

## Annexure C – Long case study Metrobus: BRT of Mexico City & Carbon Financing

### Module 6: Climate Change and Urban Mobility

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#### A. Project Overview

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**1. Name:** Metrobus: BRT of Mexico City & Carbon Financing

Many documents are available on the web on the subject.

Among others we found two basic documents:

- CDM (2011), which gives detailed information on the project and Carbon Financing;
- OECD (2012), which also describes the project in detail as a **case study** with information on public-private financing of the project.

**2. Location.** Mexico D.F. – BRT Metrobus Insurgentes.

**3. Focus.** Transportation in most Latin American cities is privately operated in the same city by hundreds or even thousands of small operators called *hombre-camión* (a man and his bus) with a high rate of accidents and low environmental efficiency. The focus here is to give an example of modernization of artisanal transport by massive transit (Bus Rapid Transit) with the case study of Metrobus in Mexico City, which was a success and often cited as a best practice. A measure exportable in many large or mid-sized cities in Latin America or elsewhere. The project has obtained financing from CDM (Clean Development Mechanism).

**4. Partners.** Government of the Federal District of Mexico; Metrobus; Various private Operators.

**5. Climatic zone/geo-physical context:**

Mediterranean climate in the tropics at 2,200 meters.

- Polar
- Temperate ✓
- Arid/semi-arid
- Tropical/sub-tropical
- Other...
- Island
- Coast
- River basin
- High plateau ✓
- Mountain
- Other:...

**6. Weather patterns and resulting vulnerabilities.** Please provide information on the weather patterns and tick the vulnerabilities the locality of the good practice is exposed to. Please briefly describe main both extreme events (frequency, severity, impacts caused, changes over time)/ slow-onset challenges that are attributable to climate change.

- Rainfall patterns ✓
- Wind patterns
- Annual temperature distributions
- Other:...
- Health risks attributable to changing climate
- Floods ✓
- Wind damage
- Drought
- Landslides
- Other:...

Details on experienced extreme events and slow onset climate change impacts:

**7. Stage.** What is the current stage of the practice?

- Planning and design
- Implementation
- Partly operational
- Fully operational ✓
- Other: ...

**Scale.** At what scale is the practice operating? You can tick more than

- one box.
- Country
- Region
- City ✓
- Town
- Sub-district
- Community/ neighbourhood

- Other: ...

## 8. Duration.

Project starting date corresponds to signature of the construction contract of Insurgentes BRT: 30/11/1994; Duration 30 years.

## 9. Summary.

Innovative mode of Public-Private association for public urban transportation of persons, especially in Latina America where the main political obstacle to the introduction of BRT's is the difficulty to transform individual operators (*hombre-camión* or the driver and his bus) into modern operators.

“Mexico City is one of the world's megacities, with over 20 million inhabitants. There are over 30 million vehicular trips in the city each day and over 3.5 million cars. Between 70 and 80 percent of trips are by public transport, including 4.5 million trips on Mexico City's 125 mile subway system. There are roughly 28,000 bus concessions in the city, roughly 70 percent of which are minibuses.

In 2005, it opened Metrobus, a BRT corridor along Avenida de los Insurgentes, probably the most important street in Mexico City. At 18 miles in length, Avenida de los Insurgentes is the largest avenue in Mexico City and one of the longest streets in the world. It crosses 16 political jurisdictions in the city and serves some of the city's most important locations, including the World Trade Center complex, a university campus, and numerous residential and commercial districts. In many ways, Insurgentes is not unlike major avenues in US cities, complete with Starbuck's, fancy restaurants, and gleaming office towers.

Metrobus serves roughly 12 miles of Insurgentes with 36 stations and two terminals. It replaced about 350 standard buses with 97 new articulated BRT vehicles. These vehicles dock at enclosed, rail-like stations, and passengers may enter or exit the vehicles at any one of four, double-wide doors. One apparently unique feature about Metrobus is that although most of the buses are owned by CISA, a private company, some are owned by RTP, a public company. In most Latin American BRT's, including all that we recently visited (Bogota, Guayaquil, Pereira), the buses are all privately owned.” Source: [qqq.govrt.org/MexicoCityMetrobus.html](http://qqq.govrt.org/MexicoCityMetrobus.html)

“Fares are collected via automatic ticketing machines located at the entrance to stations. The fare is roughly US \$0.30 (*in 2006*), which enables passengers to travel any distance they choose along the corridor.

Although the presence of fare vending machines outside of the turnstiles is an improvement over some systems, like Transmilenio, the fare collection system could be simplified. First time users must purchase a smart card for 8 pesos (about 80 US cents) and then immediately charge the smart card. The process is a little cumbersome and, if you forget to charge the smartcard, you could lose some money in the machine (which happened to one of our staff).”

Source: *ibid.*

“Typical of Latin American BRT's, there is a trust fund that that manages, invests, and distributes all fare revenues (see e.g., Guayaquil). The trust fund contracts directly with a fare collection contractor which, among other things, provides fare collection equipment, sells smartcards, collects the cash, and deposits the cash with the trust fund.

Vehicles have a maximum capacity of 160 passengers and run at extremely high frequencies, roughly 56 per peak hour along the northern half of the route. This gives Metrobus a maximum capacity of nearly 9,000 passengers per hour, far more than even the best US light rail systems. Currently, Metrobus is carrying roughly 250,000 passengers per day.

Prior to Metrobus, the travel time along the route was roughly 1.5 hours at an average speed of 14 km/hour. Metrobus has increased the speed to 21 km/hour and reduced the travel time to 1 hour.

Traffic flow for cars on Insurgentes also was changed as a result of Metrobus. For example, left turns were eliminated, except at a few intersections where dedicated left turn only lanes were constructed. This appears to have improved traffic conditions for cars, even though Metrobus required that the two center lanes be dedicated to buses only.

According to a recent study, Metrobus is reducing 35,000 tons of CO<sub>2</sub> annually. It also is reducing passenger exposure to CO, benzene, and PM 2.5 by up to 50 percent, as compared with previous bus service in the corridor.

The stations are open and very long, providing substantial passenger capacity. However, many are narrow due to the width of the median on Insurgentes. Stations do not have glass doors separating passengers from the guideway, a feature found in other systems, like Transmilenio and Pereira's Megabus. “ Source: *Ibid.* “

## B. Detailed project information

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### Challenge

#### 10. Issue.

Modernization of public transport from artisanal (*hombre-camión* or a man and his bus) in modern enterprises of public transport. Even though Metrobus was implemented in a city of 20 million inhabitants, it is a good example of modernization of traditional transportation and exportable in medium-sized cities. A typical BRT has a corridor of approximately 20 km with a travel demand of a corridor in the order of 60,000 passengers, which can be seen in medium-sized cities in a 1 or 2 million inhabitants range.

#### 11. Affected group(s).

Persons living near to construction sites. General Public. Population of Mexico traveling downtown as well as national visitors and tourists. Women who use more public transport than men are more affected as well as persons with a lower socioeconomic status. Owners and drivers of baseline buses. Between Feb. 2005 and Sept. 2009, 63 stakeholders meetings with numerous representatives were held, all of which documented. Major information channels were used including numerous leaflets on different topics, mass media communication, open phone line or email (CDM, 2011, p. 68).

#### 12. Impact.

Improve public transportation. Diminish pollution and CO2 emissions. Diminish road accidents. Save travel time. Improve quality of public transport.

### Overview

#### 13. Design.

In function of city size, demand in various corridors, it necessary to consider various alternatives with present and future demand. Metro, tram, normal bus. For an efficient mass transit, BRT is very often the winner. Provides high capacity with flexible/progressive alternative of implementation.

(Source:[http://en.wikipedia.org/Mexico\\_City\\_Metrobús](http://en.wikipedia.org/Mexico_City_Metrobús))

The Metrobus system replaced 372 standard buses and minibuses that served Avenida de los Insurgentes with 212 articulated buses that run at an average speed of 20 km/h (12 mph), doing 60 km/h (37 mph) as maximum. Doing so, travel times along the corridor are reduced up to 50%.

“Besides addressing the bus service problem, the BRT Metrobús project emerged in the context of the city’s efforts to reduce Air pollution in Mexico City with a program called Proaire 2002-2010.[8] According to Metrobús, annual environmental benefits include a reduction of 35,400

long tons (36,000 t) of Carbon dioxide, 9,700 long tons (9,900 t) of Carbon monoxide, 206 long tons (209 t) of NOx, and 1.27 long tons (1.29 t) of PM10 particulates.” (Source: *ibid.*)

According to information from the Mexico City government published in April 2006, the Metrobús carried more than 260,000 passengers daily. (Source: *ibid.*)

Initiated in 2005, the Metrobus has been expanded at various times (2008, 2010, 2011). Ticketing is pre-paid smartcard. As of 2010, the single trip cost \$5.00 Mexican Pesos (0.38 US\$). Service is free for those over 70 years old, or disabled, as well as for children under 5 accompanied by an adult.

In the CDM document of 6//05/011 (CDM, 2011) we find a good summary of the project activity:

**SECTION A. General description of project activity.**

**A.1. Title of the project activity:**

BRT Metrobus Insurgentes, Mexico  
Version 3  
6/05/2011

**A.2. Description of the project activity:**

The objective of the BRT (Bus Rapid Transit) Metrobus Insurgentes in the Zona Metropolitana del Valle de México (ZMVM)<sup>1</sup> is to establish an efficient, safe, rapid, convenient, comfortable and effective modern mass transit system based on a BRT system. The ZMVM has nearly 20 million inhabitants<sup>2</sup>. The PDD includes the BRT line Insurgentes. The project transports annually around 80 million passengers. The geographical boundary of the project is the greater metropolitan area of the city of Mexico known as ZMVM. Gases included are CO<sub>2</sub> and CH<sub>4</sub>.

Core aspects of the project are:

- A new infrastructure consisting of a BRT bus-only route with a length of 19.6 kilometres<sup>3</sup> serviced by new articulated and bi-articulated Euro 3 or Euro 4 diesel buses<sup>4</sup> with at-level boarding and alighting, real-time next bus information displays, pre-board ticketing and fare verification and rechargeable electronic cards for payment to streamline the boarding process.
- Equipment and turnstiles at the entrance to each trunk station deduct the corresponding fare.
- Centralized coordinated fleet control providing monitoring and communications to schedule services and real-time response to contingencies along trunk routes.
- Reduction of the existing fleet of buses through a scrappage program. Through scrapping of 451 buses Metrobus retires conventional transport vehicles operating currently in the project influence zone<sup>5</sup>.

The **pre-project situation** is around 3.5 million passenger cars, 180,000 motorcycles, more than 150,000 taxis and around 120,000 public transit buses plying the city<sup>6</sup> plus various metro lines.<sup>7</sup> In the baseline the passengers would use existing modes of transport including conventional buses, taxis, cars, motorcycles, rail-based MRTS (Mass Rapid Transit System, basically metro) and Non-Motorized Transport (NMT) thus causing baseline trip emissions in absence of the project. In the baseline situation these modes of transport would continue to operate. The baseline scenario is comparable to the situation prior to the

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<sup>1</sup> Greater Mexico City

<sup>2</sup> Instituto Nacional de Estadística Geografía e Informática, 2005 census

<sup>3</sup> File 70

<sup>4</sup> File 18

<sup>5</sup> File 31 (excludes the 4 tow-trucks)

<sup>6</sup> File 1

<sup>7</sup> Source: Delimitación de las zonas metropolitanas de México 2005; SEDESOL, INEGI, CONAPO; 2005 (see File 16)

project. The baseline scenario however incorporates technological advancements in terms of emissions per distance driven of various modes of transport as well as eventual fuel changes of baseline modes of transport during the project activity.

In the **project situation** the BRT complements other modes of transport and replaces partially trips made by conventional means of transit. The CDM project replaces trips made by conventional transport modes with the BRT being a more efficient, faster, safer and more reliable transport means.

**Leakage emissions** are caused by changes of congestion and speed resulting potentially in a rebound and a speed effect plus potential change of load factors of remaining buses and taxis in the city.

**Emission reductions** are achieved through reducing GHG (Greenhouse Gases) emissions per passenger-kilometre, comparing conventional modes of transport with the BRT. The BRT system has as main environmental aspect that the resource efficiency of transporting passengers in Mexico City is improved i.e. emissions per passenger kilometre are reduced compared to the situation without project. This is realized through following changes:

- **Improved efficiency:** new and larger buses are used which have an improved fuel efficiency per PKM (Passenger-Kilometre) compared with buses used in absence of the project. The 142 project buses<sup>8</sup> are articulated or bi-articulated buses with a capacity between 160 and 240 passengers, which is significantly more than the normal baseline buses used which consist of small, medium and large sized buses with capacities from 20 to 85 persons. All project buses are Euro III or IV. Project units can run on a bus-only lane thus avoiding the fuel consuming stop-and-go traffic in heavily congested roads plus achieving a higher average running speed factors<sup>9</sup> which both reduce fuel consumption per unit of distance in a significant manner.
- **Mode switching:** The BRT system is more attractive to clients due to reduced transport times<sup>10</sup>, increased safety and reliability and more attractive buses. It can thus attract private car, motorcycle and taxi users with higher emission rates to switch to public transport<sup>11</sup>.
- **Load increase or change in occupancy:** The BRT has a centrally managed organisation dispatching vehicles. The occupancy rate of vehicles can thus be increased due to organizational measures. The baseline public transit system is characterized through a large number of private companies competing for the same passengers resulting in an oversupply of buses and low occupation rates.

The BRT Metrobus is a public-private partnership (PPP), in which the public sector is responsible for the investment to deploy the required infrastructure (segregated lanes, stations, terminals, control centre etc.), a part (25%) of the investment in rolling stock and a part of the ticket selling and validation system, while the private sector is responsible for 75% of the investment in the bus fleet and part of the ticket selling

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<sup>8</sup> File 5

<sup>9</sup> Baseline buses along Insurgentes 15-19 km/h with peak hour speed of only 10km/h (File 15, p147/148) while BRT 20 km/h on average with no distinct peak hour difference due to having a bus-only lane (File 6, p.16)

<sup>10</sup> Estimation of Metrobus is 33% of savings in travel time (File 6, p.26 see also same File p.31)

<sup>11</sup> See File 6, p.33



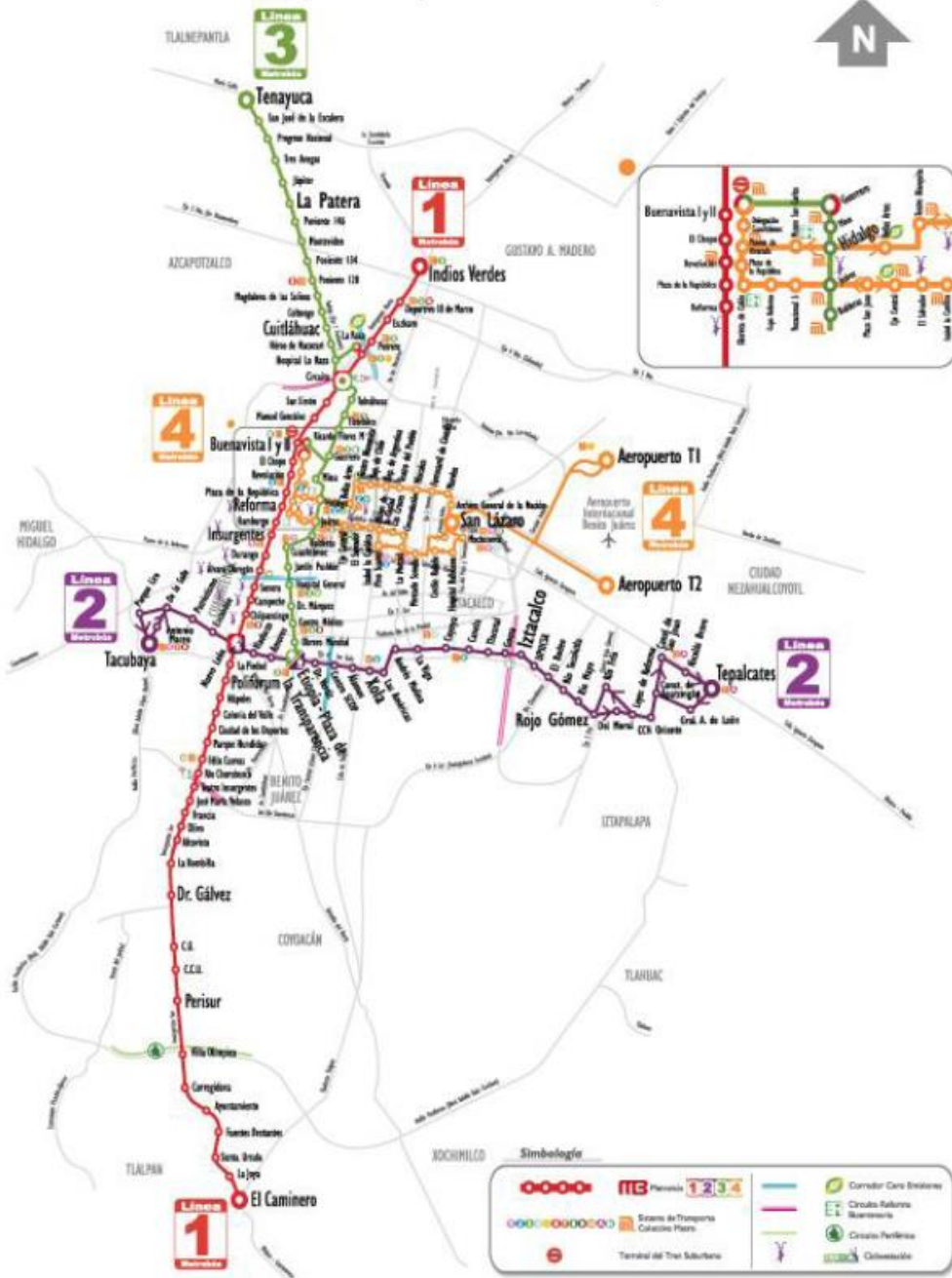
and validating system and for the operation of the services<sup>12</sup>. The system is managed by Metrobus a decentralized public organism created by the Federal District March 2005<sup>13</sup>.

The project contributes to **sustainable development** in a significant manner:

- Improved environment through less GHG and other air pollutant emissions, specifically particle matter, NO<sub>x</sub> and sulphur dioxide. This is achieved through a more efficient transport system and through new buses.
- Improved social wellbeing as a result of less time lost in congestion, less respiratory diseases due to less particle matter pollution, less noise pollution and fewer accidents per passenger transported.
- Less accidents due to improved public transit organization and management.
- Economic benefits mainly on a macroeconomic level basically by reducing the economic costs of congestion.

Average expected emission reductions of the project are 46,544 tCO<sub>2</sub> avoided per annum.

Figure 5. Map of the Metrobus System



Source: Metrobus, 2012.

Source: OECD, 2012.

**Figure 4. Metrobus**



Source: Metrobus, 2012

Source: OECD, 2012.

**14. Selection.**

The main alternatives are the following: The worst: do nothing; Expansion of the metro system, very costly; Metrobús (BRT) appeared to be the most cost-efficient solution for mass transit.

**15. Pro-poor.**

Better accessibility to Downtown services and economic activities. The subsidized tariff of 5 pesos (0.40\$US) makes the system quite affordable to low-income persons with a tariff comparable to artisanal public transportation.

**16. Impact.**

Net social benefits: important gain of time of travelers, reduction of accidents. Reduction of local pollution and greenhouse gases emissions, better efficiency of operators. In April 2006 official data indicated that the Metrobús carried more than 260,000 passengers daily.

The total estimated reductions between 2011 and 2018 is 325,811 metric tons of CO<sub>2</sub> eq. (see table below).

<b>A.4.4. Estimated amount of emission reductions over the chosen crediting period:</b>	
<b>Years</b>	<b>Annual estimation of emission reductions in tCO<sub>2eq</sub></b>
2011 (5 months)	19,878
2012	47,398
2013	47,087
2014	46,755
2015	46,420
2016	46,084
2017	45,746
2018 (7 months)	26,443
<b>Total estimated reductions 1<sup>st</sup> crediting period (tonnes of CO<sub>2eq</sub>)</b>	<b>325,811</b>
<b>Total number of crediting years (1<sup>st</sup> crediting period)</b>	<b>7</b>
<b>Annual average over the crediting period of estimated reductions (tCO<sub>2eq</sub>)</b>	<b>46,544</b>

Source: CDM 2011, p. 12.

## Stakeholders

### 17. Who were the main stakeholders in the practice and what were their roles?

A Public/Private operation with many stakeholders.

#### For the CDM financing the stakeholders were:

- a) Name of organization: Metrobus  
 Type of organization: Public/Private  
 Role of organization: Responsible of project  
 Brief description: \_\_\_\_\_
- b) Name of organization: International Bank for Reconstruction and Development (IBRD) as Trustee of the Spanish Carbon Fund (SCF)  
 Type of organization: Public  
 Role of organization: Carbon Funds  
 Brief description: \_\_\_\_\_

#### Other Stakeholders linked to the project:

Mexico City's Secretary of Environment  
 Environmental Groups

Mexico City Government

Metrobus: a decentralized body of Mexico City's government, which plans, controls and manages services.

Service operators

Fare collectors

A Trust Fund

"Figure 6 presents the parties involved in the first line (Insurgentes) of the Metrobus system. The first element is Metrobus, a decentralised body of Mexico City's government which plans, controls and manages services. The second element is the service operators, for instance, the original contract for Line 1 was given to Corredor Insurgentes, S.A. (CISA). The third group involved are fare collectors, which includes INBURSA as the bank, and two other companies that install, operate and maintain the fee collecting system. Finally, a trust fund was created to gather all collected fees so to pay out the corresponding amounts to the transportation companies based on the number of kilometres travelled. (Metrobus, 2012; Hidalgo, n.d.)."(OECD, 2012).

**Figure6.Metrobus Stakeholders**



Source: Voukas, 2012.



Additional information (Source: CDM, 2011).

**E.1. Brief description how comments by local stakeholders have been invited and compiled:**

Main stakeholders identified include persons living near construction sites of trunk routes, the general public and owners as well as drivers of existing (baseline) buses.

**Persons Living Near to Construction Sites**

Persons living near to construction sites or sites (neighbours) where major bus-stations are built are potentially affected by these activities. Also some people needed to be relocated. Various meetings were organized with the affected people and their comments were received. Meetings such as “Roundtable Workshops with Neighbours” were carried out and convened by the Federal District Government by the Secretary Office General Direction for Political Agreement, Citizen and Social Attention<sup>114</sup>, which also carried out the relevant monitoring according to each case as demanded.

**General Public**

Users of the public transport system and prime beneficiaries due to a reduced travel time, less congestion (also relevant for users of private vehicles) and an improved air quality. Metrobus through a professional company completed customer satisfaction surveys, monitoring the quality of offered services on a regular base as well as receiving client complaints<sup>115</sup>. Stakeholders and system users as well as public in general may also address complaints or remarks through the Metrobus<sup>116</sup> website or phone customer service (number 57616870 or 57616860, ext. 121). People placing complaints receive a personal addressed answer through the same mechanism used for addressing the complaint.

Records of all complaints as well as follow-up measures are maintained by Metrobus. Complaints concern, e.g. speeding, crowded buses, bus delays etc. All complaints are categorized according to type of complaint and means through which complaints were made (e.g. written, phone, Internet). Corrective measures are taken by Metrobus based on these reports.

**Owners and Drivers of Baseline Buses**

Owners and drivers of the existing (baseline) public transport system fear suffering economic losses and express their desire to be included in the system. Metrobus has been coordinating the project development closely with the transport organizations and carried out numerous meetings with their representatives to discuss all parts of the project. The existing transport sector is directly involved in the system as operators of the trunk route<sup>117</sup>.

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<sup>114</sup> File 85

<sup>115</sup> Files 68, 69, 50 to 53

<sup>116</sup> <http://www.metrobus.df.gob.mx/quejas.html>; <http://www.metrobus.df.gob.mx/foro.html?id=191-2>

<sup>117</sup> File 54

The presentation of “Corredor Insurgentes” Project by the Federal District Government to the representatives of the existing bus lines and operational routes of Route # 2 “Ramal Insurgentes, prompted the need for work groups which involved the representatives and where the purpose was to establish the characteristics of the project. At the same time as a consequence of these work groups and in order to participate in the project “Metrobus Insurgentes” small bus company owners (in total 262<sup>118</sup>) met several times, deciding themselves to constitute a legal entity having as entrepreneurial activity the transport enterprise “Corredor Insurgentes S.A.- CISA”. Consequently a request from CISA to the government was placed, to provide public transport services on “Avenida Insurgentes”, becoming eligible to offer the service in that corridor. The concession was granted to the company<sup>119</sup>.

In total between 2.2005 and 9.2009 63 stakeholder meetings with numerous representatives were held, all of which are documented<sup>120</sup>. Major information channels were used including numerous leaflets on different topics, mass media communication, open phone line or e-mail<sup>121</sup>.

## **18. Cooperation.**

A process of information and consultation of the public was initiated at the very beginning and pursued through the operation, which was a key to its success as we can see in the CDM 2011 report:

### **E.2. Summary of the comments received:**

As a general condition, the community was permanently informed and also participated actively in the development of the project. It is important to mention that the community inquiries made to the Metrobus have been attended in a timely fashion and from its very beginning. The community through civil organizations such as residents associations have been participating in the project.

The main questions raised concerned the system itself, its purpose and constitution, benefits, the impact of the project on housing and workplaces, construction time periods, traffic management, relocation retailers, public space rehabilitation, pedestrian alleys in construction site, among others<sup>122</sup>.

Comments from bus owners were focused basically on potential job and income losses and their involvement and participation in the systems operation. Negotiation meetings and roundtables were held with transport companies. The stability of bus owner’s is a key element for a successful outcome of any mass transport system. An extraordinary effort was made by Metrobus to address this matter in order to assure that bus owners were included in the transport restructuring activity. As a result organized small-scale bus owners established the enterprise CISA which received a concession for the operation of Insurgentes<sup>123</sup>.

At the institutional level, the open communication between the different levels of government and different governments has been vital to the project. It is well known that the construction of a mass transport system in a big city is very complex and requires the interaction of many government agencies

and other public and private companies with services in the area such has telephone, water, gas to mention a few<sup>124</sup>.

The project in general terms received a very positive reaction and the stakeholders suggest keeping an open communicating channel.

### **E.3. Report on how due account was taken of any comments received:**

The remarks received from people living near to construction sites were followed-up and integrated by Government Secretary Office General Direction for Political Agreement, Citizen and Social Attention. Records of requests and complaints as well as the respective corrective actions are documented. Informational documents and brochures were distributed among the community. Also many seminars and presentations were made by officials from Metrobus. Comments considering trunk road constructions are diverse and include information requests, access to roads, traffic caused, financial compensations, among others.

People who placed complaints, remarks or questions received a direct feedback from Metrobus who relied on the same communication channel (e.g. mail, phone, webpage) as used by the person depositing a claim. Metrobus has a service improvement plan which is based on evaluation reports. Included aspects concern both infrastructure as well as operational issues. Possible outcomes are e.g. an increase of bus frequencies, improved maintenance, driving practices for bus drivers, trainings to avoid disrespectful behaviour towards women in buses, among others.

The implementation of improvements derived from the users feedback can be exemplified by the campaign carried out by Metrobus “No te pases, Denúncialo” (“Draw the line, denounce it”), which was conceived due to permanent complaints from women using Metrobus services as well as the results of gender surveys where the violation of women rights as users of the system were identified. The campaign’s goal was focused on women rights and the importance of sexual abuse reports when using Metrobus. Therefore Metrobus established a permanent safe spot for women within the buses.

The results of roundtables and discussions with bus owners prompted significant changes in the way how small enterprises participate in Metrobus. As a result the concessions for the operation “Insurgentes” was granted to the enterprise CISA, constituted by bus owners who operated the route long before the initiation of the Metrobus BRT operation.

## **Actions**

### **19. Initiation.**

BRT’s is a rational solution for mass transit in large or medium sized cities. Much more economical and flexible than metros or trams, it can insure similar supply for mass transit at a much lower cost at least on a 30 years horizon.

### **20. Planning and design.**

We don’t have specific information on the planning and design of the Mexico Metrobus. The typical procedure is the following: Need of a Global Transportation Plan; Need of detailed data of travel demand which is normally obtained by a Household Origin-Destination Survey which gives detailed information on the travel patterns of all members of a household in a typical weekday. Need of a Cost-Benefit Analysis to measure global costs and benefits including social benefits. Need also of a financial analysis to see the economic feasibility of the project to be able to comply with the public-private financing requirements.

### **21. Describe the process of planning and design of the practice.**

The process described above may take between one and three years, the time to collect data, analyze it, and justify the whole process in front of official financing organisms like the World Bank or its local representatives (i.e., Banobras in Mexico).



## 22. Implementation.

Implementation is clearly part of the process. It is incorporated in cost benefit analysis as a cost (mainly cost of time due to traffic congestion during the construction of new infrastructures). This may last one or two years.

## 23. Operation and maintenance.

Operation and maintenance responsibility is function of the public-private agreements established. They must be taken into account in any costbenefit or financial analysis.

## 24. Monitoring and evaluation.

No specific information on this aspect.

## 25. Timeline.

BRT of Mexico was introduced in 2005 and had various expansion projects. As one can see, a successful BRT leads to expansions which progressively permits modernization of transportation in the main arteries of a city.

## Funding

### 26. Source. Public/Private Financing.

**Table 7: Major Parameters for Financial Assessment**

Parameter	amount
Initial Investment infrastructure	250 million MXN
Initial investment other components (buses, system control, ticketing etc) for initial year	454 million MXN
Annual average fare <sup>75</sup>	3.09 MXN
Annual average passenges <sup>76</sup>	80.322 million
Annual average <sup>77</sup> revenues	249 million MXN
Annual average <sup>78</sup> operational cost	176 million MXN

Details on financing form OECD (2012):

**Metrobus financing** - Initial studies, planning and implementation of the project were largely funded through international grants, sought mainly by the Secretary of the Environment, Claudia Sheinbaum. Buses have been largely financed privately, except for contributions by the government in the first two lines. Infrastructure has been financed mainly by the government, except for Line 4. Both Lines 1 and 2 were financed through non-recoverable investments, and through an international public bid for infrastructure. On the other hand, financing for Lines 3 and 4 took different forms. These forms implied payment of debt for more than an administration and a half, and therefore had to be approved by the city's Assembly. Table 4 presents investments in Metrobus:

**Table4. Metrobus Investments**

Line	Infrastructure	Fleet		Fare collection	Total
		Privada	Pública		
1	1,277	327	109		1,713
2	850	255	85		1,190
3	1,200	250	-		1,450
4	450	250	-		700
	3,777	1,082	194		5,053
Costs in millions of pesos.				Private	
Source: Escalante, 2012.				Public	

**Line 3** was financed via a “Payment for Services” scheme (Escalante, 2012) as follows. Metrobus rents the infrastructure for 10 years from the company that won the bid. The public bid was for Line 3 of Metrobus (lanes, stations, induced works, street and traffic lights), as well as a repayment of the avenues of Vallejo and Guerrero with hydraulic concrete, traffic and street lights, a median and certain intersections (approx. 12-14 km). The bid was for construction, maintenance and financial risk. Of the entire investment, only 1,200 million MXN was the infrastructure investment for Metrobus, which is being repaid over 10 years, 283 million MXN a year. After 10 years, it will be opened for bid again under the same scheme.

**Line 3** – According to Escalante (2012), operation for Line 3 was given to a private company that united the 430 concessionaires that operated on the corridor initially, and a large private transportation company, ADO. These were constituted into MIVSA. Each of the initial concessionaires gave up their buses for scrapping, and their concessions earned them one stock in MIVSA. The concessionaires are therefore owners of 49% of the company, with the controlling 51% belonging to ADO. The number of stocks is fixed.

**Line 4** was financed along with one of the segments of the second tier of the city’s beltway (Escalante, 2012). In addition to the cost for building the second tier of the beltway, maintaining it for the duration of the contract (20 years) and the financial risk estimated for the project, the government required bidding companies to include 700 million MXN for construction of this line, along with other small semaphore projects, several stations, and a bicycle path. Of these 700 million, 520 were used for Metrobus Line 4. The company that won the bid will recover this investment through fare paid to use the second tier of the beltway.

**Line 5** – Looking to the future, Line 5 is already being planned, and at the moment, financing is expected to come from PROTRAM, the Federal Mass Transit Programme. Lines 1 and 2 were implemented before PROTRAM existed, and Lines 3 and 4 were not

funded through this mechanism due to slow loan processing times and availability of alternate sources for funding (Escalante, 2012).

Source: extract from OECD, 2012.

### **27. Management.**

Cost effective if social benefits are taken into account. Needed strong public financing.

## **Results**

### **28. Effectiveness and efficiency.**

According to a satisfaction survey in 2009, the Metrobus was better than other options for the respondents in the following proportions: Autobuses, Microbuses y Vagonetas (85%); Normal bus routes (64%); Trolebuses (57%); Individual taxis (53%); Metro (49%). (Moreno Trejo, 2012).

The Metrobus, to our knowledge, is the first transportation project in Mexico (maybe in Latin America) that benefited financing with CO2 Bonus financing (Moreno Trejo, 2012). In 2005-6: Reduction of emissions of CO2 eq. of 29,177 tons, bonus of 211,959 Euros In 2006-7: Reduction of emissions CO2 eq. of 38, 219 tons, bonus of 159,717 Euros In 2007-8: Reduction of emissions of CO2 eq. of 39,870 tons, bonus of 166,65 Euros The sums are marginal compared to the cost of BRT's but, speaking with responsables of the Metrobus, they at least are a recognition of sustainable actions in transportation.

### **29. Stakeholder satisfaction.**

The operation is a success as shown by its rapid expansion and often shown as a best practice.

## **C. Looking to the future**

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### **Lessons learned.**

BRT's is a popular solution to modernization of public transportation in many emergent cities but also in the North. For example, Ottawa, a medium-sized city, in the end of the 70's started a BRT network accompanied with strict TDM measures linked to parking in the CBD of Ottawa (difficult and expensive), which was quite successful.

### **30. Sustainability.**

Its sustainability is mainly in offering a competitive mode of transportation vs. the automobile and its potential in reducing congestion and polluting emissions (local and CO2 eq.).

### **31. Replication.**

Experience shows that the replication is possible in many cities in the North and in the South. It appears as a feasible alternative to more expensive infrastructures like the metro or the tram. However, we may argue that the tram which has a longer lifespan than the metrobus ( i.e.: 40

vs. 30 years) could be a better option in certain circumstances (more environmental friendly and esthetic in historical cities, for example).

### **32. Scaling.**

As said before, scaling up could be the tram option, but expensive and not an obvious solution in many emergent cities. Sometimes the political aspect will dominate and streetcars (trams) will be proposed for their more spectacular or/and esthetic features. Only a case-to-case analysis would permit to decide if the choice is appropriate. Transportation is always a LOCAL decision and function of LOCAL needs and recourses.

## **D. Additional information**

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**33. Other important information.** Would be useful to students to consult the 2 studies mentioned.

**34. Information gaps.** Not really.

### **35. Sources.**

CDM (Clean Development Mechanism) – Executive Board. (6/05/2011). Project design document form (CDM PDD) – Version 03 pdf. , 131p., [www](#).

CTS EMBARQ Mexico (2012). Mobilising Private Investment for Bus Rapid Transit Systems, 47p., pdf., [www](#).

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Moreno Trejo, Arturo (2012). Metrobús, una solución a la Movilidad en un gran Metrópoli, el caso de la Ciudad de México. Mesa de trabajo: Modernización del transporte y la emisión del CO2 en Puebla. Tec de Monterrey, Puebla, Mexico. 12-14 nov.

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