Monitoring report form

(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT	
Title of the project activity	BRT Metrobus Insurgentes, Mexico
Reference number of the project activity	4945
Version number of the monitoring report	2
Completion date of the monitoring report	17/12/2014
Registration date of the project activity	10/08/2011
Monitoring period number and duration of this monitoring period	1st Monitoring Period From 10/08/2012 to 31/10/2013
Project participant(s)	**México:** Metrobús **Spain:** International Bank for Reconstruction and Development (IBRD) as Trustee of the Spanish Carbon Fund (SCF); Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; Azuliber 1, S.L; Cementos Portland Valderrivas, S.A.; Comercial de Materiales de Construccion S.L. (COMAC); Compania Espanola de Petroleo, S.A. (CEPSA); E.ON Generacion S.L.; Endesa Generacion, S.A.; Gas Natural SDG, S.A; Hidroelectrica del Cantabrico, S.A.; Iberdrola Generacion, S.A.U.; Repsol YPF, S.A.; Zeroemissions Carbon Trust, S.A.
Host Party(ies)	**Mexico**
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	- Sectoral scope 7: Transport - Methodology: ACM0016 ver. 2 - Baseline Methodology for Mass Rapid Transit Projects
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	58,965 tCO_{2eq} = ((19,748/ tCO_{2eq} in 2012 + ((47,087/365)*304) tCO_{2eq} in 2013
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	32,008 tCO_{2eq}

Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	0 tCO_{2eq} from 10/08/2012 to 31/12/2012
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	32,008 tCO_{2eq} from 1/01/2013 to 31/10/2013

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The objective of the BRT (Bus Rapid Transit) Metrobus Insurgentes in the Zona Metropolitana del Valle de México (Mexico City Metropolitan Area - MCMA) is to establish an efficient, safe, rapid, convenient, comfortable and effective modern mass transit system based on a BRT system. The MCMA has nearly 20 million inhabitants. The Project includes the BRT line Insurgentes. The project transports annually around 80 million passengers. The geographical boundary of the project is the greater metropolitan area of the city of Mexico known as MCMA. Emission reductions are achieved through reducing GHG (Greenhouse Gases) emissions per passenger/kilometer comparing conventional modes of transport with the BRT. The BRT system has as main environmental aspect that the resource efficiency of transporting passengers in Mexico City is improved i.e. emissions per passenger kilometer are reduced compared to the situation without project. Gases included are CO_2 and CH_4.

Relevant Dates of the project activity[1]	
2004	Construction of the Metrobus Insurgentes Corridor (from Indios Verdes terminal in the North to Doctor Galvez station in the South)
2005	Operation of Metrobus Insurgentes Corridor started on 19 June 2005

Core aspects of the project are:

- Infrastructure. The project includes 19.6 km of 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 stations have access ramps for mobility-impaired passengers. Picture 1 below shows a typical station on a BRT route.
- High capacity buses: Buses used on Metrobus are articulated with 160 and 240 passengers, with EURO III, EURO IV and EURO V environmental certification. Toll and access control. In Metrobus, the toll system and access control is based on the prepaid card without contact, which can be purchased and recharged at all stations through vending machines. This system allows to know the values associated with passengers in the system with geographical and temporal references, and allows users in terms of speed step and make the entrance to the BRT stations in seconds.

[1] *In 2008 the corridor was extended from Doctor Galvez station to El Caminero station. Expansion of the Metrobus Insurgentes Corridor is not included as part of this project activity, only the stations located between Indios Verdes and Doctor Galvez (both included) are considered.*

- Centralized fleet. Metrobus has a central control system from which the fleet operational controls and compliance with the schedule of services is verified by the operating companies, this tool provides the miles in operation offered by Metrobus fleet.

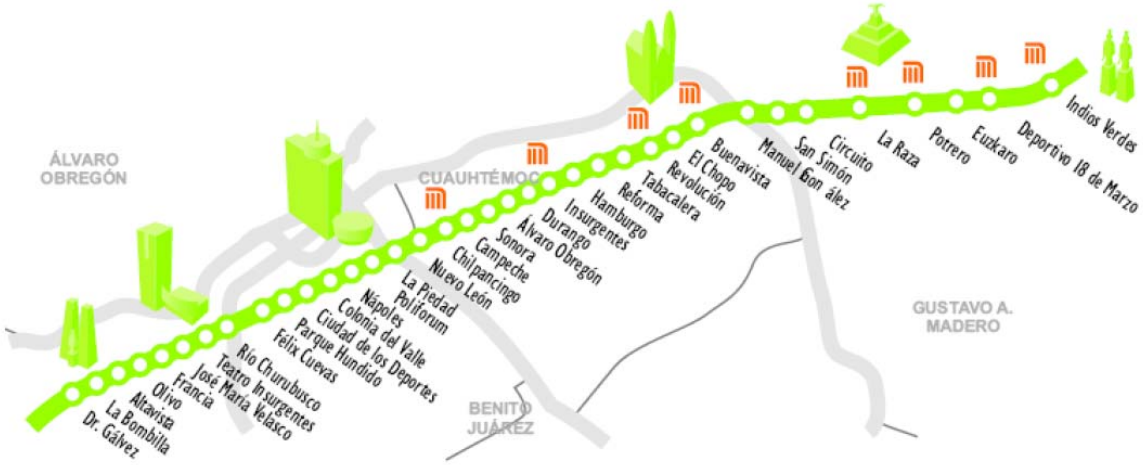
The total GHG emission reductions achieved in this monitoring period are **32,008 tCO_2**.

A.2. Location of project activity

The project activity is developed in Mexico, in the Federal District, in Mexico City. The spatial extent of the project is the larger metropolitan area of Mexico City known as MCMA. The spatial area includes the trip origins and destinations of passengers using Metrobus BRT. While the BRT lines of the project are located in the Federal District, the project boundary encompasses the entire trip of passengers using the project MRTS i.e. from trip origin to trip destination. Latter can be everywhere in the MCMA as passengers use partially the system e.g. to get downtown in the DF (Distrito Federal) from their home located e.g. in Estado de Mexico.

The Metrobus Insurgentes Corridor began operations in June 2005 along 19.6 kilometers of Insurgentes Avenue, connecting the north of the city (adjacent to the State of Mexico) to the south, where University City is located. Due to the success and public demand, it was expanded 10 kilometers South, to the start of the road heading to the State of Morelos. This expansion began operations in March 2008. The project activity only includes the Insurgentes Corridor, which begins at Indios Verdes terminal in the North, and ends at the Doctor Gálvez station in the South (Fig. 1).

Figure 1. Localization of the Insurgentes Corridor.



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)
Mexico (host)	Metrobus	No

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)
Spain	International Bank for Reconstruction and Development (IBRD) as Trustee of the Spanish Carbon Fund (SCF); Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; Azuliber 1, S.L; Cementos Portland Valderrivas, S.A.; Comercial de Materiales de Construccion S.L. (COMAC); Compania Espanola de Petroleo, S.A. (CEPSA); E.ON Generacion S.L.; Endesa Generacion, S.A.; Gas Natural SDG, S.A; Hidroelectrica del Cantabrico, S.A.; Iberdrola Generacion, S.A.U.; Repsol YPF, S.A.; Zeroemissions Carbon Trust, S.A.	Yes

A.4. Reference of applied methodology and standardized baseline

ACM0016: Baseline Methodology for Mass Rapid Transit Projects; Version 2.0
This methodology also refers to the latest approved version of the following tools:

- "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

The starting date of the crediting period is 10/08/2012 and runs for 7 years until 9/08/2019, which can be renewed.

A.6. Contact information of responsible persons/ entities

This monitoring report has been developed by Julio Ivan Martinez Cortijo (jmartinez@metrobus.df.gob.mx) from Metrobus (Project Participant), in collaboration with Zhuo Cheng (zcheng2@worldbank.org) and Patricia Marcos Huidobro (pmarcoshuidobro@worldbank.org) from the International Bank for Reconstruction and Development, as Trustee of the Spanish Carbon Fund (Project Participant).

SECTION B. Implementation of project activity

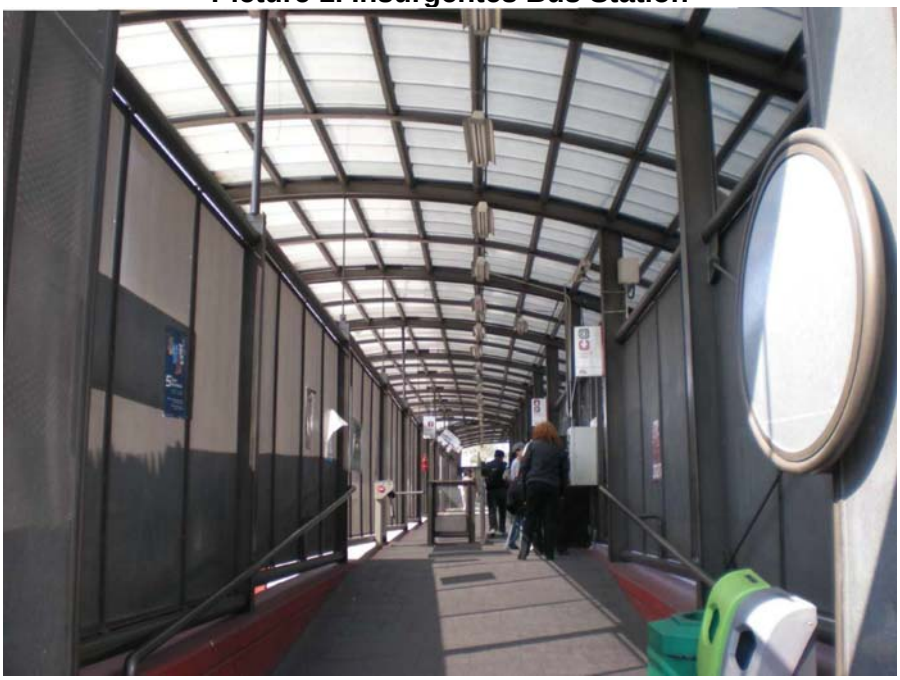
B.1. Description of implemented registered project activity

The pre-project scenario is the usage of LPG (Liquified Petroleum Gas), diesel, gasoline and electric trolleybuses, taxis, passenger cars, motorcycles, metro, suburban train and NMT (Non-Motorized Transit) for transit purposes. All of these transit modes are partially substituted by the project. The baseline situation is that in absence of the project activity these modes of transit would continue to operate being renovated under BAU (Business As Usual). This is reflected in the technology improvement factor applied to baseline emission factors per mode of transport.

Features of the BRT system include exclusive right-of-way lanes, rapid boarding and alighting, pre-board fare collection and fare verification, enclosed stations, 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.

- Infraestructure. The project includes 19.6 km of 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 stations have access ramps for mobility-impaired passengers. Picture 1 shows a typical station on a BRT route.
    - o Exclusive lane: It is the main feature and this is one of the features that generates the main benefits, because it allows to have homogeneous speeds higher than the speeds in mixed flow, control cycle times, programming services on the line, higher than in mixed flow control cycle times, programming and vial ordering, as well as discourage the transport un private vehicles.
    - o Stations: The distance between stations can maintain higher speeds and times to a particular vehicle, and contribute to the urban image of the city, creating safe public spaces on public roads. The stations are a key element as far as accessibility is concerned, with access ramps and elevated platform. Additionally has a video surveillance system in all stations.
    - o Accessibility for people with disabilities: Metrobus is the most accessible transport system in Mexico City, because almost all stations have ramps or lifts, courtesy doors that meet international standards for wheelchair specifications, notice buttons to the drivers and exclusive spaces on buses. Service for people with disabilities in Metrobus is free. Each year more than 5 million people with disabilities or older adults are transported.

Picture 1. Insurgentes Bus Station

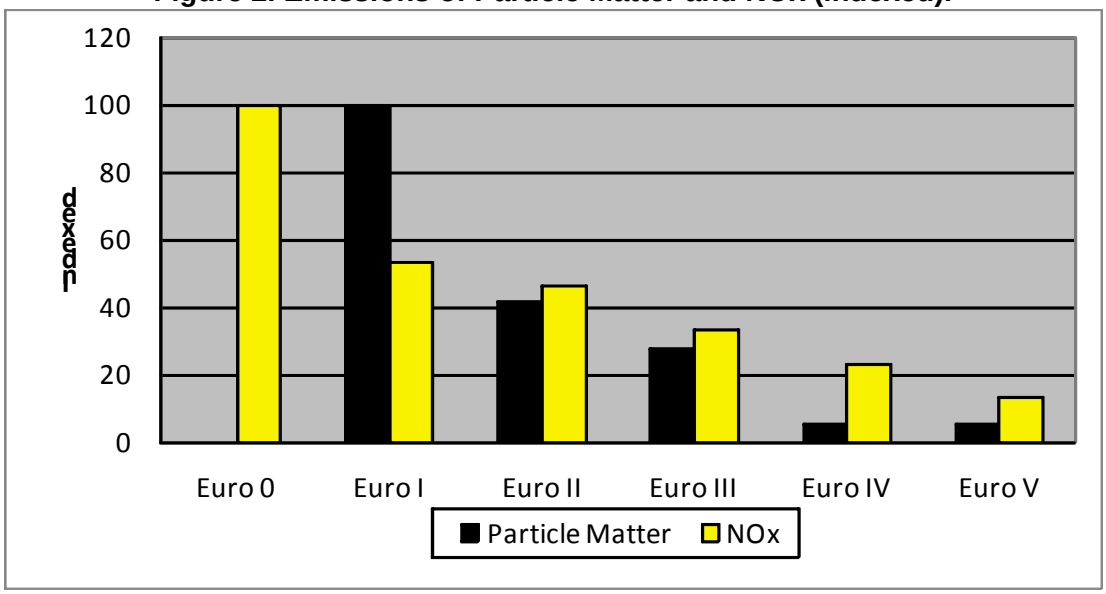


- Bus Technology. Technology used is Euro III, IV and V diesel units. Buses are new articulated and bi-articulated units (Picture 2), with a capacity of 160-240 persons and with platform-level access and room for disabled persons. In total 155 articulated and 27 bi-articulated buses are used.

Picture 2. Bus Project

Figure 2 compares the emission of different Euro categories of HDVs (Heavy Duty Vehicles). Project vehicles thereby comply all with the standard Euro III, Euro IV and Euro V. Particle matter emissions of Euro III, Euro IV and Euro V engines are factor 3.6, 18 and 18 lower respectively than Euro I and for NOx Euro III, IV and V emissions are 1.6, 2.3 and 4 times lower respectively than Euro I units thus demonstrating the highly significant local emission reductions of project versus baseline buses. Particle as well as NOx (an important pre-cursor of ground-level ozone) emissions are thereby critical components of local air quality which is a major issue in Mexico City.

Figure 2. Emissions of Particle Matter and NOx (indexed).



Source: Regulations 88/77/EEC for Euro 0; 91/542/EEC for Euro I and II; 1999/96/EC for Euro III, IV and V.

- Transit Management. The operational fleet centre manages trunk bus dispatch, informs passengers, produces reports and maintains records. Buses are equipped with GPS (Global Positioning System) or comparable 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. Also passengers have real-time information about the next available bus, and are informed of potential transit problems. The transit system operates on concessions eliminating competition at bus-to-bus level.

- Fare System. The system is based on pre-board ticketing using magnetic ticketing, which can be purchased and recharged at all stations through vending machines. Validation turnstiles at the entrance of 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. This system allows to know

the values associated with passengers in the system with geographical and temporal references, and allows users in terms of speed step, make the entrance to the BRT stations in seconds. Fare collection is centralized and managed through a trust fund.

B.2. Post registration changes

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

Studies for parameters $OC_{B,y}$ and $OC_{T,y}$ could not been conducted within the first 12 months of the monitoring report, due to the teachers' strike in Mexico DF, which affected the traffic partners by closing roads and highways. Instead, studies were conducted in November-December 2013. In order to be conservative, no emission reductions have been claimed for the period 10/08/2012 to 31/12/2012. Studies' results have been applied from January 2013 onwards. This temporary deviation of the monitoring plan was approved by the CDM Secretariat on July 2, 2014. For further information on the temporary deviation please the following request for post-registration of changes: http://cdm.unfccc.int/PRCContainer/DB/prcp155178544/view

B.2.2. Corrections

N/A.

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

The following post registration changes were incorporated in the latest version of the PDD, approved on 2/07/2014:

- As per the CDM Project Standard version 4.0, article 219 (b), the start date of the Crediting Period was delayed by one year from 10/8/2011 to 10/8/2012. As a result of the delay in the start date of the Crediting Period, the average emission reductions achieved annually by the project were updated in the latest version of the PDD from 46,544 to 45,250 tCO_2e.
- The monitoring frequency for parameters BTDp,i,y, and IPTDp,i,y have been updated from annually to year 1 and 4. Parameters required to determine leakage emissions due to congestion will not be monitored, since monitoring of these parameters is not required by ACM0016 version 03. In addition, parameters MSi,y, and VP,y will not be monitored since the project does not lead to a reduction of road capacity available for individual motorised transport modes.
- All the formulas for the calculation of the baseline, project and leakage emissions have been updated as per the latest version of methodology ACM0016, v03.0, in order to ensure the accuracy of the calculation due to the proposed monitoring frequency changes. However this did not result in a change in the ex-ante emission reductions calculation.

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

N/A

B.2.5. Changes to start date of crediting period

The start date of the crediting period has been changed from August 10, 2011 to August 10, 2012.This has already been reflected in the latest version of the PDD, dated 31/05/2014, and approved by the CDM Secretariat on 2/07/2014.

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

N/A

SECTION C. Description of monitoring system

Below is a summary of all data that must be collected:

Index	Indicator	Gathering frequency	Data Source
1	Fuel types used by cars, taxis, buses incl. bio-fuel usage	Annual	Department of Transport, Environmental Secretariat
2	Passenger transported	Monthly	Metrobus
3	Fuel consumption BRT units	Annual	Metrobus and concessionaires
4	Distance driven BRT units	Annual	Metrobus andconcessionaires
5	Passenger survey for indirect project and baseline emission per passenger and mode share baseline	Year 1, 4	Survey realized by an external company (RP&A Creatividad mercadológica)
6	Number of buses and taxis	Year 1, 4, 7 and 10	Department of Transport, Environmental Secretariat
7	Occupation rate of buses and taxis	Year 1, 4, 7 and 10	Metrobus for occupation rate of buses; and a third party for occupation rate of taxis
8	Net Calorific Value	Annual	IPCC
9	Emission factors of fuels	Annual	IPCC

The following section describes data collection procedures in more detail for each parameter.

1. NUMBER OF CARS AND TAXIS BY FUEL TYPE ($N_{X,C/T}$)

- Monitored Data: Number of cars and taxis by fuel type in the MCMA
- Unit: Number of vehicles
- Measurement Frequency: Year 1, 4; the data can be more than three years old
- Data Source: Ministry of Environment; Ministry of Transport
- Quality Control: Compare against values from previous years
- Note: This information is required when private vehicles and taxis use a different fuel than that used in the baseline parameter calculations.

2. PASSENGERS CARRIED BY PROJECT BUSES (P)

- Monitored Data: Number of passengers carried by project buses. Daily operators at each station take note of the number in the turnpike counter, and record that information in a data sheet. All data is based on people exiting project stations through turnpikes. As per the PDD, in addition to turnpikes, smart cards may also be used to monitor the number of passengers carried by the project buses. However, although the use of smart cards is expected in the medium term, this is not an option for this monitoring period.
- Unit: # passengers
- Measurement Frequency: Continuously measured; aggregated annually
- Data Source: Metrobus

- Quality Control: Total number of passengers will be cross-checked with data from the turnpike electronic system, which is compiled by a third party contractor and provided to Metrobus within 48 hours. In the case where turnpikes are not operating, passengers are not recorded, and thus not counted for the calculation of ERs, which is considered a conservative approach based on the CDM rules, due to the emission reduction is per passenger, if more passengers are transported, emissions reductions increase.Ticket revenues cannot be used as a quality control method since revenues are not 100% identical to the number of passengers, meaning that tickets can be pre-charged with various trips. .
- Note: This information is compiled by Metrobus through the Toll Systems and New Technologies Management, who provides this information to the manager of the Emission Reductions Unit/Department for the calculation of the emission reductions.

3. FUEL CONSUMED BY PROJECT BUSES (SFC_l)

- Monitored Data: Fuel consumption from each company (i.e. concessionaires) that operates Metrobus buses. Fuel consumption is recorded in logbook by the concessionaires and separated by category of vehicle for articulated buses (160 passengers) and bi-articulated (240 passengers).Each operator must report how fuel consumption and, where needed, fuel economy measurements were taken, as well as QA/QC procedures.

- Unit: Liters

- Measurement Frequency: Continuously measured; aggregated annually

- Data Source: Metrobus and concessionaries. Metrobus is responsible of collecting and consolidating the data on the fuel consumed by the project buses, based on the logbooks provided by the concessionaries.

- Quality Control: Quality control is ensured by comparing fuel consumption data with collected data from previous years, as well as with the fuel efficiency of comparable vehicles. Normal or average data range is based on previous experience per bus type. It indicates ranges and does not mean that data from buses falling outside this range is necessarily wrong. If the specific fuel consumption is outside normal ranges, the following measures are to be taken：
  - Control the distance: Is the data correct and reasonable?
  - Control the fuel consumption;
  - Is the specific consumption too high or too low: Compare the data with the previous months. Have any previous values fallen outside the range?

  If differences cannot be explained then:
  - Check documentary filling controls (data transmission and storage);
  - Check distance measurement controls (data transmission and storage)

- Note: This information is compiled by Metrobús through the manager of the Bus Fleet Unit/Department, who provides this information to the manager of the Emission Reductions Unit/Department for the calculation of the emission reductions.

4. DISTANCE TRAVELED BY PROJECT BUSES ($DD_{P,J}$)

- Monitored Data: Distance traveled by project buses. The distance traveled is provided by the concessionaries.

- Unit: km

- Measurement Frequency: Continuously measured; aggregated annually

- Data Source: Metrobus and concessionaries. Metrobus is responsible of collecting and consolidating the data on the distance travelled by the project buses, based on the logbooks provided by the concessionaries.
- Quality Control: Quality control is ensured by comparing the information provided by the concessionaire with the logbooks from Metrobus with information on kms driven taken every 15 days. This data is also used to monitor project bus fuel efficiency. In case of discrepancy between the two sources, the total distance is discussed and agreed between the concessionaires and Metrobus,

- Note: Information from the logbooks provided by the concessionaires is compiled by Metrobús through the manager of the Bus Fleet Unit/Department, which provides this information to the manager of the Emission Reductions Unit/Department in order to make the corresponding calculations.

5. PASSENGER SURVEYS (MS_I, $BTD_{P,I}$, $IPTD_{P,I,}$ PSPER, FEX_P)

- Parameters

    - MSi Distribution of project passengers by mode
    - BTDp,i Distance traveled in baseline, by mode
    - IPTDp,I Complete distance traveled from origin to destination
    - PSPER Number of surveyed passengers
    - FEXp Expansion factor

- Monitored Data: The passenger survey is used to collect the data required to determine baseline and project emissions stemming from modal shift and induced travel. The survey determines the baseline emissions per passenger respondent, as well as “indirect” project emissions, which refers to the emissions generated getting to and from the BRT stations, before and after riding the BRT.

- Unit:

    - MSi %
    - BTDp,i km
    - IPTDp,i km
    - PSPER # passengers

- Measurement Frequency: Years 1, 4 (survey conducted over a 7-day period)
- Data Source: CDM Annual Passenger Survey conducted by an external company- RP&A Creatividad Mercadológica. The first test was realized in November 2012, and the second survey was realized in June 2013.
- Quality Control: See PDD Appendix 4 Section A.7. for complete survey design including survey to be used
- Note: The emissions are calculated on a per passenger basis and are “expanded” to represent the survey population using an expansion factor calculated for each respondent. Interviews are conducted through the hiring of an independent third party that provides all information to the manager of Metrobus Emission Reductions Unit/Department, so that it uses that information to make the corresponding calculations. In the first year, in addition to the initial survey, a second measurement is carried out in a later period, with a sample size of less than half of the initial survey (as specified in the methodology).

6. NUMBER OF CONVENTIONAL OPERATING BUSES AND TAXIS ($N_{B,T}$)

- Monitored Data: Number of buses and taxis registered in MCMA
- Unit: # vehicles
- Measurement Frequency: Years 1, 4, 7 and 10 of the crediting period
- Data Source: Ministry of Environment; Ministry of Transport
- Quality Control: n/a
- Note: These parameters are only recorded in cases where the occupancy rate of buses and taxis is lower than in the baseline (in the case of buses, if the occupancy rate is reduced by 10 percentage points higher than the rate of occupation of the baseline, and in the case of taxis if less than baseline occupancy rate). See PDD Appendix 4 Section A.3 for further details regarding occupancy level calculation for conditions under which this parameter is required. In summary, this parameter is only required when: bus occupancy rate is less than 7% and/or taxi occupancy rate is less than 0.66 passengers per vehicle (taxi occupancy rates do not include the driver).

7. AVERAGE OCCUPANCY LEVEL OF CONVENTIONAL OPERATING BUSES AND TAXIS ($OC_{B,T}$)

- Monitored Data: Occupancy of conventional, non-project buses and taxis still operating in the MCMA. The methodology to determine the occupancy rate is detailed in PDD Appendix 4 Section A.5 and A.6.2.
- Unit: % for buses and average number of passengers per vehicle for taxis
- Measurement Frequency: Years 1, 4
- Data Source: For the occupancy rate of taxis studies from an independent third party are used. For the occupancy rate of buses, calculations were conducted by metrobus based on official data from the Secretary of Environment.
- Quality Control: For the occupancy rate of taxis, coverage of the occupation counts should be higher than 95% of the number of taxis that cross the checkpoint.
- Note: With the information from the Secretary of Environment, the manager of Metrobus Emission Reductions Unit/Department calculates the average occupancy level of conventional buses. In the case of taxis, an independent third party accounts the passengers on established points, and Metrobus Emission Reductions Unit/Department calculates the average occupancy level of conventional taxis.

8. NET CALORIFIC VALUE OF GASOLINE, DIESEL, AND LPG ($NVC_{G/D/LPG}$)

- Monitored Data: Net calorific value of gasoline, Diesel and LPG
- Unit: MJ / kg
- Measurement Frequency: Annually
- Data Source: IPCC Guidelines

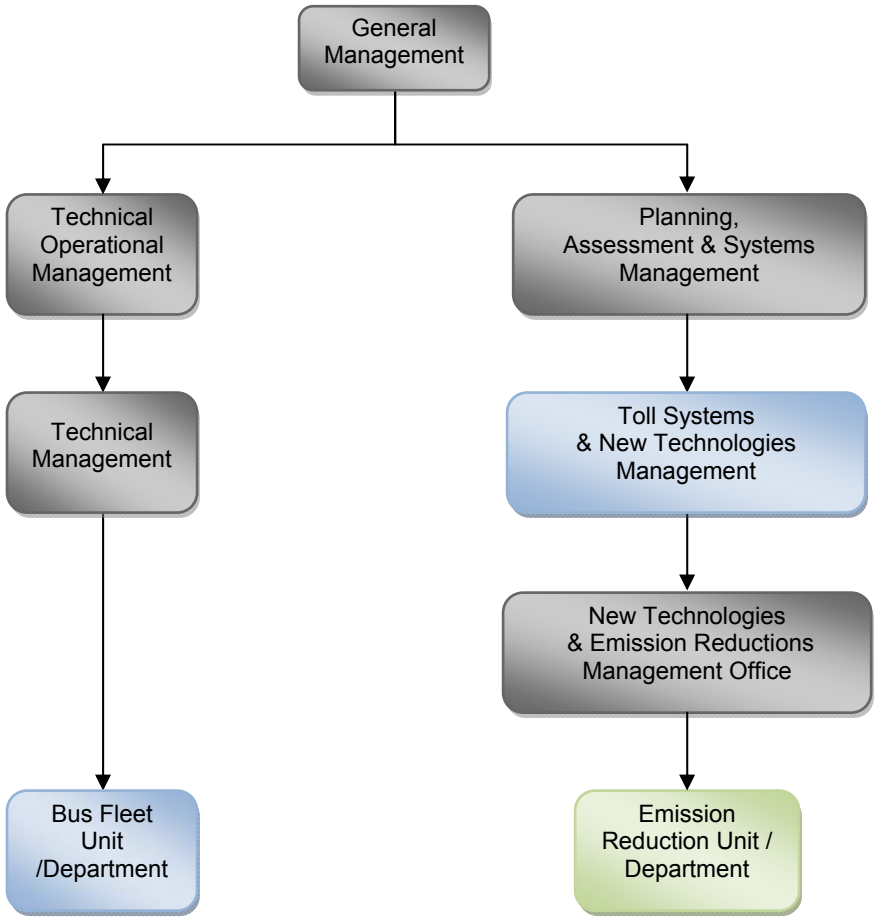
- Note: The manager of Metrobus Emission Reductions Unit/Department is in charge of compiling this information for the calculation of the emission reductions.

9. CARBON EMISSIONS FACTOR FOR GASOLINE, DIESEL, AND LPG (EFCO2, G/D/LPG)

- Monitored Data: CO_2e emissions factor for gasoline, Diesel, and LPG
- Unit: grams CO_2e / MJ
- Measurement Frequency: Annually
- Data Source: IPCC Guidelines
- Note: The manager of Metrobus Emission Reductions Unit/Department is in charge of compiling the information for the calculation of the emission reductions.

Figure 3 shows Metrobus Organigram. Staff involved in providing information for the report is shown in blue color, while those in charge of compiling, storing and processing all the information to do the necessary calculations for the monitoring report are shown in green color.

Figure 3. Metrobus Organigram



SECTION D. Data and parameters

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

Data / Parameter:	**$SFC_{C,x,}$**
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of passenger cars using fuel type x where C stands for vehicle category passenger cars
Source of data:	IPCC, reference manual 1996, Table 1-27 and 1-36
Value(s) applied):	60.0
Purpose of data:	Calculation of baseline emissions
Additional comment:	The value recorded by the IPCC is in litres per 100km. The lowest value taken here is 8.1l/100km. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8. (File 58) The share of gasoline cars is 100% (File 1) IPCC 2006 does not report fuel consumptions, thus the newest default value available is 1996. The last local study was performed 2006 and is thus elder than 3 years. No national study was available. Studies from other cities are not necessarily comparable as vehicle population and structure is different, thus IPCC default values have been taken. The IPCC default value taken (8.1 l/100km) is lower than the value measured 2006 in the study in Mexico City (10.1 l/100km; Senes, File 3) and is thus surely conservative.

Data / Parameter:	**$SFC_{T,x,}$**
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of taxis using fuel type x where T stands for vehicle category passenger taxis
Source of data:	DTP, 2009 lower 95% confidence interval
Value(s) applied):	57.0
Purpose of data:	Calculation of baseline emissions
Additional comment:	The value measured is in litres. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8. The lower 95% confidence interval of the sample is taken. The plausibility of the data is assessed below based on recent values reported by other cities. Table 1: Comparison SFC_T Mexico with Other Data Sources (l/100km) México | Taxis in other cities (Cities of Barranquilla and Quito | IPCC default 7.7 | 9 | US: 11.8-22.2 European: 8.1-11.2 The monitored value for taxis is lower than reported in other cities and at the lower end of IPCC default values although Mexico is located at 2,310 m.s.l. which leads to increased fuel consumption of vehicles. The share of gasoline taxis is 100%

Data / Parameter:	**$SFC_{M,x,}$**
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of motorcycles using fuel type x where M stands for vehicle category motorcycles
Source of data:	DPT 2009
Value(s) applied):	20.7
Purpose of data:	Calculation of baseline emissions
Additional comment:	The value measured is in litres. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8. The lower 95% confidence interval of the sample is taken. The plausibility of the data is assessed below based on recent values reported by other cities. Table 1: Comparison SFC_T Mexico with Other Data Sources (l/100km) México | Taxis in other cities (Cities of Barranquilla and Quito | IPCC default 2.8 | 3-4 | US: 9.3 – 11.2 European: 2.4-5.1 The monitored value for motorcycles is lower than reported in other cities and at the lower end of IPCC default values although Mexico is located at 2,310 m.s.l. which leads to increased fuel consumption of vehicles. The share of gasoline motorcycles is 100%

Data / Parameter:	**$SFC_{B,L,D,}$**
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of large diesel buses where B stands for vehicle category Bus and L for sub-category Large and D for fuel type diesel
Source of data:	DTP, 2010 (File 11b)
Value(s) applied):	690
Purpose of data:	Calculation of baseline emissions
Additional comment:	Data is based on measurements realized of vehicles (not a survey). The lower 95% confidence interval of the sample is taken. The Standard Deviation of the sample is very small. A previous study realized by Senes along corridor Insurgentes shows a comparable value however with a smaller sample. Nearly 50% of diesel vehicles are elder than 1993. The sample has an average age of 1994 and thus reflects the vehicle average. Other factors which lead to a high fuel consumption are the slow moving speed (Baseline speed of buses is 15-19 km/h with peak hour speed of only 10km/h), the congestion in Mexico leading to stop-and-go traffic and the altitude. Mexico is located at 2,310 m.s.l. which leads to increased fuel consumption of vehicles The value measured is in litres. To transform from litres to grams the specific weight of diesel was taken based on IEA 2005, Table A.3.8.

Data / Parameter:	$SFC_{B,L,G,}$
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of large gasoline buses where B stands for vehicle category Bus and L for sub-category Large and G for fuel type gasoline
Source of data:	IPCC, 1996
Value(s) applied):	322
Purpose of data:	Calculation of baseline emissions
Additional comment:	Table 1-29 for HDV gasoline lowest value applied. This is conservative as HDVs not only refer to buses but also trucks which have overall lower fuel consumption as they operate in less stop-and-go conditions. The value measured is in litres. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8.

Data / Parameter:	$SFC_{B,L,EL}$
Unit:	kWh/km
Description:	Specific electricity consumed of large electric trolleybuses where B stands for vehicle category Bus and L for sub-category Large and EL for fuel type electric trolleybus
Source of data:	Plan de Accion para el Uso Eficiente de la Energia en el Distrito Federal, GDF 2009
Value(s) applied):	2.48
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on vehicle statistics (not sample). Official government report. Quito has comparable values (2.2 kWh/km)

Data / Parameter:	$SFC_{B,M,G,}$
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of medium gasoline buses where B stands for vehicle category Bus and M for sub-category Medium and G for fuel type gasoline
Source of data:	DTP, 2010 (File 11c)
Value(s) applied):	293
Purpose of data:	Calculation of baseline emissions
Additional comment:	Data is based on measurements realized of vehicles (not a survey). The lower 95% confidence interval of the sample is taken. Gasoline buses of this size (50 passengers) are seldom used in other cities. A comparable study realized by Senes 2006 showed slightly higher values (51 l/100km instead of 40 l/100km). The monitored value is thus plausible. Other factors which lead to a high fuel consumption are the slow moving speed (Baseline speed of buses is 15-19 km/h with peak hour speed of only 10km/h101), the congestion in Mexico leading to stop-and-go traffic and the altitude. Mexico is located at 2,310 m.s.l. which leads to increased fuel consumption of vehicles. The value measured is in litres. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8.

Data / Parameter:	$SFC_{B,M,LPG}$
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of medium LPG buses where B stands for vehicle category Bus and M for sub-category Medium and LPG for fuel type LPG
Source of data:	DTP, 2010
Value(s) applied):	316
Purpose of data:	Calculation of baseline emissions
Additional comment:	Data is based on measurements realized of vehicles (not a survey). The lower 95% confidence interval of the sample is taken. LPG buses of this size (50 passengers) are seldom used in other cities. A comparable study realized by Senes 2006 showed slightly higher values (73 l/100km instead of 61 l/100km). The monitored value is thus plausible. Other factors which lead to a high fuel consumption are the slow moving speed (Baseline speed of buses is 15-19 km/h with peak hour speed of only 10km/h), the congestion in Mexico leading to stop-and-go traffic and the altitude. Mexico is located at 2,310 m.s.l. which leads to increased fuel consumption of vehicles. The value measured is in litres. To transform from litres to grams the specific weight of LPG was taken based on IEA 2005, Table A.3.8.

Data / Parameter:	$SFC_{B,S,G,}$
Unit:	Grams of fuel / km
Description:	Specific fuel consumed of small gasoline buses where B stands for vehicle category Bus and S for sub-category Small and G for fuel type gasoline
Source of data:	DTP, 2010
Value(s) applied):	105
Purpose of data:	Calculation of baseline emissions
Additional comment:	Data is based on measurements realized of vehicles (not a survey). The lower 95% confidence interval of the sample is taken. A comparable study realized by Senes 2006 showed identical values. The monitored value is thus plausible. The value measured is in litres. To transform from litres to grams the specific weight of gasoline was taken based on IEA 2005, Table A.3.8.

Data / Parameter:	EF_{Grid}
Unit:	$kgCO_2$ / kWh
Description:	Emission factor for the grid
Source of data:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption version 01 (UNFCCC)
Value(s) applied):	0.4
Purpose of data:	Calculation of baseline emissions
Additional comment:	Default value as provided in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01) Electricity is only used in the baseline and hydropower plants constitute in the average of the last 5 years less than 50% of total grid generation (option A2 of referenced tool)

Data / Parameter:	TDL
Unit:	%
Description:	Average technical transmission and distribution losses for providing electricity
Source of data:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption version 01 (UNFCCC)
Value(s) applied):	3%
Purpose of data:	Calculation of baseline emissions
Additional comment:	Default value of tool based on usage of electricity for baseline only

Data / Parameter:	$EF_{KM,B,CH4}$
Unit:	gCO_{2eq} / km
Description:	CH_4 emission factor of LPG buses
Source of data:	IPCC 2006, table 3.2.4
Value(s) applied):	1.4
Purpose of data:	Calculation of baseline emissions
Additional comment:	The methodology requires that CH4 emissions of vehicles using gaseous fuels are included. 0.067 gCH_4 of IPCC is multiplied with the GWP of 21 for CH_4 to calculate CO_{2eq}

Data / Parameter:	OC_C
Unit:	Passengers
Description:	Average occupation rate of passenger cars
Source of data:	DTP, 2009
Value(s) applied):	1.48
Purpose of data:	Calculation of leakage emissions
Additional comment:	Survey realized using upper 95% confidence interval. The sample size required for a 95% confidence level and a 5% maximum error bound of a point estimation of simple random sample is 359 while the actual sample size taken was 117,094 units.

Data / Parameter:	OC_T
Unit:	Passengers
Description:	Average occupation rate of taxis
Source of data:	DTP, 2009
Value(s) applied):	0.66 Excluding Driver
Purpose of data:	Calculation of leakage emissions
Additional comment:	Survey realized using upper 95% confidence interval. The sample size required for a 95% confidence level and a 5% maximum error bound of a point estimation of simple random sample is 2,504 while the actual sample size taken was 52,302 units.

Data / Parameter:	OC_M
Unit:	Passengers
Description:	Average occupation rate of motorcycles
Source of data:	DTP, 2009
Value(s) applied):	1.16
Purpose of data:	Calculation of leakage emissions
Additional comment:	Survey realized using upper 95% confidence interval. The sample size required for a 95% confidence level and a 5% maximum error bound of a point estimation of simple random sample is 151 while the actual sample size taken was 6,337 units.

Data / Parameter:	OC_B
Unit:	Passengers
Description:	Average occupation rate of conventional buses
Source of data:	Grütter Consulting AG based on data from Secretaria del Ambiente, GDF and Metrobus, 2009
Value(s) applied):	8.76
Purpose of data:	Calculation of baseline emissions and calculation of leakage emissions
Additional comment:	Based on number of units per category, bus capacity per category, passengers per day, average trip distance on the bus and distance driven per day per bus category. Is monitored also for determination of leakage occupation rate. In percentage is 17 %

Data / Parameter:	PBL_B
Unit:	Passengers
Description:	Passengers transported by conventional baseline buses per day
Source of data:	Encuestas Origen Destino, GDF, 2008 and survey passenger, Metrobus, 2009
Value(s) applied):	31,723,081
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on number of trips per day (18,651,587) and number of units per trip used (1.7 buses on average). Both data based on survey (OD and trip surveys).

Data / Parameter:	$TDBL_{P,B}$
Unit:	Km
Description:	Average trip distance travelled by passengers using conventional baseline buses prior to the project start
Source of data:	Metrobús, 2009
Value(s) applied):	6.9
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on survey (OD and trip surveys).

Data / Parameter:	DD_B
Unit:	Km
Description:	Total distance driven by all buses
Source of data:	Secretaría del Medio Ambiente del GDF, 2008
Value(s) applied):	9,116 million
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on number of large buses and average daily distance driven per unit and 365 days per annum Average distance per day driven of conventional baseline buses is: 24,994,338 Km/day

Data / Parameter:	DD_L
Unit:	Km
Description:	Total distance driven by large baseline buses (per annum)
Source of data:	Secretaría del Medio Ambiente del GDF, 2008, Table 4.3.10 p.106
Value(s) applied):	3,582 million
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on number of large buses and average daily distance driven per unit and 365 days per annum Average daily distance of 226 km per bus is based on: - 223 km per day on Sundays - 241 km/day on other days Number of large buses: 43,513

Data / Parameter:	DD_M
Unit:	Km
Description:	Total distance driven of medium baseline buses (per annum)
Source of data:	Secretaría del Medio Ambiente del GDF, 2008, Table 4.3.10 p.106
Value(s) applied):	2,632 million
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on number of medium buses and average daily distance driven per unit and 365 days per annum Average daily distance are 200 km Number of medium buses: 36,056

Data / Parameter:	DD_S
Unit:	Km
Description:	Total distance driven of small baseline buses (per annum)
Source of data:	Secretaría del Medio Ambiente del GDF, 2008, Table 4.3.10 p.106
Value(s) applied):	2,901 million
Purpose of data:	Calculation of baseline emissions
Additional comment:	Based on number of medium buses and average daily distance driven per unit and 365 days per annum Average daily distance are 200 km Number of smallm buses: 39,746

Data / Parameter:	AD_B
Unit:	Km / bus
Description:	Average annual distance driven of baseline buses
Source of data:	Secretaría del Medio Ambiente del GDF, 2008
Value(s) applied):	76,403
Purpose of data:	Calculation of leakage emissions
Additional comment:	Based on average daily distance per sub-category of bus and number of units per sub-category and 365 days per annum.

Data / Parameter:	AD_T
Unit:	Km / taxi
Description:	Total distance driven of taxis
Source of data:	Secretaría del Medio Ambiente del GDF, 2008
Value(s) applied):	73,000
Purpose of data:	Calculation of leakage emissions
Additional comment:	Used for leakage load factor change taxis if calculation is required

Data / Parameter:	$NIZ_{C/T,BL}$
Unit:	Vehicles
Description:	Number of cars/taxis on roads affected per annum in the baseline
Source of data:	Metrobús and Planeación y Vías Terrestres S.A. de C.V., 2007
Value(s) applied):	

Number of vehicles Baseline on Affected Roads (per annum, tsd)

Affected Roads	Number of cars	Number of taxis
Insurgentes	11,912,908	2,463,704
Guerrero	11,977,320	3,201,214
Coyoacán	5,880,527	1,430,183
Av. Revolución	5,979,802	1,511,153

Purpose of data:	Calculation of leakage emissions
Additional comment:	Visual counting on the identified roads. Exact locations of monitoring are defined for each affected road. Based on expansion factor of 330 days per year.

Data / Parameter:	V_B
Unit:	Km / h
Description:	Average total speed and average speed under circulation is measured
Source of data:	Metrobus and Planeación y Vías Terrestres S.A. de C.V., 2007
Value(s) applied):	

Average total speed of vehicles baseline on affected roads (km/h)

Affected Roads	Speed
Insurgentes	23
Guerrero	27
Coyoacán	20
Av. Revolución	23

Moving speed of vehicles baseline on affected roads (km/h)

Affected Roads	Speed
Insurgentes	32
Guerrero	38
Coyoacán	33
Av. Revolución	36

Purpose of data:	Calculation of leakage emissions
Additional comment:	The average total speed (time/distance) is measured. If the baseline average total speed is higher than the project total speed no rebound effect is calculated based on ACM0016 p. 17 The average moving speed is measured as this is required for vehicle speed change.

Data / Parameter:	**N_i**
Unit:	Vehicles
Description:	Number of vehicles of category i
Source of data:	Secretaría del Medio Ambiente del GDF, 2008
Value(s) applied):	

Vehicle Type	Gasoline	Diesel	LPG	CNG	Electric
Passenger cars	3,389,697	1,879	4,209	15	
	100%	0%	0%	0%	
Taxis	154,953	144	29		
	100%	0%	0%	0%	
Motorcycles	180,701				
	100%				
Small buses	39,128	62	553	3	
	99%	0%	1%	0%	
Medium buses	19,902	118	15,678	358	
	56%	0%	43%	1%	
Large buses	2,196	40,791	121	0	405
	5%	94%	0%	0%	1%

Purpose of data:	Calculation of baseline emissions
Additional comment:	Official statistics

Data / Parameter:	**RS_{BL}, RS_{PJ}**
Unit:	Km
Description:	Total distance driven of medium baseline buses (per annum)
Source of data:	Secretaría del Medio Ambiente del GDF, 2008, Table 4.3.10 p.106
Value(s) applied):	76.4 km – 4 lanes of 19.1 each one. The road space available in the baseline and the project is the same
Purpose of data:	Calculation of leakage emissions
Additional comment:	The baseline has 6 lanes (three lanes in each direction), of which 2 lanes were used as parking space. The project has 6 lanes (three lanes in each direction), of which 2 lanes are being used for the project's buses. More specifically, in the project scenario the two parking lanes have been replaced by metrobus' lanes.

Data / Parameter:	**TD_B, TD_T, TD_C**
Unit:	Km
Description:	Total distance driven by buses (B), taxis (T) and personal cars (C) in the baseline
Source of data:	TDB and TDC – File 3a – SENES "Medidas de Linea Base par el Corredor de Insurgentes", Ciudad de Mexico, 2006. TDT – File 1a – Secretaria de Medio Ambiente del GDF: Inventario de Emisiones 2006-2008
Value(s) applied):	TDB = 215 km TDT = 200 km TDC = 40 km
Purpose of data:	Calculation of leakage emissions
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	**$NCV_{x,y}$**
Unit:	J/kg in year y
Description:	Net calorific value of fuel x being specifically gasoline (G), diesel (D) and LPG (LPG)
Measured/ Calculated / Default:	Default
Source of data:	IPCC 2006, table 1.2
Value(s) of monitored parameter:	Gasoline: 42,500,000 J/kg; Diesel: 41,400,000 J/kg; LPG: 44,800,000 J/kg
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	No national value; IPCC default value lower 95% confidence interval
QA/QC procedures:	Any future revision of the IPCC Guidelines will be taken into account.
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	-

Data / Parameter:	**$EF_{CO2,x,y}$**
Unit:	gCO_2/J
Description:	CO_2 emission factor for fuel type x in the year y being specifically gasoline (G), diesel (D) and LPG (LPG)
Measured/ Calculated / Default:	Default
Source of data:	IPCC 2006, table 1.4
Value(s) of monitored parameter:	Gasoline: 67,500,000 gCO_2/J; Diesel: 72,600,000 gCO_2/J; LPG: 61,600,000 gCO_2/J
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	Any future revision of the IPCC Guidelines is taken into account.
QA/QC procedures:	Any future revision of the IPCC Guidelines will be taken into account.
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	-

Data / Parameter:	**P_Y**
Unit:	Passengers
Description:	Total passengers transported by the project activity transport system
Measured/ Calculated / Default:	Measured
Source of data:	Metrobús (Reparto Ingresos)
Value(s) of monitored parameter:	86,035,491
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Continuously, aggregated at least annually, the measured period is from 1/01/2013 to 31/10/2013
Calculation method (if applicable):	Turnpike controls at stations. Daily operators at each station take note of the number in the turnpike counter. These numbers are recorded in a data sheet. Only those customers who exit Metrobus in those stations which belong to the project activity (i.e. Insurgentes) are taking into account for the calculation of the total passengers transported by the project activity.
QA/QC procedures:	Total number of passengers will be cross-checked with data from the turnpike electronic system, which is compiled by a third party contractor and provided to Metrobus within 48 hours.
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	As explained earlier in this monitoring report, and in order to be conservative, no ERs are claimed from 10/08/2012 to 31/12/2012. Thus the number of passengers reported comprises only the period from 1/01/2013 to 31/10/2013.

Data / Parameter:	**$FC_{PJ,x}$**
Unit:	Liters
Description:	Total fuel of type *x* consumed by the project transport units
Measured/ Calculated / Default:	Measured
Source of data:	Metrobus and concessionaries. Metrobus is responsible of collecting and consolidating the data on the fuel consumed by the project buses, based on the logbooks provided by the concessionaries.
Value(s) of monitored parameter:	9,658,109.77
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Continuously, aggregated at least annually The measured period is from 1/01/2013 to 31/10/2013
Calculation method (if applicable):	Logbooks provided by the concessionaires
QA/QC procedures:	Control with previous years as well as with SFC of comparable buses (articulated and bi-articulated diesel buses). "Normal" or average data range is based on previous experience per bus type. It indicates ranges and does not mean that data from buses falling outside this range is necessarily wrong. If the specific fuel consumption is outside normal ranges, the following measures are to be taken : • Control the distance: Is the data correct and reasonable? • Control the fuel consumption; • Is the specific consumption too high or too low: Compare the data with the previous months. Have any previous values fallen outside the range? The SFC values were initially estimated for articulated buses between 64 and 78 l/100km, and for bi-articulated buses between 72 and 88 l/100km. As per the PDD (see page 134), if fuel efficiency (l/100 km) falls outside of this initial range *and* is 10% greater or less than fuel efficiency from the previously reported year, then at least one of the following comparisons may be made: (a) Comparison of fuel consumption against fuel purchase invoices; or (b) Evaluation of vehicle-kilometres traveled data. • These comparisons were not required for this monitoring period, since all values were within the normal range. If differences cannot be explained then: o Check documentary filling controls (data transmission and storage); o Check distance measurement controls (data transmission and storage) These comparisons were not required for this monitoring period, since all values were within the normal range.
Purpose of data:	Calculation of project emissions
Additional comment:	As explained earlier in this monitoring report, and in order to be conservative, no ERs are claimed from 10/08/2012 to 31/12/2012. Thus the number of liters reported comprises only the period from 1/01/2013 to 31/10/2013. The SFC for the articulated buses is higher than for the bi-articulated because biarticulated buses are newer, bigger in size and also because drivers of biarticulated buses have been trained to drive more efficiently, so less fuel is consumed. The fuel efficiency performance for each type of bus, which has been provided to the DOE in the excel sheet "Consumos Ene-Octu 2013", is calculated by dividing the kilometers by the amount of fuel consumed. From the excel sheet it can be seen that the performance is higher for biarticulated buses than for articulated.

Data / Parameter:	$DD_{PJ,x,y}$
Unit:	Km
Description:	Distance driven by project units using fuel type *x* in year *y*
Measured/ Calculated / Default:	Measured
Source of data:	Metrobus and concessionaires. Metrobus is responsible of collecting and consolidating the data on the fuel consumed by the project buses, based on the logbooks provided by the concessionaries..
Value(s) of monitored parameter:	9,756,828.62 for articulated buses and 1,851,685.40 for biarticulated buses. The measured period is from 1/01/2013 to 31/10/2013.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Continuously, aggregated at least annually The measured period is from 1/01/2013 to 31/10/2013
Calculation method (if applicable):	Based on number of turnovers per day and trip distance
QA/QC procedures:	Control with logbooks with information on kms driven taken by Metrobus every 15 days.. Used for QA of fuel consumption through SFC.
Purpose of data:	Calculation of project emissions
Additional comment:	As explained earlier in this monitoring report, and in order to be conservative, no ERs are claimed from 10/08/2012 to 31/12/2012. Thus the number of liters reported comprises only the period from 1/01/2013 to 31/10/2013.

Data / Parameter:	$SFC_{i,x,y}$
Unit:	l / 100 km
Description:	Specific fuel consumption of vehicle category I (BRT buses) using fuel x in the year y
Measured/ Calculated / Default:	Calculated
Source of data:	Metrobús
Value(s) of monitored parameter:	Articulated units: 83.33 Bi-articulated Units: 77.81 All Diesel Units It should be noted that, as the bus fleet evolved, Metrobus periodically update these $SFC_{i,x,y}$ values based on actual data. As per the PDD the SFC range for articulated buses is 64-78 l/100km, while for bi-articulated is 72-88 l/100km. For this MR the SFC values has been updated to 88.33 l/100 km y 77.81 l/100 km respectively
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Continuously, aggregated at least annually The measured period is 1/01/2013 to 31/10/2013
Calculation method (if applicable):	Total fuel / total kilometres * 100

QA/QC procedures:	SFC is not based on samples but on total data. Control with previous payment made to operators based on distance driven. Check with annual distance driven. Used for QA of fuel consumption through SFC. See parameter $\mathbf{FC_{PJ,x}}$ for more information on QA controls. The SFC values were initially estimated for articulated buses between 64 and 78 l/100km, and for bi-articulated buses between 72 and 88 l/100km. As per the PDD (see page 134), if fuel efficiency (l/100 km) falls outside of this initial range *and* is 10% greater or less than fuel efficiency from the previously reported year, then at least one of the following comparisons may be made: (a) Comparison of fuel consumption against fuel purchase invoices; or (b) Evaluation of vehicle-kilometres traveled data.
Purpose of data:	Data not required for ER calculations
Additional comment:	Data not required for ER calculations as FC is available.

Data / Parameter:	$MS_{i,y}$
Unit:	Percentage
Description:	Net share of passengers using the BRT which would have used baseline mode *i* (%) in the year y
Measured/ Calculated / Default:	Calculated
Source of data:	Survey realized by external survey company (RP&A Creatividad mercadológica) in June 2013.
Value(s) of monitored parameter:	Data is based on a survey realized on Metrobus BRT lines (see CER spreadsheet). For projections the same value has been taken: • Passenger car: 5% • Taxi: 30% • Motorcycle: 0.5% • Bus: 138% • NMT: 123% • Rail based system: 8% • Other including BRT lanes: 0% The total is more than 100% as passengers can use various modes in the baseline from their trip origin to their trip destination and can also use more than 1 bus.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Monitoring of this parameter is not required by ACM0016 version 3, since the project does not lead to a reduction of road capacity available for individual motorized transport modes.
Calculation method (if applicable):	Survey
QA/QC procedures:	N/A
Purpose of data:	Data not required for ER calculations
Additional comment:	Data not required for ER calculations

Data / Parameter:	$N_{B/T,y}$
Unit:	Buses, taxis
Description:	Number of buses and taxis
Measured/ Calculated / Default:	Default
Source of data:	Secretary of Environment, 2010
Value(s) of monitored parameter:	124,435 buses 200,769 taxis
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Years 1, 4, 7 and 10 of the crediting period
Calculation method (if applicable):	None as no change in occupation rate of taxis and buses is previewed. This assumption is based on practical experience in Transmilenio Bogota which had no change of occupation rates of baseline buses or taxis. See verification report TransMilenio 2009 (published on www.unfccc.int).
QA/QC procedures:	-
Purpose of data:	Calculation of leakage emissions, only if a change of occupation rate is registered.

Additional comment:	The data is only required for calculations of leakage if a change of occupation rate is registered. This parameter is only recorded in cases where the occupancy rate of buses and taxis is lower than in the baseline (in the case of buses, if the occupancy rate is reduced by 10 percentage points higher than the rate of occupation of the baseline, and in the case of taxis if less than baseline occupancy rate). See PDD Appendix 4 Section A.3 for further details regarding occupancy level calculation for conditions under which this parameter is required. In summary, this parameter is only required when: bus occupancy rate is less than 6.6% (occupancy rate for the baseline is 17%) and/or taxi occupancy rate is less than 0.66 passengers per vehicle (taxi occupancy rates do not include the driver).

Data / Parameter:	$OC_{B/T,y}$
Unit:	% for Buses Passengers for taxis
Description:	Average occupancy rate of buses and taxis in the year y
Measured/ Calculated / Default:	• Occupancy rate of taxis: Measured • Occupancy rate of buses: Calculated
Source of data:	• Occupancy rate of taxis: Study realized by a third party. • Occupancy rate of buses: Calculations conducted by metrobus based on official data from the Secretary of Environment.
Value(s) of monitored parameter:	12.03% for buses and 0.78 for taxis
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Years 1, 4, 7 and 10 of the crediting period
Calculation method (if applicable):	• Occupancy rate of taxis: Visual studies based on Annex 3 of the methodology and PDD Appendix 4 Section A.5.1 • Occupancy rate of buses: Calculated based on official data from the Secretary of Environment following the guidelines provided in Annex 2 of the methodology. Also, as per the PDD Appendix 4 Section A.6.2. o
QA/QC procedures:	For the occupancy rate of taxis, coverage of the occupation counts should be higher than 95% of the number of taxis that cross the checkpoint.
Purpose of data:	Calculation of leakage emissions
Additional comment:	-

Data / Parameter:	$NIZ_{C/T,\,y}$
Unit:	Vehicles
Description:	Number of cars/taxis using affected roads
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by a third party
Value(s) of monitored parameter:	-
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Monitoring of this parameter is not required by ACM0016 version 3, since the project does not lead to a reduction of road capacity available for individual motorized transport modes.

Calculation method (if applicable):	No projections as no change of total average speed is expected, thus monitoring of this parameter is not required.
QA/QC procedures:	N/A
Purpose of data:	Data not required for ER calculations
Additional comment:	Data not required for ER calculations

Data / Parameter:	**$TDIZ_{i,y}$**
Unit:	Km
Description:	Distance driven by vehicle category i in the year y which refers to taxis (T) and passenger cars (C) on affected roads
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by a third party
Value(s) of monitored parameter:	-
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Monitoring of this parameter is not required by ACM0016 version 3, since the project does not lead to a reduction of road capacity available for individual motorized transport modes.
Calculation method (if applicable):	No projections as no moving speed change is expected, thus monitoring of this parameter is not required.
QA/QC procedures:	N/A
Purpose of data:	Data not required for ER calculations
Additional comment:	Data not required for ER calculations

Data / Parameter:	**$V_{P,y}$**
Unit:	Km/h
Description:	Average speed of cars and taxis on affected roads including total average speed and average moving speed
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by a third party
Value(s) of monitored parameter:	-
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Monitoring of this parameter is not required by ACM0016 version 3, since the project does not lead to a reduction of road capacity available for individual motorised transport modes.
Calculation method (if applicable):	Same moving as well as average speed as under baseline is expected, thus monitoring of this parameter is not required.
QA/QC procedures:	N/A
Purpose of data:	Data not required for ER calculations
Additional comment:	Data not required for ER calculations

Data / Parameter:	**$BTD_{p,i,y}$**
Unit:	Km

Description:	Baseline trip distance of the cluster *p* of surveyed passengers using mode *i* in the year y
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by a third party
Value(s) of monitored parameter:	See ER spreadsheet
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	The survey is realized in the years 1 and 4 of the crediting period. The change in the monitoring frequency of this parameter, from annually to years 1 and 4 of the crediting period, has been done in accordance to version 3 of ACM0016, and approved in the latest version of the PDD, dated 31/05/2014.
Calculation method (if applicable):	Emissions are calculated per passenger and then expanded to the total passengers transported based on the expansion factor per passenger
QA/QC procedures:	See Section D.3 of this report for more information regarding the design of the survey sample.
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

Data / Parameter:	**$IPTD_{p,i,y}$**
Unit:	Km
Description:	Indirect project trip distance of the surveyed passenger using mode i in the year y
Measured/ Calculated / Default:	Measured
Source of data:	Survey realized by a third party. Based on the survey asking the modes of transit used and the trip distances from trip origin to entry station of the BRT and from exit station of the BRT to trip destination.
Value(s) of monitored parameter:	See ER spreadsheet
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	The survey is realized in the years 1 and 4 of the crediting period. The change in the monitoring frequency of this parameter, from annually to years 1 and 4 of the crediting period, has been done in accordance to version 3 of ACM0016, and approved in version 5 of the PDD, dated 31/05/2014.
Calculation method (if applicable):	Emissions are calculated per passenger and then expanded to the total passengers transported based on the expansion factor per passenger.
QA/QC procedures:	See Section D.3 of this report for more information regarding the design of the survey sample.
Purpose of data:	Calculation of project emissions
Additional comment:	-

D.3. Implementation of sampling plan

For the estimation of the indirect project emissions and baseline emissions, a passenger survey was conducted by a third party (i.e. RP&A) in November 2012 (first semester of the first reporting year). A re-test survey was performed in June 2013 (second semester of the first reporting year) in order to identify if there is seasonability. Survey results have been provided to the DOE.

The general characteristics of the survey are shown in the following table:

Parameter	Main parameters: • Baseline emissions; • Indirect project emissions. Secondary parameters and inputs: • Proportion of passengers proportion using each mode of transport, with the project and in absence of the project; • The average distance travelled by these modes with the project and in absence of the project.
Target Population	Passengers over 12 years using the BRT
Sample Frame	Passenger flow in all the stations of the BRT
Sample design	Two staged probabilistic design: • First Stage: stratified – simple random sampling (SRS) • Second stage: systematic sampling based on passengers flow per station Stratum: Stations Sub stratum: Days in the week and hours
Relative error level (CV)	For the survey a global desired level of precision (relative standard error or coefficient of variation – CV) between 5% and 10% for the parameters of interest, which implies at the same time having precision levels of 90/10 is targeted. Results obtained are based on a 95% confidence level using the more conservative boundary.
Coverage	Urban area where the BRT operates that are 36 stations of the Insurgentes Corridor
Size of Universe	In total there are an average of 335,649 passengers daily throughout the Insurgentes corridor (the daily passengers as per the PDD is 300,000, however this figure has been updated to 335,640 to reflect the actual value).
Sample Size	In general, the determination of the sample size is made by simulating, following the Särndal methodology (1992) in which a CV is fixed and the size of the sample is found by solving the formula of the variance estimator according to the design used in each case. The specific sample of each station is shown below, considering the representativeness of each season based on their influx of passengers:

ESTACIÓN	PASAJEROS POR DÍA	MUESTRA
Indios Verdes	27,411	12,24504761
Deportivo 18 de marzo	7,566	44,3628073
Euzkaro	1,719	195,2582897
Potrero	4,161	80,66546503
La Raza	5,18	64,79710425
Circuito	4,151	80,85979282
San Simón	2,356	142,4656197
Manuel González	4,338	77,37413555
Buenavista	16,495	20,34852986
Buenavista II	10,588	31,7008878
El Chopo	3,246	103,4038817
Revolución	11,157	30,08416241
Plaza de la República	7,837	42,82876101
Reforma	14,063	23,86752471
Hamburgo	11,373	29,51279346
Glorieta Insurgentes	21,391	15,69113178
Durango	4,926	68,13824604
Álvaro Obregón	9,551	35,14281227
Sonora	7,051	47,60303503
Campeche	4,607	72,85630562
Chilpancingo	17,028	19,71159267
Nuevo León	7,846	42,77963293
La Piedad	6,65	50,47353383
Polifórum	21,714	15,45772313
Nápoles	8,902	37,70489778
Colonia del Valle	7,708	43,5455371
Ciudad de los deportes	6,5	51,63830769
Parque Hundido	7,491	44,80696836
Félix Cuevas	10,381	32,33301223
Rio Churubusco	10,532	31,8694455
Teatro Insurgentes	4,285	78,33115519
José María Velasco	6,535	51,36174445
Francia	3,747	89,57806245
Olivo	3,496	96,00943936
Altavista	7,012	47,86779806
La Bombilla	6,039	55,58022851
Doctor Gálvez	20,616	16,28099534
TOTAL	335,649	2024,536408

** The project involves a total of 36 stations. Please note that Buenavista I and II are considered one station, but have been divided in two for Metrobus internal reporting reasons.*

This stratified random sampling was performed with proportional allocation according to the number of passengers per day.

For sample, as suggested in the PDD (6000 passengers interviewed), the result of average daily passengers by station was divided between the average daily passengers carried for the period, and then multiplied by the 6000 suggested passengers interviewed, as shown below:

	ESTACIÓN	PASAJEROS POR DÍA	MUESTREO ALEATORIO SIMPLE POR ESTACIÓN
CORREDOR INSURGENTES	1 Indios Verdes	27,411	490
	2 Deportivo 18 de marzo	7,566	168
	4 Potrero	4,161	80
	5 La Raza	5,180	85
	6 Circuito	4,151	75
	8 Manuel González	4,338	80
	9 Buenavista	16,495	302
	10 Buenavista II	10,588	195
	12 Revolución	11,157	210
	13 Plaza de la República	7,837	135
	14 Reforma	14,063	252
	15 Hamburgo	11,373	217
	16 Glorieta Insurgentes	21,391	410
	17 Durango	4,926	84
	18 Álvaro Obregón	9,551	165
	19 Sonora	7,051	131
	20 Campeche	4,607	75
	21 Chilpancingo	17,028	350
	22 Nuevo León	7,846	140
	23 La Piedad	6,650	107
	24 Polifórum	21,714	425
	25 Nápoles	8,902	165
	26 Colonia del Valle	7,708	146
	27 Ciudad de los deportes	6,500	124
	28 Parque Hundido	7,491	140
	29 Félix Cuevas	10,381	206
	30 Río Churubusco	10,532	203
	31 Teatro Insurgentes	4,285	82
	32 José María Velasco	6,535	130
	35 Altavista	7,012	128
	36 La Bombilla	6,039	112
	37 Doctor Gálvez	20,616	388
	TOTAL	335,649	6000

N=6000 (suggested sample)

Indios verdes= (27,411/335,649)*6000 =490

The 335,649 daily passengers in Insurgentes corridor are divided by the sample size, which is 6000. The result is 56, and this number means that every 56th passenger will be interviewed on average.

$$k = \left[\frac{n}{N}\right] = \left[\frac{335,649}{6,000}\right] = 56$$

Where:

n = population
N = Sample
k = # interviewed passengers

The number of passengers interviewed per station were distributed proportionally by day based on passenger flow according to the day of the week counting from Monday to Sunday, and according to the following percentages:

Sample per day

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
17%	17%	17%	17%	18%	9%	5%

The sample was distributed for each day according to the average passenger flow per hour, considering peak hours and low influx hours:

Hour	**% Passengers**
05:00	1.31%
06:00	4.13%
07:00	6.98%
08:00	8.28%
09:00	6.17%
10:00	5.12%
11:00	4.99%
12:00	5.24%
13:00	5.99%
14:00	6.56%
15:00	6.68%
16:00	5.74%
17:00	6.12%
18:00	7.92%
19:00	6.72%
20:00	5.11%
21:00	3.96%
22:00	2.11%
23:00	0.85%
Total	**100%***

**The total % of passengers sum up 99.98% instead of 100%. The 0.02% difference is mainly due to rounding of the figures.*

Pilot Test	The 1st test was realized in November 2012 (first semester of the first reporting year) during one week on a continuous base. The sample size was 6000 users of the BRT Line Insurgentes. The sample was distributed in accordance with the daily passenger flow per station. The 2nd test was realized in June 2013 (second semester of the first reporting year) during one week on a continuous base. The sample size was 2,722 users of the BRT Line Insurgentes (less than half of the initial survey as required by methodology, Annex 4, Section 7). The sample was distributed in accordance with the daily passenger flow per station. Fisher method was used for the statistical analysis of the sample size for the two surveys. The method confirmed that the sample size meet the 95% confidence level and 5% maximum error (statistical analysis was provided to the DOE).
Sample frequency	Once in years 1 and 4 of the crediting period during an entire week plus a re-test survey realize in the year 1 only.
Method of information collection	Face to face interviews with users older than 12 years were conducted in 36 of the 47 stations of the Insurgentes Corridor, in the span of a week. In these terminals the interviewer applied the survey to a passenger with an average time of 5 minutes. The information was gathered between 05:00 hours and 23:30 hours, in order to cover the

	times of this transport. Interviewers conducted the surveys right before passengers board into the buses. Thus the origin station of the passenger was determined, and well as the various means to get to the station.

As per the methodology ACM0016 v2, the following criteria for identifying if there has been or not seasonality has been applied:

1. A test of mean comparison between the data reported on the flow of passenger for the two surveys

Travel distance in Metrobus		
	Survey 1	Survey 2
Sample size (n)	6,000	2,722
$\sum X$	36,547.69	15,689.91
$\sum X^2$	346,508.00	141,406.73
media	6.09	5.76
S	4.5443	4.3280
S^2	20.6511	18.7315
SC	123,885.6690	50,968.3991

a) Fisher method is applied to compare the sample variances between both surveys.

$$\frac{S^2 \text{ Major}}{S^2 \text{ minor}} \text{ (Fcal)} = \frac{18.73149543}{20.65105335} = \mathbf{0.90704794}$$

Freedom degrees major = 5999

F table = **1.055576754**

Freedom degrees minor = 2721

α = 0.05

If Fcal < F table, Ho is acepted

If P > 0.05 Ho is acepted

Ho: sample variances are equal

Ho: S^2survey 1= S^2survey 2

0.907047942 <= 1.0556 Then, Ho is accepted, sample variances are equal in both surveys

b) T student method is applied to compare the variance on the trip travel distance.

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} = 20.05$$

$$t = \frac{(x_1 - x_2) - 0}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad = \quad 3.161618772$$

α	=	0.05
Freedom degrees	=	8720
t table=	=	**1.960236071**

If t cal < t table Ho is accepted

Ho: The average trip travel distance is equal in both surveys

3.161618772 > 1.9602 Then, Ho is rejected

The average trip travel distance is different in both surveys

2. A test consisting in the application of a times series model SARIMA, where it is estimated if there is any seasonality degree in the passenger flows.

Observed Data (fo)		Survey Number	
		Survey 1	Survey 2
Users that use each mode of transport	Pax would have used car	548	134
	Pax would have used taxi	1,172	812
	Pax would have used bus	4,044	3,751
	Pax would have used motorcycle	43	13
	Pax would have gone by foot	8,010	3,343
	Pax would not have made trip	192	81
	Pax would have used rail	3,064	225
	Total	**17,073**	**8,359**

Expected Data (fe)		Survey number	
		Survey 1	Survey 2
Users that use each mode of transport	Pax would have used car	458	224
	Pax would have used taxi	1,332	652
	Pax would have used bus	5,233	2,562
	Pax would have used motorcycle	38	18
	Pax would have gone by foot	7,621	3,732
	Pax would not have made trip	183	90
	Pax would have used rail	2,208	1,081

Xi^2		Survey number	
		Survey 1	Survey 2
Users that use each mode of transport	Pax would have used car	17.75	36
	Pax would have used taxi	19	39
	Pax would have used bus	270	552
	Pax would have used motorcycle	1	2
	Pax would have gone by foot	20	40
	Pax would not have made trip	0	1
	Pax would have used rail	332	678

$$fe = \frac{\text{(marginal row) (marginal column)}}{\text{(total number of subjects)}}$$

$$x^2 = \Sigma \frac{(fo - fe)^2}{fe} = \mathbf{2007.91}$$

$$\text{freedom degrees} = \text{(rows-1) (columns - 1)} = 6$$

Ho = There are not significant difference in both surveys
If calculated Xi^2< table Xi^2, Ho is accepted

In tables $Xi^{2,}$ with α =.05 and 6 freedom degrees is **12.592**

As calculated Xi^2 2007.91 > table Xi^2 (12.592) - Ho is rejected
There is seasonality between both surveys.

As per methodology ACM0016 v2, Annex 4 Section 7, if there is evidence of seasonality, within each period where there are apparent differences (i.e. November and June), independent surveys are performed and at the end, the results are compared regarding the emissions difference and the parameters on the use of modes of transport and the average travel distance.

Given that model SARIMA has probe that there is seasonability, results from the survey conducted in the first year and the re-test were compared, and the project participant found out that there were apparent differences in the emissions reductions achieved. Therefore, and in order to be conservative, results from the second survey were used for the estimation of the ERs achieved during this period.
Also, as per methodology ACM0016 v2, Annex 4 Section 7, if there are significant differences between the analysis periods, the measurements of later years (i.e. year 4) will be carried out in the periods in which seasonality is identified (i.e. November and June). Therefore, in year 4 two surveys should be conducted.

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

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

Baseline emissions are calculated per passenger surveyed. For each passenger surveyed the individual baseline emissions are calculated and multiplied with the individual expansion factor thus getting the baseline emissions of all passengers of the specific week surveyed. These are multiplied with the total of the passengers of the period to arrive at baseline emissions.

The steps that were taken into account were:

1. A survey was conducted, following the procedures presented in the PDD Annex 3, in which for each surveyed passenger, the trip distance per transport mode that would have taken place in the baseline is determined.
2. The individual baseline emissions were calculated for each surveyed passenger.
3. An individual expansion factor was applied to each surveyed passenger in accordance with the survey sample design (as defined in Annex 3), and summarize these to get the total baseline emissions of the period (week) surveyed. To get the annual (or monitoring period) baseline emissions the baseline emissions of the surveyed period (week) are calculated

per passenger of the period (week) and multiplied with the total passengers transported per year (or monitoring period).

4. Was taken the lower limit of the 95% confidence interval as total baseline emissions.

PROCEDURE

$$BE_y = \frac{P_y}{P_{SPER}} \sum_p (BE_{p,y} \times FEX_{p,y})$$

Parameter	Description
BE_y:	Baseline emissions in the year y (t CO_2)
$BE_{p,y}$	Baseline emissions per surveyed passenger p in the year y (g CO_2)
$FEX_{p,y}$	Expansion factor for each surveyed passenger p surveyed in the year y (each surveyed passenger has a different expansion factor)
P_y	Total number of passengers in the year y
P_{SPER}	Number of passengers in the time period of the survey (1 week)
p	Surveyed passenger
y	Year of the crediting period

The baseline emission per surveyed passenger is calculated based on the mode used, the trip distance per mode and the emission factor per mode:

$$BE_{p,y} = \sum_i BTD_{p,i,y} * EF_{PKM,i,y} * 10^{-6}$$

Parameter	Description
$BE_{p,y}$	Baseline emissions per surveyed passenger p in the year y (t CO_2)
$BTD_{p,i,y}$	Baseline trip distance p per surveyed passenger using mode i in the year y (PKM)
$EF_{PKM,i,y}$	Emission factor per passenger-kilometer of mode i in the year y (g CO_2/PKM)
i	Relevant vehicle category
p	Surveyed passenger (each individual)
y	Year of the crediting period

The baseline is a continuation of the current transport system consisting of various transport modes between which the population chooses:

- NMT (Non-Motorized Traffic) with bikes and per foot;
- Private passenger car;
- Taxis;
- Motorcycles;
- Buses differentiating between the sub-categories of large, medium and small buses.
- Metro and LTR are not included as their baseline emissions are taken as 0 (conservative approach).

DETERMINATION OF THE EMISSION FACTOR PER PASSENGER-KILOMETER ($EF_{PKM,i,y}$)

Passenger-kilometer (PKM) is defined as the average passenger trip distance multiplied by the number of passengers. The emission factors per PKM are determined *ex ante* for each vehicle category. Any change in the occupancy rate of taxis and buses influencing the corresponding emission factors is monitored as leakage.

For electricity-based vehicle categories, the following equation should be used:

$$EF_{PKM,i,y} = \frac{TE_{EL,i,y}}{P_{EL,i,y} \times TD_{EL,i}} \times 10^6$$

Parameter	Description
$EF_{PKM,i,y}$	Emission factor per passenger-kilometer of mode i in the year y (g CO_2/PKM)
$TE_{EL,i,y}$	Total emissions from the electricity-based vehicle category i for year y (tCO_2)
$P_{EL,i,y}$	Total passengers transported per year by the electricity-based vehicle category i for year y (passengers)
$TD_{EL,i}$	Average trip distance travelled by passengers using the electricity-based vehicle category i prior to project start (km)

The total emissions from the electricity-based vehicle category i, $TE_{EL,i,y}$, should be calculated, for each vehicle category i, using the .Tool to calculate baseline, project and/or leakage emissions from electricity consumption.. When applying the tool, the parameter $EC_{BL,k,y}$ in the tool should be taken as the amount of electricity used by the electricity-based vehicle category i for year y, consistent with the transportation of PEL,i,y passengers along the average distance $TD_{EL,i}$.

For electric trolleybuses of the baseline the following formula is taken:

$$TE_{EL,TB,y} = EC_{BL,TB,y} \times EF_{EL,y} \times (1 + TDL_y)$$

Parameter	Description
$TE_{EL,TB,y}$	Baseline emissions from electricity consumption of trolleybuses in the year y (tCO_2)
$EC_{BL,TB,y}$	Quantity of electricity consumed by baseline trolleybuses in the year y (MWh)
$EF_{EL,y}$	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 emission factor per PKM for fuel-based transport systems (e.g. road-based vehicles) for fuel-based vehicle categories, shuld be calculated as:

$$EF_{PKM,i,y} = \frac{EF_{KM,i,y}}{OC_i}$$

Parameter	Description
$EF_{PKM,i,y}$	Emission factor per passenger-kilometer of vehicle category *i* in the year *y* (g CO_2/PKM)
$EF_{KM,i,y}$	Emission factor per kilometer of vehicle category *i* in the year *y* (g CO_2/km)
OC_i	Average occupation rate of vehicle category *i* prior project start (passengers)
i	Relevant vehicle category
y	Year of the crediting period

The average occupation rate of vehicle category *i (OC$_i$)* is determined based on visual occupation studies. In the case of taxis, the driver is not included. For buses, as an alternative, the occupation rate can be determinate using the following equation:

$$OC_B = \frac{PBL_B \times TDBL_{P,B}}{DD_B}$$

Parameter	Description
OC_B	Average occupation rate of buses prior project start (passengers)
PBL_B	Passengers transported by baseline buses prior project (passengers)
$TDBL_{P,B}$	Average trip distance of passengers using baseline bus (kilometer)
DD_B	Distance driven by all baseline buses (kilometer)

Relevant fuel types, for each vehicle category, have to be identified. The emission factor per kilometer is re-calculated annually based on the recorded share of fuels per category. In case bio-fuel blends are used the bio-fuel share of the blend is accounted for with zero emission factor ($EF_{CO2,x,y}$).

If various sub-categories of buses exist (e.g. small, medium, large units) the emission factor is calculated for each bus sub-category, and after aggregated as explained further below.

The emission factor per kilometer is not constant but annually updated. Two options can be used to calculate EFKM,i,y. For each vehicle category the project can choose which option to take. During the crediting period the project cannot change between one and the other option, i.e. the decision is fixed for the crediting period. The project chooses for all vehicles an annual technology improvement factor as given by the methodology due to the difficulty in obtaining specific fuel consumption values. Formula (6) of the methodology is thus not used.

For option (2) i.e. all vehicle categories the following formula applies:

$$EF_{KM,i,y} = (IR_i)^{t+y} \frac{\sum_x (SFC_{i,x} \times NCV_{x,y} \times EF_{CO2,x,y} \times N_{x,i})}{N_i}$$

Parameter	Description
$EF_{KM,i,y}$	Emission factor per kilometer of vehicle category *i* in the year *y* (g CO_2/km)
$SFC_{x,i}$	Specific fuel consumption of vehicle category *i* using fuel type *x* prior project start (g/km)
$NCV_{x,y}$	Net calorific value of fuel *x* in the year *y* (J/g)
$EF_{CO2,x,y}$	Carbon emission factor for fuel type *x* in the year *y* (g CO_2/J)
$N_{x,i}$	Number of vehicles of category *i* using fuel type *x* prior to project start (units)
N_i	Number of vehicles of category *i* prior to project start (units)
IR_i^{t+y}	Technology improvement factor for the vehicle of category *i* per year *t+y* (ratio)
i	Relevant vehicle category
x	Fuel type
t	Years of annual improvement (dependent on age of data per vehicle category)
y	Year of crediting period

The technology improvement factor (IR) is taken from the methodology and is the same 0.99, for all the vehicles types: buses, passenger cars, taxis and motorcycles.

As various sub-categories of buses exist (small, medium, and large units), the emission factor for each sub-category ($EF_{KM,L,y}$ $EF_{KM,M,y}$ $EF_{KMS,y}$) is calculated using the equation:

$$EF_{KM,B,y} = \frac{EF_{KM,L,y} \times DD_{L,y} + EF_{KM,M,y} \times DD_{M,y} + EF_{KM,S,y} \times DD_{S,y}}{DD_L + DD_M + DD_S}$$

Parameter	Description
$EF_{KM,B,y}$	Emission factor per kilometer of buses (g CO_2/km)
$EF_{KM,L/M/S,y}$	Emission factor per kilometer of buses sub – category L (large buses), M (medium buses) and S (small buses)(gCO_2/km)

$DD_{L/M/S}$	Total distance driven of buses sub-category L (large buses), M (medium sized buses) and S (small buses) prior project start (kilometer)
y	Year of crediting period

RESULTS

As per the formulas and parameters above, the following emission factors per kilometre were calculated:

Mode	**$EF_{KM,i,y}$ (g CO_2/km)**
Passenger car	164
Taxi	216
Motorcycle	58
Conventional Bus	1,109

The emission factors were divided between the average occupation rate of each vehicle category to obtain the emission factors per passenger-kilometer per vehicle category:

Mode	**$EF_{KM,i,y}$ (g CO_2/PKM)**
Passenger car	111
Taxi	328
Motorcycle	50
Conventional Bus	127

This emission factors per passenger-kilometer per vehicle category, were multiplied by the baseline trip distance (p) per surveyed passenger using mode i in the year y, obtained through the passenger survey. The data obtained was the baseline emissions per surveyed passenger, which was multiplied by their respective expansion factor, yielding an average emission factor ($grCO_2$/passenger). Finally, just multiply this final data by the number of passengers who were in the period to obtain the total baseline emissions:

Parameter	**Value**
Number of passengers in the period (passengers)	86,035,491
Average baseline emission factor ($grCO_2$/passenger)	1,164
Total baseline emissions tCO_2	**100,161**

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

Project emissions are based on the fuel consumed by the BRT buses (direct project emissions) plus emissions caused by project passengers from their trip origin to the entry station of the BRT and from the exit station of the BRT to their final destination (indirect project emissions).
Project emissions are calculated as follows:

$$PE_y = DPE_y + IPE_y$$

Parameter	**Description**
PE_y	Project emissions in the year *y* (tCO_2)
DPE_y	Direct emissions in the year *y* (tCO_2)
IPE_y	Indirect Project emissions in the year *y* (tCO_2)

For the determination of the direct project emissions the project involves fossil fuel usage, and the following formula is used:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y}$$

Parameter	Description
$PE_{FCj,y}$	Are the CO2 emission from fossil fuel combustion in process j during the year y (tCO_2/yr)
$FC_{i,j,y}$	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$COEF_{i,y}$	CO2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	fuel types combusted in process j during the year y

If the total fuel consumed is determined on sample measurements, the following equation is used:

$$FC_{PJ,x,y} = SFC_{i,x,y} \times DD_{PJ,x,y}$$

Parameter	Description
$FC_{PJ,x,y}$	Total fuel consumed by project transport units using fuel type *x* in year *y* (mass or volume units of fuel)
$SFC_{i,x,y}$	Specific fuel consumption of vehicle category *i* using fuel *x* in year *y* (mass or volume unit per kilometre)
$DD_{PJ,x,y}$	Distance driven by transport units consuming fuel *x* in year *y* (km)

RESULTS

As per the above formulas and parameters, the direct project emissions during this monitoring period are as follows:

Parameter	Value
Distance driven articulated buses (km)	7,995,352
Distance driven bi-articulated buses (km)	1,517,386
Fuel consumed (l)	7,843,435.4
Direct project emissions (tCO_{2eq})	**19,895**

The Indirect project emissions are those caused by passengers from their trip origin up to the project activity entry station, and from the project activity exit station up to the trip final destination. The survey identifies the origin, the project entry station, the project exit station and the final destination of the passenger plus the modes used between the different points, e.g. bike from origin to project entry station and taxi from project exit station to final destination. The distances between origin and entry and between exit and destination are calculated based, e.g. on public transit routes, electronic maps and GPS (identical to baseline trip determination). The emission factors per passenger-kilometer used for indirect project emissions are identical to the baseline passenger-kilometer factors ($EF_{PKM,i,y}$).

The following steps were taken:

1. A survey was conducted, in which for each surveyed passenger the trip distance per mode used to/from the BRT was determined.
2. The individual indirect project emissions were calculated for each surveyed passenger.
3. An individual expansion factor was applied to each surveyed passenger in accordance with the survey sample design (as defined in Annex 3), and summarize these to get the total indirect project emissions of the period (week) surveyed. To get the annual (or monitoring period) indirect project emissions, the indirect project emissions of the surveyed period (week) are calculated per passenger of the period (week) and multiplied by the total passengers transported during the monitoring period.

4. The lower limit of the 95% confidence interval was used to estimate the total indirect project emissions.

PROCEDURE

$$IPE_y = \frac{P_y}{P_{SPER}} \sum_p (IPE_{p,y} * FEX_{p,y}) \times 10^{-6}$$

Parameter	Description
IPE_y:	Indirect project emissions in the year y (tCO_2)
$IPE_{p,y}$	Indirect project emissions per surveyed passenger p in the year y (g CO_2)
$FEX_{p,y}$	Expansion factor for each surveyed passenger p surveyed in the year y (each surveyed passenger has a different expansion factor)
P_y	Total number of passengers in the year y
P_{SPER}	Number of passengers in the time period of the survey (1 week)
p	Surveyed passenger
y	Year of the crediting period

The indirect project emission per surveyed passenger is calculated based on the mode used, the trip distance per mode and the emission factor per mode:

$$IPE_{p,y} = \sum_i IPTD_{p,i,y} \times EF_{PKM,i,y}$$

Parameter	Description
$IPE_{p,y}$	Indirect project emissions per surveyed passenger *p* in the year *y* (g CO_2)
$IPTD_{p,i,y}$	Indirect project trip distance *p* per surveyed passenger using mode *i* in the year y (PKM)
$EF_{PKM,i,y}$	Emission factor per passenger-kilometer of mode *i* in the year *y* (gCO_2/PKM)
i	Relevant vehicle category
p	Surveyed passenger

THE RESULTS

Based on the surveyed passenger and the survey design, the corresponding expansion factors are applied to calculate total indirect project emissions. Total indirect project emissions are determined based on the upper limit of the 95% confidence interval as results are based on a sample/survey.

The same method of expansion factors is used as outlined in the baseline section.

Indirect project emissions are only included for the project passengers. Passengers transported are based on passengers entering BRT stations.

As per the formulas and parameters above, the following emission factors per kilometre were obtained:

Transport Mode	$EF_{KM,i,y}$ (g CO_2/km)
Passenger car	164
Taxi	216
Motorcycle	58
Conventional Bus	1,109

The emission factors were divided between the average occupation rate of vehicle category to obtain the emission factors per passenger-kilometer per vehicle category:

Transport Mode	$EF_{KM,i,y}$ (g CO_2/PKM)
Passenger car	111
Taxi	328
Motorcycle	50
Conventional Bus	127

This emission factors per passenger-kilometer and vehicle category, were multiplied by the indirect project trip distance (p) per surveyed passenger using mode i in the year y, obtained through the passenger survey. The data obtained was the indirect project emissions per surveyed passenger, which was multiplied by their respective expansion factor, yielding an average emission factor ($grCO_2$/passenger). Finally, just multiply this final data by the number of passengers in the reporting period to obtain the total indirect project emissions:

Parameter	Value
Number of passengers in the period (passengers)	86,035,491
Average indirect project emissions per passenger ($grCO_2$/passenger)	561
Total indirect project emissions tCO_2	**48,258**

E.3. Calculation of leakage

Leakage emissions include the following sources:

- Emissions due to changes of the load factor of taxis and buses of the baseline transport system due to the project ($LE_{LFB,y}$ and $LE_{LFT,y}$)
- Emissions due to reduced congestion on affected roads, provoking higher average vehicle speed, plus a rebound effect ($LE_{CON,y}$)
- Upstream Emissions of Gaseous Fuels ($LE_{UP,y}$)

Leakage emissions are calculated as follows:

$$LE_y = LE_{LFB,y} + LE_{LFT,y} + LE_{CON,y} + LE_{UP,y}$$

Parameter	Description
LE_y:	Leakage emissions in the year *y* (tCO_2)
$LE_{LFB,y}$	Leakage emissions due to change of load factor buses in the year *y* (tCO_2)
$LE_{LFT,y}$	Leakage emissions due to change of load factor taxis in the year *y* (tCO_2)
$LE_{CON,y}$	Leakage emissions due to reduced congestion in the year *y* (tCO_2).
$LE_{UP,y}$	Leakage emission due to upstream emission of gaseous fuel in year *y* (tCO2)

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

The project could have a negative impact on the load factor of the conventional bus fleet. Load factor changes are monitored for the entire city as the potential impact is not necessarily in the proximity of the project BRT (buses can be used in other parts of the city). The load factor of buses is monitored in the years 1, 4 and 7 of the crediting period. Leakage from load factor change of buses is only included if the load factor of buses has decreased by more than 10 percentage points comparing the monitored value with the baseline value, and are calculated as:

$$LE_{LFB,y} = \max\left\{\frac{1}{10^6} \times N_{B,y} \times AD_B \times EF_{KM,B,y} \times \left(1 - \frac{OC_{B,y}}{OC_B}\right); 0\right\}$$

Parameter	Description
$LE_{LFB,y}$	Leakage emissions due to change of load factor of buses in the year *y* (tCO_2)
$N_{B,y}$:	Number of baseline buses in the year *y* (buses)
AD_B	Average annual distance driven by baseline buses (km/bus)
$EF_{KM,B,y}$	Emission factor per kilometer for baseline buses in the year *y* (gCO_2/km)
$OC_{B,y}$	Average occupancy rate of baseline buses in the year *y* (passengers)
OC_B	Average occupancy rate of baseline buses prior to the project start (passengers)

The project could have a negative impact on the load factor of taxis. Load factor changes are monitored for the entire city as taxis operate all over the city and are not confined to deliver their services in certain areas. The load factor of taxis is monitored in the years 1, and 4 of the crediting period. This leakage is calculated as follows:

$$LE_{LFT,y} = \max\left\{\frac{1}{10^6} \times N_{T,y} \times AD_T \times EF_{KM,T,y} \times \left(1 - \frac{OC_{T,y}}{OC_T}\right); 0\right\}$$

Parameter	Description
$LE_{LFT,y}$	Leakage emissions due to change of load factor of taxis in the year *y* (tCO_2)
$N_{T,y}$:	Number of taxis in the year *y* (taxis)
AD_T	Average annual distance driven per taxi (km/taxi)
$EF_{KM,T,y}$	Emission factor per kilometer of taxis in the year *y* (gCO_2/km)
$OC_{T,y}$	Average occupancy rate of taxis in year *y* (passengers)
OC_T	Average occupancy rate of taxis prior to the project start (passengers)

The maximum load factor change attributed to taxis is the emission reductions due to passengers switching from taxis to the project (calculated by the emission factor per passenger-kilometer for taxis, the trip distance and the number of passengers transported by the project, which would have used taxis in absence of the project). This maximum condition is established as load factors might worsen citywide also due to factors external to the project and leakage from a load factor change taxis due to the project can at maximum be according to the number of passengers transported by the project which in absence of latter would have taken a taxi.
The occupancy rate of taxis is monitored through visual occupation studies counting the number of passengers (see PDD Annex 3).

The parameter emission factor per kilometer of baseline taxis in the year *y* ($EF_{KM,T,y}$) is calculated using the equation for $EF_{KM,i,y}$ presented in the baseline emissions section, substituting *i* for T (taxis).

For the determination of emissions due reduced congestion ($LE_{CON,y}$), no moving speed change is expected since the project does not lead to a reduction of road capacity available for individual motorised transport modes, thus monitoring of this parameter is not required,

Upstream of gaseous fuels ($LE_{UP,y}$) shall be only included if the project vehicles consume more gaseous fuels than baseline vehicles. Since the project vehicles consume diesel, which a liquid fuel, upstream emissions from gaseous fuels are not considered.

RESULTS

Following the formulas and parameters the following values of leakage emissions were calculated:

The resulting average occupancy rate of baseline buses in the monitoring period is 17% and the average occupancy rate of baseline buses prior to the project start is 12.03%. Since this rate does not decrease more than 10 percent, leakage emissions due to changing load factor baseline buses are not calculated.

Parameter	Value
Leakage emissions due to changing load factor baseline buses	0
Leakage emissions due to changing load factor taxis	-571,943
Leakage emissions (tCO_{2eq})	**0**

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	100,161	68,153	0	32,008

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)	58,965 t CO_{2eq} (Estimated number reported in the PDD)*	32,008 t CO_{2eq} (Calculated number for the study period)

**58,965 t CO_{2eq} = 19,748 tCO_{2eq} in 2012 + ((47,087/365)*304) 39,218 tCO_{2eq} in 2013*

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

>> The ERs estimated in the PDD for the period 1/1/2013 to 31/10/2013 are slightly higher (39,218 tCO_{2eq}) than the actual values achieved (32,008 tCO_{2eq}).

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)	0	32,008

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
Organization name	Metrobús
Street/P.O. Box	Av. Cuauhtémoc N. 16, 5 piso, Col. Doctores, Deleg. Cuauhtémoc
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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.
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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