

# Monitoring Report

**CDM Project 0672:  
BRT Bogotá, Colombia: TransMilenio Phase II-IV  
Monitoring Period 1.1.2007 – 31.12.2007**

Monitoring Report prepared by Dr. Jürg M. Grütter, grütter consulting

In cooperation with Deysi Rodriguez and Susana Ricaurte<sup>1</sup>, TransMilenio S.A.

Report Version 1.0  
February 23<sup>rd</sup> 2008



---

<sup>1</sup> Until 31.12.2007 TransMilenio S.A.; since 1.2.2008 with Grutter Consulting

Lead Author  
 Dr. Jürg M. Grütter  
 grütter consulting  
[jgruetter@gmail.com](mailto:jgruetter@gmail.com)  
[www.transport-ghg.com](http://www.transport-ghg.com)

Project number	0672
Project title	BRT Bogotá Colombia: TransMilenio Phase II to IV
Registration date	December 7 <sup>th</sup> 2006
Start of crediting period	01.01.2006
Sector scope	Transport
Methodology used	AM0031 "Baseline Methodology for Bus Rapid Transit Projects"
Monitoring period	01.01.2007 – 31.12.2007
Project participants	TransMilenio S.A. and CAF
Host country	Colombia
Project developer	grütter consulting
ERs in period	70,109 tCO <sub>2eq</sub>

## CONTENTS

### Contents

<b>1. THE PROJECT</b> .....	<b>4</b>
<b>2. PROJECT IMPLEMENTATION</b> .....	<b>4</b>
<b>3. MONITORING APPROACH</b> .....	<b>5</b>
<b>4. MONITORING PERIOD</b> .....	<b>5</b>
<b>5. DATA</b> .....	<b>5</b>
5.1. PROJECT ACTIVITY .....	5
5.1.1. <i>Parameters Monitored</i> .....	5
5.1.2. <i>Parameters not Monitored</i> .....	6
5.1.3. <i>Formulas</i> .....	6
5.1.4. <i>Results</i> .....	7
5.2. BASELINE .....	7
5.2.1. <i>Parameters Monitored</i> .....	7
5.2.2. <i>Parameters not Monitored</i> .....	8
5.2.3. <i>Formulas</i> .....	9
5.2.4. <i>Results</i> .....	9
5.3. LEAKAGE .....	9
5.3.1. <i>Parameters Monitored</i> .....	9
5.3.2. <i>Parameters not Monitored</i> .....	10
5.3.3. <i>Formulas</i> .....	10
5.3.4. <i>Results</i> .....	11
5.4. EMISSION REDUCTIONS .....	12
<b>6. COMPARISON MONITORED EMISSION REDUCTIONS WITH PDD</b> .....	<b>12</b>
<b>7. ENVIRONMENTAL IMPACT</b> .....	<b>13</b>
<b>ANNEX 1: FUEL CONSUMED AND DISTANCE DRIVEN</b> .....	<b>14</b>
<b>ANNEX 2: PASSENGERS TRANSPORTED</b> .....	<b>15</b>
<b>ANNEX 3: SURVEYS</b> .....	<b>16</b>
<b>ANNEX 4: LEAKAGE</b> .....	<b>17</b>

## Abbreviations

AM	Approved Methodology
BRT	Bus Rapid Transit system
CAF	Andean Development Corporation
CDM	Clean Development Mechanism
GHG	Greenhouse Gases
GPS	Global Positioning System
IDU	Instituto de Desarrollo Urbano
IPK	Index Passenger Kilometre
PDD	Project Design Document
STT	Secretaría de Tránsito y Transporte de Bogotá

## 1. The Project

TransMilenio is a sustainable mass urban transport system based on a Bus Rapid Transit (BRT) system. TransMilenio phase II-IV which is the project is an extension of phase I. Phase I is not part of this CDM project. TransMilenio is a public-private partnership, in which the public sector is responsible for the investment to deploy the required infrastructure (segregated lanes, stations, terminals, etc.), while the private sector is responsible for the investment of the bus fleet, the ticket selling and validating system, and for the operation of the trunk and feeder services. The objective of TransMilenio is to establish an efficient, safe, rapid, convenient, comfortable and effective modern mass transit system ensuring high ridership levels. TransMilenio has as main environmental aspect that the resource efficiency of transporting passengers in Bogotá is improved i.e. emissions per passenger trip are reduced compared to the situation without project. This is realized through new and larger buses, mode switching from taxis and private cars to public transport and improved occupancy rates due to dispatching vehicles based on a centrally managed organisation. The project is located within the metropolitan area of the city of Bogotá, Colombia.

Project participants are TransMilenio S.A. and the Andean Development Corporation CAF acting on behalf of the State of the Netherlands for the purchase of Emission Reductions represented by its Ministry of Housing, Spatial Planning and the Environment. Host party is Colombia. The project was registered as CDM project # 0672 on December 7<sup>th</sup> 2006 by the UNFCCC. The methodology used by the project is AM0031.

## 2. Project Implementation

The technology deployed by TransMilenio has following main components:

- **Infrastructure:** This consists basically of dedicated bus lanes including new bus-stations and integration stations located at the end of dedicated bus lanes to ensure a smooth transfer to feeder lines.
- **Bus Technology:** Bus technology used is Euro II and Euro III. Buses operating on dedicated lanes are new articulated buses with a capacity of 160 persons with platform-level access including room for disabled persons. Feeder buses are new buses with a capacity of 70-90 passengers.
- **Transit Management:** The operational fleet centre manages bus dispatch, informs passengers, produces reports and maintains records. All buses are equipped with a Global Positioning System (GPS) linked to the operation centre.
- **Fare System:** The system is based on pre-board ticketing using magnetic ticketing. This streamlines the boarding process and optimizes operations. The fare system integrates feeder and main lines. Fare collection is centralized and managed by a private company through a concession.

TransMilenio has implemented the new transit management scheme as well as the fare system prior to starting with operations of phase II. Bus technology used in all buses operating in phase II is Euro II or Euro III. Infrastructure for Phase II has been completed as planned. All trunk routes of Phase II were fully operational in the first semester of 2006. In 2007 no new trunk routes have been built and put into operation.

**Table 1: Infrastructure Completed by the Project (as of 31.12.2007)**

Phase	Trunk route	Distance	Completion date
Phase II	Americas	13.0 km	2003
Phase II	NQS	19.3 km	2006
Phase II	Suba	10.0 km	2006

Source: IDU

### 3. Monitoring Approach

The monitoring methodology is based on AM0031 and is detailed in the PDD.

The area in charge of the CDM project monitoring is the “environment area” inside the operations department. This unit is under direct supervision of the CEO of TransMilenio S.A. TransMilenio S.A. is ISO 9000 certified. The staff in charge of monitoring has received during entire 2006 back-up support and quality control services by grütter consulting including various on-site visits. The current monitoring report has been formulated by Dr. Jürg M. Grütter, grütter consulting in consultation with TransMilenio. TransMilenio will receive also in 2008 back-up services through grütter consulting.

A customized monitoring software has been designed for the CDM project allowing to enter all required monitoring data, performing quality checks and calculating the outputs in terms of GHG reduced and the environmental impact of the project. Staff in charge has been trained on software usage in various occasions. The software version used for this report is 2.442

A (Spanish) CDM monitoring manual has been realized for TransMilenio and staff has been familiarized with this manual in a special training course realized mid 2006. The Manual defines responsibilities and procedures, has a section on all data variables to be monitored, includes monitoring report formats as well as the Spanish formats of the modal split survey, the load factor taxi and the load factor buses surveys. The data section has for each data variable information on how to collect the required information, the frequency of collection, data units (including transformation of common data units), quality control measures to be realized, steps to be taken in case of data problems, how to enter data in the monitoring software (step by step guide) and some additional hints and comments.

### 4. Monitoring Period

The monitoring period is 1.1.2007 to 31.12.2007

### 5. Data

#### 5.1. Project Activity

##### 5.1.1. Parameters Monitored

<b>Data/Parameter</b>	TC <sub>TB</sub> and TC <sub>FB</sub>
<b>Data unit</b>	Liters
<b>Description</b>	Fuel consumption trunk (TC <sub>TB</sub> ) and feeder buses (TC <sub>FB</sub> ) (total TransMilenio)
<b>Values</b>	TC <sub>TB</sub> = 45,589,048 litres TC <sub>FB</sub> = 10,528,105 litres
<b>Data source</b>	TransMilenio S.A. Each operator of feeder and/or trunk buses reports monthly the fuel consumed to TransMilenio (contractual obligation)
<b>Measurement method</b>	Based on standard measurements of filling stations managed by operators; Data is reported in American gallons; the software translates this into litres based on the standard conversion factor American gallon to litre of 3.7854 l/gal
<b>Quality control</b>	The software automatically calculates specific consumptions and highlights extreme values. Extreme values are defined in the monitoring values and have been established based on average recorded values plus an upper and a lower boundary of ±15% respective to the average recorded value for trunk and for feeder units. In case of extreme values an explanatory note is given which is recorded in the software.
<b>Comment</b>	All buses use diesel fuel

<b>Data/Parameter</b>	DD <sub>TB</sub> and DD <sub>FB</sub>
<b>Data unit</b>	Kilometers
<b>Description</b>	Distance driven trunk (DD <sub>TB</sub> ) and feeder buses (DD <sub>FB</sub> ) (all TransMilenio)
<b>Values</b>	DD <sub>TB</sub> = 75,551,777 kilometres DD <sub>FB</sub> = 28,368,562 kilometres
<b>Data source</b>	TransMilenio S.A. Based on actual distance driven and not on distance paid to operator (latter is slightly minor)
<b>Measurement method</b>	Based on measurements by operator and GPS
<b>Quality control</b>	Data is used for quality control of fuel used (see above)

<b>Data/Parameter</b>	P <sub>TM,T</sub> and P <sub>TM,I</sub> and P <sub>PJ</sub>
<b>Data unit</b>	Passengers
<b>Description</b>	Passengers transported by TransMilenio all phases (P <sub>TM,T</sub> ), Phase I only (P <sub>TM,I</sub> ) and Phase II-IV "the project" (P <sub>PJ</sub> )
<b>Values</b>	P <sub>TM,T</sub> = 386,570,841 passengers P <sub>TM,I</sub> = 272,539,359 passengers P <sub>TM,PJ</sub> = 114,031,482 passengers
<b>Data source</b>	TransMilenio S.A. Based on passengers entering stations of trunk routes. Passengers using only feeder buses are not counted i.e. the data reported is conservative and sub-estimates the project impact.
<b>Measurement method</b>	Mechanical control at stations (turn-pikes) Phase I passengers are such that enter stations of trunk routes of phase I. Passengers entering stations which cater to trunk routes of more than 1 phase are separated proportionally to the number of trunk routes serving that station. Project passengers are calculated as total passengers minus Phase I passengers.
<b>Quality control</b>	Operations department cross-checks data with fares paid

### 5.1.2. Parameters not Monitored

The following parameters are not monitored but used for calculation purposes.

**Table 2: Parameters not Monitored Project Activity**

Parameter	Unit	Description	Value	Source
EF <sub>CO<sub>2</sub>,D</sub>	gCO <sub>2e</sub> /litre	CO <sub>2</sub> emission factor diesel large bus	2,661	AM0031, Table A.1.
EF <sub>CH<sub>4</sub>,D</sub>	gCO <sub>2e</sub> /litre	CH <sub>4</sub> emission factor diesel large bus	2	AM0031, Table A.1.
EF <sub>N<sub>2</sub>O,D</sub>	gCO <sub>2e</sub> /litre	N <sub>2</sub> O emission factor diesel large bus	21	AM0031, Table A.1.

### 5.1.3. Formulas

Formula (1)

$$P_{PJ} = P_{TM,T} - P_{TM,I}$$

Where:

- P<sub>PJ</sub> Passengers transported by the project (TransMilenio phase II-IV)  
P<sub>TM,T</sub> Passengers transported by TransMilenio in total  
P<sub>TM,I</sub> Passengers transported by TransMilenio Phase I

Formula (2)

$$TC = (TC_{TB} + TC_{FB}) \times \frac{P_{PJ}}{P_{TM,T}}$$

Where:

TC	Total consumption of fuel of the project
TC <sub>TB</sub>	Total consumption of fuel of trunk buses
TC <sub>FB</sub>	Total consumption of fuel of feeder buses
P <sub>PJ</sub>	Passengers transported by the project
P <sub>TM,T</sub>	Passengers transported by TransMilenio in total

Formula (3)

$$PE = TC \times (EF_{CO_2,D} + EF_{CH_4,D} + EF_{N_2O,D})$$

Where:

PE	Project emissions
TC	Total consumption of fuel
EF <sub>CO<sub>2</sub>,D</sub>	CO <sub>2</sub> emission factor diesel
EF <sub>CH<sub>4</sub>,D</sub>	CH <sub>4</sub> emission factor diesel (based on GWP)
EF <sub>N<sub>2</sub>O,D</sub>	N <sub>2</sub> O emission factor diesel (based on GWP)

## 5.1.4. Results

The total project emissions of the monitoring period (equivalent to the year 2007) are 44,430 tCO<sub>2eq</sub>

Details of the data reported per month (fuel consumption, passengers transported and distance driven) are found in the Annexes.

## 5.2. Baseline

### 5.2.1. Parameters Monitored

<b>Data/Parameter</b>	TD <sub>T</sub> and TD <sub>C</sub>
<b>Data unit</b>	Kilometers
<b>Description</b>	Average trip distance of passengers using TransMilenio which in absence of latter would have used taxis (TD <sub>T</sub> ) or passenger cars (TD <sub>C</sub> )
<b>Values</b>	TD <sub>T</sub> = 9 kilometre TD <sub>C</sub> = 12 kilometre
<b>Data source</b>	TransMilenio S.A.
<b>Measurement method</b>	Based on 6 annual surveys Passengers which would have used taxis or passenger cars are asked entry and departure station. The monitoring software calculates the distance between these stations and calculates the average value for the respective month.
<b>Quality control</b>	Based on values significantly lower or higher than the average value
<b>Comment</b>	If the annual average value monitored is higher than pre-fixed baseline value of 7km for taxis and 9km for passenger cars then latter value is taken (conservative approach). Therefore in 2007 no adjustment is made to changing trip distances.

<b>Data/Parameter</b>	N <sub>x,C</sub>
<b>Data unit</b>	Cars
<b>Description</b>	Share of passenger cars using fuel type "x" of passengers using TransMilenio which in absence of latter would have used a passenger car
<b>Values</b>	0% of vehicles using alternative fuels

	85 % of vehicles using gasoline 9 % of vehicles using diesel 5 % of vehicles using gaseous fuels
<b>Data source</b>	TransMilenio S.A.
<b>Measurement method</b>	Based on 6 annual surveys Passengers who would have used passenger cars are asked the fuel type their car is using.
<b>Quality control</b>	None
<b>Comment</b>	Data is only used if the share of vehicles using gaseous fuels is larger than 10% or if the share of vehicles using alternative fuels is larger than 1% (see PDD). The share of diesel vehicles is irrelevant as diesel GHG emissions would be higher than gasoline ones (see PDD Table A.3.10.1) and changes to the fixed baseline emission factor are only made if the result leads to lower than baseline emission factors. As this is not the case in 2007 no adjustment is made to changing fuel type used.

<b>Data/Parameter</b>	$P_{P,j}$
<b>Data unit</b>	%
<b>Description</b>	Share of passengers transported by TransMilenio who would have used transport mode "i"
<b>Values</b>	91% would have used conventional buses 3% would have used passenger cars 5% would have used taxis 1% would have used NMT (Non-Motorized Transport) 0% would not have made the trip
<b>Data source</b>	TransMilenio S.A.
<b>Measurement method</b>	Based on 6 surveys realized in 2007
<b>Quality control</b>	Based on values significantly higher than the average value

<b>Data/Parameter</b>	Policies
<b>Data unit</b>	None
<b>Description</b>	Policies that affect baseline
<b>Values</b>	None
<b>Data source</b>	District of Bogotá, Ministry of Transport, Ministry of Energy and Mines, Ministry of Environment
<b>Measurement method</b>	Review of legislation
<b>Quality control</b>	None
<b>Comment</b>	No policy which affects baseline parameters was implemented in 2007 and thus no adjustment is made.

### 5.2.2. Parameters not Monitored

The following parameters are not monitored but used for calculation purposes. Values are fixed ex-ante based on the registered PDD.

**Table 3: Parameters not Monitored Baseline (all for 2007)**

Parameter	Unit	Description	Value	Source
$EF_{P,C}$	$gCO_{2eq}/passenger$	Emission factor per passenger transported of passenger car	1,765	PDD Table A.3.10.2.
$EF_{P,T}$	$gCO_{2eq}/passenger$	Emission factor per passenger transported of taxis	2,322	PDD Table A.3.10.2.
$EF_{P,Z}$	$gCO_{2eq}/passenger$	Emission factor per passenger transported of baseline buses	921	PDD Table A.3.11.2.

### 5.2.3. Formulas

Formula (4)

$$BE = \sum_i (EF_{P,i} \times P_{PJ,i})$$

Where:

BE Baseline CO<sub>2eq</sub> emissions  
 EF<sub>P,i</sub> Baseline emission factor per passenger transported in vehicle category "i"  
 P<sub>PJ,i</sub> Passengers transported by the project that without the project activity would have used category "i", where "i" includes Z (buses, public transport), T (taxis), or C (passenger cars)<sup>2</sup>. The passengers transported per category "i" are calculated based on the share of passengers per category "i" determined through the sample survey.

### 5.2.4. Results

The total baseline emissions of the monitoring period (equivalent to the year 2007) are 114,539 tCO<sub>2eq</sub>

Details of the data reported are found in the Annex.

## 5.3. Leakage

### 5.3.1. Parameters Monitored

<b>Data/Parameter</b>	CEM, ASP
<b>Data unit</b>	Tons
<b>Description</b>	Amount of cement / asphalt used per km trunk road
<b>Values</b>	No trunk roads constructed and delivered in 2007
<b>Data source</b>	IDU
<b>Measurement method</b>	
<b>Quality control</b>	
<b>Comment</b>	

<b>Data/Parameter</b>	DT <sub>CEM</sub> and DT <sub>ASP</sub>
<b>Data unit</b>	Kilometres
<b>Description</b>	Length of trunk roads built with cement / asphalt
<b>Values</b>	No trunk roads constructed and delivered in 2007
<b>Data source</b>	IDU
<b>Measurement method</b>	
<b>Quality control</b>	
<b>Comment</b>	

<b>Data/Parameter</b>	BSCR <sub>w</sub>
<b>Data unit</b>	Buses
<b>Description</b>	Buses scrapped by project
<b>Values</b>	273 buses
<b>Data source</b>	TransMilenio S.A.
<b>Measurement method</b>	Based on scrapping reports

<sup>2</sup> NMT and IT is not included as emissions are 0 for this category in the baseline

<b>Quality control</b>	Controlled by STT
<b>Comment</b>	Small and medium sized buses are translated into large buses (relation 4:1 and 2:1 according to PDD); cut-off date of buses registered until 31.12.2007

<b>Data/Parameter</b>	BA <sub>PJ</sub>
<b>Data unit</b>	Years
<b>Description</b>	Average age of scrapped buses
<b>Values</b>	20 years
<b>Data source</b>	TransMilenio S.A.
<b>Measurement method</b>	Based on scrapping reports
<b>Quality control</b>	Controlled by STT
<b>Comment</b>	Small and medium sized buses are translated into large buses (relation 4:1 and 2:1 according to PDD); cut-off date of buses registered until 31.12.2007

### 5.3.2. Parameters not Monitored

The following parameters are not monitored but used for calculation purposes. Values are fixed ex-ante based on the registered PDD.

**Table 4: Parameters not Monitored Leakage (all for 2007)**

Parameter	Unit	Description	Value	Source
EF <sub>CEM</sub>	tCO <sub>2eq</sub> /t cement	Emission factor for cement	0.99	AM0031, Appendix A
EF <sub>ASP</sub>	tCO <sub>2eq</sub> /t asphalt	Emission factor for asphalt	0.03	AM0031, Appendix A
EF <sub>BM</sub>	tCO <sub>2eq</sub> / bus	Emission factor for bus manufacturing	42	AM0031, Appendix A
BA <sub>BL</sub>	Years	Average replacement age baseline scenario	40	PDD Table A.3.3.1.
UEF	%	Default factor for upstream emissions from fuel production	14	AM0031, Appendix A
LE <sub>CONG</sub>	tCO <sub>2eq</sub>	Emissions leakage from reduced congestion	-3,451	PDD Table A.3.8.2.

### 5.3.3. Formulas

Formula (5)

$$LE = LE_{UP} + LE_{CONG}$$

where:

LE Emissions leakage  
 LE<sub>UP</sub> Emissions leakage due to upstream processes  
 LE<sub>CONG</sub> Emission Leakage from reduced congestion

Potential emissions due to reduced load factors buses and taxis are not considered in the second crediting year according to the PDD.

If LE < 0 then leakage is not included

If EL > 0 then leakage is included

Formula (6)

$$LE_{UP} = LE_{CON} + LE_{LSP} + LE_{UFP}$$

Where:

LE<sub>UP</sub> Emissions leakage due to upstream processes

LE<sub>CON</sub> Emissions leakage due to construction  
 LE<sub>LSP</sub> Emissions leakage due to reduced life-span of buses  
 LE<sub>UFP</sub> Emission leakage due to upstream emissions from fuel production

Formula (7)

$$LE_{CON} = \frac{CEM \times EF_{CEM} \times DT_{CEM} + ASP \times EF_{ASP} \times DT_{ASP}}{Y}$$

Where:

LE<sub>CON</sub> Emissions leakage due to construction  
 CEM Cement used per kilometre of trunk lane  
 ASP Asphalt used per kilometre of trunk lane  
 EF<sub>CEM</sub> Specific emissions factor for cement  
 EF<sub>ASP</sub> Specific emissions factor for asphalt  
 DT<sub>CEM</sub> Total kilometres of trunk lanes built in project made of cement (km \* number of trunk lanes)  
 DT<sub>ASP</sub> Total kilometres of trunk lanes built in project made of asphalt (km \* number of trunk lanes)  
 Y crediting years of project (7)

Formula (8)

$$LE_{LSP} = \frac{\sum_{w=1}^y BSCR_w \times EF_{BM} \times \frac{BA_{BL} - BA_{PJ}}{BA_{BL}}}{Y}$$

Where:

LE<sub>LSP,y</sub> Emissions leakage due to reduced life-span of buses  
 BSCR<sub>w</sub> Bus units scrapped by project in the year “w”, where w = 1 to “y”  
 EF<sub>BM</sub> Emissions factor for bus manufacturing  
 BA<sub>BL</sub> Average age BAU when buses are replaced /retired in the baseline scenario  
 BA<sub>PJ</sub> Average bus age of scrapped buses under the project activity  
 Y crediting years of project (7)

Medium sized and small buses are “converted” into large buses based on the passenger capacity, taking large buses as such with a capacity of 80 persons<sup>3</sup>.

Formula (9)

$$LE_{UFP} = (PE - BE) \times UEF$$

Where:

LE<sub>UFP</sub> Emission leakage due to upstream fuel production emissions  
 PE Project emissions  
 BE Baseline emissions  
 UEF Upstream emissions multiplier, based on default factor

### 5.3.4. Results

Leakage emissions due to construction in 2007 are: 5,481 tCO<sub>2</sub>

Leakage emissions due to scrapping in 2007 are: 3,829 tCO<sub>2</sub>

<sup>3</sup> 2 medium = 1 large, 4 small = 1 large

Leakage emissions due to upstream fuel production in 2007 are: -9,815 tCO<sub>2</sub>

Leakage emissions due to congestion reduction in 2007 are: -3,451 tCO<sub>2</sub>

The total leakage emissions of the monitoring period (equivalent to the year 2007) are -3,956 tCO<sub>2eq</sub>. According to the methodology and for a conservative approach negative leakage is not claimed by the project as additional emission reduction and the leakage value is thus set at 0 tCO<sub>2eq</sub>.

For additional information on leakage see the Annex.

## 5.4. Emission Reductions

**Table 5: Emission Reductions**

<b>Emission</b>	<b>tCO<sub>2eq</sub></b>
1. Baseline Emissions	114,539
2. Leakage Emissions	0
3. Project Emissions	44,430
4. Emission Reductions (1-2-3)	70,109

Total emission reductions monitored in the crediting period (year 2007) are 70,109 tCO<sub>2eq</sub>

## 6. Comparison Monitored Emission Reductions with PDD

Table 6 compares expected with actual results of core data influencing emission reductions.

**Table 6: Comparison Actual and Expected Core Data**

<b>Parameter</b>	<b>Actual value</b>	<b>Expected value</b>	<b>Comment</b>
Emission reductions	70,109 tCO <sub>2</sub>	134,011 tCO <sub>2</sub>	48% lower than expected; Reasons see below
Baseline emissions	114,539 tCO <sub>2</sub>	216,246 tCO <sub>2</sub>	47% lower than expected; same relation as emission reductions
Project emissions	44,430 tCO <sub>2</sub>	79,391 tCO <sub>2</sub>	44% lower than expected; same relation as emission reductions
Leakage emissions	0 tCO <sub>2</sub>	2,845 tCO <sub>2</sub>	As expected
Passengers transported by project	114 million	208 million	Passenger numbers are far below the expected. This fact is due to projection deficiencies when planning Phase II of TransMilenio, interdependence of the quantity of passengers phase II with implementation of Phase III and a deficient rerouting of conventional buses.
Fuel consumed by project	17 million litres	30 million litres	Related to passengers transported.
IPK trunk buses (Index Passenger-Kilometre)	5.1	5.4	Slightly lower than expected; the lower average load factor is due to the operational difficulties described above
Fuel efficiency trunk buses	60l/100k m	61l/100k m	Values as expected
Fuel efficiency feeder buses	37l/100k m	38l/100k m	Values as expected
Share of passengers which would have used passenger cars	2.6%	5.5%	Lower than expected and lower than in the previous year
Share of passengers	5.4%	5.6%	Value as expected

Parameter	Actual value	Expected value	Comment
which would have used taxis			
Share of passengers which would have used buses	90.6%	88%	Slightly higher than expected
Share of passengers which would have used NMT or not made the trip	1.4%	0.8%	Higher than expected and higher than previous year

The most important difference is the number of passengers transported. This has led to nearly 40% less emission reductions than expected. The reasons as explained are basically due to operational difficulties in the re-organization of the remaining bus fleet. Work is underway to reorganize remaining public transit routes integrating them as feeder lines to TransMilenio. This could boost emission reductions of the project.

## 7. Environmental Impact

The project also monitors local environmental impacts including:

- SO<sub>2</sub> emissions based on the fuel used and its sulphur contents
- NO<sub>x</sub> emissions based on distance driven and emission factors
- Particle emissions based on distance driven and emission factors

The sulphur contents of fuel in Bogota was mid 2007 1200 ppm according to official regulations and in accordance with measurements made.

**Table 7: Impact of Project on Local Emissions**

Pollutant	Emission Reductions (tons)
SO <sub>2</sub>	54
NO <sub>x</sub>	2,257
Particle Matter	296

## Annex 1: Fuel Consumed and Distance Driven

**Table A1: Fuel Consumption, Distance Driven and Fuel Efficiency of Trunk Buses (total TransMilenio)**

Operator	Fuel consumed in gallons	Distance driven in kilometres	Fuel efficiency in kilometres per gallon
SI 99	1,884,120	11,602,589	6.2
Express del Futuro	1,939,187	12,113,489	6.2
Transmasivo	2,091,998	13,466,541	6.4
Metrobus	1,431,159	8,234,364	5.8
Ciudad Movil	1,335,089	7,859,475	5.9
SI 02	1,643,284	11,290,676	6.9
Connexion Movil	1,718,554	10,984,644	6.4
<b>Total</b>	<b>12,043,390</b>	<b>75,551,777</b>	<b>6.3</b>

1 gallon = 3.7854 litres

**Table A2: Fuel Consumption, Distance Driven and Fuel Efficiency of Feeder Buses (total TransMilenio)**

Operator	Fuel consumed in gallons	Distance driven in kilometres	Fuel efficiency in kilometres per gallon
ETMA	518,141	5,169,167	10.0
TAO	312,933	3,233,603	10.3
Al Norte 2	513,478	4,943,721	9.6
Al Capital	691,631	7,050,803	10.2
Citimovil	240,339	2,598,685	10.8
SI 03	504,718	5,372,583	10.6
<b>Total</b>	<b>2,781,240</b>	<b>28,368,562</b>	<b>10.2</b>

1 gallon = 3.7854 litres

## Annex 2: Passengers Transported

**Table A3: Passengers Transported by TransMilenio 2007 per Month**

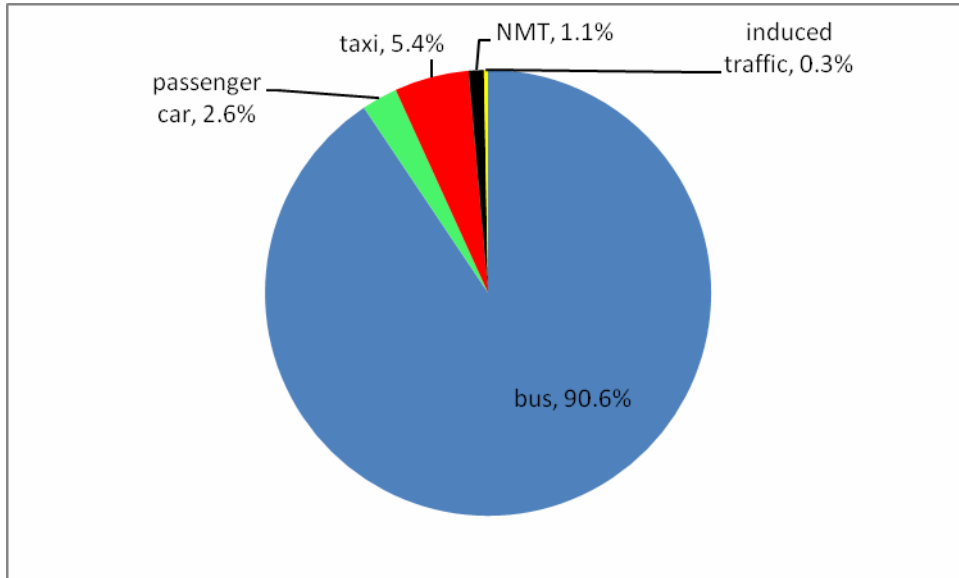
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total passengers	25,974,463	30,657,098	33,904,958	29,963,513	33,622,718	30,515,198	30,086,939	33,795,764	33,705,814	35,626,444	36,009,926	32,708,006	386,570,841
Passengers Phase I	18,956,751	22,252,776	24,377,827	21,358,457	23,923,633	21,546,551	21,143,353	23,940,759	23,716,731	24,959,099	23,943,599	22,419,823	272,539,359
Passengers Project	7,017,712	8,404,322	9,527,131	8,605,056	9,699,085	8,968,647	8,943,586	9,855,005	9,989,083	10,667,345	12,066,327	10,288,183	114,031,482

## Annex 3: Surveys

Number of surveys realized 2007: 6 units

Number of persons interviewed: between 1'033 and 1'142 per survey

**Graph A3: Modal Distribution of Passengers Using TransMilenio**



## Annex 4: Leakage

**Table A4: Leakage Emissions**

Concept	Leakage emissions in tCO <sub>2eq</sub> <sup>4</sup>
Leakage due to construction	5,481
Leakage due to scrapping	3,829
Leakage due to reduced upstream emissions of fuel saved	- 9,815
Leakage due to reduced congestion	- 3,451
Leakage due to reduced load factor buses and taxis <sup>5</sup>	0
<b>Total leakage</b>	<b>-3,956</b>
<b>Leakage as reported for emission reduction</b>	<b>0<sup>6</sup></b>

Construction emissions are identical to 2006 as no new construction has been realized in the year 2007.

**Table A5: Scrapage Emissions**

	Large buses	Medium buses	Small buses	Weighed total
Scrapped units	180	119	132	273 <sup>7</sup>
Average year of scrapped units	1988	1981	1993	1987

Source : TransMilenio

Weighting according to PDD : 2 medium = 1 large ; 4 small = 1 large

Average age: 2007-1987 = 20 years

The annualized scrapage emissions of 2006 are added to the annualized scrapage emissions of 2007.

<sup>4</sup> Positive figure means that the project has caused indirectly additional emissions; negative figure means that the project has caused indirectly additional emission reductions

<sup>5</sup> Not monitored in 2007 in accordance with PDD (to be monitored 2008)

<sup>6</sup> Negative leakage is taken as 0 i.e. the project does not claim these additional emission reductions.

<sup>7</sup> Includes 3 unspecified units assumed as large units (conservative approach)