CARBON FINANCE OPPORTUNITIES IN TRANSPORTATION AND CLEAN DEVELOPMENT MECHANISM (CDM) IN DEVELOPING COUNTRIES-

EXAMINING THE INTERPLAY OF INVESTMENT, EMISSION REDUCTION, AND CARBON CREDIT REVENUE:

BOGOTA TRANSMILENIO AND CHONGQING BRT

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Abstract

The Clean Development Mechanism (CDM), established under the 1997 Kyoto Protocol and overseen by the United Nations Framework Convention on Climate Change (UNFCCC), provides a funding mechanism for Greenhouse Gas (GHG) reduction projects in developing countries. Despite the logical relationship with GHG, the transport sector represents a small percentage of projects approved for CDM financing, possibly because of its complex and lengthy implementation process as well as the general large scale cost. In an attempt to examine CDM's practical applicability as a financing tool for the transport sector, this study will focus on CDM's financial contributions to select BRT projects: Bogota's (Colombia) TransMilenio and Chongqing (China) BRT. This study hypothesizes that the CDM financing in these BRT projects must be significant in covering the projects' operating deficits. The study's findings indicate that in the case of TransMilenio, while the CDM financing was not a significant contributor to the total cost, it guaranteed access to cheaper financing with low interest rate. BRT Chongqing, on the other hand, has shown to correlate to the hypothesis in so far as the CDM earnings were available. The study concludes that CDM financing has limited and marginal impact for the project completion and direct costs. However, its practical applicability rests in mitigating the project's financial risk. CDM's limitation remains in the market-driven nature of the Certified Emission Reduction (CER) price and other fundamental issues in the mechanism itself.

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Abbreviations and Acronyms

ADB	Asian Development Bank
BAU	Business as Usual
BRT	Bus Rapid Transit
CDM	Clean Development Mechanism
CER	Certified Emissions Reduction
CO_2	Carbon Dioxide
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EU	European Union
EU ETS	European Union Emissions Trading Scheme
FDI	Foreign Direct Investment
GHG	Greenhouse Gas
IET	International Emissions Trading
IGES	Institute for Global Environmental Strategies
IRR	Internal Rate of Return
JI	Joint Implementation
LDC	Least Developed Countries
LoA	Letter of Approval
LRT	Light Rail Transit
OE	Operational Entity
OECD	Organization for Economic Co-operation and Development
PIN	Project Idea Note
PDD	Project Design Document
PoA	Programme of Activities
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

Chapter 1. Introduction

The transport sector's contribution to the level of greenhouse gas (GHG) emissions poses a significant concern for any global sustainable environment effort. United Nations Framework Convention on Climate Change's (UNFCCC) provisions to reduce GHG emissions through market-based financing mechanisms, such as the Clean Development Mechanism (CDM), could help reduce GHG, particularly in developing countries. However, despite this hopeful possibility of reduction, the prevalence of CDMs devoted to transportation projects is relatively small.

In an attempt to examine CDM's practical applicability as a financing tool for the transport sector, this study will focus on CDM's financial contributions to select BRT projects that benefitted from CDM financing: Bogota's (Colombia) TransMilenio and Chongqing (China) BRT. By examining these two cases, this paper will address the following questions:

- What is each project's impetus for building the BRT network? What are the unique challenges presented to each city's BRT project development and construction?
- What is each BRT's incentive for seeking CDM financing?
- In what areas of each project was the CDM financing specifically helpful thereby leading to the completion of each project?
- How can these two case studies serve as models for engaging project participants' interest in future transport CDM projects?

1.1 Background

United Nations Framework Convention on Climate Change (UNFCCC), established in 1992, is a global response to climate change and a cooperative attempt to reverse problems resulting from changing climate. Under the UNFCCC's Kyoto Protocol, an international climate negotiation on greenhouse gases (GHGs) reduction was adopted in 1999 and came into effect in 2005. The Protocol mandated that Annex I countries[1], the thirty-seven developed/industrialized countries and European countries, commit to reducing GHG emission levels by an average of 5 percent from 1990 GHG emission levels over the first phase of Kyoto Protocol (2008-2012). Currently, the Kyoto Protocol is in its second commitment phase (2013-2020) with amendments made in 2012. While the Kyoto Protocol is a legally binding treaty requiring Annex I countries to comply with the emission reduction target matching each country's unique capacity, it further provides those countries with three different flexible market-based mechanisms as cost-effective avenues of meeting the reduction compliance. The three

[1] Annex I countries: OECD countries and countries in transition economies (UNFCCC website under Parties

market-based mechanisms are: (1) EU Emission Trading; (2) Clean Development Mechanism (CDM); and (3) Joint Implementation (JI) (UNFCCC 2013a).

Kyoto Protocol's Article 12 established Clean Development Mechanism (CDM) with a two-fold purpose. First, to assist non-Annex I countries[2] to facilitate sustainable development, and second, to assist Annex I countries to meet the GHG emission reduction targets in a cost-effective way[3].

Under the CDM mechanism, private entities in the Annex I countries are entitled to earn Certified Emission Reduction (CER) through participating in CDM projects in developing countries, enabling them to apply those earned units towards meeting their emission target in a cost-effective way. This method can be viewed as a vehicle of emission reduction that benefits both Annex I and non-Annex I countries. In the language of EU Emission Trading, one unit of CER is the one-ton equivalent of carbon dioxide (CO_2). Thus, countries with the extra emission units to spare are allowed to sell the unused emissions unit/allowances to other countries that need to lower their targets through carbon trading market (UNFCCC 2013a)

The CDM mechanism is described in Article 17 of the Kyoto Protocol (UN 1998, Article 17). In the carbon trading market, emissions units/allowances are treated and tracked as a commodity. The Assigned Amount Units (AAUs) is an "allowed amount" of emissions for each Annex I country, structured within the overall emission target as outlined in the Kyoto Protocol. One unit of AAU is equivalent to one unit of carbon credits such as CERs, generated from CDM projects, and Emission Reduction Units (ERUs), earned from JI projects. After exhausting the allowed AAUs, CERs and ERUs may be utilized to offset the excessive emissions that could not be reduced. The carbon trading markets are considered as means of cost-effective emission reduction compliance, more favorable than only regulation-based reduction mechanisms (UNFCCC 2013a)

Not surprisingly, the transport sector represents one of the largest contributors of global GHG, and it is expected to continue to contribute significant share of emissions in the future. According to the Intergovernmental Panel on Climate Change (IPCC), the transport sector contributed 23 percent of energy-related CO_2 emissions in 2004, and road vehicles accounted for around 75 percent among those energy-related CO_2 emissions, with the fastest growing trends among energy using sectors over the last decade. Furthermore, if there is no change in energy usage pattern in the future, total transportation energy use and CO_2 emissions will increase to about 80 percent from the current levels by 2030 (IPCC 2007, 325).

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[2] Non-Annex I: middle and low-income developing countries that do not have obligations for GHG reduction but they may engage in Kyoto Protocol by participating in CDM (UNFCCC website under Parties and Observers Section)

[3] Article 12 summarizes CDM's objectives as follows: "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3" (UN 1998, Article 12).

Despite its significant contribution to GHG emission percentage, the transport sector within the overall CDM financed projects has not had enough representation. As of March 2013, the number of transport sector CDM projects accounted for 0.4 percent among the total CDM projects (UNEP Risoe 2013). This lack of representation is mainly due to "inherent complexity of quantifying emission reductions from mobile sources" (Millard-Ball and Ortolano 2010, 533) and the difficulty of proving "Additionality"[4] – demonstration that the project would have otherwise been emitted GHG in the absence of CDM project registration. Given the transport sector's significant potential in GHG reduction and underrepresentation in CDM mechanism, it is necessary to investigate and analyze the risks, barriers and challenges that inhibit the growth of reduction efforts.

In the context of developing countries, the CO_2 emission share of the transport sector is relatively small, with current data showing 4.4 percent of annual growth rate between 1990 and 2007. However, transport-related CO_2 emissions from non-Annex I, developing countries will most likely surpass the industrialized countries' emissions by 2025 (IEA 2009a, 176). In addition, individual car ownership is forecasted to increase exponentially due to rapid urbanization and economic growth anticipated in developing countries (IEA 2011, 87). Therefore, developing countries would benefit from having public transportation systems. Huizenga and Leather (2012) further state:

> The developing world will be the most important source of GHG emissions from transport in the very near future, and substantial changes will be required in its growth path in order for the transport sector in the developing world to be part of the solution to climate change rather than to be part of the problem. Early action will be required to avoid a lock-in effect to a high carbon growth path resulting from continued rapid growth of individual motorized vehicles enabled by an aggressive expansion of road infrastructure and aided by a pricing system of transport which continues to promote rather than constrain further growth of private motorization. (388)

Following the above descriptions, authors discuss the need for a low-carbon, sustainable transportation policy in developing countries suggesting a paradigmatic move from the "Predict and Provide," with a focus on supplying road infrastructures based on demand prediction, to the "Avoid-Shift-Improve (A-S-I) approach": *Avoid* trips through land use planning; *Shift* travel to the more efficient modes such as public transits and non-motorized modes; and *Improve* the technology of vehicle and fuel efficiency, all three integrated in a comprehensive manner (Huizenga and Leather 2012, 380-382).

In order to achieve sustainable transportation paradigm in response to global climate change in developing countries, leveraging transportation CDM could serve as opportunities for developing countries—as a primary tool for reducing emission to address climate change and a funding instrument for the developing countries. Yet, since there are barriers and risks to be registered as transportation CDM cases and received CERs, investors are hesitant to invest in

[4] "Article 12 of the Protocol states that projects must results in 'reductions in emissions that are additional to any that would occur in the absence of the project activity'. The CDM projects must lead to real, measurable, and longterm beneifts related to the mitigation of climate change." (UNEP 2011, 13)

transportation CDM, instead, favoring the readily obtainable CER projects such as renewable projects. Not enough studies have been conducted to analyze the risks facing transportation CDM and investor outlook (Millard-Ball and Ortolano 2010, 534).

1.2 Research Objectives

This paper will examine two successful transport projects within the subfield of Bus Rapid Transit (BRT), Bogota (Colombia) TransMilenio and Chongqing (China) BRT. The two cases of BRT systems were selected based on the initial research of the 40 transportation CDM portfolios. Within the 40 transportation CDM projects, BRT projects outweigh Metro projects even though Metro projects generate larger amount of CERs. BRT projects appear to have a greater appeal to potential investors for reasons which will be explored later in this paper.

The Bogota case and the Chongqing case offer two variations of BRT projects that received CDM financial backing. The Bogota system is relatively large, developed as an additional layer of bus system over an existing but poorly managed one. Chongqing BRT is a new development and is much smaller in scale.

The research objectives of this paper will be to analyze the reasons behind the fruitful outcome of the Bogota TransMilenio and Chongqing, ultimately identifying a matrix for success. As mentioned earlier in this paper, there are hypotheses that attempt to explain the scarcity of transport projects with CDM financing. In brief, the most prevalent explanation for this phenomenon is linked to the impediments in the CDM approval process itself.

Given the discussions in the field of CDM financing in the transport sector, it is important to understand how the two BRT projects cited in this paper overcame the various levels of impediments. Investigating the unique challenges posed to each city's BRT project development and construction could, needless to say, inform future project developers' of risks and management. Since CDM itself is ultimately a financing mechanism involving multitude of investors, investigating the two BRT cases' appeal to their investors and respective host governments could expand research in the transport CDM field. Finally, analyzing the possibilities of these two case studies' potential to serve as models for engaging project participants' interest in future transport CDM projects could open up CDM financing as a viable option for the transport sector.

1.3 Research Methodology

Research Design

Carbon market's design is complex, and its direct impact on the environment is difficult to quantify. Although deliberately designed to reduce carbon emission through fixed structures to assess quantity and convert those terms to measurable currency, ultimately, the system's

reliance on supply and demand, has created something of a barrier to its efficacy.

The result of this research on the carbon market and its related mechanisms to reduce GHG leads to the conclusion that the carbon market does not necessarily produce a direct, positive result on the environment. Consequently, rather than surveying the wide range of mass transit systems in developing countries to identify the common reasons for the specific transport project's success, this paper focuses on Bus Rapid Transit (BRT) to narrow down the range of analysis on the real contribution of the carbon market to the building of urban transportation. Examining BRTs already completed, two cases stood out as unique examples of the real contribution of the carbon market: Bogota's TransMilenio and Chongqing BRT.

Primary Sources

Authorities and agencies of Colombia and China's BRT systems were contacted. Because of the language barrier, it was not possible to conduct meaningful interviews with these authorities. However, along with brief telephone conversations, they offered email replies with some guidance for this work. Due to the possible sensitivity issues related to the BRTs being semi-government funded projects, it was difficult to pin down relevant financial data pertaining to the total cost of the BRTs and other substantive information.

For Bogota's TransMilenio, the Consul General of Colombia in New York City[5] and an officer of Group Research and Development in Transport, Traffic and Road Safety[6] and an officer of Multimodal Transport Group, International and Support[7], both at the Colombian Ministry of Transport were contacted. For Chongqing, Party Branch Secretary and Vice General Manager[8] overseeing the BRT project was contacted. In email communications to these officials, questions about CDM's financing role, operating budget, and overall financing structure were posed.

As it will be discussed in greater detail in later sections, it was concluded that CDM's role did not amount to a significant percentage of financing when viewed against the overall project cost. Its most visible role appeared to be in supporting the operating budget of each project, creating an income stream in a sense. Examining the projects' actual budget would have been a necessary step. Unfortunately, with all those contacted in Bogota and Chongqing, adequate response regarding financials were not obtained. This lack of significant primary data concerning the actual financing of the projects is a limitation of this study.

The most valuable primary source for this study was Dr. Jürg Grütter, an international transport CDM expert and consultant, who offered a broad view on the applicability of CDM financing to the transport sector and on enhancing project viability with CDM financing. As it will be discussed later in the Discussion section, Dr. Grütter also provided his first-hand account of

[5] Email sent on Oct. 30, 2013
[6] Email sent on Oct. 30, 2013
[7] Email sent on Oct. 30, 2013
[8] Email sent on Oct. 30, 2013

both TransMilenio and Chongqing BRT. In terms of appropriate references for this project, his recommendation was to refer to each project's UNFCCC's Project Development Document (PDD), with specific attention to the "Additionality" sections (See Appendix B for detail information). The Additionality section in the PDD outlines the possibility of CO_2 reduction as a result of the CDM financing in a particular project. As such, it offers a comprehensive picture of each BRT's financial limitations for needing a CDM financing and of CDM's applicability to the reduction scenario.[9]

The transport CDM expert's insight on issues confronting multinational transport projects requiring CDMs helped conceptualize this research. His view on carbon financing is that because the infrastructure costs are high, its impact is marginal, even with the consideration of higher CER prices of the past. Carbon finance's potential impact lies in possibly reducing the financial risk of operational deficits. While infrastructure investment in a transport project does not need to be repaid by ticket sales as in the case of many public urban transit systems, both TransMilenio and BRT Chongqing were designed to be operationally self-sufficient with limited subsidies, which meant that they had to cover their own operational costs.

Secondary Sources

The most significant secondary source input came from UNFCCC's Project Design Document (PDD) and Monitoring Report. These documents exist for every CDM project in which carbon market was implicated. The PDDs are, by and large, extensive and detailed, but each PDD describing a specific BRT has its unique information dissemination system. Some PDDs contain descriptive financial details while others are sketchy.

Chapter 2. Transportation Sector in Clean Development Mechanism (CDM)

2.1 Transportation Sector and Developing Countries

2.1.1 Rapid Urbanization and GHG Emissions in Developing Countries

To understand developing countries' contribution to global GHG emissions, the need for the transport sector CDMs and the mechanism's potential for emission reduction, it is critical to discuss the inter-relatedness of rapid population growth, economic growth, and private car ownerships.

In forecasting urban density and economic activities in developing countries, rapid urbanization and economic growth go in tandem (OECD 2012; UNPD 2011). The most important contributing factor is population growth in the developing countries. According to IEA's statistics in *Transport, Energy and CO_2: Moving Toward Sustainability* (2009, p 50), the rate of

[9] Email from Dr. Jürg Grütter on Nov. 1, 2013

population growth in developing countries, or non-OECD countries, is expected to exceed that of developed countries. The developed countries, or OECD countries' share of global population is forecasted to decrease to 16 % in 2035 from 18% in 2011. To illustrate the magnitude of the population growth, for example, both China and India combined, is forecasted to have nearly 3 billion in populations by 2035, a figure larger than the combined OECD population (IEA 2011, 58-60).

Furthermore, population growth is particularly significant to urbanization. Migration to urban areas is anticipated, so that by 2035 over 5.3 billion people worldwide will be living in urban areas from 3.4 billion in 2009. The contributing share of economic growth from developing countries is projected to rise to 61 % in 2035 from 44% in 2010 (IEA 2011, 57). This data supports the expectation that population growth will trigger future economic growth. As more and more people migrate to urban areas, their income is likely to increase based on wider and more complex economic opportunities. This progression of events is related to the rise of future energy demand (IEA 2011, 58-60).

Along with growth, urban transportation demand is expected to increase. There is a strong relationship between income levels and the rate of personal car ownership. A typical correlation can be observed by looking at per capita income and personal car, or light duty vehicle (LDV) ownership when LDV ownership rises rapidly up to the point of reaching USD 5,000 per capita income. The IEA further forecasts the growth of autos to increase 250-375 % by 2050 based on population and economic growth scenarios (IEA 2009, 59-60). It stated that transportation is responsible for a quarter of energy-related CO_2 emission worldwide, and also energy use in transportation will increase to approximately 50% by 2050 if there is no further intervention (IEA 2009, 43).

Three methods that can be applied to reduce GHG emissions in transportation sector can be categorized as: i) Modal Shift, ii) Efficiency, and iii) Alternative Fuels. Efficiency and Alternative Fuels are associated with technological improvements in manufacturing and improved quality of fuel sources. Modal Shift is the shift to public transportation from individual vehicle use, a method relevant to CDMs (IEA 2009, 67).

2.1.2 Low-carbon Sustainable Transportation in Developing Countries

In addition to the large share of global emission contribution, rapid and unregulated motorization growth has created local air pollution for 80 percent of developing cities and a global tally of over 1.3 million fatal traffic accidents (Sakamoto et al. 2010, 6). Traffic congestion caused by excessive private car use compromises productivity of the workforce and accessibility to destinations. Without proactive intervention to change transport modal structure to public transportation, unmanaged motorization in developing countries will continue to be accompanied by air pollution, safety and traffic congestion. These consequences are found to incur high social costs of some 10 percent of gross domestic product (GDP) in some countries. Solutions are suggested for sustainable transportation in developing countries (Replogle and Hughes 2012, 56-57).

Sakamoto et al. (2010, 28) use the terminology “leapfrogging” the paradigm toward the sustainable transport (See Figure 2.1.). The term implies shifting the way of coping with transport problem from the conventional supply-side approach to transportation policy. In their analysis, leapfrogging enables developing countries to reverse social costs such as road accidents, public health issues, social impacts, and environmental degradation. The concept of sustainable transportation has become valuable concept in many developing countries because of their growing dependence on road transport and increasing infrastructure challenges (Wittneben et al. 2009, 92-94). Wittneben et al. summarize sustainable transport as:

> Generally speaking, sustainable transport is the consequence of different measures and policies aiming at influencing transportation need and behaviour towards an increased accessibility with a lower environmental impact in an economically feasible manner. (94)

Table 2.1. Key characteristics of unsustainable and sustainable transport

	Unsustainable transport	**Sustainable transport**
Transport volume	Requires a high level of numbers of trips and trip distances due to sprawled urban development and inefficient logistical networks.	The demand for travel is minimised and journeys are short, owing to compact urban development, mixed land use and optimised logistical chains.
Transport modes	Reliance on private motorised transport for passengers, and heavy goods vehicles for freight.	Most passenger trips are made by public or non-motorised transport, and freight is carried by rail and other low-carbon modes.
Transport technologies	Vehicles rely on inefficient, fossil-fuel engines. The transport network is inefficiently managed.	Low carbon vehicle technologies are mainstreamed, including highly efficient engines, hybrids, plug-in hybrids and electric vehicles. New technologies such as “Intelligent Transport Systems” and “Smart Logistics” help manage transport systems in highly efficient ways.
Transport pricing	The price paid by users for vehicles, fuel, parking and road space do not cover the full external costs to society, encouraging motorised vehicle use at the expense of more sustainable choices.	The price paid by transport users fully ‘internalises’ the true costs, managing growth in motorised vehicle use and encouraging environmentally friendly alternatives.
Resilience to climate	Transport systems are highly	Transport assets are screened

change	vulnerable to changes in the climate.	against vulnerability criteria, and are developed in a way that is resilient towards changes in climate.

(*Source*: Sakamoto et al. 2010, 7)

To attain the optimal sustainable transport, as described earlier in the introduction of this paper, "Avoid-Shift-Improve" approach is the consensus framework in the transport sector. Avoid refers to change the land use and transportation management; Shift refers to changing modal shift from private cars to more efficient and environmentally favorable mode such as non-motorized transport and public transport; and Improve refers to vehicle to fuel-efficiency related to technological advancement. The ASI framework offers the possibility of emission reduction with minimizing externalities for sustainable transport (Sakamoto et al. 2010, 23). Banister (2008) supports the sustainable mobility in an integrated manner by stating that: "The intention is not to prohibit the use of the car, as this would be both difficult to achieve and it would be seen as being against notions of freedom and choice. The intention is to design cities of such quality and at a suitable scale that people would not need to have a car" (74).

2.1.3 Carbon Finance Opportunities of Transportation CDM in Developing Countries

Even though CDM may not be able to serve as the only funding source or building sustainable infrastructure, carbon credits generated from CDM could be one of the diversified funding mechanisms. CDM as a funding mechanism is flexible, meaning that income stream for building transport infrastructure can be combined with other funding sources from public and private funding. To the extent that it is flexible enough to be used in combination with other sources makes funding mechanism highly worthy of consideration. Domestic funding is a primary funding source because 2 to 13 percentage of domestic budget is earmarked for transportation sector. In addition to that figure applicable to the state funding, there is city and local level domestic funding that can also be counted in the category of the domestic funding. However, domestic funding for transport sector occupies fairly significant portion of the budget because the sector is considered integral to economic growth however this perception carries bias toward the road infrastructure and motorization. If the available domestic funding could be redirected toward sustainable public transport, emission reduction goal could be achieved along with other existing funding sources (Sakamoto et al 2010, 11-12).

The next category of funding is "international public flows" which generally implies assistance from foreign government and international organizations by way of Official Development Assistance (ODA) and Export Credits. The current rationale for these types of assistance includes improving trade at the local and international level and poverty reduction. These types of assistances do not consider low emission transport and sustainable transport priorities. However, the sources of funding are available and can be redirected toward the sustainable transportation. Likewise, private funding sources follow the similar scheme with public funds focusing on motor vehicle manufacturing and maintenance and construction and

operation of infrastructure (Sakamoto et al 2010, 13-16).

Yet, the climate funds and mechanisms are well suited for the mitigation and adaptation purposes. Climate financing is largely divided into two categories: 1) climate funds such as Global Environment Facility (GEF) Trust Fund and the Climate Investment Funds (CIF), which help in capacity building, technology transfer and investments; and 2) carbon market mechanisms which includes CDM (Sakamoto et al 2010, 17).

Active since 2005, CDM is project-based mechanism that generates emission credits or CERs. These credits are traded in a supply and demand driven market of emission credits in the EU Emission Trading System. Private entities from the industrialized countries with Annex I classification must meet Kyoto Protocol's emission reduction targets within each country's emission allowances. If they exceed the allowed limit of emissions, they may demand carbon credits in order to comply with the Kyoto Protocol. In such a case, their options for earning the credits are to buy the CER in the emission market, or to participate in reduction-related ventures, CDM projects, in developing nations (UNFCCC 2013a).

As a project-based market instrument, participants of potential CDMs must satisfy numerous stringent procedural approvals by the UNFCCC to be offered CERs from its Executive Board. Earning carbon credits by engaging in CDM projects is seen as generating extra revenues and incentives for the private firms and project developers of developed countries. Furthermore, developing countries, or host countries, potentially benefit from participating in CDM projects in their countries. Emission reduction projects further aim to promote *sustainable developments* in developing countries through technology transfer from North to South. As a result, CDM projects could be highly beneficial to developing countries, where development funding shortage exists and where those externally driven developments would not have occurred without the need to earn carbon credits (World Bank 2010, 2).

The sustainability issue is officially considered only in the initial stage of involvement by Designated Operational Entities (DOEs), the independent body within the UNFCCC that assists the Executive Body (EB). Even though the window of consideration is small, there are still controversies on the question of measuring sustainable development because standardized measure indicators are absent under the UNFCCC codes. If the project developer is the state itself in developing countries, sustainability factor matters; but because of the absence of measure indicators, potential participants' investment decisions are not significantly affected by the sustainable development issue. Less Developed Countries, mostly low-income countries, face the lack of funding sources, technology, and expertise (World Bank 2010, 6-7).

One concern regarding CERs that stem from a CDM is the price fluctuation in EU's emission market which ranges from EUR 4 to 25. Though there is a limitation on its uncertainty of revenue, given its flexibility and additionality on mitigation revenue sources, CDM could be an opportunity by municipalities or private entities (Sippel and Michaelowa 2013, 364).

2.2 Transportation CDM

2.2.1 Current Status of Transportation CDM

As of March 2013, across all sectors, there is a total of 9,016 CDM projects. Yet only 40 CDM projects out of the above total figure are for the transportation sector, accounting for a mere 0.4 % of the total number of projects, equating to 5240 CERs per year, or 0.4 % of the total CERs per year (See Table 2.2.) comparing the transport sector to other categories. In contrast to CDM's low representation in the transport sector, in the energy sector, including renewables, energy efficiency, and fuel switch, the number of registered CDM projects exceeds 80 % of the total CDMs. Accordingly, the percentage of CERs per year is over 70% of the total CERs generated by all sectors per year. Thus, the analysis of the current CDM status by sector shows a distinct underrepresentation of the transportation sector.

Table 2.2. Types of CDM activities including Transport CDM

Type of project	No. of project		CERs/yr		CERs Issued	
Renewables	6,253	69.4%	652,033	52%	277,894	23%
CH4 reduction & Cement & Coal mine/bed	1,421	15.8%	223,103	18%	95,071	7.9%
Supply-side EE	619	6.9%	131,878	11%	56,358	4.7%
HFCs, PFCs, SF& & N2O reduction	149	1.7%	144,581	12%	729,013	60%
Demand-side EE	313	3.5%	12,403	1.0%	2,279	0.2%
Fuel switch	149	1.7%	75,412	6.0%	40,583	3.4%
Afforestation & Reforestation	72	0.8%	3,417	0.3%	5,704	0%
Transport	40	0.4%	5,240	0.4%	872	0.07%
Total	**9,016**	**100.0%**	**1248,067**	**100%**	**1,207,774**	**100%**

(Based on data from UNEP Risoe Center's CDM pipeline database as of March 2013)

UNEP Risoe Center's CDM pipeline database (as of March 2013) references current CDM project status in terms of geographical distribution worldwide, linking major host countries with the total amount of CERs issued. China, India, South Korea, Brazil, and Mexico are the top 5 countries where the largest amounts of CERs were generated. China distinguishes itself as the largest supplier of CERs, accounting for approximately 61 %, significantly greater than the next largest supplier, India with approximately 20%. This data illustrates the uneven geographical distribution of the CDM projects, and furthermore, that mostly middle-income countries are perhaps favored as host countries rather than Least Developed Countries (LDCs)

among the developing non-Annex I countries. This analysis opens up the discussion for ways in which LDC countries can tap into CDMs in the transportation sector.

In terms of the registered subcategories within the CDM transportation projects, 13 Bus Rapid Transit projects, 4 motorbikes projects, and 5 rail-based transportation systems have been registered under CDMs, as presented in Table 2.3. Of the many subcategories that could be included, only the three types of transportation projects mentioned above are actively registered. In the following chapters, this paper will examine the investment preference by risk and returns from project participants' perspective. The potential of under-utilized sub-types of transportation CDM projects for possible investment will also be analyzed. Table 2.4. shows the geographic distribution of the transportation CDM projects. This table may possibly represent the various preferences on transportation CDM project by its distinct status and needs of a city. However, the table also invites an investigation through the readiness of external investment by a given host country and by sub-type of transportation project.

Table 2.3. Transport subtypes details

Sub-types used in Transport CDM projects	Number of Registered projects	Number of CER Issuance projects	kCERs Issued	Average Actualized Issuance Percentage
Bus Rapid Transit	13	4	658	42%
Motorbikes	4	-	0	-
Mode shift: Road to rail	5	1	84	18%
More efficient train system	0	-	-	-
More efficient vehicles	1		0	
Rail: regenerative braking	1	1	130	105%
Metro: efficient operation	0	-	0	-
Scrapping old vehicles	0	-	-	-
Biodiesel for transport	1	-	0	-
Cable cars	1	-	0	-
Total	**26**	**6**	**872**	**-**

(Based on data from UNEP Risoe Center's CDM pipeline database as of March 2013)

Table 2.4. Geographical distribution by subtypes of transport CDM

Host country	BRT	Metro	Cable Cars	LRT	Electric Motorbikes	Biodiesel for transport	Rail: regenerative braking	Fuel Efficiency Improvement	Total
India	-	3	-	-	4	-	1	-	8
Colombia	5	-	1	-	-	-	-	-	6
Mexico	4	1	-	-	-	-	-	-	5
China	3	-	-	-	-	-	-	-	3
Guatemala	1	-	-	-	-	-	-	-	1
Malaysia	-	-	-	-	-	-	-	1	1
Paraguay	-	-	-	-	-	1	-	-	1
Tunisia	-	-	-	1	-	-	-	-	1
Total	**13**	**4**	**1**	**1**	**4**	**1**	**1**	**1**	**26**

(Based on data from UNEP Risoe Center's CDM pipeline database as of March 2013)

2.2.2 Methodology Framework for Transport CDM Projects

In preparation for a CDM project, project design requires creating a methodology in order to quantify the eligible amount of CERs that the project can produce, an amount equal to the emission reduction, or the difference between the actual and baseline emissions. Baseline emission refers to the emission amount in the absence of a CDM project. Quantifying the actual emissions is calculated during the monitoring periods. Since CDM is a project-based mitigation activity, methodology varies by the type of mitigation activities in relation to its particular sector and by its applied technology type and measure (UNFCCC 2012, 5). It can be concluded that the feasible carbon credits, CERs, are highly dependent on methodology in that it is intimately tied to calculating the baseline and actual emission.

In Grütter's (2007, 11-15) report specifically examining transport CDM projects, the author describes three approaches that could be undertaken to reduce the GHG emissions in the transport sector. Grütter breaks down the three approaches of emission reductions in transport sector based on three different measurement units: 1) per kilometer; 2) per unit transported – e.g., number of passengers; and 3) frequency of travel. Viewed in this perspective, as of March, 2013, according to the UNEP Risoe Center's database of all CDM pipeline in detail, 32 large-scale and 5 small scale methodologies exist in the transport sector, as seen in Table 2.5. The scale is determined by the amount of emission reduction of 60,000 tCO_2eq/year. In respect to the approved large-scale methodologies, 16 Mass Rapid Transit Projects, 14 Bus

Rapid Transit project, and one modal shift of freight transportation are employed. As for small-scale methodologies, 14 emission reduction by low-greenhouse gas emission vehicles, one cable car, two bio-CNC transportation applications, and one energy-efficiency system have been adopted.

Program of Activities (PoA), shown in the second column of Table 2.5., has been adopted since 2005 to allow for the development of many projects in several developing countries, while the traditional CDM, or non-PoA designated CDM, could only take place in one geographic site as a single project. In the UNFCCC's description, "Under a programme of activities (PoA) it is possible to register the coordinated implementation of a policy, measure or goal that leads to emission reduction. Once a PoA is registered, an unlimited number of component project activities (CPAs) can be added without undergoing the complete CDM project cycle"(UNFCCC 2013a, sec. CDM Project Cycle). The PoA approach is beneficial for the less developed countries where it is most likely to have non-viable small-scale projects implemented. It is designed to reduce the transaction costs, investment risks and uncertainties to expedite the approval process. Clearly, receiving the PoA designation is a favorable factor for the potential CDM.

Table 2.5. UNFCCC Approved Methodologies for Transport Sector

Approved Methodology	Transport Sector	Number of Projects	Number of PoAs
ACM: Large scale Consolidated Methodologies; and AM: Large scale Methodologies		32	1
ACM16	Mass Rapid Transit Projects	16	1
AM31	Baseline Methodology for Bus Rapid Transit Project	14	
AM90	Modal shift in transportation of cargo from road transportation to water or rail transportation	2	
AM101	High speed passenger rail systems		
AM110	Modal shift in transportation of liquid fuels		
AMS: Small scale Methodologies		18	5
AMS-III.C.	Emission reductions by low-greenhouse emission vehicles	14	1
AMS-III.S.	Introduction of low-emission vehicles to commercial vehicle fleets		3
AMS-III.U.	Cable Cars for Mass Rapid Transit System (MRTS)	1	
AMS-III.AA.	Transportation Energy Efficiency Activities using Retrofit Technologies		
AMS-III.AP.	Transport energy efficiency activities using post - fit Idling Stop device		
AMS-III.AQ.	Introduction of Bio-CNG in transportation applications	2	
AMS-III.AT.	Transportation energy efficiency activities installing digital tachograph systems to commercial freight transport fleets	1	
AMS-III.AY.	Introduction of LNG buses to existing and new bus routes		1
AMS-III.BC.	Emission Reductions through Improved Efficiency of Vehicle Fleets		

(Based on data from UNEP Risoe Center's CDM pipeline database as of March 2013)

As shown in Table 2.5., in the transportation sector, one PoA of 'Mass Rapid Transit Project' is registered as a large scale methodology and one PoA of 'Emission reductions by low-greenhouse emission vehicles' as a small scale one where many number of traditional CDM projects are used as methodologies. On the other hand, for small-scale CDM projects, there are

three ‘low-emission vehicles to commercial vehicle fleets’ and one ‘introduction of LNG buses to existing and new bus routes’ PoAs where a traditional CDM project has not been yet employed. In addition, as Binsted et al. (2013) mention as follows, the Executive Board of the UNFCCC has started the recognition of reforms in the transportation sector:

> The CDM is currently undergoing reform with discussions taking place largely in the Ad Hoc Working Group on Further Commitments under the Kyoto Protocol (AWG-KP). As part of this process the Executive Board of the UNFCCC is seeking to make the CDM more accessible to underrepresented sectors, which should increase its suitability for the transport sector. (38)

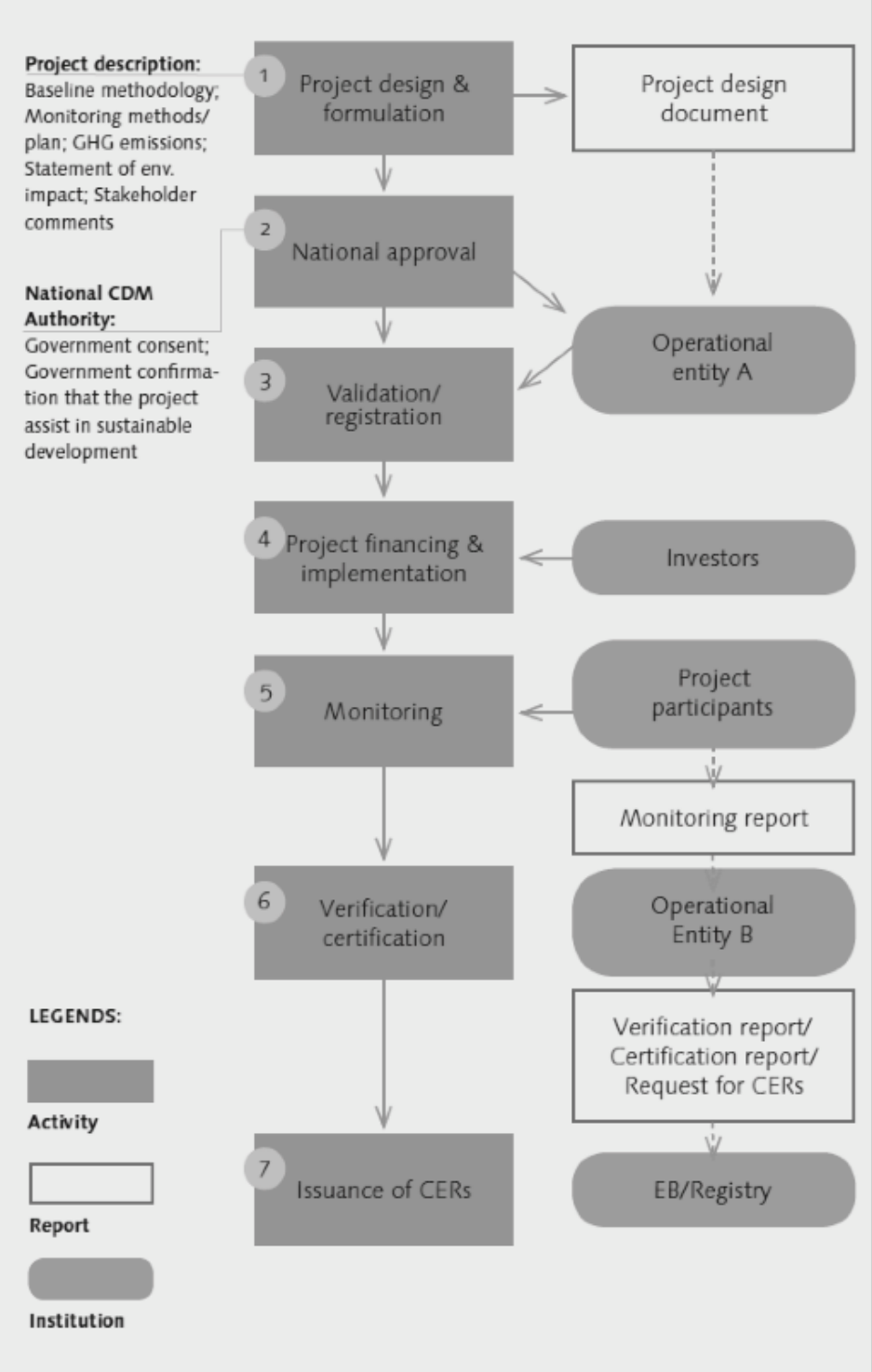
The reform of the CDM is likely to strengthen the role of Program of Activities, increasing the emphasis on sustainable development co-benefits, and it could also enable the support of sector wide policies.

All of these developments would provide enhanced opportunities for the financing of land transport activities. These opportunities could include the scaling up of individual projects, such as vehicle scrapping and recycling, currently being validated in Egypt as a PoA (Binsted et al. 2013, 38-39). To further explain, the first PoA in the transport sector is The Egypt Vehicle Scrapping and Recycling Programme which began in 2011. This PoA supports the funding to replace the old polluting taxi fleets to new taxi vehicles in Cairo along with Egypt’s Traffic Law 121 with support from the World Bank. One old scrapped taxi is anticipated to reduce one to two tons of CO_2 emissions (ESMAP 2010).

2.2.3 CDM Project Cycle Description

The CDM project cycle is unparalleled in its complexity because the typical elements of a construction project, such as the project design, its development, and investment structure are based on intangible pollutants, an atypical commodity. The carbon market, central to a CDM project, is created by regulations on cap on emissions. Its concept is based on the idea that CO_2 emissions amount can be traded as a commodity by synthetically producing CO_2 credits thereby engaging the potential CDM projects which are the emission offsetting entities. The UNFCCC regulations regulate the complete process of the pollutant-based market. Therefore, the players and procedures involved in a potential CDM project cycle are distinctive and important features of the project development compared to a conventional project development. The following figure 2.2. from UNEP (2012) is useful in understanding the CDM project cycle, particularly the transportation CDM projects. The key phases of a typical CDM project cycle are briefly summarized below. Major actors for each stage are indicated in parentheses following the title of each stage.

Figure 2.2. CDM Project Cycle



(*Source*: UNEP 2012, 351)

(1) Project Design and Formulation (Project Participants)

Project design and formulation can be initiated and created by one of two possible entities. The first is the host country, more specifically, the state, and the second is an external private entity, i.e., Annex-I countries or developed nations. In the first case where the project is initiated by the host state, typically a prearranged entity is in place, usually an external private source that has agreed to exchange the CERs expected from this particular project.

In the second case where an external private entity initiates the project, this party is usually an outright investor who has evaluated the potential risks and returns of the project in question. The project developer could include not only the potential external entity, the investors, but depending on the scale of the project, the project developers could include the outsourced consultants and other outside experts. These consultant and outside experts could also be integrated to form a complete investor profile of the project in question. In both scenarios, the project owners submit their proposals to UNFCCC to begin the CDM registration process. Project design document (PDD) must follow the UNFCCC's specified methodology and regulation (UNFCCC 2013aa, CDM Project Cycle).

(2) National Approval (Designated National Agency)

Once the project owner submits the potential plans for CDM registration, the next step involves obtaining the host country's Designated National Agency's (DNA) approval. The host country's DNA is charged with evaluating the proposed project's potential contributions for sustainable development. The DNA consent is integral to the project moving forward (UNFCCC 2013aa, CDM Project Cycle).

(3) Validation (Designated Operational Entity)

Once the DNA of the host country approves the project and its potential contributions, the next screening process must pass the standards of UNFCCC's Designated Operating Entity (DOE). DOE evaluates the project design document (PDD) in its entire scope. The highlights of the significant criteria include validity of emission reduction methodology and calculation, and overall adherence to the requirements set forth by the Kyoto Protocol (UNFCCC 2013a, CDM Project Cycle).

(4) Registration (Executive Board)

The registration process is predominantly administrative, managed by the Executive Board (EB) of the UNFCCC. The process is relatively straightforward involving checking and vetting processes. Unless further request arises for the review of the project at this point, the project is considered formally registered as CDM project (UNFCCC 2013a, CDM Project Cycle).

(5) Project Financing & Implementation (Project Participants)

Project financing and implementation involve the physical construction of the project or

PDD. This process is a fieldwork actualizing the concept in the procedure outlined by the UNFCCC. This step is omitted from the formal project cycle as it is not an administrative function overseen by the UNFCCC (UNFCCC 2013a, sec. CDM Project Cycle).

(6) Monitoring (Project Participants)

After the project's completion and operation, the project participants or owners must prepare the monitoring reports on the progress of the emission reduction on scheduled period to the UNFCCC. This documentation must prove that the completed PDD meets the emission reduction and sustainable development benefits projected on the initial PDD. This document is essentially one that states the overall results of the project. The UNFCCC does not assess the validity of this document at this juncture (UNFCCC 2013a, sec. CDM Project Cycle).

(7) Verification (Designated Operational Entity)

UNFCCC's DOE verifies the monitoring reports to ascertain the emission reduction results. The expectation is that by this stage of the project, the emission reduction has been met, and Certification is issued. However, there are cases of failed emission reduction quota, in which case certification is not issued. According to the UNFCCC website, Verification is conducted with independent review and ex-post determination (UNFCCC 2013a, sec. CDM Project Cycle).

(8) Issuance of CERs (Executive Board)

After DOE's verification, request for the issuance of CERs is called for approval from the secretariat and the Executive Board (EB) of UNFCCC. Unless three or more members of the EB require vetting, the CERs are issued (UNFCCC 2013a, sec. CDM Project Cycle).

By reviewing the steps involved in receiving CERs, it is evidently clear that the process is costly, time-consuming, and highly bureaucratic in nature. If the PDD's methodology is rejected at the Project design stage, such an early rejection may encourage the project owner, developers, and investors to rethink and resubmit the revision. However, if the project's PDD passes the UNFCCC's approval process and reaches the near end Validation and Verification stage, obtaining CERs becomes a realistic monetary incentive for the involved entities. Unfortunately even at this late stage of the UNFCCC's vetting process, a PDD could get rejected. This type of project failure has been documented. From investors' perspective, it is an unfortunate outcome, to say the least. CDMs for this reason, is viewed as an investment risk (ADB 2013, 7; Grütter 2007, 5-6).

In the following section of this paper, the problem of regulatory risks acting as a possible investment barrier will be further explored. In addition, other risks and investment barriers, such as project risk, and market risks will be examined.

2.2.4 Risks and Barriers in Transportation CDM

Risks for CDM project can be categorized in three ways: (1) Generic project risk; (2) Regulatory risk; and (3) Market risk. Each risk will be explained in detail in the following subsections. While Generic project risk indicates the risks that every project may face, Regulatory risk and Market risk are associated with CDM-specific risks. Depending on its criteria, however, the Generic project risk, Regulatory risk, and Market risk might be overlapped each other. As each phase of a project is discussed, the relevant risks within each phase will be also discussed. The rationale for this approach, rather than separating out the three distinct risks categories is that each phase produces unique features, which includes risks associated. By approaching the risks in this manner, it will become clear where there are overlapping issues (UNEP and EcoSecurities 2007, 79-86; Makuch et al. 2012, 295-297).

(1) Generic Project Risk/ Non-regulatory Risk

Generic project risk can be defined as the universal risk faced by any project. To initiate the project in developing countries, the decision for a country would be based on analysis on country political risk

(2) Regulatory Risk (See Table 2.6.)

- **Country political risk**
  Country political risk pertains to political and economic stability of the host country. International political insurance can mitigate these risks.

- **Counterparty risk**
  Counterparty risk pertains to risks associated with any relationship with contractual partners.

- **Methodology risk**
  Designing the project document has to be based on the methodology approved both by the Methodology Panel (Meth Panel) the Executive Board of the UNFCCC. However, it is feasible that the project developer for owner can create new methodology. In this case, the time and effort put toward the CDM project are prolonged according to the feasibility of the approval by the UNFCCC. For instance, the average time taken for the approval for new methodologies has been around 303 days. Millard-Ball and Ortolano (2010) studied the complexity of the approval of the methodology by DOE and EB claiming that the transportation sector has been disportionately affected by the market leakages i.e., rebound effects.

- **Host country approval risk**
  Host country's Designated National Authority (DNA) need to approve the project design document (PDD). If there is no appropriate DNA in the host country the process would

be burdensome to the project owners.

- **Validation & registration risk**
  The PDD has to be approved by the third party. If there is any error in PDD, the validating party requests the clarification on the project owner.

- **Monitoring/ verification risk**
  During the verification process by a third party, if the current project state does not accurately reflect the projections described in the original PDD, the project may suffer the risk of being terminated.

- **Review of issuance risk**
  Even at this advanced stage of the project approval process, the Executive Board of the UNFCCC could deny acceptance of the Monitored and Verified Report thereby rejecting the project from proceeding.

Table 2.6. Types of regulatory risk

Type of Regulatory risk	Definition	Quantification of risk (cost)	Institutional source of risk
Host country risk	Risk that DNA approval will not occur or will be seriously delayed (and that national CDM rules will adversely affect project progress)	1. Non-approval 2. Delayed approval 3. Adverse Approved Project implementation impacts	National Government
Methodology risk	Risk that new methodologies may not be approved or are otherwise not applicable	1. New methodology not approved 2. New methodology not applicable	CDM Executive Board
Validation risk	The risk that the project will fail to pass DOE validation or there is a delay	1. Failed DOE validation 2. Delayed DOE validation	Designated Operational Entity
Registration risk	(After validation, is there risk that a project is not registered) Delay in registration of a project	1. Failed registration 2. Delay in registering a project	Designated Operational Entity
Certification risk	Certain or all emissions reductions are not verified by DOE	1. Full emissions reductions rejected 2. Partial emissions reductions rejected	CDM Executive Board

Non-host country sale/trade risk	Cap/restriction on non-host country national allocation plans for CDM projects	1. Partial sale/trade in CERs 2. No sale/trade in CERs	Designated Operational Entity

(*Source:* Makuch et al. 2012, 296)

(3) Market Risk

EU Emission Trade Scheme (ETS) is the largest carbon trading market at present. Since the price of CER is dependent on the supply and demand on market, the price of CER is unstable. Suppliers of the CERs are those participating in the CDM projects and selling on the EU ETS market.

Chapter 3. Role of transportation CDM finance: Interplay of Investment, Emission Reduction, and Carbon Credit Revenue

Transportation CDM projects are intimately intertwined with aspects of sustainable development issues, such as emission reduction and CER revenues. Financial investment, regardless of the identity of the project's stakeholder and project location, appears to be the fundamental driver of the project's successful outcome. Transportation CDM benefits could be sub-classified into three categories: Environmental, economic, and social benefits.

First, in terms of environmental benefits, transport CDM offers concrete and standardized platform to monitor the result of emission reduction and link those results to financial investment. The assessment methodologies remain controversial however, and these include behavioral change projections, such as ridership statistics, objectively difficult to ascertain. In terms of economic and social benefits, direct impact resulting from transport CDM is not clearly relatable because these benefits are, to some extent, subjective assessment of social changes. Previously mentioned ridership statistics could also be viewed as economic as well as social benefits. Despite transport CDM's uneven benefits profile, it clearly produces benefits rooted in measurable sustainable development goals, the CO_2 emission reduction in a given metropolitan region.

Simply put, transport CDM's strength lies in its direct and measurable environmental benefits that are traceable to financial investment. This chapter's primary objective will be to investigate data from CDM database to extrapolate the relationship between financial investment pattern and final outcome within the BRT sector. Focusing on the relationship between environmental benefits and financial incentives stemming from them, such as CERs, investments in each BRT CDM project could be analyzed on its merit: CERs' percentage over the total investments could show the cost-effectiveness of reducing CO_2 as well as the contribution of CER thereby making a case for project viability.

Within the subtypes of transport CDMs, BRT CDM projects have shown to be noteworthy to investigate in that its variation on CER ratio/percentage over the total investment distinguished itself from other types. Later in this chapter, these distinguishing observations will be explored, possibly to forecast its replicable quality for other expected projects.

From the group of BRT projects documented, Bogota BRT, first ever BRT project financed by CDM, is often viewed as an exemplary CDM project. However, data from the Chongqing BRT project in China generated statistics that are appealing to both potential project management and financial investors. In brief, the analysis of those data led to the conclusion that the Chongqing case has the highest percentage of CER share over the total project cost.

This chapter is devoted to case study and delves into the unique features of Bogota TransMilenio and Chongqing BRT. The case study will include analysis of the two cases since the Bogota project, thus far, has been viewed as a benchmark for BRT CDMs. Hopefully, this analysis will provide a window of new opportunities that the transport sector could look to in order to replicate success. In practical terms, this case study could have implications on potential investors and stakeholders of transport CDM. Finally, the analysis of the two cases could offer recommendations for improving the CDM transport project as well as the "big picture" of perhaps reorganizing CDM as a financing tool for sustainable transportation development in developing countries.

Table 3.1. CDM transport projects: Investment and CER Estimates

	Estimated Initial Investment (Millions of Euros)	**Crediting duration (years)**	**Total estimated ERs (Millions of tCO2)**	**Estimated ER income (Millions of Euros)**	**CDM Finance as % of Project Cost**
BRT Chongqing Lines 1-4, China	41	21	4.94	39	**97%**
Cable Car Metro Medellín, Colombia	8	21	0.4	3	41%
Plant-Oil Fuel Production, Paraguay	2	21	0.12	1	37%
BRT Barranquilla, Colombia	54	21	1.26	11	21%
BRT Macrobus Guadalajara, Mexico	57	21	1.16	10	18%
BRT Metrobus Insurgentes, Mexico	43	21	0.89	7	17%
BRT Lines 1-5 EDOMEX, Mexico	173	21	3.18	26	15%

BRT TransMilenio Bogotá, Colombia	425	21	6.31	50	**12%**
Rail Transport of New Automobiles, India	17	10	0.23	2	10%
Low GHG metro rolling stock, India	39	10	0.41	3	8%
Metro Delhi, India	1,444	21	11.18	92	**6%**
Metro One Mumbai India	338	10	1.96	14	4%
BRT (COSAC I), Peru	151	10	0.69	5	3%
Metro Line 12, Mexico City	1,433	21	2.7	23	**2%**
BRT Rea Vaya, South Africa	302	10	0.4	3	1%
BRT Zhengzhou, China	NA	21	4.98	42	NA
BRT MIO Cali, Colombia	NA	21	4.43	38	NA
BRT Metroplus Medellin, Colombia	NA	21	3.86	35	NA

(*Source:* Nelson et al. 2012, 9; IGES CDM Project Data base [Last Update 1 Aug. 2012])

Table 3.1. shows the investment intensity, CO_2 reduction amount, and CER revenues by each transportation project type. Its last column indicates the CER revenues as a percentage of the total investment amount. The last column in this table indicates the pattern that Metro CDM projects have relatively low shares of CER over investment amount ranging from 2 to 6 percent, compared to BRT CDM projects. The BRT projects show wide-ranging values from 1 to 97 percent, with most falling in the 10 to 20 percent range. One can infer that BRT projects are inherently less costly mass transit option system with relatively lower capital intensity in reducing one ton of CO2eq than Metro system. Supporting this inference is the meaningful values displayed in Table 3.1. above – its data factor in the CER revenues, a direct measurement of CO_2 reduction emission (1 ton of CO_2 = 1 CER).

3.1 Overview of BRT System and Two Cases Funded by CDM

As of March 2013, out of approximately 9,016 projects in the CDM pipeline, only 40 projects represented the transport sector. There are a number of BRT projects in various phases of the CDM process, but it is unclear as to when and if they will be registered (UNEP Risoe 2013).

Bus Rapid Transit (BRT) is characterized by an overarching goal to elevate the mass transit bus system thereby elevating the general standard of end user experience. Infrastructures of dedicated bus lanes, including right of way lanes, constitute the basis for streamlining bus traffic. Infrastructure can also include rapid boarding and disembarking stations that eliminate idling, contributing to emissions reduction. It is also supported by an efficient fare system that consists of free between-lines transfer and pre-board fare collection. The BRT system also employs user information technology such as clear route maps and real time bus tracking display. Low emission buses conform to clean technology (UNFCCC 2006, 6; Grütter 2007, 22).

3.1.1 Rationale for Case Selection

To examine the impact of CDM funding in the transport sector, two BRT cases were selected: Bogota's TransMilenio and Chongqing BRT. The main driving force behind the selection of the two cases is that within the transport sector, TransMilenio and Chongqing BRT represent two of only three BRT that actually received CER credits.

TransMilenio received CER credits seven times, within 12-15 months apart of each issuance; beginning in 2007 while Chongqing received the credits twice in 2012. Other BRTs' CER credit status is pending. Furthermore, at the time of Project Development, TransMilenio was projected to receive CER credits of $25 million (ESMAP 2011, 5), the largest amount of CER credit in the transportation sector. TransMilenio is the only BRT that completed its first crediting period of 7 years thereby having a complete set of data with for baseline emission and emission reduction by project. This data availability represents the pre and post project's estimate and actual data.

As for Chongqing BRT, in addition to receiving CER credits, it has the highest percentage, 97%, when expressing CDM's financial contribution as a percentage of the initial investment cost. This percentage figure is significant given that the next BRT with the highest CDM contribution as a percentage of the total initial investment is Transmetro Barranquilla (Colombia), at 21% (Nelson et al. 2012, 9).

The significance of the percentage figure is better understood when the two factors, the initial investment cost and reduced emissions are inversed. The initial investment cost is viewed as a fraction of reduced emissions in tons converted into currency through issued CER credits. The result is the capital intensity per one ton of reduction. Therefore, The Chongqing BRT could be said to have the lowest "Capital investment (USD) per reducing one tonne of CO_2 equivalent", costs of implementing BRT only when considering capital costs.

3.2 Overview of Two CDM Cases' Financing and Operation

3.2.1 Bogota TransMilenio

Figure 3.1. TransMilenio BRT in city of Bogota

(*Source*:http://www.publicamion.com.co/noticias/las-perlas-de-transmilenio.html)

TransMilenio is perhaps the more complex of the two cases, primarily because it is a transportation system that replaced and reorganized an extensive existing bus system. The project was conceived as a multi-phase one, and the phase, which pertains to CDM participation, is Phase 2. Phase 2 is characterized by the emphasis with which the importance of CDM's participation is delineated because financing became a major obstacle for Phase 2.

TransMilenio had initially relied on public financing during Phase 1, whereby 64% of funding came from the government of Colombia and 36% from the District of Bogota. Phase 2's success was heavily dependent on public support but the combined effect of reduced income flow from fuel tax and other sources from which Phase 1 (constructed 1998-2000) had previously benefitted, along with significantly higher than expected cost of Phase 2 impacted its possibilities for completion.

The original projected cost for Phase 1 was $186 million while the revised projected cost was $ 532 million, the difference stemming from myriad issues including changes in major routes' and related components' construction method, as well as higher land acquisition cost

(UNFCCC 2004, 19). In addition, as a public finance project, TransMilenio was in direct competition for public finance with other domestic social agenda, especially given the large cost overrun. Phase 2's construction was forestalled as a result, but ultimately, the second phase is one that drew CDM financing.

TransMilenio's Phase 2 was registered as an international private-public partnership with CDM financing. The host, Colombian government, was represented as TransMilenio S.A.; the Netherlands' Corporación Andina de Fomento-CAF, as administrator of the CAF-Netherlands CDM facility; the Netherlands Ministry of Infrastructure and Environment "IenM"; and Grütter Consulting AG of Switzerland. This CDM financed project has a 7-year CER crediting period starting in 2006 and renewable twice, meaning 21 years of total possible financial crediting through the sale of GHG emissions (Grütter 2007, 22).

With CDM registration in Phase 2, TransMilenio's additional income source would be secured through the sale of GHG emission reductions. It is estimated that TransMilenio will realize $ 130-350 million over the entire crediting period, the amount range determined by the fluctuation and future price of CERs. The estimated CDM income for TransMilenio represents an average of 10% of the total infrastructure investment, or one-third of investment realized by its project owner, Bogota Municipality. Although the CDM income covers a small portion of the investment cost, it is a significant enough contribution to make a difference in whether the project was able to continue or not.

3.2.2 Chongqing BRT

Chongqing BRT, the first of its kind in China, is characteristically different than Bogota's TransMilenio in that its existing bus operating system is a centralized one dispatched by Public Transport Holding Corporation, a government affiliated office, and comprised of a series of "feeder" lines. Unlike Bogota's "informal" system of multiple bus companies competing for passengers resulting in low passenger ridership, Chongqing's system is a "standard" one, organized by a central agency (UNFCCC 2006, 19).

Chongqing's existing bus system lacked efficiency in financial and end user terms, and the system itself needed updating. However, the existing bus system did not require scrapping and rebuilding of major infrastructure elements (UNFCCC 2006, 9). It therefore formed into a project that sought to continue the existing transport system with improved systems framework. Other options within public and private transport, such as a metro system and improving roadways for private vehicles, were considered. The option to install a new metro system would have posed larger financial burden (UNFCCC 2006, 20) while improving roadways for private vehicles would have been counterintuitive to environmental objectives.

In its initial project assessment, Chongqing city officials identified key reasons for implementing a modern BRT system. Reducing emissions was one of the key reasons. The new BRT system projected to consume less gaseous fuel than the existing bus system. Series

of studies concluded that 66% of emission reductions would be possible with the new BRT system (UNFCCC 2006, 9).

Figure 3.2. BRT Chongqing

(*Source:* http://www.transportphoto.net/photo.aspx?id=206501725&c=Chongqing)

A new BRT system, with expected total cost of $114 million, however, posed several financial as well as technical obstacles. The Chinese government would fund 49% of the cost, covering infrastructure overhaul and rebuilding, including road reconstruction, pedestrian bridge construction, and system control implementation, while Chongqing Bus Rapid Transit Co., Ltd. would fund the balance 51%. The new system would have been a project with full public financing, posing an investment barrier because the government would be considering its financial commitment to the BRT project along with other competing domestic agenda.

The proposed BRT system also posed an operational barrier since ridership ticket sales would only cover about two-thirds of the operational cost, requiring continuous subsidy (UNFCCC 2006, 21-22). This financial constraint projected a negative cash flow over the construction period. CDM funding was viewed as a funding source option from the initial onset of the new BRT's planning because it offered a viable financing solution for the complete investment cost and the operational shortfall.

Chapter 4. Findings and Discussion

In addition to examining the existing literature pertaining to challenges for transport CDMs, this section will devote to examining this author's interpretation of project documentations and interviews with transport CDM experts. Restating the research objectives of this project:

- What is each project's impetus for building the BRT network? What are the unique challenges presented to each city's BRT project development and construction?
- What is each BRT's incentive for seeking CDM financing?
- In what areas of each project was the CDM financing specifically helpful thereby leading to the completion of each project?
- How can these two case studies serve as models for engaging project participants' interest in future transport CDM projects?

4.1 Previous Studies on Transportation CDM Challenges

Previous works on transportation CDM projects have focused on the topic of under representation of the transportation sector relative to other sectors. These works on transportation CDM projects identify three broad factors viewed as reasons for the underrepresentation.

The first factor is the challenges involved in measuring CO_2 amount projected to be reduced by the projects. Wittneben et al's (2009) research is representative of such works asserting that the transportation sector, by nature, is incompatible with CDM financing in quantifying CO_2 reduction amount produced in the presence of a potential project. The research articulates the methodological difficulties that are tied to working with CO_2 amount produced by a large number of small vehicles. Establishing a baseline using these vehicles sources as well as calculating and monitoring emission reductions are equally challenging, requiring large data. Methodologies tend to become complex and its application just as bewildering (Wittneben et al. 2009, 96).

Calculating the difference between the baseline and the new modality presents a problem stemming from ambiguous statistical data presented by complex methodologies. In the initial stages of the CDM process, the PDD projects the expected CO_2 reduction based on existing public transportation passenger load, private vehicle passenger load, or combination of both measured against future CDM transport project's passenger load. These data points are inconsistent with CDM project's exacting requirements. Because it is difficult to pinpoint all the future passengers in new projects, expected CO_2 reduction is not accurate and constitutes a mere conjecture. Therefore, as a result of the difficulty in assessing data, the Executive Board of

the UNFCCC tend to be more critical in approving the transport projects than other sectors (Millard-Ball and Ortolano 2010, 538).

The second factor implicated in the transport sector's underrepresentation is the procedural complexity of the CDM approval process leading to delay. As discussed in Section 2.2.4., each stage of UNFCCC's project approval template calls for extensive information gathering and monitoring involving various participants within the project. Along with its inherently lengthy infrastructure building time, the project approval time tends to discourage potential participants. Potential participants are less willing to step into a project that requires multiyear commitment yielding results in the distant future (Millard-Ball 2010, 545).

Wittenben et al. assert that the potential transport CDM projects would benefit from sectorial approach with sector specific requirements. They argue that sector specific measurement method for expected reduction amount with systematic managerial process for actualized reduction amount would be more suited to the transport sector (2009, 93).

The current study too, was motivated by the under representation of transport projects in the CDM pipeline. However, this work has focused on exploring the previously unstudied aspect of financial implications of CDM financing in the transport sector. Specifically, this research examines the role of CDM financing in successfully completing the project as well as the particular areas of the project that benefited from CDM financing. Isolating the nature of CDM's impact on the successful completion of the project could possibly help identify with more accuracy future transport projects that could benefit from CDM.

4.2 Findings

As mentioned previously in this paper, the Chongqing BRT and TransMilenio CDM projects are inherently dissimilar. Their respective characteristics are summarized in the table below and are based on key pre-project conditions:

Table 4.1. Findings on Chongqing BRT and TransMilenio CDM projects

	Bogota TransMilenio BRT	Chongqing BRT
Project Owner	**Private-Public Partnership:** TransMilenio S.A	**Public:** Chongqing Bus Rapid Transit Development Co. Ltd
Project Participants	i) TransMilenio S.A.(Colombia, host); ii) Corporación Andina de Fomento - CAF (as administrator of the CAF-Netherlands CDM facility) (the State of the Netherlands);	i) Chongqing Bus Rapid Transit Development Co. Ltd. (China); and ii) Grütter Consulting AG (Switzerland)

	iii) Netherlands Ministry of Infrastructure and Environment "IenM" (the State of the Netherland); and iv) Grütter Consulting AG (Switzerland);	
Methodology	ACM0031 Version 03	AM0031, Version 03
First crediting period	Jan 2006 - Jan 2012	Oct 2010 - Oct 2017
Baseline Emission Projection	383,200 tCO_2eq/a (annual average)	460,772 tCO_2eq/a (annual average)
Estimated Annual Emission Reduction	246,563 tCO_2eq/a (as per PDD)	218,067 tCO_2eq/a (as per PDD)
Realized Annual Emission Reduction	73,060 annual average CERs issued during 2007-2013 (as per Monitoring Report)	79,528 CERs issued on April 2012; 79,988 CERs issued on Nov. 2012 (as per Monitoring Report)
Funding sources other than CDM	Phase II - National government (66%); and local fuel surcharges (34%)	Pilot lane - The government fund (49% of investment being road reconstruction, pedestrian bridges and system control); and the remaining part is paid by the Chongqing Bus Rapid Transit Co. * A similar investment cost distribution is expected for the remaining other lines
Total Capital Costs/ The estimated cost per kilometer of trunk route	Phase 2 - $545 million ($13.3 million per km) Phase 3 - N/A Phase 4 - N/A	$114 million (Entire project) $ 0.6 million USD/km[10]
Operating costs/deficits and estimated CER revenues	N/A	USD 0.14 per ticket covers ⅔ of operating cost per passenger. Estimated average cash flow over the period is negative. Remaining operating deficits were estimated to $100,000/year and annual CER revenue was projected to earn $ 2.8million.
A. Investment Analysis	Not applicable (Infrastructure is 100% public financed and not repaid)	Not applicable
B. Barrier Analysis	**i) Investment barrier** District of Bogota had to cover 36% of	**i) Investment barrier** Chongqing Bus Rapid Transit Co. Ltd

[10] "This is a much lower cost than most BRTs in Latin America basically due to not adding additional road space, not constructing new roads and using common crossings." (UNFCCC 2006, 22)

	infrastructure costs with the fuel surcharge where there is a cap to raise. **ii) Political barrier** Competition with other sector projects. **iii) Resistance of the existing transport sector barrier** 57 private bus companies were expected to be affected negatively.	needed 51% of the investment cost; and operating costs could not covered. **ii) Lack of prevailing practice barrier** - Based on region-wide
C. Common Practice Analysis	BRT is not a common practice in Colombia except Transmilenio Phase I	**First of its kind:** BRT Chongqing could be one of first in its kind in China.

(*Sources:* UNFCCC 2013b; UNFCCC 2013c; Grütter Consulting 2006; Grütter Consulting 2012)

These two public transportation projects were initiated by their respective municipal governments. In both cases, the national governments assumed infrastructure costs while leaving the remaining costs such as bus fleet, ticket machines and the operation of bus services, to the city government. The two projects faced a funding shortfall and sought CDM financing. To be registered for CDM funding, the project should prove its fiscal necessity.

Chongqing BRT appears to possess exceptional financial condition when compared to other BRT CDM cases. During the early phase of Chongqing's Crediting Period (2010-2017), a German buyer, KfW (UNFCCC, PDD, 19) agreed to buy its CER credits. CDM financing mechanism was a favorable factor in moving the Chongqing project as planned. TransMilenio on the other hand is quite a unique project in that it is neither financially sound nor did it benefit from CDM financing.

Dr. Grütter's view (2014) on carbon financing for the transport sector is that because the infrastructure costs are high, its impact is limited, even in the context of higher CER prices of the past. However, carbon financing's potential impact lies in possibly reducing the financial risk of operational deficits. This view has been corroborated by TransMilenio and Chongqing BRT cases' reliance on CDM finance in closing the operational deficit. While infrastructure investment in a transport project does not need to be repaid by ticket sales as in the case of many public urban transit systems, both TransMilenio and Chongqing were designed to be operationally self-sufficient without subsidies which meant that they had to cover their own operational costs. Having to cover the project's operational cost was a burden and challenge to both TransMilenio and Chongqing.[11]

A. Infrastructure

The intrinsic difference between the two projects is the timing of the CDM involvement and subsequent registration preparation. In TransMilenio case, CDM funding was a form of an intervention to offset the project's Phase II's unexpected overrunning costs stemming from

[11] Email from the transport CDM expert date Oct. 30, 2013

infrastructure design changes. In Chongqing's case, from the initial stages of the BRT conceptualization, the Chongqing municipality calculated CDM funding into the financial design. Dr. Grütter (2014) pointed out an important difference that the infrastructure capital costs resulted from the different infrastructure requirements in the two country's context.

According to Dr. Grütter (2014), the main difference between Latin American and Chinese BRTs is the composition of the infrastructure cost. Generally speaking, in Latin American BRT construction, land purchase and paving of new heavy-duty cement roads specialized for bus use are needed. In Colombia, these requirements are mandated by law. Chinese BRT installation costs in general tend to be lower than the Latin American counterparts because the Chinese tend to use existing roads and separate the BRT lane and systems, such as ticketing system and passenger flyover bridges. Therefore, the initial investment for Latin American BRTs require intensive up front capital. On the contrary, Chinese BRTs tend to bear low up front capital investment although wear and tear pavement repair can be expected every two years. These region-specific differences suggest that different infrastructure design requirements play a significant role in the financial scale, the timing of capital investment, and operating costs.

B. Political Environment

Colombian and Chinese complex political environment affected the respective BRT projects' outcome in terms of their reliance on CDM. In China's case, its government did not offer additional subsidy for the BRT's operating costs. Therefore, Chongqing expected operating shortfall, and the expected annual CER income from CDM registration was a meaningful and substantial financial resource for them.

In Colombia's case, TransMilenio was borne out of political motivation. Its Project Design Document (PDD) outlines an ongoing competition among various political agendas, such as education and healthcare, resulting from domestic intra-party tension in Bogota. Furthermore, according to Dr. Grütter (2014), initially, Colombia wanted to participate in a climate change project, and this objective led to the BRT and eventually, the CDM. He further commented that one of the development banks for the BRT required TransMilenio to be registered as a CDM project in order to receive a loan. It can be concluded that although the financing of the project was not helped by the actual CER income as designed, an approval as a CDM project indirectly helped its overall financing. Dr. Grütter (2014) also commented that the project's Phase II cost-overrun is not so much a result of the design change but that it was a "political" underestimation of the up-front investment. This fact is not written in any of the official documents. Finally, unlike the Chongqing BRT, the Colombian government offered subsidy during BRT's operation.

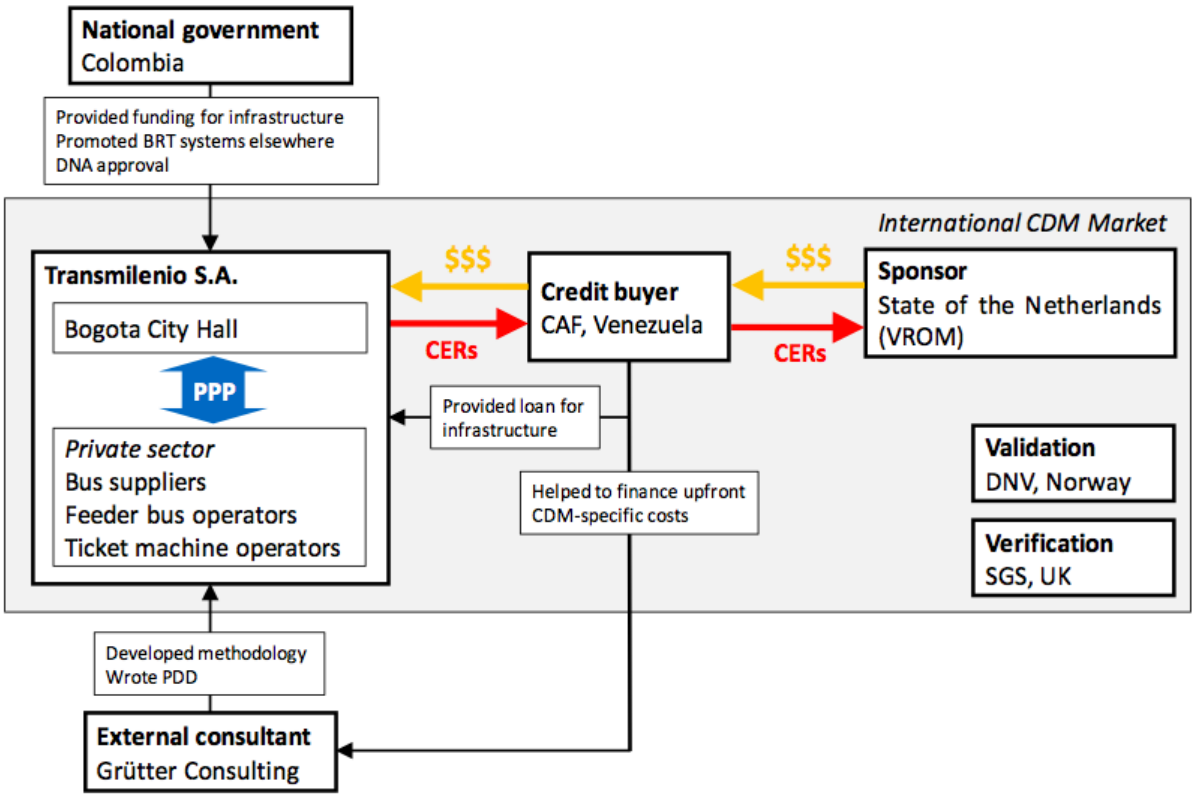
C. BRT Management

In TransMilenio BRT case, the management company is TransMilenio, S.A., which is a public company involved in only organizing and managing the BRT planning and operation. Operations are contracted out to several private companies tendered by bidding process divided by different functions of the operation: bus operation and collecting fare. The relationship between the municipality and the private sector is clearly illustrated in Figure 4.1.

This rather complicated organization could be attributable to the resistance of the existing transport sector predating the BRT, as indicated in the TransMilenio Project Development Document (PDD). In Bogota, competition amongst existing private bus companies owning lanes and buses led to tension and fight for passenger ridership.

In the Chongqing BRT case, during the project development phase, the project owner was projected to bear the financial burden resulting from the operating cost deficit. Lacking necessary financing resources was a major challenge in implementing the BRT system because establishing a public transit system was already included in the municipality plans. The municipality had to make a financial decision based on the cost-effectiveness of transit system.

Figure 4.1. Key Stakeholders and their Relationship to TransMilenio



(*Source:* OECD 2010, 31)

The Chongqing BRT was managed and operated by a public company, Chongqing Bus Rapid Transit Development Co. Ltd. According to Dr. Grütter (2014), the BRT Chongqing recently ceased operation, returning to the city's former bus transit system run by private companies affiliated with the government. This outcome is a result of the operating deficit unable to be covered by the CER income related to the low CER price as well as the lack of a credit buyer in the second contract period.

D. Challenges

Proving additionality is factored in during the initial CDM project eligibility process overseen by the UNFCCC. In the additionality test, in the case of the TransMilenio project, Phase II's cost overrun expectation was the main reason for the CDM application. However, Dr. Grütter (2014) commented that a cost underestimate was built into the project to secure approval from the Colombian government which required 15 percentage of Internal Return Rate (IRR) for the project to be feasible. Political implications were critical in the outcome of this project. Dr. Grütter (2014) mentioned that this additionality test is simply not applicable to TransMilenio and that this approach is not attractive in reducing CO_2 emission.

BRT Chongqing required low costs in infrastructure as described earlier, and the incremental deficit was not an obstacle. But the presence of the operating deficit was a risk to the project's advancement. Dr. Grütter (2014) identified that the actual carbon financing's role in BRT Chongqing was in "reducing financing risks regarding to deficits" rather than literally providing any real financial assistance.

E. CER Income Contribution

Dr. Grütter (2014), CEO of the Grütter Consulting, (See Figure 4.1.) commented on the CER buyer identification and the financing process in the case of TransMilenio. According to Dr. Grütter (2014), in an attempt to be a part of a climate change project, a Dutch development bank required that the project be registered as a CDM. Grütter Consulting participated in TransMilenio as a project investor and still receives CER after the successful CDM approval. These carbon credit income earned from the monitoring emission reduction reporting process, also overseen by the Grütter Consulting, has to be sold to a credit buyer. Grütter Consulting embraced the risks for developing CDM methodology and registration with own investment in this case.

Dr. Grütter (2014) stated that unfortunately, at the current time, there is no second crediting period buyer in the TransMilenio project due to the low price of the CERs in the EU ETS market. He emphasized that the CER income in TransMilenio was insignificant as a part of the total operating budget: Its value was the approximate equivalent of a half an hour of operating the TransMilenio BRT. However, CDM registration facilitated the loan process from

the development bank. That development bank sold the carbon credits (CERs) to the Dutch government as shown in Figure 4.1.

F. CER Price

According to Dr. Grütter (2014), the CER's future price is dependent on international negotiation on reduction target and existence of each country's carbon tax and offsetting system. As of this writing, the international negotiation on emission target is pending until 2015. He said that the participation of the U.S. and India is critical to the emission reduction target. Other problematic issues relate to the fact that CER trading is politically managed in order to stabilize the CO_2 price with a price cap in some countries. Dr. Grütter (2014) expects that the carbon market is adjusting to its pilot phase in China and is optimistic on the prospect of stabilization of the system around 2020-2030.

4.3 Discussion

This research was conceptualized to examine the reasons behind the infrequency of transport projects in the CDM pipeline. In the process of identifying the possible obstacles to the transport sector in CDM projects, it was concluded that the CDM's greatest contribution to a potential project is that it reduces the project's financial risk. One significant feature of CDM projects is that they are generally urban public project initiatives led by a municipal government, usually a city government with financial constraints.

In spite of its relatively insignificant contribution to the project cost, Dr. Grütter's (2014) interview and a particular study (OECD 2010, 58) confirm that the impact of the CDM registration in TransMilenio's case extended beyond the actual capital injection. CDM registration attracted additional investment sources by increasing project profile. It can be considered that CDM registration itself facilitated the overall financing process by enhancing the potential project's reputation by association with the CDM thereby helping the project's feasibility in the initial project design phase.

Several barriers were analyzed in the two cases reviewed in this paper. In TransMilenio, the PDD claimed that a CDM registration could boost the project's priority within the diverse policy agenda of the Bogota City government. Additionally, the efficient reorganization of the operating institution's management with the help from the developed countries' involvement and transportation CDM experts could expand the knowledge base of the project team. Chongqing BRT's case, on the other hand, is mainly focused on financial operating deficit problem arising from the financial constraint.

From the interview with Mr. Grütter (2014), it could be concluded that CDM registration "reduces the financial risks" rather than actually filling up gaps to cover operating costs, as it was hypothesized in the beginning of this research. Potential BRT CDM projects are expected to have low popularity due to non-compensatory CER price relative to transaction costs and time spent. However, depending on individual national offsetting regulations on each country's own carbon market and carbon tax, each country varies in their willingness to pay for carbon offsets. Dr. Grütter (2014) mentioned that Mexico is willing to pay the offset cost of US$ 4 because it has a carbon tax system.

Contrary to this project's initial expectation, the interview with Dr. Grütter (2014) reshaped the author's working hypothesis. It could be concluded that CDM income "reduces the financial risks" for financing the project rather than ensuring financial viability during the life cycle of the project.

4.4 Limitation and Future Research

Amongst the various barriers standing in the way of a potential project, the issue of deficient financial resources has been examined. This research ultimately investigated CDM's financial impact by isolating two BRT CDM projects: Bogota's TransMilenio BRT Phase II-IV and Chongqing BRT Line 1-4. Case selections were made based on data availability and project success.

Research with primary sources has been conducted through written correspondence with transport CDM experts. Despite numerous attempts to access financial data from direct finance operation departments in TransMilenio S.A. and Chongqing Co. Ltd., it was not possible to attain the possibly confidential financial reports containing information on capital and operating costs as well as the fiscal figure of exchanged CER incomes in the carbon market. Secondary sources came from the UNFCCC, IGSE's database as well as other multinational organizations' publications.

Main challenge to this research can be summarized as: 1) Relatively thin research in the subject, 2) Limited access to interviewees, and 3) Data scarcity. First, as a result of the relatively thin research in the field, most of the secondary research was based on the review of the publicly available database and documents on the UNFCCC website. These documents are written under required guidelines and protocol, facilitating comparisons among the CDM projects. However, the final CER income is actualized in US dollars through the sale of the credits in the over the counter carbon market and is therefore undisclosed. If the information on the monetized CER revenues in USD had been accessed, that information could have proved useful in conducting this research to evaluate the financial efficiency of the CERs.

As for the second challenge, limited access to interviewees, most individuals on the contact list were unreachable when detailed follow-ups were requested, even with initially favorable response. However, Dr. Grütter, a project participant and transport CDM developer,

generously shared his experience and insight in carbon financing, comparing the two cases in response to this author's inquiries.

The third and final challenge to this research was data scarcity. Financial information such as cash flow and income statements for TransMilenio S.A and Chongqing would perhaps have offered other sources of analysis for the projects.

To enhance the likelihood of future transport projects being approved for CDM financing, due diligence stages of Project Development and subsequent Monitoring could include detailed financial forecasting information. Detailed forecasting information could include annual estimates of operating cost shortfall showing deficient income from respective sources. Project planning phase should also include data tying the CO_2 reduction cost and overall project cost. Identifying capital efficiency inherently built into a potential project would address the importance of seeking projects with the most "capital efficient" profile. Furthermore, more work on the idea presented in this research, particularly regarding the 'mitigation cost" as it relates to the CDM framework could also help identify projects likely to succeed with CDM financing.

Future research in the area of transport CDM's underrepresentation could include projects involving cooperation with the UNFCCC to modify the reporting standards of Project Planning and Monitoring Phases. By streamlining projects that make the most financial sense, the number of transport projects with CDM financing could be increased because those projects are most likely to succeed and therefore most likely to be approved by the UNFCCC.

4.5 Conclusion

As one of the innovative market-based financing tool, CDM could be considered an alternative funding source for the transport sector in developing countries with paucity in funding. The transportation sector in the CDM pipeline represents a mere 0.4% due to the inherent difficulty in calculating the emission reduction in the transportation sector. Combined effects of the emission reduction, based on passenger load projection and baseline, and the lengthy and costly CDM registration process is the low occurrence of transport projects in the registered CDMs.

These technical and regulatory challenges for the transport sector in CDM projects notwithstanding, this research focuses on the financial implications of the CER incentive arising from CDM activities. By examining two seemingly successful cases, Bogota's TransMilenio in Colombia and BRT Chongqing in China, selected from the initial literature review the study informs the project background, its impetus, CDM revenue's contribution, as well as limitations. Through interviews with a transport CDM expert with experiences in both cases and many other similar projects, the study finds that the differences in infrastructure requirement by country resulted in different capital structure which influenced the extent of the financing and its timing. Also, different political context could impact the project's conceptualization, planning, management, as well as its long-term viability. The study concludes that the specific financial

benefit of a transport CDM is its capacity to facilitate project completion and viability by reducing the project's financial risk.

Returning to the cases examined in this study, Bogota's TransMilenio showed that the CDM registration status and its CER revenues guaranteed access to cheaper financing from a development bank with low interest rate. Acquiring the CDM registration though its fiscal amount was not significant in in Bogota's TransMilenio. In the case of the Chongqing BRT, having zero subsidy during its operation, it has shown to be efficiently managed to bridge its operating deficits by obtaining extra CDM revenues during the operation in so far as the CDM earnings were available from the credit buyer under the two-year contract. The contract, unfortunately, has not been renewed and the municipality could not find a new purchaser. Disappointingly, the new BRT system in Chongqing, compared to the city's conventional bus system, proved to be inefficient long-term without CER income. Chongqing's bus system returned to the conventional system, scrapping the new BRT system. It can be concluded that in the Chongqing BRT case with a high reliance on CER income, the BRT system could face vulnerability due to the CER price fluctuation. The project's viability is unstable at best.

Limitations of this research study can be summarized as 1) insufficient follow-up data access from direct personnel involved in each project, possibly as a result of sensitivity issues involving municipal finance information; and 2) undisclosed CER price which makes it difficult to ascertain the exact monetary value of carbon finance to measure the corresponding fiscal benefits.

This project was begun with the hope of initiating awareness of the carbon finance program to developing countries in need of sustainable transportation development and technology. The author viewed the study of financial incentives relevant to the transport CDMs to be an area most pertinent to the potential project participants and stakeholders of municipality and governments considering public transportation system. Other possible audience for this paper could be the lending and or funding sources, such as multilateral development banks assisting a developing country's sustainable development. Finally, officials at the UNFCCC could possibly benefit from this study in their goal to attract future project participants and investors.

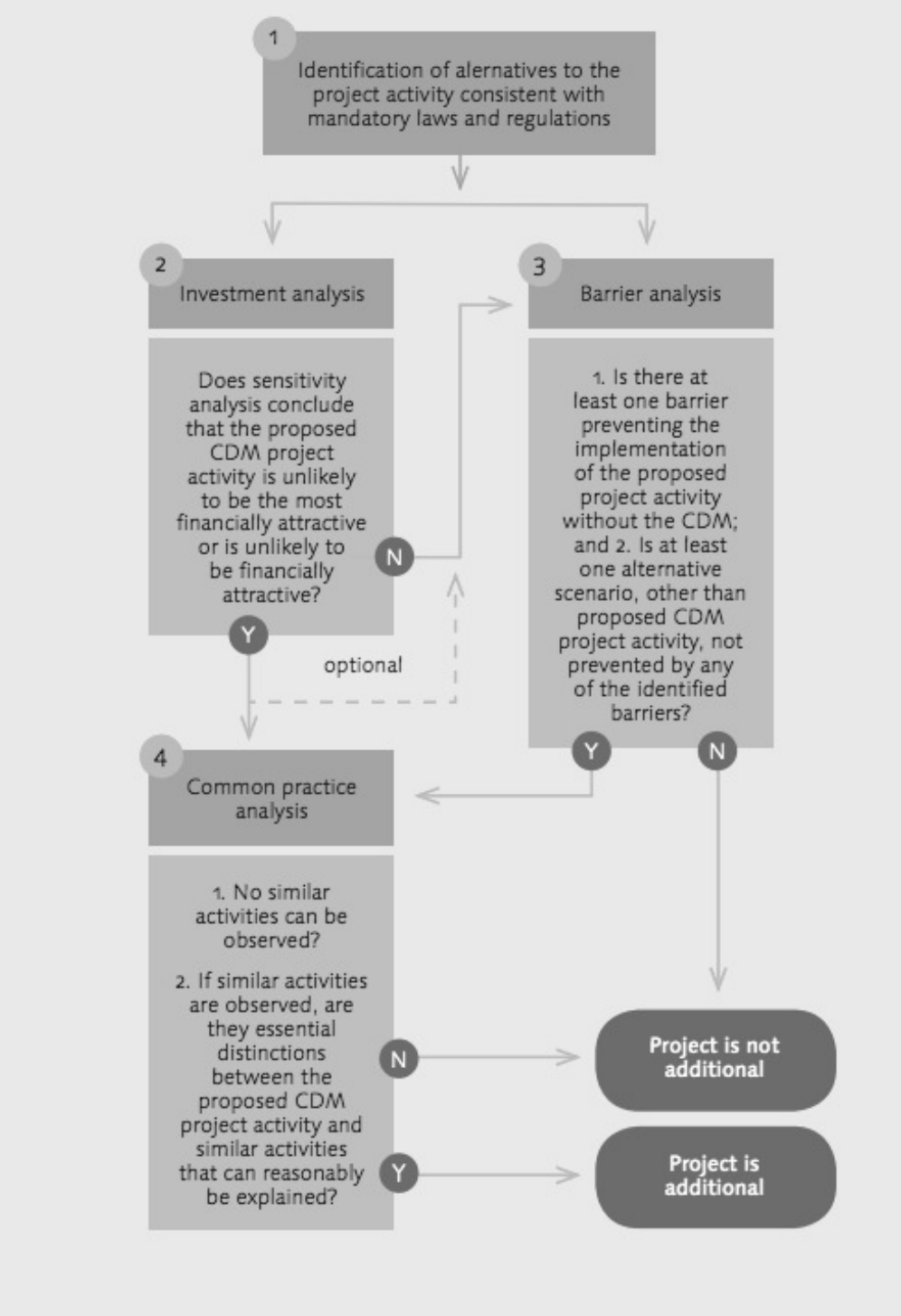
Appendix

A. Contact record

Country	Name	Institution	Position	Contact Date	Follow-ups
Switzerland	Jürg M. Grütter	Grütter Consulting	CEO	10/30/13 3/19/13	10/30//13 11/01/13 3/21/14 3/24/14
Colombia	Juanita Santos	Colombia Consulate General		10/30/13	10/30/13
Colombia	Gerardo Avila Rodriguez	Group Research and Development in Transport, Traffic and Road Safety	Coordinator	10/30/13	n/a
Colombia	María Andrés Palacios Rumié	Multimodal Transport Group, International and Support	Coordinator	10/30/13	n/a
Colombia	Susana Ricaurte	Grütter Consulting	Colombia Branch	10/30/13	10/30/13
Colombia	Sandra Patricia López Celis	TRANSMILENIO S.A.	Subgerencia de Comunicacion-es y Atención al Usuario	12/4/13	12/5/13
China	Xiaolei Wang	Chongqing Public Transit Vehicle Maintenance Co., Ltd.	Party Branch Secretary & Vice General Manager	12/4/13	12/5/13

(*Source:* Author)

B. Flowchart of tool for the demonstration and assessment of Additionally
(Source: UNEP 2011, 34)



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