International Journal of Management, IT & Engineering
Vol. 9 Issue 6, June 2019,
ISSN: 2249-0558 Impact Factor: 7.119
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

A STUDY AND ANALYSIS OF DATA ON PROJECTS FOR CLEAN DEVELOPMENT MECHANISM

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Abstract

The Clean Development Mechanism (CDM) allows emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of Carbon-di-oxide. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol.

This paper discusses Kyoto Protocol (KP) as the Background of Clean Development Mechanism (CDM) and also discusses CDM as one of the mechanisms of Kyoto Protocol. The governance mechanism of CDM is also explained. CDM being introduced and developed with the twin objective of sustainable development of the developing countries, and a flexible and cost effective tool for the legally binding GHG mitigation by the developed countries, vital and latest statistics on CDM projects is provided and analysed for scenario building. At the end of the paper a discussion has also been made and conclusions provided. Some future research areas have also been identified.

Keywords: Kyoto Protocol; KP; Clean Development Mechanism; CDM; Sustainable Development, Energy; Environment; Green House Gases; GHG; UNFCCC

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1. Background of CDM

The Clean Development Mechanism (CDM) allows emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of Carbon-di-oxide. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The roots of the Clean Development Mechanism (CDM) lie in the Kyoto Protocol. The Kyoto Protocol is generally seen as an important first step towards a truly global emission reduction regime that will stabilize anthropogenic (i.e., human-emitted) Green House Gases (GHG) concentration at a level which will avoid dangerous climate change. The Kyoto Protocol was adopted at the third conference of the Parties (COP 3) to the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto, Japan, on December 11, 1997 [1, 2].

As a result of the vigorous industrial activities of the industrialized nations, the UNFCCC placed onus on them for higher levels of GHG emissions in the atmosphere and thus came heavily on the developed nations under the principle of “common but differentiated responsibilities”. The Kyoto Protocol legally commits its Parties by setting internationally binding emission reduction targets. The detailed rules for the implementation of the Kyoto Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and are referred to as the "Marrakesh Accords". The Kyoto Protocol came into force on February 16, 2005 and targets six main green house gases: Carbon Dioxide (CO_2); Methane (CH_4); Nitrous Oxide (N_2O); Hydro Fluorocarbons (HFCs); Per Fluorocarbons (PFCs); and Sulphur Hexafluoride (SF_6). The six GHG are translated into CO_2 equivalents in determining reductions in emissions [1, 2, 3].

As per the Kyoto Protocol, the industrialized nations (referred to as Annex I countries [1, 2] which includes Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, European Union, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain, Northern Ireland and USA) ratifying the protocol are bound to reduce green house gas emissions by an average of 5 % below 1990 levels (base year for most of the parties to Kyoto Protocol) by

the first commitment period of 2008 to 2012. These reduction targets are in addition to the industrial gases, chlorofluorocarbons, or CFCs, which are dealt with under the Montreal Protocol (1987) on Substances that Deplete the Ozone Layer [2, 3].

An amendment to the Kyoto Protocol was adopted on December 08, 2012 at a UN Climate Change Conference held at Doha, Qatar. This amendment to the Kyoto Protocol is referred to as "Doha Amendment to the Kyoto Protocol". The salient features [2] of this amendment are:

(a) A next commitment period of eight years for GHG emissions reduction was targeted from January 01, 2013 to December 31, 2020.

(b) A revision of the commitments along with a revised list of GHG to be reduced and reported by the Annex I countries who agreed to carry forward in the next commitment period of Kyoto Protocol.

(c) A minimum target of 18% reduction below 1990 levels in GHG emissions is to be achieved within the time span of eight years of the second commitment period.

(d) The composition of Parties in the second commitment period is different from the first commitment period.

As per the Kyoto Protocol, the signatories to the Kyoto Protocol have to meet their GHG reduction targets primarily through targeting their national means and measures. But, the Kyoto Protocol also provides some flexibility to these countries by providing three international market-based mechanisms to achieve their reduction targets. These mechanisms are International Emissions Trading, Clean Development Mechanism (CDM) and Joint implementation (JI). A brief description [1, 2] of the mechanisms of Emission Trading and Joint Implementation (CDM is discussed in detail in the next section) is as follows:

Parties with commitments under the Kyoto Protocol (Annex B Parties which is nearly identical list as Annex I except Belarus or Turkey [4]) have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions, or "assigned amounts". The allowed emissions are divided into "assigned amount units" (AAUs). Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare - emissions permitted them but not "used" - to sell this excess capacity to countries that are over

their targets. Thus, a new commodity was created in the form of emission reductions or removals. Since carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon. Carbon is now tracked and traded like any other commodity. This is known as the "carbon market."

The mechanism known as “joint implementation” defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO2, which can be counted towards meeting its Kyoto target.

2. Clean Development Mechanism (CDM): An Introduction

Although the Annex I countries are supposed to meet their GHG reduction targets primarily on their own but this flexibility mechanism of CDM under Article 12 of the Kyoto Protocol is provided with the dual intention of sustainable development of developing countries in a comparatively easy, flexible and cost effective way by the Annex B countries (industrialized countries) while attaining their reduction targets through clean and green projects in developing countries. For example; it requires US $50 for mitigating one ton of CO2 equivalent in developed countries whilst in developing countries the same can be done at the rate of US $15 per ton of CO2 equivalent. While investors profit from CDM projects by obtaining reductions at costs lower than in their own countries, the gains to the developing country host parties are in the form of finance, technology, and sustainable development benefits. Out of three mechanisms of Kyoto Protocol, CDM is the only mechanism where developing countries can participate in the Protocol and join the global offers to mitigate the climate change. CDM is the first global, environmental investment and credit scheme of its kind, providing a standardized emission offset instrument, known as Certified Emission Reduction (CER) credits [5].

CDM grants Annex B countries the right to generate or purchase some Certified Emission Reduction (CER) credits, each equivalent to one tonne of CO2, from projects undertaken outside Annex I countries i.e. in the countries which do not have binding emission reduction targets, since greenhouse gases have the same impact no matter where they are emitted they should be

reduced where it is less costly and feasible. Thus, provides industrialized countries some flexibility in how they meet their emission reduction or limitation targets [2, 5].

A CDM project must be able to avoid emissions that would otherwise have occurred. Some typical CDM projects may be Power Generation through renewable resources, Installation of solar lights or solar heaters, Installation of more energy efficient air-conditioning systems or heating systems or industrial boilers, etc.

3. Governance Mechanism of CDM

The Governance of CDM is made through CDM Executive Board, Panels and Teams, National Authorities, Validators and Verifiers.

The CDM Executive Board (CDM EB) supervises the Kyoto Protocol's clean development mechanism under the authority and guidance of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP). The CDM EB is fully accountable to the CMP. The CDM EB will be the ultimate point of contact for CDM Project Participants for the registration of projects and the issuance of CERs. The CDM Executive Board (CDM EB) may establish committees, panels or working groups to assist it in the performance of its functions. The CDM EB shall draw on the expertise necessary to perform its functions, including from the UNFCCC roster of experts. In this context, it shall take fully into account the consideration of regional balance [5, 6].

The various established teams or panels or working groups under CDM EB are [5, 6]: Methodologies Panel (Meth Panel); Afforestation & Reforestation Working Group (A/R WG); Small Scale Working Group (SSC WG); Accreditation Panel (CDM AP); Registration and Issuance Team (RIT); Carbon Dioxide Capture and Storage Working group (CCS WG).
The Meth Panel, A/R WG SSC WG, CCS WG were established to prepare recommendations to CDM EB on submitted proposals for new baseline and monitoring methodologies in their respective fields and maintain close liaison amongst themselves.

The Accreditation Panel was established to develop recommendations and facilitate the decision making of the CDM EB in accordance with the standards and procedure for accrediting operational entities. A designated operational entity (DOE) (act as Validator and Verifier on behalf of CDM EB) is an independent auditor accredited by the CDM Executive Board (CDM EB) to validate project proposals or verify whether implemented projects have achieved planned greenhouse gas emission reductions.

The CDM Registration and Issuance Team is a group of external experts that assist the CDM EB by assessing requests for registration of project activities or programmes of activities as well as requests for issuance for which review has been requested.

A designated national authority (DNA) is the organization granted responsibility by a Party or host country to authorise and approve participation in CDM projects. Establishment of a DNA is a primary requirement for participation by a Party in the CDM. The primary task of the DNA is to evaluate potential CDM projects for their suitability to the host country in achieving its sustainable development goals, and upon satisfaction to provide a letter of approval to project participants in CDM projects. This letter of approval must declare that the project activity contributes to sustainable development in the country, that the country has ratified the Kyoto Protocol, and that participation in CDM is voluntary and no hidden motives. It is then submitted to CDM Executive Board to support the registration of the project. DNAs have additional roles to play, such as the submission of proposed standardized baselines for their country, among others. These responsibilities have increased as the CDM has evolved [5, 6].

The following Figure 1 (Source: [5]) depicts the Cycle of Project Development under CDM. This cycle also depicts the role of governing bodies of CDM in various project development stages:

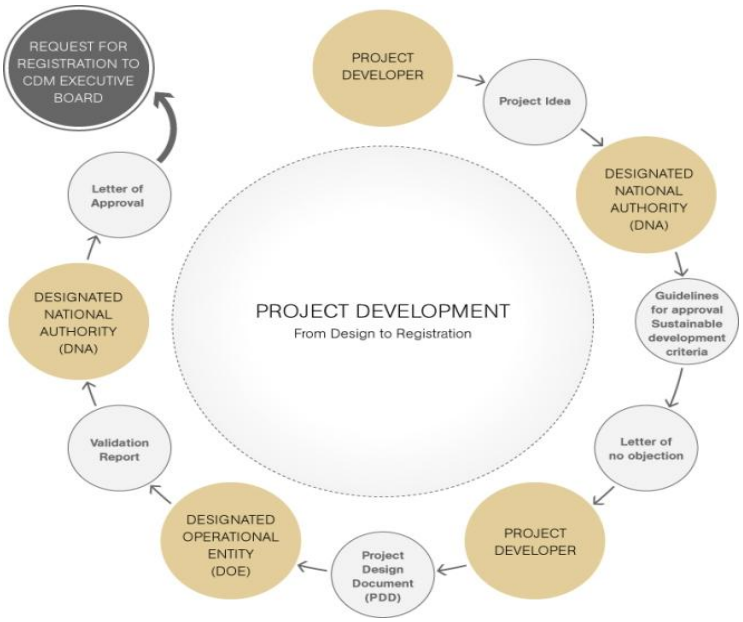

Figure 1 (Source: [5]): Cycle of Project Development under CDM

4. CDM Projects: An Overview

Table 1 (source [7]) depicts the technology types that are being transferred from which country to which country as a result of CDM projects. Table 2 depicts the host countries of CDM projects along with their number of CDM projects bagged and also their percentage share in the total registered projects. This table shows only those host countries which have more than one percent share in the total registered CDM projects. Table 3 classifies the CDM projects by the regions recognized by the UNFCCC as well as enumerates the absolute and respective percentage share of these regions in the total registered CDM projects. Table 4 classifies the CDM projects based on their size i.e. small and large. Table 5 depicts the classification of CDM projects by Scope i.e. the major sector of their operations. Table 6 depicts the CERs issued by each of the host countries of CDM projects and their percentage share in the total CERs issued. This table also recognizes only those host countries which have more than one percent share in the total CERs issued. Table 7 provides the cumulative and Year-wise break-up from 2004 to 2018 of total registered CDM projects in top 10 countries i.e. those countries having greater than 1% share of total registered projects and also of all other countries involved in CDM projects. Table 8 classifies the methodologies or tools or techniques approved by the CDM EB for use in the GHG reduction on the basis of scope sector. This table also classifies these approved

methodologies on the basis of their applicability i.e. in small scale projects or large scale projects or both (consolidated).

Type of technology	**Main countries of origin**	**Main countries of destination**
Biomass energy	Belgium, Denmark, Japan	Malaysia, India, Brazil, Indonesia
Wind power	Denmark, Germany, Spain, USA	China, India, Brazil, Mexico
Landfill gas	Italy, UK, France, USA, Ireland, Netherlands	Brazil, Mexico, Argentina, Chile, China
HFC decomposition	France, Germany, Japan	China, India
Hydro-power	France, Germany, UK, Spain	Ecuador, Panama, Honduras, South Korea, Mongolia
Agriculture	Ireland, Canada, UK	Mexico, Brazil, Philippines, Ecuador
Energy efficiency in industry	Japan, Italy, USA	India, China, Malaysia
N2O destruction	Germany, Japan, France	South Korea

Table 1: Beneficiary Countries of Technology Transfer due to CDM Projects [7]

Host Party	**Number Of Projects**	**Percent**
China	3764	48.23
India	1667	21.36

Brazil	343	4.39
Viet Nam	255	3.27
Mexico	192	2.46
Indonesia	147	1.88
Thailand	144	1.84
Malaysia	143	1.83
Chile	103	1.32
Republic of Korea	88	1.13

Table 2: Distribution of registered projects by Host Party (only those with >1% share) (from 2004 to 2018) [8]

Region	**No. of Projects**	**Percent**
Africa	218	2.79
Asia & Pacific	6533	83.71
Economies in Transition	49	0.63
Latin America & Caribbean	1004	12.86

Table 3: Distribution of registered projects by UNFCCC region (from 2004 to 2018) [8]

Scale	**No. of Projects**	**Percent**
Large	4676	59.92
Small	3128	40.08

Table 4: Distribution of registered projects by Scale (from 2004 to 2018) [8]

Scope No.	Scope Label	No. of Projects	Percentage
1	[1] Energy ind. (ren/non-ren)	6526	75.20
13	[13] Waste handling and disposal	931	10.73
4	[4] Manufacturing ind.	376	4.33
15	[15] Agriculture	202	2.33
10	[10] Fugitive emiss. (solid/oil/gas)	163	1.88
3	[3] Energy demand	136	1.57
5	[5] Chemical ind.	118	1.36
8	[8] Mining/mineral prod.	84	0.97
14	[14] Afforestation/reforestation	66	0.76
7	[7] Transport	30	0.34
11	[11] Fugitive emiss. (halon/SF6)	25	0.29
9	[9] Metal production	13	0.15
2	[2] Energy distr.	8	0.09

Table 5: Distribution* of registered projects by Scope (*Note that a project may be considered in more than one scope sector) (from 2004 to 2018) [8]

Host Party	No. of CERs	Percent
Brazil	1.44E+08	7.31
Chile	29953561	1.52
China	1.09E+09	55.30
India	2.47E+08	12.60
Indonesia	32614450	1.66
Mexico	33190293	1.69
Republic of Korea	1.78E+08	9.04
Vietnam	22250742	1.13

Table 6: Percentage CERs issued from registered projects in a Host Party (having more than 1%

share) (from 2005 to February 2019) [8]

No. of Registered Projects in															
Host Party	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cumulative of Top 10 Countries (Having > 1% share)	1	35	344	368	381	600	750	991	2898	241	110	73	28	26	7
Total (Cumulative of All Countries Involved)	1	62	409	425	431	684	809	1107	3235	297	158	91	52	39	11

Table 7: Year-wise break-up of total registered CDM projects in top 10 countries and all countries involved [8]

Scope	No. Of Method-ologies (All)	Perc-entage (All)	Small Scale	Perc-entage (small scale)	Large Scale	Perc-entage (Large scale)	Cons-olidated	Perc-entage (conso-lidated)
[1] Energy Industry (renewable/non-renewable)	71	27.20	20	18.52	35	29.91	16	44.44
[2] Energy Distribution	9	3.45	6	5.55	3	2.56	0	
[3] Energy Demand	31	11.88	19	17.60	12	10.25	0	
[4] Manufacturing Industry	34	13.03	13	12.04	15	12.82	6	16.67
[5] Chemical Industry	23	8.81	7	6.48	14	11.96	2	5.55
[6] Construction	1	0.38	1	0.92	0		0	
[7] Transport	20	7.66	13	12.04	5	4.27	2	5.55
[8] Mining/Mineral Production	1	0.38	0		0		1	2.78
[9] Metal Production	9	3.45	0		9	7.69	0	
[10] Fugitive Emissions (solid/oil/gas)	9	3.45	2	1.85	6	5.13	1	2.78

[11] Fugitive Emissions halon/SF6)	10	3.83	2	1.85	8	6.84	0	
[13] Waste Handling and Disposal	27	10.34	15	13.89	7	5.98	5	13.89
[14] Afforestation/ Reforestation	4	1.53	2	1.85	1	0.85	1	2.78
[15] Agriculture	12	4.60	8	7.41	2	1.71	2	5.55

Table 8: Approved methodologies by scope (Note that a methodology can be linked to more than one sectoral scope as well as scale of the project) [8]

5. Discussion and Conclusion

Globally, the maximum number of technology transfer (including equipment) took place in the sector of Bio-mass Energy and Hydro-Power Projects although the percentage of these projects in which technology transfer took place is low due to the fact a large number of CDM projects were registered in these fields. India is also a beneficiary of technology transfer but share is quite less in comparison to countries like Brazil, China and Mexico [7].

China leads in terms of number of CDM projects bagged and India is the next but the margin in between is quite large. The major share of the CDM projects lies in the Asia Pacific region. China also tops the list of share of CERs issued from these CDM projects and India is next but again the margin in between is quite high. Thus, it can be said that China is deriving the most and far ahead in obtaining the quantitative as well as qualitative benefits from these CDM projects [8].

Globally the CDM projects are mainly in the field of Energy Industries with a heavy presence in the field of renewable energy. This may also be due to the fact the largest number of approved methodologies for GHG mitigation are in this field only. Waste Handling and disposal, and manufacturing sector are the next two scope sectors but with a large gap. This necessitates the introduction, exploration and innovation of more and more methodologies in diverse fields or scope sectors, especially the manufacturing and process industries sector, for GHG reduction or mitigation [8].

The majority share of CDM projects are in the scope sector of Wind Energy and Hydro Power. This global pattern is also true for India [8, 9]. In India, Karnataka, Maharashtra and Tamil Nadu are the favourite destinations of these CDM projects and mainly the projects are in the field of renewable energy [10].

Although the statistics portrays a satisfactory situation, a larger investigation is required in regard to the actual sustainable development of the host countries of these CDM projects. The number

of registered CDM projects spiked in the year of 2012 which needs an analysis to capture the favourable circumstances. Moreover, the technical difficulties and costs associated with the CERs as well as project registrations [11] also warrant a thorough investigation.

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