERs generated can either be claimed to meet national or private emission reduction targets or sold to other buying entities in the carbon market. With an average value of CER price 5-15Euros (Cha, Lim, Tak, 2008), CERs provide the financial thrust necessary to realize emission reduction projects that are initially economically impractical.

The strict application of the 'additionality' approach was ingrained within CDM projects to preserve the environmental integrity of the regime and to prevent project entities from exploiting possible loopholes that may channel unmerited revenue to undeserving hands. Additionality refers to the statement in Article 12.5 of the Kyoto Protocol which specifies that emission reductions are only to be certified under the CDM if they are additional to any that would occur in the absence of the certified project activity (Muller, 2009). The current official view accepts additionality only for CERs from projects that would not have been realized in a business-as-usual (BAU) scenario, i.e. without the impact of the CDM (Muller, 2007). In this respect, projects under the CDM carry a certain "environmental credibility", making it a suitable driver for renewable energy projects.

However, the CDM is not short of criticism, with concerns of it delivering "fake" carbon credits (Friends of the Earth International, 2010). Pearson (2007) states that "these projects merely shift the location at which emissions reductions are made through the Kyoto Protocol without delivering additional sustainable development benefits to host countries and do not help catalyse the fundament shifts in energy production and use". Most of these concerns root from the initial exploitation of the CDM through hydrofluorocarbon (HFC-23) capture projects, which were highly criticized for not bearing any apparent sustainable evelopment benefits for the respective host nations. The issue of the CDM's inability to contribute to sustainable development was highlighted by Lloyd and Subbarao (2009); where they observed that the CDM's "envisaged developmental opportunities appear to be more hypothetical than real and it has become clear that the sustainable development aspect of CDM projects is taking a back seat to the emissions reduction aspect".

Much of the criticism hurled at the CDM setup tails back to the vague conceptuality of sustainable development, causing many to doubt the ability of the CDM to achieve its second objective. A common opinion amidst the literature is that the dual goals of the CDM seem to clash with one another. Lloyd and Subbarao (2009) emphasized this situation, stating that "the twin CDM goals are odds with each other and that increased economic activity in the developing countries will lead to overall increases in the world emissions unless the developed countries agree to further reduce their emissions to make up for the increases of developing countries". Many studies (Olsen, 2007; Olsen &Fenhann, 2008; Sutter &Parreno, 2007) have attempted to show how the CDM has contributed to sustainable development using a variety of literature review and quantification methods—with many expressing the lack of contribution, as reflected by Olsen (2007) that "[if] left to market forces, the CDM does not significantly contribute to sustainable development".

The concept of sustainable development remains controversially relative to perspective and is highly subjective. Different projects under the CDM may contribute to sustainability in very different manners, as further emphasized by Knechtel (2006) where "[r]enewable energy and energy efficiency projects certainly have a different [sustainable development] profile than other project types". However, it is safe to state that the ability of renewable energy projects to decouple economic growth and development from rising emissions whilst expanding access to modern energy services among under-serviced populations is critical to the global needs of today (Knechtel, 2006). Looking at this perspective—while there remains doubt over the sustainable development contribution of other projects under the CDM—the possible contributions of renewable energy projects embody the true definition of sustainability.

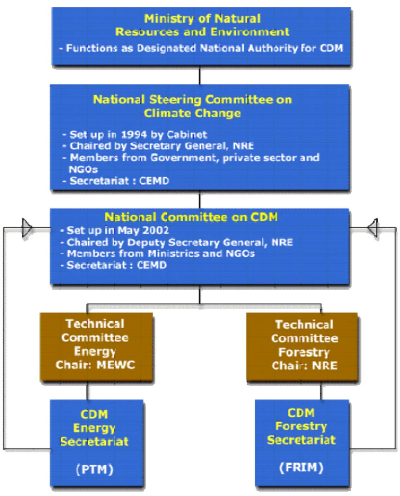
With this in mention, renewable energy projects should be the main focus of the CDM, as the 'renewables' are crucial elements in the foundationof sustainable development.In an era where the world faces an uncertain energy supply for the future, there is no doubt about the critical importancethat renewable energy carries and its significance in improving the quality of life especially in rural areas. Beginning with small projects that will provide clean and consistent energy to rural area population, the CDM can and should focus in driving the advancement of renewable energy in developing nations.

5.1 Driving renewable energy in Malaysia

Malaysia is currently nearing the threshold of transitioning between developing and developed—with the backing of good industrial infrastructure and natural resource abundance. This unique state of transition gives it a political, economical and social advantage to proactively incorporate the implementation of renewable energy within their development outlines. With 97.8% of Malaysians currently having access to electricity (Jamaludin, 2009) and an increasing awareness of environmental issues within the community, the necessity for cleaner energy within the market is growing firmly. All these factors collectively open the window of opportunity for what Lloyd and Subbarao (2009) envision as a "reallocation of resources and an urgent movement towards renewable energy supply" to "bridge the gap between a clearly unsustainable situation and some form of steady-state ecologically manageable equilibrium"—in which the CDM is capable of providing the financial and technological impetus.

5.2 Recent policy advancements

The CDM is very well received in Malaysia, with the government forwarding many directives and policies to facilitate an effective implementation of the mechanism. Since the year 2002, the National Steering Committee on Climate Change (NSCCC) agreed on the establishment of two-tiered organization and a national institutional arrangement for the CDM (CDM for Energy Sector, 2010). The existence of an official framework ensures the credibility of the mechanism, which in turn gives confidence to project proponents. The figure below shows the nation's CDM institutional framework:



CEMD: Conservation and Environmental Management Division
MEWC: Ministry of Energy, Water and Communication
PTM: PusatTenaga Malaysia
FRIM: Forest Research Institute Malaysia
NGOs: Non-Governmental Organisations

Figure 2: Malaysia's CDM institutional framework (Source: CDM for Energy Sector, 2010)

5.3 Possibility of unilateral CDM Projects

At present, projects under the CDM in Malaysia are implemented with a bilateral approach, where Annex 1 countries invest and have large influence over each project. The bilateral character of the CDM has unfortunately led to an unequal distribution of projects in a geographical point of view, with 83% of the total projects under the CDM are based in China and India alone. The design of the CDM likens a voluntary market-based mechanism, causing investment activities to gravitate to countries where transaction costs and investment risks are low and opportunities are high (Sieghart, 2009). Sieghart (2009) adds that "investors articulate their concerns that in addition to conventional types of project risks, CDM projects possess risks which are CDM specific, such as validation and CDM Executive Board (EB) registration, and verification and monitoring". This circumstance has proven to be a restricting barrier for a balanced implementation of projects, as proponents naturally seek investments that give optimum returns.

With this in mind, the possibility of unilateral CDM—projects that do not have an Annex 1 Party letter of approval at time of registration—may be considered a viable option for developing nations. Unilateral projects operate with the Non-Annex 1 entity selling the generated CERs after the Annex 1 Party has provided written approval to the CDM EB or banks the accruing credits for later use (Sieghart, 2009).

The unilateral approach will allow Malaysian energy powerhouses an opportunity to create renewable energy options whilst ensuring that the project is in line with the sustainable development goals on the nation. With the firm vision for renewable energy set in place, public and private energy entities should begin taking large strides into renewable energy development.

Future Outlook

The need for an improved CDM has been emphasized following the recent proceedings of the Conference of Parties (COP) 15 at Copenhagen in December 2009. The outcome of COP15, where a commitment to keep a global warming increase at 2^oC or less and to allocate an annual funding flow of $10 billion for battling climate change, was received with mixed reactions, leaving many parties disgruntled and being accused of being a disaster due to the absence of any legally binding agreement. During the course of COP15, talks of a possible extension of the Kyoto Protocol beyond its expiration date of 2012 surfaced, thus giving the CDM—or a revised CDM-like mechanism—greater prominence in the future. Regardless of the outcome, the development of renewable energy will remain a worldwide priority following concerns of fossil fuel depletion and extensive carbon emission; therefore, the focus of future global environmental initiatives should be inclined to that direction.

Conclusion

The issue of relieving our dependence on rapidly-depleting fossil fuels as a primary energy source remains a global challenge. It is estimated that global primary energy demand will increase by 1.6% per year from 2004 to 2030, growing from 11.2 to17.1 billion tonnes of oil equivalent (Btoe)/annum by 2030; a cumulative increase of more than 50% (IEA, 2007). Therefore, the development of renewable energy is crucial in this present time, to ensure that consistent and reliable alternative energy options are put into effective motion before the peak of fossil fuel depletion.

As developing nations struggle to find a sustainable balance between achieving development and environmental preservation, renewable energy options have not received deserved attention due to the existing restrictive barriers. The two-pronged approach of the CDM has the potential to realize rapid advancements of renewable energy projects within developing nations—providing both the financial and technological thrusts which currently hinder a more rapid advancement.

Malaysia, in all its potential, utilizes less than 1% of its renewable energy capacity. Renewable energy projects under the CDM in Malaysia only account for 21% of the total—a far cry to the average of 64% among Asian countries. In response to this, the government has proactively sought initiatives to increase renewable energy implementation, including firm policies to facilitate more CDM activity. The establishment of economical and political strategies, coupled with the abundance of natural resource, gives Malaysia a good foundation for renewable energy advancements, opening a relevant window of opportunity for the CDM to act as a driver for renewable energy projects.

Acknowledgement

The study was carried out under the Universiti Malaya UMRG research grant RG058 09SUS.

References

[1] Australian Business Council for Sustainable Energy (2005). Renewable energy in Asia: The Malaysia report

[2] Asia Pacific Economic Cooperation, APEC (2006). Energy demand and supply outlook.

[3]Asia Pacific Energy Research Centre, APERC (2005). APEC Energy overview.

[4]Balce, G. R., Tjaroko, T. S., Zamora, C. G. (2003). *Overview of biomass for power generation in Southeast Asia*.ASEAN Centre for Energy.

[5]CDM for Energy Sector (2010). Clean Development Mechanism for Energy Sector, (http://cdm.eib.org.my/index.php)

[6]Cha, K., Lim, S., Hur, T. (2008). Eco-efficiency approach for global warming in the context of Kyoto Mechanism, *Ecological Economics. Vol. 67: 274-280. ScienceDirect.*

[7]Fenhann, J. (2010). UNEP Riso Pipeline, (http://www.CD4CDM.org)

[8]Friends of the Earth International (2010). (http://www.foei.org)

[9]Hasan, A.F. (2009). *Energy efficiency and renewable energy in Malaysia, Malaysia Energy Commission*.Paper presented at the AFEEC/FAPECA Conference & Meetings, 15th July 2009, Kuala Lumpur Convention Centre.

[10]International Energy Agency (IEA) (2007). Medium term oil market report.OECD, Paris vol. 1007, pp. I-82(83).

[11]Jaafar, Mohd. Zamzam, *et al.* (2001). Chemistry and Technology Conference, PIPOC; 2001.
Jamaludin, A. F. (2009). *Energy mix and alternative energy for sustainable development in Malaysia*.Universiti Putra Malaysia.

[12]KeTTHA (2008). Ministry of Energy, Green Technology Water, (http://www.kettha.gov.my/default.asp)

[13]Knechtel, A. L. (2006). *The Clean Development Mechanism: Strengthening sustainable development?* Faculty of Graduate studies, University of British Columbia.

[14]Lim, K. O., ZainalAlauddin, Z. A., Abdul Quadir, G. Abdullah, M. Z. (1999). *Energy productivity of some plantation crops in Malaysia and the status of bioenergy utilisation*. Proc. of the World Renewable Energy Congress 99, Malaysia.

[15]Lloyd, B., Subbarao, S. (2009). Development challenges under the Clean Development Mechanism (CDM)—Can renewable energy initiatives be put in place before peak oil? *Energy Policy.Vol. 37:237-245. ScienceDirect*.

[16]MPiA. (2009). *Proposed 5-year plan (2010-2015) for Malaysia solar PV industry*.Proposed by the Malaysian Photovoltaic Industry Association (MPiA).

[17]Muller, A. (2007). *How to make the Clean Development Mechanism sustainable—The potential of rent extraction. Energy Policy.*Vol. 35: 3203-3212. Elsevier.

[18]Müller, B. (2009). *Addtionaility in the Clean Development Mechanism: Why and what?*EV 44.Oxford Institute for Energy Studies.

[19]Olsen, K. H. (2007). The Clean Development Mechanism's contribution to sustainable development: A review of the literature. *Climatic Change, Vol 84: 59-73. Springer Science.*

[20]Olsen, K. H., Fenhann, J. (2008). Sustainable development benefits of Clean Development Mechanism: A new methodology for sustainability assessment based on text analysis of the Project Design Documents submitted for validation. *Energy Policy, Vol. 36: 2819-2830. ScienceDirect.*

[21]Pearson, B. (2007). Market failure: Why the Clean Development Mechanism won't promote sustainable development. *Journal of Cleaner Production.Vol. 15: 247-252. ScienceDirect.*

[22]Shuit, S. H., Tan, K. T., Lee, K. T., Kamaruddin, A. H. (2009). Oil palm biomass as a sustainable energy source: A Malaysian case study. *Energy, Vol.34:1225-1235. Elsevier*.

[23]Sieghart, L. C. (2009). Unilateral Clean Development Mechanism – An approach for a least developed country? The case of Yemen.*Environmental Science & Policy, Vol.12:198-203. ScienceDirect*.

[24]Sopian, K., Othman, M. Y., Yatim, B., Daud, W. R. W. (2005). Future directions in Malaysian environment-friendly renewable energy technologies research and development, *Volume 1 (2005) 30-36.ISESCO Science and Technology Vision.*

[25]Southeast Asia Renewable Energy Newsletter, 2nd Quarter. (2007). UK Trade & Investment,(http://www.uktradeinvest.gov.uk)

[26]SumianiYusoff (2005). Renewable energy from palm oil: Innovation on effective utilization of waste. *The Journal of Cleaner Production, Vol. 14(2005), pg 87-93.*

[27]Sutter, C., Parreño, J. C. (2007). Does the current Clean Development Mechanism (CDM) deliver its sustainable development claim? An analysis of officially registered CDM projects.*Climatic Change, Vol.84: 75-90. Springer Science*

[28]Yusoff, S., Hansen, S. B. (2005). Feasibility study of performing a Life Cycle Assessment on crude palm oil production in Malaysia, *LCA Case studies. Int. J LCA (OnlineFirst): 1-9.*

[29]UNFCCC (2010). United Nations Framework Convention on Climate Change, (http://unfccc.int/2860.php/)

Advances in Environmental Technologies
10.4028/www.scientific.net/AMR.726-731

The Application of Clean Development Mechanism as a Driver for Renewable Energy Projects in Malaysia

10.4028/www.scientific.net/AMR.726-731.3189