Division 44
Environment and Infrastructure

The CDM in the Transport Sector

Module 5d

Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities

gtz
Sector project
Transport Policy Advisory Service

commissioned by:
Federal Ministry
for Economic Cooperation
and Development

OVERVIEW OF THE SOURCEBOOK

Sustainable Transport:
A Sourcebook for Policy-Makers in Developing Cities

What is the Sourcebook?

This *Sourcebook* on Sustainable Urban Transport addresses the key areas of a sustainable transport policy framework for a developing city. The *Sourcebook* consists of more than 25 modules mentioned on the following pages. It is also complemented by a series of training documents and other material available from http://www.sutp.org (and http://www.sutp.cn for Chinese users).

Who is it for?

The *Sourcebook* is intended for policy-makers in developing cities, and their advisors. This target audience is reflected in the content, which provides policy tools appropriate for application in a range of developing cities. The academic sector (*e.g.,* universities) has also benefited from this material.

How is it supposed to be used?

The *Sourcebook* can be used in a number of ways. If printed, it should be kept in one location, and the different modules provided to officials involved in urban transport. The *Sourcebook* can be easily adapted to fit a formal short course training event, or can serve as a guide for developing a curriculum or other training program in the area of urban transport. GTZ is elaborating training packages for selected modules, all available since October 2004 from http://www.sutp.org or http://www.sutp.cn.

What are some of the key features?

The key features of the *Sourcebook* include:

- A practical orientation, focusing on best practices in planning and regulation and, where possible, successful experiences in developing cities.
- Contributors are leading experts in their fields.
- An attractive and easy-to-read, colour layout.
- Non-technical language (to the extent possible), with technical terms explained.
- Updates via the Internet.

How do I get a copy?

Electronic versions (pdf) of the modules are available at http://www.sutp.org or http://www.sutp.cn. Due to the constant updating of all modules print versions of the English language edition are no longer available. A print version of the first 20 modules in Chinese language is sold throughout China by Communication Press.

Any questions regarding the use of the modules can be directed to sutp@sutp.org or transport@gtz.de.

Comments or feedback?

We would welcome any of your comments or suggestions, on any aspect of the *Sourcebook*, by e-mail to sutp@sutp.org and transport@gtz.de, or by surface mail to:

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Further modules and resources

Further modules are anticipated in the areas of *Financing Urban Transport*, *Reftrofit,* and *Induced Travel* (among others). Additional resources are being developed, and Urban Transport Photo CD-ROMs and DVD are available (some photos have been uploaded in http://www.sutp.org – photo section). You will also find relevant links, bibliographical references and more than 400 documents and presentations under http://www.sutp.org (http://www.sutp.cn for Chinese users).

Modules and contributors

(i) *Sourcebook Overview and Cross-cutting Issues of Urban Transport* (GTZ)

Institutional and policy orientation

1a. *The Role of Transport in Urban Development Policy* (Enrique Peñalosa)

1b. *Urban Transport Institutions* (Richard Meakin)

1c. *Private Sector Participation in Urban Transport Infrastructure Provision* (Christopher Zegras, MIT)

1d. *Economic Instruments* (Manfred Breithaupt, GTZ)

1e. *Raising Public Awareness about Sustainable Urban Transport* (Carlos F. Pardo, GTZ)

Land use planning and demand management

2a. *Land Use Planning and Urban Transport* (Rudolf Petersen, Wuppertal Institute)

2b. *Mobility Management* (Todd Litman, VTPI)

Transit, walking, and cycling

3a. *Mass Transit Options* (Lloyd Wright, University College London; Karl Fjellstrom, GTZ)

3b. *Bus Rapid Transit* (Lloyd Wright, University College London)

3c. *Bus Regulation & Planning* (Richard Meakin)

3d. *Preserving and Expanding the Role of Non-motorised Transport* (Walter Hook, ITDP)

3e. *Car-Free Development* (Lloyd Wright, University College London)

Vehicles and fuels

4a. *Cleaner Fuels and Vehicle Technologies* (Michael Walsh; Reinhard Kolke, Umweltbundesamt – UBA)

4b. *Inspection & Maintenance and Roadworthiness* (Reinhard Kolke, UBA)

4c. *Two- and Three-Wheelers* (Jitendra Shah, World Bank; N.V. Iyer, Bajaj Auto)

4d. *Natural Gas Vehicles* (MVV InnoTec)

4e. *Intelligent Transport Systems* (Phil Sayeg, TRA; Phil Charles, University of Queensland)

4f. *EcoDriving* (VTL; Manfred Breithaupt, Oliver Eberz, GTZ)

Environmental and health impacts

5a. *Air Quality Management* (Dietrich Schwela, World Health Organization)

5b. *Urban Road Safety* (Jacqueline Lacroix, DVR; David Silcock, GRSP)

5c. *Noise and its Abatement* (Civic Exchange Hong Kong; GTZ; UBA)

5d. *The CDM in the Transport Sector* (Jürg M. Grütter)

Resources

6. *Resources for Policy-makers* (GTZ)

Social and cross-cutting issues on urban transport

7a. *Gender and Urban Transport: Fashionable and Affordable* (Mika Kunieda; Aimée Gauthier)

About the author

Dr Jürg M. Grütter is an economist specialized on global environmental issues with a focus on GHG and transport. He holds a doctorate degree in economics from St. Gallen, Switzerland and a postgraduate in development affairs from the ETH Zürich, Switzerland. Dr. Grütter has worked on climate change projects in more than 30 countries worldwide and has also been involved in policy advice for climate change negotiations. He is working since 1991 on transport and climate change issues. Grütter is the founder and owner of grütter consulting, established in 1996 with offices in Bolivia and Switzerland. Grütter has developed on behalf of the Swiss private sector energy agency EnAW methodologies for domestic transport measures in Switzerland and has coached more than 80 leading transport enterprises in Switzerland. Grütter has realized for these firms among other the GHG documentation and the monitoring software. In 2006 Grütter negotiated jointly with EnAW an agreement to sell GHG reductions of these transport firms from 2006–2012 to a private Swiss entity for domestic compliance purposes. These were the first GHG reduction sales of transport firms used for Kyoto compliance purposes worldwide. Grütter is also lead reviewer of methodologies for the UNFCCC and has commented on most transport methodologies. He is the author of the first approved large-scale CDM transport methodology (AM0031 for BRTs) as well as the author of the only registered CDM transport project (TransMilenio). Grütter consulting is managing a large portfolio of CDM transport projects of diverse nature and has also signed a contract with the World Bank to develop in the course of 2007 four new CDM transport methodologies. Strategic allies of grütter consulting include Carbotech AG, Thomas Bürki GmbH, and CAF. For further information see http://www.transport-ghg.com or contact the author at jgruetter@gmail.com

grütter consulting

Module 5d

The CDM in the Transport Sector

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BRT lane, Jakarta, 2006

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1. Introduction

The Kyoto Protocol entered into force on February 16th 2005. The Protocol has as target to reduce Greenhouse Gas (GHG) emissions and includes binding emission reduction commitments for Annex I countries (industrialized economies). The Protocol establishes three innovative "mechanisms" known as Joint Implementation, the Clean Development Mechanism and Emissions Trading. These are designed to help countries with reduction commitments cut the cost of meeting their emissions targets by taking advantage of opportunities to reduce emissions that cost less in other countries than at home. Any legal entity may participate in the mechanisms, albeit under the responsibility of their governments. The Clean Development Mechanism (CDM) is related to projects realized in developing countries with GHG reductions sold to countries with reduction commitments (Annex I parties in the United Nations Framework Convention on Climate Change terminology). The resulting emission reductions are called Certified Emission Reductions (CERs). The CDM also aims to help developing countries achieve sustainable development.

Abbreviations

AM	Approved Methodology
BRT	Bus Rapid Transit
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CNG	Compressed Natural Gas
DOE	Designated Operational Entity
DNA	Designated National Authority
EB	Executive Board of the CDM
ERPA	Emission Reduction Purchase Agreement
EUA	European Union Emission Allowances
EU ETS	European Union Emission Trading System
GEF	Global Environment Facility
GHG	Greenhouse Gases
IETA	International Emissions Trading Association
LDR	Light Duty Rail
LPG	Liquefied Petroleum Gas
NMT	Non-Motorized Transport
PDD	Project Design Document
PIN	Project Identification Note
PP	Project Proponent
UNFCCC	United Nations Framework Convention on Climate Change
VER	Voluntary Emission Reduction

Fig. 1
Urban traffic contributes to local pollution and climate change: Local bus in Bogotá.
Photo courtesy by Carlos F. Pardo

Sustainable transport projects in general reduce GHG emissions. Such projects could thus qualify for the CDM and benefit from the sale of GHG offsets. This makes good projects economically more attractive and reduces barriers towards their successful implementation. The CDM can constitute an important additional revenue source for sustainable transport projects next to traditional income sources including the GEF (Global Environmental Facility).

This module contains the following chapters:

1. *The CDM and the GHG market:* The rules, regulations and procedures governing the CDM are outlined and core aspects of the GHG market are explained.
2. *CDM transport projects:* The CDM potential of different types of transport projects are analyzed and the scope of approved CDM transport methodologies is presented.
3. *Core elements of a transport methodology*: The major components that have to be covered when preparing a CDM methodology are preseanted.
4. *Case Study: The TransMilenio CDM project*: TransMilenio is the first officially registered CDM transport project. The path towards registration, results, costs and benefits are detailed.
5. *Outlook on CDM and transport*.

2. The CDM and the GHG market

2.1 The CDM

Under the CDM buyers receive Certified Emission Reductions (CERs) for the actual amount of GHG reductions achieved through the project. CERs can be produced potentially from any projects initiated after the year 2000, without a specific end date for the mechanism itself. The CDM market is regulated by the UNFCCC. All projects presented have to use a methodology approved by the UNFCCC[1]. If the project does not fit under any of the currently listed approved methodologies either changes to existing methodologies (amendments) or a new methodology can be proposed. For the latter a specific format of the UNFCCC needs to be used. After submission, the proposed new methodology is reviewed by the Methodology Panel of the UNFCCC and approved or rejected by the Executive Board of the UNFCCC. During this process in general the Methodology Panel asks for certain changes and clarifications of proposed methodologies. As of March 2007 more than 220 methodologies for full-scale project activities had been proposed of which 16 transport methodologies[2]. 40 large scale methodologies have been approved of which one transport methodology (AM0031 for BRT projects). The process of getting a methodology approved is time-consuming and the risk of rejection is considerable. However, if a specific project fits under an existing approved methodology, the whole process of setting up a project as a CDM project is much easier.

As of March 2007 nearly 600 CDM projects have been registered by the UNFCCC of which only one is a transport project (TransMilenio Bogotá, registered December 2006 under the project number 0672)[3]. More than 50% of registered projects are small-scale project activi-

[1] The list of approved methodologies is found under http://cdm.unfccc.int/methodologies/index.html.

[2] 9 of these methodologies are for biofuel production which is not a specific transport methodology as the biofuel can also be used for industrial or energy generation purposes; the only approved biofuel production methodology was therefore classified by the UNFCCC not as transport methodology but as methodology in the sectoral scopes "chemical" and "energy industries". Additionally three small-scale transport methodologies have been proposed to the moment.

Box 1: Key issues and basic requirements for CDM projects

In order to ensure that the CDM is a credible instrument that reduces global emissions of greenhouse gases, only those emission reductions can be credited to the project owner that would not have occurred in the absence of the registered CDM project activity. This is the concept of ***additionality*** which states that the emissions resulting from the project are lower than the ***baseline***, *i.e.,* a hypothetical scenario that would be likely without the CDM project. This hypothetical scenario can be based on a comparsion with similar activities and technologies in the same country or other countries, or to actual emissions prior to project implementation. In a stricter sense, additionality means that the project activites would not have happened in the absence of CDM funds. As proof, the existence of ***barriers*** (such as financial barriers, risks, technological barriers, etc.) that hinder the implementation of the project activities can be used. If these barriers can be overcome through the CDM and the funds generated from the CDM, then the project activities may be regarded as additional.

Emission reductions of a CDM project are calculated as the difference between the baseline emissions and the project emissions. In addition, leakages have to be included in the calculation. ***Leakages*** are defined as changes in emissions (both positive and negative) that occur outside the ***project boundary*** but are still induced by the project activities (example: the reduced congestion created by a new mass urban transport project can lead to a rebound effect creating additional trips and thus emissions.)

Projects have to be voluntary and have to contribute to ***sustainable development*** according to the criteria established by the national climate change authority. This is a requirement for the national approval of CDM projects. Projects also have to make a ***stakeholder assessment*** and the PDD is listed for public comments on the website of the UNFCCC.

[3] The complete list of registered projects can be found under http://cdm.unfccc.int/Projects/registered.html.

ties. The term "small-scale CDM project" is defined by the UNFCCC. No general definition is made but in general transport projects which reduce less than 60,000 tons of CO_2eq per year are considered as small-scale projects. Small-scale projects can use simplified baseline and monitoring methodologies, have a shorter approval process and pay less registration fees thus reducing their transaction costs. Projects have been registered from numerous countries worldwide[4]. The number and variety of projects registered shows clearly that the CDM is a feasible and workable option for additional project finance.

The key issues and basic requirements for a project to qualify as a CDM project are presented in Chapter 2. A brief summary is given in the Box on "Key issues and basic requirements for CDM projects".

2.2 CDM project cycle

The CDM project cycle is determined at least partially by the UNFCCC. Figure 2 shows the CDM project cycle up to getting the first CERs.

Project identification phase

In general CDM projects are not designed as stand-alone projects. The normal procedure is to assess the GHG reduction potential of conventional transport projects *e.g.,* public transport projects. If they have a reduction potential then they are identified as a potential CDM project. The CDM is thus a component of a conventional transport project and not "the project" itself [5]. The "conventional" transport project must have merits of its own and be feasible but potentially not attractive enough from a technical and financial viewpoint without CDM. CDM improves the financial terms of sustainable transport projects and reduces barriers towards its implementation. CDM can thus make conventional transport projects more attractive and more feasible. Before entering the CDM stage the usual project (not CDM) specific technical and financial feasibility studies are required. Most projects start their actual CDM phase with a Project Identification Note (PIN). Such a PIN could, for example, be initiated by a city administration that wishes to implement a Bus Rapid Transit (BRT) system and is trying to assess the option of additional CDM funding. The PIN is not compulsory on behalf of the UNFCCC but it gives prospective buyers or CDM project developers an indication of the magnitude of the project in terms of GHG reductions, potential risks and benefits. It is used as a selling document for attracting interest of potential buyers and investors in the

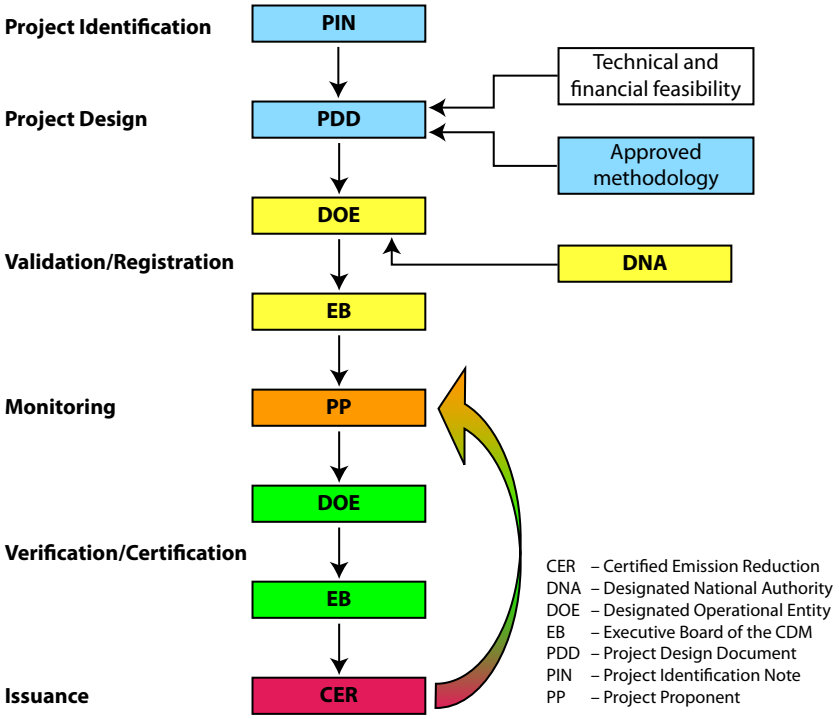


Fig. 2
CDM project cycle.
Source: UNFCCC, adapted by Grütter

Fig. 3
The rules for the CDM are set at the UNFCCC conferences: A session at the COP 11 in Montreal 2005.
Photo courtesy of Holger Liptow, 2005

[4] For project locations see http://cdm.unfccc.int/Projects/MapApp/index.html.

[5] This is equal to most other projects *e.g.,* the main purpose of a windmill project is electricity generation and not GHG reduction (which is the CDM component).

CDM part of the project. In general the PIN is formulated by a specialized CDM project developer using a standard format, *e.g.,* that of the World Bank.

Project design phase

The project design phase is under control of the project owner or project proponent (PP) (*e.g.,* a municipality for a BRT). The project has to be formulated in a specific format given by the UNFCCC, called the Project Design Document ***PDD***. The PDD is formulated in English. It has to use an UNFCCC approved methodology. The newest version of the PDD including guidelines how to complete the PDD are available at the UNFCCC website[6]. The PDD for full-scale projects is different (more extensive) than the PDD for small-scale projects. In general the PDD is formulated by a specialized CDM project developer[7]. Projects may opt for a crediting period of 10 years non-renewable or 7 years renewable up to twice. However project activities under the CDM can in no case be longer than the expected operational lifetime of the project.

Validation/registration phase

The validation of the PDD is done by a UNFCCC approved Designated Operational Entity DOE. The project owner selects, contracts and pays the DOE. He can choose any DOE approved by the UNFCCC for the specific sectoral scope. The list of approved DOEs is available at the UNFCCC website[8]. As of February 2007 DOEs approved for the transport sector were Japan Quality Assurance Organization (JQA), Det Norske Veritas Certification (DNV), TÜV SÜD Industrie Service (TÜV SÜD), SGS United Kingdom (SGS), and TÜV NORD CERT (RWTUV). All PDDs in the validation/registration phase are posted on the UNFCCC website for public comment for a duration of 1 month[9]. Project owners have to respond to public enquiries and to comments made by the DOE to pass successfully validation. During or after validation the project has to receive the approval of the host country (country in which the project is being realized). The approval is given by the Designated National Authority ***DNA***. The respective DNA can be found on the UNFCCC website[10]. The criteria for national approval are determined by each DNA but include as minimum an assessment of the contribution of the project towards sustainable development[11]. After receiving the DNA approval and after a positive validation report the DOE makes a request for registration for the proposed CDM project. The registration will be considered valid after 8 weeks (4 weeks for small-scale projects) if no request for review was made by minimum 3 members of the Executive Board ***EB*** of the CDM. Registration is the formal acceptance by the EB of a validated project as a CDM project activity and is the prerequisite for the issuance of CERs related to that project activity. All registered project including the full documentation (PDD, validation report, approvals) are listed on the UNFCCC website[12]. If the EB requests a review, the project owner can respond to enquiries made. Eventually he will have to change parts of the project. The possibility also exists that the EB rejects approval

Fig. 4
Traffic in Hanoi.
Photo courtesy of Gerhard Menckhoff, 2004

[6]) http://cdm.unfccc.int/Reference/PDDs_Forms/PDDs/index.html

[7]) The project developer is listed in the PDD as person/organisation responsible for the formulation of the baseline. Project owners interested in identifying or contracting project developers with relevant experience could thus review registered PDDs of comparable projects.

[8]) http://cdm.unfccc.int/DOE/list/index.html

[9]) http://cdm.unfccc.int/Projects/Validation/index.html

[10]) http://cdm.unfccc.int/DNA/index.html

[11]) Criteria and methodology to assess the contribution to sustainable development are determined by each DNA individually.

[12]) http://cdm.unfccc.int/Projects/registered.html

of the proposed project. Projects can only create Certified Emission Reductions CERs after registration. The window for claiming retroactively emission reductions was closed end 2006.

Monitoring

After the project has been registered and is operating successfully, the project owner has to monitor the emission reductions achieved by the project. To this end, the specific monitoring procedures—defined beforehand in the monitoring methodology that forms part of the PDD—have to be followed. The monitoring process established in the PDD specifies, among others, the parameters to be monitored, the monitoring method and the monitoring frequency. The monitoring period is determined by the project owner, *e.g.,* 1 year. The emission reductions achieved during that period are summarized in a monitoring report and can then be verified, certified and sold (see below). CERs can only be sold at the end of each monitoring period and after successful completion of the verification/certification process. Therefore, the first revenues from the CDM will only be available some time after the project has started. A very large project may opt for a shorter monitoring period to receive CERs and thus payment from the buyer more quickly while a smaller project might opt for a longer monitoring period to reduce the (fixed) cost of verification of each report.

Verification and certification

The monitoring report is verified by a ***DOE***. In the case of small-scale projects the same DOE can be used as for project validation while for large-scale projects the DOE used for verification has to be distinct from the DOE used for validation. The list of UNFCCC approved DOEs for verification for each sectoral scope can be found at the UNFCCC website[13]. The monitoring reports are also published on the website of the UNFCCC for public comments[14]. The DOE verifies emission reductions of the registered project, certifies as appropriate and requests the ***EB*** to issue Certified Emission Reductions ***CERs*** accordingly. The issuance will be considered final 15 days after the request is made unless a request of review is made by minimum 3 members of the EB in which case explanations or changes may be required or eventually the claim for issuance of CERs may be rejected.

Cost and time involved

The estimated costs and time needed for the various steps of the CDM project cycle are summarized in the table below. No standard arrangements exist between project owners and project developers. In general, project developers do not charge for realizing a PIN if receiving a period of exclusivity for project development and marketing. The majority of contracts established currently include no upfront disbursements of project owners *i.e.,* the project developer often together with the buyer of CERs pays for the PDD development, validation, registration and first verification costs. These costs are then either subtracted from the payments of CERs or the project developer participates in the shares of CERs or shares of revenues. Project developers can thus burden part of the risk of the project (validation, registration as well as partially implementation risk). No standard time required for writing a PDD can be given as this depends basically on the project complexity, involvement of the project owner and the arrangement made with the project developer.

Note: Cost and time required are estimates and may vary between projects considerably. Cost estimates refer to transport projects which tend to have a significantly higher complexity compared to average CDM projects in the field of energy or industry.

Additional costs can arise from the sale of emission reductions (contract costs, brokerage fees). Contracts can be closed in which the project developer or the buyer of CERs covers all upfront costs with payment in CERs thus reducing the financial exposure of the project owner as well as his risk in case of non approval of the project.

The total time from taking the decision to formulate a CDM project until successful registration is between 6 and 12 months for projects using an approved CDM methodology. A project's CERs are available for sale only

[13] http://cdm.unfccc.int/DOE/list/index.html

[14] http://cdm.unfccc.int/Issuance/MonitoringReports/index.html

Table 1: Estimated cost and time required for steps in project cycle[15)]

Step	Estimated Cost in US$	Estimated Time	Main Actor
PIN elaboration	0[16)]	1 month	Project developer
Methodology approval	20,000–200,000[17)]	3–18 months	Project developer
PDD elaboration	20,000–100,000[18)]	2–6 months	Project developer
Validation	5,000–10,000	3–6 months	DOE
National approval	Country specific[19)]	1–3 months[20)]	DNA
Registration	• No fee for projects with less than 15,000 tons CERs per year • All others 0.1 US$ per CER for first 15,000t and 0.2 US$ per CER for all emission reductions over 15,000 t/y (average over crediting period) according to PDD	• 1 month small scale • 2 months large scale if no request for review is made	EB of the UNFCCC
Monitoring	Project specific	Time period determined by project	Project owner
Verification	3,000–10,000	2-4 months	DOE
Certification	• Issuance fee equals registration fee (registration fee is deducted from first year issuance fee) • 2% of CERs for the adaptation fund	2 weeks if no request is made	EB of the UNFCCC

Source: Grütter, 2007

after the project's crediting period has started, a monitoring report has been realized and verification as well as certification have been concluded. Assuming that the crediting period starts right after registration and that the first monitoring report is realized after 1 year of monitoring the project can expect its first CERs around 2 to 2.5 years after having started with the procedures. As most emission reduction purchase agreements are based on payment upon delivery the first income from the sale of CERs will also accrue only after this period. Contracts, however, can be established in which the buyer makes a first advance payment upon expected CER delivery. The standard contract between buyers and sellers of CERs is called an ERPA (Emission Reduction Purchase Agreement). A default format of such a contract can be found on the website of IETA[21)]. The specific conditions of a contract are project- and client-specific, *i.e.,* they depend on factors such as project size (projects with a high number of CERs are more attractive), project implementation date (the sooner the more attractive), project complexity (the simpler the better), availability of a methodology, availability of information (number of additional studies

Fig. 5
The BRT system in Guayaquil, Ecuador.
Photo courtesy of Carlos F. Pardo

[15)] Cost a project owner must bear.

[16)] In general done free of charge by project developers against a period of exclusivity (non-competitive agreement) for marketing the project.

[17)] Lower end for simple small-scale methodology; higher end for complex large-scale methodology including additional studies to be performed; arrangements can be made for payment in CERs.

[18)] Dependant basically on project complexity and size; arrangements can be made for payment in CERs.

[19)] In many countries this is done free of charge.

[20)] In most countries this can be done in parallel to validation.

[21)] See http://www.ieta.org

required), project risk (registration, verification, implementation, delivery and political risk), upfront payments required, guarantees assumed by seller (delivery guarantees), involvement of the project developer (*e.g.,* only PDD or also assistance in monitoring and verification), risk sharing agreements made etc. Contracts exist basically which specify a fixed price or which index the price to the EU ETS.

Contracts for PDD elaboration given to project developers should include as minimum following components:

- PDD completion according to the format of the UNFCCC (in English only);
- Accompany client in the validation process and respond to all inquiries and changes required;
- Accompany client in the national approval process and respond to all inquiries and changes required;
- Accompany client in the UNFCCC approval process and respond to all inquiries and changes required;
- Train project staff in monitoring.

Payment should be conditioned at least partially upon successful CDM project registration or be established in percentage of CERs to ensure the required quality of work.

Development of a new methodology

If the project does not fit under an existing approved methodology, the process of project preparation will be more complex, more expensive and more time-consuming. The process for establishing a new methodology is outlined in Figure 6.

As presented, the whole sequence takes at least 8 months. However, immediate approval of a methodology is highly improbable. Normally a methodology receives technical clarifications, thereafter a "B" and then it is assessed again by the Meth Panel (and can again receive technical clarifications before either receiving an "A" or a "C"). The Methodology Panel basically gives a feedback to the methodology proponent including which elements are non-acceptable or require changes. The Methodology Panel in general does not suggest a solution to the highlighted problems.

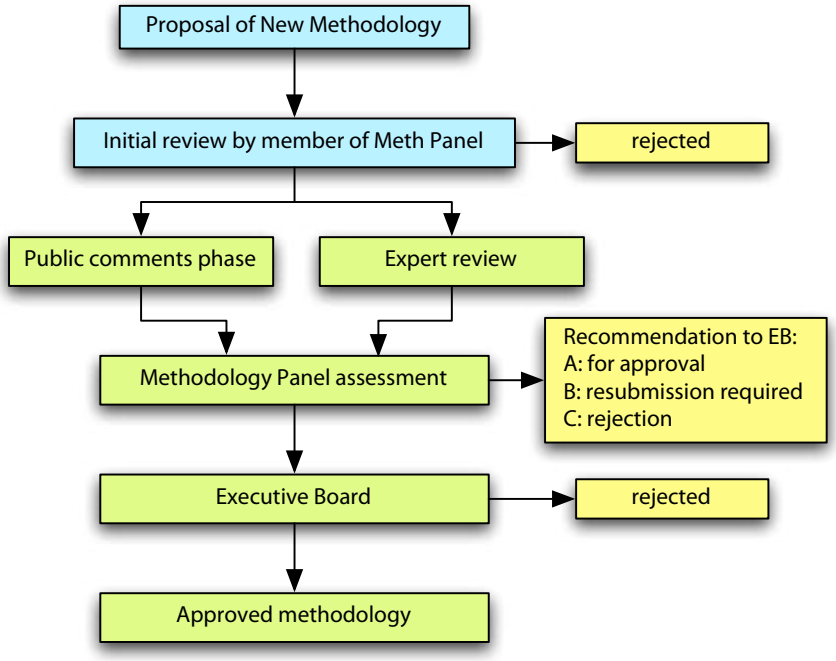


Fig. 6
CDM methodology approval process (large-scale projects)[22].
Source: Jürg M. Grütter

[22] For small-scale methodologies the procedures are simplified. Methodologies are not open for public comments and no external review is conducted. The small-scale panel directly assesses the proposed new small-scale methodology and gives comments. Also the format used for small-scale methodologies is simpler and much shorter than for large-scale methodologies.

[23] The more complex the longer.

Table 2: Time involved to develop a new methodology

Step	Estimated time	Remark
Development of a new methodology	2-6 months[23]	Methodology must be accompanied by a draft PDD of a concrete project; normally done by the project developer
Initial review	< 1 month	Done by a member of the Meth Panel
Public comment	1 month	
Expert review	1 month	2 experts are assigned by UNFCCC to review in detail the methodology; parallel to public comment
Meth Panel assessment	3-6 months	Time required depends on pipeline of methodologies presented
EB approval	1 month	EB meetings are normally 2-4 weeks after Meth Panel meetings; EB only decides on "C" or "A" cases

Table 3: Transport CDM methodologies proposed[27)]

Number	Name	Scope	Status
NM 052	Urban Mass Transportation System, Bogotá, Colombia	BRT	Rejected (C)
NM 083	Auto LPG in India	Fuel-switch	Rejected (C)
NM 105	Methodology for BRT Projects	BRT	Approved (A) and published as AM0031
NM 128	Modal shifting in industry for transport of product/feedstocks	Mode shift road to ship	Rejected (C)
NM 158	Mexico Insurgentes Avenue BRT Pilot Project	BRT and general infrastructure changes	Rejected (C)
NM 201	Cosipar Transport Modal Shift Project	Mode shift road to ship	Retired by project participants
NM 205	Improving the fuel efficiency of vehicle fleets	Vehicle fleet efficiency	Not yet reviewed
Small-scale transport methodologies proposed			
n.a.	Behavior-oriented demand-side energy efficiency programmes in the transport sector	EcoDrive	Rejected
n.a.	Amendment to AMSIIIC	Mode shift road to pipeline	Rejected
n.a.	Introduction of low-emission vehicles to commercial fleets	Vehicle fleet efficiency	Not yet reviewed
n.a.	GHG efficient bus fleets	Bus fleet efficiency	Not yet reviewed

Status March 2007

On average the time required for the whole process from methodology development to EB approval is in the range of 12–24 months. For example, the methodology for BRT systems (registered as approved methodology AM0031) was contracted by the CAF December 2004, was entered as methodology to the UNFCCC in May 2005 and was approved by the EB June 2006.

Up to mid-March 2007 a total of 223 methodologies had been presented, of which 40 had been approved[24)]. The approval rate is thus around 25%. 7 large-scale transport and 9 biofuel production methodologies had been presented of which 1 transport[25)] and 1 biofuel methodology[26)] was approved. Transport methodologies proposed and their status as of March 2007 is visible in Table 3.

The success rate for transport methodologies has thus been significantly lower than the average success rate for methodologies. The reason for this low success rate basically lies in the methodological complexity of transport projects, especially concerning determination of baseline emissions, monitoring requirements and leakage effects. It is understandable that first methodologies and projects were developed for simple projects or "low-hanging fruits" such as landfill projects, renewable energy generation, industrial energy efficiency or HFC and N_2O abatement projects. In the future more proposals in the field of transport projects can be expected as the CDM market grows in maturity.

2.3 The GHG market

The carbon market can be divided in three large segments:

- The allowance-based market in which the European Union Emissions Trading Scheme EU ETS is by far the most important;
- The project-based market for compliance with the Kyoto Protocol in which the CDM is the largest part;
- The voluntary market trading Voluntary Emission Reductions (VERs).

[24)] Various are still under consideration.

[25)] AM0031 for BRT.

[26)] Methodology for biofuel production based on waste vegetable cooking oil, AM0047.

[27)] Excludes biofuel methodologies.

Fig. 7
EU ETS price for contracts 2008 in € per t CO_2.
Source: EEX, April 2007

Regular market information is published by Point Carbon[28)] and by IETA[29)] (International Emissions Trading Association) in cooperation with the World Bank. Latter publish in regular intervals "State and Trends of the Carbon Market" free of charge. The website of IETA is also an excellent source for information on upcoming carbon events.

EU ETS

The EU ETS, in which EU emission allowances (EUA) are traded, was created by the European Union as a core element to meet its Kyoto commitments. It is currently by volume and value by far the largest carbon market. It has a first phase until end 2007 and a 2nd phase commensurate with the Kyoto Protocol between 2008 and 2012. Prices in the EU ETS, especially those of the 2nd phase, have a strong influence on prices paid in the project-based market. Price volatility in the EU ETS has been high as shows Figure 3. The figure also shows a certain downward trend of EUA prices paid since 2006 after having reached a peak of €32 per ton of CO_2.

Current trading prices for phase 1 contracts (2007) and more important phase 2 contracts 2008, 2009 until 2012 are listed *e.g.,* in EEX (European Energy Exchange)[30)] or in the ECX (European Climate Exchange)[31)]. CERs—generated by CDM projects—can be exchanged into EUAs at a 1:1 ratio. EUA prices paid, however, will be higher than CER prices paid as the former are allowances without risk and can be used fully for compliance, while CERs can only be used partially for compliance purposes[32)]. However the EU ETS serves as a reference price for CERs and contracts can also be established in which payment for CER is based on the price for EU ETS (with a discount of 20–40%).

Project-based market

The CDM is by far the largest part in the project-based market, followed by Joint Implementation (JI). In 2005 around 400 million

[28)] http://www.pointcarbon.com
[29)] http://www.ieta.org
[30)] http://www.eex.de
[31)] http://www.europeanclimateexchange.com
[32)] Companies and governments can only use CERs to a certain extent, *e.g.,* up to 20% of their emission reduction targets. The remaining reductions have to be achieved domestically. CERs are thus not completely fungible reducing their value relative to EU-ETS credits.

tons of CERs were contracted for future delivery at an average price of US$8 per ton (source: Pointcarbon, 2006). Prices of 2006 were on average around US$10 per ton (source: World Bank) with a slight decline (around 10%) comparing the second and third quarter with the first quarter. Buyers are basically purchasing funds, private entities and to a minor degree governments. Prices vary greatly from contract to contract, mainly based on the distribution of risk between buyer and seller. Risks include rejection of the new methodology (if a new methodology is required), non-approval of registration, implementation risk (failure, delay or only partial implementation) and non-approval of CER issuance. Also GHG reductions might be significantly less than expected due to difficult ex-ante estimations (*e.g.,* in a public transport project number of passengers to be transported or potential mode-switch). Especially the implementation risk can be considerable in transport projects. Contracts are basically for payment upon delivery of CERs to the buyers account. A small number of contracts offer a limited advance payment. However, many contracts include payment of upfront transaction cost by the buyer or the project developer. Most buyers offer the seller a choice either between fixed forward or indexed forward contracts or mixtures between the two options.

Voluntary market

Outside the regulated CDM market a significant voluntary market exist *e.g.,* in the US or due to the demand of companies which wish to neutralize part of their emissions on a voluntary basis. While certain standards exist in the voluntary market it is far less regulated than the CDM market. This has the advantage of simplicity and thus lower transaction costs and of direct agreements between the buyer and seller. The voluntary market also allows for GHG projects which would not qualify for the CDM *e.g.,* due to methodological or additionality problems. The downturn is that due to lack of regulation the integrity or quality of Voluntary Emission Reductions (VERs) also varies greatly. This in turn leads to a large price variation and significantly lower prices being paid for VERs than for CERs. Prices at the high end for VERs tend to ask for conditions comparable to CERs thus provoking also comparable transaction costs. The price range paid for VERs in 2006 was between US$4 and 10 per ton of VER.

Fig. 8
The BRT system in Jakarta/Indonesia.
Photo courtesy of Carlos F. Pardo

3. CDM transport projects

Three ways exist to reduce GHG emissions in transport:

- Reduce emissions per kilometre
- Reduce emissions per unit transported
- Reduce distances or number of trips

Actual projects may also combine these three possibilities.

3.1 Projects reducing emissions per kilometre

Projects in the transport sector reduce emissions per kilometre driven either by increased efficiency (new technology or improved fleet management), by infrastructure improvements or by switching to low carbon fuels.

Technology/vehicle change

This includes faster than "business as usual" vehicle replacement or acquiring low-emission vehicles *e.g.,* hybrids. A normal fleet replacement[33] could not be considered as a CDM project as this would also occur in absence of the CDM. There exists a small-scale methodology that could be used for projects which acquire vehicles with low GHG emissions *e.g.,* hybrids or electric units. However, no CDM project has been forwarded in this area to the moment. The cost of changing large fleets to low-emission vehicles is high and can only be covered to a small extent by CDM revenues thus making such projects economically unfeasible without significant other funding sources. Technology change may be a component of a larger project, *e.g.,* a BRT project including new vehicles, or a project realizing various measures to reduce total fleet emissions including, *e.g.,* a partial change to low emission vehicles.

[33] Normal refers to "business as usual", *e.g.,* buses, in absence of the CDM, are renewed every 10 years by a specific company.

Behavioural change including improved fleet management

Projects in this area could include *e.g.,* improved maintenance practice of fleets, usage of low emission tyres and oils or driver training to reduce emissions per distance driven. A wide range of behavioural change projects exist potentially. A methodology for driver training had been proposed but was rejected by the EB basically due to methodological deficiencies in its formulation. Stand-alone projects using individual components of improved fleet management tend to be small thus reducing their attractiveness as a CDM project.

Fuel-switch

GHG emissions per distance driven can be reduced by switching from high to low carbon fuels. Currently this includes a switch from liquid to gaseous fuels (CNG or LPG), the usage of biofuels or the usage of electric energy. The latter is combined with a technology change *e.g.,* using trolleybuses instead of diesel buses. In many countries CNG and to a decreasing part LPG is used for transport. The GHG reduction potential is limited (10-20% compared to diesel or gasoline powered units) thus limiting the size of a potential stand-alone fuel-switch CDM project. For CNG/LPG as well as biofuel projects not only consumers could claim CERs but also producers or distributors of low carbon fuels (*e.g.,* in the case of gaseous fuel in combination with companies offering vehicle conversion). Making a CDM biofuel project from the production site is much simpler and leads to larger projects.

Fig. 9
Informal transport can be very unattractive.
Photo by Sascha Thielmann, 2007

BOX 2: Types of biofuels

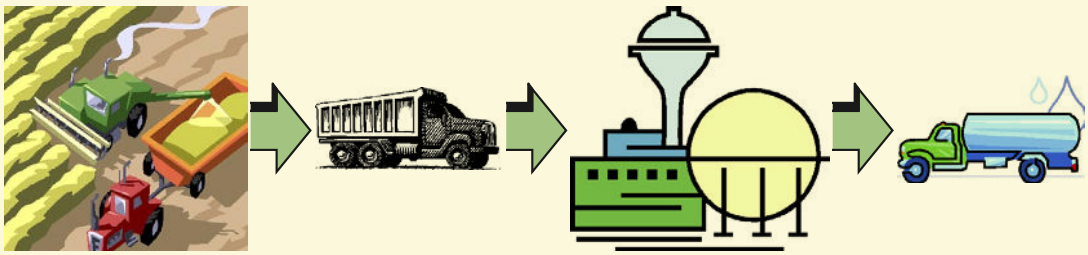
A distinction of biofuels related to the GHG effect can be made between:

- ***Biofuels from waste vegetable cooking oils***. As these oils were already used for other purposes no additional upstream emissions result thus making them attractive from a GHG perspective. The available offer of used vegetable cooking oil is limited, its collection can be costly, processing can be challenging and in general alternative usage for energy purposes (*e.g.,* foundries) is already in place thus limiting the CDM potential for this kind of biofuel for transport purposes. A CDM methodology for waste vegetable cooking oil has been approved by the EB of the UNFCCC February 2007.
- ***Biofuels from "energy" crops*** to produce biofuel which can be blended with gasoline or diesel. Various CDM methodologies have been presented for claiming CERs from producing biofuels including ethanol production, biofuel from palm-oil, soya as well as other crops. None of these methodologies has been approved to the moment basically due to problems concerning possible double-counting of emission reductions, assurance of non-export of biofuels and upstream emissions associated with biofuels (see Box on "***GHG Emissions of Biofuels***").
- ***Biogas***. The usage of biogas in transport is not yet wide-spread. However, it is technically of no problem to reach normal gas quality and use the biogas *e.g.,* in vehicles. Migros, a large Swiss retailer has, for example, a fleet of distribution trucks using biogas produced from biomass waste collected from its supermarkets and restaurants. No methodology on usage of biogas for transport purposes has yet been proposed, although this would not be of a major difficulty. Biogas could be produced *e.g.,* from waste biomass, from landfills or from waste-water treatment facilities.

BOX 3: GHG emissions of biofuels

Biofuels are by no means neutral in their GHG emissions. The plant takes up CO_2 during its growth which is again released when burning the biofuel, *e.g.,* in a vehicle. CO_2 plant uptake and fuel burning neutralize each other. However, the process of planting, harvesting, transport and transformation leads to GHG emissions in the life-cycle of producing biofuels. These need to be compared with the life-cycle emissions of conventional fuels to establish the GHG reduction due to usage of biofuels (well-to-wheel analysis). GHG life-cycle emissions of biofuels are crop, location and case specific. CDM methodologies for biofuels thus need to take into account localized life-cycle emissions.

Figure 10: Biofuel GHG Emissions



Emissions related to crop production include:

- Emissions due to energy usage in crop cultivation and harvesting;
- Emissions due to fertilizer usage (N_2O) including potentially upstream emissions associated with chemical fertilizer production;
- Emissions related to land-use change leading to changes in carbon stocks in carbon pools (*e.g.,* energy crops are planted on areas formerly covered by forests). This is one of the unresolved methodological issues.

Transport emissions include those associated with the transport of the agricultural input to the biofuel refinery and the transport of the (blended) biofuel to the gas-station.

Biofuel production related emissions include:

- Energy used for the refinery of the biofuel (electricity and fossil fuel);
- Methane emissions resulting from waste-water treatment facilities of the refinery;
- Upstream emissions resulting from the usage of methanol.

However the Executive Board has insisted to the moment that the project boundary and monitoring of a production based biofuel project needs to include final consumers basically to prevent problems of double-counting and potential problems of biofuel exports to Annex I countries. Fuel-switch could be a component of more integral projects *e.g.,* efficient fleet management or in mass public transport projects using alternative fuels and capturing the GHG reduction and corresponding CERs from this component along with other reductions.

Infrastructure projects

Infrastructure projects potentially include a wide array of different projects such as bridges, fly-overs, intelligent traffic signals, toll-roads, improved road maintenance etc. While some infrastructure changes lead to reduced trip lengths (*e.g.,* tunnels or traffic guidance systems), most potentially lead to reduced emissions per kilometre due basically to less congestion and thus a higher and more constant average vehicle speed. One CDM methodology proposed potentially included infrastructure projects. However, the proposal was rejected basically due to problems of separating the project-induced effect from other changes occurring simultaneously, monitoring deficiencies and problems with the project boundary leading to a possible underestimation of negative leakage effects caused *e.g.,* by induced traffic and downstream congestion. The methodological complexity of such projects is high especially due to having to prove that emission reductions are due to the project and not to other changes outside the project influence (force majeur). In addition the estimation and monitoring of the rebound effect including induced traffic caused, for example, by less congestion tends to be difficult and costly.

BOX 4: GHG efficient fleets

Various measures to reduce GHG emissions per kilometre driven could be taken simultaneously by fleet operators (buses, trucks, taxis). Measures could include the usage of (blended) biofuels, advanced fleet replacement, improved maintenance of units, training of drivers, usage of devices to reduce fuel consumption such as water injection etc. Currently a CDM small scale methodology to capture these effects under the heading of "GHG efficient bus fleets" developed by grütter consulting on behalf of the World Bank is under discussion at the UNFCCC. The project for which this methodology will be applied are two large bus fleets of a municipality in India, with expected emission reductions in the order of 30,000–40,000 tons of CO_2 annually. The methodology, which is expected to be approved in the first semester of 2007 could be used by large fleet operators using buses which want to modernize their fleet and which are willing to take steps to reduce GHG emissions beyond business as usual (BAU is basically determined by the methodology as a 1% improvement per year of GHG emissions occurring also in absence of the project due *e.g.,* to normal vehicle replacement). A similar approach could also be used for large taxi or truck fleets.

3.2 Projects reducing emissions per unit transported

GHG reduction projects in this area can be realized in freight or passenger transport.

3.2.1 Passenger transport

Basically emissions per passenger trip can be reduced through:

- Mode switch;
- Usage of larger units;
- Improved occupation rates.

Mode switch leads to less GHG emissions if a switch occurs from a mode of transport with high emissions per transported passenger to one of low emissions. Typical examples include reduced usage of private cars and increased usage of public transport or projects favouring bikes.

Larger units (maintaining a comparable occupation rate) in public transport lead to reduced emissions per passenger transported. Examples are *e.g.,* changing to a public transport system using large buses (*e.g.,* articulated buses for 160 passengers) instead of microbuses[34]. Large buses use more fuel per kilometre but by far not proportional to their carrying capacity thus

[34] Of course the unit size must be matched to the respective demand. In many cities, especially of Latin America, the privatization and deregulation of public transport has provoked the usage of small units competing for passengers.

resulting in a significant reduction of emissions per passenger-kilometre.

Improved occupation rates of units also lead to reduced emissions. Possible projects in this field include car-pooling projects or organizational improvements in managing public transport optimizing the load factor of buses.

Public transport projects

Numerous cities worldwide are modernizing their urban public transport systems. The most prominent measures taken include the establishment of Bus Rapid Transit Systems (BRTs) and investment in rail-based systems such as Light Duty Rail or metro lines. The GHG reductions achieved by such investments can be captured through the CDM thus making these investments economically more viable and reducing barriers towards their implementation.

BRT Projects: There is no precise definition of what constitutes a BRT system. Features of BRT systems include exclusive right-of-way lanes, rapid boarding and alighting, free transfers between lines, pre-board fare collection and fare verification, enclosed stations, clear route maps, real-time information displays, automatic vehicle location technology to manage vehicle movements, modal integration at stations, effective reform of the existing institutional structures for public transit, clean vehicle technologies and excellence in marketing and customer service. There exists an approved CDM methodology for BRTs (AM0031) and also a registered CDM BRT project (TransMilenio Bogotá). Further CDM BRT projects are under development including Pereira and Cali in Colombia and Quito, Ecuador with expected registration in 2007. BRTs are being implemented in many cities worldwide and the potential for this type of CDM project is considered as very large due to the fact of many projects and of relatively large emission reductions per project. The Bus Rapid Transit methodology developed by grütter consulting and approved by the UNFCCC includes among others mode-switch, usage of larger units as well as improved occupation rates as measures to reduce GHG emissions. Combining various measures in one project reduces transaction costs and makes monitoring simpler[35].

Fig. 11
The minibus system in Dar es Salaam.
PhPhoto by GTZ, 2005

Rail based public transport: Projects in this area include metro, LDR (Light Duty Rail), trams or cableways such as the cableway established in Medellín, Colombia to transport people to a metro-station. Compared to a conventional public transport system based on buses rail projects have significant GHG reductions. However, the actual magnitude of GHG reductions depends considerably on the efficient management of operations (occupation rate of units basically), technology used and the carbon factor of electricity of the respective country. If electricity is produced mainly by coal, electric based transport systems will have fewer advantages than in countries where electricity production is largely based on renewables. No methodology has yet been approved for rail based public transport. However a new methodology is under preparation and approval can be expected for the year 2007.

3.2.2 Freight transport

In freight transport similar to passenger transport emission reductions per unit transported can be achieved either by mode-switch, usage of larger units or improved load factors. In practice, however, projects will be basically about mode-switch *e.g.,* from road to rail or road to ship as monitoring of improved load factors is extremely complex and difficult to separate from ”business as usual”. Three CDM methodologies have been proposed in this area

[35] All effects are cumulatively monitored.

Fig. 12
Public transport in Pereira, Colombia.
Photo courtesy of Carlos F. Pardo 2005

to the moment but none has been approved. One of the major difficulties is that additional trips on the low-emission mode need to be proved. If company "A" decides to move its goods by train instead of truck but total railroad capacity remains constant then the overall GHG balance does not change. The freight of company "A" will simply replace the freight of company "B" which formerly used train but was then "crowded out" by company "A". Projects for mode-switch in the freight area would thus have more success if they were formulated from the supply-side *i.e.,* owners of ports, ships, or railroad companies which increase the supply of low GHG modes of freight transport *e.g.,* a new railway is constructed for freight purposes.

3.3 Projects reducing trips

Projects in this area are basically through behavioural change inducing, for example, people to reduce usage of their cars or projects in the area of spatial planning reducing trip distances, *e.g.,* from home to work. The methodological complexity of such projects is very high, especially in the field of separating the project effects from other effects (to avoid giving CERs for force majeur). The determination of leakage[36] and of an acceptable baseline is also a challenge.

[36] See Box on Key Issues CDM for a short definition of leakage.

4. Core elements of a CDM transport methodology

Any CDM project proposed to the UNFCCC needs to use an approved methodology and be written in the format prescribed by the UNFCCC. This chapter gives an overview of the core parts of the PDD (Project Design Document). To illustrate the specific requirements strong reference is made to one particular case, *i.e.,* the approved BRT methodology AM0031 "Methodology for BRT Projects"[37]. As of March 2007 it is the only approved CDM transport methodology for large-scale projects. The methodology has been used successfully by TransMilenio, Bogotá (see following chapter). The methodology can de downloaded from the UNFCCC website[38].

4.1 Applicability conditions

The applicability conditions describe elements with which the project needs to comply if it wants to use this methodology.

The core applicability conditions of AM0031 are:

- The BRT system as well as the baseline public transport system are road-based, *i.e.,* the methodology is not applicable in cities with a rail-based system. The complete trip has to be performed in the baseline as well as in the project case by road-based transport.
- The BRT system replaces a traditional public transport system in a given city, partially or fully. The BRT system can have partial coverage in the city, however, in that case in the part of the city where the BRT is established it must be possible to complete entire trips on the BRT, *i.e.,* the BRT must include feeder and main routes. If the BRT consists of a stand-alone trunk route and conventional buses not integrated into the BRT system provide for passengers then the methodology is not applicable as only a part of the trip would be realized in the project.

[37] The biofuel methodology approved by the EB February 2007 is listed under the sectoral scope of energy and chemical industry as the biofuel can be used not only in transport but also for industrial or for energy generation purposes.

[38] http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

- The methodology is only applicable if no biofuels are used in the baseline as well as in the project case. This applicability condition might be reverted once biofuel methodologies get approved. The latter is required to determine the emission factor of biofuels.

4.2 Approach

The approach used to determine emission reductions in AM0031 is based upon comparing emissions per passenger trip in the project with those in absence of the project (baseline case). This means that total emissions per passenger trip need to be included in both cases. If passengers use in their trip, for example, three different buses then the methodology sums the emission of the three buses and counts this as one trip. This is the reason why the BRT system needs to encompass the total passenger trip and thus needs to be an integrated system with feeder units. The emissions per trip per passenger for each mode of transport for the baseline are determined ex-ante while emissions per passenger trip of the project are monitored. Emission reductions are the difference between The "emissions per trip" baseline versus project multiplied with the amount of passengers transported by the project.

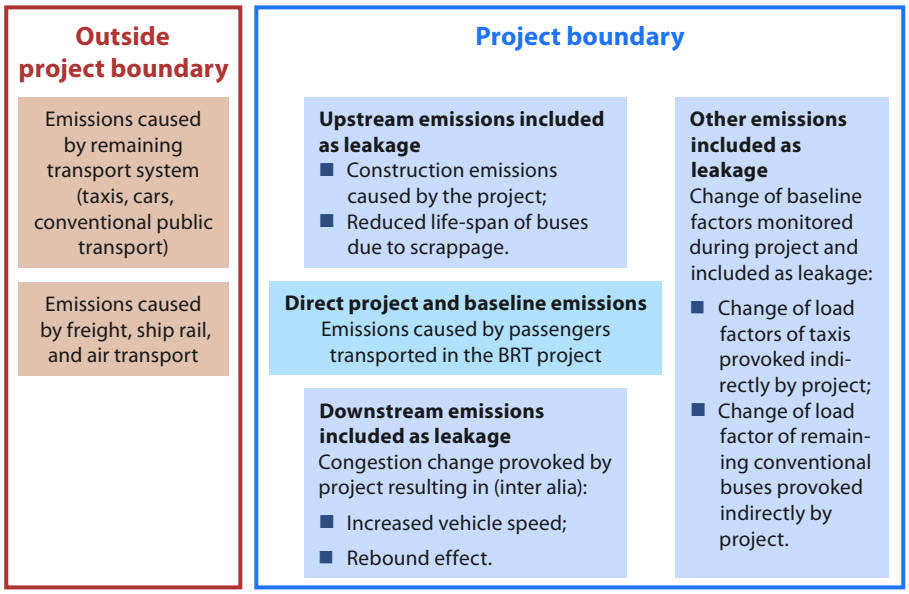
4.3 Project owner

The project owner receives the CERs. It must be clarified ex-ante who is the owner of the emission reductions (*e.g.,* municipalities). Essentially the project owner is the entity that induces the changes leading to emission reductions. However, the project owner is not always apparent at first glance. In a BRT system *e.g.,* following parties are basically involved:

- Central government (in the case of Colombia financing *e.g.,* the infrastructure cost with up to 70%);
- The municipality which owns the system (in the case of Colombia it finances the infrastructure at minimum with 30%);
- System manager which in general is the local government (in the case of Bogotá TransMilenio is the system manager; TransMilenio is fully owned by the municipality);
- Financial institutions which provide loans to the municipality or the bus operators;
- Bus operators who invest in new buses and provide bus services (mostly contracted through public bidding processes);
- Clients who use the new system (*e.g.,* instead of using their car).

The project propronent and thus receptor of CERs is the municipality who makes the final decision on implementing such a system and who puts up and owns the infrastructure. The national government as well as involved financial intermediaries finance potentially part of the system or give loans – they are, however, not the bodies who take the decision, nor do they actually own the infrastructure. Bus operators, who often claim that emission reductions are due to their investment in new buses, operate services based on licenses. They are thus simply providing a service and comply with the regulations for which they have obtained a licence. They are also paid for this service or obtain a share of revenues. Bus operators could claim credits if they go beyond providing the required service, *e.g.,* by using hybrid buses although only diesel buses are asked for or by using biofuels although only conventional fuels are required. The additional emission reductions from these "additional" investments or changes could be demanded by bus operators.

Fig. 13
Project boundary



4.4 Additionality

The concept of additionality as used in the CDM is that the project must prove that the emission reductions are additional to any that would occur in the absence of the certified project activity (Kyoto Protocol, Art. 12, 5c). A stricter interpretation used (not always) by the CDM Executive Board is that the project must show that it would not have occurred in absence of the CDM, *i.e.,* not only the emission reductions are additional but the project itself. The proof of additionality is basically made by using the additionality tool provided for by the EB. This tool basically includes the following steps:

1. Identification of all possible alternatives to the project activity, including the project itself without CDM;
2. Investment analysis to proof that the project is not the most financially attractive option and/or barrier analysis;
3. Common practice analysis to show that the project activity without CDM is not common practice in comparable circumstances;
4. Impact of registration of the proposed project activity as a CDM project, *i.e.,* it must be shown that due to the CDM the project overcomes the barriers identified and/or is financially more attractive due to the CDM.

In the case of AM0031 possible alternatives to a BRT include a continuation of the current transport system, the establishment of a rail-based system, a re-organization of the current transport system or a BRT without CDM. The instrument used to proof additionality is based on barriers identified including investment barrier (lack of finance, other politically more interesting investment opportunities, high investment level), political resistance, resistance from the conventional transport sector, lack of experience with BRTs etc.

4.5 Baseline

The baseline for a CDM project activity is the scenario that reasonably represents the GHG emissions that would occur in the absence of the proposed project activity. Again possible alternatives to the project need to be identified and the most probable in absence of the project activity needs to be identified. One of the options which need to be assessed also is the project in absence of the CDM, *i.e.,* the project itself could be the baseline or the most probable scenario. If this is the case there are no additional emission reductions and thus there is no CDM project. The baseline is not simply the current or past situation. It is the situation we expect to have under business as usual circumstances in the future. In would be wrong to assume, for example, that the baseline would be simply current or past transport emissions as vehicles would be replaced also in absence of the project activity. The methodology determines how the baseline is identified. For the identified baseline thereafter baseline emissions need to be calculated[39)].

Fig. 14
Fossil fuels used in the transport sector are a major source of carbon dioxide emissions.
Photo courtesy of ConocoPhilips

AM0031 identifies steps to determine the baseline. AM0031 is applicable if the baseline identified is a continuation of the current transport system. Baseline emissions are thereafter calculated using the following two main steps:

1. Determine emissions per passenger transported per vehicle category. This emission factor is calculated ex-ante project implementation including the usage of a fixed technology change factor. The baseline emission factor is adapted to potential changes in trip distance and type of fuel used by passenger cars if the surveys indicate that changes in trip distance or fuel type used would lead to lower baseline emission factors. An example: The emissions per passenger-trip of a passenger car in Bogotá are for the year 2005 1,801 grammes of

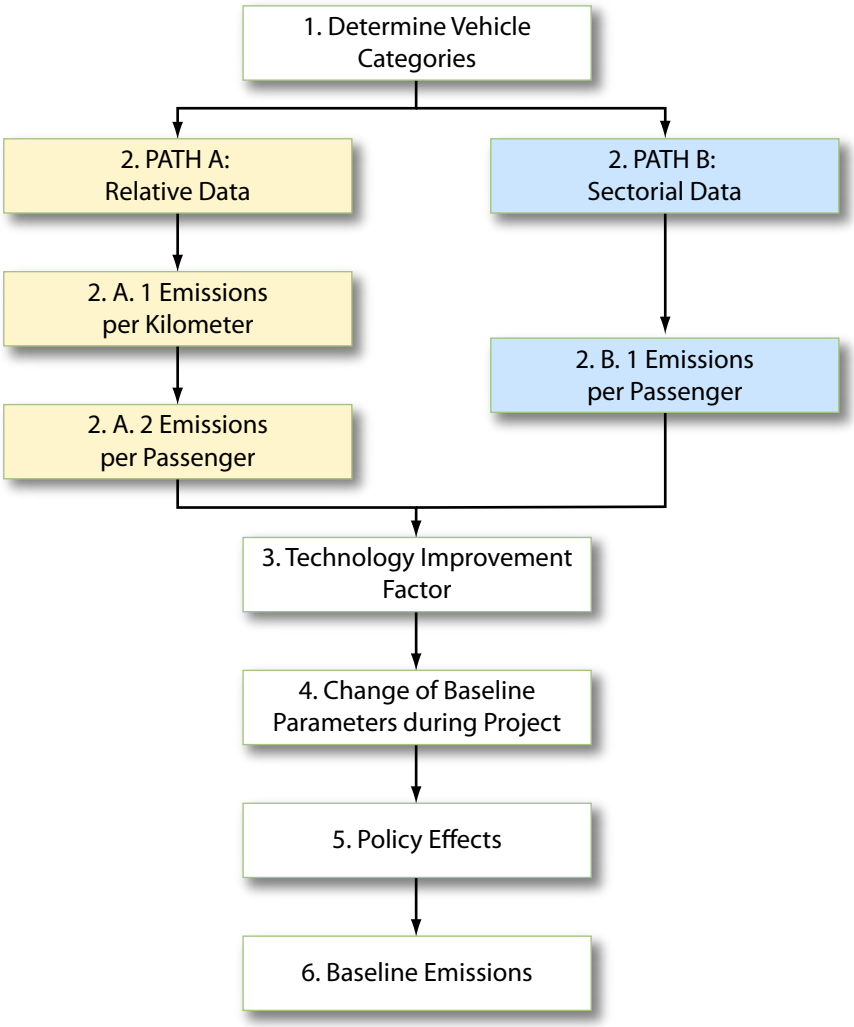
[39)] Key factors and criteria including maximum age of data are defined in the methodology.

CO_2 per passenger. The calculation is based on a fuel consumption of 11.7 l/100 km gasoline, an emission factor of 2,338 g CO_2/l of gasoline, an occupation rate of 1.37 passengers per car and an average distance driven of 9 km per trip. For the year 2006 the same factor is 1,783 g CO_2 per passenger[40].

2. Based on the passengers transported by the project and their modal split the total baseline emissions of the project are calculated ex-post. Core baseline parameters used for calculating the baseline emission factors are reviewed through an annual survey with changes only being applied if the baseline emissions factors would be lower than the original factor to ensure a conservative approach. Passenger numbers are recorded by the system operator. An example: TransMilenio has emissions per passengers 2005 of 381 g CO_2 per passenger. Based on the survey it can be calculated that TransMilenio has transported in this year around 5 million passengers which in absence of TransMilenio would have used passenger cars. The emission reductions for this part of mode-shift are thus 5*(2,338-381) = 9,785 tons of CO_2.

For an example of an actual calculation please refer to the published PDD or TransMilenio (available on the website of the UNFCCC).

Fig. 15
Path to determine baseline emissions of AM0031.



4.6 Project emissions

Project emissions are those that result due to the project activity, *i.e.,* from the operation of the planned BRT system. In the case of AM0031 project emissions are based on the fuel and fuel type consumed by the project (feeder and trunk lane units).

4.7 Leakage

Leakage is defined by the UNFCCC as the net change of GHG emissions, which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity. Leakage is an important issue in transport projects, *e.g.,* additional infrastructure investments may cause reduced congestion and thus increased average vehicle speeds leading (at least in urban driving conditions) to reduced emissions while at the same time provoking additional trips (rebound effect) and a shift to private vehicles due to reduced trip time.

The leakages incorporated in AM0031 are:

- Upstream construction emissions based on cement and asphalt used for trunk road construction. Especially the production of cement is energy and thus CO_2 intensive. The corresponding emissions are attributed to the project as leakage.
- Emissions due to scrapping vehicles which would otherwise have continued to operate. The production of buses also requires energy. Reducing the normal life-span of vehicles thus leads to additional emissions (*e.g.,* instead of 1 bus circulating for 20 years 2 buses are assembled for the same time period).
- Upstream emission reductions due to reduced fuel usage of the project versus the baseline. Fuel saved does not need to be refined nor

[40] Due to the annual default improvement factor of 1% fixed in the methodology.

transported. The saved well-to-tank emissions are thus attributed as negative leakage to the project (*i.e.,* the project results in additional emission reductions beyond those captured directly).

- Leakage due to changes in the occupation rate of remaining conventional buses and taxis in the city. The BRT system might provoke that buses still remaining on the road loose passengers and continue operating thus leading to increased emissions per passenger transported.
- Leakage due to reduced congestion (due to a reduced number of buses basically) leading to reduced emissions due to increased vehicle speed and leakage due to the rebound effect (these two effects are in contrarian direction).

4.8 Emission reductions

Emission reductions equal baseline minus project minus leakage emissions.

4.9 Sustainable development impact

The project must show its impact on sustainable development. This includes the social and the local as well as the transboundary environmental impact. Additional requirements concerning sustainable development might be asked for by the national authorities. Another important prerequisite is that all required environmental permits and studies are provided.

The social impact of transport projects include more or less jobs created, less accidents, an improved livelihood, less time lost due to reduced congestion, improved health and less respiratory diseases due to improved air quality. The environmental impact of transport projects next to the global impact include less local pollutants such as particle matter, NO_X and other precursors of ozone, and SO_2.

4.10 Stakeholder involvement

The project must also prove that the stakeholders who are affected by the project have been included, *i.e.,* it must be demonstrated how their opinions or criticism was taken into account. Stakeholders of a public urban transport project include, for example, the affected transport sector, people living in the proximities of construction areas as well as the users of public transport. In general, stakeholder assessments form part of an Environmental Impact Study required for most projects of this size and are thus not an additional burden for a CDM project. During the process of project validation the PDD is open for comments and posted on the website of the UNFCCC. The project owner must respond adequately to comments made during this 1 month consultation process.

4.11 Monitoring

The methodology describes what parameters, in what frequency and with what types of measurements need to be monitored. The PDD describes this thereafter in detail for the specific project. The PDD also needs to include a description of the organization and responsibilities for monitoring as well as quality assurance methods to be used.

In the case of AM0031 the basic monitoring to be realized is fuel consumption of project buses, distance driven, passengers transported and a regular survey to determine which mode of transport (traditional buses, passenger cars, taxis, motorcycles, NMT or would not have made the trip) passengers would have used in absence of the project. The survey is based on a questionnaire fillid in by users of the project based on a representative sample. The core characteristics of the survey are included in the methodology. Additionally some parameters concerning leakage need to be monitored such as the exact number of buses actually scrapped or changes in the load factor of taxis and remaining buses realized through visual occupation studies every 3 years. Again, the methodology describes the core elements of studies to be realize while the PDD contains all details.

Fig. 16
Fossil based power (lignite power station) side-by-side with agro-power (rapeseed).
Photo courtesy of Klaus Neumann, Mehrum/Germany, 2007

5. Case study: The TransMilenio CDM project

5.1 TransMilenio

TransMilenio[41] started operation with the first trunk routes end of the year 2000 in Bogotá, Colombia. Bogotá is the capital of Colombia and has as metropolitan area around 8 million inhabitants. It is situated at an altitude of around 2,600 msl. TransMilenio serves worldwide as example for a modern and efficient public transport system. TransMilenio is a public-private partnership, in which the public sector is responsible for the investment to deploy the required infrastructure (segregated lanes, stations, terminals, etc.), while the private sector is responsible for the investment of the bus fleet, the ticket selling and validating system, and for the operation of the trunk and feeder services.

Features of the BRT system of TransMilenio include exclusive right-of-way lanes, rapid boarding and alighting, free transfers between lines, pre-board fare collection and fare verification, enclosed stations, clear route maps, real-time information displays, automatic vehicle location technology to manage vehicle movements, modal integration at stations, effective reform of the existing institutional structures for public transit, clean vehicle technologies and excellence in marketing and customer service. The BRT system of TransMilenio is considered as a model-case for a modern mass urban transit system and is being replicated by various cities world-wide. TransMilenio replaces a chaotic system of many small independent enterprises competing at bus-to-bus level for passengers with a consolidated structure with formal enterprises competing for concessions.

Fig. 17
TransMilenio in the center of Bogotá.
Photo by Jürg M. Grütter

Fig. 18
Traditional bus transport in Bogotá.
Photo by Jürg M. Grütter

The technology deployed has 4 main components: infrastructure, buses, transit management, and fare system.

Infrastructure

TransMilenio will establish till 2015 around 350 km of dedicated bus lanes including new bus-stations and integration stations located at the end of dedicated bus lanes to ensure a smooth transfer to feeder lines (140 km of the above mentioned 350 km correspond to trunk lanes of phase I not part of the CDM project). Each station has a modular design with obstacle-free waiting areas and elevated level-access to articulated buses with a high platform. Stations have access ramps for mobility-impaired passengers and selected stations have bicycle parking and storage facilities. As of end 2006 250 km of trunk lanes were already built and under operation.

Bus technology

Bus technology used are to a minor extent Euro II buses (compulsory since model-year 2001) and to a majority Euro III units. Buses operating on dedicated lanes are new articulated buses

41) http://www.transmilenio.gov.co

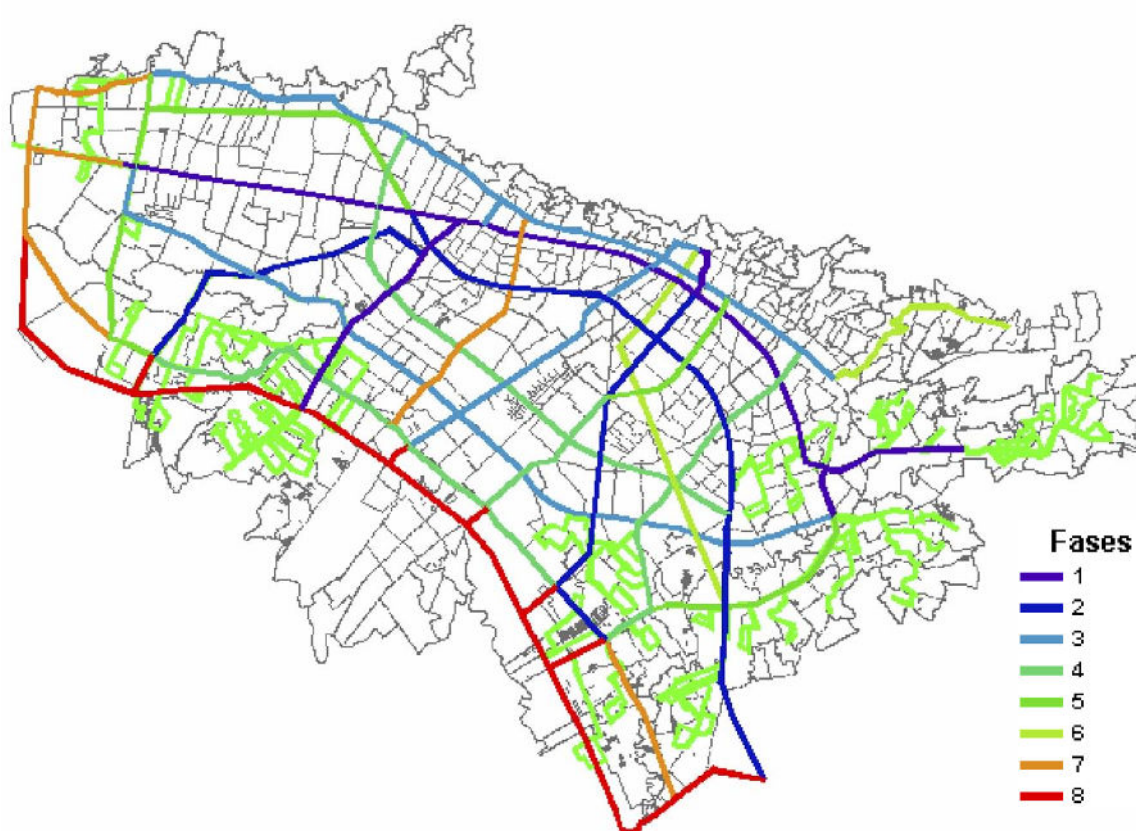


Fig. 19
TransMilenio trunk routes as planned till 2030.
Source: TransMilenio 2006

Fase I:
In operation since 2001
Fase II:
In operation since 2006

with a capacity of 160 persons with platform-level access including room for disabled persons. Feeder buses are new buses with a capacity of 70–90 passengers. As of end 2006 Trans-Milenio included around 850 articulated buses and 350 large feeder buses.

Transit management

The operational fleet centre manages bus dispatch, informs passengers, produces reports and maintains records. All buses are equipped with a Global Positioning System (GPS) linked to the operation centre. The novelty of the operational fleet centre is that an efficient management of bus fleets can take place optimizing load factors through coordinated scheduling of service. The transit system operates on concessions eliminating competition at bus-to-bus level. Also passengers have real-time information about the next available bus and are informed of potential transit problems.

Fare system

The system is based on pre-board ticketing using magnetic ticketing. This streamlines the boarding process and optimizes operations. The fare system integrates feeder and main lines. Fare collection is centralized and managed by a private company through a concession.

The project contributes to ***sustainable development*** in a significant manner:

- Improved environment through less GHG and other air pollutant emissions, specifically CO_2, particle matter, and NO_X. This is achieved through a more efficient transport system and through new buses;
- Improved social wellbeing as a result of less time lost in congestion, less respiratory diseases due to less particle matter pollution, less noise pollution and fewer accidents per passenger transported;
- Creation of more than 1,500 temporary construction jobs for unskilled workers of the surrounding communities for construction works of Phase II;
- Economic benefits mainly on a macroeconomic level. Bogotá can improve its competitive position by offering an attractive and modern transit system and can reduce the economic costs of congestion.

5.2 GHG reductions of TransMilenio

The District of Bogotá signed in 2001 a contract with the Andean Development Corporation CAF including the TransMilenio CDM project[42]. CAF also finances a part of the infrastructure required for TransMilenio. CAF thereafter contracted in 2005 grütter consulting to develop the CDM project. The BRT methodology developed by grütter consulting was approved by the EB of the UNFCCC in July 2006 (AM0031) and TransMilenio was successfully registered as the first CDM transport project in December 2006 (project number 0672). The project owner is the District of Bogotá through TransMilenio.

TransMilenio phase I was prepared by grütter consulting as a VER (Voluntary Emission Reduction) project, selling the emission reductions from 2001–2012 on the voluntary market, while phase II onwards is registered as a CDM project. The TransMilenio CDM project has opted for a crediting period of 7 years renewable up to twice. The first crediting period started January 2006 and will end 2012. The first monitoring period covering the year 2006 has been realized and delivery of the first certified emission reductions CERs is due mid 2007.

Emission reductions are caused by the following changes:

- ***Renewal of bus fleet***: TransMilenio uses new buses with state-of-the-art technology while baseline buses are on average 15 years and older. The new units have an improved fuel efficiency and lower GHG and local emissions.
- ***Increased capacity of buses***: TransMilenio uses larger units with a capacity of 160 passengers per bus on trunk routes. Conventional buses are much smaller. Emissions per passenger-kilometre can thus be reduced.
- ***Improved operating conditions for buses***: Confined, segregated bus lanes together with bus-priority traffic signals allow buses on the route to operate more efficiently and without interference from other traffic thus reducing fuel consumption and GHG emissions. The conventional system is based on competition for passengers between buses on the same route without having segregated lanes for public transport.
- ***Centralized bus-fleet control***: This allows for a coordinated scheduling of bus services that dynamically adjusts bus frequency with demand to result in fewer buses scheduled in off-peak hours. The load factor of buses is thus optimized leading to lower emissions per passenger transported. The conventional system is based on a large number of very small bus companies without schedule coordination operating with low load factors at off-peak hours. The reason is that individual owners continue operating as long as variable costs are covered while a centrally controlled system optimizes total cost resulting in an optimal load factor of buses all the time.
- ***Mode shift***: The BRT system is more attractive to clients thus inducing a switch from high-emission transport modes such as passenger cars or taxis to a low-emission transport mode. The increased attractiveness of the BRT system is based on having a faster, more reliable, safer and more convenient transport system.
- ***Introduction of fare pre-payment technology*** helps streamline the boarding process and thus reduces bus-idle GHG emissions.

Indirectly TransMilenio also reduces GHG emissions of other vehicles circulating in the

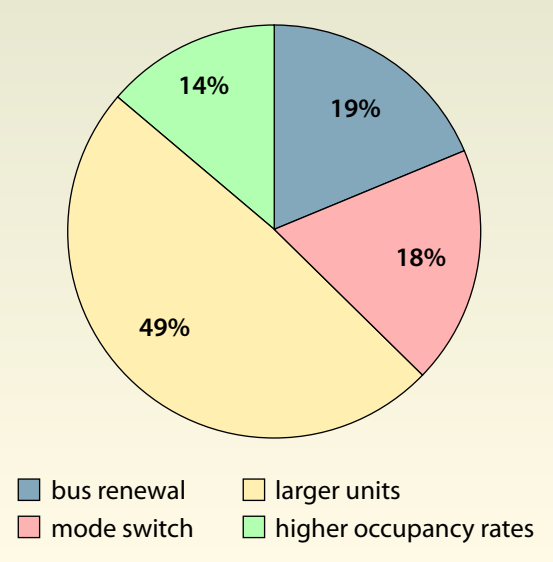


Fig. 20
Relative effect of measures on GHG emission reductions.
Source: Grütter, based on monitored data of TransMilenio, 2007

[42] In a first instance another consulting company was contracted but the methodology proposed by this company was rejected by the UNFCCC.

influence region of TransMilenio due to improved traffic conditions as a result of an elimination of interference from buses competing for passengers with other vehicles. These (indirect) emission reductions, however, are not claimed by the project.

Figure 20 shows the impact of different measures upon GHG emission reductions. Clearly in the case of TransMilenio the usage of larger buses has contributed most to GHG reduction. The conventional transport system of Bogotá relied to a significant extent on small and medium sized buses. Their replacement with large and articulated buses leads to a significant increase of the average size of buses.

Figure 21 shows the development of transported passengers of TransMilenio. Coverage of Phase I of TransMilenio of all public transport trips realized was around 10%, while 70% of all trips shall be covered through TransMilenio with completion of Phase IV expected around 2015. 2006 TransMilenio transported some 350 million passengers on its routes. It is expected that this number will increase to around 900 million passengers by 2012. The distinction is made between Phase I and the all other phases as Phase I is the VER project and the rest the CDM project.

Figure 22 compares baseline, leakage and project emissions of the CDM project of TransMilenio[43]. The emission reductions are baseline minus leakage minus project emissions.

Figure 23 shows the emission reductions of TransMilenio. CERs are received from 2006 onwards while VERs since 2001. In total TransMilenio realizes until 2012 emission reductions of around 3.8 million tons of CO_2 of which 2.1 million tons correspond to VERs and 1.7 million tons to CERs. The latter reduction is smaller due to the shorter crediting period and due to gradual growth. Data 2007 onwards is based on projections which basically depend upon the implementation of future phases and on the expected passenger numbers. 2006

[43] The baseline was established following the methodology explained in the former chapter.

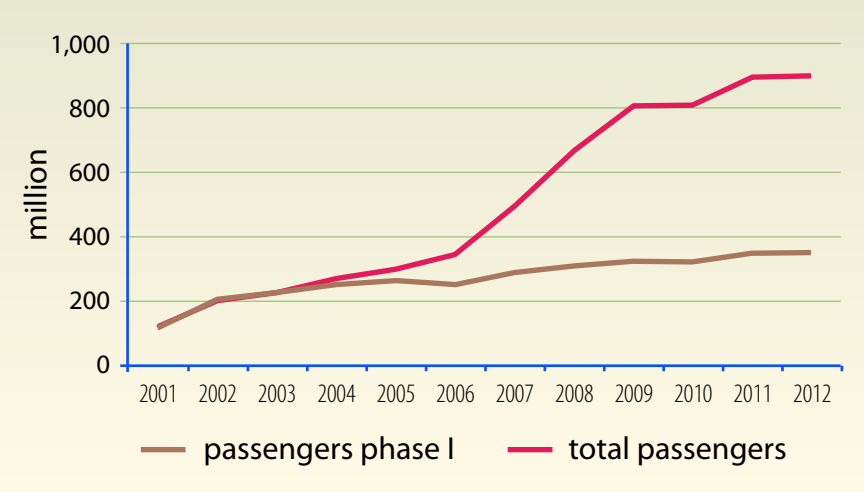


Fig. 21
Passengers transported by TransMilenio.
Source: Grütter based on data TransMilenio; 2001–2006 monitored data; 2007–2012 projections

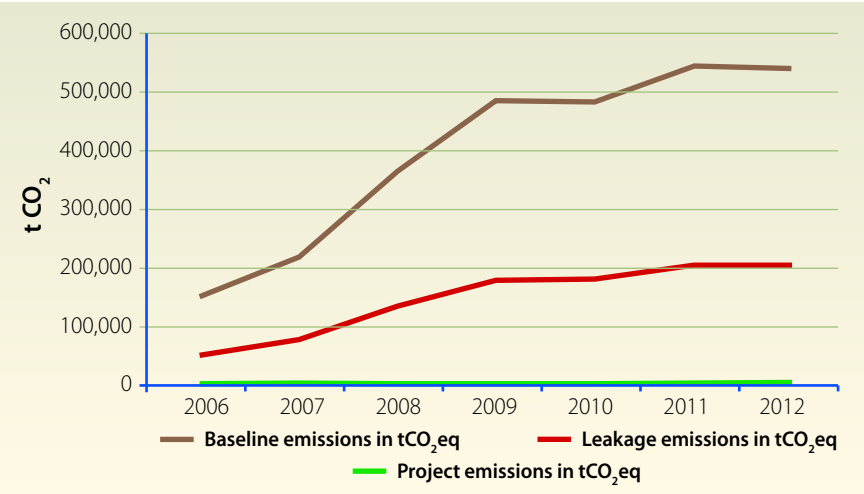


Fig. 22
Projected baseline, project and leakage emissions of the CDM project TransMilenio.
Source: Grütter based on PDD

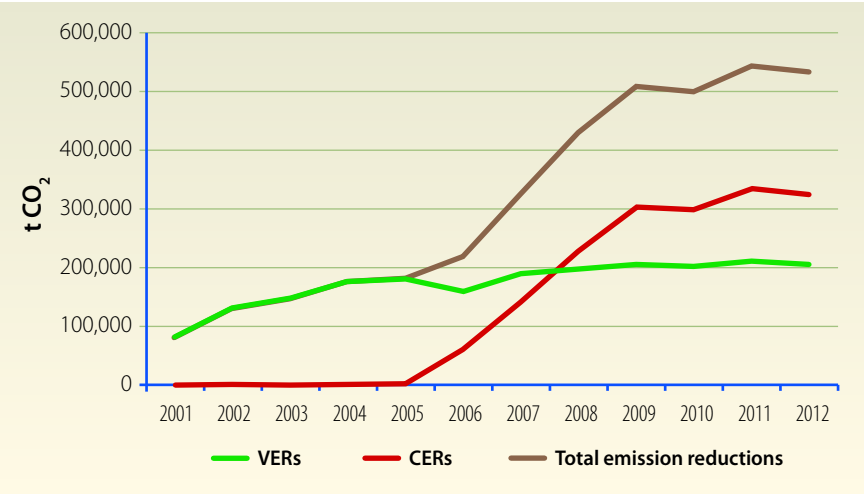


Fig. 23
GHG reductions of TransMilenio.
Source: Grütter based on data TransMilenio; 2001–2006 monitored data; 2007–2012 projections

TransMilenio was able to reduce CO_2 emissions by more than 200,000 tons receiving VERs for over 150,000 tons and around 60,000 CERs.

The monitoring of the CDM and VER project is done through a customized software developed by grütter consulting. Basically TransMilenio monitors the number of passengers, fuel consumed, distance driven of trunk and feeder buses, and through a bi-monthly survey that assesses the transport mode passengers would have used in absence of TransMilenio. Next to this some parameters for leakage—such as the actual amount of cement used in trunk road construction and the occupation rate of taxis and the remaining bus fleet—are monitored[44].

5.3 CDM benefits for TransMilenio

The benefits of having a UNFCCC registered climate change project and thus the ability to sell GHG offsets as CERs brings numerous benefits to TransMilenio including such of financial as well as such of intangible nature.

Financial benefits

The financial benefits depend basically on the project performance in terms of GHG reductions and on the price paid for the emission reductions. TransMilenio has opted for a registration period of 7 years which can be renewed up to 2 times, *i.e.,* for a period of up to 21 years. Insecurity of future prices after the first Kyoto period (ending 2012) are high. However, in general higher prices are expected due to increased demand for GHG offsets while marginal reduction costs increase. Table 4 shows the expected benefits from the sale of GHG offsets for TransMilenio. As mentioned these financial benefits depend on the successful implementation of future phases of TransMilenio as well as price expectations for the future of GHG offset credits.

TransMilenio is set to gain at minimum US$130 million over the entire crediting period and, in the case of increasing prices, up to US$350 million. The CDM income represents on average 10% of the total infrastructure investment cost of TransMilenio or ⅓rd of the investment realized by the project owner, Bogotá municipality, which finances a minimum of 30% of the total investment. Income from CDM will not be able to fully cover the investment cost. It is, however, a substantial contribution towards investment and can make the decisive difference for a project to get it implemented. Last but not least the usage of the funds obtained from the sale of GHG offsets are not tied and can be used upon discretion of the project owner. This gives the project owner a steady flow of discretionary income.

The monitoring cost specific for the CDM project are marginal as data required would be collected anyway by the project. TransMilenio *e.g.,* realizes regular customer satisfaction surveys amongst its users. The mode survey required for the CDM project is added to the regular survey, *i.e.,* simply the additional questions are added or other questions are replaced by mode usage questions. The additional cost is thus basically the verification cost. Verification cost plus some additional time required for monitoring in total surmount to less than US$30,000 per year including all costs such as staff, office costs, additional costs due to the survey[45] etc. This is marginal in relation to the income received from the sale of GHG offsets.

[44] Latter only every three years based on a visual occupation study.

[45] TransMilenio realizes anyway customer satisfaction surveys. Few additional questions were added to this survey.

Table 4: Financial benefits of CDM for TransMilenio

Item	GHG reductions until 2012 (tCO_2eq)	Expected income from sale of emission reductions until 2012 (US$)	GHG reductions until 2026 (tCO_2eq)	Expected Income from sale of emission reductions until 2026 (US$)
CERs	1,700,000	20,000,000	8,500,000	100–300,000,000
VERs	2,100,000	10,000,000	5,000,000	30–50,000,000
Total	3,800,000	30,000,000	13,500,000	130–350,000,000

Source: calculation by Grütter based on expansion projections of TransMilenio and calculated GHG offsets; price range from 2012 onwards based on constant prices as currently (low level and price increase based on increasing world market price due to increased marginal cost of offsets)

Other benefits

TransMilenio has various other benefits apart from the monetary ones listed above. They include:

- ***International recognition*** as project that contributes towards reducing global warming. The prestige of having a CDM project is far higher than that of a VER project which has no independent international registration. In the case of TransMilenio the prestige is even higher as it is the first transport CDM project registered worldwide.
- ***Political pressure to continue project implementation*** due to being registered as a CDM project and due to the revenues of the CDM project which only occur if the project is implemented. This increases the pressure for implementing also future phases to secure the corresponding GHG offsets.
- ***Environmental benefits*** of TransMilenio are quantified and externally verified. While this refers basically to GHG reductions the monitoring software used also tracks local environmental benefits such as reduced particle, NO_X and sulphur dioxide emissions. The economic benefit of the reduced pollution is also calculated. The monitored local pollutants reduction in the year 2006 (comparing TransMilenio emissions with the baseline bus system) are around 900 tons less of particle matter, 170 tons less sulphur dioxide and around 6,800 tons less NO_X emissions. The economic benefits of this reduced pollution are calculated in US$56 million for the year 2006, *i.e.,* a very substantial economic benefit compared to the investment realized[46].

The risk of TransMilenio in embarking upon CDM were minimal as all upfront costs and risks were assumed by CAF in cooperation with grütter consulting, *i.e.,* TransMilenio did not have to disburse one cent upfront and started receiving income from the sale of GHG offsets in the year 2007. The majority of large-scale CDM projects are arranged according to this model.

[46] Calculations based primarily on reduced health costs due to reduced pollution levels.

6. Outlook on CDM and transport

Methodologies

Currently two CDM transport methodologies exist: AM0031 for BRT projects and a small-scale methodology for technology change of vehicles. However in 2007 various new CDM transport methodologies are expected to be approved by the EB including following areas:

- Biofuel production methodology(ies): most probably these will be crop specific (*e.g.,* palm-oil, ethanol). However, credits can only be claimed for domestic usage of biofuels and the proponent must assure that no land-use change has occurred and that biofuel GHG reductions are not accounted for by another project or by another country, *i.e.,* it must ensure that biofuel included in the project is not exported to an Annex I country (countries with emission reduction obligations under the Kyoto Protocol). One biofuel production methodology based on the usage of waste vegetable cooking oils was approved by the EB of the UNFCCC in February 2007[47]. However, biofuel methodologies in general are not transport specific as the fuel can be used also in industrial and energy appliances.
- Efficient bus fleet management (and eventually truck and/or taxi): A small-scale methodology for this area is currently under

[47] Approved methodology AM0047.

Fig. 24
Biodiesel from rapeseed is promoted in Germany.
Photo courtesy of UFOP e.V.
http://www.ufop.de

Fig. 25
Trucks on a German highway.
Photo courtesy of Klaus Neumann

preparation by grütter consulting on behalf of the World Bank. Basically the methodology will allow to cluster various measures under one project with the aim of reducing GHG emissions per distance driven. Measures would include fuel-switch (*e.g.,* to biofuel blends), technology change (*e.g.,* to hybrids), behavioural changes (*e.g.,* ecological driving), enhanced vehicle replacement, improved maintenance and fleet optimization. The methodology will be submitted to the UNFCCC in the first semester of 2007 and approval is expected for mid 2007.

- Metro or LDR methodology: This methodology will cover stand-alone rail-systems such as new metro, LDR or tram lines. Eventually the methodology will also include stand-alone BRT trunk routes not integrated into feeder systems. Grütter consulting is currently developing such a methodology and approval is foreseen for the year 2007.
- Freight mode-switch methodology: Three proposals have already been submitted in this area, two of which were rejected and one is still under discussion. It is not expected that the current proposal under discussion will be approved. However, a fairly significant number of projects are possible in this area and it is probable that a new proposal for a methodology for this area will be launched.

Other methodologies for CDM transport projects will probably be proposed during the year 2007 including, for example, a land-use change methodology or the usage of a programmatic approach including various measures by various stakeholders to reduce emissions. Such methodologies tend to be complex and an approval in 2007 is not probable. For 2007 a range of transport methodologies can be expected thus increasing considerably the scope for potential projects even excluding biofuel production projects.

Projects

For the above mentioned methodologies concrete CDM projects exist. Once the methodology is approved the respective projects can be forwarded, validated and registered. As this process takes time it is not expected that many CDM transport projects using ***new*** methodologies will achieve registration in 2007.

However, it is expected that in 2007 various BRT projects will succeed to register as CDM projects. Over 100 BRTs worldwide are currently under design, planning, construction or implementation. Most of these would qualify as CDM projects. Not including CDM in the preparation of a BRT project equals to loosing an opportunity.

BRT CDM projects currently under development and up for expected registration in the first semester 2007 include the BRT of Pereira/Colombia and the BRT of Cali/Colombia. Both are interesting cases as they are different from TransMilenio:

- Pereira is a small city of around 500,000 inhabitants. Expected emission reductions from the BRT are around 40,000 tons of CO_2 reduced per annum and are much smaller than those of TransMilenio, Bogotá. Pereira can thus show the viability of a BRT for smaller cities as well as the viability of realizing a CDM transport project even of limited size. The CDM project is being developed by grütter consulting on behalf of CAF for Megabus as the owner of the BRT system.
- Cali is a city of around 4 million inhabitants in Colombia. The special feature of its BRT, which is expected to start operations in 2008, is that it will cover from the start more than 90% of all trips. It integrates the existing transport system and will depend on a number of segregated trunk routes, pre-trunk routes and feeder lines. Expected annual emission reductions of this project are around 140,000 tons of CO_2. The CDM project is being developed by grütter consulting on behalf of CAF for Metrocali as the owner of the BRT system.

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