



Monitoring Report

**CDM Project 0672:
BRT Bogotá, Colombia: TransMilenio Phase II-IV
Monitoring Period 1.1.2006 – 31.12.2006**

**Monitoring Report sponsored by CAF and Transmilenio S.A.
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Project number	0672
Project title	BRT Bogotá Colombia: TransMilenio Phase II to IV
Registration date	December 7 th 2006
Start of crediting period	01.01.2006
Sector scope	Transport
Methodology used	AM0031 "Baseline Methodology for Bus Rapid Transit Projects"
Monitoring period	01.01.2006 – 31.12.2006
Project participants	TransMilenio S.A. and CAF
Host country	Colombia
Project developer	Grütter consulting
ERs in period	59,020 tCO _{2eq}

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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 7th 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 are Euro II and Euro III buses. 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 are 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.

Table 1: Infrastructure Completed by the Project (as of 31.12.2006)

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 2007 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 2.411

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 1.1.2006 to 31.12.2006

5. Data

5.1. Project Activity

5.1.1. Parameters Monitored

Data/Parameter	TC _{TB} and TC _{FB}
Data unit	Liters
Description	Fuel consumption trunk (TC _{TB}) and feeder buses (TC _{FB}) (total TransMilenio)
Values	TC _{TB} = 42,006,133 liters TC _{FB} = 10,035,489 liters
Data source	TransMilenio S.A. Each operator of feeder and/or trunk buses reports monthly the fuel consumed to TransMilenio (contractual obligation)
Measurement method	Based on standard measurements of filling stations managed by operators; Data is reported in American gallons; the software translates this into liters based on the standard conversion factor American gallon to liter of 3.7854 l/gal
Quality control	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.

Comment	All buses use diesel fuel
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Data/Parameter	DD _{TB} and DD _{FB}
Data unit	Kilometers
Description	Distance driven trunk (DD _{TB}) and feeder buses (DD _{FB}) (all TransMilenio)
Values	DD _{TB} = 69,713,337 kilometres DD _{FB} = 27,128,046 kilometres
Data source	TransMilenio S.A. Based on actual distance driven and not on distance paid to operator (latter is slightly minor)
Measurement method	Based on measurements by operator and GPS
Quality control	Data is used for quality control of fuel used (see above)

Data/Parameter	P _{TM,T} and P _{TM,I} and P _{PJ}
Data unit	Passengers
Description	Passengers transported by TransMilenio all phases (P _{TM,T}), Phase I only (P _{TM,I}) and Phase II-IV "the project" (P _{PJ})
Values	P _{TM,T} = 345,681,771 passengers P _{TM,I} = 251,932,354 passengers P _{TM,PJ} = 93,749,417 passengers
Data source	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.
Measurement method	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.
Quality control	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 _{CO₂,D}	gCO _{2e} /litre	CO ₂ emission factor diesel large bus	2,661	AM0031, Table A.1.
EF _{CH₄,D}	gCO _{2e} /litre	CH ₄ emission factor diesel large bus	2	AM0031, Table A.1.
EF _{N₂O,D}	gCO _{2e} /litre	N ₂ O emission factor diesel large bus	21	AM0031, Table A.1.

5.1.3. Formulaes

Formula (1)

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

Where:

- P_{PJ} Passengers transported by the project (TransMilenio phase II-IV)
P_{TM,T} Passengers transported by TransMilenio in total
P_{TM,I} 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 _{TB}	Total consumption of fuel of trunk buses
TC _{FB}	Total consumption of fuel of feeder buses
P _{PJ}	Passengers transported by the project
P _{TM,T}	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 _{CO₂,D}	CO ₂ emission factor diesel
EF _{CH₄,D}	CH ₄ emission factor diesel (based on GWP)
EF _{N₂O,D}	N ₂ O emission factor diesel (based on GWP)

5.1.4. Results

The total project emissions of the monitoring period (equivalent to the year 2006) are 37,881 tCO_{2eq}

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

Data/Parameter	TD _T and TD _C
Data unit	Kilometers
Description	Average trip distance of passengers using TransMilenio which in absence of latter would have used taxis (TD _T) or passenger cars (TD _C)
Values	TD _T = 10 kilometers TD _C = 11 kilometers
Data source	TransMilenio S.A.
Measurement method	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.
Quality control	Based on values significantly lower or higher than the average value
Comment	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 2006 no adjustment is made to changing trip distances.

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

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	3% of vehicles using gaseous fuels
Data source	TransMilenio S.A.
Measurement method	Based on 6 annual surveys Passengers who would have used passenger cars are asked the fuel type their car is using.
Quality control	None
Comment	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 2006 no adjustment is made to changing fuel type used.

Data/Parameter	$P_{P,j,i}$
Data unit	%
Description	Share of passengers transported by TransMilenio who would have used transport mode "i"
Values	89.1% would have used conventional buses 4.3% would have used passenger cars 5.5% would have used taxis 1.0% would have used NMT (Non-Motorized Transport) 0.1% would not have made the trip
Data source	TransMilenio S.A.
Measurement method	Based on 6 surveys realized in 2006
Quality control	Based on values significantly higher than the average value

Data/Parameter	Policies
Data unit	None
Description	Policies that affect baseline
Values	None
Data source	District of Bogotá, Ministry of Transport, Ministry of Energy, Environment and Mines
Measurement method	Review of legislation
Quality control	None
Comment	No policy which affects baseline parameters was implemented in 2006 and thus no adjustment is made. Regulations issued by the Ministry of Environment, Energy and Mines were reviewed under http://www.minminas.gov.co/minminas/pagesweb.nsf?opendatabase Resolución 1180 of June 21, 2006 is important in this context. It is a regulation concerning the fuel quality and environmental criteria for fuel specifications: According to this regulation bio-fuel could be added up to 5% to diesel in Bogotá from 1.2008 onwards. Regulations issued by the Ministry of Transport were reviewed under http://www.mintransporte.gov.co/Servicios/Normas/archivo/consulta_normaxarea.asp Regulations issued by the District of Bogotá were reviewed under http://www.alcaldiabogota.gov.co/sisjur/ Interesting is the new master plan for transport (decree 319 of 2006). However this is a planning document and has not yet been enforced.

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 2006)

Parameter	Unit	Description	Value	Source
EF _{P,C}	gCO _{2eq} /passenger	Emission factor per passenger transported of passenger car	1,783	PDD Table A.3.10.2.
EF _{P,T}	gCO _{2eq} /passenger	Emission factor per passenger transported of taxis	2,345	PDD Table A.3.10.2.
EF _{P,Z}	gCO _{2eq} /passenger	Emission factor per passenger transported of baseline buses	930	PDD Table A.3.11.2.

5.2.3. Formulaes

Formula (4)

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

Where:

- BE Baseline CO_{2eq} emissions
 EF_{P,i} Baseline emission factor per passenger transported in vehicle category “i”
 P_{PJ,i} 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)¹. 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 2006) are 96,902 tCO_{2eq}

Details of the data reported are found in the Annex.

5.3. Leakage

5.3.1. Parameters Monitored

Data/Parameter	CEM, ASP
Data unit	Tons
Description	Amount of cement / asphalt used per km trunk road
Values	351 tons of cement/kilometre trunk road No asphalt was used in Phase II
Data source	IDU
Measurement method	Based on construction reports
Quality control	Comparison with plans
Comment	All trunk roads phase II; Data reported is significantly lower than the original projected data as latter confused concrete with cement

¹ NMT and IT is not included as emissions are 0 for this category in the baseline

Data/Parameter	DT _{CEM} and DT _{ASP}
Data unit	Kilometres
Description	Length of trunk roads built with cement / asphalt
Values	110.42 kilometres of cement trunk road 0 kilometres of asphalt trunk road
Data source	IDU
Measurement method	Based on construction reports
Quality control	Comparison with plans
Comment	All trunk roads phase II; includes all lanes of all built trunk roads; does not reduce the kilometres of trunk roads for those which replaced existing roads (16.8km) as would be allowed by the methodology and is thus a conservative value.

Data/Parameter	BSCR _w
Data unit	Buses
Description	Buses scrapped by project
Values	1'824 buses
Data source	TransMilenio S.A.
Measurement method	Based on scrapping reports
Quality control	Controlled by STT
Comment	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 31.12.2006 All buses used for phase II included even if scrapped before 1.1.2006

Data/Parameter	BA _{PJ}
Data unit	Years
Description	Average age of scrapped buses
Values	29 years
Data source	TransMilenio S.A.
Measurement method	Based on scrapping reports
Quality control	Controlled by STT
Comment	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 31.12.2006 All buses used for phase II included even if scrapped before 1.1.2006

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 2006)

Parameter	Unit	Description	Value	Source
EF _{CEM}	tCO _{2eq} /t cement	Emission factor for cement	0.99	AM0031, Appendix A
EF _{ASP}	tCO _{2eq} /t asphalt	Emission factor for asphalt	0.03	AM0031, Appendix A
EF _{BM}	tCO _{2eq} / bus	Emission factor for bus manufacturing	42	AM0031, Appendix A
BA _{BL}	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 _{CONG}	tCO _{2eq}	Emissions leakage from reduced congestion	-1'829	PDD Table A.3.8.2.

5.3.3. Formulaes

Formula (5)

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

where:

LE Emissions leakage

LE_{UP} Emissions leakage due to upstream processes

LE_{CONG} Emission Leakage from reduced congestion

Emissions due to reduced load factors buses and taxis is not included in the first 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_{UP} Emissions leakage due to upstream processes

LE_{CON} Emissions leakage due to construction

LE_{LSP} Emissions leakage due to reduced life-span of buses

LE_{UFP} 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_{CON} Emissions leakage due to construction

CEM Cement used per kilometre of trunk lane

ASP Asphalt used per kilometre of trunk lane

EF_{CEM} Specific emissions factor for cement

EF_{ASP} Specific emissions factor for asphalt

DT_{CEM} Total kilometres of trunk lanes built in project made of cement (km * number of trunk lanes)

DT_{ASP} 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_{LSP,y} Emissions leakage due to reduced life-span of buses

BSCR_w Bus units scrapped by project in the year "w", where w = 1 to "y"

EF_{BM} Emissions factor for bus manufacturing

BA_{BL} Average age BAU when buses are replaced /retired in the baseline scenario

BA_{PJ} Average bus age of scrapped buses under the project activity

Y crediting years of project (7)

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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 persons².

Formula (9)

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

Where:

LE _{UEF}	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

The total leakage emissions of the monitoring period (equivalent to the year 2006) are -1,601 tCO_{2eq}. 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_{2eq}.

For additional information on leakage see the Annex.

5.4. Emission Reductions

Table 5: Emission Reductions

Emission	tCO _{2eq}
1. Baseline Emissions	96,902
2. Leakage Emissions	0
3. Project Emissions	37,881
4. Emission Reductions (1-2-3)	59,020

Total emission reductions monitored in the crediting period (year 2006) are 59,020 tCO_{2eq}

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

Parameter	Actual value	Expected value	Comment
Passengers transported by project	94 million	147 million	Phase II started with operational difficulties; Phase II attractiveness for passengers also depends partially on implementation of Phase III. Implementation including rerouting of conventional buses has been deficient to the moment.
Fuel consumed by project	14 million litres	21 million litres	Related to passengers transported.
IPK trunk buses (Index Passenger-Kilometre)	5.0	5.4	Slightly lower than expected; the lower average load factor is due to the operational difficulties described above
Fuel efficiency trunk	60l/100km	61l/100km	Values as expected

² 2 medium = 1 large, 4 small = 1 large

buses			
Fuel efficiency feeder buses	37l/100km	38l/100km	Values as expected
Share of passengers which would have used passenger cars	4.3%	5.5%	Slightly lower than expected
Share of passengers which would have used taxis	5.5%	5.6%	Value as expected
Share of passengers which would have used buses	89.1%	88%	Slightly higher than expected
Share of passengers which would have used NMT or not made the trip	1.1%	0.8%	Value as expected

Actual value = monitored value in the year 2006 / Expected value = projected value in the PDD

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.

7. Environmental Impact

The project also monitors local environmental impacts including:

- SO₂ emissions based on the fuel used and its sulphur contents
- NO_x emissions based on distance driven and emission factors
- Particle emissions based on distance driven and emission factors

Table 7: Impact of Project on Local Emissions

Pollutant	Emission Reductions (tons)
SO ₂	46
NO _x	1,838
Particle Matter	243

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	2,230,205	13,870,322	6.2
Ciudad Movil	1,552,047	8,585,587	5.5
Express del Futuro	1,619,535	10,283,178	6.3
Metrobus	1,266,133	7,767,171	6.1
Transmasivo	1,624,262	11,134,924	6.9
SI 02	1,390,879	9,766,400	7.0
Conexion Movil	1,413,820	8,305,755	5.9
Total	11,096,881	69,713,337	6.3

1 gallon = 3.7854 litres

Graph A1: Fuel Efficiency of Trunk Buses

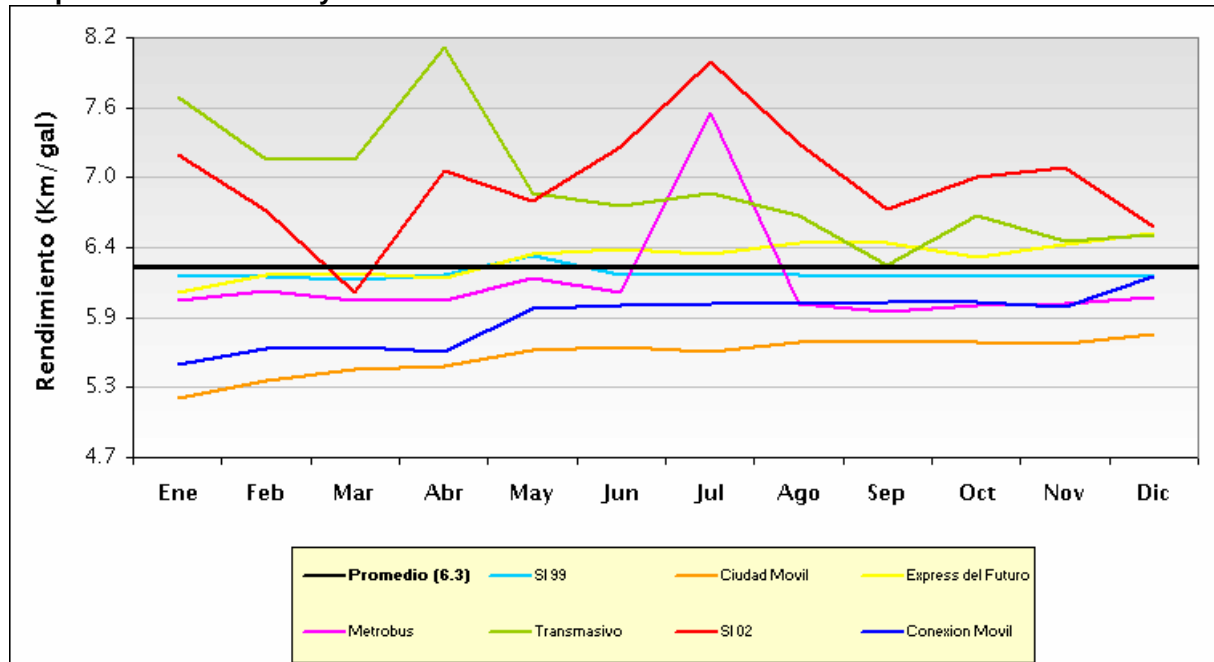
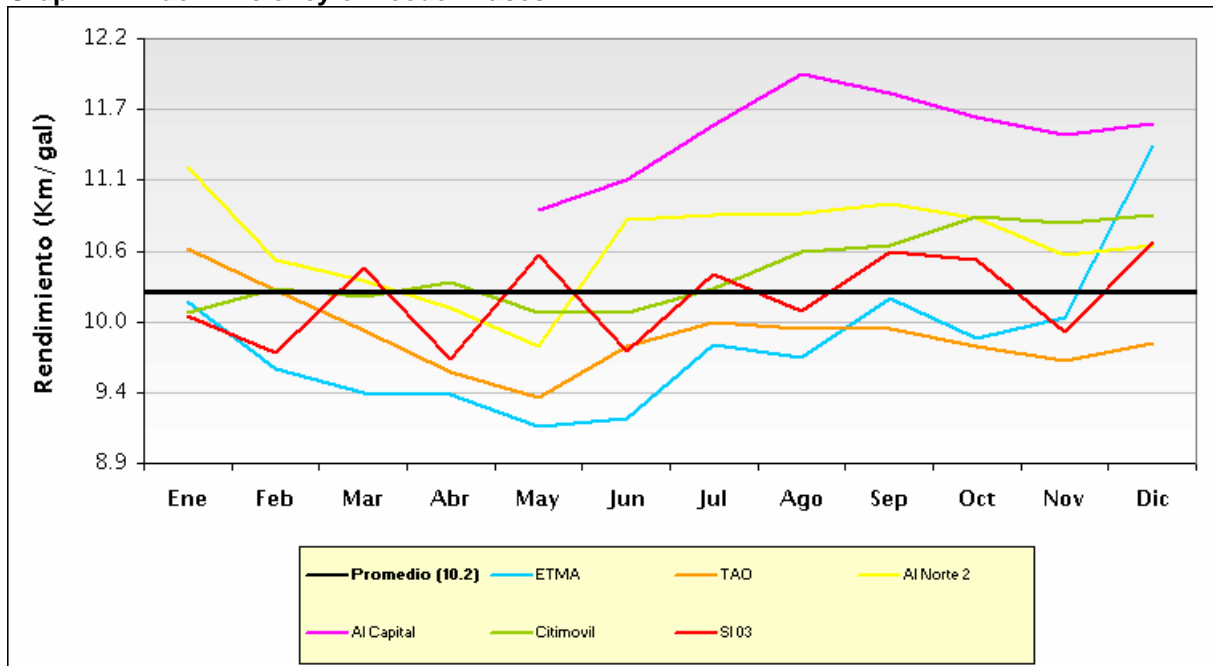


Table A2: Fuel Consumption, Distance Driven and Fuel Efficiency of Feeder Buses (total TransMilenio)

Operator	Fuel consumed in gallons	Distance driven in kilometres	Fuel efficiency in kilometres per gallon
ETMA	523,261	5,146,241	9.8
TAO	493,317	4,879,578	9.9
Al Norte 2	302,846	3,210,934	10.6
Al Capital	156,561	1,801,158	11.5
Citimovil	537,544	5,586,459	10.4
SI 03	637,575	6,503,676	10.2
Total	2,651,104	27,128,046	10.2

1 gallon = 3.7854 litres

Graph A2: Fuel Efficiency of Feeder Buses



Annex 2: Passengers Transported

Table A3: Passengers Transported by TransMilenio 2006 per Month

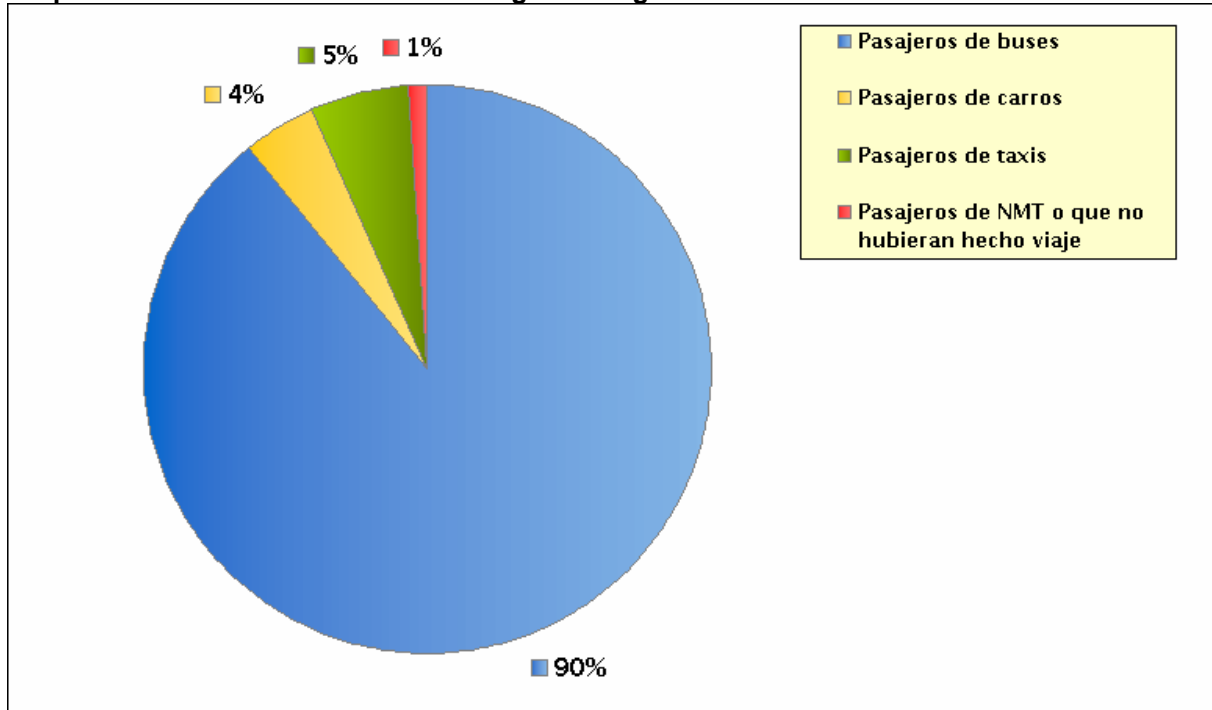
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total passengers	21,767,165	26,328,003	29,269,991	25,862,823	31,367,220	29,188,387	28,518,872	30,789,858	31,336,797	31,271,268	30,880,101	29,101,286	345,681,771
Passengers Phase I	17,501,931	21,387,421	23,699,409	20,355,765	22,036,287	20,330,534	19,898,405	21,825,866	22,065,583	21,829,500	21,373,934	19,627,719	251,932,354
Passengers Project	4,265,234	4,940,582	5,570,582	5,507,058	9,330,933	8,857,853	8,620,467	8,963,992	9,271,214	9,441,768	9,506,167	9,473,567	93,749,417

Annex 3: Surveys

Number of surveys realized 2006: 7 units³

Number of persons interviewed: between 1'030 and 2'500 per survey

Graph A3: Modal Distribution of Passengers Using TransMilenio



³ 6 of which included distance driven

Annex 4: Leakage

Table A4: Leakage Emissions

Concept	Leakage emissions in tCO _{2eq} ⁴
Leakage due to construction	5,481
Leakage due to scrapping	3,010
Leakage due to reduced upstream emissions of fuel saved	- 8,263
Leakage due to reduced congestion	- 1,829
Leakage due to reduced load factor buses and taxis ⁵	0
Total leakage	-1,601
Leakage as reported for emission reduction	0⁶

Table A5: Calculation Base for Construction Emissions

Trunk route	Longitude in km	Number of lanes
Américas	12.98	4
NQS	19.30	2
Suba	9.95	2
Total km constructed (lanes)	110.42 km	

Source: IDU

Cement used per kilometre of trunk road:

- Road width: 3.5 metres (source: IDU)
- Height of concrete: 0.25 metres (source: IDU)
- Density of concrete: 2.4 ton/m³ (source: IDU)
- Tons of concrete per km of lane of trunk road = $3.5 \times 0.25 \times 2.4 \times 1,000 = 2,100$ tons
- Percentage of cement in concrete: 16.7% (source: IDU)
- **Tons of cement per km of lane of trunk road = $2,100 \times 0.167 = 351$ ton cement**

Table A6: Scrappage Emissions

	Large buses	Medium buses	Small buses	Weighed total
Scrapped units	815	1,996	30	1,824 ⁷
Average year of scrapped units	1981	1974	1992	1977

Source : TransMilenio

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

Average age: 2006-1977 = 29 years

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

⁵ Not monitored in 2006 in accordance with PDD (to be monitored 2008)

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

⁷ Includes 3 unspecified units assumed as large units (conservative approach)