Exploring standardised baselines for CDM and other carbon finance mechanisms in transport

Report for the Project

Applicability of Post 2012 Climate Instruments to the Transport Sector (CITS)

on behalf of the Asian Development Bank

Final Report

Urda Eichhorst, Wolfgang Sterk, Susanne Böhler,

and Hanna Wang-Helmreich

August 2010

Publisher's Information

Publisher

Asian Development Bank (ADB)

6 ADB Avenue, Mandaluyong City 1550, Metro Manila, Philippines

Website: www.adb.org

Authors:

Urda Eichhorst, urda.eichhorst@wupperinst.org

Wolfgang Sterk, wolfgang.sterk@wupperinst.org

Susanne Böhler, susanne.boehler@wupperinst.org

Hanna Wang-Helmreich, hanna.wang-helmreich@wupperinst.org

Wuppertal Institute for Climate, Environment and Energy

Döppersberg 19, 42103 Wuppertal

Project co-ordinator:

Urda Eichhorst

Acknowledgements

This report is based on research commissioned by the Asian Development Bank under TA 7243-REG: Implementation of Asian City Transport – Promoting Sustainable Urban Transport in Asia Project. Contract No.: COSO-41-420.

Contents

Tables

Figures

1 Introduction

Under the Kyoto Protocol's Clean Development Mechanism (CDM), industrialised countries (Annex I countries) can finance greenhouse gas (GHG) emission reduction projects in developing countries (non-Annex I countries) and count the resulting Certified Emission Reductions (CERs) towards their Kyoto emission targets. In addition, in many industrialised countries companies can also purchase CERs and count them towards their national climate protection obligations. The purpose of this mechanism is to allow industrialised countries to tap into low-cost emission reduction potentials in other countries and thus achieve their Kyoto targets more cost-efficiently. Moreover, the CDM is to assist the host countries of the projects in achieving sustainable development.

Although the CDM has in general proven to be a popular tool (to date more than 2,200 projects have been registered), transport has not done well under the current CDM. This is partly due to the fact that the CDM requirements do not fit well with the specific characteristics of the transport sector. For the purpose of calculating the emission reductions achieved by a project, the project participants have to establish a so-called baseline, i.e. a scenario that reasonably represents the emissions that would occur in the absence of the project. The emissions reductions are calculated by comparing the baseline to the actual emissions from the project. As transport projects intervene in complex environments and affect high numbers of small mobile emission sources, developing baselines for CDM transport projects has so far been very challenging.

In the late 1990s discussions began under the UNFCCC on developing standardised baselines as a method to simplify baseline establishment in CDM projects. Instead of establishing emission baselines on a project-by-project basis a standardised value or approach is applied to all projects meeting certain criteria. To date, increasing numbers of default values are available for many tools and methodologies and several methodologies rely on benchmarking. The discussion of standardised baselines gained further momentum as part of proposals for structurally improving the CDM. The Subsidiary Body for Scientific and Technological Advice is requested to forward recommendations on modalities and procedures for the development of standardised baselines to the sixth Conference of the Parties serving as the Meeting of the Parties to the Protocol held in Cancún in November 2010 (CMP 6). In transport, so far only default values for fuel emissions and vehicle efficiency are employed.

The ADB has engaged the Wuppertal Institute for a study that aims to help ensure that the transport sector can benefit from the revised/new climate change mitigation instruments which are being considered as part of a new climate change agreement. At the same time, scoping of new climate instruments can also be used to stimulate the development of a network of persons and organizations with an interest in methodological questions on future climate instruments and their applicability to the transport sector. This is expected to be helpful in the upcoming discussion on detailed guidelines for different types of new mitigation instruments.

The main task of the Wuppertal Institute was to explore and flesh out the concept of standardised baselines for CDM (and other carbon finance instruments) in transport using Bus Rapid Transit (BRT) as case study.

BRT has gained attention as a high-quality, metro-like transit service around the world. Especially in developing countries, more and more cities are opting for BRT to improve their public transport services, since BRT comes at a fraction of the cost of similar rail-based solutions.

BRT developments are able to reduce transport emissions by providing more efficient transport services compared to both private vehicle use and conventional bus services. Emission reductions through BRT are achieved by several factors (Wright, 2005; Wright and Fulton, 2005; PDD BRT Bogotá, 2006):

1. Modal shift: Reducing private vehicle use and subsequent associated emissions by increasing the share of public transport ridership through dramatically improved quality of service (in terms of travel time, comfort, security, cleanliness, etc.), as well as encouraging transit-oriented development around stations and along corridors.
2. Constructing segregated busways or providing exclusive rights of way that permit uninhibited bus movements without delays from mixed traffic, increasing average speed and avoiding emission-intensive stop-and-go.
3. Replacing several smaller buses with a larger articulated vehicle thus improving efficiency (reduced emissions per passenger kilometre).
4. Improved vehicle technology: the conventional buses that are replaced through BRT systems in developing countries are often old and inefficient. BRT developments are often combined with requiring minimum-emission standards for vehicles and scrapping the replaced vehicles.
5. Where possible GPS controlled management of the fleet can allow the optimisation of demand and supply during peak and non-peak periods further improving efficiency.

To what extent the emission reduction potential of BRT systems can be realised ultimately depends on local conditions and system characteristics. The challenges for standardisation of emission baselines for BRT are illustrated in this study based on BRT developments in Hefei City in the People’s Republic of

China. The study was carried out in consultation with local Chinese organizations.

Methodology

The study analyses to what extent and under which conditions the options currently under consideration under the UNFCCC for further development of the CDM and other mitigation instruments can incentivise policies and measures aiming at behavioural changes in the transport sector. For the CDM, this mainly means analysing the option of standardised baselines. BRT serves as a case study. Consequently, the focus in this paper is on urban road-based passenger transport.

Apart from vehicle efficiency, most of the 24 transport CDM projects in the pipeline are BRT projects.[1] Also outside of the CDM, BRT interventions have benefited from climate finance (e.g. through the Global Environment Facility (GEF) and the Clean Technology Fund (CTF)).[2] BRT developments are also expected to continue further. Thus, BRT baseline methodologies provide a good example to assess possibilities for standardisation regarding policies and measures that aim at behavioural changes in the transport sector.

In the first step, the concept of standardised baselines under the CDM is elaborated. Second, the ASIF model (Schipper et al., 2000) is introduced as analytical framework to assess standardisation options in transport. The ASIF model is often used to quantify transport-related emissions and serves to identify the relevant indicators for which suitability for standardisation needs to be assessed.

---

[1] As of 1 June 2010 (Fenhann, 2010) ten BRT projects are at validation, one registered (Transmilenio Bogotá), one negatively validated (BRT Seoul) by the CDM Executive Board.

[2] The GEF started its "Promoting Environmentally Sustainable Transport" programme in 2000. To date the GEF has invested about $200 million in sustainable urban transport projects in more than 73 cities worldwide. Initially, GEF support to the transport sector focused on technological solutions, but GEF-4 (2006–10) emphasizes "nontechnology" options, such as planning or modal shift, including BRT (GEF, 2009). In China the GEF set up the Urban Transport Partnership Programme with the World Bank. The programme covers 19 cities throughout the country, including the developments of BRT systems in Chongqing, Dongguan, Luoyang, Zhengzhou, Jinan, Weihai and Urumqi (GEF, 2009; World Bank, 2008).

The Clean Technology Fund (CTF) is one of the two multi-donor Trust Funds within the World Bank's Climate Investment Funds (the other one being the Strategic Climate Fund). It aims to support demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse gas emissions savings. In transport the CTF supports both efficiency improvements and modal shift, e.g. in Mexico's Urban Transport Transformation Program (World Bank, 2009). Currently most CTF investments are however in the energy sector (see http://www.climatefundsupdate.org/listing/clean-technology-fund).

Against this background, chapter three compares different BRT baseline methodologies to analyse how baseline projections are commonly handled and what conclusions can be drawn for standardisation. Apart from CDM methodologies for BRT, the draft GEF GHG manual BRT model and the CTF methodology for transport emissions are analysed.

Based on this analysis the possibilities for standardisation of an emission baseline for BRT are discussed, examining the suitability of the different ASIF elements for standardisation. Here, the Hefei case study serves to illustrate the opportunities and challenges of standardised baselines regarding in particular travel behaviour like modal split and trip length. To this end, a survey of mobility behaviour in Hefei is conducted to generate data on modal shares and trip length.

Standardised baselines are not only relevant to the CDM, but also to other carbon finance mechanisms for which GHG emission reductions need to be assessed (e.g. financing nationally appropriate mitigation actions (NAMAs) according to the Bali Action Plan, CTF, GEF). The analysis therefore also discusses the potential of standardised baselines in transport in this wider context.

Finally, the study aims to elaborate recommendations for the inclusion of standardised baselines in a reformed CDM and other future mitigation instruments to foster sustainable transport activities under the international climate regime. Towards this end, necessary elements of modalities and procedures for standardised baselines in the CDM are formulated with a special focus on transport.

2 Standardised baselines in the transport sector

2.1 Definition and background

The development of standardised baselines has been discussed as a method to simplify the calculation of emission reductions in CDM projects since the late 1990s. Standardisation further aims to enable objective comparison and add more predictability to decision-making. A baseline is said to be standardised when key parameters to determine baseline emissions are not specified on a project-by-project basis, but instead a standardised value or approach is applied to all projects meeting certain criteria. These may be, for example, all projects of a certain sector, sub-sector or category within a geographical boundary or even globally. Therefore, standardised baselines are also called multi-project baselines.

Standardised parameters can include benchmarks for emission intensities, default factors or otherwise standardised approaches. Sometimes the terms performance benchmarks or emission intensity benchmarks are therefore used interchangeably for standardised baselines. However, the two terms describe an approach to achieve standardisation.

Apart from standardising baselines, standardised methods could also be developed for establishing additionality[3] and determining ex-post project emissions (IETA, 2010). Where the entire additionally determination cannot be standardised, standardised approaches could be developed for barrier tests. Barrier testing in the CDM is used to determine whether the proposed project activity faces barriers that prevent its implementation. This can be investment or technological barriers, barriers due to prevailing practise or yet other barriers. If it can be demonstrated that the barrier(s) can only be overcome by registering the project as CDM activity, the project is deemed additional.

In some cases combined benchmarking for baseline and additionality establishment may be possible, i.e. where emission reductions below a certain performance threshold identified as the baseline are automatically additional (see e.g. AM0070 below). Or dual benchmarking, where a benchmark is established to identify the baseline emissions, e.g. the top 45% performing facilities, and a more stringent benchmark level to demonstrate additionality,

[3] Additionality means that a project activity, i.e. its emission reductions, would not have occurred in the absence of the CDM project. Being able to demonstrate a project's additionality is a key requirement for CDM registration.

e.g. the top 20% performing facilities, as in the recently submitted cement benchmarking methodology of the Cement Sustainability Initiative.

Nevertheless, the two steps should first be regarded separately. Taking the example of renewable electricity projects where the national grid emission factor is used as baseline, renewable electricity projects will always beat the baseline, but this does not say anything about whether a specific project is business as usual or not.

2.1.1 Objectives of standardised baselines

The main idea behind standardised baselines is to simplify baseline establishment in CDM project development, holding promise for:

- Enhancing the objectivity in determining baseline emissions (and additionality);
- Increasing transparency of reviews and decisions;
- Lowering transaction costs for individual projects in the longer term (once a performance standard has been established and data gathering has been done);
- Reducing uncertainty for project proponents associated with the current project approval process as standardisation may avoid the need for each project to have its baseline and additionally demonstration individually approved by the EB, leading to better predictability, potentially leading to a better flow of investment to developing countries;
- Potentially improving regional distribution through lowering project development costs due to the simplified preparation of PDDs;
- Potentially improving sectoral distribution by simplifying the preparation of PDDs in underrepresented sectors, and
- Ultimately increasing the scale of emission reductions being realised through the CDM.

The aim of standardised baselines must be to ensure environmental integrity while minimising transaction costs.

2.1.2 Experiences with standardisation to date

Standardised approaches are already possible under the CDM today. Currently, they mainly come in one of two forms:

1. emission intensity or performance benchmarks; or
2. default emission factors or values.

Setting emission intensity benchmarks

Setting emission intensity benchmarks for a certain activity, sub-sector or sector requires that data be gathered from a ‘significant and representative share’ of comparable activities in the sector (CAN-I, 2010). Comparability, however, not only depends on the activity as such, but also on the geographical scope within which activities are compared. So adequate data needs to be gathered which is “significant and representative” within the chosen scope.

This will result in a GHG intensity curve, reflecting the status quo. In a next step, based on such curves specific GHG intensity levels have to be determined to become the crediting threshold – the level of intensity below which project credits will be generated (CAN-I, 2010). To ensure environmental integrity, a conservative crediting threshold must be chosen. So, an (emission) performance threshold represents a level which is significantly better than average. To further ensure that crediting baselines reflect ongoing technological improvements, standardised baselines will have to be strengthened for each year or each couple of years after the establishment of the curve. In other words, standardised baselines will have to be dynamic.

On emission performance benchmarks, paragraph 48 (c) of the modalities and procedures for the CDM (Marrakesh Accords) on choosing a baseline methodology offers the following approach: “The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.”

A similar approach is applied in the consolidated methodology ACM 0013 for *new grid-connected fossil fuel fired power plants using less GHG intensive technology*[4]. It uses an emission intensity benchmark based on the 15% most efficient power plants that use the same fuel as the project plant and any technology available in the same geographical area. This benchmark is then compared with the emission factor of the technology and fuel type identified as the most likely baseline scenario and the lower of the two is taken as the crediting baseline.

Combined benchmarking is already applied in methodology AM0070 for efficient refrigerators, where a benchmark is calculated for the specific electricity consumption for respective storage volume classes and designs, taking into account autonomous energy efficiency improvements. As long as the specific electricity consumption of refrigerators of a particular class and design produced and sold in the host country by the manufacturer involved in the project activity

[4] http://cdm.unfccc.int/UserManagement/FileStorage/2FZGM7DP09CJA1RVBE8OX6W35TSUIK

is lower than the benchmark during each year of the crediting period, the emission reductions are deemed additional.[5]

Default factors

Where local data is not available, default factors can be used. Default factors are pre-defined values for a variable, such as fuel emission factors, based on empirical evidence.

On default values, for instance the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (version 02)[6] allows project developers to use IPCC default values for fuel emissions adjusted for uncertainty, use national or regional default values for liquid fuels if based on well documented, reliable sources or to apply project-specific values.

Electricity grid emission factors are another example of default values that is already widely used within the CDM.

Additionality and standardised baselines

As mentioned above, two general options exist when it comes to assessing additionality in projects using standardised baselines:

- Using emission intensity benchmarks also for assessing additionality: using the same threshold for the crediting baseline and additionality, in which case any emission reductions beyond the chosen baseline, e.g. better than the top 15%, are automatically deemed additional (*combined benchmarking*).
- Applying an emission intensity benchmark and a separate additionality test to filter projects that would achieve better-than-benchmark performance under business-as-usual, i.e. without CDM revenues (free-riders).

If a combined benchmark approach is applied it is vital that a very conservative crediting threshold is chosen to ensure environmental integrity – at what level this threshold is chosen (e.g. top 10%, 15% or 20%) will in the end be a political decision.

Approaches to standardise additionality (barrier) testing could include:

- Practice-based approach: additionality is determined based on a common-practice analysis. To avoid analysing common practice on a project-by-project basis, a common-practice standard could – at least in theory – be developed at the national or regional level. Such a standard would also have to take development trends/planned activities into account and should cover

[5] http://cdm.unfccc.int/UserManagement/FileStorage/V35MBIS0GWTRK1LEQP94D7YO8UH26C

[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

an adequately large geographical scope to be conservative and representative at the same time. Comparing across national borders seems unfeasible due to differing transport policies and national circumstances. Even setting common practice at the national level may be difficult in regard to certain transport activities, especially when it comes to behavioural choices, such as mode choice, which are highly dependent on the local context. On the other hand, using a smaller than national level would result in a multitude of standards. It is subject to more research to what extent (sub-)national common-practice standards could be clearly and objectively defined for transport and if developing numerous sub-national standards would really simplify additionality testing in the end. For BRT, a common-practice analysis would not only entail whether or not BRT developments can already be deemed common-practice, but would need to define common-practice system characteristics. These include road network and station characteristics, vehicle technology, station accessibility, operations (including ITS technology), as well as passenger information. All these factors contribute to the efficiency, quality and attractiveness of a BRT system, ultimately influencing its efficiency and its potential to draw passengers from other modes.

- Technology-based approach: additionality is determined based on exceeding a pre-defined technological standard (equivalent to a certain efficiency level). This approach is applied in industrial boiler projects in the USA, where a project developer must add at least one emissions-reducing technology to exceed the performance threshold to achieve additionality (UNFCCC, 2010). In transport, this would translate into efficient vehicle technology. A project would then achieve additionality if a vehicle technology was applied that is not usually used, e.g. because it is too expensive. Theoretically, technology standards could also include other technologies, such as intelligent transportation system technologies. However, the technology standard approach to define additionality is based on the assumption that surpassing a certain technological standard is directly related to emission reductions. E.g. reduced emissions per vehicle kilometre travelled due to lower fuel consumption. If no direct correlation can be established between the used technology and emission reductions, a technology standard will hardly serve to prove additionality. The efficiency of BRT systems, however, depends on a whole range of technologies and system characteristics, of which vehicle technology is but one factor. Other technologies/system characteristics range from segregated busways to GPS controlled fleet management or other ITS technology, all of which contribute to higher average speeds and smooth flows associated with lower emissions, but their effects are difficult to isolate. All in all, BRT systems cannot be captured by a single technology standard.

Challenges of standardisation

The preceding paragraph has already indicated the difficulties to standardise more complex systems, such as transport sub-systems. Before targeted data gathering can take place the system boundary for standardisation needs to be defined. The concept of standardised baselines, in particular in the form of emission intensity or performance standards, has emerged from more or less homogeneous industry sectors and the power sector. Capturing the transport sector with its multiple mobile emitters, different factors determining transportation performance and extremely variable circumstances across and within countries in standardised baselines seems a much more daunting endeavour.

The increased upfront burden of necessary data collection costs is another huge challenge to constructing performance standards or defining adequate default values. This is exacerbated by the bottom-up approach to methodology development and the ‘public good’ nature of CDM methodologies, which means that the “first mover” will have to bear the costs for developing the standard, while all subsequent project developers will benefit from a standardised baseline. To address this problem of a ‘first mover disadvantage’, a top-down approach may be more suitable to developing standardised baselines (UNFCCC, 2010), including provision of finance for data collection at the international level.

As mentioned, the development of standardised baselines has mainly focused on sectors such as cement or power generation, where a large body of data was already available (Spain and EC, 2010). So far, not much research has been conducted specifically on standardised baselines in transport and methodological uncertainty remains as to which elements can be adequately captured by standardised baselines for transport. In the following chapters we apply the ASIF framework (Schipper et al., 2000) to examine the scope for standardisation parameter by parameter.

2.2 Constructing standardised baselines for transport

The transport sector consists of different sub-sectors, including passenger and freight transport, transport systems (ground travel, air and water), as well as infrastructures (road, rail, waterways etc). Besides, the geographical scope of transport relations can be local, regional, national or global. For current transport CDM, the geographical scope is local. For nationally appropriate mitigation actions (NAMAs), on the other hand, the national level may gain in importance.

Since both “business as usual” activities and development trends can vary significantly across different geographic areas, standardised baselines in transport are expected to be of limited scope and confined to certain sub-sectors.

In general, the following issues need to be taken into account when designing standardised baselines:

- What are parameters and methods suitable* for standardisation?
- What is the appropriate geographical scope or level of aggregation?
- How can environmental integrity be ensured, seeking a balance between over-crediting and under-crediting of projects?
- How often would baselines have to be updated (in order to properly reflect changing circumstances) and how can this be institutionalised?

*Suitability here is understood in two tiers: 1) suitability in terms of *comparability* of parameters or methods across projects (the rationale being that a standard can only be developed for similar activities), 2) suitability in terms of *feasibility* (this includes data availability, potential costs, political viability etc.).

The following section first gives an overview of the parameters necessary in the determination of transport-related emissions and in setting an appropriate geographical scope in general. This sets the basis for exploring the possibilities to standardise baselines for BRT projects in chapter three and for the subsequent discussion in chapter four.

2.2.1 Required parameters to determine baseline emissions in transport – laying the basis for standardisation

The ASIF framework (Schipper et al., 2000) is often used to quantify transport-related emissions. It can serve as a first orientation towards identifying relevant indicators for which suitability for standardisation needs to be assessed.

Emissions are a product of:

- (A) the total transport **a**ctivity or the demand in person- or tonne-kilometres,
- (S) the modal **s**tructure
- (I) the energy **i**ntensity of each mode (modal energy intensity in MJ/person-km or MJ/tonne-km)
- (F) the carbon content of the **f**uel used in each mode.

Each of these parameters itself entails different indicators, for which data is needed.

(A) Total transport activity

The total transport activity encompasses the total passenger travel or freight activity for each mode within a project boundary, usually expressed in person- or tonne-kilometres.

(S) Modal structure

The modal structure or modal split represents the share of transport modes in a given transport system or within a given project boundary. Modal split in passenger transport covers car transport, different types of public transport (both rail and buses of different sizes), paratransit (often minivans), tricycles and two-wheelers etc, as well as non-motorized modes like walking and cycling. Modal shares can vary between districts within a city, between cities and within and between countries. Nevertheless there are also similarities in modal shares in large cities or in rural areas, so that data could potentially be aggregated.

(I) Energy intensity of each mode (modal energy intensity in MJ/person-km or MJ/tonne-km)

Modal energy intensity depends on vehicle efficiency, usage and occupancy rate or freight load.

- Vehicle efficiency depends on the vehicle type, fuel type, engine technology, its size, shape and weight, its vintage (accumulated mileage) and maintenance. Usually, data is based on information of car manufacturers and local car registries.
- Usage refers to driving cycles and speeds, routing, driver behaviour and ambient conditions.

In Europe, for instance, fuel consumption of vehicles is assessed based on the New European Driving Cycle (NEDC). However, internationally different standards exist to assess fuel consumption, so that different values may be determined for the same car model depending on the standard that is applied. Fuel consumption assessments should reflect the local realities as much as possible (e.g. average speeds, elevations etc.).

- Modal intensity per person or freight-tonne further depends on the occupancy rate and the freight-tonnes per vehicle. Usually occupancy rate of cars differs according to the trip purpose. The occupancy rate is usually higher for leisure than for commuting. In public transport the value differs according to location, day and time and generally depends on the attractiveness of the system, as well as on cultural values and perceptions.

Modal energy intensity is hence an aggregate value that differs from region to region.

(F) Carbon content of the fuel used in each mode

The carbon content of the fuel or the fuel emission factor relates to emissions from the combustion of fuel – the amount of carbon released for each unit of energy consumed (often expressed in gCO_{2e}/MJ). The carbon content of the fuel is generally known with a high degree of precision. Nevertheless, the carbon content in the same fuel type varies across countries. Most importantly, however, the fuel emission factor depends on the applied understanding of system boundaries, that is, if upstream emissions of production, refining and delivery are also included or if only the carbon content itself is taken into account. If more of a life-cycle approach is included the fuel emission factor can vary significantly for the same fuel.

Standardisation requires that activities for which standards are developed are comparable. Depending on the transport activity under scrutiny all or only part of the above parameters need to be determined to calculate project baseline emissions.

Looking at the ASIF parameters, we find that travel distance (A) and mode choice (S) are the most variable (least homogeneous) parameters. Energy intensity, in particular vehicle efficiency (I) and fuel emission factors (F) hence are the two parameters for which standardisation seems more easy to achieve and on which efforts on default factors have focused so far (see chapter three).

2.2.2 Setting an appropriate geographical scope or level of aggregation

Identifying an adequate geographical scope for which data on similar activities can be deemed comparable or representative is not only important for emission intensity benchmarks, but also for the development of at least some default values, such as occupancy rates, which can be assumed to vary significantly between countries or regions.

CAN International (2010: 3) in its submission to the UNFCCC suggests that “there can be no correction applied for material quality, climatic and national circumstances” and that standardised baselines “shall be based on the GHG efficiency of the most GHG efficient installations globally”. While this may be adequate for certain industries and power generation, it seems hardly feasible for the transport sector. For transport as a much more diverse sector, emission intensity benchmarks and certain default values will have to take national or regional circumstances into account to adequately reflect the ‘most-likely’ baseline.

Setting the aggregation level is a key determinant of how effective a standardised baseline is likely to be. Aggregation can be done according to transport sub-sector, technology, geographical area and target groups. Highly aggregated standardised baselines will not be able to capture country- or region-specific differences. To ensure environmental integrity and avoid the risk of over-crediting on a large scale, it is particularly important for highly aggregated baselines to be conservative. This may, however, lead to undercrediting of certain project activities, potentially impacting their attractiveness for CDM project developers.

Gathering the associated data and ensuring it is representative within the chosen geographical boundary will be one of the most important steps in establishing standardised baselines.

Having introduced the ASIF model as analytical framework to assess standardisation options in transport, the next chapter will now compare different BRT baseline methodologies to analyse how baseline projections are commonly handled and what conclusions can be drawn for standardisation.

3 Learning from existing experience: comparability of baseline methodologies for BRT – potential for standardisation?

This section includes a systematic comparison of existing methodologies for calculating baseline emissions from BRT projects. To date (as of May 2010) two approved CDM methodology exist for BRT – AM0031 and ACM0016. However, only one BRT project has so far been registered. More projects using AM0031 and ACM0016 are only at the validation stage.[7]

The scope of reviewed methodologies also includes one rejected methodology for CDM and other carbon finance methodologies for transport. Overall, the reviewed methodologies and project documentation are:

- Transmilenio BRT methodology (AM0031 and Transmilenio PDD)
- NM0229 Methodology for Mass Rapid Transit Projects
- ACM0016 Baseline Methodology for Mass Rapid Transit Projects
- GEF draft GHG Manual BRT Model
- Clean Technology Fund (CTF) Guidelines for Calculating GHG Benefits of CTF Investments in Transport[8]

As we have seen earlier, a baseline is said to be standardised when *key parameters to determine baseline emissions* are not specified on a project-by-project basis but a standardised value or approach is applied to *all projects of the same category*.

Consequently, in order to assess the comparability of BRT baseline methodologies three questions need to be answered:

1. Do the analysed methodologies cover exactly the same project category?
2. Are the key parameters to determine baseline emissions the same across all methodologies?
3. Are standardised values already used for parts of the parameters and which ones?

[7] As of 1 June 2010 (Fenhann, 2010) ten BRT projects are at validation, one registered (Transmilenio Bogotá), one negatively validated (BRT Seoul).

[8] The CTF Guidelines for Calculating GHG Benefits of CTF Investments in Transport can be found in Annex 3 of the Working Document “Clean Technology Fund: Results Measurement System” of the CTF Trust Fund Committee Meeting of 11 May 2009 (CTF/TFC.3/8). Online at: http://www.climateinvestmentfunds.org/cif/workingdocuments/129 (accessed 22 July 2010).

The analysis is structured in three main categories: 1) scope (to what project categories is the methodology applicable), 2) project boundary (what emission sources are covered by the methodology) and 3) baseline calculation and data requirements (what are the key parameters and data sources).

To compare the different methodologies and project documentation in detail, their calculations, data requirements (e.g. baseline vehicle speeds, technology split, fuel type split, occupancy, fuel efficiency etc.), data sources for each of the data categories, and the extent to which default values are already used in current baseline methodologies are assessed (detailed information is compiled in excel spreadsheets, provided in electronic format). An overview of the default values already in use in the above transport methodologies is given in table A1 in the annex.

One of the fundamental differences between the assessed methodologies is that the first three methodologies were designed for CDM and therefore require very accurate emission estimations, whereas a larger degree of uncertainty in emission estimations is accepted in the CTF and GEF methodologies, where no offset credits are traded. This is reflected in the level of detail and accuracy of data requirements in the methodologies (further explored below). Differences, however, also exist in the scope of the assessed methodologies, which has implications for project boundaries.

3.1.1 Scope

The *Baseline Methodology for Bus Rapid Transit Projects* **AM0031** (and the Transmilenio PDD) covers project activities that reduce emissions through the construction or expansion and operation of a Bus Rapid Transit (BRT) system for urban road based transport, including efficiency improvements of bus systems or buses and where the BRT system replaces existing public transport services, either partially or completely.

The proposed methodology **NM0229** for Mass Rapid Transit Projects Version 1.0 aimed at the simplification of AM0031 and was created to be applied to new MRT infrastructure (partial system changes or extensions) and operations consisting either of segregated bus lanes or a rail-track system for passenger transport.

NM0229 was rejected by the UNFCCC for various reasons including transparency, consistency and lack of readability of the methodology. First of all, some of the methodology’s definitions were considered to be ambiguous, as it remained unclear whether concepts such as project boundary, project zone and zone of influence could be used interchangeably or referred to different contexts. Furthermore, the treatment of both leakage emissions due to longer trip length and induced traffic needed considerable revision.

The example of NM0229 serves to illustrate the considerable methodological difficulties in establishing an accurate baseline for BRT interventions, which fulfils the requirements of the UNFCCC. Nevertheless, these problems were overcome in **ACM0016** *Baseline Methodology for Mass Rapid Transit Projects*, which covers the same scope as NM0229, i.e. project activities that establish and operate segregated bus lanes (or a rail-based Mass Rapid Transit System) in urban or suburban regions, including Bus Rapid Transit systems.

In regard to BRT, the applicability of ACM0016 and AM0031 is very similar. However, ACM0016 explicitly excludes operational improvements (e.g. new or larger buses) of an already existing and operating bus system, whereas improved fuel-use efficiency through new and larger buses is encompassed in AM0031. Furthermore, ACM0016 is confined to BRT systems to the most part based on dedicated bus lanes[9], whereas AM0031 is more widely applicable.

The **GEF draft BRT model** is applicable to BRT interventions in general; its baseline calculation, however, also implicitly assumes that a ‘traditional’ road-based public transport system (bus system) is already in place.

The **CTF** methodology has the widest scope of the analysed methodologies as it is designed generally for all transport projects that restrain future increases in GHG emissions caused by the expected growth in private motorization.

3.1.2 Project boundary

Concerning the definition of the project boundary, the **CTF** methodology, because of its general scope, is correspondingly vague, including all anthropogenic GHG emissions by sources that are significant and reasonably attributable to a certain project activity.

In the **GEF draft BRT model** the exact project boundary also varies according to each project, but is loosely defined as the area and transport modes affected by the respective BRT activity and their related emissions.

Both the CTF and the GEF BRT methodology differentiate between direct project emissions, post-project direct emission reductions and indirect emission savings. Direct emission reductions are those which occur during the lifetime of the project and are directly attributable to the project activity. Post-project direct emission reductions are those related to financial mechanisms that are set up within a project activity and still operational after the project ends, such as partial credit guarantee facilities, risk mitigation facilities, or revolving funds,

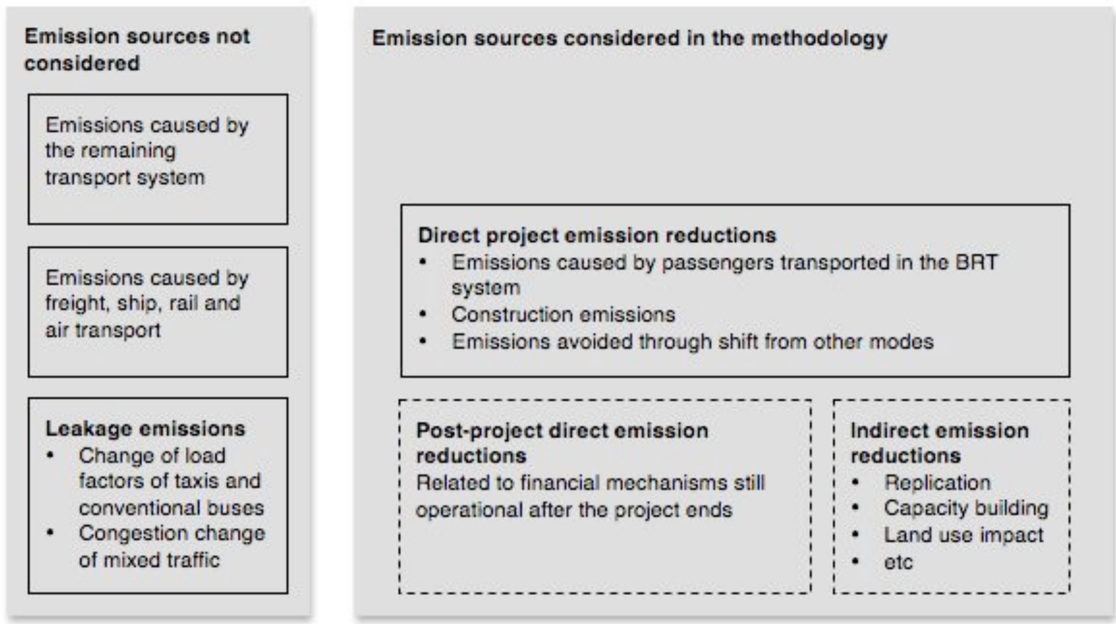
[9] “It is not a requirement that 100% of the route is a bus-only lane as buses might share lanes with other modes of transport e.g. at traffic crossings, bridges, tunnels, in narrow parts or on roads with limited traffic e.g. in suburban parts of the city. However to qualify for this methodology the included bus route must be in general a bus-only lane.“ (ACM0016: 1).

which may facilitate investments yielding CO_2 reductions after the project duration. Direct post-project emissions can be quantified with the same methodology as the direct investments, but “the nature of direct post-project emissions dictates that conservative assumptions be used with reference to leakage rates and financial instruments’ effectiveness” (ITDP, 2009: 9). These effects are not counted towards a project’s *direct* effects under the CTF and are also accounted for separately under the GEF.

Under the GEF methodology, indirect impacts can be made accountable to capture less tangible long-term GHG savings achieved after the project’s completion, e.g. due to activities that build institutional capacity, improve the enabling environment and stimulate replication. The GEF methodology developed an average replication impact of 8.4 for high-quality BRT projects based on empirical experiences with replication of BRT systems in Curitiba, Quito and Bogotá (see table 1). To estimate indirect impacts, one must rely heavily upon assumptions and expert judgment resulting in high uncertainties. Direct and indirect emission reductions are therefore not aggregated but treated separately.

Figure 1 illustrates the project boundary of GEF BRT projects.

Figure 1: Project boundary GEF draft BRT model



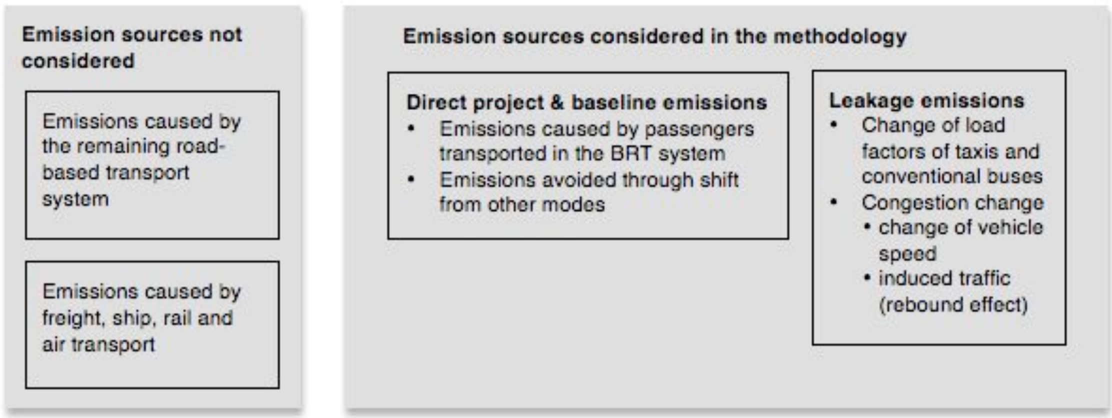
Source: own illustration based on ITDP (2009)

Similarly to GEF, the project boundary of **AM0031** encompasses the passenger trips completed on the BRT project in the respective city – in the case of Transmilenio in the city of Bogotá. The spatial extent is determined by the outreach of the new BRT project and covers mobile source emissions of different modes of road transport for passengers which use the BRT system (buses, passenger cars, motorcycles, taxis). In contrast to the GEF methodology, leakage emissions due to a change in load factors of taxis and conventional buses, as well as congestion change are included in the project boundary, whereas indirect and post-project emissions (as defined in the GEF and CTF methodology) are not included in the CDM methodology, since they cannot be accurately monitored.

Regarding upstream emissions from fuel production, version 1 of AM0031 still included a default value of 14% (based on L-B- Systemtechnik GmbH, 2002), which was used in Transmilenio. In version 3, no provisions to calculate upstream emissions from fuel production are provided in order to keep the methodology simple. Consequently, in order to ensure that the calculated emission reductions are conservative, the use of the methodology is limited to cases where the upstream emissions under the project activity are likely to be equal or lower than in the baseline scenario.

Figure 2 illustrates the project boundary of AM0031.

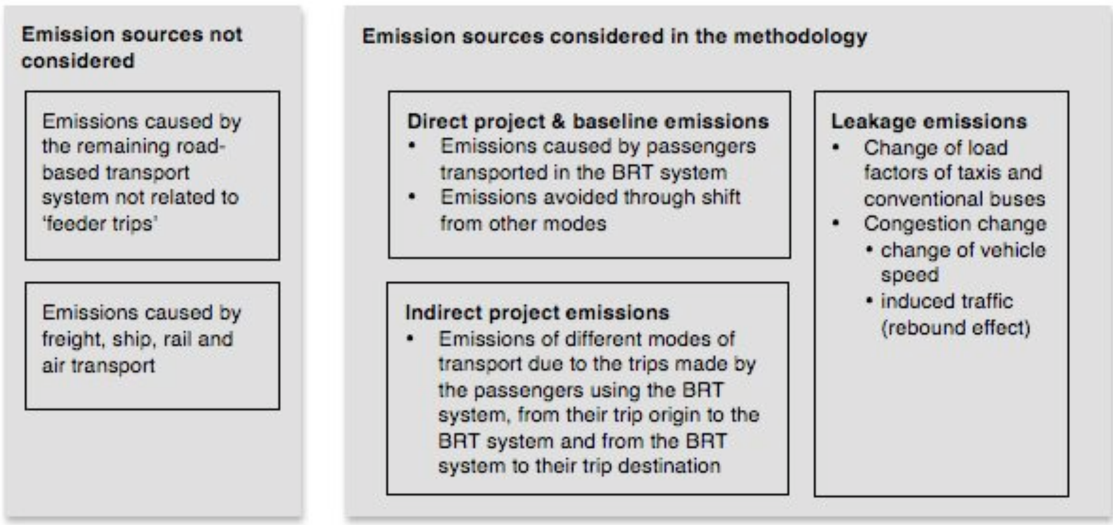
Figure 2: Project boundary AM0031



Note: Although construction emissions are not included in the baseline and monitoring methodology, construction emissions were included in Transmilenio as upstream leakage together with well-to-tank emissions of fuels and reduced lifetime of buses due to scrappage. A quick screening revealed that the same approach is taken by other projects using AM0031 currently at validation, but not by all of them.

In **ACM0016** the spatial extent of the project boundary encompasses the urban area in which the project takes place. It is based on the origins and destinations of passengers using the project system. As the project cannot control the trip origins or destinations of passengers, the spatial area of the project is the entire city or urban area in which the project operates. This means that ‘feeder trips’ made by the passengers using the BRT system, from their trip origin to the BRT entry station and from the BRT exit station to their trip destination are covered in the project emissions (called indirect emissions[10] as opposed to the direct project emissions resulting from the fuel consumption of the BRT system). This is the essential difference of the project boundary between ACM0016 and AM0031 (see figure 3).

Figure 3: Project boundary ACM0016



Note: In the only BRT project using ACM0016 to date (BRT Lines 1-5 EDOMEX, Mexico), which is currently at validation, construction emissions and well-to-tank emissions of fuels are not included as upstream leakage. No provisions to calculate upstream emissions from the production of the fuels are provided in order to keep the methodology simple. Therefore, in order to ensure that the calculated emission reductions are conservative, this applicability condition aims to limit the use of the methodology to cases where the upstream emissions under the project activity are likely to be equal or lower than in the baseline scenario.

Same as in AM0031 no provisions to calculate upstream emissions from fuel production are provided.

In both CDM methodologies, in case of using electricity from an interconnected grid or captive power plant for the propulsion of the transport systems, the project boundary also includes the power plants connected physically to the electricity system that supply power to those transport systems.

The difference in scope and project boundary in the analysed methodologies naturally results in differing requirements for emission calculations. The differences, however, mostly affect project emissions (e.g. feeder trips in

---

[10] Note that "indirect emissions" in ACM0016 are differently defined than in the GEF methodology. The term is used despite its ambiguity because it represents the terminology used in the respective methodologies.

ACM0016) and leakage, but not so much baseline emissions, as discussed in the next chapter.

3.1.3 Baseline calculation and data requirements

As mentioned earlier, the stringency and required level of accuracy of emission estimations differs between CDM methodologies vs. GEF and CTF requirements.

To ensure the environmental integrity of the **CDM** and because financing is directly tied to the amount of CO_{2e} abated, requirements of AM0031 and ACM0016 for calculating emissions are very strict both at project entry (ex-ante) and during the project (monitoring). Different formulae with clearly defined parameters are used to calculate baseline (and project) emissions (see excel spreadsheet “Comparison of BRT methodologies” for detailed information). Although the CDM methodologies do not make mention of the ASIF methodology, the formulae used to calculate baseline emissions inevitably cover all ASIF parameters. Essentially, the CDM methodologies calculate the baseline trip distance per vehicle category that would have been used in the absence of the BRT system by the BRT passengers, multiplied with the respective fuel consumption and fuel emission factors for each vehicle category.

Baseline emissions and emission reductions are calculated ex-ante to project implementation and are verified through *annual* monitoring. Emissions are determined per passenger surveyed and upscaled according to total passenger numbers and modal split. A fixed technology change factor is used in ex-ante calculations. The baseline emission factor is adapted to potential changes in trip distance and type of fuel used by passenger cars if the surveys reveal that baseline emissions in a particular year were actually lower than estimated ex-ante. A template for passenger surveys is provided in each of the methodologies.

The **GEF** draft methodology on the other hand only requires emissions to be estimated *ex-ante*, because this is when financing is made available. The GEF draft methodology is based on ASIF and uses a spreadsheet-based Transportation Emissions Evaluation Model for Projects (TEEMP) to estimate emission savings of the anticipated project scenario against the baseline scenario. The model measures the changes in emissions brought about by the introduction of a new BRT system by identifying the likely future ridership and making certain reasonable assumptions about how riders would have travelled had the new system never been built. The baseline must factor in the likely expansion of the specific market (e.g. vehicle km of travel by vehicle and fuel type, development in fuel economy and carbon intensity of fuels etc); where limited market information is available a conservative estimate of a modest improvement in fuel economy should be used.

The methodology recognises that at an early planning stage detailed data is often not available and project impacts are less certain. While the GEF draft methodology encourages detailed gathering of local data, it also allows more uncertainty in the data used, such as secondary sources or international literature if local data is not available, e.g. for average trip length of different transport modes. The focus is on positive long-term impacts (including capacity building etc. for which impacts are hard to quantify) rather than on accuracy.

The **CTF** methodology on the other hand focuses on a detailed *ex-post* assessment of GHG benefits to monitor the market transformational impacts of CTF investments. Nevertheless, the methodology is also used to estimate emission savings before project implementation. In contrast to the CDM and the GEF methodologies, however, the CTF methodology is not used for project approval. So even ex-ante assessments are conducted only after the project investment plan has already been approved. During the project's monitoring and evaluation, ex-post data is collected and applied. Differences between ex-ante estimations and ex-post calculations are analysed to improve ex-ante estimations in the future. Emission calculations are also based on ASIF and heavily rely on transport models to assess emission reductions. Since the CTF methodology is designed for transport projects in general, the provided equations are not BRT-specific, but have to be adjusted to BRT by project developers.

Despite the outlined differences in assessment approaches and requirements for data accuracy (see also table 1), for all BRT projects *baseline emissions constitute those emissions caused by the alternative transport mode a person would have used in the absence of the project activity*. In other words, baseline emissions are based upon emissions per transported passenger. Consequently, data is required on the following indicators:

- The transport modes used in absence of the BRT project and
- their specific fuel consumption (including the former bus system, as well as other non-bus modes), which largely depends on the age of vehicles in use and average speeds,
- the fuel types used by the different transport modes and their carbon emission factor (based on the net calorific value of the fuel),
- the occupancy rate of the vehicles by mode,
- the trip distance for each mode used and
- the total number of passengers on the new system.

These are the core indicators that need to be determined to calculate the baseline emissions for BRT interventions. Table 1 gives an overview of the data sources applied for those indicators in each of the methodologies.

Looking at the data requirements for the above indicators, we find that default values can be employed for fuel efficiency (specific fuel consumption) of different transport modes and for fuel emission factors across all methodologies (please refer to table A1 for a more detailed overview of all default factors used in the different methodologies). These defaults can be national or regional values if available or based on IPCC.[11] All other data is assessed on a project-specific basis and is based on local traffic counts, observations and surveys or other local (or national) statistics, as well as information on the planned new BRT system. Due to its general character, the CTF methodology does not specify most of the data requirements above. However, it emphasises that "data and assumptions necessary for the GHG emission reduction assessment are normally highly project specific" (CTF/TFC, 2009: 18).

Table 1: Key parameters for BRT baseline establishment and data sources per methodology

Indicator	AM0031	ACM0016	GEF	CTF
The transport modes used in absence of the BRT project	Passenger survey	Passenger Survey	Derived from passenger numbers on new system and overall modal split	No specifications
Fuel types of different modes	Local statistics	Local statistics	Local statistics or secondary sources	Official statistics or survey
Average speeds	Project data or local statistics	Project data or local statistics	Local observations or secondary sources	Local observations and/or transport modelling
Specific fuel consumption by mode and fuel type	Local statistics, national or international literature, or IPCC values multiplied by an annual technology improvement factor of 0.99 for buses, taxis and passenger cars, 0.997 for motorcycles	Local statistics, national or international literature, or IPCC values multiplied by an annual technology improvement factor of 0.99 for all vehicle categories	GEF default value, assuming 10% fuel efficiency improvement per decade	No specifications

[11] Latest version of the IPCC Guidelines on National GHG Inventories, Vol. 2 (Energy).

Indicator	AM0031	ACM0016	GEF	CTF
Fuel emission factor	IPCC values	Fuel supplier statistics, sample measurements, regional or national or IPCC default values	GEF default factors or local data	IPCC values adjusted for the locally available fuel heating values and vehicle technology mix
Average occupancy rate of the vehicles by mode	Project statistics or official statistics	Project statistics or official statistics	Secondary materials or local observations	Survey or default values
Average trip distance for each mode	Project statistics or official statistics	Project statistics or official statistics	Local statistics or default value (for buses only)	No specifications
Total number of passengers on the new system	Recorded per entry station	Based on turnpike or electronic ticketing system	Based on operational plan plus a suitable traffic model or derived from use in current bus system using draft BRT model to estimate future ridership	No specifications

Source: own compilation

An illustrative example of the differences in data requirements for baseline calculation is that both CDM methodologies base the modal shift data from other transport modes on annual passenger surveys, whereas the GEF methodology assumes a certain relation between the quality characteristics of the new BRT system and its potential to draw passengers from other modes which is calculated by the model (a maximum of 25% of passengers are assumed possible to be drawn from other modes). Which modes the resulting percentage of passengers is drawn from is then 'guesstimated' on the basis of the prevailing overall modal split (of private vehicles) in the project city. The CTF methodology is less specific on the exact requirements for BRT projects, but a BRT example provided in the methodology calculated the expected modal shift from private cars based on transport modelling.

Obviously, the CDM methodologies will result in the most accurate information, but also the highest requirements for data gathering (on an annual basis).

Differences also exist between the two CDM methodologies. Whereas the key parameters are the same for baseline establishment, the set of formulae used for calculating baseline emission vary slightly[12]. Furthermore, AM0031 includes N_2O and CH_4 emissions, which are not considered in ACM0016. The templates provided for passenger surveys are also not the same and are more detailed in ACM0016 (also including trip origins and destinations outside the BRT system, in line with the larger project boundary).

Summarising the above assessment, we find that default values are mainly being employed for two parameters: fuel emission factors and vehicle efficiency (including a fixed technology improvement factor).[13] In reference to the ASIF model, the used default values fall into the categories modal energy intensity, composed of vehicle efficiency, usage and occupancy (I) and energy content of the fuel (F). It must be noted that defaults can be either national or international, so that defaults themselves can vary across projects. What’s more, vehicle efficiency is only one component to determine modal energy intensity, usage and occupancy rates still need to be assessed on a project-by-project basis.

For transport activity (A) and modal structure (S) BRT methodologies also require data to be assessed locally either on the basis of existing statistics or on the basis of targeted traffic counts and new surveys. The only exception to this rule is the GEF draft GHG model for BRT, which provides a default factor of 6km as average passenger trip length on the existing bus system to be used as a fallback option in case that no standard values are available from household or spot surveys. This may be seen as a first step towards standardisation, the implications of which are discussed in the next section.

Returning to the initial three questions (1. Do the analysed methodologies cover exactly the same project category? 2. Are the key parameters to determine baseline emissions the same across all methodologies? 3. Are standardised values already used for parts of the parameters and which ones?) we find that while all methodologies are applicable to BRT projects, their exact scopes and project boundaries differ.

What’s more, the different foci of the methodologies (accurate emission reduction estimation ex-ante and ex-post in CDM, rough estimation ex-ante in GEF including indirect effects in the longer term, focus on market transformation and transport modelling in the CTF) present considerable barriers to harmonising methodologies across CDM and other carbon finance mechanisms. While the CDM cannot become less stringent in regard to accuracy in order to safeguard environmental integrity, requesting the same level of accuracy from GEF or CTF projects ex-ante would increase their

[12] Larger differences exist in calculations of project emissions as pointed out in 3.1.2 on project boundaries. It is beyond the scope of this paper to describe these differences here, but an overview can be gained from the electronic appendix on the comparison of methodologies.

[13] Default factors are also used for construction emissions as can be seen in table A1.

transaction costs and add an additional burden to project developers. Raising the requirements for emission calculations could potentially reduce the number of transport projects being developed under the GEF and CTF, foregoing their corresponding emission reductions. Surely, improving emission accounting should not lead to less emission savings being realised.

Despite the differences in the objectives of the methodologies, it can be said that the key parameters to determine baseline emissions are essentially the same, but the requirements for data accuracy and data sources are laxer in the non-CDM methodologies. Furthermore, the greater part of the data needs to be localised, only few default values are in use, meaning that baselines are highly project-specific.

Clearly, a further standardised baseline could simplify emission calculation in all methodologies. To what extent this is suitable is discussed in more detail in the next section.

4 Discussion: The challenge of standardising baselines in transport

Based on the above analysis, the following paragraphs apply the ASIF framework to discuss what would be necessary in order to reach a higher level of standardisation of a baseline for BRT interventions in theory and to what extent this seems (un)suitable. Secondly, requirements for data, update intervals and costs are discussed.

4.1 ASIF parameters suitable for standardisation

We have seen above that currently default values are only in use for fuel emissions (F) and for the vehicle efficiency part of modal energy intensity (I). The following section therefore discusses the possibilities to standardise ASIF parameters in reverse order, starting with fuel emissions and modal energy intensity, before discussing the potential to standardise (elements of) modal structure and total transport activity.

As mentioned above, baseline emissions for BRT projects depend on emissions per passenger kilometre for each mode that would have been used in the absence of the BRT system. The key parameters necessary to determine baseline emission can hence be sorted according to ASIF as follows:

F	Fuel emissions
I	Fuel consumption for each mode, depending, inter alia, on vehicle age
	Speed
	Occupancy
S	Transport modes used in absence of the BRT system
	Trip length by mode
A	Total number of passengers on the new system

4.1.1 Fuel emission factors (F)

We have seen that different default values already exist for (fossil) fuel emission factors. These can be national or international based on IPCC. Upstream emissions are usually not included in these default values and will need to be assessed separately if they are to be included in the baseline emissions at all. Where upstream emissions are not included in the baseline, it must be clear that project activities will generate the same or lower upstream emissions than the baseline (fuel switch situations hence usually require the consideration of upstream emissions). As mentioned earlier, version 1 of AM0031 used a default value of 14% for upstream emissions from fuel production (based on L-B-Systemtechnik GmbH, 2002). In reality, upstream emissions of fuel production, refining and delivery can vary significantly even for the same fuel (consider tar-sand-based gasoline as an extreme), depending on the fuel's origin, so different suppliers may have different upstream emissions. Nevertheless, using a conservative default factor can greatly simplify baseline emission calculation, while ensuring environmental integrity. Alternatively, upstream emission standards can be developed at the national level, ideally individually for each of the main oil companies, if they do not already exist.

Concerning biofuels, the situation is different. The IPCC (2006, Volume 2, Energy) only provides emission factors for CH_4 and N_2O emissions of biofuels, because CO_2 emissions of biofuels are captured in volume 4 on Agriculture, Forestry and Other Land-use in the national greenhouse gas inventories. So, no international standard is available for carbon emissions of biofuels. In the CDM BRT methodologies the CO_{2e} emission factor for the biofuel share in blends is to be calculated as equal to zero (and upstream emissions are not considered). No reference is made to biofuels in the GEF methodology (for CTF see next paragraph).

Similar to fossil fuels, upstream emissions can vary greatly for biofuels, and if they were to be considered in baseline calculations, there should be at least national if not local values. However, accurate assessment of life-cycle-emissions of biofuels remains a difficult and heatedly debated topic, especially where indirect impacts on land-use are concerned, which have been underestimated in the past (see for instance Rughani, 2008 and Biofuelwatch, undated). The CTF methodology requires using version 1.8b (or later) of the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (GREET), developed by Argonne National Laboratory[14], to calculate the effect of changes to the fuel cycle from well-to-tank of non-fossil fuels.

In conclusion, using default values for the carbon content of fossil fuels is already common practice and suitable both in terms of comparability and feasibility. The situation is similar with respect to conservative default factors for upstream emissions from fossil fuel production. It is furthermore standard in the CDM to calculate emissions from the biofuel share in blended fuels as equal to

[14] Available for download at http://www.transportation.anl.gov/modeling_simulation/GREET/index.html.

zero. Developing a coherent standard for upstream fuel emissions for biofuels seems more difficult in terms of comparability of cultivation, refining and delivery. Nevertheless, it should be noted that underestimating emissions in the baseline, e.g. by applying a conservative default factor, only results in a more stringent baseline and hence less emission reduction credits for the project.

Where the same fuel is used in the project as in the baseline scenario, the effect of the fuel emission factor on the emission savings is expected to be relatively small compared to other differences brought about by BRT developments, including through enhanced vehicle technology, higher occupancy rates or increased average speeds.

4.1.2 Modal energy intensity (I)

As explained above, modal energy intensity is a compound of vehicle efficiency, usage and occupancy. Default values are currently only used for vehicle efficiency. It should be noted that even using IPCC default values for vehicle efficiency, local data on vehicle technology and age of average vehicles are still required to decide on the most appropriate IPCC values.

To take a further step in standardisation of modal energy intensity, standard values would be needed for the average age of vehicles, average occupancy rates and speeds. In principle all these factors vary according to local circumstances, such as wealth, local transport systems, level of motorisation, mobility culture etc.

Nonetheless, for certain elements the development of default averages based on empirical data may be possible over time. For instance, the Clean Technology Fund (CTF/TFC, 2009) expects that default values for *occupancy rates* of vehicles and average freight tonnes per vehicle will soon be established based on the analysis and data from initial Clean Technology Fund (CTF) projects. To what extent these defaults can be regarded as representative remains to be seen. As concerns comparability of occupancy rates, this will largely depend on the geographical scope for which averages shall be developed. Perhaps equally important to purely geographical boundaries may be other socio-economic indicators, such as average income or overall level of motorisation.

Whether representative values for occupancy rates can be developed may only be possible to tell *after* having gathered a large enough sample for different transport modes in differently sized cities across different regions. It is questionable that this will be possible based on CTF projects only. Nonetheless, analysing data from existing project documentation seems a feasible approach as a first step to assess comparability and judge if development of widely applicable defaults is suitable, Ideally a coordinated effort would be made by several institutions funding or otherwise involved in BRT developments worldwide to merge their data and make use of all the information that already exists, but remains scattered.

Developing a default value for average *vehicle technology* and *age* can essentially be seen as a benchmark for vehicle efficiency, when combined with existing default values for fuel consumption for the different vehicle types (IPCC or national values). As always, in order to avoid overcrediting, such a benchmark would have to be conservative and ultimately require a political decision at which level to set the technology standard for a crediting baseline. While this seems feasible as far as data gathering is concerned (data on vehicle type and age is usually available from car registries or bus operators) it is questionable to what extent this is politically wanted. Assuming such a benchmark would be set at the national level following the top-runner approach, e.g. setting the crediting baseline for each vehicle category at the fuel efficiency level of the 20% vehicles with the best technology in a country this will result in rather ambitious baselines for the remaining 80%, resulting in less potential for emission reductions at the project level, especially in less developed cities.

One step further, several institutions have already suggested that energy intensity benchmarks (in MJ/vkm), could be developed for specific vehicle fleets both public and commercial, including buses (urban and interurban), metro, light rail, rail, taxis or logistics fleets (TRF, 2010; IETA, 2010). An energy intensity benchmark would be independent of the type of transport fuel used. Alternatively, fuel consumption benchmarks could be developed for fleets expressed in l/vkm. Either way, this would require gathering substantial amounts of data on fleet ages, vehicle technologies and related fuel consumption (and the heat value of fuels) to be representative. Bus fleets would still need to be disaggregated at least into large, medium and small buses and/or mini-vans to ensure representativeness.

In combination with default values for occupancy rates or average freight tonnes per vehicle, fuel consumption benchmarks could theoretically also be developed for modal intensity benchmarks, expressed in l/passenger-km.

The amount of data necessary for developing such a benchmark in a robust manner, however, should not be underestimated. Lack of data availability may seriously hamper such an attempt. For instance, Ecofys in their work on Sectoral Proposal Templates for transport in Beijing, China encountered difficulties in gathering vehicle efficiency data (in TJ/person-km), which they found “impossible to collect […] at this level from direct sources such as statistical yearbooks or other publications” (Ellermann et al., 2009: 8)[15]. Keeping

[15] They relied on previous studies by the Chinese Energy Research Institute instead.

in mind that Beijing already has quite good data availability compared to other Chinese cities (Ellermann et al., 2009), this illustrates that developing such benchmarks e.g. at national level will be difficult and costly at best.

The last key parameter for modal fuel intensity is average speed. Speed is highly dependent on local characteristics of the transport system, as well as on mobility culture. It does not appear suitable for standardisation in terms of a fixed default value. Instead, fixed speed emission adjustment factors as used in the GEF draft BRT model could be applied to account for emission differences due to speed.

In conclusion it can be said that potential for further standardisation of modal energy intensity exists, but that the suitability for standardisation may only be properly judged after a first trial of data gathering and comparison.

What's more, even if modal energy intensity were to be standardised to a large extent, project specific information on which modes would have been used in the absence of the BRT system would still need to be gathered locally, which we examine in the following.

4.1.3 Modal structure (S)

For BRT project baselines, the prevailing modal structure in the project city (or project area in a city) is relevant for the transport modes used in absence of the BRT system – the key determinant of baseline emissions and hence also emission reductions.

Usually data on modal structure needs to be gathered on a project basis to adequately reflect local circumstances. Where local circumstances are very similar, at least certain elements of modal structure may be more or less comparable. The GEF draft GHG model for BRT provides a default of 6km as average passenger trip length on the existing (non-BRT) bus system (to be used if no local data is easily attainable). Using such a default value, however, introduces considerable uncertainties; likely underestimating trip distances especially in (monocentric) and big megacities.

Underestimating trip lengths in the baseline results in an ambitious baseline scenario. On the one hand, this is positive for the environmental integrity of the mechanism, but on the other hand projects might find it difficult to beat such a baseline. Further research comparing average trip lengths on bus systems from different cities of comparable size and spatial structure for different countries would have to be conducted to identify if robust default values can be established for different sets of cities within a certain scope and what level of uncertainty this would potentially entail.

Clearly, this is not possible within the scope of this research. However, the case of Hefei, a Chinese city where demand for transport is rapidly growing, is used to illustrate the challenges or opportunities to develop standards for modal structure.

Box 1: Challenges for standardisation in Hefei

Background

Hefei is the capital of Anhui Province and is located 450 km west from Shanghai between central China and the booming coastal regions. The total urban area is just over 7266 sq km, of which over 640 sq km are classified as urban area. At the end of 2008, Hefei had a total of 4.87 million inhabitants with around 2 million living in the urban centre. The number of daily bus passengers has increased steadily from 700,000 in 2003 to 1,700,000 in 2009. As the number of individual cars also increases by 200-300 per day, congestion is becoming a matter of concern for policy makers. Currently, congestion is concentrated mainly in the old city centre.

Photo: Traffic in Hefei, 2009 by Martin Ruhé

The dynamic growth of passenger transportation is, however, expected to continue and the public transport system, which accounts for about 20% of all trips in Hefei, is operating at capacity. Against this background a transit-oriented development is envisaged, including the extension of BRT and the development of light rail or metro lines. The first BRT line in Hefei started operation in 2009. At present, three BRT lines are in operation. Plans foresee seven BRT lines with a combined length of 200 km by 2020.

The city has deployed BRT buses of different lengths: 6, 12 and 18m. The most common BRT vehicles are 12m in length. There is currently no one single emission standard (e.g. EUR III) being applied to BRT buses. The city is currently experimenting with a small number of electric buses, however, none are in BRT operation (Interview Hefei City Planning and Design Institute, 2010).

BRT is supposed to supplement and integrate with the subway system currently under construction in Hefei. The final length of BRT lines will depend on the number and total length of subway lines to be built in Hefei (Interview Hefei City Planning and Design Institute).

Photo: BRT outside the city centre in Hefei, 2010 by Matthias Kracht

The average speed of regular buses in Hefei is 16 to 18 km/h, while BRT buses reach an average of 22 to 25 km/h. These values may vary significantly from line to line and from district to district. Due to widespread construction efforts and associated rerouting, trip lengths and speeds are often severely impacted. (Interview Hefei City Planning and Design Institute, 2010)

Daily passenger trips are around 1.8 million. The exact share of BRT trips is not clear at times, however, it is estimated that 20% of all passenger trips are conducted via BRT (Interview Hefei City Planning and Design Institute, 2010).

Results of Household Survey in 2010[16]

In March/May 2010 a household survey was conducted in Hefei. The mobility behaviour of 10,872 persons was analysed. The survey revealed that 61% of the interviewees did not own a private car and did not have access to a company car. Nevertheless, the modal analysis showed that 45% of all km were travelled by private motorised transport as a driver or passenger. In comparison, 35% of km were conducted by bus (see figure 4).

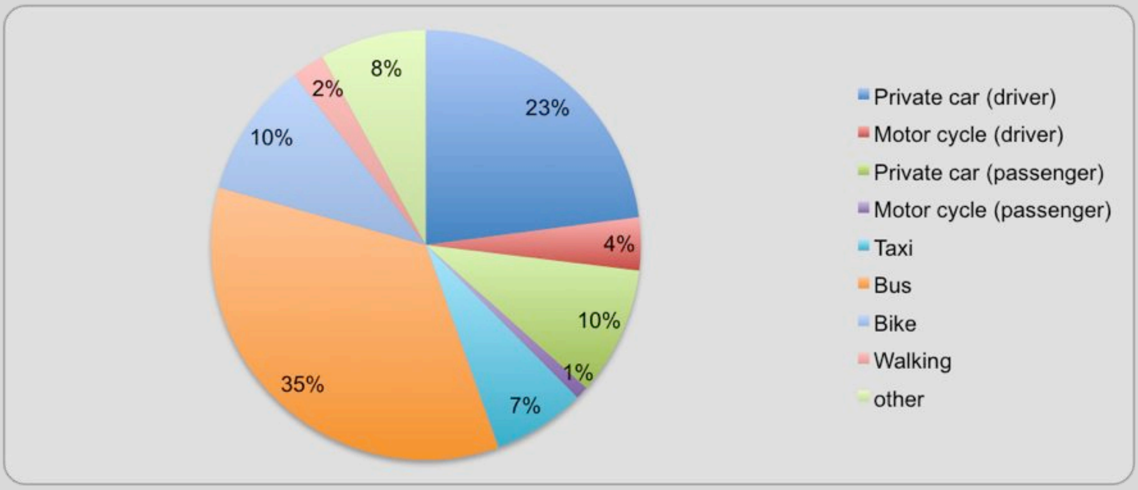
Possibilities for standardisation

These results for the modal share of public transport are within the range of those in other Chinese cities like Beijing (34.5% in 2007), Shanghai (30% in 2004), Guangzhou (32% in 2006),

[16] The household survey was conducted in cooperation with the School of Architecture and Urban Planning of Anhui University of Architecture.

or Dalian (43% in 2007) (Hu et al., 2009). However, a difference of 5% can translate into significant differences in associated emissions (which of course also depend on a range of other factors). Mode use is usually a result of different factors determining mobility behaviour. Besides individual factors on the demand side such as income, age and access to cars, local factors like urban structure and, most importantly, transport policy determine distance travelled as well as the share of the particular mode used. The share of public transport in Hong Kong of 72% is an example for how local determinants can significantly impact the modal share.

Figure 4: Modal split in Hefei (in km)



The average trip length on buses in Hefei is seven kilometres, which is not too far off the default of six kilometres determined by the GEF. But a difference of just one kilometre translates into a deviation of 15%, which has a significant impact on the calculation of the resulting emissions. In order to determine a more accurate value of average trip length further inquiries in the form of passenger interviews may be necessary.

Taking into consideration that populated areas and infrastructure systems in most cities of emerging and developing countries are growing fast, trip length is also expected to increase. The aspect of spatial growth as well as sociodemographic changes, accompanied with an increase in motorization, leads to an enlargement of individual action space – and often a drop in public transport shares. These dynamics are illustrated by other studies, e.g. the share of public transport in China dropped by 6% in recent years (Hu et al., 2009), as well as by experiences of transport development in industrialised countries within the last decades.

In conclusion, robust defaults could hardly be developed for the entire modal split due to local circumstances and high dynamics in growing cities. Aspects such as city and infrastructural growth as well as economics have a profound impact on individual mobility behaviour. As shown above, even a small deviation from the default, e.g. for average trip length can have a large impact on emission values.

In order to ensure the development of a coherent local transport planning process and demand-oriented transport infrastructure, local authorities should investigate mobility indicators on a regular basis. The objective for standardisation to lower transaction costs for individual projects in the longer term may therefore be rather contradictory to developing locally appropriate transport policies and measures.

As explained above, in the case of CDM projects the modal share in the baseline is assessed through passenger surveys to accurately capture the project impact. While the modal structure in a particular city naturally affects the baseline modes, the baseline modal structure and modal trip length amongst BRT users may well be different to the city wide modal share, particularly, if the modal structure for a particular set of trips is assessed. Therefore, even if comparable levels of modal share could be developed for comparable sets of cities, more contextual information is still necessary for BRT interventions under the CDM, which can only be assessed on a project-by-project basis.

In fact, it seems unsuitable to apply a standard modal split, even if comparable values could be developed, due to local specifics like transport policies and high dynamics in the particular cities.

4.1.4 Total transport activity (A)

Total transport activity in a specific locality is highly dependent on a range of variables, including inter alia the level of motorisation, spatial structure and level of economic development. In particular in developing countries, where motorisation is rapidly increasing, transport activity is constantly changing (in contrast, transport activity has remained largely constant e.g. in Germany over the last decades).

For BRT baselines, the (expected) total number of passengers on the new system must be known in order to assess the baseline emissions of those passengers. This information is clearly project-specific and not suitable for standardisation.

Standardising transport activity is not feasible or even sensible. It would be equivalent to setting a benchmark for industrial output volume instead of setting a benchmark for emission intensity per unit of output. Baseline transport activity will hence always have to be assessed on a project basis.

4.1.5 Summary

BRT baselines largely depend on modal structure, which differs from city to city, making baselines not easily comparable across projects. In the end no single benchmark can be developed for BRT interventions, since baseline emissions depend on many different indicators that cannot be easily aggregated into one unit.

Further research into default values or benchmarks for modal energy intensity and average trip lengths by mode nevertheless holds potential for simplifying at least some steps in baseline setting for BRT in the future.

It is however clear that there will always be a trade-off between simplification through standardisation and the ability to grasp local circumstances. The higher the level of aggregation, the less project specific the baseline and hence the emission reductions will be. At the same time this means that a very conservative standard is required for the CDM, where emission reductions are offset, to ensure environmental integrity.

This is an issue for CDM projects since finance is directly linked to emission reductions. The relatively small emission reductions of BRT projects compared to the overall investment are already a barrier to CDM projects on BRT and perhaps more so than methodological issues (Millard-Ball, 2008). So, applying conservative standards may in fact make CDM activities less attractive to project developers as fewer credits can be gained, where local circumstances are such that agreed defaults or benchmarks result in lower baseline emissions than a project-specific assessment.

In particular in BRT projects, where there will always remain a need to gather data at the project level anyhow, project proponents will have to weigh the cost of additional data gathering efforts against potentially higher gains through higher emission reductions.

In regard to standardising methodologies across different climate finance mechanisms, our analysis showed that due to the differing foci between the GEF, CTF and CDM this would not be easy. Approaches by the GEF to simplify ex-ante emission calculations at the cost of accuracy will not work for the CDM. On the other hand, CDM requirements may add unnecessary additional data burdens on GEF and other non-credited carbon finance projects.

Along the same lines, standardised baselines and default values hold more potential for other climate finance projects in transport, where accuracy is less important. Since for these mechanisms overestimating emission reductions would not result in lower global emission reductions a higher level of uncertainty around default factors or benchmarks seems acceptable.

4.2 Data requirements and possible starting points

As mentioned earlier, in order to develop emission intensity benchmarks or default values, representative data needs to be gathered for a significant share of similar activities. Gathering good quality, reliable data from comparable activities in different geographical areas poses significant challenges as transport data in many developing countries is only poorly documented or gathered. To establish baseline curves and distinguish between business-as-usual and superior practices, data needs to be disaggregated and recent. Where different existing datasets are used in combination to establish baseline curves, they may need to be reconciled to ensure consistency (UNFCCC, 2010). For instance classifications may differ between datasets, e.g. Chinese statistics do not include direct data on transport sector energy consumption. Instead, transport-related energy consumption data is included in three different categories under energy consumption: 1) transport, storage and post; 2) wholesale, retail trade, hotel and restaurants, as well as in 3) residential consumption. The scope of classifications of different datasets hence needs to be clear before datasets are used in combination (Ellermann et al., 2009). Furthermore, measuring units e.g. for fuels may also differ between datasets (e.g. cubic meters vs. metric tonnes for natural gas, which accordingly require different conversion rates to calculate energy content and emissions). In many cases, however, data will need to be gathered from scratch.

Data gathering for standardised baselines should be institutionalised at the national level (supported internationally) in conjunction with efforts on national GHG inventories. Setting up such data inventories will therefore not only support the development of standardised baselines for CDM, but also prepare for quantifying the effects of NAMAs and contribute to the formulation of bi-annual national communications as envisaged in the Copenhagen Accord (although national communications on transport are currently mostly based on national fuel sales).

However, in many developing countries, key data collection systems may still be in early stages. This means that capacity building and financial support from the international community will be required to enable national institutions to gather relevant data. At the same time, this may be an opportunity to set up systems that follow an international standard to develop transparent and consistent data that is internationally comparable.

Updating standards

Furthermore, routinely updating emission intensity benchmarks or default values is necessary to take account of technology improvements or other socio-economic developments, e.g. those affecting motorisation and occupancy rates. A fixed annual technology improvement factor as currently used in the CDM and in the GEF could be used for efficiency-related benchmarks. Nevertheless, an appropriate interval for updates needs to be decided.

Keeping baseline standards for transport up-to-date in rapidly developing countries may pose particular challenges, especially where leap-frogging takes place from e.g. very old buses to highly fuel-efficient new buses. If such developments are not captured, e.g. in fleet standards, the risk of over-crediting emission reductions is high. Standards would need to be updated every few years.

Continued commitment to data collection is hence required. Developing standardised baselines is therefore not a one-off activity, but needs to become an institutionalised process to ensure that data is collected consistently and completely over time and that the relevant resources are allocated accordingly.

Costs

The costs for data gathering and developing defaults or benchmarks must not be underestimated, in particular taking into account that global standards will not be suitable in the transport sector. Michaelowa (2010) puts the cost to establish electricity grid emission factors of large countries at ca. 100,000 US dollars and states that several million dollars will be needed to establish full performance standards. Costs for updating those standards would come on top of that.

Whether the development of standardised baselines will finally lead to decreased transaction costs compared to a project-by-project baseline establishment will largely depend on the number of projects that will be developed using the standardised baseline.

In any case, however, baseline establishment costs are expected to shift from project developers to public or multi-lateral institutions, where standardised baselines are developed. As mentioned before, the incentive for project developers to bear the cost of designing standardised baselines, which will then be freely available for everyone is minimal. So, a ‘top-‘down approach will be necessary (see also chapter 5.2).

Institutional issues

To ensure quality and accuracy of the data, datasets will need to be verifiable and should be verified through spot checks by an independent verifier. Top-down development of high-quality datasets and standardised baselines could significantly contribute to an enabling environment for carbon markets, by reducing the transaction costs for single carbon finance projects, making investments more attractive for project developers.

It is critical for the international community to be prepared to support national or municipal institutions in gathering and verifying such data in a carefully coordinated approach. A new body in charge of standardised baselines under the CDM Executive Board could fulfil such a coordinating role (see chapter 5.2 on modalities and procedures). As mentioned earlier, some efforts to gather data for default values are already under way by international institutions. The Clean Technology Fund Trust Fund Committee in its Guidelines for *Calculating GHG Benefits of CTF Investments in the Transport Sector* aims at developing default values for different aspects of GHG reduction measurements. It states that "(r)esources may be available under the CTF for undertaking these measurements [to allow establishment of default values] and to build databases as part of project preparation, which will not only aid GHG assessment for the project, but will be an investment in terms of baseline values for other analyses to be conducted subsequently" (CTF/TFC, 2009: 21). The GEF has also developed default factors based on results from past projects and expert opinion, e.g. for vehicle efficiency values.

To make use of synergies, efforts to generate transport databases to develop default values and emission intensity benchmarks should be coordinated and a unified methodology agreed to establish universally applicable datasets/ defaults for all carbon finance projects in transport (be it CDM, NAMAs, CTF or GEF). If project experience by different donors, countries, cities and project proponents can be merged this may be a good starting point.

5 Conclusions and Outlook

This chapter first draws conclusions on the extent to which further development of standardised baselines for the CDM as currently considered under the UNFCCC can incentivise policies and measures aiming at behavioural changes in the transport sector, focusing on BRT. Finally, suggestions for the further development of CDM modalities and procedures are formulated with a special focus on transport.

5.1 Standardised baselines for BRT – no quick solution for fostering modal shift

The study systematically compared existing methodologies for calculating baseline emissions from BRT projects, namely two CDM methodologies (AM0031 and ACM0016), the GEF draft BRT model and the CTF Guidelines for Calculating GHG Benefits of CTF Investments in Transport. Analysis of the comparability of the methodologies regarding their scope, project boundary, emission calculation and data requirements revealed several differences:

- The CTF guidelines have the largest *scope*, being applicable to all transport projects that restrain future transport emissions. All other methodologies are explicitly designed for BRT (or rail-based mass transit) projects. The GEF methodology can generally be used for all BRT projects, the CDM methodology ACM0016 is the most confined. In contrast to AM0031 it excludes operational improvements (e.g. new or larger buses) of an already existing and operating bus system and requires that most part of the BRT system be based on dedicated bus lanes.
- In both the CTF and GEF methodologies, the focus is on positive emission impacts in the long-term and ensuring that emission reductions through sustainable transport projects are actually being realised rather than precise emissions accounting as is required by the CDM to create tradable credits.
- The *project boundary* is not explicitly defined for BRT in the CTF guidelines because of its general scope. The GEF includes as direct project emissions all emissions caused or avoided by passengers travelling on the BRT system, as well as construction emissions. Both the GEF and CTF methodologies further identify emission reductions not directly caused during the project's lifetime, such as financial mechanisms still operational after the project ends (so-called post-project direct emissions) and so-called indirect emission reductions, including replication effects of successful BRT systems, effects of capacity building etc. Due to the different levels of uncertainty

associated with the different types of emission reductions, they are not, however, aggregated with direct project emission savings.

The CDM methodologies' project boundary includes emissions caused or avoided by passengers travelling on the BRT system, as well as leakage emissions due to a change in load factors of taxis or conventional buses or a change in congestion. The largest difference between the CDM methodologies is that 'feeder trips' made by the passengers using the BRT system, from their trip origin to the BRT entry station and from the BRT exit station to their trip destination are covered in the project emissions of ACM0016 but not in AM0031.

- Regarding *emission calculation* and *data requirements* the CTF and GEF methodologies accept a higher degree of uncertainty in the data than the CDM methodologies. The CDM methodologies require annual passenger surveys to assess modal shift to the BRT system from other transport modes and use this data to continuously update the baseline if necessary. The GEF methodology on the other hand assumes a certain relation between the quality characteristics of the new BRT system and its potential to draw passengers from other modes. Which modes the resulting percentage of passengers is drawn from is then 'guesstimated' on the basis of the prevailing overall modal split. The CTF methodology in a BRT example calculated the expected modal shift from private cars based on transport modelling. All in all, the CDM methodologies will result in the most accurate information, but also the highest requirements for data gathering (on an annual basis).

Despite these differences, we found that the core parameters to calculate emission baselines are the same across all methodologies. We used the ASIF model to examine these parameters and assess to what extent standardised baselines or default values can be developed for BRT projects. The parameters are:

A	Total number of passengers on the new BRT system
S	Transport modes used in absence of the BRT system
	Trip length by mode
I	Fuel consumption for each mode, depending, inter alia, on vehicle age
	Speed
	Occupancy
F	Fuel emissions

The study showed that existing climate finance mechanisms such as the CDM, the GEF and the CFT already employ some default values for fuel emissions and fuel consumption in the transport sector. However, most data remains project specific. Importantly, no single benchmark can be developed for BRT interventions, because baseline emissions depend on many different indicators that cannot be easily aggregated into one unit. As BRT baselines largely depend on the local modal structure, which can vary substantially even between similar cities, baselines are not easily comparable across projects. Modal structure is driven by individual factors on the demand side, such as income, age and access to cars, as well as local factors like urban structure and local transport policy. The share of public transport in Hong Kong of 72% is an example for how local determinants can significantly impact the modal share. This is a large impediment for emission calculations compared, for instance, to vehicle efficiency improvements and one which will not be solved through standardising baselines. In order to capture the effects of behavioural changes, such as modal shift, data on total transport activity and modal structure cannot be justifiably standardised, but need to be gathered at the project level.

The example of Hefei illustrates how the rapid urbanisation dynamics that are taking place in most developing countries make standardisation even more difficult. In Hefei, the number of daily bus passengers has increased steadily from 700,000 in 2003 to 1,700,000 in 2009 while the number of individual cars is increasing by 200-300 per day. To have an accurate picture of baseline emissions data would in principle have to be constantly updated. This raises the question whether the effort to gather the necessary data for standardised baselines would in fact be significantly smaller compared to a project-based approach.

Nevertheless, further research into the development of default values and vehicle or fleet efficiency benchmarks could simplify baseline setting for BRT to some extent in the future. Parameters suitable for standardisation are, however, mainly related to fuel and modal emission intensity. Information on which transport modes would have been used in the absence of the BRT system will always have to be gathered locally to reflect a project’s impact.

Clearly, standardising baselines or parts thereof is not a quick-fix solution. It will take considerable time and resources until representative data is gathered and analysed – and not least until a benchmark level will be agreed upon. It is also clear that there will always be a trade-off between simplification through standardisation and the ability to grasp local circumstances. This means that a conservative standard is required for the CDM to ensure environmental integrity. Applying conservative standards may however make CDM activities less attractive for project developers as fewer credits can be gained.

Further work will also need to be conducted on determining an appropriate geographical scope for different standards. Aggregation at a high level will facilitate project development as these standardised baselines would be applicable to high numbers of projects. However, highly aggregated standardised baselines will not be able to capture country- or region-specific differences and may thus easily lead to over- or under-crediting of reductions. Neglecting to gather detailed local data will also impair the ability to design locally appropriate transport policies and measures.

Due to the high diversity in transport behaviour across, but also within countries, relatively small geographical scopes will likely be required for comparable standards in transport, increasing the data requirements compared to more homogenous sectors.

Standardised baselines beyond the CDM

A clear trade-off exists between simplification and accuracy of calculating transport emissions. However, this trade-off is particularly grave when it comes to CDM activities. As an offset mechanism, calculating exact or very conservative emission reductions is essential to ensure the environmental integrity of the mechanism (to avoid that too many tonnes of CO_2 are offset and therefore not mitigated at the global scale).

In regard to standardising BRT methodologies across different climate finance mechanisms we conclude that due to the different foci of the GEF, CTF and CDM this will not be easy. Approaches by the GEF to simplify ex-ante emission calculations at the cost of accuracy will not work for the CDM and universally applying CDM requirements would add additional data burdens on GEF, CTF or other non-credited carbon finance projects.

For climate finance instruments which do not result in tradable credits there may be more room for standardisation in the sense that precision (of the exact amount of emission reductions) is less important than ensuring that projects are being implemented and that emission reductions are actually happening. So, default values with a higher level of uncertainty may be justifiable in the name of simplification (and therefore reduction of transaction costs actually leading to higher economic efficiency) in other climate finance projects, such as uncredited NAMAs, GEF or CTF projects.

Further promise may lie in sector-wide approaches. Due to its local specificities, in the case of transport a sectoral approach could be established at the local level, for example taking in transport within a given city. A “project” could then consist of a series of coordinated activities to avoid, shift and improve transport within the city. But here, too, many methodological questions still need to be answered regarding geographic scope, which transport modes to include and associated leakage. Lack of comprehensive data at the city level will also remain a hurdle for sector-wide approaches (compare Ellermann et al., 2009).

To be able to design appropriate transport policies and measures, gathering detailed data to get a clear picture of the situation would in the end still be necessary. In that sense, measuring, reporting and verification is not so much an inconvenient imposition from the international policy level, but should in fact in any case be done for the sake of being able to design good transport policy.

5.2 Further development of CDM Modalities and Procedures

Decision 2/CMP.5 on further guidance relating to the CDM "Requests the Subsidiary Body for Scientific and Technological Advice to recommend modalities and procedures for the development of standardized baselines that are broadly applicable, while providing for a high level of environmental integrity and taking into account specific national circumstances, and to forward a draft decision on this matter to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its sixth session".[17] It further invites Parties, intergovernmental organizations and admitted observer organizations to make submissions to the secretariat on their views on modalities and procedures for the development of standardised baselines. Unless otherwise stated, the following section is based on these submissions.[18]

In coherence with existing modalities and procedures for CDM baseline methodology development, determining the appropriate entities for developing, reviewing and approving standardised baselines will be necessary.

Baseline development

- The EB should play an active role in the development of standardised baselines.[19] Several submissions to the UNFCCC suggest that the EB should, through its support structure, itself develop standardised baselines

[17] http://unfccc.int/resource/docs/2009/cmp5/eng/21a01.pdf#page=4

[18] All documents are available online at: http://unfccc.int/resource/docs/2010/sbsta/eng/misc03r01.pdf and: :http://unfccc.int/parties_observers/ngo/submissions/items/3689.php

[19] According to the Marrakesh Accords, CDM baseline development is, in principle, a bottom-up process in which project-specific methodologies are put forth by project developers for approval by the CDM Executive Board (EB). Nevertheless several exceptions from the bottom-up procedure already exist. COP 7 in Marrakech mandated the EB to develop top-down methodologies to foster small scale projects, for which a dedicated Small Scale Panel was set up under the EB. CMP 5 in Copenhagen mandated the EB to develop top-down methodologies particularly suitable in countries with less than ten registered projects. The EB further develops standardised tools for aspects relevant to many project activities, such as the *Combined tool to identify the baseline scenario and demonstrate additionality*. The Executive Board could hence also be mandated to develop top-down methodologies for standardised baselines, in addition to bottom-up initiatives.

(e.g. EU and Japan). Previous experiences with the EB regarding transport methodologies, however, have shown that the EB may not be well suited to develop standardised baselines for transport due to a lack of transport experts and transport expertise in the EB and the Methodologies Panel (see Millard-Ball and Ortolano, 2010). If the EB were solely to rely on its existing structure, strengthening the transport expertise of the Meth Panel or its access to transport experts should be ensured.

- However, the EB is already operating at stretched capacity, leading to delays in project approval. Expanding the resources of the Executive Board by setting up an expert commission may hence be necessary. IETA (2010) suggest that the EB create a 'Stakeholder Advisory Panel for Standardised Approaches' with official standing, to support and advise the EB and Secretariat on the development of standardised baselines and related new CDM guidance. It must be ensured that such a Standardised Baseline Panel would include experts from all sectors, in particular those currently underrepresented in the CDM, such as transport.
- Priority in the 'top-down development' of standardised baselines should be given to sectors (and regions) so far underrepresented in the CDM.
- Standardisation initiatives by other stakeholders should also be encouraged and supported. The Executive Board and its support structure should consider the results from these efforts in their own deliberations.
- In particular where the level of aggregation is confined to a national or regional scope, the EB is unlikely to have the capacity to define standardised parameters for multiple geographical areas. Wherever possible, use should be made of the existing capacity of DNAs and other national institutions in data gathering and adaptation of the proposed standardised baselines to local data.
- International financial institutions can also play a strong role in gathering and sharing information as part of their past and ongoing project activities. The Partnership for Sustainable Low Carbon Transport (SloCaT) further set up a working group on transport data & assessment, whose work includes, inter alia the review of a GEF methodology for measuring GHG benefits of GEF transportation projects.[20] A unified methodology should be agreed to establish consistent datasets.
- Regional multilateral organizations, such as regional development banks, could also be mandated by the EB to coordinate efforts to gather necessary data and develop standardised baselines for final approval by the EB. It is important that such a process be seen as impartial, transparent, credible and rooted in national and regional circumstances.

[20] http://www.sutp.org/slocat/work-program/transport-data-and-ghg-assessment/

- Financial support for data gathering will have to be made available internationally to facilitate the development of standardised baselines, since the common good nature of methodologies and the significant cost of data gathering are a disincentive for project proponents alone to move towards standardisation. This will be particularly important in less or least developed regions where institutional capacity to gather transport data is low.
- Financial resources to develop standardised baselines in transport could come from the Executive Board, from existing carbon finance mechanisms targeted at the transport sector, such as the CTF and GEF, and in the future could also be part of the financial support for NAMAs, since standardised baselines will not only be suitable for CDM project development.

Reviewing new standardised baselines

- Proposals for new standardised baselines should be reviewed by the Methodologies Panel or a new Standardised Baseline Panel under the EB.
- DOEs or another mandated independent agency should verify the database used for standardisation.
- In accordance with current procedures for the development of methodologies for CDM and to ensure transparency all proposed methodologies, baselines and data collected should be made available to the public for peer-review and comments early in the process.

Approval of standardised baselines

- The Executive Board will make the final decision on approval of standardised baselines based on the final recommendations by the Methodologies Panel or a new Standardised Baseline Panel

Environmental integrity

Any baseline proposed and/or approved by the EB must observe the overall principles of conservativeness and environmental integrity of the system.

As mentioned earlier, regular updates of intensity benchmarks will be necessary and need to be institutionalised. The adequate interval for updating standardised baselines will differ depending on the nature of the baseline or default value.

Annex

Table A1: Default values in BRT and transport methodologies

Note: IPCC values stem from the IPCC Guidelines on National GHG Inventories, Vol. 2 (Energy)

Indicator	Source	Value
Baseline Methodology AM0031 and BRT Bogotá: TransMilenio Phase II to IV		
Construction and manufacturing emissions[21]		
Emission factor for bus manufacturing	default value	42 tCO_{2e} per bus manufactured
Specific emission factor for cement (tCO_2/tonne cement)	default value	0.99 tCO_{2e} per t of cement
Specific emission factor for asphalt (tCO_2/tonne asphalt)	default value	0.03 tCO_{2e} per t asphalt
Vehicle efficiency/emission factors		
Technology improvement factor for fuel consumption in buses, taxis and passenger cars	default value	0.99
Technology improvement factor for fuel consumption in motorcycles	default value	0.997
Emissions factor per kilometre by vehicle category	IPCC default values	
Emissions factor per distance for Passenger cars travelling at a specific speed	CORINAIR speed emission factor default formula (leakage parameter 6 in baseline methodology)	$EF = 135.44 - 2.314 * V + 0.0144 * V^2$
Speed dependency factor for passenger cars (relation between vehicle speed and emissions)	CORINAIR	1.4 litre < capacity of the cylinder (CC) < 2.0 litre for Euro I onwards with a speed range

[21] Default values for manufacturing and construction are extracted from version 1 of the baseline methodology and applied in the Transmilenio PDD; in version 3 they are no longer explicitly included. However, the same default values for construction emissions continue to be used in BRT projects based on AM0031 and are also the same as in the GEF methodology.

Indicator	Source	Value
		between 13.1 and 130 km/h
Fuel emission factors		
Emission factors for CO_2, CH_4, N_2O by vehicle category and fuel type (in gCO_{2e}/litre)	baseline methodology appendix, based on IPCC	see table 1 in the annex
Fuel consumption of vehicle types (l/km)	IPCC values[22]	IPCC factors are adjusted based on local statistics on vehicle age and technology
Upstream emissions multiplier / default factor for upstream emissions from fuel production	default value based on L-B-Systemtechnik GmbH, 2002	14%
Other indicators		
Elasticity factor additional and/or longer trips[23]	default value	0.1
ACM0016 Baseline Methodology for Mass Rapid Transit Projects		
Vehicle efficiency/emission factors		
Specific fuel consumption of vehicle category and fuel type prior to project start (gr/km)	IPCC default values for the respective vehicle categories (latest year)	
Emissions factor per kilometre of cars/taxis travelling at a specific speed	CORINAIR speed emission factor default formula	$EF = 135.44 - 2.314 * V + 0.0144 * V^2$
Technology improvement factor (per annum) for buses, passenger cars, taxis and motorcycles (incl. tricycles)	default factor	0.99
Fuel emission factors		
Net calorific value of fuel type (J/gr)	Regional, national or IPCC default values[24]	
Emission factor for CO_2 (gCO_2/J) for fuel type in year y	Regional, national or IPCC default values	

[22] Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, tables 1-27 to 1-42.

[23] The additional impact of new and longer trips shall be assessed via the direct application of a 'capacity elasticity', i.e. the percentage of additional cars resulting from a percentage change in road capacity. This factor, inter alia, is needed to assess the rebound impact of additional road space.

[24] IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.

Indicator	Source	Value
NM0229 Methodology for Mass Rapid Transit Projects, Version 1.0		
Construction and emissions		
Specific emission factor for cement (tCO_2/tonne cement)	default value	0.99 tCO_2 per t of cement
Specific emission factor for asphalt (tCO_2/tonne asphalt)	default value	0.03 tCO_2 per t asphalt
Vehicle efficiency/emission factors		
Specific fuel consumption by vehicle category and fuel type prior project start (gr/km)	IPCC default values for the respective vehicle categories	
Emission factor per kilometre of vehicle category in year x (grCO 2 /km)	IPCC default values (2006)	
Vehicle speed emission factor passenger cars	CORINAR	$EF_{KM,V,C} = 135.44 - 2.314 * V + 0.0144 * V^2$
Technology improvement factor for buses with an average age pre Euro 1	default value	0.99
Technology improvement factor for buses with an average age Euro 1 or newer	default value	1
Technology improvement factor for passenger cars, taxis, motorcycles incl. tricycles	default value	0.99
Fuel emission factors		
Net calorific value of fuel type (J/gr)	National or IPCC default values	
Carbon emission factor for fuel type “x” ($grCO_2$/J)	National or IPCC default values	
Other indicators		
Elasticity factor additional and/or longer trips	default value	0.1
CTF Guidelines for Calculating GHG Benefits of CTF Investments in Transport Sector		
Mobility indicators		
Vehicle occupation in average passengers per vehicle and average freight tonnes per vehicle to be able to link the VKT in the base year to passenger-kilometres travelled and freight-tonne-kilometres transported	default values soon to be established based on empirical data	

Indicator	Source	Value
Fuel emission factors		
Fuel emission factors	adjusted IPCC factors and rules	
GEF GHG module - BRT		
Construction emissions		
Tonnes of steel per km infrastructure	default value	143,2 t/km
Tonnes of cement per km infrastructure	default value	737,8 t/km
Tonnes of bitumen per km infrastructure	default value	403,5 t/km
Specific emission factor for steel (tCO_2/tonne steel)	default value	2,5 tCO_2/t
Specific emission factor for cement (tCO_2/tonne cement)	default value	0,99 tCO_2/t
Specific emission factor for bitumen (tCO_2/tonne bitumen)	default value	0,03 tCO_2/t
Mobility indicators		
Average passenger trip length on existing bus system	GEF default value	6 km
Vehicle efficiency/emission factors		
Fuel efficiency by vehicle category and fuel type (km/litre), assuming 10% improvement of efficiency per decade	default value	see table A3 in the annex
Speed emission adjustment factors for different speeds (CO_2, PM, NO_x)	default value	see table A4 in the annex
Fuel emission factors		
Fuel emission factors for new buses for different years (CO_2, PM, NO_x)	default value	See table A5 in the annex
Dissemination factors / indirect effects		
Average replication impact of 'gold standard' BRT projects[25]	Historical data about BRT replication	Average of 8.4 (Curitiba Phase

[25] The replication factor is used to estimate indirect emission savings in GEF BRT projects. The final replication rate depends on system characteristics (quality). The average of 8.4 is multiplied with a percentage of 'gold standard' characteristics derived on the basis of BRT system characteristics, each of which is assigned a certain value. If all 'good quality criteria' are met, the full replication rate of 8.4 applies. If less than 80% of the criteria are fulfilled, no replication rate is assumed (ITDP, 2009).

Indicator	Source	Value
	effects collected; further evaluation for further refinement is planned	I: 4.4; Quito Phase I: 3.3; TransMilenio: 17)
Other indicators		
Renovation rate (relation between total passengers using the link and maximum passenger volume on the critical link during peak hour)	default value	2
Default value for uncertainty regarding of peak hour boardings	default value	0.8
Multiplier to convert peak hour ridership figure to a daily figure	default value	10
Multiplier to convert daily estimated baseline demand to annual baseline demand	default value	310
Multiplier to convert peak hour bus km to a daily bus km	default value	14
Multiplier to convert daily bus km to annual bus km	default value	310

Source: own compilation

Table A2: Default Emission Factors for all Vehicle Categories and Fuel Types (gCO_{2e}/litre)

Vehicle category	CO_2-emission factors		CH_4 emission factors		N_2O emission factors	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
Bus large	2 313	2 661	11	2	9	21
Bus medium	2 313	2 661	12	2	12	36
Bus small	2 313	2 661	13	1	14	51
Taxis	2 313	2 661	11	1	14	23
Passenger cars	2 313	2 661	11	1	14	23
Motorcycles	2 313	2 661	29	-	7	-

Source: Baseline methodology AM0031 p. 41 based on IPCC 1996 Guidelines for National GHG Inventories

Table A3: GEF fuel efficiency factors at 50 kmph (km/litre)

Vehicle category	2010		2019		2029	
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel
Cars	9	11	9,9	12.1	10.89	13.31
2-Wheeler	40	0	44	0	48.4	0
3-Wheeler	25	0	27.5	0	30.25	0
Taxi	8	11	8.8	12.1	9.68	13.31
Bus	1.8	2.2	1.98	2.42	2.178	2.662
Jeepney/RTV	6	7	6.6	7,7	7.26	8.47
Walking/Cycling			0	0	0	0
BRT	2,2	3	2.42	3.3	2.662	3.63

Source: ITDP (2009)

Table A4: GEF speed emission adjustment factors

Speed	CO_2	PM	NO_x
15	-94	-21	-56
20	-51	-16	-46
25	-39	-12	-37
30	-23	-9	-29
35	-15	-7	-21
40	-9	-4	-14
45	-3	-2	-7
50	0	0	0
55	2	2	6
60	5	3	13
65	3	3	13
70	6	3	13

Speed	CO_2	PM	NO_x
75	0	1	10
80	5	-1	7
85	-7	-5	4
90	2	-8	1
95	-16	-8	1
100	-3	-8	1

Source: ITDP (2009)

Table A5: Fuel emission factors for new transit systems buses

	2010	2019	2029
CO_2 (g/km)			
Gasoline	2605	2368	2153
Diesel	2278	2071	2071
LPG	1936	1760	1760
PM (g/km)			
Gasoline	0.00	0.00	0.00
Diesel	0.01	0.00	0.00
LPG	0.00	0.00	0.00
NO_x (g/km)			
Gasoline	0.00	0.00	0.00
Diesel	0.11	0.08	0.08
CNG	0.10	0.10	0.10

Source: ITDP (2009)

References

Biofuelwatch (undated) A New Fuel Quality Directive: A new instrument for large-scale agrofuel expansion. Available online at: http://www.biofuelwatch.org.uk/docs/fqd_briefing_sheet_3.pdf.

CAN-I – Climate Action Network International (2010) CAN-International submission on the development of standardised baselines. Available online at: http://unfccc.int/resource/docs/2010/smsn/ngo/180a.pdf.

CTF/TFC (2009) Clean Technology Fund Results Measurement System. CTF/TFC.3/8. Available online at: http://www.climateinvestmentfunds.org/cif/workingdocuments/129.

Ellermann, C., M. Vieweg, N. Höhne, K. Jiang, X. Zhuang, O. Padraig, X. Li (2009) Sector Analysis Report: Transport – Testing sectoral proposal templates in China's transportation sector. Cologne/Beijing: Ecofys.

Fenhann, J. (2010) CDM Pipeline, 1 June 2010. UNEP/Risoe Centre. Available online at: http://cdmpipeline.org/.

GEF – Global Environment Facility (2009) Investing in Sustainable Urban Transport: The GEF Experience. Available online at: http://www.thegef.org/gef/sites/thegef.org/files/publication/Investing-Urban-Transportation_0.pdf.

Hu X., S. Chang, J. Li and Y. Qin (2009): Energy for sustainable road transportation in China: Challenges, initiatives and policy implications, Energy (2009), doi:10.1016/j.energy.2009.05.024 (article in press).

IETA (2010) IETA response to the call for input on modalities and procedures for standardised baselines. 22 March 2010. Available online at: http://unfccc.int/resource/docs/2010/smsn/ngo/186.pdf.

Interview Hefei City Planning and Design Institute (2010) Interview with an employee of the Hefei City Planning and Design Institute conducted on 4 June 2010, the interviewee has requested to remain anonymous.

IPCC (2006) 2006 Guidelines for National GHG Inventories, Vol. 2 (Energy). Available online at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

—— (1996) Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available online at: http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

ITDP - Institute for Transportation and Development Policy (2009) Proposed Manual for Calculating Greenhouse Gas Benefits of Global Environmental Facility Projects: Initiatives to Improve Transport System and Vehicle Fuel Efficiency. Draft for Comment by Reviewers 2/28/09, Prepared for the United Nations Environment Program, Global Environmental Facility Secretariat

Michaelowa, A. (2010) Options for standardisation in the CDM. Presentation at side event at SB32, "Improving efficiency and effectiveness of the CDM trough standardized baselines", 2 June 2010, Bonn.

Millard-Ball, A. (2008) Bus Rapid Transit and Carbon Offsets. Issues Paper Prepared for: California Climate Action Registry. Nelson\Nygaard Consulting Associates. Available online at: www.climateactionreserve.org/.../future-protocol-development_bus-rapid- transit-and-carbon-offsets.pdf.

Millard Ball, A. and L. Ortolano (2010) Constructing carbon offsets: The obstacles to quantifying emission reductions, Energy Policy Volume 38, Issue 1, pp. 533-546.

Rughani, D. (2008) Life Cycle Assessments of Greenhouse Gas Emissions for Common Agrofuel Feedstocks. Available online at: http://www.biofuelwatch.org.uk/docs/lca_assessments.pdf.

Schipper, L., C. Marie-Lilliu and R. Gorham (2000) Flexing the Link between Transport and Greenhouse Gas Emissions. A Path for the World Bank, Paris: International Energy Agency.

Spain and the European Commission on behalf of the European Union and its Member States (2010) Modalities and procedures for the development of standardized baselines (SBSTA), Paper No. 3 in UNFCCC (2010) – Subsidiary Body for Scientific and Technological Advice (2010): Views related to modalities and procedures for the development of standardized baselines from the clean development mechanism. Submissions from Parties and relevant organizations. Available online at: http://unfccc.int/resource/docs/2010/sbsta/eng/misc03r01.pdf.

TRF – Transport Research Foundation (2010) Submission on modalities and procedures for the development of standardised baselines, 22nd March 2010. Available online at: http://unfccc.int/resource/docs/2010/smsn/ngo/185a.pdf.

UNFCCC (2010) – Subsidiary Body for Scientific and Technological Advice (2010): Views related to modalities and procedures for the development of standardized baselines from the clean development mechanism. Submissions from Parties and relevant organizations. Available online at: http://unfccc.int/resource/docs/2010/sbsta/eng/misc03r01.pdf.

World Bank (2009) Project Information Document (PID) Appraisal Stage. Report No.: AB4704. Available online at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/09/08/000104615_20090909113242/Rendered/PDF/UTTP0PID0Appra121020091for0infoshop.pdf.

World Bank (2008) Project appraisal document on a proposed grant from the Global Environment Facility Trust Fund to the People's Republic of China for a China-GEF-World Bank Urban Transport Partnership Program. Report No.: 43249-CN. Available online at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/06/11/000333038_20080612001424/Rendered/PDF/432490PAD0REVI17391B01OFF0USE0ONLY1.pdf.

Wright, L. (2005) Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities Module 3b – Bus Rapid Transit. Version 2.0. Eschborn: GTZ. Available online at: http://www.sutp.org/index.php?option=com_docman&task=cat_view&gid=31&Itemid=54&lang=.

Wright, L. and L. Fulton (2005) Climate Change Mitigation and Transport in Developing Nations, *Transport Reviews*, Vol. 25, No. 6, 691–717.

CDM Baselines and Project Documentation

ACM0016 / Version 1, *Baseline Methodology for Mass Rapid Transit Projects.* URL: http://cdm.unfccc.int/UserManagement/FileStorage/CDM_ACM5L7HFZT82UX8RKPJFT4H24BRNK94CU.

AM0031 / Version 3, Baseline Methodology for Bus Rapid Transit Projects. URL: http://cdm.unfccc.int/UserManagement/FileStorage/TKF9YBPE4R2A3L1V87CSXQWOZDI0HN.

F-CDM-NMSUMmp / Version 1, CDM: Proposed New Methodology, Meth Panel summary recommendation to the Executive Board, 12-16 November 2007. URL: http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?meth_ref=NM0229.

NM0029 / Version 1, Proposed New Baseline and Monitoring Methodologies: Methodology for Mass Rapid Transit Projects, 29 May 2007. URL: http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?meth_ref=NM0229.

PDD BRT Bogotá, Colombia: TransMilenio Phase II to IV / Version 4.1, 6 September 2006. URL: http://cdm.unfccc.int/UserManagement/FileStorage/E6LUMUUAQA83IUZAPO9XWBMS6BTSAB.

PDD BRT Lines 1-5 EDOMEX, Mexico. Version 1.0 02.02.2010 URL: http://cdm.unfccc.int/UserManagement/FileStorage/DRQZPNVG78015WTA26BSJCL4E9YFXH.