STUDY ON FEASIBILITY OF MASS TRANSIT SYSTEM DEVELOPMENT PROJECT APPLYING CLEAN DEVELOPMENT MECHANISUM

by Atsushi FUKUDA,** Tuenjai FUKUDA,*** Yasuki SHIRAKAWA**** and Thaned SATIENNAM*****

1. Introduction

The Clean Development Mechanism (CDM) allows industrialized countries which were ratified the Kyoto protocol (Annex I) to have GHG emission reduction projects in developing countries to earn emission reduction credits (Certified Emission Reduction or CER) to meet a part of their GHG emission reduction targets. Applying this mechanism, a developing country can receive technological and financial supports from an industrialized country and develop ecologically friendly/sustainable transport system from early stage of its development, while giving an industrialized country some flexibility to meet its emission reduction limitation target. Besides GHG reduction, a developing country can also reduce roadside air pollutants and energy consumption in most of cases.

The transport sector is one of major sources of greenhouse gas (GHG) emissions which account for up to 25 percent of total emissions in many developed and developing countries[1, 2)]. Thus, applying CDM has been expected. Utilization of CDM schemes to mass transit system development project is one of a possibility as it would be providing advance technology and alleviating financial burden from huge investment. However, only two CDM projects in the transport sector have been registered at UNFCCC until now (as of May 2009).

In this paper, current situations applying CDM to transport sector, especially mass transit system development which the authors have involved, was summarized. Then, problems and several ideas were discussed to utilize CDM more efficiently in this field.

2. Current Situation of CDM in Transport Sector

Currently, there have been more than 1,590 CDM projects registered at UNFCCC and is expected to produce CERs amounting to more than 2.9 billion tons of CO_2 equivalent in the first commitment period of the Kyoto Protocol. However, only two projects have been registered in the transport sector as shown in Table 1.

Table 1: Registered CDM projects in the transport sector[1)]

Registered	Title	Host Parties	Other Parties	Methodology	Reductions
07 Dec 06	BRT Bogotá, Colombia: TransMilenio Phase II to IV	Colombia	Switzerland Netherlands	AM0031	246563
29 Dec 07	Installation of Low Green House Gases (GHG) emitting rolling stock cars in metro system	India	Japan	AMS-III.C. ver. 10	41160

*Keywords: Clean Development Mechanism, Mass Rapid Transport Development

**Member of JSCE, Dr. Eng., Dept. of Transportation Eng. & Socio-Tech., Coll. of Sci. and Eng., Nihon Univ.,
(7-24-1 Narashinodai, Funabashi, Chiba, Japan, TEL & FAX 047-469-5355)

*** Member of JSCE, Dr. Eng., Research Inst. of Sci. and Eng., Nihon Univ.,
(7-24-1 Narashinodai, Funabashi, Chiba, Japan, TEL & FAX 047-469-5355)

****Non Member of JSCE, M. Sc., President, Climate Consulting, LLC, Japan,
(2-37-3-106 Inukura, Miyamae-ku, Kawasaki, Kanagawa, Japan, TEL & FAX 044-975-4230)

***** Member of JSCE, Dr. Eng., Dept. of Civil Eng., Faculty of Eng., Khon Kean Univ.,
(123 Mittraphab Road, Muang Khon Kean, 40002 Thailand, TEL & FAX +66-4320-2846)

Since CDM is only mechanism which allows an industrialized country to get emission reduction credits from a developing country that does not have emission reduction target under Kyoto protocol, utilization of CDM increases total amount of GHG emission from Annex I parties. Thus, CDM project must qualify through a rigorous registration and issuance process designed by UNFCCC to ensure real, measurable and verifiable emission reductions that are additional to what would have occurred without the project as shown in Fig.1. If applicable methodology is not available, new methodology must be developed first in which explanation of additionality, baseline setting, monitoring method must be explicitly included.

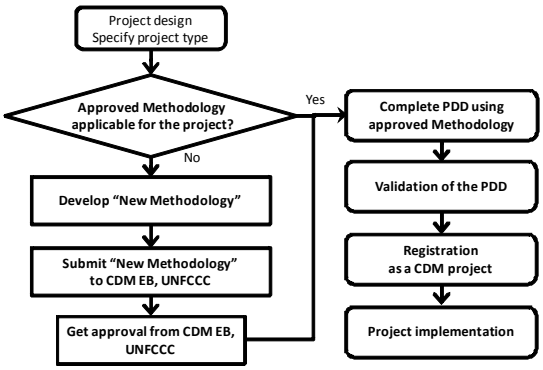

Fig. 1: Process implementing CDM project
Source: UNFCCC.

In the transport sector, fuel consumption, driving conditions, travel demand and/or traffic flow conditions shall be estimated by applying some models to calculate the baseline emission that emits without the project. Especially, emission sources (without mass transit system) might be from numerous numbers of motor vehicles so that accuracy on estimation using some models can always be questionable as well as whether a feasibility of monitoring can be realistic. Thus, in spite of many efforts, only one methodology for full-scale CDM and four methodologies for small-scale CDM (annual emission reduction is less than 60,000 tons of CO_2 equivalent) have been approved as shown Table 2 and only three methodologies are still on evaluation process as shown in Table 3. Out of 8 methodologies, AMS-III.T and U can be applied unique transport projects case only. The methodology AM0031 was developed for the BRT introduction project TransMilenio Phase II to IV in Bogotá, Colombia and NM0266 is basically similar method with AM0031 but applying any rail transport system with have egress and access trip with other vehicle.[1,3,4] On AM0031 and NM0266, the baseline will be confirmed supplementary based on the result of interview survey with introduced mass transit system users to reduce uncertainty on demand forecasting. That is reason why AM0031 was approved. Feasibility of approach on AM0031 was examined by comparing modal share calculated from interview surveys which were conducted every two-month in the year 2006 and projected modal share in the project design document. Projects applying AM0031 was proposed at METROCALI, MEGABUS in Colombia and BRT project in Seoul, South Korea.[5,6,7]

Table 2: Approved methodology for transport sector [1)]

Reg. No.	Methodology title
AM0031	Methodology for Bus Rapid Transit Projects
AMS-III.C.	Emission reductions by low-greenhouse gas emitting vehicles
AMS-III.S.	Introduction of low-emission vehicles to commercial vehicle fleets
AMS-III.T.	Plant oil production and use for transport applications
AMS-III.U	Cable Cars for Mass Rapid Transit System (MRTS)

Table 3: New methodology for transport sector on evaluation [1)]

Reg. No.	Methodology title
NM0233	Methodology for vegetable-derived fatty acid methyl ester biodiesel production for transportation
NM0258	Methodology for Bus Lanes
NM0266	Methodology for Rail Based Urban Mass Rapid Transit Systems (MRTS)

Table 4: Result of monitoring in CDM project 0672 [1)]

	Actual value	Expected value
Share of passengers which would have used passenger cars	4.3%	5.5%
Share of passengers which would have used taxis	5.5%	5.6%
Share of passengers which would have used buses	89.1%	88%
Share of passengers which would have used NMT or not made the trip	1.1%	0.8%

On the other hands, AMS-III.C and S are the methodology for a project which introduces low-greenhouse gas emitting or low-emission vehicles. AMS-III.C was applied for the JICA project installing rolling stock cars with regenerative brake to metro system in India. Tricycle-taxi retrofit project was proposed using AMS-III.C in the Philippines.

3. Feasibility Studies on CDM projects for Mass Transit System Development in Bangkok

(1) The outlines of CDM studies for mass transit system development in Bangkok

The outline and estimated emission reduction of the studies which have been carried out to examine a feasibility of

applying CDM to mass transit system development project and develop new methodology, especially employing demand forecasting approach at the transportation network level, and also the authors involved or carried out are summarized as follows;

a) Environmental impacts of MRT Blue Line extension by Japan Bank for International Cooperation (JBIC) [3)]

JBIC studied environmental impacts of extension of blue line of Mass Rapid Transit which is first subway system in Bangkok Metropolitan Area. In this study annual CO_2 emission reduction was estimated using result of transportation demand analysis study by Office of Transport and Traffic Planning and Policy (OTP), MOT (TDMC III) and emission factors which was developed Japan Transportation Cooperation Association study before as well as roadside pollutants. Reduction was expected to come from modal sifting from passenger vehicle and bus transport to subway system and estimated as 14,965 tons of CO_2 eq./year .

b) Environmental impacts of MRT Blue Line extension by OTP [4)]

In succession to JBIC study, OTP conducted the environmental impact study of MRT blue line extension. On this study, estimated CO_2 emission reduction became 120,450 tons of CO_2 eq./year in 2010 and 312,440 tons of CO_2 eq./year in 2020. Even the similar approach with the previous study was employed, there are quite big differences with projection in the previous study and this might come from renewal of demand forecasting by e-BUM which was new version of TDMC.

c) Bus Rapid Transit (BRT) South Line development [5)]

Bangkok Metropolitan Administration is going to operate Bus Rapid Transport (BRT) with 45 articulated buses on Rama III road. This impact was estimated by using Extended Life Cycle Environmental Load (ELCEL) [6)] which is the approach including Life Cycle Assessment on ordinary emission reduction estimation such as demand sifting in order to include additional emission from flyovers construction, BRT operation, etc. Since the road capacity will be reduced by introducing excursive lanes for BRT operation, ordinary buses which are operated on same route should be reduced. In the case of 50 % reduction of ordinary buses, CO_2 emission reduction is estimated in 26,446 tons of CO_2 eq./year.

d) Diesel Bus replacement by CNG Bus by MITI [7)]

There are many private bus companies operated second-hand diesel bus with the concession from Bangkok Mass Transit Authority (BMTA). Fuel economy of such bus is very low so that it is expected to reduce emission by replacement by CNG bus. Applying the similar approach with AMS-III.S, emission reduction from the case 900 diesel buses will be replaced with CNG bus or modified to CNG Engine is estimated in 3,582 tons of CO_2 eq./year.

e) BRT in Hanoi by MITI[7)]

BRT is planned on the route between Kim Ma in the city center and Ha Dong where is outskirt of Hanoi. Since 78 big buses and 52 small buses are operated on this route, project introducing 60 articulated buses with capacity of 170 passengers and kick existing buses out from this market was assumed based on the interview with a bus operator. Using the same approach with AMS-III.C, emission reduction from this project will be in 8,454 tons of CO_2 eq./year.

(2) Summary of studies

Results of all studies were summarized in Table 5. From the comparison between two studies for MRT Blue Line extension, it is clear that the result of traffic demand forecasting is significant on estimation of CO_2 emission reduction. Some guidelines should be developed to decide framework such as spatial boundary of a study, parameters for a model, etc.

Table 5: Summary of studies

Studied Mass Transit System	CO_2 Emission reductions (t/yr)	CER (million Baht)	Remarks
MRT Blue Line ext.	14,965	10.0	JBIC, yr. 2006
MRT Blue Line ext.	120,450	80.0	OTP, yr. 2010
	312,440	208.0	OTP, yr. 2020
BRT South Line	26,446	17.6	50 % reduce, wLCA
CNG Bus Replace	3,582	2.4	900 buses
BRT Hanoi	8,454	5.6	72+56 buses

Comparing two BRT projects in Bangkok and Hanoi, emission reduction from BRT in Hanoi is considerably small although the number of articulated buses which will be introduced is larger than Bangkok project. On the estimation of emission reduction applying AMS-III.C and S, only reduction from demand sifting become subject to

estimation and reduction form alleviation of traffic congestion on whole road network may not be considered so that emission reduction might be projected restrictedly.

Also, from BRT project in Bangkok, it is found that LCA might be considered on the project which required huge infrastructure development, although LCA has never been required on CDM for mass transit system development project.

4. Required studies to promote CDM for mass transit system development

To make mass transit system development project utilizing CDM possible, following improvements or modification on CDM process and/or mechanism;

a) Simplify the process to CDM

A rigorous registration process makes implementation of CDM project difficult so that the process should be simplified. One of idea is to make even a developing country to accept national emission reduction target. However, many of developing countries seem not to be accepted such target. Thus, target only for transport sector, or sectoral approach should be proposed and its feasibility should be examined.

b) Program/Policy based CDM

A CDM project using small-scale CDM methodology can reduce not much amount of emission because only small sized transport operator can be subjected. When there are many similar operators which would like to have CDM, it is more effective if those projects can be bundled into one program. Such approach was already approved by UNFCCC as program CDM. However, no trial in transport sector so that applicability of program CDM should be studied.

c) Cooperation with ODA

Since financial assistant from CER from CDM project might be few percent of total investment cost for mass transit system development. Thus, cooperation with ODA fund is compulsory to utilize CDM project effectively. The study how to cooperate with ODA should be done.

5. Conclusion

In this paper, current situation and experiences of CDM in transport sector, especially for mass transit system development, were summarized. Also, problems and required future studies in infrastructure planning field were introduced.

References

1) Clean Development Mechanism, United Nations Framework Convention on Climate Change, http://cdm.unfccc.int/index.html.
2) CDM board approves first transport methodology, http://www.climatechangecapital.com/news-and-events/ccc-in-the-news/cdm-board-approves-first-transport-methodology.aspx
3) Japan Transport Cooperation Association, Japan Weather Association and Transport System Lab. of Nihon University: Study for development of atmospheric environmental impact assessment methodologies on the extension of the subway blue line in Bangkok, Japan Bank for International Cooperation, 2006
4) Office of Transport and Traffic Planning and Policy: Feasibility Study of CDM project for Subway Project, 2008 (in Thai).
5) Kaneko, S.: Study on CO2 Emission Reduction of Public Transport Introduction with Consideration of Life Cycle -in Case of BRT in Bangkok, Thailand-, Master Thesis of Graduate School of Science and Engineering, Nihon University, 2009 (in Japanese)
6) Kato, S., Shibahara, N., Osada, M. and Hayashi, Y.: A Life Cycle Assessment for Evaluating Environmental Impacts of Inter-regional High-speed Mass Transit Projects, Journal of the Eastern Asia Society for Transportation Studies, Vol. 6, pp. 3211 - 3224, 2005.
7) Study on the preparation of methodologies for the promotion of CDM/JI in the transport sector, Ministry of Economy, Trade and Industry, 2005.