Assessment Report

Insurgentes Avenue Bus Rapid Transit Pilot Project
Mexico City, Mexico

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Contract No. 716201

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1. Introduction

This report is provided to The World Bank as a deliverable of the assessment of greenhouse gas (GHG) emission reductions for the Insurgentes Avenue Bus Rapid Transit (BRT) Pilot Project (the "BRT Project") located in Mexico City, Mexico. The project was implemented and it is managed by Metrobus, a decentralized public entity within the Secretary of Transport of the City of Mexico. The World Bank is listed in the PDD as a project participant and supported Metrobus in the monitoring and reporting activities, including collecting data and information required for this GHG emission reductions assessment.

The project activity consists of a 19.06 km corridor with exclusive bus lanes, fuel-efficient high capacity buses, and other improvements to increase efficiency and reduce fuel consumption of vehicles within the project boundary, resulting in a net reduction of GHG emissions. The BRT Project corridor runs along Insurgentes Avenue starting at Indios Verdes in the north and ending in Doctor Galvez, Rectoria in the south.

The monitoring methodology, CDM Proposed New Methodology: Monitoring (CDM-NMM) – "GHG emission reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed," stipulates the procedure for the overall quantification of emission reductions resulting from the project through the identification of discrete emissions changes and leakage "components." As outlined in the NMM, overall net project emission reductions are comprised of 23 distinct Components: numbers 1 through 5 are project emission reductions (reductions in GHG emissions to the atmosphere directly caused by project implementation); Component numbers 6 through 11 are project emission increases (increases in emissions into the atmosphere directly caused by project implementation); and Project Leakages 1 – 12 are emission leakages (increases in project emissions that are indirectly caused by project implementation). Table 1 below contains details of each component.

The baseline methodology, CDM Proposed New Methodology: Baseline (CDM-NMB) - "GHG emissions reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed" includes the methodology to calculate the dynamic baseline of vehicle population that would have existed on the BRT Project. The baseline methodology prescribes the procedure to calculate the vehicle population and associated emissions that would have existed in the absence of the BRT Project, as a result of vehicle replacements and technology improvements. The methodology is used in the calculation of Baseline Component 1 (dynamic) "Operating condition improvements and/or the substitution of the number and technology of buses that operate on the main route or BRT corridor."

TABLE 1: NMM Methodology Emission Components and Leakages

	Component Number	Concept
Emissions Reductions	1	Operating condition improvements and/or the substitution of the number and technology of buses that operate on the main route or BRT corridor
	2	Improving the operating conditions for other vehicles operating on the main route
	3	Operating condition improvements and/or the substitution of the number and technology of buses that operate on feeder routes.
	4	Improving the operating conditions for other vehicles operating on the feeder routes
	5	Modal shift from cars on the route to buses
Emissions Increases	6	Extra buses required due to Modal shift from cars, Metro or other more-fuel-efficient-transport to buses on the BRT corridor plus rebound and new trip creation on the buses
	7	Elimination of left turns on the route or BRT corridor generates increased travel time and distance for those vehicles that now have to go-round-the-block
	8	Longer distance required for vehicles to cross the corridor due to the elimination of crossing points in the with-project case.
	9	Longer time required for vehicles to cross the route or BRT corridor due to traffic signal timing altered giving priority to buses
	10	Increase in fuel consumption during construction due to traffic delays on all vehicles that use the route
	11	Greenhouse gas emissions due to construction activities of the project and energy used to produce the construction materials
Leakgages	Leakage 1	Greenhouse gas emissions generated whilst smelting the old vehicles removed from service
	Leakage 2	Transferring buses to the project activity that were previously in service on a different route
	Leakage 3	Buses displaced by the project activity are not scrapped
		Buses outside boundary are scrapped
	Leakage 4	Buses have to dead-head to reach their route
	Leakage 5	Competing buses on alternative routes
	Leakage 6	Project activity causes modal shift away from the buses
	Leakage 7	Shift from other forms of transport (outside the project boundary) to the buses
	Leakage 8	Additional delay to cross the main route for other traffic is so great that it affects several blocks either side of the main route.
	Leakage 9	Prohibition of left turns, the elimination of crossing-points or other factors force vehicles to change to alternative routes
	Leakage 10	Feeder route improvements adversely affect traffic flow on their cross-streets
	Leakage 11	Other vehicles that previously used routes outside the project boundary transfer to the main route
	Leakage 12	Project activity fuel-use or fuel-handling enhances pilfering or evaporative emissions

Metrobus prepared a “Reporte de Reduccion de Emisiones” (Emission Reduction Report, ERR) covering the November 1, 2011 – October 31, 2012 reporting period. This is the seventh reporting period for the BRT Project. As was the case for previous monitoring periods, while for the most part the NMM monitoring methodology guided the development of the ERR[1], a number of deviations from the NMM were nonetheless identified. Metrobus justified the deviations as

[1] The Emission Reduction Report also relied on the non-validated PDD, the Spanish Carbon Fund Monitoring Guidelines, and Metrobus procedures as guidance documents used in the preparation of the reports. However, these were not included in the established Criteria; therefore, are excluded from this assessment as Criteria documents.

required by the specific design of the BRT Project, where some of the Components outlined in the NMM are not relevant or not applicable to the BRT Project.

Because the project monitoring and reporting procedure incorporated deviations from the NMM and the Project has not obtained the CDM validation, the possibility to execute a verification following CDM guidelines on materiality and assurance was excluded. Therefore, a best practice analysis and evaluation approach was applied, including consideration of elements contained in ISO-14064-3: 2006 such as the definition of limited assurance. Hence, First Environment's approach to the assessment of emission reductions claimed in the ERR[2] is to evaluate, to a limited assurance, that emission reductions are not overstated. For this reason, First Environment will hereafter refer to this report as an assessment rather than verification.

2. Objectives

The purpose of this assessment was, through review of appropriate evidence, to:

- Provide limited assurance that the emission reduction assertions made in relevant monitoring reports are real and are not overstated by using the Monitoring Methodology NMM and Baseline Methodology NMB as a general framework.

The goal for this project is to obtain a limited level of assurance as defined by International Standard ISO 14064 - *Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions.*[3]

3. Assessment Scope

Specific scope metrics for the assessment are outlined in the table below:

Project Location	Mexico City, Mexico
Geographic Boundaries	The "Insurgentes BRT Corridor" in Mexico City – 19.06 km of Insurgentes Avenue starting at Indios Verdes in the north and ending in Doctor Galvez, Rectoria in the south.
Greenhouse Gases Included	GHG emission reductions (expressed in units of Carbon Dioxide equivalents (CO_2e)) resulting from the implementation of a Bus Rapid Transit project on the Insurgentes Corridor. GHG included are CO_2, CH_4, and N_2O.
Reporting Periods	The assessment covers the following reporting period: November 1st, 2011 – October 31st, 2012
Source of Emission Reduction Assertions	Reporte de Reducción de Emisiones - Reducción de Emisiones de Gases de Efecto Invernadero por el septimo año de operación del Corredor Metrobús insurgentes. Ex-post calculation workbooks for the reporting period.

[2] As discussed and agreed upon with The World Bank on October 30, 2013.
[3] While the definition of "limited assurance" is defined in International Standard ISO 14064-3, the full standard was not used as Criteria for this assessment.

4. Standards Used to Assess Emission Reductions (Criteria)

The following table outlines the guidance and protocols used to conduct this assessment:

Standard of Assessment	• Baseline: CDM Proposed New Methodology: Baseline (CDM-NMB) - "GHG emissions reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed." Document version 1.7; 5-Jan-2006 • Monitoring: CDM Proposed New Methodology: Monitoring (CDM-NMM) - "GHG emission reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed." Document version 1.7; 5-Jan-2006
Assessment Process	• Use and consideration of best practices and guidance documents as deemed necessary.
Level of Assurance	Limited Assurance
Materiality	Overstatements greater than five percent of the project's total GHG emission reduction assertion are considered material

The Project Design Document *"Mexico, Insurgentes Avenue Bus Rapid Transit Pilot Project"* Version: 1.7, January 4, 2006 (PDD) is not used as Criteria for this assessment. However, the PDD was used as a source of Project data and information where deemed useful.

5. Overview of the Assessment Process

To review the Project's GHG information, the following assessment process was used:

- conflict of interest review;
- selection of Assessment Team;
- initial interaction with The World Bank contacts;
- review of Metrobus' seventh "Reporte de Reduccion de Emisiones" (ERR);
- development of the Assessment Plan;
- overall review and evaluation of raw data, calculations procedures, and GHG reported emission reductions under review;
- follow-up interaction with The World Bank contacts for clarifications, corrective actions, or supplemental data requests as needed; and
- final statement and report development.

The assessment process was utilized to gain an understanding of the Project's emission sources and reductions (including the risk for leakage), to evaluate the collection and management of data, calculations that lead to the results, and the means for reporting the associated data and results. Based on the level of information provided by Metrobus and The World Bank during this assessment and information gathered by First Environment during the 2009 site visit, no additional visit was deemed necessary by First Environment.

5.1 Conflict of Interest Review

Prior to beginning any assessment project, First Environment conducts an evaluation to identify any potential conflicts of interest associated with the Project. No potential conflicts were found for this Project.

5.2 Audit Team

First Environment's Audit Team consisted of the following individuals who were selected based on their auditing experience, as well as familiarity with the assessment process for greenhouse gas emission reduction projects.

- Project Manager - Luca Nencetti, Ing.
- Lead Assessor - John Mosheim, P.E., CEM
- Senior Oversight - Jay Wintergreen
- Internal Reviewer - Michael Carim

5.3 Project Kick-off

The project was initiated on October 30, 2013 with a kick-off conference call between members of the First Environment team and the The World Bank. Meeting attendees included:

The World Bank
Patricia Marcos Huidobro, Carbon Finance Specialist

First Environment, Inc.
Project Manager - Luca Nencetti, Ing.
Lead Assessor - John Mosheim, P.E., CEM

The kickoff meeting discussions confirmed the scope, process, team members, and tentative schedule for the assessment. For discussion and review purposes, First Environment provided a preliminary version of the Assessment Plan v.0 prior to the kickoff meeting to Ms. Huidobro.

5.4 Development of the Assessment Plan

An initial Assessment Plan was sent to World Bank on October 30, 2013. As in the previous reporting period, elements of the NMM were not strictly followed due to difficulties associated with data monitoring and exclusions resulting from BRT Project specific conditions. This issue was discussed during the October 30, 2013 kickoff call between The World Bank and First Environment and agreed upon by both parties to proceed with a limited assurance assessment of the GHG assertion.

An assessment (as opposed to a verification) provides more flexibility in the use of professional judgment to determine whether, taking into account all elements of the project and methodology deviations, the emission reduction assertions provided in the ERR are *not overstated*.

The Assessment Plan was revised to Version 1 after the kickoff call on October 31, 2013. The Assessment Plan specifies assessment to a "limited" level of assurance as defined by International Standard ISO 14064 - *Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions*.

5.5 Project Status

In response to First Environment's inquiry regarding Project and monitoring changes, Metrobus confirmed that no significant changes (operational, ownership, etc.) had occurred since the last assessment[4]. First Environment also reviewed the findings from the assessment of the prior reporting period and other relevant documentation to support the current assessment project. The results are presented in Section 6 of this report.

5.6 Emission Reduction Data and Calculation Assessment

This assessment used a best practice analysis and evaluation approach to evaluate the monitored data and reported emission reductions, and identify if it contained material overstatements. Specifically, First Environment reviewed data collection systems and procedures, monitored data and supporting reports including the emission reduction calculation spreadsheets with all applicable emission factors, constants, and variables.

5.7 Corrective Actions and Supplemental Information

The team requested supplemental information to support emissions calculations and to confirm how the raw data was processed in the emission reduction calculations. Supplemental information requests were conducted both informally by email and phone and through official Clarification and Corrective Action Requests.

Several clarification and corrective action requests were submitted to The World Bank by the audit team during the assessment. A detailed list of the clarification and corrective action requests and a brief summary of the resolutions is attached in Appendix A.

Where First Environment received responses that did not completely satisfy the nature of the request, it applied professional judgment and determined if these would or would not have a material impact on the assessment opinion and proceeded accordingly.

While the Audit Team found deviations in the ERR from the Criteria, specifically the NMM, qualitatively none of these deviations were significantly different from the deviations identified during the assessment of the previous reporting period.

5.8 Assessment Reporting

Assessment reporting, represented by this document, records the assessment process and identifies its findings and results. Assessment reporting consists of this report and it is delivered to The World Bank.

6. Project Conformance with Assessment Criteria

6.1 Project Overview

The "Insurgentes BRT Corridor" was implemented along 19.06 km of the 34 km of Insurgentes Avenue, starting in Indios Verdes in the north and ending in Doctor Galvez, Rectoria in the south in Mexico City, Mexico. The project began operating on June 19, 2005.

[4] Sampling Plan_BRT Insurgentes Mexico_GGM_041213.doc

The pilot BRT system was built using the center two lanes and medians and includes 34 stations distributed approximately 550 meters apart along a 19.06 kilometer stretch of Insurgentes Avenue. Initially, 80 new diesel fuel high-capacity articulated autobuses replaced a fleet of around 350 existing buses and microbuses within the boundary of the Insurgentes Avenue project. Distances traveled by the BRT Project buses experienced a steady increase between 2006 and 2012, which is indicative of an increase of number of trips and ridership.[5]

Messrs. John Mosheim and Bob Previdi visited Mexico City on October 20 to 21, 2009, during the assessment of the prior reporting period, to confirm and document the basic physical elements of the BRT system as stated in the Project Design Document (PDD) and the NMM.

The World Bank provided First Environment with a copy of the "Spanish Carbon Fund Clean Development Mechanism Emission Reductions Purchase Agreement" (ERPA) dated October 31, 2005 and its amendment of April 25, 2007. During the course of this assessment, First Environment did not attempt to determine the legal validity of this document nor the ownership rights of Metrobus to the emission reductions claimed in the assertions.

6.2 Data Collection and Monitoring Processes

First Environment examined the data and information provided by The World Bank regarding the Project's operation for the reporting period subject to this assessment, beginning November 1, 2011 until October 31, 2012. The information was provided in the form of ERR, operational data reports, management and technical reports, fuel consumption reports, and passenger survey summary reports and data, and other supporting documents. First Environment inquired about several aspects of the data collection and management and Project information provided by Metrobus. In particular, the Audit team requested samples of raw data to the degree such data was available given the automated nature of some of the passenger and bus operation data collection. The evidence provided, and the results of the site visit conducted in the previous monitoring period, confirm that there is no indication that Metrobus does not have adequate data collection and monitoring procedures to consistently support the data and information required to generate the seventh ERR.

As mentioned previously, during the data and information evaluation performed by First Environment, several deviations from the NMM were identified. Specifically, a number of Components and Leakages were not monitored in accordance with the NMM or were excluded from the monitoring activity, as detailed further in Section 6.2.2.

6.2.1 Component and Leakage Monitoring

As in the previous reporting period, Metrobus provided justifications and explanations as to why certain Project Components and Leakages were not monitored in accordance to NMM. The components and leakages not monitored during the November 1, 2011 – October 31, 2012 reporting period do not differ from the ones not monitored during the previous monitoring period. The list of Component and Leakage elements that were applicable and monitored by Metrobus is provided in the table below. Details of the assessment of each emission Component and Leakage are provided in Section 6.2.2.

[5] Page 28-29 of the 2011-2012 ERR

Component/ Leakage	Applicable to Project	Component Activity	Vehicles Affected
C1	Yes	Vehicles on each main route within the project boundary (Main routes can substantially modify traffic behavior on intersecting streets)	Buses (fuel consumption measured directly)
C2	Yes		All vehicles except buses (fuel consumption change determined from difference in travel time)
C5	Yes	Modal shift to buses from private cars and other forms of transport	Reduction in use of private cars
C6	Yes		Increased bus service to cover extra demand
L4	Yes	Buses have to dead-head to reach route	Buses

During the course of this assessment no evidence was discovered or reviewed that would indicate that the deviations from the NMM, NMB, or emission calculations discrepancies result in material overstatements (over 5 percent) of emission reductions.

6.2.2 Assessment of Monitoring Components and Leakages

A description of deviations from the NMM and quantitative discrepancies with respect to monitoring of each Component and Leakage follows.

Component Number 1 - Baseline (Dynamic): Operating condition improvements and/or the substitution of the number and technology of buses that operate on the main route or BRT corridor.

Discussion: The baseline Component determines the GHG emissions of the buses, minibuses, and microbuses that would have been in operation if the Project had not been implemented.

Initial baseline data were provided by the original baseline study report[6] published in 2006. Vehicle technical data are subsequently adjusted based on improved technology and specifications.

The baseline calculation procedures followed the guidelines of the NMM, and no significant miscalculations were found by First Environment when recalculating the vehicle replacement and fuel consumption.

Certain assumptions were made by Metrobus to simplify the determination of the baseline:

- Km/day driven by diesel buses were calculated as weighted average of weekdays and weekend km/day travelled.
- Fuel consumption for CNG vehicles was assumed the same as LPG vehicles.

[6] "Medidas de linea base para el corredor Insurgentes, Ciudad de Mexico", SENES Ltd, March 2006.

A zero (0) baseline vehicle growth along the Insurgentes corridor assumption was not reported transparently in the ERR. This is a conservative assumption, (NOVRn = NOVR0) resulting in reducing the baseline emission and therefore the overall GHG emission reduction.

The resulting baseline GHG emissions reported by Metrobus are 27,702 metric tonnes of CO_2e.

Conclusion: No evidence reviewed in the course of the assessment indicates that calculation results of Component 1 - Baseline are an overstatement of emissions for this component.

Component Number 1 - Project: Operating condition improvements and/or the substitution of the number and technology of buses that operate on the main route or BRT corridor.

Discussion: As it was verified during the site visit performed for the previous monitoring period, fuel consumption per hour for each bus is measured by monitoring six fuel injectors and utilizing algorithms to translate this information into volume of diesel fuel used by each bus. Distance traveled by bus is also logged electronically for each bus. These two numbers (fuel use and odometer readings) are used to obtain the fuel economy per bus in km/l (FEN). Bus data is downloaded periodically during the course of the year. During the previous monitoring period, Metrobus provided information indicating that it periodically monitors the fuel economy reported by the bus operations to verify that FEN falls within a pre-established acceptance interval.

The average number of buses operating (NNVAn) in the Project during the monitoring period was calculated by Metrobus based on operation records. As a conservative approach, the number of buses (110) was estimated from the number of buses in operation during the weekdays, excluding weekends and holidays.

The resulting Component 1 GHG project emissions reported by Metrobus are 21,726 metric tonnes of CO_2e.

Conclusion: No evidence reviewed in the course of the assessment indicates that the reported information results in an overstatement of emission reductions for this component.

Component Number 2: Improving the operating conditions for other vehicles operating on the main route.

Discussion: Emission reductions for this component were omitted. The ERR states that this omission was caused by monitoring difficulties resulting from Metro's line 12 construction activities and its impact in private vehicle's traffic flow and travel times. This is a deviation from the NMM. The same omission was identified during the assessment of the prior reporting period and resolved satisfactorily as a conservative deviation. The emission reductions that could be attributed to Component Number 2 were calculated ex-ante in the PDD and amounted to about 10,890 metric tonnes of CO_2e.[7]

[7] Based on ex-ante calculation results described on page 90 of PDD.

Conclusion: As this component accounts for emission reductions, implicitly reporting a value of zero (0) is a conservative deviation. No evidence reviewed in the course of the assessment indicates that zero is an overstatement of emission reductions for this component.

Component Number 3: Operating condition improvements and/or the substitution of the number and technology of buses that operate on feeder routes[8].

Discussion: This component was not monitored or reported and therefore is reported as zero. The exclusion is justified by the fact that the Project does not operate buses on routes feeding the Insurgentes Corridor.[9] The same Component exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed for the current monitoring period and that this Component is still not applicable to the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Component Number 4: Improving the operating conditions for other vehicles operating on the feeder routes.[10]

Discussion: This component was not monitored or reported and therefore is reported as zero. The exclusion is justified by the fact that the no feeder routes were defined within the Project activity; therefore, it does not affect the operating conditions of other vehicles operating on such routes.[11] The same Component exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed for the current monitoring period since then and that this component is still not applicable to the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Component Number 5: Modal shift from cars on the route to buses.

Discussion: For the determination of Component Number 5, Metrobus made a series of conservative assumptions on order to simplify the calculation and the data collection.

1) AKAVn (annual kilometers per vehicle avoided by private vehicles whose users switched to mass transit in year n) was not monitored in accordance with the NMM. The NMM states that the data for this variable is determined each reporting period from on-board rider-ship surveys. However, for the calculation of GHG emissions for this component, the default value 19.06 km/day was used for the AKAVn. The same deviation was identified during the assessment of the prior reporting period. In response to inquiries regarding this deviation from the NMM, Metrobus provided information justifying that the

[8] Ex-ante PDD value for Component Number 3 is zero.
[9] The PDD page 54 states that Feeder Routes are not included in the Insurgentes BRT corridor project, thus this Component does not apply to the Project.
[10] Ex-ante PDD value for Component Number 4 is zero.
[11] The PDD page 55 states that Feeder Routes are not included in the Insurgentes BRT corridor project, thus this Component does not apply to the Project.

ex-ante value of 19.06 km is a conservative assumption. First Environment reviewed the information provided by Metrobus and found it acceptable. The justification is attached to this report (Appendix B).

2) VFCUn, (vehicle fuel efficiency in km/l in year "n") is based on information from a traffic study[12] on efficiency of vehicles traveling on Insurgentes Avenue. The value adopted (9.98 km/l) is a conservative assumption since it assumes the best traffic conditions (highest fuel efficiency) for those vehicles whose owners opt for modal shift to Insurgentes public transportation; therefore, such an assumption reduces the emission reductions achieved by the project.

3) NPSVn (number of people shifting from private vehicles to mass-transit): the World Bank clarified that two separate passenger surveys were conducted during 2012. One was conducted by Metrobus as part of their internal reporting and quality system, and the second was conducted by a third party. Since the results of the surveys were higher (24 percent modal shift) than historical trends, it was decided to use data from the 2010-11 monitoring period (16.2 percent modal shift).

4) APPVn (average number of people per private vehicle). The value of 1.62 passengers per vehicle was determined from a "visual" study conducted by a third party at strategic points of the Corridor in 2010. The value is determined as the average value between working and non-working days over a 19- day period. The inclusion of weekend days in the survey makes it more representative of the actual traffic conditions. In addition, the fewer vehicles traveling on weekends contribute to increasing the value of APPVn, thus reducing the emission reduction claimed under this Component.

Conclusion: No evidence reviewed in the course of the assessment indicates that the deviations resulted in an overstatement of emission reductions. Therefore, using professional judgment, the audit team, on the basis of the information made available by Metrobus, can provide limited assurance that these deviations do not result in an overstatement of emission reductions.

Component Number 6: Extra buses required due to Modal shift from cars, Metro, or other more-fuel-efficient-transport to buses on the BRT corridor plus rebound and new trip creation on the buses.

Discussion: During the course of the assessment, the audit team raised clarification requests regarding the determination of the parameters required to calculate the additional GHG emissions related to Component 6. Metrobus resolved the issues raised by the audit team by adopting a conservative approach to the determination of the parameters.

1) ANNBn (Annualized average number of new buses in service in year "n"). This parameter effectively coincides with NNVAn at Component 1 - Project. As explained, the parameter calculated by Metrobus is based on operation records. As a conservative approach, the parameter estimated into account only the number of buses in operation

[12] Escenarios de consumo de energía y emisiones de gases de efecto invernadero del transporte de pasajeros de las zonas metropolitanas de Monterrey y Guadalajara, UNAM (2009)

during the weekdays, excluding weekends and holidays, when Metrobus operates with a reduced fleet.

2) Rebound effect (Mmn+Nn): Surveys were conducted for the first three years of the project activity; Metrobus then elected to use an assumed value for the calculation. The justification is that the rebound effect due to passengers shifting from other less polluting mean of transportation and new passengers is not effectively verifiable from surveys after a few years of operation. As additional conservative measure, for this monitoring period Metrobus has increased the assumed value to 10.5 percent from 8 percent used in the past three years.

The calculated additional number of buses required to transport the passengers due to the rebound effect is 29, generating additional 5,728 t CO_2e emissions.

Conclusion: No evidence reviewed in the course of the assessment indicates that the assumptions made for the determination of Component 6 resulted in an overstatement of emission reductions. Therefore, using professional judgment, the Audit Team, on the basis of the information made available by Metrobus, can provide limited assurance that this deviation does not result in an overstatement of emission reductions

Component Number 7: Elimination of left turns on the route or BRT corridor generates increased travel time and distance for those vehicles that now have to go-round-the-block.

Discussion: Emission reductions for this component were not reported. Metrobus explained the exclusion stating that the impact of a specific change (i.e., implementation of the Corridor) in the traffic patterns occurs when that change is being implemented. Therefore, since the corridor was implemented more than seven years ago, it can be assumed that the operation has been normalized; thus, the elimination of left turns does not have any impact on the traffic patterns anymore. The same discrepancy was identified, analyzed, and resolved during the assessment of the prior reporting period. Ex-ante calculations of emission increases from Component 7 in the PDD were in the range of 800 metric tonnes CO_2e[13], or 1.9 percent of the total emission reduction for the current monitoring period.

Conclusion: The amount of emissions estimated ex-ante in the PDD for this Component were a small fraction of the total emission reductions and a small fraction of the GHG emission reduction excluded for Component 7. Based on professional judgment and the review of relevant information, the Audit Team determined, with a limited level of assurance, that the exclusion of emissions of Component 7 is acceptable and does not result in a material overstatement of emission reductions.

Component Number 8: Longer distance required for vehicles to cross the corridor due to the elimination of crossing points in the with-project case.[14]

[13] PDD, page 92: the ex-ante emissions estimate for this component at the lower 95 percent confidence level is 812 MTCO2e/year.
[14] Ex-ante PDD value for Component Number 8 is Zero.

Discussion: This component was not monitored or reported and therefore is reported as zero . The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this component does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Component Number 9: Longer time required for vehicles to cross the route or BRT corridor due to traffic signal timing altered giving priority to buses.

Discussion: This component was not monitored or reported and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. During First Environment's 2009 site visit, Metrobus stated that traffic signal timing had not been changed as a result of the Project; therefore, there were no emissions resulting from this component. Metrobus has stated that Project conditions have not changed and that this component does not affect the Project.

Conclusion: No evidence discovered or reviewed in the course of the assessment contradicts the reported information.

Component Number 10: Increase in fuel consumption during construction due to traffic delays on all vehicles that use the route.

Discussion: Not applicable. This component applied to the construction stage of the Project.

Component Number 11: Greenhouse gas emissions due to construction activities of the project and energy used to produce the construction materials.

Discussion: Not applicable. This component applied to the construction stage of the Project.

Leakage 1: Greenhouse gas emissions generated whilst smelting the old vehicles removed from service.

Discussion: Not Applicable. This one time only leakage was accounted for and addressed satisfactorily during the assessment of the prior reporting period.

Leakage 2: Transferring buses to the project activity that were previously in service on a different route.[15]

Discussion: This leakage was not monitored or reported and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence discovered or reviewed in the course of the assessment contradicts the reported information.

[15] Ex-ante PDD value for Leakage 2 is Zero.

Leakage 3: Buses displaced by the project activity are not scrapped. Buses outside boundary are scrapped.[16]

Discussion: This leakage was not monitored or reported and therefore is indirectly reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence discovered or reviewed in the course of the assessment contradicts the information provided by The World Bank.

Leakage 4: Buses have to dead-head to reach their route.

Discussion: This leakage is included in the Project, and the additional distance and emissions involved are included in Component Number 1[17] as part of the BRT buses' kilometers travelled. Therefore Leakage 4 is not explicitly quantified in the ERR. Metrobus indicated that Leakage Number 4 is based on fixed distance allocations given to the bus operators and by accounting for the number of buses that stay in each garage and where they begin their route; as opposed to odometer readings. There is no detailed description of explanation for this approach in the ERR; however, the Audit Team considered this monitoring deviation from the NMM acceptable. The same quantification approach has been applied for the prior reporting period and deemed acceptable during the previous assessments.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 5: Competing buses on alternative routes.[18]

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 6: Project activity causes modal shift away from the buses.[19]

Discussion: This leakage was not monitored and therefore is reported as zero. According to information contained in the ERR and supporting documents provided by Metrobus, there is evidence of a modal shift *towards* the Project for all reporting periods.

[16] Ex-ante PDD value for Leakage 3 is Zero.
[17] Consistent with page 59 of PDD.
[18] Ex-ante PDD value for Leakage 5 is Zero.
[19] Ex-ante PDD value for Leakage 6 is Zero.

The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 7: Shift from other forms of transport (outside the project boundary) to the buses.[20]

Discussion: This leakage was not monitored and therefore is indirectly reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 8:[21] Additional delay to cross the main route for other traffic is so great that it affects several blocks either side of the main route.

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 9:[22] Prohibition of left turns, the elimination of crossing-points, or other factors force vehicles to change to alternative routes.

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 10:[23] Feeder route improvements adversely affect traffic flow on their cross streets.

[20] According to page 59 of the PDD this leakage is automatically included in Components 5 and 6.
[21] The PDD page 96 states that this leakage is automatically included in in the Project activity calculations.
[22] The PDD page 96 states that this leakage is automatically included in in the Project activity calculations.
[23] The PDD page 81 states that Feeder Routes are not included in the Insurgentes BRT corridor project thus this leakage does not apply to the Project. Therefore, no emissions are associated with Leakage 10.

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 11:[24] Other vehicles that previously used routes outside the project boundary transfer to the main route.

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

Leakage 12: Project activity fuel-use or fuel-handling enhances pilfering or evaporative emissions.[25]

Discussion: This leakage was not monitored and therefore is reported as zero. The same exclusion was identified, analyzed, and accepted during the assessment of the prior reporting period. Metrobus has stated that Project conditions have not changed since and that this leakage does not affect the Project.

Conclusion: No evidence reviewed in the course of the assessment contradicts the reported information.

6.2.3 Sampling Optimization

Sampling optimization was not performed as part of the Project. During the 2009 site visit, Metrobus indicated that sampling optimization would not be performed beyond the first reporting period. This is a deviation from the NMM. However, this deviation was also identified during the assessment of the prior reporting period and was considered acceptable.

6.3 Emission Reduction Calculation Assessment

As part of the emission reduction calculation assessment, the Audit team reviewed all the assumptions and sampled the relevant supporting data and calculations applied to determine the emission reductions generated by the Project during the November 1, 2011 – October 31, 2012 reporting period.

During the assessment of the emissions reduction quantification, the Audit Team sampled activity data and parameters applied in the calculations and confirmed that they were consistent with the evidence provided. A risk-based approach was used for the sampling plan, focusing on

[24] The PDD page 97 states that this leakage is automatically included in the Project activity calculations.
[25] PDD shows an ex-ante null value for Leakage 12. During the 2009 site visit Metrobus stated that this Leakage is very small and is not applicable to the Project, the PDD states the same.

Components and Leakages that had the highest risk of producing significant errors in the reported emission reductions. Similarly, the Audit Team applied a risk-based sampling approach to assess the consistency between the formulas applied in the calculations and the NMM. The calculation errors discovered during the assessment period were corrected appropriately, excluding the occurrence of material overstatement of emission reductions.

First Environment can confirm, with limited assurance, that the emission reductions totals for the November 1, 2011 – October 31, 2012 Emission Reductions Report provided by Metrobus for the Project are free of material overstatement.

7. Assessment Conclusion

First Environment was retained to provide assessment services for the Project's GHG emission reduction assertions based on the following fundamentals:

- *Level of assurance:* Limited assurance.
- *Assessment criteria:*

  Baseline: CDM Proposed New Methodology: Baseline (CDM-NMB) - "GHG emissions reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed." Document version 1.7, 5-Jan-2006 (NMB).

  Monitoring: CDM Proposed New Methodology: Monitoring (CDM-NMM) – "GHG emission reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed." Document version 1.7, 5-Jan-2006 (NMM).
- *Objectives of assessment:* Using the NMM and NMB as a general framework, provide limited assurance that the emission reduction assertions made in relevant monitoring reports are real and are not overstated.
- *Definition of materiality:* Overstatements of more than five percent of the GHG reduction assertion are considered material.
- *Scope, including:*
  - *Boundaries of the assertion:* The "Insurgentes BRT Corridor" in Mexico City – 19.06 km of Insurgentes Avenue starting at Indios Verdes in the north and ending in Doctor Galvez, Rectoria in the South.
  - *Source of emission reductions assertion:* Reporte de Reducción de Emisiones - Reducción de Emisiones de Gases de Efecto Invernadero por el septimo año de operación del Corredor Metrobús insurgentes.

    Ex-post calculation workbooks for the reporting period.
  - *GHG Sources, Sinks Reservoirs (SSRs):* The building of a corridor with exclusive bus lanes, the introduction of more fuel efficient high capacity buses, modal shift from private vehicles to Metrobus buses, and other improvements to increase efficiency and reduce fuel consumption of vehicles.

- *The greenhouse gases included in the emission reduction calculations are:*
  - *Carbon Dioxide - CO2;*
  - *Methane - CH4;*
  - *Nitrous Oxide - N2O.*

- *Assertion Period:* November 1, 2011 – October 31, 2012.

Based on the assessments performed and the historical evidence collected, First Environment concludes, with a limited level of assurance, that with respect to the GHG assertions reported below, as contained in the ERR provided by Metrobus:

- no evidence reviewed indicated that the assertions are not real;
- no evidence reviewed indicated that the assertions are overstated; and
- no evidence reviewed indicated that the assertions are not calculated in consistency with the general framework established by the Project's NMM and NMB.

Reporting Period: November 1, 2011 – October 31, 2012	
Mean Emission reductions (tCO_2e)	**41,968**
Lower 95th Confidence Interval Emission reductions (tCO_2e)	**35,210**

8. Assessor Signatures

John Mosheim
Senior Engineer, P.E., CEM

APPENDIX A

Appendix A

ID	Corrective Action Request	Response	Assessment Conclusion
CAR#1	Values in Cuadro 2 for “dia habil” are incorrect and inconsistent with average values (promedio) calculated in the same table.	Metrobus provided revised calculations and updated monitoring report.	Response is acceptable
CAR#2	The Component 2 section of the Monitoring Report should include a more clear justification of the reasons not accounting for such Component and why such approach would be more conservative.	Metrobus explained that the construction of metro line #12 has affected the traffic patterns in the Corridor area, making monitoring more uncertain. While emission reductions were being generated, Metrobus decided that, in order to be conservative, this Component will be excluded this monitored period.	Response is acceptable
CAR#3	Component 5, NPSVn parameter; please correct or justify the following inconsistencies: a. The Nov 2011 Cambio Modal reported in "Metrobus Reporte Opinion de Usuarios, 02 Marzo 2012" shows a cambio modal of 16.3%, instead of the 16.2% used in the Reporte de Reduccion de Emissiones. b. The same 02 Marzo 2012 report indicates a Cambio Modal for Enero 2012 of 19.71%, and no 24% modal shift change was found in this report.	PP clarified that two different types of surveys were conducted during 2012. The “"Metrobus Reporte Opinion de Usuarios, 02 Marzo 2012", which was conducted by Metrobus as part of their internal reporting and quality system, and the surveys conducted by a third party, i.e. ISA – Investigaciones Sociales Aplicadas. The results of the ISA surveys were higher than historical trends and it was decided to use data (16.2 % modal shift) from the previous period Opina survey 2011 (CTS_Metrobús2011_Tablas.pdf).	Response is acceptable
CAR#4	Please provide supporting evidence for the APPVn value of 1.62 personas por vehiculo indicated in the Monitoring Report.	Metrobus provided appropriate reference for the source of APPVn value.	Response is acceptable

ID	Corrective Action Request	Response	Assessment Conclusion
CAR#5	Please provide an explanation why Component 7 - Elimination of left turns on main routes - does not apply to the project and/or why it was not monitored.	Metrobus responded that the impact of a specific change (i.e. implementation of the corridor) in the traffic patterns occurs when that change is being implemented. Therefore, since the corridor was implemented more than 7 years ago, it is assumed that the operation has been normalized, and thus the elimination of left turns does not have any impact on the traffic patterns anymore.	Response is acceptable
CAR#6	ERR corrections - Page 10: Cuadro 1 year dates are incorrect Page 13: NOVRn date should be 2011-2012 Page 13: Text mentions Cuadro 3 it should be Cuadro 4 Page 21 equation needs to be reformated. Page 23: Septimo Informe de Reduccion de Emissiones, top header refers to the sixth year of operation instead of seventh.	Metrobus revised the Emission Reduction Report to include the requested corrections.	Response is acceptable

ID	Clarification Request	Response	Assessment Conclusion
CR#1	Provide the details to determine the 229 km/dia travelled by the "Autobus" category, and how it relates to the values in Table 4.3.10 of "Inventario de Emisiones de la ZVNM, 2006".	229 km/day is an average value which has been calculated based on the working days and non-working days from Table 4.3.10 of “Inventario de Emisiones de la ZVNM, 2006”.	Response is acceptable
CR#2	Please clarify how the number (14) of Microbus Gasolina taken out of service was calculated in the Reemplazo tab of “Operacion1112.xls”.	Metrobus provided description and evidence of the quantification procedure.	Response is acceptable
CR#3	Please provide justification for the CNG microbuses fuel efficiency value of 1.4 km/L found in Page 16 of the Report.	Since average fuel efficiency values are not available for CNG, its fuel efficiency was assumed to be the same as LPG.	Response is acceptable
CR#4	Please clarify how the final value of NNVAn was determined to be 87.	In order to be conservative the value of 87 buses has been replaced by 110 buses, which is the estimated average number of buses that operated in the corridor during this monitoring period.	Response is acceptable
CR#5	Please explain the result of 106 buses (total flota) indicated in Page 11 of the Report. This is inconsistent with the data included in “Operacion1112.xls”.	Metrobus revised the report and the calculation. The correct value is 119 buses, which is the maximum number of buses operating in the corridor on a working day in October 2012. (See “Operación 1112”, sheet ECOxSEM Cell M40).	Response is acceptable

ID	Clarification Request	Response	Assessment Conclusion
CR#5B	Regarding the determination of AKTNn, please clarify why the "Insurgentes factor" (0.8181) is applied to the number of buses in operation but not to the total km driven by the bus fleet (9,910,951 km), which we understand is the total km driven by all the buses in operation on the entire Line 1, not just the Insurgentes/CDM portion.	Metrobus responded that the "Insurgentes factor" does not apply to the total kms driven, since only those kms driven by the buses that were in operation before the extension of Line 1 have been taken into account.	Response is acceptable
CR#6	Please confirm the result for "Kilometros diarios recorridos por cada autobus (AKTNn)". Current result is based on the Dia Habil promedio bus count of 108 buses and not 2011-2012 flota 106 buses indicated in Page 11 of the Report.	Metrobus revised the calculation of "promedio ponderado de kilometros diarios" and it is based on the average number of buses operating during weekdays (the number of buses varies not only with the day but also with the season of the year). The value is based on the revised value of 110 buses (instead of 108), as explained in the response to CR#4.	Response is acceptable
CR#7	Please justify the use of 9.98 km/L as a valid number to use for "Efficiencia de combustible de los vehiculos privados" in Page 19 of the Report, providing the source for this data.	Metrobus provided reference source for fuel efficiency of private vehicles, which is assumed under conditions of free-flow automobile traffic at 80 km/h.	Response is acceptable
CR#8	Please clarify why the 24% result for Cambio Modal obtained in the recent survey was considered not representative or not valid.	Metrobus responded that historically the percentage of users that contribute to the modal shift has been quite below the survey result of 24%. Therefore, in order to take a conservative approach, the team decided to use data (16.2 % modal shift) from the survey for the previous monitoring period (2011).	Response is acceptable
CR#9	Please clarify the determination procedure for the 21 extra buses count used in the Report.	Metrobus response provides information on calculation method. The value for the rebound effect (Rebote) was increased to 10.5%. This is more conservative than the initial value of 8% value, as utilized in the past 3 reporting periods.	Response is acceptable

ID	Clarification Request	Response	Assessment Conclusion
CR#10	Please clarify how the value for TLSVn was determined, providing appropriate supporting evidence.	Metrobus provided the details on the determination procedure and the worksheet summarizing data from periodic passenger surveys used to determine average trip length.	Response is acceptable
CR#10B	Please justify why in the calculation of TLSVn Longitud media de viaje calculated in BD_Metrobus1211 – RESULTADOS LMV.XLS, Tab Matrices, the value of "distancia ponderadas" seems to include values beyond the Dr. Galvez Station (which we believe is outside of the Insurgentes project boundary)	Metrobus confirmed that since traffic patterns are representative of the entire Corridor, studies and surveys are conducted for the entire corridor, which has been operating in an integrated way since 2009.	Response is acceptable

APPENDIX B

APPENDIX B:

JUSTIFICATION FOR AKAVn VALUE
Provided by Metrobus - December 6, 2013

The passenger survey asks if Metrobus riders have a car and if they have left it parked at home. Only those that respond "yes" to both these conditions are considered in calculating Comp 5 (modal shift). From this, we conclude that these riders have replaced their whole trip (i.e., home to destination) with a trip using Metrobus.

The distance is correct because the value reflects the length of a displaced trip in a private vehicle. According to Table 17 of the SENES report, the distance traveled in private vehicles averages 39.6 Km, and the Inventory report (2008) for the whole city states that the distance traveled averages 31 Km (p 105). However, the SENES study is more relevant since it focused specifically on the Insurgentes corridor (not the whole city). According to its results (refer to Tables 17 and 18 of the study), the distance baseline cars traveled on the corridor is similar to distance of an average trip on Metrobus, and the total distance that these baseline cars traveled is 39.6 km.

Based on this we conclude that (a) given that former drivers leave their car parked at home and realize their whole door-to-door trip without the car and utilizing Metrobus; and (b) that the average baseline travel distance per day for cars utilizing the Insurgentes corridor was 39.6 km (Senes study Table 18), then it is reasonable to use half of this distance (19.8 km) as a one-direction trip distance for a private car user using the Insurgentes corridor in the baseline. And, since we actually apply the value 19.058 km, which is less than 19.8 km, then 19.058 can be considered a conservative value