Monitoring report form

(Version 04.0)

MONITORING REPORT	
Title of the project activity	BRT Zhengzhou, China
Reference number of the project activity	4744
Version number of the monitoring report	1.0
Completion date of the monitoring report	05/08/2014
Registration date of the project activity	07/06/2011
Monitoring period number and duration of this monitoring period	2nd monitoring period 26/07/2012 to 25/06/2014
Project participant(s)	Zhengzhou Bus Communication Company Grütter Consulting AG
Host Party(ies)	China
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Transport, sectoral scope 7 AM0031, Version 3.1.0, Baseline Methodology for Bus Rapid Transit Projects
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	319,266[1]
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	173,734
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	43,807
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	129,927

[1] 2012 according to PDD 144,407 tCERs (actual 160 days instead of 366 days and therefore 144,407/366*159=62,734 tCERs), 2013 full year (165,350 tCERs) and 2014 189,099 tCERs (actual 176 instead of 365 days and therefore 189,099/365*176=91,182 tCERs)

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The objective of the BRT (Bus Rapid Transit) Zhengzhou is to establish an efficient, safe, rapid, convenient, comfortable and effective modern mass transit system based on a Bus Rapid Transit (BRT) system. Zhengzhou is the capital of the Province of Henan and has a population of around 3.5 million inhabitants. The project includes 4 exclusive BRT bus lanes plus their feeder lines. The BRT is managed by the Zhengzhou Bus Communication Company which is part of the Municipal Government of Zhengzhou. The Zhengzhou Bus Communication Company is the parent company of the operational bus companies consisting of the BRT bus company, and the bus companies 1, 2, 3 and 4. The BRT bus company operates the trunk and support lines of the BRT system and the bus companies 1 to 4 operate the feeder lines plus bus lines not included in the BRT project. The geographical boundary of the project is the city of Zhengzhou. Gases included are CO_2, CH_4 and N_2O.

The baseline situation is the trip emissions passengers of the system would have caused in absence of the project. They would have used different modes of transit to realize their trip which together result in the baseline emissions. Project emissions are based on the actual fuel consumption of buses forming part of the project. Emission reductions are the result of reduced GHG emissions per passenger trip comparing the baseline with the project situation. The BRT Zhengzhou reduces GHG emissions by improving the resource efficiency of transporting passengers in the urban area of Zhengzhou i.e. emissions per passenger trip are reduced compared to the situation without project. This is realized through following changes:

- Improved efficiency: new and larger buses are used with a better fuel efficiency per passenger transported compared with those used in absence of the project.
- Mode switching: The BRT system is more attractive to clients due to reduced transport times, increased safety and reliability and more attractive buses. It can thus attract private car and taxi users with higher emission rates to switch to public transport.
- The integration with feeder lines allows for efficient transport trips of customers combing fine density feeder lines with high capacity trunk routes.
- Load increase or change in occupancy: The BRT has a centrally managed organisation dispatching vehicles on trunk routes. The occupancy rate of vehicles can thus be increased due to organizational measures.

The technology deployed by the BRT Zhengzhou has following main components:

- A new infrastructure of dedicated bus lanes and elevated bus stations along trunk routes that allow pre-board ticketing. Equipment and turnstiles at the entrance to each trunk station deduct the corresponding fare.
- Centralized coordinated fleet control providing monitoring and communications to schedule services and real-time response to contingencies along trunk routes.
- Extensive feeder lines on all BRT routes. The BRT system is integrated into the other public transport systems existing of Zhengzhou. Feeder bus lines are operated by various companies, but all under the framework of Zhengzhou public transport.

Table 1 lists the relevant dates of the project activity.

Table 1: Relevant Dates of BRT Zhengzhou

Date	Action
01/02/2009	Project starting date (construction contract)[2]
05/2009	Operational start of project[3]
07/06/2011	CDM project registration date

The project operated continuously during the entire crediting period.

The total emission reductions achieved in this monitoring period are **173,734 tCO_2**

A.2. Location of project activity

Host country

People's Republic of China

Region/State/Province

Province of Henan

City/Town/Community

Zhengzhou

Physical/Geographical location

The project is located within the metropolitan area of the city of Zhengzhou which has the geographical coordinates of 34° 45′ N, 113° 38′ E. The geographical boundary of the project is the routes from origin to destination used by the people. The project itself includes all feeder and trunk bus routes of the BRT. The geographical location of the project is thus the urban area of the city of Zhengzhou.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
China (host)	Zhengzhou Bus Communication Company	No
Switzerland	Grütter Consulting AG	No

A.4. Reference of applied methodology and standardized baseline

AM0031, Version 3.1.0, Baseline Methodology for Bus Rapid Transit Projects

Additionally following tools were used:

- Tool for the demonstration and assessment of additionality (Version 05.2)
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01)

A.5. Crediting period of project activity

[2] Registered PDD p.62

[3] File 1

Crediting period: 7 years renewable; starting date 07/06/2011

Crediting period corresponding to this monitoring period: 07/06/2011 to 06/06/2018

A.6. Contact information of responsible persons/ entities

Responsible for this Monitoring Report is:
Jürg Grütter
Grütter Consulting AG
Thiersteinerstr 22, 4153 Reinach, Switzerland
jgruetter@transport-ghg.com, www.transport-ghg.com

The person/entity is a project participant.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

Features of the BRT system of Zhengzhou include exclusive right-of-way lanes, rapid boarding and alighting, free transfers between lines trunk lines, pre-board fare collection and fare verification, clear route maps, real-time information displays, automatic vehicle location technology to manage vehicle movements, clean vehicle technologies and excellence in marketing and customer service. The technology deployed has 4 main components. Infrastructure, buses, transit management and fare system.

Infrastructure

The project establishes exclusive separated bus lanes including new bus-stations. Each station has a modular design to ensure uniformity of the corridor's image with obstacle-free waiting areas and elevated level-access to articulated buses with a high platform. All trunk route stations have access ramps for mobility-impaired passengers. The trunk routes[4] are complemented by supporting BRT lines and a large number of feeder lines replacing to a large extent the existing conventional bus system. Passengers can use for their entire trip components of the new system by using buses operating on trunk routes, supporting lines and/or feeder lines. Supporting lines operate partially on the same trunk route and the same station on the trunk route is used by the trunk bus and by supporting units. The concept used in Zhengzhou is of a ring-road trunk route where various supporting lines enter for some stations while a specific trunk bus line covers the entire ring-route. Feeder lines are thereafter connected to the supporting lines for fine distribution of passengers i.e. destinations less frequented.

Bus Technology

Buses on trunk routes are new diesel and CNG articulated 18 m units, with Euro standard 3, 4 and 5, a capacity of 130-160 persons with platform-level access including room for disabled persons. Buses on supporting routes are new Euro 3, 4 and 5 12-13.7 m diesel and CNG units with a capacity of 80-120 passengers[5]. On feeder lines buses used are CNG and diesel Euro 2, 3, 4 and 5 units (basically 12 m and medium sized buses), and some 0-emission electric buses[6]. The project also uses a large number of CNG-hybrids and diesel-hybrids (no plug-in hybrids i.e. no electric charging possible i.e. the hybrids consume only diesel or CNG fuel).

[4] Trunk routes have as characteristics that they are bus only lanes (segregated bus corridors) with a high passenger demand. Supporting BRT lines have a medium passenger demand and buses operating on such routes use partially the BRT trunk road i.e. part of their trip is made on bus-only lanes. Feeder lines operate under mixed traffic conditions and have low to medium passenger demand. Passengers can switch from feeder to supporting or trunk lines in walking distance.

[5] File 2a

[6] File 2b

Photo 1: Trunk Bus Station

Transit Management

The operational fleet centre manages trunk bus dispatch, informs passengers, produces reports and maintains records. Trunk buses are equipped with GPS (Global Positioning System) to identify their position and track distance driven. This is linked to the operation centre. The novelty of the operational fleet centre is that an efficient management of bus fleets and bus dispatch can take place optimizing load factors through coordinated scheduling of service.

Fare System

The system is based on pre-board fare paying using magnetic ticketing. Validation turnstiles at the entrance to each station detect each electronic ticket and deduct the corresponding fare. This streamlines the boarding process, allows drivers to concentrate on bus operation and plays a key role in optimizing operations. Fare-card payment machines are installed at the stations as well as at other central facilities.

Photo 2: Turnpikes at Trunk Station

Line B1 (ring line) of the project is fully operational since 28/05/2009[7] with a distance of 31.8 km. The trunk route B2 with a length of 21 km is operational since end of January 2014. The BRT trunk route B3 with a length of 31.6 km started operations end of June 2014. Of the 105.8 km of planned trunk routes 84.4 km are operational. The trunk route B4 should be operational by end of 2015. The trunk routes B2-B4 have suffered a delay basically due to planning of routes based on experience with the Line B1 and the construction of the

[7] File 1

metro. The city did not want to get additional roads clogged by constructing at the same time due to metro and BRT construction.

34 support lines are operational as of end of June 2014 with a total of 467 km (however trunk and support routes as well as some support routes overlap partially) and with a total of 139 feeder lines[8]. More support and feeder routes have been established as at the stage of initial planning only support routes for the first trunk route B1 had been designed.

In accordance with the registered PDD page 12 some routes and lines have changed. The PDD states on page 12 that the table indicating trunk, support and feeder lines and routes are indicative and also mentions: "Trunk, support as well as feeder line locations, distances and routings might still change as the current information is based on planning data and projections. These are constantly updated based on the actual experience gained with the first BRT lane recently inaugurated as well as based on normal city development".

Table 2: Operational Trunk and Support Lines as of 25/06/2014

BRT Line	Distance (km)	Construction start	Operational start
Line B1 (trunk line)	31.8	10/02/2009	28/05/2009
Line B2 (trunk line)	21	10/2013	26/01/2014
Line B3 (trunk line)	31.6	12/2013	26/06/2014
Line B10	20.2	Support lines to B1 and thus no construction required	13/09/2010
Line B11	20.3		28/05/2009
Line B12	19.5		28/05/2009
Line B13	12.2		28/05/2009
Line B15	14.9		28/05/2009
Line B16	17		28/05/2009
Line B17	17.2		28/05/2009
Line B18	14.9		28/05/2009
Line B19	10		28/05/2009
Line B20	17		22/09/2010
Line B21	11		22/09/2010
Line B23	13.5		10/06/2012
Line B25	9.8		26/01/2013
Line B26	13		26/03/2013
Line B27	8.4	Support lines to B2	26/01/2014
Line B28	7		26/01/2014
Line B29	11	Support lines to B3	26/06/2014
Line B30	17.6		26/06/2014
Line B33	7.3		26/06/2014
Line B35	18.2		26/06/2014
Line B37	13.5		26/06/2014
Line B38	16		26/06/2014
Line B50	11.2		26/06/2014
Line B51	16.5		26/06/2014
Line B52	14.5		26/06/2014
Line B53	15.5		26/06/2014
Line B58	11		26/06/2014
Line B59	10.5		26/06/2014
Line B60	13.6		26/06/2014
Line B52	14.5		26/06/2014
Line B53	15.5		26/06/2014
Line B58	11		26/06/2014
Line B59	10.5		26/06/2014
Line B60	13.6		26/06/2014
Total	**551.8**		

Source: Zhengzhou Bus Communication Company, File 3a, see also map File 3b

[8] As of end 06/2014; see File 19 Feeder Line Data for June 2014

The BRT system is fully operational in accordance with the PDD however with one trunk route still lacking. While the expansion of the project is not as fast as anticipated, the sections implemented are in accordance with the PDD and the only difference is the project outreach.

No special events have been registered during the monitoring period. The project was fully operational all the time.

Relevant dates are listed under Section A.1.

No event occurred during the monitoring period, which impacts the applicability of the methodology.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

No temporary deviations have been applied during this monitoring period.

B.2.2. Corrections

No corrections to project information or parameters fixed at validation have been approved during this monitoring period or are submitted with this monitoring report.

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

No permanent changes from the registered monitoring plan, applied methodologies or applied standardized baseline have been approved during this monitoring period or are submitted with this monitoring report.

B.2.4. Changes to project design of registered project activity

No changes to the project design of the project activity have been approved during this monitoring period or are submitted with this monitoring report.

B.2.5. Changes to start date of crediting period

No changes to the start date of the crediting period have been approved during this monitoring period or are submitted with this monitoring report.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable

SECTION C. Description of monitoring system

The monitoring methodology is based on AM0031 Version 3.1.0.

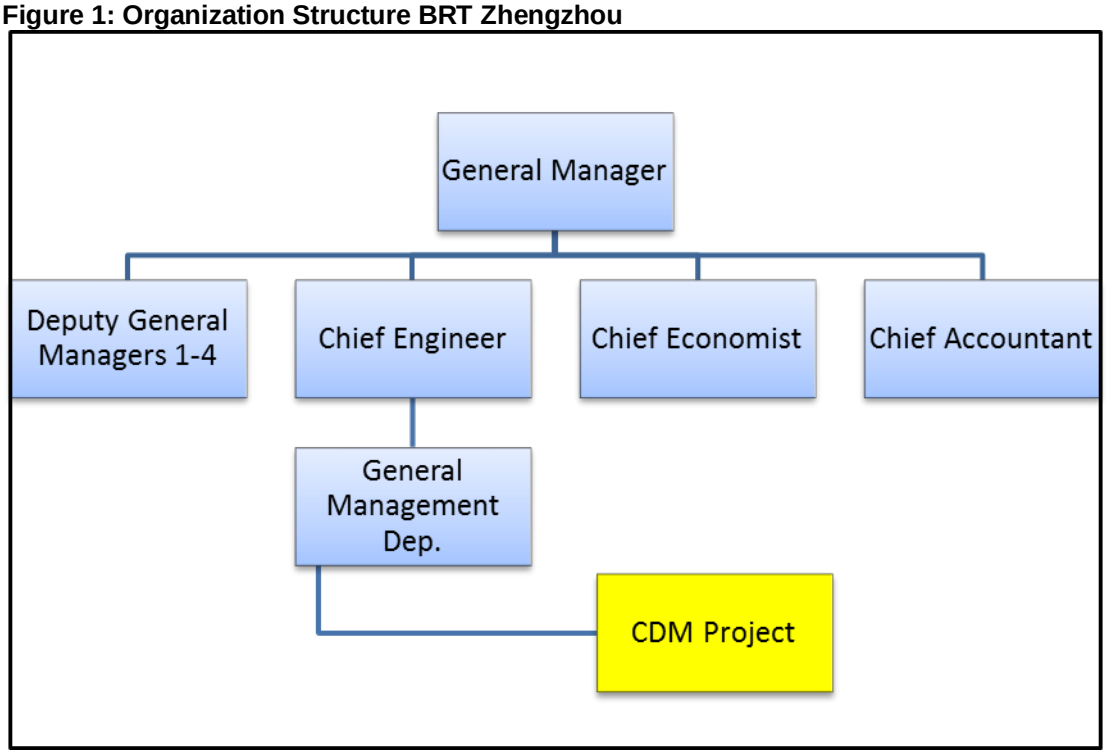
The monitoring plan has two aims: to ensure the environmental integrity of the project activity and to ensure that the data monitoring requirements are closely aligned with the current practice of the project operator.

A (English-Chinese) monitoring manual has been realized for the Zhengzhou Bus Communication Company[9] and staff has been familiarized with this manual in a special training course[10]. The Manual defines responsibilities and procedures and has a section on all data variables to be monitored. The data section has for each data variable information on how to collect the required information, the frequency of collection, data units (including transformation of common data units), quality control measures to be realized, steps to be taken in case of data problems, and some additional hints and comments.

ORGANIZATION STRUCTURE: RESPONSIBILITIES AND ORGANIZATION

The Management Department of the Zhengzhou Bus Communication Company is in charge of all CDM related information and data management. This Department is responsible to check and verify all data of BRT ring line, support lines and feeder lines, to make data reports and to back up all the data. The Maintenance Department is responsible for the data collection and provides all data to the Management Department. The operation companies of the different lines are in charge of collecting all data like number of passengers, operation distance and fuel consumption, and make the reports which are delivered to the Maintenance Department.

Figure 1: Organization Structure BRT Zhengzhou



The responsibilities of the Zhengzhou Bus Communication Company are:

1. Collect in the required frequency all data for the monitoring of the CDM project;
2. Perform data and information quality control according to the monitoring manual;
3. File all documents in the manner and timing that the monitoring manual demands.

Grütter Consulting AG realizes the monitoring reports and makes quality assurance. Grütter Consulting AG does this service in many CDM BRT projects using the same methodology. Core responsibilities of Grütter Consulting AG include:

1. Check data quality and collect, if required, additional data;
2. File all documents in the manner and timing that the monitoring manual demands;
3. Realize an annual monitoring report;
4. Answer all inquiries and additional information requests by the DOE for the verification report. Furthermore, reply to all inquiries received during the process of issuance.

[9] File 4

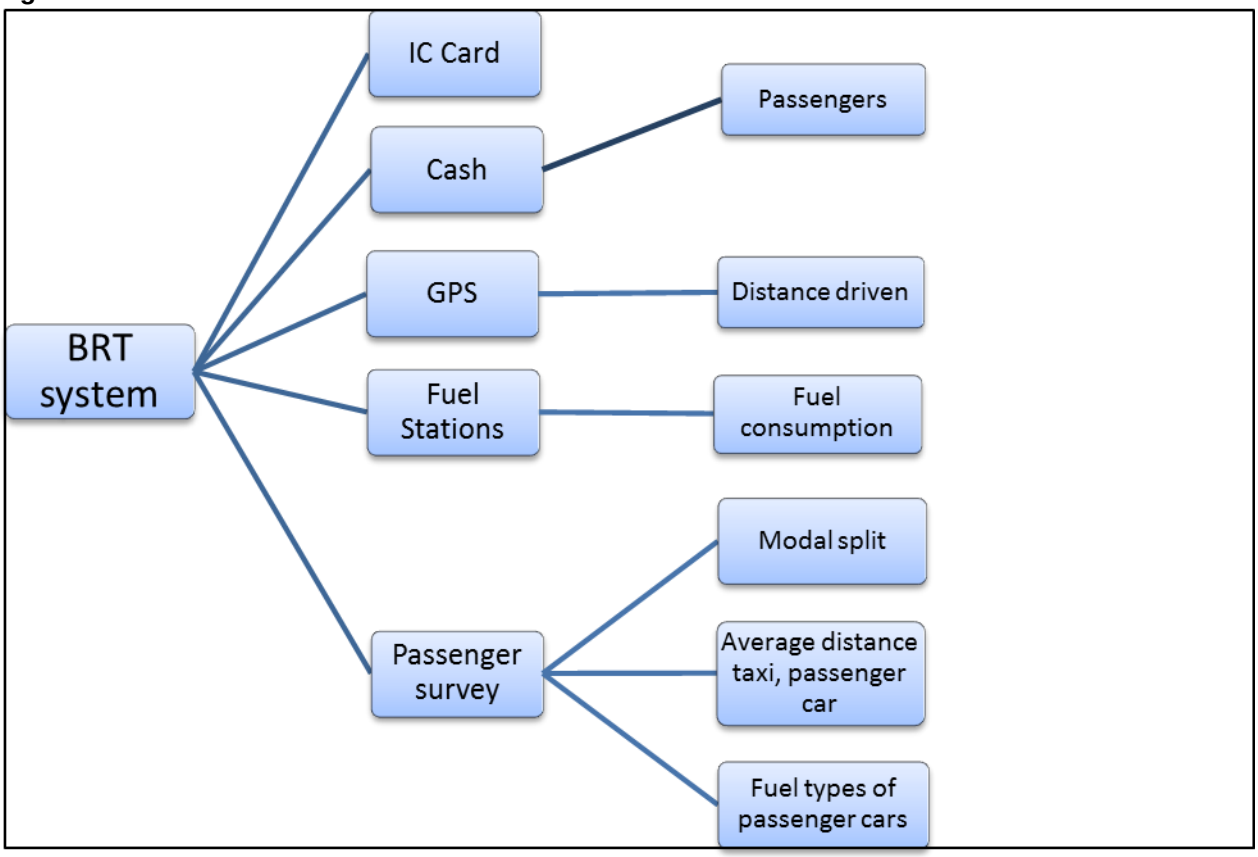
[10] File 5

DATA GENERATION

Data for the monitoring comes from the structure presented in Figure 2:

- Passenger data is the sum of the IC Card result and the total cash divided by the bus fare.
- Distance driven is obtained by using GPS devices on the buses and the number of trips realized by each bus.
- Fuel consumption is derived from the invoices of the fuel stations cross-checked with the Zhengzhou Bus Communication Company internal controls.
- The passenger survey is carried out by an external third party.

Figure 2: Overview Data Sources



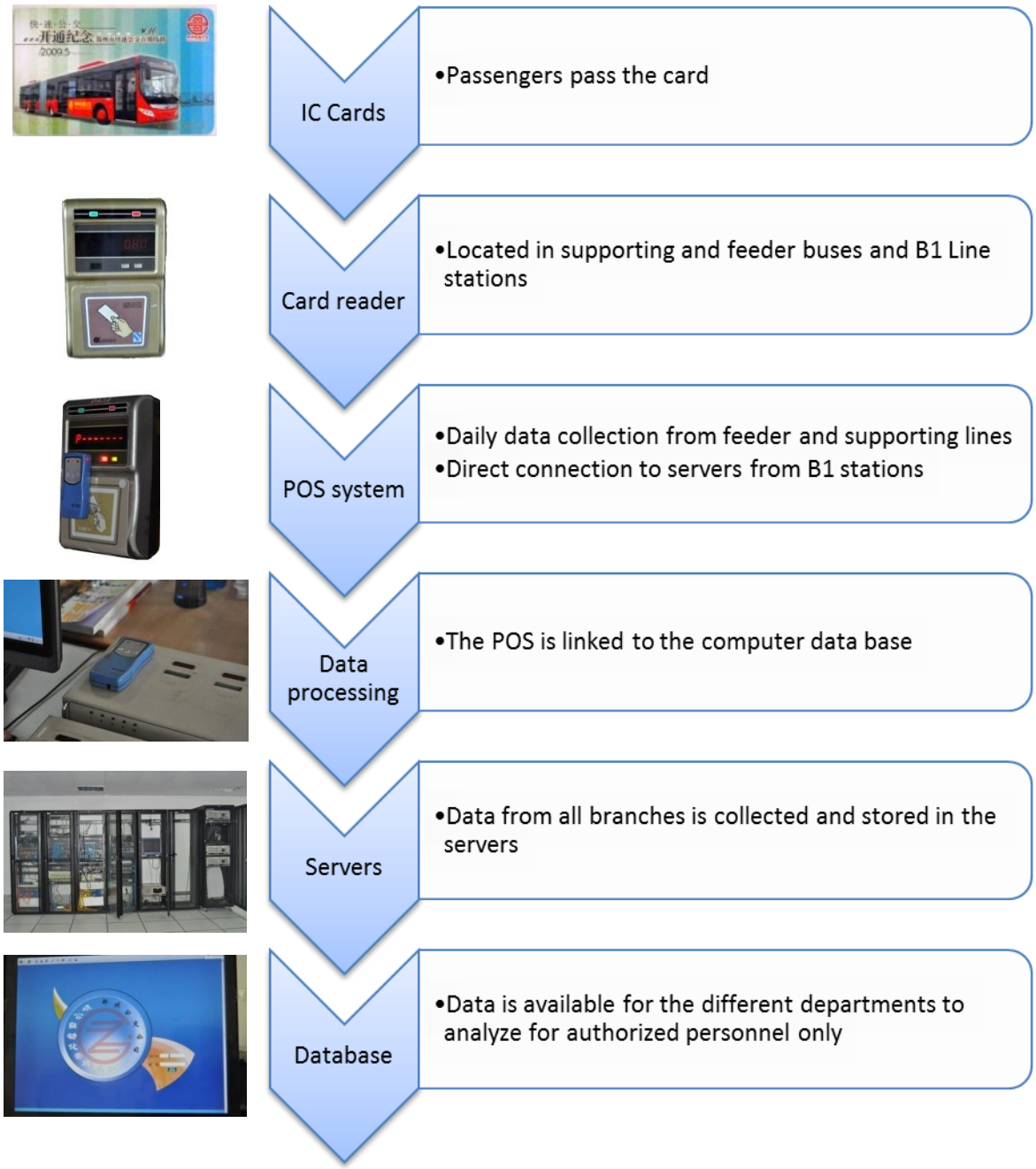
PASSENGERS TRANSPORTED

Data on passenger numbers is generated from IC card users and from cash payment.

Payment with IC Cards

Data from IC cards is gathered by the Zhengzhou Bus Communication Company. The Net Center of the company is in charge of gathering, processing and archiving the data within the central Database. The process to gather IC Card data from the IC card system is shown in Figure 3.

Figure 3: **IC Cards Data Collection Process**



Non-contact IC card technology is widely used in public transport. The Zhengzhou Bus Communication Company has two different suppliers for the IC Cards: The Beijing Yicheng Xin Tong Smart Card Co., Ltd. and Shandong Huaguan Smart Card Co., Ltd. The IC cards used belong to the MIFARE 1 S50 non-contact series. Their characteristics are:

- Operating Frequency: 13.56MHz;
- Data retention: > 10 years;
- Data can be written more than 100,000 times
- Cards meet the ISO / IEC 14443-1, and the Ministry of Construction, "IC card application management construction and technical requirements."[11]
- Working temperatures: -20˚C to +70˚C

[11] For more on China's legislation toward IC Cards see http://www.wjj.dl.gov.cn/htmlfile/3/5337.html

- The card material is PVC with the following dimensions: 85.47mm ≤ length ≤ 85.72mm, 53.92mm ≤ width ≤ 54.03mm, 0.70mm ≤ thickness ≤ 0.97mm; lead angle: 3.18mm arc, in line with ISO 14443 specifications.

All card readers are powered by electricity. In case of malfunction the buses are immediately taken out of service until the problem is fixed. Extra card readers are available in case of need. Malfunctions are addressed immediately and considering the nature of the malfunction, proper operation is restored in general within two or three days. In most cases malfunctions are a result of battery breakdown. If the malfunction is due to a problem in the internet communication or due to lack of electricity at the station, the POS system has an internal memory of over 1,000 records.

Data from the card readers is transferred in two ways according to its location: on the bus or at the bus station. Card readers are inside the bus for support lines as well as for feeder lines. In that case, daily data gathering is done at the bus depot after service hours following the procedure shown above. Communication problems between the card reader and the computer system can only be due to a malfunction of the POS reader, however there are more than 100 of this readers in the company and any of those can be used by any card reader. In case of malfunction, the bus is taken out of operation and immediately serviced in the different branches.

Data from passengers is gathered daily and transferred directly to the central Database. In the Net Center digital backups are made daily and stored for minimum one year. The servers process and file the data where latter is kept in an IBM Total Storage LTU Ultrium Cleaning Cartridge as well in an HP DDR-3 24 GB disk storage device.

Figure 4: **Backup Devices and Net Center**

Card readers used in the Zhengzhou BRT are shown in the following Figure.

Figure 5: **Model FZJ-42 for Card Readers**[12]

[12] See also File 9

Data reading and writing adopts DES, RAS safe algorithm, which can guarantee the security of data storing and transmitting[13]. Card readers have a backup memory with a large capacity, and can a keep the stored data for up to ten years. Card readers can resist high frequency pulse interference of above ±4500V, and work normal under suboptimal conditions like low temperature, speeding or steep climbing. The devices run with a power supply of +7V and +50V. When the power supply fails or is replaced, stored data will be kept in the machine's internal memory. The distance to read the electronic smart card is 0 to 10 cm and it takes less than 0.3 seconds to read the information from the card. The card readers contain a real clock circuit with a maximum time error of 60 seconds per month.

IC Cards operation is checked daily and routinely maintenance is carried out by branch supervisors for feeder lines and supporting lines. Personnel within the BRT B1 stations check and report daily the functioning of this system.

The following table summarizes the information on the equipment used.

Table 3: **Equipment Used for Electronic Ticketing of Passengers**

Item	Manufacturer	Model or series	Location
Non-contact IC card	The Beijing YichengXin Tong Smart Card Co., LTD and Shandong Huaguan Smart Card Co., LTD	MIFARE 1 S5	Passengers
IC Card readers (POS system)	GMCC	FJZ-42	All buses and on B1 stations
Infrared Data Gathering Machine	GMCC	CJH - 02D	Bus depots
Data reclaiming Multiplexer	GMCC	DLQ-20E	Bus depots
GPS modules	Ublox	LEA 5s	All buses

Cash Payment

Passengers pay through electronic smart cards or by cash. Cash is introduced in a special secure slot and collected daily at every bus depot from where it is transferred to the cash counting department for each branch. Bills and coins are separated, counted and reported. The results are then kept and processed in a central office where all cash from all branches is collected and then reported to the central Database.

Figure 6: **Cash Payment Procedure**

Cash passenger numbers are derived by dividing the total cash collected through the fixed fare of 1 RMB per passenger valid since 01/08/2010[14].

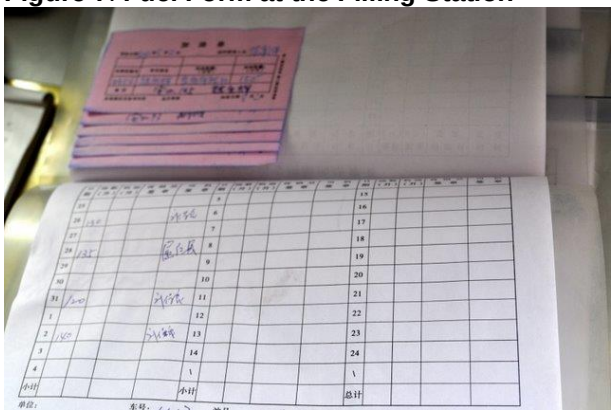
[13] See http://www.gmcc.com.cn/english/ic.htm for more information

[14] File 7

FUEL CONSUMED

Fuel is obtained from third party companies but also checked by the Zhengzhou Bus Communication Company. Every time a bus goes to refill it has to show a slip where it says its estimated amount of fuel to refill, ID of bus, driver and date. Two copies of this form are issued and each driver keeps a separate personal log of the dates and amount of fuel filled to each bus.

Figure 7: **Fuel Form at the Filling Station**



The fuel stations and the relevant departments of each branch of the Zhengzhou Bus Communication Company collect the information. Data is checked at the end of the month through the invoices each fuel company sends to the bus company[15]. Constant communication between both parties is kept in order to avoid any discrepancies in the fuel consumption data.

Diesel consumed has no bio-fuel share[16].

Electric buses are only in use since 08/2011 (2-10 units depending on the month). The electricity consumed is recorded at the charging station. The accuracy class of the meter is 0.5S i.e. it means the deviation is not more than ± 0.5%. Meters are calibrated by "The Measurement and Test Department of Zhengzhou Electricity Supply Bureau" – however as the buses are new and have less than 1 year no calibration has yet taken place. The charging facilities have been established at fuel stations and are also new. The charging stations are owned by the filling stations and not the project owner. For details of the electric charging facility see File 15.

Since 01/2012 also diesel-hybrid and CNG-hybrid buses are used as feeder units. The hybrids cannot be re-charged with electricity and thus use only diesel or CNG fuel.

Since 04/2014 few LPG articulated buses are also used on trunk routes.

Fuel stations belong to third parties and the calibration of the fuel pumps follows China's law. Data is available for the total fleet and not a sample. Data plausibility control is carried out through specific consumption of fuel (liter per 100 km for diesel units, m^3 per 100 km for CNG units and kWh per 100 km for electric units[17]). Based on the PDD chapter B.7.1. for the parameter TC standard random variations are those that are inside the range of ± 10% of the monitored average of realized measurements.

DISTANCE DRIVEN OF BUSES

Data on distance driven is only used as QA for fuel consumption data by calculating the specific fuel consumption. Data of distance driven therefore is not used for any emission reduction calculations.

[15] The cut-off is fuel invoices. Fuel bought at the station in this month is included (the cut-off date for each month is the 25th). This is the only feasible way and is made in all BRT projects that way also in CDM project 0672 where the UNFCCC has already issued various consecutive times CERs. Monthly data and the cut-off date in principle are irrelevant for ER calculations as the aggregate is taken over the crediting period which includes various months. Also AM0031 says that TC is based on company records.

[16] File 12

[17] The quantity of electric units is however very small to assess variations; LPG units are only singular units since April 2014 and therefore no variations can yet be assessed.

Each bus has a UBLOX LEA 5S GPS module installed. GPS and the processing of its data is organized by Zhengzhou Tiamaes Technology Co., Ltd. Its duties include the maintenance and monitoring of the GPS system.

The accuracy of the GPS is 5m RMS[18]. The GPS system communicates directly to the servers of the Zhengzhou Bus Communication Company using 2G technology (GPRS or CDMA). In case of malfunction of the GPS, the bus is taken out of operation and taken immediately to service. As data from GPS is constantly under supervision, any malfunctions are addressed immediately and if necessary the GPS device is replaced by a new one.

Figure 8: Technical Specifications of GPS Module

Receiver performance data

Receiver type	50-channel u-blox 5 engine GPS L1 C/A code GALILEO L1 open service (with upgrade) SBAS: WAAS, EGNOS, MSAS, GAGAN	
Max. update rate	4 Hz (ROM version), 2 Hz (Flash version)	
Accuracy[1]	Position	2.5 m CEP
	SBAS	2.0 m CEP
Acquisition[1]	LEA-5H/5S/5Q	LEA-5A/5M
Cold starts:	29 s	32 s
Warm starts:	29 s	32 s
Aided starts[2]:	< 1 s	< 1 s
Hot starts:	< 1 s	< 3 s
Sensitivity[3]	LEA-5H/5S/5Q	LEA-5A/5M
Tracking:	–160 dBm	–160 dBm
Reacquisition:	–160 dBm	–160 dBm
Cold starts:	–144 dBm	–143 dBm
Timing accuracy	RMS	30 ns
	99%	< 60 ns
	Granularity	21 ns
Time pulse	Configurable	0.25 to 1000 Hz
A-GPS	Supports AssistNow Online and AssistNow Offline, OMA SUPL compliant	
Operational limits	Velocity: 500 m/s (972 knots) Altitude: 50,000 m	
Operating temp.	–40° C to 85° C	
Storage temp.	–40° C to 85° C	

[1] All SV @ –130 dBm
[2] Dependent on aiding data connection speed and latency
[3] Demonstrated with a good active antenna

PASSENGER SURVEY

The surveys are realized by Zhengzhou Lianbang Business Consulting Co., Ltd[19]. The company was trained 13/01/2010 by Grütter Consulting AG on the surveys[20]. Grütter Consulting AG checks all surveys.The training included an introduction to the contents of the survey, its objective and methodology. Special emphasis was made to the requirement of random questioning of passengers and to follow the distribution given in order to follow the patterns of passenger usage of the BRT. A survey trial was made at several stations with random passengers. Surveyors were supervised to check the proper conduction of the survey[21].

[18] File 14; RMS is 1 sigma idem to 1 standard deviation and means that in 95% of the cases the accuracy will be better than 5m

[19] For Contract see File 10a and 10b and for Business License of survey company File 10c

[20] File 8

[21] File 8

The Zhengzhou Lianbang Business Consulting Co. Ltd. performs QA/QC of surveys through:

- Instruction and guidance of surveyors;
- Random checks during the survey at different BRT stations;
- Random calls of surveyed passengers to check data consistency.

The survey objectives are:

- Determine the mode of transport passengers of the BRT would have used in absence of the project activity.
- Determine for passengers which would have used passenger cars in absence of the project the type of fuel used by the passenger car they would have taken in absence of the project.
- Determine for passengers who in absence of the project activity would have used taxis or passenger cars the trip distance on the project system.

For detailed information on the survey see Section D.3.

DATA STORAGE

Data for the Zhengzhou Bus Communication Company is gathered and processed by the Net Center. The Zhengzhou Bus Communication Company transmits as electronic files the data on passengers, fuel consumption and distance driven on a regular base to Grütter Consulting AG. Grütter Consulting AG makes a quality check of this data based on testing the plausibility of given data. Plausibility is checked by comparing given values with average, upper and lower boundaries as well as by making a comparison with historic data.

The survey company keeps all hard copies of surveys and transmits an electronic survey report plus scanned copies of all surveys for each performed survey to Grütter Consulting AG. This report is checked for correctness and plausibility by Grütter Consulting AG.

Grütter Consulting AG keeps electronic records including backups of all reports delivered by the Zhengzhou Bus Communication Company and by the survey company.

PROCEDURES FOR HANDLING INTERNAL AUDITS AND NON-CONFORMITIES

The Data Management Office of the Zhengzhou Bus Communication Company is in charge of managing and processing the data coming from the operation of the BRT.

Procedures for internal controls include:

- Bus supervisors are in charge of double checking the records kept by the different drivers with records maintained by the fuel stations. It is also their duty to contact fuel stations and report any discrepancies in the data.
- All monitored data was controlled randomly through a spot check by an audit realized at the premises of the operator by staff of the Zhengzhou Bus Communication Company and Grütter Consulting AG.
- All information delivered by the Zhengzhou Bus Communication Company and by the survey company is controlled by Grütter Consulting AG for plausibility.

Data is generated to a large extent by 3rd parties which are not project participants. This is true for the fuel consumption (3rd party fuel stations deliver fuel consumption records) and the survey which determines the baseline mode plus other information. These companies have no vested interest with GHG emission reductions and have their internal control procedures. Passenger data is recorded and transmitted to the Central Database of the Zhengzhou Bus Communication Company with the use of the POS system which downloads and processes the data automatically. Distance driven is recorded and transmitted automatically (GPS system) and is thus also not directly managed by the project owner.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	**$SEC_{T,G/D/CNG}$**
Unit:	l/100km and m^3/100km
Description:	Specific energy consumption taxis gasoline, diesel and CNG
Source of data:	Taxi Company of Zhengzhou Bus Communication Company, 2009
Value(s) applied):	Gasoline taxis: 9.01 l/100km Diesel taxis: 6.0 l/100km CNG taxis: 8.0 m^3/100km Share gasoline taxis: 25% Share diesel taxis: 5% Share CNG taxis: 70%
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	**$SEC_{C,G}$**
Unit:	l/100 km
Description:	Specific energy consumption passenger cars
Source of data:	"Harvard Kennedy School: China's Fuel Economy Standards for Passenger Vehicles", 3.2009 based on data of CATARC China Automotive Technology and Research Center) and NDRC (National Development and Reform Commission) as well as automobile producers
Value(s) applied):	8.5
Purpose of data:	Baseline emission calculations
Additional comment:	100% of cars use gasoline

Data / Parameter:	**$SEC_{Z,D,L/M}$**
Unit:	l/100km
Description:	Specific energy consumption of large and medium diesel buses
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	Large units: 33.7 l/100km Medium units: 27.6 l/100km
Purpose of data:	Baseline emission calculations
Additional comment:	Large size units: 60 passengers and more Medium size units: 30-40 passengers No small diesel units

Data / Parameter:	**$SEC_{Z,G,S}$**
Unit:	l/100km
Description:	Specific fuel consumption of small gasoline buses
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	26.1
Purpose of data:	Baseline emission calculations
Additional comment:	Only 3 units No large and no medium gasoline units

Data / Parameter:	SEC_{TB}
Unit:	kWh/100km
Description:	Quantity of electricity consumed by electric trolleybuses per 100km
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	120.0
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	$SEC_{Z,CNG,L/M}$
Unit:	m^3/100km
Description:	Specific energy consumption of large and medium CNG buses
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	Large size: 28.8 Medium size: 25.0
Purpose of data:	Baseline emission calculations
Additional comment:	No small CNG buses

Data / Parameter:	$DD_{Z,D,L/M}$ $DD_{Z,G,S}$ $DD_{Z,CNG,L/M}$ DD_{TB}
Unit:	Kilometers
Description:	Distance driven of diesel buses (large and medium), gasoline buses (small), CNG buses (large and medium) and electric trolleybuses year 2008
Source of data:	Maintenance Department of Zhengzhou Bus Communication Company, 2009
Value(s) applied):	Large diesel buses: 90,066,612 Medium diesel buses: 29,671,440 Small gasoline buses: 248,076 Large CNG buses: 110,490,624 Medium CNG buses: 16,107,840 Electric trolleybuses: 3,040,824
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	$EF_{Grid,CM}$
Unit:	$kgCO_2$/kWh
Description:	Emission factor for the grid
Source of data:	UNFCCC, Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 1.0
Value(s) applied):	0.4
Purpose of data:	Baseline and Project emission calculations
Additional comment:	Default value of Tool based on Scenario A, option A2.

Data / Parameter:	TDL
Unit:	---
Description:	Average technical transmission and distribution losses for providing electricity
Source of data:	UNFCCC, Tool to calculate baseline, project and/or leakage emissions from electricity consumption (EB 39 Annex 7), Version 01

Value(s) applied):	3%
Purpose of data:	Baseline and Project emission calculations
Additional comment:	Default value of Tool

Data / Parameter:	**$EF_{CO2,CNG,Z/T/C}$**
Unit:	gCO_2/m^3
Description:	CO_2 emission factor of CNG buses, taxis and passenger cars
Source of data:	IPCC, 2006 table 1.4. and PetroChina Company Ltd., 2009
Value(s) applied):	2,163
Purpose of data:	Baseline and Project emission calculations
Additional comment:	Based on NCV of CNG of 38.6 MJ/m^3 (national value) and the carbon emission factor of 56.1 gCO_2/MJ from IPCCC, 2006, table 1.4. (the average value is taken and not the upper or lower boundary as the same fuel is used for project and baseline units)

Data / Parameter:	**$EF_{CH4,CNG,Z}$**
Unit:	gCO_{2e}/m^3
Description:	CH_4 emission factor of CNG expressed in $CO_{2eq}$for buses
Source of data:	IPCC, 2006 table 3.2.4
Value(s) applied):	563
Purpose of data:	Baseline and Project emission calculations
Additional comment:	Based on SEC buses baseline (28.8 m^3/100km) and CH_4 emission factor per km of IPCC (7.715) plus GWP of CH_4 (21)

Data / Parameter:	**$EF_{N2O,CNG,Z}$**
Unit:	gCO_{2e}/m^3
Description:	N_2O emission factor of CNG expressed in $CO_{2eq}$for buses
Source of data:	IPCC, 2006 table 3.2.4
Value(s) applied):	109
Purpose of data:	Baseline and Project emission calculations
Additional comment:	Based on SEC buses baseline (28.8 m^3/100km) and N_2O emission factor per km of IPCC (0.101) plus GWP of N_2O (310)

Data / Parameter:	**$EF_{CH4,CNG,T/C}$**
Unit:	gCO_{2e}/m^3
Description:	CH_4 emission factor of CNG expressed in CO_{2eq} for taxis and passenger cars
Source of data:	IPCC, 2006 table 3.2.4
Value(s) applied):	123
Purpose of data:	Baseline emission calculations
Additional comment:	Based on SEC taxis baseline (8.0 m^3/100km) and CH_4 emission factor per km of IPCC (average of upper and lower limit of 0.215 and 0.725) plus GWP of CH_4 (21)

Data / Parameter:	**$EF_{N2O,CNG,T/C}$**
Unit:	gCO_{2e}/m^3
Description:	N_2O emission factor of CNG expressed in CO_{2eq} for taxis and passenger cars
Source of data:	IPCC, 2006 table 3.2.4

Value(s) applied):	188
Purpose of data:	Baseline emission calculations
Additional comment:	Based on SEC taxis baseline (8.0 m^3/100km) and N_2O emission factor per km of IPCC (average of upper and lower limit of 0.027 and 0.070) plus GWP of N_2O (310)

Data / Parameter:	**OC_T**
Unit:	Passengers
Description:	Average occupation rate of taxis
Source of data:	Grütter Consulting, 2009
Value(s) applied):	1.18
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	**OC_C**
Unit:	Passengers
Description:	Average occupation rate of passenger cars
Source of data:	Grütter Consulting, 2009
Value(s) applied):	1.66
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	**P_Z**
Unit:	Passenger trips
Description:	Passengers trips with buses in the baseline year 2008
Source of data:	Zhengzhou Bus Communication Company, 2009 and Grütter Consulting, 2009
Value(s) applied):	670,634,722
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	**DD_Z**
Unit:	Km
Description:	Distance travelled all buses in the baseline year 2008
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	249,625,416
Purpose of data:	Baseline and Leakage emission calculations
Additional comment:	

Data / Parameter:	**$TD_{C,T}$**
Unit:	Km
Description:	average distance of users of passenger cars and taxis
Source of data:	Grütter Consulting, 2009
Value(s) applied):	10.6 for passenger cars 10.2 for taxis
Purpose of data:	Baseline emission calculations
Additional comment:	

Data / Parameter:	N_B
Unit:	Buses
Description:	Total number of baseline public transport buses in Zhengzhou
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	3,717
Purpose of data:	Baseline and leakage emission calculations
Additional comment:	

Data / Parameter:	N_T
Unit:	Taxis
Description:	Total number of taxis in Zhengzhou
Source of data:	Zhengzhou Vehicles Administration Office, 2009
Value(s) applied):	10,356
Purpose of data:	Baseline and leakage emission calculations
Additional comment:	

Data / Parameter:	N_C
Unit:	Passenger cars
Description:	Number of passenger cars in Zhengzhou
Source of data:	Zhengzhou Vehicles Administration Office, 2009
Value(s) applied):	209,303
Purpose of data:	Baseline and leakage emission calculations
Additional comment:	

Data / Parameter:	VD_T
Unit:	Kilometers
Description:	Annual average distance driven of taxis in Zhengzhou
Source of data:	Taxi Company of Zhengzhou Bus Communication Company, 2009
Value(s) applied):	109,200
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	VD_Z
Unit:	km
Description:	Annual average distance driven per bus baseline
Source of data:	Zhengzhou Bus Communication Company, 2009
Value(s) applied):	67,158
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	$ROC_{Z,0}$
Unit:	%
Description:	Average occupancy rate relative to capacity of buses baseline
Source of data:	Zhengzhou Bus Communication Company, 2009; Grütter Consulting, 2009

Value(s) applied):	31%
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	**TR_C**
Unit:	Trips
Description:	Number of daily trips realized by passenger cars baseline
Source of data:	Zhengzhou Vehicles Administration Office, 2009, Grütter Consulting, 2009
Value(s) applied):	1,292,584
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	**SRS**
Unit:	%
Description:	Share of road space used by public transport in the baseline
Source of data:	Zhengzhou Bus Communication Company, 2009, Grütter Consulting, 2009, Taxi Company of Zhengzhou Bus Communication Company, 2009, Zhengzhou Vehicles Administration Office, 2009
Value(s) applied):	4%
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	**RSB / RSP_p**
Unit:	Km
Description:	Road space available baseline / Road space available project
Source of data:	Baseline: Zhengzhou Planning and Design Institute, 2009 Project roadspace used: BRT Zhengzhou, 2009 based on trunk routes planned
Value(s) applied):	Baseline: 1,232 km Road space quit cumulative 2010 32 km, 2011 onwards 106 km
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	**BSCR**
Unit:	buses
Description:	Buses not required due to the project
Source of data:	Calculation
Value(s) applied):	**Table 4: Buses not Required due to Project (Cumulative)**
Purpose of data:	Leakage emission calculations
Additional comment:	

2011	2012	2013	2014	2015	2016	2017	2018
213	234	256	280	307	336	367	402

Data / Parameter:	**V_B**
Unit:	km/h
Description:	Vehicle speed baseline (average total speed) of passenger cars

Source of data:	Grütter Consulting, 2009
Value(s) applied):	22
Purpose of data:	Leakage emission calculations
Additional comment:	

Data / Parameter:	**V_P**
Unit:	km/h
Description:	Vehicle speed project
Source of data:	Grütter Consulting, 2009
Value(s) applied):	22
Purpose of data:	Leakage emission calculations
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	**P_{PJ}**
Unit:	Passengers
Description:	Passengers transported by project
Measured/ Calculated / Default:	Measured
Source of data:	Zhengzhou Bus Communication Company (File 17 and File 19), and Survey realized by Zhengzhou Lianbang Business Consulting Co. Ltd (number of buses used per passenger; File 11)
Value(s) of monitored parameter:	1,512,844,561
Monitoring equipment:	Data on passenger numbers is generated from card users and cash payments. Passenger numbers based on entry statistics based on income from ticket sales through cash at stations and buses plus electronic tickets. Passengers from trunk and support lines can change freely and no double counting occurs as the passenger is only counted once when entering the station. A special survey of feeder line passengers is made to check for passengers using feeder plus supporting/trunk lines. Passenger cards meet the ISO / IEC 14443-1, and the Ministry of Construction "IC card application management construction and technical requirements." IC Cards operation is checked daily and routinely maintenance is carried out by branch supervisors. See for details Section C 4.1.
Measuring/ Reading/ Recording frequency:	Continuous measuring (passengers enter continuously stations or buses and are recorded real time) with monthly aggregated reports.

Calculation method (if applicable):	$P_{PJ} = P_{PJ,T} + P_{PJ,F}$ $P_{PJ,T}$ includes trunk and support line passengers. $P_{PJ,T} = P_{PJ,T,gross}$*(100%-x%) x = Percentage of passengers of feeder lines which use a trunk/support line bus (based on survey) x= 34% for 8/2012 to 7/2013 (File 11a) x= 32% for 8/2013 to 7/2014 (File 11b/c) $P_{PJ,T}$ = 183,761,325 $P_{PJ,F}$ = 1,329,083,236 Monthly data is based on 26th till 25th of next month.
QA/QC procedures:	Non-contact IC card technology is widely used in public transport. The Zhengzhou Bus Communication Company has two different suppliers for the IC Cards: The Beijing YichengXin Tong Smart Card Co., LTD and Shandong Huaguan Smart Card Co., LTD. Both companies have ISO 9001 certification for Quality Management System as an indication of the level of product reliability. All card readers are powered by electricity. In case of malfunction the buses are immediately taken out of service until the problem is fixed. Extra card readers are available in case of need. Malfunctions are addressed immediately and considering the nature of the malfunction, proper operation is restored in general after two days. In most cases malfunctions are a result of battery breakdown. If the malfunction is due to a problem in the internet communication or due to lack of electricity at the station, the POS system has an internal memory of over 1,000 records. For survey QA see Section D.3.
Purpose of data:	Baseline emissions
Additional comment:	See spreadsheet for monthly data and details. Passengers trunk line sheet “Summary BRT-B Lines” with passengers trunk gross and passengers net. Passengers feeder line see sheet “summary feeders” Total passengers see sheet “Project”

Data / Parameter:	**$TC_{T/F}$**
Unit:	Liter, m^3 and kWh
Description:	Total diesel, CNG, LPG and electricity consumed by the project (trunk and feeder buses)
Measured/ Calculated / Default:	Measured
Source of data:	Zhengzhou Bus Communication Company (File 18 and 19)

Value(s) of monitored parameter:	$Diesel_{Trunk}$: 24,265,661 liter $Diesel_{Feeder}$: 90,921,697 liter Diesel total: 115,187,358 liter CNG_{Trunk}: 2,048,475 m^3 CNG_{Feeder}: 43,083,328 m^3 CNG total: 45,131,803 m^3 LPG_{Trunk}: 9,494 m^3 LPG_{Feeder}: 0 m^3 LPG total: 9,494 m^3 $Electricity_{Trunk}$: 0 kWh $Electricity_{Feeder:}$ 226,287 kWh Electricity total: 226,287 kWh
Monitoring equipment:	Based on reports per bus of fillings made per day at filling stations. The equipment is of independent filling stations. See Section C. The filling stations are not managed by the project but by independent companies. The calibration of the fuel pumps follows China's law. The data is thus based on **reports** as also indicated in the approved methodology as well as the registered PDD and is not a measurement of the project owner. The electricity consumed is recorded at the charging station and also the bus itself has a meter. The accuracy class of the meter is 0.5S i.e. means the deviation is not more than ±0.5%. The charging facilities are owned and operated by the filling stations (same as petrol/diesel filling stations) and are thus not under control of the project owner. The calibrations of the electric meters at the filling stations is made by the government and is initiated and controlled also by the government i.e. calibrations are automatically done by the relevant government entity and not dependent on the fuel station.
Measuring/ Reading/ Recording frequency:	Daily with monthly aggregated reports.
Calculation method (if applicable):	Sum of feeder line fuel consumption and of trunk/support line fuel consumption. The fuel consumption is reported for each line individually and summed up. No bio-fuel blend is used[22]. Monthly data is based on 26th till 25th of next month.
QA/QC procedures:	Data plausibility control for is carried out through specific consumption of fuel (liter per 100km or m^3 per 100km or kWh per 100km). Based on the PDD chapter B.7.1. for the parameter TC standard random variations are those that are ±10% of the monitored average of realized measurements. In Section E2 the values and the upper and lower band are reported. The monitored values are inside this band. See for details Section C.
Purpose of data:	Project emissions
Additional comment:	

Data / Parameter:	**$DD_{T/F}$**
Unit:	Kilometres
Description:	Distance driven of BRT buses (trunk, and feeder buses)

[22] File 12

Measured/ Calculated / Default:	Measured
Source of data:	Zhengzhou Bus Communication Company (File 18 and 19)
Value(s) of monitored parameter:	DD_T: 56,676,240 $DD_{F,D}$: 238,933,490 $DD_{F,CNG}$: 119,234,528 $DD_{F,elec}$: 249,259 DD_F total: 358,417,277
Monitoring equipment:	Based on GPS. The accuracy of the GPS is 5m RMS[23]. The GPS system communicates directly to the servers of the Zhengzhou Bus Communication Company using 2G technology (GPRS or CDMA). In case of malfunction of the GPS, the bus is taken out of operation and taken immediately to service. As data from GPS is constantly under supervision, any malfunctions are addressed immediately and if necessary the GPS device is replaced by a new one. GPS are not calibrated. The GPS calibrates itself automatically and on a continuous base with 3 satellites and triangulates its position with these 3 satellites. The procedure of determining a 2-D position is based on using signals received from the best (or only) three available GPS satellites. Altitude is assumed to be known and constant. A 2-D position solution will only be determined if signals from three or more satellites are available. See for details Section C 4.3.
Measuring/ Reading/ Recording frequency:	Daily aggregated monthly
Calculation method (if applicable):	Sum of feeder line distance driven and of trunk/support line distance driven. The distance driven is reported for each line and fuel type (some feeder lines operate CNG and diesel or CNG/diesel and electric trolleybuses) individually and is then summed up. Monthly data is based on 26th till 25th of next month.
QA/QC procedures:	For trunk and feeder buses the project follows the alternative A of the methodology AM0031, which is based on the total fuel consumed by the project activity. The parameter distance driven is thus used only for quality control of fuel used for BRT buses.
Purpose of data:	Project emissions
Additional comment:	For trunk/support units the distance driven is separated in 18m and 12m buses to determine the relevant specific fuel consumption. 18m buses: 13,522,432 km 12m buses: 43,153,808 km

Data / Parameter:	**$TD_{C/T}$**
Unit:	Kilometres
Description:	Trip distance of project passengers which in absence of the BRT would have used passenger cars or taxis
Measured/ Calculated / Default:	Measured (individual trip distance) and calculated (average)
Source of data:	Survey realized by Zhengzhou Lianbang Business Consulting Co. Ltd. (independent 3rd Party) (File 16)
Value(s) of monitored parameter:	Distance of passengers which would have used passenger cars: 6.8 km Distance of passengers which would have used taxis: 6.9 km

[23] File 14

Monitoring equipment:	None, based on survey
Measuring/ Reading/ Recording frequency:	Based on bimonthly surveys realized 20-26/08/2012, 20-26/10/2012, 15-21/12/2012, 22-28/02/2013, 22-28/04/2013, 18-24/06/2013, 21-27/08/2013, 21-27/10/2013, 17-23/12/2013, 21-27/02/2014, 21-27/04/2014, and 21-27/06/2014
Calculation method (if applicable):	Based on average values of realized surveys
QA/QC procedures:	See section D3
Purpose of data:	Baseline emissions
Additional comment:	An adaptation of baseline emission factors cars and taxis due to changing trip distance is realized as the monitored values are lower than the baseline values. See Section E1.

Data / Parameter:	X_C
Unit:	%
Description:	Fuel type used by passenger cars of users of the project BRT
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by Zhengzhou Lianbang Business Consulting Co. Ltd (independent 3rd Party) (File 16)
Value(s) of monitored parameter:	Cars using gasoline: 100% Cars using diesel: 0% Cars using gaseous fuels: 0% Cars using alternative fuels: 0%
Monitoring equipment:	None, based on survey
Measuring/ Reading/ Recording frequency:	Based on bimonthly surveys realized 20-26/08/2012, 20-26/10/2012, 15-21/12/2012, 22-28/02/2013, 22-28/04/2013, 18-24/06/2013, 21-27/08/2013, 21-27/10/2013, 17-23/12/2013, 21-27/02/2014, 21-27/04/2014, and 21-27/06/2014
Calculation method (if applicable):	Based on average values of realized surveys
QA/QC procedures:	See section D3
Purpose of data:	Baseline emissions
Additional comment:	No adaptation of the baseline emission factor of cars is made as the monitored fuel types used are idem to the baseline fuel types.

Data / Parameter:	$S_{PJ,i}$
Unit:	%
Description:	Share of passengers which in absence of the project would have used mode *i*
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by Zhengzhou Lianbang Business Consulting Co. Ltd. (independent 3rd Party) (File 16)
Value(s) of monitored parameter:	Passengers which would have used a car: 7.2% Passengers which would have used a taxi: 10.1% Passengers which would have used a conventional bus: 79.7% Passengers which would have used NMT (Non-Motorized Transit):2.9% Passengers which would not have made the trip: 0.1%
Monitoring equipment:	None, based on survey
Measuring/ Reading/ Recording frequency:	Based on bimonthly surveys realized 20-26/08/2012, 20-26/10/2012, 15-21/12/2012, 22-28/02/2013, 22-28/04/2013, 18-24/06/2013, 21-27/08/2013, 21-27/10/2013, 17-23/12/2013, 21-27/02/2014, 21-27/04/2014, and 21-27/06/2014

Calculation method (if applicable):	Average values of all surveys realized in the monitoring period. Share of passengers mode "i" = Number of passengers which responded with mode "i" in survey / total number of people surveyed
QA/QC procedures:	The selection of persons for interviews is based on a systematic random sampling based on the flow of passengers per station per day. This is done by questioning every 5th passenger until they reach the required number of surveys per time bracket entering the station of the pilot line. The surveyor begins by questioning a passenger and then after finishing five passengers later they question again another passenger until they reach the required number of surveys. The survey is realized on all week days including weekends with the sample size per day being proportional to the number of passengers transported by the project per average week day. The number of surveys conducted per station is proportional to the average number of entry passengers at that station. See Section D3 for survey control details.
Purpose of data:	Baseline emissions
Additional comment:	

Data / Parameter:	**Policies**
Unit:	None
Description:	Review of relevant transport and fuel policies
Measured/ Calculated / Default:	Observed
Source of data:	Zhengzhou Bus Communication Company
Value(s) of monitored parameter:	No new relevant policies for the years 2012, 2013 and 2014. Sources reviewed include: Ministry of Transportation (http://www.moc.gov.cn/) , the Energy Foundation (http://www.efchina.org/), the China Sustainable Transportation Centre (http://www.chinastc.org/home) and the GIZ sustainable transport China Blog (http://sustainabletransport.org/)
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Annually new relevant transport and fuel policies are listed and their potential influence or impact on the project is assessed.
Calculation method (if applicable):	None
QA/QC procedures:	None
Purpose of data:	Baseline emissions
Additional comment:	

Data / Parameter:	**X_Z**
Unit:	None
Description:	Bio-fuel content of fuels used by project and baseline buses
Measured/ Calculated / Default:	Observed
Source of data:	Zhengzhou Branch Office of China National Petroleum Corporation (File 12)
Value(s) of monitored parameter:	0% bio-fuel
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Annual

Calculation method (if applicable):	None
QA/QC procedures:	
Purpose of data:	Project and baseline emissions
Additional comment:	

Data / Parameter:	**OC_T**
Unit:	Passengers
Description:	Average occupation rate of taxis
Measured/ Calculated / Default:	Measured based on sample
Source of data:	Survey realized under instruction of Grütter Consulting AG (File 6)
Value(s) of monitored parameter:	1.18
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Year 3 and year 7
Calculation method (if applicable):	Average of all points measured
QA/QC procedures:	See section D3 for details Survey realized using upper 95% confidence interval idem to the baseline approach. The sample size required for a 95% confidence level and a 10% maximum error bound (relative precision level) of a simple random sample is 266 while the actual sample size taken was 1,263 units i.e. more than required.
Purpose of data:	Leakage emissions
Additional comment:	See Section D3 for details. Leakage load factor change taxis has to be included if the occupation rate of taxis drops below 1.08 (1.18 baseline factor – 0.1 as defined in the methodology). The occupation rate is however higher than 1.08 and therefore no leakage.

Data / Parameter:	**ROC_Z**
Unit:	%
Description:	Average occupation rate of buses relative to capacity
Measured/ Calculated / Default:	Calculated based on measured input data
Source of data:	Zhengzhou Bus Communication Company (File 13)
Value(s) of monitored parameter:	43%
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Year 3 and 7
Calculation method (if applicable):	Same methodology is used as for baseline study i.e. the total amount of passengers transported baseline is multiplied with the average trip distance and divided by the annual distance driven of baseline buses divided by the average capacity of the bus i.e. (passengers x TD_P)/(DD x capacity bus)

QA/QC procedures:	Input data distance driven and passengers transported based on official reports (see also parameters above); average distance driven based on survey used for passengers (see above)
Purpose of data:	Leakage calculation
Additional comment:	Leakage load factor change baseline buses has to be included if the occupation rate of baseline buses drops below 21% (0.31 baseline factor – 0.1) The occupation rate is above the benchmark value of 21% and has even increased showing a positive impact of the program also on the other bus routes. No leakage bus occupation rate is therefore included.

The following monitoring parameters are not required:

- **N_T/N_Z:** Based on the registered PDD this parameter needs not be monitored if no leakage due to change of occupation rates. As this is not the case (occupation rate taxis and buses above threshold value) this parameter is not recorded.

D.3. Implementation of sampling plan

Surveys or visual occupation rates based on samples are required for following parameters:

1. Passenger survey to determine mode used, trip distance per mode and fuel passenger cars.
2. Number of passengers which use a trunk bus and have already used a feeder bus
3. Average occupation rate taxis

PASSENGER SURVEY

Sampling Design

The survey is realized to collect the following data:

1. Mode passengers would have used in the baseline;
2. Trip distance on the project system of passengers which respond with passenger cars and taxis;
3. Type of fuel used by cars for respondents of passenger cars.

The target population is the users of the BRT system of Zhengzhou.

Survey Principles are:[24]

1. The sampling size is determined by the 95% confidence interval and the 5% maximum error margin. The registered PDD states a minimal sample of 500 units (Annex A.7.) In practice the sample size of the conducted surveys has been >1,100 valid units per survey totalling for the monitoring period of 23 months 12 surveys with a total of 13,984 respondents which is significantly more than required by the registered PDD.
2. Sampling must be statistically robust and relevant i.e. the survey has a random distribution (random selection of passengers) and is representative of the persons using the project transport system.
3. The methodology to select persons for interviews is based on a systematic random sampling based on the flow of passengers per station per day. The number of surveys conducted per station shall be proportional to the average number of entry passengers at that station (e.g. if 10% of passengers used station 1 as entry point then 10% of the surveys shall be conducted at that station). Records of minimum 1 week of passengers (entry station and passengers per day) shall be used to realize the survey design. Brackets per day can be used e.g. 6-9, 9-12, 12-15, 15-18. Also various stations can be clustered together. Stations selected are on trunk routes thus including all trunk and supporting routes. All stations are included in the survey. The clustering is made over a maximum of 5 neighboring stations thus not affecting in a significant manner distance driven. Within these stations the selection of passengers is random. Whenever new trunk routes are included calculations are remade.

[24] In accordance with the registered PDD Annex 7

4. Only persons over age 12 are interviewed.
5. The survey is realized on all week days including weekends with the sample size per day being proportional to the number of passengers transported by the project per corresponding week day. Surveys are conducted during the entire period of operation of the system.
6. Non-responses are recorded.
7. All original surveys are recorded, scanned as electronic copies and stored.
8. Surveys are conducted at bus stations when people wait for bus-boarding. It should be avoided to realize the survey with people de-boarding the bus as latter will not want to invest time in a survey thus potentially giving wrong answers.
9. The selected weeks for surveys do not correspond to a public holiday.
10. The survey is realized bi-monthly.

The above listed survey principles have all been implemented.

The actual sampling size used is between 1,133 and 1,192 surveys each time. Surveys were made 20-26/08/2012, 20-26/10/2012, 15-21/12/2012, 22-28/02/2013, 22-28/04/2013, 18-24/06/2013, 21-27/08/2013, 21-27/10/2013, 17-23/12/2013, 21-27/02/2014, 21-27/04/2014, and 21-27/06/2014.

All these surveys were done by questioning every 5th passenger until they reach the required number of surveys per time bracket (plus reserve number) entering the station thus guaranteeing random selection. The surveyor begins by questioning a passenger and then after finishing five passengers they question again another passenger until they reach the required number of surveys. The survey is realized on all week days including weekends with the sample size per day being proportional to the number of passengers transported by the project per average week day. The number of surveys conducted per station is proportional to the average number of entry passengers at that trunk station. Records of 1 week of passengers (entry station and passengers per day) were used to realize the survey design. Clustering of hours e.g. 6-9, 9-12, 12-15, 15-18 and of stations is made. This is to ensure a representative survey. Data is registered by hand on paper by the surveyor and all paper copies are thereafter scanned to have an electronic back-up file. All originals are available to the verifier. From the paper copy the data is transferred by the survey company to an excel file and then sent to Grütter Consulting AG.

The average value as resultant of these 12 surveys is taken for all calculations. The PDD in chapter B.7.1 under S_{PJ} clearly indicates that the average values of the surveys are taken. Point 17 of the Standard for "Sampling and Surveys for CDM Project Activities and Programme of Activities", Version 04.1 of the UNFCCC also indicates that "When sampling is undertaken, unless differently specified in the methodology applied, the sample mean (or proportion) value shall be used for the emissions reduction calculation, not the lower or upper bound of the confidence interval."

Collected Data

The following table shows results of collected data.

Table 5: Survey Data

Parameter	Result
% of passengers which would have used a car	7.2%
% of passengers which would have used a taxi	10.1%
% of passengers which would have used a bus	79.7%
% of passengers which would have used NMT	2.9%
% of passengers which would not have made the trip	0.1%
Average trip distance user cars (km)	6.8 km
Average trip distance user taxis (km)	6.9 km
Share of passenger cars gasoline	100%
Share of passenger cars diesel	0%
Share of passenger cars gaseous fuels	0%
Share of passenger cars electric or other	0%

Analysis of Collected Data

The number of surveys realized in this period is checked to see if the required 95% confidence interval of the survey and the 5% error level of the survey correspond and the average is thus reliable. The following table shows the analysis of the collected data.

The sampling size has been checked for a 95% confidence interval and a 5% relative precision level in accordance with the PDD is based on the following formulae[25]:

$$n \geq \frac{1.96^2 \times \frac{p \times (1-p)}{p^2}}{0.05^2}$$

Where:

n	sample size
p	proportion mode
1.96	95% confidence interval
0.05	relative precision level

The required number of surveys is calculated for the share of mode users buses which represent around 80% of respondents. The required sample size is thereby 392 whilst the actual sample size is 13,984. We can see therefore that the sample number is sufficient to comply with the required 95% confidence interval and a 5% relative precision level.

To check the reliability of the survey the relative precision level is calculated using the following formulae[26]:

$$R = \frac{0.5 \times (CIW)}{p} \times 100\%$$

Where:

R	Reliability (relative precision level)
CIW	width of confidence interval
p	proportion mode

CIW is the difference of the upper and the lower 95% confidence interval which is 1.96*standard error of proportion.

$$s\tan dard\_error\_of\_proportion = \sqrt{(1-f)\frac{pq}{n}}$$

Where:

f	sample proportion (n/N)
p	proportion mode
q	1-p
n	sample size
N	actual number

For the project the standard error of proportion is 0.0034[27] with a resultant CIW at a 95% confidence level of 0.0133. The resulting reliability or the relative precision level is therefore 1% which is far better than the 5% required by the methodology for the overall survey.

[25] See “Best Practices Examples Focusing on Sample Size and Reliability Calculations”, EB 67, Annex 6, p.5, paragraph 23; N i.e. the total number of passengers is around 900 million and thus a very large size thus warranting the approximate equation

[26] See “Best Practices Examples Focusing on Sample Size and Reliability Calculations”, EB 67, Annex 6, p.43, paragraph 224

[27] p = 0.80; q= 0.20; n=13,984; N=274,404,049 (gross total passenger number on BRT line)

Concerning the share of fuels used by passenger car only 1 respondent answered with diesel and not gasoline.

Concerning the trip distance the sampling size has been checked for a 95% confidence interval and a 10% relative precision level (based on EB 67 Annex 6, p. 22 point 112) with the following formulae[28]:

$$N = \frac{1.96^2 \times \left(\frac{SD}{AV}\right)^2}{0.1^2}$$

Where:

N	sample size
SD	Standard deviation
AV	Average (mean)
1.96	95% confidence interval
0.1	relative precision level (based on EB 67 Annex 6, p. 22 point 112)

The required sample size for cars calculated ex-post based on actual SD is 116 units whilst the actual sample size was 1,016 units thus showing compliance with the confidence level and precision level required.

To check the reliability of the sample size cars for the trip distance the relative precision level is calculated using the following formulae[29]:

$$R = \frac{0.5 \times (CIW)}{AV} \times 100\%$$

Where:

R	Reliability (relative precision level)
CIW	width of confidence interval
AV	Average (mean)

The Reliability or the relative precision level is 3% which is better than the 10% required by EB 65 Annex 2, p.2 point 9.

The required sample size for trip distance taxis calculated ex-post based on actual SD is 162 units whilst the actual sample size was 1,411 units thus showing compliance with the confidence level and precision level required.

To check the reliability of the sample size taxis for the trip distance the relative precision level is calculated using the following formulae[30]:

$$R = \frac{0.5 \times (CIW)}{AV} \times 100\%$$

Where:

R	Reliability (relative precision level)
CIW	width of confidence interval
AV	Average (mean)

The reliability or the relative precision level is 3% which is better than the 10% required by EB 65 Annex 2, p.2 point 9.

[28] See “Best Practices Examples Focusing on Sample Size and Reliability Calculations”, EB 67, Annex 6, p.12, paragraph 56

[29] See “Best Practices Examples Focusing on Sample Size and Reliability Calculations”, EB 67, Annex 6, p.41, paragraph 205

[30] See “Best Practices Examples Focusing on Sample Size and Reliability Calculations”, EB 67, Annex 6, p.41, paragraph 205

Summarized the survey complies with all monitored parameters with the requirements set forth by the methodology and the relevant EB guidelines.

BUS USAGE

Sampling Design

The sample design is based on the registered PDD Annex A.8. An annual survey of feeder line passengers is made to determine the number of buses used per trip. Principles of the survey are:

1. The survey is realized once annually.
2. The survey is realized from 7AM to 7PM on a workday (entire survey time i.e. not on each route the survey must be performed during the entire time)
3. Minimum 10% of all feeder lines are included.
4. Passenger are asked the following questions:
    a. Will you use after de-boarding the bus immediately a BRT trunk/supporting bus?
    b. Did you use right before boarding this bus a BRT trunk/supporting bus?
5. The average share of feeder passengers using a BRT trunk/supporting bus is determined and the number of feeder passengers is deducted by this share.

Collected Data

For the period 08/2012 to 07/2013 the survey was realized 16-22/04/2013. The proportion of passengers which use only 1 bus is thereby 66%.

For the period 08/2013 to 06/2014 the survey was realized 21-27/02/2014. The proportion of passengers which use only 1 bus is thereby 68%.

Analysis of Collected Data

The sampling size has been checked for a 95% confidence interval and a 10% relative precision level in accordance with the Standard for "Sampling and Surveys for CDM Project Activities and Programme of Activities", CDM-EB50-A30-STAN, point 10, based on the following formulae[31]:

$$n \geq \frac{1.96^2 \times \frac{p \times (1-p)}{p^2}}{0.1^2}$$

Where:

n	sample size
p	proportion mode (0.865 in this case)
1.96	95% confidence interval
0.1	relative precision level

The required sample size calculated ex-post based on the proportion of users of 1 bus is 198 units for the survey 2013 while the actual sample size was 1,049 units[32].

The required sample size calculated ex-post based on the proportion of users of 1 bus is 185 units for the survey 2014 while the actual sample size was 1,188 units[33].

[31] See "Best Practices Examples Focusing on Sample Size and Reliability Calculations", EB 67, Annex 6, p.5, paragraph 23; N i.e. the total number of passengers is around 900 million and thus a very large size thus warranting the approximate equation

[32] File 11a

[33] File 116

The standard error of the sample proportion is determined by[34]:

$$\sqrt{\left(1-f\right)\times\frac{p\times q}{n}}$$

Where:

f	sampling fraction i.e. n/N (for 2013 1,049/723,644,264[35] and for 2014 1,188/605,438,972[36])
q	is idem to 1-p (2013 1-0.660 and for 2014 1-0.675)
n	sample size (2013 1,242 and 2014 1,188)

$$R=\frac{0.5\times(CIW)}{p}\times 100\,\%$$

Where:

R	Reliability (relative precision level)
CIW	width of confidence interval
p	proportion mode

For 2013 the resulting Reliability or the relative precision level is 4% and for 2014 also 4% - both of which are better than the 10% required by the Standard for "Sampling and Surveys for CDM Project Activities and Programme of Activities", point 10.

TAXI OCCUPATION RATE

Sampling Design

The sampling design is based on the PDD Appendix A.6.1. The counting is based on visual occupation counting the number of passengers occupying the vehicle excluding the driver. Data was collected on 3 different days on 3 different locations between 7AM and 7PM. The categories used where 0, 1 , 2, 3, and 4 persons. The survey was conducted under instruction of Grütter Consulting AG between 24 and 26 /02/ 2014.

Collected Data

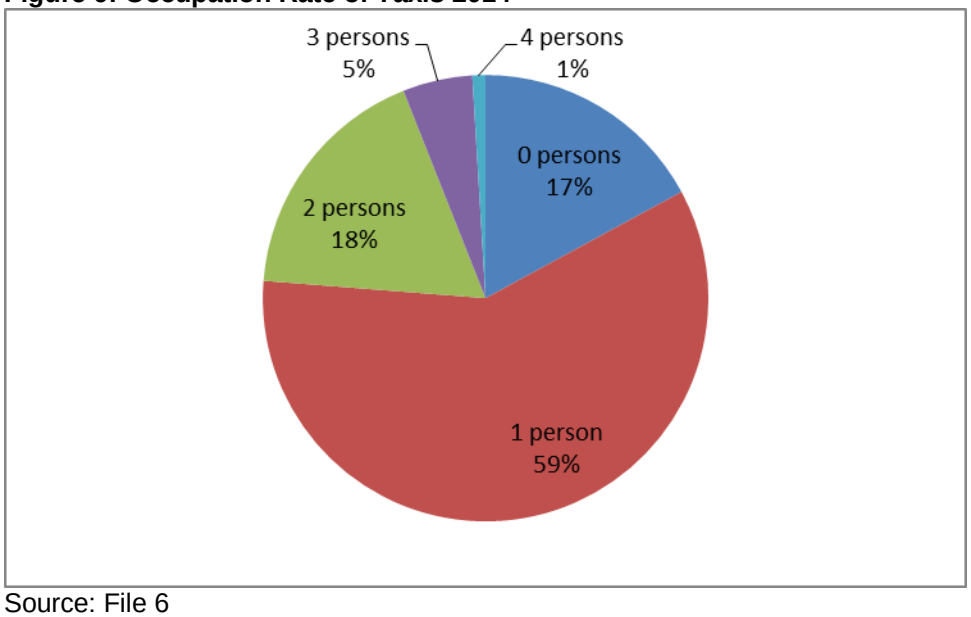
Data collected is the number of passengers per taxi. The following figure shows the distribution of taxis with number of passengers.

[34] See "Best Practices Examples Focusing on Sample Size and Reliability Calculations", EB 67, Annex 6, paragraph 217 ff

[35] Number of feeder line passengers 08/2012 to 07/2013

[36] Number of feeder line passengers 08/2013 to 06/2014

Figure 9: Occupation Rate of Taxis 2014



Source: File 6

Analysis of Collected Data

The following data shows the analysis of the collected data.

Table 6: Calculations Occupation Rate Taxis, 2014[37]

Parameter	Value
Total number of passengers	1,435
Total number of taxis	1,263
Average occupation rate	1.14
Standard deviation	0.79
Standard error of average	0.0221
Upper 95% confidence interval	1.18

The baseline occupation rate as used for the emission factor in the PDD is the upper 95% confidence interval (to have a conservative baseline emission factor). Therefore for comparison purposes also the upper 95% confidence interval of the project study must be taken i.e. the value of 1.18.

Demonstration of Confidence and Precision

The sampling size has been checked for a 95% confidence interval and a 10% relative precision level in accordance with the Standard for "Sampling and Surveys for CDM Project Activities and Programme of Activities", CDM-EB50-A30-STAN point 10. The following formulae is used[38]:

$$N = \frac{1.96^2 \times \left(\frac{SD}{AV}\right)^2}{0.1^2}$$

Where:

N	sample size
SD	Standard deviation
AV	Average (mean)
1.96	95% confidence interval
0.1	relative precision level

[37] File 6

[38] See "Best Practices Examples Focusing on Sample Size and Reliability Calculations", EB 67, Annex 6, p.12, paragraph 56

The required sample size calculated ex-post based on actual SD is 266 units whilst the actual sample size was 1,263 units i.e. more thus showing compliance with the confidence level and precision level required.

To check the reliability of the sample the relative precision level is calculated using the following formulae[39]:

$$R = \frac{0.5 \times (CIW)}{AV} \times 100\%$$

Where:
R Reliability (relative precision level)
CIW width of confidence interval
AV Average (mean)

CIW is the difference of the upper and the lower 95% confidence interval. Reliability or the relative precision level is 4% which is far better than the 10% required by the Standard point 10.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Total Baseline Emissions

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i,y} \right) \quad (1)$$

Where:
BE_y Baseline emissions in year y (tCO_{2e})
$EF_{P,i,y}$ Transport emissions factor per passenger in vehicle category i in year y (gCO_{2e}/passenger)
$P_{i,,y}$ Passengers transported by the project (BRT) in year y that without the project activity would have used category i, where i=Z (buses, public transport), T (taxis), C (passenger cars).

The mode passengers would have used in absence of the project is determined through the mode survey.

Passengers per Category i

$$P_{i,y} = P_y \times S_{i,y} \quad (2)$$

Where:
$P_{i,,y}$ Passengers transported by the project which in absence of latter would have used transport type i, where i=Z (buses, public transport), T (taxis), C (passenger cars), NMT (non-motorized transport) and IT (induced transport, i.e. would not have traveled in absence of project) (passengers)
P_y Total passengers transported by the project monitored in year y (passengers)
$S_{i,,y}$ Share of passengers transported by the project which in absence of latter would have used transport type i, where i=Z (buses, public transport), T (taxis), C (passenger cars), NMT (non-motorized transport) and IT (induced transport, i.e. would not have traveled in absence of project) (%)

Adjustment to Change of Trip Distance

$$CD_{i,y} = \frac{TD_{i,y}}{TD_i} \quad (3)$$

Where:

[39] See "Best Practices Examples Focusing on Sample Size and Reliability Calculations", EB 67, Annex 6, p.41, paragraph 205

$CD_{i,y}$ Correction factor for changing trip distance in category i for the year y, where i includes T (taxis) and C (passenger cars) (no unit)
TD_i Average trip distance in kilometers in category i before project start (km)
$TD_{i,y}$ Average trip distance in kilometers in category i in the year y (km)

Note: The adjustment is only made if $TD_{i,y}<TD_i$

Adjustment to Change of Fuel Used by Passenger Cars

For passenger cars $EF_{KM,C,y}$ is annually adapted according to changes in fuel composition of passenger cars. This is only made if the emission factor calculated is lower than the original emission factor used.

2. PARAMETERS AND DATA USED

The following table lists the monitored baseline parameters used (see also Section D.2.).

Table 7: Monitored Baseline Parameters

Parameter	Unit	Description	Value	Source
P_{PJ}	Passengers	Project passengers	1,512,844,561	File 11,17,19
$S_{PJ,i}$	%	Share of project passengers using mode "i" in absence of the project	Cars: 7.2% Taxis: 10.1% Bus: 79.7% NMT: 2.9% Induced: 0.1%	File 16
X_C	%	Share of fuel type "x" used by passenger car users of BRT	Gasoline: 100% Diesel, Gaseous, electric and others: 0%	File 16
$TD_{C/T}$	Km	Trip distance of project passengers which in absence of the BRT would have used passenger cars or taxis	Cars: 6.8 km Taxis: 6.9 km	File 16
Used for P_{PJ}	None	Share of feeder passengers which use a BRT trunk bus prior/after using the feeder unit	34% for period 08/2012 to 07/2013 32% for period 08/2013 to 06/2014	File 11a-e

The following parameters are not monitored but used for calculation purposes. Values are fixed ex-ante based on the registered PDD (see also Section D.1.).

Table 8: Baseline Parameters not Monitored

Parameter	Unit	Description	Values	Source
$EF_{P,C}$	gCO_{2eq}/passenger	Emission factor per passenger transported of passenger car	2012: 1,211 2013: 1,199 2014: 1,187	PDD table A.4.
$EF_{P,T}$	gCO_{2eq}/passenger	Emission factor per passenger transported of taxis	2012: 1,671 2013: 1,654 2014: 1,638	PDD table A.4.
$EF_{P,Z}$	gCO_{2eq}/passenger	Emission factor per passenger transported of baseline buses	2012: 296 2013: 293 2014: 290	PDD table A.4.
X_C	%	Share of fuel type "x" used by passenger cars baseline	Gasoline: 100%	PDD chapter B.6.2.
$TD_{C/T}$	Km	Trip distance baseline passenger cars or taxis	Cars: 10.6 Taxis: 10.2	PDD chapter B.6.2.
$EF_{P,C}$ Corrected for trip distance	gCO_{2eq}/passenger	Emission factor per passenger transported of passenger car	2012: 776 2013: 768 2014: 760	See calculation below
$EF_{P,T}$	gCO_{2eq}/passenger	Emission factor per	2012: 1,128	See calculation

Corrected for trip distance		passenger transported of taxis	2013: 1,116 2014: 1,105	below

Adaptation to the change of trip distance must be made for cars as well as taxis as the trip distance is shorter than in the baseline (see following table).

Table 9: Trip Distance per Mode

Parameter	Unit	Passenger car	Taxi
Baseline trip distance	Km	10.6	10.2
Project trip distance	Km	6.8	6.9
Adaptation of EF required due to lower trip distance Project compared to Baseline	Yes/No	Yes	Yes
CD (Correction Factor for Trip Distance)	None	0.	0.

The adaptation trip distance is made via the correction factor CD (see formulae 3 above). The EF baseline is multiplied with the CD.

$$CD_{i,y} = \frac{TD_{i,y}}{TD_i}$$

Where:

$CD_{i,y}$ Correction factor for changing trip distance in category i for the year y, where i includes T (taxis) and C (passenger cars) (no unit)

TD_i Average trip distance in kilometers in category i before project start (km)

$TD_{i,y}$ Average trip distance in kilometers in category i in the year y (km)

The survey registers that passenger cars as used by project passengers are gasoline powered idem to the baseline (see table below). Therefore no adaptation to fuel type used is made.

Table 10: Fuels Used by Passenger Cars

Parameter	Gasoline	Diesel	CNG/gaseous fuels	Electricity/0-emission
Baseline situation	100%	0%	0%	0%
Project situation	100%	0%	0%	0%

BASELINE RESULTS

Table 11: Baseline Emissions

Parameter	Unit	26/06/2012 to 31/12/2012	01/01/2013 to 31/12/2013	01/01/2014 to 25/06/2014	Total
Passengers	passengers	327,381,082	803,703,525	381,759,954	1,512,844,561
Emissions cars	tCO_{2eq}	18,397	44,717	21,028	84,143
Emissions taxis	tCO_{2eq}	37,194	90,380	42,515	170,089
Emissions buses	tCO_{2eq}	77,196	189,511	90,018	356,725
Baseline Emissions	tCO_{2eq}	132,787	324,608	153,561	610.956

Source: CER spreadsheet

Calculations are presented in the spreadsheet.

Data of passengers and fuel consumption is recorded on a monthly base (with cut-off date being 25th of each month).

The total baseline emissions of the monitoring period are 610,956 tCO_{2eq}

E.2. Calculation of project emissions or actual net GHG removals by sinks

FORMULAES

$$PE_y = \sum_x \left[TC_{x,y} \times (EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x}) \right] \quad (4)$$

Where:

PE_y	Project emissions of buses in year y (tCO_{2e})
$TC_{x,y}$	Total consumption of fuel type x in year y (liter or m^3)
$EF_{CO2,x}$	CO_2 emission factor for fuel type x (gCO_2/liter or m^3)
$EF_{CH4,x}$	CH_4 emission factor for fuel type x (gCO_{2e}/liter or m^3)
$EF_{N2O,x}$	N_2O emission factor for fuel type x (gCO_{2e}/liter or m^3)

For all bus types the total fuel consumed is known and therefore Alternative A of the methodology is taken. The PDD had previewed to use alternative B with the average specific fuel consumption based on non-availability of fuel consumption per bus line at the moment of PDD writing. However this situation has changed and the more precise path of alternative A can be used (the result will be the same if the specific consumption per bus is initially calculated and then again multiplied with the distance driven).

For the few feeder buses using electricity, the following formulae is used in accordance with the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

$$PE_{EC,TB,y} = EC_{PJ,TB,y} \times EF_{EL,y} \times (1 + TDL_y) \quad (5)$$

Where:

$PE_{EC,TB,y}$	Project emissions from electricity consumption of trolleybuses in the year y (tCO_2)
$EC_{PJ,TB,y}$	Quantity of electricity consumed by project trolleybuses in the year y (MWh)
$FE_{EL,y}$	Emission factor for electricity generation in the grid in the year y (tCO_2/MWh)
TDL_y	Average technical transmission and distribution losses for providing electricity in year y

The EF and TDL are fixed for the crediting period ex-ante in the registered PDD and are based on the default values of the mentioned tool.

Data plausibility control is carried out through specific consumption of fuel (liter or m^3 per 100km). Based on the PDD chapter B.7.1.for the parameter TC standard random variations are those that are in a ±10% range of average recorded values.

Table 12: Average of Specific Fuel Consumption (liter/100km for diesel and m^3/100km for CNG)

Parameter	Average	Lower boundary	Upper boundary
18m trunk buses diesel	57 l/100km	51 l/100km	63 l/100km
12m support line buses diesel	39 l/100km	35 l/100km	43 l/100km
Diesel feeder buses	38 l/100km	34 l/100km	42 l/100km
CNG feeder buses	36 m^3/100km	32 m^3/100km	39 m^3/100km

Source: CER Monitoring Sheet

Figure 10: Monthly average SFC 18m Diesel Trunk Buses in l/100km

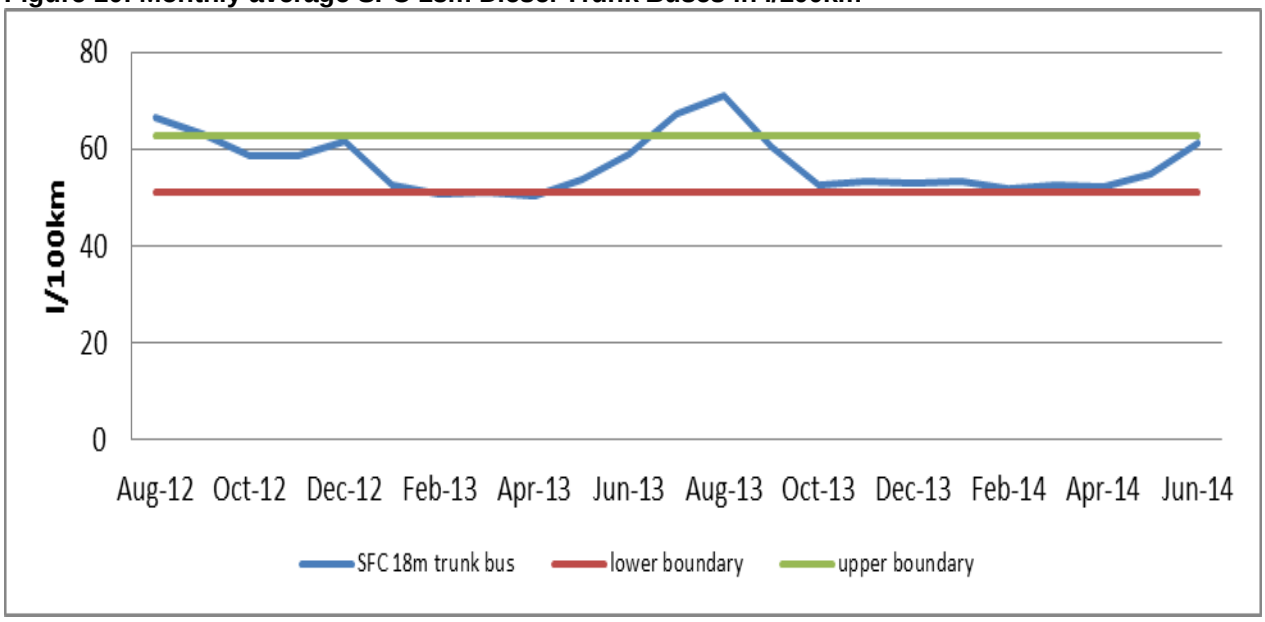


Figure 11: Monthly average SFC 12m Diesel Support Buses in l/100km

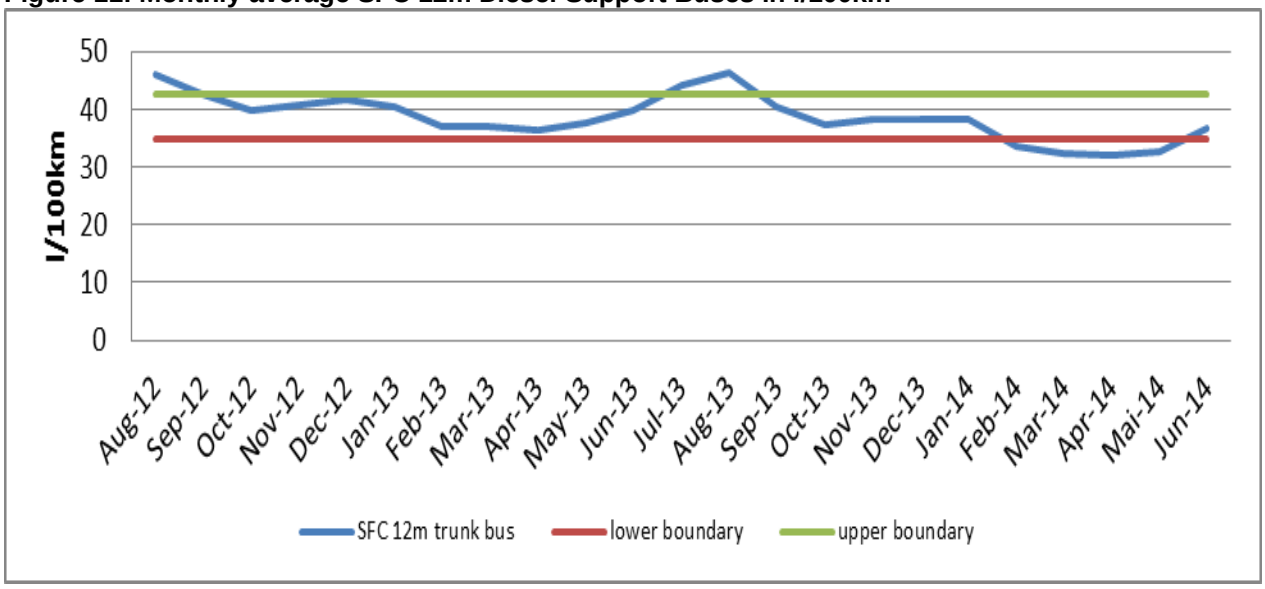


Figure 12: Monthly average SFC Diesel Feeder Buses in l/100km

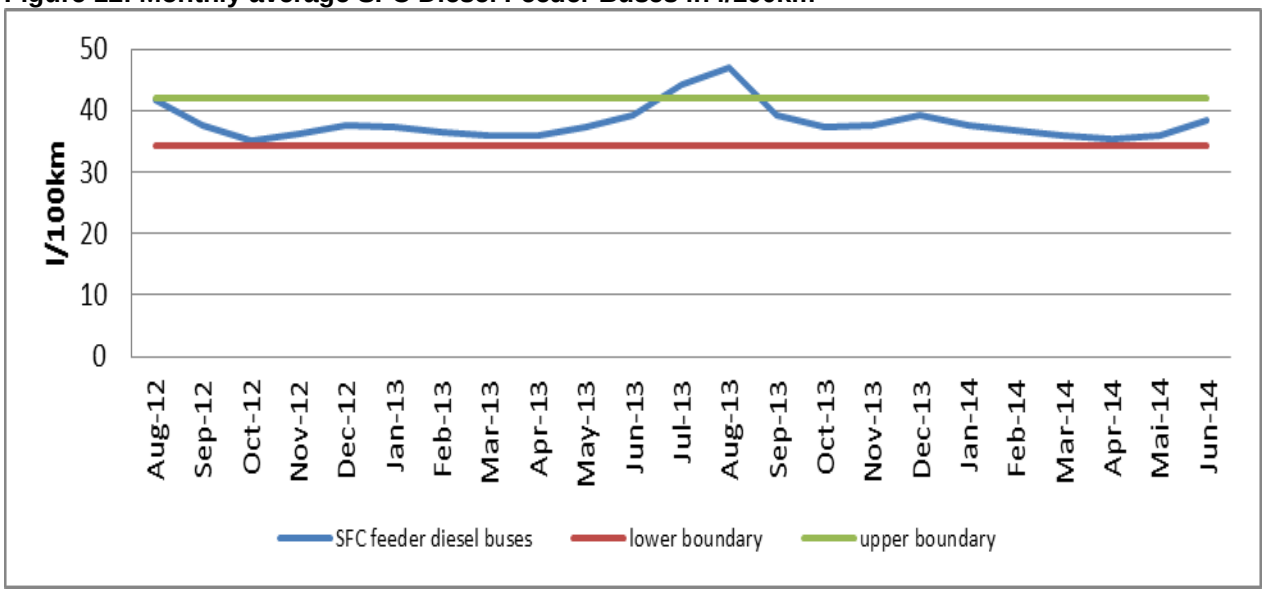
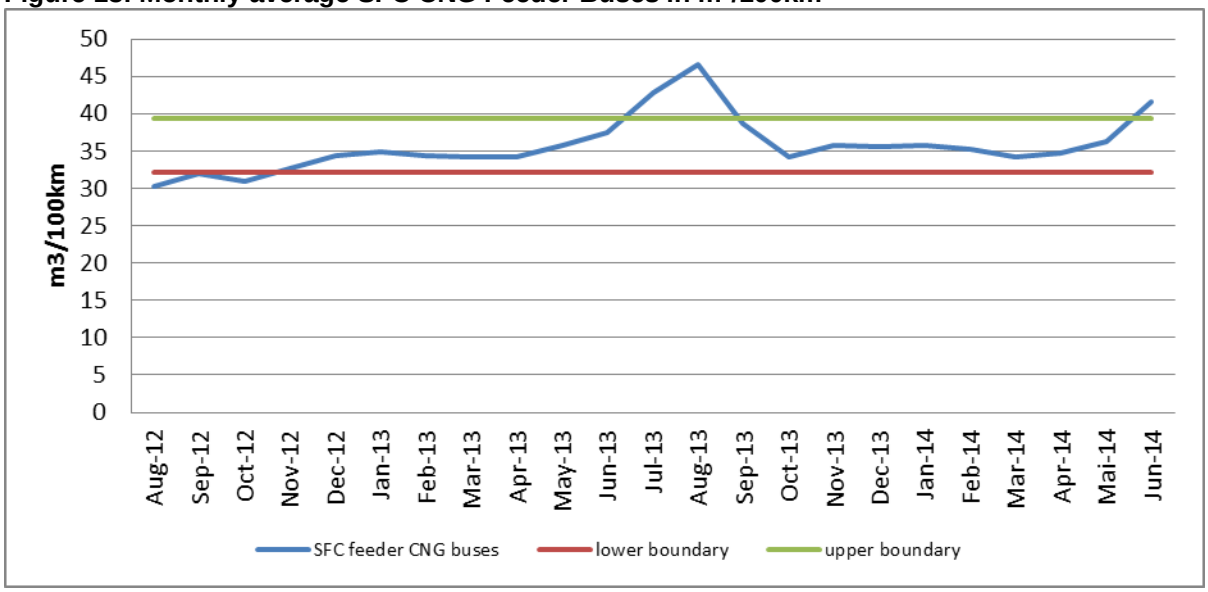


Figure 13: Monthly average SFC CNG Feeder Buses in m^3/100km



Numbers are except for summer months where due to high temperatures AC is used with the corresponding increase in fuel consumption within the boundaries. The diesel support buses have towards the last 12 months a lower SFC. This is however slightly misleading as since mid 2013 also CNG buses are used on support routes without separating the distance driven of diesel and CNG support buses. Therefore SFC is slightly understated in these months. The SFC of CNG feeder buses has increased slightly compared to mid 2012. The reason is that CNG feeder buses today are basically 12-13.6m buses whilst formally they were 10.2-10.6m buses with a lower passenger capacity and lower weight. In fact a large part of the CNG feeder fleet today is hybrids[40].

Only between 2 and 10 electric buses are being used on different feeder lines[41]. Thus no useful comparison over buses can be made. The average figure of 99 kWh/100km is thus not further analysed.

The average distance driven per bus per month is checked for plausibility comparing distances over months. Distance driven is also separated in the fuel type used as CNG buses in general have a lower reliability factor and thus in general lower distances driven per month. An upper and a lower range based on ±10% idem to the SFC is also made for plausibility check.

Table 13: Average Distance Driven per Month per Bus (km per month)

Parameter	Average	Lower boundary	Upper boundary
Trunk and support buses	5,063	4,556	5,569
Diesel feeder buses	4,386	3,947	4,824
CNG feeder buses	3,942	3,547	4,336

Source: CER Monitoring Sheet

[40] See File 20

[41] whilst the number of diesel buses and CNG buses are in total 4,417 units (trunk and feeder buses as of 06/2014) i.e. the electric bus numbers are completely insignificant

Figure 14: Monthly Average Distance Driven Trunk/Support Line Buses in km

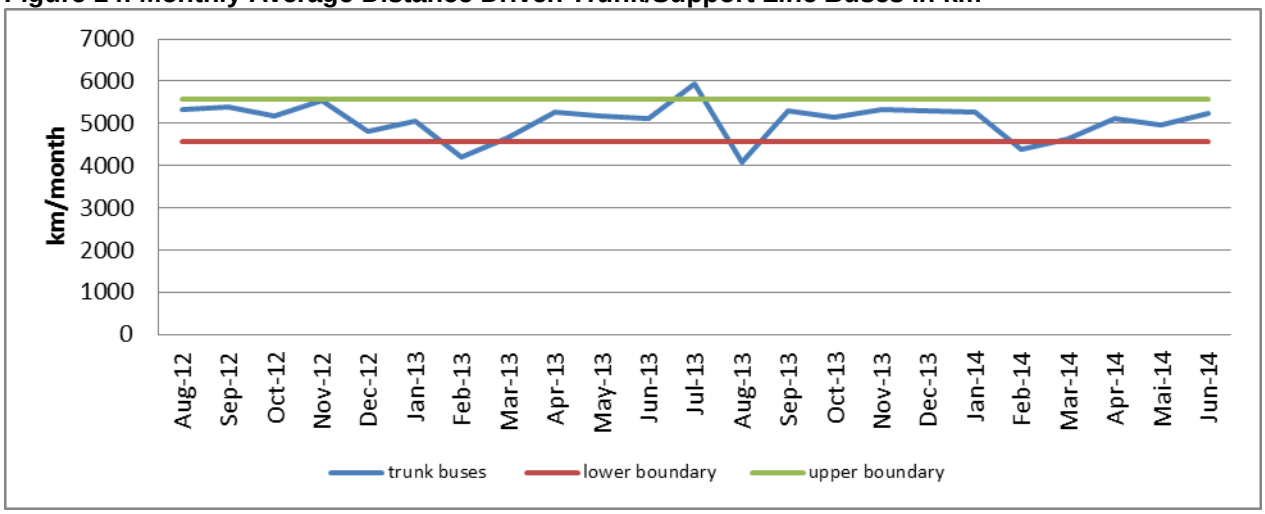


Figure 15: Monthly Average Distance Driven Diesel Feeder Buses in km

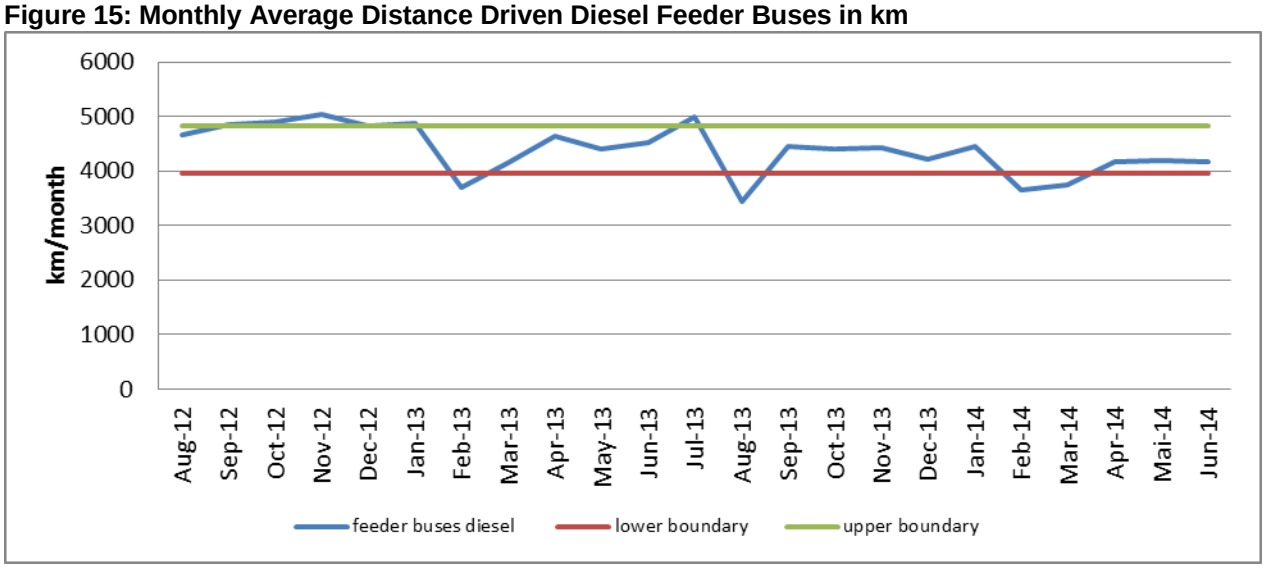
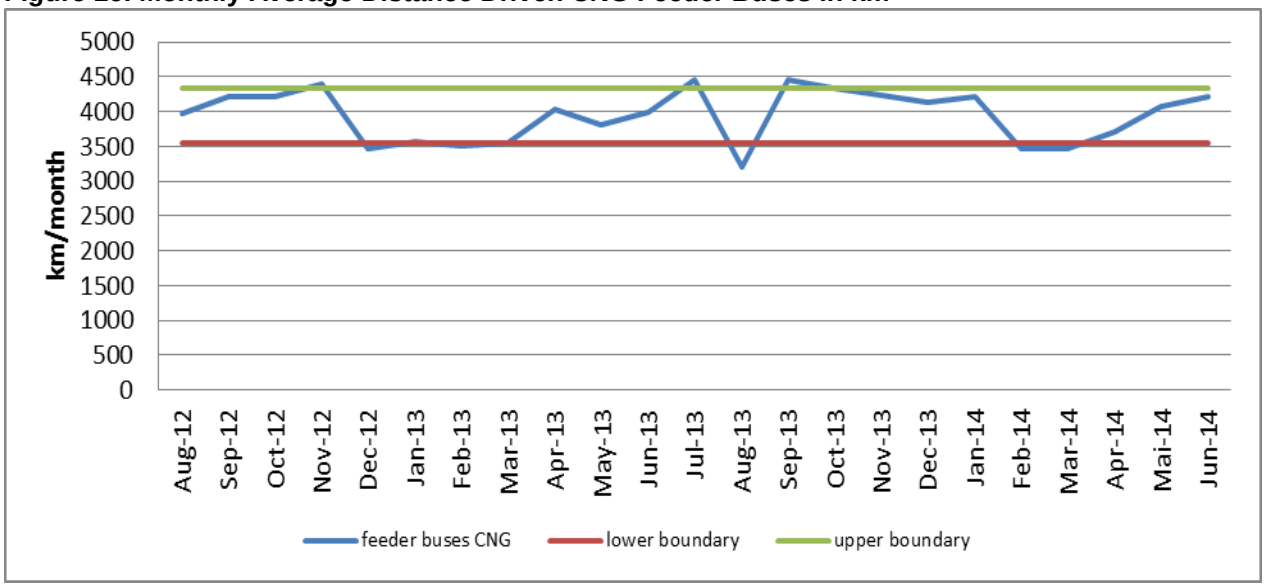


Figure 16: Monthly Average Distance Driven CNG Feeder Buses in km



Also here we observe that the distance driven of the buses is inside the normal fluctuation range and thus plausible. Lower than average distances driven are usually in the month of January/February (Chinese New Year) and again August (vacations students).

PARAMETERS AND DATA USED

The following table lists the monitored project parameters used (see also Section D.2.).

Table 14: Monitored Project Parameters

Parameter	Unit	Description	Value	Source
TC_D	Liter	Total diesel fuel consumed by project buses	115,187,358	File 18,19
TC_{CNG}	m^3	Total CNG fuel consumed by project buses	45,131,803	File 18,19
TC_{LPG}	m^3	Total LPG consumed by project buses	9,494	File 18
TEC	kWh	Total electricity consumed by project buses	226,287	File 19
DD_T	km	Distance driven of trunk buses	56,676,240	File 18
$DD_{F/D}$	Km	Distance driven of diesel feeder buses	238,933,490	File 19
$DD_{F/CNG}$	Km	Distance driven of CNG feeder buses	119,234,528	File 19
$DD_{F/elec}$	Km	Distance driven of electric feeder buses	249,259	File 19

The following parameters are not monitored but used for calculation purposes. Values are fixed ex-ante based on the registered PDD (see also Section D.1.). A very low number of new LPG articulated buses is being used since April 2014. For this fuel the EF were determined in accordance with the procedure used for gaseous buses.

Table 15: Project Parameters not Monitored

Parameter	Unit	Description	Value	Source
$EF_{CO2,Z}$	gCO_{2eq}/l	CO_2 emission factor of large diesel powered buses	2,661	AM0031, appendix A table A1
$EF_{CH4,Z}$	gCO_{2eq}/l	CH_4 emission factor of large diesel powered buses	2	AM0031, appendix A table A1
$EF_{N2O,Z}$	gCO_{2eq}/l	N_2O emission factor of large diesel powered buses	21	AM0031, appendix A table A1
$EF_{CH4,CNG,Z}$	gCO_{2eq}/m^3	CH_4 emission factor of CNG powered buses	563	PDD B.6.2.
$EF_{N2O,CNG,Z}$	gCO_{2eq}/m^3	N_2O emission factor of CNG powered buses	109	PDD B.6.2.
$EF_{CO2,CNG,Z}$	gCO_{2eq}/m^3	CO_2 emission factor of CNG powered buses	2,163	PDD B.6.2.
$EF_{CH4,LPG,Z}$	gCO_{2eq}/m^3	CH_4 emission factor of LPG powered buses	68	See below
$EF_{N2O,LPG,Z}$	gCO_{2eq}/m^3	N_2O emission factor of LPG powered buses	3	See below
$EF_{CO2,LPG,Z}$	gCO_{2eq}/m^3	CO_2 emission factor of LPG powered buses	1,788	See below
$EF_{grid,CM}$	$kgCO_2/kWh$	Emission factor for the grid	0.4	PDD B.6.2.
TDL	None	Average technical transmission losses for providing electricity	3%	PDD B.6.2.

The EF for LPG is based on the data listed in the following table.

Table 16: Project Parameters not Monitored

Parameter	Unit	Description	Value	Source
NCV_{LPG}	MJ/kg	Net Calorific Value of LPG	52.2	IPCCC, 2006, Table 1.2, upper 95% confidence interval
D_{LPG}	kg/m^3	Specific weight (density) of LPG	0.5222	IEA, 2005, table A.3.8
$EF_{CO2,LPG}$	gCO_2/MJ	CO_2 emission factor of LPG	65.6	IPCC 2006, table 1.4, upper 95% confidence interval
$EF_{CH4,LPG}$	$kgCH_4/TJ$	CH_4 emission factor of LPG buses	62.0	IPCC 2006, Table 3.2.2.
$EF_{N2O,LPG}$	kgN_2O/TJ	N_2O emission factor of LPG buses	0.2	IPCC 2006, Table 3.2.2.
GWP CH_4	gCO_2/gCH_4	Global warming potential CH_4	21	https://unfccc.int/ghg_data/items/3825.php
GWP N_2O	gCO_2/gN_2O	Global warming potential N_2O	310	https://unfccc.int/ghg_data/items/3825.php

PROJECT RESULTS

Table 17: Project Emissions

Parameter	Unit	26/06/2012 to 31/12/2012	01/01/2013 to 31/12/2013	01/01/2014 to 25/06/2014	Total
Diesel consumed	liter	27,047,009	61,668,226	26,472,123	115,187,358
CNG consumed	m^3	5,767,899	24,797,405	14,566,499	45,131,803
LPG consumed	m^3	0	0	9,494	9,494
Electricity consumed	kWh	80,726	126,459	19,102	226,287
Project Emissions	tCO_{2eq}	88,979	235,870	112,373	437,222

Source: CER spreadsheet

Data of fuel consumption is recorded on a monthly base (with cut-off date being 25th of each month).

The total project emissions of the monitoring period are 437,222 tCO_{2eq}

For details see CER spreadsheet.

E.3. Calculation of leakage

$$LE_y = LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y} \quad (6)$$

where:

LE_y Emissions leakage in year y (tCO_{2eq})
$LE_{LF,Z,y}$ Emissions Leakage from change of load factor in baseline buses in year y (tCO_{2eq})
$LE_{LF,T,y}$ Emissions Leakage from change of load factor in taxis in year y (tCO_{2eq})
$LE_{CONG,y}$ Emission Leakage from reduced congestion in year y (tCO_{2eq})

If $LE_y < 0$ then leakage is not included
If $LE_y > 0$ then leakage is included

Following leakage sources are included in the PDD (section B.6.1.):

1. Change of load factor of the baseline transport system due to the project, i.e. the project potentially influences the occupancy rate of the remaining vehicles. This is monitored on a regular basis during project execution.

2. Reduced congestion in remaining roads, provoking higher average vehicle speed, plus a rebound effect. The total impact of congestion is calculated ex-ante and not monitored.

For the sake of a conservative approach, leakage is only considered if the total annual effect is to reduce estimated emission reductions.

The monitored occupation rates of taxis and of buses in 2014 are 1.18 for taxis which is above the threshold value of 1.08 and for buses 43% which is also above the threshold value of 21%. Therefore no leakage of Change of load factor taxis and buses has been included.

The reduced congestion leakage is negative due to a negative rebound leakage with a 0 speed leakage (see following table).

Table 18: Congestion Leakage Based on Registered PDD (tCO_2)

	26/06/2012 to 31/12/2012	01/01/2013 to 31/12/2013	01/01/2014 to 25/06/2014	Total
Days in period	153	365	176	
Rebound effect	-3,316	-7,832	-3,727	-14,876
Speed effect	0	0	0	0
Total congestion leakage	-3,316	-7,832	-3,727	-14,876
Total leakage accounted for by project	0	0	0	0

Source: PDD Table A.11.; PDD annual value transformed in daily values for determination of monitoring period values; see CER spreadsheet for details

Therefore leakage emissions are 0 for the crediting period.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	610,956	437,222	0	173,734

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	319,266[42]	173,734

E.6. Remarks on difference from estimated value in registered PDD

The PDD had estimated for the same period around 30% more passengers than actually achieved by the project due basically to not yet having finalized all trunk routes. Lower passenger numbers not only result directly in less emission reductions but also reduce the system efficiency, reflected in average GHG emissions per passenger transported of currently 290 gCO_2 / passenger transported versus projected values for the same time period of around 235 gCO_2 / passenger.

[42] 2012 according to PDD 144,407 tCERs (actual 160 days instead of 366 days and therefore 144,407/366*159=62,734 tCERs), 2013 full year (165,350 tCERs) and 2014 189,099 tCERs (actual 176 instead of 365 days and therefore 189,099/365*176=91,182 tCERs)

This factor is therefore crucial for the resulting emission reductions and the reason for reductions only being around 55% of the expected value.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	43,807	129,927

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
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Document information

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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